Key Words: Urban redevelopment project, Natural experiment, Daytime population dynamics, Urban network analysis

UNDERSTANDING PERCEIVED PHYSICAL DISORDER USING SUBJECTIVE MEASUREMENT

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Research-in-Motion (RiM)

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Physical disorder refers to an environmental characteristic marked by high levels of decay and disorderliness (Sampson & Raudenbush, 1999), which can detrimentally impact mental health, disease rates, crime levels, and the socioeconomic status of neighborhoods (Hill et al., 2005). Due to its significance and direct relevance to the built environment, the concept has been measured both objectively and subjectively in the related urban planning and geography literature. On the one hand, many scholars have adopted objective measurements to assess physical disorder (e.g., presence of litter and abandoned buildings) using virtual street audit. More recently, with the advancement of big data, researchers constructed assessment scales using five categories (e.g., architecture, commerce), proposing a scalable method for identifying Street View Imagery (SVI) using Deep Learning (DL) models (Chen et al., 2023).On the other hand, some scholars argue perceived disorder differs from objective assessments (Franzini et al., 2008), which could lead to potential bias as they can not reflect subtle subjective experiences. However, limited research has measured physical disorders subjectively on a large scale due to time constraints and labor costs with conventional questionnaires. Therefore, this study aims to bridge this gap by proposing a subjective evaluation method using Machine Learning (ML) models, computer vision (CV) algorithms integrated with SVI data for assessing physical disorder to seek empirical evidence for urban studies.

Due to limited subjective perception data, this research proposes to collect designers' perceptions on five major categories of physical disorder (i.e., architecture, commerce, road, greenery, and infrastructure disorder) following the theoretical framework from pairwise SVIs rankings using Shanghai as a case study site with an online visual survey. We invite 50 designers to rank SVI pairs from 300 randomly sampled locations for higher perceived disorder and score them through algorithms. This approach has been applied in studies that measure subjective psychological perceptions in a similar fashion (Zhang et al., 2018) and was deemed credible. Then, we utilize CV and DL algorithms to extract high-level street features (e.g., tree, plant) and low-level image features (e.g., saturation) as explanatory variables to train the ML model. Utilizing the best predictive ML models, we can further predict the citywide subjective physical disorder spatial patterns. Lastly, we regress 5 subjectively measured physical disorder scores separately with housing price data to compare its explanatory performance and its impacts empirically, uncovering several insights. For instance, the OLS regression result has substantiated those subjective perceptions of physical disorder significantly affect housing prices, demonstrating the broad applicability of this automated approach to measuring subjective physical disorder. Notably, negative correlations are found between commercial, greenery, and infrastructure disorder and housing prices, indicating the necessity for urban design to enhance environmental and economic value.

To conclude, this article makes several meaningful contributions to the existing literature. Firstly, our research

offers a novel method using computer algorithms and big data to subjectively measure an under-addressed concept, physical disorder, which could be used as a training set to predict other urban scenes in the future. Secondly, our approach provides a complementary perspective for studying urban decay, capturing nuances often neglected by solely relying on objective measures. Finally, it has the potential to clarify what street physical characteristics may heavily influence physical disorder and further deduce its adverse effects on public health and safety. This empowers urban designers to devise targeted strategies, fostering healthier and more pleasant urban environments conducive to an equitable society.

Citations:

- Chen, J., Chen, L., Li, Y., Zhang, W., & Long, Y. (2023). Measuring Physical Disorder in Urban Street Spaces: A Large-Scale Analysis Using Street View Images and Deep Learning. Annals of the American Association of Geographers, 113(2), 469–487. https://doi.org/10.1080/24694452.2022.2114417
- Franzini, L., Caughy, M. O., Nettles, S. M., & O'Campo, P. (2008). Perceptions of disorder: Contributions of neighborhood characteristics to subjective perceptions of disorder. Journal of Environmental Psychology, 28(1), 83–93. https://doi.org/10.1016/j.jenvp.2007.08.003
- Hill, T. D., Ross, C. E., & Angel, R. J. (2005). Neighborhood Disorder, Psychophysiological Distress, and Health. Journal of Health and Social Behavior, 46(2), 170–186. https://doi.org/10.1177/002214650504600204
- Sampson, R. J., & Raudenbush, S. W. (1999). Systematic Social Observation of Public Spaces: A New Look at Disorder in Urban Neighborhoods. American Journal of Sociology, 105(3), 603–651. https://doi.org/10.1086/210356
- Zhang, F., Zhou, B., Liu, L., Liu, Y., Fung, H. H., Lin, H., & Ratti, C. (2018). Measuring human perceptions of a large-scale urban region using machine learning. Landscape and Urban Planning, 180, 148–160. https://doi.org/10.1016/j.landurbplan.2018.08.020

Key Words: physical disorder, subjective perception, street view images, environmental audit, deep learning