Resources and Tools to Improve Pedestrian Safety

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16. Abstract

While pedestrian safety is found in many Strategic Highway Safety Plans across the country, there may be potentially competing values and beliefs that influence the deployment of effective pedestrian safety strategies. Understanding shared values and beliefs among transportation stakeholders about pedestrian safety is critical to growing a positive traffic safety culture, deploying effective strategies to improve pedestrian safety, and ultimately achieving our nation's goal of zero deaths on our roadways.

This project sought to improve pedestrian safety by developing resources to assess and grow beliefs among transportation stakeholders to support the deployment of effective pedestrian safety strategies. This report includes a literature review, results from 10 stakeholder interviews, a survey created to reveal stakeholder beliefs about pedestrian safety and their understanding, support for, and engagement in pedestrian safety strategies, survey results, and a toolkit entitled: *Tools and Resources to Improve Pedestrian Safety.* The toolkit includes a resource focused on growing public participation and tools that address growing supportive beliefs to improve pedestrian safety, ways to prioritize pedestrian safety and bolster current approaches, telling your pedestrian safety story, engaging in meaningful conversations about pedestrian safety, and promoting pedestrian safety across the social environment.

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1 INTRODUCTION

Pedestrian fatalities are both increasing in absolute numbers (with 6,516 pedestrian deaths in 2020) and as a percentage of all roadway fatalities (Insurance Institute for Highway Safety, 2022b; National Highway Traffic Safety Administration, 2022a; Sandt et al., 2020; Schneider, 2020a). Pedestrian deaths increased 59% between 2009 and 2020 while other deaths from motor vehicle crashes grew by 9% over the same period (Insurance Institute for Highway Safety, 2022b). Transportation stakeholders are uniquely positioned to lead efforts to improve pedestrian safety and whether stakeholders engage in effective strategies to improve pedestrian safety is influenced by their traffic safety culture – their shared values and beliefs.

While pedestrian safety is found in many Strategic Highway Safety Plans across the country, there may be potentially competing values and beliefs that influence the deployment of effective pedestrian safety strategies. Values such as prioritizing traffic flow and efficiency may influence planning, prioritization, and design efforts (Sandt et al., 2016). Further, beliefs about support (or lack of support) for pedestrian strategies may influence the deployment and implementation of effective strategies to improve pedestrian safety. Therefore, understanding shared values and beliefs among transportation stakeholders about pedestrian safety is critical to growing a positive traffic safety culture, deploying effective strategies to improve pedestrian safety, and ultimately achieving our nation's goal of zero deaths on our roadways.

This project sought to improve pedestrian safety by developing resources to assess and grow beliefs among transportation stakeholders to support the deployment of effective pedestrian safety strategies. This is the final report in the project which summarizes Tasks 1 – 3. In Task 1, a literature review was conducted and interviews with traffic safety stakeholders were completed. The literature review focused on identifying published research to identify the culture -- the values and beliefs -- among traffic safety stakeholders surrounding pedestrian safety prioritization and deployment of strategies and to understand the barriers and challenges that might inhibit the implementation of pedestrian safety strategies. The interviews focused on understanding the current pedestrian safety culture and opportunities for improvement from ten current traffic safety stakeholders involved in decision-making about the implementation of pedestrian safety strategies (e.g., traffic engineers, traffic designers, and planners, pedestrian (and bike) coordinators, policy experts, and other transportation agency staff).

In Task 2, a survey was designed and implemented with current traffic safety stakeholders to reveal beliefs about pedestrian safety and their understanding, support for, and engagement in strategies. Based on the review of the literature, the survey was designed to focus on the following topics:

- prioritization of pedestrian safety,
- beliefs about a Safe System Approach for pedestrians,
- current approaches to pedestrian safety,
- familiarity, support for, and use of best practices to improve pedestrian safety,
- getting public input,
- use of the Complete Streets approach, and

- valued resources used by practitioners.

The survey was administered online using Qualtrics, an online survey platform, and survey data collection occurred between September 19, 2023 and October 19, 2023. A total of 399 surveys were completed; however, 63 surveys did not include any responses besides the organization type and role and were removed from the analysis. The survey respondents included engineers, planners, behavioral traffic safety professionals, public health advocates/educators/leaders, advocates, and others representing a variety of organizations including state and local departments of transportation, planning organizations, public health organizations, and advocacy organizations. A total of 336 surveys were summarized.

In Task 3, a toolkit for stakeholders was created. The toolkit included five tools and one resource. The tools were designed to be used independently of one another and in any order. The resource focused on growing public participation, and the tools addressed:

- growing supportive beliefs to improve pedestrian safety,
- ways to prioritize pedestrian safety and bolster current approaches,
- telling your pedestrian safety story,
- engaging in meaningful conversations about pedestrian safety, and
- promoting pedestrian safety across the social environment.

The toolkit was designed to be a standalone document (using the portable document format – pdf) that could be shared over the internet or printed.

2   BACKGROUND

Pedestrian fatalities from motor vehicle crashes have increased since 2009 (National Highway Traffic Safety Administration, 2022a; Schneider, 2020b; Insurance Institute for Highway Safety, 2022b; Governors Highway Safety Association, 2022). On average, "a pedestrian was killed every 81 minutes and injured every 10 minutes in traffic crashes in 2020" in the United States National Highway Traffic Safety Administration, 2021). Most of these deaths occurred in urban settings (82%), not at intersections (75%), and when it was dark (77%) (National Highway Traffic Safety Administration, 2022b). While the ages of pedestrians killed varied, 71% were male. Alcohol was involved (for the driver and/or pedestrian) in almost half (47%) of the incidents. Just under one-third (30%) of pedestrians killed had a BAC of 0.08% or higher (National Highway Traffic Safety Administration, 2021). Minorities, immigrants, and low-income populations are over-represented in pedestrian crashes (Smart Growth America, 2022a). This may result from less infrastructure in poorer neighborhoods, more walking for transport, and differing beliefs among recent immigrants about traffic safety (Chakravarthy et al., 2010, 2012; Chen et al., 2012; Smart Growth America, 2022a). Ultimately, everyone begins and ends a trip as a pedestrian. Whether traveling short distances from a parked car to a store entrance, strolling to check the mail or take out the trash, or walking for exercise or relaxation, pedestrian safety is broadly relevant to all people (National Highway Traffic Safety Administration, n.d.).

As cities continually plan ways to accommodate population growth and access to resources, multimodal forms of transportation that are equitable and accessible to all are becoming the priority for traffic transportation stakeholders (Smart Growth America, 2022a). Walking, the most basic, common, affordable, and universal mode of transportation (WHO, 2013), offers extensive physical and mental health benefits and should be an accessible and safe option of transportation in every community in the United States (Sandt et al., 2020). Unfortunately, the growth in U.S. pedestrian fatalities is outpacing other traffic deaths (Sandt et al., 2020, p. 6), and the most recent traffic safety data indicate pedestrian deaths increased in 2020 despite the onset of the COVID-19 pandemic and a related drastic decline in vehicle miles traveled (American Association of State Highway and Transportation Officials (AASHTO), 2021; National Highway Traffic Safety Administration, 2022b).

Achieving the nation's goal of zero deaths and serious injuries in our transportation system will require greater investment in and commitment to measures that protect pedestrians. The majority of Strategic Highway Safety Plans (SHSP) (39 out of 52) have "pedestrian safety" in some form as an "Emphasis Area," although six of these are secondary emphasis areas (USDOT, n.d.). And six states have a "Special Topic" category included that is titled: "Older driver/pedestrian special rule" (USDOT, n.d.). Pedestrian safety strategies and countermeasures are plentiful in range and approach including engineering for roadway and vehicle design and technology, education for drivers and pedestrians, approaches to traffic enforcement and speed management, and practices for planning, land use development, public engagement, and greater attention to equity concerns (USDOT, n.d.). Despite the availability of various pedestrian safety strategies, singular efforts targeting just pedestrians, just drivers, only environmental design, or sole roadway projects do not seem to be enough to positively impact pedestrian safety outcomes. There is an increasing need for integration and communication between stakeholders in pedestrian and traffic safety

rather than approaching different pedestrian strategies as if they are targeting isolated issues (McCann, 2013). Vision Zero and a Safe System Approach acknowledge the need for comprehensive efforts that combine strategies whereby environmental (engineering) tactics and policy requirements are integrated with behavior-change efforts (Brookshire et al., 2016), and more recently, vehicle technology and commitments to equity are also essential considerations to be integrated into pedestrian and traffic safety efforts (*Equity in Transportation Infrastructure: Connecting Communities, Removing Barriers, and Repairing Networks Across America*, 2021; Kim, 2014).

Notably, the USDOT published the National Roadway Safety Strategy (NRSS) on January 27, 2022. The NRSS has been hailed as a landmark advancement in the nation's progress toward meaningful adoption of Vision Zero and a Safe System Approach. Its focus on zero as "the only acceptable number of deaths and serious injuries on our roadways" (U.S. Department of Transportation, 2022a, p. ii) has been described by advocates as an encouraging development (Transportation for America, 2022) and groundbreaking "paradigm shift" (Wilson, 2022) corresponding to new acknowledgment and recognition that "safety is USDOT's top priority" (U.S. Department of Transportation, 2022b). This marks a historic departure from balancing goals around safety with those of system efficiency and cost management (Singer, 2022, pp. 218–219) and a tolerance of "safety targets" that projected increases in traffic deaths (Wilson, 2022). Figure 1 briefly compares the traditional approach with that of the newer Vision Zero approach.

Traditional Approach	Vision Zero
• Traffic deaths are **inevitable** • **Perfect** human behavior • Prevent **collisions** • **Individual** responsibility • Saving lives is **expensive**	• Traffic deaths are **preventable** • Integrate **human failing** in approach • Prevent **fatal and severe crashes** • **Systems** approach • Saving lives is **not expensive**

Figure 1. Overview comparison of the traditional approach versus Vision Zero

Note: Figure adapted from the Vision Zero Network's overview (Vision Zero Network, 2022)

3   LITERATURE REVIEW

3.1   Literature Review Materials and Methods

To obtain research articles for the literature review, a keyword search was conducted using databases of published academic research (e.g., Google Scholar, TRID database and Montana State University Library search engines Academic Search Complete and EBSCO). Initially, the search was limited to peer-reviewed and publicly available literature published in English after 2000. Word search and phrase combinations included: "pedestrian safety beliefs," "pedestrian safety attitudes," "pedestrian safety challenges," "pedestrian safety barriers," "pedestrian safety implementation," and "factors affecting pedestrian safety." The initial search resulted in a limited number of peer-reviewed literature. The search was then broadened to include more recent grey literature germane to traffic safety to provide a broader picture of the culture that may be influencing traffic safety stakeholders' beliefs.

In addition to the literature review, a series of interviews were conducted with 10 current traffic safety stakeholders involved in decision-making about the implementation of pedestrian safety strategies (e.g., DOTs, traffic engineers, traffic designers and planners, pedestrian (and bike) coordinators, policy experts, and transportation agencies). An interview protocol (guidance and questions) was created to support this interview process.

3.2   Literature Review Results

A wide range of pedestrian safety strategies and countermeasures are available to create a safer and more pedestrian-friendly experience, and these strategies are within the reach of traffic safety stakeholders (Goughnour et al., 2021; Stoker et al., 2015; Taylor Raulerson et al., 2018; Zegeer & Bushell, 2012). Yet, despite the availability of strategies, countermeasures, and guidance to support pedestrian safety, roadway fatalities among all users have increased since 2010 – and they have increased at an even faster rate for pedestrians and bicyclists (U.S. Department of Transportation, 2022a, p. 10). Indeed, "after three decades of decreases, U.S. pedestrian fatalities increased by 48% in 8 years, from 4,109 in 2009 to 6,080 in 2016" (Schneider, 2020b, p. 1069), and that trend has continued through the latest available data for 2020, which saw 6,516 pedestrian fatalities (National Highway Traffic Safety Administration, 2022a).

Pedestrian safety prioritization and stakeholder engagement are influenced by traffic safety culture – shared values and beliefs. Thus, the goals of this literature review are to identify values and beliefs about pedestrian safety prioritization and deployment of strategies to improve pedestrian safety and to understand the barriers and challenges that inhibit implementation among pedestrian safety stakeholders such as DOTs, traffic engineers, traffic designers and planners, pedestrian (and bike) coordinators, law enforcement, policy makers, and regulatory agencies.

Planning, design, infrastructure, policy, perceived support, and funding have been identified as factors that may influence pedestrian safety prioritization and implementation. Further, ideologies (belief systems) such as an affinity for speed (Bellis et al., 2021; Lewyn, 2017; Smart

Growth America, 2022a), the priority of traffic flow (Moran, 2021), and American individualism (Greene, 2008; Turner, 2008) influence the current traffic system. These ideologies are included in this review because they offer a sense of additional belief systems at play in the traffic safety system that impact strategies and countermeasures to improve pedestrian safety, as well as the degree to which those who are charged with selecting and deploying these strategies and countermeasures feel empowered and can be successful. Finally, a brief review of some pedestrian safety best practices used in the U.S. and internationally are included. While the review of best practices for pedestrian safety is not comprehensive, it provides context for better understanding the culture around pedestrian safety.

3.2.1 Competing Values and Priorities

Cities and towns have the ability to affect change and increase pedestrian safety and even influence their states to join them in these efforts (Smart Growth America, 2022a). Yet, a lack of momentum to implement pedestrian safety may be due to the fact that other issues, projects, or goals are given priority, and there may be conflicting priorities that act as barriers to pedestrian safety initiatives such as an "emphasis on moving drivers quickly, which comes at the expense of pedestrian safety" (Frattaroli et al., 2006, p. 382).

The literature provided insight into some of conflicting interests or demands that stakeholders encounter within different aspects of their work in pedestrian safety including aspects of planning, design, infrastructure, policy, perceived support, and funding.

3.2.1.1 Planning, Design, Infrastructure, and Policy

A variety of issues relating to transportation planning, design, infrastructure, and policy influence pedestrian safety efforts and may challenge their prioritization and implementation. Since most pedestrian fatalities occur at night and away from intersections, there is a need to design more (and better) crossing options as well as improve lighting (American Association of State Highway and Transportation Officials (AASHTO), 2021). Additionally, underserved populations are more likely to be victims in pedestrian fatalities, suggesting a need for assessment of current infrastructure and more equitable investments in transportation access (Smart Growth America, 2022a). The Safe Routes to School Partnership notes in their most recent annual report that, "with few resources for active transportation infrastructure and programming, many communities lack sidewalks, crosswalks, and bike lanes to make it safe for people to walk and bicycle. This is especially true in low-income communities and in predominantly Latinx or Black neighborhoods, where walking and bicycling infrastructure is less available…" (Jones & Lieberman, 2022, p. 75). Policies like the Complete Streets initiatives are trying to address many, if not most, of these issues (Federal Highway Administration, 2022c), but various conflicting priorities can challenge progress.

An example of a challenge with planning and design is seen in how travel demand modeling predictions may not accurately account for multimodal transportation demands (Clifton & Muhs, 2012; T. A. Litman, 2003; Singleton & Clifton, 2013; Stopher & Greaves, 2007) because efforts to design for multiple transportation modes often run up against competing demands for limited space (Furth, 2021; Gössling et al., 2016; T. Litman, 2019a; Newman & Kenworthy, 2015).

Further, transportation stakeholders are often tasked with confining their work based upon the current conditions of the built environment, which commonly leads to compromises in pedestrian project elements or even their complete removal from plans (Prytherch, 2018; Stoker et al., 2015). In many instances, current infrastructure has been designed to primarily accommodate motorized traffic (Newman & Kenworthy, 2015; Prytherch, 2018; Weiner, 2016); as a result, the experience of pedestrians has not been prioritized (T. A. Litman, 2003; Schneider et al., 2021; Stoker et al., 2015). The current emphasis on multimodal forms of transportation is a shift in focus for transportation infrastructure (Khedri et al., 2022; Prytherch, 2018) and thus a potential barrier for transportation stakeholders.

Travel demand modeling, which developed in the postwar era, is an estimation process that incorporates existing information about populations and transportation facilities to forecast travel behavior and travel demand (National Cooperative Highway Research Program, 2012; Weiner, 2016). It is a highly influential transportation planning practice that is relied upon to direct limited resources to the "best" projects; transportation project identification, prioritization, and selection are all informed by travel demand modeling (National Cooperative Highway Research Program, 2012). However, in practice, travel demand modeling is imperfect (Rasouli & Timmermans, 2012) and has been criticized for biasing resource allocation toward projects that accommodate growth in motorized traffic (e.g., highway expansions) to the exclusion of projects that support travel by nonmotorized modes such as walking and bicycling (T. Litman, 2019b; Weiner, 2016). While there is interest in full integration of nonmotorized models into travel demand forecasting (National Cooperative Highway Research Program, 2012), it remains less developed and practiced compared to forecasting for motorized (i.e., automobiles and public transportation) travel. Part of the reason for this is the tendency for travel demand models to focus on the flow of traffic across large areas -- trip distances that are longer than most travel by walking and bicycling. As a result, many regions focus on modeling the demand for motorized traffic (i.e., automobiles and public transportation) and simply exclude nonmotorized travel from their models entirely (T. Litman, 2019b).

Without inclusion in the standard estimations for travel behavior and travel demand, it is difficult for projects that support walking and bicycling to be comparably assessed and ultimately deemed worthy of competitive funding (Khedri et al., 2022; T. Litman, 2022a). This focus on the flow of traffic across larger areas also tends to bias project prioritization toward larger projects in general; it is difficult for smaller projects focused on improving conditions for walking and bicycling to be considered significant enough when judged on the magnitude of estimated impacts (as opposed to the degree to which estimated benefits would exceed costs) (Noyce et al., 2021).

Another reason travel demand modeling may bias resource allocation toward motorized traffic projects may be the information collected (through household travel surveys and automatic traffic counters) does not accurately gather and represent nonmotorized activities such as walking and biking. For example, some travel surveys have a distance threshold below which nonmotorized trip information is not collected (Clifton & Muhs, 2012; Singleton & Clifton, 2013; Stopher & Greaves, 2007; T. A. Litman, 2003; Rasouli & Timmermans, 2012; Hankey et al., 2012).

When transportation planning is rooted in the demand for travel, the main priority becomes efficient system capacity (Martens, 2017), which can compete with the prioritization of safety. With the National Roadway Safety Strategy and its latest Strategic Plan, the U.S. Department of Transportation has adopted safety as its top priority (U.S. Department of Transportation, 2022a, 2022b). However, states are not required by law to do the same. In the absence of a federal requirement, Smart Growth America argues that "states must make safety the top priority governing all street design decisions" (Smart Growth America, 2022a, p. 17). However, such an approach to planning and design would fundamentally shift the approach commonly taken that "balances" safety with other goals, such as system efficiency (as commonly measured by vehicle throughput and congestion) (Singer, 2022, pp. 218–219).

Urban sprawl is a common type of development and design pattern that decreases pedestrian safety (Stoker et al., 2017). It is a common "development pattern in North America, and increasingly prevalent across the world. Sprawl is a multidimensional development pattern but is typified as: widely dispersed population and low-density development; rigid separation of land uses, poorly defined activity centres, and poor accessibility" (Stoker et al., 2017, p. 211). Strip malls and big shopping centers strung across miles of arterial roadways paint a picture of common urban sprawl developments typical in the U.S. that are factors in traffic injury rates (Stoker et al., 2017, p. 219). "Sprawling development patterns do not promote safe walking environments" yet are prioritized when developing public roadways (Stoker et al., 2017, p. 219).

Traffic calming is the practice of introducing design features and strategies to reduce traffic speeds and volumes (Federal Highway Administration, 2017; T. Litman, 2017). Examples of traffic calming include curb extensions, raised crosswalks, pedestrian refuge islands, and pavement treatments. A road diet is another form of traffic calming and refers to a roadway conversion (or reconfiguration), often in the form of a conversion from an existing four-lane undivided roadway to a three-lane roadway consisting of two through lanes along with two-way turn lanes in the center; road diets "can improve safety, calm traffic, provide better mobility and access for all road users, and enhance overall quality of life" (Burden & Lagerwey, 1999; Federal Highway Administration, 2021).

Infrastructure that supports walking and bicycling is often subject to inclusion in or exclusion from projects based on whether enough space is available, or motorized traffic flow will be impacted. As a result, traffic calming measures and road diets that could improve pedestrian and bicyclist safety (Bunn et al., 2003) may fail to be implemented out of concerns relating to congestion, cut-through traffic, and parking availability (Graveline, 2022; Jouliot, 2018). In U.S. transportation planning settings, it has long been considered acceptable for built environment features that separate pedestrians and bicyclists from motorized traffic to be intermittently present or even entirely absent; dedicated facilities to separate bicyclists from motorized traffic, for example, were strongly resisted in the U.S. until relatively recently (circa 2008-2010) (Furth, 2021; Surico, 2021). One challenge a pedestrian or bicyclist may experience in the U.S. is the sudden disappearance of a facility that provided separation and refuge from motorized traffic (e.g., a sidewalk or a bike lane that abruptly ends and gives walkers/bicyclists the feeling of being 'dumped' into mixed traffic) (Bhattacharya et al., 2019). For many in the U.S. who want to walk or bike, this can be a deterrent (Dill & McNeil, 2016).

Infrastructure and design strategies that support the safety of nonmotorized travelers typically involve slowing down motorized traffic and increasing the degree to which nonmotorized travelers are separated from fast-moving traffic, such as the implementation of Complete Streets designs (Schneider, 2018). These share a common set of goals and align with Vision Zero and a Safe System Approach (Burden & Litman, 2011; Goughnour et al., 2021, 2021; Marcus, 2019; Schneider, 2018). These strategies support safety goals but often conflict with motorized travel efficiency and speed.

A "complete street" is a term used to describe a street that is "safe, and feels safe, for all users" – meaning the street serves "pedestrians, bicyclists, public transportation users, children, older individuals, individuals with disabilities, motorists, and freight vehicles" (Federal Highway Administration, 2022a). The Complete Streets movement emerged in the early 2000s from conversations among many stakeholders and was founded "to change the priorities of the transportation system that produced roads" that often overtly exhibited "that people who are not in cars shouldn't be there" (McCann, 2013, p. 2). Since the founding of the National Complete Streets Coalition, Complete Streets policies (i.e., laws, resolutions, and internal agency directives) have committed "states, cities, and towns to building all future road projects to safely accommodate everyone using them" (McCann, 2013, p. 2).

A recent example of Complete Streets policy at the state level is the passage in March 2022 of *Move Ahead Washington*, which provides new direction to Washington State Department of Transportation staff who plan and design projects to incorporate Complete Streets features on all projects to be constructed on state highways routed over city streets with an estimated cost of $500,000 or more where design commences July 1, 2022 or beyond (Gaines, 2022). The law (*Move Ahead Washington, RCW 47.24.060 Street Access—Principles of Complete Streets—Requirements*, 2022) states that, "in order to improve the safety, mobility, and accessibility of state highways, it is in the intent of the legislature that the department [WSDOT] must incorporate the principles of complete streets with facilities that provide street access with all users in mind, including pedestrians, bicyclists, and public transportation users" (*Move Ahead Washington, RCW 47.24.060 Street Access—Principles of Complete Streets— Requirements*, 2022). The new law also specifically addresses the connection between speed limits, crashes, and a Safe System Approach, directing WSDOT to adjust the speed limit to a lower speed with appropriate modifications to roadway design and operations to achieve the desired operating speed in those locations where this speed management approach aligns with local plans or ordinances, particularly in those contexts that present a higher possibility of serious injury or fatal crashes occurring based on land use context, observed crash data, crash potential, roadway characteristics that are likely to increase exposure, or a combination thereof, in keeping with a Safe System Approach and with the intention of ultimately eliminating serious and fatal crashes (*Move Ahead Washington, RCW 47.24.060 Street Access—Principles of Complete Streets— Requirements*, 2022, emphasis added).

At the federal level, FHWA recently issued a report to Congress – *Moving to a Complete Streets Design Model: A Report to Congress on Opportunities and Challenges* – that responded to Congressional direction for USDOT to adopt a Complete Streets design model and provide an update on the FHWA Complete Streets initiative, established in March 2021 (Federal Highway Administration, 2022c). Over the past 20 years, hundreds of jurisdictions, including two-thirds of

the states, have adopted Complete Streets policies "directing their transportation agencies to routinely plan, design, build, and operate safe street networks for everyone" (Federal Highway Administration, 2022c, p. 5).

The Congressional report identifies opportunities in five key areas for continued progress on Complete Streets efforts, which all relate to the traffic safety culture among key stakeholders that impact pedestrian safety:

- Improve data collection and analysis to advance safety for all users.
- Support rigorous safety assessment during project development and design to help prioritize safety outcomes across all project types.
- Accelerate adoption of standards and guidance that promote safety and accessibility for all users and support innovation in design.
- Reinforce the primacy of safety for all users in the interpretation of design standards, guidelines, and project review processes.
- Make Complete Streets FHWA's default approach for funding and designing non-access-controlled roadways. (Federal Highway Administration, 2022c, p. 5)

Despite increasing acceptance and codification of the Complete Streets concepts, challenges toward Complete Streets remain – "in principle, Complete Streets are multimodal and provide safe access for all roadway users" but "in practice, it is not always possible to accommodate all modes in a single street due to right-of-way constraints, so a practical approach to Complete Streets also focuses broadly on building Complete Networks" (Federal Highway Administration, 2022c). As Prytherch (2018) observes, even the model state statute for Complete Streets policy developed by the National Complete Streets Coalition and AARP in 2013 acknowledged the "difficult politics and 'sticking points' for state D.O.T. officials," offered sample compromise language, and "reassured officials that not every street need be equally multimodal as long as states 'build an integrated network' that emphasizes different modes and provides 'high-quality access for everyone'" (Prytherch, 2018, p. 132).

As acknowledged by McCann, "the Complete Streets movement has helped bring about a tremendous burst of activity and change in the way roads are planned, funded, designed, and built. But it is far from the first to point out that roads should be safe for everyone traveling along them, or to argue for more transportation choices" (McCann, 2013, p. 3). See Table 1. Infrastructure and Design Strategies to Support Nonmotorized Safety for infrastructure and design strategies that support nonmotorized travel.

Table 1. *Infrastructure and Design Strategies to Support Nonmotorized Safety*

Strategies	Overview
Transportation-Specific Strategies	
Complete Streets	An approach to transportation policy and design that emerged in the 2000s as an alternative to the term "routine accommodation" that focuses on safe, convenient, and comfortable access for all users, including travelers who are walking, bicycling, and riding public transportation (McCann, 2013)
Road Diets	A safety strategy (in practice since the 1970s and termed in the 1990s) that refers to a roadway reconfiguration or conversion, which typically entails reduction in the number of travel lanes via introduction of a two-way center turn-lane. Road diets open up or reclaim space for other uses; as a result, they are a tool for creating complete streets (Burden & Lagerwey, 1999)
Traffic Calming	An approach to transportation design and management that gained popularity in the 1970s and has endured as a strategy to reduce motor vehicle traffic volumes and speeds and thereby improve safety for both motorists and nonmotorists.
Vision Zero and a Safe System Approach	A new traffic safety paradigm developed in Sweden in the 1990s based on a shift away from reducing crashes and toward the goal of eliminating the risk for serious injury or fatality, with the premise that building a safe system means crashes have tolerable health losses (Johansson, 2009)
Walkability	An approach to urban planning and design focused on supporting access by walking. The term emerged in the 1960s and has gained popularity with renewed focus on pedestrian safety and access. Speck's *General Theory of Walkability* holds that, for walking to be a favored option, it must be useful, safe, comfortable, and interesting (Speck, 2013)
Urban Planning Strategies	
New Urbanism	An approach to urban design and planning that emerged in the 1980s and gained prominence in the 1990s and employs principles for regional- and neighborhood-level development focused on community building and environmental preservation and conceived as a counter to sprawl.
Smart Growth	A regional approach to urban planning that emerged in the 1990s and gained prominence in the 2000s and employs principles for transportation and land use development focused on compact clusters of land development that are conducive to walking, bicycling, and riding public transportation and conceived as a counter to sprawl

As support for and adoption of the transportation strategies described in Table 1. Infrastructure and Design Strategies to Support Nonmotorized Safety have grown, more attention has been given to the role that a widely used federal manual has in either supporting – or obstructing – the realization of goals surrounding Vision Zero and a Safe System Approach. The Manual on Uniform Traffic Control Devices (MUTCD) "defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public travel" and is published by the Federal Highway Administration (Federal Highway Administration, 2022b). In theory, this manual leads to a recognizable and reliable travel environment across U.S. communities, but in practice critics argue that its application has limited the adoption of new design treatments that support traffic safety – especially for pedestrians and bicyclists (National Association of City Transportation Officials, 2021). However, better alignment to accommodate this shift in focus on transportation infrastructure may be forthcoming as work is underway on the 11th Edition of the MUTCD. The Infrastructure Investment and Jobs Act (IIJA) codifies that the USDOT will update the MUTCD by no later than May 15, 2023, and every four years thereafter, "to promote the safety, inclusion, and mobility of all road users" (Federal Highway Administration, 2022b).

Transportation planning and engineering are often portrayed as neutral technical exercises, in part due to their reliance on highly mathematized modeling perceived as "scientific" in nature. However, there is increasing recognition that these processes are embedded within sociopolitical contexts that are influenced by values and beliefs, as well as the distribution of power. For example, in developing his theory of transport justice, Karel Martens (2017) argued that, "typically, most well-intentioned planners and engineers follow professionally accepted procedures to analyze the state of the transportation system and to develop solutions to alleged problems such as road congestion, air pollution, increasing costs, or poor service levels," but "the way in which these solutions work out for different persons, and the often systematic way in which they affect different persons, are routinely ignored in the practice of transportation planning" (Martens, 2017, p. 5). Eric Dumbaugh, a Professor of Urban and Regional Planning with a doctorate in Civil and Environmental Engineering, has also critiqued the fact that "most traffic engineering programs in the U.S. do not have a single course that covers the issue of road safety," and yet graduates of these programs are credentialed as experts in the field (Singer, 2022, p. 96). As Barbara McCann, founding Executive Director of the National Complete Streets Coalition, observed, "the success of the complete streets movement shows how important it is to reframe the way we think and talk about long-standing built environment issues" and "demonstrates that building political will is important both when a policy is being debated and when it is time for agencies to put it into practice" (McCann, 2013, p. 171).

This political aspect is demonstrated in research conducted among transportation planning and engineering students and U.S. adults about their beliefs about transportation planning and policy. Ralph et al. (2022) found consensus among transportation planning students about transportation policy and what policy tools should be used (i.e., expanding transit, strengthening regulations, sharing the road, and mixing land use). Planning students also widely agreed that a goal of planning should be to reduce driving, raise federal gas taxes, and use congestion pricing to address congestion. There was less consensus about these planning policies and tools among engineering students and the U.S. public. Especially among the U.S. public, Ralph et al. (2022) suggested a pattern emerged regarding transportation policy that reflected a "yes, but" approach

(Ralph et al., 2022, p. 7). In other words, while the public supported some policies, the public was less willing to support policies that "make driving more expensive or inconvenient" such as raising gas taxes, congestion pricing, and reducing driving.

3.2.1.2 Perceived Support

There is a sense reported among some traffic safety professionals that they do not always feel support for certain pedestrian safety initiatives (and even some broader traffic safety efforts) from the public and sometimes from their own leadership (National Center for Rural Road Safety, 2022). Pedestrian safety is not always portrayed as a priority (Sandt et al., 2020). Traffic safety stakeholders are primarily working within a roadway traffic system historically designed with vehicles and traffic flow in mind, and "the complexity of the problem and lack of 'easy fixes'" tend to induce a sense that "nothing can be done" (Bergman et al., 2002, p. 264). Similarly, there tends to be a belief among the general public that suffering from motor vehicle crashes is "just a risk people take" – that "we have a culture that just accepts it [nearly 40,000 deaths from motor vehicle crashes annually]" (Yen & Krisher, 2022). The shift to safety as the top priority among national traffic agencies, traffic stakeholders, and across the social environment has not been a uniform and readily adopted shared vision.

3.2.1.3 Funding

With the recent passing of the IIJA, state transportation agencies will receive funding for multimodal transportation system projects and upgrades. State-by-state fact sheets plot out priorities and associated funding each state will receive, and pedestrian safety and equitable considerations are written into them all (USDOT, 2021). Local and tribal governments in each state can compete for funding ($6 billion) from a new program called Safe Streets for All, which will provide funds directly to "'vision zero' plans and other improvements to reduce crashes and fatalities, especially for cyclists and pedestrians" (USDOT, 2021). Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grants will also be available ($15 billion), and Racial and Ethnic Approaches to Community Health (REACH) grants have already been in use in some states to improve pedestrian safety and increase access to safer modalities of travel for communities of color (Multnomah County, n.d.; USDOT, 2021).

The IIJA reauthorized the Transportation Alternatives Program ("TAP") – the primary source of federal funding for walking, bicycling, and Safe Routes to School (SRTS) – through 2026. Only about half (52%) of TAP project applications receive funding, suggesting that the demand for these investments far outpaces available funding (Jones & Lieberman, 2022). Nevertheless, the SRTS Partnership notes a troubling trend in its latest annual report, finding that states are transferring more funds away from TAP, shifting resources away from biking and walking and towards road and bridge projects. Four out of five cities will spend infrastructure funds on roads and bridges compared to about one in four that will spend on public transit (Funk et al., 2022; Hawkins, 2022). "Prior to 2022, no state had transferred more than 50 percent of their TAP funds out of the program, and this year, six states fell into this category" (Jones & Lieberman, 2022, p. 76).

In addition, investments to support active transportation are relatively small. Among the 31 states funding active transportation with state revenue in 2022, the per capita annual average was $1.93 (Jones & Lieberman, 2022). Another analysis of spending, for fiscal years 2012-2016, found that federal transportation funds amounting to $2.36 per capita were obligated to projects for bicycling and walking (League of American Bicyclists, 2018, p. 138). An assessment of FHWA Highway Trust Fund obligations by improvement type by the U.S. Government Accountability Office for fiscal year 2013 found that 47% of obligations were for roads and 17% were for bridges, compared to 9% for safety enhancements and other improvements (including 1% for spending on sidewalks and bicycle trails) (U.S. Government Accountability Office, 2014). Advocates for sustainable and equitable transportation have suggested the share of spending devoted to supporting walking and bicycling should be at least comparable to their mode share, if not even higher; for example, Litman argues for investing 10-30% of infrastructure spending on non-auto modes to achieve mode share targets as well as targets for congestion reduction, public health, and emission reductions (T. Litman, 2022b). According to the most recent National Household Travel Survey, walking was used for 10.5% of person trips, compared to 2.5% for public transit, 82.6% for private vehicles (McGuckin & Fucci, 2018), and 1% for bicycling (League of American Bicyclists, 2018). Further, pedestrians and bicyclists are over-represented in traffic fatalities in relation to their share of all trips. As of 2016, bicyclists made up 2% of traffic fatalities while pedestrians made up 16% (League of American Bicyclists, 2018). In summary, walking and bicycling make up about 12% of all trips and about 18% of all traffic fatalities but receive an estimated 2% of infrastructure spending.

Meanwhile, past and current transportation funding investments have heavily focused on roadways, highways, and bridges, and related projects primarily oriented toward motorized traffic (T. Litman, 2022b; U.S. Government Accountability Office, 2014). In their study investigating the gap between pedestrian infrastructure needs and spending, Makarewicz et al. (2018) note that, "despite increased flexibility in use of federal surface transportation funds and an increased emphasis on the importance of walkable communities, investments in pedestrian infrastructure remain a tiny fraction of total need and pale in comparison to investments in other modes of transportation" (Makarewicz et al., 2018, p. 145).

3.2.2 Ideologies

Support for strategies and countermeasures to improve pedestrian safety are shaped by several ideologies. An ideology is defined as "the doctrines, opinions, or way of thinking of an individual, class, etc.; specif., the body of ideas on which a particular political, economic, or social system is based (Collins English Dictionary, 2022).

The U.S. transportation system involves every other major U.S. system influenced by ideologies (economic, political, social, etc.), so beliefs held about traffic and pedestrian safety may be reflective of differences in the "foundational views" that different stakeholder groups have about transportation (Ralph et al., 2022, p. 11). Ideologies such as an affinity for speed (Bellis et al., 2021; Lewyn, 2017; Smart Growth America, 2022a), the priority of traffic flow (Moran, 2021), and American Individualism (Greene, 2008; Turner, 2008) help us understand the underlying context of the current transportation system. Within each ideology, different sets of competing values or beliefs exist that illustrate the intricacies of the ideology. To further investigate the

culture around pedestrian safety, it is beneficial to consider the ideologies that influence traffic safety stakeholders, from DOTs, traffic engineers, traffic designers, planners, and pedestrian (and bike) coordinators to law enforcement, policy makers, and regulatory agencies.

3.2.2.1 Affinity for Speed

One prevalent theme that recurred in the literature is the prioritization of speed throughout many aspects of the transportation system. Historically, speed has been prioritized more than safety in the U.S. transportation system (Bellis et al., 2021; Lewyn, 2017; Smart Growth America, 2022a). A foundational example of this stems from the 1920s when a spike in pedestrian and cyclist deaths from car crashes spurred communities, cities, and states to petition for in-vehicle mechanical speed restrictions; in response, the auto industry was able to mount a successful reframing of the issue – shifting blame to pedestrians and cyclists rather than on the higher than necessary speed allowed for automobiles (Norton, 2022). Those efforts of the early auto industry have had an enduring legacy as U.S. traffic systems have clung to a preference for speed in both automobiles and traffic flow (Norton, 2022).

At the heart of the U.S. affinity for speed is the convenience of accessing places near and far as quickly as possible. With each advance in transportation technology, the demands of travel have prioritized space for high-speed travel at the expense of pedestrian spaces to move freely (Forsyth & Southworth, 2008; Holtz, 1997). It has been suggested that U.S. preferences toward automobile values "have been codified in the transportation and street design standards that we struggle with today" (Forsyth & Southworth, 2008). By contrast, peer countries such as Germany, Denmark, the United Kingdom, the Netherlands, Canada, Japan, Australia, and France have prioritized roadway network designs that slow speeds and provide more dedicated space for pedestrian travel; as a result, the U.S. in general has higher roadway fatalities and more dangerous roads than most high-income international peers (International Transport Forum, 2021) especially for vulnerable road users such as pedestrians and bicyclists (Buehler & Pucher, 2017, 2021b; González-Hermoso & Morales-Burnett, 2021; Pucher & Buehler, 2010; Zegeer & Bushell, 2012; Zipper, 2022a).

Another example of the priority of speed and mobility is Americans' longstanding aversion to the roundabout as a traffic calming strategy (Vehicle Title and Registration Services, 2020; Widmar, 2021). Studies have proven roundabouts are safer than intersections with stop signs or signals as they reduce vehicle crash injuries by 75% (Vehicle Title and Registration Services, 2020) as well as pedestrian crash injuries by 75% (Governor's Highway Safety Association, 2021). Slowly, roundabouts have been increasingly installed across the country (Transportation Research Board, n.d.; USDOT, 2020). In 2003, there were approximately 300 roundabouts in the U.S. (Transportation Research Board, n.d.), and as of 2021, Kittleson and Associates estimated there were about 8,800 (Taylor & Rodegerdts, 2022). However, despite the safety improvements and increase in prevalence of roundabouts, public opinion continues to be somewhat negative, because roundabouts force drivers to slow down (Vehicle Title and Registration Services, 2020; Widmar, 2021).

3.2.2.2 Car Culture or "Motorism"

It's been noted that people in the U.S. walk and bicycle less than most of our peer nations (Althoff et al., 2017; Buehler & Pucher, 2021a). Across much of the U.S., there is a "culture-wide presumption that driving is normal and normative," and the notion of citizenship is often synonymous with being a motorist (Millard, 2014). Historian Emma Rothschild has long documented that the U.S. landscape has been organized for the use of automobiles, and those who venture from that "autocentric" norm are dissenting an entire belief system (Millard, 2014; Rothschild, 2022). Bellah et al. (1992) and Millard (2014) assert that this "auto-industrial complex" culture (as described by Rothschild) is more than just a love of cars, but it is a cultural ideology that can be pervasive and accepted as simply common sense. (Millard, 2014) coins the term "motorism" as the ideas and cultural norms that center the automobile as an essential mechanism of freedom and situate U.S. citizens as motorists.

3.2.2.3 Ideology of Flow

Understanding the parameters under which traffic transportation stakeholders design, operate, and measure the performance of their systems helps illustrate the values and constructs that shape those systems. Traffic performance has been defined and measured for nearly a century in this country by the efficiency of moving quantities of vehicles through defined spaces in the least amount of time, known as traffic flow (Al-Sobky & Mousa, 2016; Elvik, 2017; Ghadage et al., n.d.; Lieu, 1999; National Research Council (U.S.). Transportation Research Board, 2000). Traffic-flow theory is the specific mathematical way the design and operation of streets and highways are assessed, which has evolved with technology and understanding of traffic-flow processes since its beginnings in the 1930s. It remains the fundamental framework for transportation systems and the techniques and procedures that guide them (Al-Sobky & Mousa, 2016; Lieu, 1999).

As Elvik (2017) notes, safety considerations were not an initial component of the traffic-flow theory. In fact, safety impacts of traffic performance and road design were not premeditated or consciously planned in original planning and designs. The major highway expansion and automobile boom that occurred after the Second World War were based on models of volume and speed, and the safety response since has been to reactively address the "safety effects of various elements of road design and traffic control" (Elvik, 2017, p. 171). Only with more recent efforts that embrace a more holistic, multimodal, and proactive approach to transportation planning and design has traffic safety been viewed as a preventative consideration (Schweppe, 2001). Even as more modern safety considerations have been interwoven into roadway design, the ideology of flow or "uninterrupted movement of cars over the safety of pedestrians" is still prevalent (Moran, 2021, p. 302).

3.2.2.4 Perceptions of Responsibility / "Victim Blaming"

Perceptions about responsibility and blame for pedestrian injuries and fatalities influence beliefs, behaviors, and policies in traffic safety (Magusin, 2017). Pedestrian safety advocate Schmitt (2020) suggested that "the way we view these incidents in a general sense reflects certain cultural assumptions and wider power dynamics," and the U.S. driving culture "affects the way

we perceive blame and responsibility in these cases, usually in ways that are not beneficial to pedestrians" (Schmitt, 2020, pp. 48–49).

Some have argued that "victim blaming" or believing that pedestrians are responsible for their safety within the larger transportation system serves to uphold dominant political and economic interests (relating to, for example, automobile manufacturing and highway building) and plays out in the road transport system at the expense of certain sectors of the community who suffer as a result (T. Litman, 2022b; Martens, 2017). Others document there are even times when children are assigned the responsibility of their own road safety when they have zero stake in its creation (Roberts & Coggan, 1994; Waygood, 2017), and "pedestrian injuries are a leading cause of childhood mortality" (Insurance Institute for Highway Safety, 2022a; Roberts & Coggan, 1994). Other specific populations including older adults, immigrants, and residents of lower-income neighborhoods are also groups who are more frequently the victims of pedestrian/vehicle crashes and have also been assigned blame (Sandt et al., 2020; Smart Growth America, 2022a).

Pedestrian advocates for reform have coined the term "windshield bias" or "windshield perspective" to describe the tendency for conclusions about the travel environment to be drawn by the way in which users move through it (Gatersleben et al., 2013; Schmitt, 2014, 2020, p. 49). Heavy reliance on automobiles for daily travel contributes to a dominant narrative in the media and among various traffic stakeholders that emphasizes "the responsibility of pedestrians for their own safety and minimizes the responsibility of drivers" for the safety of travelers outside their own vehicles (2020, p. 49). For example, in a study of news media discourse about pedestrian traffic fatalities, Magusin (2017) identified three typical ways that pedestrian fatalities are framed in news media coverage: "factual reports of the incident; criminal reports of the charge resulting from the incident; or humanized narratives emphasizing the tragedy of the incident" (Magusin, 2017, p. 65). The most common frame used to describe pedestrian fatalities is a factual frame, characterized by reporting facts, using language that avoids eliciting emotion about the pedestrian who was killed, and fails to situate the issue within a greater context that would prompt people to view pedestrian fatalities as more than isolated incidents (Magusin, 2017, p. 87). Further, when referencing the driver, most media coverage used the noun "vehicle" to refer to both the car and the driver which distances the person from the act and potentially distances the driver from responsibility (Magusin, 2017, pp. 81–82).

Similarly, researchers from the Center for Urban Transportation Research analyzed media discourse about fatal bicycle crashes between 2009 and 2018 in Hillsborough County, FL, and found that a majority of news reports used episodic (rather than thematic) framing, and "largely functioned to remove blame from the motorist and to highlight the bicyclist's actions" (Scheffels et al., 2019, p. 628). According to the researchers, "these linguistic strategies reflect the assumption that responsibility for safety rests on the bicyclist and detracts attention from potential social policy reform that would lead to fewer bicyclist fatalities" (Scheffels et al., 2019, p. 628).

The influence of language choice was also affirmed in a study of language patterns used regarding traffic crashes involving pedestrians (Goddard et al., 2019). In this study it was found that the language used significantly influenced readers' interpretation of both what happened and what to do in a scenario involving a traffic crash involving a pedestrian (Goddard et al., 2019).

Specifically, when language referred to an incident as an "accident" instead of a "crash," used language that indicated a lack of agency, focused on the victim, used object-based language versus person-based language, and included a false statement about the victim, participants were more likely to assign blame to the pedestrian than the driver and were less inclined to assign punishments to the driver (Goddard et al., 2019). This study concluded that language choices influence beliefs and shape perceptions about blame, punishment, and preferred solutions in the context of a crash involving a pedestrian (Goddard et al., 2019).

Perhaps taking the ideology of victim blaming a step further is the phenomenon that penalizes people for walking on roadways. "Jaywalking" became a criminal offense in the 1920s as a result of the auto industry's push to get pedestrians off the roads so that vehicle speeds did not have to be restricted (Lewyn, 2017). The term "jaywalker" emerged as a derogatory way to categorize people who utilized roadways for walking. "The term 'jay' originally meant 'a country hayseed out of place in the city.' Thus, a jaywalker was a pedestrian out of place in the city and oblivious to the dangers of motor traffic. Automobile lobbyists and lobbyist-influenced 'safety groups' used this term to stigmatize walkers" (Lewyn, 2017, p. 1170). Roadway transportation history shows that efforts to stigmatize "the jaywalker as a bogeyman can be traced directly to those desperate to find someone else to blame for the rise of traffic" deaths (Singer, 2022, p. 23).

Police enforcement of jaywalking has continued into current times and disproportionately targets minorities and the poor (Lewyn, 2017; Sandt et al., 2020; Schmitt, 2020). Perceptions of responsibility that assign blame to pedestrians for their injuries alongside the dominant frame used in media portrayals that situates the issue of pedestrian injuries and fatalities as a behavioral problem rather than an environmental one (Frattaroli et al., 2006, p. 381) have implications and may influence stakeholder prioritization and implementation of strategies.

The revisioning of traffic safety, now known as Vision Zero that began in Sweden in 1995, has been an effort to shift the sense of responsibility for roadway safety such that:

No more would the government blame jaywalkers and nuts behind the wheel for their deaths. Instead, when someone died on the road, government officials and traffic engineers were responsible; *they* had to explain how *they* had let it happen. And instead of designing for a perfect human, those officials began designing roads from the starting point: What might go wrong? Blame, in the form of traffic enforcement, was deprioritized. Instead, the road was built to reduce the harm of inevitable mistakes. (Singer, 2022, p. 219)

3.2.2.5 American Individualism

Some of the value systems or character traits that are considered positive attributes of U.S. citizenship have been shown to impact the culture surrounding traffic safety and attitudes toward nonmotorized road users. The ambition of American individualism stems from 18th century U.S. founders such as John Locke who promised fathomless individual freedoms and opportunities for material wealth with a hands-off government (Bellah et al., 1992). Some believe this resolute individualism has permeated the American value system to such a degree that Americans struggle to think in terms of what is best for the common good (Greene, 2008; Turner, 2008).

It has been suggested that automobiles are an empowering mechanism and representation of individual freedom and social identity for many Americans (Cotten Seiler, 2008). The simple act of driving a car represents freedom, individualism, and the sense of personal agency that is often portrayed as synonymous with being American (Crawford, 2020). Reaching the age of 16 and earning a driver's license is perceived as an important rite of passage for American adolescents. Historically and currently, groups vying for entry into public and political spheres (women, African Americans, immigrants) have been shown to seek access to this powerful resource – the automobile (Cotten Seiler, 2008).

3.2.2.5.1 Equity

Almost hand in hand with beliefs about American individualism can be found justifications for inequalities where "a sense or illusion of empowerment among the otherwise disempowered" becomes a false sense of individual achievement in a system that is structurally unjust (Greene, 2008, p. 118). This is where positive perceptions about American individualism and coinciding motorism have been thought to disenfranchise those who choose to walk or bicycle or simply cannot afford motorized travel (Millard, 2014; Rothschild, 2022).

Research has shown that racial, economic, and disability biases contribute to disparities in the transportation system just as in other systems. "The legacy of bias almost certainly contributes to ongoing pedestrian safety disparities and transportation inequity" (Roll & McNeil, 2022, p. 4). Our country's history of land use and zoning, housing policies and lending, and the wealth gap between black and white Americans has negatively impacted "low-income and [Black, Indigenous and People of Color] BIPOC communities, ranging from increased exposure to environmental hazards, inferior schools, exposure to crime, and diminished access to jobs. The resulting segregated housing landscape contributes to different transportation experiences, travel options, and safety conditions, including areas with higher concentrations of low-income and BIPOC residents being exposed to higher [vehicle miles traveled] VMT density and more high-speed arterials" (Roll & McNeil, 2022, p. 4).

These underlying inequities that have been noted in the transportation system are beginning to be recognized and treated as systemic barriers rather than problems that can be solved as individual occurrences or instances. Disparities in traffic fatalities by race and ethnicity are consistent with a larger transportation system that has racial bias. Raifman and Choma (2002) suggest that poor design and lack of safe and alternative modes of transportation such as "disproportionate traffic stops" and "potential bias in the travel demand models used to forecast impacts of investments" are inequities that permeate the entire system (Raifman & Choma, 2022, p. 2).

Through more recent policy advances and available funding, the U.S. is recently attempting to (1) do a better job at addressing the inequities that are entrenched in the design and structure of our current transportation system and (2) realize that individual-focused strategies that rely on changing the behaviors of pedestrians are not enough (*Equity in Transportation Infrastructure: Connecting Communities, Removing Barriers, and Repairing Networks Across America*, 2021; Jones & Lieberman, 2022; Kravetz & Noland, 2012; Sandt et al., 2020; USDOT, 2021).

3.2.3 A Glimpse of Best Practices and Strategies

To provide more context around the culture of pedestrian safety, this section provides a brief summary of some of the best practices for pedestrian safety strategies as well as insights on how international peers have used these practices and experienced success. A variety of transportation organizations in the U.S. promote countermeasures and offer guidelines for best practices in pedestrian safety strategies, including public agencies at the state and federal levels, the publicly funded Pedestrian and Bicycle Information Center (PBIC), as well as nonprofit organizations such as the National Association of City Transportation Officials (NACTO).

Reducing speeds, changing roadway designs (e.g., roundabouts, speed bumps), and implementing more stringent vehicle regulations (safer and smaller vehicles) are some of the strategies that have been suggested to improve pedestrian safety (Federal Highway Administration, 2017; T. Litman, 2017; Schneider, 2018; Tyndall, 2021). In their analysis of the increase in pedestrian fatalities between 2009 and 2016, Hu & Cicchino (2018) of the Insurance Institute for Highway Safety suggest "transportation agencies can improve urban arterials by investing in proven countermeasures, such as road diets, median crossing islands, pedestrian hybrid beacons, and automated speed enforcement. Better road lighting and vehicle headlights could improve pedestrian visibility at night" (Hu & Cicchino, 2018, p. 37). Many of these strategies have been adopted by international peers yet have had slower acceptance in the U.S. (Buehler & Pucher, 2017, 2021b; Moravčík & Jaśkiewicz, 2018; Soathong et al., 2019; Zipper, 2022a, 2022b). The successful deployment and implementation of best practices and strategies that support nonmotorized safety by peer countries, accompanied by their decreasing levels of nonmotorized serious injuries and fatalities, offer hopeful examples for the U.S. to consider in light of goals embracing Vision Zero and a Safe System Approach to transportation.

3.2.3.1 Reducing Speed

Schmitt (2020) argues that "speed is perhaps the most crucial factor that will determine whether a pedestrian will walk away from a crash unscathed or will be killed" (Schmitt, 2020, p. 28). The largest group of traffic fatalities worldwide are pedestrians killed in motorized vehicle crashes, and "excessive speed is the primary contributory factor in such crashes" (Hussain et al., 2019, p. 241).

It is important for policy makers to prescribe speeds that are safe, i.e., survivable, for all road users. For pedestrians, it is not possible to fully eliminate the risk of fatality. However, our results suggest an impact speed of 30km/h has on average a risk of a fatality of around 5%. The risk increases to 13% for an impact speed of 40km/h and 29% at 50km/h. Speed limits should be set lower in areas of poor visibility and thus slower reaction times. Furthermore, such speed limits could be supported by appropriate speed calming approaches such as physical measures (e.g., roadway design, pedestrian islands, and speed humps), surface treatments (e.g., road markings, rumble strips, and perceptual countermeasures), and traffic enforcement (e.g., speed cameras) to motivate drivers lowering their traveling speeds. Such speed limits and speed calming approaches are already commonly used by best practice countries that have the lowest road fatality rates and that practice a Safe System Approach to road safety. (Hussain et al., 2019, p. 247)

Indeed, the Vision Zero strategy "is to manage kinetic energy in crashes and collisions" so that they are survivable (Johansson, 2009, p. 828). Smart Growth America argues that decision makers throughout our transportation system will "have to unwind the deeply embedded, invisible yet powerful emphasis on speed, which is completely incompatible with safety" (Smart Growth America, 2022a, p. 11).

In the U.S., speed is often pinpointed by advocacy groups and journalists investigating pedestrian incidents, local Strong Town members from Rockford, Illinois began investigating their city's safety conditions based on the following questions: "How 'safe' are pedestrians; What areas are less safe than others for pedestrians; How can we work together to maximize safety and accessibility for non-motorized users of our transportation network?" (Smith & Smith, 2018). The results of this investigation boiled down to speed. Buehler and Pucher (2021b) note that, "many urban roads in the USA have speed limits far exceeding the general speed limit of 35mph, and most pedestrian and cyclist fatalities occur on those higher-speed urban roads" and few cities use traffic-calming measures (Buehler & Pucher, 2021b, p. 60). Additionally, speed limits are "more strictly observed in Dutch, Danish, German, and British cities than in American cities" while use of automated enforcement is rare in the U.S. (12 states use automated speed enforcement, 22 have cities with red-light cameras) (Buehler & Pucher, 2021b, p. 62).

The Federal Highway Administration (FHWA) published a Primer on Safe System Approach for Pedestrians and Bicyclists where traffic safety stakeholders can find a Safe System-style overview to pedestrian safety, and "safe speed" is highlighted as a major element (Goughnour et al., 2021). The primer provides an overview of the five elements – safe road users, safe vehicles, safe speeds, safe roads, and post-crash care – involved in a Safe System Approach as well as several examples of federal, state, and local safety plans (Goughnour et al., 2021, pp. 4–5).

3.2.3.2 Roadway and Vehicle Design

Roadway design features are another best practice, but a myriad of competing priorities may slow or stifle progress. As noted by Buehler and Pucher (2021b), "many studies have confirmed the importance of good walking and cycling infrastructure in promoting more and safer walking and cycling" and "international comparative research has documented that Dutch, Danish, and German cities generally have more extensive, higher quality, and better integrated walking and cycling infrastructure than American cities" (Buehler & Pucher, 2021b, p. 57). They reference Hass-Klau's comparative analysis that recommends pedestrians being on sidewalks physically separate from vehicles along roads and "special protections for pedestrians crossing roads at intersections and crosswalks (advanced pedestrian signals, raised crossings, improved lighting, turn restrictions for cars); reduced general urban speed limits; traffic-calming of residential neighbourhoods; and car-free zones in districts with high levels of walking (mostly in the city centre)" (Buehler & Pucher, 2021b, p. 57). They also note that roads in the U.S. are generally much wider than in European cities and that U.S. intersections are designed for the needs of motor vehicles and maximizing flow while minimizing any traffic delays (Buehler & Pucher, 2021b, p. 59). "Indeed, these car-oriented roadway design guidelines have been explicitly included for many decades in the standard American manuals for building roads and intersections" while "in contrast, roadway design manuals for the Netherlands, Denmark,

Germany, and the United Kingdom specifically highlight the need to promote walking and cycling safety" (Buehler & Pucher, 2021b, p. 59).

Road design can be an "upstream solution" that helps to prevent dangerous behavior before it occurs and focuses on safer systems rather than individual behavior (Smart Growth America, 2022a, p. 37). Roundabouts are an example of a design feature to reduce crash injuries but can be considered inconvenient for drivers who would prefer intersections with stop signs or signals (Vehicle Title and Registration Services, 2020) (Governor's Highway Safety Association, 2021). Many benefits come with the roundabout design relating not only to safety but also the preclusion of road widening (Widmar, 2021).

Another best practice that other countries have embraced to make pedestrians safer relates to a package of policies that promotes the sale and purchase of smaller passenger vehicles, including significantly higher taxes for motor vehicle purchases, registrations, and fuels, as well as vehicle standards that take into account vehicle design impacts on the safety of nonoccupants (including pedestrians).

Buehler and Pucher (2021b) note that "several studies show that larger motor vehicles pose a much greater safety hazard for pedestrians and cyclists than smaller, conventional sedans" but that "personal light trucks in the USA are larger and more powerful than those in Europe" and grew to 72% of new personal vehicle sales in the U.S. by 2018, compared to an average of 33% across the United Kingdom, Germany, Denmark, and the Netherlands (Buehler & Pucher, 2021b, p. 64). They note that, "one of the reasons for the greater popularity, larger size, and more powerful personal light trucks in the USA is the much lower price of petrol in the USA: $0.81 per litre in 2018 compared to $1.73 in Denmark, $1.82 in the UK, $1.95 in Germany, and $2.05 in the Netherlands" such that fuel taxes account for 61%-67% of the total fuel price in these countries, compared to 21% in the US (Buehler & Pucher, 2021b, p. 64). Passenger vehicles overall are smaller in the European Union than in the U.S., "with the average car sold in the EU having just 75% of the average U.S. car's weight" (Freemark & Jenkins, 2022).

Fatal single-vehicle pedestrian crashes involving sport utility vehicles (SUVs) increased 82% between 2009 and 2016 (Hu & Cicchino, 2018). Tyndall (2021) analyzed data for all fatal vehicle collisions in the U.S. and estimated that 1,100 pedestrian deaths could have been averted between 2000 and 2019 if the growth in SUVs had been replaced with cars; he also found no evidence of the shift in the passenger vehicle market toward larger vehicles resulted in improved aggregate motorist safety.

Along with higher fees for vehicle purchases and fuels, registration fees are a strategy to encourage the purchase of smaller vehicles. France is one country that uses this strategy, and Washington, DC, recently adopted a weight-based registration scale that is the first of its kind in the U.S (Freemark & Jenkins, 2022; Lazo, 2022).

Regulations on vehicle design is another practice that has made a positive difference in Europe – reducing pedestrian fatalities and injuries – yet is a practice the U.S. has avoided (Schmitt, 2017b). Regulators at the National Highway Traffic Safety Administration studied potential vehicle safety regulations like those enacted throughout Europe but have not implemented any.

"In 2010, the European Union (EU) introduced new auto safety standards designed to reduce pedestrian fatalities and injuries, stemming from a set of recommendations released by the United Nations the previous year" (Schmitt, 2017b). The EU regulations reduce risk of head trauma with design "features like higher hoods to reduce the severity of impact in the event a driver strikes someone outside the car. Mandates to improve 'survivability' for pedestrians have prompted some vehicle makers to incorporate external airbags" (Schmitt, 2017b). Indeed, vehicle designs that incorporate pedestrian protection are "one of the last frontiers of vehicle safety" but the U.S. has fallen behind international peers as "NHTSA has been reluctant to regulate it because it so closely relates to styling" (Schmitt, 2017). In other words, with the absence of both "regulatory push" via the Federal Motor Vehicle Safety Standards and "demand-pull" via consumer information provided from the New Car Assessment Program (Global NCAP, 2022), the U.S. passenger fleet is trending toward larger vehicles with aesthetic characteristics that reduce nonoccupant safety, such as bull bars or push bumpers and tall SUVs, minivans, and pickup trucks with front blind zones that are much higher than passenger sedans and compact cars. In contrast, peers such as the European Union are pursuing policies to improve passenger fleet safety – for example, the General Safety Regulations were implemented in 2022 and "helped set a new standard for the minimum safety regulations and safety features in new vehicles in the EU" (Global NCAP, 2022, p. 8).

Another reason U.S. regulators have avoided implementing international safety standards relates to the number of SUVs and pickup trucks that do not fit within international guidelines created for smaller vehicles. SUVs and trucks were 63 percent of the U.S. new car sales in 2016 (Schmitt, 2017b). "In 2015, researchers at the University of Michigan determined that pedestrians are more than three times as likely to be killed when struck by an SUV than when struck by a regular passenger vehicle. The critical design factor is the high, blocky front end, which pushes people below the wheels instead of over the hood" (Schmitt, 2017a). Yet those "big square-nosed SUVs" are still selling all over the country; "those front end features that kill and maim pedestrians are popular with consumers" (Schmitt, 2017a).

3.2.3.3 U.S. Resources and Guidelines

In addition to the FHWA Primer on Safe System Approach for Pedestrians and Bicyclists (2021), there are a variety of other resources and guidelines that leading transportation agencies and advocates in the U.S. offer promoting their endorsed best practices.

The FHWA has a webpage devoted to *Safe Transportation for Every Pedestrian* (STEP) (Federal Highway Administration, 2022d). This webpage has links to some guidance, seven different countermeasure tech sheets, the STEP Studio (a tool to assist selecting and implementing countermeasures), a conversational webinar about innovation, and an assortment of case studies from different pedestrian efforts in different states. The STEP Studio walks a traffic safety professional through suggested steps for selecting and implementing a countermeasure (STEP Studio). The MUTCD guidance that accompanies the list of countermeasures in the STEP Studio document recommends signage, lighting, signals, and curb, and crosswalk design countermeasures (Federal Highway Administration, 2022d). Speed is consistently recognized as a factor in pedestrian incidents yet strategies to reduce speed do not appear among the recommended countermeasures.

Additionally, FHWA has a separate website, PEDBIKESAFE.org, that guides a user through a series of pedestrian and bike issue-related questions to assist them in selecting a countermeasure appropriate for their situation (Federal Highway Administration, n.d.). Case studies are also available for reference.

NHTSA includes pedestrian safety in their eight different program topics for which states can request a technical program assessment (National Highway Traffic Safety Administration, n.d.). This invites an outside team to come in and comprehensively assess the program's strengths, weaknesses, and opportunities for improvement (National Highway Traffic Safety Administration, n.d.). The programs are assessed on the standards set forth in the Highway Safety Program Guideline No. 14 written in November 2006.

Another resource for pedestrian safety guidance comes from a national coalition that works to improve communities, Complete Streets by Smart Growth America (Smart Growth America, 2022a). Their annual publication, Dangerous by Design, is a comprehensive look at the data, design, and planning that directly impact U.S. communities, particularly the most vulnerable. Many of the solutions they offer confront the prevailing ideologies and priorities that have shaped the U.S. transportation system (and created dangerous spaces for pedestrians and other non-motorists). They also describe the challenge of making change: "Improving safety isn't a mystery, but inertia is hard to overcome" (Smart Growth America, 2022a).

An additional Complete Streets web-based tool is available via Smart Growth America that focuses on quantifying the benefits of Complete Streets projects and contains assistance for leaders and advocates to communicate the advantages to their communities (Hope, 2021). The tool is titled "The Benefits of Complete Streets," and it has an accompanying guidebook to lead one through use of the tool as well as a examples of communities with successful implementation stories (Smart Growth America, 2022b). Four benefit areas within a community can be measured (environment, health, safety, and economic) all while incorporating an equity approach, and the tool includes technical guidance (Hope, 2021).

There are various guidelines and examples of best practices that can be found among related search terms, such as guidelines for selecting countermeasures for uncontrolled locations published by a Civil Engineering doctoral student (Rab, 2017) or best practices for pedestrians themselves provided by city safety coalitions (City of Mercer Island, 2012). There are many recommendations or best practices targeting pedestrians and drivers. There is a bulk of literature with a pedestrian-centered focus, such as an article advising parents on their role in keeping their children safe in pedestrian situations (Morrongiello & Barton, 2009). However, since our role in this literature review is to help understand traffic safety stakeholders' beliefs surrounding the field of pedestrian safety, we purposefully avoided guidance from insurance, law enforcement, youth organizations, school curriculums, and other agencies that only focused on pedestrian behavior.

3.2.4 Safety Culture, Integration, and the Safe System Approach

The direction of pedestrian safety in the U.S. is headed toward strategies that embody an overall safety culture, integrate pedestrian strategies into other traffic safety and public health efforts,

and embrace the Safe System Approach (Federal Highway Administration, 2022c; Goughnour et al., 2021). Pedestrian safety is a wide-reaching traffic safety issue affecting communities, so broadening the context of pedestrian safety to connect with larger values that people care about such as health and livability issues may motivate prioritization and promote implementation (Bergman et al., 2002; Frattaroli et al., 2006). For example, Frattaroli et al., (2006) found that among participants in their study, there was a general sense that pedestrian safety was a low priority. It was suggested that to increase prioritization of pedestrian safety and build support for implementation, reframing the pedestrian injury issue "as part of broader improvements to enhance livability, and connecting these improvements to the crime, violence, and drug selling issues which dominate many local agendas" could be advantageous (Frattaroli et al., 2006, p. 384). Similarly, Bergman and colleagues (2002), suggested that recognizing pedestrian safety as "health and livability issues instead of one that is just related to traffic" may increase support for pedestrian safety.

To further a sense of community health and safety, "pedestrian injuries and deaths should be viewed as a critical public health issue"; "Incorporating safety from traffic into broader efforts to increase walking and physical activity has the potential to have a significant [physical] health impact" (Stoker et al., 2017, p. 211). "Despite the scale of the pedestrian safety problem around the globe, the potential health benefits of increasing walking appear to far outweigh the additional risk" as walking and other means of active transport help mitigate some of the primary factors of premature death by increasing activity levels (Stoker et al., 2017, p. 212).

Approaching pedestrian safety with a safety culture lens allows for more comprehensive stakeholder engagement (integration) as suggested by the Safe System Approach as well as community involvement as recommended by (Frattaroli et al., 2006) and efforts like the Safe Routes to School initiative (Centers for Disease Control and Prevention (CDC), 2021).

Despite a long history of linkages between public health, transportation, and urban planning, the fields have diverged in practice and have operated relatively independently reflecting differences in the missions and goals, funding sources, planning and development processes, partnerships and performance metrics for each sector. However, in recent years, the need for transportation, health, and other stakeholders to work together more closely to improve public health outcomes has been increasingly recognized. (American Association of State Highway and Transportation Officials (AASHTO) Committee on Environment and Sustainability, 2019)

Historian Peter Norton draws a comparison to public health lessons about cigarettes – strategies like cigarette filters that focused attention on making cigarettes safer obfuscated the core problem of freeing ourselves from cigarettes in the first place (Zipper, 2021). Elsewhere, he argues that addressing the problems of car dependency requires changing "three things: laws, engineering standards, and social norms" and that "you have to push on all three" to achieve change (Hill, 2022). This speaks to the interconnectedness of goals surrounding Vision Zero and the degree to which the U.S. relies on private vehicles for passenger travel overall – or, as Todd Litman advocates, "Vision Zero, Meet VMT Reductions" (T. Litman, 2020).

Harnessing support for pedestrian safety from the community has been identified as an important facilitator in advancing pedestrian safety prioritization, integration, and deployment (Bergman et

al., 2002; Frattaroli et al., 2006). Not engaging community members is a potential missed opportunity in garnering support and reducing barriers to pedestrian safety strategies being implemented (Frattaroli et al., 2006). Several suggestions to engage community members have been identified including implementing a process for feedback and addressing community members' concerns, using credible data to ignite support and raise awareness for the issue of pedestrian safety, and establishing a coalition or task force to address barriers that may arise when implementing pedestrian strategies (Frattaroli et al., 2006). Bergman and co-authors (2002) also suggested organizing a coalition with broad representation (i.e., health, safety, traffic engineering, environmental enhancement, trauma victims and their families) to advocate for pedestrian safety as a way to harness community support.

One public health initiative, Safe Routes to School (SRTS, n.d.), is an example of a comprehensive effort to make students' travels to school safer and more health-focused (Centers for Disease Control and Prevention (CDC), 2021). Safe Routes to School efforts are implemented around six "Es" of an integrated approach: Engagement, Equity, Engineering, Encouragement, Education, and Evaluation (Safe Routes Partnership, 2020). Another comprehensive effort is the Federal Highway Administration (FHWA) Safe Transportation for Every Pedestrian (STEP) initiative, which started in 2017 and has seven countermeasures to help states improve pedestrian safety (Redmon et al., 2021). In 2020, the United States Department of Transportation (USDOT) published a pedestrian safety action plan as part of their "comprehensive approach that encompasses improvements to the roadway and surrounding environment, increased education on the shared responsibility of both pedestrians and motorists along with enforcement and adjudication of pedestrian safety laws" (United States Department of Transportation, 2020). In this action plan, it is noted that a National Pedestrian Safety Partnership Plan (NPSPP) is being developed between NHTSA, FHWA, and the leadership of USDOT to collectively envision better pedestrian safety and how the pedestrian safety status currently could be improved by 2035 (United States Department of Transportation, 2020).

Several transportation agencies have published resources and toolkits to assist traffic safety stakeholders in engaging and involving the public (their communities) in dialogue, planning, and even design of different transportation projects (including pedestrian efforts). FHWA published the Virtual Public Involvement: A Collection of Tools, Techniques, and Examples (USDOT, 2018), and USDOT has a site with tools to assist community members' involvement in transportation decision-making processes (USDOT, 2016).

As mentioned earlier in this review, pedestrian safety strategies and countermeasures have often been treated or approached as isolated or siloed efforts (Brookshire et al., 2016; *Equity in Transportation Infrastructure: Connecting Communities, Removing Barriers, and Repairing Networks Across America*, 2021; Kim, 2014; McCann, 2013), but "the system aspect of the Safe System Approach requires strong partnerships and collaboration across departments and between agencies" (Goughnour et al., 2021). Pedestrian safety, and its overarching goal of equalizing access to safe transportation for all road users, is an opportunity to integrate multimodal transportation efforts with a Vision Zero goal of safety for all road users.

3.3 Formative Interviews

In Task 1, a series of formative interviews with current traffic safety stakeholders involved in decision making about the implementation of pedestrian safety strategies (e.g., DOTs, traffic engineers, traffic designers and planners, pedestrian (and bike) coordinators, policy experts, and transportation agencies) was conducted. An interview protocol (guidance and questions) was developed. The purpose of the semi-structured formative interviews was to get a better sense of the current pedestrian safety culture and opportunities for improvement. The interviews examined beliefs about pedestrian safety prioritization and deployment of strategies, explored barriers and challenges that might inhibit the implementation of pedestrian safety strategies, and offered examples of success. The information learned from these stakeholder interviews were used to design surveys of traffic safety stakeholders about their attitudes, values, and beliefs related to pedestrian safety in Task 2 of this project.

3.3.1 Methodology for Interviews

We conducted a series of formative interviews with 13 current traffic safety stakeholders employed by various organizations (federal government, state DOTs, MPO, one university/research center, national advocacy groups, and one private consultancy). Most interviews were individual (n=9); one group interview was conducted with four participants. To recruit participants, an email was sent to 14 stakeholders asking if they would be interested in participating in a 45–60-minute interview to discuss pedestrian safety. In the event of non-response, an additional invitation email was sent approximately one week later with a third request sent after another week. One respondent rejected the request, three did not respond, and 10 responded and were interviewed. A copy of the informed consent (Appendix A. Stakeholder Interview Consent Form) was included in the email for their review. In some cases, where the researcher and the stakeholder had a colleague in common, we asked the colleague to make an email introduction. We followed the introduction with a separate email (not including the colleague) containing the same recruitment language.

Interviews, using a semi-structured interview protocol (Appendix B. Interview Protocol – Semi-Structured Interview Questions), were conducted over the phone and recorded using WebEx. Interviews lasted about 45-60 minutes. At the start of each interview, the researcher confirmed that the participant received the informed consent, answered any questions they had, and confirmed their willingness to participate by having them verbally indicate yes or no. The interviews were recorded and transcribed.

The interview participants represented a mix of rural and urban transportation roles including federal-level program grant managers, state-level ped/bike safety program managers and coordinators, policy development personnel, local-level executive planners, regional technical assistance for a national organization, policy experts for nonprofit transportation advocacy group, planners and advocates of street design, researchers in public health injury prevention, and government affairs personnel for a national nonprofit organization.

3.3.2 Summary of Stakeholder Interviews

Interview transcripts were reviewed and summarized. The main themes that emerged in response to the protocol questions are described, and illustrative quotes are provided.

3.3.2.1 Momentum

When asked what was going well in the context of pedestrian safety, participants described a growing level of interest and awareness in pedestrian safety. Most participants described an increase or a positive shift, including greater energy around the topic and it being an important consideration for decision makers. One participant described what is going well in pedestrian safety as "I guess the biggest thing is that we're actually trying to account for it. In the past, it really was not much of a consideration." Participants also described changes in messaging and strategies, mentioning them as positive changes for increased effectiveness.

3.3.2.2 Resources and Needs

Participants described accessing a variety of resources and sources of information. Many participants rely on information from state and federal agencies and federally funded grantees and information centers. Participants also described getting information from academic literature such as journal articles and from colleagues, including through social media.

Participants indicated that they need more data, particularly data specific to pedestrian safety and specific to their jurisdiction (i.e., their specific state or locality, especially in rural areas). Some participants described a need for more timely data, more accurate data, or for specific kinds of data and assessments (such as pedestrian counts/utilization similar to those used for vehicles). Participants also described needing more funding to do pedestrian safety work (including changing restrictions on current funding), with one participant indicating that funding is needed for data and analysis. Beyond describing needing data, participants also described needing improved assessments, evaluation, and research to inform their activities and strategies in pedestrian safety, including one participant who said "We need metrics that define success… and we don't have those… We don't have the data."

3.3.2.3 Decision Makers

When asked about decision makers involved in pedestrian safety, participants described a wide range of stakeholders at many different levels from road users and owners to local, state, and federal government agency leadership. Participants also mentioned agency staff, such as traffic engineers and city managers, and external professionals such as consultants and advocates. Elected officials were frequently named, including city councils, mayors, and tribal governance as well as state governors and representatives along with state and federal legislatures.

Among these different decision makers, particularly effective individuals were described as having skills in gathering public input and listening to community members, being generally well informed, and collaborating with many different groups and agencies. Participants described

using accurate data and sharing it in beneficial ways, particularly storytelling, as strategies used by effective decision makers.

Describing behaviors that the decision makers could engage in to improve pedestrian safety, participants discussed advocating for pedestrians, including understanding different types of pedestrians and their varying needs. Multiple participants described prioritizing pedestrians over vehicle throughput "or even vehicular comfort"; one interviewee described this succinctly, sharing of decision makers who "actually publicly acknowledge that vehicular throughput is not the primary characteristic that concerns them when considering the reconfiguration of a street."

Participants again described using research and data to make informed decisions. Finally, participants suggested that decision makers should witness and gain firsthand knowledge of the pedestrian experience through walkabouts and that decision makers should be flexible and open-minded, seeking resources and information through public input as well as from leading governmental and non-profit agencies.

3.3.2.4 Public Input

When asked about getting public input and community participation in roadway decision making, participants described the importance of reaching the public in diverse ways that offer flexibility including in-person and virtual options at varying times for easy access as well as using strategies that make it easy to get input (e.g., using technology, implementing smaller-scale trial changes so people can experience new strategies, options for ongoing input). There was a general sense that to get public input, it was important to meet people where they are, to honor their time (i.e., offer compensation), and to capitalize on existing events or situations where people may already be gathering. One participant described this successful idea as a "go to where the people are model." Some participants suggested there is a lot of value in engaging diverse groups of people including different age groups like youth and older adults as important voices in the public input process.

3.3.2.5 Pedestrian Infrastructure Maintenance

Some participants acknowledged the struggle for stakeholder participation in ongoing maintenance of pedestrian infrastructure, noting that starting new projects is viewed as more desirable than doing the mundane tasks of maintenance. To keep stakeholders involved in maintenance, participants suggested ensuring maintenance is funded, continually assessed, and that it is championed by essential leaders and stakeholders.

Participants indicated it was advantageous for states to approach pedestrian facility maintenance as they do other roadway projects where maintenance is not an option but a requirement of every project. Several participants referred to the Americans with Disabilities Act (ADA) compliance as the measure for maintenance they use for pedestrian safety. Others have relied on crowdsourcing data for identifying areas of need and qualifying projects as "safety projects" so that the projects would qualify to receive federal funding.

3.3.2.6 Safe System Approach

Most participants were familiar with the Safe System Approach (SSA); one was unfamiliar. Participants described the SSA as an approach to traffic safety that considers all components of the transportation system, emphasizing shared responsibility and recognizing human fallibility. One participant described the SSA as a "holistic approach that is attempting to break down silos between the various different safety actors," and connect all of those responsible for safety. Participants identified the SSA goal to minimize the consequences of human error with intentional engineering and planning strategies while adequately providing post-crash response.

A few participants specifically likened the SSA to Vision Zero as a system that is designed to generate desired outcomes. Most felt the SSA connected well with pedestrian safety efforts because it moves beyond pedestrian and driver individual behaviors and includes infrastructure, environmental, vehicle design, policy, norms, broader social, cultural, and governmental levels of systems. Some participants noted how pedestrians have historically been placed with the blame, but the SSA looks at all factors that contribute to pedestrian incidents and overall walkable safety ensuring that pedestrians have equal stake in the SSA.

3.3.2.7 Complete Streets Initiative

The Complete Streets initiative was described by the participants as the newest or most recently developed roadway design mandate that is intended to consider all potential road users (not just vehicles), their needs, and their safety while going through the whole roadway design process: planning, design, operations, construction, etc., and/or any modifications. Complete Streets was described as attending to the needs of differing modes of travel in an area while ensuring safety and comfort within the system.

When asked who they perceived supported Complete Streets initiatives, the participants mentioned a mix of stakeholders they discerned were supportive and less supportive. Among stakeholders characterized as supportive were those who prioritized the most vulnerable users and communities and roadways in the most need. Stakeholders who were mentioned as less supportive were engineers and planners unfamiliar with Complete Streets and perhaps more resistant to change, some elected officials or others concerned with cost and efficiency, and drivers who may oppose slower speeds and more traffic congestion.

Participants voiced general agreement that Complete Streets initiatives adequately address pedestrian safety efforts. Some based their agreement on the fidelity of implementation and if all contextual factors come together as intended. Some participants noted that Complete Streets can seem aspirational and that it can be very challenging, requiring local trade-offs and concessions with thorough explanation. A lack of resources prevents full implementation everywhere. Further, some participants said Complete Streets has become a buzz term that appeases some standards but still can result in unsafe streets for certain road users as there can be a lack of true understanding among stakeholders. It was also noted that Complete Streets can be applied to a specific road in a specific location but not holistically to the area.

When asked if there was a better approach for pedestrian safety efforts than the Complete Streets model, most participants did not name one. One participant stated, "The complete streets methodology is good. It's just doing it." Another asserted, "It's always the case when people really come in and do something, take a serious effort to make space for everyone and, prioritize safety and access as opposed to throughput, we see incredible results." However, some felt that Complete Streets is a policy tool that requires political support, flexibility, and continual updates to be successful and meet the needs of diverse communities.

3.3.2.8 Equity and Other Considerations

Participants were given the space to add anything else they felt was important to share about pedestrian safety before the conclusion of their interviews, and several participants discussed the importance of equity and how transportation can disproportionately disadvantage some neighborhoods and communities more than others. Another point that several participants highlighted was the significance of comprehensive engagement across sectors and organizations as well as emphasizing pedestrian safety as much more than just traffic safety in a community. "It's not just about traffic safety. It's about health. It's about quality of life, economic development, et cetera."

One participant shared that small surface-level changes have not been enough to make a difference in pedestrian fatalities and injuries and that comprehensive system-wide change would be necessary to positively affect change. "Safety, whether pedestrian safety or any kind of safety cannot be added into the existing system. The existing system must change. And that has never been what makes anything popular in transportation; it's bipartisan and popular because we say nothing has to change..." One major piece of the systemic change that participants spoke of involved the realization that design impacts user behaviors.

4   STAKEHOLDER SURVEY

4.1 Survey Methodology

The Center for Health and Safety Culture developed and conducted a survey with traffic safety stakeholders to reveal beliefs about pedestrian safety and their understanding, support for, and engagement in pedestrian safety strategies. Based on the review of the literature, the survey was designed to focus on the following topics:

- Prioritization of pedestrian safety,
- Beliefs about a Safe System Approach for pedestrians,
- Current approaches to pedestrian safety,
- Familiarity, support for, and use of best practices to improve pedestrian safety,
- Getting public input,
- Use of the Complete Streets approach,
- Valued resources used by practitioners.

A copy of the survey is provided in Appendix C. Survey Questions. The Montana State University Institutional Review Board (IRB) reviewed and approved the survey. We administered the survey online using Qualtrics, an online survey platform.

The lead researcher sent an email to Traffic Safety Culture Pooled Fund members across the United States asking for their help and support in recruiting a variety of stakeholders in their state to complete a brief survey. The Traffic Safety Culture Pooled Fund members were asked to send an email to people who they may know (or people who may recognize them by their role) to request their participation in the survey. Email recruitment language was provided (Appendix D. Participant Recruitment).

The Traffic Safety Culture Pooled Fund Members were asked to reach out to the following people in their state: State Department of Transportation (DOT) employees (leaders, engineers, behavioral safety), city/county DOT/public works employees (engineers, planners), metropolitan and rural planning organization (MPO/RPO) employees, public health people working on traffic safety/injury prevention, and pedestrian advocacy groups and anyone they felt has an interest and stake in pedestrian safety.

Data collection occurred between September 19, 2023 and October 19, 2023. A total of 399 surveys were completed. Upon further review, 63 surveys did not include any responses besides the organization type and role. These were removed from the analysis, leaving 336 surveys that are summarized in this report.

4.2 Organization and Role of Participants

Survey participants were from 12 states (Idaho, Illinois, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Montana, Texas, Utah, Vermont, and Washington). Table 2 summarizes the organizations of the participants; Table 3 summarizes their role. Advocacy organizations

included bicycle and pedestrian safety, public safety, workplace safety, and community engagement and representation. Other organizations included local government, education, consultants, emergency medical services, law enforcement, and transit authorities.

Table 2. *Organizations of Survey Respondents*

Organizations	Number of Respondents	Percent
State Department of Transportation (DOT)	171	50.9
City/County Department of Transportation/Public Works	34	10.1
Planning Organization (MPO, RPO, etc.)	33	9.8
Public Health	24	7.1
Advocacy Organization	19	5.7
Other	55	16.4
Total	336	100.0

Table 3. *Roles of Survey Respondents*

Role	Number of Respondents	Percent
Engineer	125	37.2
Planner	67	19.9
Behavioral Traffic Safety Specialist/Manager/Leader	36	10.7
Public Health Advocate/Educator	22	6.5
Public Health Leader/Policy Maker	12	3.6
Advocate	15	4.5
Other	58	17.3
Missing (unknown)	1	0.3
Total	336	100.0

4.3 Survey Results

The results present relative frequency responses for each of the survey topics:

- Prioritization of pedestrian safety,
- Beliefs about a Safe System Approach for pedestrians,
- Current approaches to pedestrian safety,
- Familiarity, support for, and use of best practices to improve pedestrian safety,
- Getting public input,
- Use of the Complete Streets approach.

The final question was an open-ended question asking for three resources that are "most valuable in improving pedestrian safety." The responses included both strategies (e.g., enforcement) and resources (e.g., Complete Streets Guide).

The survey included 76 individual questions (of which 13 were conditionally asked based on the response of a previous question). Most respondents (84.8%) completed all questions that they were asked.

4.3.1 Prioritization of Pedestrian Safety

How the safety of pedestrians is prioritized within an organization can influence the actions taken to improve pedestrian safety (Sandt et al., 2016). The survey asked three questions to explore the prioritization of safety by various organizations. For each question, prioritization was rated on a five-point scale from 1 (low) to 5 (highest).

- Most respondents (79.1%) indicated that, based on what their organization *says*, the safety of pedestrians was a high (or the highest) priority.
  - However, when asked based on what their organization *does*, only half (50.1%) reported the safety of pedestrians was a high (or the highest) priority.
    - On average, based on what the organization does, respondents associated with public health rated their organization lower on pedestrian safety ($M = 2.50$, $SD = 1.06$) compared to everyone else ($M = 3.39$, $SD = 1.03$).
- When asked about their perceptions of how organizations prioritized the safety of pedestrians:
  - 47.6% indicated pedestrian safety was a high (or highest) priority of their state's Department of Transportation (DOT).
    - On average, respondents associated with the state DOT reported a higher prioritization ($M = 3.52$, $SD = 0.90$) compared to everyone else ($M = 2.90$, $SD = 1.21$). That is, those within the state DOT perceived greater prioritization by the DOT than everyone else.
  - 30.3% indicated pedestrian safety was a high (or highest) priority of most local departments of transportation/public works in their state.

o 41.0% indicated pedestrian safety was a high (or highest) priority of most municipal planning organizations (MPOs) or rural planning organizations (RPOs) in their state.

Based on these responses, there may be opportunities within organizations to clarify the discrepancy between the organization's espoused values (i.e., what they say are priorities) versus actual practices. Exploring these discrepancies may increase practices that improve pedestrian safety.

Furthermore, there may be opportunities to increase the prioritization of pedestrian safety among some agencies (e.g., public health) and grow shared values about pedestrian safety across agencies.

4.3.2 Beliefs About a Safe System Approach for Pedestrians

Growing a safe transportation system includes improving safety for all road users. Fundamental to the Safe System Approach (SSA) is shared responsibility and accountability to road users most likely to be injured (see https://highways.dot.gov/safety/zero-deaths). The survey asked two questions to explore these beliefs.

- When asked about levels of responsibility for the safety of pedestrians, respondents indicated that many stakeholders were very or extremely responsible:
  o the pedestrians themselves: 58.2%
  o design engineers: 78.3%
  o planners: 74.2%
  o system owners (e.g., the state, county, city): 74.8%
  o elected officials: 45.3%
  o advocacy organizations: 48.3%

- Most respondents (89.3%) agreed that a transportation system should be designed and operated to account for and accommodate the users most likely to be injured. However, some did not perceive similar levels of agreement among other stakeholders.
  o 22.0% perceived that most leaders in their organization would not agree (either disagree or neither agree nor disagree).
  o 28.3% perceived that their state's Department of Transportation (DOT) would not agree.
  o 38.7% perceived that most local departments of transportation/public works in their state would not agree.
  o 29.1% perceived that most planning organizations (MPOs, RPOs) in their state would not agree.
  o 63.3% perceived that most elected officials in their state would not agree.

Many respondents indicated that responsibility for pedestrian safety was shared; however, there may be opportunities to grow these beliefs and thereby motivate more engagement in practices to improve pedestrian safety.

Furthermore, some respondents perceived that their leaders would not agree that the transportation system should be designed and operated to account for users most likely to be injured and did not perceive agreement in other organizations. Growing agreement to accommodate vulnerable road users may increase use of practices to improve pedestrian safety.

4.3.3 Current Approaches to Pedestrian Safety

We explored whether agencies were changing their approaches to pedestrian safety by asking two questions.

- About two-thirds of the respondents (64.2%) indicated their agencies were changing their approaches to pedestrian safety while about one in seven (13.6%) indicated they were focused on strategies they have used in the past.

- Over half of the respondents (61.3%) indicated that pedestrian safety was integrated throughout their programmatic areas while about one in five (19.5%) indicated it was isolated or siloed.

- About two-thirds of the respondents (68.6%) indicated their agencies were investing/spending more on pedestrian safety (31.4% indicated their agencies were spending the same or less).

Growing beliefs that organizations are changing their approaches to pedestrian safety, including integrating pedestrian safety throughout programmatic areas and increasing investments, may make it more likely that other organizations also adopt these changes.

4.3.4 Familiarity of, Support for, and Use of Best Practices

The Federal Highway Administration (FHWA) has identified several practices with evidence of improving pedestrian safety (see https://highways.dot.gov/safety/pedestrian-bicyclist/step). We asked four questions about these practices including the respondent's familiarity with the practice, their perception as to whether the practice improves safety (i.e., perceived efficacy of the practice), perception of support from leadership within their organization for the practice (i.e., perceived injunctive norms), and their perception of how often the practices are used (Table 4).

Table 4. *Beliefs About and Use of Best Practices*

Best Practice	Familiarity[1]	Improve Pedestrian Safety[2]	Leadership Support[3]	Use[4]
Medians and pedestrian refuge islands	78.3%	87.4%	52.6%	27.5%
Separating pedestrians from the roadway	77.3%	87.7%	59.1%	32.7%
Road diets (roadway configuration)	70.5%	79.9%	47.8%	20.4%

Best Practice	Familiarity[1]	Improve Pedestrian Safety[2]	Leadership Support[3]	Use[4]
Crosswalk visibility enhancements	69.8%	88.4%	63.6%	49.3%
Reducing speeds in areas where Pedestrians cannot be separated from the roadway	67.3%	76.7%	44.5%	18.7%
Rectangular rapid flashing beacons	66.1%	74.1%	50.2%	29.2%
Raised crosswalks	63.1%	72.2%	32.6%	10.9%
Pedestrian hybrid beacons	62.4%	73.0%	44.0%	22.5%
Leading pedestrian interval	50.2%	67.9%	39.5%	16.9%

[1]Very or extremely familiar; [2]Somewhat or strongly agreed; [3]Very or extremely support; [4]Use often or very frequently.

Overall, respondents indicated relatively high levels of familiarity and perceptions of efficacy of the practices (i.e., the practices are effective at improving pedestrian safety) and lower levels of perceived support by leadership and use. This indicates there may be opportunities to increase use of these practices by growing supportive beliefs and clarifying expectations by leadership.

Levels of familiarity were lower among those associated with public health. Averaging across the nine practices, 45.5% of those associated with public health reported high levels of familiarity with the practices (i.e., very or extremely familiar) compared to 68.9% among everyone else. There may be a need to provide education to those in public health about these strategies.

Furthermore, perceptions of support by leadership most varied between those associated with a state DOT and everyone else for three practices: separating pedestrians, reducing speeds, and raised crosswalks (Table 5). Increasing support by leadership within DOTs may increase use of these practices.

Table 5. *Beliefs About Support of Leadership for Three Practices*

Best Practice	Leadership Support[1] Among State DOT	Leadership Support[1] Among Everyone Else
Separating pedestrians from the roadway	55.1%	63.2%
Reducing speeds in areas where Pedestrians cannot be separated from the roadway	34.2%	54.9%
Raised crosswalks	24.5%	41.0%

[1]Very or extremely support.

4.3.5 Public Input

Getting input from the public is an important component of transportation efforts that seek to serve the needs of all road users (U.S. Department of Transportation Federal Highway Administration, 2023). The survey asked two questions about getting public input.

- Relatively few respondents indicated their own organization did very well or extremely well at getting public input. More specifically:
    - 33.6% indicated their organization does very or extremely well at getting input from people who may be potentially impacted by changes to the roadway system before starting designs.
    - 28.7% indicated their organization does very or extremely well at getting feedback on designs.
    - 17.6% indicated their organization does very or extremely well at trying small scale (sometimes temporary) changes so people can actually see and experience how a new design might work.

- Similarly, few respondents perceived that their state DOT did very well or extremely well at getting public input. Specifically,
    - 17.0% indicated their state DOT does very or extremely well at getting input from people who may be potentially impacted by changes to the roadway system before starting designs.
    - 17.7% indicated their organization does very or extremely well at getting feedback on designs.
    - 12.9% indicated their organization does very or extremely well at trying small scale (sometimes temporary) changes so people can actually see and experience how a new design might work.

Improving pedestrian safety is complex and resources are limited. Obtaining quality public input to inform the needs of the community and explore potential approaches may lead to better outcomes with limited funding. Organizations might consider partnering with other agencies who are skilled at public input approaches.

4.3.6 Complete Streets

The Complete Streets approach has been shown to improve pedestrian safety (Smart Growth America, 2023). We asked three questions about Complete Streets.

- About half of the respondents (51.6%) indicated that they were very or extremely familiar with the Complete Streets approach.

- About four in ten respondents (43.2%) indicated that their organization has a Complete Streets policy. Among those who reported their agency had a Complete Streets policy (*n*=119), the following indicated their policy was strong in:
    - establishing commitment and vision: 60.5%

- applying to all projects and phases: 47.1%
- adopting excellent design guidance: 45.4%
- prioritizing underinvested and underserved communities: 37.0%
- creating a plan for implementation: 37.0%
- mandating coordination: 36.1%
- setting criteria for choosing projects: 30.5%
- allowing only clear exceptions: 28.6%
- requiring proactive land-use planning: 23.5%
- measuring progress: 18.5%

The Complete Streets approach provides a framework for stakeholders involved in roadway transportation to address the needs of all road users – including pedestrians. Establishing Complete Streets policies can codify policies and procedures that improve pedestrian safety. Growing the number of organizations with Complete Streets policies and improving the strength of the policies is one strategy to holistically improve pedestrian safety.

4.3.7 Valued Resources

Respondents were asked what three resources they found most valuable in improving pedestrian safety. Table 6 lists the responses that were resources.

Table 6. *Pedestrian Safety Resources Identified by Respondents*

Resources
2021 AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities
America Walks
America Planning Association
American Association of Retired Persons (AARP) Walk Audit Tool Kit
Bike Walk Kansas City
Blue Zones
CDC's Walkability programs
Crash Modification Factor (CMF) Clearinghouse
Complete Streets Guide
FHWA Bicycle and Pedestrian Planning, Program, and Project Development Guidance
FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations
FHWA Low-Cost Safety Countermeasures
FHWA Non-Motorized User Safety: A Manual for Local Rural Road Owners
FHWA Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations Final Report
FHWA's Safe Transportation for Every Pedestrian (STEP) programs and guidance
FHWA Vulnerable Road User Safety Assessment Guidance
Guidance for Installation of Pedestrian Crosswalk on Michigan State Trunkline Highways
Institute of Transportation Engineers (ITE) Traffic Calming Toolkit
Institute of Transportation Engineers (ITE) Transportation Planning Handbook
Kentucky Transportation Cabinet (KYTC) Complete Streets Manual
League of American Bicyclists
Manual of Uniform Traffic Control Devices
Minnesota's Best Practices for Pedestrian and Bike Safety
Minnesota's Demonstration Project Guide
Minnesota's Facility Design Guide
Minnesota Department of Health Inclusive Walk Audit Facilitator's Guide
Minnesota Department of Health Let's Go for a Walk Guide
Minnesota Statewide Pedestrian System Plan
Minnesota's Best Practices for Pedestrian and Bicycle Safety (2021)
MnDOT's and Change Lab Solutions websites
MnDOT's pedestrian design guide (Chapter 8 of the facility design guide).
National Association of City Transportation Officials (NACTO) Bicycle Guide
National Association of City Transportation Officials (NACTO) Urban Street Design Guide
National Complete Streets Coalition
National Safe Routes Partnership
Guide for Pedestrian & Bicyclist Safety at Alternative and Other Intersections and Interchanges (NCHRP 948)
CROW Design Manual for Bicycle Traffic (Netherlands)
Pedestrian & Bicycle Information Center
Planetizen
Public Right-of-Way Accessibility Guidelines (PROWAG)
Smart Growth America
Safe Routes to School Plans
Safe Streets for All (SS4A)
Safe System Approach
Strong Towns
Traffic Incident Management Systems (TIMS)
Vision Zero

5 TOOLKIT

5.1 Toolkit Development

The Center for Health and Safety Culture created a toolkit for stakeholders entitled: *Tools and Resources to Improve Pedestrian Safety.* The toolkit included five tools and one resource. The resource focused on growing public participation, and the tools addressed:

- growing supportive beliefs to improve pedestrian safety,
- ways to prioritize pedestrian safety and bolster current approaches,
- telling your pedestrian safety story,
- engaging in meaningful conversations about pedestrian safety, and
- promoting pedestrian safety across the social environment.

The toolkit was designed to be a standalone document (using the portable document format – pdf) to be shared over the internet or printed. The toolkit can be found at the Montana Department of Transportation's Traffic Safety Culture Pooled Fund website at: https://www.mdt.mt.gov/research/projects/trafficsafety-ips.aspx.

6 CONCLUSIONS

Transportation stakeholders are uniquely positioned to lead efforts to improve pedestrian safety. and whether stakeholders engage in appropriate strategies to improve pedestrian safety is influenced by their traffic safety culture – their shared values and beliefs. Understanding shared values and beliefs about pedestrian safety among transportation stakeholders is critical to growing a positive traffic safety culture, deploying effective strategies to improve pedestrian safety, and ultimately achieving our nation's goal of zero deaths on our roadways. This project sought to improve pedestrian safety by developing resources to assess and grow beliefs among transportation stakeholders to support the deployment of effective pedestrian safety strategies.

In this project, a review of the literature was conducted seeking a better sense of the culture within which stakeholders and traffic safety professionals in positions to make decisions regarding pedestrian safety prioritization and deployment are operating. A look into the culture surrounding pedestrian safety involved investigating the factors that impact the values, attitudes, and beliefs of the stakeholders working in pedestrian safety as well as the barriers and challenges that may be inhibiting the prioritization and deployment of pedestrian safety strategies. In addition to reviewing the literature, formative interviews were conducted with current traffic safety stakeholders involved in decision-making about the implementation of pedestrian safety strategies (e.g., traffic engineers, traffic designers and planners, pedestrian (and bike) coordinators, policy experts, and other transportation agency staff). The interviews examined beliefs about pedestrian safety prioritization and deployment of strategies and explored barriers and challenges that might inhibit the implementation of pedestrian safety strategies.

The literature showed that traffic safety stakeholders in the U.S. are faced with a range of competing priorities when it comes to selecting, designing, planning, garnering support, and deploying pedestrian safety strategies. Funding, political will, working within the confines of already established infrastructure, as well as building new infrastructure with different functional priorities for different groups of users, are barriers that pedestrian safety stakeholders must manage. Another theme that recurred in the literature around barriers pedestrian safety stakeholders face is the undercurrent of prevalent belief systems – termed ideologies – that subtly yet powerfully impact the traffic transportation system. These ideologies influence the foundational perspectives stakeholders have as well as the beliefs they perceive other stakeholders, the public, and people in power have regarding priorities in transportation.

For perspective on what the literature showed are proven best practices for addressing pedestrian safety, a synopsis of the best practices available to transportation stakeholders was given. Often the literature pointed to ways other peer countries have adopted these practices and subsequently experienced declining pedestrian fatalities; U.S. traffic safety stakeholders may look to these examples for guidance and as beacons of hope. Indeed, U.S. commitments to the Vision Zero objective, a Safe System Approach, traffic safety culture, and Complete Streets initiatives have been emerging across the country, and the pedestrian resources available (toolkits, primers, other integration-focused tools) support a more comprehensive approach. A more comprehensive and integrated approach where pedestrian safety becomes a consideration in every transportation project and where every road user is equally considered in every roadway project is the goal for pedestrian safety.

The semi-structured formative interviews provided a better sense of the current pedestrian safety culture and opportunities for improvement. The interviews showed a growing level of interest and awareness is creating momentum around pedestrian safety, which is described as bringing energy and a positive shift to this important topic that has not had as much consideration in the past. While there are still many resources and needs (e.g., data, data analysis, metrics for success, adjustments to funding restrictions) identified by interview participants that would greatly improve their effectiveness, participants acknowledged they have various agencies, colleagues, sources of information, and research that they turn to for pedestrian safety strategies and guidance. The interviews highlighted maintenance of pedestrian facilities and infrastructure as something that should be reassessed and included as part of all other roadway projects where maintenance is automatically included and assumed a project requirement. The comprehensive and connected systems components of the Safe System Approach and Complete Streets initiatives were supported by the interview participants as preferable approaches for dealing with pedestrian safety as long as they are applied with fidelity and consideration for each roadway area's contextual needs. Included in those contextual needs are the comfort and safety of all road users and the inclusion of an array of stakeholders across the social environment in a collective goal of safety taking precedence over other traffic priorities. The interviews emphasized a few key concepts for pedestrian safety stakeholders: that design affects behavior and that changes must be comprehensive and system-wide to positively affect change.

A survey was developed and implemented with pedestrian stakeholders to better understand six aspects components of traffic safety culture that may impact pedestrian safety. The respondents included engineers, planners, behavioral traffic safety professionals, public health advocates/educators/leaders, advocates, and others representing a variety of organizations including state and local departments of transportation, planning organizations, public health organizations, and advocacy organizations.

Based on the responses of the survey participants:

- There may be opportunities within organizations to clarify the discrepancy between the organization's espoused values (i.e., what they say are priorities) vs. actual practices regarding pedestrian safety. Exploring these discrepancies may increase practices that improve pedestrian safety.

- There may be opportunities to increase the prioritization of pedestrian safety among some agencies (e.g., public health) and grow shared values about pedestrian safety across agencies.

- Many respondents indicated that responsibility for pedestrian safety was shared; however, there may be opportunities to grow these beliefs and thereby motivate more engagement in practices to improve pedestrian safety.

- Some respondents perceived that their leaders would not agree that the transportation system should be designed and operated to account for users most likely to be injured and did not perceive agreement in other organizations. Growing agreement to accommodate vulnerable road users may increase use of practices to improve pedestrian safety.

- Most respondents indicated their organizations were changing how they approached pedestrian safety, efforts were becoming more integrated, and they were investing more. Growing beliefs that organizations are changing their approaches to pedestrian safety including integrating pedestrian safety throughout programmatic areas and increasing investments may increase these changes.

- Overall, respondents indicated relatively high levels of familiarity and perceptions of efficacy of nine best practices; however, they reported lower levels of perceived support by leadership for and use of these practices. This indicates there may be opportunities to increase use of these practices by growing supportive beliefs and clarifying expectations by leadership. Perceptions of support by leadership most varied between those associated with a state DOT and everyone else for three practices: separating pedestrians, reducing speeds, and raised crosswalks. Increasing support by leadership within DOTs may increase use of these practices.

- Many respondents rated their organizations low on how well they get public input to inform the needs of the community and explore potential approaches to improve pedestrian safety. Similarly, respondents rated their state's DOT low. There are opportunities to improve practices for getting public input.

- About half of the respondents indicated that they were very or extremely familiar with the Complete Streets approach, and about four in ten respondents indicated that their organization has a Complete Streets policy. There are opportunities to grow knowledge about the Complete Streets approach and increase the number of organizations with Complete Streets policies.

In addition, the respondents identified a variety of resources that they find valuable to improve pedestrian safety. It is important to note the limitations of these findings. These results only represent the beliefs of those who participated in the survey. The results cannot be generalized to others in their organizations, other organizations, their state, or other states. Nonetheless, the responses revealed potential opportunities as reported by these respondents about ways to improve shared values and beliefs that may improve pedestrian safety.

Based on a review of the literature, stakeholder interviews, and survey results, a toolkit for stakeholders involved in pedestrian safety was created. The toolkit resource focused on growing public participation, and the tools addressed:

- growing supportive beliefs to improve pedestrian safety,
- ways to prioritize pedestrian safety and bolster current approaches,
- telling your pedestrian safety story,
- engaging in meaningful conversations about pedestrian safety, and
- promoting pedestrian safety across the social environment.

The toolkit can be found at the Montana Department of Transportation's Traffic Safety Culture Pooled Fund website at: https://www.mdt.mt.gov/research/projects/trafficsafety-ips.aspx.

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8   APPENDICES

8.1   Appendix A. Stakeholder Interview Consent Form

Consent Form

SUBJECT CONSENT FORM FOR PARTICIPATION IN HUMAN RESEARCH AT MONTANA STATE UNIVERSITY (MSU)

Researchers at the Center for Health and Safety Culture (CHSC) are asking you to participate in a research study to develop resources to assess and grow beliefs among stakeholders to support deployment of effective strategies to improve pedestrian safety. This form describes this study and explains how you may ask questions. This study is being led by Dr. Kari Finley, a Research Scholar at CHSC and Jamie Arpin, a Research Scientist at CHSC.

What the study is about

The purpose of this research is to develop resources to assess and grow beliefs among stakeholders to support deployment of effective strategies to improve pedestrian safety. We want to get a better sense of the current pedestrian safety culture and opportunities for improvement. We also want to better understand beliefs about pedestrian safety prioritization and deployment of strategies and barriers and challenges that might inhibit the implementation of pedestrian safety strategies. This information will be used to inform the development and design of stakeholder surveys to reveal beliefs about pedestrian safety and their understanding, support for, and engagement in pedestrian safety strategies and to develop tools and resources to support pedestrian safety.

What we will ask you to do

We will ask you to participate in an interview that will take about 45-60 minutes.

Risks and discomforts

We do not anticipate any risks to you from participating in this interview.

Benefits

You may benefit from reflecting on your own experiences as a traffic safety stakeholder. The conversation may provide insights that will be helpful. Information from this study will be used to inform the development and design of stakeholder surveys to reveal beliefs about pedestrian safety and their understanding, support for, and engagement in pedestrian safety strategies and to develop tools and resources to support pedestrian safety.

Funding

This project is funded through a grant to Montana State University's Center for Health and Safety Culture from Montana Department of Transportation and the Federal Highway Administration (FHWA). There are no costs to you. Your participation will not impact your relationship with Montana State University or the state of Montana.

Compensation for participation

There is no compensation provided for participating in this study.

Audio Recording

We will audio record the conversation and use the recording to develop a transcription. Following transcription, the audio recording will be deleted. By participating in the interview, you agree to be recorded.

Privacy/Confidentiality/Data Security

Your name, email address, and any other identifying information will be removed from the transcriptions and not stored. Access to the data will be limited to Center staff who are working on this project. Data will be analyzed for common themes and results will be reported in summary format. We may use brief direct quotes to illustrate themes but will ensure they do not contain detail that may identify you.

Taking part is voluntary

Your participation is voluntary. You may choose not to participate without penalty or impact on your relationship with MSU or CHSC. If you choose to participate in the interview, you may skip any questions you do not wish to answer or discontinue your participation at any time.

Follow-up studies

We may contact you again to request your participation in a follow-up study. As always, your participation will be voluntary, and we will ask for your explicit consent to participate in any of the follow-up studies.

If you have questions

The main researcher conducting this study is Kari Finley, PhD, a Research Scholar at CHSC. You may contact her at kari.finley@montana.edu. You will also have a chance to ask questions of the interviewer before the interview. If you have any questions or concerns regarding your rights as a subject in this study, you may contact the Institutional Review Board (IRB) for Human Participants at 406-994-4706 or access their website at http://www.montana.edu/orc/irb/index.html.

Consent

Proceeding with this research or interview indicates your consent to participate.

Researcher Documentation of Interview Consent:

Yes_____ No_____ Date:_____

8.2 Appendix B. Interview Protocol – Semi-Structured Interview Questions

Semi-Structured Formative Interview Questions

Name:
Position:
Organization:
Date of Interview:

Interviewer to introduce themself, thank person for their time, confirm receipt of informed consent, and ask if they have any questions.
Ask if the person is willing to participate and be recorded.
If not willing to participate, thank them for their time and end the conversation.
    If willing to participate but not be recorded, take notes throughout interview and after.
    If yes to both, "I'll now turn on the recording."

We are working on a research project to better understand beliefs among traffic safety stakeholders (e.g., DOTs, traffic engineers, traffic designers and planners, pedestrian (and bike) coordinators, law enforcement, policymakers, and regulatory agencies) about pedestrian safety prioritization and using strategies to improve pedestrian safety. We are interested in your thoughts and experiences about pedestrian safety in the work you do.

1. What is your role in transportation and traffic safety? Pedestrian safety?
   a. Do you work in primarily urban or rural areas or both?

2. What's going well in your work on pedestrian safety?

3. Where do you go for pedestrian safety strategies and information?

4. What does your organization need in order to better use transportation resources to improve pedestrian safety? (Examples might be: gathering more robust data, better understanding of the targeted funding for pedestrian efforts, tools and best practices, specific policy directives, different pedestrian safety approaches, other?)

5. Thinking now specifically about improving pedestrian safety in light of many possible competing priorities, who are the important decision makers?
   a. Let's go through each of these roles and think of what behaviors each of these roles could do to improve pedestrian safety?
   b. When you think about someone in this role who is doing these things really well, what makes them effective?

6. Public and community input is often understood to be an important component for decision making and planning, including hearing from vulnerable road users, but we have heard that the amount and quality of community participation varies.
   a. From your perspective, what works well in terms of getting public input and community participation in roadway decision making?

7. We understand that maintenance can be a tricky issue and can require collaboration from many different stakeholder groups, from the general public to homeowners to business owners and others. What recommendations do you have for engaging relevant stakeholders for support of pedestrian infrastructure and the maintenance of that infrastructure?
   a. If landowners are not supportive, are there other possibilities for ensuring ongoing maintenance?
   b. How are these facilities managed?

8. In a sentence or two, how would you describe the Safe System Approach?

9. How does the Safe System Approach connect to improving pedestrian safety?

10. Are you familiar with the Complete Streets initiative? *If yes:* How would you describe the complete streets initiative?
    a. From your perspective, who supports the Complete Streets initiative? Do you think the general public does? Your supervisors? Political leaders?
    b. Who is less supportive of the Complete Streets initiative? Why?

11. From your perspective, does Complete Streets adequately prioritize and address pedestrian safety?
    a. Are there any unintended consequences, especially for pedestrian safety?
    b. Is there a better approach?

12. Could you tell us about any jurisdictions (other cities or states) that are leaders in pedestrian safety, as well as people who are experts in this field?

13. Is there anything else you'd like to share about pedestrian safety?

Thank you again for spending time with me today.

8.3 Appendix C. Survey Questions

The following is the text of the survey. The survey was implemented online; therefore, this does not represent how the questions appeared to the respondents.

The Center for Health and Safety Culture, on behalf of the Transportation Pooled Fund on Traffic Safety Culture, is seeking your insights about pedestrian safety.

We are asking for your participation in this important, brief survey. The results will be used in a research project to develop resources for various stakeholders regarding pedestrian safety. We know your time is valuable, and we appreciate your participation.

Your participation is voluntary, and we will only share summary results. You can stop at any time. Your responses are confidential. This study has been approved by the Montana State University Institutional Review Board. If you have questions or comments about the survey, please contact Jay Otto with the Center for Health and Safety Culture at jayotto@montana.edu. If you have questions about your rights as a participant, you may contact the MSU IRB at irb@montana.edu

Proceeding with the survey indicates your consent to participate. Thank you for taking this survey!

Jay Otto (jayotto@montana.edu)

To begin, what best describes your organization?
- o   State Department of Transportation (DOT)
- o   city/county department of transportation/public works
- o   planning organization (MPO, RPO, etc.)
- o   public health
- o   advocacy organization (please specify focus of the organization)
- o   other _____

What best describes your role?
- o   engineer
- o   planner
- o   behavioral traffic safety specialist/manager/leader
- o   public health advocate/educator
- o   public health leader/policy maker
- o   advocate
- o   other _____

Based on what your organization **says**, how is the safety of pedestrians prioritized?
- o   low priority
- o   somewhat of a priority
- o   moderate priority
- o   high priority
- o   highest priority

Based on what your organization **does**, how is the safety of pedestrians prioritized?
- o   low priority
- o   somewhat of a priority
- o   moderate priority
- o   high priority
- o   highest priority

In your opinion, how do the following organizations prioritize the safety of pedestrians? *Even if you are not sure, give your best guess.*

	low	somewhat	moderate	high	highest
your state's Department of Transportation (DOT)	o	o	o	o	o
most local departments of transportation/public works in your state	o	o	o	o	o
most MPOs or RPOs in your state	o	o	o	o	o

In your opinion, how responsible are the following for the safety of pedestrians?

	not at all	somewhat	moderately	very	extremely
The pedestrians themselves	o	o	o	o	o
Design engineers	o	o	o	o	o
Planners	o	o	o	o	o
System owners (e.g., the state, county, city)	o	o	o	o	o
Elected officials	o	o	o	o	o
Advocacy organizations in your state/community	o	o	o	o	o

In your opinion, how much do the following agree or disagree with the statement: "A transportation system should be designed and operated to account for and accommodate the users most likely to be injured or seriously injured." *Even if you are not sure, give your best guess.*

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
you	o	o	o	o	o
most leaders in your organization	o	o	o	o	o
your state's Department of Transportation (DOT)	o	o	o	o	o
most local departments of transportation/public works in your state	o	o	o	o	o
most planning organizations (MPOs, RPOs) in your state	o	o	o	o	o
most elected officials in your state	o	o	o	o	o

How would you describe your organization's current approach to pedestrian safety? *Even if you are not sure, give your best guess.*

	1	2	3	4	5	
We focus on strategies we have used in the past	o	o	o	o	o	We are changing our approaches to pedestrian safety
Pedestrian safety is isolated or siloed	o	o	o	o	o	Pedestrian safety is integrated throughout our programmatic areas

How would you describe your organization's current investment in/spending on pedestrian safety?

- o Much less than in the recent past
- o Somewhat less than in the recent past
- o About the same
- o Somewhat more than in the recent past
- o Much more than in the recent past

How familiar are you with the following practices?

	Not familiar at all	Somewhat familiar	Moderately familiar	Very familiar	Extremely familiar
Crosswalk visibility enhancements	o	o	o	o	o
Leading pedestrian interval	o	o	o	o	o
Medians and pedestrian refuge islands	o	o	o	o	o
Pedestrian hybrid beacons	o	o	o	o	o
Rectangular rapid flashing beacons	o	o	o	o	o
Road diets (roadway configuration)	o	o	o	o	o
Raised crosswalks	o	o	o	o	o
Separating pedestrians from the roadway	o	o	o	o	o
Reducing speeds in areas where pedestrians cannot be separated from the roadway	o	o	o	o	o

How much do you agree or disagree that each of the following improves pedestrian safety?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	I don't know
Crosswalk visibility enhancements	o	o	o	o	o	o
Leading pedestrian interval	o	o	o	o	o	o
Medians and pedestrian refuge islands	o	o	o	o	o	o
Pedestrian hybrid beacons	o	o	o	o	o	o
Rectangular rapid flashing beacons	o	o	o	o	o	o
Road diets (roadway configuration)	o	o	o	o	o	o
Raised crosswalks	o	o	o	o	o	o
Separating pedestrians from the roadway	o	o	o	o	o	o
Reducing speeds in areas where pedestrians cannot be separated from the roadway	o	o	o	o	o	o

To what degree do you think the leadership of your organization supports the use of these practices?

	Not at all	Somewhat	Moderately	Very	Extremely	I don't know
Crosswalk visibility enhancements	o	o	o	o	o	o
Leading pedestrian interval	o	o	o	o	o	o
Medians and pedestrian refuge islands	o	o	o	o	o	o
Pedestrian hybrid beacons	o	o	o	o	o	o
Rectangular rapid flashing beacons	o	o	o	o	o	o
Road diets (roadway configuration)	o	o	o	o	o	o
Raised crosswalks	o	o	o	o	o	o
Separating pedestrians from the roadway	o	o	o	o	o	o
Reducing speeds in areas where pedestrians cannot be separated from the roadway	o	o	o	o	o	o

When applicable, how often are these practices actually used?

	Never	Rarely	Sometimes	Often	Very frequently	I don't know
Crosswalk visibility enhancements	o	o	o	o	o	o
Leading pedestrian interval	o	o	o	o	o	o
Medians and pedestrian refuge islands	o	o	o	o	o	o
Pedestrian hybrid beacons	o	o	o	o	o	o
Rectangular rapid flashing beacons	o	o	o	o	o	o
Road diets (roadway configuration)	o	o	o	o	o	o
Raised crosswalks	o	o	o	o	o	o
Separating pedestrians from the roadway	o	o	o	o	o	o
Reducing speeds in areas where pedestrians cannot be separated from the roadway	o	o	o	o	o	o

How well do you think your organization does the following?

	Not well at all	Somewhat well	Moderately well	Very well	Extremely well
Gets input from people who may be potentially impacted by changes to the roadway system before starting designs	o	o	o	o	o
Gets feedback on designs	o	o	o	o	o
Tries small scale (sometimes temporary) changes so people can actually see and experience how a new design might work	o	o	o	o	o

Display This Question:
If To begin, what best describes your organization? = State Department of Transportation (DOT)

How well do you think your state's Department of Transportation (DOT) does the following?

	Not well at all	Somewhat well	Moderately well	Very well	Extremely well
Gets input from people who may be potentially impacted by changes to the roadway system before starting designs	o	o	o	o	o
Gets feedback on designs	o	o	o	o	o
Tries small scale (sometimes temporary) changes so people can actually see and experience how a new design might work	o	o	o	o	o

How familiar are you with the Complete Streets approach to planning, designing, building, operating, and maintaining streets?
- o Not at all familiar
- o Slightly familiar
- o Moderately familiar
- o Very familiar
- o Extremely familiar

Does your organization have a Complete Streets policy?
- o No
- o Yes
- o I don't know

Display This Question:
If Does your organization have a Complete Streets policy? = Yes

To what degree does your Complete Streets policy…

	Not at all	Somewhat	Moderately	Very	Extremely	I don't know
Establish commitment and vision	o	o	o	o	o	o
Prioritize underinvested and underserved communities	o	o	o	o	o	o
Apply to all projects and phases	o	o	o	o	o	o
Allow only clear exceptions	o	o	o	o	o	o
Mandate coordination	o	o	o	o	o	o
Adopt excellent design guidance	o	o	o	o	o	o
Require proactive land-use planning	o	o	o	o	o	o
Measure progress	o	o	o	o	o	o
Set criteria for choosing projects	o	o	o	o	o	o
Create a plan for implementation	o	o	o	o	o	o

What three resources do you find most valuable in improving pedestrian safety?

_____
_____
_____

Thanks so much for completing the survey!

8.4 Appendix D. Participant Recruitment

<div align="center">Pedestrian Stakeholder Survey 2023 – Recruiting emails</div>

<u>Email to Traffic Safety Culture Pooled Fund Board Member</u>
As you may know, we (Center for Health and Safety Culture) are engaged in a pooled fund project to develop resources to assess and grow beliefs among stakeholders to support deployment of effective strategies to improve pedestrian safety. We shared with you the Task 1 Report (review of literature) and are now working on assessing beliefs among stakeholders by using a survey.

We need your help and support. Our goal is to get a variety of stakeholders in your state to complete a brief survey. Specifically, we are seeking participation by state DOT employees (leaders, engineers, behavioral safety), city/county DOT/public works employees (engineers, planners), MPO/RPO employees, public health people working on traffic safety/injury prevention, and pedestrian advocacy groups. We know this is a long list AND we learned in Task 1 that all these groups have an influence on improving pedestrian safety.

Getting people to complete surveys is challenging as we are all getting so many survey requests. We know that people are more likely to complete a survey if they perceive benefit and if they are asked by someone they know or can connect with. Therefore, we are asking for your assistance in "making the ask" to increase survey participation.

Our request: We are asking that you copy the text below and send an email to people who you may know (or people who may recognize you by your role) to request their participation in the survey. Please feel free to modify the text. We would also request you send a reminder in one week (reminder text is available below as well).

Specifically, we are asking that you reach out to the following in XX state:
- leaders, engineers, and safety specialists/program managers in your state's DOT (if your behavioral safety efforts are handled by a separate agency like a department of public safety, please include them as well).
- leaders, engineers, and safety specialists in city or county departments of transportation or public works
- Any MPOs or RPOs
  - Particularly: XX (list specific MPOs in their state)
- Anyone in public health working on injury prevention
- Any pedestrian advocacy organizations in your state
- Anyone you feel has an interest and stake in pedestrian safety

Sending an email directly to individuals will increase participation.

We recognize this is a significant ask. We know that more people will respond if you ask them as opposed to us (whom they don't know). And we know that the more people who complete the survey, the more we can learn about improving pedestrian safety.

Please do not hesitate to contact me with any questions or concerns.

Thanks so much for your time and your commitment to growing traffic safety culture!

IRB Protocol #2023-957

Email text for participants:

Subject: important input on pedestrian safety in our state

Hi [name],

I represent our state in the Pooled Fund on Traffic Safety Culture. Our state, along with others, is sponsoring a project to improve pedestrian safety – a safety concern in our state.

I am asking key stakeholders (engineers, planners, safety specialists, public health, advocacy organizations, etc.) for their input by completing a brief survey (8-10 minutes). Responses will be aggregated and analyzed to inform the development of resources that will be made available to us and others across the US.

I have two requests:
1. Complete the brief survey (8-10 minutes). You can use a desktop computer or mobile device. [link]

2. Share this email with others within your organization that are involved in any aspects of pedestrian safety (engineering, design, education, etc.).

Thank you so much for your consideration in helping us improve pedestrian safety in our state.

[your name]

IRB Protocol #2023-957

Reminder text for participants (one week later):

Subject: reminder on input on pedestrian safety in our state

As I mentioned in an email about a week ago, I represent our state in the Pooled Fund on Traffic Safety Culture, and we are sponsoring a project to improve pedestrian safety – a safety concern in our state.

I am sending this reminder to request you complete the brief survey and share the initial email with others within your organization who are involved in any aspects of pedestrian safety (engineering, design, education, etc.).

If you have already completed the survey – thank you so much! If you have not yet, here is the link:
[link]

You can use a desktop computer or mobile device.

You can also still forward this request to others.

Thank you so much for your consideration in helping us improve pedestrian safety in our state.

[your name]

IRB Protocol #2023-957