THE EFFECT OF URBAN DESIGN ON THE PEDESTRIANS’ SAFETY PERCEPTION: LIGHTING, VEGETATION, AND ROADWAY LANES

1. Background

Walking, the most common form of transportation, is a risky activity. Although in recent years the trend is the reduction in the number of traffic victims, a considerable percentage of the deceased are still pedestrians. Studying the factors involved is fundamental.

Many studies have focused on identifying objective risky situations related to urban design. However, along with the objective risk there is a perceived sense of risk that has been less studied despite its impact: pedestrians modify their behaviour seeking an accepted level of risk, increasing the accident rate in places where the objective and perceived safety do not match. Therefore, quantifying the safety perception is of vital importance.

2. Aim

The objective of the present study was to analyse the effect that certain configurations of urban design variables have on the pedestrians’ safety perception.

3. Materials and methods

Methodology consists of a field study, in which the safety perception of participants before urban stimuli was quantified.

3.1. Stimuli

Stimuli were virtual reality environmental simulations. This allowed to apply different configurations of design configurations on the same basis, a visual-auditory replica of a real street that was considered representative and apt for the study.

Specifically, variables were: (1) “natural lighting”, (2) “artificial lighting”, (3) “vegetation”, and (4) “number of roadway lanes”. For each of these, different configurations were considered. Thus, for natural lighting, “day” and “night” configurations were applied; for artificial lighting, “2800K”, “4500K”, and “10500K”; for vegetation, “trees” or “non-trees”; and for number of roadway lanes, “1” or “2.” These were studied in combination, giving 18 environmental simulations (Table 1). The scenarios were generated by Unity3D (v5.6; www.unity3d.com). The head-mounted display HTC vive (www.vive.com) was used to reproduce the stimuli.

3.2. Participants

Sample consisted of 70 participants. The sample was balanced in sex, and contained a broad sample of ages in order to discern specific needs. All of them, were placed on a pedestrian crossing of the stimulus, in order to quantify the safety perception.

On the one hand, psychological record consisted on self-assessment. The six concepts that describe the perception of Dominance (psychological) and the LFHF (neuropsychological) levels were:

- The presence of vegetation generates a greater level of Dominance.
- The presence of vegetation generates lower levels of Arousal.

On the other hand, neuropsychological record consisted on Heart-rate variability. The ratio between the low (0.05-0.15 Hz) and the high (0.15-0.4 Hz) frequencies of this signal (LF/HF), which is related to the activation of the sympathetic nervous system (associated to arousal), was calculated using the Welch method.

4. Results

Preliminary results show that it is possible to affect the pedestrians’ diurnal safety perception through the design of the urban environment. Tables 2 and 3 show the average Dominance (psychological) and LFHF (neuropsychological):

5. Conclusions

Different urban design configurations can affect the pedestrians’ safety perception. In addition, at the methodological level, the present study suggests that the combined use of virtual reality and psycho-neuropsychological record are a useful urban design tool. Results are of interest to the agents involved in urban design, as urban planners and policy makers, in their work towards a safer city for pedestrians.