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THE ASSOCIATION OF DISTRACTION AND CAUTION DISPLAYED BY PEDESTRIANS AT A LIGHTED CROSSWALK

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ABSTRACT: The rates of deaths and injuries among pedestrians have fallen in recent years, but still remain public health problems as about 5000 pedestrians die each year. Because pedestrians have been shown to be responsible or partially responsible for many of the crashes in which they are involved, we sought to assess the relationship of distracted walking and performing routine cautionary behaviors of pedestrians crossing a busy street in a southwestern city at an intersection, adjacent a university. The behavior of 866 individuals was recorded by trained observers as pedestrians walked across a 105-foot wide street served by a stop light and zebra painted crosswalk. We defined distracted pedestrians as those wearing headphones, talking on a cell phone, eating, drinking, smoking or talking as they crossed the street. Caution was measured by looking left and right, and entering the crosswalk only when the white proceed light was illuminated. We found that only 13.5% of walkers looked left and right and entered the crosswalk while the white light was flashing. Approximately 20% of walkers were distracted as they crossed the street. Regression analysis indicated that distraction was negatively, but weakly associated with displaying cautious pedestrian behaviors. Because traffic lights were routinely ignored and lack of caution was predicted by distraction, we suggest that inexpensive education efforts target pedestrians near college campuses.

KEY WORDS: pedestrian; safety; distraction.

INTRODUCTION

Injuries constitute a serious public health challenge in the United States. This fact is evidenced by the United States Congress mandating that the Centers for Disease Control and Prevention create the National Center for Injury Prevention and Control in 1992.[1] One type of injury that has

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drawn attention are those that involve pedestrians. From 1974 to 2001 nearly 175,000 American pedestrians were killed in mishaps that involved motor vehicles. This type of injury accounts for about 12% of all traffic-related fatalities. Such events are frequent, as on average, one American pedestrian is killed every 108 minutes. In recent years this rate translates into just less than 5000 deaths.[3] Another important pedestrian issue is injuries, which are much more frequent events than are fatalities and have numbered approximately 70,000 in recent years.[3,4] These account for two-thirds of all severe traffic injuries in the population.[2]

Although some efforts to reduce pedestrian injuries and deaths are fairly recent, the issue of pedestrian injuries and deaths are not new. As far back as 1866 records indicate that 140 Londoners were killed by horse drawn carriages. By 1912 it had been noted that with the arrival of the automobile dangers to pedestrians increased, and walkers were advised to ''keep a sharp look-out'' in order to cross the street safely.[1] As the number of motorized vehicles increased so did pedestrian deaths. In America the number of pedestrians killed peaked in the late 1970s when 8096 were killed during 1979.[2]

There is however some potentially good public health news, as long-term trends in pedestrian deaths are decreasing. Since the peak in 1979, the number of pedestrians killed have fallen to 4703 in 2000.[3] While this is clearly a welcome trend, it is not known if this desired tendency is a result of improvements in infrastructure safety, more alert and careful walkers and/or safer drivers. Another possibility, or even likely explanation for the decease in deaths and injuries is that fewer people are walking as a means of transportation or for exercise. If this hypothesis is true, the public health gains evidenced by fewer pedestrian deaths could be a phantom accomplishment, as other public health goals encourage communities to create more opportunities for people to walk for exercise or transportation.[4] It is possible, or even likely that fewer people are walking for transportation or exercise than in the past. One indirect measure of this fact is that obesity rates have steadily climbed in the United States since the 1970s and lack of exercise is one likely cause of that fact.[5] Accordingly governmental agencies have created goals that seek an increase the proportion of trips made by walking of less than 1 mile from the current rate of 17% to 25% by 2010.[4] If this goal is achieved it would mean more walkers would be exposed to traffic and would thus potentially temper the gains in pedestrian safety observed in recent years. Thus, while public health officials would prefer to note fewer pedestrian deaths, they would not like it to be the result of fewer people being physically active.

Many attempts to improve pedestrian safety have involved engineering strategies or the redesign of the traffic environment. Specific strategies utilized include increasing the visibility of pedestrians,[6] attenuating traffic[7] and increasing the number of warning signals for motorized vehicles.[8,9] There is little question that engineering strategies are appropriate and effective, however, the costs associated with these changes, such as building tunnels under, and walking bridges over, busy streets and erecting more traffic lights can be prohibitive and such steps are not always feasible.[10]

While poor driving behaviors and engineering strategies are important, the behaviors of pedestrians are thought to be factors in pedestrian/motor vehicle incidents, because in most cases, data from police generated traffic reports show that mistakes or illegal actions by drivers are not mentioned.[11] Correcting unsafe pedestrian behaviors would be a less expensive way to reduce pedestrian injury and death rates than are engineering changes. Important pedestrian behaviors that can be factors in fatal and non-fatal crashes include such things as the improperly crossing of a roadway, inattentiveness, and failure to obey traffic signs. These unsafe behaviors have been shown to account for 28, 15, and th percent of pedestrian deaths, respectively.[11] Inattentativeness by pedestrians is a factor that is similar to those highlighted in recent research assessing distracted automobile drivers. Automobile drivers are known to multi-task by doing such things as simultaneously speaking on telephones, eating, speaking with others in the vehicle, wearing headphones, or manipulating in-car technologies.[12] One study found that the risk of collision while driving and simultaneously speaking on a cellular telephone was 4.3 times higher than when an in car phone was not in use.[13] That collision rate is similar to driving with a blood alcohol level at the legal limit.[14] Thus, we hypothesize that a statistically significantly greater proportion of pedestrians who cross a busy street while multitasking (speaking on cell phones, eating, speaking with other walkers and wearing headphones) will exhibit more inattentive behaviors and will subsequently fail to exhibit cautionary behaviors (looking left, and right, waiting until the light has changed, stay within the bounds of a crosswalk and obeying the signal) than those who are not distracted. Because more than two-thirds of the pedestrians that are killed are males[3] we anticipated that males will be more distracted than females and that they would exhibit significantly fewer cautionary behaviors than females. A final purpose of this study is to provide a description of cautionary behaviors of pedestrians while crossing a busy thoroughfare.

METHODS

Data Collection

Data from the present study was collected in Las Vegas, Nevada. During the 1998–2000 period the average number of pedestrian deaths in that city was 10 per year, which translates into a rate of 2.02 deaths per 100,000 residents. This rate placed Las Vegas number 94 in pedestrian deaths among American cities with populations over 100,000.[3]

Data were collected at an intersection near a large university. This intersection is the ''T'' style and observations were only made of those crossing the continuous street. The street is seven-lanes in width, and a 30-mile per hour speed limit is posted. This particular intersection was selected because it fits the criteria of an urban road where almost 2/3s of pedestrian fatalities occur and because the plurality of fatalities occur on roads with posted speed limits of 30–39 miles per hour.[3] Other rationale for choosing this site was because local police records show that 50% of the most dangerous intersections for walkers in Las Vegas located along on this street.[15] Additional reasons for selecting this location is that research has shown that traffic automobile drivers, bicycle riders and pedestrians around college campuses frequently fail to observe traffic rules[16] and college campuses are known to be dangerous places for pedestrians.[10]

The intersection is regulated by a stoplight that provides a walk signal that is accompanied by beeping sound at the time pedestrians are free to legally enter the street. The white ''walk'' hand stoplight signal is illuminated for 8.25 seconds. Walkers that leave the curb the instant that the white walk hand illuminates have 35 seconds to cross the street and those who leave just before the white hand turns to orange have 26.25 seconds to cross the street before the light turns red. For the two previously described scenarios, walkers are required to ambulate at rates of 2.56 and 3.17 feet per second, respectively, in order to traverse the 105 foot street width before the cross traffic receives a green light. The time allotted at this crosswalk meets the suggested guidelines of walking speeds of 3 to 3.5 feet per second.[17]

Trained graduate students unobtrusively observed and recorded pedestrian demographic characteristics and behaviors as they crossed the street. Demographic variables included gender and estimated age by decade (e.g., teens, 20s,). The behaviors that were assessed are recommendations and included looking left and right, staying within the zebra crosswalk, waiting on the curb until the light turned green and not to have entered the crosswalk after the light had switched to the orange signal.

These recommendations include the overarching suggestion to obey traffic signals and to check for approaching vehicles even when the green light or ''walk'' sign is illuminated. Other recommendations are to look left-right-left before crossing the street and continue looking while traversing the roadway[2] For one to be identified as a cautious pedestrian they were required to looked left and right and to have entered the crosswalk while the white hand was flashing. A distracted pedestrian was defined as one talking on a mobile phone, wearing headphones, speaking with another walker, or drinking, eating or smoking while they crossed the street. To be labeled as drinking or smoking one had to be carrying a drinking vessel or holding a lit cigarette, respectively. Those defined as eaters had to have some type of food in their hands while crossing the street.

Because more than one person would often cross the street during the same light change, the first person to arrive at the intersection was the one observed. A second reason for observing the first person to arrive at the intersection is that others have noted that when groups of people cross streets those at that the back of the pack usually follow the movement of the group without checking traffic.[16] If more than one observer was present, the second person to arrive at the intersection was selected to be examined by the second observer. Each data collector observed only one pedestrian per change of light, and observed that person all the way across the street. Observations were always made from the same location and the relative direction of the pedestrian's ambulation (toward or away from the observer) was recorded. This step was taken because a protective traffic arrow for motorized traffic making a left hand turn offered those walking toward the observer to proceed to a mid-street raised median while autos made their turn. Those walking away from the observer were not afforded this opportunity because the left turning traffic crossed their immediate paths.

In order to ensure inter-rater reliability prior to official data collection all observers met at the intersection and rated the same 12 individuals as they crossed the street. Because inter-rater reliability was unacceptable (<.9 agreement) for selected items, detailed operational definitions were created. The behaviors that had the lowest inter-rater reliability were looking to the left and right, waiting on the curb and staying within the walkway boundaries. Thus the following operational definitions were created. In order for a person to be credited for looking left and right a noticeable turn of the chin was required. For one to have correctly waited on the curb, both feet must have remained on the curb until the white walk light illuminated. Finally those who stepped out of the crosswalk on two or more consecutive steps were considered to have been outside the walkway. After the creation of the operational definitions all inter-rater reliabilities

were above .9 on an additional 12 walkers. Data were collected from mid-April to December 2002.

Statistics

Descriptive statistics were used to describe the participants and their behaviors. Multiple linear regression was be utilized to determine the relationship between distracted walking and caution displayed crossing the street. Analysis of variance was used to identify differences across gender. Alpha was set at .05 for all statistics. The SPSS[18] statistical package was used for all calculations.

RESULTS

A description of the gender and age distributions of the sample are provided in Table 1. Observers identified more males ($n = 535$) than females ($n = 332$) and a plurality of those observed were estimated to be in their twenties.

A description of the cautionary behaviors and whether one was distracted while crossing the street are presented in Table 2. Pedestrians typically displayed some cautionary behaviors and most obeyed the traffic signal, but many did not. A solid minority of walkers (20.1%) were also distracted as they crossed the street, as 50 crossed the street while wearing

TABLE 1

Description of the Sample

	N	%
Sex		
Male	439	61.4
Female	276	38.6
Age		
Teens	9	1.2
20s	508	58.6
30s	185	21.3
40s	87	10.0
50s	51	5.9
60s	23	2.7
70s	3	.3

TABLE 2

Cautionary and distracted behaviors observed while crossing the street

	Yes (%)	*No (%)*
Cautionary behaviors		
Looked left	475 (54.8)	389 (44.9)
Looked right	356 (41.1)	511 (58.9)
Waited for walk signal	505 (58.2)	362 (41.8)
Entered walk after yellow light	213 (24.6)	654 (75.4)
Stayed in walk	573 (66.1)	294 (33.9)
Distractions		
Eating/drinking or smoking	131 (15.1)	736 (84.9)
Headphones or cellphone	50 (5.7)	817 (94.3)

headphones or talking on a mobile phone and an additional 131 were eating, drinking or smoking while in the crosswalk.

The linear regression analysis revealed that while controlling for gender and whether one was walking toward or away from the observer the sole significant predictor of exhibiting cautionary behaviors was whether or not one was distracted as they crossed the street. The equation was significant ($F = 5.7$, [3,863] $p = .0010$). The lone significant predictor of exhibiting cautious behaviors was the total number of distractions while crossing the street ($t = 3.83$, $p < .001$). However, only 1.6% of the variance in cautious behaviors is explained by this model.

DISCUSSION

One of this study's interesting findings was that a small proportion of pedestrians obeyed traffic signals and followed suggested safety guidelines when crossing a busy street. This finding is disturbing because pedestrian deaths are common, as on average, about 15 pedestrians die each day.[10] This finding is also important because improperly crossing the street is the principal factor in those pedestrian incidents when only the pedestrian is in the wrong (29%).[19]

Further our data show that only 13.5% of pedestrians looked left and right while crossing the street, and waited on the curb until the light had turned green before stepping into the intersection. Each of these cautionary behaviors is suggested by the CDC and is designed to reduce

injuries and fatalities. This lack of respect for the traffic signals places pedestrians at increased risk of death or injury. Because crossing a street is considered to be an easily accomplished motor behavior, it is tempting to recommend simple and elementary educational efforts that target these behaviors. The disappointing news is that many public education programs have not worked well to reduce motor vehicle injuries to pedestrians.[20] Others argue that there is little evidence that educational interventions can reduce the number of pedestrian crashes, there is evidence that interventions can change behaviors.[21] However one intervention conducted on a Virginia college campus was successful in increasing the proportion of students who properly crossed the street as measured by using a zebra crosswalk with the modest total of $10,000 for the entire project.[10] The results of this study are promising as the intervention improved pedestrian road crossing behaviors and these positive behaviors persisted after the formal intervention period had concluded. Although the authors of this study were correct in taking credit of the intervention success they noted that a recent and well-publicized pedestrian death at this college could have influenced pedestrian behaviors.[10]

Our most interesting finding is that distraction while walking predicted the demonstration of fewer cautionary behaviors on the part of pedestrians as they crossed the street. This lack of cautionary behavior potentially places walkers at risk for an incident with a motor vehicle. Even though the seemingly simple act of crossing a street has been the subject of ridicule as evidenced by such sayings as, ''S/He cannot walk across the street and chew gum at the same time,'' a certain level of concentration and attentiveness is indeed necessary to safely accomplish that task. The consequences can be deadly as inattentiveness is thought to responsible for 10%–15% of pedestrian deaths[11] which is an important and yet preventable contribution to traffic deaths. Although no pedestrian injuries or deaths were observed in this study, our findings mimic those that assess motor vehicle operators who multitask.[12] In both cases distraction is associated with excess risk.

Another interesting finding is that distraction was a significant predictor of cautionary behaviors displayed, although it explained a small proportion of the variance in our dependent variable. Nonetheless this finding merits further study, and efforts to reduce distracted walking and enhance cautionary behaviors are suggested.

The data addressing gender differences is also worthy of note. Because a large majority of pedestrians killed are males, 68% in 2002,[3] we anticipated that males would exhibit less caution than females as they traversed the street. Our data indicate that males and females displayed

similar levels of caution as they crossed the roadway, as there were no significant differences in cautionary behaviors across sex. There may be an alternative explanation that elucidates the relationship of gender and pedestrian traffic deaths and injuries. Assuming that our sample is representative of nationwide pedestrian data, more males were walkers and therefore would have greater exposure to environments, where they could be injured or killed by motor vehicles. Almost 2/3s of our sample (61.7%) was male, thus it is possible that more males are killed because more males walk, and not because they participate in riskier behaviors, are more distracted or display less caution than females.

Similarly age failed to predict cautionary behaviors or distraction, although a large proportion of those killed are children.[2] The nature of the location of the data collection was such that few people that age crossed this street. In fact almost 60% of our sample was estimated to be in their twenties and only nine were thought to be teenagers or younger. Such a small sample size makes it unlikely that statistical differences could be detected.

As with all studies, this one has limitations. The current study sought to describe the behavior of pedestrians as they crossed the street. There is the chance that a particular individual could have been observed more than once on the same or different days. Even though 867 observations were made it is likely that we observed the same people on more than one occasion. There is also a chance that a history effect could have affected results because during the observation period at least two newspaper articles appeared that focused on pedestrian safety, one in the university newspaper and one the a large daily. Both stories[15,22] highlighted the dangers that pedestrians encounter when crossing this particular street (Maryland Parkway). Therefore this publicity could have affected the behavior of walkers. There was also a publicized law enforcement intervention in effect at the time of data collection. It was reported that at least 58 tickets and 12 warnings to motor vehicle operators were written. Ironically there were no tickets issued to walkers.[22] This finding is disappointing as some research suggests that enforcement of laws addressing pedestrian behavior may be effective at improving street crossing cautionary behaviors.[10]

While there is no single strategy that will reduce pedestrian injuries and fatalities, a comprehensive approach that includes engineering, enforcement and education, of both drivers and pedestrians is suggested.[3] Again, because engineering changes are often expensive and enforcement is spotty and inconsistently applied, the education tactic is one that might be effective because research shows that at the time of pedestrian/car

encounters the pedestrian is likely to be taking risks while crossing the street.[3] Because being distracted was associated with displaying less caution in the present study we suggest that pedestrian education efforts that highlight the importance of displaying caution while crossing the street and the value of undistracted walking in traffic be initiated.

Further there is a clear need to convince policy makers that injury prevention, including pedestrian safety, is a serious matter. Providing some monies for interventions would be an appropriate first step. However, before this can be done we must work to dispel the notion that pedestrian injuries are a matter of fate. This thinking argues that traffic incidents are a matter of destiny and could not have been prevented despite our best efforts. Conversely the injury prevention model that is supported by authors is proactive and hypothesizes that many or most injuries can be prevented. The behaviors exhibited by pedestrians in this study are changeable and provide evidence that their safety behaviors can be improved.

A next step would be to do a case series study to determine if injured pedestrians were distracted at the moment of the injury. Admittedly this would require detailed and accurate police reports and/or honest responses to interview questions by victims or witnesses to the events.

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