

Emotional Landscapes: Mapping Urban Park Sentiments Using Natural Language Processing

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Abstract:

Public parks are essential to urban life, fostering physical activity, mental health, and social cohesion. Traditional methods to assess park perception—like surveys—are often time-consuming and slow to adapt to urban change. This study introduces an automated, scalable approach for capturing public sentiment using geolocated Google Reviews and Natural Language Processing (NLP), applied to urban parks in Philadelphia. We show how emotional expressions vary across space and time, providing actionable insights for planners and community designers.

Methodology. Our study analyzed over 37,000 Google Reviews from 2016 to 2024 across more than 200 parks in Philadelphia, each with a minimum of 25 reviews. Reviews were collected using Outscraper and processed with a fine-tuned RoBERTa model to classify 28 emotions, later grouped into six overarching clusters: Inspiration, Relaxation, Engagement, Discovery, Frustration & Annoyance, and Sorrow. We applied exponential decay weighting to favor recent reviews and geocoded the outputs for spatial analysis and visualization.

Unlike many prior studies that focus only on sentiment polarity, we emphasize emotional richness and spatial storytelling through cartographic outputs. Emotions were visualized using choropleths, bivariate maps, and cluster-based classifications at the park level. Figure 1 outlines the analytic workflow.

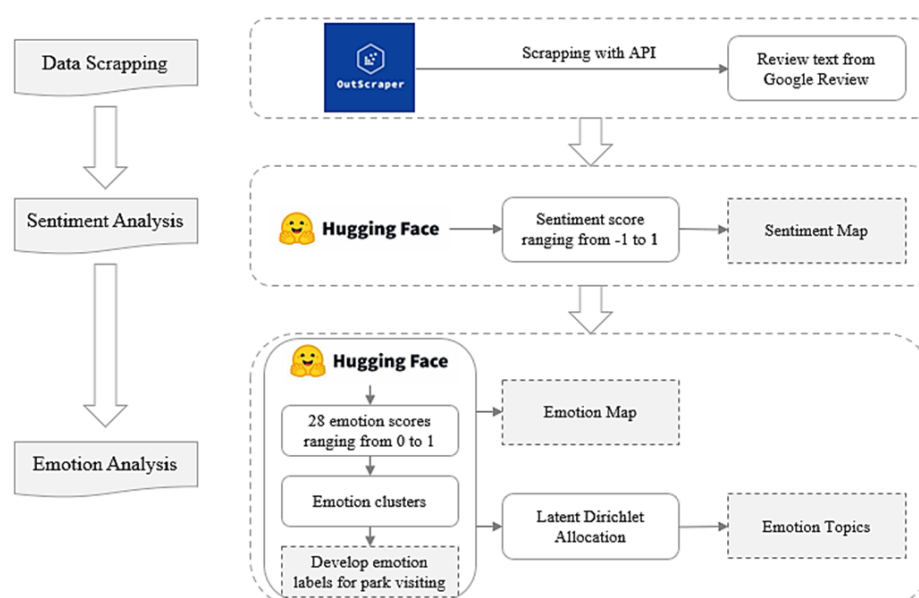


Figure 1. Workflow: Data collection, emotion classification, and spatial mapping.

Results. The analysis revealed generally positive sentiments toward parks in Central, West, and Northwest Philadelphia, with temporal fluctuations influenced by seasonal factors. Positive sentiment peaked in 2021, likely reflecting increased

park use after pandemic restrictions, but showed a decline in subsequent years. Neighborhood playgrounds received more negative feedback, often linked to concerns about maintenance and safety. Emotion mapping highlighted Inspiration and Relaxation as the dominant sentiments across most parks. Central parks like John F. Kennedy Plaza exhibited consistently high positive sentiment, while some smaller parks in Northeast and South Philadelphia displayed higher levels of Frustration & Annoyance, often tied to cleanliness and safety concerns. Discovery emotions were prominent in parks with unique natural or historical features, while Sorrow was more prevalent in memorial parks (Figure 3).

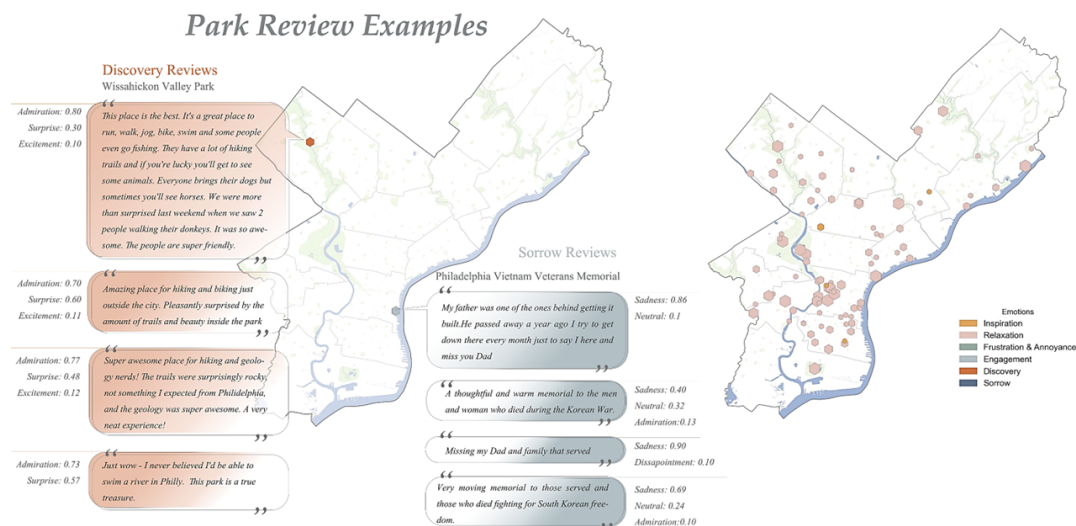


Figure 2. Spatial distribution of “Discovery” and “Sorrow” emotions (left); dominant emotion per park (right).

Conclusions. By combining NLP and geospatial analysis, this work demonstrates how digital footprints can inform equitable urban design. Our methods allow for scalable emotional mapping, replicable across cities. The integration of real-time user feedback with spatial visualization supports the ICA’s broader mission to foster inclusive, sustainable urban environments.

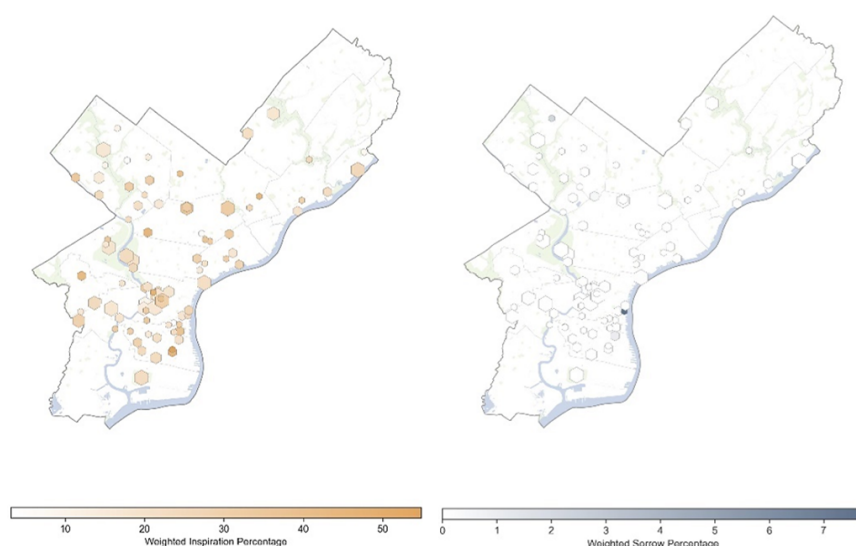


Figure 3. Distribution of all six emotion clusters across Philadelphia’s parks.

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References.

1. Dodds, P.S., Harris, K.D., Kloumann, I.M., Bliss, C.A., & Danforth, C.M. (2011). Temporal patterns of happiness and information in a global social network: Hedonometrics and Twitter. *PLOS ONE*, 6(12), e26752.
2. Mohammad, S.M. (2020). Practical and ethical considerations in the effective use of emotion and sentiment lexicons. *LREC Proceedings*, 2020.
3. Hauthal, E., Burghardt, D., & Kühne, O. (2021). Affective cartography: Perspectives and research challenges. *Cartographic Journal*, 58(3), 165–175.