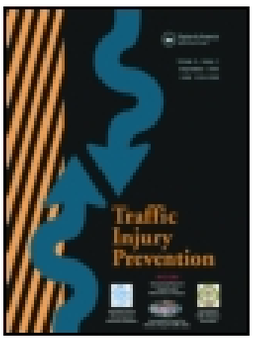

Traffic Injury Prevention

ISSN: 1538-9588 (Print) 1538-957X (Online) Journal homepage: http://www.tandfonline.com/loi/gcpi20

Pedestrian crossing behavior, an observational study in the city of Ushuaia, Argentina

Fernando Martín Poó, Ruben Daniel Ledesma & Roberto Trujillo

To cite this article: Fernando Martín Poó, Ruben Daniel Ledesma & Roberto Trujillo (2017): Pedestrian crossing behavior, an observational study in the city of Ushuaia, Argentina, Traffic Injury Prevention, DOI: 10.1080/15389588.2017.1391380

To link to this article: http://dx.doi.org/10.1080/15389588.2017.1391380

PEDESTRIAN CROSSING BEHAVIOR, AN OBSERVATIONAL STUDY IN THE CITY OF USHUAIA, ARGENTINA

Fernando Martín Poó[a], Ruben Daniel Ledesma[a], and Roberto Trujillo[b]

[a]Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Facultad de Psicología, Universidad Nacional de Mar del Plata

[b]Facultad de Psicología, Universidad Nacional de Mar del Plata

Corresponding author. *Poó, Fernando Martín*. Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET). Universidad Nacional de Mar del Plata, Facultad de Psicología. E-mail: poo.fernando@conicet.gov.ar; poo.fernando@gmail.com

Adress: **Deán Funes 3250 - Cuerpo V - Nivel III (7600) Mar del Plata - Buenos Aires – Argentina.**

Abstract

Objectives: Pedestrian crashes are a critical problem in Latin American countries. However, little research has been published about pedestrians and even less about their behaviors in a naturalistic context. The objective of the present research was to explore risky pedestrian crossing behaviors in traffic intersections in an argentine city (Ushuaia). It is focused in different stages of the crossing process, traffic code violations, and other potentially risky behaviors such as distractions. A high frequency of risky behaviors among pedestrians was expected. Moreover, according to previous findings, it was hypothesized that men and younger pedestrians would show riskier behaviors.

Methods: Participants were 802 pedestrians (53,9 % females) observed at several intersections (with and without traffc ligths) in the city of Ushuaia. Behaviors were codified following a

standardized observation protocol. Observers documented information on behavior previous to, during, and after crossing. Gender and age were also registered. Data were gathered through video recording. Frequency analyses of observed behaviors were conducted for the total sample, as well as by gender and by age group. A general crossing risk index was calculated to facilitate comparisons between the genders and age groups. We conducted an ANOVA to evaluate gender and age differences for this index.

Results: A high proportion of risky behaviors were observed among pedestrians. The majority of pedestrian waited in the street (as opposed to on the sidewalk) before crossing, did not comply with traffic lights, or crossed outside the crosswalk. An important number of pedestrians were distracted while crossing. Men presented higher scores on risky behaviors than women. No differences were observed by age groups.

Conclusions: The high level of risk behaviors during the different stages of street crossing is worrisome and reinforces the idea that pedestrians are responsible for many of the conflicts with motorists. Many of the risky behaviors seem to be associated with gender, which is in line with the previous literature showing more risk behaviors among men than women. No differences were found for age groups. Findings are interpreted considering some features of the argentine road culture.

Introduction

Pedestrians are among the most vulnerable users in a road system. According to the WHO (2013), this group accounts for 22% of all traffic fatalities. In the Americas, the Pan American Health Organization (2013) estimated this percentage at 12.1% for the countries of North America, 22.8% for those of the Southern Cone (Argentina, Chile, Paraguay and Uruguay) and 30.8% for those of Mesoamerica. Indeed, the problem seems to be graver and more persistent in the nations of Latin America, even though there is comparatively little research in those countries. In this paper, pedestrian crossing behavior in a city of Argentina was analyzed. It is hoped that this study will provide information that is relevant to the study of pedestrian risk behaviors and illustrate the types of behaviors that occur in a cultural context where traffic crashes involving pedestrians are still much too common.

Literature Review

Walking is the most frequently used, and most dangerous, mode of urban mobility. Generally, the danger comes from the interaction between pedestrians and motor vehicles in a shared space. In urban areas, this interaction can occur under varying circumstances, but the risk is greatest when the pedestrian attempts to cross a roadway (da Silva et al. 2003; Lee and Abdel-Aty, 2005), especially at a location that is not designed for that purpose (King et al. 2009). For this reason, much of the research on the subject has focused on pedestrian crossing behavior, the human and environmental variables associated with increased risk, and possible interventions.

One important factor is whether or not the crossing occurs at a designated area, given that behaviors can vary significantly depending on this circumstance. When crossing at a non-designated area, pedestrians tend to exhibit more imprudent behaviors. In these cases,

pedestrians registered shorter waiting times, tended to wait on the road prior to crossing, behaved more aggressively than at designated and signed crossings, and ran across the roadway (Mitman et al. 2008; Zhuang and Wu, 2011). Visual search patterns also differ by crossing area type. At non-designated areas, pedestrians spend much of their time observing vehicles while they cross, but very little time before they actually begin to cross (Zhuang and Wu, 2011). Hassan (2005) observed the inverse pattern in designated areas.

Infrastructure has a critical influence on behavior. At designated crossing areas, risk behaviors might be similar to those observed at non-designated crossings, but the contextual variables influence their expression and the emergence of other behaviors. At designated areas, the riskiest behaviors are crossing outside of the pedestrian walkway and crossing irrespective of the traffic light (King et al. 2009; Ren et al. 2011). King et al. (2009) observed that the relative risk of not abiding by the traffic light was eight times greater than abiding by it (Tiwari et al. 2007). The length of the crossing and the prolonged duration of a red light might induce pedestrians to cross when it is not permitted. This behavior may be interpreted as a consequence of a pedestrian's tendency to become impatient when a traffic light remains red for too long (Ren et al. 2011).

Additionally, there exist risk behaviors that are difficult to control even with the influence of infrastructure. Distractions are a clear example of this. The most studied are eating and drinking, cellphone use, and conversing with other pedestrians (Hatfield and Murphy, 2007; Zhuang and Wu, 2011). Of all of these, cellphone use is the one that most affects crossing behavior. Pedestrians speaking on cellphones pay less attention to traffic prior to beginning to cross, wait less time for traffic to stop, and walk more slowly while crossing (Hatfield and

Murphy, 2007).

Gender and Age:

Differences in pedestrian behavior according to gender and age are well documented in the literature. The evidence indicates that men suffer more injuries than women (Rosembloom, 2009, Tom and Granié, 2011; Yagil, 2000). With few exceptions (e.g. Díaz, 2002; Evans and Norman, 1998; Ren et al. 2014), the majority of the research indicates that men abide by road rules less frequently, register shorter waiting times before crossing, are more prone to cross on red and at non-designated areas, walk more quickly, interact more frequently with vehicles in motion, cross with reduced margins of safety, display a decreased perception of danger, and are more accepting of risk (Brosseau et al. 2013; Moyano Díaz, 2002, Hamed, 2001; Herrero-Fernández et al., 2016; Jain et al. 2014; Jiménez Romero, 2010; Marisamynathan and Vedagiri, 2014; Mitman et al., 2008; Rosenbloom, 2009; Tiwari et al., 2007; Tom and Granié, 2011; Yagil, 2000; Zhuang and Wu, 2011). There are also differences in the ways the different genders interact with certain situational variables. Yagil (2000) indicates that, in the case of men, the volume and speed of traffic appear to be relevant factors that influence the decision to cross, while, in the case of women, the presence and behavior of other pedestrians seems to be more influential.

In terms of age, the majority of the research points to a pattern that indicates that young and middle-aged adults are the group that least abide by the rules of the road when crossing (e.g. Hamed, 2001; Ferenchak, 2016). More often than others, this group of pedestrians crosses at non-designated areas, walks outside of the crosswalk markings, pays less regard to traffic lights, crosses with reduced margins of safety, and is involved in more crashes (Lee and Abdel-Aty, 2005; Mitman et al., 2008; Ren et al., 2011). Although older adults are more respectful of the

rules of the road, advanced age negatively impacts mobility (e.g. Wang et al. 2014). Consequently, older adults find it more difficult to cross with adequate safety margins (Brosseau et al. 2013; Holland and Hill, 2010). Additionally, older adults may make poorer crossing decisions because they have a harder time evaluating their surroundings, a factor that increases their crossing risk (Ferenchack, 2016).

Cultural and environmental differences

Although a certain regularity in pedestrian behavior can be identified, there are cultural and environmental factors that vary from region to region and can influence pedestrian behavior (Papadimitrou et al. 2009). For example, in Argentina there are a few typical and distinctive factors to keep in mind. One has to do with the layout of urban cores, which generally follow an orthogonal model, with either a grid or checkerboard pattern. In cities of this type, there is an intersection at approximately every 100 meters and they are for the most part formed by perpendicular streets (see Figure 1 in Appendix). This is a prototypical crossing situation in many Argentine cities. Another item of note is that at these intersections, the pedestrian is given priority by law, whether a crosswalk is marked or not. However, this rule is almost never respected in practice, and this disregard is "accepted" in many regions. In short, the environmental and cultural variables are very important to understanding the phenomenon at the local level.

The objective of this study was to explore pedestrian crossing behavior at the intersections of an Argentine city (Ushuaia). One point of particular interest was to observe whether differences in behavior existed at intersections with traffic lights versus those without them. Furthermore, behavioral differences by age and gender were analyzed. The study focused

on pedestrian risk behaviors at different stages of the crossing process (walking, waiting, starting to cross, etc.). Traffic code violations (e.g. crossing on red) as well as other potentially risky behaviors (e.g., distractions) were considered. Differences in risky behaviors among age and gender groups were expected. Specifically, and in line with the existing literature, it was hypothesized that male and younger pedestrians would exhibit riskier behaviors.

Methodology

Participants

The sample consisted of 802 pedestrians (53.9% female) observed on public roadways at various intersections in the City of Ushuaia, Argentina. Ushuaia is known as the world's southernmost city. It is a mid-sized city (according to the 2010 census, population: 56,956 inhabitants; population density: 2460 hab/km^2), but the number of automobiles per capita is among the highest in the country (one vehicle per every 2.1 inhabitants), according to the city transit authority. Two age groups were established: (1) youth (17 to 30 years of age); and (2) adults (31 years of age and older). The observed frequencies for each group were: 49.1% for young people; and 50.9% for adults.

Variables and instruments

Observations were codified according to a standardized documentation protocol. The instrument was designed based on the work of Tom and Granie (2011) and Zhuang and Wu (2011). The protocol included contextual and road environment variables, as well as variables related to crossing behavior. Observers documented information on behavior prior to crossing (e.g., coming to a halt), during crossing (trajectory, pace, etc.) and after crossing (ending location). The pedestrian's gender and age were also documented.

Procedure

The data were gathered by shooting video in the AVCHD format with a JVC camera (GZ-HM440BU model). The camera was set up on one of the four corners such that vehicular traffic came from the right and pedestrians walked toward the camera. Observations were made between the months of October and December, 2013 (the southern hemisphere's spring). At that time of year, Ushuaia enjoys good weather and walking conditions are favorable. Daytime temperatures were observed to range from 3° to 16° Celsius.

The observations were made in two sectors of the city, labeled first and second center (See the Appendix). Both sectors were in the city's financial and commercial district, and consequently had significant foot and vehicular traffic. In order to select the intersections for this study's observations, several crossings were explored to ensure those selected were similar in terms of the number of street lanes and the volume of vehicular and pedestrian traffic. Five intersections were selected, three in the first center and two in the second center (See Table 1 for a detailed description). Fifty-six percent of the observations were made in the first center (See the Appendix for the locations of the observed pedestrian crossings). Observations were made on four weekdays (36% on Mondays, 14% on Tuesdays, 8% on Thursdays, and 28% on Fridays) and one weekend day (14% on Saturdays); they were made at two times of day (50% in the morning, 50% in the afternoon) during which 50 minutes of video were shot. Lastly, the video recordings were analyzed and codified according to the observation protocol.

Pedestrians may pay attention to multiple objects at the same time when crossing the street. When we observed this behavior, our decision was to consider the most prevalent stimulus for the pedestrian. Behaviorally, we considered the movement and direction of the head, and the

object for which attention seemed to be fixed for most time. The age of each pedestrian was estimated based on the individual's appearance. Although the estimation of a person's age can result in errors, this procedure has been employed previously by other researchers (Brosseau et al., 2013; Zhuang and Wu, 2011).

Frequency analyses of observed behaviors were conducted for the total sample, as well as by gender and by age group. Differences in behaviors at intersections with and without a traffic light were also analyzed. In this case, as well as in the case of behaviors by gender and age group, contingency tables were used and Pearson's chi-squared index was computed. Additionally, it was decided to calculate a general crossing risk index to facilitate comparisons between the genders and age groups. In order to construct this index, variables that suppose varying levels of risk were considered. These variables were: position prior to crossing (e.g., on sidewalk, on roadway); pace (e.g., walking, running); regard for crosswalk and traffic light (at crossings with traffic lights); and the presence of distractions. Behavior was codified such that the lowest value corresponds with the most prudent behavior, and the highest with the riskiest (for example, regard for the traffic light was coded as follows: green light = 0; yellow light = 1; and red light = 2). Once the variables were codified, the values were added up to obtain an overall index score (the higher the score, the greater the crossing risk).

Results

It is important to highlight a few results to illustrate the prevalence of risky behaviors (Table 2). Of those who halted prior to crossing (for a passing vehicle or a traffic light), only 39% (n=79), 95% CI (33, 46), waited on the sidewalk. At intersections with a traffic light, only 7%, 95% CI (5.4, 8.9), looked at the traffic light before starting to cross; the others looked at the

cars or at other pedestrians. At these intersections, 28.3%, 95% CI (25, 31), started crossing without regard for the traffic light; in other words, on yellow (6.6%) or red (21.7%). While crossing, at intersections marked with crosswalks, 88%, 95% CI (85, 90), crossed completely outside the crosswalk (6.1% started or finished outside the crosswalk and only 5.8% remained entirely within the crosswalk from start to finish). Lastly, 11.7%, 95% CI (9, 13.3), of pedestrians were distracted in one way or another while crossing, mainly by using their cellphones.

Compared to men, women were more likely to halt prior to crossing, χ^2 (2, N=802) = 7.03 $p < .05$, pay greater attention to the behavior of other pedestrians than to cars and traffic lights prior to crossing χ^2 (2, N=650) = 23.84, $p < .001$, and had greater regard for crosswalks χ^2 (3, N=802) = 12.38, $p < .01$. There were no observed behavioral differences among age groups (See appendix for complete results).

With respect to the risk behavior index, an ANOVA revealed that men presented significantly higher scores than women, F (1, 798) = 4.764, $p = .029$, Cohen's $d = .15$. In terms of age, no significant differences were observed, F (1, 798) = .979, $p = .323$. Nor where significant differences observed in the gender x age interaction, F (1, 798) = .698, $p = .404$.

Table 3 shows the frequency of pedestrian behaviors observed at intersections with and without a traffic light (For complete results see appendix). Significant differences were observed in the pace prior to crossing, χ^2 (2, N=802) = 25.382, $p < .001$; waiting location, χ^2 (2, N=802) = 25.878, $p < .001$; and pace while crossing χ^2 (2, N=802) = 9.858, $p < .01$. At intersections with a traffic light, pedestrians were more likely to halt prior to crossing (37.5%); wait before crossing, either on the sidewalk (17.8%) or in the roadway (19.7%); and run while crossing (9.2%).

Discussion

Results showed a high level of risk behaviors during the different street crossing stages, irrespective of intersection type (i.e. with or without a traffic light). This is worrisome given the elevated vulnerability of pedestrians within road systems, and it reinforces the position maintained by some researchers with respect to pedestrian responsibility for many of the conflicts with motorists (Moyano Díaz, 2002).

The lack of regard for road rules and signs is noteworthy. It is worth mentioning, for instance, that only 6.1% of pedestrians walk entirely within the crosswalk while crossing, and that at intersections with traffic lights, almost a third of pedestrians do not heed the traffic light. In addition to violations of road rules, negligent crossing behaviors were also frequently observed, such as not coming to a halt prior to crossing, inadequately assessing one's surroundings and crossing while distracted. For example, only 10% of pedestrians stopped and waited on the sidewalk prior to starting to cross. Further, 11.7% were clearly distracted while crossing. Although percentage-wise this is a low number, in absolute terms, it represents a large number of pedestrians who were not paying full attention while crossing the street, a highly dangerous behavior. King et al. (2009) maintains that the little regard pedestrians have for road rules is understandable considering the very low risk these behaviors pose to the individual. Which is to say, most of the time pedestrians do not suffer negative consequences when they disregard the rules.

At intersections with a traffic light, some differences in pedestrian behavior were observed. Pedestrians came to a halt prior to crossing more often (37.5%), and when they did so, they had a higher likelihood of waiting on the sidewalk (17.8%). Nevertheless, these percentages

are still low. One worrisome observation is that the presence of a street light seemed to induce more pedestrians to run while crossing. This is understandable in a context where pedestrian priority is seldom respected, even when the traffic light gives the pedestrian the right of way, as is the case in Argentina.

Many of the abovementioned behaviors seem to be associated with gender, which is in line with the previous literature that showed more risk behaviors among men than women (Brosseau et al. 2013; Herrero-Fernández et al. 2016; Jain et al. 2014; Jiménez Romero, 2010; Marisamynathan and Vedagiri, 2014; Zhuang and Wu, 2011). The analysis of our general risk index indicated that men engage in more risky behaviors when crossing the street than do women. The observations show that they tend to have less regard for crosswalks, are less likely to come to a halt prior to starting to cross, and cross while distracted more often than do women. In addition to risk behaviors, gender also seems to make a difference with respect to other variables related to street crossing. For example, at intersections without traffic lights women tend to pay more attention to the behavior of other pedestrians when deciding when to start crossing, while the majority of men pay attention to the vehicular traffic. Yagil (2000) observed a similar pattern of behavior. This author interpreted this to mean that among women the behavior of other pedestrians stimulates compliance with the rules in the presence of a "walk/don't walk" sign. In the present study, however, these signs were not present. Therefore, it can be assumed that other pedestrians served as key information sources in the crossing decision.

Although there is evidence in the literature that indicates young and middle-aged pedestrians exhibit more risk behaviors (Hamed, 2001; Ferenchak, 2016; Mitman et al. 2008; Ren et al. 2011), this study did not find differences among age groups. In part, it is possible that

the absence of this difference is due to the way this variable was estimated and codified. Given the study's observational nature, only an approximate estimation of a pedestrian's age was possible. Moreover, only a small number of elderly people were observed. This reflects Ushuaia's demographics, which has an age pyramid with a broad base in the adolescent and young adult strata. Given the low number of elderly adults observed, only two large age groups were codified, which might have resulted in a loss of variability. However, the ranges used were similar to those defined in other studies (Brosseau et al., 2013; Holland Hill, 2010; Zhuang & Wu, 2011). Moreover, we also followed the reports of the WHO that stated that the most vulnerable group on the road is the one comprised between the ages of 18 and 29 years.

Pedestrian behavior is highly dependent on context to the point that some researchers indicate it is impossible to compare research results from different countries, and even from different areas of a single city (Papadimitrou et al. 2009). Influences in this regard include both the environmental characteristics and road culture of each country (Özkan and Lajunen, 2011). For example, one important behavior is what pedestrians pay attention to when they start crossing at an intersection, both when a traffic light is present and when it is not. The results of this study show that in both cases, pedestrians pay the most attention to vehicular traffic. This was more pronounced, however, at intersections with traffic lights. This behavior, which seems paradoxical, can be explained as an expression of the road culture. In Argentina, it is common for drivers to disregard the rules of the road that give priority to pedestrians. Consequently, pedestrians might well believe that drivers may not necessarily stop, even when the traffic light is red. This also explains why pedestrians are more motivated to run at intersections with street lights.

There are also other limitations to using an observational methodology to study pedestrian behavior. It only captures situational behavior, limited to local conditions and the observer's field of vision (Papadimitrou et al. 2016). The details of the behavior, such as the prior trajectory, are lost, and these limitations can result in the erroneous generalization of behaviors that are associated to specific environmental conditions. For this reason, care must be taken with respect to the scope of the results. Further, observational studies do not illuminate the motives behind the behaviors. For that, it is necessary to conduct studies that combines observations with other quantitative methodologies.

The results indicate the importance of having diagnostic information on risk behaviors that has been generated in a natural context. They also alert about the need to implement immediate interventions to reduce pedestrian risk behaviors. To be effective, these interventions should take multiple approaches, combining environmental changes with education, awareness raising and control measures.

Acknowledgements

This research was supported by Consejo Nacional de Investigaciones Científicas y Técnicas and Universidad Nacional de Mar del Plata (Argentina). We express our gratitude to these institutions for their support. The author also wishes to thank Darío Bard for his translation services.

References

Barrero LH, Quintana LA, Sánchez A, Forero A, Quiroga J, Felknor, S. Pedestrians' Beliefs about Road Crossing in Bogotá: Questionnaire Development. Univ Psychol. 2013 May/Aug;12(2), 433-444.

Buedo P, Silverman P, Stickar A. Errores humanos autorreferenciados por los peatones del sistema vial de la ciudad de Bahía Blanca, Argentina. Estudio descriptivo observacional. Rev Med Urug. 2016 Apr;32(1), 36-41.

Brosseau M, Zangenehpour S, Saunier N, Miranda-Moreno L. The impact time of waiting time and other factors on dangerous pedestrian crossings and violations at signalized intersections: A case study in Montreal. Transp Res Part F Traffic Psychol Behav. 2013 Nov;21, 159-172.

da Silva MP, Smith JD, Najm WG. Analysis of Pedestrian Crashes. DOT HS 809 585. National Highway Traffic Safety Administration, Washington, DC. 2003

Ferenchack NN. Pedestrian age and gender in relation to crossing behavior at midblock crossings in India. J Traffic Transp Eng. 2016 Aug;3, 345-351.

Hamed MM. Analysis of pedestrians' behavior at pedestrian crossing. Safety Sci. 2001 Jun;38(1), 63-82

Hassan SE, Geruschat DR, Turano KA. Head movements while crossing the street: effects of vision impairment. Optometry Vision Sci. 2005 Jan;82(1), 18-26.

Hatfield J, Murphy S. The effects of mobile pone use o pedestrian crossing behaviour at signalised and unsignalised intersections. Accid Anal Prev. 2007 Jan;39(1) 197-205

Herrero-Fernández D, Macía-Guerrero P, Silvano-Chaparro L, Merino L, Jenchura EC. Risky

behaviour in youg adult pedestrians: Personality determinants, correlates with risk perception, and gender differences. Transp Res Part F Traffic Psychol Behav. 2016 Jan;36, 14-24.

Holland C, Hill R. Gender differences in factors predicting unsafe crossing decision in adult pedestrian across the lifespan: a simulation study. Accid Anal Prev. 2010 Jul;42(4), 1097-1106.

Jain A, Gupta A, Rastogi R. Pedestrian crossing behaviour analysis at intersections. Int J Traffic Transp Eng. 2014 Jan;4(1), 103-116.

King MJ, Soole, DW, Ghafourian, A. Illegal pedestrian crossing at signalised intersections: Incidence and relative risk. Accid Anal Prev. 2009 May;41(3), 485-490.

Lee C, Abdel-Aty M. Comprehensive analysis of vehicle-pedestrian crashes at intersections in Florida. Accid Anal Prev. 2005 Jul;37(4), 775-886

Marisammynathan S. Vedagiri P. Study on pedestrian crossing behavior at signalized intersections. J Traffic Transp Eng. 2014 Apr;1(2), 103-110.

King MJ, Soole D, Ghafourian A. Illegal pedestrian crossing at signalised intersections : Incidence and relative risk. Accid Anal Prev. 2009 May;41(3), 485-490.

Mitman MF, Ragland DR, Zegeer CV. The Marked Crosswalk Dilemma: Uncovering Some Missing Links in a 35-Year Debate. Safe Transportation Research & Education Center. UC Berkeley: Safe Transportation Research & Education Center. 2008. Retrieved from: http://escholarship.org/uc/item/13r7q036

Moyano Díaz E. Theory of planned behavioir and pedestrians' intentions to violate traffic regulations. Transp Res Part F Traffic Psychol Behav. 2002 Sep;5, 169-175.

Özkan T. Lajunen T. (2011). Person and environment: Traffic culture. In B. Porter (Ed.), Handbook of traffic psychology. Elsevier: Amsterdam. 2011: 179–192.

PAHO. Road Safety Facts in the Region of the Americas. Washington, DC : PAHO, 2013.

Papadimitrou E, Lassarre S, Yannis G. Introducing human factors in pedestrian crossing behaviour models. Transp Res Part F Traffic Psychol Behav. 2016 Jan;36, 69-82.

Papadimitrou E, Yannis G, Golias J. A critical assessment of pedestrian behaviour models. Transp Res Part F Traffic Psychol Behav. 2009 May;12(3), 242-255.

Pérez López, R. (2014). Movilidad cotidiana y accesibilidad: ser peatón en la ciudad de México. Cahiers, CEMCA. 2014 1, 3-21

Ren G, Zhou, Z, Wang W, Zhang Y, Wang W. Crossing Behaviors of Pedestrians at Signalized Intersections. Observational Study and Survey in China. Transportation Res Rec. 2011 Dec;2264(1), 65-73.

Rosembloom T. Crossing at a red light: Behaviour of individuals and groups. Transp Res Part F Traffic Psychol Behav. 2009 Sep; 12, 389-394

Tiwari G, Bangdiwala S, Saraswat A, Gaurav S. Survival Analysis: Pedestrian risk expusure at signalized interventions. Transp Res Part F Traffic Psychol Behav. 2007 Feb; 110, 77-89.

Tom & Granie. Gender differences in pedestrian rule compliance and visual search at signalized and unsignalized crossroads. Accid Anal Prev. 2011 Sep;43(5), 1794-1801.

Wang W, Guo H, Gao, Z, Bubb H. Individual differences of pedestrian behaviour in midblock crosswalk and intersection. Int J Crashworthiness, 2014 May;16(1), 1-9.

Yagil, D. Belief, motives, and situational factors related to pedestrians' self-reported behavior at signal-control crossings. Transp Res Part F Traffic Psychol Behav. 2000 3, 1-13.

Zuang X, Wu C. Pedestrians' crossing behaviors and safety at unmarked rodway in China. Accid Anal Prev, 2011, 43, 1927-1936. doi:10.1016/j.aap.2011.05.005

Table 1. Features of the observed intersections

Intersections	Traffic light	Zebra Crossing	N° of lanes	Width	Direction
Perón y Kuanip	X		2	7.80 mts	One way
San Martín y Roca		X	2	8.70 mts	One way
San Martín y Godoy		X	2	8.70 mts	One way
San Martín y 25 de mayo		X	2	8.70 mts	One way
Rubinos y Kuanip			2	7.80 mts	One way

Table 2. Frequency of observed pedestrian behaviors for the total sample and the age and gender subsamples.

Indicator	**Total N=802**	**Women n=432**	**Men n=370**
Pace prior to crossing			
Walking	74.7 (599)	71.5(309)	78.4 (209)
Halts	24.8 (199)	28.2(122)	20.8 (77)
Running	.5 (4)	.2 (1)	.8 (3)
Waiting location			
% waiting on sidewalk	9.9 (79)	11.6 (50)	7.8 (29)
% waiting on roadway	14.7 (118)	16.4 (71)	12.7(47)
% not waiting	75.4(605)	72(311)	79.5(294)
Paying attention to traffic light, car traffic or other pedestrians at intersection with traffic lights			
% paying attention to traffic light prior to crossing	7 (1)	0	1.5 (1)
% paying attention to car traffic	94.1 (143)	92.9 (79)	95.5 (64)
% paying attention to other pedestrians	2.6 (4)	3.5 (3)	1.5 (1)

% not paying attention to any environmental factor	2.6 (4)	3.5 (3)	1.5 (1)
Paying attention to car traffic or other pedestrians at intersections without traffic lights			
% paying attention to car traffic	85.5 (556)	81.6 (283)	90.1 (273)
% paying attention to other pedestrians	9.8 (64)	14.7 (51)	4.3 (13)
% not paying attention to any environmental factor	1.7 (30)	3.7 (13)	5.6 (17)
Crossing when light is green (*)			
% that respect the traffic light	71.7	69.4	74.6
% that do not respect the traffic light (yellow)	6.6	8.2	4.5
% that do not respect the traffic light (red)	21.7	22.4	20.9
(*) at intersections with traffic lights			
Location when starting to cross			
% starting outside the crosswalk	90.4(725)	88.7(383)	92.4(342)
% starting outside the crosswalk but heading towards it	1 (1)	0	3 (1)

% starting within the crosswalk	9.5 (76)	11.3(49)	7.3 (27)
Crossing trajectory			
% crossing outside the crosswalk	88 (706)	86.8(375)	89.5(331)
% crossing within the crosswalk	6.1 (41)	8.6 (37)	3.2 (12)
% crossing within then outside the crosswalk	3.7 (30)	3.2 (14)	4.3 (16)
% crossing outside then within the crosswalk	2.1 (17)	1.4 (6)	3.0 (11)
Pace while crossing			
% walking	94.4(757)	94.2(407)	94.6(350)
% running	4.5 (36)	5.1 (22)	3.8 (14)
% that stop during crossing	1.1 (9)	.7 (3)	1.6 (6)
Distraction while crossing			
% distracted while crossing	11.7 (91)	10.6(46)	12.2 (45)
% texting/reading on cellphone	1.9 (15)	1.9 (8)	1.9 (7)
% talking on cellphone	2.1 (17)	1.4 (6)	3 (11)
% talking with other pedestrian	7.4 (59)	7.4 (32)	7.3 (27)

Table 3. Frequency of observed pedestrian behaviors at intersections wirh and without traffic ligths

Indicator	Intersections	
	Without traffic ligths	With traffic ligths
Pace prior to crossing		
Walking	78 % (507)	60.5 % (92)
Halts	21.8 (142)	37.5 % (57)
Running	.2 (1)	3 (2)
χ^2 (2, N=802) = 25.382, $p < .001$		
Waiting location		
% waiting on sidewalk	8 % (52)	17.8 % (27)
% waiting on roadway	13.6 % (88)	19.7 % (30)
% not waiting	78.5 % (510)	62.5 % (95)
χ^2 (2, N=802) = 25.878, $p < .001$		

Pace while crossing		
% walkingx	95.5 % (621)	89.5 % (136)
% running	3.4 % (22)	9.2 % (14)
% that stop during crossing	1.1 % (7)	1.3 % (2)
χ^2 (2, N=802) = 9.858, $p < .01$		

