Center for Public Health Systems Science

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BROOKINGS

Tobacco Town: Modeling the Effects of Tobacco Retailer Reduction

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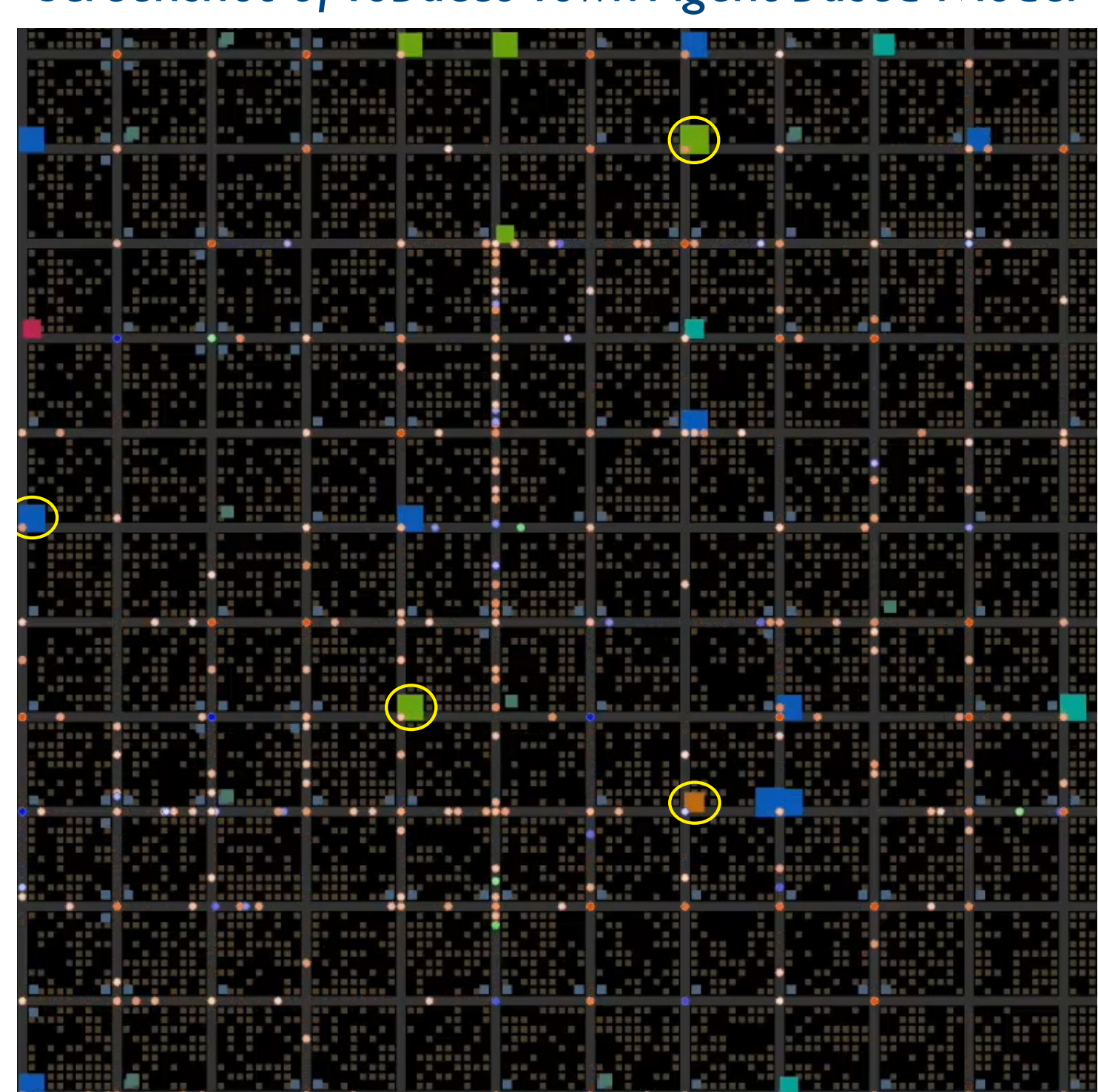
BACKGROUND

Point-of-sale policies such as those regulating location and density of tobacco retailers have the potential to reduce cigarette consumption and smoking initiation. However, there are few studies that examine the mechanisms by which these policies operate. This study uses computational modeling to examine the interplay between retailer density reductions and patterns of tobacco purchasing.

This study presents the first agent-based model used to examine the effects of realistic tobacco control policies.

METHODS

In this study, we develop an agent-based model of a hypothetical environment, *Tobacco Town*, populated by individuals ("agents") who are consumers of tobacco products. The town consists of a basic grid geography, containing a street network, key locations where agents spend time, and tobacco retailers. Agents travel about the town, making periodic choices about whether to purchase cigarettes—and if so, where and when. Many model elements are rooted in empirical sources (e.g., census, national surveys).

Screenshot of Tobacco Town Agent-based Model

- Agent: car
- Agent: bike
- Agent: walk
- Convenience Store
- Liquor Store
- Pharmacy
- Supermarket
- Tobacco Shop
- Cigarette purchase

*Size of retailer corresponds to cigarette price

What is agent-based modeling?

Agent-based modeling (ABM) is a type of dynamic modeling that uses computer simulations to examine how complex systems behave as a function of their individual elements' (agents) interactions with each other and their environment.

RESULTS

Preliminary model policy experiments have examined the effects of 1) random retailer reduction and 2) restricting the type of retailers allowed to sell tobacco products. In the figures below, Total Cost is the sum of travel costs and purchasing costs, normalized in dollars. Retailer Density is the number of retailers per square mile.

What happens if general retailer density is reduced?

Starting from a baseline retailer density, density was randomly reduced in 10% increments from 10% to 50%. Total cost increases non-linearly as density is reduced ($F=30.2$, $p<.001$).
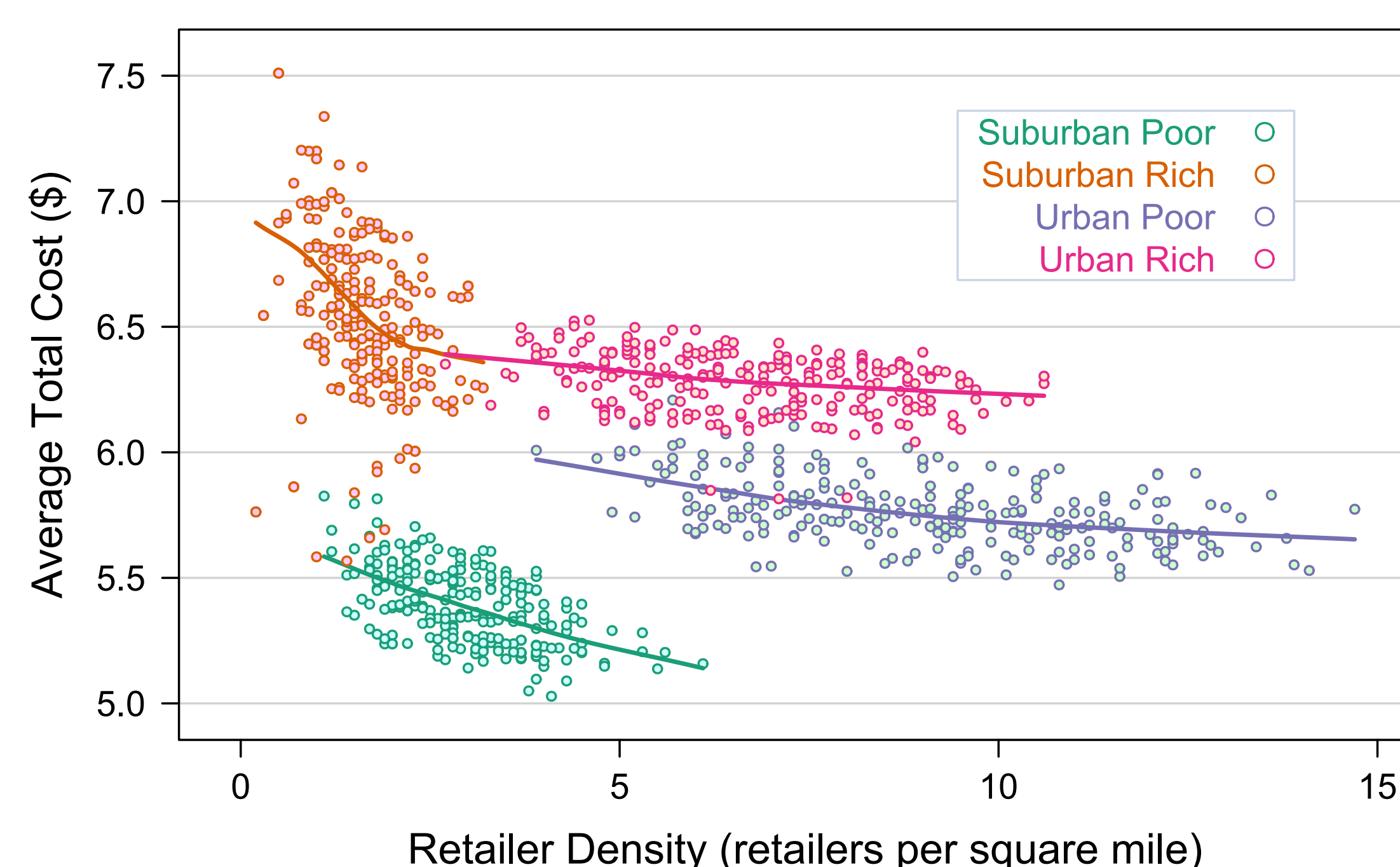
What happens if pharmacies or convenience stores no longer sell tobacco?

Removing pharmacies results in only a minor reduction in retailer density (from 6.8 to 6.3 retailers/sq. mile) and has no noticeable effect on total costs. Conversely, removing all convenience stores results in a large density reduction (from 6.8 to 4.1 retailers) and leads to a significant community by condition interaction ($F=8.1$, $p< .001$) on total costs.
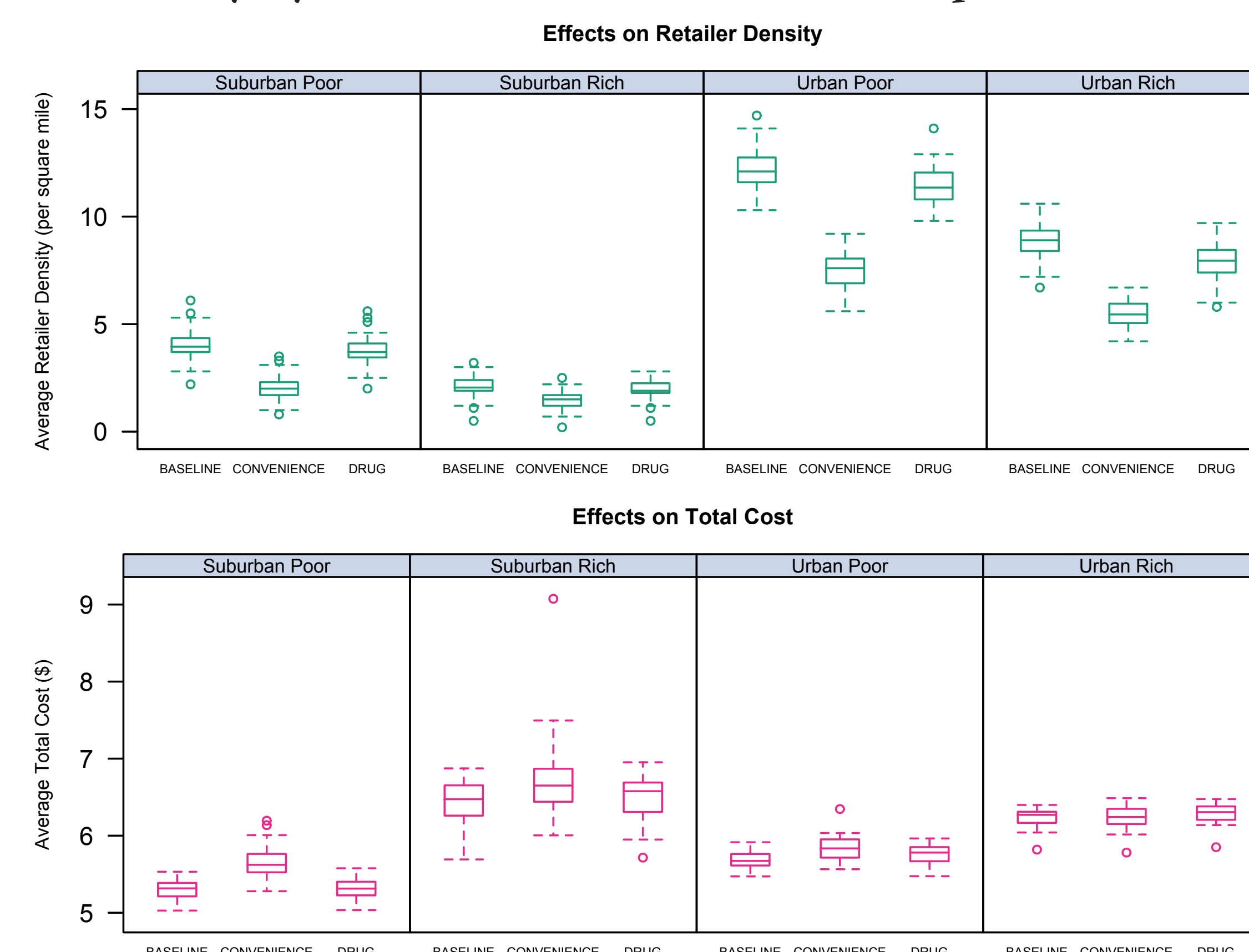
CONCLUSIONS

This study demonstrates the utility of computational modeling for studying the complexities of implementing public health policies. Although model parameters are still being tested and finalized, preliminary results suggest:

- Policies designed to reduce retailer density have potential non-linear effects on tobacco costs

- Policy effects are context dependent

- The need for new research to address current gaps in travel and purchasing literature

NEXT STEPS

The long-term goal of this project is to develop and disseminate a state of the art, empirically-calibrated model that would serve as a policy design tool for communities considering adopting new tobacco control policies. Future plans include:

- Testing other tobacco policy interventions
  Other policies to explore include: location-based restrictions, increased licensing fees, and attrition (cap & winnow).

- Expanding the current *Tobacco Town* model
  Future phases of the model will incorporate: geographical momentary assessment (GMA) data, retailer dynamics, realistic physical space, tobacco initiation and cessation, and underage/social sourcing.

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