# STRUCTURAL DIVERSITY OF URBAN GREEN SPACE AND ITS IMPACT ON AFFECTIVE WELL-BEING AND BRAIN FUNCTION

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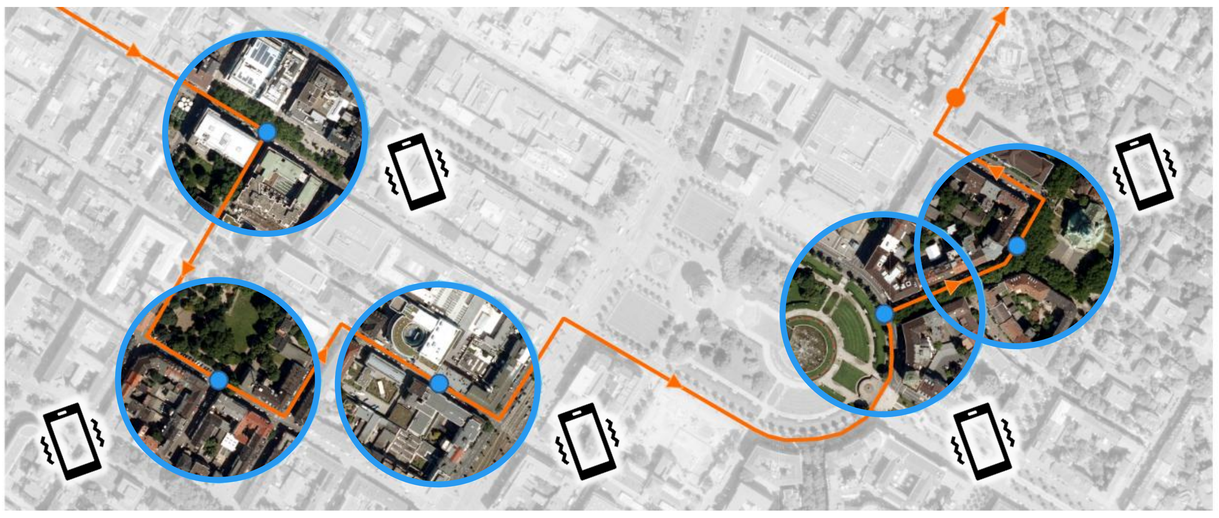
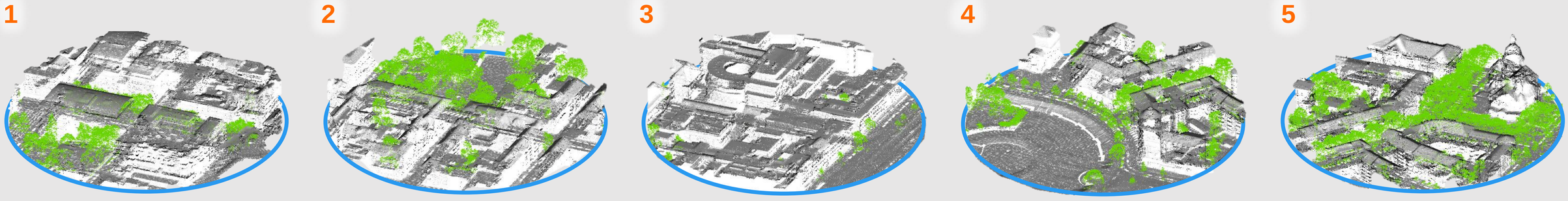
## Relevance of urban green spaces for daily-life well-being

Urban green spaces are widely recognized as protective factors for mental health, yet most research treats green space as a uniform category[1,2]. Structural diversity, particularly the distinction between vegetation greenness[3] and height[4], has received little attention, especially in relation to momentary well-being and underlying neural mechanisms. We combined Ecological Momentary Assessment (EMA) with high-resolution geospatial mapping and functional MRI to investigate how vegetation greenness and height exposure influences affective valence in everyday life.

## Methods



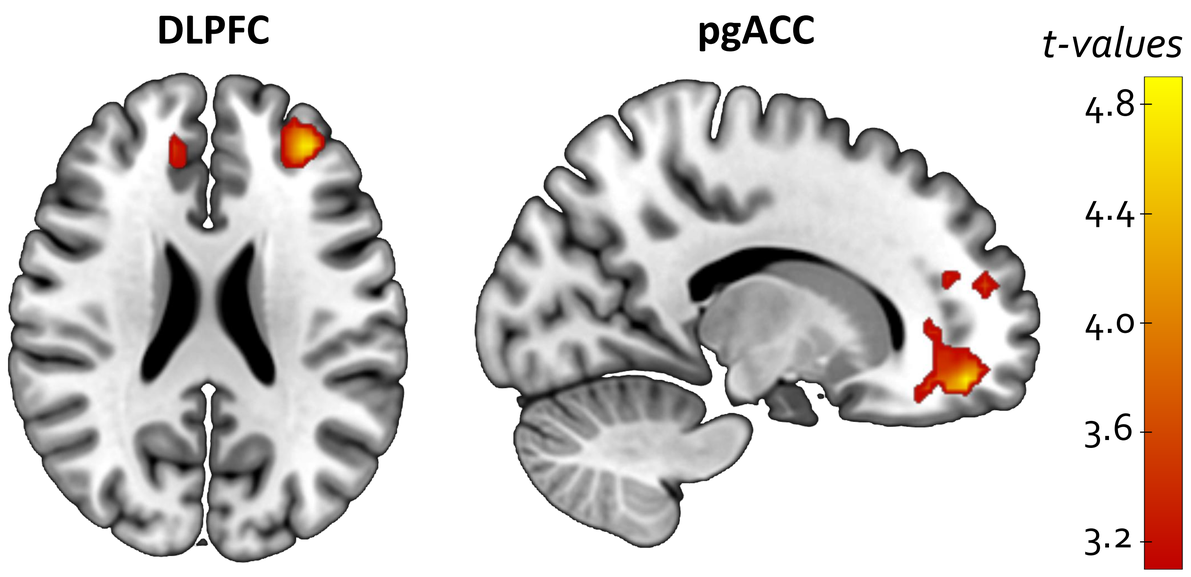




### Ambulatory Assessment

**Participants:** 184 young adults
**Duration:** 7 days
**E-diary:** affective valence
**Mobile sensing:** GPS tracking (NDVI)

### Neuroimaging

**fMRI:** emotional faces vs. shapes task (Hariri et al.[5])




$P_{FWE}$ = 0.038 $t$ = 4.78

$P_{FWE}$ = 0.027 $t$ = 4.88

## Results

- **Vegetation greenness** positively predicted momentary affective valence (p=0.023) while **vegetation height** explained additional variance beyond horizontal green (p=0.004)
- Negative associations between **vegetation height slopes** and activity in **DLPFC** ($P_{FWE}$=0.038) and **pgACC** ($P_{FWE}$=0.027).

## Conclusion

Vegetation greenness appears to offer broadly uniform benefits, whereas vegetation height elicits heterogeneous affective responses linked to regulatory brain systems. Together, the findings underscore the importance of considering structural diversity in urban greening strategies and highlight interindividual differences as a key factor in shaping mental health benefits of nature exposure.

## References

[1] Twohig-Bennett & Jones. (2018). The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. Environmental Research. https://doi.org/10.1016/j.envres.2018.06.030
[2] van den Bosch, & Ode Sang (2017). Urban natural environments as nature-based solutions for improved public health – A systematic review of reviews. Environmental Research. https://doi.org/10.1016/j.envres.2017.05.040
[3] Astell-Burt & Feng (2019). Association of Urban Green Space With Mental Health and General Health Among Adults in Australia. JAMA Network Open. https://doi.org/10.1001/jamanetworkopen.2019.8209
[4] Zhang, et. al (2022). Effects of tree canopy on psychological distress: A repeated cross-sectional study before and during the COVID-19 epidemic. Environmental Research. https://doi.org/10.1016/j.envres.2021.111795
[5] Hariri, et. al (2002). Serotonin Transporter Genetic Variation and the Response of the Human Amygdala. Science. https://doi.org/10.1126/science.1071829