

# **Systems thinking for urban health in Latin America: Lessons from SALURBAL**

**USING AGENT-BASED MODELLING TO UNDERSTAND TRANSPORTATION  
& ITS IMPACT ON URBAN HEALTH IN LATIN AMERICA**

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# WHY TRANSPORTATION?

**Transportation is an important determinant of health & wellbeing**

- **Facilitates access to health care, employment, education etc.**
- **Air and noise pollution**
- **Physical activity**

**Can exacerbate social segregation & health inequalities**

# MODEL PURPOSE

Model commuter decision-making and behavior in a Bogota-inspired city.

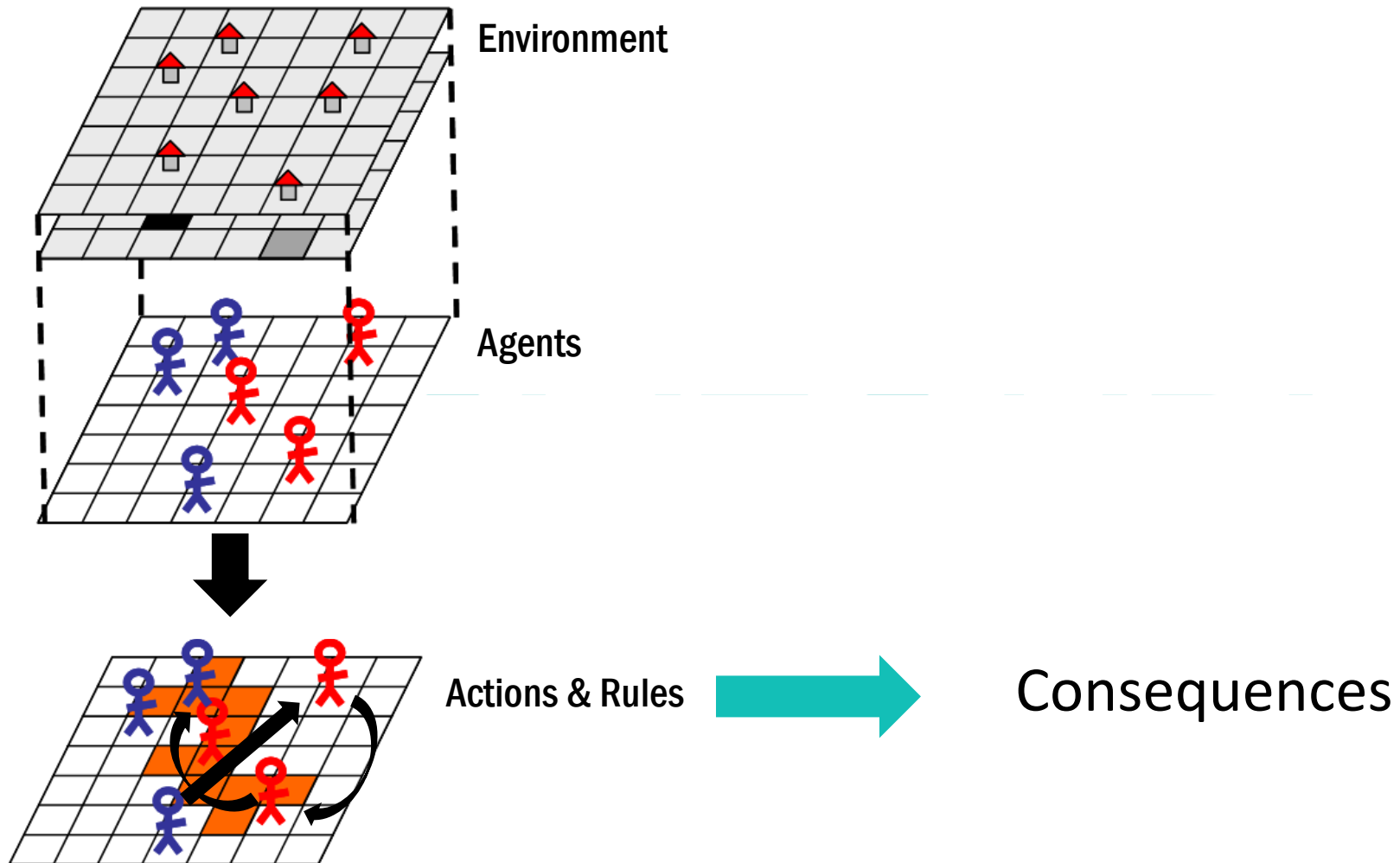
Use this model to explore three types of policies:

- Public transportation-oriented policies
- Car-focused policies
- Interventions improving personal safety from crime

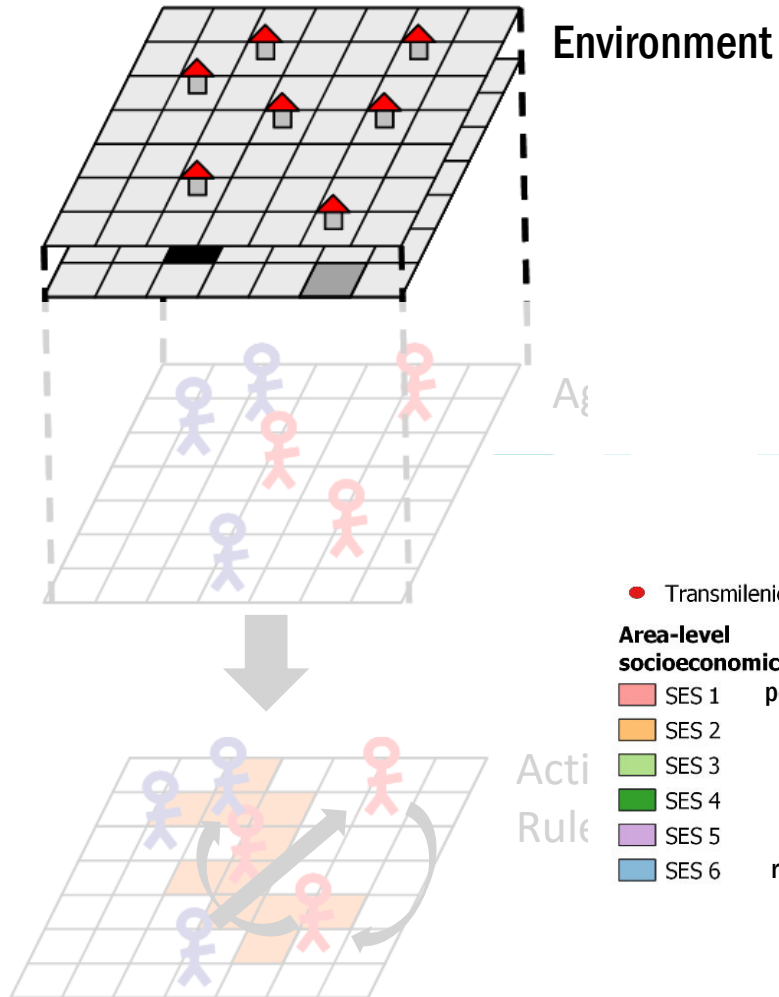
Impact on mode share & physical activity



# AGENT BASED MODEL



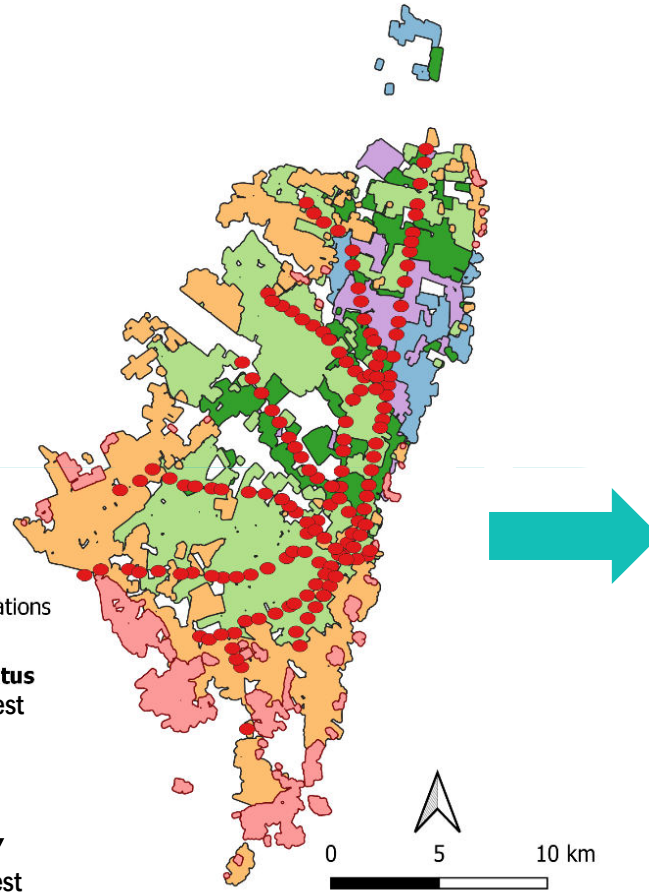
# PHYSICAL ENVIRONMENT



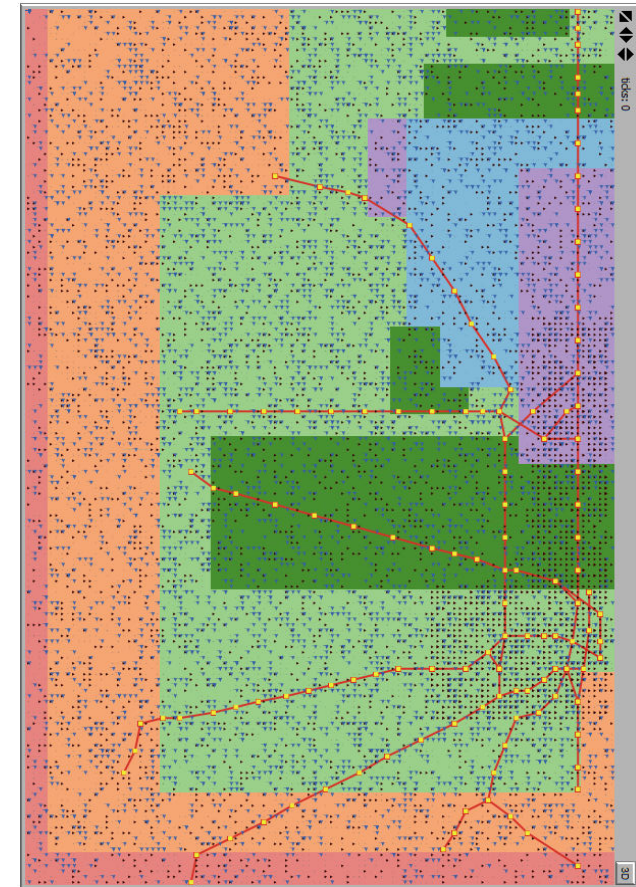
● Transmilenio stations

**Area-level socioeconomic status**

- SES 1 poorest
- SES 2
- SES 3
- SES 4
- SES 5
- SES 6 richest

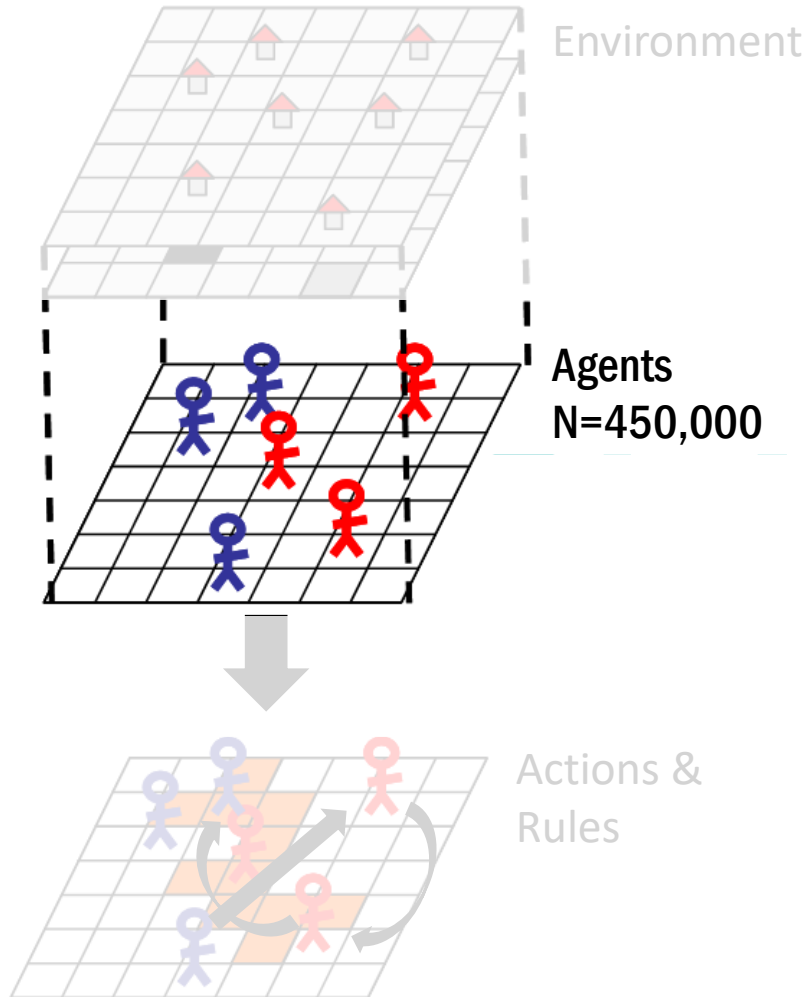


Bogota

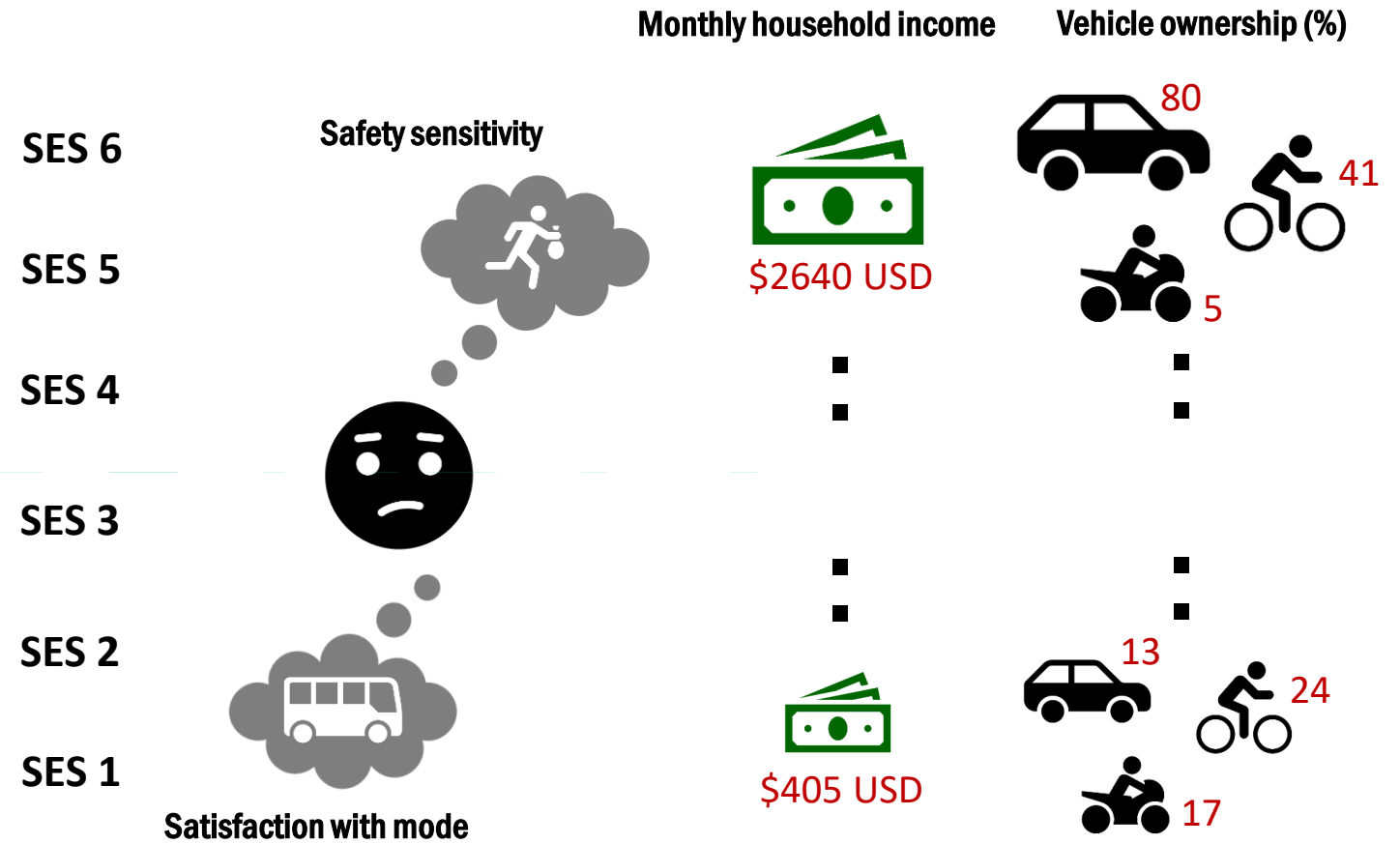


Bogota-inspired city

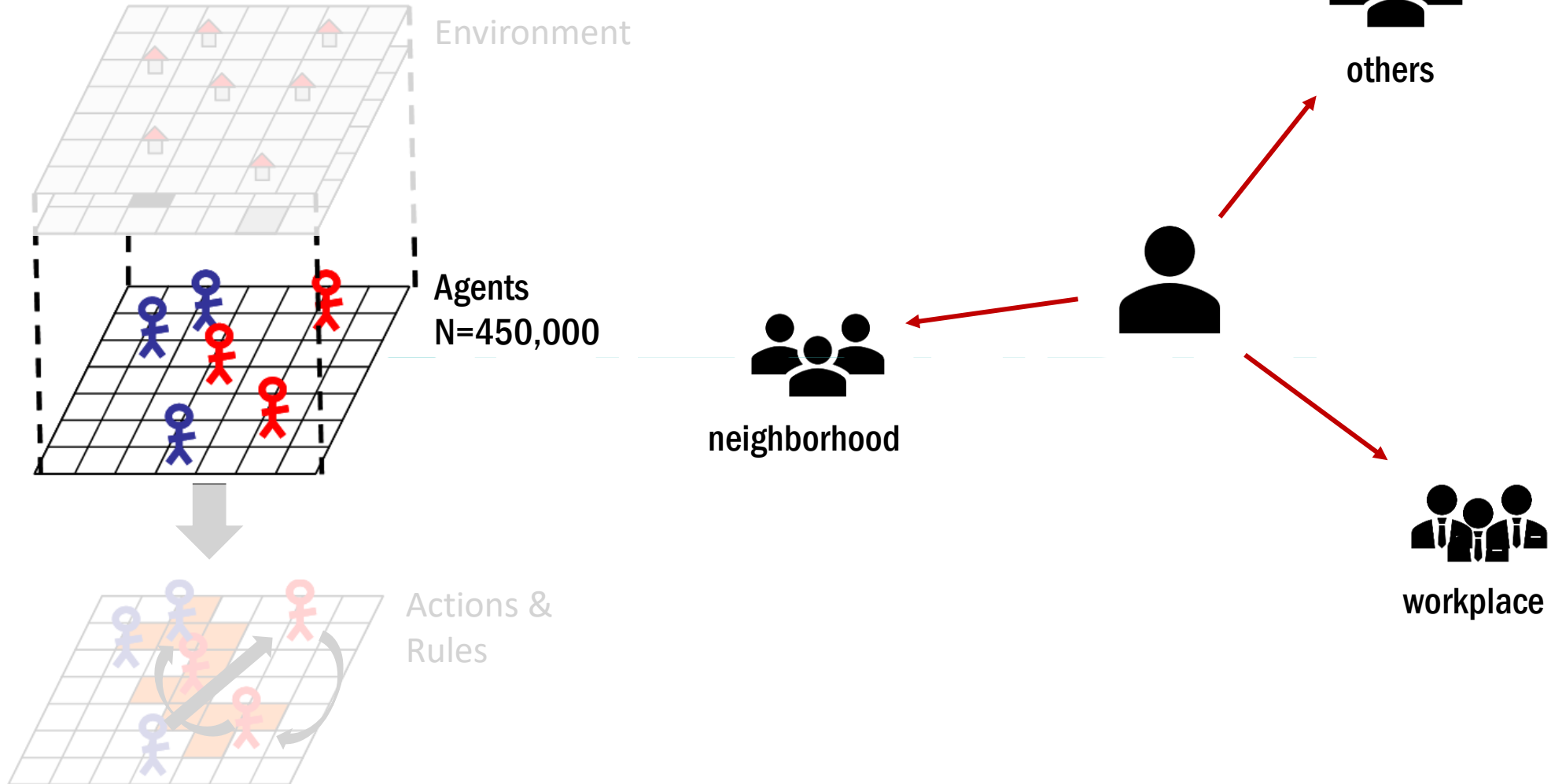
# AGENT PROPERTIES



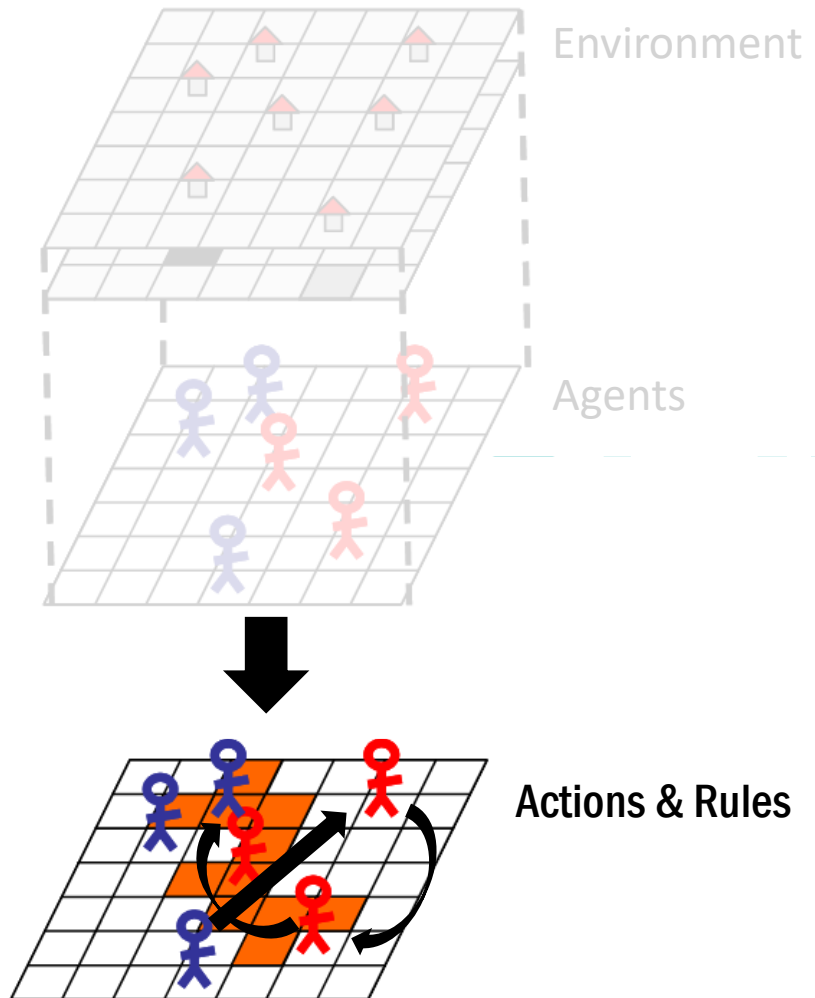
2019 Bogota Household Travel Survey & eCAF Survey



# SOCIAL ENVIRONMENT



## ACTIONS & RULES



Five modes represented in the model: car, motorbike, bus, BRT, bicycle, walking

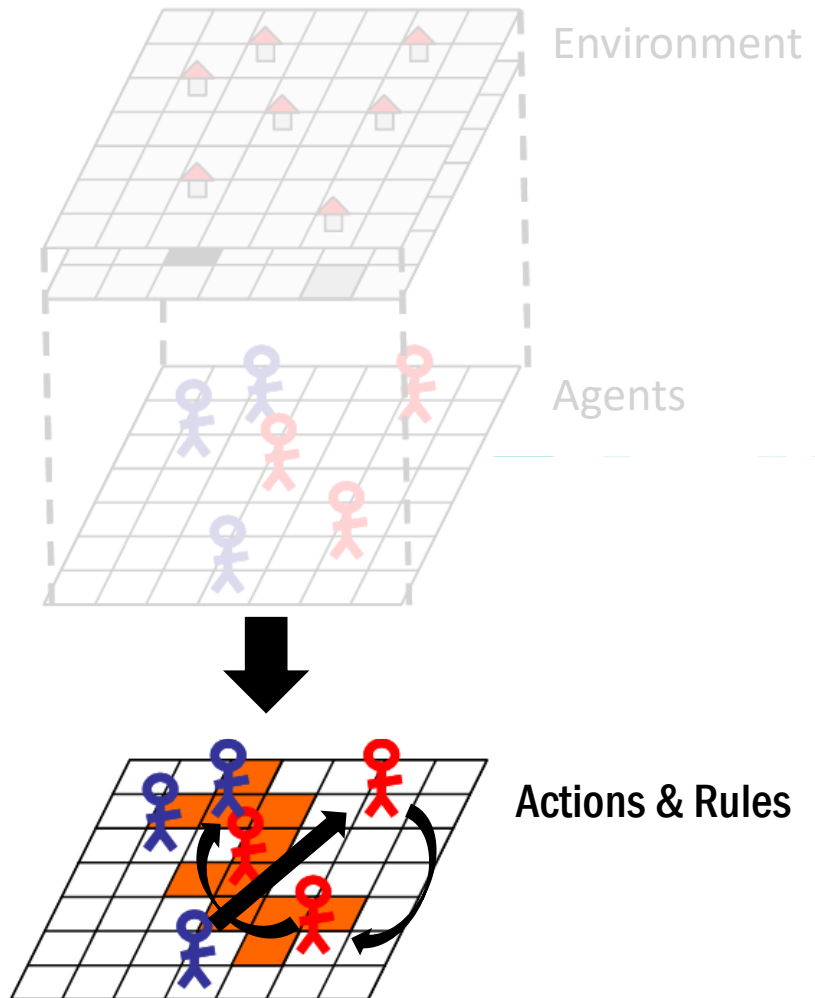
Each day, people decide how to commute to work based on the following rules:

1. Eliminate modes they don't have access to
2. Evaluate the perceived safety\* of each mode and avoid modes considered too unsafe
3. Evaluate the utility of each mode and choose the mode with the highest utility

\*safety - personal safety from crime



## ACTIONS & RULES



Five modes represented in the model: car, motorbike, bus, BRT, bicycle, walking

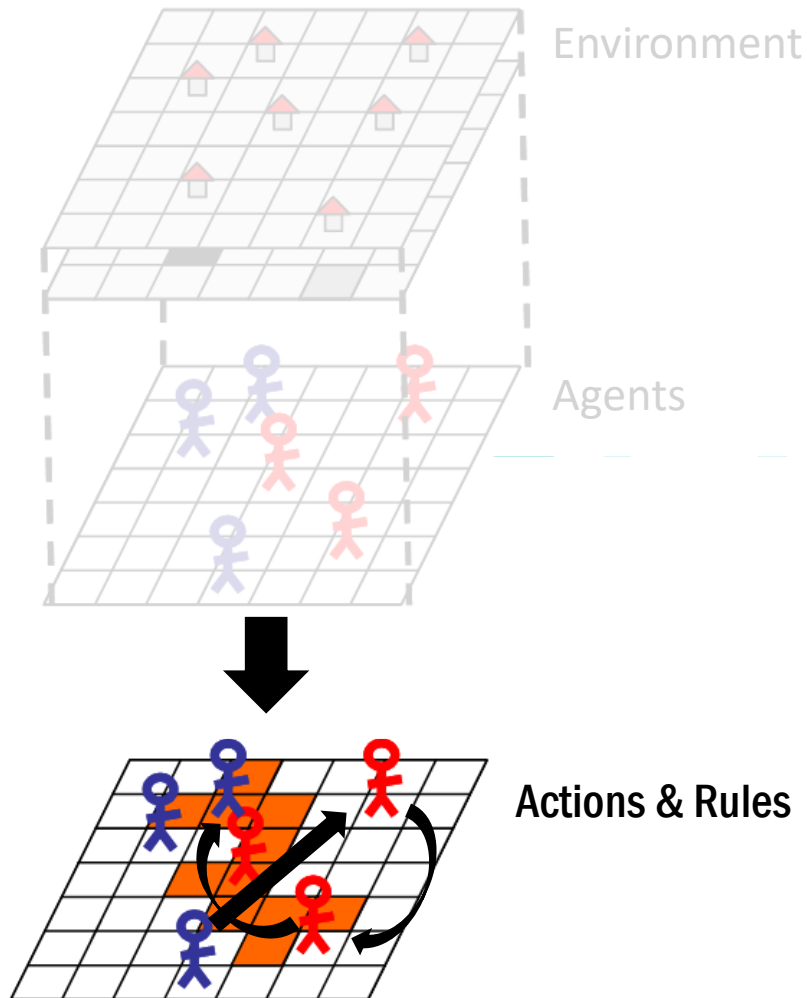
Each day, people decide how to commute to work based on the following rules:

1. Eliminate modes they don't have access to
2. Evaluate the perceived safety\* of each mode and avoid modes considered too unsafe
  - Crime statistics
  - Own past experiences
  - Friends' past experiences

Perceived risk of each mode  $\times$  Crime sensitivity
3. Evaluate the utility of each mode and choose the mode with the highest utility

\*safety - personal safety from crime

## ACTIONS & RULES



Five modes represented in the model: car, motorbike, bus, BRT, bicycle, walking

Each day, people decide how to commute to work based on the following rules:

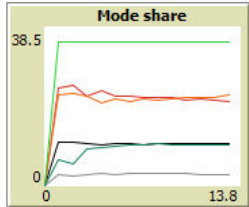
1. Eliminate modes they don't have access to
2. Evaluate the perceived safety\* of each mode and avoid modes considered too unsafe
3. Evaluate the utility of each mode and choose the mode with the highest utility
  - Relative cost – e.g., fares, fuel, parking
  - Estimated travel time – own and friends' past travel time
  - Level of satisfaction with mode of travel

\*safety - personal safety from crime

Interface Info Code

Edit Delete Add  | normal speed  view updates on ticks

% Mshift 16.38

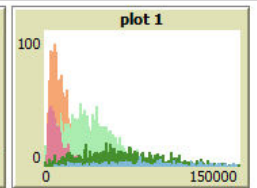
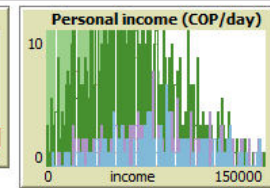
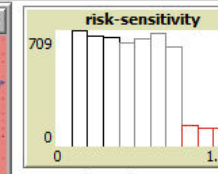
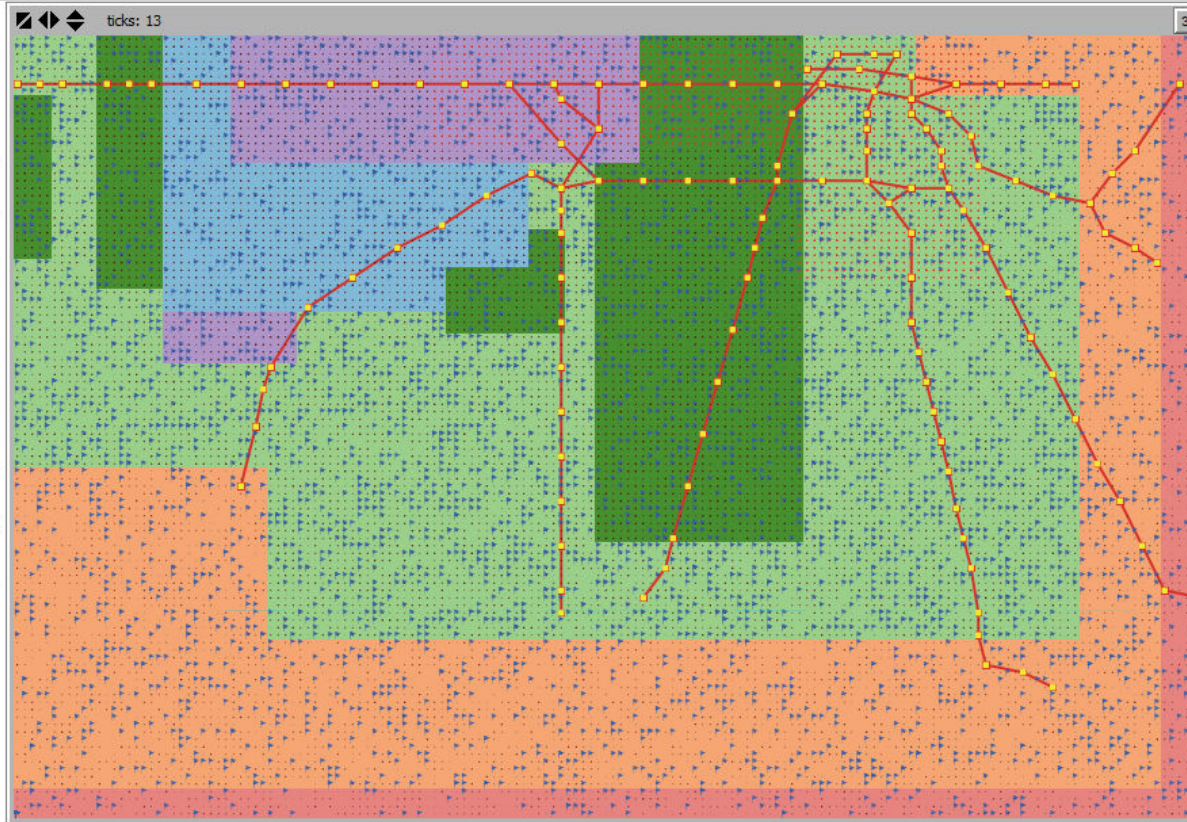


% Mode share

Car	Mbike	Bus
10.22	2.78	21.94
Bike	Walk	BRT
34.94	9.78	20.34
Car2 exp	Mbike2 exp	Bike2 exp
18.2	7.9	2.8
Bus2 exp	BRT2 exp	
1.7	2	

run-type

All people

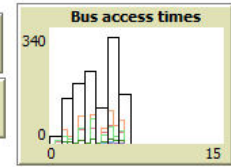


% Crime by mode

Car	Mbike	Bus	BRT	Bike	Walk
0	0	0	0	0.40068	0.408997

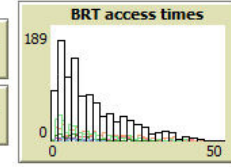
Bus access time (min)

Mean	7.74	9.41	8.23	6.87	6.88	6.67	8.77
Total	4.1	4.12	4.14	3.99	4.03	5.78	4.95
SD	1.56	1.52	1.59	1.55	1.65	0.67	0.31



BRT access time (min)

Mean	9.8	15.97	9.72	9.52	9.58	8.39	8.65
Total	11.96	16.93	14.21	9.35	8.45	5.65	7.36
SD	10.14	12.54	11.04	7.79	6.56	3.26	3.67



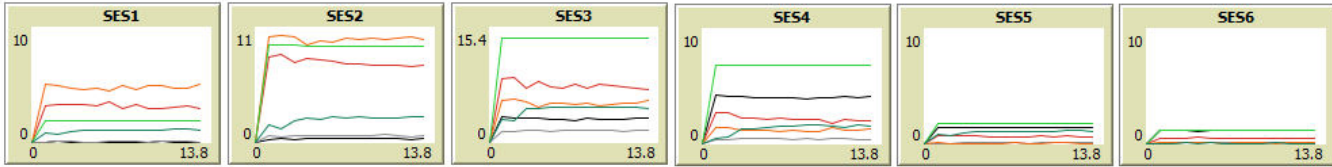
OVERALL one-way commute travel time (min), by mode

Car	Mbike	Bike	Bus	BRT	Walk
9.99	10.09	24.77	43.59	36.92	44.66

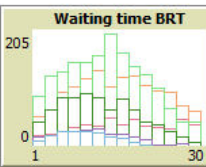
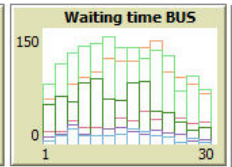
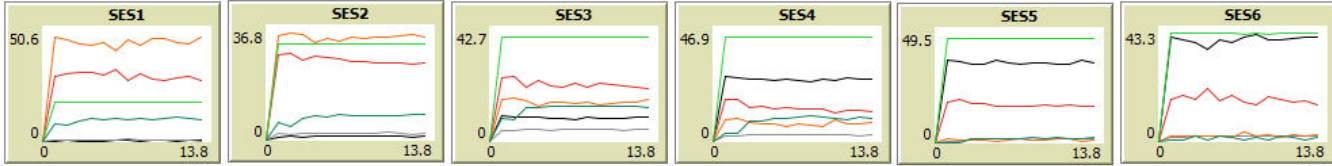
Total DAILY active time (min), by mode

Walk	Bike	Bus	BRT
89.32	49.53	16.48	32.06

Absolute % mode share



Relative % mode share



# CHALLENGES

**Tension between realism and abstraction**

**Finding data sets to inform model parameters**

**Computational constraints**

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# NEXT STEPS

**Aligning the simulated output with observed travel patterns**

**Simulating different policy scenarios**

- **Public transportation changes e.g., BRT lines, travel speeds, fare price**
- **Car-focused policies e.g., changing parking costs**
- **Increasing personal safety from crime e.g., crime reduction measures**

**Expand model focus to consider air pollution**

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