Cycling Beyond the Shortest Path: Analyzing Micro-Scale Environmental Influences on Route Selection

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1 Introduction

Urban bike commuting is influenced by a variety of factors that, while either facilitating or hindering the experience, significantly impact cyclists' route choices and not always the shortest path is the chosen route due to perceptions related to infrastructure and the streetscape. We focus our analysis on the city of Bari, a medium-sized, car-dependent city in southern Italy with limited yet growing bike infrastructure. In this context, we aim to assess the extent to which urban bike commuters deviate from their shortest routes, identifying critical links that are frequently avoided, preferred links that are frequently engaged and the subjective factors driving these deviations. Specifically, this paper aims to address the following research questions:

1) To what extent do urban biker deviate from their shortest paths? What are the main subjective factors that influence these deviations?

2) What are the most critical edges (i.e., street segments systematically avoided by bike users) and the most desirable edges (i.e., street segments systematically used by bike users even though they are not the fastest routes) in the city of Bari? What infrastructural and micro-scale characteristics do they share?

2 Data and methods

We aim to calculate the detours of bicycle commuters in Bari from their shortest routes and examine the relationship between these deviations, users' socio-demographic characteristics, micro-scale elements of the surrounding environment, and various land use and street features that shape the urban space.

This allows us to identify critical links and classify them based on their microscale, land use, and street attributes. The main dataset is a big-data GPS tracking panel dataset containing nearly 9,000 bike commuting trips made by 235 users between May and August 2023. Supporting dataset consist of Google Street Views, land use attributes and street elements of the Bari's road network segments. In order to calculate the overlap between actual paths and shortest paths, for every bike commuting trip, the GPS tracks are map-matched to the real street network and the correspondent shortest path is calculated via standard shortest path on network algorithm.

2.1 Semantic segmentation and data scarcity

Besides municipal data on bike lane construction planning, the city of Bari lacks information on road infrastructure characteristics, the built environment, greenery, traffic density, speed limits and other relevant factors. The only available data come from voluntary contributions to Open Street Map, which, in the case of Bari, are sparse. In this context, there is a need to gather quality data from alternative sources. Semantic segmentation is a computer vision technique that provides detailed image segmentation by linking pixels to specific categories. We apply semantic segmentation to Bari street views to gather detailed information about the streetscape of every street segment in the network, including the amount of greenery, sky visibility, and the presence of roads and sidewalks, among other elements. In this context, the segmented streetscapes of Bari serve as subjective, eye-level perceptions of users regarding their surroundings.

2.2 Modeling the association between deviation from shortest path and independent variables

To analyze the relationship between how much riders deviate from the shortest path and our factors of interest, a trip-level database will be constructed. The dependent variable captures the extent of overlap between the shortest path and the actual path for each trip. The independent variables reflect the presence and quantity of streetscapes, space syntax, land use and street and traffic attributes along the shortest path for each trip. By examining the amount of overlap as a function of our factors of interest along the shortest path, we interpret the results as follows: the extent to which an increase or decrease of one element on the shortest path translates into an actual adoption of the shortest path (i.e., the shortest path is also the actual path taken).

3 Expected results

Thanks to the comparison between the shortest paths and the actual paths, we will be able to assess if and to which extent urban bike commuters in Bari deviate to the shortest path, intrinsically evaluating if the topological metric is a good proxy for route choice. Furthermore, we will provide evidence of path detouring in order to look for more attractive paths coming at the cost of longer routes. Thanks to the independent variables of interest collected, we will be able to detail the reason behind such deviations and give direct insights on urban features' bike attractiveness. Thanks to the map-matching technique, we will be able to detect critical street segments as the ones systematically avoided despite being part of shortest routes.