Bicycle traffic analysis before and after mobility interventions using crowdsourced data

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Introduction

- Urban centers worldwide are grappling with mounting issues caused by **motorized road transport**.
- Cities face the challenge to enhance the quality of urban environment **promoting sustainable transport modes** such as bicycles.
- **Creating bicycle paths and expanding sidewalks** to allocate road space for active travel modes emerge as fundamental measures for promoting sustainable urban mobility.
- Numerous cities have implemented **sustainable urban transport policies**, resulting in notable shifts toward active mobility and enhanced road safety.
- To plan for active modes and/or assess policies to promote cycling, city and transport authorities **rely on data**. However, cycling data is hardly available, especially in comparison to other modes such as cars.

- Exploiting novel data sources, such as **crowdsourced data**, is a means of addressing data gaps.

The Athens Great Walk

- Following the lead of numerous cities, and within the framework of the **Sustainable Urban Mobility Plan** of the City of Athens, a series of novel traffic and parking arrangements for the city center were examined.
- Athens implemented several impactful mobility interventions formed a **major urban regeneration plan** titled the Athens Great Walk (AGW), including:
  - Increase of sidewalks in streets with high pedestrian traffic
  - Exclusive lanes for pedestrians and cyclists
  - Exclusive bus lanes
  - Motorcycle, taxi and disabled parking management
- One of the most significant traffic interventions was the widening of sidewalks on **Panepistimiou Street**, and the creation of a dedicated lane for micromobility users.

Fig 1. The pilot Implementation of mobility interventions on Panepistimiou St.

18 June 2020

- Expansion of Panepistimiou St **sidewalks.**
- Establishment of a **new cycleway.**
- The **traffic lanes reduced** to 3.

Objective

The investigation of the impact of a new cycleway on Panepistimiou St., implementing in the framework of AGW, to bike and e-bike trips

using crowdsourcing open data, which are paired with the original data of the Horizon Europe project PHOEBE.

The PHOEBE project

- The PHOEBE project ("Predictive Approaches for Safer Urban Environment") was initiated to **enhance road safety** for vulnerable road users.
- The project, which includes three pilot city use-cases—Athens, Valencia, and West Midlands-focuses on **investigating the impact of the AGW on bicycle trips** in the central area of Athens.

Methodology

- An **interrupted time series (ITS) analysis** was developed to assess the effectiveness of the new cycleway on daily changes in number of bike trips from June 2019 to 2023.
- The **primary examined intervention** is the implementation of the new cycleway and sidewalk expansion on Panepistimiou St. during AGW's pilot phase.
- **The end of the Covid-19 lockdown**, which entailed the closure of educational institutions and retail establishments, should also be considered as an additional interruption.
- A linear regression model using **generalised least squares** was developed to estimate the effect of the intervention on the level change for cycling counts.
- Autocorrelation between residuals was assessed using an **autoregressive moving average** (ARMA(0,1)) model.

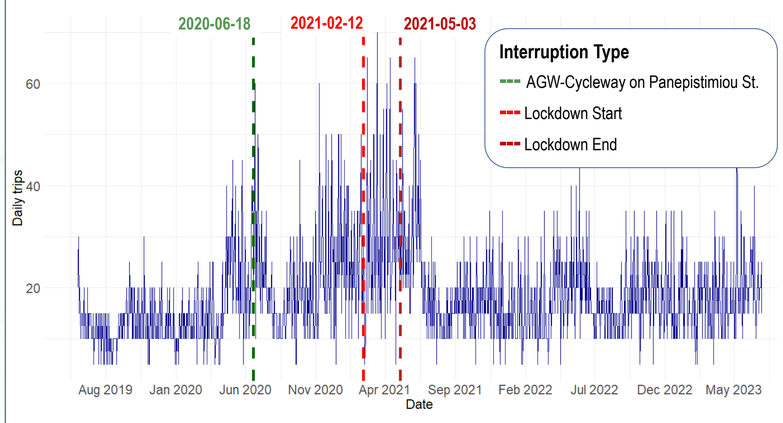

Fig 2. Cycling trips on Panepistimiou St and the examined interventions

Data Collection

- Crowdsourcing was used to collect open data, capturing daily **bike and e-bike trips in the center of Athens** before and after the implementation of the AGW, via the 'Strava Metro' service.

STRAVA METRO

- Strava is a **crowdsourced fitness app**, which utilizes anonymized, aggregated Global Positioning System (GPS) data from its users to analyze activity over space (e.g. edges) and time (e.g. hour, year etc.).
- This data are matched to the nearest recreational or transport line from **Open Street Map** (OSM).
- Bikes and e-bikes trips were recorded:
  - **between June 2019 and June 2023**
  - **for 89 edges** corresponding to 27 OSM street ids,

where the examined mobility intervention was implemented

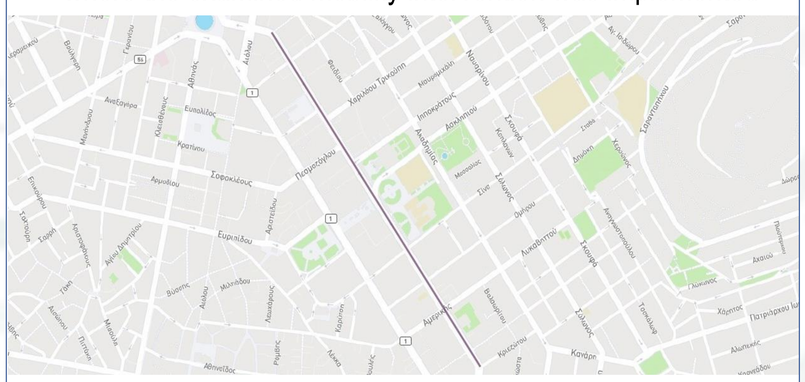

Fig 3. Study Area

- To **aggregate the trip data** effectively, we elevated our analysis from the edge level to the street level Fig. 3.
- Throughout this process, meticulous consideration was given to the **minimum daily trip counts** among the examined edges, with an understanding that these trips encompassed the entire length of the street.

Results and Discussion

- The following table provides a detailed **snapshot of daily cycling trips** across multiple years.

Table 1. Monthly summaries of daily cycling trips on Panepistimiou St.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	n/a	n/a	n/a	n/a	n/a	15	11	9	15	14	13	13
2020	13	14	13	19	24	**26**	21	13	19	18	24	27
2021	26	28	29	31	27	30	16	14	18	18	18	14
2022	16	15	14	20	22	20	15	14	18	20	19	18
2023	18	17	18	17	21	21	n/a	n/a	n/a	n/a	n/a	n/a

Results and Discussion (continue)

2019 Cycling activity **remained relatively modest**.

2020 **The landscape altered** significantly, primarily due to the introduction of the new cycleway in June.

2021 The **positive impact persisted**, potentially influenced by concurrent lockdowns, promoting active mobility.

2022 2023 Although 2022 and 2023 **recorded a slight decline** in cycling traffic, levels remained notably higher than those observed prior to the AGW intervention in 2019

In the ITS model,

- "Time" variable represents the study days, tracking the progression of time from 0 to 1477 day.
- "AGW_new_Cycleway" & "Covid19_Lockdown_end" are binary variables indicating whether the specific intervention occurred at a given time.
- "AGW_new_Cycleway_time_since" & "Covid19_end_time_since" are variables measuring the time that has elapsed since the intervention took place, providing insight into the post-intervention period.

Table 2. Uncontrolled ITS analysis

	Value	t-value	p-value	
(Intercept)	9.789	9.318	0.000	**
Time	0.026	5.359	0.000	**
AGW_new_Cycleway	-2.180	-1.408	0.159	.
AGW_new_Cycleway_time_since	0.015	1.975	0.049	**
Covid19_Lockdown_end	-11.190	-8.274	0.000	**
Covid19_end_time_since	-0.043	-6.779	0.000	**

- The positive coefficient for "Time" suggests a slight upward trend in daily cycling trips over time. **For each 100 days, we can expect additional 3 cycling trips**.
- The new cycleway and sidewalk expansion **did not significantly affect daily cycling trips**, likely due to the generally low rate of cycling in Athens which could marginally enter the area of statistical error.
- However, the time elapsed since this intervention showed a positive effect, contributing **to increased cycling trips**.
- **The end of COVID-19 lockdown** had a significant negative impact on cycling activity

Conclusion

- The analysis results highlight the **dynamic nature** of urban cycling patterns.
- While interruptions such as the Covid-19 pandemic can lead to temporary extreme changes in cycling, **well-executed active mobility infrastructure projects, like the AGW, can ultimately promote and sustain cycling** over time.
- It's imperative to acknowledge that Strava constitutes a **relatively small sub-sample** of the overall population. Addressing this limitation could further enhance the robustness and representativeness of the findings of the current analysis.
- Overall, this research **contributes to the growing body of knowledge on sustainable urban transportation** and provides practical recommendations for promoting cycling.

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