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Pedestrian age and gender in relation to crossing behavior at midblock crossings in India

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ABSTRACT

Pedestrians have unique needs to ensure their safety as they interact with others within a transportation system. Since this is especially true in third world context, it is imperative to gain a better understanding of pedestrian behaviors in developing countries. The goal is to have planners and engineers create appropriate design guidelines and inform policy decisions. Data on pedestrian characteristics and behavior metrics were gathered from midblock crossings in Bangalore, Karnataka, India. Quadratic and logistic regressions suggest that pedestrian delay and utilization of crossings increase with age, while conflicts decrease with it. Male waiting time is approximately half of female waiting time, and males are twice as likely to cause conflicts with motor vehicles. These strong patterns will hopefully aid in the understanding of pedestrian behavior in relation to motor vehicle traffic in urban areas of developing countries, encouraging safer crossings to be designed.

1. Introduction

Being some of the most vulnerable users within a transportation system, pedestrians present specific challenges to transportation design and have particular needs. Due to different pedestrian characteristics, these needs require an in-depth understanding of pedestrian behavior. Pedestrians account for 22% of fatalities on roadways around the world (World Health Organization, 2013a). This number rises to above 75% in some under-developed nations (Muhlrad, 1987). Further highlighting the importance of understanding pedestrian behavior in the third world countries is the fact that upwards of 74% of all pedestrian fatalities occur in under-developed nations (Berkley et al., 1993). This figure equates to more than 500 pedestrian fatalities every day on roadways in third world countries (World Health Organization, 2013b). These tragedies should be treated as both foreseeable and avoidable. If an understanding can be obtained of how and why these fatalities occur, progress can be made to prevent them. Pedestrians' behaviors, with characteristics such as age and gender, will provide important insights into understanding their safety. In this paper, the influence of pedestrian characteristics on behavior is studied specifically at midblock

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crossings. The study also focuses on a third world context, as these countries present the most volatile areas of interaction between pedestrians and motor vehicles. The goal of this paper is to fill a gap in the current knowledge of pedestrian behavior due to its implications for pedestrian safety. The following literature review will first examine the most pertinent behavioral factors regarded as dependent variables. It will then detail past researches on the independent variables (gender and age). These sections will examine the pertinent factors in general, and not necessarily in a third world context. Then, the specific importance of India and the developing world will be introduced.

Dependent behavioral variables chosen for this study include pedestrian delay time, utilization of available crossing treatments, and conflicts between pedestrians and motor vehicles. Pedestrian delay is an important variable to study because pedestrians frequently become impatient while waiting to cross the street (Guo et al., 2012). If a pedestrian becomes impatient and unwilling to wait for a shorter vehicle gap, then he or she is more likely to enter a risky situation while crossing the roadway. Similarly, pedestrians who do not use the available crossing infrastructure are also more likely to enter risky situations. Although the safety benefits of crosswalks and other similar pedestrian treatments have been called into question by past researches, people that are willing to disobey established rules are more likely to dispose themselves to risk during their crossing (Zegger et al., 2005). This increases the likelihood of poor safety outcomes. The final dependent variable used for this analysis is conflict between pedestrians and vehicles. This variable possesses a more direct relationship with safety outcomes, as it is an indicator of collisions (Grayson et al., 1984). Gender and age are analyzed in relation to the aforementioned dependent variables.

Past research has shown that the gender of a pedestrian is an important characteristic in determining pedestrian behaviors such as waiting time and proclivity towards risk (Hamed, 2001; Kadali and Perumal, 2012; Kingma, 1994). In particular, it has been shown that male pedestrians are more willing to violate regulations and make unsafe crossing decisions. They are also less likely to perceive risk when crossing a roadway in the presence of motor vehicles (Díaz, 2002; Holland and Hill, 2007, 2010). This relationship between males and higher rates of risky behavior has even been shown in young children aged 5–8 years old (Barton and Schwebel, 2007). Male pedestrians also tend to wait for shorter amounts of time than female pedestrians when crossing a roadway (Tiwari et al., 2007). Correspondingly, male pedestrians have significantly faster walking speeds than their female counterparts, possibly relating to their shorter waiting times (Tarawneh, 2001). As is expected, males comprise up to 80% of pedestrian fatalities (Odero et al., 1997). In addition to pedestrian behavior being strongly dependent on biological gender, as shown in past researches, it has also been found to depend on the psychological masculinity of an individual (Granié, 2009).

Along with gender, the pedestrian characteristic of age is a significant variable in relation to pedestrian behavior. Higher pedestrian age correlates with decreased risk perception, larger minimum gap acceptance, and longer waiting times when crossing a street (Hamed, 2001; Holland and Hill, 2007; Kadali and Perumal, 2012). Pedestrian speeds are also significantly related to pedestrian age, and the speeds of pedestrians are slower as they get older (Tarawneh, 2001). Past researchers have found that pedestrians between 21 and 30 years of age are the fastest age group (Tarawneh, 2001). There remains some ambiguity regarding the relationship between pedestrian age and actual risk and conflict. While younger pedestrians are more willing to violate regulations, older pedestrians make more unsafe decisions (Díaz, 2002; Holland and Hill, 2010; Lee and Abdel-Aty, 2005). Such unsafe decisions are primarily related to older pedestrians' difficulties in interpreting the situation. Having a clearer understanding of this relationship, especially at midblock crossings in developing countries, will greatly aid the understanding of pedestrian behavior, and therefore support the overall safety of third world transportation systems.

A specific theory that has been supported in past researches to predict pedestrian behavior is of particular interest to the current study. The Theory of Planned Behavior is a method of predicting pedestrian behavior based on the intentions of the users of the system (Díaz, 2002; Evans and Norman, 1998; Holland and Hill, 2007). The theory is a good predictor of intentions, and shows that pedestrian behavior, especially with respect to safety, can be predicted and accounted for. This supports the goal of this paper, which is to help predict pedestrian behavior based on specific characteristics, in order to improve the safety of transportation systems. Just as past researchers have shown the feasibility of predicting pedestrian behaviors through the Theory of Planned Behavior, it is hopeful that the results of this study will also aid in predicting pedestrian behaviors.

This research details the relationship between age, gender and behavior in a third world context. The various behavioral variables are performed in a third world context for two reasons. First, there are serious safety concerns in third world countries, and second, the bulk of the past researches regarding pedestrian characteristics and behavior were conducted at intersections in developed countries. This paper looks specifically at third world midblock crossings, which can prove uniquely problematic and yet still a popular crossing location in informal third world settings. In India, the transportation system is a wholly different paradigm from those typically studied in developed countries. For example, during 2013–2014, over 80% of the motor vehicles sold in India were motorized two-wheelers (Society of Indian Automobile Manufacturers, 2015). This unique composition of traffic causes pedestrians to act in unique manners, and therefore warrants examination. Understanding how pedestrian behavior differs among these distinctive pedestrian contexts can inform design decisions of midblock crossing locations.

The rest of this paper builds upon the previously discussed body of knowledge. Section 2 details data collection at midblock crossings in Bangalore, India. Section 3 presents the findings and analysis, and Sections 4 and 5 provide a discussion of results and conclusions. Based on pedestrian characteristics of age and gender, a clear picture of pedestrian behavior at midblock crossings in a third world context is presented. These insights promote greater safety throughout the transportation systems.