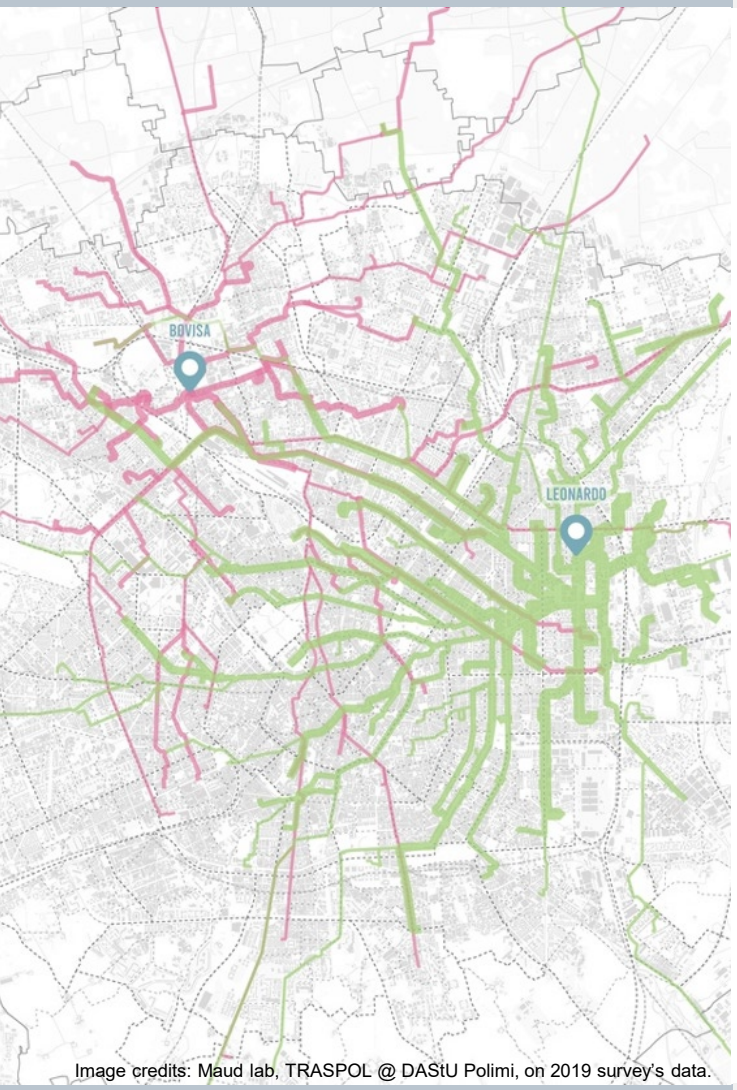

Image credits: Maud lab, TRASPOL @ DAStU Polimi, on 2019 survey's data.

Sustainable mobility policies at Universities: what after the pandemic?

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Transport demand management (TDM) policies have increasingly gained attention also whithin the **university context**: the huge number of **daily commuters** to universities from vast catchment areas strongly impacts the transport system, as well as the neighborhood they are settled in.

A wide range of statistic and econometric models have been applied in the last decade to **university travel demand survey** results to understand the main determinants of the commuting, and many Universities developed various TDM strategies to **reduce the negative environmental and social impact**.

Though, are these still valid under and **after COVID-19 circumstances**?

The pandemic has dramatically impacted all spheres of people's activity, especially their **mobility habits**: public transport (PT) has been the most impacted sector, having yet to recover, as a considerable quota of users switched to other modes.

Should in the post-covid transition period policies re-orient towards **retaining people on public transport** and prevent the switch towards car usage?

This paper aims to **investigate users' characteristics** to understand how mobility management policies in universities can be reshaped by targeting different groups of users, relying on the **case study of Politecnico di Milano**'s population.

Contents

Materials and model

Surveys

2019 mobility survey (Polimi, 10000+ answers, 19% of population):

- In-depth **analysis of mobility patterns** → GHG emission estimate
- **Willingness to change transport mode**

2020 mobility survey (national, 7600+ answers, 14% of population):

- Analysis of pre-covid mobility (less detailed than 2019 survey)
- **Future scenario**: **user stated preference** for transport mode in heavy- and **mild-risk of infection**

→ Assumed as "post-covid transitioning situation"

Surveys have been cleaned and filtered for campus in Milan city only.

Materials and model

Variables

Characteristics of users *common to both surveys* used in the analysis:

- Gender: male or female
- Age: under 35, 35-50, over 50 years old
- Category: staff or students
- Transport mode: aggregation of the various modal chain (aggregated into private, public, and active according to the type of mode used for the main leg of the trip)
- Duration: travel time in minutes
- Frequency: weekly trips to university
- Distance: travel distance in kilometres (asked for private transport and active modes, based on municipality-to-campus car distance for PT)
- Vehicle: availability of a private car or motorbike
- Public transport subscription: possess of a PT subscription

Materials and model

Model

The **modal choice preferences and willingness to change** the commuting mode before and after the pandemic have been estimated using **a Logit model**.

$$P(Y_i = k|X_i) = \frac{e^{z_{ik}}}{1+\sum_{s=2}^{K} e^{z_{is}}} \qquad (1)$$

where Y_i – respondent's I response with possible categories k =2,…,K. k=1 is the base category. Z_{ik} represents preferences of respondent i with choice k. Preferences are equal to

$$Z_{ik} = X_i\beta^k = \beta_0^k + \beta_1^k male_i + \beta_2^k age_i + \beta_3^k staff_i + \beta_4^k vehicle_i + \beta_5^k duration_i + \beta_6^k staff * duration_i + \beta_7^k duration_i^2 + \beta_8^k staff * duration_i^2 + \beta_9^k distance_i + \beta_{10}^k personal_i * distance_i + \beta_{11}^k distance_i^2 + \beta_{12}^k personal_i * distance_i^2 + \beta_{13}^k vehicle_i * duration_i + \beta_{14}^k vehicle_i * duration_i^2 + \beta_{15}^k vehicle_i * distance_i + \beta_{16}^k vehicle_i * distance_i^2 + \beta_{17}^k abb\_public_i + \beta_{18}^k frequency_i + \beta_{19}^k transfers_{1i} + \beta_{20}^k transfers_{2i} + \beta_{21}^k transfers_{3i} + \beta_{22}^k transfers_{4i} + \epsilon_{ik},$$

Materials and model

Research design

Three cases (with Stata 14 sofware):

Table 2 Summary of research design

Survey	Before covid		After Covid (scenario 1)
Object	Modal choice	Willingness to switch	Soft Covid restrictions – Willingness to switch
Question	Which mode(s) do you use to commute?	If you commute by car, are you considering changing mode?	Which transport mode(s) will you use considering a mild risk of infection?
Model	Model 1.1: multinomial logit (1)	Model 1.2: binomial logit (1)	Model 2: multinomial logit (1)
Focus	Switching from private to public transport		Switching from public transport to other modes

Contents

Results

Pre-Covid mobility

In model 1.1 we calculated *odds ratio of choosing a transport mode* depending on personal characteristics (pre-covid):

- Gender: mostly not significant (just men's odds of using active modes are higher by 58,0%)
- > 35-year-old: more prone to use private transport compared to active modes (by 58,3%) [people under 35 are mostly students, who usually have none or low incomes].
- Duration and distance dependencies: **not linear**.
- Availability of private vehicle: highly increases odds of use (obv…).
- PT pass: highly **increases the probability** of using the PT, but also **using active modes to commute** (odds increase by 88%).
- Frequency of commuting: not significantly change the respondent's behaviour.

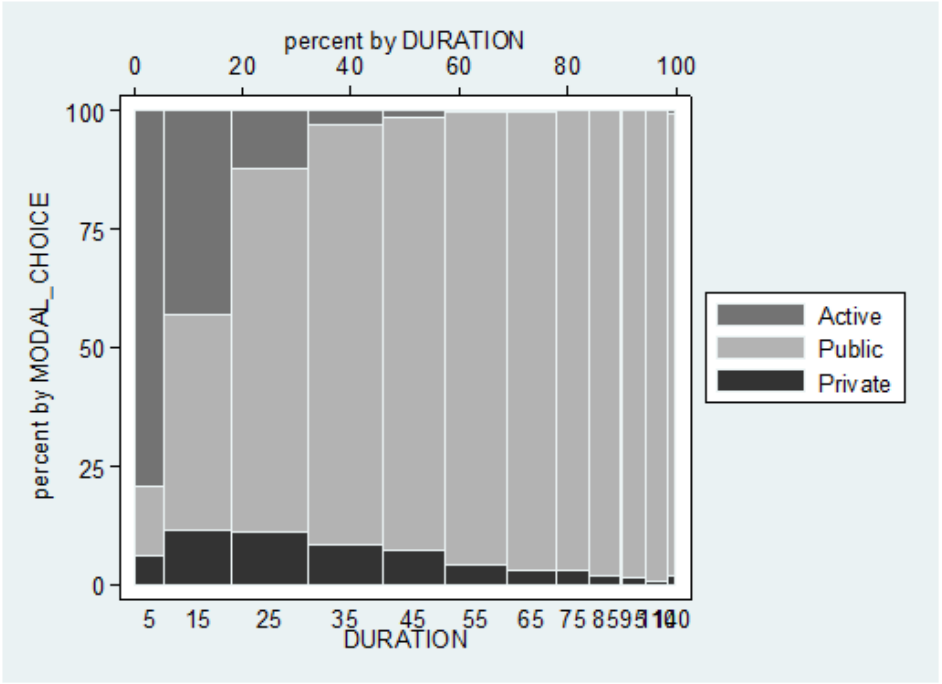
Results

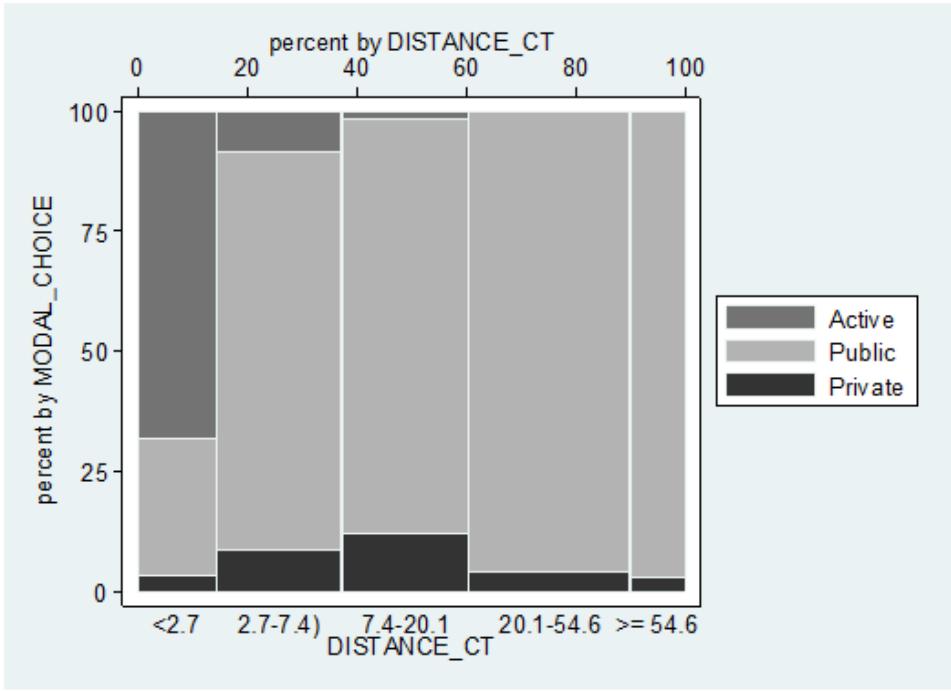
Pre-Covid mobility

Spine plots for distance and duration (highlights):

- Active modes for short trips
- Cars or motorcycles: highest relative quota for average time/distance trips;
- Public modes: long-distance and time-consuming journeys

Figure 2 Duration and distance spine plots for modal choice questions (pre-covid survey)





Results

Pre-Covid willingness to change

In model 1.2 we calculated *odds of switching from private transport to other ways of commuting to the university* (stated, pre-covid):

- Gender: not significant
- Age: younger (<35) would more likely switch away from car
- Duration and distance dependencies: **not linear**
- Availability of private vehicle: highly increases odds of not to abandon (obv…), however, 13% consider switching to PT anyway
- PT pass: highly increases the probability of switch to PT (obv…).
- Frequency of commuting: people **travelling often are less likely to change** (otherwise would have already done so, reasonably).
- Combinations: if any, switching away from car is more probable.

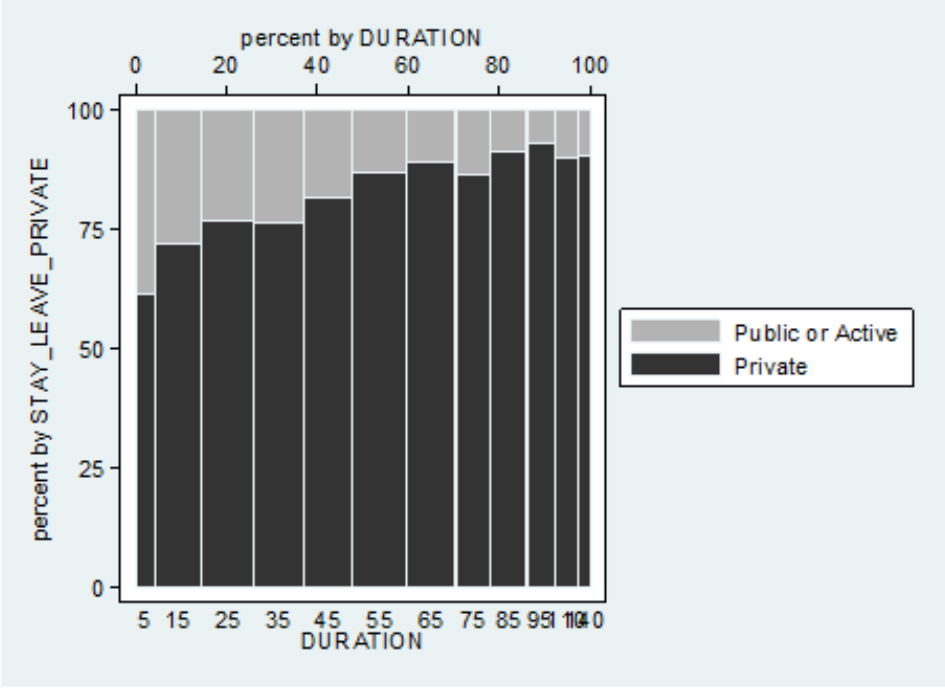
Results

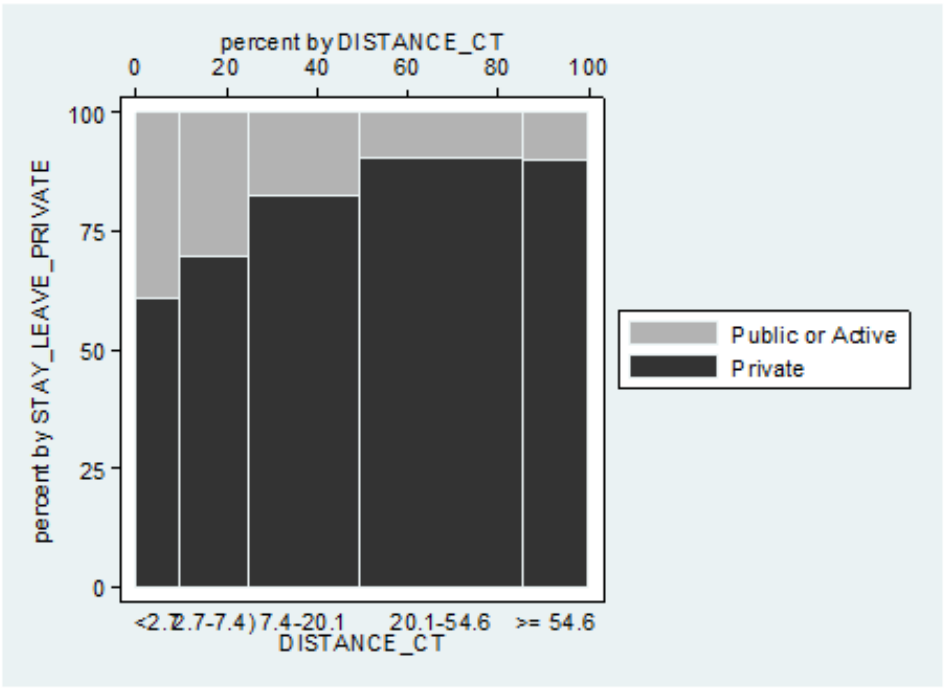
Pre-Covid willingness to change

Spine plots for distance and duration (highlights):

- Willingness to leave the private vehicle decreasing with both time and distance
- Distance effect is the same between 20-55 km and above 55 (a plateau is reached)

Figure 3 Duration and distance spine plots. Model 1.2





Results

Post-Covid stated change

In model 2 we calculated *odds of switching from public transport to either active or private* (stated, in mild-risk "post-covid" scenario"):

- Gender: not significant
- Age: older respondents less likely to leave PT to active modes than younger (odds -86%), **age not significant for car**.
- Duration and distance dependencies: **not linear,** very similar to each other. Nearest people (2.7 km or <20 min) will use active modes (16-18%). Within 7.4-20 km (60-80 min) distance (duration): highest quota of switchers to private mode (~6%).
- Availability of private vehicle: highly increases odd to switch to it (obv…), however, >10% consider switching to PT anyway.
- PT pass: increases the probability of remain on PT.
- Frequency of commuting: not significant.

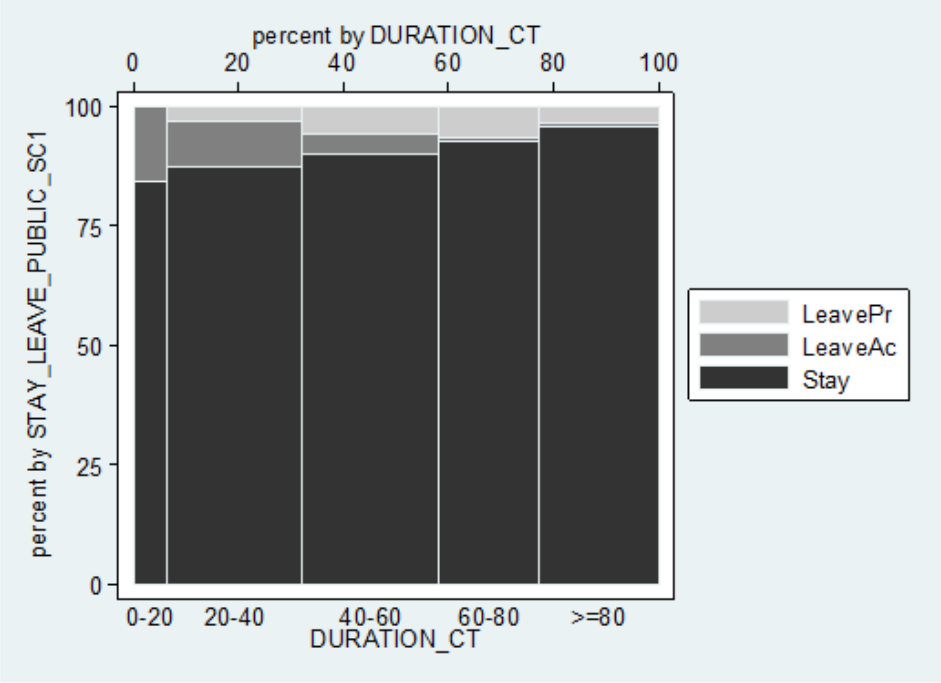
Results

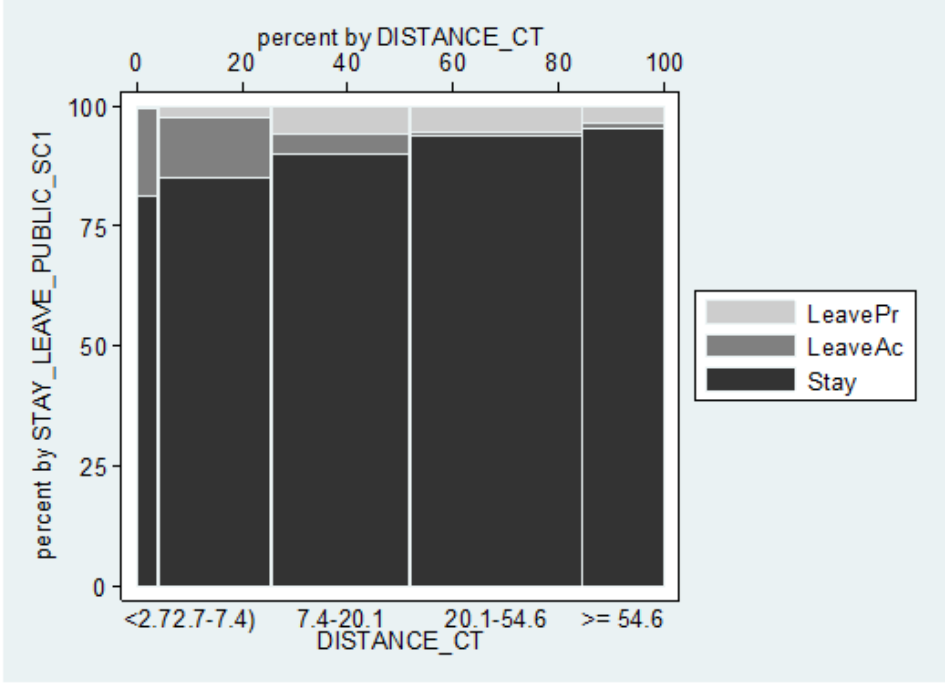
Post-Covid stated change

Spine plots for distance and duration (highlights):

- Probability to remain on PT increases with distance and time
- Willingness to switch to the car is again parabolic, with the maximum extending in a lower range of distance (than actual car usage): the suburbs' origins are affected the most.

Figure 4 Duration and distance spine plots. Model 1.2





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Discussion

Mobility management policies: classification

Universities worked on **policies aimed at reducing the use of private vehicles to curb emissions** of carbon dioxide and other pollutants, make more livable campuses and neighbourhoods, and provide knowledge about sustainable mobility.

According to Colleoni et al. (2019), University mobility management strategies could be summarised into four different groups:

- Concession: activities aimed at promoting sustainable mobility through incentives or other opportunities
- Restriction: less frequent than the previous kind, these policies aim at limiting the use of private vehicles
- Persuasion: these activities aim at changing people's behaviours
- Technical and organisational innovation: actions that require structural changes (hardware or "software")

Discussion

Mobility management policies: what's to come

The set of available policies hasn't changed much, though the context in the long tail of the COVID pandemic requires considering **a new dimension of the problem**, **at least in the medium term**:

Nudging (/forcing) car users to change mode

Preventing PT users to switch to car

→ Distance from university is one of the most relevant variables related to mode choice, in actual preferences and stated ones.

Discussion

Mobility management policies: factors

Gender was **not significant** in willingness to change mode before the Covid and it is still not after.

Age is a significant factor in the choice of travelling by car or confirming that choice in a pre-pandemic situation.

However, the **age resulted not significant in stating the aim to leave public transport in favour of car commuting**.

On the other hand, **it proved significant in preventing to leave from public transport in favour of active mobility**.

↳ *Policies to foster change towards active mobility may be more effective if targeted to young people, while the ones aiming to keep public transport ridership may have an effect also on older people.*

Discussion

Mobility management policies: distance

The distance at which it is relatively preferable to **travel by car** or use it abandoning public transport shows interestingly **a parabolic trend**, *unlike the findings of a large part of other case studies in literature* (wider catchement area of Polimi?).

Posses of PT subscription is relevant for the choice of using and keeping riding it and **university subsidies are widely used**, though:

- Subsidy to very **long PT trips** may result in **draining resources**
- Subsidy **short PT trips** may use resources that could be more effectively used to **improve conditions for the active mobility**
- For short-medium distances specific policies should be implemented:
  - To **extend the range of cyclability** especially for students (supporting the creation of safe and fast cycling corridors, handing out riding incentives, …)
  - To **keep PT ridership** (supporting the enhancement of supply to surroundings, subsidizing subscriptions, etc.).

Discussion

Weaknesses and further research

Weaknesses of this study:

- Use of surveys with different structure and questions (limiting the possibility to directly compare results)
- Missing factors and variables: remote learning/working (not just frequency of trip), income, season effect, spatial effects (other from distance), …
- Case-study specific: need to prove results in other contexts

Further research:

- (Overcoming weaknesses)
- Comparison of pre-covid situation with new revealed preferences in the current situation
- Dedicated survey sections, other models and statistical techniques

Thank you for your time

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