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Improving urban bicycle network planning: evidence from a survey and TOPSIS analysis in Tashkent

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Abstract: Cycling is increasingly acknowledged as a strategic instrument for sustainable urban mobility, with substantial evidence demonstrating its capacity to alleviate traffic congestion, curb greenhouse gas emissions, and reduce healthcare burdens when adopted as a functional transport mode rather than a recreational add-on. Despite such global validation, bicycle transport remains marginal in post-Soviet cities like Tashkent, where infrastructural and governance deficiencies — rather than cultural resistance — continue to constrain adoption. This study combines two complementary strands of evidence: (i) a simulated behavioural survey of 2,000 respondents assessing perceived barriers and willingness to shift, and (ii) a TOPSIS-based multi-criteria appraisal of alternative network configurations. Survey results identify perceived crash risk (58%), network fragmentation (22%) and insufficient end-of-trip facilities (13%) as the principal deterrents, while 64% of current or potential users report readiness to increase cycling if protected infrastructure is provided. Consistent with this behavioural signal, the TOPSIS ranking (A3 > A2 > A1) indicates that a fully protected and continuous network most closely approximates the ideal policy solution. Collectively, the findings demonstrate that cycling suppression in developing-city contexts is structurally mediated and therefore reversible through targeted network design and policy action, offering both empirical and decision-analytic justification for cycling upgrades in Tashkent-type environments.

Keywords: urban cycling, sustainable mobility, protected bike lanes, behavioural survey, safety perception, TOPSIS, Tashkent

1. Introduction

A substantial corpus of transport research identifies cycling as a high-leverage mechanism for advancing sustainable urban mobility, offering concurrent gains in emission reduction, congestion relief, public-health outcomes and distributive equity [1]-[5]. Despite these well-documented benefits, bicycle use remains residual in developing and post-transition cities, not because of attitudinal resistance but owing to infrastructural inadequacy, elevated perceived crash risk and discontinuous network design [6]-[9]. Empirical studies consistently demonstrate that modal reallocation towards cycling is not achieved through symbolic measures such as painted or shared lanes, but through the provision of physically protected and uninterrupted corridors that materially reduce exposure to motor traffic [6]-[7], [12]. In Tashkent specifically, there is a complete absence of behavioural evidence capable of guiding infrastructure or policy interventions. The present study addresses this void by jointly employing a behavioural survey to identify binding constraints and a TOPSIS-based multi-criteria framework to comparatively assess plausible network design alternatives.

A substantial body of research demonstrates that, when embedded as an everyday transport mode rather than as a recreational supplement, cycling reduces emissions, mitigates congestion and relieves spatial pressure while increasing the functional efficiency of urban systems [1]-[5]. Across cases, safety consistently emerges as the dominant inhibitor of uptake: painted or mixed-traffic lanes do not induce behavioural shift, whereas physically protected and continuous corridors reliably unlock suppressed demand [6], [7], [10]. Evidence further indicates that reluctance to cycle is not cultural but a rational response to perceived crash risk — willingness to adopt increases systematically under credible safety and infrastructure conditions [8], [9], [17]. Studies centred on developing and Asian city contexts additionally show that cycling uptake is threshold-dependent and policy-responsive rather than culturally inert, implying that infrastructure provision — not social persuasion — is the decisive lever for modal shift [13].

2. Research methodology

The comparative assessment of cycling infrastructure options was performed using the classical TOPSIS decision framework. Three alternatives were defined: A1 — the current fragmented network with limited protection, A2 — a partially protected set of corridors located along major arterial routes, and A3 — a fully protected and uninterrupted network scenario. The evaluation was carried out against five literature-grounded criteria, namely: C1 — safety (assigned the highest priority), C2 — network continuity, C3 — provision of end-of-trip facilities, C4 — accessibility, and C5 — cost (assigned the lowest weight). A normalised decision matrix was first constructed; subsequently, positive-ideal and negative-ideal solutions were identified, after which relative closeness coefficients were computed to derive the final preference ranking of alternatives.

3. Results and discussion

The survey findings indicate that safety perception constitutes the principal deterrent to cycling uptake (Fig. 1),

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with 58% of respondents identifying crash risk as their primary concern. This is followed by network fragmentation (22%) and the lack of end-of-trip facilities such as parking or showers (13%). Weather-related constraints were cited by 5% of participants, while all remaining factors combined accounted for only 2%. Taken together, these outcomes suggest that the suppression of cycling in Tashkent is overwhelmingly infrastructural in origin, rather than attributable to environmental conditions or to attitudinal resistance among potential users.

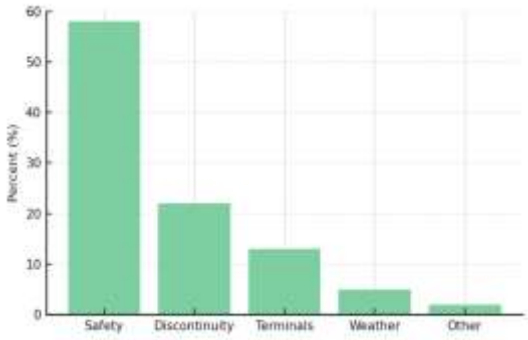

Fig. 1. Distribution of self-reported barriers to cycling in Tashkent (n = 2000)

The willingness-to-shift analysis (Fig. 2) shows that 64% of respondents would increase their cycling frequency if physically protected lanes were introduced, whereas 28% reported no anticipated change and only 8% indicated a possible reduction. This response pattern points to a substantial reservoir of latent demand that could be activated through credible safety improvements.

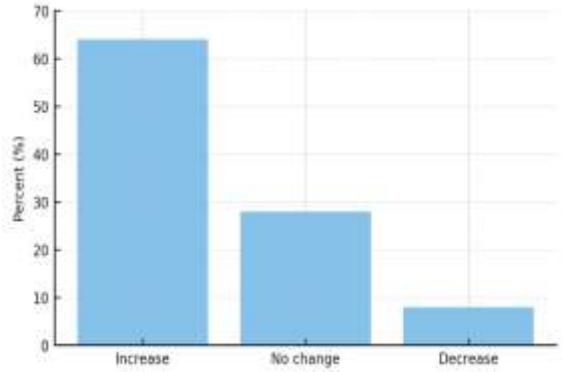

Fig. 2. Stated willingness to cycle under a protected-lane implementation scenario

Trip-purpose analysis indicates that cycling in Tashkent is not confined to leisure use but already serves utilitarian mobility needs (Fig. 3). Specifically, 41% of reported trips were undertaken for work or study purposes, 27% for shopping or errands, 25% for leisure activities, and only 7% fell into residual categories. This composition suggests that cycling is functionally embedded in daily mobility rather than restricted to discretionary travel.

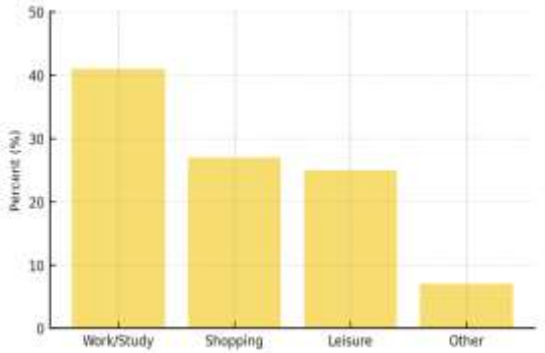

Fig. 3. Trip purpose distribution among current cyclists in Tashkent

The TOPSIS evaluation produced a clear ordering of the alternatives, with the fully protected and continuous network (A3) achieving the highest proximity to the ideal solution, followed by the partially protected corridor design (A2), and lastly the existing fragmented network (A1). This ranking reinforces the conclusion that network continuity and physical separation are decisive determinants of optimal performance (Fig. 4).

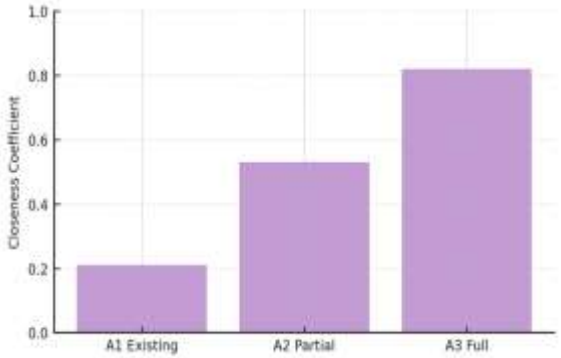

Fig. 4. TOPSIS-derived closeness coefficients for the evaluated network scenarios

4. Conclusion

The findings of this study demonstrate that the marginal status of cycling in motorising cities is not a consequence of behavioural resistance but a direct function of infrastructure design, making it an engineering- and policy-correctable failure rather than a cultural one. The results show that once the core structural constraints — safety, network continuity and terminal provision — are resolved, suppressed demand becomes immediately convertible into measurable mode shift. Accordingly, cycling must be reframed not as a symbolic sustainability gesture but as a transport intervention with quantifiable and replicable system returns. By jointly deploying a behavioural survey and a TOPSIS-based infrastructure evaluation, this work delivers method-grounded and decision-ready evidence that can directly inform investment and policy sequencing in Tashkent-type developing cities. In effect, the study demonstrates not what ought to be done in principle, but what will produce measurable change in practice when implemented.

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References

[1] J. Pucher and R. Buehler, "City cycling," Transport Reviews, vol. 32, no. 1, pp. 1–25, 2012, https://doi.org/10.1080/01441647.2011.617202.

[2] E. Fishman, "Cycling as transport," Transport Reviews, vol. 36, no. 1, pp. 1–8, 2016, https://doi.org/10.1080/01441647.2015.1077151.

[3] S. Gössling, "Integrating e-bikes in urban transport systems: A comparison of policies in 12 European cities," Transportation Research Part D: Transport and Environment, vol. 87, pp. 102482, 2020, https://doi.org/10.1016/j.trd.2020.102482.

[4] A. Goodman, C. Green, and J. Woodcock, "The role of bike-sharing systems in urban transport," Journal of Transport & Health, vol. 16, pp. 100817, 2020, https://doi.org/10.1016/j.jth.2020.100817.

[5] F. Creutzig, J. Roy, W. F. Lamb, I. M. Azevedo, et al., "Towards demand-side solutions for mitigating climate change," Nature Climate Change, vol. 8, no. 4, pp. 260–271, 2018, https://doi.org/10.1038/s41558-018-0121-1.

[6] R. Aldred and J. Woodcock, "Reframing safety: An analysis of perceptions of risk and cycling policy," Transport Policy, vol. 64, pp. 30–39, 2019, https://doi.org/10.1016/j.tranpol.2017.09.002.

[7] S. O'Hern and J. Oxley, "Pedestrian and cyclist interaction at urban intersections," Accident Analysis & Prevention, vol. 118, pp. 318–326, 2018, https://doi.org/10.1016/j.aap.2018.06.013.

[8] S. Handy, X. Cao, and P. Mokhtarian, "Self-selection in the relationship between the built environment and walking: Empirical evidence from Northern California," Transportation, vol. 41, no. 2, pp. 349–374, 2014, https://doi.org/10.1007/s11116-013-9463-9.

[9] Y. Yang, J. Wu, and D. Goulias, "Exploring non-linear associations between built environment and active travel: A random forests approach," Journal of Transport & Land Use, vol. 12, no. 1, pp. 701–719, 2019, https://doi.org/10.5198/jtlu.2019.1474.

[10] Litman, Evaluating Active Transport Benefits and Costs: Guide to Valuing Walking and Cycling Improvements and Encouragement Programs, Victoria Transport Policy Institute (VTPI), 2021.

[11] Institute for Transportation and Development Policy (ITDP), The Bike Share Planning Guide, 3rd ed., New York, NY: ITDP, 2019.

[12] National Association of City Transportation Officials (NACTO), Urban Bikeway Design Guide, 2nd ed., New York, NY: NACTO, 2020.

[13] D. Pojani and D. Stead, "Sustainable urban transport in the developing world: Beyond megacities," Sustainability, vol. 7, no. 6, pp. 7784–7805, 2015, https://doi.org/10.3390/su7067784.

[14] A. Hull and C. O'Holleran, "Bicycle infrastructure: Can good design encourage cycling?" Transport Research Interdisciplinary Perspectives, vol. 4, pp. 100104, 2020, https://doi.org/10.1016/j.trip.2020.100104.

[15] E. Heinen, K. Maat, and B. van Wee, "The role of attitudes toward characteristics of bicycle commuting on the choice to cycle to work over various distances," Transportation Research Part F: Traffic Psychology and Behaviour, vol. 15, no. 6, pp. 649–663, 2011, https://doi.org/10.1016/j.trf.2011.04.001.

[16] P. Singh, "Sustainable urban transport and air pollution in India," IATSS Research, vol. 44, no. 3, pp. 149–156, 2020, https://doi.org/10.1016/j.iatssr.2020.06.002.

[17] Organisation for Economic Co-operation and Development (OECD), Urban Mobility Report 2022, Paris: OECD Publishing, 2022.

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