International Co-operation on Theories and
Concepts in Traffic Safety

The Role of Human Subjective Perceptions and Objective Measurements of the Urban Environment in Explaining Pedestrian Injury Severity

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Human perception of the urban landscape is crucial in shaping local residents' engagement and informing policies that enhance their quality of life. Particularly at the street level, this perception influences behaviors and can lead to diverse social outcomes, such as affecting an individual's sense of place, walking behavior, and both physical and psychological health. Although research has revealed possible connections between human perceptions of the environment and safety, the exact relationship between these factors and pedestrian injury severity is still unknown.

This study investigates the complex relationship between perceptions of the urban environment and crash injury severity outcomes. It addresses the challenge of conducting time-consuming interviews by utilizing an advanced deep-learning method and street view imagery (SVI). The research employs the Place Pulse 2.0 dataset to train a model to identify six key subjective perceptions indexes—security, depression, boredom, liveliness, wealth, and aesthetics—from SVI of Seoul, the study area. Place Pulse 2.0, a crowdsourcing platform, enables online volunteers to evaluate urban environments by presenting them with paired images and soliciting their preferences. In addition to subjective assessments, the study incorporates an objective analysis using a deep convolutional neural network to examine physical features from SVIs obtained from the crash scenes (, an approach acknowledged as effective for SVI segmentation. Ensemble learning methods are then applied to explore the relationship between perceptions of urban environments and crash injury severity.

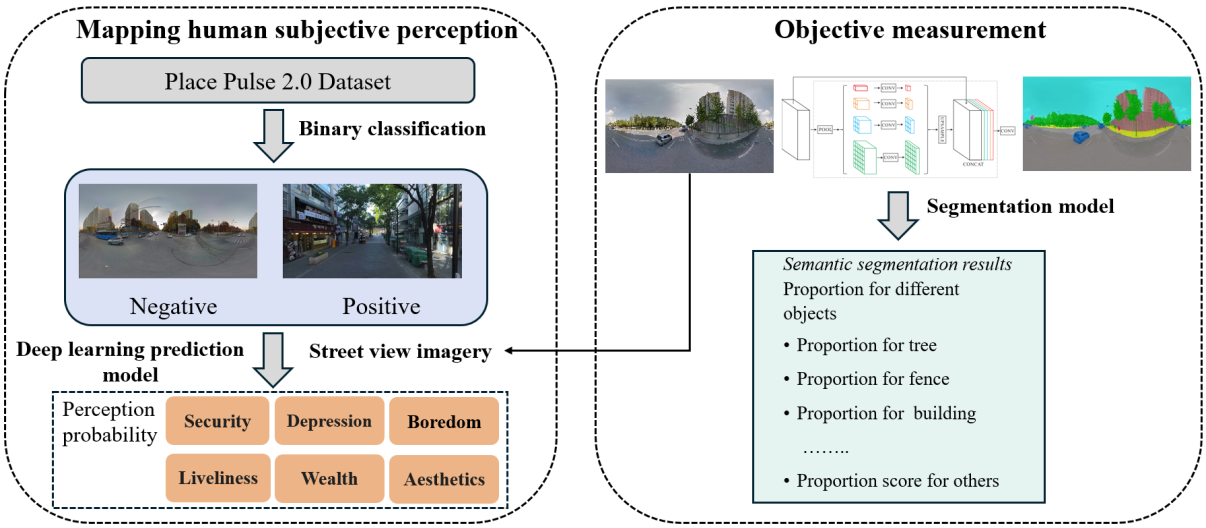

Figure 1. Framework of urban environment perception measurement

The findings reveal that the model achieves moderate to high accuracy in predicting subjective perceptions, with all metrics scoring above 0.5. Notably, the prediction models for aesthetic perception are particularly accurate, achieving an 84% accuracy rate. Spatial analysis of the perception features reveals a significant heterogeneity pattern, with aesthetics identified as the most influential factor on crash injury severity in general. In contrast, perceptions of liveliness and security have minimal impact. Interestingly, a sense of security often mismatches with actual crash safety; in some areas, the greater the perceived safety by pedestrians, the higher the likelihood of fatal and severe injuries, until a certain threshold where perceived and actual safety align. The study underscores the value of complementing subjective and objective evaluations of the urban environment, offering a holistic approach to understanding and mitigating crash injury severity. This integration significantly advances the field by enhancing our understanding of how these varied assessments can individually and collectively influence pedestrian crash injury severity outcomes.

Keywords: Injury severity; Human subjective perception; Street view image; Deep learning