Can E-scooters Enhance Active-Mobility Health Outcomes?

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Goals of this talk

Spur conversations about meaningful research

My background: AI, DBS

- Connect, brainstorm, collaborate!
- Help me to improve my work
  - What's the most interesting story?
  - What's missing?
  - What's unhelpful?
  - Fill in the gaps in my knowledge
- How will I know when I should bring it to policymakers?

Goals of this research

Hypothesis

E-scooters have the potential to enhance population-wide public health outcomes by activating system feedbacks.

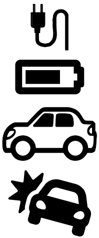
Explore potential system behaviours

- Tie transportation to wellbeing
- Connect some documented car-bike-escooter interactions
- $\begin{cases} \textit{Yes}: & \text{In which policy-space regions?} \\ \textit{No}: & \text{What might minimise harm?} \end{cases}$

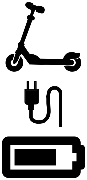
Transportation policy $\rightarrow$ *intrinsic good*

Objective	Correlate	Mechanisms	Technology
Wellbeing $\leftarrow$	**Lifespan** QALY DALY LEGPH Gini SDGs ⋮ $\leftarrow$	**Active lifestyle** **Clean air** **Mobility safety** Mobility equity Child cognitive development Reduced parental burdens Public space reclamation Economic efficiency Low resource use Stable biosphere Stable climate Global equity ⋮	$\leftarrow$ 

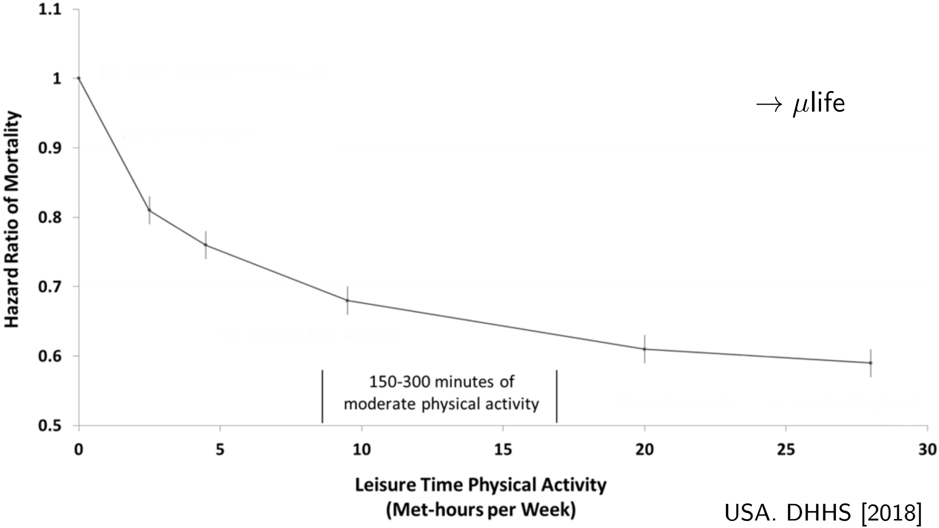
Transportation policy → *local decarbonisation, air*

Objective	Correlate	Benefits	Technology
~~*Wellbeing*~~ Local $CO_2 \downarrow$ ← Profit	~~Lifespan~~ ~~QALY~~ ~~DALY~~ ~~LEGPH~~ ~~Gini~~ ~~SDGs~~ ⋮ ←	~~Active lifestyle~~ ∼ **Clean air** ~~Mobility safety~~ ~~Mobility equity~~ ~~Child cognitive development~~ ~~Reduced parental burdens~~ Public space reclamation ~~Economic efficiency~~ ~~Low resource use~~ Stable biosphere Stable climate Global equity ⋮	← 

Transportation policy → *decarbonisation* + *human-scaling*

Objective	Correlate	Benefits	Technology
Cars ↓ Local CO_2 ↓ ← Profit	~~Lifespan~~ ~~QALY~~ ~~DALY~~ ~~LEGPH~~ ~~Gini~~ ~~SDGs~~ ⋮ ←	~~**Active lifestyle**~~ **Clean air** **Mobility safety** Mobility equity Child cognitive development Reduced parental burdens Public space reclamation ∼ Economic efficiency ∼ Low resource use ∼ Stable biosphere ∼ Stable climate ∼ Global equity ⋮ ←	

Daily movement → lifespan (and healthspan)



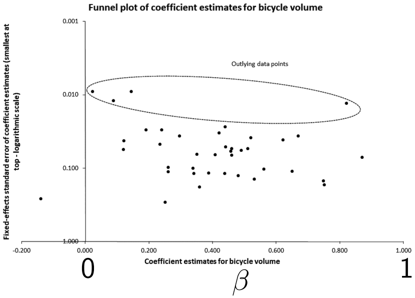
→ μlife

USA. DHHS [2018]

Safety In Numbers (S-I-N): more biking $\rightarrow$ safer biking

Collisions $\propto (\Delta x)^{\beta}, \quad \beta \approx 0.4$

- risk per km $\propto \frac{(\Delta x)^{\beta}}{(\Delta x)} = (\Delta x)^{\beta - 1}$
- e.g. twice as many cyclists $\rightarrow \sim 35\%$ safer



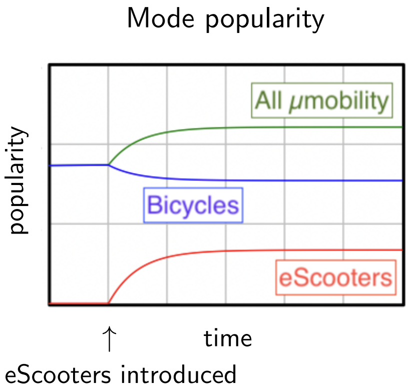
. . . why?

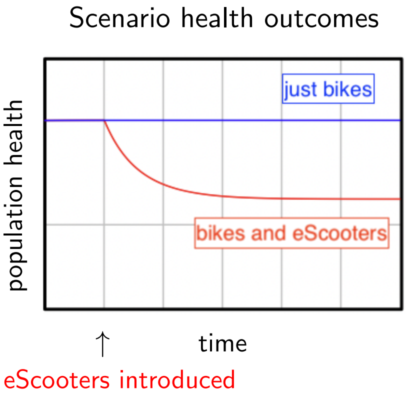
[Elvik and Goel, 2019]

Assumptions & simplifications

1. Bikes and eScooters contribute similarly to S-I-N
2. Infrastructure: just convenience, not safety (for now)
3. Constant *n* trips/day (no induced demand)
4. Mode choice:
   - safety — Pr(deterred)
   - convenience — Pr(infrastructure supports trip)
   - speed — linear
   - utility — Pr(mode supports trip)
5. Crash safety does not depend on speed
   - Scooter desirability $\propto$ speed

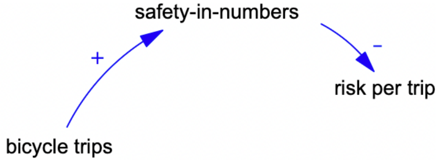
Expected behaviour





μMobility $\leftrightarrows$ life expectancy

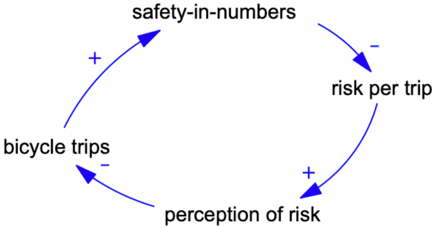
More biking $\rightarrow$ safer biking



Elvik and Goel [2019]; Aldred [2016]; Fyhri et al. [2017]

μMobility ⇆ life expectancy

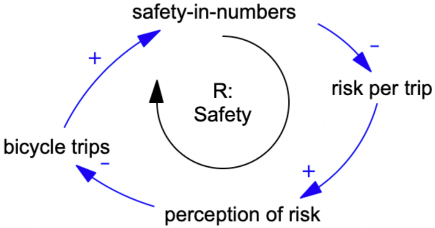
🚲 Safer biking → more biking



Aldred and Crosweller [2015]; Hoye [2018]; Rérat and Schmassmann [2024]...

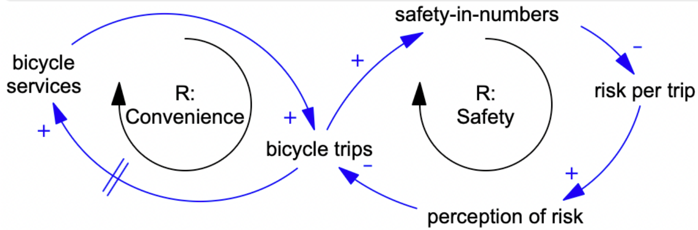
μMobility $\leftrightarrows$ life expectancy

Safer biking $\rightarrow$ more biking



Aldred and Crosweller [2015]; Hoye [2018]; Rérat and Schmassmann [2024]...

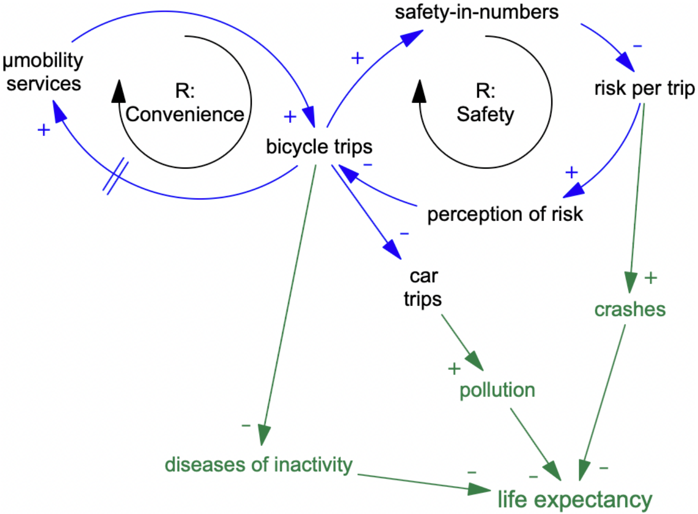
More biking ⇆ more biking infrastructure



Dill and Carr [2003]; Macmillan and Woodcock [2017]; Cordeau [2023]; Rérat and Schmassmann [2024]…

μMobility ⇆ life expectancy

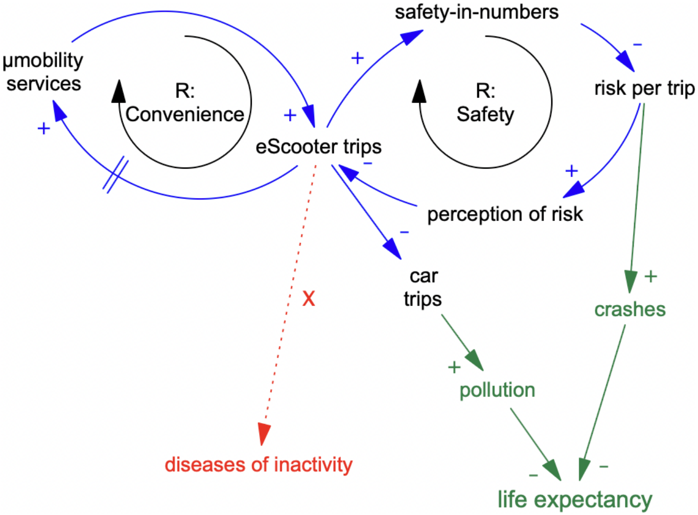
Activity improves health



USA. DHHS [2018]; Lieberman [2021]; Herrmann et al. [2024]

μMobility $\leftrightarrows$ life expectancy

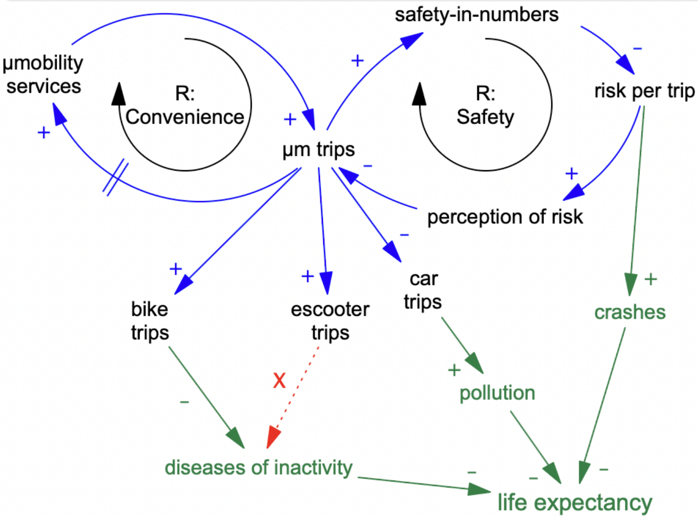
eScooters do not improve health



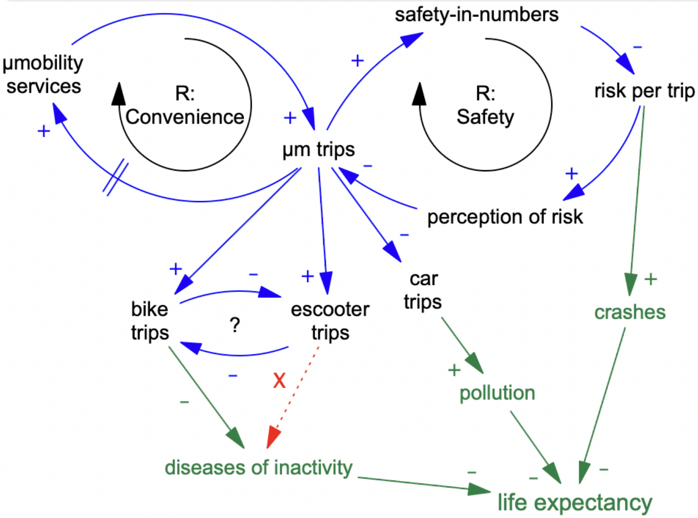
Payne et al. [2025]; Herrmann et al. [2024]

μMobility ⇆ life expectancy

🛴 🚲 µmobility → life expectancy



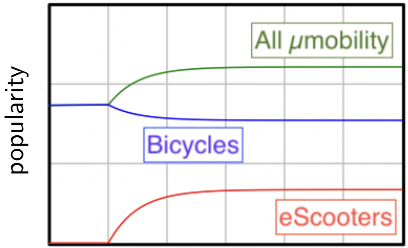
μMobility ⇆ life expectancy



McKenzie [2019]; Zhang et al. [2021]; Wang et al. [2023]

Expected behaviour

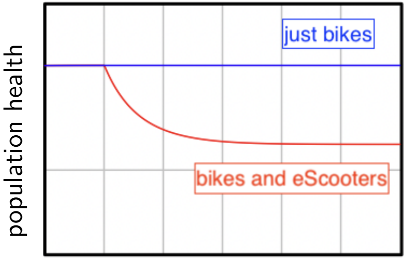
Mode popularity



↑ time

eScooters introduced

Scenario health outcomes

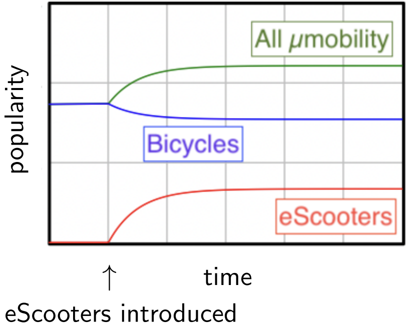


↑ time

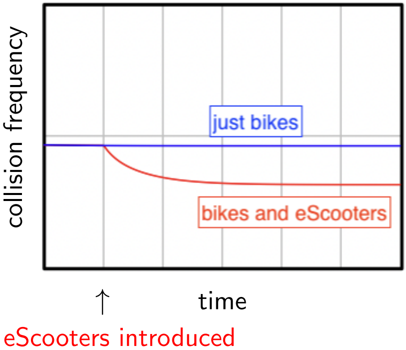
eScooters introduced

Adding S-I-N dynamics

Mode popularity

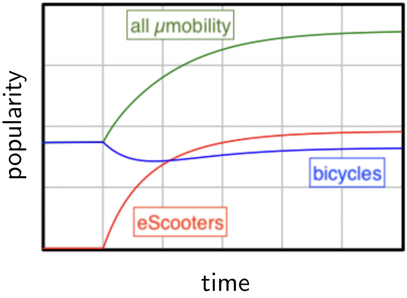


Bicycle safety

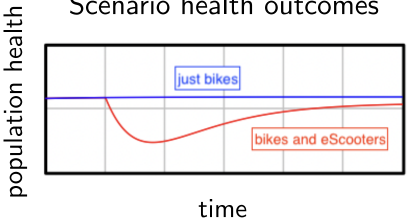


Adding S-I-N dynamics

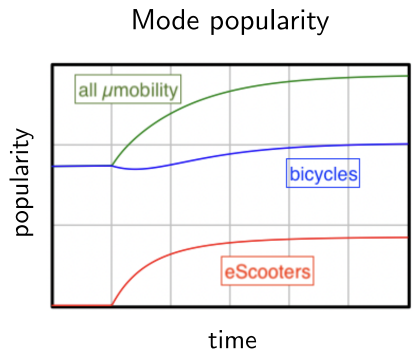
Mode popularity

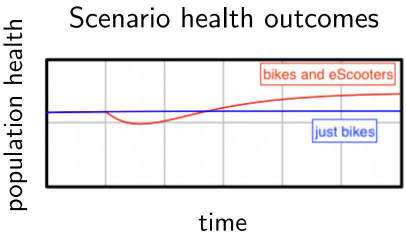


Scenario health outcomes



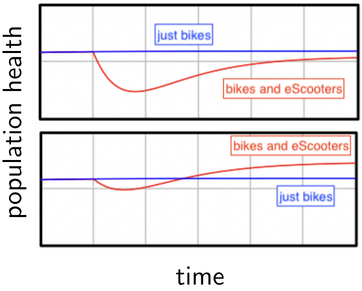
Adding S-I-N dynamics





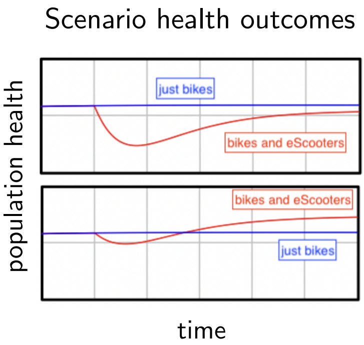
S-I-N, Convenience, and Speed Limits

Scenario health outcomes

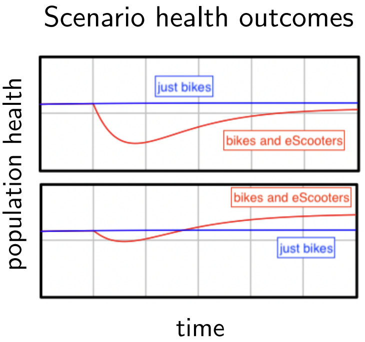


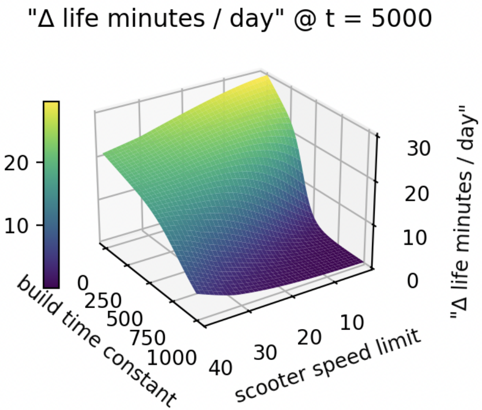
1. Infrastructure build time?
2. scooter speed limit?
   - bikes go 14 km/h

S-I-N, Convenience, and Speed Limits

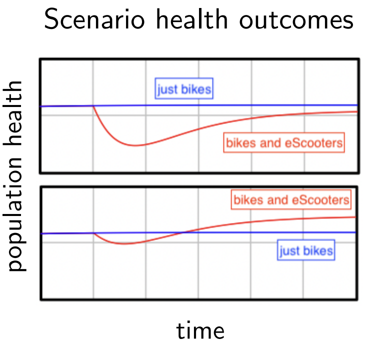


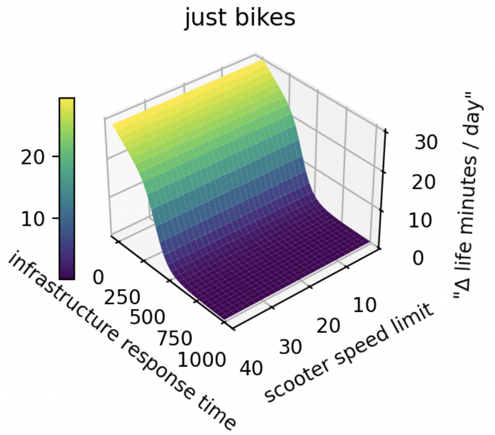
S-I-N, Convenience, and Speed Limits



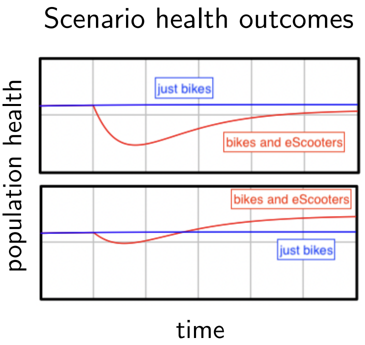


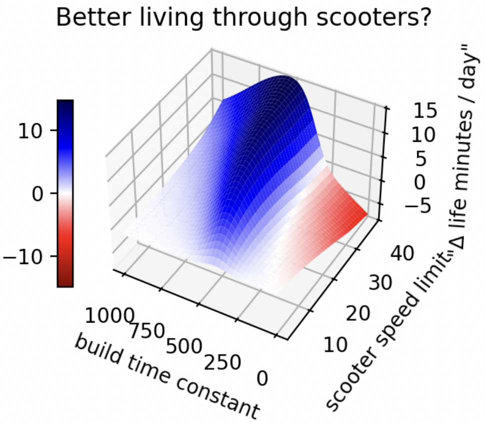
S-I-N, Convenience, and Speed Limits



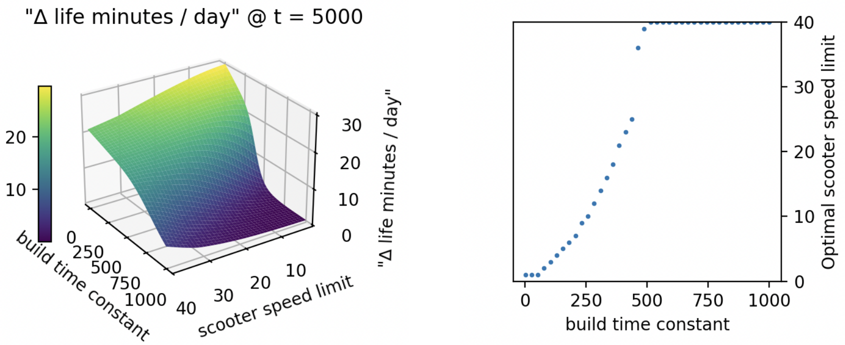


S-I-N, Convenience, and Speed Limits

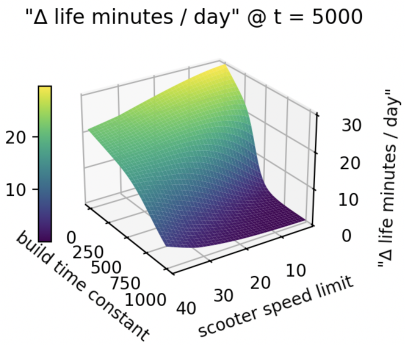


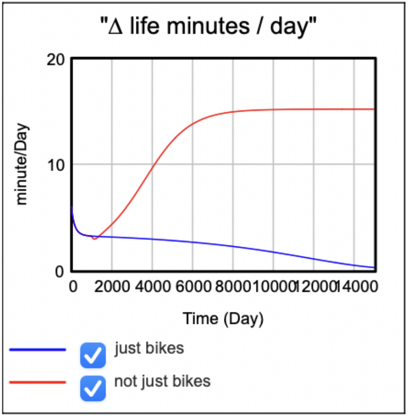


S-I-N, Convenience, and Speed Limits

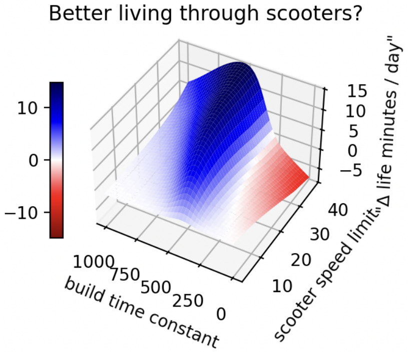


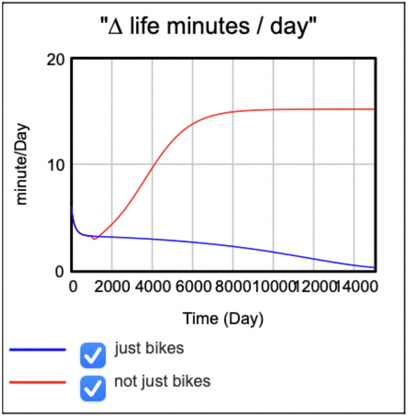
S-I-N, Convenience, and Speed Limits



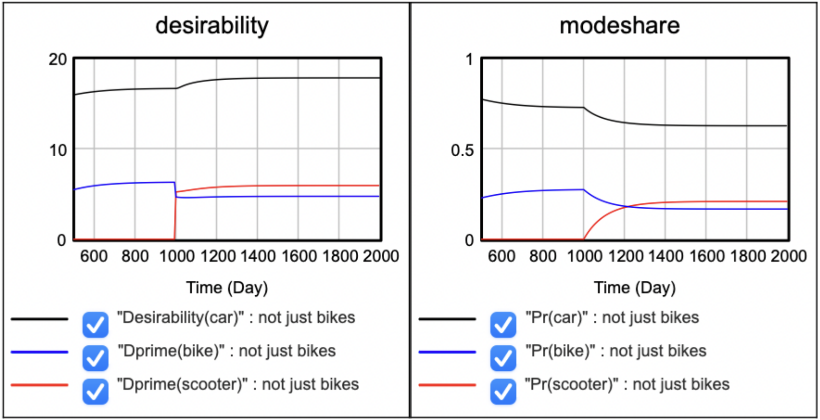


S-I-N, Convenience, and Speed Limits



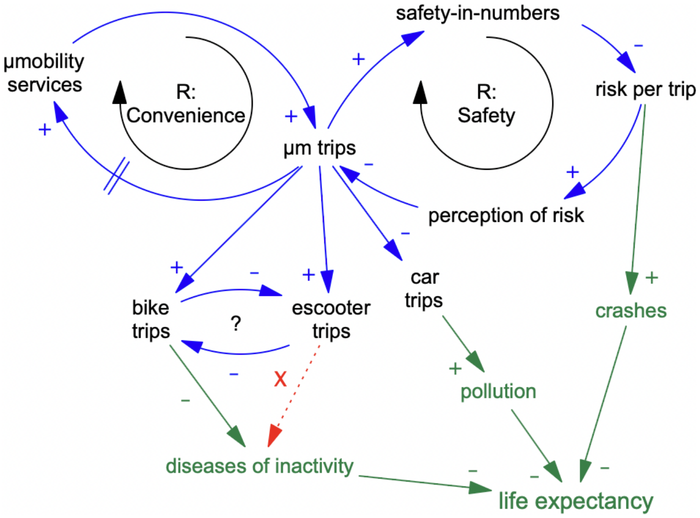


Traffic congestion



. . . what, still no induced demand?

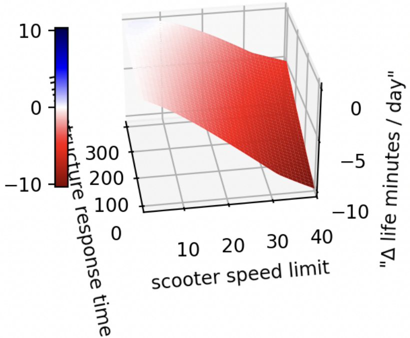
Pollution

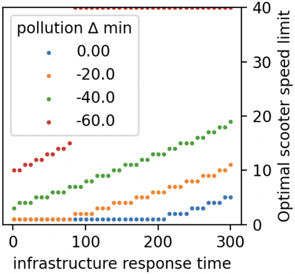

safety-in-numbers
µmobility services
R: Convenience
R: Safety
risk per trip
µm trips
perception of risk
bike trips
escooter trips
car trips
crashes
?
X
pollution
diseases of inactivity
life expectancy

Pollution

Pollution Δ life-minutes / day = 0

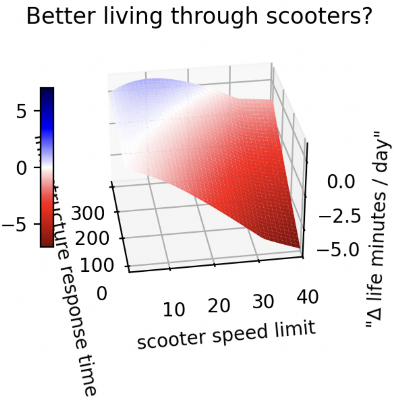
Better living through scooters?

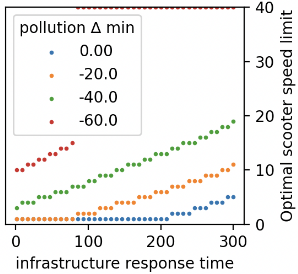




Pollution

Pollution Δ life-minutes / day = -20

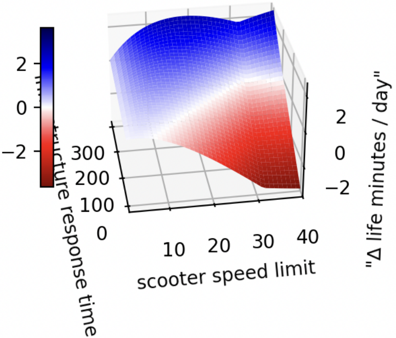


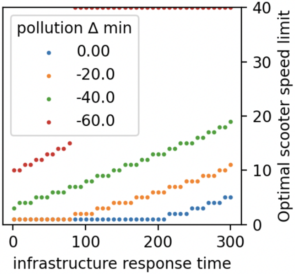


Pollution

Pollution Δ life-minutes / day = -40

Better living through scooters?

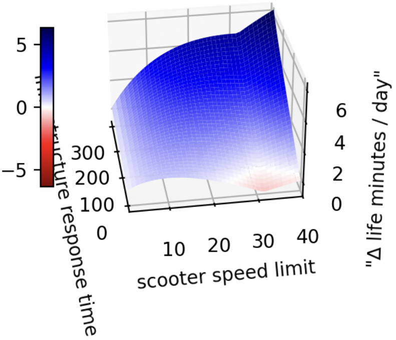


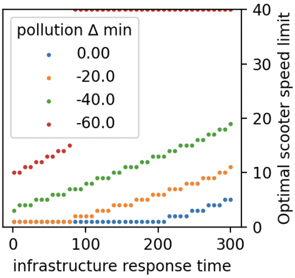


Pollution

Pollution Δ life-minutes / day = -60

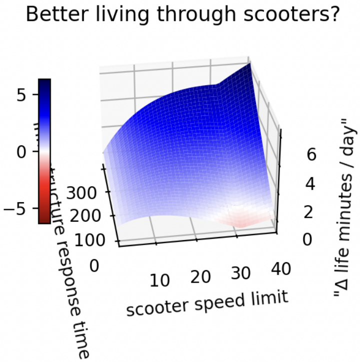
Better living through scooters?



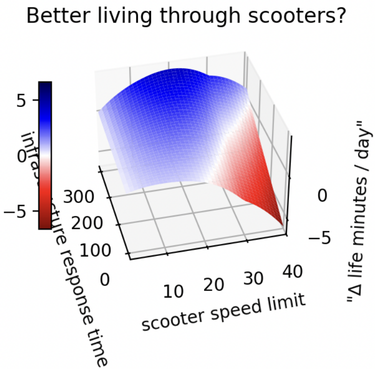


Bike–e-scooter conflicts

Pollution = -60, no conflicts

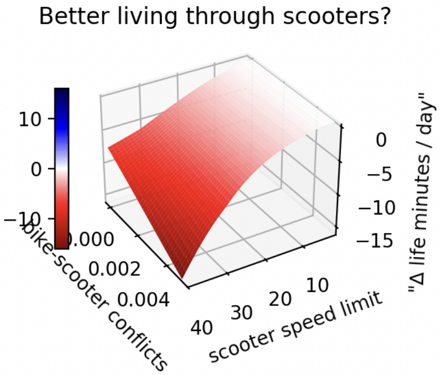


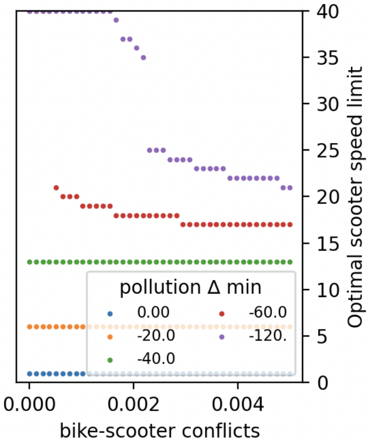
Pollution = -60, conflicts



Bike–e-scooter conflicts

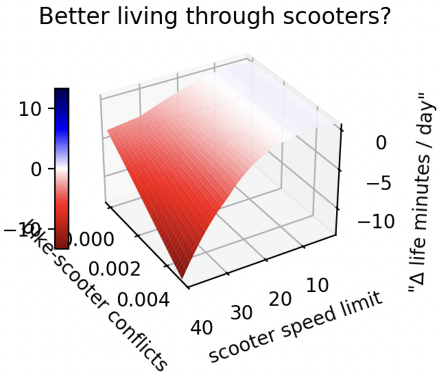
Pollution Δ life-minutes / day = 0

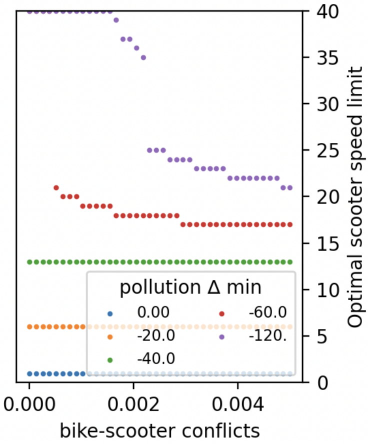




Bike–e-scooter conflicts

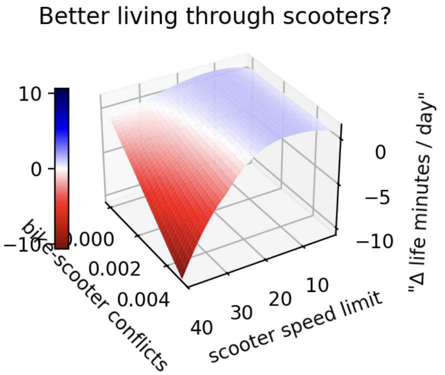
Pollution Δ life-minutes / day = -20

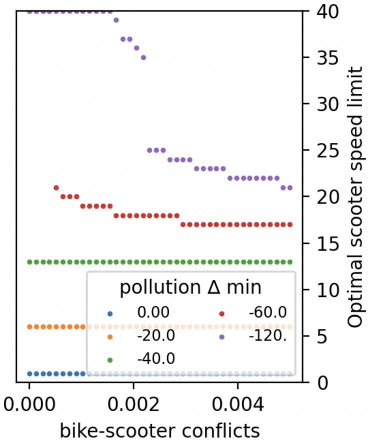




Bike–e-scooter conflicts

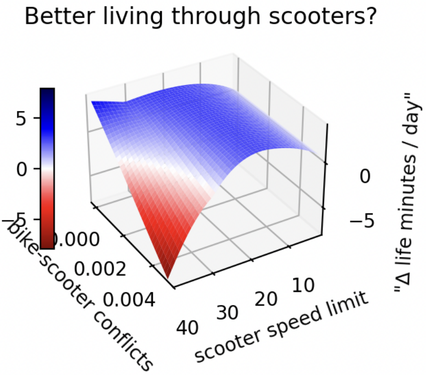
Pollution Δ life-minutes / day = -40

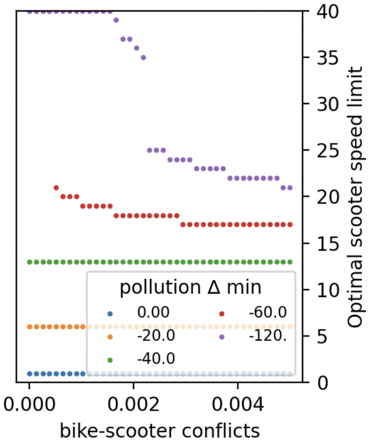




Bike–e-scooter conflicts

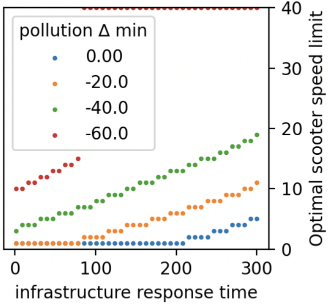
Pollution Δ life-minutes / day = -60



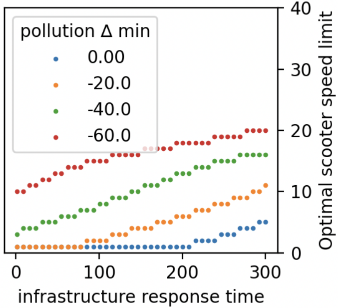


Bike–e-scooter conflicts

No fast-pass disincentive



Fast-pass disincentive



Conclusions

If e-scooters activate system feedback loops:

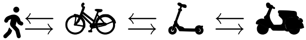
Potential public health benefit when:

- High market differentiation
- Bicycles are superior in some ways (e.g. cargo?)
- Low infrastructure improvement rate
- Polluted cities
- Minimise bike-scooter conflicts

Speed limits?

- e-scooter speed is easy to regulate. . .
    - But it's being done with the wrong goals!

Future work

- Whence β?
-  . . . ?
- Dynamics of other Mechanisms
- Traffic models, learning agents
- Decarbonisation:
    - local ⇆ global?
- Feedback? Collaborations?
    - Get in touch!

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