Exploring walking differences by socioeconomic status using a spatial agent-based model

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Outline

1. Introduction
2. Research methods
3. Scenario simulations, results and summary
4. Discussions and conclusions

Introduction

- Environmental effects on walking have received increasing attention
- Walking is different by socioeconomic status, this differences by SES in walking arise from dynamic interactions between people and environments over time
- These dynamic relations are not easily captured by statistical models
- Agent-based models allow us to be explicit about these relations

Why agent-based model?

- A type of computational model for simulating the actions and interactions of a number of agents to gain understanding at the whole system level
- Advantages:
  - more convenient for ABMs to incorporate individual's walking behaviors and interaction with environment in the models
  - allow capturing dynamic processes
  - more convenient to represent the heterogeneity within the population
  - can make full use of the knowledge from both macro and micro levels
  - may help to find causal relationship
  - can be used to test possible changing policy

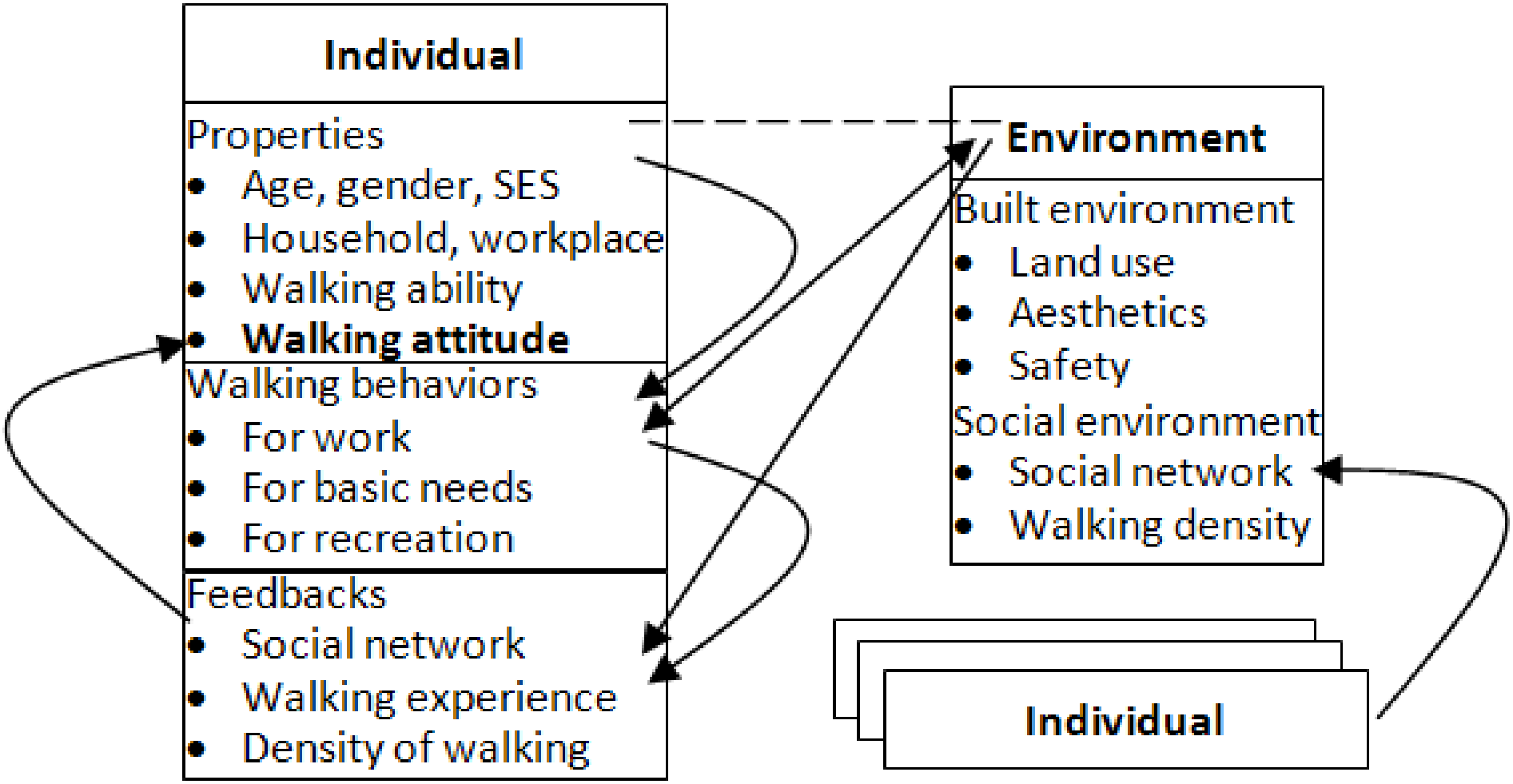
Research objectives

- Develop an agent-based model to simulate adults' daily walking within an urban area in USA.
- Use the model to explore how built and social environmental features contribute to SES differences in walking by contrasting different scenarios
- Use the model to examine the effectiveness of policy intervention by contrasting different scenarios

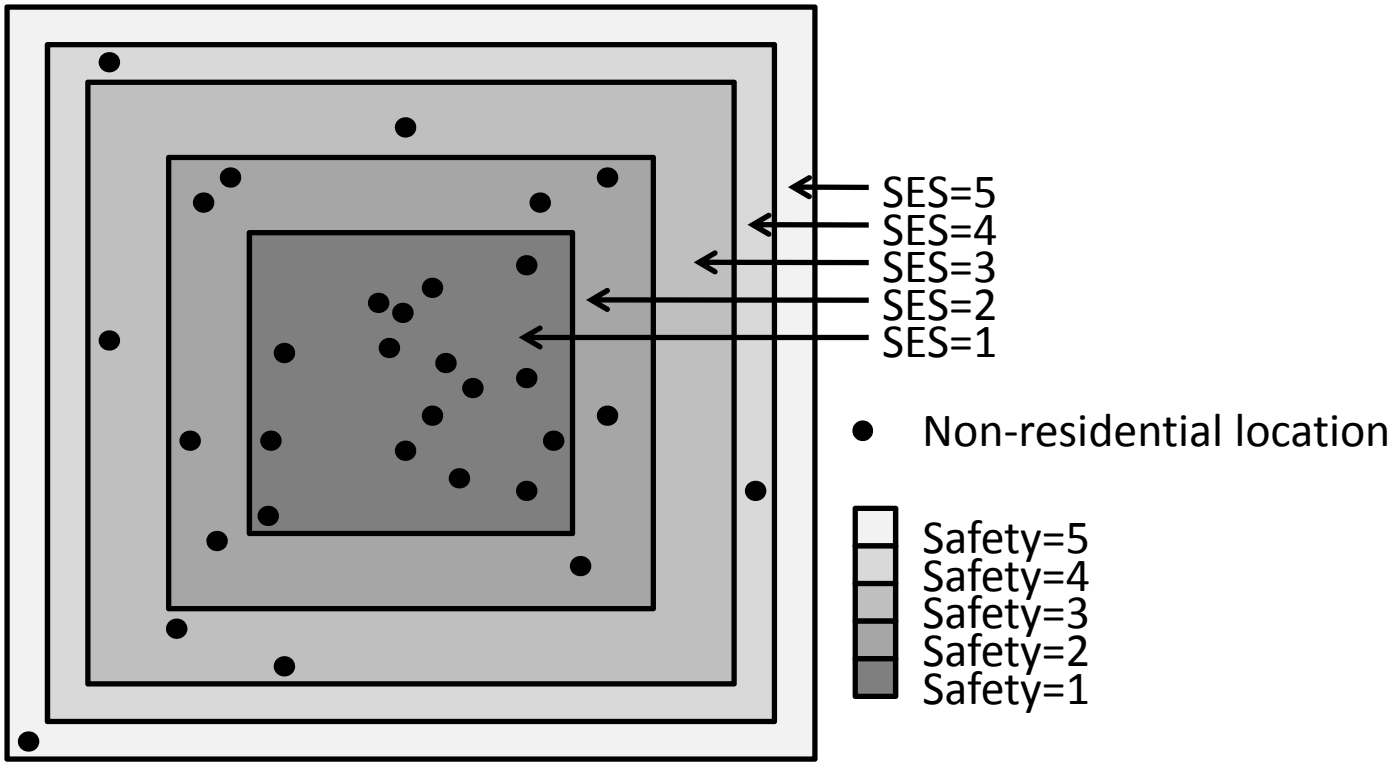
A spatial agent-base model

- For the walking of urban adults of the USA
- A city of 108,000 adult population and 64 km^2 , a number of locations such as grocery, shop, social place, workplace and household, based on Ann Arbor
- Some parameters were calibrated by 2001 NHTS
- See *American Journal of Preventive Medicine (2011, March)*

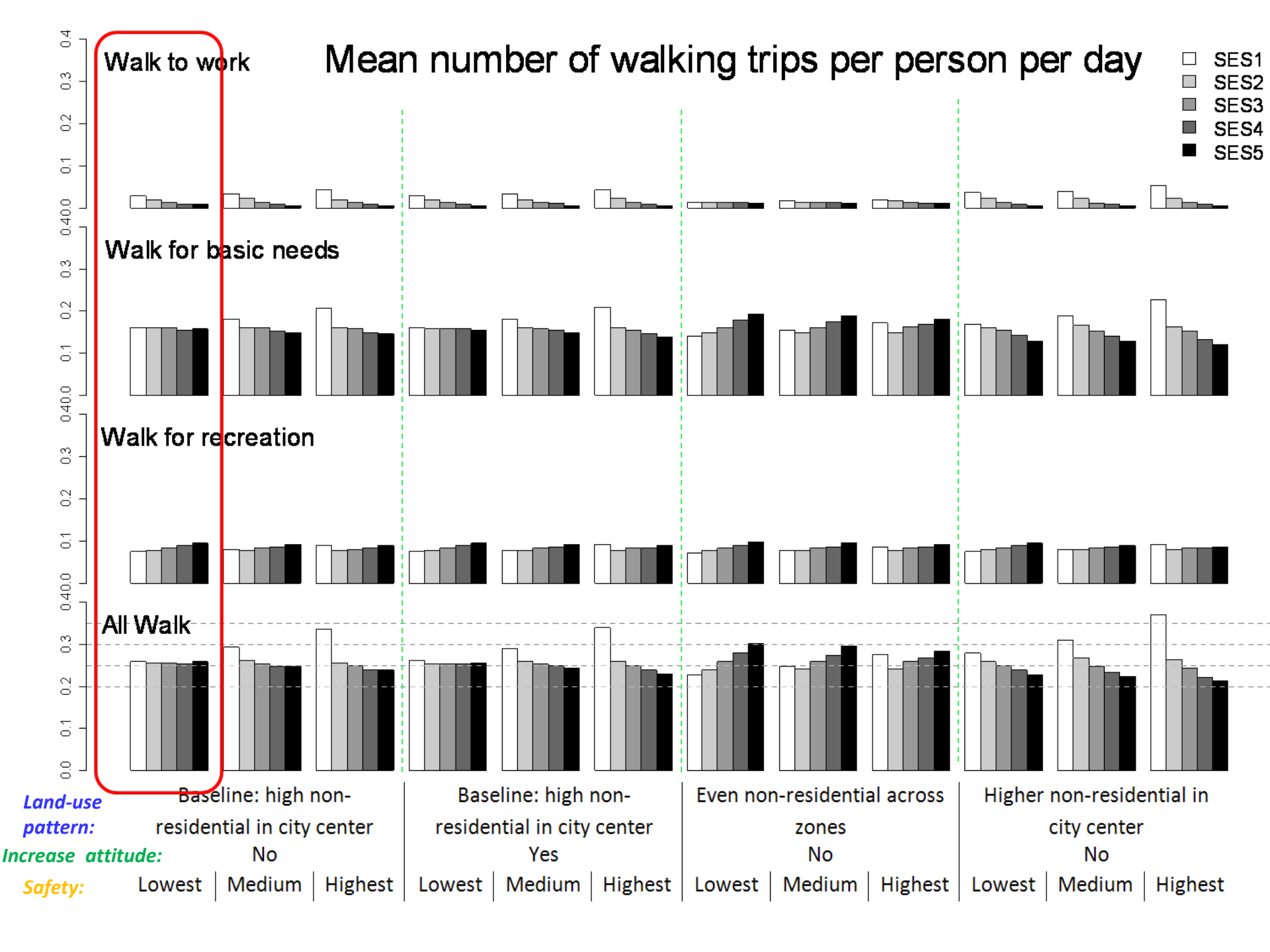
Framework of the model



Baseline simulation



Strict SES segregation, lower SES zones with lower safety level but higher non-residential density


Mean number of walking trips per person per day
SES1
SES2
SES3
SES4
SES5
Walk to work
Walk for basic needs
Walk for recreation
All Walk
0.0
0.1
0.2
0.3
0.4
Land-use pattern:
Increase attitude:
Safety:
Baseline: high non-residential in city center
No
Lowest
Medium
Highest
Baseline: high non-residential in city center
Yes
Lowest
Medium
Highest
Even non-residential across zones
No
Lowest
Medium
Highest
Higher non-residential in city center
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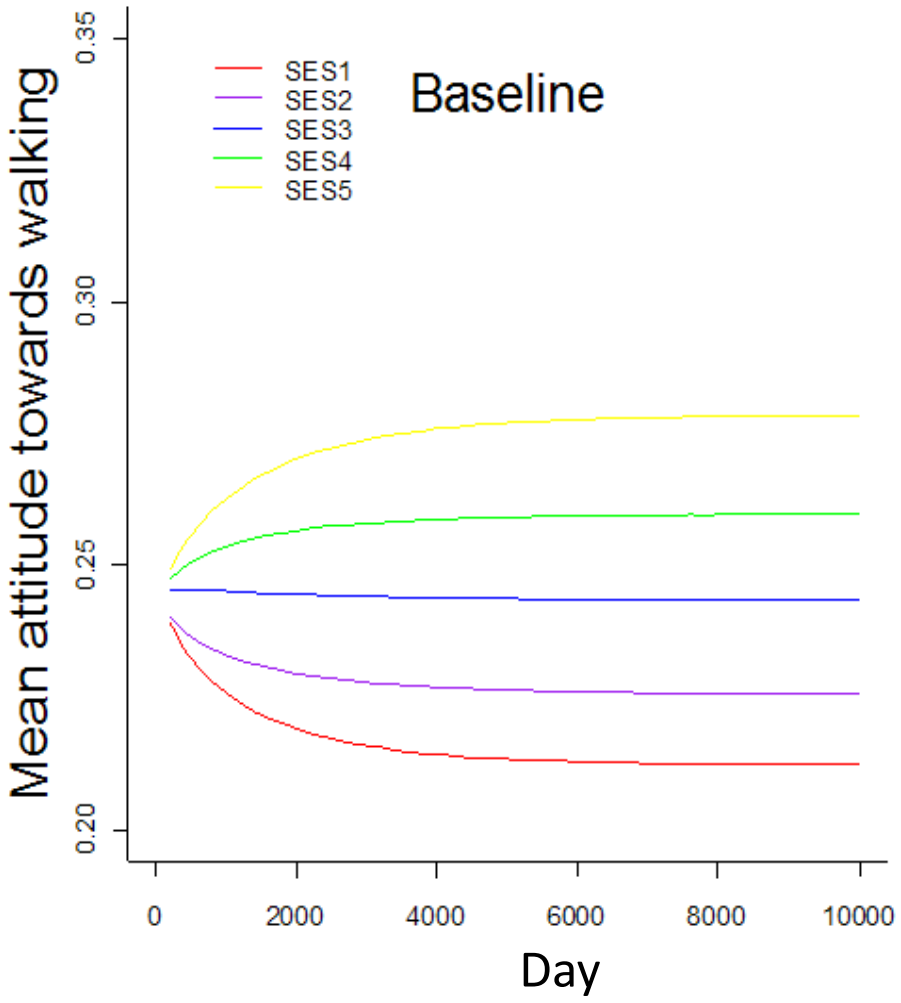
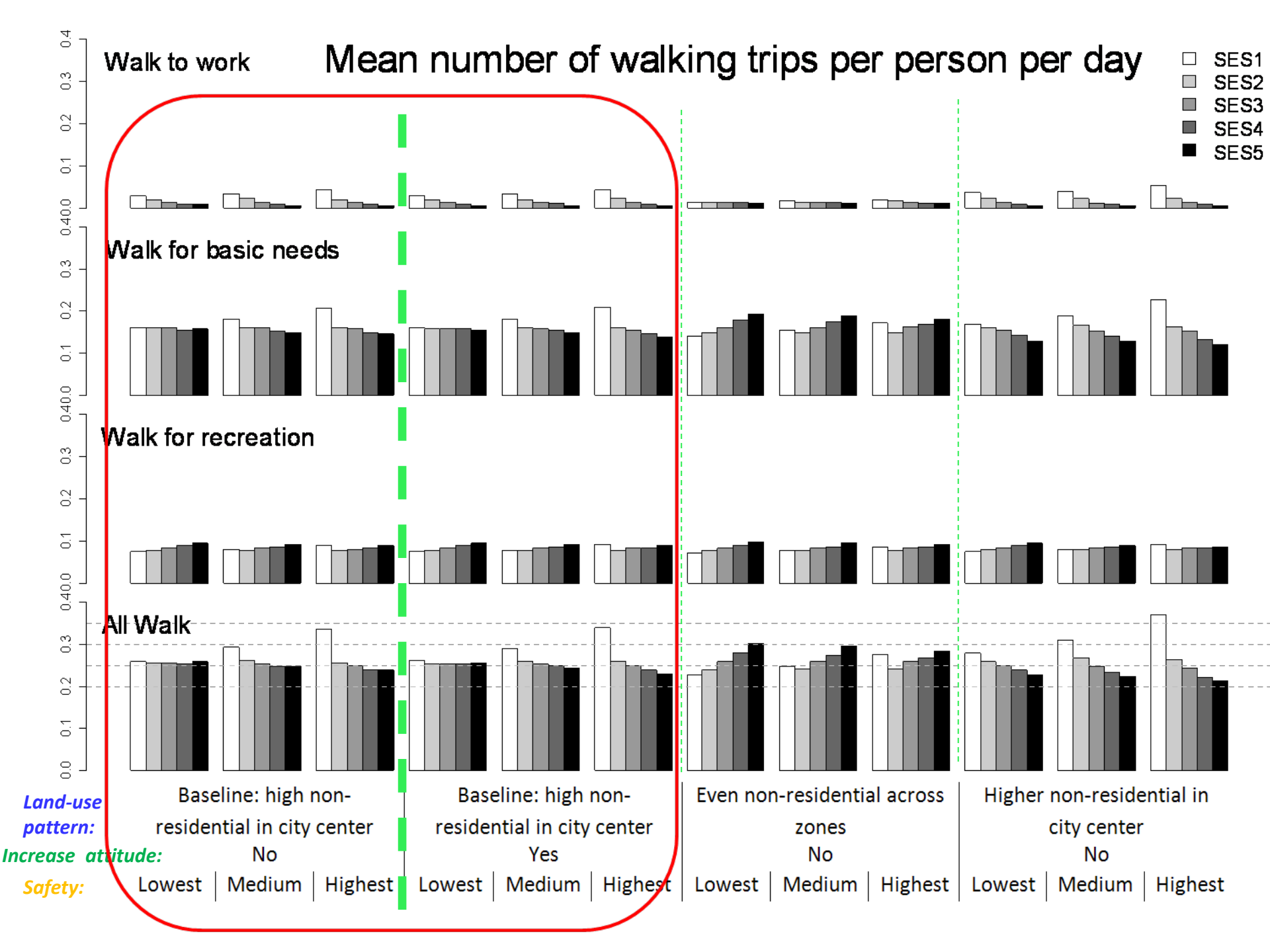

Baseline
SES1
SES2
SES3
SES4
SES5
Mean attitude towards walking
0.20
0.25
0.30
0.35
0
2000
4000
6000
8000
10000
Day

Scenario 1: How to increase walking among lowest SES group?

- Increase attitudes towards walking in lowest SES group
- Improve safety of lowest SES neighborhood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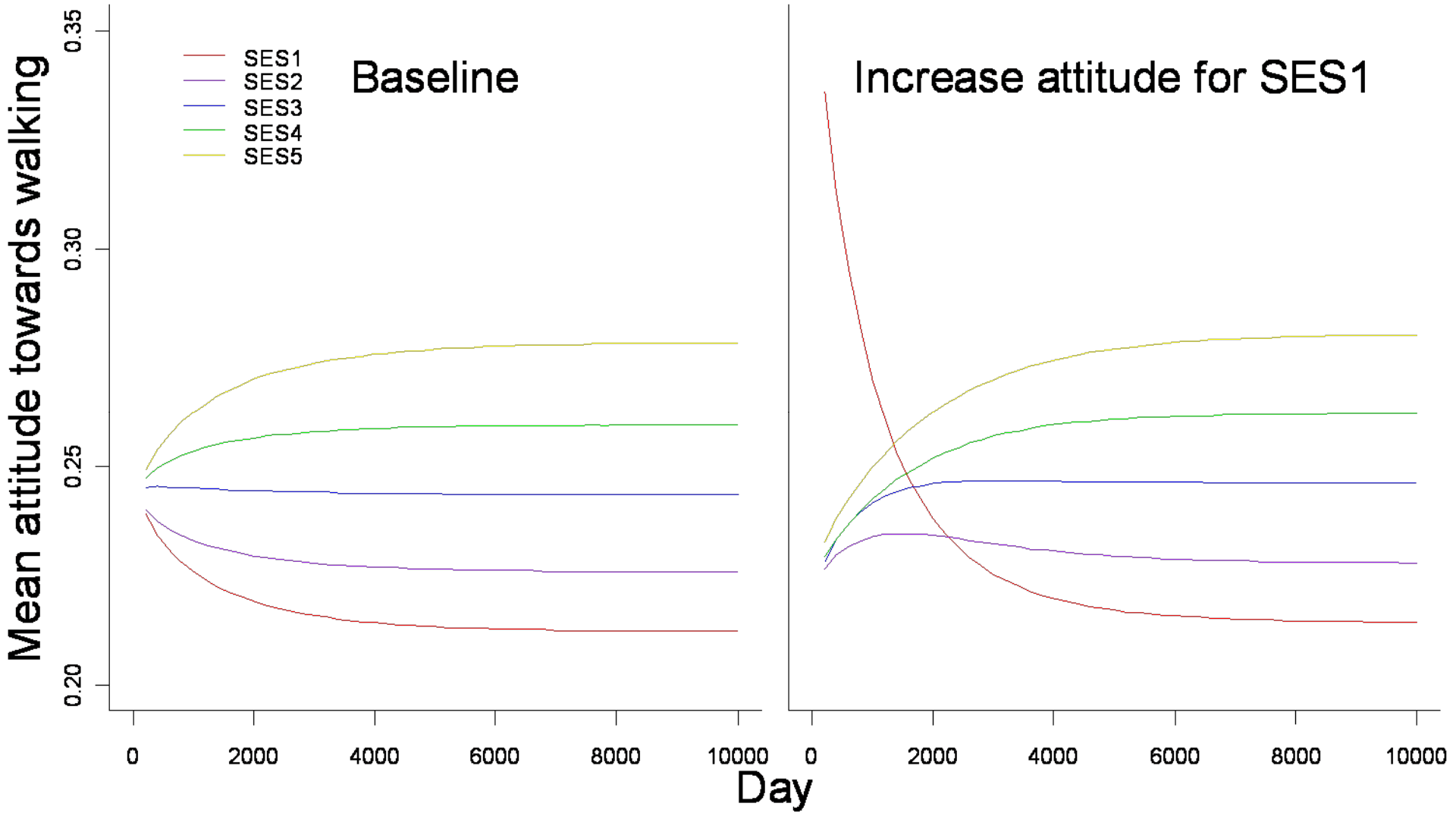
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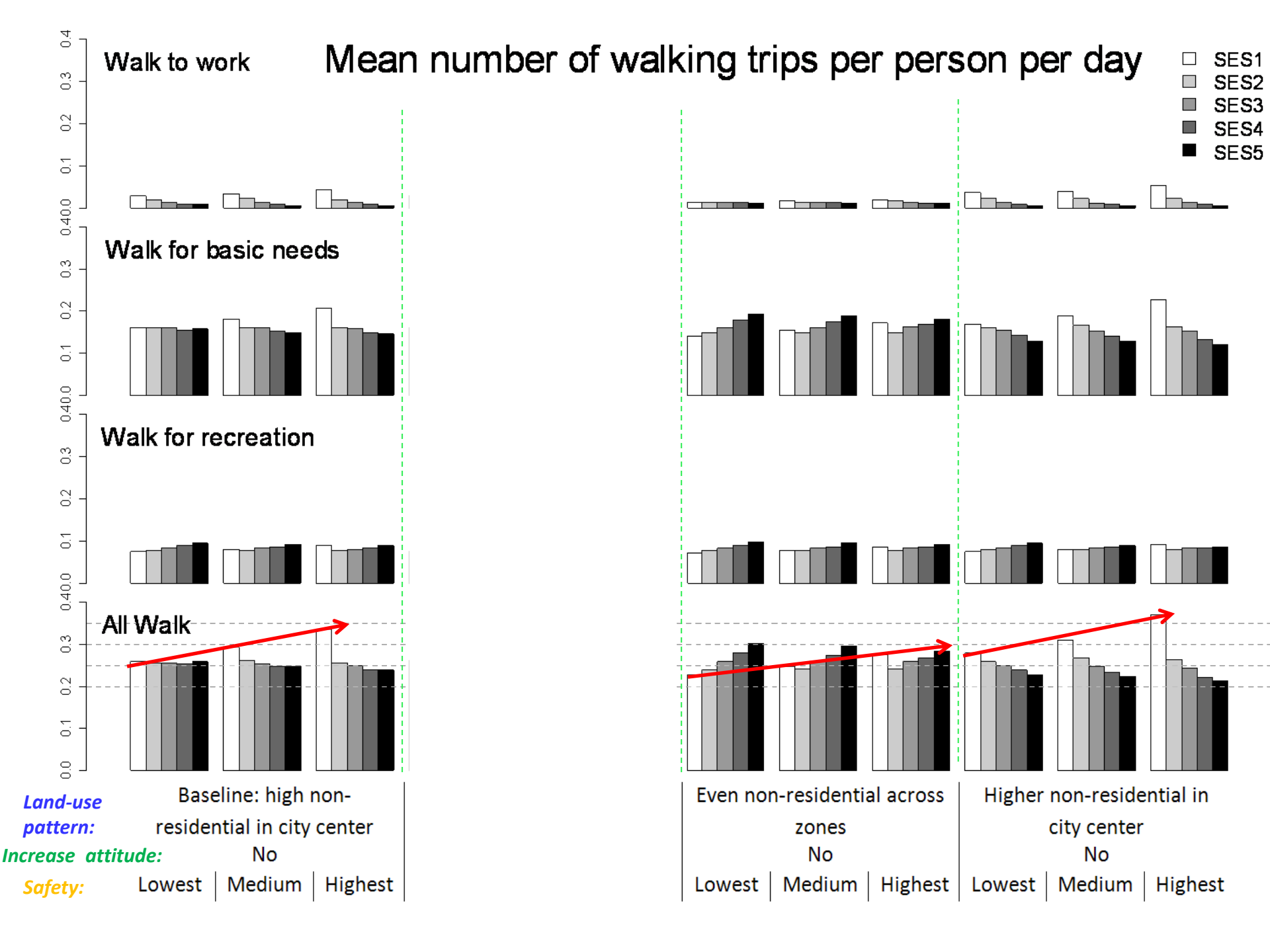
SES3
SES4
SES5
Baseline
Increase attitude for SES1
0
2000
4000
6000
8000
10000
Day

Scenario 2: Does the impact of increasing safety depend on land use mix?

- Patterns of land-use mix:
  - Baseline: non-residential density within each of the five zones decays outwards with the ratio of 1/2

  Compare to:

  - A scenario with even distribution of Non-residential density (ie less land use mix in the core compared to baseline scenario)
  - A scenario with more skewed distribution of land use (ie even greater land use mix in the core compared to baseline)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No
Safety:
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Medium
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Lowest
Medium
Highest
Lowest
Medium
Highest

Summary from above scenarios

- Walking amongst lowest SES persons
  - More to work, less for recreation.
  - Lowest walking attitudes due to the lowest safety
  - Higher density of non-residential locations provide more chance for their walk to work and for basic needs.
- To increase walking amongst lowest SES persons
  - Increase walking attitude does not work
  - Increase safety level is effective
- With higher concentration of non-residential locations around lower SES persons' neighborhood
  - Lower SES persons walk more
  - Increase safety is more effective

Discussions and conclusions

- Importance of providing a supportive environment for walking
- Under the assumptions of our model, the walking increases that could result from increasing a positive attitude towards walking wear out over time if other features of the environment are not conducive to walking
- Impact of safety varies by the patterns of land-use mix
- Possible improvements for the model
  - Need public transportation system
  - Interaction between walking and safety, land-use
- The potentials of agent-based models