

Environmental factors related to perceived stress in open public spaces

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I. ABSTRACT

Current city living has been related to various manifestations of stress and a higher risk for mental health problems (Lederbogen, et al., 2011). Lederbogen et al. (2013) have named a set of influencing factors to urban social stress including infrastructure, socio-economic factors, noise and environmental pollution. It remains an open question, which factors of the built environment are critical to influence subjectively perceived urban stress (PUS), how these factors interact and how they can be addressed by planning and urban design in order to maximize pedestrian comfort. This talk introduces a framework of environmental factors and spatial analysis tools shown useful to describe and predict PUS in open public spaces (OPS). In a first step, environmental properties have been constructed for a sample of OPS in the city of Darmstadt, Germany, using the space syntax framework (Hillier & Hanson, 1984). These were paired to users' ratings of spatial qualities such as loudness and subjectively perceived safety and stress (figure 1). Isovist vertice density has been shown to be weakly associated to users' ratings of safety ($r = .365$, $p = .09$, Pearson), while global and citywide integration of a street segment have been shown closely related to PUS ($r = 0.432$, $p = 0.04$, Pearson) (Knöll, Neuheuser, Li, & Rudolph-Cleff, 2015). In a second step, the data has been analyzed using different types of multivariate models with the aim to predict ratings of PUS with a highly explained variance and significance. Open space typologies (park, square, courtyard, streets) were found the best predictors for PUS, followed by building coverage ratio, isovist vertices numbers and syntactical characteristics. A model has been presented that uses a combination of environmental properties and achieves a predictive power of $R^2 = 54.6\%$ (Knöll, Neuheuser, Cleff, & Rudolph-Cleff, 2016). These results are a first attempt to predict more complex emotions such as perceived urban stress by analyzing factors of the built environment and using standard planning tools such as GIS and Space Syntax. They extend existing models that have predicted tranquility in green spaces (Watts, Pheasant, & Horoshenko, 2014) or activities and spatial experience in streetscapes (Bielik, Schneider, Kuliga, Valasek, & Donath, 2015). The framework may be useful to architects and neuroscientists alike, who seek to identify urban configurations likely to be perceived as stressful and seek to further investigate pedestrian comfort by pairing environmental factors with geo-referenced, psychophysiological effects.

Keywords: Open Public Space, Built Environment, Perceived Urban Stress, Pedestrian Comfort, Space Syntax



FIGURE 1 SHOWS PARTICIPANTS RATING ENVIRONMENTAL PROPERTIES IN OPEN PUBLIC SPACES (OPS) USING A SMARTPHONE APP (HALBLAUB MIRANDA, HARDY, & KNÖLL, 2015). IN THE CENTRE, AN ISOVIST WITH A HIGH VERTICES DENSITY (VERTEX NUMBER / ISOVIST AREA²) IS SHOWN, WHICH IS WEAKLY ASSOCIATED TO USERS' RATINGS OF AN OPS AS "SAFE". ON THE RIGHT, A MAP OF DARMSTADT SHOWS THE GLOBAL INTEGRATION ($R=N$) VALUES OF ITS STREET SEGMENTS (RED INDICATES HIGH GLOBAL INTEGRATION), WHICH ARE SIGNIFICANTLY RELATED TO RATINGS OF OPS AS "MAX. STRESSFUL" (KNÖLL, NEUHEUSER, LI, & RUDOLPH-CLEFF, 2015).

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