Pedestrian Safety Practitioners’ Perspectives of Driver Yielding Behavior across North America

Robert J. Schneider*
rischnei@uwm.edu
University of Wisconsin Milwaukee, Department of Urban Planning
2131 E. Hartford Avenue
Milwaukee, WI 53211
United States
Tel: (414) 229-3849
Fax: (414) 229-6976

Rebecca L. Sanders
rebeccasanders@ou.edu
University of Oklahoma, Division of Regional and City Planning
Gould Hall, 830 Van Vleet Oval
Norman, OK 73019-6141
Tel: (405) 325-5691
Fax: (405) 325-7558

*Corresponding author

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ABSTRACT

This study presents results from a recent internet survey of practitioners in the pedestrian safety field about their perceptions of driver yielding behavior in cities throughout North America. As one of the first studies to attempt to understand driver and pedestrian interactions from a macro perspective, this research combined perceptions of local driver yielding rates in three different crosswalk scenarios with open-ended comments to understand factors that may influence driver yielding behavior. Responses from 387 practitioners in 171 cities suggest that rates of driver yielding to pedestrians in marked crosswalks are related to characteristics such as social norms, roadway design, law enforcement, and pedestrian volumes. Respondents generally indicated that drivers are more likely to yield to pedestrians on roadways with fewer lanes and slower travel speeds. However, the results also suggest notable geographic differences in yielding culture. Practitioners also indicated that crosswalk laws were rarely enforced in most communities. The paper concludes with a theoretical framework for future empirical research on driver yielding as it relates to driving and walking culture, roadway design, crosswalk laws, and enforcement.
INTRODUCTION

After a steady decline during the previous decade, the number of pedestrians killed in United States traffic crashes increased each year between 2009 and 2012. The 4,743 pedestrian fatalities in 2012 represented 14.1% of people killed in traffic crashes in the United States (up from 10.9% in 2004) (1). Canada also experienced a 10-year decline, but pedestrian fatalities have remained relatively steady since 2008. The 315 pedestrians killed in 2011 represented 15.7% of all traffic fatalities (up from 11.8% in 2005) (2,3,4).

In all states and provinces, the law requires drivers to yield the right-of-way to pedestrians crossing within a marked crosswalk (unless a signal prohibits the pedestrian from crossing or the pedestrian enters the crosswalk when a vehicle is too close to yield). While this law varies with respect to location of the pedestrian relative to the curb, lane-positioning of approaching vehicles, presence of crosswalk markings, and whether the driver must stop or yield, the core message at marked crosswalk locations is consistent: approaching drivers who have enough time to see a pedestrian in the crosswalk must allow that person to cross the street. However, this law is routinely violated throughout North America, resulting in pedestrian crashes and injuries. The most common primary contributing factor in pedestrian crashes reported in California between 2008 and 2012 was violating “pedestrian right-of-way” (37%) (5). During the same five-year period, the most common contributing circumstance in Wisconsin pedestrian crashes was driver “failure to yield” (28%) (6). Therefore, improving driver yielding behavior has the potential to reduce pedestrian injuries and fatalities.

Purpose

This study is intended to improve understanding of driver yielding behavior by drawing on the collective knowledge of pedestrian safety practitioners across North America. A secondary purpose is to identify differences in the social norms governing driver yielding behavior (i.e., driver yielding culture) between communities. If there are differences in driver yielding behavior between communities, this information can be used to improve research designs and provide insights into strategies that have been effective at increasing driver yielding in particular jurisdictions.

An online survey was used to achieve these purposes, since this method can gather information from a large number of practitioners and different geographic regions. This study is not intended to precisely measure driver yielding behavior, which requires observing pedestrians and vehicles at field study sites. Collecting field data is important for future research but was not practical or necessary for the purpose of this exploratory study.

LITERATURE REVIEW

Previous studies have examined the relationship between driver yielding behavior and signage and marking, signalization, and roadway design treatments. Driver yielding has been shown to increase after implementing in-street pedestrian crossing signs (7), high-visibility crosswalks with overhead warning signs (8), advance yield signs and markings (9,10), leading pedestrian intervals (11), and rectangular rapid flashing beacons (12,13,14). In addition, drivers tend to yield to pedestrians more frequently when approaching at lower speeds (15,16) and on roadways with fewer lanes (15).

Other studies have documented increases in driver yielding after targeted police enforcement at crosswalks. Police enforcement campaigns in three small Canadian cities (17); Miami Beach, FL (18); and Gainesville, FL (19); all led to increased rates of drivers yielding to
pedestrians at targeted crosswalks. Driver yielding improvements in Miami Beach were sustained for one year after the targeted enforcement program was completed. Both Florida studies showed that driver yielding rates also increased at “control” crosswalks where no warnings or tickets were issued.

Several researchers have examined public understanding of crosswalk laws. Many drivers and pedestrians in the San Francisco Bay Area did not understand how they were supposed to interact at crosswalks, particularly crosswalks that were not marked with painted lines (20). In addition, pedestrians in marked crosswalks were more likely to be involved in potential multiple-threat situations (e.g., driver in one lane stops but driver approaching in the adjacent lane does not see and stop for the pedestrian) (21). These studies suggested that crosswalk laws may be confusing, counterintuitive, or possibly inappropriate for the local driving culture. The authors emphasized the need for education and enforcement strategies to supplement engineering treatments, particularly at uncontrolled crosswalks.

Studies have also explored differences in driver yielding rates based on pedestrian and driver characteristics. These suggest that drivers may be more likely to yield to pedestrians holding a cane (16,22), wearing brighter clothing (23), entering the crosswalk more assertively (23), and classified as “White” ethnicity (within a majority-“White” community) (24). Drivers of more expensive cars may be less likely than other drivers to yield to pedestrians (25).

Few studies have been conducted in multiple cities, and even fewer have attempted to identify differences in driver yielding between communities. A study of three crosswalk sites each in Buffalo, NY, and Sacramento, CA, found no significant increase in driver yielding rates in either city after crosswalks were marked (26), but studies in the San Francisco Bay Area, CA, and Washington, DC, found that drivers were more likely to yield to pedestrians in marked crosswalks than unmarked crosswalks along the same roadway corridor (21,27). Additionally, Huang, Zegeer, and Nassi (7) found that a significantly higher percentage of drivers yielded to pedestrians after in-street pedestrian crossing signs were installed in four of six upstate New York cities, but no significant difference after this treatment was installed at one site in Portland, OR. A recent study of two-lane roundabouts found differences in driver yielding rates among sites in six communities. For example, drivers in Annapolis, MD, and Towson, MD, were more likely than drivers in Raleigh, NC, and Winston-Salem, NC, to yield to pedestrians at two-lane roundabouts (16). These results support the possibility of geographic differences in driver yielding behavior.

While these studies have contributed to a greater understanding of driver yielding behavior in specific circumstances, no study has attempted to draw all of the factors together into a larger, holistic framework for understanding driver yielding to pedestrians. This paper attempts to help fill this gap in the literature.

SURVEY DESIGN AND DISTRIBUTION
An online survey was used to investigate pedestrian safety practitioners’ perceptions of driver yielding behavior. The 18 survey questions gathered demographic information as well as perceptions of driver and pedestrian behavior in the area (e.g., city, town, etc.) where respondents worked, including:

- Driver yielding rates along various roadway facilities.
- Rates of enforcement for driver yielding laws.
- Pedestrian crossing behaviors.

Schneider and Sanders
Questions asking specifically about yielding rates used the following scale:

- Almost Always (More than 85%).
- Often (60% to 85%).
- About half the time (40% to 59%).
- Occasionally (15% to 39%).
- Almost Never (Less than 15%).

An “I don’t know” option was also included to discourage guessing. Additionally, comment boxes followed each question to allow respondents to elaborate on their responses. The survey was developed based on a need for greater understanding of the subject given the current literature and was modified after pre-testing by six experts in the pedestrian safety field.

Participation in the online survey was solicited via e-mail in Fall 2013. The e-mail was distributed initially to a list of pedestrian and bicycle professionals in North America, and forwarded in “snowball” fashion to other practitioners. No material incentives were offered for participation. A total of 419 people completed the survey. Participants who indicated that they had no experience in the field of pedestrian safety (defined as “working on pedestrian transportation, driver behavior, and/or safety issues”) or worked outside of North America were dropped from consideration in order to ensure a minimum level of validity in the analysis process. After data cleaning, there were 387 valid, completed surveys.

Table 1 shows the survey participant characteristics. Approximately 43% of respondents reported working in areas with a metro population of at least one million people, although some worked in small jurisdictions within that area (e.g., Albany, CA, within the San Francisco Bay Area). A majority of respondents had at least six years of experience in the pedestrian safety field. Since most respondents had multiple years of experience, they were assumed to have a reasonable understanding of yielding behavior in the communities where they worked. Planners, engineers, researchers, and advocates were particularly well-represented among the respondents.
### TABLE 1  Survey Population Characteristics (N=387)

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Survey respondents worked in 171 North American cities. Madison, WI, had the most respondents (16), followed by Portland, OR (14), and Seattle, WA (14). Nineteen cities had five or more respondents; 104 cities had a single respondent.

ANALYSIS

The primary analysis focused on the following open-ended question: “Why do you think that drivers in your community exhibit this yielding behavior? Do you think any local, state, or federal policies have influenced yielding behavior, either directly or indirectly?” Both authors reviewed all responses to this question and developed lists of common factors independently. After comparing lists and discussing small differences, a list of 15 factors was finalized: education about the law, enforcement of the law, urban design and roadway design, vehicle speed, vehicle volume, driver alertness, driver behavioral norms, driver socio-demographic characteristics, land use and pedestrian volume, pedestrian assertiveness, pedestrian predictability, pedestrian visibility, pedestrian behavioral norms, pedestrian socio-demographic characteristics, and social fabric. The original database was re-coded according to the final factor list.

A second analysis summarized a set of questions that asked participants to estimate driver yielding rates under three scenarios in the community where they worked. Introductory text explained that each scenario applied to uncontrolled, marked crosswalks (i.e., locations where there is no traffic control that requires drivers on the main roadway to stop) and stated, “For these questions, consider ‘drivers yielding’ to a pedestrian to be defined as a driver in the right lane stopping or slowing for a single, adult pedestrian who either just started to enter a marked crosswalk or clearly appears ready to enter a marked crosswalk from the right side of the street. Only consider drivers who, given the posted speed limit, would have sufficient distance to see the pedestrian in order to stop in advance of the crosswalk. Assume that the marked crosswalk has no additional pedestrian crosswalk enhancements other than a painted crosswalk and crosswalk warning sign (i.e., no flashing beacons, median islands, yield-to-pedestrian bollards, etc.).” Given these specific conditions, the three questions asked practitioners to estimate driver yielding rates on the following roadways:

- Two lanes (one in each direction) and actual traffic speed of 25 to 30 mph (40 to 48 kmh).
- Two lanes and actual traffic speed of 35 to 40 mph (56 to 64 kmh).
- Four lanes and actual traffic speed of 35 to 40 mph (56 to 64 kmh).

Since the response options were given in ordered categories, the data were summarized by showing the percentage of responses in each category and identifying the median response category.
RESULTS
The North American practitioners provided many insights about driver yielding behavior. Impressively, 342 (88%) of the 387 participants provided a substantive response to the open-ended question about why drivers exhibit certain yielding behaviors in their community. Most respondents mentioned multiple reasons, which were grouped into the list of 15 factors. The most commonly-cited factors are listed below. These factors are further combined in the following sections to help frame the presentation of results.

- Driver behavioral norms (cited by 142 respondents).
- Urban design and roadway design (123).
- Enforcement of laws (105).
- Education about laws (101).
- Land use and pedestrian volume (55).
- Vehicle speed (42).
- Pedestrian behavioral norms (27).
- Social fabric and socio-demographic characteristics (21).

Although the remaining factors (e.g., vehicle volume, driver alertness/distraction, pedestrian visibility) may still impact driver yielding behavior, they are not discussed in detail because they were each mentioned by fewer than 20 respondents.

Driver and Pedestrian Behavioral Norms
Behavioral norms are the typical behaviors exhibited by drivers and pedestrians throughout a community. Many professionals believe that these norms influence how individual drivers and pedestrians behave at specific crosswalk locations, independent of other factors.

- “I think [drivers] follow the behavior of other drivers.” (*FL, 20+ years experience*)
- “No one else yields…it frankly feels unsafe as a motorist to stop…due to the risk of being rear ended.” (*MO, 11-20 years experience*)
- “Local culture is for vehicles to have priority even if that is different from policy.” (*AL, 11-20 years experience*)
- “I think that local custom and a generally laid back atmosphere in this community leads to drivers yielding to pedestrians most of the time, except on certain 4 lane roads.” (*NS, 6-10 years experience*)
- Drivers often yield because of the “large military population that is used to always yielding to pedestrians on base.” (*NC, 11-20 years experience*)
- “Operating a motor vehicle is a right not to be interfered with by other users of the road. While perhaps not formal policies, the actions of road agencies (local and state) over the years tend to reinforce such an attitude.” (*WV, 20+ years experience*)

Many respondents emphasized that pedestrians also contribute to the social norms governing interactions at crosswalks. For example, pedestrians who enter the crosswalk in front of approaching vehicles so that drivers need to slow or stop indicate that the social norm is for drivers to yield. Pedestrians exhibiting this behavioral norm were often referred to as “assertive.”

- “There is a general understanding that invincible university students will walk into the street, so drivers tend to be on high alert…This behavior spreads elsewhere in town.” (*VA, 6-10 years experience*)
• “In Boston, pedestrians have always crossed at will and drivers, while irritated maybe, give them space.” *(MA, 20+ years experience)*
• “Naturally, it depends on how forcefully the pedestrian asserts his/her right of way.” *(OR, 6-10 years experience)*

In contrast, respondents suggested that pedestrians who wave vehicles past or wait for a sufficient gap in traffic to enter the crosswalk, even when they have a legal right to cross, indicate that the social norm is for drivers not to yield. Pedestrians exhibiting this behavioral norm were sometimes referred to as “passive.”

• “People in Minnesota tend to not want to inconvenience others too much, so they wait patiently for a gap. And if a car does stop and wave them across, they tend to [walk quickly or run across]; I've never seen that in a place like Berkeley.” *(MN, 6-10 years experience)*
• “[The] culture in Wisconsin [is] that pedestrians should wait for a gap in cars.” *(WI, 6-10 years experience)*
• “Pedestrians do not ‘claim the crosswalk,’ and many drivers react negatively if they do.” *(NC, 11-20 years experience)*

Several respondents connected driver and pedestrian behavioral norms (e.g., assertive pedestrian behavior was associated with drivers yielding, while passive pedestrian behavior was associated with drivers not yielding).

• “In ‘pedestrian friendly’ locations, motorists seem to yield to pedestrians pretty well—and in those locations pedestrians seem more assertive when crossing. On busier, car-oriented streets, pedestrians seem less assertive and motorists tend to keep going unless stopped by a sign or signal,” *(NY, 6-10 years experience)*
• “It is engrained in the culture on the road: drivers don’t yield where they should; pedestrians yield where they don’t have to. There's like some sort of respect for a hierarchy on the road (with automobilists on top).” *(QC, 3-5 years experience)*

In addition to being an important factor contributing to driver yielding behavior, several participants noted that behavioral norms for drivers and pedestrians differed by community:

• “It may be cultural. Yielding to pedestrians is far more common throughout northern California than on the East Coast where I previously worked.” *(CA, 3-5 years experience)*
• “Minnesota ‘nice’ has something to do with it, I believe. I have worked and lived in Boston and New York and the rate of stopping for pedestrians seems much higher in Minnesota.” *(MN, 3-5 years experience)*

Data from the three driver yielding scenario questions corroborate the idea that driver yielding culture differs across North American communities. Figure 1 shows the distribution of responses for how often drivers yield when approaching uncontrolled, marked crosswalks on two-lane arterial or collector roadways with actual traffic speeds of 25 to 30 mph (40 to 48 kmh) in three cities. Even with the relatively small number of responses in each city, these results hint that there may be differences in driver yielding behavior between cities. The median response value in San Francisco was “often” (60% to 85% of the time), while the median response in Washington, DC was “occasionally” (15% to 39% of the time). The same median response analysis was applied to all 33 communities that had at least two respondents and were the central
city of a metropolitan region with more than 500,000 people (Figure 2). Note that “almost
never” and “occasionally” were grouped and “often” and “almost always” were grouped to
simplify Figure 2.

Under this two-lane, 25 to 30 mph (40 to 48 kmh) scenario, professionals in the
northwestern United States and southwestern Canada perceived higher rates of driver yielding
than professionals in other parts of North America. Similar geographic differences in yielding
rates were revealed for the other two scenarios (though the rates of yielding in most cities were
perceived to be lower on roads with more lanes and higher traffic speeds). There was no
noticeable difference between rates of yielding depending on the language of the state law (i.e.,
whether the law required drivers to “stop” or “yield”).
FIGURE 1  Distribution of perceived driver yielding rates in three cities: two-lane roads, 25 to 30 mph (40 to 48 kmh)

San Francisco, CA  
(10 responses)

Seattle, WA  
(14 responses)

Washington, DC  
(11 responses)
FIGURE 2  Perceived driver yielding rates in North American cities: two-lane roads, 25 to 30 mph (40 to 48 kmh)
Urban Design and Roadway Design Characteristics, including Vehicle Speed

Professionals also cited the importance of urban design attributes, such as building setbacks and the presence and size of street trees, on driver yielding behavior. For example:

- “Combination of the design of the built environment (i.e., on-street parking, buildings edging the roadway, wide sidewalks) all contribute to slower traffic. [Then the]
  pedestrian expectation [is] that drivers will stop.” (OR, 6-10 years experience)
- “[Portland’s] short blocks, combined with the fact that commute distance/time is shorter than the average…make people less stressed out and more aware of pedestrians when driving.” (OR, 6-10 years experience)

Respondents echoed the findings of the literature review when discussing traffic control devices and aspects of roadway design such as crosswalk markings, curb-to-curb width, number of lanes, curb extensions, and other traffic calming features.

- “There is greater yielding if marked crosswalks, bulb-outs, and medians are present.”
  (OR, 6-10 years experience)
- “The number of lanes seems to have a significant relationship to driver yielding, especially for drivers traveling in the inside lanes where sight lines to pedestrians on the curb side are poor.” (CA, 6-10 years experience)
- “In areas with slower speed limits the pedestrian yield signs posted in the road between the two yellow lines really helps remind drivers to yield.” (VA, 6-10 years experience)
- “On streets where cars are supposed to actively share space with pedestrians (unmarked but low speed streets), yielding is common. On streets where cars actions are more controlled (high speed, signalized streets), yielding is highly uncommon.” (WA, 3-5 years experience)

Related to roadway design, vehicle speed was also mentioned frequently by practitioners. Many professionals pointed out that higher vehicle speeds mean that drivers must notice a pedestrian in the crosswalk at a greater distance from the crosswalk in order to stop or yield.

- “I think drivers traveling at higher speeds often don’t see pedestrians in time to yield, especially on roads with two lanes in each direction.” (MT, 6-10 years experience)
- “If [drivers] are going too fast they may be afraid if they stop they may be rear-ended.”
  (PA, 20+ years experience)
- “As you bring the travel speeds down drivers are generally more willing to stop because it is less of an inconvenience.” (CO, 6-10 years experience)
- “Design guidance to use the highest design speed feasible…leads to speed limits (and actual speeds) so high that braking is usually a last resort for motorists…” (CA, 11-20 years experience)

Results from the three crosswalk scenario questions give additional support to these comments. Figure 3 shows that most respondents perceived local yielding rates to be higher on narrower, slower-speed roadways.
FIGURE 3 Distribution of perceived driver yielding rates on three types of roadways

- **2-Lane, 25-30 MPH** (375 responses)
- **2-Lane, 35-40 MPH** (344 responses)
- **4-Lane, 35-40 MPH** (344 responses)
Land Use and Pedestrian Volume
Many professionals cited the importance of land use (e.g., proximity to downtown core, commercial districts, university campuses, schools, etc.) on driving yielding behavior because of its relationship with pedestrian volumes. Respondents suggested that areas with more pedestrians condition drivers to be alert and ready to yield to pedestrians who enter a crosswalk.

- “Motorists yield more where…there are lots of pedestrians crossing...In dense business districts, yielding is high.” *(MA, 20+ years experience)*
- “In locations where pedestrian crossings are frequent, most cars yield to peds at crosswalks.” *(VA, 11-20 years experience)*
- “Autos are used to having the road to themselves. In areas where there is heavy pedestrian traffic autos are far more likely to yield.” *(PA, 3-5 years experience)*
- “As the number of bikes and pedestrians has increased so has the yielding behavior.” *(MT, 11-20 years experience)*

Enforcement of Laws
Enforcement introduces the threat of being ticketed or warned by police for not yielding to a pedestrian in a crosswalk. Respondents suggested that a high level of enforcement, particularly through targeted efforts like crosswalk stings, may increase the importance of yielding in drivers’ minds.

- “On…campus and in school zones, drivers are more likely to yield to pedestrians in crosswalks, partly because speed is lower, partly because of higher risk of enforcement.” *(IL, 3-5 years experience)*
- “Many drivers will not yield unless they feel they are being watched or can be tracked (cameras or witnesses)...” *(CA, 11-20 years experience)*
- “Generally there are no consequences to not yielding. Enforcement is practically non-existent.” *(CA, 11-20 years experience)*
- “Lack of sufficient police enforcement on drivers’ yielding to pedestrians…has a negative influence in my area. I have also observed some police officers do not yield to pedestrians!” *(NC, 3-5 years experience)*
- “The only things that seemed to affect yielding were the pedestrian sting programs.” *(DC suburbs, 20+ years experience)*

Despite the emphasis given to enforcement in their responses, practitioners from most parts of North America reported low rates of enforcement within their jurisdiction. Of 358 respondents, 77% indicated that the law was almost never enforced and 15% indicated that it was only occasionally enforced.

Education about Laws
Education programs are designed to inform drivers of the yielding law and to help them understand how to behave according to the law. The educational aspects of enforcement are also included in this category.

- “Ad campaigns to yield to pedestrians have been running in my community which helps create awareness.” *(VA, 6-10 years experience)*
- “I think a lot of drivers are not aware of the laws.” *(WI, 20+ years experience)*
• “I…believe that getting a license is so easy—no training and the testing is a joke—that
people simply don’t know much beyond the very obvious rules of the road.” (CA, 11-20
years experience)
• “Active public education efforts about pedestrian and bicycle safety have contributed [to
driver yielding]….” (WA, 20+ years experience)

Social Fabric and Socio-demographic Characteristics
Social fabric reflects the extent of each person’s connections with other members of the
community. Several professionals suggested that drivers may be more likely to yield when they
are more likely to know (or relate to) people who are crossing the street.
• “I think drivers in Berkeley are generally conscientious of pedestrians given…many of
them probably walk at some frequency.” (CA, 1-2 years experience)
• “I think we have a pretty good percentage of people who walk or bike often and
understand that those users have ROW at most intersections/crosswalks.” (WA, 1-2 years
experience)
• “I feel like Oregonians, in general, have more respect for our fellow people. Pedestrians
are less likely to jaywalk. Drivers are more likely to be courteous…mutual respect leads
to improved transportation behavior in general.” (OR, 3-5 years experience)
• “There seems to be a cultural ethic here of thinking broadly about the community as a
whole, which includes looking out for pedestrians.” (WA, 1-2 years experience)

Tying It All Together
Many respondents emphasized that certain characteristics influencing driver yielding behavior
were related.
• “I think yielding is more common…on a 2-lane street because pedestrians are more likely
to be more assertive on narrower streets. I think enforcement COULD influence driver
behavior if it were frequent, consistent and publicized widely…” (DC, 1-2 years
experience)
• “1) Partly, it's about traffic engineering. Our roadways have been designed for many
decades to minimize stopping for drivers…This builds an expectation for drivers to not
need to stop unless absolutely necessary. 2) Mostly, I think it's about culture and
emulating your peers and following the status quo. Drivers see other drivers fail to yield
to pedestrians, so in turn they also do not yield to pedestrians. Even pedestrians do not
expect drivers to yield to them. 3) In addition to ‘traditional’ traffic engineering, police
enforcement (lack thereof) also reinforces this culture norm. Drivers who do not yield to
pedestrians face no legal repercussions.” (CA, 3-5 years experience)
• “I think most drivers are unaware of the law about yielding to pedestrians in crosswalks.
The design of our streets reinforces this notion.” (NC, 11-20 years experience)

These comments suggest that relationships between different factors may ultimately
determine whether or not drivers yield to pedestrians. Figure 4 presents a conceptual framework
suggesting how community and site factors may relate to driver yielding behavior at a specific
location. The top row summarizes the main community-level factors that contribute to driver
and pedestrian behavioral norms; the middle-row represents the site-level factors that may
impact the probability of a driver yielding; and the bottom-row represents the driver’s behavior
(yield or not yield). The figure is described in the following paragraphs.
Urban Design & Land Use Characteristics (upper left box)
Many professionals suggested that low-density suburban areas with low pedestrian volumes and high-speed, multi-lane roadways contributed to a culture of drivers expecting to travel at high speeds without stopping and passive pedestrian behavior. In contrast, mixed-use areas near the urban core and college campuses with high pedestrian volumes and low-speed, narrow roadways were believed to contribute to pedestrian assertiveness and driver caution.

Education about and Enforcement of Driver Yielding Laws (upper right box)
Independent of the built environment, education and enforcement can also contribute to norms where drivers in a community know and follow the law.

Social Norms (upper middle box)
The social norms that develop at the community level may influence not only how aware drivers are of their responsibility to yield, but also how willing and prepared they are to yield if a pedestrian is present. Similarly, social norms can influence pedestrians’ awareness of their rights and their willingness to assert them.

Specific Crosswalk Context (middle row box)
The likelihood of yielding at a specific crosswalk may relate to the factors on the top row (social norms, education and enforcement, and urban design/land use), and may be further influenced by characteristics of the crosswalk site. These include nearby land use and urban design features (e.g., pedestrian crossing volume, number of lanes, traffic calming treatments) and site-specific education and enforcement (e.g., in-street pedestrian crosswalk signs, presence of a police officer near the crossing).
Driver Yielding Behavior (bottom row box)

Finally, the decision about whether or not to yield at the crosswalk site may be related to the personal characteristics of the pedestrian and the driver, including unconscious and overt biases, and how much experience the driver has as a pedestrian.

Summary

This framework focuses on the main factors discussed in the section above, so it does not include possible feedback loops (e.g., changes that result in more drivers yielding at a particular crosswalk may impact social norms throughout the community) and may not be the only way to describe driver yielding behavior. However, the figure presents a way of conceptualizing the pathways leading to driver yielding behavior, draws from the collective knowledge of a professional community, and can help expand the conversation about driver yielding. Ultimately, thinking broadly about the many possible influences on driver yielding behavior may help practitioners identify more effective strategies to increase yielding and improve pedestrian safety at uncontrolled crosswalks.

DISCUSSION

The findings presented in this paper provide insights into the dynamics of driver yielding behavior at uncontrolled crosswalks. As Figure 4 summarizes, the results suggest that education (e.g., public awareness programs), enforcement (e.g., crosswalk stings), and roadway design (e.g., narrower roadways; traffic calming) strategies may help increase yielding. Practitioners also suggest that land use leading to more pedestrian activity (e.g., higher-density, mixed-use development) may improve driver behavior. Strategies targeted at increasing driver yielding at specific locations may also have positive impacts on other locations in the same community due to shifts in driver and pedestrian behavioral norms. However, the results should be interpreted carefully, recognizing the need for more field research. There are several important areas for future study.

Considerations

The study analyzes perceptions of driver yielding rates, which may be higher or lower than yielding rates calculated from precise field measurements. For example, the high reported rates of driver yielding in Philadelphia appear to be an anomaly on the East Coast of the United States. These perceptions may have been inaccurate or based only on a limited set of streets, such as the busy, constrained roadways of the Center City or University City District in Philadelphia (which may have relatively higher yielding rates). These possibilities underscore the importance of refining these results using field observations of driver yielding behavior. However, the strength of this study is the collective knowledge from the pedestrian safety field. Even if some individual perceptions are inaccurate, aggregating responses from practitioners throughout North America provides useful information about patterns in driver yielding to investigate through future research.

The survey was conducted in a snowball, rather than a systematic, fashion. As such, some cities had greater representation than others. This may have been due to city size, local attention to pedestrian safety, or other reasons, such as professionals in some communities not having seen nor having had time to respond to the survey. These challenges were addressed in part by removing respondents with no experience in the pedestrian safety field from the analysis and by only mapping results from cities with two or more respondents.
Additionally, open-ended comments suggested that not everyone read the questions carefully. For example, a few respondents thought incorrectly that the pedestrian crosswalk scenarios applied to locations with traffic signals or stop signs. Incorrect interpretation of questions is a common limitation of survey methods. Despite these limitations, this paper contributes to the literature and thinking about pedestrian safety because it presents patterns in data from a fairly large sample size to suggest a framework for investigating driver yielding. In doing so, this paper serves as a springboard for future research on the topic.

Future Research

The evidence of geographic differences in driver yielding culture provided by this study opens new, important issues for pedestrian safety policy and research:

- National studies using driver yielding as a proxy measure for pedestrian safety should be done in a variety of communities. Pedestrian safety treatments may not have the same impact in every community.

- Guidelines for pedestrian safety treatments should recognize differences in driver yielding behavior among communities. In addition, pedestrian crash modification factors may not generalize to all communities with different yielding behaviors.

Additional research is also needed to understand how social norms related to driver yielding develop in various communities. This information can help reveal specific strategies that could be used in other communities to change driver yielding culture. Case studies of communities that have strong yielding cultures, including interviews with local engineers, planners, law enforcement officers, and residents, could be one approach to gather this information. An exploration of the differences in behavior between the United States and Canada could be particularly enlightening: the 36 Canadian respondents reported slightly higher rates of driver yielding than United States respondents, but the Canadian sample size was too small to emphasize this result.

While failure to yield is a common cause of pedestrian crashes, it is also important to understand whether or not increased rates of driver yielding actually create a safer pedestrian environment. Few studies have attempted to make this direct connection. One study found that the number of pedestrian crashes went down in St. Johns, NL, and Fredericton, NB, after police enforcement programs had increased driver yielding rates (17). In addition, a Florida DOT campaign increased awareness of pedestrian laws, and the state pedestrian fatalities decreased by more than six percent between 2011 and 2012 (28). However, the safety improvements are not tied directly to increased driver yielding at specific crosswalks. More research is needed to quantify the magnitude of potential pedestrian injury reduction and determine the extent to which increasing driver yielding rates is a helpful safety policy.

Understanding driver yielding behavior is important for pedestrian safety. But it is also important for creating livable communities—places where people of all ages and abilities feel comfortable walking, playing, socializing, and doing business. Communities where drivers are aware of their responsibility and allow pedestrians to cross the street at legal crossings may be better places to live, work, and visit.
CONCLUSION

This paper contributes to the understudied field of factors affecting driver yielding behavior. While much research has focused on the efficacy of specific treatments in particular field locations, this study draws upon the collective knowledge of practitioners throughout North America to inform a potential framework for future research on driver yielding behavior. In particular, practitioners provided evidence of:

- Differences in driver yielding culture among communities.
- Higher rates of yielding on narrower, lower-speed roadways.
- Rare enforcement of crosswalk laws in most communities.

The insights gained from this paper can lead to more rigorous evaluation of driver yielding behavior in the future, as well as innovations in treatments to reduce pedestrian injuries and fatalities.
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