REARRANGING THE DECK CHAIRS ON THE TITANIC

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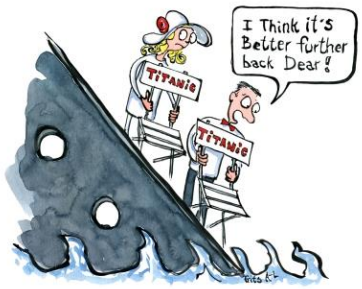
https://github.com/jpain3/Rearranging-the-Deck-Chairs

Problem Articulation



Frits Ahlefeldt – "The Hiking Artist"

Martha's Vineyard Museum

zeenews.india.com

egypttoday.com

The phrase "Rearranging the deck chairs on the Titanic is typically used metaphorically in the sense of "**to occupy oneself with some trivial activity while ignoring something much more important.**"

During an actively unfolding crisis, the ability to identify activities as 'trivial' versus essential can be unclear, and some activities could actively *prevent* a crisis or even recover from it.

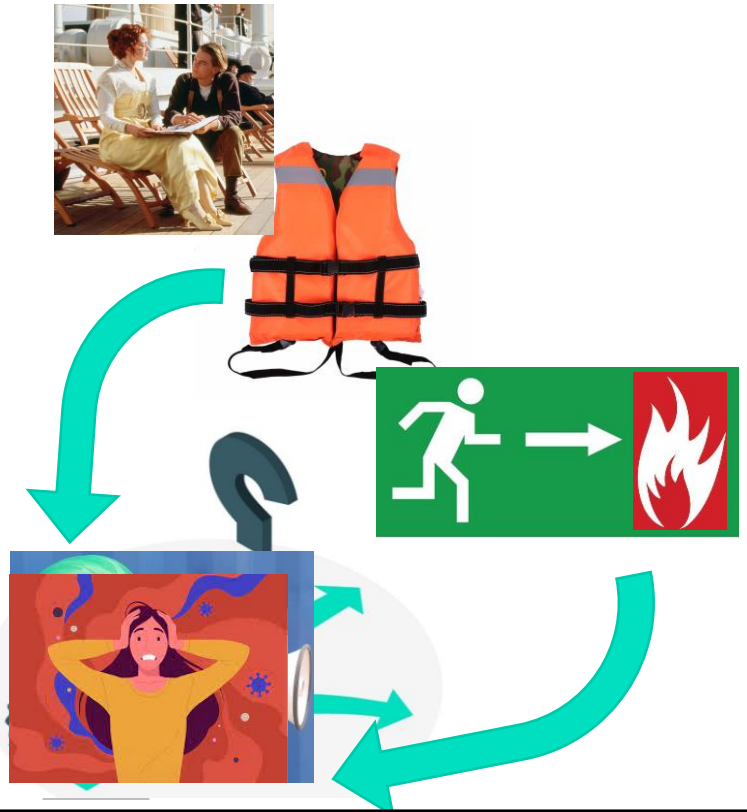
Aside from prevention and mitigation, people can also evacuate from a crisis.

But not necessarily successfully.

Under what circumstances could "rearranging the deck chairs" or any possibly preventative activity during a crisis have been helpful in reducing deaths?

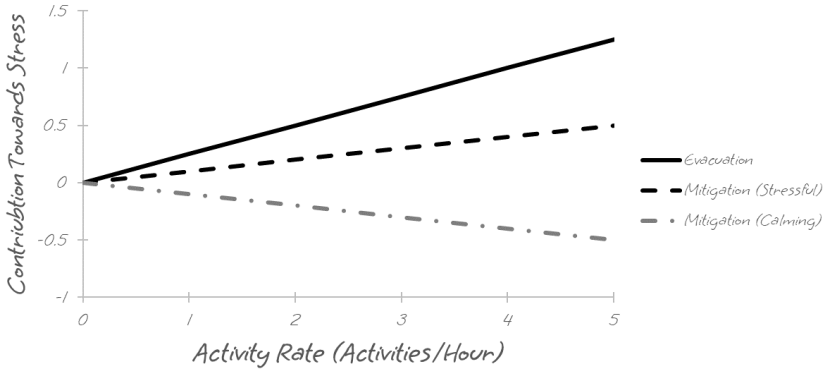
How can the actions of the people during an evolving and crisis materially affect the both the physical and behavioral dynamics of the crisis, and how do you balance those actions with the immediate value of fleeing?

Dynamic Hypothesis



- An exogenous event kicks off a crisis that actively erodes a system's ability to support life. If a critical lower threshold is passed, it will spell doom for those still exposed to danger.
- Those in this eroding system have three options with their limited time:
  1. Do nothing
  2. Work to mitigate the crisis, possibly buying time
     (or even preventing or reversing further degradation of the situation)
  3. Flee (evacuate)
- Fleeing has the immediate effect of removing people from harm...
  - Though it may be inefficient, resulting in more harm than good
- Concentrating effort on one path reduces effort available for the others
- **Concern for Safety** is a function perception of the current capability to resist the crisis, and also perception of activities around each person. Evacuation is stressful, while mitigation actives are less so (or even calming)
  - Low levels of concern will increase efficacy of evacuation efforts
  - High levels of concern lead to panic and less efficacious evacuation

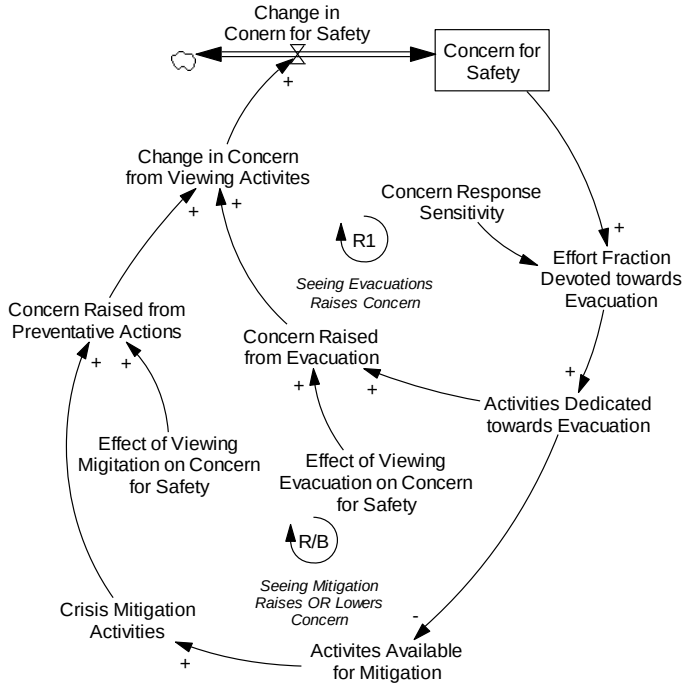
Reference Modes



Key Variables, Stocks and Flows

Variable	Units	Category
Concern for Safety	Dmnl	*Stock*
Capability to Resist Crisis	Dmnl	*Stock*
People exposed to Crisis	People	*Stock*
Evacuated (Survived)	People/Hour	Flow
Evacuated (Died)	People/Hour	Flow

Capturing Effect of Activities on Stress (Concern for Safety)



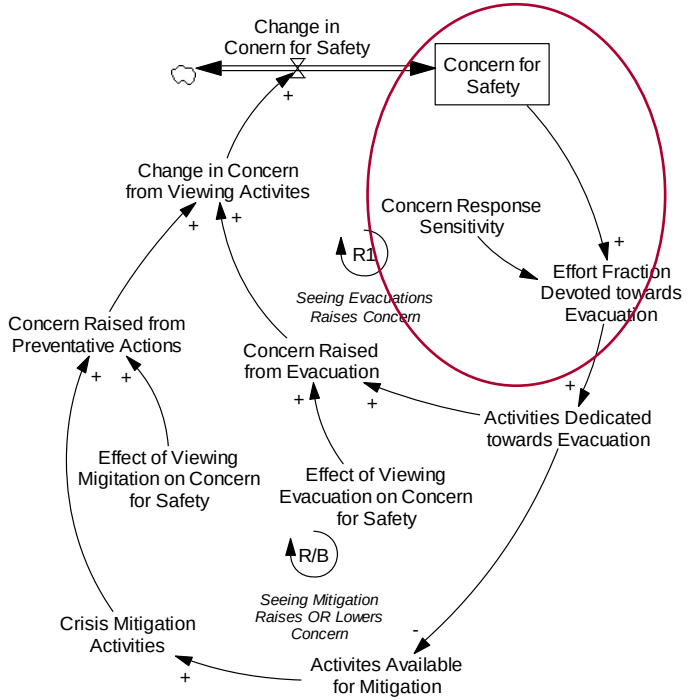
Concern for Safety

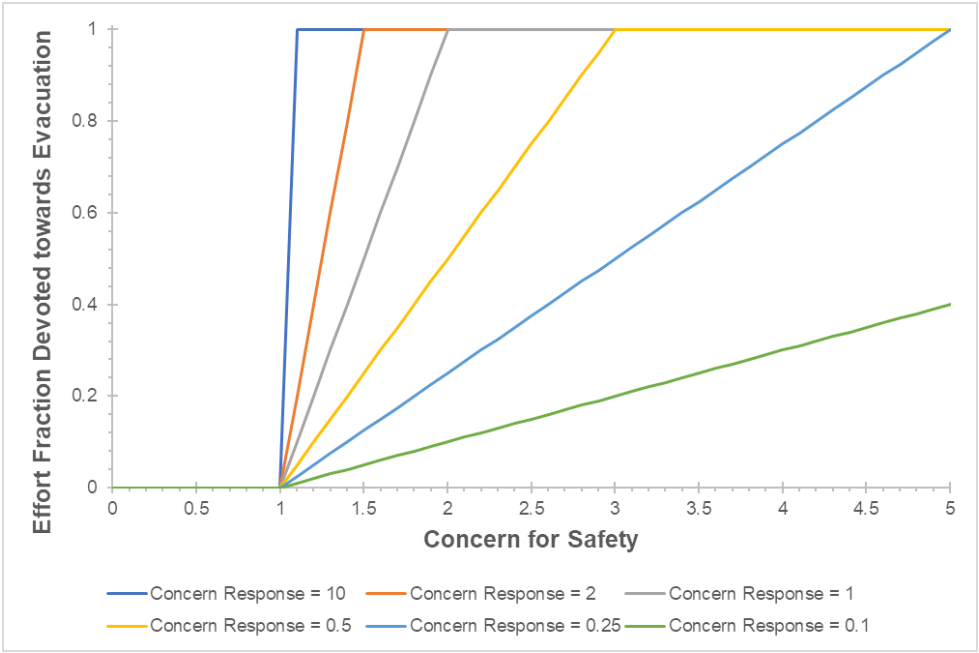
- Increases as crisis develops and fraction of time left begins to drop
- Affected by perception of crisis mitigation activities going one
- Assume that seeing evacuations will only drive up concern

Polarity of Loop through Mitigation Efforts can be Reinforcing OR Balancing

- **Reinforcing if sign on Effect is (+)**
- **Balancing if sign on Effect is (-)**
  - E.g. ‘calming’ to see mitigation happening during crisis

Capturing Effect of Activities on Stress (Concern for Safety)





Capturing Effect of Stress on Performance

Disaster Dynamics: Understanding the Role of Quantity in Organizational Collapse

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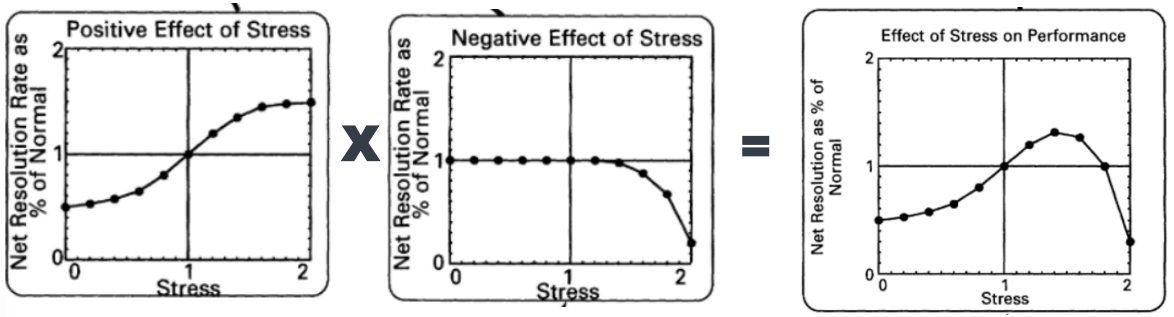
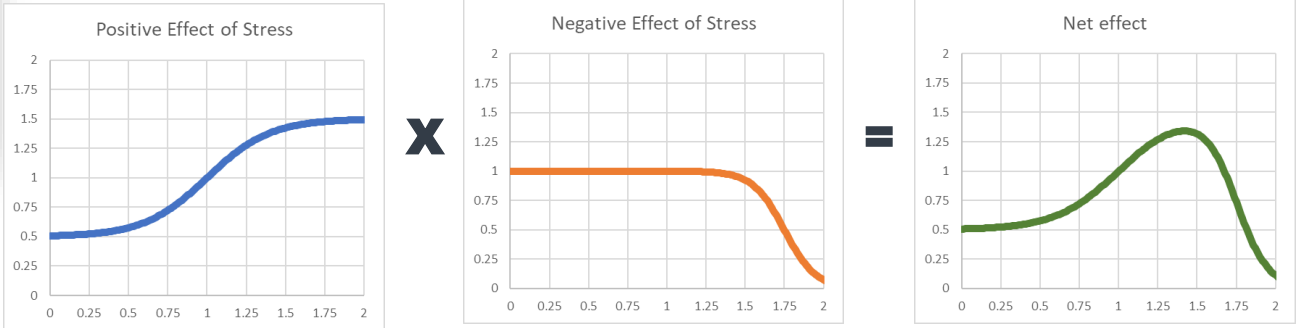
Nelson P. Repenning
Massachusetts Institute of Technology

This article examines the role that the quantity of non-novel events plays in precipitating disaster through the development of a formal (mathematical) system-dynamics model. Building on existing case studies of disaster, we develop a general theory of how an organizational system responds to an on-going stream of non-novel interruptions to existing plans and procedures. We show how an overaccumulation of interruptions can shift an organizational system from a resilient, self-regulating regime, which offsets the effects of this accumulation, to a fragile, self-escalating regime that amplifies them. We offer a new characterization of the conditions under which organizations may be prone to major disasters caused by an accumulation of minor interruptions. Our analysis provides both theoretical insights into the causes of organizational crises and practical suggestions for those charged with preventing them.•

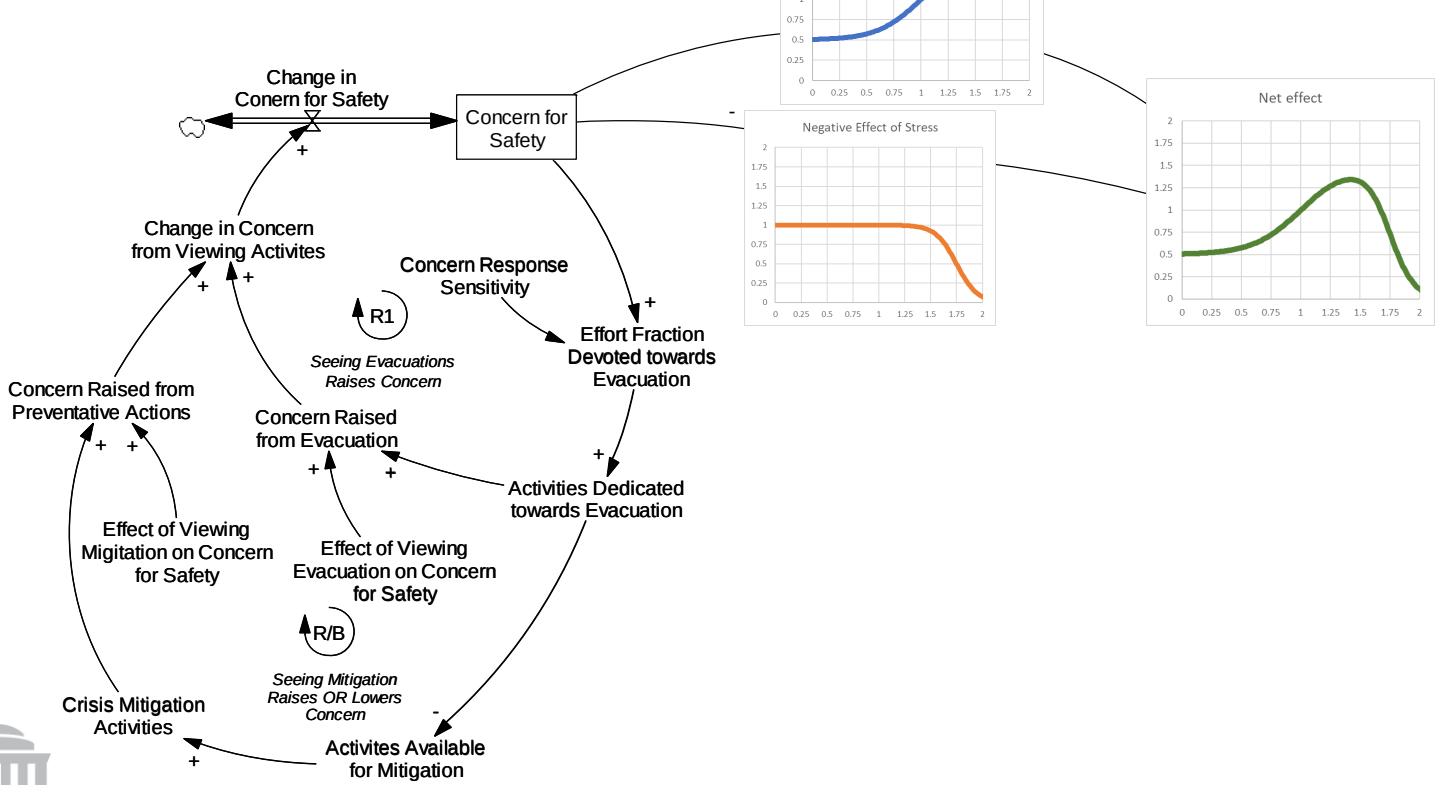
Major disasters have long interested organization theorists (Perrow, 1984; Shrivastava, 1987; Weick, 1993b; Vaughan, 1996), and their causes continue to be an active area of inquiry. Accidents like the nuclear catastrophe at Chernobyl or Union Carbide's gas leak at Bhopal are major social events responsible for immeasurable human suffering and environmental damage. There are few more compelling opportunities for organization theory specifically, and the social sciences in general, to prevent suffering and contribute to humanity. Moreover, major disasters provide a unique opportunity to study organizational processes in situations that are far from equilibrium. Just as the designers of bridges and airplanes test their systems under extreme conditions that are rarely, if ever, experienced during actual use, major catastrophes provide a similar opportunity to learn more about the vulnerability and resilience of human and social systems.

The literature on disaster and its flip side, safety, includes in-depth case studies (e.g., Shrivastava, 1987; Weick, 1993b; Vaughan, 1996), studies of learning from accidents and error (e.g., Cook and Woods, 1994; Carroll, 1995), theories of high-hazard or accident-prone organizations (Turner, 1976; Sagan, 1993; Perrow, 1994), theories of high-reliability organizations (Roberts, 1990; Schulman, 1993; Weick, Sutcliffe, and Obstfeld, 1999), and theories of how to manage accident and error (e.g., Reason, 1997). A significant insight emerging from this literature is that major disasters often do not have proportionately large causes. Theorists increasingly recognize

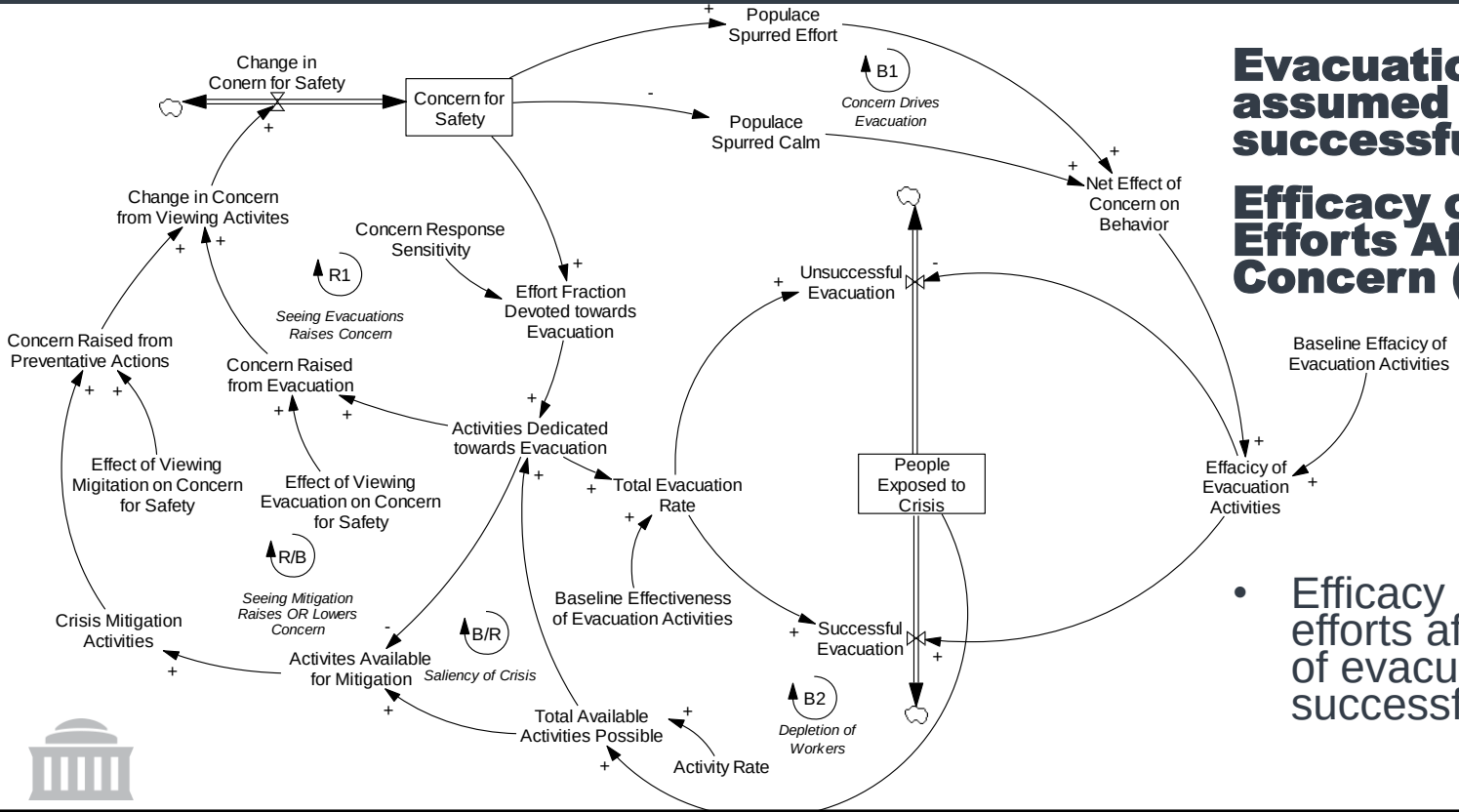




Capturing Effect of Stress on Performance



Evacuation Efficacy is affected by Stress

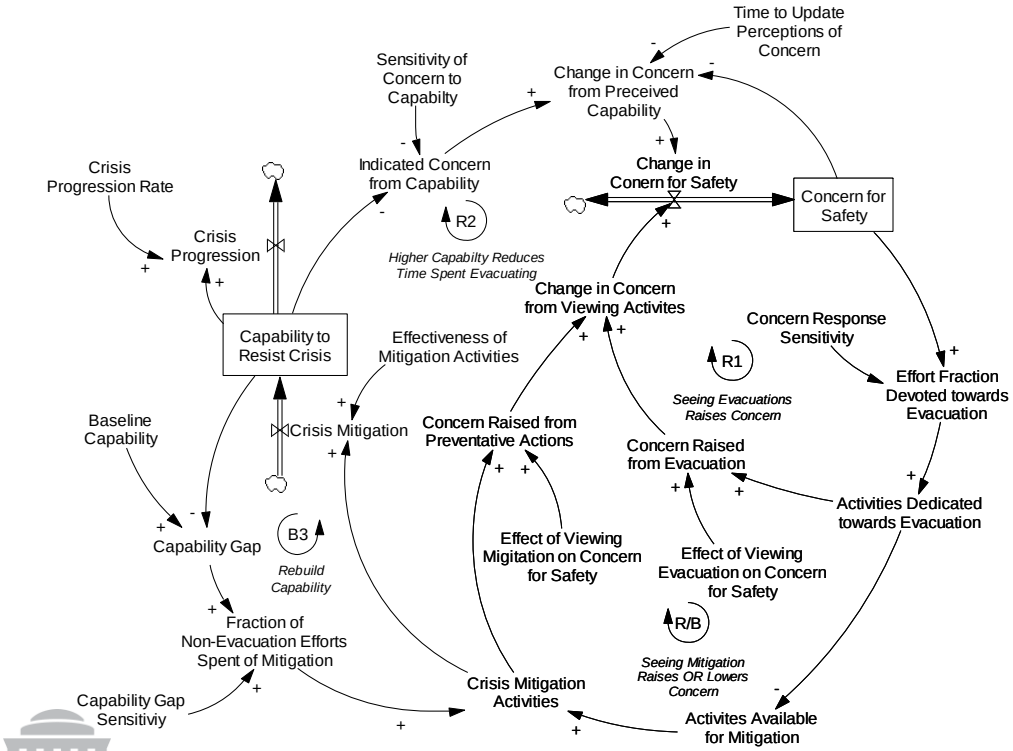


Evacuation is NOT assumed to be successful

Efficacy of Evacuation Efforts Affected by Concern (stress)

- Efficacy of evacuation efforts affects what fraction of evacuations are successful

Capability to Manage (Resist) a Crisis

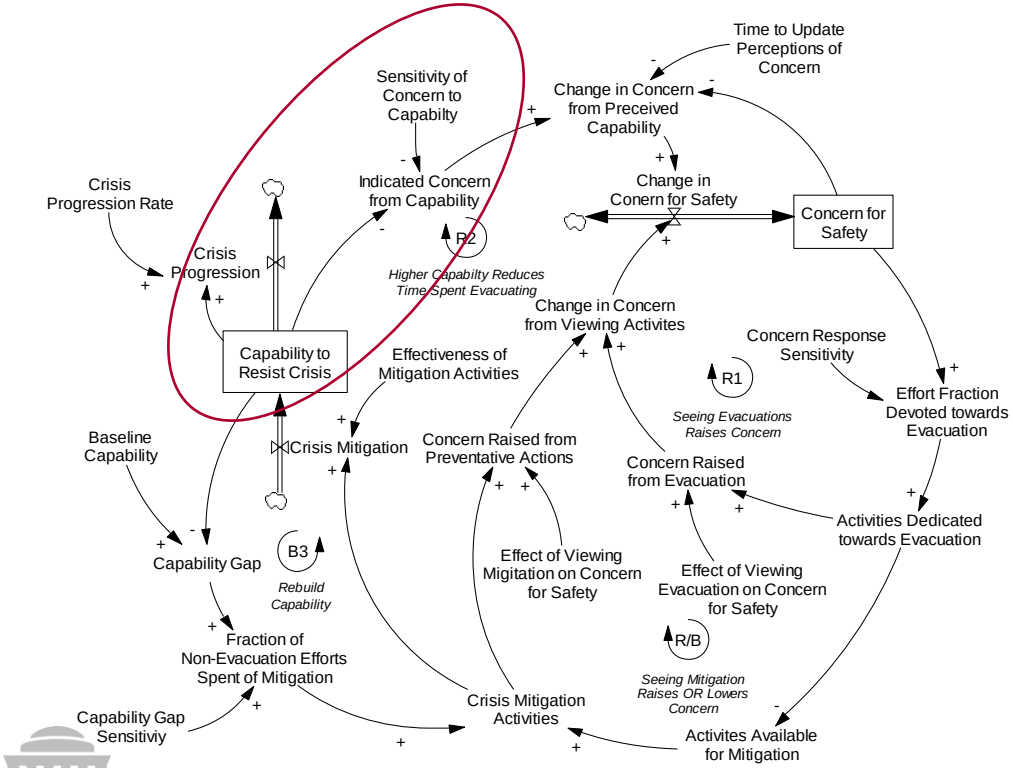


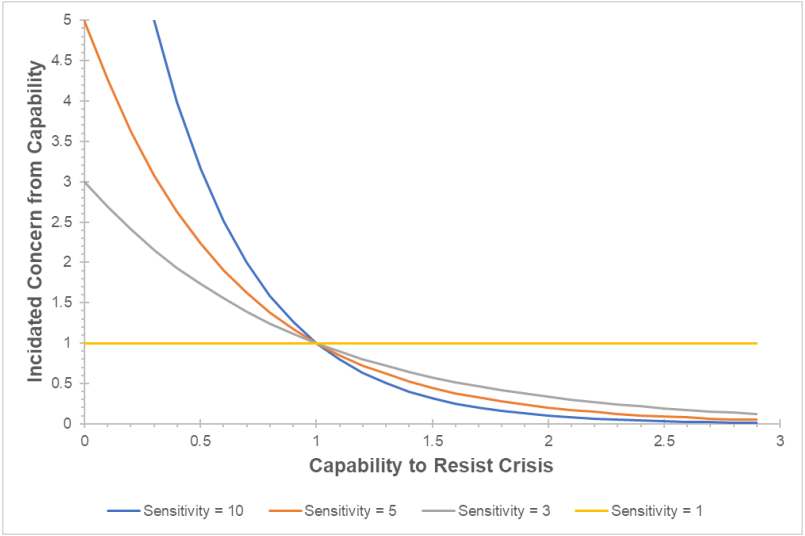
Mitigation Activities Can Improve Capability

- "Rearranging the Deck Chairs" would have low to no build on capability, but some other activities might help!
- Perception of capability to resist crisis affects level of concern and how much idle time is spent in mitigation activities
- Crisis progression erodes capability, but mitigation and rebuild it!

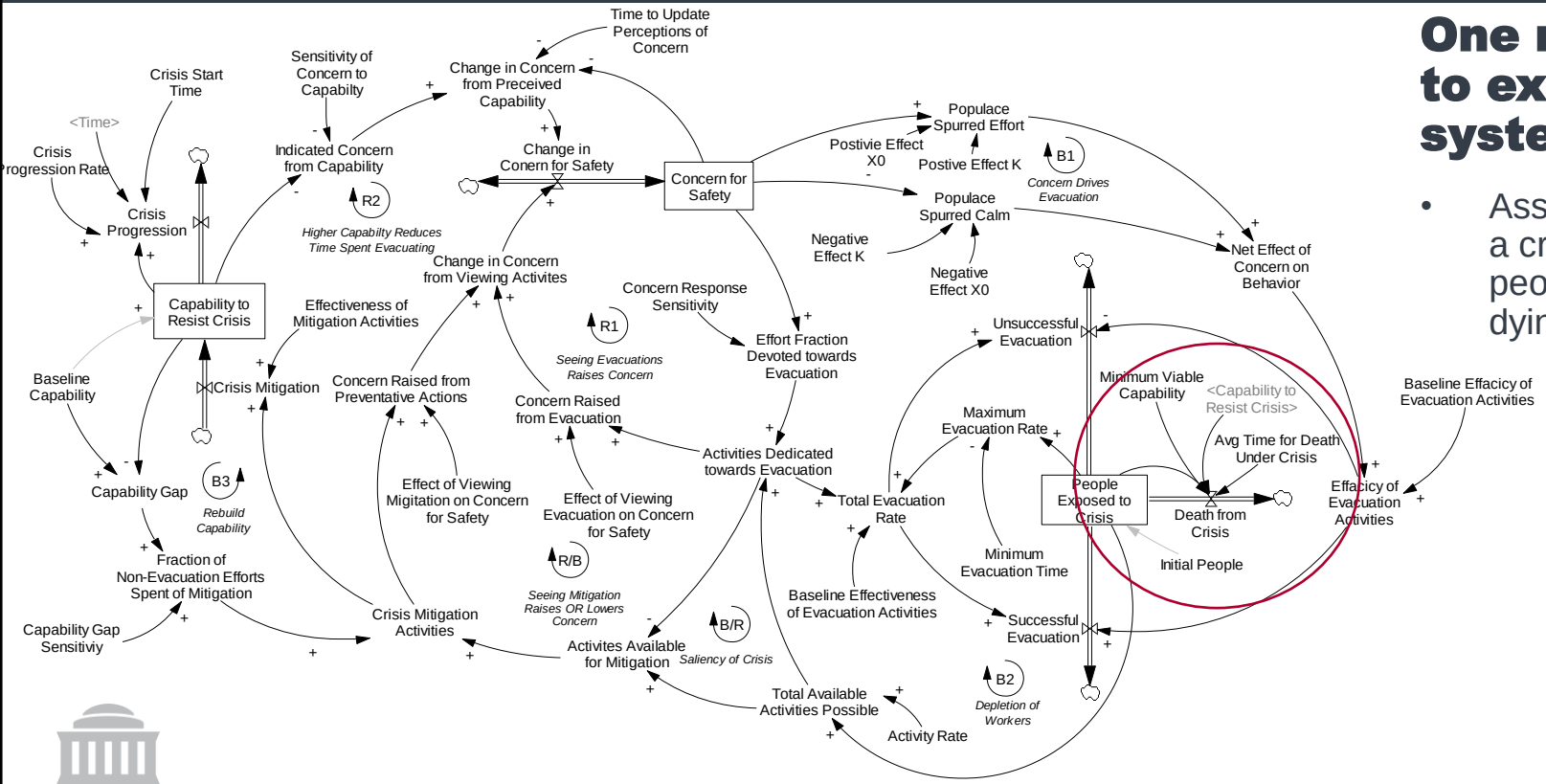
Capability here could also be 'System Capability to Support Life' or even directly operationalized e.g. 'Feet above Waterline' for a ship

Capability under Crisis





Full Combined Model



One more way to exit the system

- Assume that below a critical capability, people start rapidly dying

Exploring Dynamic Behavior

Parameter	Baseline Value	Units
Activity Rate	1	Activities/Person/Hour
Avg Time for Death Under Crisis	1	Hour
Baseline Capability	1	Dmnl
Baseline Efficacy of Evacuation Activities	0.5	Dmnl
Capability Gap Sensitivity	1	Dmnl
Concern Response Sensitivity	0.05	Dmnl
Crisis Progression Rate	0.5	Dmnl/Hour
Crisis Start Time	10	Hour
Effect of Viewing Evacuation on Concern for Safety	0.25	Dmnl/Activity
Effect of Viewing Mitigation on Concern for Safety	0.01	Dmnl/Activity
Effectiveness of Evacuation Activities	1	People/Activity
Effectiveness of Mitigation Activities	0.05	Dmnl/Activity
Initial	100	People
Minimum Evacuation Time	5	Minutes
Minimum Viable Capability	0.01	Dmnl
Negative Effect K	-10	Dmnl
Negative Effect X0	1.75	Dmnl
Positive Effect K	5	Dmnl
Positive Effect X0	1	Dmnl
Sensitivity of Concern to Capability	5	Dmnl
Time to Update Perceptions of Concern	0.5	Hour

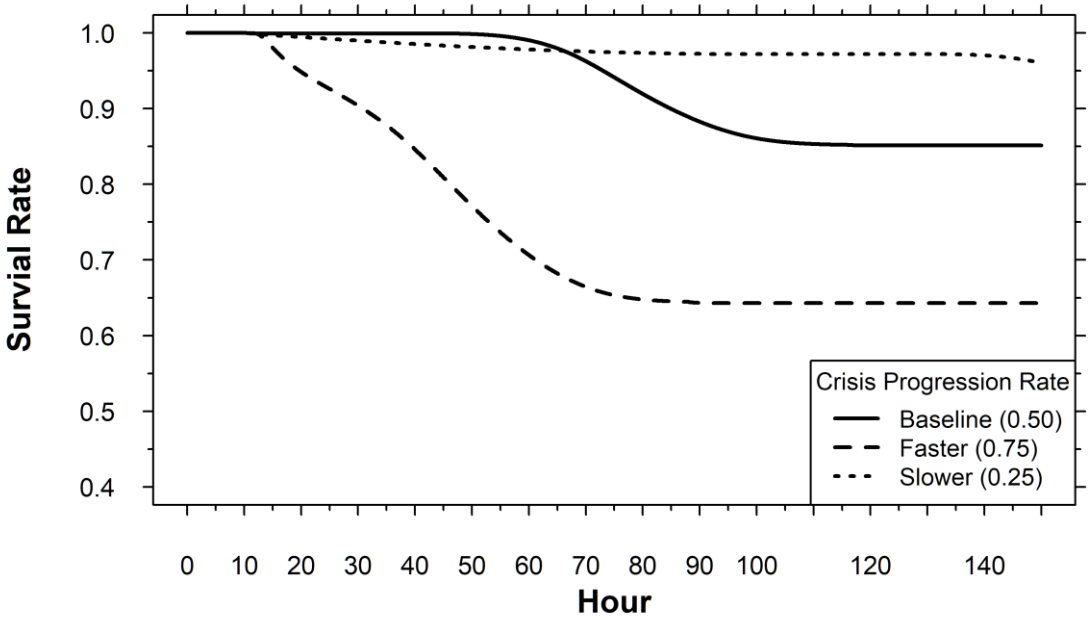
Exploring Dynamic Behavior

Parameter	Baseline Value	Units
Activity Rate	1	Activities/Person/Hour
Avg Time for Death Under Crisis	1	Hour
Baseline Capability	1	Dmnl
Baseline Efficacy of Evacuation Activities	0.5	Dmnl
Capability Gap Sensitivity	1	Dmnl
Concern Response Sensitivity	0.05	Dmnl
Crisis Progression Rate	**0.5**	**Dmnl/Hour**
Crisis Start Time	10	Hour
Effect of Viewing Evacuation on Concern for Safety	0.25	Dmnl/Activity
Effect of Viewing Mitigation on Concern for Safety	**0.01**	**Dmnl/Activity**
Effectiveness of Evacuation Activities	1	People/Activity
Effectiveness of Mitigation Activities	**0.05**	**Dmnl/Activity**
Initial	100	People
Minimum Evacuation Time	5	Minutes
Minimum Viable Capability	0.01	Dmnl
Negative Effect K	-10	Dmnl
Negative Effect X0	1.75	Dmnl
Positive Effect K	5	Dmnl
Positive Effect X0	1	Dmnl
Sensitivity of Concern to Capability	5	Dmnl
Time to Update Perceptions of Concern	0.5	Hour

Parameterized semi-realistically

- Vary intensity of how fast the crisis erodes the system's capability to support life
- Vary how effective mitigation activities are
  - >0 but small (effective but weak)
  - =0 no actual influence on crisis
- Also vary behavioral effect of viewing mitigation activities specifically:
  - >0 (stressing)
  - <0 (calming)

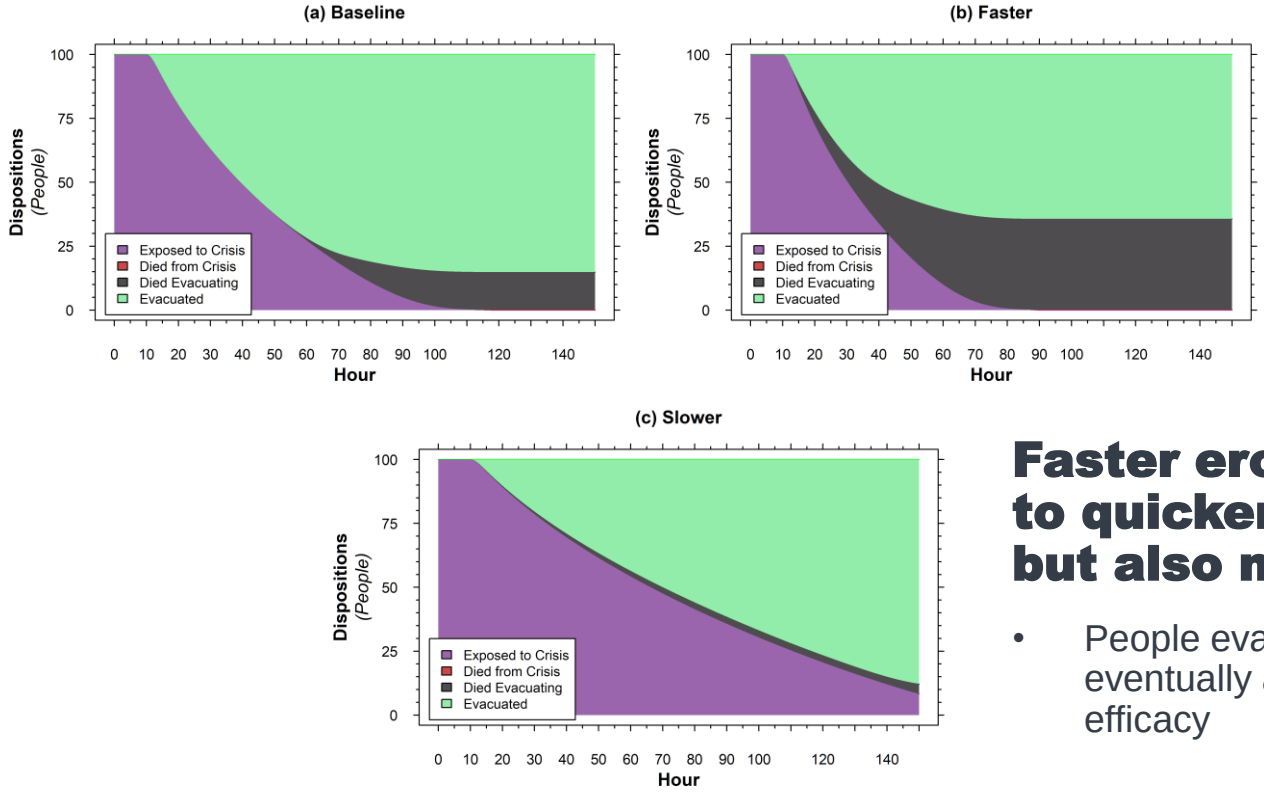
Varying Crisis Progression Rate



Baseline behavior and dynamics is as expected

- Rate at which crisis erodes capability largest driver of survival rate

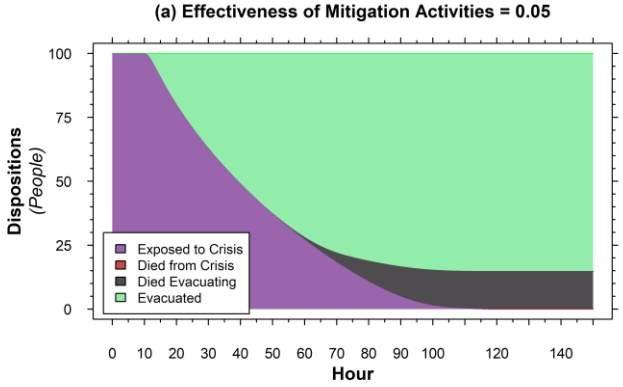
Varying Crisis Progression Rate

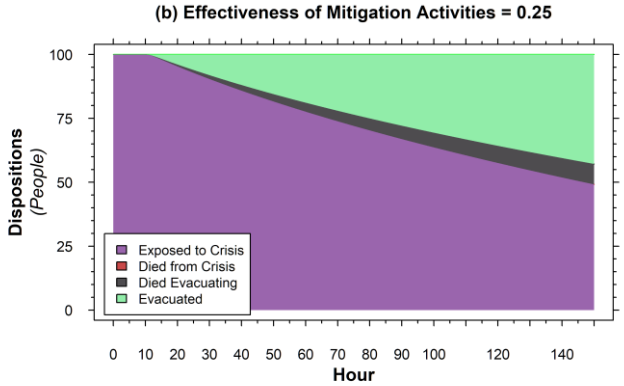


Faster erosion leads to quicker response, but also more stress

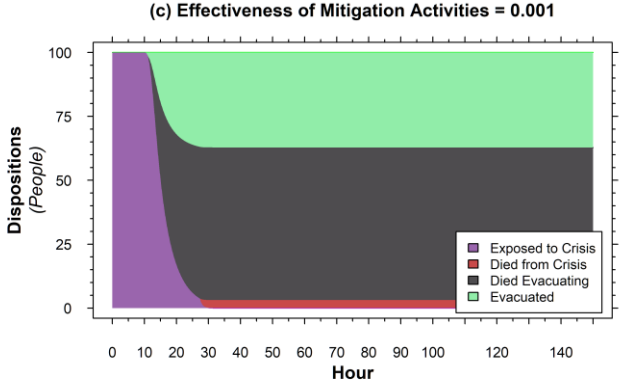
- People evacuate quicker, but eventually at decreasing efficacy

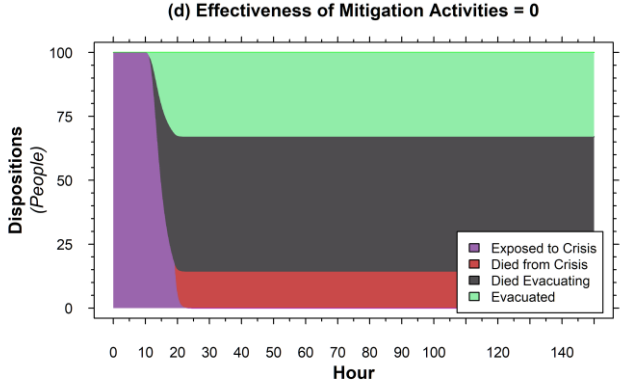
Varying Effectiveness of Mitigation Activities





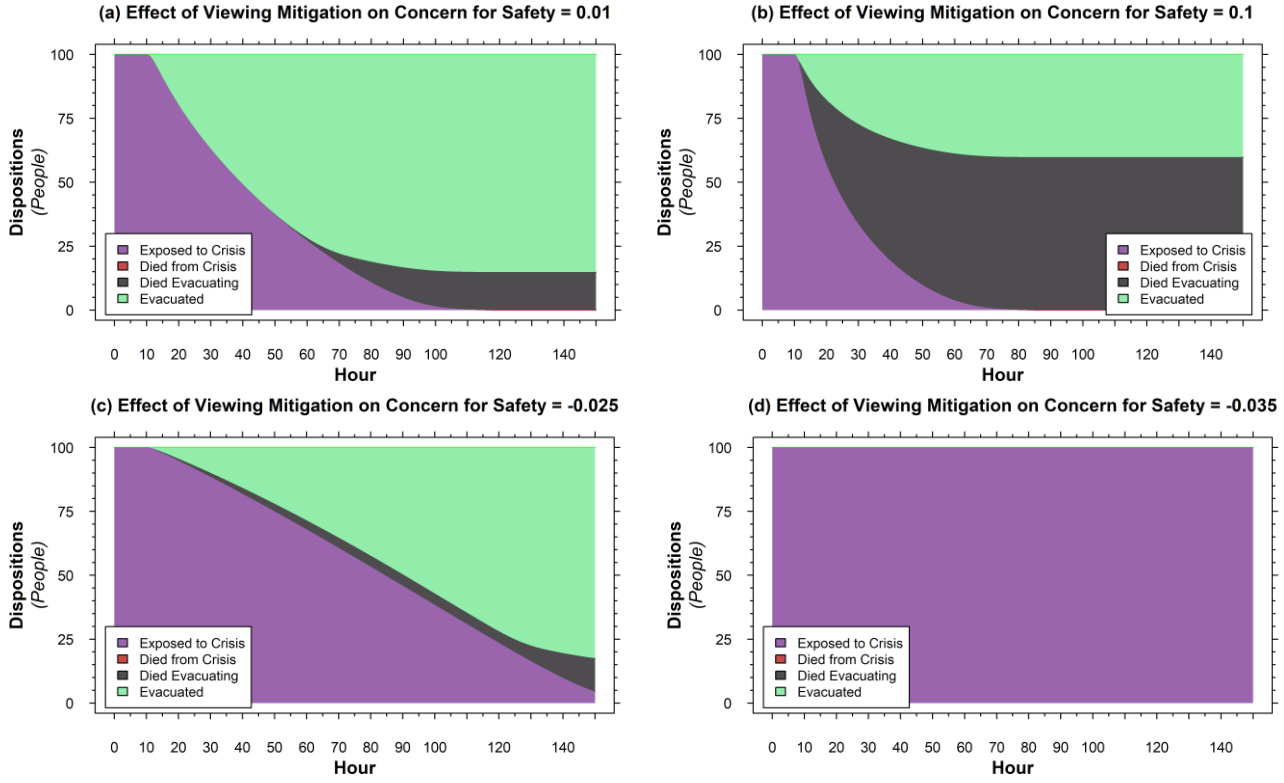
Less Effective Mitigation leads to quicker evacuation but also more deaths





Totally ineffective mitigation leads to significant deaths from the crisis itself

Varying Effect of Viewing Mitigation



More stressful mitigation means faster evacuation, but often less efficacious

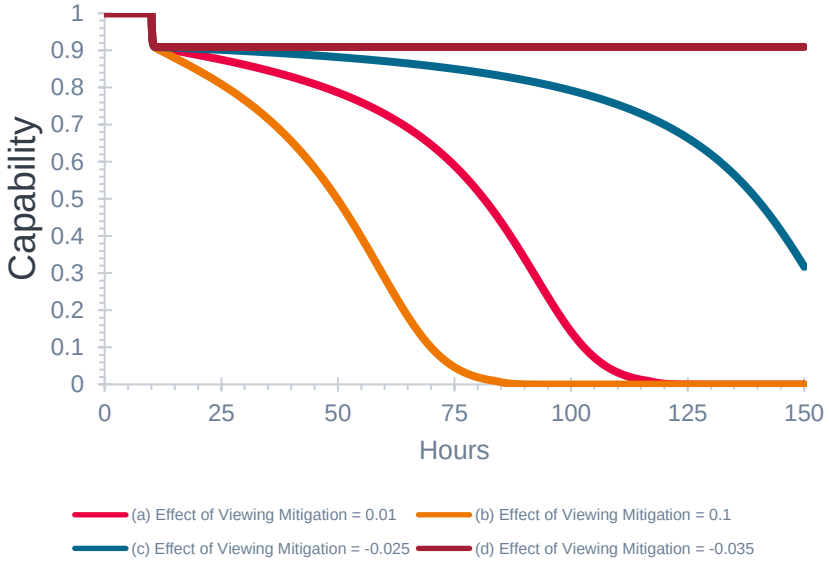
Calming, but still effective, mitigation can increase evacuation efficaciousness,

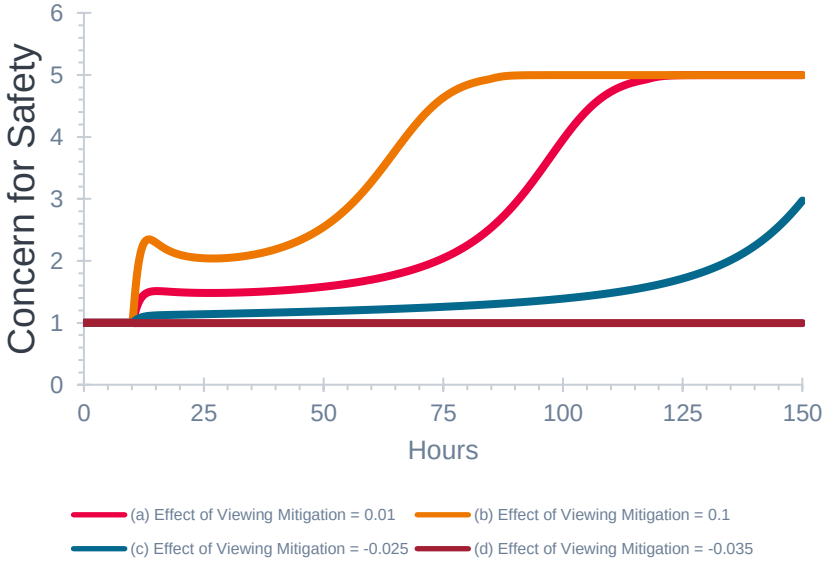
...or even allow people to prevent crisis from progressing

- Here, people don't panic and flee, and instead spend effort maintaining system capability

Varying Effect of Viewing Mitigation

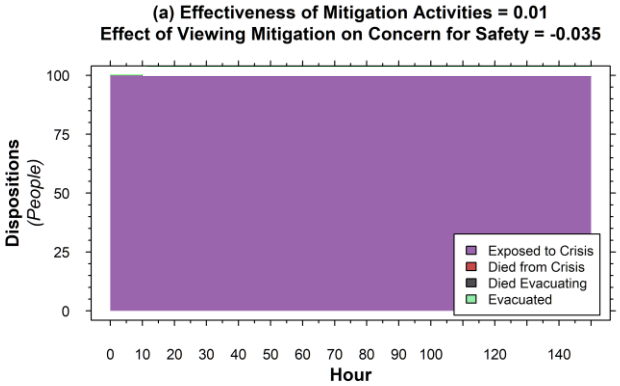
Effectiveness of Mitigation Activities	0.05	Dmnl/Activity

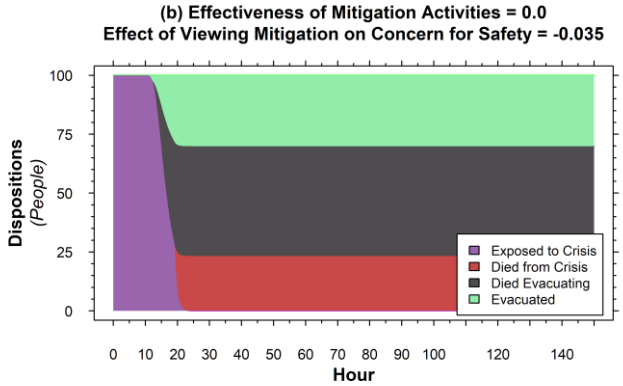


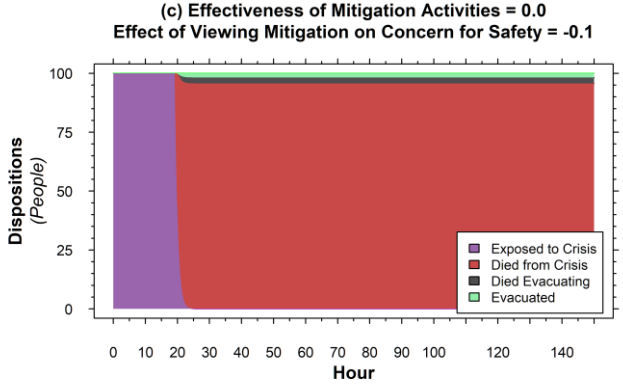


...but what if mitigation is totally ineffective for building capability?

Effect with Totally Ineffective Mitigation





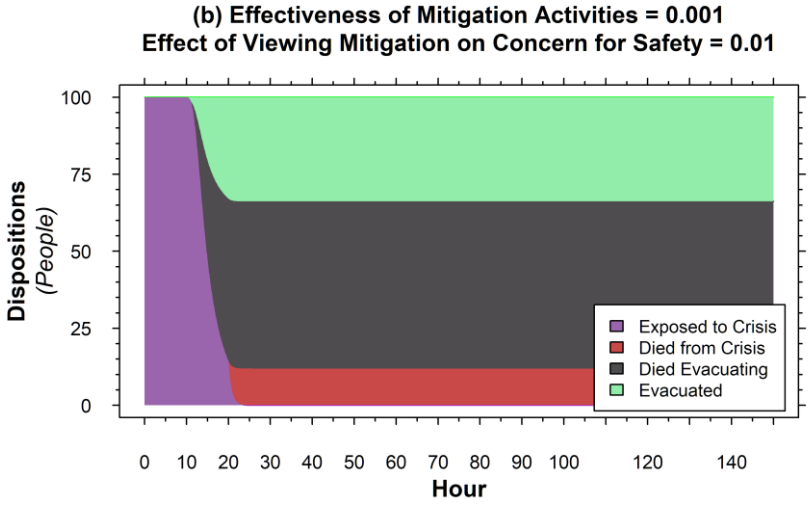


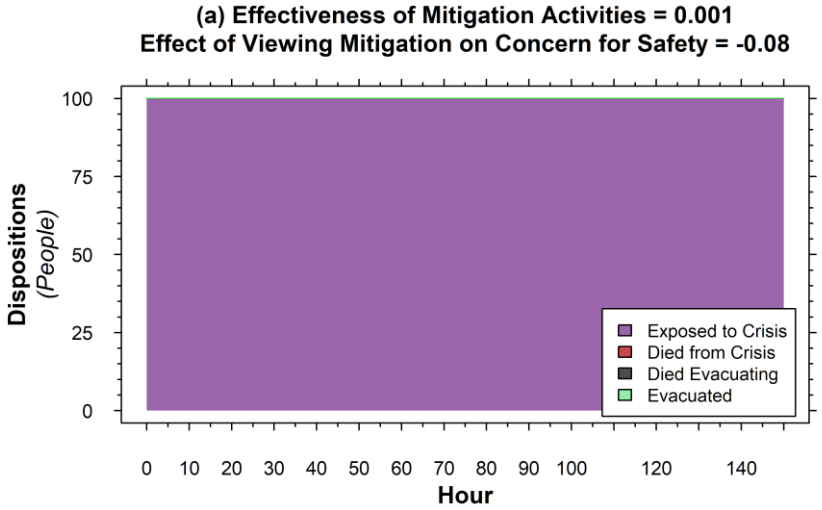
Previous positive effect of calming mitigation lost when mitigation is totally ineffective

For *very* calming mitigation, can get 'head in the sand' outcome with negligible evacuation until it is too late

This is 'rearranging the deckchairs'

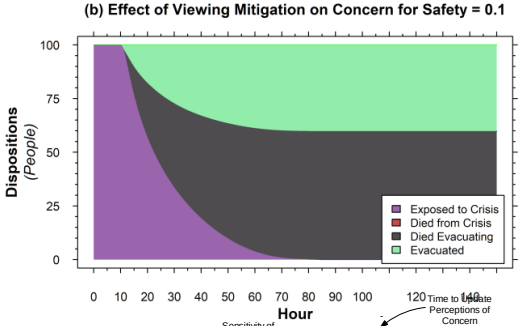
Mitigation must be Marginally Effective

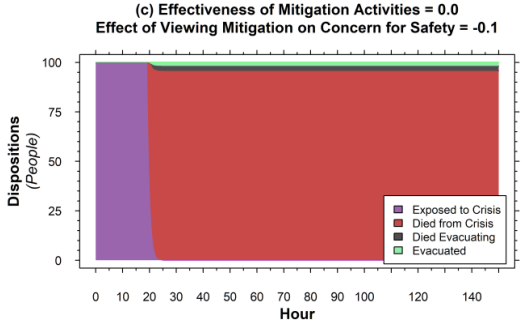


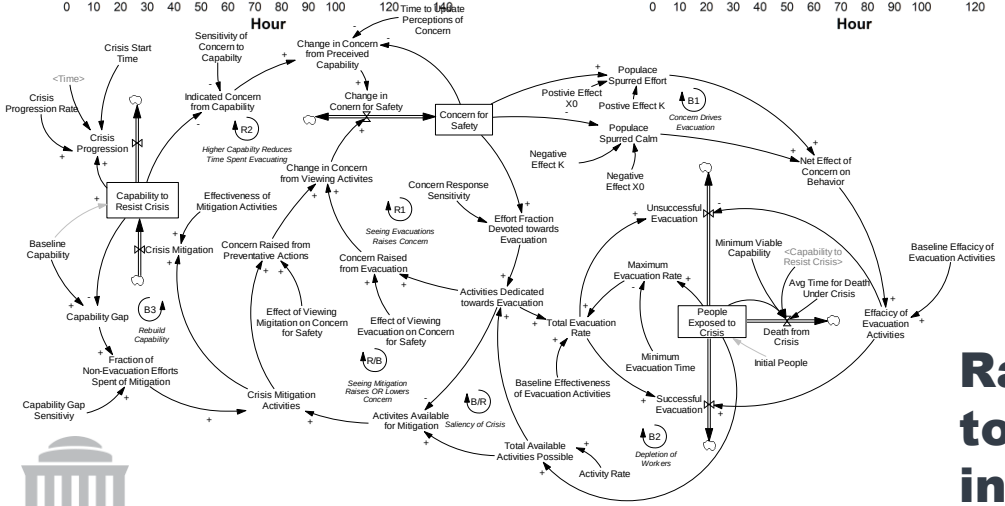


For even marginally effective mitigation, calming can be helpful

Additional Thoughts







Dynamic outcomes are a function of physics and behavioral mechanisms

- Physics largely ignored in this quick analysis, focus on behavioral features
- Mitigation activities can have two purposes: buying time and calming people down
- But, if too calm, then can ignore the problem at hand and before long its too late

Raises practical question: how to identify real effective vs ineffective mitigation?

Additional Backup Slides

Full Model by Itself with Embedded .mdl