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Hazard perception test for pedestrians☆

Tova Rosenbloom *, Roi Mandel, Yotam Rosner, Ehud Eldror

Department of Management, Bar-Ilan University, Ramat-Gan, Israel

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ABSTRACT

Research Goal: This research was aimed to construct and develop a unique system for training of pedestrians – children, adults and older persons – to cross streets safely and especially to detect successfully on-road hazards as pedestrians. For this purpose, an interactive computerized program has been inspired by the format of the popular HPT (hazard perception test) for drivers.
Methods: The HPTP (hazard perception test for pedestrians) includes 10 pairs of video clips that were filmed in various locations but had a similar hazardous element. The clips presented potentially dangerous crossing scenarios such as a vehicle merging from the right side of the road from the perspective of the pedestrian who is trying to cross the street. The participants were asked to press the spacebar key every time they identified an approaching hazard. The participants were instructed to use the arrow keys for moving the viewing panel to the left or to the right in order to enlarge the field of view accordingly. Totally, 359 participants took part. Adults, children, and elders were assigned to two practice groups and three control groups in a 3 (age groups) × 5 (experimental groups) design. One practice group underwent pretest, practice, discussion and posttest, the second experimental group through pretest, practice and posttest, one control group that underwent posttest only, the second control group underwent pretest, discussion and posttest and the third control group underwent both pretest and posttest.
Findings: The most important finding was that children and adults who underwent practice received higher scores in the posttest compared to the pretest. Also, children who underwent practice increased their use of the arrow keys in the posttest compared to the pretest. Across conditions men scored higher than women on the HPTP, and used the keys more often. Age differences were found, with adults scoring being the highest, followed by children and the older persons.

1. Introduction

Pedestrians are vulnerable road users all over the world. In 2012, 4743 pedestrians were killed in road crashes in the United States, constituting 14% of all road fatalities, and pedestrian injuries were estimated at 76,000 (U.S. Department of Transportation and National Highway Traffic Administration, 2014). Pedestrian injury rates in Israel are high compared to other countries, with fatality rates in 2013 reaching as high as 33% of all road related fatalities (OECD, 2014), with the majority of fatal and non-fatal injuries occurring on urban roads (Israeli Central Bureau of Statistics, 2014).

Previous research has focused on demographic variables associated with the safety of pedestrians' road crossing behavior such as reported marital status, age, gender, educational level, income and vocational status (Gueguen and Pichot, 2001; LaScala et al., 2000). Age and gender are associated with risk taking at road crossing with the group at most risk is young men who were observed while crossing (Hamed, 2001; Rosenbloom, 2006). Parenthood was found to be related to pedestrian behavior, as parents take fewer risks at crossing than non-parents (Hamed, 2001). Personality characteristics also have been shown to be associated with risky behavior at crossing. For instance, sensation seekers seek more risks at crossing than sensation-avoiders (Rosenbloom and Wolf, 2002). Also, cultural values that are self-reported can predict risk taking at crossing, such that religious pedestrians were found willing to take much more risks than irreligious pedestrians (Kouabenan, 1998; Rosenbloom et al., 2004).

Situational variables may also dictate pedestrians' inclination to take risks in road crossing. Hamed (2001) observed pedestrians and found that people that hurry to work take more risks at crossing than others. The familiarity level of the pedestrians with the neighborhood matters also when pedestrians are going to cross street unsafely (Blatt and Furman, 1998). Other situational variables associated with safe crossing that have been found in observational studies were mobile phone use (Nasar et al., 2008) and the presence of law enforcers in the vicinity (Rosenbloom, 2006).

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* Corresponding author. Tel.: +972 3 5741011; fax: +972 3 5741959.
E-mail addresses: rosenbt1@mail.biu.ac.il, tovarosenbloom@gmail.com (T. Rosenbloom).

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The driver–pedestrian interaction at the crossing also affects pedestrian safety. The observed yielding rates for pedestrian in China were 3.5% of all drivers (Zhuang and Wu, 2014), and similar rates were found in Sweden (5%) (Varhelyi, 1998). Yielding rates were higher for handicapped, assertive or salient pedestrians (Harrell, 1994; Harrell and Andrew, 1993), or for women crossing with a stroller (Malamuth et al., 1978). Pedestrian behavior also varied in accordance with the type of vehicle approaching, as they attempted crossing the road more often when approached by private vehicle, than when approached by a heavy vehicle (Hamed, 2001).

Engineering studies have tested the effect that infrastructure changes have on pedestrians' safety behavior. Turner et al. (2006) showed that the more the lanes of the road and the higher the legal speed the smaller the willingness of drivers to yield to pedestrians. Huang and Cynecki (2000) indicated that traffic islands that lead people to cross in crossings can increase the use of road crossings and Dougald (2004) presented the requisite engineering features of the road for safe crossing.

Children and older persons are at high risk of pedestrian injury. Children under 14 have many limitations as pedestrians, as their physiological, motor, cognitive, and emotional faculties have yet to mature fully. Young children can have problems to determine the safe timing of crossing the road (Rosenbloom and Wolf, 2002), a failure that possibly originates from an over reliance on the distance factor, attributed to their still-developing physical, motor, and perceptual skills (Briem and Bengtsson, 2000; Plumert et al., 2004). Furthermore, children's appraisal of the prospective danger and sensation of fear in road crossing scenarios is low compared to adults (Rosenbloom et al., 2008). Likewise, children's ability to assess crossing locations as safe or dangerous develops only around ages nine to eleven (Shinar, 2007). Even when children seem to be aware of proper road crossing behaviors, their actions seems to indicate only partial understanding of the situation. For example, even when children stop at the curb before crossing, they do not always look to both sides and they often run while crossing (Zeedyk and Kelly, 2003)

Similarly, the deterioration of sensory, motor, and cognitive abilities in older persons may have an adverse effect on their road crossing abilities (Bian and Andersen, 2008; Dewar and Olson, 2007; Sparrow et al., 2002). In addition, older persons are not always aware of their age-related limitations, leading to misconceptions and over estimation of their actual road crossing performance (Zivotofsky et al., 2012). The aim of the present research was to test the effectiveness of road crossing training to replace some of these misconceptions with more realistic estimates, consequently reducing road crossing risk to pedestrians.

1.1. Training to detect hazards on the road

One of the popular strategies for improving driving safety is hazard perception (HP) training for drivers. Many tools have been developed for that purpose. The hazard perception test (HPT) has been constructed in many variations. The definition of HP is the ability to foresee dangerous situations on road (Horswill and McKenna, 2004). The system is based on computerized software designed for diagnosing training. Drivers that use this system practice by watching various typical road situations that they have to cope with while driving such as a driver that tries to overtake him or her from the right side, a child that bursts onto the road, or people just standing or walking near the road. The trainees press a key when they identify a cue for a dangerous situation.

The program strains drivers in various traffic situations that may occur while driving, such as a vehicle that is parking on the side, people standing by the road, and the like. Using the keyboard, the trainees are instructed to indicate the priming signs for dangers that they identify. Some countries (e.g., the UK) add this task to the driving license test, together with the written and the practical tests. There is evidence that drivers that were trained by this program were involved in less road accidents than those who were not trained by it (Haworth and Mulvihill, 2006; Sagberg and Bjørnskau, 2006). Also, Petzoldt et al. (2013) found that road hazard perception related cognitive training of drivers contributes to reconstruction and improvement of brain processes thereby improving their performance. Further research has indicated that computerized practice of hazard perception contributes to improve driving performance beyond the specific skills that have been included in the training program (Casutt et al., 2014).

1.2. HPT for pedestrians

Based on the evidence that simulative means may contribute to driving skills improvement, we sought to develop a training system that can strengthen necessary skills for pedestrians for safer behavior on roads, especially for children and older people. Recently, some efforts have been made in order to develop interactive simulations for acquiring skills that are crucial for safe road crossing and for practicing them. Hunt et al. (2011) used a computer-based method that has been created for practicing gap acceptance (between vehicles) of older pedestrians. The participants were trained to judge accurately and realistically the velocity of passing vehicles. They were taught to use the vehicle's velocity to better estimate gap acceptance. In a follow-on study, Dommes and Cavallo (2012) used a simulator that was aimed to illustrate various traffic conditions for pedestrians. Participants who practiced these situations adopted safer crossing strategies, crossed the "streets" faster and demonstrated much safer "crossing" behavior than other participants who did not and demonstrate safer "crossing" after training compared to their performance before training. These training systems are aimed at improving different skills that are necessary for safe road crossing. However, to date, none of these systems is aimed at improving hazard perception of pedestrians while crossing roads. The goal of the current research was to develop and validate a computerized program for acquisition of skills for hazard perception on roads as pedestrians – a hazard perception test for pedestrians (HPTP). Also, this research was aimed to test the effectiveness of the training by this program among groups of children, adults and older pedestrians in means of their after-training performance in HPTP. Following previous studies that used methodologies for practice and training of road users (for example, Petzoldt et al., 2013) our experiment's design included both individual practice and group discussion. Also, we adopted the recommendation of Dogan et al. (2012) to use feedback in order to improve the performance of road users' trainees. So, we hypothesized that road users who will be exposed to the HPTP and will go through either individual practice accompanied with feedback and/or a group discussion will achieve higher scores in the HPTP after the intervention.

1.3. The research goal

Because in Israel the share of the injured pedestrians out of the total injuries in road crashes is exceptionally high (OECD, 2014) it is important to find ways to reduce these numbers and to prevent injury to pedestrians. Since training of drivers for hazard perception has been shown to be effective, we developed a similar tool for pedestrians and dubbed it the HPTP. Unlike to the HPT for drivers, the HPTP is presented to the users from the pedestrians' perspective. After the construction of the tool we tested its effectiveness on pedestrians' performance in this means in a series of experiments for children, adults, and older persons following the recommendation of Lobjois and Cavallo (2007) to use special interventions for these age groups.