A Comprehensive Framework to Measure Multidimensional Urban Vibrancy Using Multisource Spatiotemporal Datasets: A Comparison of Latent and Dynamic Urban Vitality

Dan Qiang[1] and Grant McKenzie[2]

[1]Platial Analysis Lab, Department of Geography, McGill University, dan.qiang@mail.mcgill.ca

[2]Platial Analysis Lab, Department of Geography, McGill University, grant.mckenzie@mcgill.ca

Urban vitality is a key representation of urban economic, sustainable development, and social well-being. Numerous studies have calculated metrics and developed frameworks for improving classic urban vitality analyses. The classical latent vitality is frequently used to depict the vibrancy of the physical built environment by accessibility, density, and functionality with block or parcel units. However, most of these indicators are static and do not reflect temporality. Recently, the emergence of successive and multi-sourced spatiotemporal datasets has made it possible to overcome the barriers of static analysis. This provides a strong potential to measure real-time dynamic urban vitality. Some researchers have started using geographic big data to capture dynamic vitality through, for instance, population heatmaps, traffic trajectory, and mobile phone data. By contrast, less attention has been paid to features of urban dynamics in different types of mobility. Few have evaluated temporal dynamic vitality through a comprehensive measure or index, not to mention investigated the relationship between dynamic and latent urban vitality. Thus, this study proposes to bridge the gap by presenting a comprehensive framework to portray multidimensional urban vibrancy. We try to uncover the effects of spatial dynamics on urban structure, function, and resilience through four key steps. First, by developing a methodology to identify "mobility vitality" using various transit modes, which serves as one aspect of dynamic vitality. Second, by combining different dynamic vitalities represented by various spatiotemporal datasets together into one framework. Third, by understanding and combining the concepts of dynamic urban vitality and latent urban vitality into a comprehensive framework. Last, by developing a web-based platform that ingests a range of data and outputs measures of dynamic/comprehensive urban vitality to better inform urban planners and policymakers. The results of this work will help us better understand the spatiotemporal activity variability within a city and the reasons contributing to the variation. Additionally, unveiling the connection between dynamic vitality and the built

environment will generate critical insights to foster urban vibrancy in under-developed neighborhoods within cities and provide scientific guidelines for human-oriented urban design.