Effect of Urban Design and Natural Environment on Affect, Perceived Exertion and Cerebral Oxygenation During Active Transport: An Immersive Virtual Reality and Multi-Study Design

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Résumé

Introduction. Increasing active transport, such as walking or cycling, is key to reducing human-driven greenhouse gas emissions and improving health outcomes (Chevance et al., 2023; Gravett & Mundaca, 2021; Moutet et al., 2025). Yet, journeys of less than 5 km – which can be cycled in 15–20 minutes – represent 50% of European car journeys (Neves & Brand, 2019; World Health Organization, 2022). To facilitate the transition from private cars to active transport, it is crucial to create urban environments that induce positive experiences of active transportation, fostering positive affective memories and increasing the intention to use these modes in the future (Cheval et al., 2025). The aim of this registered report is to investigate the effects of colourful urban design and natural environment on psychological (i.e., affective responses, remembered and anticipated pleasure), psychophysical (i.e., perceived exertion) and neurobiological (i.e., prefrontal oxygenation) outcomes during immersive, virtual active transport sessions.

Methods. Seventy adults who intended to increase their use of active transport will take part in three 15-minute, moderate-intensity cycling (Study 1) or walking (Study 2) sessions. These sessions will involve three different virtual environments: (a) an urban environment (UE); (b) an urban environment with a colourful design (UE+C); and (c) an urban environment with natural features (UE+N). Core affect (valence and arousal) and perceived exertion will be measured six times during each session using self-report questionnaires. To assess the neural mechanisms underlying cognitive effort, activity in the dorsolateral prefrontal cortex will be monitored using functional near-infrared spectroscopy (fNIRS) throughout the sessions. Additionally, heart rate, heart rate variability and respiratory rate will be measured using a Biopac device. After each session, participants will complete self-report questionnaires assessing remembered pleasure, anticipated pleasure for the next session, self-efficacy, and intention to engage in active transport. Linear mixed-effects models (MEMs)

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will be used to analyse the effects of conditions on core affect, remembered and anticipated pleasure, perceived exertion and cerebral oxygenation. In addition, MEMs will be used to explore whether self-efficacy predicts intention and whether anticipated pleasure contributes to the explanatory variance of intention. Finally, correlations and time series analyses will be employed to explore the interplay between in-task variables (core affect, perceived exertion, and cerebral oxygenation).

Hypotheses. It is hypothesised that the UE+C and UE+N conditions will induce a higher positive affective valence, alongside greater remembered and anticipated pleasure, as well as lower perceived exertion and cerebral oxygenation, when compared to the UE condition.

Results. Pilot data will be collected in June 2025, and preliminary results will be presented at the ACAPS Congress.

Conclusion/Perspectives. Findings are expected to advance theoretical understanding of how the environment influences affective and effort-related variables, and how these variables interact. This experimental research will pave the way for future empirical studies, such as randomised controlled trials, which will examine how urban design can facilitate the transition to active transports.

Références

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