

*Standing Committee on Pedestrians (ANF10)*  
*Robert J. Schneider, Chair*

## **Pedestrian Transportation Research: Past and Future**

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### **ABSTRACT**

Pedestrian travel is the universal form of human transportation and a gateway to all other modes of travel. The pedestrian research field has grown tremendously over the last two decades, and the Pedestrian Committee has expanded its connections within the TRB organization. We analyzed the official minutes from 15 years of Pedestrian Committee meetings to identify key pedestrian-related topics, including “safety,” “data,” “street,” and “design,” and show how prominent topics have evolved over time. We grouped important pedestrian references from the last 50 years cited by 74 online survey respondents into four main categories: pedestrian safety studies, walkability and roadway design studies, pedestrian travel and the built environment studies, and pedestrian transportation guidebooks. The pedestrian transportation field is evolving, and the Pedestrian Committee will continue to identify research needs and share relevant research on enduring topics such as pedestrian safety at roadway crossings as well as emerging issues such as pedestrian interactions with autonomous vehicles (AVs) and micromobility devices. Moving forward, these efforts to connect research and practice will help ensure that pedestrians of all ages, abilities, and needs are included in the planning, designing, financing, and implementation of transportation systems throughout the world.

### **INTRODUCTION**

Pedestrian travel, with or without assistive devices, is the universal form of human transportation. People of all ages and incomes travel as pedestrians to work, to stores, to school, and as a part of trips made by almost all other forms of surface transportation, including cars, buses, trains, and bicycles. This was true 100 years ago when the Transportation Research Board (TRB) was formed (originally named the National Advisory Board of Highway Research), and it remains true today.

This TRB Centennial paper has three specific purposes: 1) provide a brief overview of the historical context for the TRB Standing Committee on Pedestrians (typically referred to as the Pedestrian Committee); 2) identify the most important pedestrian research produced during the last 50 years; and 3) suggest enduring and emerging pedestrian research needs. As a whole, this paper places the pedestrian transportation mode in its proper place—at the center of all personal transportation options. This paper follows a similar Pedestrian Committee paper developed 20 years ago (1).

## HISTORICAL CONTEXT FOR THE PEDESTRIAN COMMITTEE

The Pedestrian Committee was established in 1970, and it has been active for nearly 50 years (Table 1 shows all of its chairs). This section describes the pedestrian transportation field as the committee was established and grew. It also shows how recent committee initiatives have responded to rapid changes in this dynamic field.

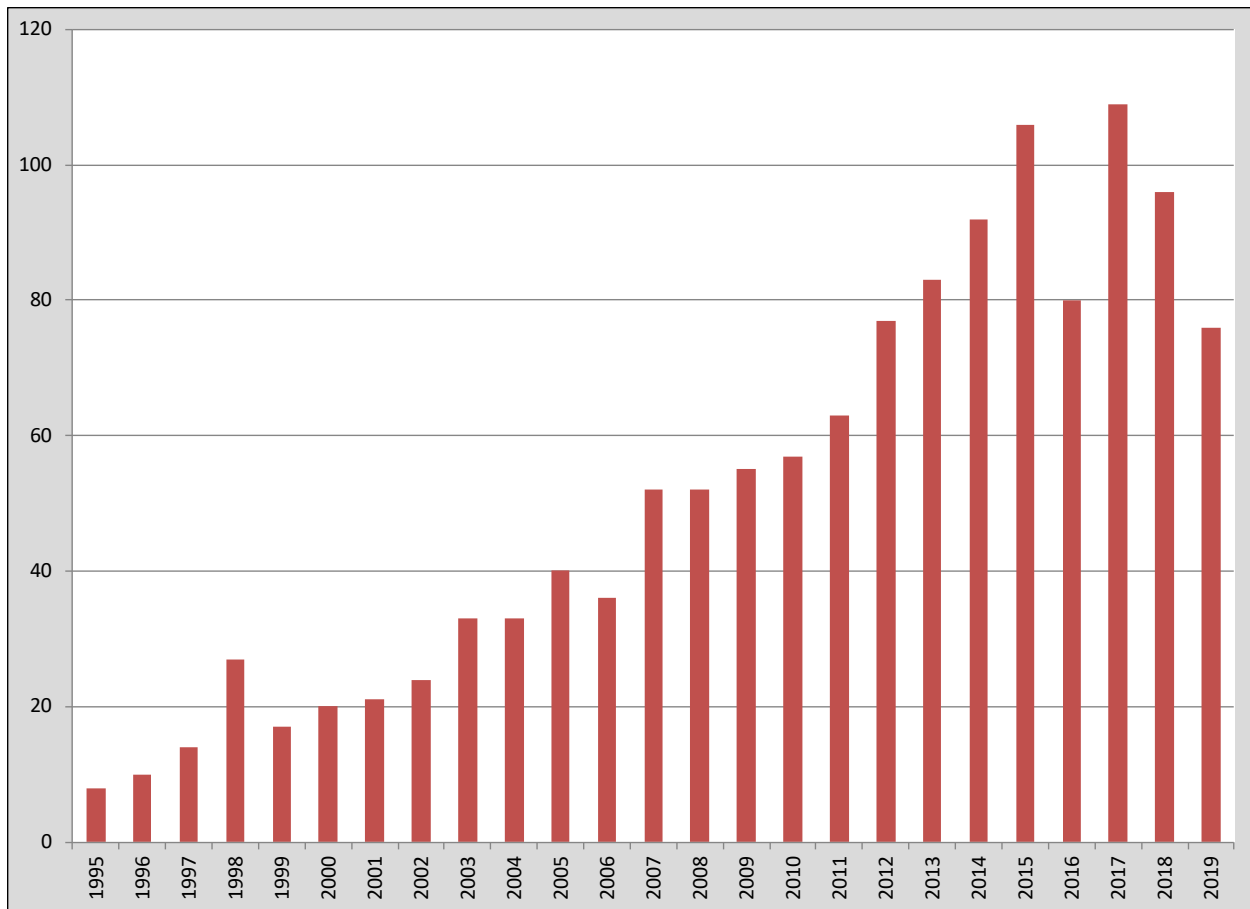
**TABLE 1 TRB Pedestrian Committee Chairs**

<b>Chair</b>	<b>Years</b>
Mr. Robert Sleight	1970-1976
Ms. Julie Anna Fee Cirillo	1976-1979
Mr. John Fegan	1979-1982
Mr. Charles Zegeer	1982-1988
Ms. Kay Colpitts	1988-1994
Mr. Michael Cynecki	1994-1997
Ms. Ann Hershfang	1997-2003
Ms. Peggy Drake	2003-2005
Dr. Ron Van Houten	2005-2008
Mr. Shawn Turner	2008-2014
Dr. Robert Schneider	2014-present

### **Committee Establishment and Growth**

The committee's formation coincided with a growing interest in pedestrian safety and pedestrian movement as an important mode of transportation. Many high-income countries had invested heavily in automobile infrastructure and devoted a significant amount of public space to automobile movement and parking in the decades prior to and immediately after World War II. The 1960s and 1970s saw critical examinations of how certain aspects of motorization could harm neighborhoods and how encouraging pedestrian activity could enhance public space (2-4). Further, pedestrian safety was a particularly serious problem during this period, as United States pedestrian fatalities reached a recorded high of 8,096 in 1979 (United States pedestrian fatalities reached a recorded low of 4,109 in 2009 before increasing back to approximately 6,000 in 2016 and 2017, a dramatic increase that requires further investigation) (5). In response to the large number of fatalities and injuries during the 1970s, the US Department of Transportation's Federal Highway Administration (FHWA) and National Highway Traffic Safety Administration (NHTSA) launched separate and collaborative pedestrian safety programs. FHWA focused primarily on engineering and the environment while NHTSA focused on pedestrian and driver behaviors that lead to crashes. NHTSA's initial pedestrian crash typology has been used by agencies and practitioners worldwide over the last 50 years (6).

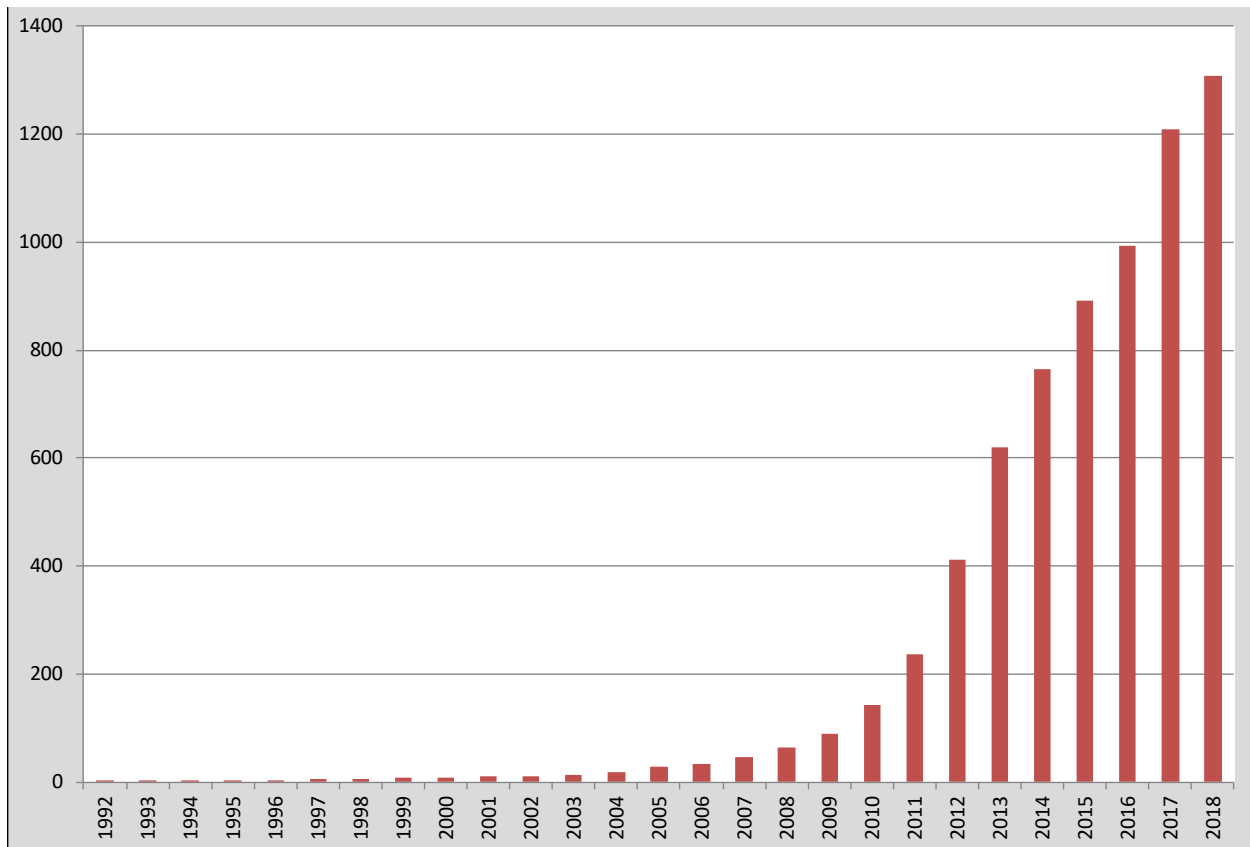
Pedestrian Committee activity has grown significantly since the early 1990s. The committee received fewer than 20 research papers each year from the 1980s through the early 1990s, but it received a record 109 papers in 2017 (Figure 1). The growth in papers received by the committee tracked closely with the growth in papers received throughout TRB from 2009 to 2017. The small decline since then is likely because some papers focused on topics such as pedestrian safety analysis, pedestrian data collection, and public health have gone to other committees that have expanded their interest in pedestrian issues.



**FIGURE 1 TRB Annual Meeting Papers Submitted to the Pedestrian Committee**

The increase in pedestrian-related research since the early 1990s is consistent with more formal recognition of pedestrian issues at the national level in the United States, such as the Americans with Disabilities Act (7) and federal transportation bills since the Intermodal Surface Transportation Efficiency Act (8). It is also consistent with widespread adoption of “Complete Streets” policies at local, regional, and state agencies, which require accommodating all types of users in roadway projects (9) (Figure 2). More recently, major policy initiatives such as Vision Zero and Safe Systems approaches have driven further interest in pedestrian research.

Over the last three decades, an increasing amount of pedestrian research has been funded by the National Cooperative Highway Research Program (NCHRP), FHWA, NHTSA, state departments of transportation, university transportation centers, and public health organizations. This includes the first-of-its-kind Association of American State Highway and Transportation Officials (AASHTO) *Guide for the Planning, Design and Operation of Pedestrian Facilities* (10). During this time, the US Department of Transportation also established the Pedestrian and Bicycle Information Center (PBIC), a clearinghouse for pedestrian- and bicycle-related research and information dissemination (11). Growth in pedestrian research also coincides with the increasing number of practitioners who focus on pedestrian planning, design, engineering, and research at the local, regional, and state levels, including government, consulting, and advocacy organizations. The Association of Pedestrian and Bicycle Professionals (APBP), formalized in 1998, has grown to more than 1,200 members in the US and Canada (12).



**FIGURE 2 Total Agencies with Complete Streets Policies in the US (1992-2018)**

Source: Smart Growth America (9).

Pedestrian travel is researched throughout the world and international researchers have contributed to the Pedestrian Committee throughout its history. Committee leaders agree that papers from outside the US have increased notably over the last two decades. From 2013 to 2017, the Pedestrian Committee published papers from Australia, Bangladesh, Brazil, Canada, China, Greece, India, Iran, Italy, New Zealand, Singapore, South Korea, and the UK.

**Expansion of Relevant Research Domains and Collaborators**

The Pedestrian Committee’s current Triennial Strategic Plan commits the committee to cover topics including pedestrian safety, accessibility, mobility, equity, behavior, facilities, programs, and data, with an ultimate goal of providing supportive research to improve conditions for walking all over the world. As the research field has expanded, the committee has transformed from an internally-focused group to a well-integrated group within TRB. For example, the Pedestrian Committee hosts annual Human Factors Workshops that draw participants from many areas of the transportation profession. Recent topics have explored the latest increase in US pedestrian fatalities, roadway lighting for pedestrian safety, and the impact of alternative intersection designs on pedestrians with visual disabilities. Within the last decade, the committee helped organize a spotlight conference on pedestrian and bicycle safety (13) and produce an issue of TR News on Active Transportation and Health (14).

The committee collaborates informally with other TRB committees that address transportation in developing countries, intersection design, and autonomous vehicles, and has developed formal joint subcommittee partnerships with committees such as:

- Environmental Justice in Transportation (to address issues related to walking and health and equity in pedestrian transportation outcomes).
- Traffic Flow Theory (to coordinate on pedestrian modeling and simulation research).
- Safety Data, Research, and Analysis (to coordinate on pedestrian safety research methods and analysis tools).
- Highway Traffic Monitoring (to coordinate on pedestrian data needs).
- Bicycle (to coordinate on university pedestrian and bicycle education and on emerging low-speed vehicles that may interact with pedestrians, such as Segways, shared bicycles, and electric scooters).

The committee has also established its own new subcommittees, including Pedestrian and Autonomous Vehicle Interactions, to address important emerging topics. The committee summarizes the scope of each of these subcommittee partnerships on a TRB Pedestrian Committee website (<http://pedbikeinfo.org/trbped/>) (15). As the committee has expanded within TRB, annual committee meeting attendance has grown to more than 100 people and the committee friends list has grown to more than 400 people. These volunteers include a mix of researchers, advocates, and practitioners representing academic institutions; consulting firms; non-governmental organizations; and governmental agencies across the globe.

### **Development of Pedestrian Research in Last 20 Years**

Several broad trends illustrate the dynamic nature of pedestrian research over the last two decades:

- Technical expertise has increased among pedestrian planners, designers, engineers and other professionals. Research has provided better methods of safety analysis, demand estimation, suitability assessment, and prioritization. As these methods are integrated into practice, practitioners recognize the need to refine them, which drives the demand for additional research in more specialized areas of the field.
- New policy approaches (e.g., Complete Streets, Vision Zero, Safe Systems) have expanded the range of transportation professionals who address pedestrian issues. Twenty years ago, a single pedestrian specialist may have addressed most pedestrian issues within an agency. Now, pedestrian needs are considered by a variety of transportation professionals working together, including planners, engineers, designers, and traffic monitoring specialists. Pedestrian issues are also addressed by other related disciplines such as economic development and public health. The widening scope of the pedestrian field drives more partnerships with a broader range of professionals and additional research needs.

The Pedestrian Committee takes minutes at its annual meetings in Washington, DC. These minutes show key pedestrian research topics that have been discussed over time. After excluding words fundamental to the basic operation and purpose of the TRB Pedestrian Committee (e.g., “pedestrian” and “walk”), the most common words found in the last 15 full Pedestrian Committee meeting minutes (2004-2018) were “safety,” “data,” “street,” and “design” (Table 2). Grouping these common words into word clouds by three-year periods shows the evolution of pedestrian research during this 15-year time period (Figure 3). The meeting notes analysis method is described in Appendix A (16).

**TABLE 2 Common Keywords in TRB Pedestrian Committee Meeting Notes (2004-2018)**

<b>Keyword</b>	<b>Frequency</b>
Safety	199
Data	120
Street	101
Design	98
Workshop	94
Community	85
Plan	85
Fund	75
Webinar	72
Public	70
Guide	68
Active	62
Traffic	58
Vehicle	58
Cross	55
Health	55
Sign	54
Speed	53
Project	53
Video	47



## **IMPORTANT PEDESTRIAN RESEARCH FROM THE LAST 50 YEARS**

This section highlights important pedestrian research produced in the last 50 years. Professionals with experience in the pedestrian transportation field were invited to participate in an online survey to describe the most “influential” and “useful” pedestrian research conducted since 1970.

The main section of the survey asked participants to cite up to three influential pedestrian studies and up to three useful pedestrian studies. More details about the survey method are provided in Appendix B. Seventy-four participants entered more than 220 responses in this section, ultimately providing approximately 100 unique studies. Respondents did not appear to make a distinction between influential and useful studies, so these two groups of responses were analyzed together.

The influential and useful references mentioned by respondents were grouped into categories (each reference was assigned to a single category that fit best, though several covered multiple topics). The most common categories were:

- **Pedestrian safety studies (86 citations).** This category encompasses a wide range of subtopics, including pedestrian crossing safety, safety in numbers, speed and pedestrian injury severity, pedestrian crash types, child pedestrian safety, pedestrian safety audits, driver yielding to pedestrians, and proactive pedestrian safety analysis.
- **Walkability and roadway design studies (39 citations).** This category covered the relationship between pedestrians and public space, pedestrian level of service, roadway design, and complete streets.
- **Pedestrian travel and the built environment studies (27 citations).** This category includes research on the relationship between land use and street networks and pedestrian activity as well as the role of residential self-selection in neighborhood pedestrian activity levels.
- **Pedestrian transportation guidebooks (22 citations).** This category included guidebooks produced by transportation agencies.

The most frequently-mentioned studies within these four categories are listed in Table 3. Other categories of pedestrian research mentioned by respondents included active transportation and health, accessibility for people with disabilities, pedestrian demand assessment (i.e., counts, volumes, and models), and pedestrian and driver behavior.

This summary of the most influential and useful pedestrian research represents the perspectives of professionals in the pedestrian field who responded to the survey. Since the authors of this paper distributed the survey, the responses could potentially be biased towards research done by people who are more closely associated with their professional networks. Given these limitations, eight Emeritus and long-standing members of the Pedestrian Committee suggested additional important pedestrian references. These are listed in Table 4. We contend that the entire reference list of this paper, including studies listed in Table 3, Table 4, and elsewhere in the text, are a good representation of the core references in the pedestrian field from the last 50 years.

It is also important to recognize the broader context surrounding pedestrian research over the last 50 years. As in any field, some topics have received more funding than others (e.g., driven by the priorities of federal and state agencies, foundations, and other organizations); some topics have been more interesting to individual researchers based on their personal experiences; some topics may have been researched to address the concerns of vocal local constituencies. As one respondent stated:



*“Considerations about what research you receive should prompt questions of who did this research benefit...? And, there should be acknowledgement about the bias and lens of what [led] that research.”*

Another survey respondent recognized the value of past pedestrian research for informing the field today:

*“If we are able to see the future more clearly, it is because we stand on the shoulders of many giants who worked (often in the face of significant criticism) in the past. It is humbling to think about their work and how it has shaped the profession.”*

**TABLE 3 Most Frequently Mentioned Pedestrian Studies from last 50 Years (Part 1)**

<i>Pedestrian Safety Studies</i>		
<u>Common Name of Study</u>	<u>Authors (Year)</u>	<u>Significance</u>
Safety Effects of Marked versus Unmarked Crosswalks (17)	Zegeer et al. (2005)	Analyzed pedestrian crashes at 1,000 marked versus 1,000 unmarked crosswalks in 30 US cities at uncontrolled locations. Provided guidance for installing marked crosswalks and other pedestrian improvements at uncontrolled locations based on motor vehicle traffic volume, posted speed limit, number of travel lanes, and presence of a raised median.
Improving Pedestrian Safety at Unsignalized Crossings (18)	Fitzpatrick et al. (2006)	Tested the effectiveness of several uncontrolled pedestrian crossing treatments in different roadway contexts. Results led to further study and use of pedestrian hybrid beacons and in-street pedestrian crossing signs.
Safety in Numbers (19)	Jacobsen (2003)	Showed that higher levels of pedestrian activity were associated with lower crash risk per pedestrian trip.
Impact Speed and a Pedestrian's Risk of Severe Injury or Death (20)	Tefft (2013)	Summarized previous research on the relationship between speed and pedestrian injury severity. Updated work from earlier studies to better control for all key factors influencing injury outcomes.
<i>Walkability and Roadway Design Studies</i>		
<u>Common Name of Study</u>	<u>Authors (Year)</u>	<u>Significance</u>
Pedestrian Planning & Design (21)	Fruin (1971)	Quantified pedestrian density and facility capacity characteristics. Results were used as the basis for the density-based level of service metric in the Highway Capacity Manual.
Street Rivals: Jaywalking and the Invention of the Motor Age Street (22)	Norton (2007)	Documented the social construction of public street space in the US. Showed how public opinion transformed in the early 1900s from viewing streets as places to be shared by pedestrians and vehicles to thoroughfares where automobile movement generally had priority over pedestrian access.
Designing Walkable Urban Arterials (23)	Institute of Transportation Engineers (2010)	Provided practical guidance to support walkable communities through roadway design. Recognized that arterial and collector roadways should prioritize pedestrian needs in areas where surrounding land uses support pedestrian activity.

**TABLE 3 Most Frequently Mentioned Pedestrian Studies from last 50 Years (Part 2)**

<i>Pedestrian Travel and the Built Environment Studies</i>		
<u>Common Name of Study</u>	<u>Authors (Year)</u>	<u>Significance</u>
Travel and the Built Environment (24)	Ewing & Cervero (2010)	Summarized empirical studies of how built environment characteristics are associated with pedestrian activity. Quantified the magnitude of associations between walking and land use diversity, intersection density, and nearby destinations.
Built Environment Correlates of Walking (25)	Saelens & Handy (2008)	Summarized previous built environment studies to show that pedestrian transportation was related to development density, distance to activity destinations, and land use mix.
Examining the Impacts of Residential Self-Selection on Travel Behavior (26)	Cao, Mokhtarian, & Handy (2009)	Summarized previous studies and found that the built environment had a significant influence on travel behavior, including walking, even after controlling for people with preferences for walking self-selecting into walkable neighborhoods.
<i>Pedestrian Transportation Guidebooks</i>		
<u>Common Name of Study</u>	<u>Authors (Year)</u>	<u>Significance</u>
PedSAFE: Pedestrian Safety Guide and Countermeasure Selection System (27)	Zegeer, Nabors, & Lagerwey (2013)	Summarized pedestrian safety engineering and design treatments. Described research on benefits of each treatment, provided important considerations for applying each treatment, and showed the types of crashes each treatment could help prevent.
NACTO Urban Street Design Guide (28)	National Association of City Transportation Officials (2013)	Provided straightforward guidance, references, and easy-to-understand graphics to illustrate pedestrian facilities for streets and intersections.
Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations (29)	Blackburn, Zegeer, & Brookshire (2017)	Recommended possible pedestrian crossing treatments depending on roadway facility type, traffic volume, speed, and other variables. Summarized available crash reduction factors for recommended pedestrian crossing treatments.

**TABLE 4 Additional Important Pedestrian References from last 50 Years**

<u>Common Name of Study</u>	<u>Authors (Year)</u>	<u>Significance</u>
Alcohol Involvement in Pedestrian Crashes (30)	Blomberg et al. (1979)	Quantified the high prevalence of alcohol involvement in pedestrian fatalities and injuries. Showed common characteristics of alcohol-involved pedestrian crashes.
Willie Whistle: Reducing Child Pedestrian Crashes through Public Education (31)	Preusser and Blomberg (1984)	Showed that child-friendly safety videos could improve child pedestrian crossing behavior and reduce child midblock dart and dash crashes.
Pedestrian Walking Speed and Start-Up Time (32)	Knoblauch, Pietrucha, and Nitzburg (1996)	Measured pedestrian crossing speeds for different ages and showed that it is appropriate to provide more crossing time for pedestrians aged 65 or older.
Pedestrian and Bicycle Crash Types of the 1990s (33)	Stutts, Hunter, and Pein (1996)	Provided a comprehensive review of factors associated with pedestrian crashes and pedestrian crash types based on more than 5,000 crashes in six states in the early 1990s.
Pedestrian and Bicycle Injuries: Emergency Room Data vs. Police Reported Data (34)	Stutts and Hunter (1999)	Highlighted the high prevalence of underreporting in police crash reports. 64% of reported pedestrian injury events did not involve a motor vehicle. 53% of pedestrians were injured in non-roadway locations such as sidewalks, parking lots, or off-road trails.
AASHTO Guide for the Planning, Design and Operation of Pedestrian Facilities (10)	AASHTO (2004)	Established official guidance for pedestrian planning, design, and operations to supplement the AASHTO's <i>A Policy on Geometric Design of Highways and Streets</i> .
Rectangular Rapid Flashing Beacon (RRFB) Effectiveness (35)	Shurbutt and Van Houten (2010)	Conducted field experiments that showed RRFB installations to be effective at increasing driver yielding to pedestrians at uncontrolled crosswalks on multilane roadways.
High-Visibility Enforcement and Driver Yielding to Pedestrians: Gainesville, FL Case Study (36)	Van Houten et al. (2013)	Demonstrated that enforcement combined with media outreach could change social norms and increase driver yielding to pedestrians at uncontrolled crosswalks. Four-year follow-up study also showed continued driver yielding improvement (37).

## **ENDURING PEDESTRIAN RESEARCH ISSUES AND FUTURE RESEARCH NEEDS**

The pedestrian transportation field continues to evolve in response to the demand for high-quality research to inform policy and practice. Some important research topics from the past continue to endure. Other research topics have emerged recently in response to new areas of interest and technological development.

The online survey also asked participants to list up to three research topics that would be most helpful to inform their work in the next 10 years. Eighty-three respondents collectively suggested more than 190 ideas that were classified into general topics (each idea was assigned to a single category that fit best, though several covered multiple topics). The most commonly-cited research topics are presented as enduring and emerging pedestrian research topics below.

### **Enduring Pedestrian Research Topics**

Enduring pedestrian research topics include safety (50 suggestions), pedestrian demand (41 suggestions), accessibility for all pedestrians (26 suggestions), and funding and economic benefits (23 suggestions).

#### *Safety*

The majority of research ideas suggested were within the broad topic of pedestrian safety. This is not surprising since the World Health Organization estimates that at least 310,000 (23%) of the 1.35 million people killed in traffic crashes worldwide each year are pedestrians (38). Critically, annual pedestrian fatalities have increased in the US since 2009. In 2016 and 2017, annual pedestrian fatalities were the highest in more than two decades (approximately 6,000 each year). Pedestrian fatalities are also increasing more rapidly than automobile driver and passenger fatalities and now account for approximately 16% of all traffic-related deaths (4). Pedestrian professionals are interested in the underlying causes of this increase and whether or not it is also occurring globally. To better understand pedestrian crash risk, safety data need to be more representative of the full range of incidents that produce injuries. Most current analyses that rely on police-reported crashes exclude pedestrian injuries due to falls (e.g., due tripping hazards, ice, and other maintenance issues) and crashes involving bicycles, scooters, and other non-motorized vehicles. There is a need to supplement police-reported crash data with emergency response and hospital records. Other safety-related topics suggested by survey respondents included the effectiveness of specific engineering, education, and enforcement treatments; pedestrian and driver behaviors, including distraction, associated with injury outcomes; pedestrian safety at night; better pedestrian safety research in suburban, rural, and small community areas; and pedestrian safety impacts of new transportation technologies.

#### *Pedestrian Demand*

While several dozen pedestrian demand modeling studies have been undertaken in the last decade, many survey respondents still seek better research to estimate pedestrian volumes. Pedestrian volume information can be used to control for exposure in pedestrian safety analyses, inform decisions about pedestrian facility designs, assess pedestrian crossing warrants, and help prioritize locations for pedestrian investments. Survey respondents suggested using mobile

device GPS data and compiling the growing number of automated and manual pedestrian counts from a variety of communities to develop better pedestrian demand models.

### *Accessibility for All Pedestrians*

People of all abilities travel as pedestrians. Accessible public ways should be provided and maintained for people who are in wheelchairs, use assistive devices, have vision or hearing limitations, or experience other disabilities. These accommodations have been mandated in the US since the 1990 Americans with Disabilities Act. Pedestrian accessibility research has been conducted over the last 50 years and continues to be needed as the proportion of older pedestrians with limited mobility increases. Further, new pedestrian crossing treatments, roadway designs, and emerging technologies reshape the experiences of pedestrians with disabilities. For example, roundabouts and alternative intersections provide different cues to people with vision and hearing disabilities. Electric-powered vehicles and other devices can be more difficult to hear than traditional automobiles. Shared scooters and other forms of micromobility may create potential conflicts when they are operated or parked in the pedestrian environment. Research can help ensure that people with disabilities continue to travel safely and comfortably as the transportation system evolves.

### *Funding and Economic Benefits*

Funding levels for pedestrian transportation vary throughout the world and by jurisdiction within countries. Within the US, states spend an average of 2.0% of their federal transportation dollars on pedestrian and bicycle projects (39), which is far below the percentage of trips that are made by pedestrians (10.5%) and percentage of traffic-related fatalities that are pedestrians (16%) (5,40). Within this context, pedestrian professionals continue to look for studies showing the economic benefits of investing in better pedestrian environments. Survey respondents emphasized the need for more research to monetize the health, local business, and safety benefits of pedestrian-friendly communities.

### **Emerging Research Issues**

Several issues in the transportation field are likely to become more prominent and have significant impacts on pedestrian research and practice in the next decade. These issues encompass equity (11 suggestions) and interactions with new transportation technologies (31 suggestions).

### *Disparities in Pedestrian Travel and Health Outcomes*

Survey respondents emphasized the need for future research on disparities in pedestrian safety and investments by race, class, age, gender, and location. Well-designed roadways for pedestrian travel are not distributed equitably across communities. Low-income and minority communities are overrepresented in pedestrian crashes (41,42) and may lack opportunities to engage in developing strategies to improve local pedestrian conditions. There are also differences in pedestrian fatality rates by gender and age (5,40). The Pedestrian Committee has always focused on equity for people with disabilities, but it has recently expanded its emphasis on equity to examine how socioeconomic characteristics relate to pedestrian experiences and outcomes within its Triennial Strategic Plan.

### *Pedestrian Interactions with New Transportation Technologies*

The most common future research topic suggested by survey respondents was pedestrian interactions with new transportation technologies. Electric vehicles, for example, may reduce pedestrian exposure to vehicle emissions but may also introduce unintended consequences, such as being more difficult to detect by pedestrians or reducing gas-tax based revenue available to build pedestrian infrastructure. Rapid adoption of new forms of micromobility (i.e., personal conveyances such as e-bikes and e-scooters) and ride share systems may present challenges for pedestrians competing for limited amounts of transportation right-of-way. These new technologies will require much research and conversation to safely integrate into future roadway design, policy, and safety monitoring systems.

Autonomous vehicles (AVs) also present opportunities and potential concerns for pedestrians. While the emergence of highly automated driving systems has the potential to improve pedestrian safety, these vehicles may also transform urban form, travel behavior, roadway and vehicle design, and interactions between roadway users in unexpected ways. Concerns have been raised about shifting expectations for who is responsible for user safety on public roadways. For example, will pedestrians be expected to change behavior or wear sensors in order to be “visible” to AVs? As AV technologies develop, the Pedestrian Committee aims to advance and share research on key pedestrian issues that will be used by current and future practitioners, researchers, private industry, and other stakeholders to improve pedestrian safety, equity, comfort, and mobility in all transportation systems.

As walking is the gateway to all other modes of travel, pedestrian needs should be fully considered in industry research as companies develop, test, and adopt new technologies. Critically, pedestrian needs and the social, environmental, health, and economic benefits of pedestrian travel should be fully considered in research that informs community policies and practices to integrate AVs, micromobility devices, and other forms of travel into their transportation systems.

### **CONCLUSION**

Pedestrians will remain the core of healthy, low carbon, and sustainable transport systems in the US and abroad. The pedestrian transportation field continues to evolve, sustaining the demand for high-quality research to inform policy and practice. The Pedestrian Committee will continue to identify research needs and share relevant research on enduring topics such as pedestrian safety at roadway crossings as well as emerging issues such as pedestrian interactions with AVs and micromobility devices. Moving forward, these efforts to connect research and practice will help ensure that pedestrians of all ages, abilities, and needs are included in the planning, financing, and implementation of transportation systems throughout the world.

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## **Appendix A. Meeting Minutes Word Analysis Method**

The member-approved minutes of each full TRB Pedestrian Committee meeting from 2004 to 2018 were analyzed to reflect key themes that emerged over the years. The software Wordart (<https://wordart.com/>) was used to count the number of times each word appeared in the notes and to create word clouds. Each word cloud graphic is a simple tabulation of the words most frequently included in the meeting notes for each three-year period. The three-year periods included 2004-2006, 2007-2009, 2010-2012, 2013-2015, and 2016-2018. Documents referred to as attachments or appendices to the meeting notes were not included in the word lists. The word lists did not include common words (as defined by the online program), numerical text, specific person-names, organization names and abbreviations, and place-names. Words common to most TRB committees were excluded, and words fundamental to the basic operation and purpose of the TRB Pedestrian Committee were also excluded (e.g., “pedestrian” and “walk”). After filtering the three-year lists according to the criteria above, the lists were limited to those words mentioned at least three times. The lists were also limited to the 50 words mentioned most frequently. The words in the cloud graphics are sized according to the frequency of the words mentioned; larger words represent words mentioned most often.

## **Appendix B. Online Survey Distribution and Analysis Process**

An online survey titled, “What is the Most Important Pedestrian Transportation Research in the Last 50 Years?” was open from January 13, 2019 to February 20, 2019. A link to the survey was distributed in a snowball fashion through professional networks. It was initially sent to e-mail lists maintained by the TRB Pedestrian Committee, Association of Pedestrian and Bicycle Professionals, Pedestrian and Bicycle Information Center, and World Society on Transportation and Land Use Research. It was also shared with the state department of transportation pedestrian and bicycle coordinators through the Federal Highway Administration and university urban planning professors through the Planet list. The link was also e-mailed directly to several university transportation center leaders. In addition to e-mail, the link was shared through social media platforms. Individuals who took the survey were encouraged to share it with other professionals working on pedestrian-related issues.

A total of 243 people consented to participate in the survey, and 207 people responded with information about their professional background. These 207 respondents had a range of years of experience within the profession, worked as practitioners and researchers, and represented many different types of organizations. The majority of respondents were from the US (35 states and the District of Columbia), but there was also representation from Europe, Canada, Australia, and New Zealand. There were no responses from other countries.

For this paper, the most important pedestrian research from the last 50 years was identified by 74 respondents who listed at least one “influential” or “useful” study. Each respondent had an option to list up to three influential and three useful studies. In all, the 74 respondents cited 222 total references (several respondents listed the same study as both influential and useful, so these duplicates were not counted). Approximately 100 unique references were represented. The summary of future research topics was based on the 83 respondents who suggested at least one research topic. Each respondent had an option to list up to three important research topics. In all, the 83 respondents suggested 191 total topics.

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