

Urban perceptual inequalities of 15-minute city: A Comparative Streetscape Analysis of Residential Areas and Transit-Oriented Development (TOD)

Martin Zidong Yu ^a, Xintao Liu ^{a, *}

^a Department of Land Surveying and Geo-Informatics, The Hong Kong Polytechnic University, Hong Kong, Martin Z Yu – Martin-zidong1.yu@polyu.edu.hk, Xintao Liu - xintao.liu@polyu.edu.hk

* Corresponding author

Keywords: Street view images (SVIs), Urban streetscapes, Human perception, 15-minute city, Transit-oriented development (TOD)

Abstract:

Walking has been long considered the most representative active mobility means of daily short-distance and transit-dependent travel, therefore becoming one of the paramount objectives in current urban sustainable policies. In this context, the 15-minute city concept is introduced and discussed to further specify the implementation of promoting walking in cities (Abbiasov et al., 2024; Moreno et al., 2021). Having promoted this sustainable concept in cities, there is a strong demand for multidisciplinary stakeholders to better understand the walking environment perceived by pedestrians within a 15-minute commuting context.

Research oversight on the perceptual urban environment within a 15-minute commuting context can be problematic. It was reported that the walkability perception of surrounding environments can affect physical and mental health (Su et al., 2017). Urban space covering by 15-minute distance can be to some degree considered as dense and prosperous areas most frequently visited by pedestrians. Meanwhile, the investment from the government and communities to enhance urban environments is always limited, which is inadequate and unrealistic for covering large-scale areas (D'Orso & Migliore, 2020). Research questions are accordingly presented and will be addressed in this study:

- By utilizing the SVIs, how to quantitatively measure the human perceptions of the built environment given the context of 15-minute commuting areas?
- Can different areas with similar perception profiles be measured and determined? What are the heterogeneous patterns of local neighborhood and transit-oriented development (TOD) areas?

A spatial data-driven comparative analysis is introduced to capture and investigate the visual walking perception of surrounding streetscapes and the relationship with accessibility to nearby urban functions within the 15-minute commuting context, using Hong Kong as an empirical case. SVIs would be first used to capture the human perceptions in terms of the surrounding visual environments, via a deep learning approach featured by Vision Transformers (ViT). Six kinds of perception are quantified and scored, including safety, boredom, depression, wealth, liveliness, and beauty. A clustering approach is then applied to aggregate all areas using their areal perception scores, showcasing the spatial heterogeneous patterns. Selected analytical results are reported below:

Figure 1 presents the clustering result of urban perceptual streetscape by LTPUs in Hong Kong, while all LTPUs can be classified into 4 groups labeled with different colors. A large number of LTPUs (58.9%) are classified into group 1, presenting a major focus on the perceptions of depression, wealth, and liveness. These LTPUs are largely located in the downtown areas such as Kowloon and Hong Kong Island, featuring densely built environments and flourishing urban activities. Figure 2 reports the clustering results of urban perceptual streetscape by MTR stations. All stations are classified into 5 groups labeled with different colors and indicate substantial spatial heterogeneity regarding their distribution. 7 MTR stations are identified as groups 1 and 2 with slightly higher scores of beauty, both far from the downtown and primarily located on the outskirts of the city. The SVI samples from these groups are mostly expansive landscapes with sparse buildings and human activities. We find essential differences exhibited by groups 3 and 4, in terms of perception, distribution, and SVIs sample. MTR stations in group 3 are characterized by a strong focus on boredom and depression and are distributed across new towns of Hong Kong which are mostly for residential purposes.



Figure 1. Clustering result of urban perceptual streetscape by LTPUs in Hong Kong. (A) clustering heatmap of aggregated perception scores; (B) the spatial distribution of clustered LTPUs; (C) selected SVI sample to represent different groups.

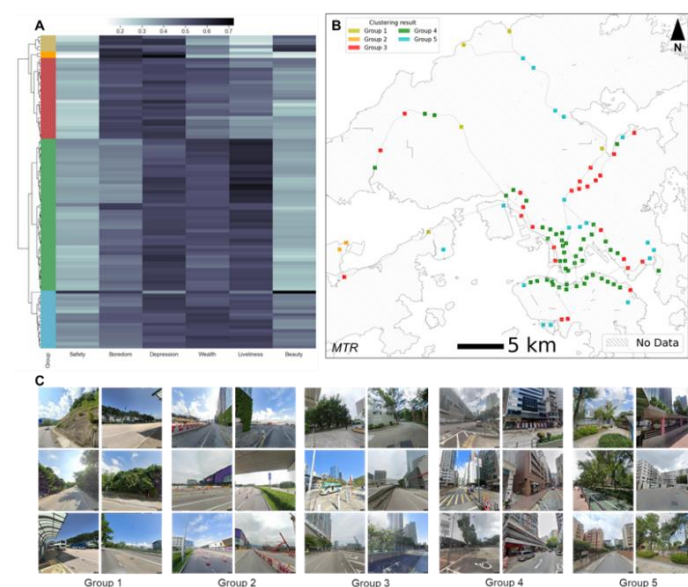


Figure 2. Clustering result of urban perceptual streetscape by MTR stations in Hong Kong. (A) clustering heatmap of aggregated perception scores; (B) the spatial distribution of clustered metro stations; (C) selected SVI sample to represent different groups.

References

- Abbasov, T., Heine, C., Sabouri, S., Salazar-Miranda, A., Santi, P., Glaeser, E., & Ratti, C. 2024. The 15-minute city quantified using human mobility data. *Nature Human Behaviour*, 8(3), 445-455.
- D'Orso, G., & Migliore, M. (2020). A GIS-based method for evaluating the walkability of a pedestrian environment and prioritised investments. *Journal of transport geography*, 82, 102555.
- Moreno, C., Allam, Z., Chabaud, D., Gall, C., & Pratlong, F. (2021). Introducing the “15-Minute City”: Sustainability, resilience and place identity in future post-pandemic cities. *Smart cities*, 4(1), 93-111.
- Su, S., Pi, J., Xie, H., Cai, Z., & Weng, M. (2017). Community deprivation, walkability, and public health: Highlighting the social inequalities in land use planning for health promotion. *Land Use Policy*, 67, 315-326.