



Relations between temperamental fear and risky pedestrian behavior



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ABSTRACT

Objective: Child pedestrian injury poses a significant global public health challenge. This study examines relations between temperamental fear and children's risky pedestrian behavior, utilizing mediation analytic strategies to study underlying mechanisms of the hypothesized relation.

Methods: As part of a larger study, 240 seven- and eight-year-old children completed 30 crossings in a virtual reality (VR) pedestrian environment. Three pedestrian behaviors were considered: start gap (lag after a traffic gap appears before child initiates crossing into the gap), time to contact (TTC; gap between avatar and the lead oncoming vehicle), and hits (collisions with vehicles in simulated crossings). Temperamental fear was measured by parent report.

Results: Fearful children were more likely to be struck by virtual vehicles, and the relation between fear and risky pedestrian behaviors was mediated by start gap and TTC. Specifically, children who were temperamentally more fearful were more likely to hesitate before initiating crossing, which led to shorter gaps between themselves and the oncoming vehicle, hence causing them to be more likely to be hit by virtual vehicles. Gender interacted with fear, such that fearful girls were most likely to be hit.

Conclusions: Both temperamental fear and gender influenced the risk of child pedestrian injuries. Delayed entry into traffic and shorter gaps between children and oncoming vehicles may underlie this relation. Future research should explore how these factors might influence the effectiveness of prevention programs.

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1. Introduction

Child pedestrian injury is a significant public health challenge both in the United States and globally. In the United States, 279 children younger than 14 years old died from pedestrian injuries in 2011, and another 33,518 children suffered non-fatal pedestrian injuries (NCIPC, 2014). Globally, it is estimated that over 30,000 child pedestrians are killed each year (Toroyan and Peden, 2007).

Multiple factors contribute to pedestrian injury risk among 7- and 8-year-olds, the target age group for this research. Environmental risk factors are prominent and include factors such as neighborhood street design and traffic engineering, the presence of sidewalks, and vehicle speed control (World Health Organization, 2013). Also relevant is the contextual environment in which many young children walk, which often involves busy and complex pedestrian environments that they negotiate without adult

supervision (Macpherson et al., 1998; Martin et al., 2007; McDonald et al., 2011).

Another significant risk factor for child pedestrian safety, and the focus of the present investigation, is individual child characteristics. It has been long-recognized that children's cognitive and perceptual development plays a significant role in pedestrian injury, with inferior cognitive-perceptual skills associated with increased risk (Schwebel et al., 2012). Similarly, children's pedestrian safety is influenced by cognitively-influenced temperamental traits such as inhibitory control and risk-taking tendencies. Children who tend to be more inhibited and risk-averse have reduced injury risk (Barton and Schwebel, 2007; Hoffrage et al., 2003; Tabibi et al., 2012).

The role of other individual difference factors, such as emotion-based temperament, is less well understood (Barton and Schwebel, 2007; Schwebel et al., 2012). Fearful children have greater stress, react more anxiously to a range of situations, inaccurately perceive vulnerability in multiple settings, and are more often overwhelmed by new information at school (Rothbart and Jones, 1998; Talge et al., 2008). As road-users, fearful children might be affected in their ability to process information accurately and quickly compared to less fearful children. Information processing is

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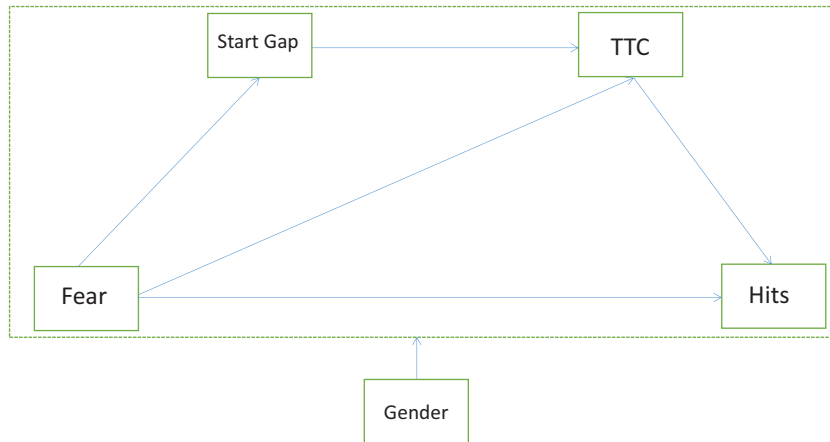


Fig. 1. Conceptual Model.

Note: TTC: time to contact.

critical to pedestrian safety, as a safe pedestrian must perceive a complex traffic environment, judge moving objects and the safety of entering the street, and time street entry so that he or she can cross the street within a traffic gap that permits sufficient time for the crossing (Schwebel et al., 2012). Reduced speed or accuracy of processing the perceived environment or in making decisions about traffic gap safety due to fearful reactions could lead to delayed entry into traffic gaps, entry into narrower gaps between oncoming traffic, and higher likelihood of injury when crossing streets.

Fear may also interact with other individual characteristics, such as gender, in influencing children’s risks of pedestrian injuries. In a study of bicycling safety, for example, Peterson et al., (1997) used a 5-point visual Likert-style scale to measure acute situational fear and found that girls reported more fear in entering simulated traffic gaps than boys, whether or not potential collisions were anticipated. Others have reported gender-related differences in street behavior. Barton and Schwebel (2007) found that girls tend to wait longer before entering a street to cross whereas boys were more likely to enter the near lane of traffic before the far lane was vacant. Stevens and colleagues (Stevens et al., 2013) found a similar pattern in a bicycling situation, where girls were more likely to wait for the lead car to completely pass the crosswalk before entering to cross, whereas boys were likely to start crossing the street while the lead car was still passing by.

Taken together, a picture emerges to suggest fear may be related to risky pedestrian behavior. Fearful children may delay entry into traffic gaps, creating a shorter gap between themselves and oncoming traffic and therefore increasing risk of pedestrian injury. This pattern may be true especially in girls, who are more likely to be fearful and also more likely to hesitate before entering traffic. Fig. 1 presents a conceptual model of our hypotheses, which we tested among 7–8 year old children who crossed streets within a virtual pedestrian environment. The squares in the figure represent variables of interest, and the arrows in the figure represent directional effects between two variables. Our hypotheses, represented conceptually in the figure, can be summarized as follows:

1. Fearful children will be more likely to demonstrate risky pedestrian behaviors, as assessed by collisions with vehicles in the virtual pedestrian environment (hits), compared to less fearful children.
2. The relation between fear and risky pedestrian behavior will be explained partially by a delayed entry into traffic gaps (longer

- start gaps), and subsequently shorter gaps between the pedestrian and oncoming traffic (shorter TTC). Fearful children will have larger delays entering traffic, leading to shorter latencies between themselves and oncoming traffic while crossing the street and hence more risky pedestrian behaviors.
3. The relationship between fear and risky pedestrian behavior will differ by gender (interaction). Girls will wait longer before crossing streets than boys. Girls also will have higher levels of fear than boys.
4. Together, gender and fear will interact to amplify the relations between female gender and pedestrian safety and between fear and pedestrian safety. That is, the combination of fearfulness and female gender will create particularly elevated risk of pedestrian injury, as mediated by delayed entry into traffic and shorter times to contact. Low fear and male gender will be associated with reduced risk.

2. Methods

2.1. Participants

A total of 240 children ages 7–8 (M = 7.98 years, SD = .65) were recruited from community sources in the Birmingham, Alabama area, as part of a larger study (Schwebel et al., 2014). The sample was 43% male, 52% Caucasian, and 42% African–American.

Table 1
List of fear items from CBQ (7-point scale, Rothbart et al., 2001).

Items
Is not afraid of large dogs and/or other animals. (R)
Is afraid of burglars or the “boogie man.”
Is afraid of loud noises.
Does not worry about injections by the doctor. (R)
Is not afraid of the dark. (R)
Is afraid of fire.
Is very frightened by nightmares.
Is afraid of the dark.
Is rarely frightened by “monsters” seen on TV or at movies. (R)
Is not afraid of heights. (R)
Is rarely afraid of sleeping alone in a room. (R)
Gets nervous about going to the dentist.

Note: (R) signifies the item was reversed before computing mean.

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