SCHOOL OF MEDICINE
CASE WESTERN RESERVE UNIVERSITY

Center for Community Health Integration
Research & Development for Community Health & Integrated, Personalized Care

Social Determinants of Health from a Feedback Perspective: Insights and Opportunities for Advancing Health Equity, from Local to Global

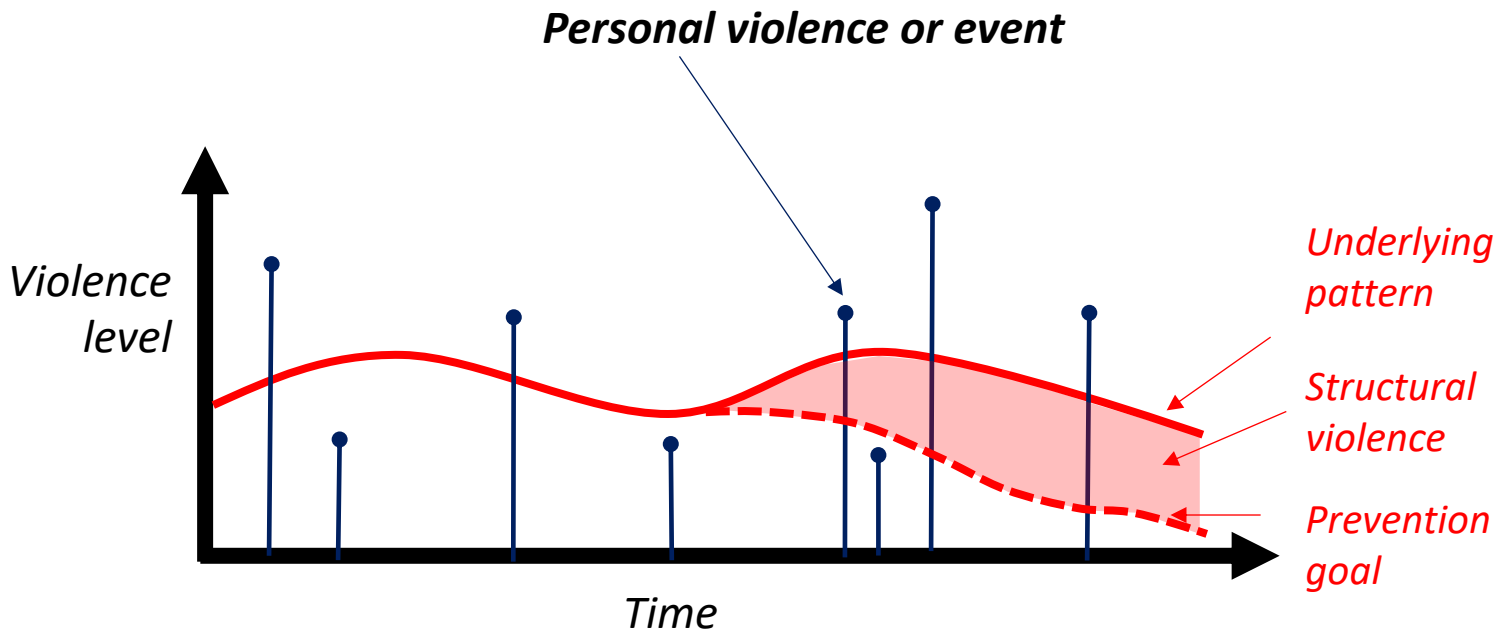
Peter S. Hovmand, PhD, MSW

PHRI Seminar Series | September 10, 2021

Overview

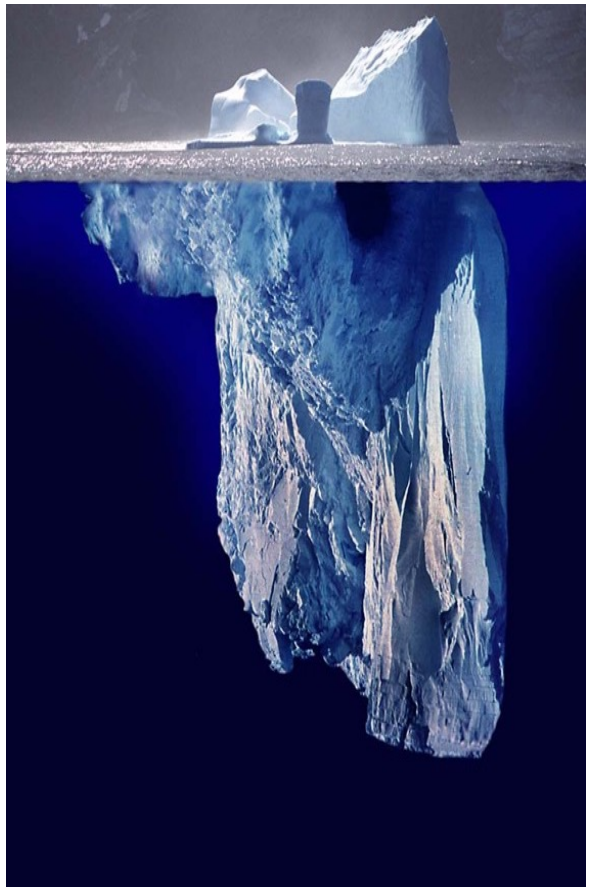
1. Context for understanding *structural violence* as a complex adaptive system
2. Overview of system dynamics as a method for understanding systems from an *endogenous or feedback perspective*
3. Introduction to *participatory systems modeling* using Community Based System Dynamics
4. Insight on *generic structures* underlying structural violence
5. Opportunities for research and action

Structural violence



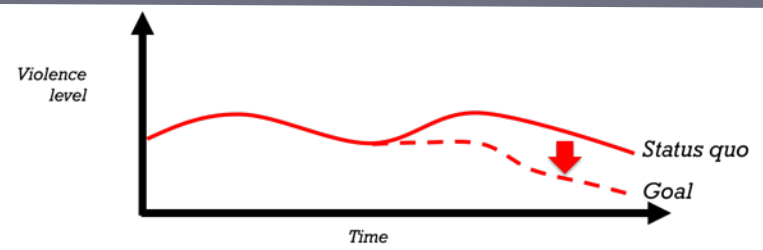
Johan Galtung (1969). Violence, peace, and peace research. *Journal of Peace Research, 6*(4), p. 171

Iceberg metaphor for structural violence

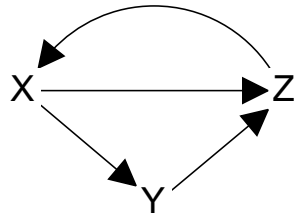


Events

Patterns over time



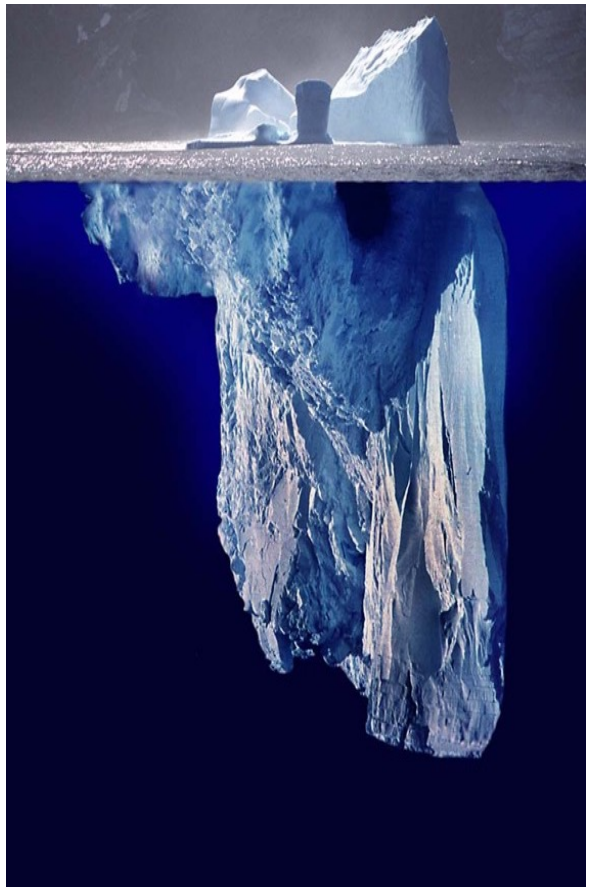
Structure



Values, attitudes, and norms

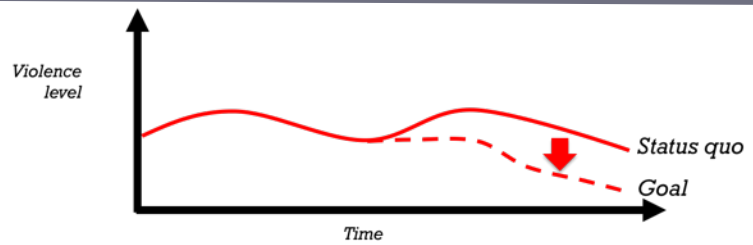
E.g., ‘family’, gender roles, culture, social needs, …

Seeing systems underlying structural violence

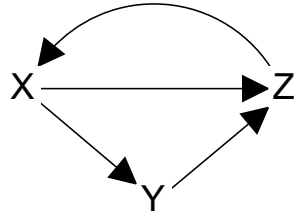


Events

Patterns over time



Structure



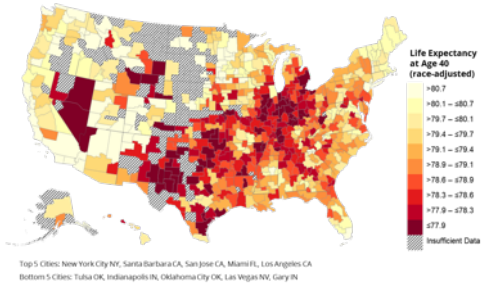
Values, attitudes, and norms

E.g., ‘family’, gender roles, culture, social needs, …

Different ways to structure of systems

Metaphors of systems

Maps of systems



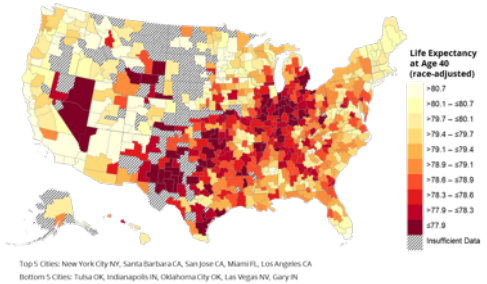
Formal models of systems

Multilevel statistical models
Spatial models
Network models
Simulation models
Analog, Discrete event, microsimulation, agent-based modeling, system dynamics

Different ways to structure of systems

Metaphors of systems

Maps of systems

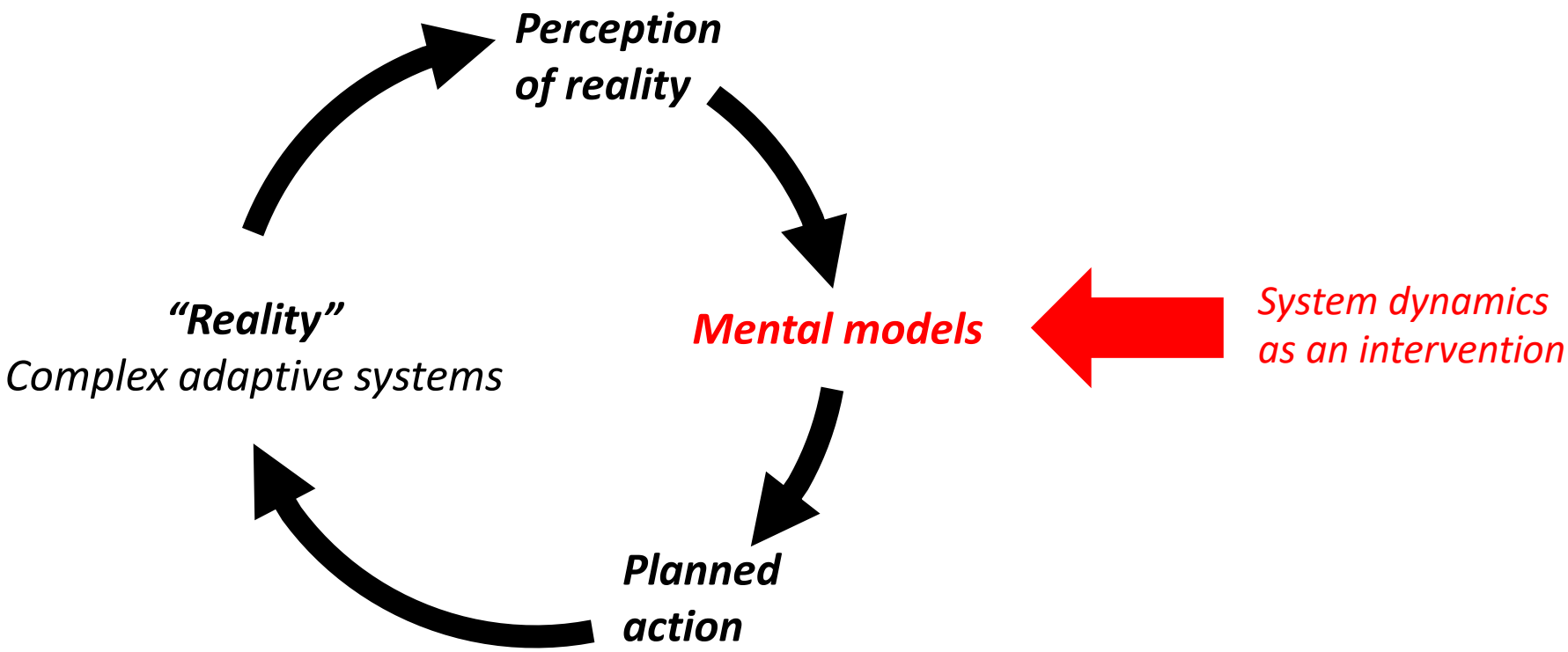


Formal models of systems

Multilevel statistical models
Spatial models
Network models
Simulation models
Analog, Discrete event, microsimulation, agent-based modeling, ***system dynamics***

System dynamics and the endogenous perspective

Focusing on improving the mental models in cycles of planned action



Johnson-Laird, P. (1983). Mental models: Towards a cognitive science of language, inference and consciousness. Cambridge, MA: Harvard University Press.

System Dynamics

System dynamics is the use of informal maps and formal models with computer simulation to uncover and understand endogenous sources of system behavior (Richardson, 2011)

Foundations

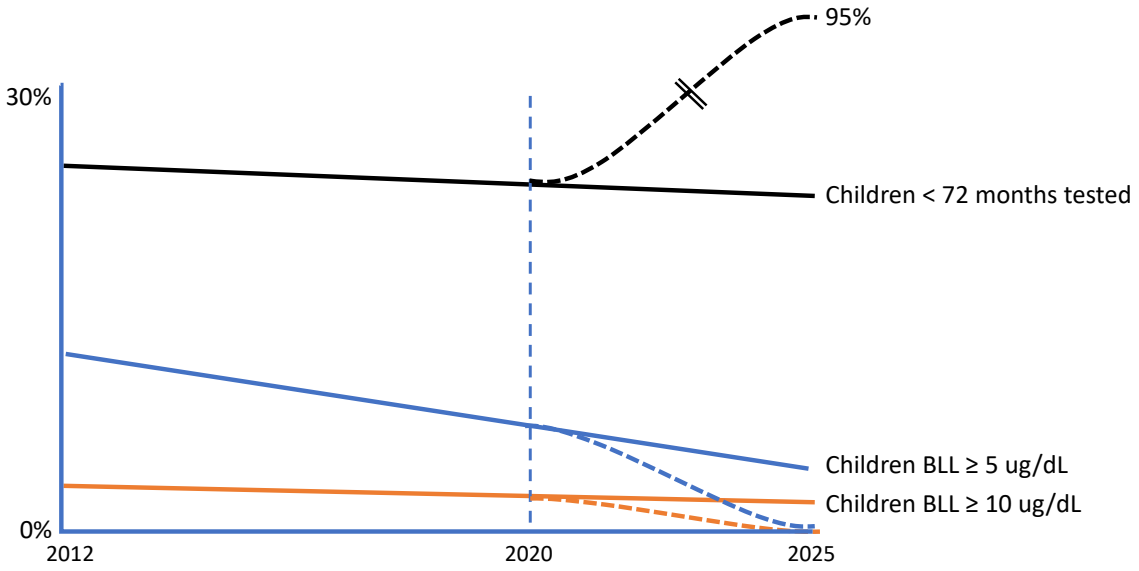
- Endogenous perspective
  - Stock or level (state) variables representing accumulations
    - Flow or rate variables representing activity
      - Using computers to simulate more realistic mathematical models

Richardson, G.P. (2011). Reflections on the foundations of system dynamics. *System Dynamics Review, 27*(3), 219-243.

System Dynamics

System dynamics is the use of informal maps and formal models with computer simulation to uncover and understand endogenous sources of *system behavior* (Richardson, 2011)

Problem definition or “reference mode” for lead exposures for Cuyahoga County



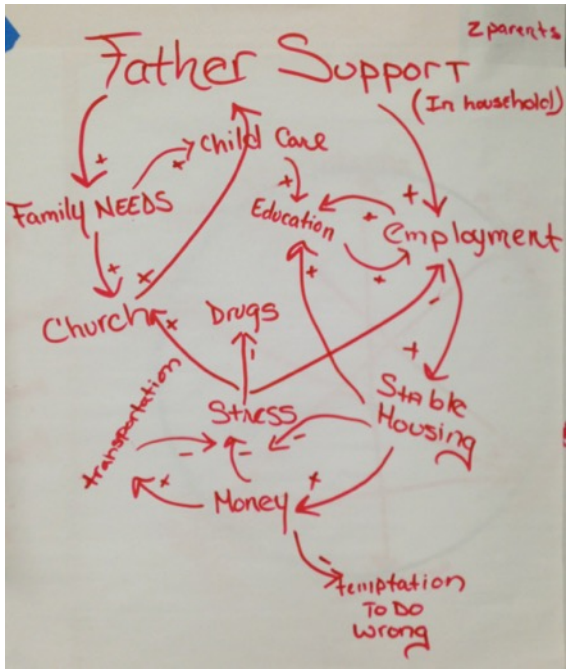
Based on data from https://www.cdc.gov/nceh/lead/data/state/ohdata.htm (retrieved February 22, 2021)

Richardson, G.P. (2011). Reflections on the foundations of system dynamics. *System Dynamics Review, 27*(3), 219-243.

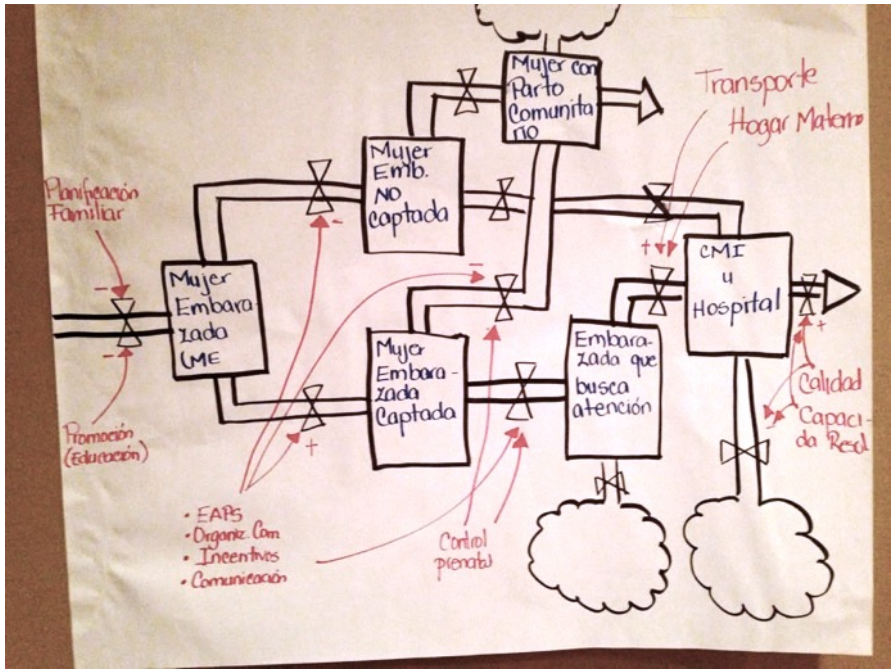
System Dynamics

System dynamics is the use of *informal maps* and formal models with computer simulation to uncover and understand endogenous sources of system behavior (Richardson, 2011)

Causal Loop Diagram

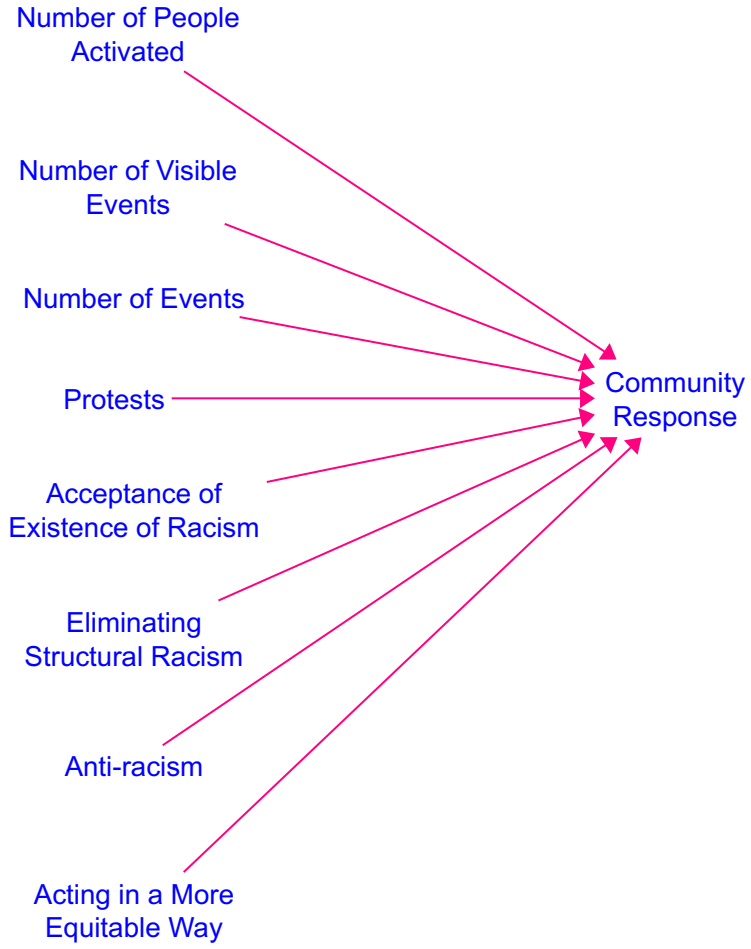


Stock and Flow Diagram

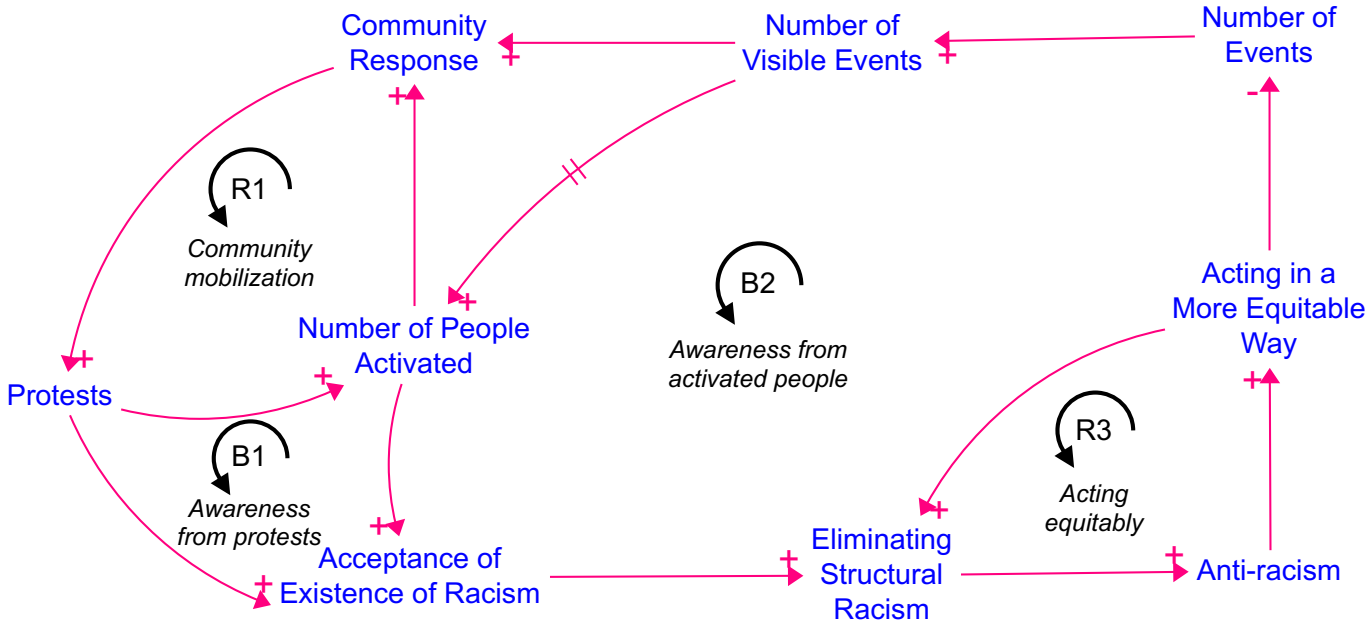


Richardson, G.P. (2011). Reflections on the foundations of system dynamics. *System Dynamics Review, 27*(3), 219-243.

Endogenous sources of system behavior



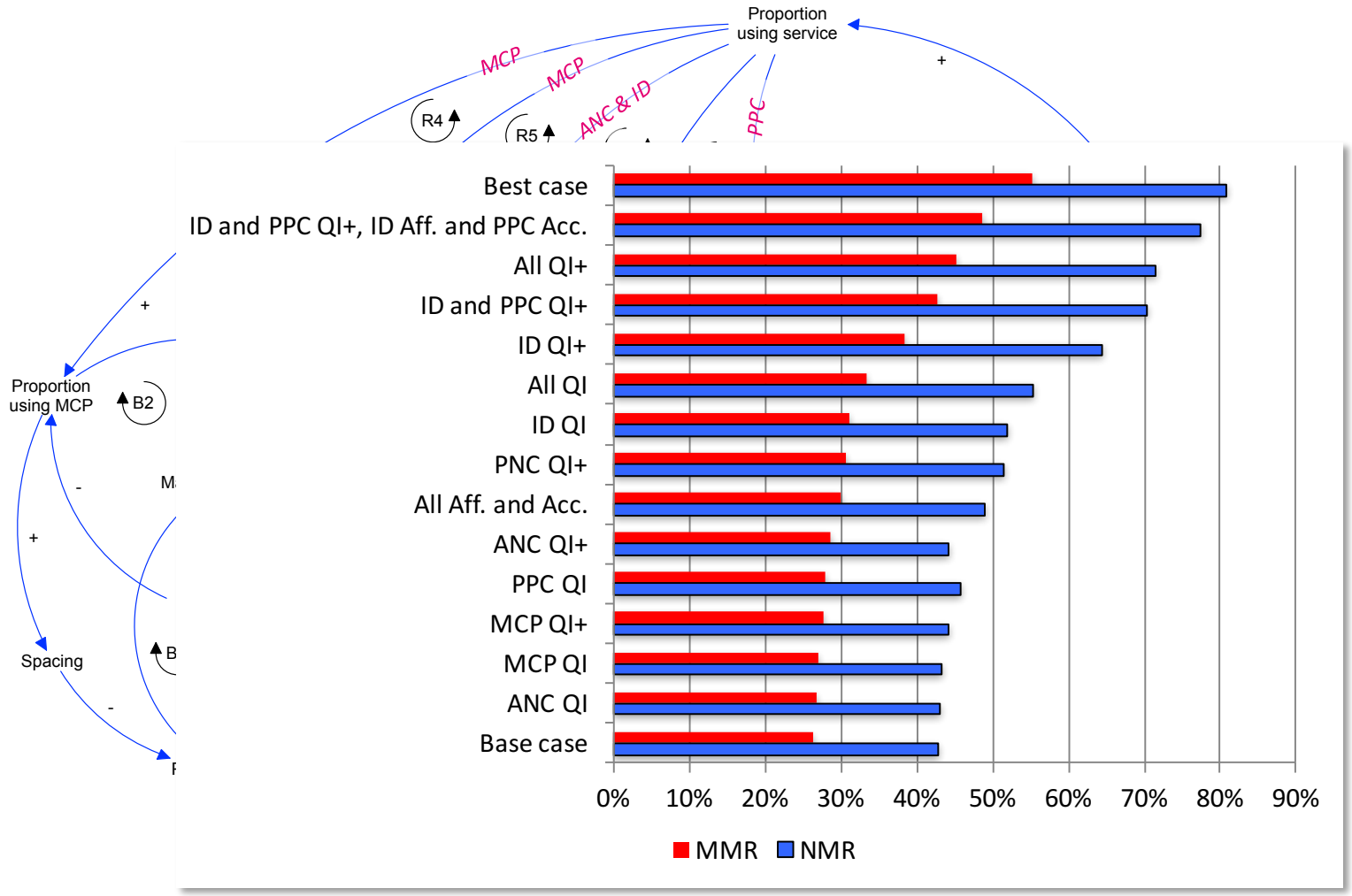
Linear cause-effect perspective



Endogenous or feedback perspective

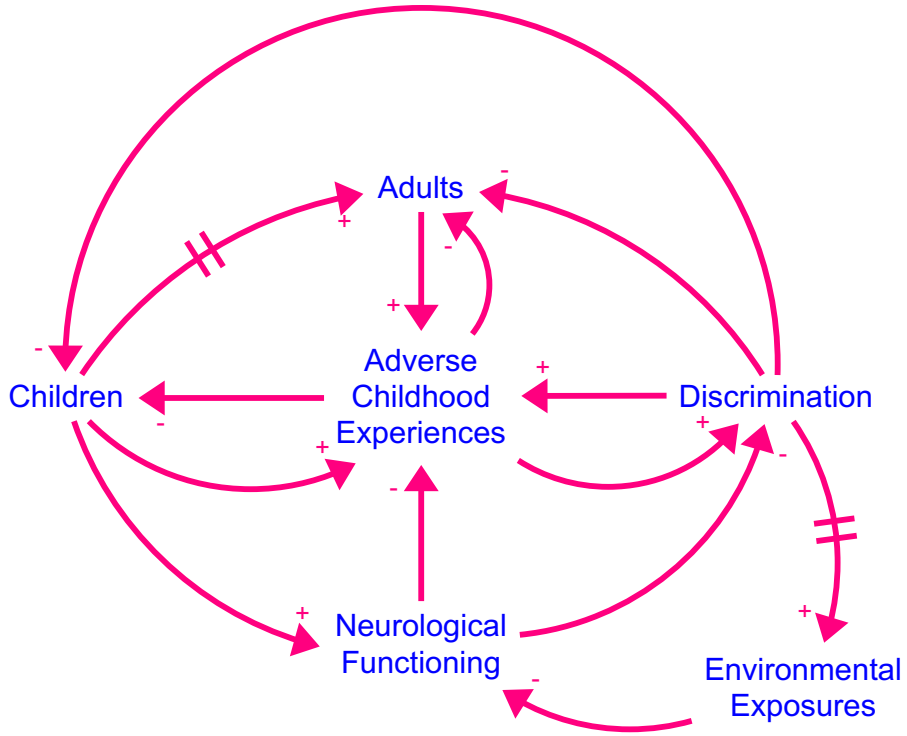
Formal models with computer simulation

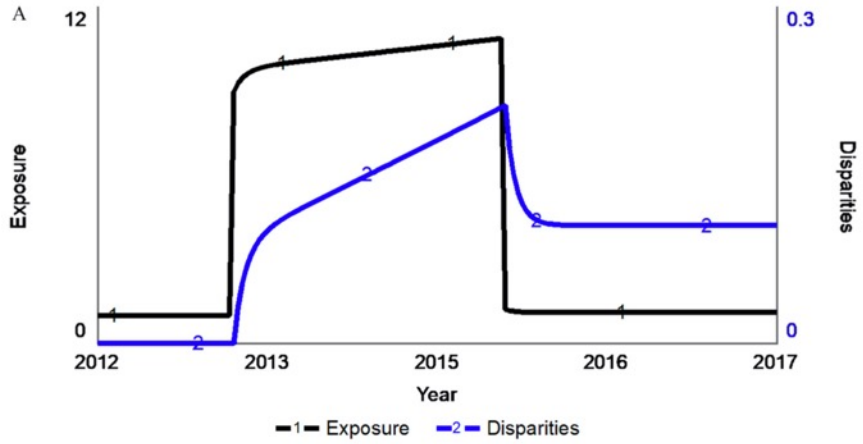
System dynamics is the use of informal maps and *formal models with computer simulation* to uncover and understand endogenous sources of system behavior (Richardson, 2011)

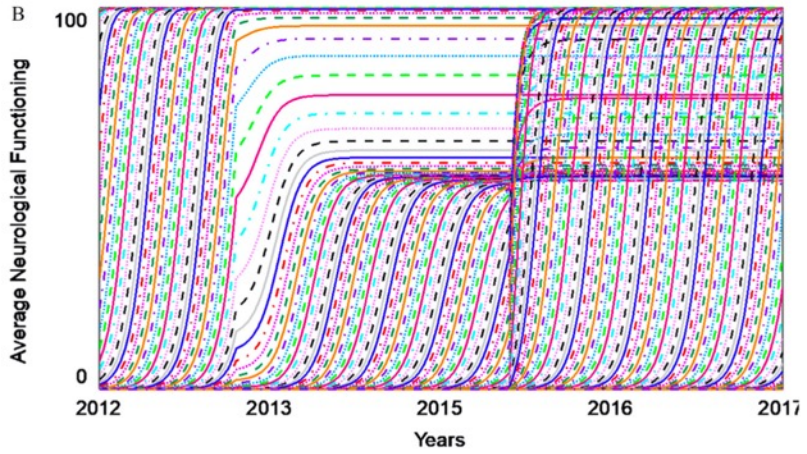


Richardson, G.P. (2011). Reflections on the foundations of system dynamics. System Dynamics Review, 27(3), 219-243.

Formal simulation model of discrimination, cumulative risk from environmental exposures, and disparities in children's cognitive development

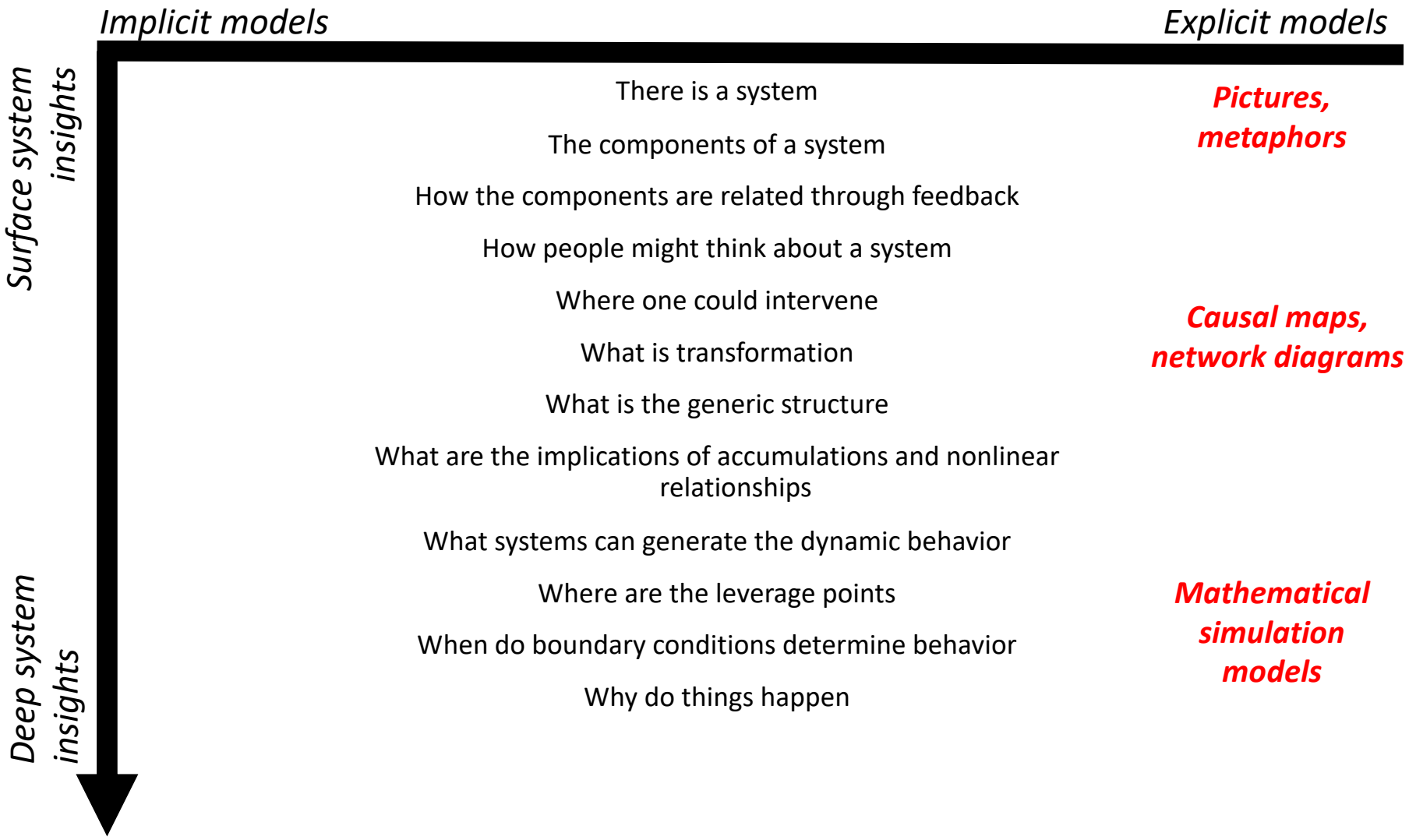




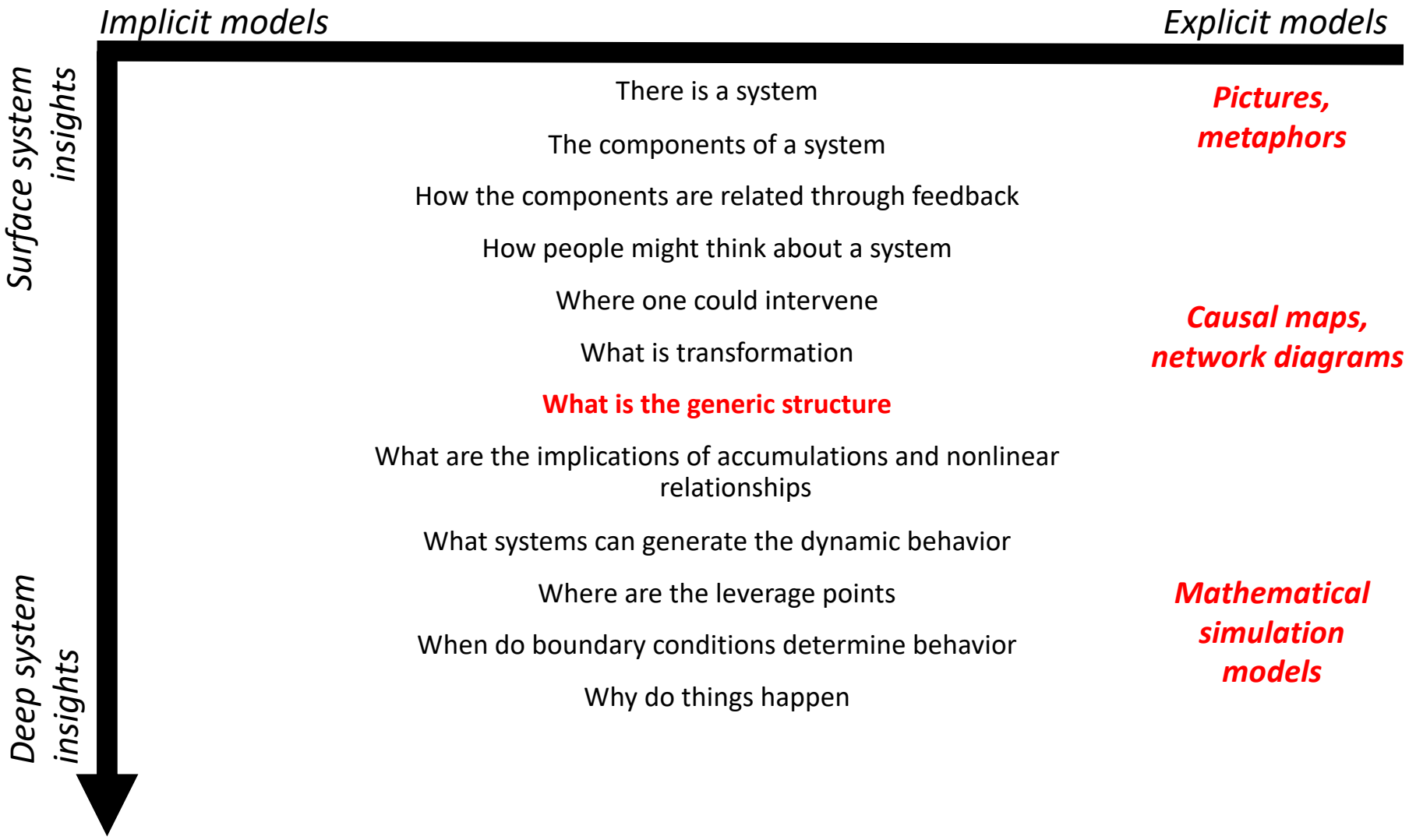


Payne-Sturges, D. C., Cory-Slechta, D. A., Puett, R. C., Thomas, S. B., Hammond, R., & Hovmand, P. S. (2021). Defining and Intervening on Cumulative Environmental Neurodevelopmental Risks: Introducing a Complex Systems Approach. *Environmental Health Perspectives, 129*(3), 35001. doi:10.1289/EHP7333

Levels of system insight

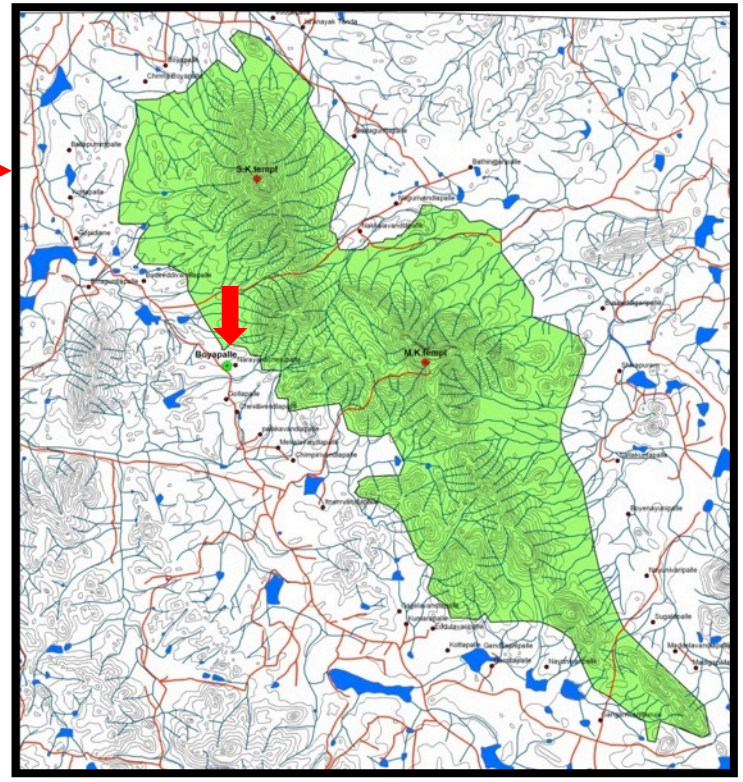


Levels of system insight



Community Based System Dynamics

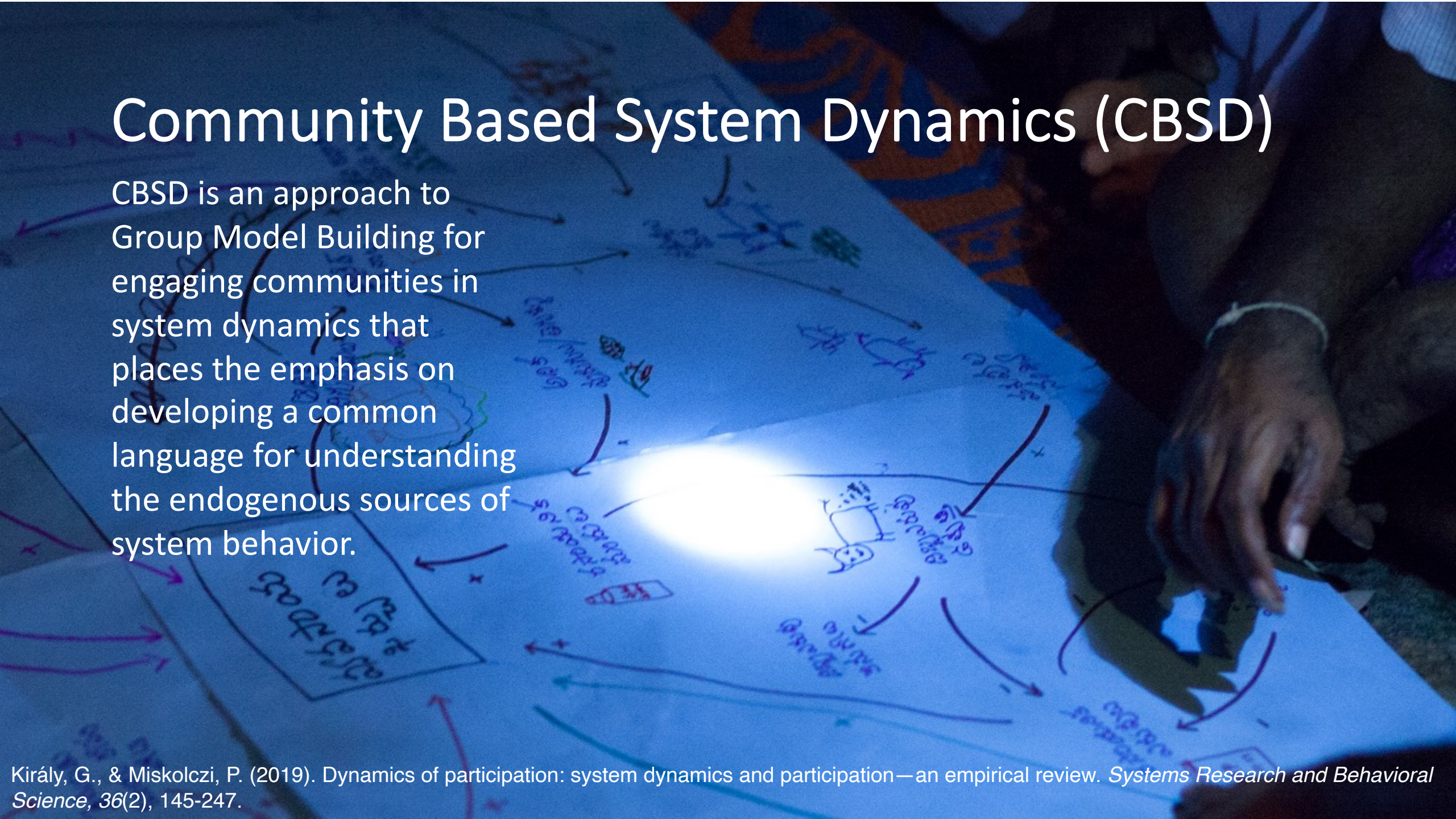
Diversity of local contexts



In collaboration with Foundation for Ecological Security, India and Gautam Yadama (Boston College)

Community Based System Dynamics (CBSD)

CBSD is an approach to Group Model Building for engaging communities in system dynamics that places the emphasis on developing a common language for understanding the endogenous sources of system behavior.



Király, G., & Miskolczi, P. (2019). Dynamics of participation: system dynamics and participation—an empirical review. *Systems Research and Behavioral Science, 36*(2), 145-247.

Scriptapedia (https://en.wikibooks.org/wiki/Scriptapedia)

Systems Research and Behavioral Science
Syst. Res. **29**, 179–193 (2012)
Published online in Wiley Online Library
(wileyonlinelibrary.com) **DOI**: 10.1002/sres.2105

■ *Research Paper*

Group Model-Building 'Scripts' as a Collaborative Planning Tool

Peter S. Hovmand[1]*, David F. Andersen[2], Etiënne Rouwette[3], George P. Richardson[2], Krista Rux[1] and Annaliese Calhoun[1]

[1] *Washington University in St. Louis, Washington, MO, USA*
[2] *University at Albany, State University of New York, USA*
[3] *Radboud University Nijmegen, Nijmegen, The Netherlands*

Group model building (GMB) is a participatory method for involving stakeholders in the process of developing system dynamics models. GMB has historically consisted of undocumented structured small-group exercises. This paper describes an effort to document GMB scripts called Scriptapedia, and how documented GMB scripts can be used to design more effective GMB sessions that address cultural and ideological barriers to collaboration. A case study of a project to develop a coordinated community response to domestic violence is used to illustrate the use of scripts for planning collaboration. The paper concludes with a discussion of potential limitations of scripts and implications for future research. Copyright © 2012 John Wiley & Sons, Ltd.

Keywords group model building; scripts; participatory system modelling; system dynamics

INTRODUCTION

Developing effective collaborations often entails identifying and aligning the incentives specific to a given problem (Barrett, 2007). This can be especially challenging in dynamically complex systems where the incentives evolve over time. People typically invoke a set of mental models (e.g. Johnson-Laird, 1983; Doyle and Ford, 1998) to solve problems that consistently underestimate the effects of delays, accumulations, nonlinear relationships and the interaction of feedback mechanisms (Dörner, 1997; Sterman, 2000). Formal models[1] help stakeholders improve their mental models by seeing and simulating the behavior of a system better. This allows stakeholders to develop collaborations by gaining system insights into a problem through the development and analysis of a common model.[2]

There are a variety of approaches for developing and simulating formal models of complex systems (for an overview, see Pidd, 1998; Gilbert and

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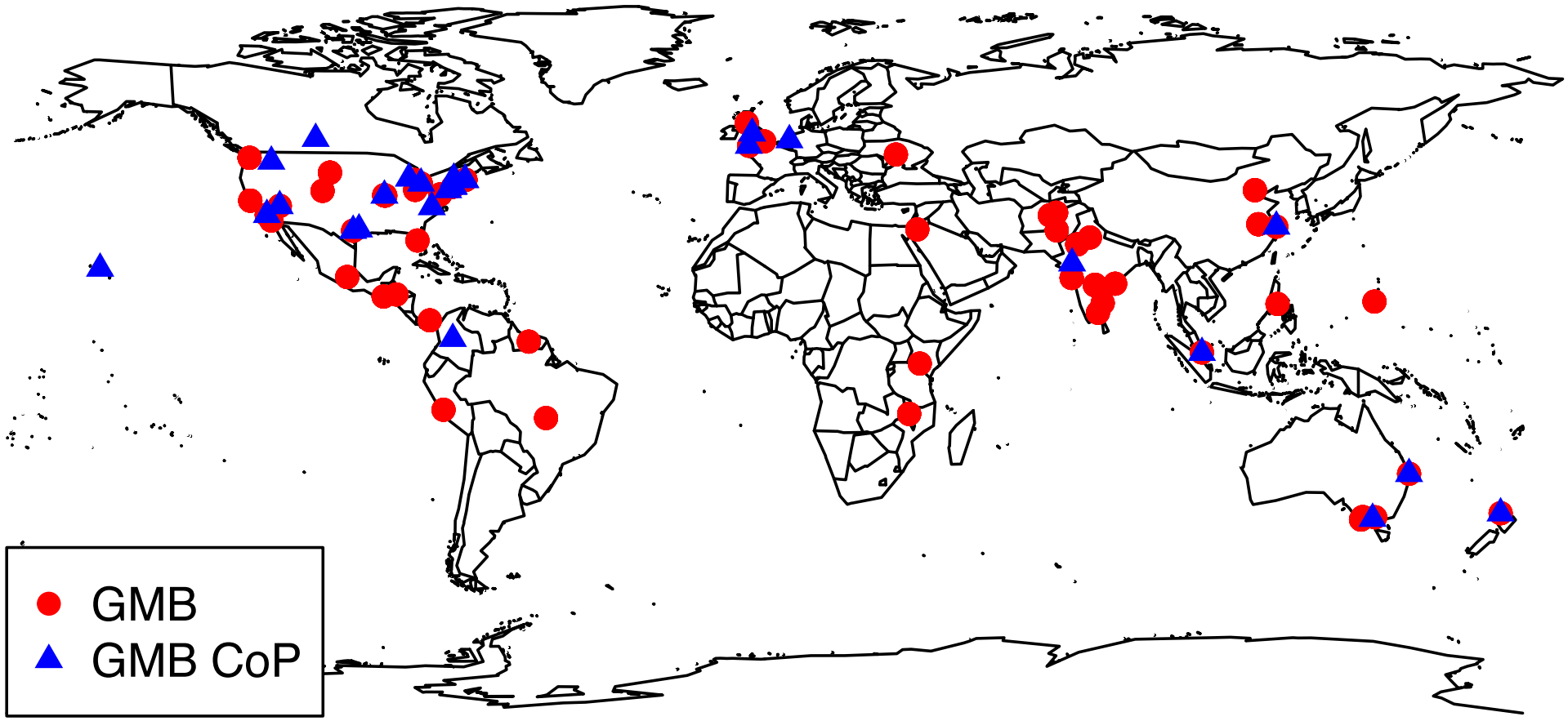
E-mail: phovmand@wustl.edu

[1] Examples of formal models that allow stakeholders to see and simulate a system include discrete event simulation models, agent-based models and system dynamics models.
[2] A model is 'common' in the sense that it is objectively and independently *available* to all stakeholders. This does not imply that all stakeholders endorse a common model.

Spread of GMB/CBSD and communities of practice

Topics:

Addiction and recovery
Climate change
Domestic violence
Emotional support
Energy insecurity
Environmental health
Family planning
Food security
Foster care
Gun violence
Health access
Housing
Inclusive education
Maternal mortality
Mental health
Neonatal mortality
Obesity
Overdose deaths
Sexual assault
Smoking
Stigma
Suicidal ideation
Undernutrition



Insights on generic structures

Similar underlying generic structures across contexts (mental health)

Trani *et al. Conflict and Health* (2016) 10:25
DOI 10.1186/s13031-016-0089-2

Conflict and Health

RESEARCH Open Access

Community based system dynamic as an approach for understanding and acting on messy problems: a case study for global mental health intervention in Afghanistan

Jean-Francois Trani[1*], Ellis Ballard[1], Parul Bakhshi[2] and Peter Hovmand[1]

Abstract

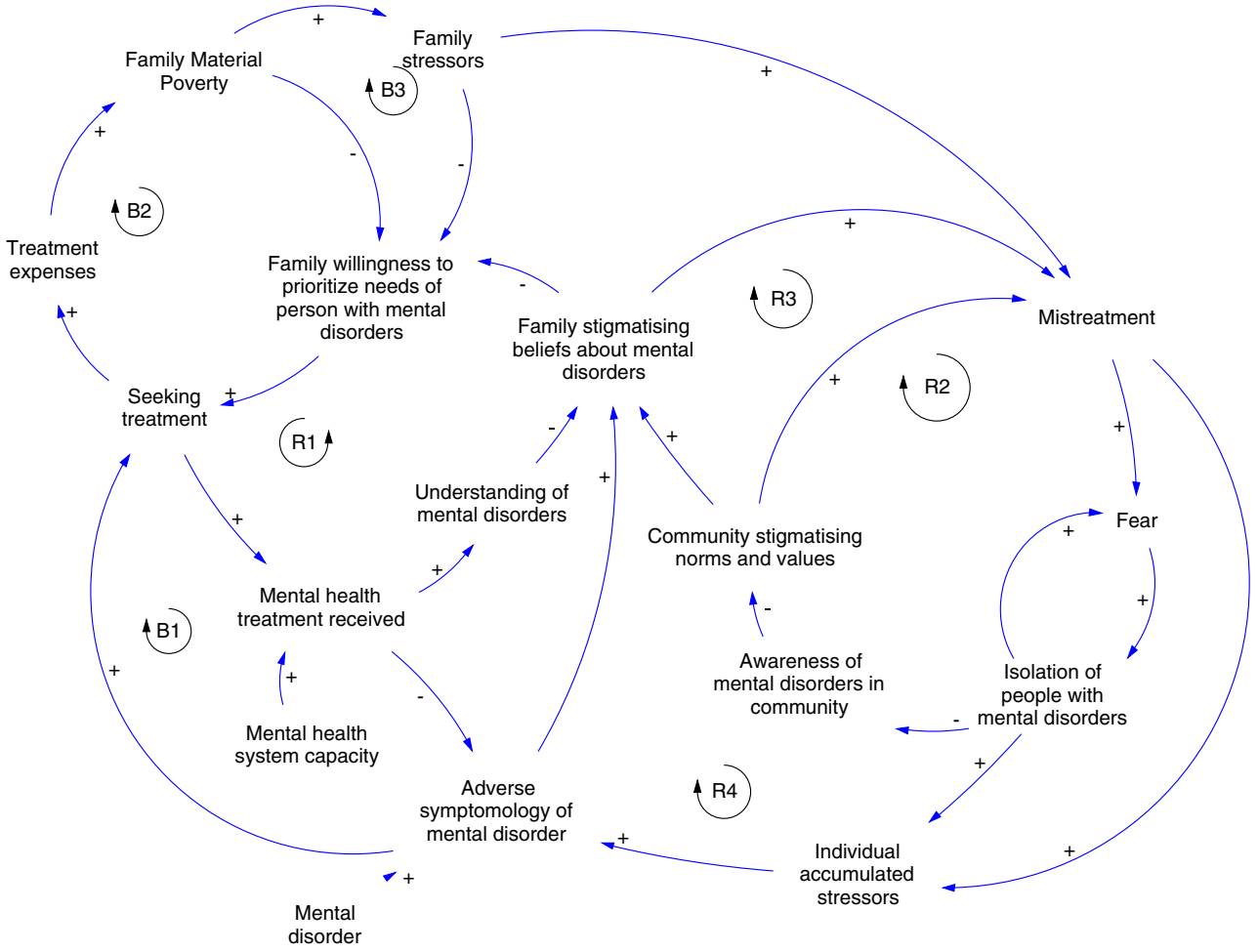
Background: Afghanistan lacks suitable specialized mental healthcare services despite high prevalence of severe mental health disorders which are aggravated by the conflict and numerous daily stressors. Recent studies have shown that Afghans with mental illness are not only deprived of care but are vulnerable in many other ways. Innovative participatory approaches to the design of mental healthcare policies and programs are needed in such challenging context.

Methods: We employed community based system dynamics to examine interactions between multiple factors and actors to examine the problem of persistently low service utilization for people with mental illness. Group model building sessions, designed based on a series of scripts and led by three facilitators, took place with NGO staff members in Mazar-I-Sharif in July 2014 and in Kabul in February 2015.

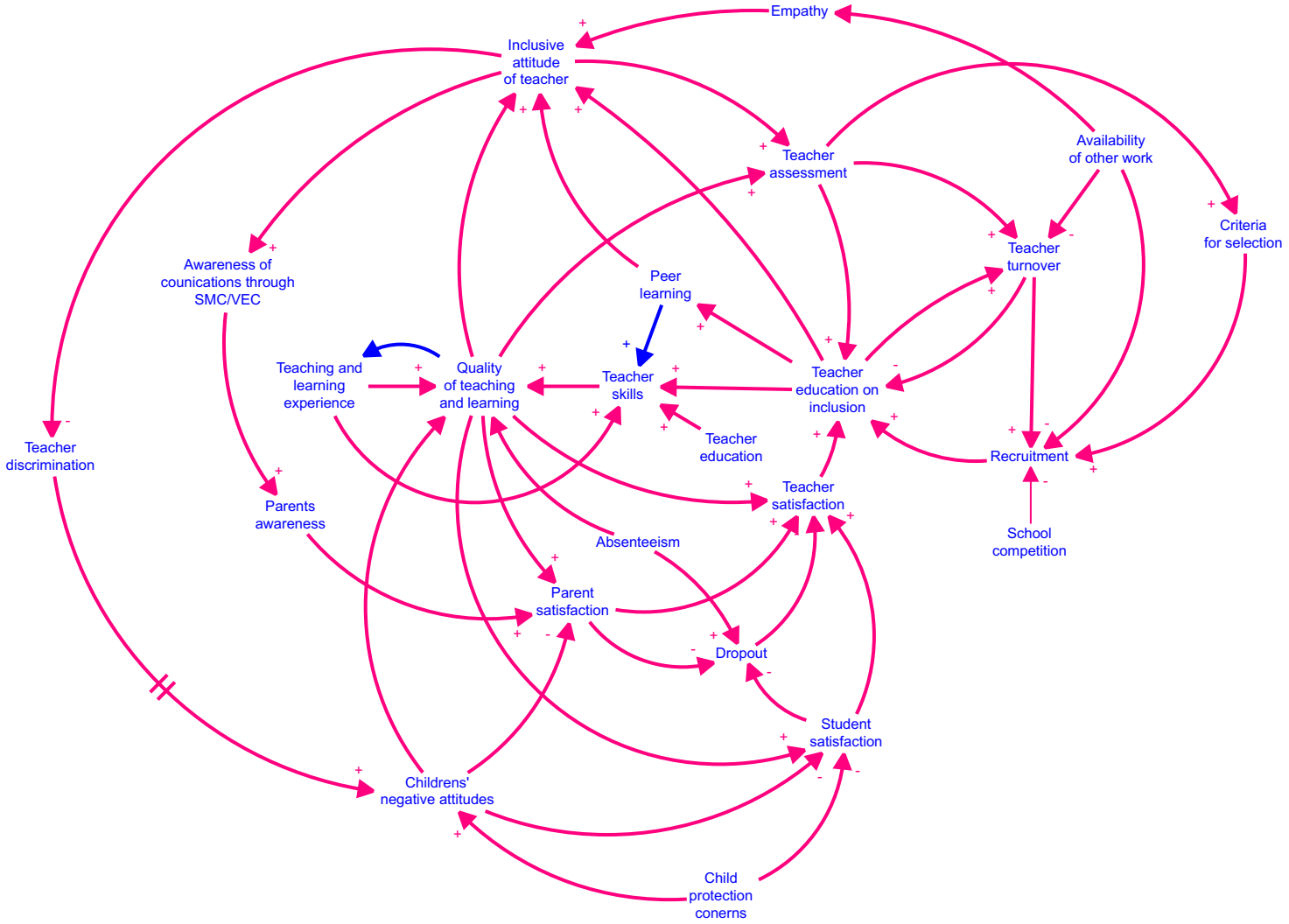
Results: We identified major feedback loops that constitute a hypothesis of how system components interact to generate a persistently low rate of service utilization by people with mental illness. In particular, we found that the interaction of the combined burdens of poverty and cost of treatment interact with cultural and social stigmatizing beliefs, in the context of limited clinical or other treatment support, to perpetuate low access to care for people with mental disorders. These findings indicate that the introduction of mental healthcare services alone will not be sufficient to meaningfully improve the condition of individuals with mental illness if community stigma and poverty are not addressed concurrently.

Conclusions: Our model highlights important factors that prevent persons with mental illness from accessing services. Our study demonstrates that group model building methods using community based system dynamics can provide an effective tool to elicit a common vision on a complex problem and identify shared potential strategies for intervention in a development and global health context. Its strength and originality is the leadership role played by the actors embedded within the system in describing the complex problem and suggesting interventions.

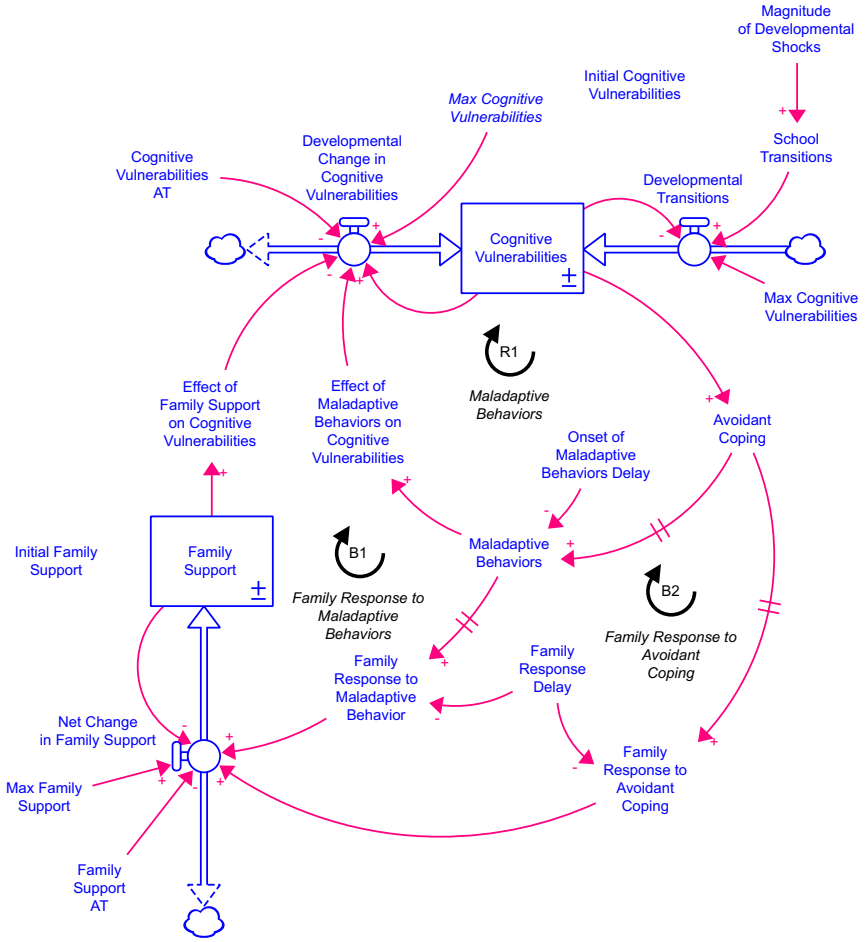
Keywords: Afghanistan, Causal loop diagram, Community based system dynamics, Complex problems, Development intervention, Mental health



Similar underlying generic structures across contexts (inclusive education)

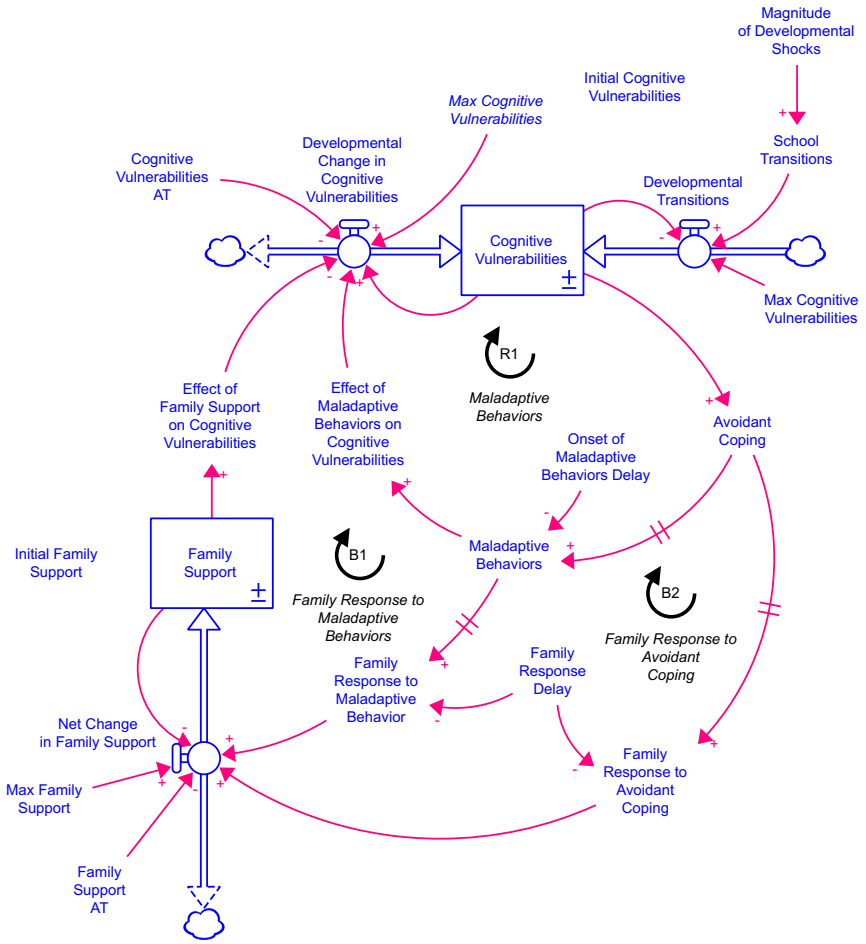


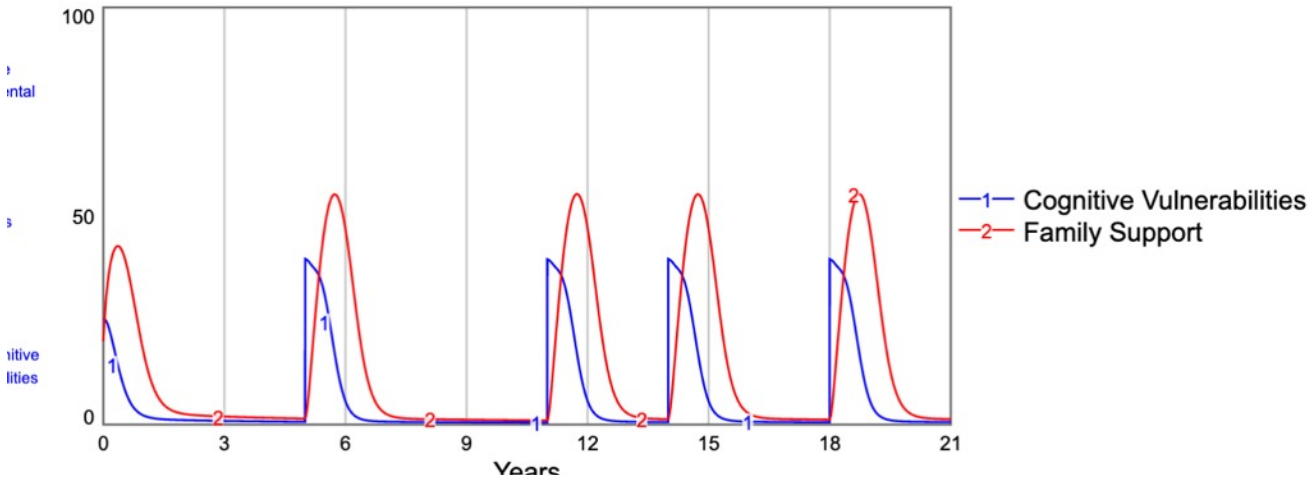
Developing novel hypotheses to identify underlying systems



Dynamics of Cognitive Vulnerabilities and Family Support Among Latinx Children and Adolescents (version 2-2-9, online interface) in collaboration with Esther Calzada, Lauren Gulbas, Su Yeon Kim, Saras Chung, Jill Kuhlberg, Carolina Hausmann-Stabile and Luis H. Zayas

Developing novel hypotheses to identify underlying systems





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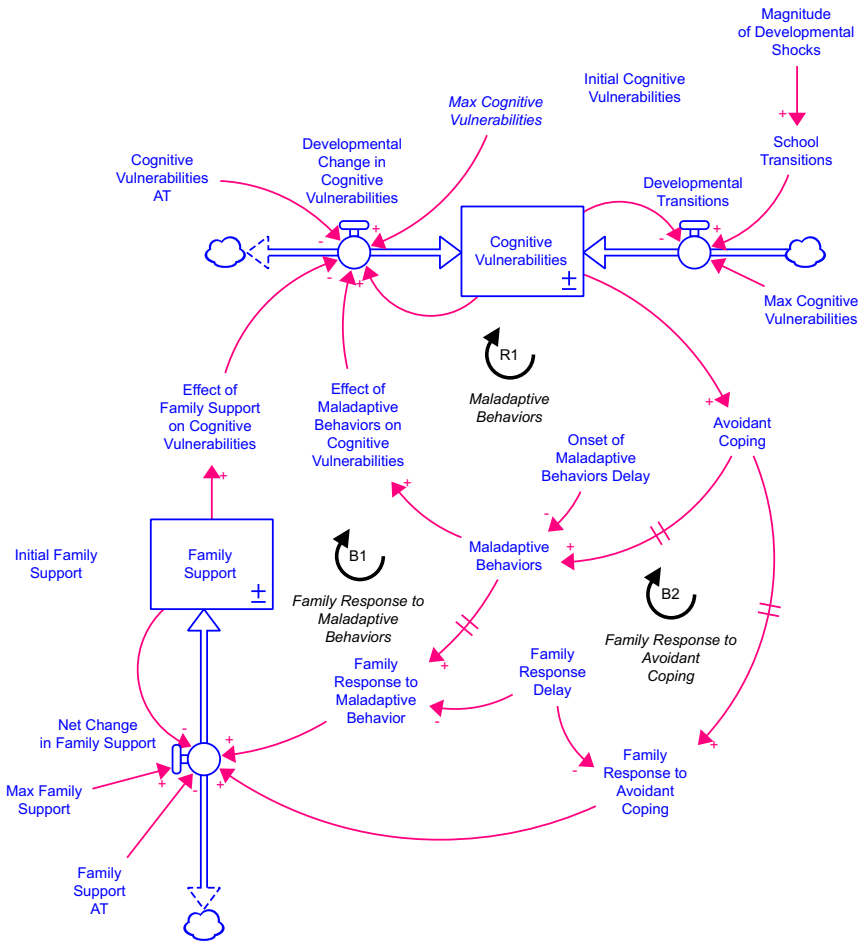
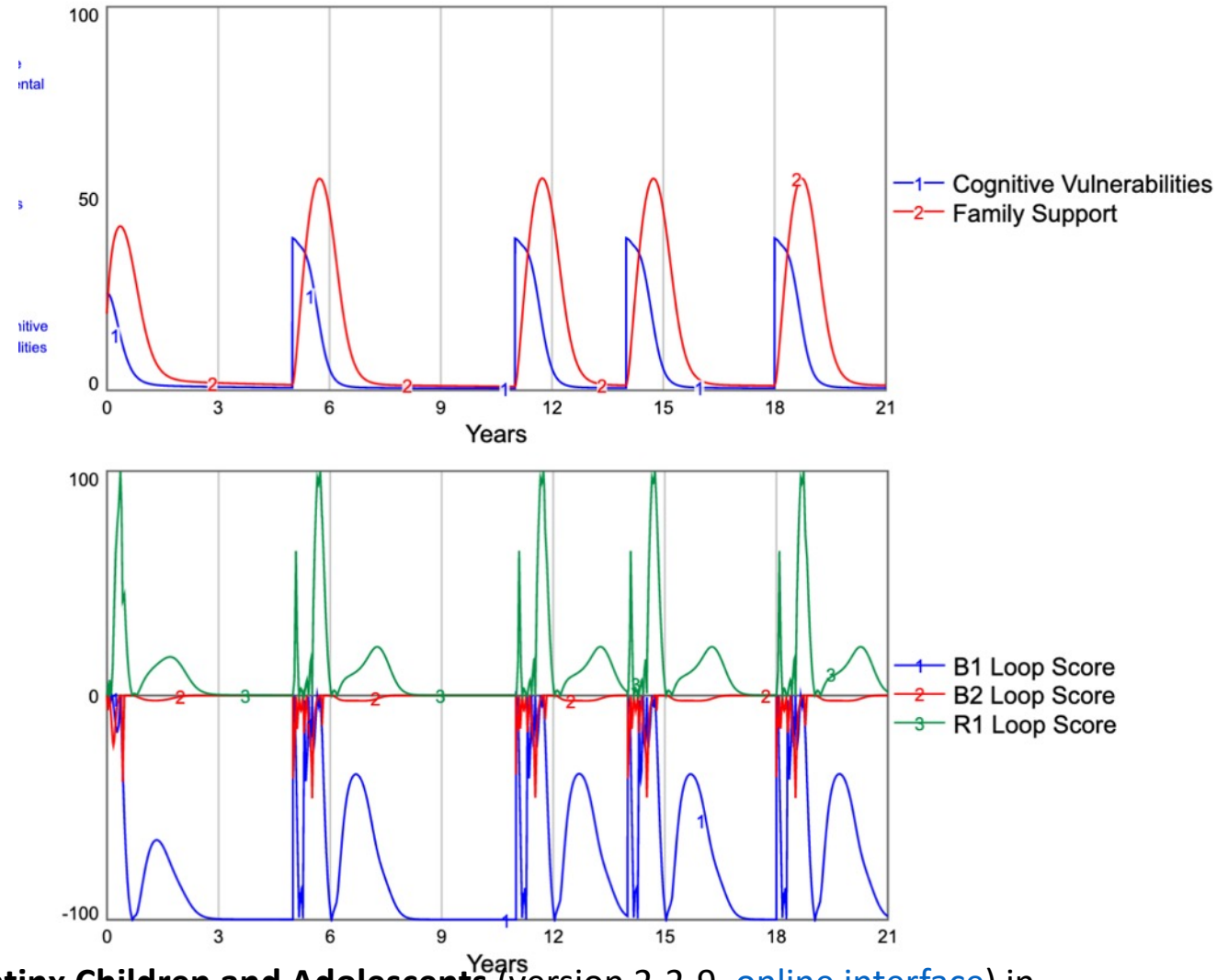




Dynamics of Cognitive Vulnerabilities and Family Support Among Latinx Children and Adolescents (version 2-2-9, online interface) in collaboration with Esther Calzada, Lauren Gulbas, Su Yeon Kim, Saras Chung, Jill Kuhlberg, Carolina Hausmann-Stabile and Luis H. Zayas

Opportunities for research and action

Initial core modeling team for the Cross-Sector Innovations Initiative (CSII) project

Greg Brown, PolicyBridge

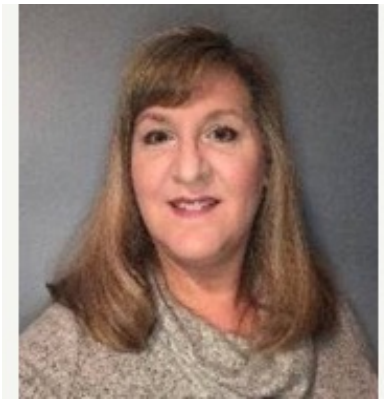
Delores Collins, A Vision of Change

Robin Gotler, Case Western Reserve University

Andrea Lyons, United Way

Angela Newman-White, Cuyahoga County Board of Health

Kurt Stange, Case Western Reserve University

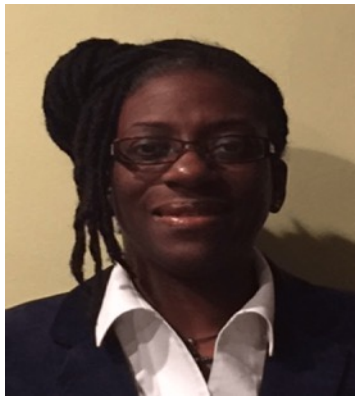


Martha Halko, Cuyahoga County Board of Health

Patricia Terstenyak, Center for Health Affairs

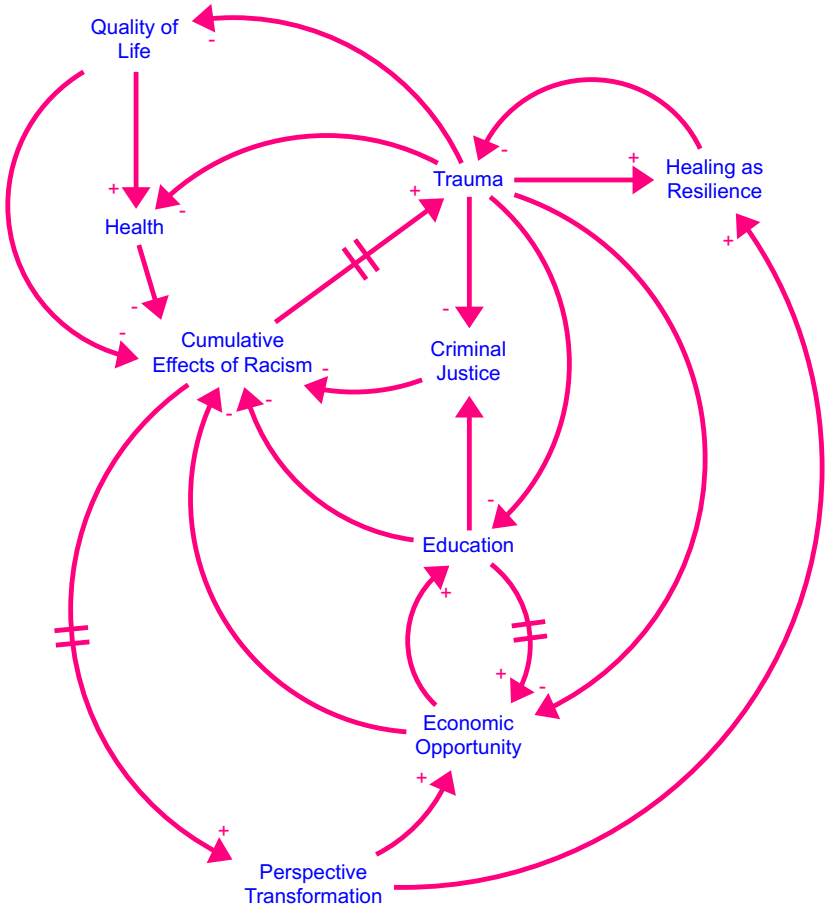
Heidi Gullett, Case Western Reserve University

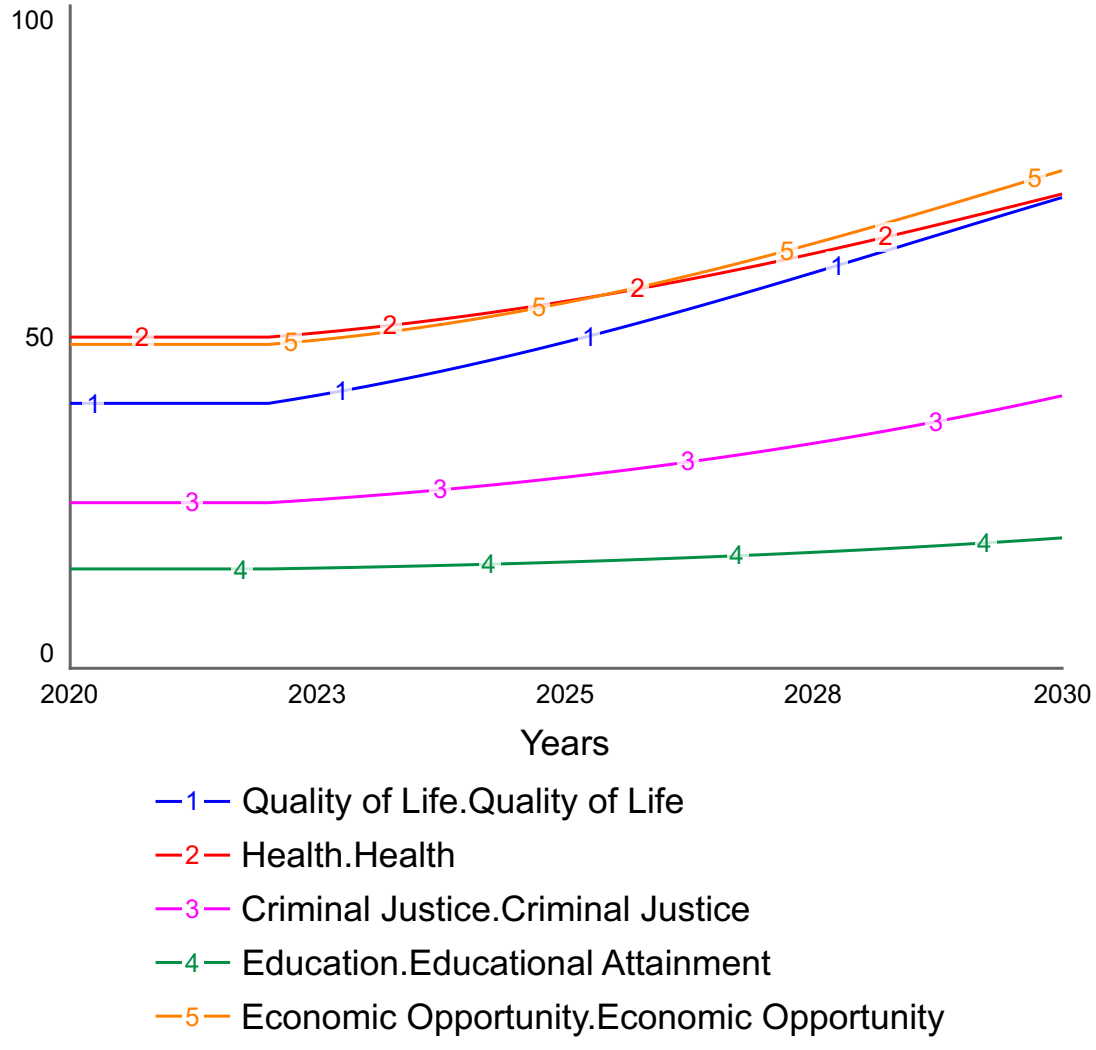
Peter Hovmand, Case Western Reserve University



Nichelle Shaw, Cuyahoga County Board of Health

Systems Change for Racial Equity (SCORE) Model Prototype (August 9, 2021, online interface)





HIP CUYAHOGA Health Improvement Partnership

Fogarty International Center Implementation Science Network (ISN) on clean cooking implementation

Rosenthal, J., Arku, R. E., Baumgartner, J., Brown, J., Clasen, T., Eisenberg, J. N. S., . . . Yadama, G. N. (2020). Systems Science Approaches for Global Environmental Health Research: Enhancing Intervention Design and Implementation for Household Air Pollution (HAP) and Water, Sanitation, and Hygiene (WASH) Programs. *Environmental Health Perspectives, 128*(10), 105001. doi:doi:10.1289/EHP7010

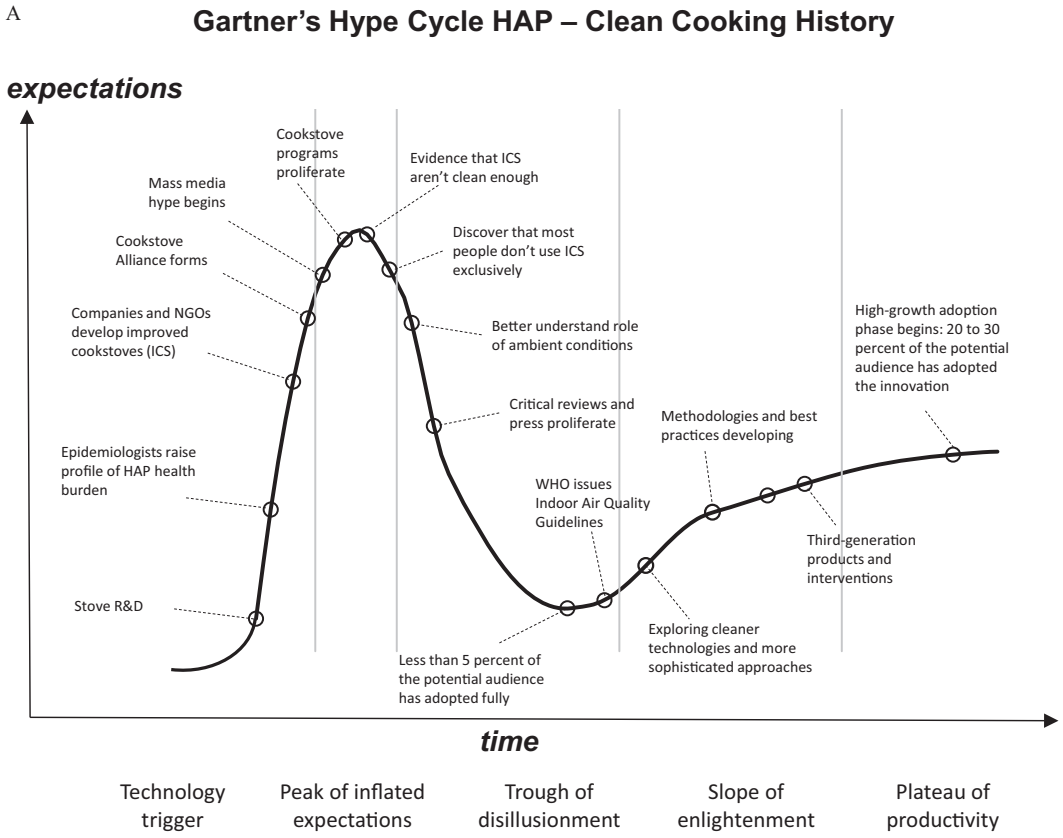
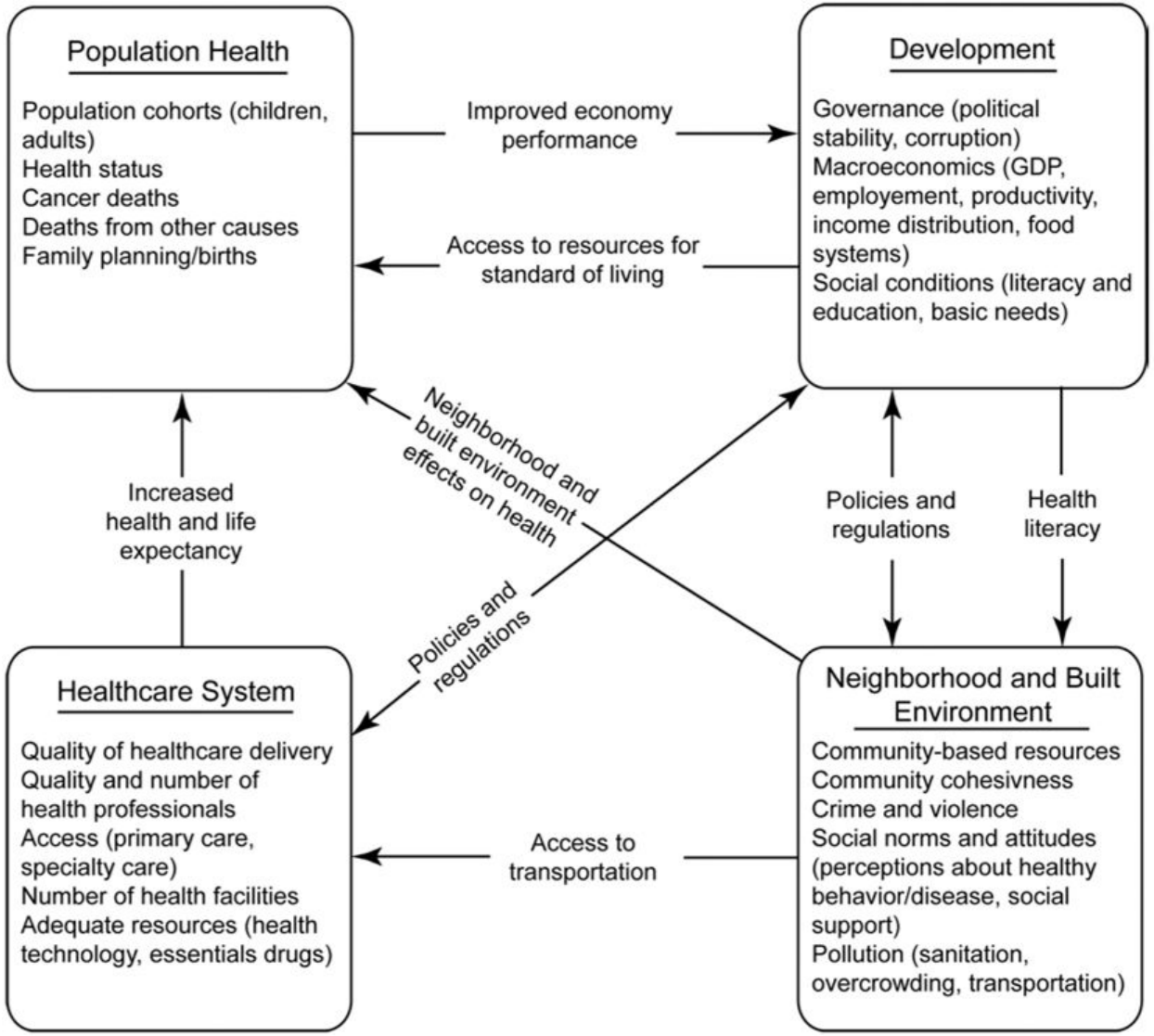


Figure 1. (A) Household air pollution (HAP)—clean cookstove history mapped onto Gartner's Hype Cycle (adapted from Fenn and Raskino 2008). (B) Water, sanitation, and hygiene (WASH)—point-of-use water treatment history mapped onto Gartner's Hype Cycle (adapted from Fenn and Raskino 2008). Note: HWTS, household water treatment and safe storage; NGO, nongovernmental organization; R&D, research and development; WHO, World Health Organization.

NCI: Global cancer disparities

Williams, F., Zoellner, N., & Hovmand, P. S. (2016). Understanding global cancer disparities: The role of social determinants from a system dynamics perspective. *Transdisciplinary Journal of Engineering and Science, 6*, 11-23.




Thank you!!
Questions?
psh39@case.edu