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Developing a self-reporting method to measure pedestrian behaviors at all ages

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ABSTRACT

The objective of this study was to develop and validate a self-reporting scale to measure injury risk behaviors among pedestrians of all ages. The Pedestrian Behavior Scale (PBS) was developed that included 47 items enabling respondents to evaluate the frequency with which they had different types of pedestrian behaviors. The validation study was carried out on 343 participants (126 men and 217 women) between the ages of 15 and 78. Factor analyses were used to differentiate between 4 axes. Factor 1, "transgression", included items concerning offence of legal rules and errors. Factor 2 included "lapses" items. Factor 3 comprised "aggressive behavior" items and factor 4 included "positive behavior" items. A revised version of the PBS with 20 items was produced by selecting those items that loaded most strongly on the four factors. The 20-item version had good internal reliability. The effects of demographic and mobility variables on the PBS scores were investigated. This instrument will be useful in measuring the frequency of these different types of behaviors among the pedestrians who are most at risk, analyzing the psychological factors used to predict PBS scores and thus better adapt preventive actions to the different populations of vulnerable road users of all ages.

1. Introduction

Even though pedestrian exposure to traffic when crossing represents a small part of total walking activity, 11,000 of the 78,000 deaths in traffic accidents in the 23 OECD countries in 2006 concerned pedestrians (SafetyNet, 2009). In France, 535 pedestrians were killed and 5523 seriously injured in traffic accidents in 2006 (ONISR, 2007). Therefore, understanding pedestrian behaviors when crossing remains a road safety challenge.

Tools for observing pedestrian behaviors, however, are few and far between. While ethological observation in road environment (Latrémouille et al., 2004; Zeedyk and Kelly, 2003), is still the best way of understanding the effect of environment on pedestrian behaviors in one given context (Sisiopiku and Akin, 2003), they do not provide a complete view of everyday pedestrian injury risk behaviors in different contexts.

Another method for studying pedestrian behaviors consists in using declared behavior questionnaires aimed at providing a self-report on travel and crossing practices (Evans and Norman, 1998, 2003; Yagil, 2000; Zhou and Horrey, 2010; Zhou et al., 2009). This kind of method permits to classify the wide ranging pedestrian behaviors into a system of behavioral factors (Elliott and Baughan, 2004). This method is likely to be beneficial for research investigating pedestrian safety, because it would provide a framework in which to study a number of important issues, such as which type of behaviors are involved in road accidents and what psychological mechanisms explained this behaviors. Few tools are available, however, and they often focus on a few transgressive behaviors by pedestrians when crossing.

One of the most complete questionnaires is the one developed in the United Kingdom on adolescent pedestrian behaviors by Elliott and Baughan (2004), validated in New Zealand (Sullman and Mann, 2009), Spain (Sullman et al., 2011) and France (Abou et al., 2008). Based on a list of 43 behaviors judged to be dangerous by the experts and on a survey of 2433 adolescents between the ages of 11 and 16, it identified 21 pedestrian behaviors, differentiated into 3 axes: unsafe street crossings, dangerous games in the street and planned protective behaviors. It cannot be used, however, to measure pedestrian behaviors in relation to the rules and some of the items are only adapted for an adolescent population, such as playing chicken during crossing behaviors. Based on this tool, a questionnaire measuring behaviors of pedestrians of all ages was developed in France and validated with adults (Granié, 2008) and adolescents (Granié, 2009). Using and developing the items from Elliott and Baughan (2004), its aim was to measure pedestrian behaviors in terms of endangerment and transgression. In its current design, however, this tool did not differentiate between errors and lapses in putting oneself in danger. This distinction made it possible to gain a more detailed understanding of behaviors with accident risks, depending on intentionality and the nature of the deviation from safe behavior.

A first differentiation of risk behaviors should indeed be made between violations – intentional – and mistakes – unintentional

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– which have different psychological origins and require different mode of remediation (Reason et al., 1990). Thus, mistakes involve failures of cognitive skills and could be corrected by educational campaigns and training courses. Transgressions involve motivational factors and should be only countered by altering attitudes of specific groups to specific kind of transgressive behaviors.

On a second level, two types of behaviors can be differentiated among mistakes: lapses and errors (Reason et al., 1990). Lapses (slips and inattention) are defined as involuntary deviations in the action, ill-suited to the original intent. Errors concern failures in intent, ill-suited to the situation. This concerns deficiencies in the decision-making or inferential processes involved in choosing an objective and/or the resources for achieving it.

Among these errors, Reason et al. (1990), after Rasmussen (1980), differentiated between two categories. Errors related to knowledge are produced when a trial and error procedure is needed to find the right solution to a new problem. Errors related to the rules come from an inappropriate application of a pre-established rule for action to the situation: either the individual applies the right rule in the wrong way or fails to apply it, or he applies the wrong rule.

Individuals do not perform acts in isolation, however, but rather in a regulated social environment. Thus, while errors concern individual cognitive processes, violations are produced in a social context in which behavior is governed by procedures, practices, rules and norms (Reason et al., 1990). Violations are defined as deliberate deviations from practices, whether formalized or not, that are socially considered as "necessary to maintain the safe operation of a potentially hazardous system" (Reason et al., 1990, p. 1316). If the deviation is not intentional, the action will be classified as an error; if the difference between the action and socially constructed practices is voluntary, the action will be classified as a violation. Violations produced on the road mainly concern deviation from social rules that have a certain degree of intentionality, but their objective is not to cause injury or damages. These violations are associated with attitudes and motivations (Aberg, 1998; Yagil, 1998) and are influenced by the social context (Reason et al., 1990).

This distinction between violations, errors and lapses was examined in several studies on drivers, using the Driver Behavior Questionnaire (DBQ) (Reason et al., 1990). They showed that men and young drivers committed more violations than women, who committed more errors (Özkan et al., 2006; Reason et al., 1990), that elderly drivers committed fewer violations but more errors (Gabaude et al., 2010) and that lapses increased with age (Özkan et al., 2006). New dimensions of accident risk behaviors have been developed in the context of the DBQ to measure drivers' aggressive behaviors (Lawton et al., 1997) and drivers' positive behaviors (Özkan and Lajunen, 2005) toward other road users.

The DBQ has been validated in many countries (Gras et al., 2006; Sullman et al., 2002; Xie and Parker, 2002) and was also used as a conceptual framework to construct tools for investigating these different types of behavior in other types of road users. Thus, Elliott et al. (2007) developed a Motorcycle Rider Behavior Questionnaire (MRBQ) with 43 items. Submitted to a sample of more than 8000 motorcyclists, it has shown that errors were the main predictor of accident risks for powered two-wheelers.

Based on the conceptual framework of the Driver Behavior Questionnaire (DBQ), Moyano Diaz (1997) validated a 16-item Pedestrian Behavior Questionnaire (PBQ) in Chile. Using the PBQ with Chilean pedestrians, he found results similar to those obtained with drivers: men and young pedestrians committed more violations than women and adult pedestrians (Moyano Diaz, 1997, 2002). This tool was recently validated in Brazil (Torquato and Bianchi, 2010) and a version was developed in Turkey, this time differentiating between violations, aggressive behaviors and errors (Yildirim, 2007). In both cases, the results showed more violations by men. Furthermore, more errors were observed among young pedestrians (17–25 years) than among older pedestrians (25–49 years) (Torquato and Bianchi, 2010).

For now, this tool has never been validated in Western societies, even though it would be a useful resource for gaining a more detailed understanding of risky behaviors among pedestrians of all ages, studying the relationships between these different types of risky behaviors and pedestrian accidentology and analyzing risk factors. The purpose of this study was to validate a Pedestrian Behavior Scale for all ages to differentiate between violations, errors and lapses among these behaviors. Based on the studies by Lawton et al. (1997) and Özkan and Lajunen (2005) on drivers and Yildirim (2007) on pedestrians, the goal of this tool was also to provide an understanding of aggressive and positive behaviors by pedestrians toward other road users.

2. Method

2.1. Materials

Using the conceptual framework of the DBQ (Reason et al., 1990) and scales of aggressive driver behaviors (Lawton et al., 1997) and positive driver behaviors (Özkan and Lajunen, 2005) toward other road users, a Pedestrian Behavior Scale (PBS) was constructed. Its items were based on existing validated versions of the PBQ (Moyano Diaz, 1997; Torquato and Bianchi, 2010; Yildirim, 2007), as well as other self-reported Pedestrian Behavior Scales (Elliott and Baughan, 2004; Granié, 2008). The items in the Likert scale differentiated between 5 types of pedestrian behaviors. Offences were defined as an intentional deviation from the legal rules of pedestrian behavior (10 items, e.g. "I cross outside the pedestrian crossing even if there is one less than 50 meters away"). Errors were defined as making decisions that put the pedestrian in danger, but without disobeying the legal rules (11 items, e.g. "I start walking across the street, but I have to run the rest of the way to avoid oncoming vehicles"). Lapses were defined as ill-suited behaviors related to a lack of concentration on the task (8 items, e.g. "I realize that I do not remember the route I have just taken"). According to this definition, crossing without looking was considered as a lapse behavior even when pedestrian light is green, particularly at a crossroad. Then, items concerning lapse during crossing (e.g. "I forget to look before crossing") did not precise if the crossing is regulated or not. Positive behaviors were defined as behaviors that appease social interactions (5 items, e.g. "I thank a driver who stops to let me cross"). Aggressive or antisocial behaviors were defined as conflicting behaviors with other road users (6 items, e.g. "I get angry with a driver and hit his vehicle"). In keeping with Torquato and Bianchi (2010), "filter" items were added (7 items, e.g. "I walk in covered areas (such as shopping centers)"). For each item, the participant was asked: "As a pedestrian, how often do you have the following behaviors?" from "1 = never" to "6 = very often".

Along with answering the PBS, information was gathered on gender, age, the number of years participants have had a driver's license, ownership and use of a motor vehicle, kilometers driven weekly in a motor vehicle, weekly frequency of walking and daily walking time, and the accident history as a driver and as a pedestrian in the previous 5 years.

In order to obtain the widest, most diversified sample possible in terms of age, socio-professional categories and geographical location, we undertook a web-based collection using social networks. The questionnaire was filled out online and its completion took 10 min. Only results from participants living in France were kept. The participants answered the questionnaire individually, after obtaining their informed consent. The responses were totally