

Model, Dynamics, and Analysis in Drinking Groups

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Time, Space, Place...

“The social world is differentiated into configurations of time, space and objects...Associated with these configurations is...a pattern of behavior...”

- Cavan (1966)

What is a Drinking Event?



Events Defined

Drinking events are comprised of the context(s) and environment(s) in which drinking occurs. They are bound by time and begin with the first sip of alcohol and end when one's BAC reaches 0.0

Assumptions

- Events are complex (multi-determined, multi-level)
- Events are dynamic
- Events are inherently ecological
- Events can have transitory risk
- Cumulative events can have long-term risk

**Why are events
important?**



Prevention Paradox

“A large number of people exposed to a small risk can create many more cases of harm than a small number exposed to a high risk.”

Schneider and Lilienfeld (2011)

Emergent Properties



CRIME SCENE D

Violent Night

8:02 59°

KCAL 9
kcal9.com

Leverage Points

Leverage points are places within a complex system where a small shift in one thing can produce big changes in everything.

Meadows (1997)

Technology

Advances and access to mobile “smart technologies” have the potential for individualized, context and environment specific, inexpensive, real-time interventions.

Mabry et al. 2008

Earlier Studies

Drunk in Public, Drunk in Private: The Relationship Between College Students, Drinking Environments and Alcohol Consumption

**J. D. Clapp, Ph.D.,¹ M. B. Reed, Ph.D.,² M. R. Holmes, B.A.,¹
J. E. Lange, Ph.D.,² and R. B. Voas, Ph.D.³**

Deconstructing Contexts of Binge Drinking Among College Students

John D. Clapp, Ph.D.^{1,2,*}
Audrey M. Shillington, Ph.D.²
Lance B. Segars, Ph.D.²

Environmental and Individual Predictors of Error in Field Estimates of Blood Alcohol Concentration: A Multilevel Analysis*

JOHN D. CLAPP, PH.D.,¹ JONG W. MIN, PH.D., AUDREY M. SHILLINGTON, PH.D., MARK B. REED, PH.D.,
JAMES E. LANGE, PH.D., AND MEGAN R. HOLMES, B.A.

Bar Methods

- A multi-method, multi-level study
- Interviewed patrons and collected BrAC samples
- Portal Design with Random Sampling
- Observed bar environments
- Patrons $n=1040$; Bars $n=30$

Overview of Data Modeled

- 1024 people surveyed at 30 different bars
- Information:
 - BrAC measurements before entering the bar and after leaving it
 - Duration time in the bar
 - The amount of money available to spend on food and on alcohol
 - Desired level of alcohol intoxication to reach during the drinking activity

Bar Results: HLM

- Hierarchical Linear Model: Predictors of BrAC Change
 - Individual level variables associated with higher BrAC change:
 - Gender
 - Drinking intentions
 - Plans to continue drinking
 - Number of minutes spent in the bar
 - Bar level variables associated with BrAC change:
 - Dancing (negative association with BrAC)
 - Temporary bars (positive association with BrAC)

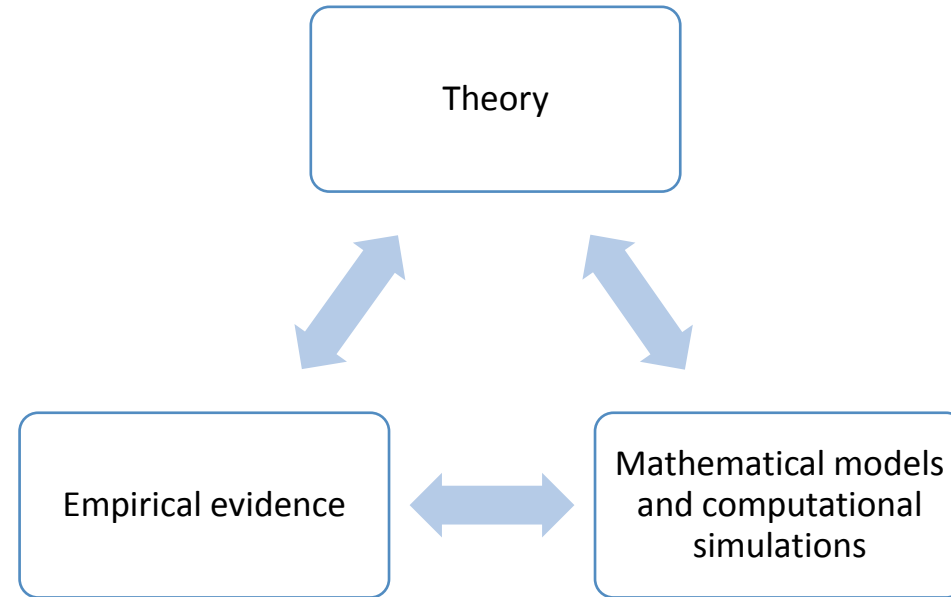
Clapp et al. (2009); Reed et al., (2014)

Some unanswered questions...

What about groups?

**What about
dynamics?**

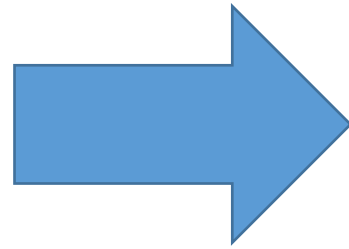
Collaborative Approach



Mathematical model



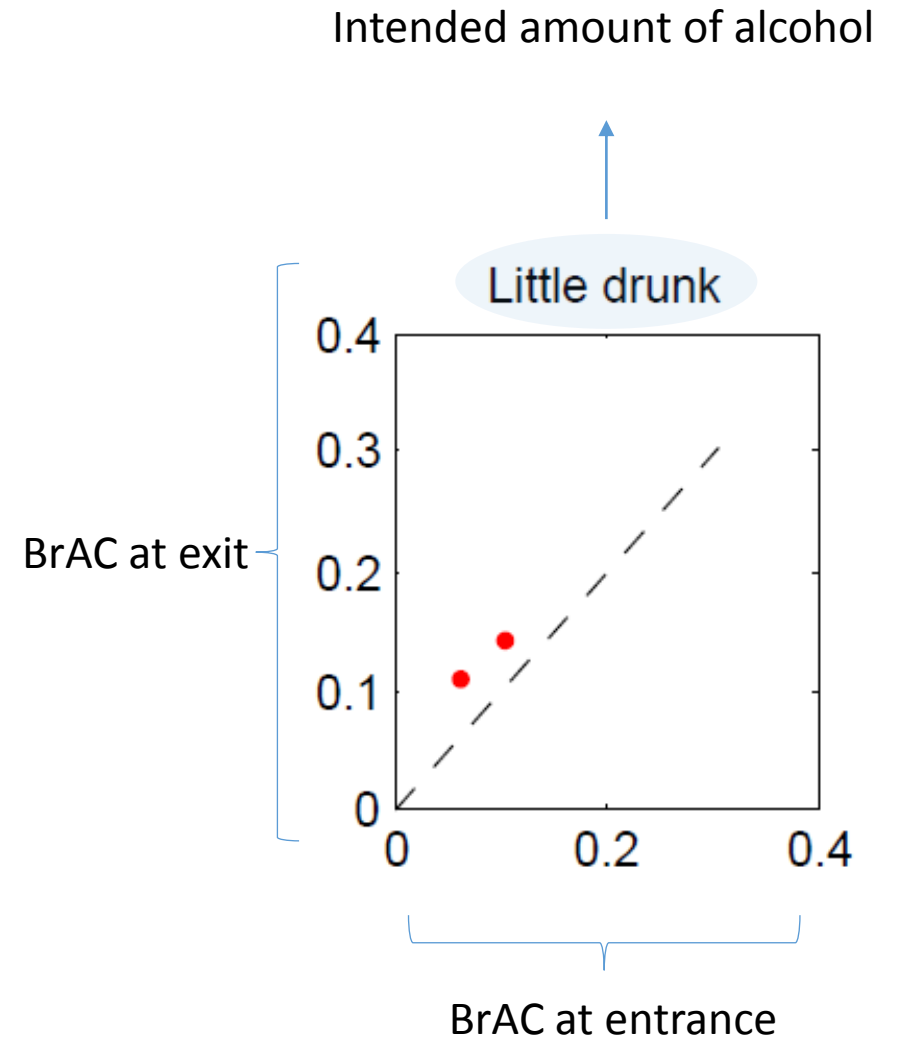
Group of people



Dynamical
System

Field data*

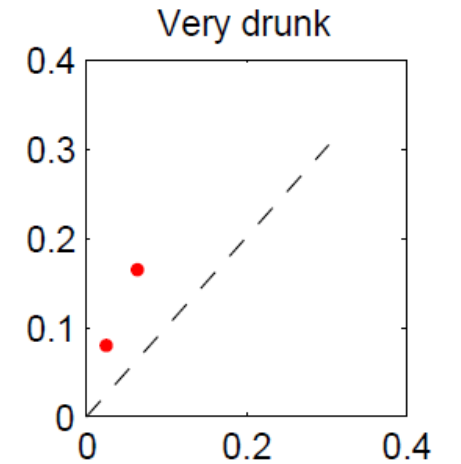
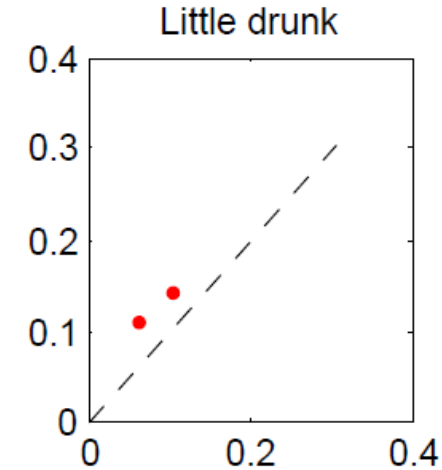
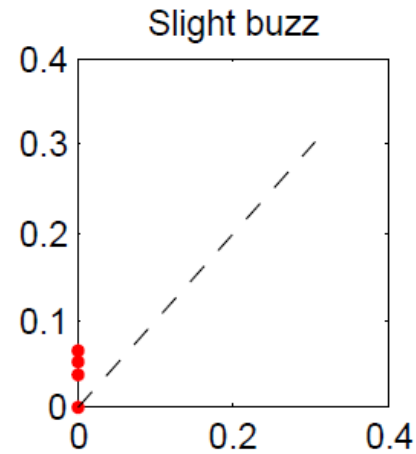
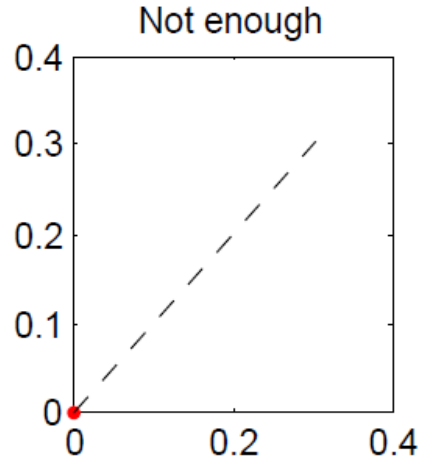
- 30 different bars
- Questionnaire and BrAC sample on 839 people
- Collected information per subject:
 - BrAC at entrance and exit
 - Amount of alcohol intended to consume
 - Whether alone or in a group



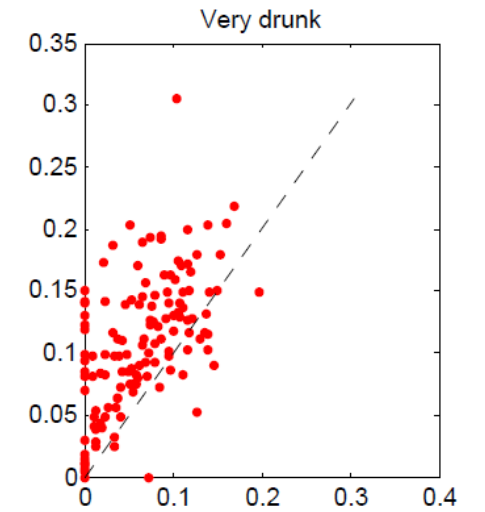
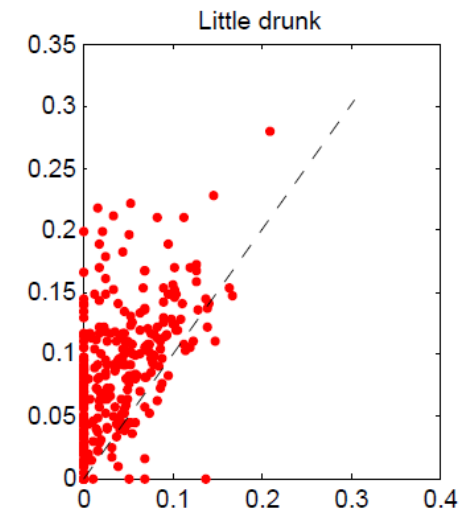
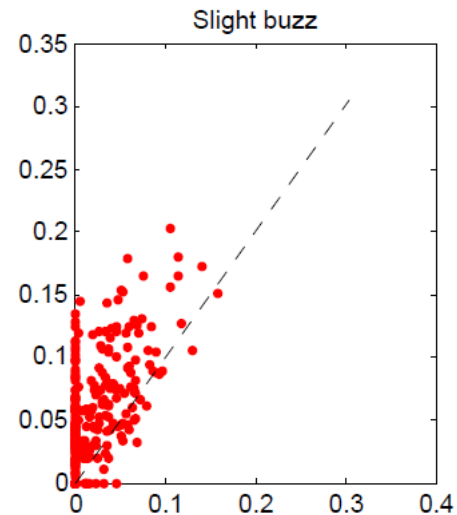
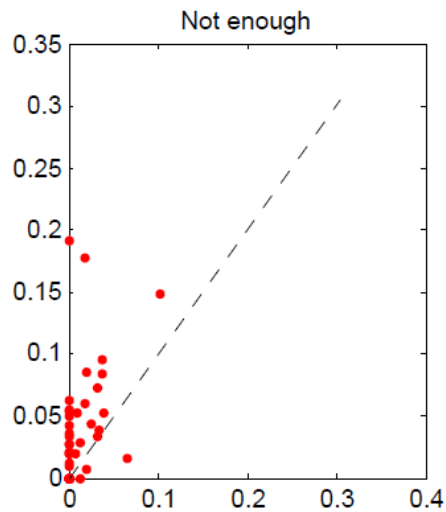
* Clapp, John D., et al. "Measuring College Students' Alcohol Consumption in Natural Drinking Environments Field Methodologies for Bars and Parties." *Evaluation review* 31.5 (2007): 469-489.

Field data: Reality Doesn't Match Intentions

Alone



In a group

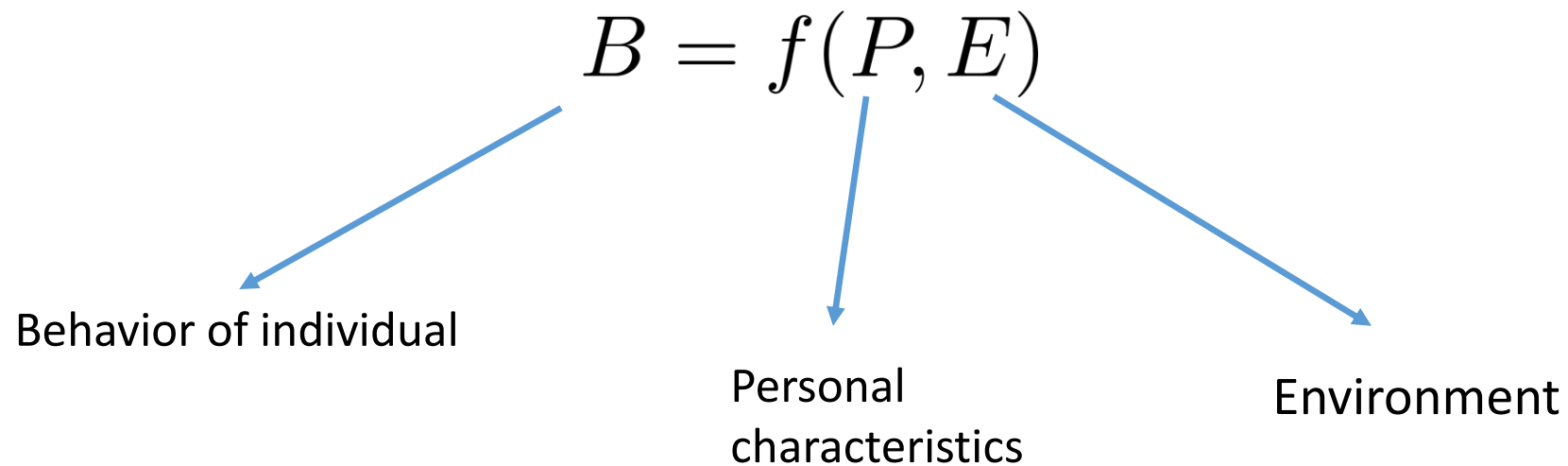


Mathematical model

- Dynamic system based on Lewin's model of behavior: $B = f(P, E)$
 - Behavior is a function of person and environment.
- Newton's Second Law of Motion: acceleration is a function of the net force or influence acting on an individual's behavior
 - In this case, the social influence, the strength of individual motivation, and environmental pressures.

Mathematical model

Kurt Lewin* : **dynamics** of the behavior of a group member are given by



* Kurt Lewin. Field theory in social science. Harpers, 1951

Mathematical model

Model of drinking behaviors from Lewin's formula perspective:

- Vector of **measurable** variables that indicate the “condition” of individual i

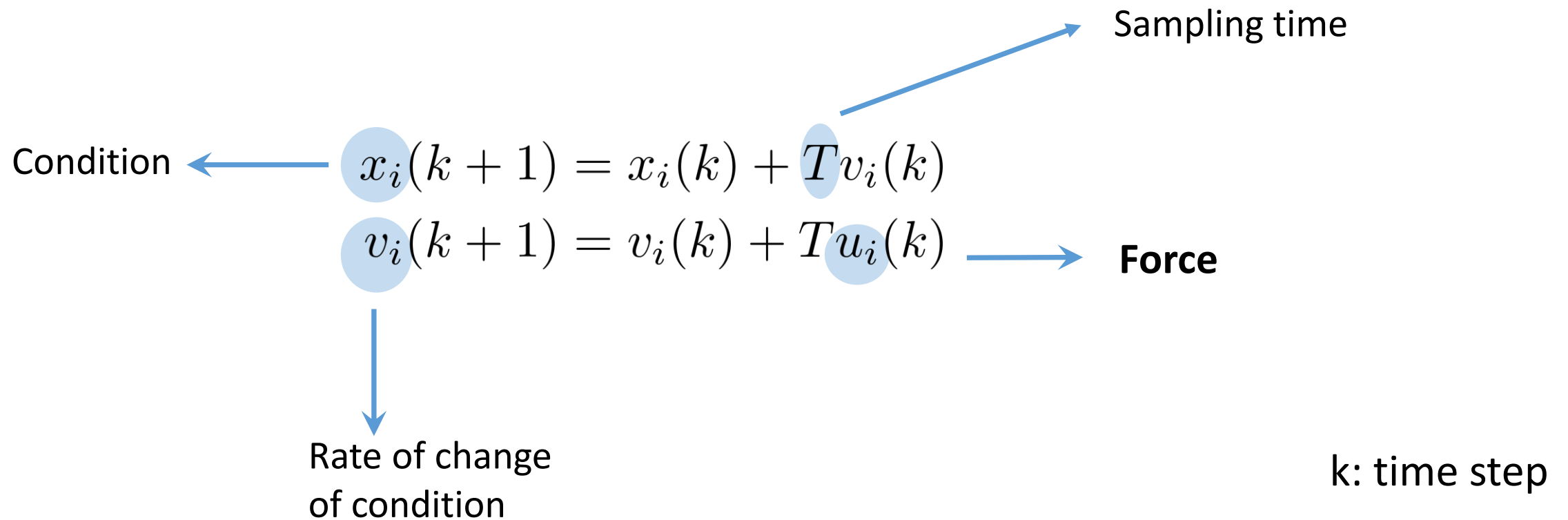
$$x^i = [x_1^i, x_2^i, \dots, x_p^i]^\top$$

For example, Breath Alcohol Content (BrAC)



Mathematical model

Dynamics that determine behavior of individual i



Mathematical model

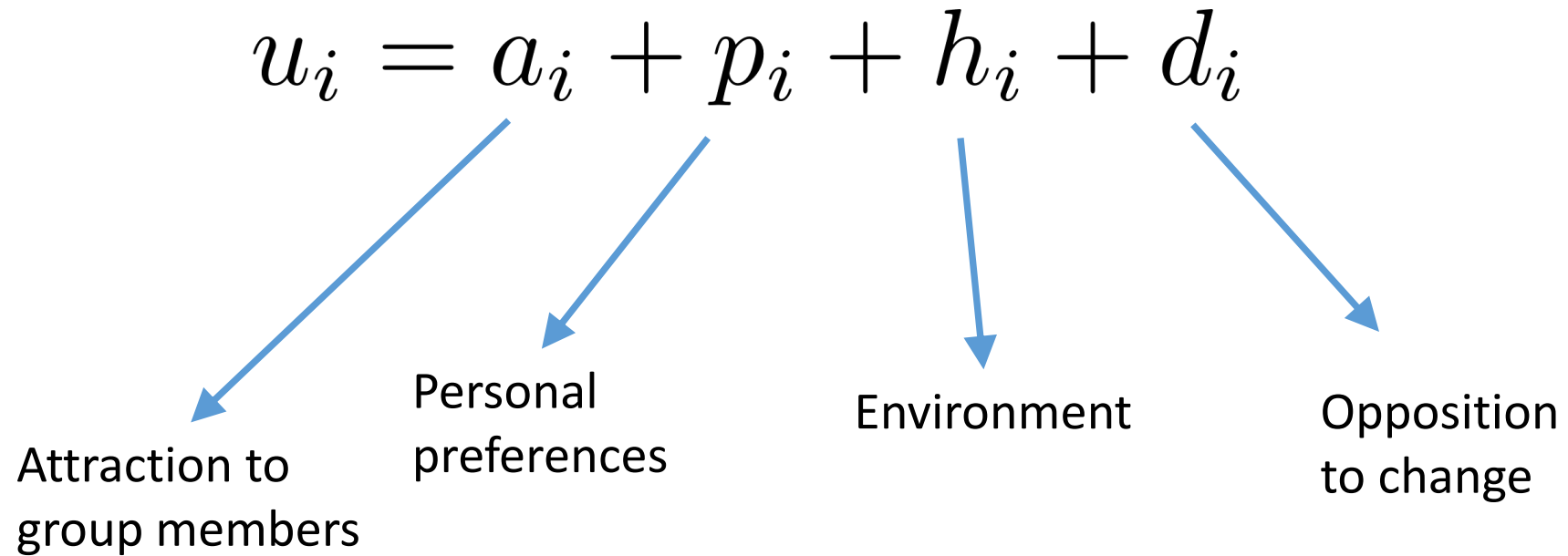
Force acting on behavior of individual i

$$u_i = \sum_j F_j$$

Sum of different force or influence components

Mathematical model

Force acting on the behavior of individual i

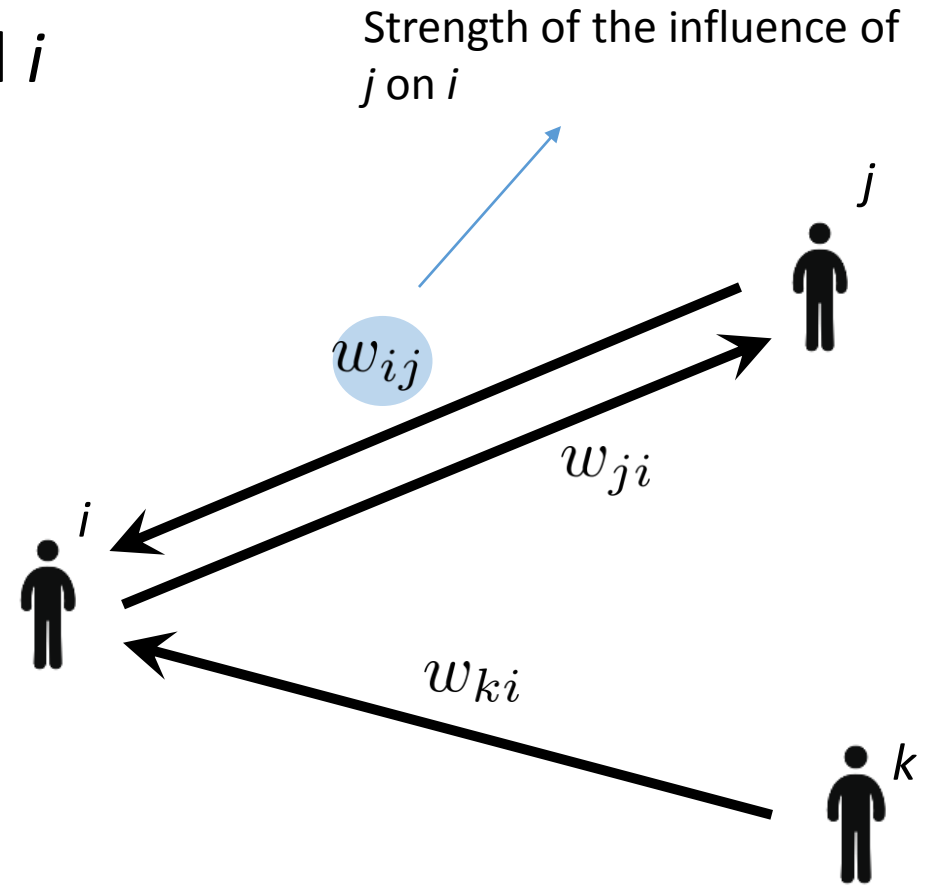


Mathematical model

Force acting on the behavior of individual i

$$u_i = a_i + p_i + h_i + d_i$$

Attraction component



Mathematical model

Force acting on the behavior of individual i

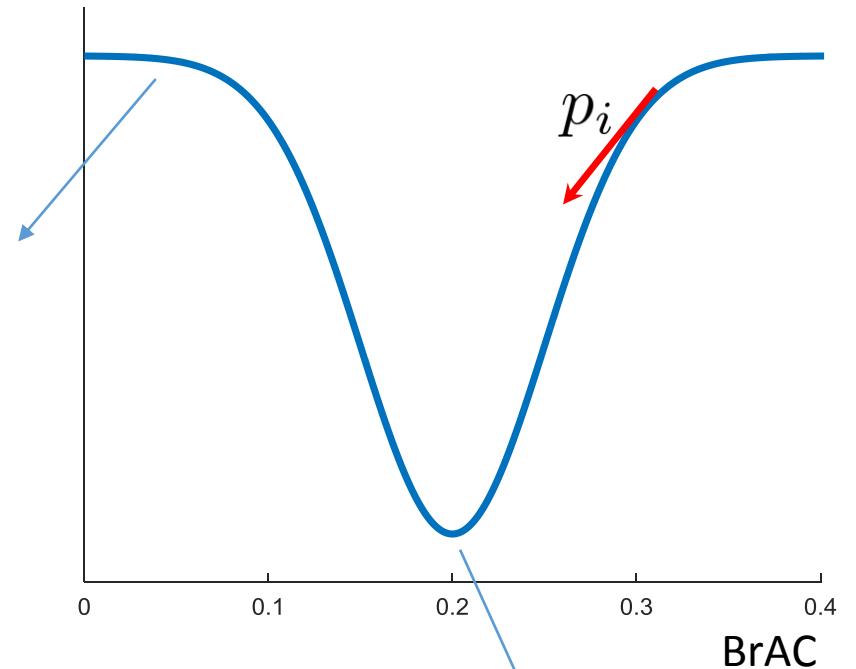
$$u_i = a_i + p_i + h_i + d_i$$



Influence of personal preferences

p^i : force given by negative gradient of a cost function

Region of lowest preference



Point of highest preference

Mathematical model

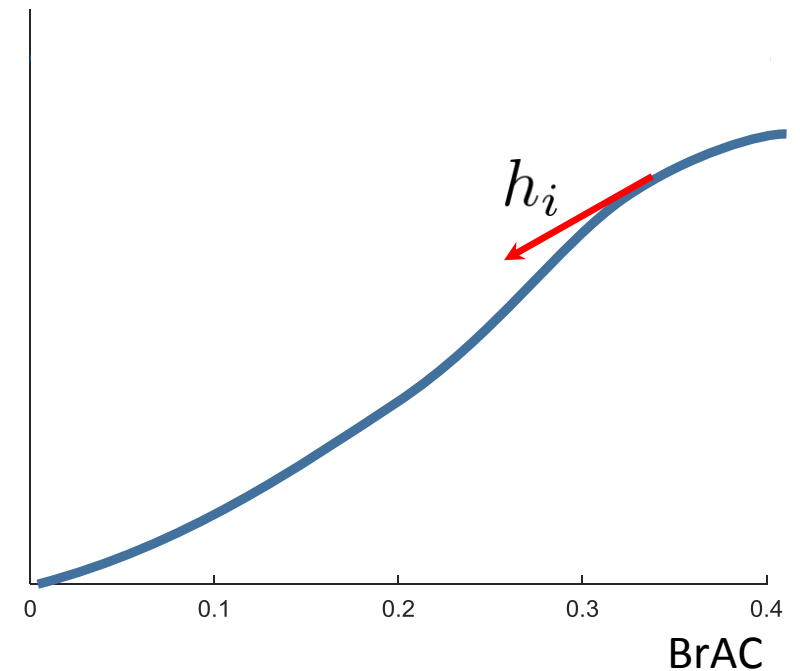
Force acting on the behavior of individual i

$$u_i = a_i + p_i + h_i + d_i$$

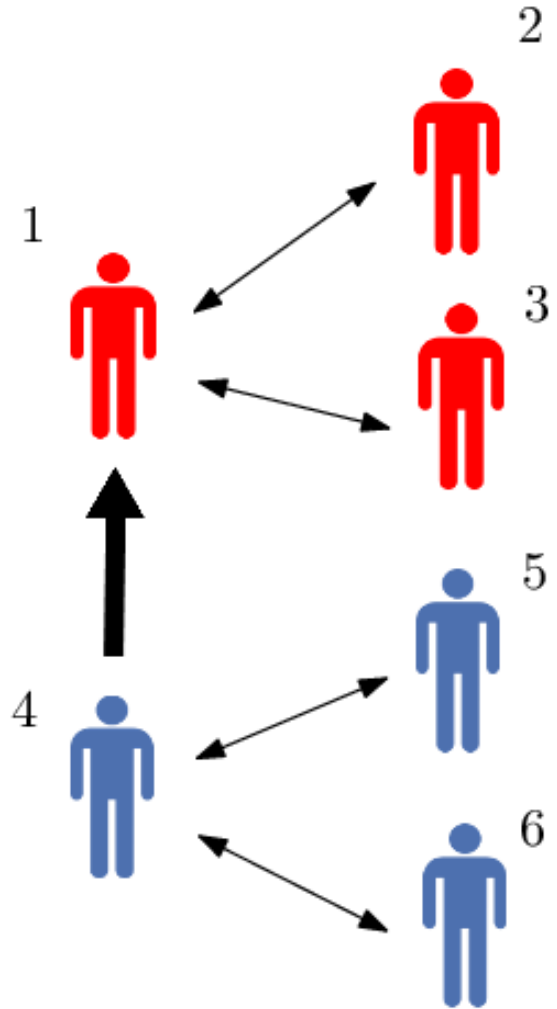
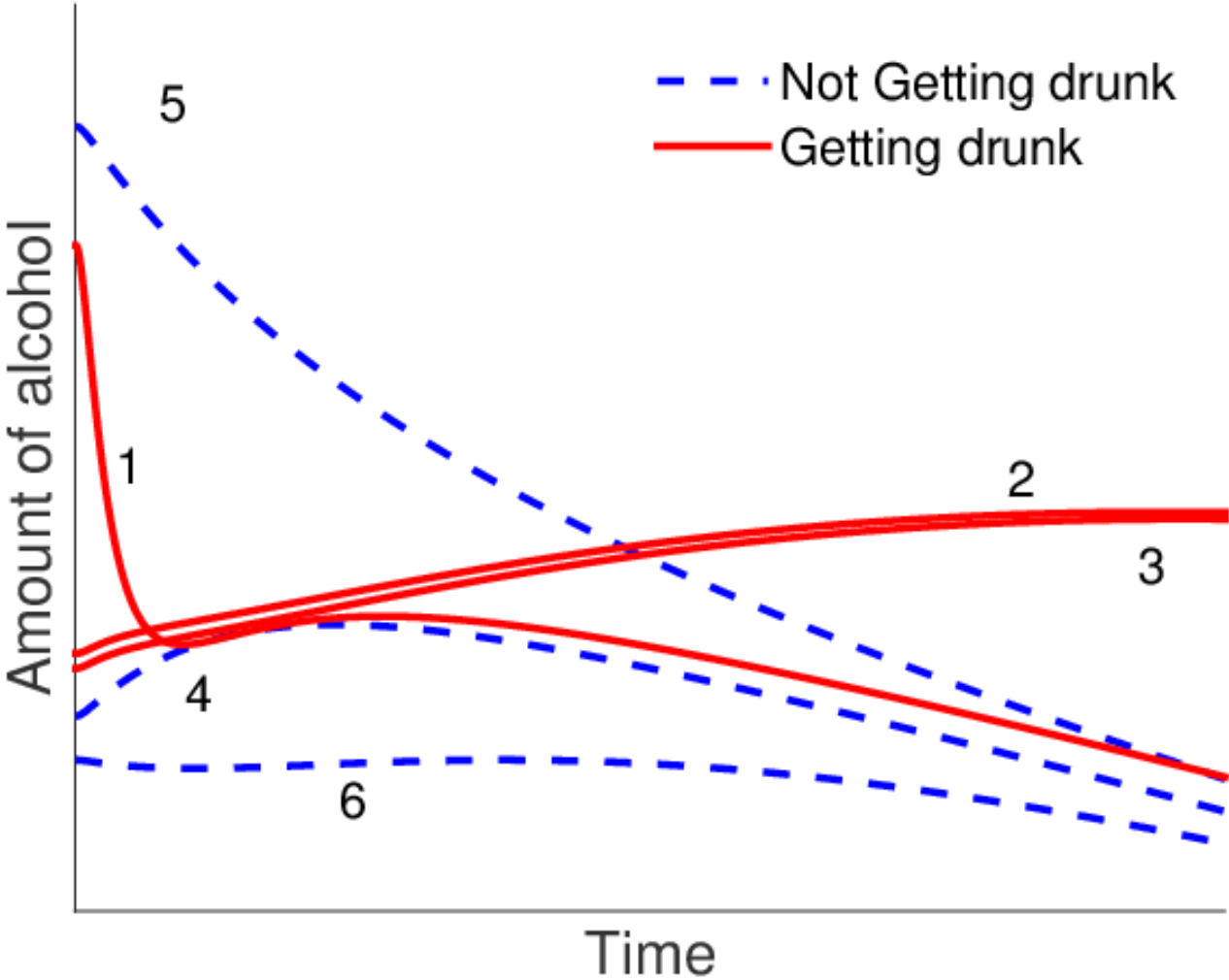
Influence of the environment

h^i : force given by negative gradient of a cost function

Environment profile that prevents higher values of the BrAC

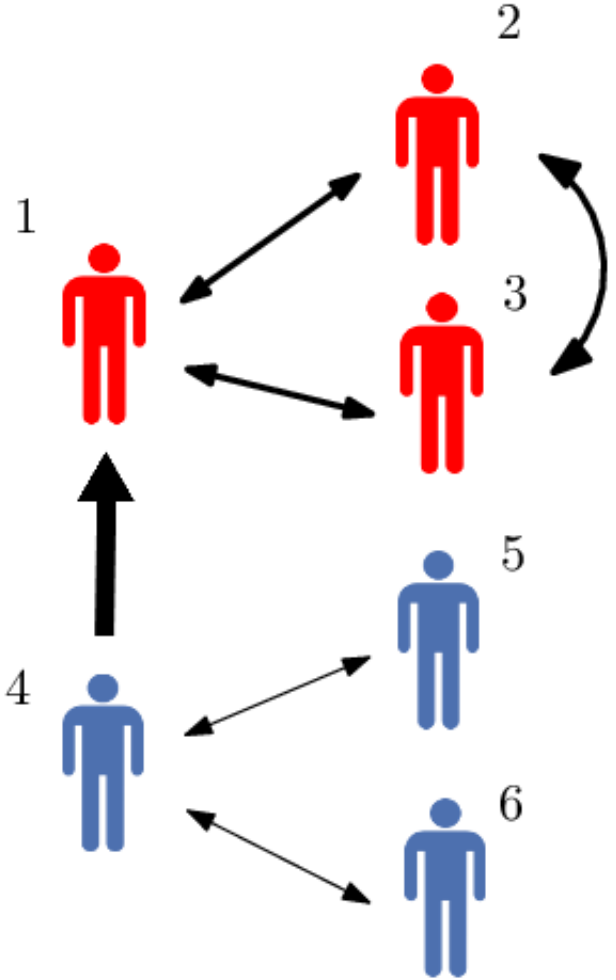
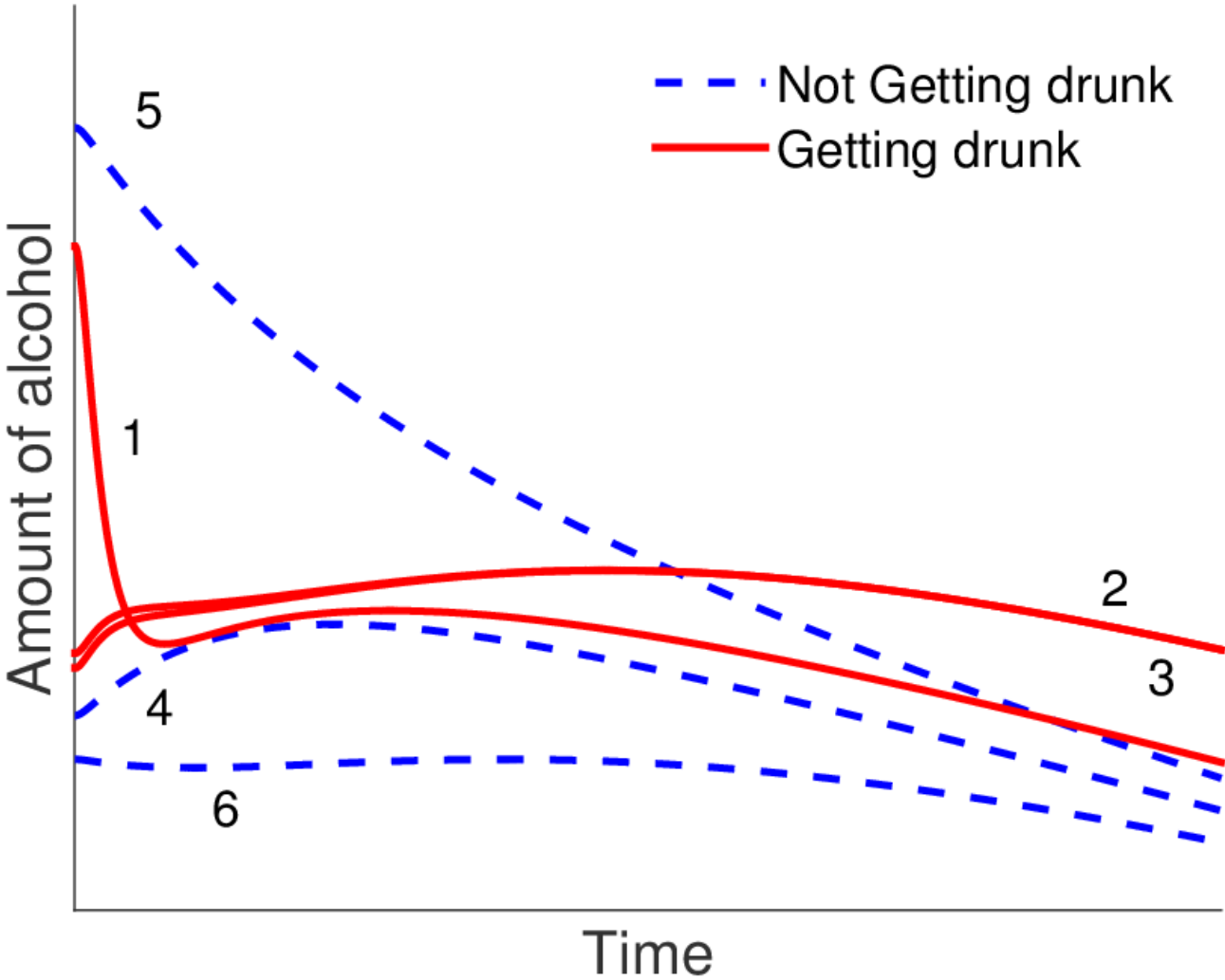


Simulations: case 1



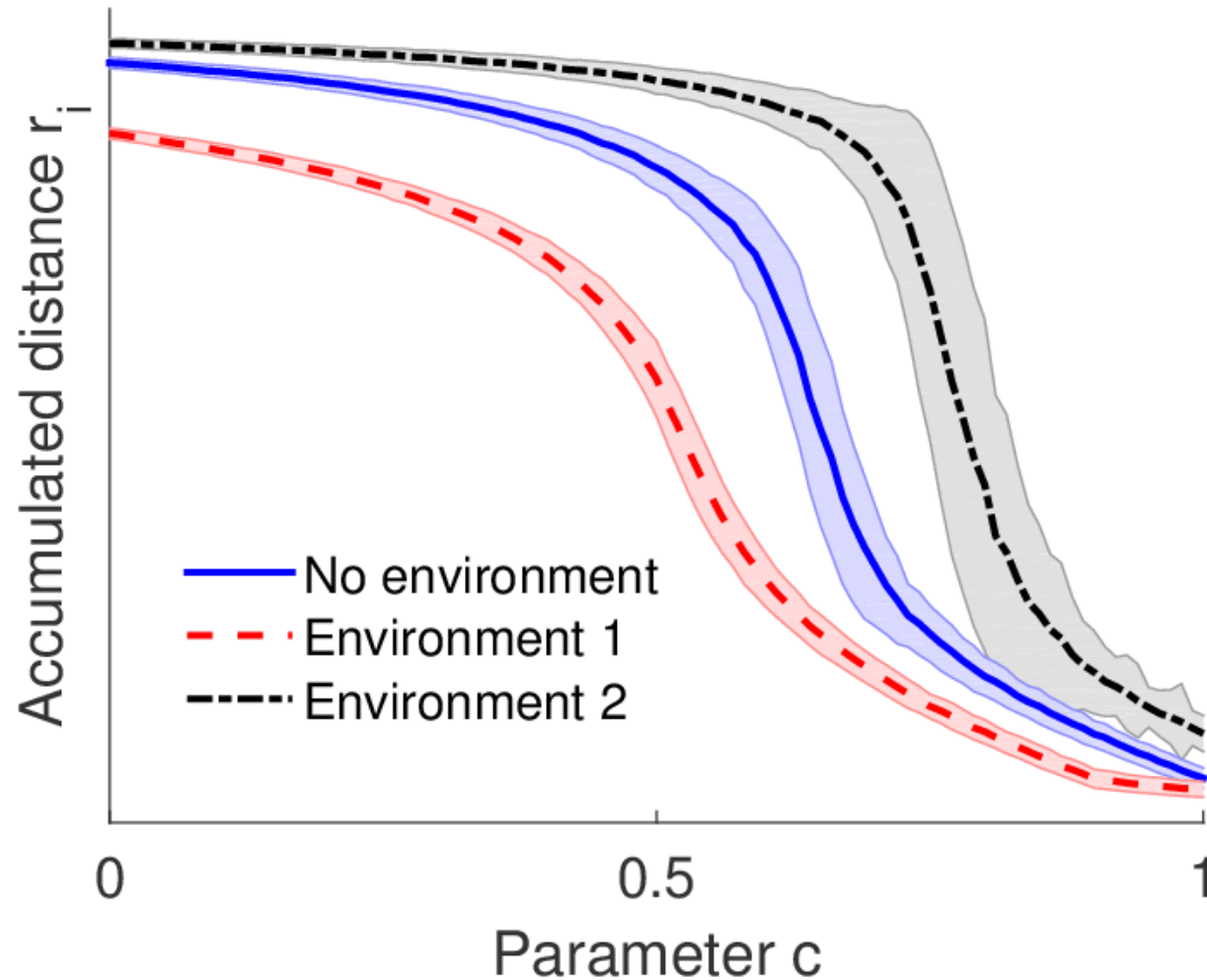
Color: preference
Thickness arrow: attraction strength

Simulations: case 2



Color: preference
Thickness arrow: attraction strength

Monte Carlo Simulations

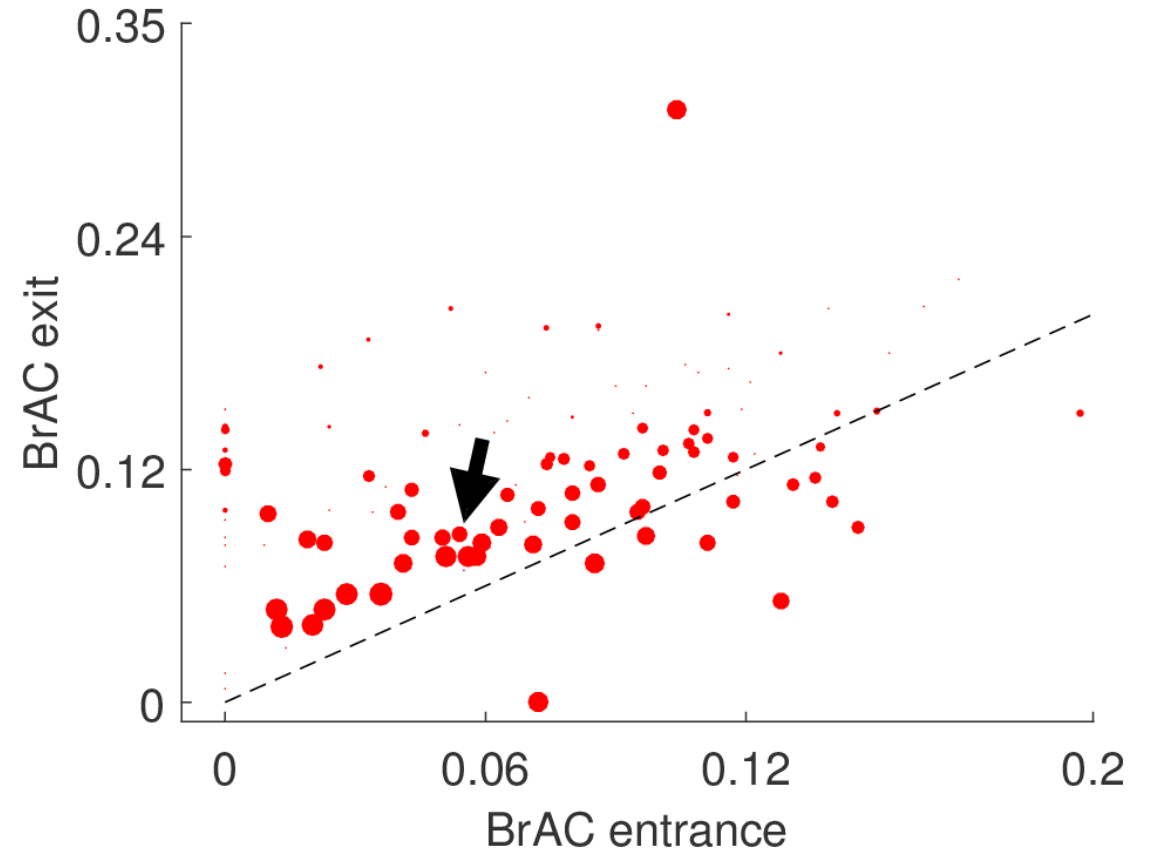
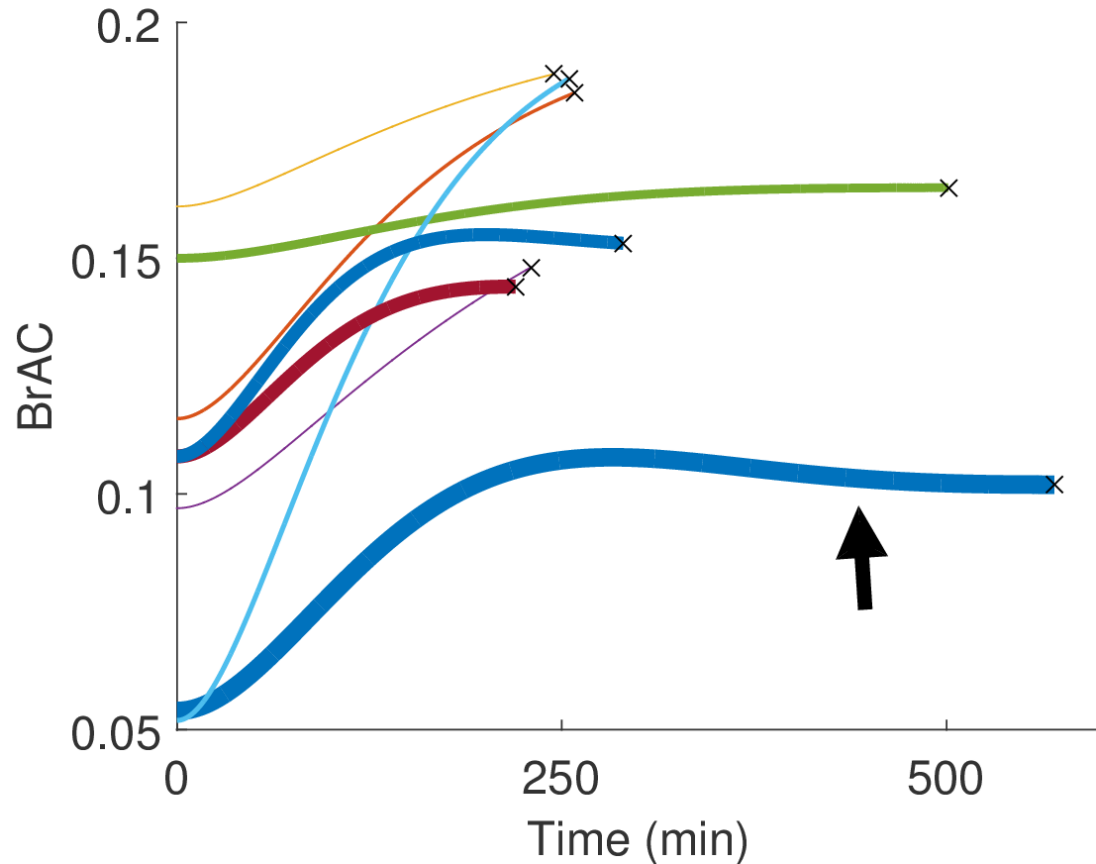


- $c = 0$: No personal preference,
Only social influence
- $c = 1$: No social pressure,
Only personal preference

Environment 1: lower values of BrAC
Environment 2: higher values of BrAC
Desired condition: low values of BrAC

r_i : history of how close the trajectory
of the individual was to his/her
desired condition

Modeling field data



Predicted trajectories and social influence for people with personal preference category "very drunk"

Strength of social influence: Thickness of lines and dots

Summary

- Groups in drinking environments are not static but dynamic.
- A mathematical model of such dynamics helps to understand and explain high-risk behaviors.
- Decision-making dynamics are influenced by the individual preferences, social interactions, and the environment.

Cheers!

