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Human factors of pedestrian walking and crossing behaviour

Eleonora Papadimitriou[a,*], Sylvain Lassarre[b], George Yannis[a]

[a]*Department of Transportation Planning and Enginnering, NTUA, 5 Heroon Polytechniou str., GR-15773, Athens, Greece*
[b] *IFSTTAR - Institut français des sciences et technologies des transports, de l'aménagement et des réseaux, 14-20 Boulevard Newton, Cité Descartes, Champs sur Marne, F-77447 Marne la Vallée Cedex 2, France*

Abstract

Human factors related to pedestrians have received somewhat less attention in the literature compared to other road users, although it is often underlined that road and traffic factors appear to explain only a small part of pedestrian walking and crossing behaviour in urban areas. The understanding of pedestrian behaviour in urban areas may assist in the improved design and planning of the road and traffic environment, and consequently to the improvement of pedestrian comfort and safety. The objective of this research is the exploration of human factors of pedestrian walking and crossing behaviour in urban areas. More specifically, this research aims to capture and analyse key components affecting pedestrian walking and crossing behaviour, namely the pedestrians' attitudes, perceptions, motivations, behaviour and habits.

A questionnaire was designed aiming to capture key human factors of pedestrian walking and crossing behaviour including their mobility characteristics and travel motivations, their risk perception and their value of time, their attitudes towards walking and related preferences, their walking and crossing behaviour and compliance to traffic rules, their self-assessment, their opinion on drivers etc. The questionnaire included 54 questions and the responses were given on a 5-point Likert scale (e.g. from "strongly agree" to "strongly disagree", from "never" to "always"), plus some basic questions on demographics. The questionnaire was filled by 75 survey young and middle-aged participants, out of which 40 were males. A thorough descriptive analysis of the questionnaire data was carried out, in order to identify main trends and patterns. A principal component analysis of the data was then implemented, in order to identify underlying factors ("components") of pedestrian walking and crossing behaviour.

The descriptive analysis of the questionnaire responses revealed that most pedestrians have positive attitudes, preferences and behaviours (e.g. risk-conscious and compliant); nevertheless, there is a non-negligible proportion of pedestrians who have negative attitudes and are willing to make dangerous actions (e.g. cross diagonally or at mid-block). A PCA results suggest that there are three dimensions of human factors of pedestrian behaviour: the first two concern their risk perception and risk taking (one reflecting risky attitudes behaviours and the other one reflecting conservative attitudes and behaviours) and the third one concerns walking motivations. There are also two groups of pedestrians identified by a cluster analysis over the dimensions scores: "positive and motivated" vs. "negative and unmotivated" pedestrians.

* Corresponding author. Tel.: +30 210 7721380; fax: +30 210 7721454.
  E-mail address: dpavlou@central.ntua.gr

1. Background and objectives

The literature on human factors and road user behaviour in road and transport design is extensive (e.g. Fuller & Santos, 2002). Human factors related to pedestrians have received somewhat less attention in the literature compared to other road users, although it is often underlined that road and traffic factors alone may explain only a small part of pedestrian walking and crossing behaviour in urban areas (Papadimitriou, 2012). The understanding of pedestrian behaviour in urban areas may assist in the improved design and planning of the road and traffic environment, and consequently to the improvement of pedestrian comfort and safety. On the other hand, there are several studies dealing with human factors in pedestrian road crossing decisions, however these factors are examined alone, outside the context of the road and traffic environment. As a result, these studies provide useful insight on the behavioural and psychological aspects of pedestrian decisions, but have little applicability in terms of describing the crossing behaviour in urban areas (Papadimitriou et al. 2009).

The objective of this research is the in-depth analysis of human factors of pedestrian walking and crossing behaviour in urban areas. More specifically, this research aims to capture and analyse key components affecting pedestrian walking and crossing behaviour, namely the pedestrians attitudes, perceptions, motivations, behaviour and habits, and identify 'profiles' of pedestrians on the basis of these human factors.

1.1. Literature review

There are numerous studies dealing with human factors of pedestrians' crossing behaviour, using formal tools such as questionnaires or in-depth interviews. Hine (1996) used in-depth interviews to identify pedestrians' perception as regards difficulty to cross and assessment of traffic conditions and crossing facilities in the centre of Edinburgh.

Evans and Norman (1998) developed hierarchical regression models for road crossing behaviour, by means of completed questionnaires which included scenarios of three specific potentially dangerous road crossing behaviours. Pedestrians stated crossing behaviour was then modelled in relation to measures of attitude, subjective norm, perceived behavioural control, self-identity and intention. Yagil (2000) proposed multivariate regression models for the self-reported frequency of unsafe crossings in relation to beliefs regarding the consequences of the behaviour, instrumental and normative motives for compliance with safety rules, and situational factors.

Diaz (2002) developed a structural equations model for explaining pedestrian risk-taking behaviour on the basis of attitude, subjective norm, perceived control, behavioural intention and reported violations, errors and lapses. Self-reported crossing behaviour data from pedestrians in the city of Santiago was used on that purpose. Holland and Hill (2007) tested for age and gender differences in road crossing decisions within a theory of planned behaviour analysis including intention, situation and risk perception effects. Oxley et al. (1997) examined the crossing behaviour of elderly pedestrians at mid-block locations by measuring a number of indicators such as kerb delay, gap acceptance, crossing time, time-of-arrival, minimum safety margin and crossing style (non-interactive vs. interactive). Results showed that elderly pedestrians present increased kerb delay, and accept larger gaps; however they also frequently adopt unsafe interactive crossing styles.

A related study (Bernhoft and Carstensen, 2008) revealed that older pedestrians appreciate sidewalks and crossing facilities much more than younger pedestrians. Rosenbloom et al (2008) used a similar method to examine the crossing behaviour of children and found that not looking was the most prevalent unsafe behaviour, followed by the combination of not looking and not stopping, and not stopping before crossing. They also found that children accompanied by an adult committed more unsafe behaviours, especially when not holding hands with the adult.

Sisiopiku & Akin (2003) define spatial crossing compliance rate (SCCR) (i.e. how pedestrians use crosswalks with respect to the location) and temporal crossing compliance rate (TCCR) (i.e. how pedestrians use red signal at traffic controlled locations). The study used both questionnaire and field survey data to compare the perceived and observed compliance rates and concluded that unsignalised mid-block crosswalks were the treatment of preference to