Advancing Science
& Practice in the
Retail Environment

aspirecenter.org

Tobacco Town:

A computational model for exploring environmental effects of retail tobacco control policies

Douglas Luke (& Todd Combs, Ross Hammond)| June 7, 2021

STANFORD PREVENTION RESEARCH CENTER
the science of healthy living

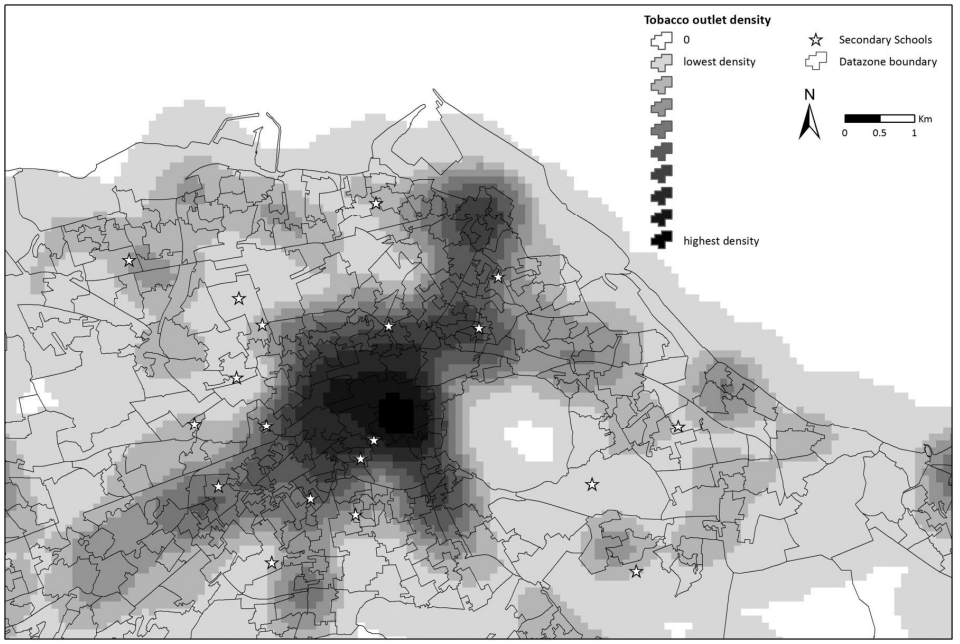
Washington University in St. Louis

Center for Public Health Systems Science
Brown School

UNC GILLINGS SCHOOL OF GLOBAL PUBLIC HEALTH

Goals

- The case for *retail* tobacco control policies
- The case for ABMs in tobacco control science
- Tobacco Town agent-based model
  - How it works
  - What we are learning



Retailer density in Edinburgh – from Shortt et al., 2014, *Tobacco Control.*

ASPiRE

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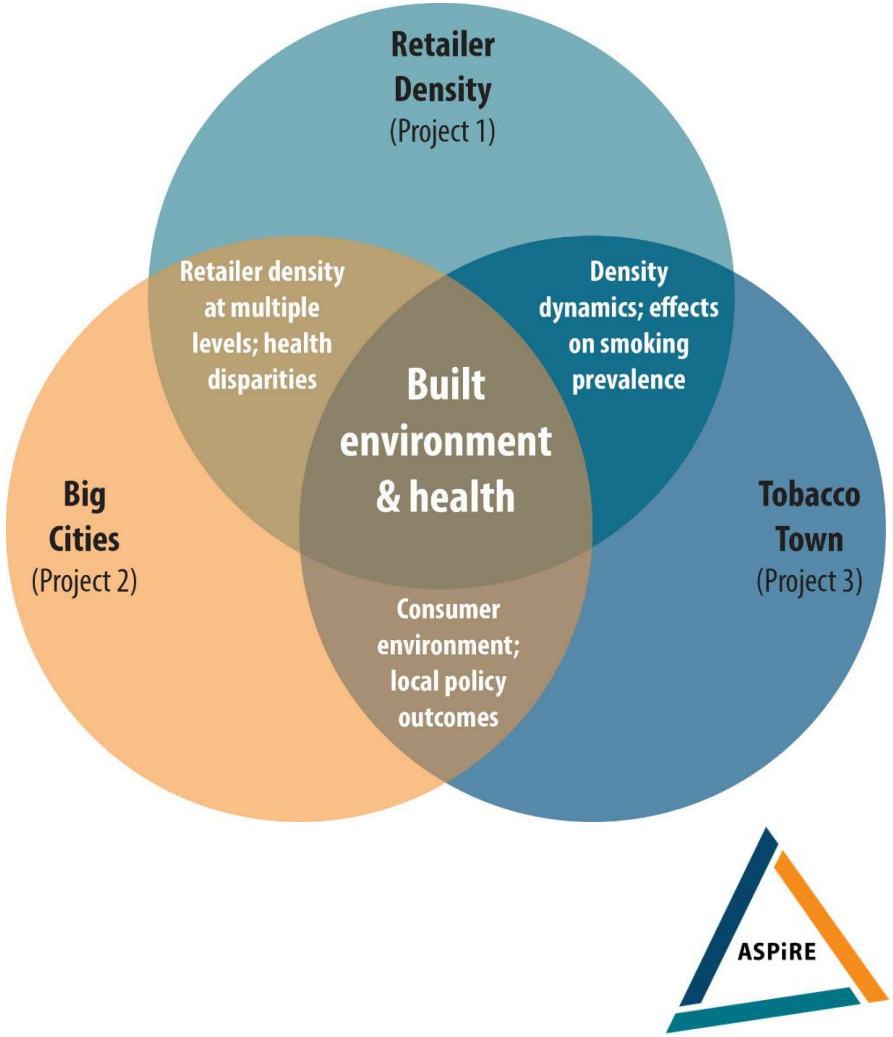
- Goal: *to build a rigorous, scientific evidence base for effective tobacco control in the retail environment to reduce the public health burdens of tobacco use*
- 3 research projects
- 3 support cores
  - Administrative core
  - Data core
  - D & I core



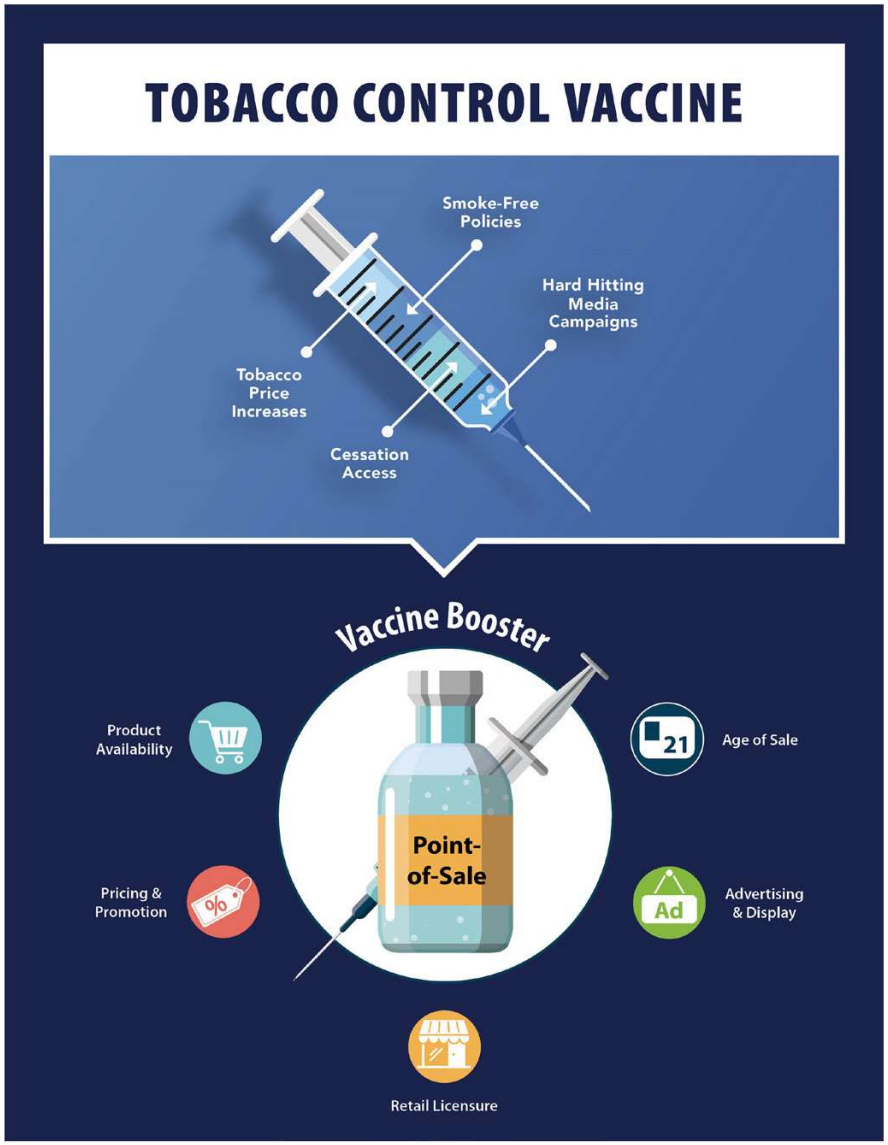
Tobacco Retail Environment

Developing evidence-based policies focusing on where tobacco products are sold

We know what works

5 **retailer-focused strategies** act as a Vaccine Booster

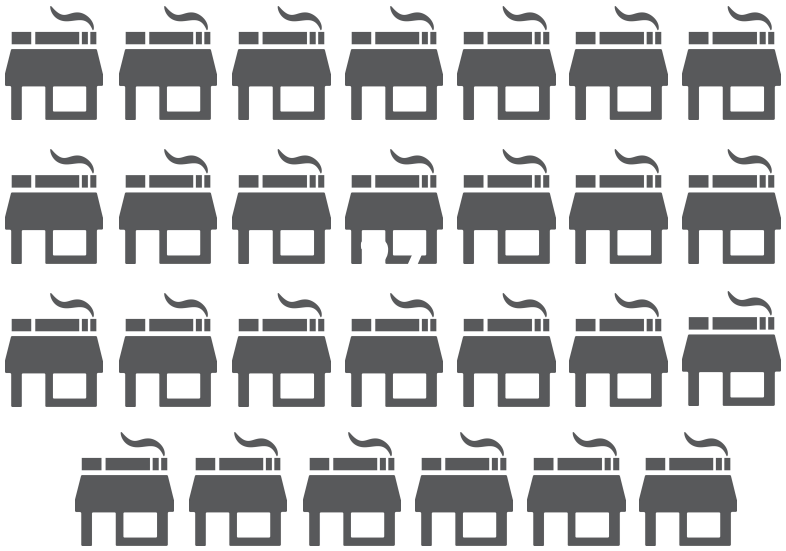
- Product Availability
- Pricing & Promotion
- Age of Sale
- Advertising & Display
- Retail Licensure



Source: Kong AY, King BA. (2020). Tobacco Control.

Tobacco retailers are ubiquitous

In 2020, there were **27 tobacco retailers** for every **1 McDonald's** in the US



380,000

14,000

Source: https://www.cdc.gov/statesystem/factsheets/licensure/Licensure.html

Many types of retailers sell tobacco

Warehouse

Tobacco

Pharmacy

Discount

Grocery

Alcohol

Gas/Convenience

MJ7

Health equity: Restrict location, undo disparities

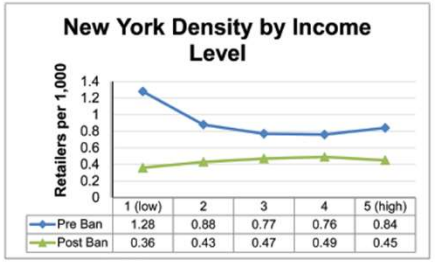
Nicotine & Tobacco Research, 2017, 239–244
doi:10.1093/ntr/ntw185
Original investigation
Advance Access publication August 26, 2016

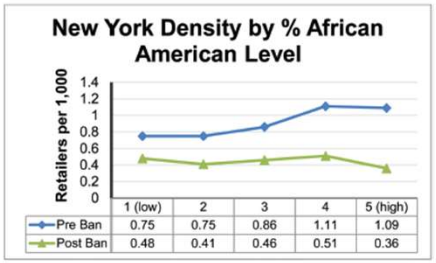
SRNT

Original investigation

Reducing Disparities in Tobacco Retailer Density by Banning Tobacco Product Sales Near Schools

Kurt M. Ribisl PhD[1,2], Douglas A. Luke PhD[3], Doneisha L. Bohannon MPH[3], Amy A. Sorg MPH[3], Sarah Moreland-Russell PhD[3]





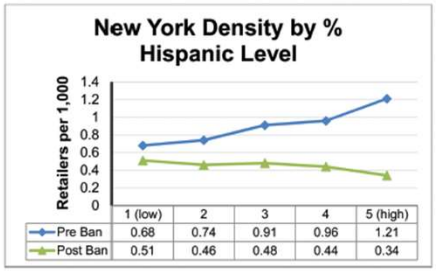
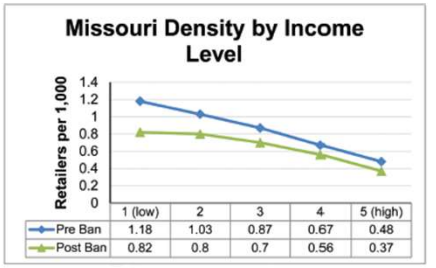
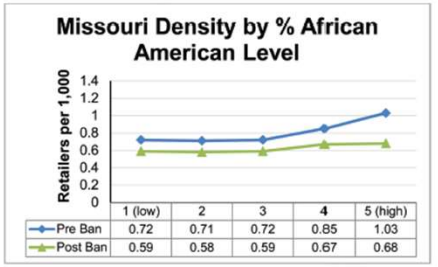


Figure 1. Pre- and post-ban tobacco retailer density in New York by census tract income and racial/ethnic composition.





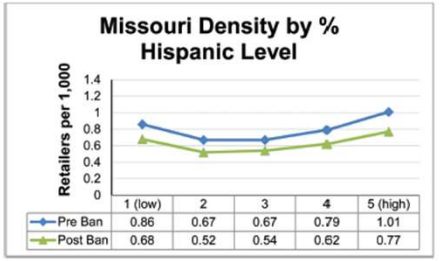


Figure 2. Pre- and post-ban tobacco retailer density in Missouri by census tract income and racial/ethnic composition.

Slide 8

MJ7 Doug, I put this as a placeholder mostly -- do you plan to mention this research of yours? I think it's a great one to share!

Maria Julian, 8/11/2020

Retail tobacco policies

- Examples
  - Tobacco retail license
  - License cap
  - Retailer buffer
  - Restrict product availability
  - Tobacco 21

Retail tobacco policies

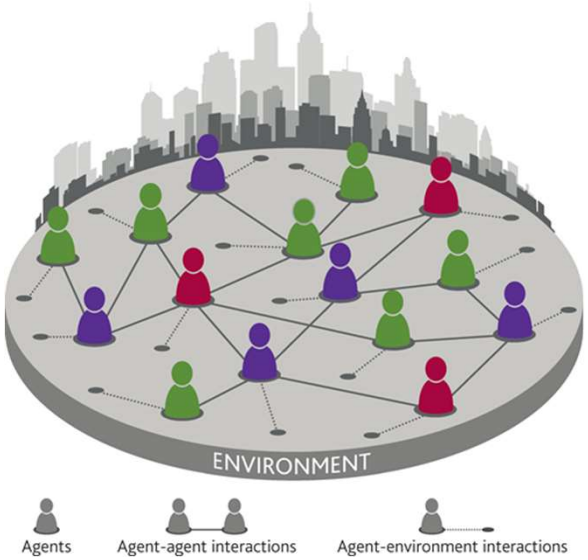
- Examples
  - Tobacco retail license
  - License cap
  - Retailer buffer
  - Restrict product availability
  - Tobacco 21
- Outcomes
  - Increased distance to retailer
  - Increased distance to product
  - Increased time to retailer
  - Increased costs
  - Reduced exposure
  - Reduced purchase opportunities

Agent-based Models

Powerful tools to explore behavioral dynamics within complex systems

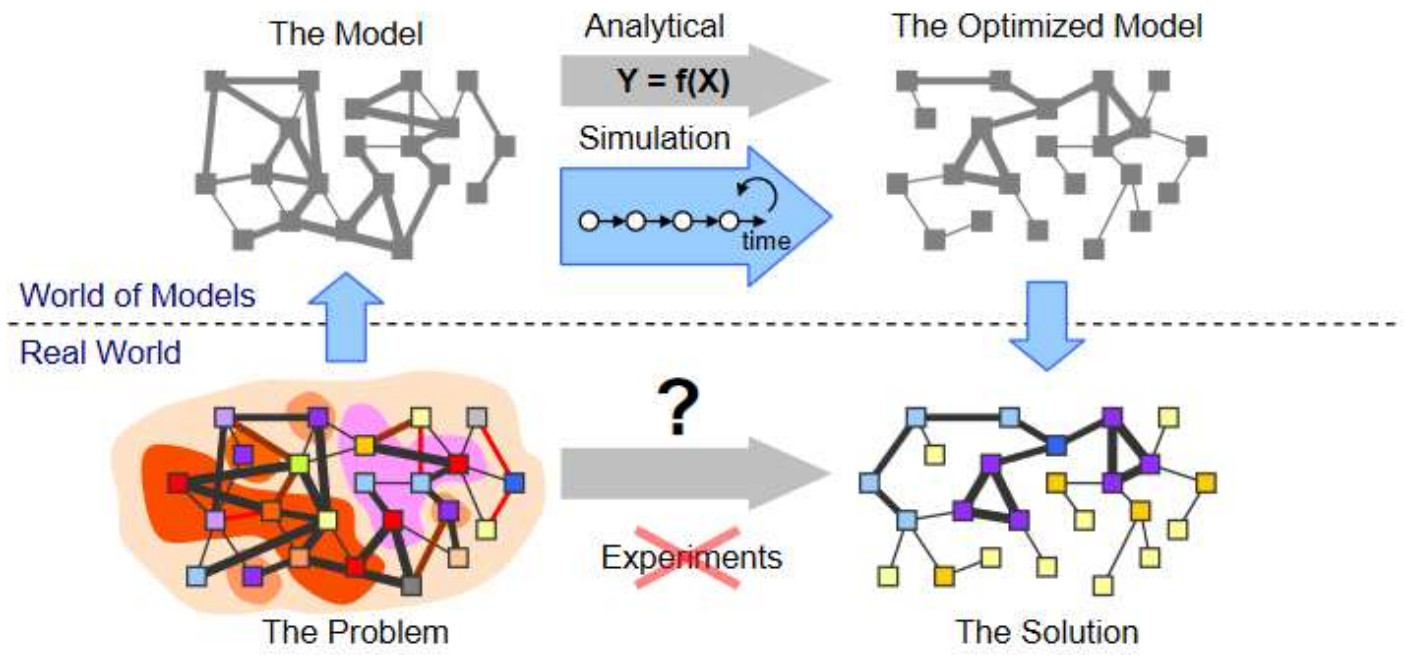
What is an ABM?

- A bottom-up simulation approach that is used to study complex systems by exploring how individual elements (agents) of a system behave as a function of their characteristics and interactions with each other and the environment.
- Emphasizes
  - Heterogeneity
  - Environments that are physical or social
  - Emergent behavior
- Mechanistic view –
  - ‘Don’t understand it if you can’t build it’



https://www.bankofengland.co.uk/quarterly-bulletin/2016/q4/agent-based-models-understanding-the-economy-from-the-bottom-up

Computational modeling to solve real-world problems



Borshchev, A., & Filippov, A. (2004, July). From system dynamics and discrete event to practical agent based modeling: reasons, techniques, tools. In *Proceedings of the 22nd international conference of the system dynamics society* (Vol. 22).

Building an ABM - PARTE system

- Agent **P**roperties
- Agent **A**ctions
- Agent **R**ules
- **T**ime
- **E**nvironment

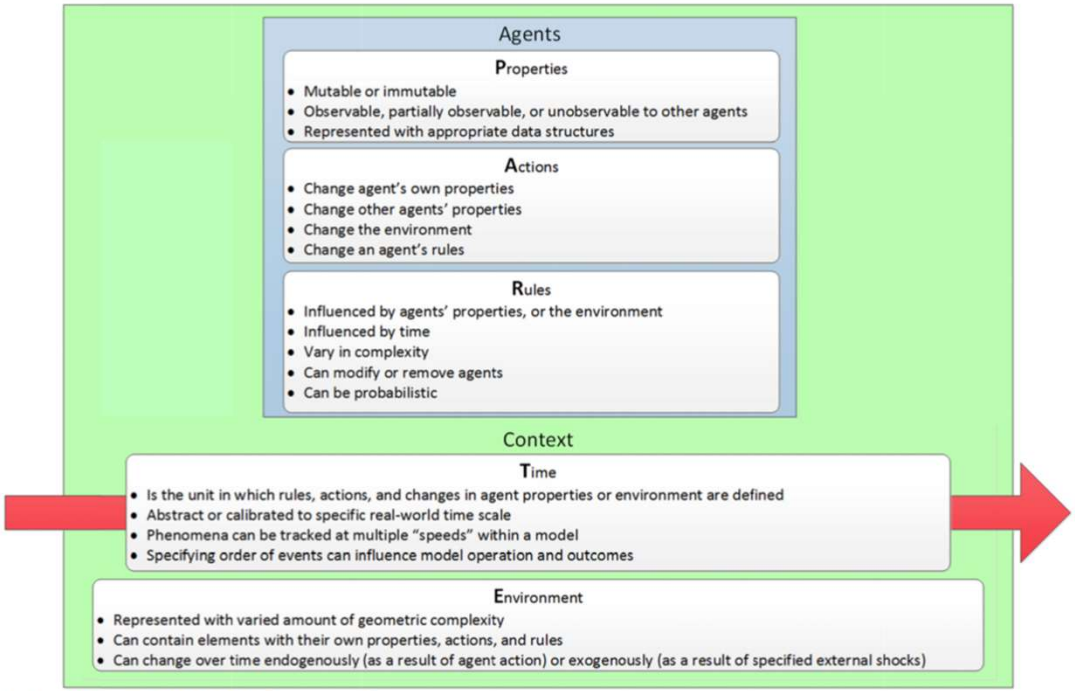


FIGURE A-1 PARTE framework.

Hammond, R. (2015) IOM Report - Assessing the Use of Agent Based Models for Tobacco Regulation

1 + 16 reasons to do complex systems modeling

- Prediction
- Other reasons
  - Explain
  - Guide data collection
  - Illuminate core dynamics
  - Suggest dynamical analogies
  - Discover new questions
  - Promote scientific habit of mind
  - Bound outcomes to plausible ranges
  - Illuminate core uncertainties
  - Offer crisis options in near-real time
  - Demonstrate tradeoffs

- Challenge robustness of prevailing theory
- Expose prevailing wisdom as incompatible with available data
- Train practitioners
- Discipline the policy dialogue
- Educate the public
- Reveal the simple to be complex, and vice versa

From Epstein, 2008; *Why Model?*
http://www.santafe.edu/media/workingpapers/08-09-040.pdf

ABMs in public health – moving beyond infectious disease

- Longest history of ABMs in public health is in the modeling of infectious diseases
  - Large-scale models (often using synthetic populations of entire nations or even the planet)
  - Used by policymakers, federal governments, industry
- Examples
  - http://www.epimodels.org/
  - http://fred.publichealth.pitt.edu/
  - https://www.youtube.com/watch?v=ECJ2DdPhMxI
  - https://mattbierbaum.github.io/zombies-usa/
- More recent ABM applications in:
  - Chronic disease (e.g., Walking School Bus, food behaviors)
  - Public health policy (Tobacco Town, violence prevention)
  - Implementation science

Usefulness of ABM for tobacco control

- Use computational models when we cannot use real-world experiments
  - *Unethical to experiment on communities to study retail tobacco policy effects*
- Introduce change (shock) and examine changes in behavior & environment
  - *Restricting menthol sales or prohibiting coupons*
- Can expose gaps in existing data or surveillance systems
  - *How far are people willing to travel to purchase cigarettes?*
- Results of computational models are improved when based on data and scientific evidence
  - *For example, PATH, BRFSS, PUMS (Census)*

Hammond RA. Complex systems modeling for obesity research. *Prev Chronic Dis*. 2009;6(3):A97.

Tobacco Town

Using agent-based modeling as a policy laboratory in tobacco control

R21 CA172938 – NCI
U01 CA154281 – NCI
P01 CA225597 - NCI
(With Ross Hammond; Kurt Ribisl, UNC; Lisa Henriksen, Stanford)

Tobacco Town - History

TT#1

Tobacco Town 1 (*2012-2015)*

- Abstracted retailer density model
- 4 town types: poor/rich by suburban/urban

Tobacco Town – Minnesota (*2016-2018)*

- Focus on Minnesota policy considerations (esp. Menthol)
- Added rural town types, all based on representative Minnesota localities

ASPiRE

Tobacco Town – ASPiRE (*2018-2023)*

- Added retailer dynamics, specific tobacco products
- Building models using synthetic populations for 30 large cities

ASPiRE

ASPiRE Tobacco Town

- Aims
  - Build a series of ***simulation models*** to identify interactions between the retail environment for tobacco and purchase and use behaviors

  - Use the models as ***policy laboratories*** to explore potential impact of various retail policies across contexts and populations

  - Work with CAB members to ***tailor models to cities***, test the likely impact of prioritized policies and disseminate results to stakeholders

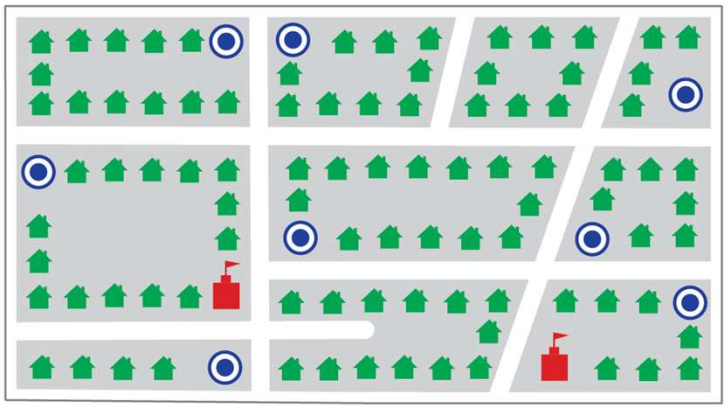
What's new in ASPiRE Tobacco Town

- Adding more policies
  - Pricing
    - Minimum price (price floor)
    - Prohibiting discounts & coupons
  - Finer detail for density reduction policies
    - Cap & winnow number of retailers by neighborhood or ward
- Incorporating real geography
  - Streets, natural boundaries, routes
- Incorporating real sociodemographics
  - Reflecting truer neighborhood characteristics

Example policies in Tobacco Town

BUILT ENVIRONMENT

Pre



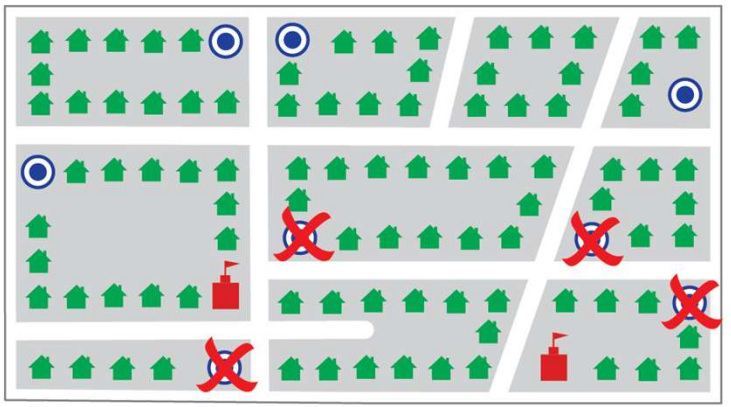
Tobacco Retailer

Policy Application

Place

- Cap total number of licenses
- Restrict sales to tobacco shops
- Require minimum distance between retailers

Post

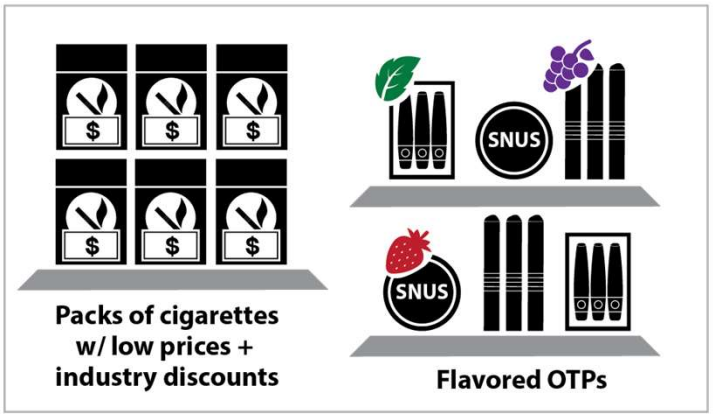


Tobacco Retailer

Example policies in Tobacco Town

CONSUMER ENVIRONMENT

Pre

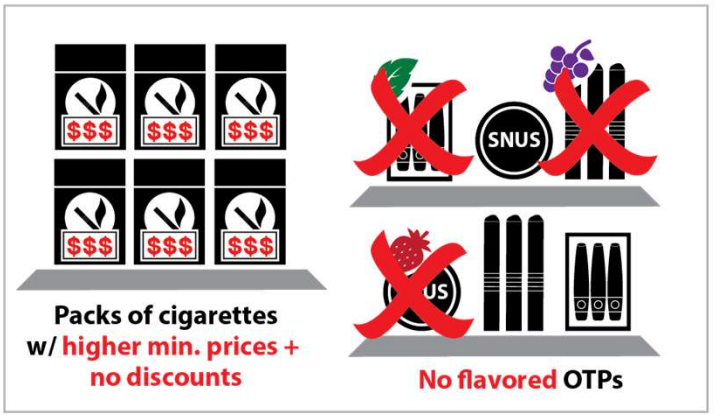


Policy Application

Price
- Establish minimum price and packaging laws
- Ban price discounting
- Ban coupon redemption

Product availability
- Restrict flavored products and menthol

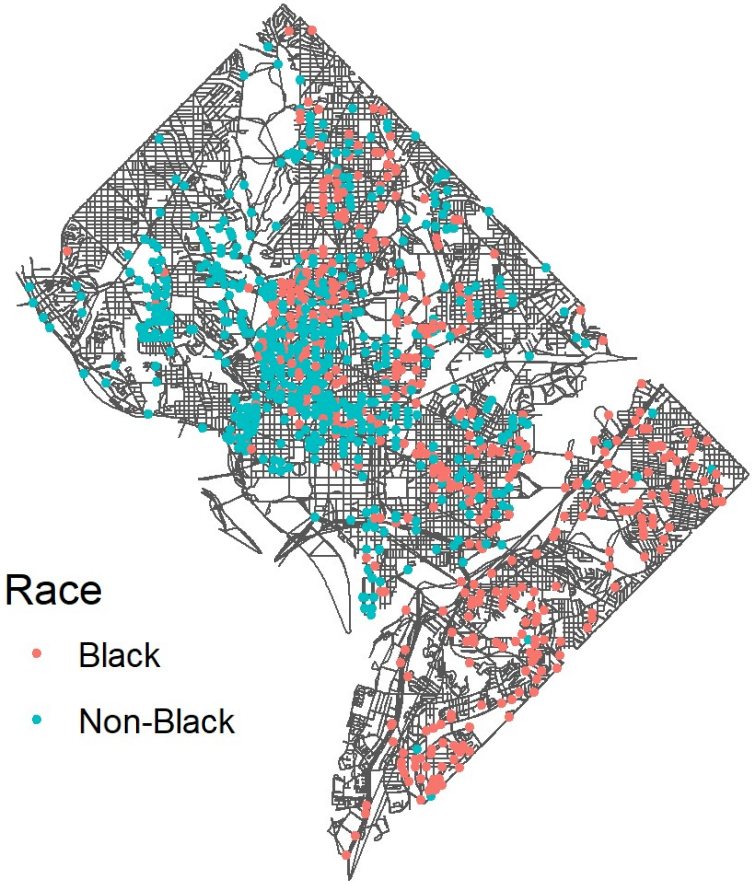
Post

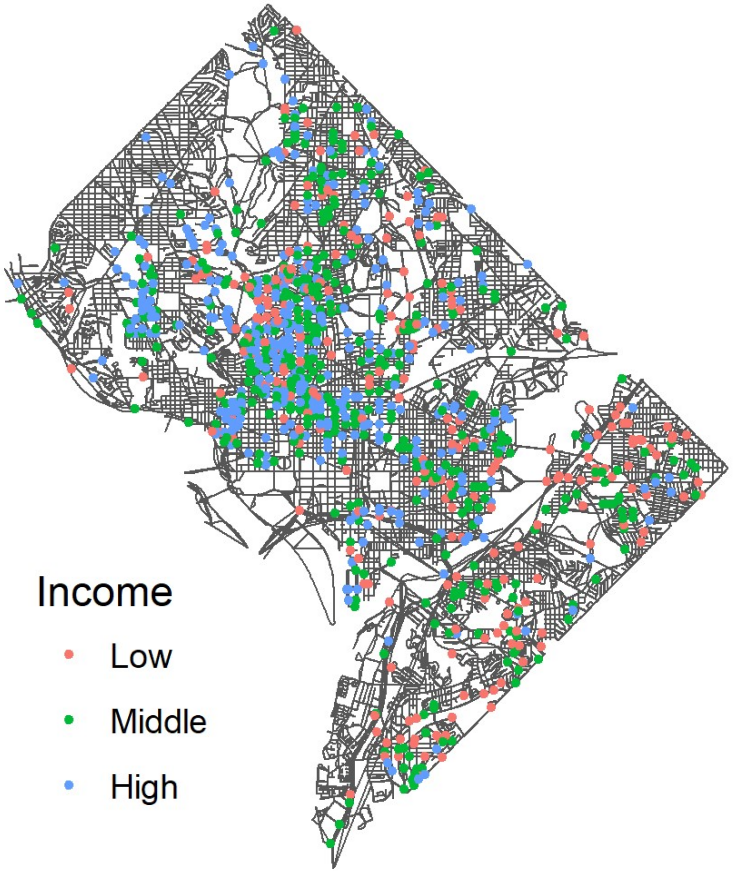


Building blocks of Tobacco Town

- Empirical data:
  - Population and demographics
  - Smoking characteristics
  - Retailers (location & type)
  - Cigarette prices
- Economic and public health literature/theories:
  - Decision-making
  - Price sensitivities
  - Travel and purchasing

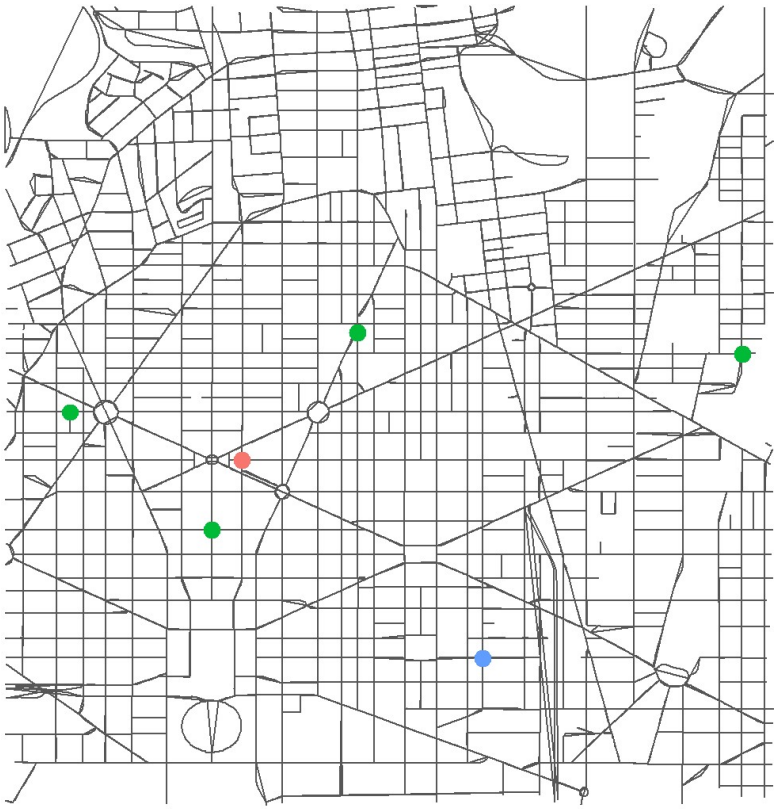
Using real demographics to build populations





ASPiRE

Using real geography to map daily routes



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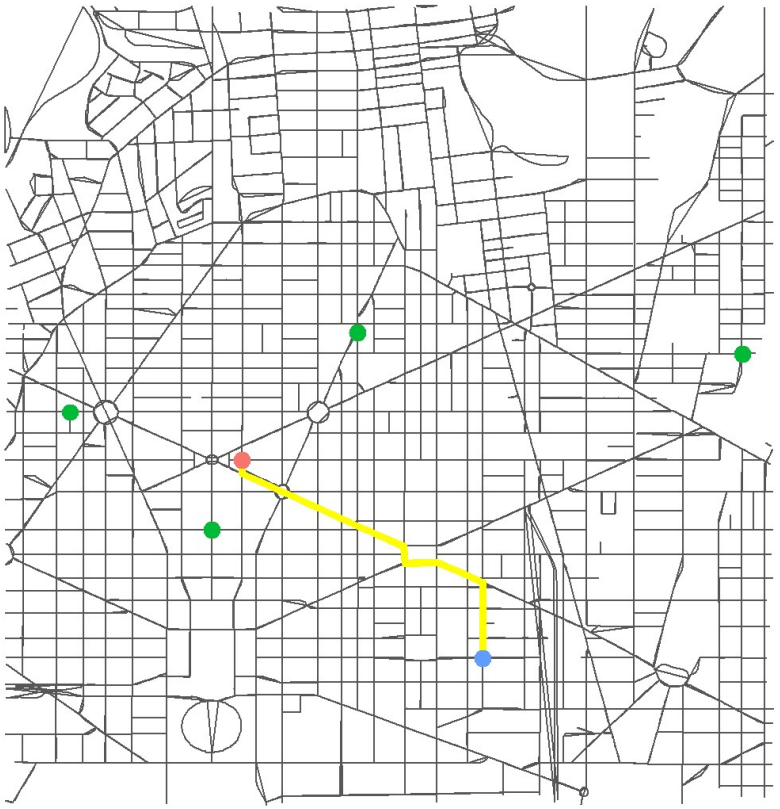
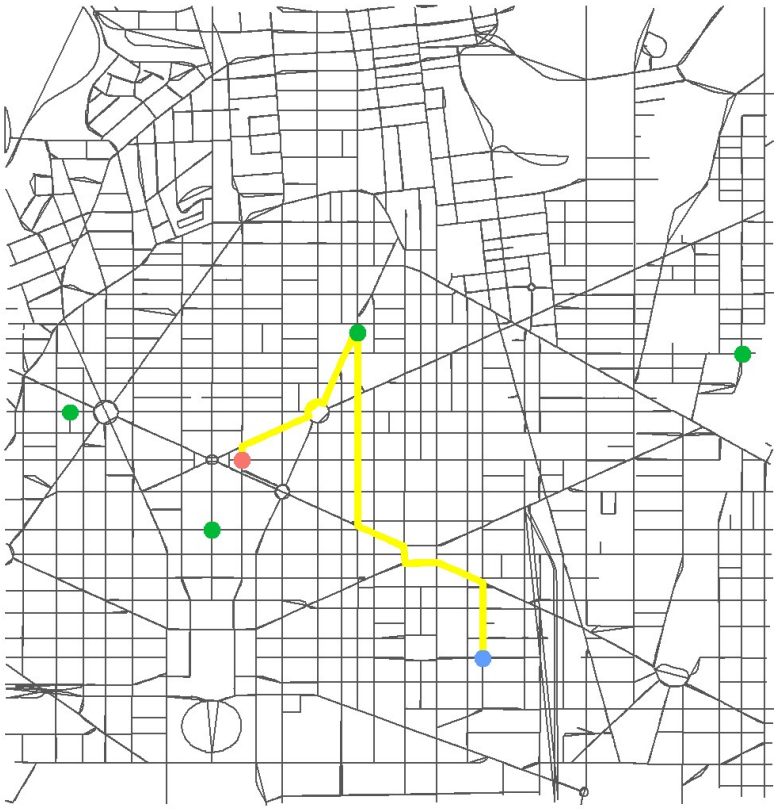
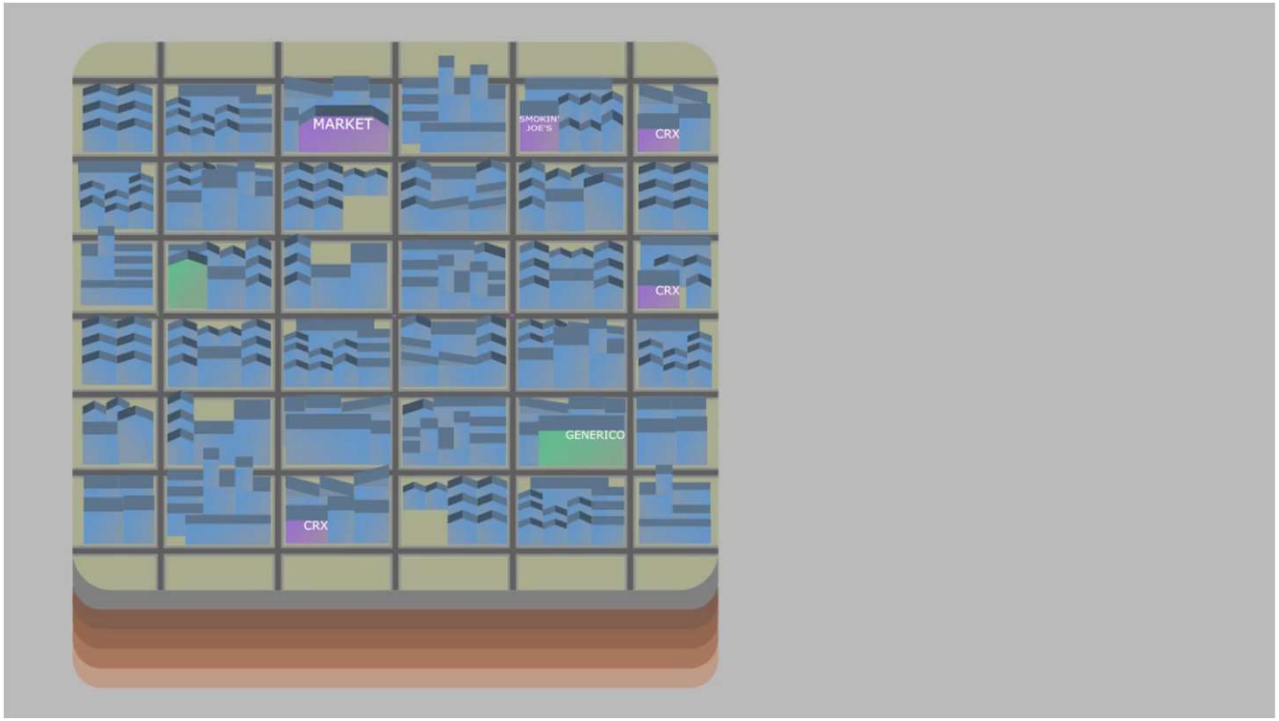


Using real geography to map daily routes



What is happening under the hood?



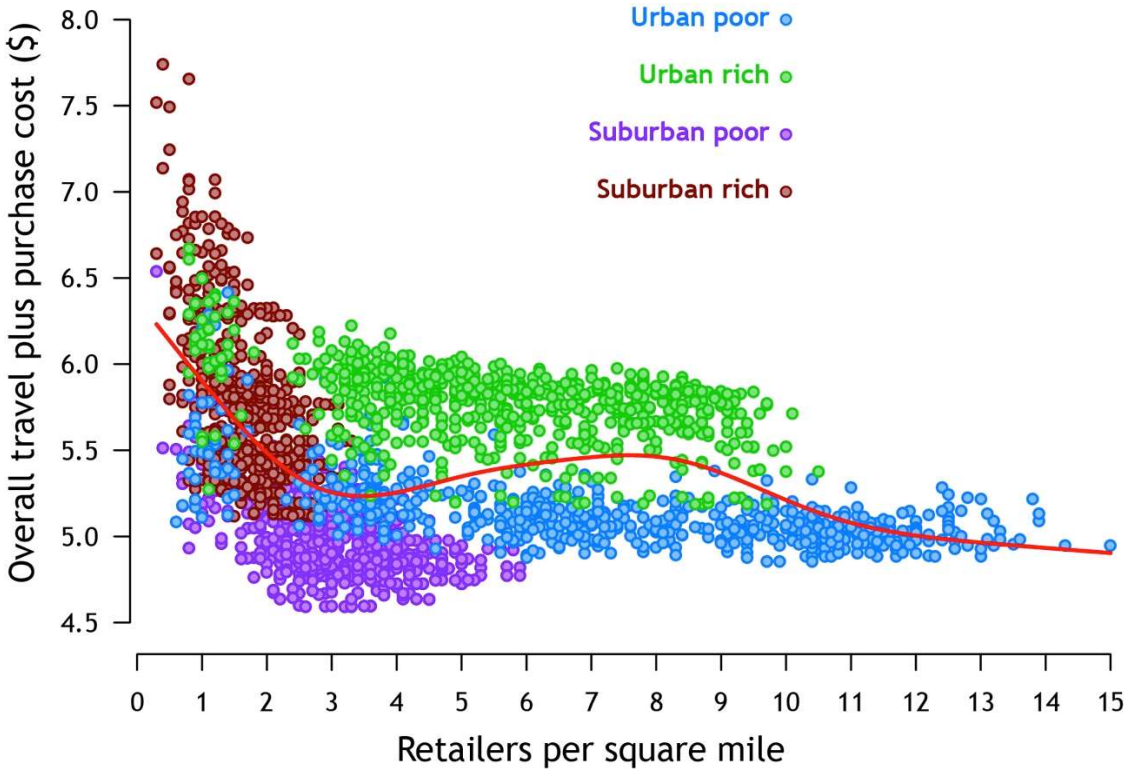
https://tobaccotown.shinyapps.io/Minnesota/

ASPiRE

What Are We Learning?

1) Density reduction effects are non-linear
2) Strong policies, and multiple policies have larger effects
3) Policy effects are community-specific
4) Policies have different potential for affecting disparities & behavior
5) Density and proximity are not the same thing

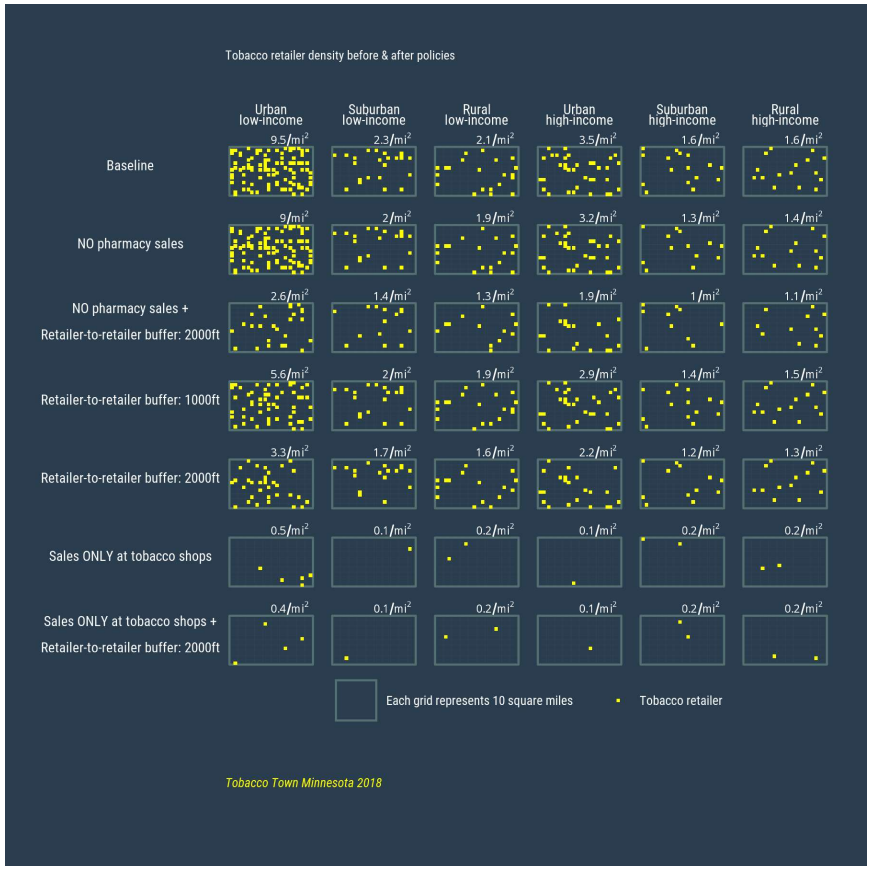
Density reduction may need to reach threshold before effects are seen



Luke, D. A., Hammond, R. A., Combs, T., Sorg, A., Kasman, M., Mack-Crane, A., ... & Henriksen, L. (2017). Tobacco town: computational modeling of policy options to reduce tobacco retailer density. *American journal of public health*, *107*(5), 740-746.

Policy effects depend on context

- No ‘one-size-fits-all’ policy
- Layering of policies may help remove community disparities

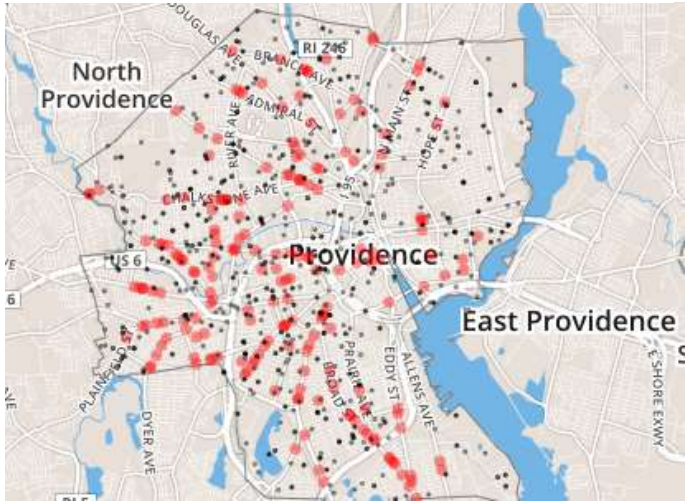


Tobacco Town Minnesota; https://tobaccotown.shinyapps.io/Minnesota/

Density & Proximity – not the same

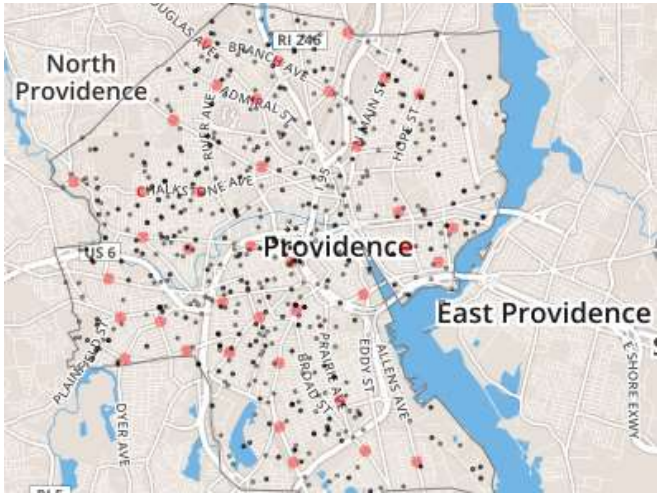
- Density reductions ≠ proximity changes
- Similar density policies ≠ similar proximity results

Baseline: Density: **9.7/mi²**



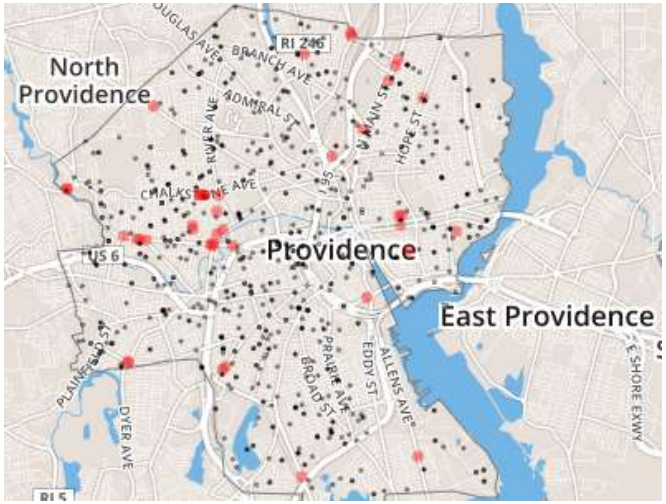
Avg Proximity: **0.16 mi**

Retailer-2K: Density: **1.8/mi²**



Avg Proximity: **0.27 mi**

School-2K: Density: **2.0/mi²**



Avg Proximity: **0.45 mi**

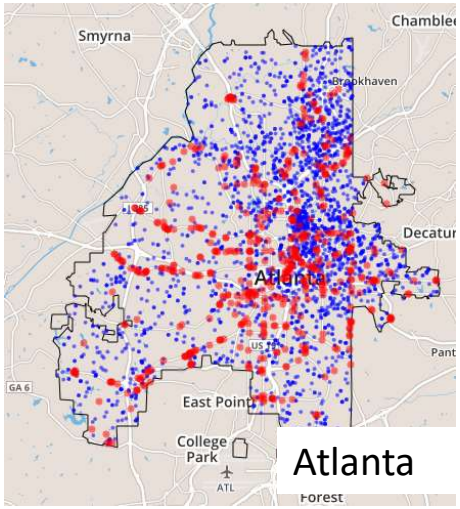
Avg Proximity = median distance from resident to nearest retailer

From Models to Tools

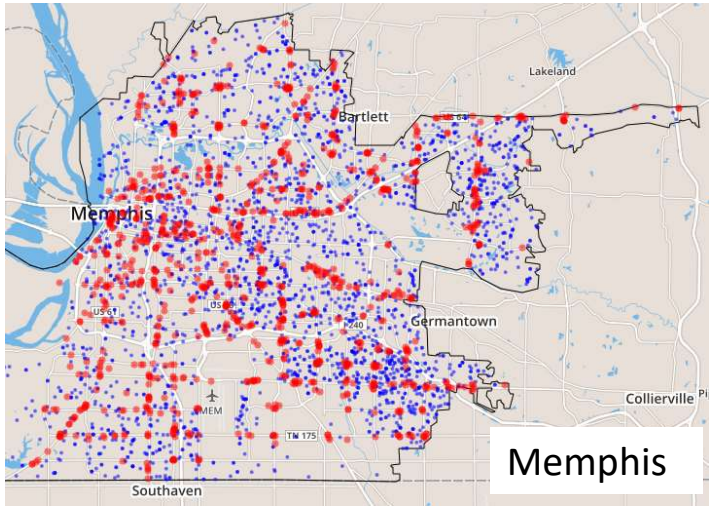
Developing dashboard tools that can be used by community partners to explore effects of retailer reduction policies

Tobacco Town - ASPiRE progress

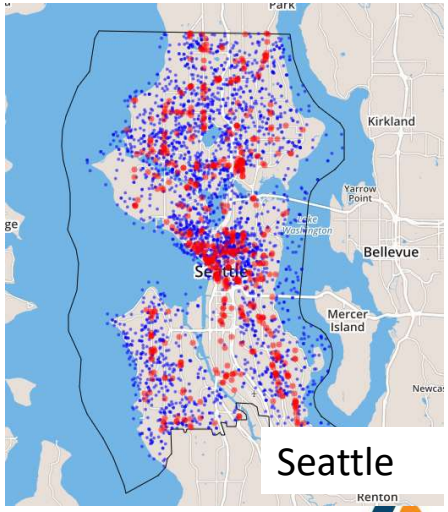
- Built virtual environments for each of the 30 CAB member cities
  - Real-world geographies, tobacco retailer locations, synthetic populations



Atlanta



Memphis



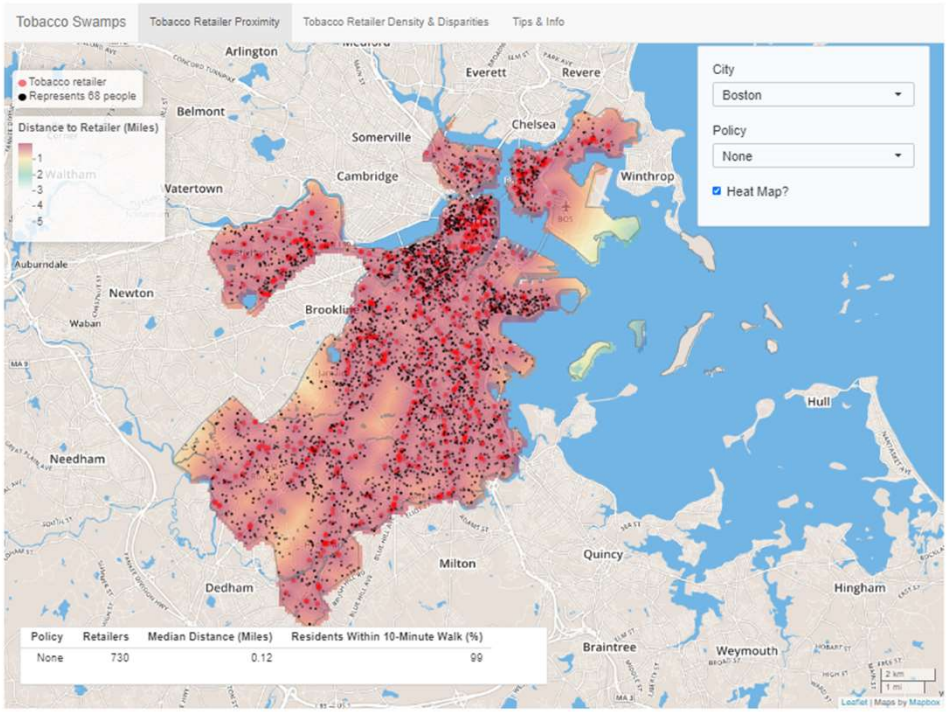
Seattle

- Working with partners to identify prioritized policies for each city
- Developing dashboard to allow interactive exploration of policy effects

Tobacco Swamps Dashboard

Use this tool to…

- Look at retailer density and proximity in different cities
- Compare how different policies might affect proximity to retailers and overall density



Available at: aspirecenter.org/tobacco-swamps/

Early conclusions

- Policy mechanisms (& effects) are *community specific*
- Community *engagement* has been critical for all phases o ABM development and testing
- ABMs can reveal underlying mechanisms, which may provide *architecture* for tailored design of policies
- Also because of the focus on mechanisms, ABMs hold critical promise for studying rise and fall of tobacco-related *disparities*

ASPiRE

Helpful URLs

- **The ASPiRE Center:** http://aspirecenter.org/
- **Tobacco Swamps Dashboard:** https://aspirecenter.org/tobacco-swamps/

Contact us

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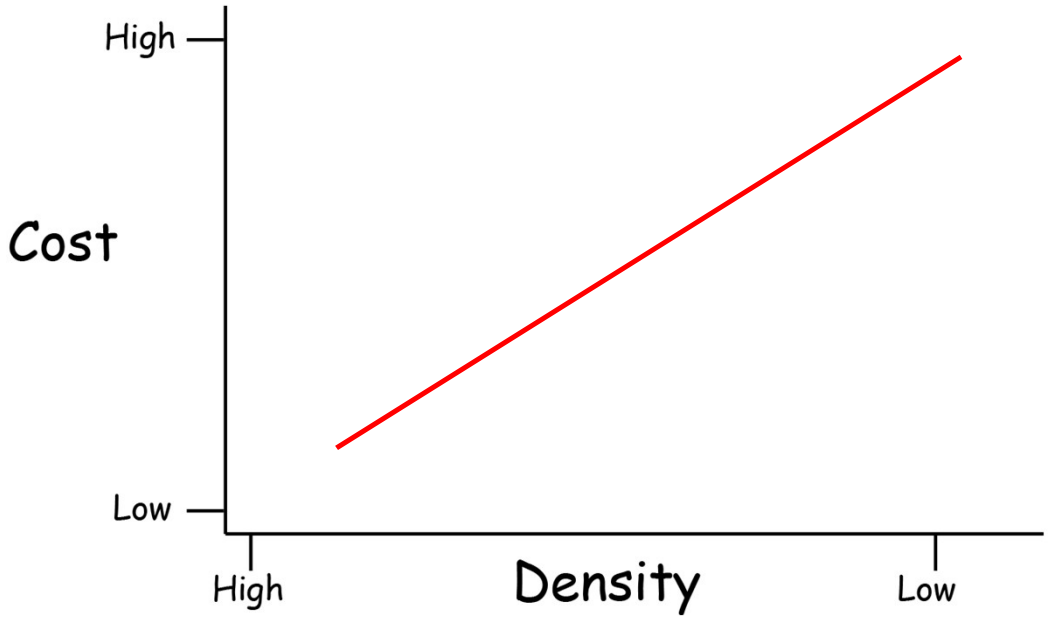
lbrossart@wustl.edu

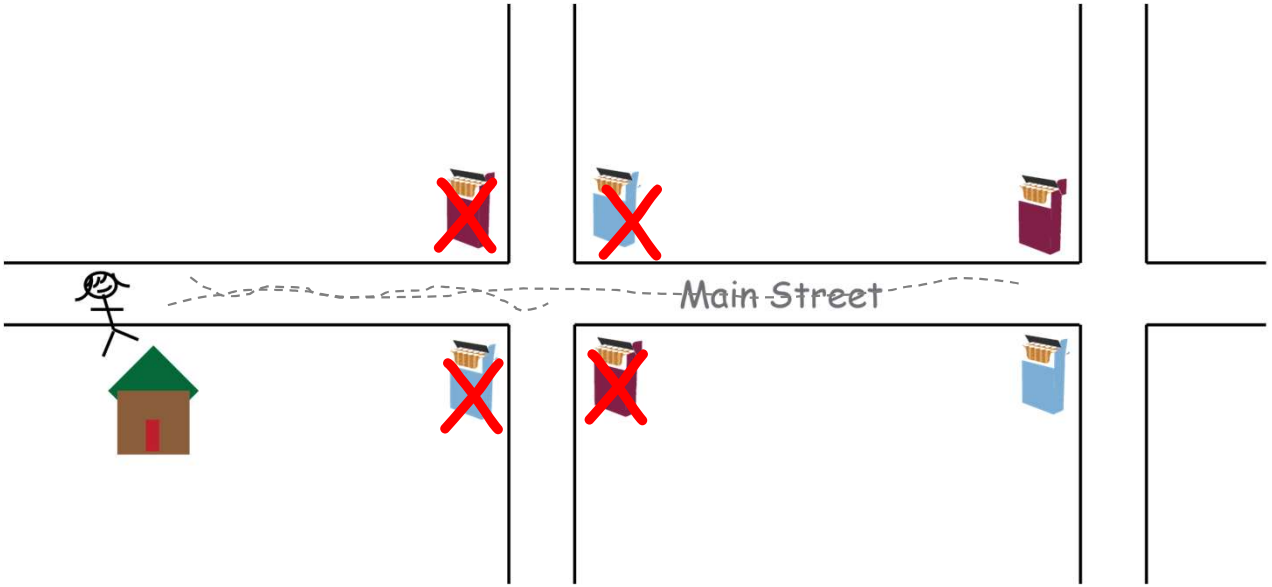
CPHSS Twitter
@CPHSSwustl

Thinking about retailer density and cost…

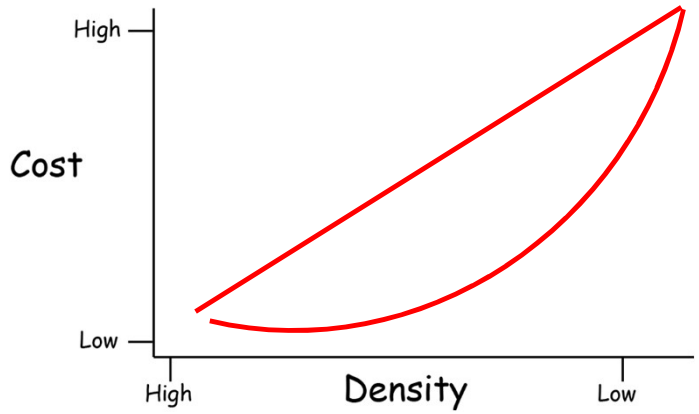
- We might assume…



How does reduced density actually affect behavior?



So, in reality…

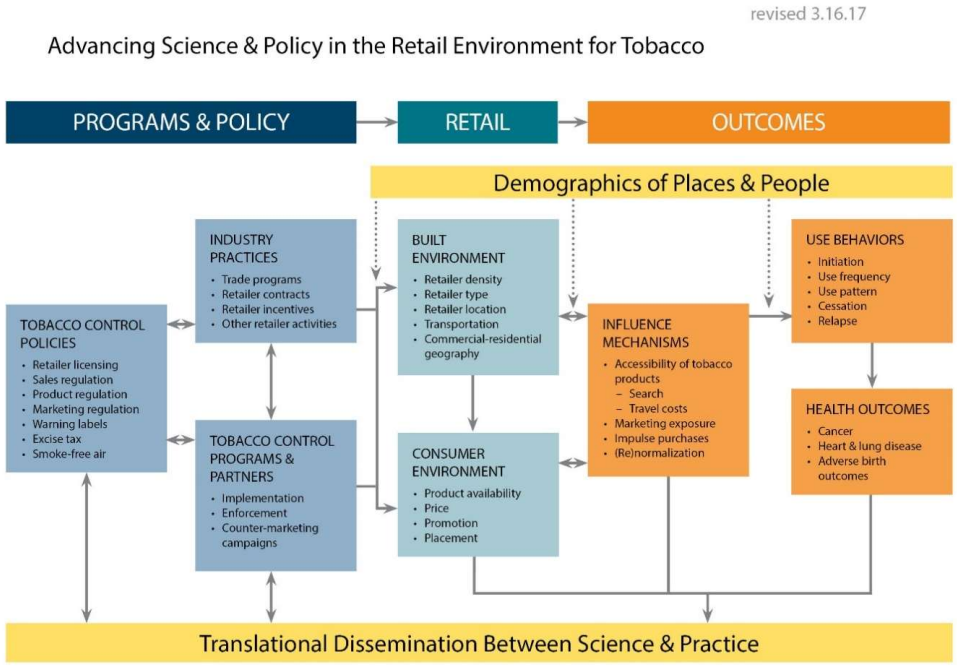


Some things we don't know yet…

- Consumer tobacco retailer preferences
  - When, where, & why?
- Consumer tobacco cost preferences & threshold
  - Is price or convenience more important?
  - How much is *too* much? (cost, distance)
- So, we are collaborating on Big City Tobacco Control (Project 2) surveys

Importance of policy

- Policies are
  - social mechanisms
  - that shape environments
  - to affect behavior and health
- We use (effective) policies because of their
  - low cost
  - high reach
  - sustainability



Importance of policy

- Policies are
  - social mechanisms
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- We use (effective) policies because of their
  - low cost
  - high reach
  - sustainability

However, we often don't know how or why certain policies work!

Why reduce density & make cigarettes harder to get?

- **We know**:
  - Increasing the costs of cigarettes lowers consumption (tax)[1]
  - Making it harder to smoke reduces initiation & deters relapse (smoke-free air laws)[2]

- **Retail-focused policies aim to**:
  - *Make products harder to get*
    - Fewer and farther between
    - Prohibit certain products
  - *Increase costs*
    - Direct: non-tax pricing policies
    - Indirect: increased travel time & distance, opportunity costs
  - *Reduce use*
  - *And, can be tailored to the individual characteristics of specific communities!*

1. Levy, D, Chaloupka, F & Gitchell, J. The Effects of Tobacco Control Policies on Smoking Rates: A Tobacco Control Scorecard. *JPHMP*. 2004;10. 338-53. 10.1097/00124784-200407000-00011.
2. Shang C. The effect of smoke-free air law in bars on smoking initiation and relapse among teenagers and young adults. *Int J Environ Res Public Health*. 2015;12(1):504-20. Published 2015 Jan 9. doi:10.3390/ijerph120100504

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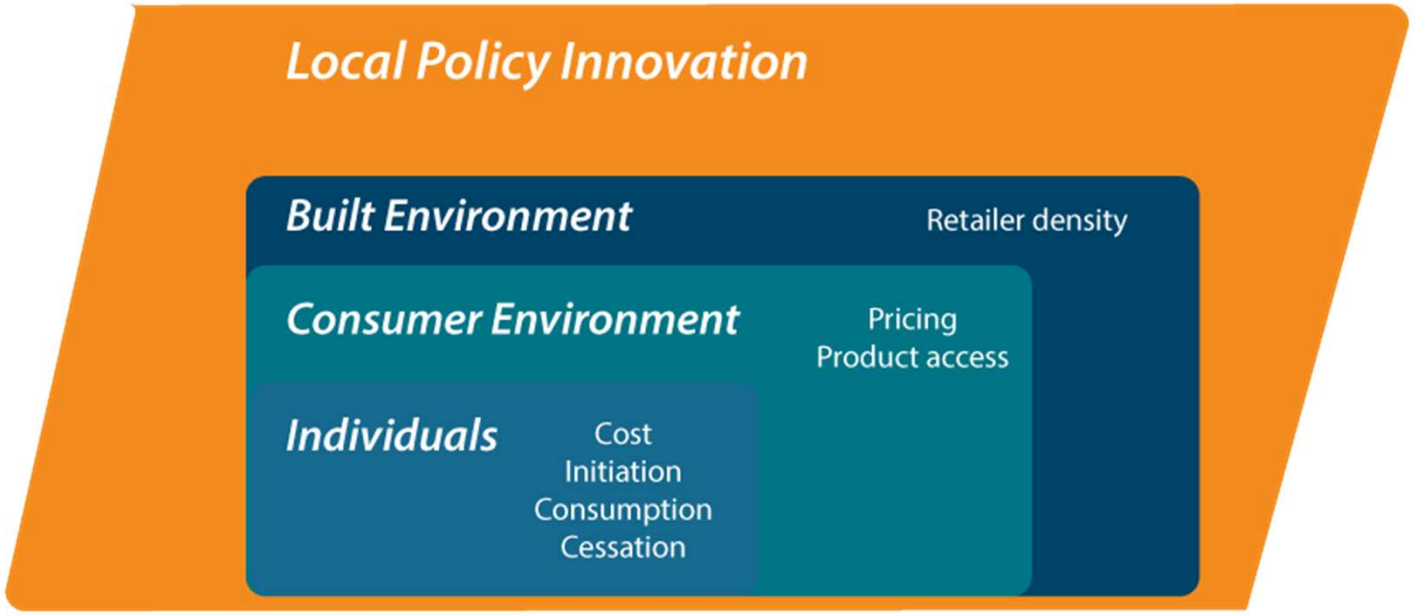
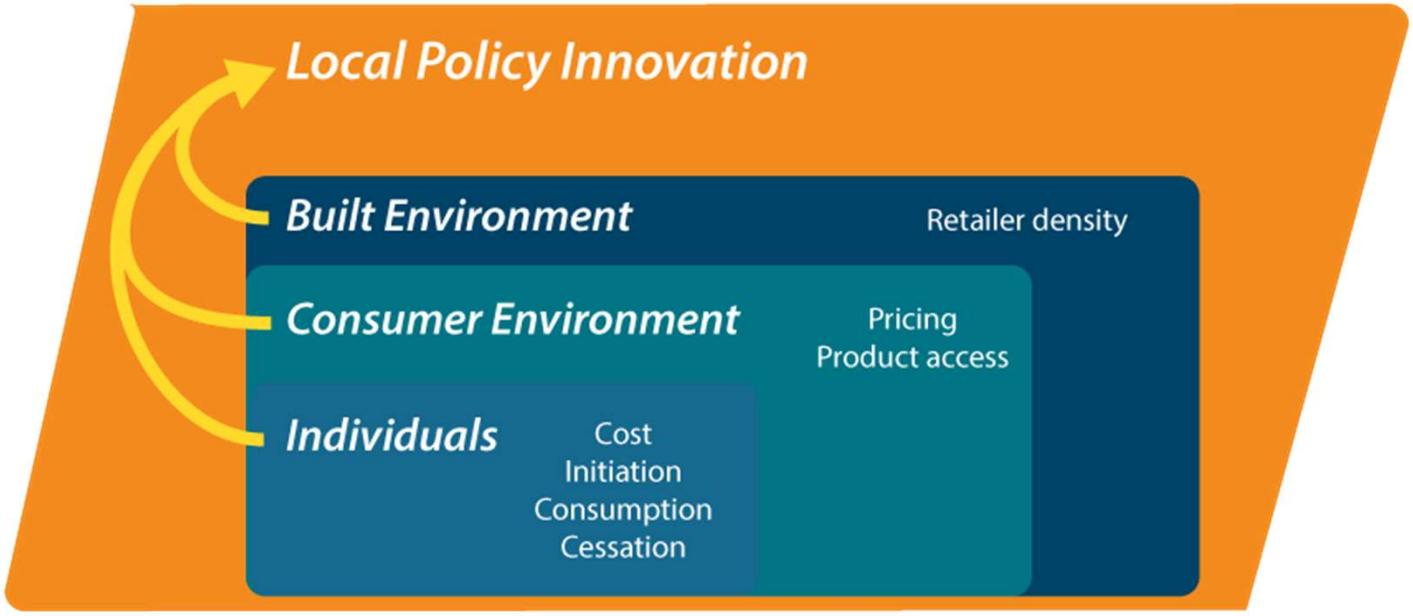
Tobacco Town Conceptual Framework



Tobacco Town Conceptual Framework



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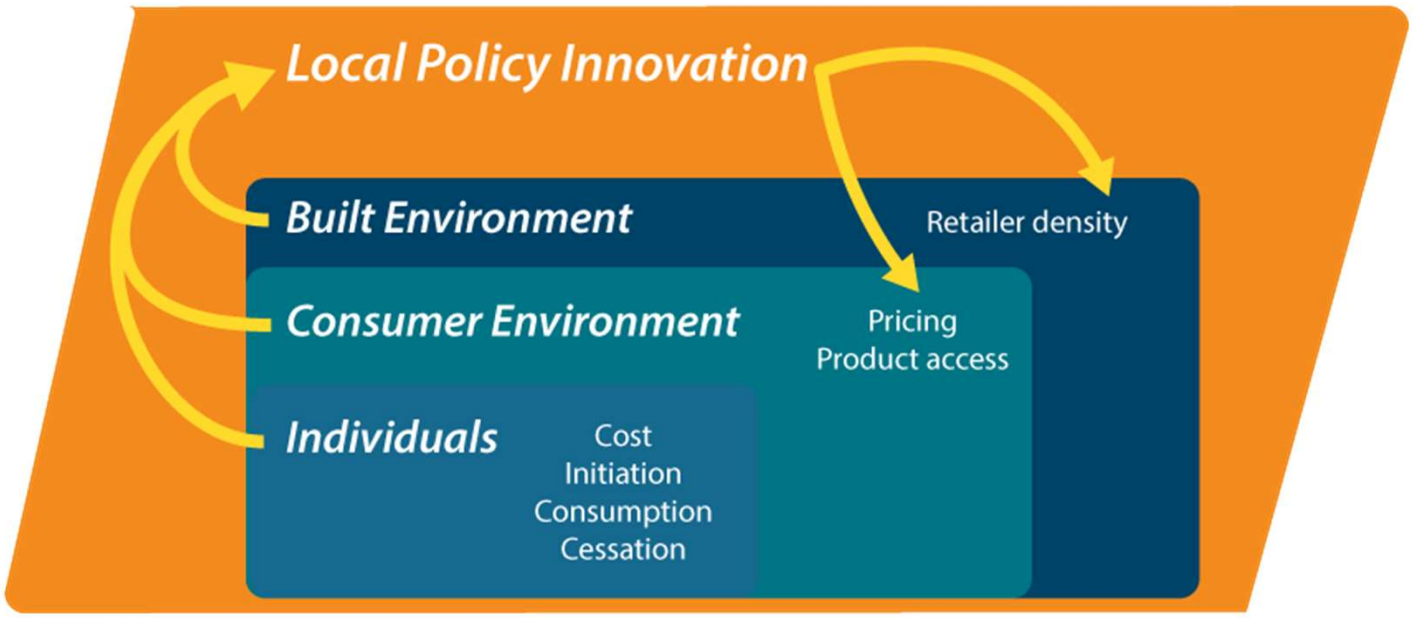
Tobacco Town Conceptual Framework



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