



Kreuger Consulting

Insight Through Simulation

MODELING HUMAN BEHAVIOR

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EXECUTIVE SUMMARY

- Public health models require more realistic models of human behavior.
- Using a tobacco policy ABM, we present a method that allows easy switching and comparison between different behavior frameworks.
- We discuss key elements of a human behavior framework, giving the example of the Perceptual Control Theory framework.



APPROXIMATING HUMAN BEHAVIOR



- perfect agent knowledge
- unlimited agent computational ability
- limited decision objective function



- humans have imperfect knowledge
- humans have limited computational ability
- multiple, possibly conflicting, objectives



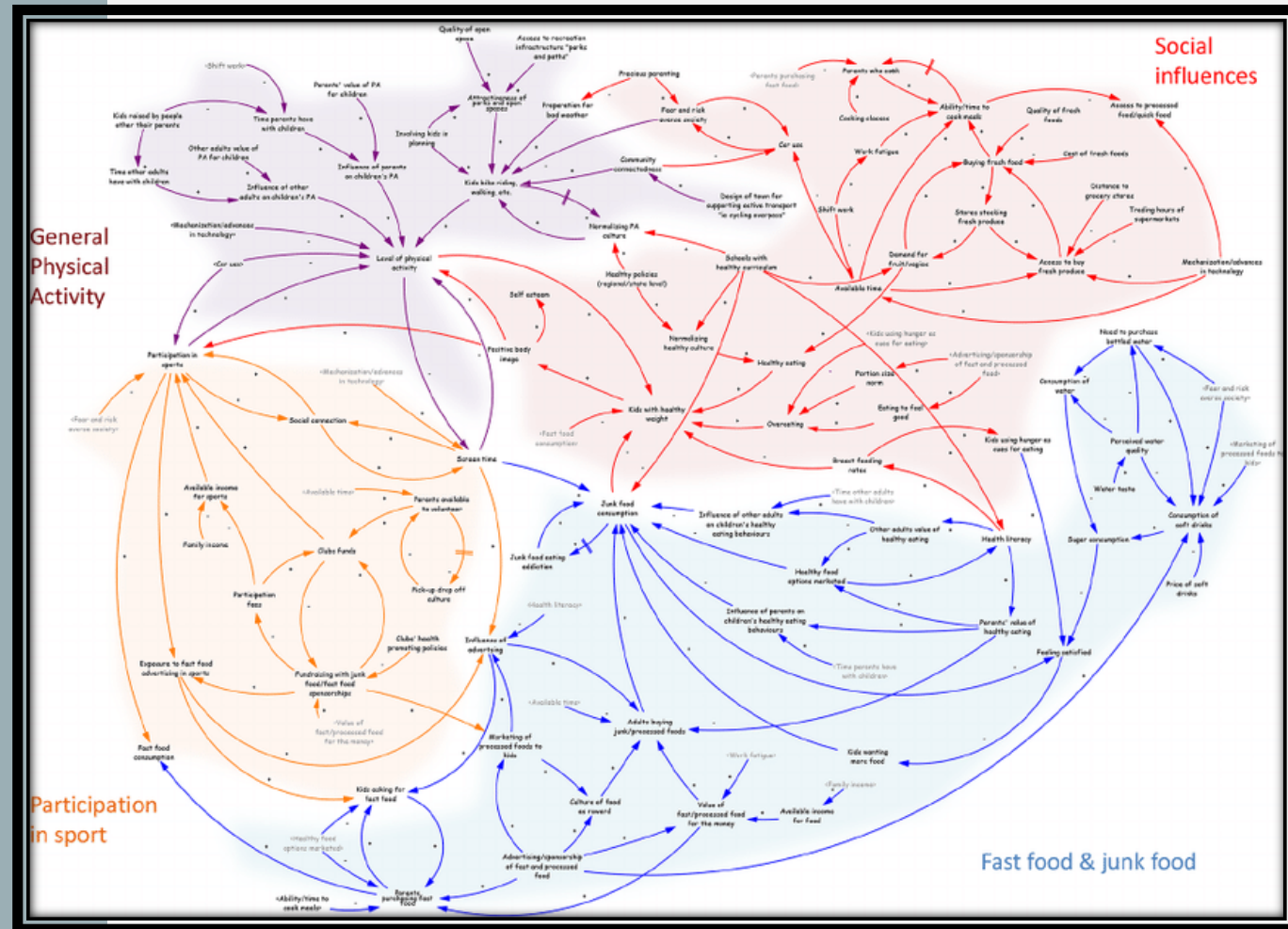
PROJECT GOAL

Compare different realistic behavior frameworks

Use one within a policy model

COMPLEX ADAPTIVE SYSTEMS

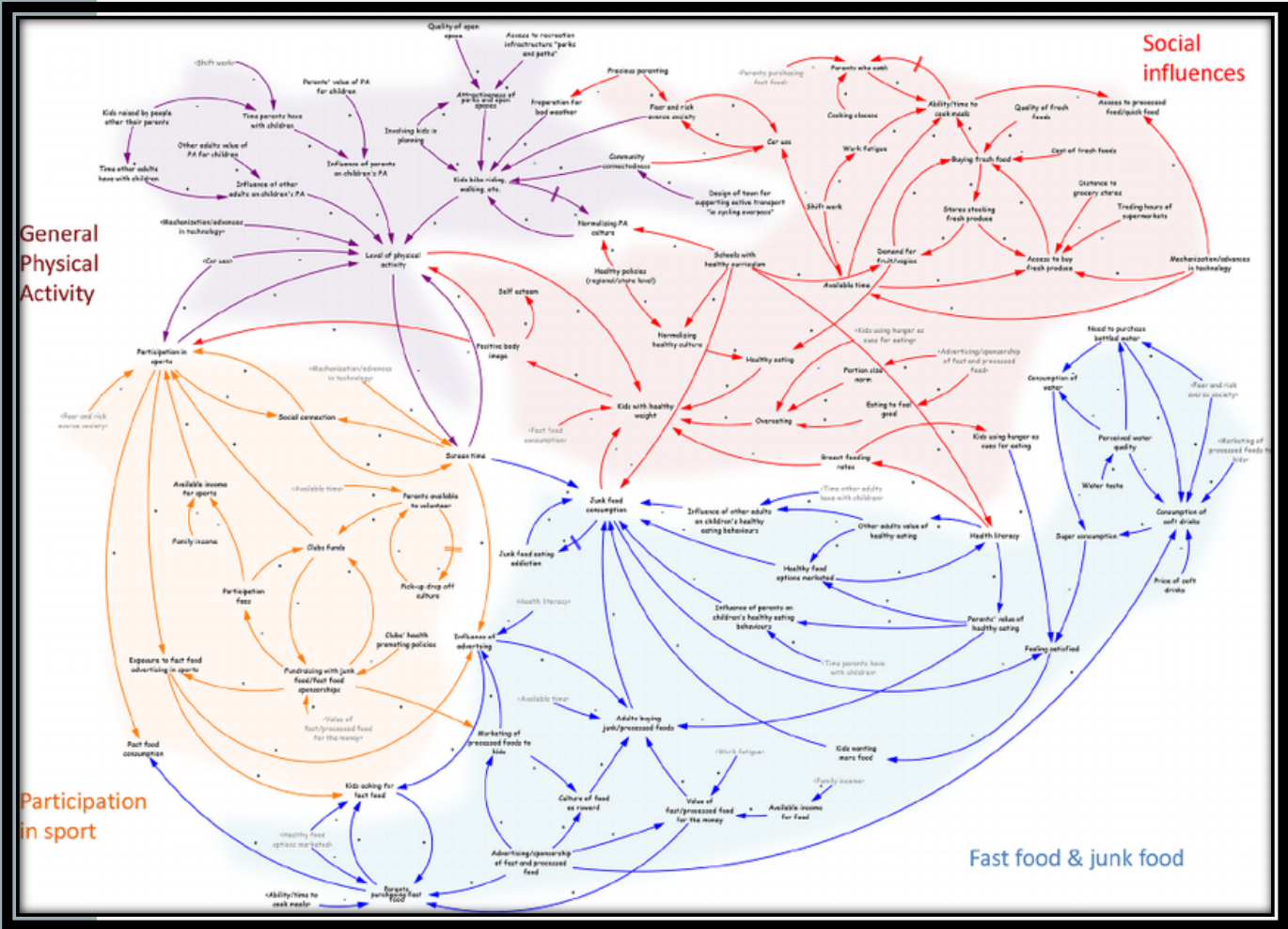
- Feedback loops
- Causal delays
- Non-linearities
- etc.



From: *A Community Based Systems Diagram of Obesity Causes* accessible at [ResearchGate](https://www.researchgate.net/publication/312222222)

SOCIAL SYSTEMS

- Noisy/missing data
- Unclear causal relationships
- Unpredictable human behavior
- Decentralized policy and control



From: A Community Based Systems Diagram of Obesity Causes accessible at [ResearchGate](https://www.researchgate.net/publication/312211111)



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MODELING GOALS

Optimization
and prediction



VS

Explanation and
insight





PUBLIC HEALTH PROBLEM: TOBACCO

Tobacco

- a leading cause of preventable mortality

Interventions

- e.g. excise tax, age restrictions, social media

Human behavior

- price minimizing behaviors e.g. coupons, format, pricing tiers



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MODEL INTRODUCTION: TPMS



City modeled after the Minneapolis Metro area

Urban core
Suburban ring
Rural perimeter



People

Daily work schedule
Social connections
SES, gender, education

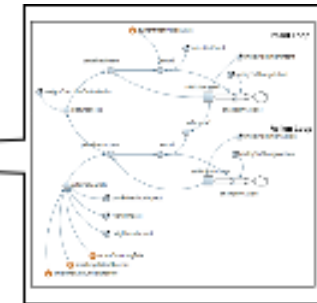
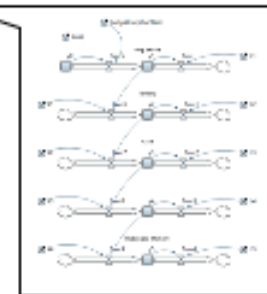
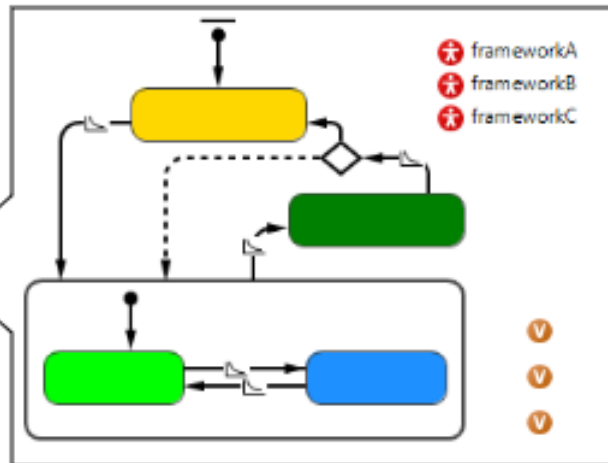
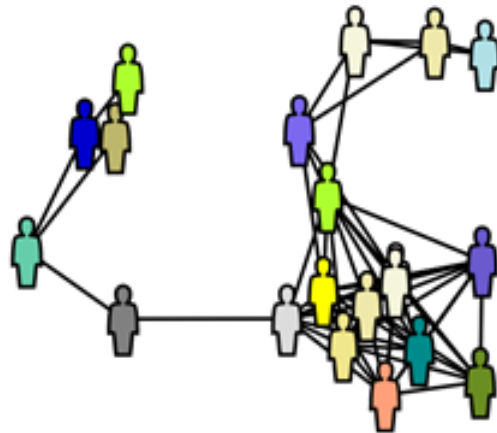


Tobacco Retailers

Tobacco products
Prices
Sales
Taxes



MODULAR BEHAVIOR FRAMEWORKS

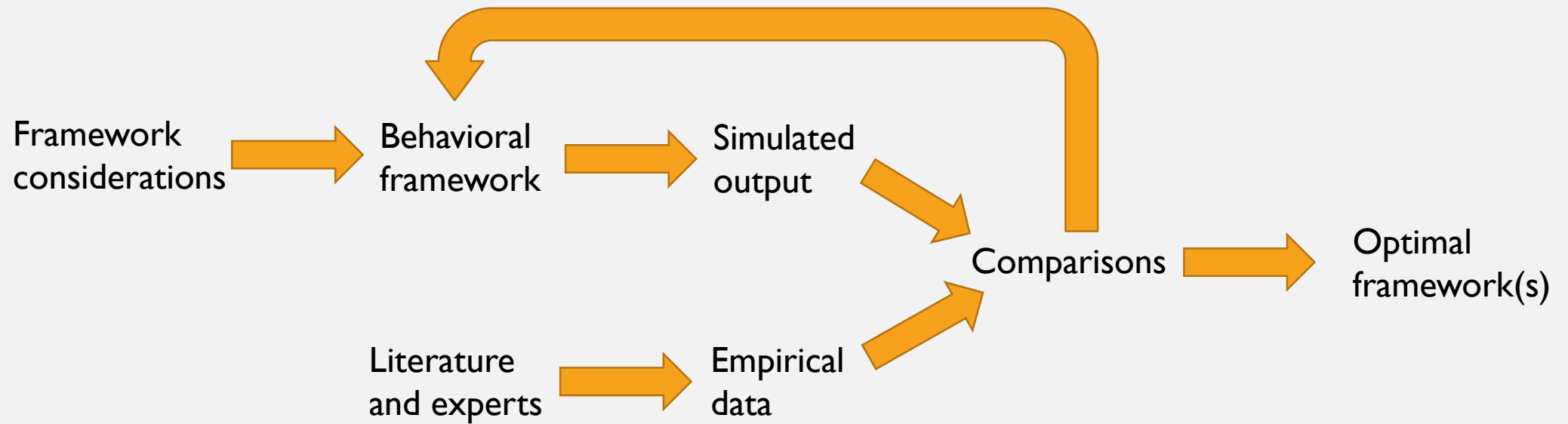




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SIMULATION CYCLE

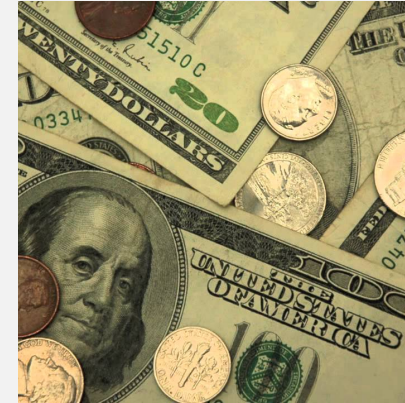




CONSIDERATIONS: SCOPE



Smoking is driven in part by addiction, which is not rational. Need a behavior framework for this.



Purchasing is driven by (boundedly) rational behavior. Use an econometric model: Discrete Choice Experiment.



CONSIDERATIONS: FEEDBACK





CONSIDERATIONS: PERCEPTION

The more my
friends smoke

The less extreme
I perceive my
smoking

The more
comfortable I am
smoking more



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CONSIDERATIONS: EXTERNAL VALIDITY

You are **at home** and have decided to buy tobacco. The stores below are your options.
You have **1.5** cigarettes left.
Planned tax increases:
• Packs have **no tax** planned.
• Cartons will increase by **\$1.00 in 3 months**.

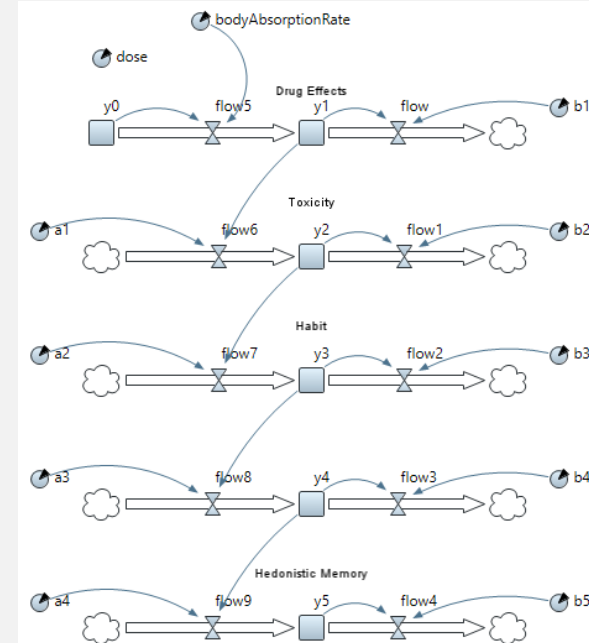
Your chosen regular cigarette brand is considered **MEDIUM** tier.

	Store 1			Store 2			Store 3			Opt Out
	Tier	Packs	Cartons	Tier	Packs	Cartons	Tier	Packs	Cartons	
Cigarettes	4 minute ride			4 minute ride			1 minute walk			No Purchase <input type="radio"/>
	Low	\$6.46 \$5.81 <input type="radio"/>	\$58.15 <input type="radio"/>	Low	\$6.17 \$4.13 <input type="radio"/>	\$54.92 <input type="radio"/>	Low	- - <input type="radio"/>	- - <input type="radio"/>	
	Medium	\$7.42 \$5.70 <input type="radio"/>	- <input type="radio"/>	Medium	- - <input type="radio"/>	- - <input type="radio"/>	Medium	\$8.99 \$8.01 <input type="radio"/>	- - <input type="radio"/>	
High	- - <input type="radio"/>	- - <input type="radio"/>	High	- - <input type="radio"/>	\$127.04 <input type="radio"/>	High	\$8.84 <input type="radio"/>	- - <input type="radio"/>	- - <input type="radio"/>	
Other tobacco products	Product	Price		Product	Price		Product	Price		
	Disposable e-cigarette	\$9.95 <input type="radio"/>		Disposable e-cigarette	\$9.95 <input type="radio"/>		Disposable e-cigarette	\$7.96 <input type="radio"/>		
	Chew	\$7.12 <input type="radio"/>		Chew	\$7.12 <input type="radio"/>		Chew	- <input type="radio"/>		
	Roll-your-own with 50 rolling papers	- <input type="radio"/>		Roll-your-own with 50 rolling papers	\$14.95 <input type="radio"/>		Roll-your-own with 50 rolling papers	\$16.82 <input type="radio"/>		

Question 9/12

Standard DCE technique

Addiction framework validated with mice and cocaine use





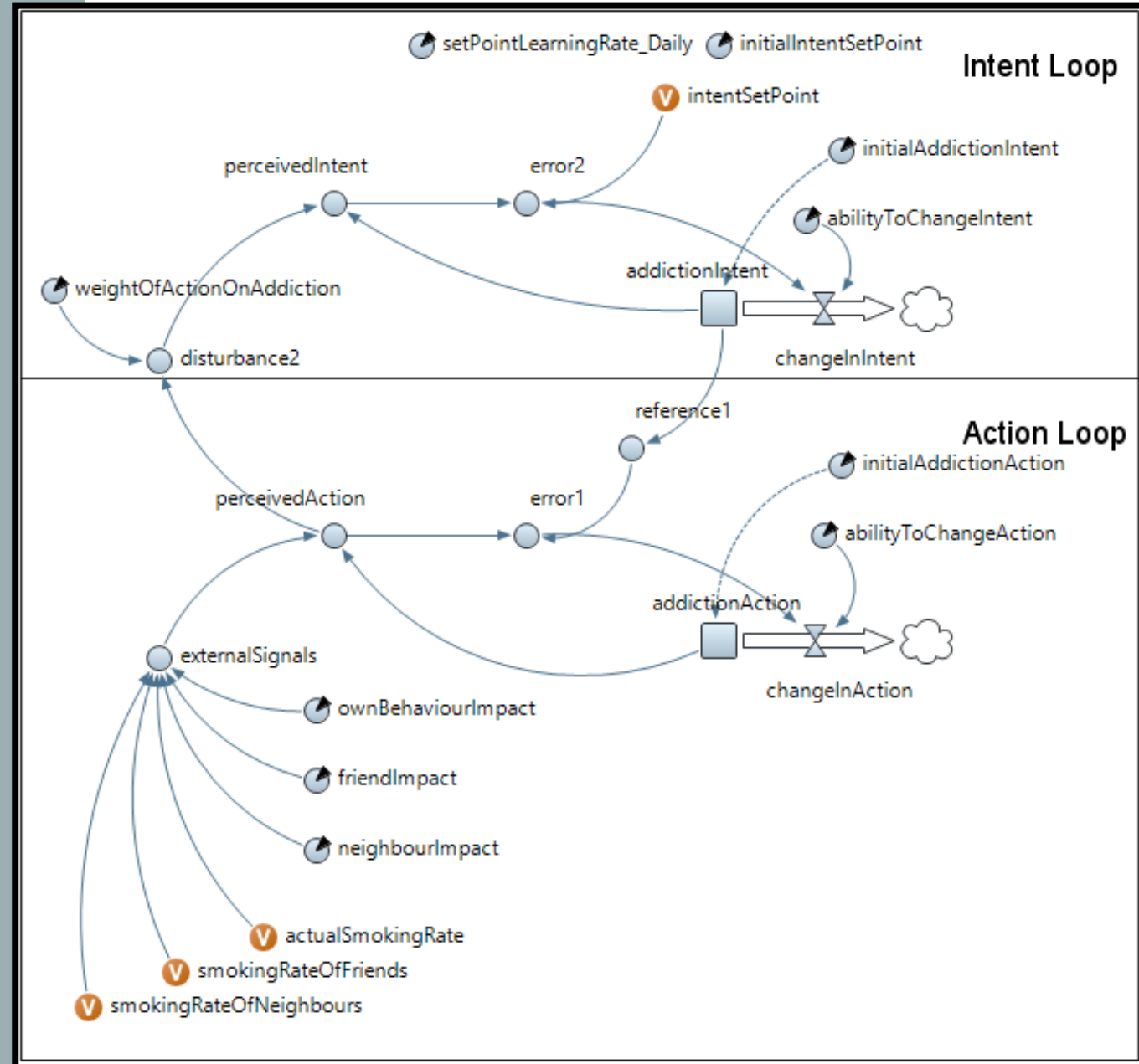
OPTIMAL FRAMEWORKS

Best framework for consumption: Mice Model

Best framework overall: Perceptual Control Theory



PERCEPTUAL CONTROL THEORY FRAMEWORK

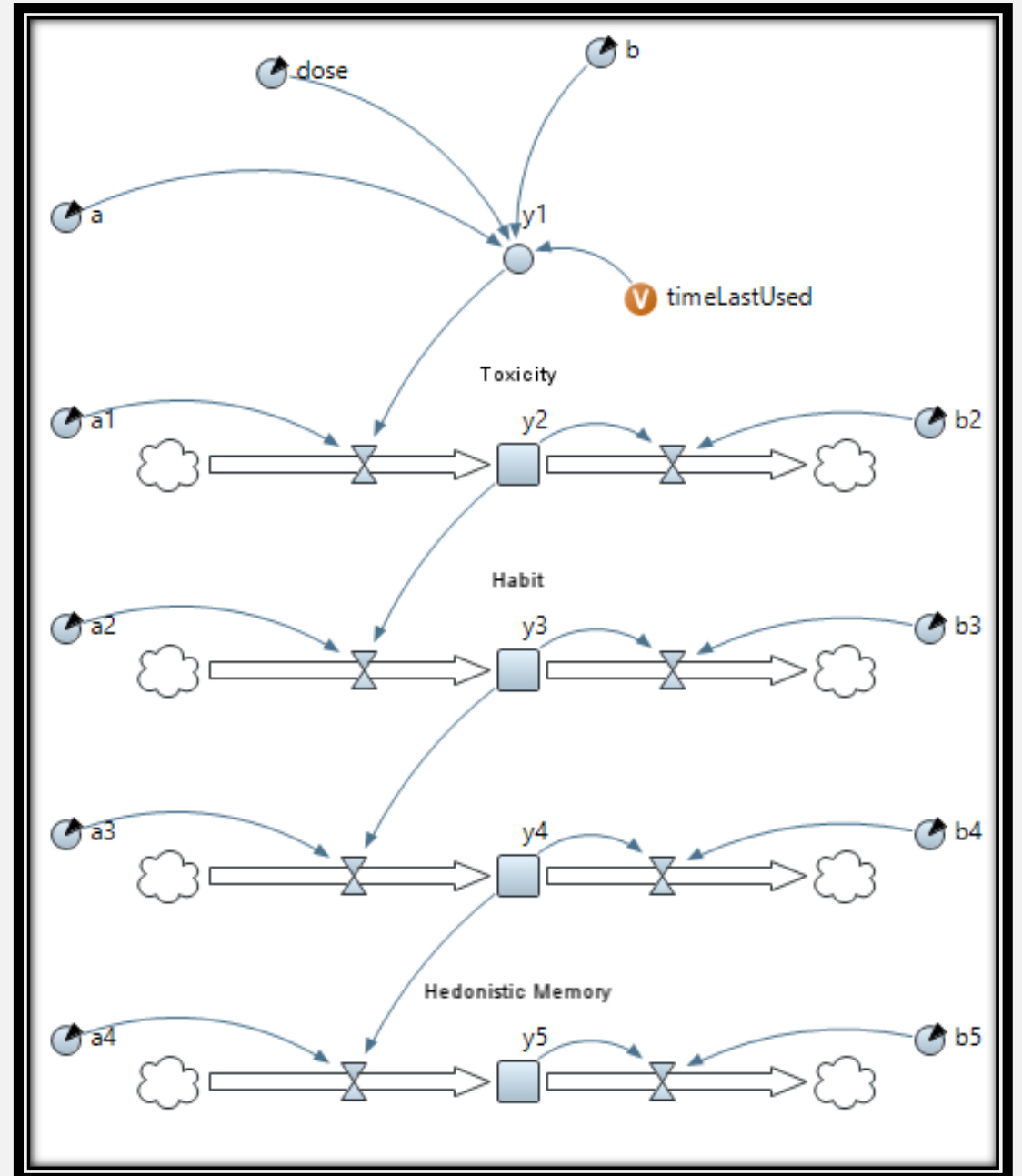




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MICE MODEL FRAMEWORK





WHY ANYLOGIC

Method-agnostic

- Agents can be given ABM, SD, mathematic, or algorithmic internal logic

Visual coding

- Collaboration with non-programming and non-modeling team

OO language

- Java



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QUESTIONS?