

An Expanded Feedback View of Decision Maker Mental Models

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(Paper Draft Outdated – To Be Updated!)

Summary

- It may be useful to simulate the feedback dynamics of individual and group mental models to study certain problems, like the diffusion of insurgent tactics.
- A good place to begin is to expand on Richardson, Andersen, Maxwell, & Stewart's (1994) SDS conference paper on mental model research.
- The main part of my paper elaborates on Richardson et al.'s causal map by incorporating the following theories necessary to make a more “complete” representation of the decision process.
 - **cue perception and interpretation**
 - **mental models**
 - **decision-making**
 - **attention (salience)**
 - **social influence**
- The paper includes a small, initial simulation of part of the decision-making and social influence dynamics and shows how to simulate this model using the Global Terrorism Database data set.

Example Problem: Diffusion of Insurgent Tactics



Insurgents pose a **difficult threat** to counterinsurgents such as the US in Iraq and Afghanistan.

Cells can **rapidly change their tactics** to respond to and even anticipate counterinsurgent actions.

It is **too difficult to predict exactly** which new tactics insurgents will use, but it may be **useful to understand how tactics “diffuse”** throughout an insurgent population.

We know **most** about what happened (group A attacked target B on date C using method D).

We know a **bit less** about the networks involved (group A’s members, their interactions with each other and their interaction with other actors). However, we can estimate the composition and communication patterns of “typical” cells.

We know **even less** about mental models. How did the cell decide to use one tactic or another? Interviews are difficult (impossible?) and self-reporting on these matters is unreliable.

Example Data: Global Terrorism Database

•Who

- Insurgents – estimate their attributes and identities based on region, demographics, or randomly; some groups claim responsibility for attacks or are identified

•What

- Actions (insurgent attacks)
- Target type (government, military, etc)
- Target (in cases where the specific target is important)

•Where

- Countries, regions, cities, neighborhoods

•Why

- Self-claims
- By attacker identity

•When

- Date

•How

- Suicide or not
- Number of attackers
- Weapons used
- Vehicles used
- Method of attack



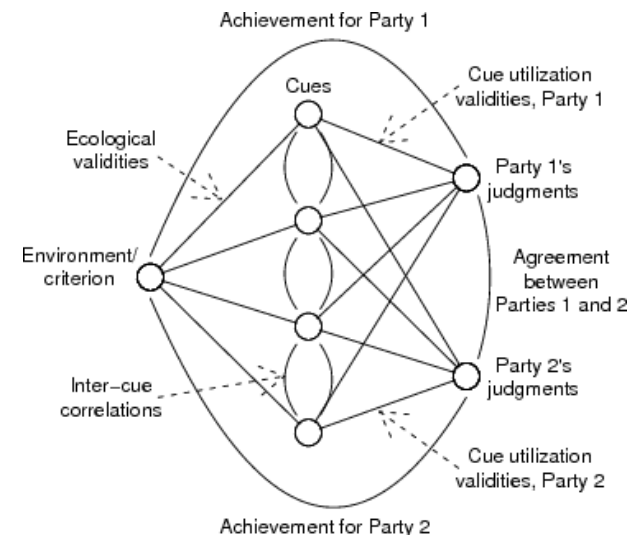
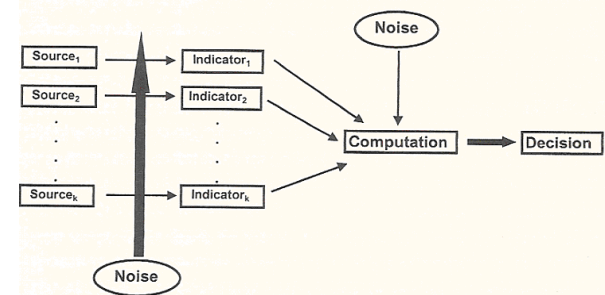
•Outcomes

- Success or failure
- Targets killed, wounded, captured
- Perpetrators killed, wounded captured
- Property damage

| year | month | day | City | Suicide | Attacktype1 | Targettype1 | Entity1 |
|------|-------|-----|----------|---------|-------------|-------------|---------|
| 2007 | 1 | 4 | Baghdad | 0 | 3 | 14 | 26 |
| 2007 | 1 | 5 | Basra | 0 | 6 | 1 | 11 |
| 2007 | 1 | 6 | Baghdad | 0 | 1 | 3 | 20 |
| 2007 | 1 | 8 | Baghdad | 0 | 2 | 6 | 13 |
| 2007 | 1 | 8 | Baghdad | 0 | 3 | 14 | 26 |
| 2007 | 1 | 8 | Baghdad | 0 | 3 | 14 | 13 |
| 2007 | 1 | 10 | Karabala | 0 | 2 | 14 | 13 |
| 2007 | 1 | 10 | Tal Afar | 1 | 3 | 3 | 20 |

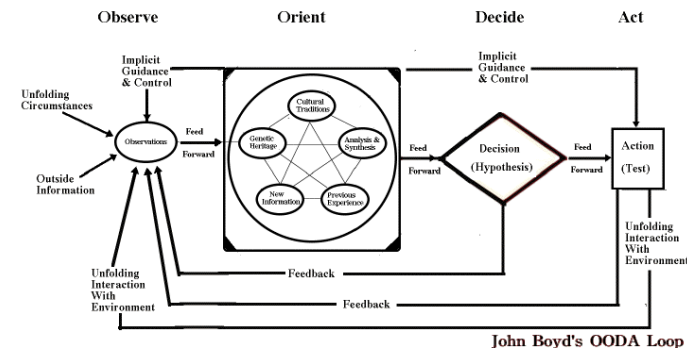
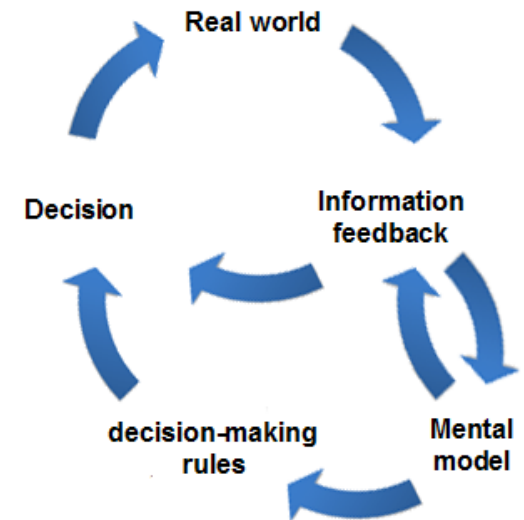
Theory: Cue Perception & Interpretation

- A decision maker only sees the world imperfectly:
 1. A **state of the world**.
 2. A **cue** about the state of the world.
 3. A **perceived state of the world**. The speed with which states of the world are perceived depends on the **salience** of the cues informing the perceived state. A decision maker can only perceive a state of the world if he or she is paying attention to the relevant cues.
 4. A **goal**. Both a perceived state of the world and a goal state of the world are necessary to form a gap. The gap allows perceptions to be understood as a mental model idea about a problem, a solution, or a causal explanation.



Theory: Mental Models

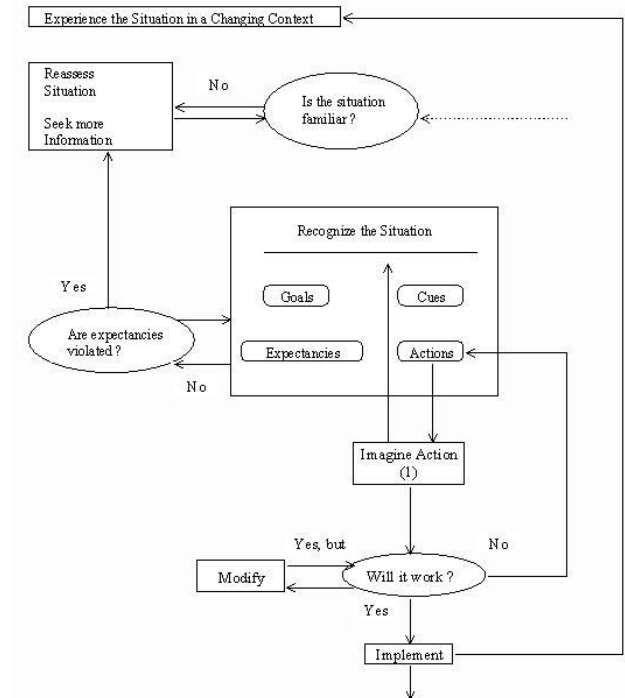
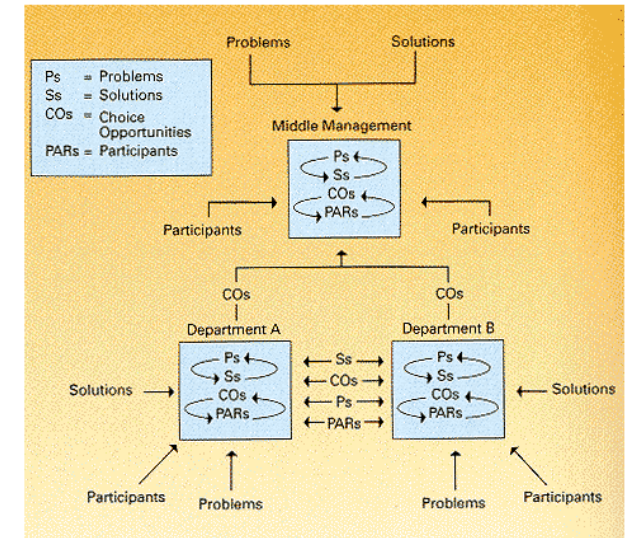
- Mental models may be divided into several kinds of ideas: ends, means, and means-ends -- corresponding to the **problems**, **solutions**, and **causal explanations** in the decision maker's mind:
1. A “**problem**” idea corresponds to the “ends” part of a mental model. The statement behind a problem idea is, "Problem X is important and needs to be addressed now.”
 2. A “**solution**” idea corresponds to the “means” part of a mental model. The statement behind a solution idea is, "Solution Y is feasible and available for use now.”
 3. A “**causal explanation**” idea corresponds to the “means-ends” part of a mental model. The statement behind a causal explanation idea is, "Solution Y is effective at addressing problem X.”
 4. These mental model ideas are measured via **certainty** and **salience**.
 5. A combination of certain and salient problem, solution, and causal explanation creates **pressure** for a **decision**.



Theory: Decision-Making and Salience/Attention

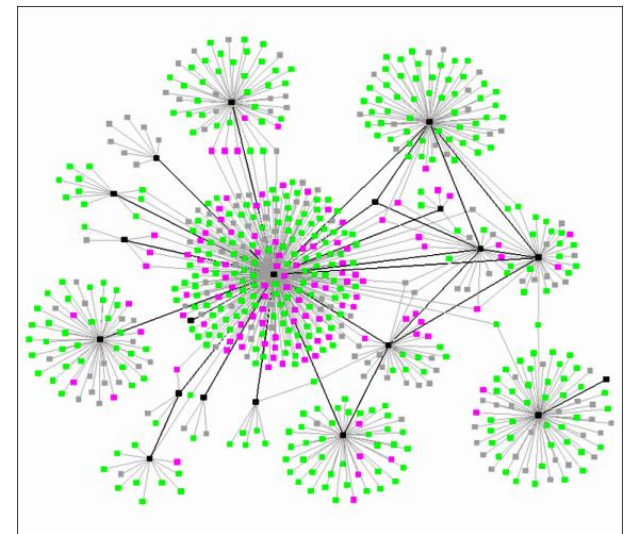
- All the time, decision makers change their **goals**, the **attention** that they pay to **cues** and **mental model ideas**, and the **mental model ideas** themselves.
- Intuitive decision making is similar. In a **simple match** decision, the decision maker easily matches the situation with an action. In a **diagnosing the situation** decision, the decision maker matches the situation feature by feature. In an **evaluate course of action**, the decision maker mentally simulates the situation.
- **Salience** (prominence of a cue or idea in a decision maker's attention) is based on **direct experience** as well as **consequences** for- and **aspirations** of- the decision maker. Some dynamics of salience:
 1. Various positive feedback loops between idea certainty and salience.
 2. Attention inertia (attention is a stock!).
 3. Attention shifting (fix and forget).
 4. Threshold effects.
 5. Agenda crowding (attention is the ultimate bottleneck).

GARBAGE CAN MODEL OF DECISION-MAKING



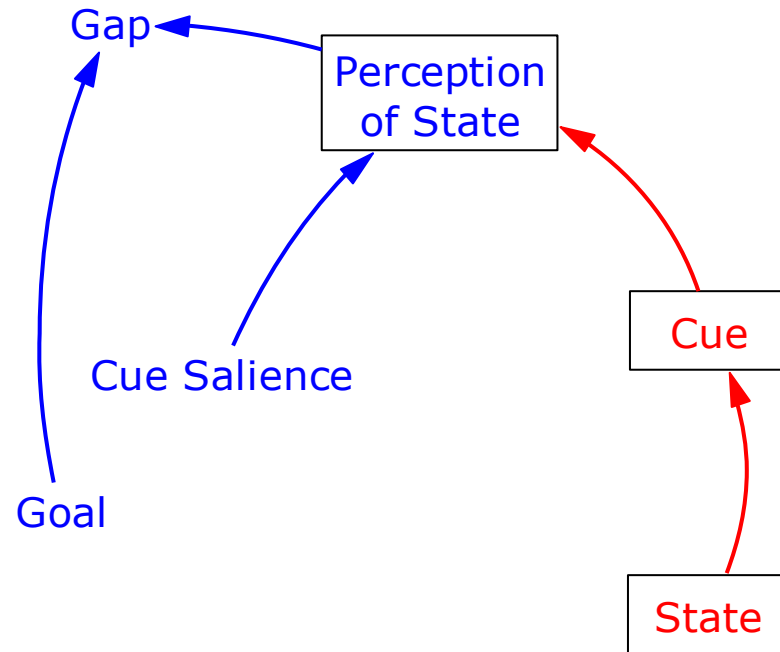
Theory: Social Influence

- Ideas infect others more or less rapidly, due to:
 1. The **inherent persuasiveness** of the sender to the receiver. This is a catch-all constant that encompasses charisma, power relationships, social similarity, institutional reporting structures, etc.
 2. The **frequency, length, and intensity of communication** by the sender to the receiver. The more the amount of communication, the more salient the sender's message is to the receiver and the more chances the sender has to sway the receiver's opinion.
 3. The **difference between sender and receiver opinions**. This is known as “bounded confidence”, where the more of a gap there is between sender and receiver opinions (certainties of mental model ideas), the less the sender's opinion will change.
 4. The **certainty** of the receiver's opinion. The more certain the receiver is of a mental model idea, the harder it is to sway them.



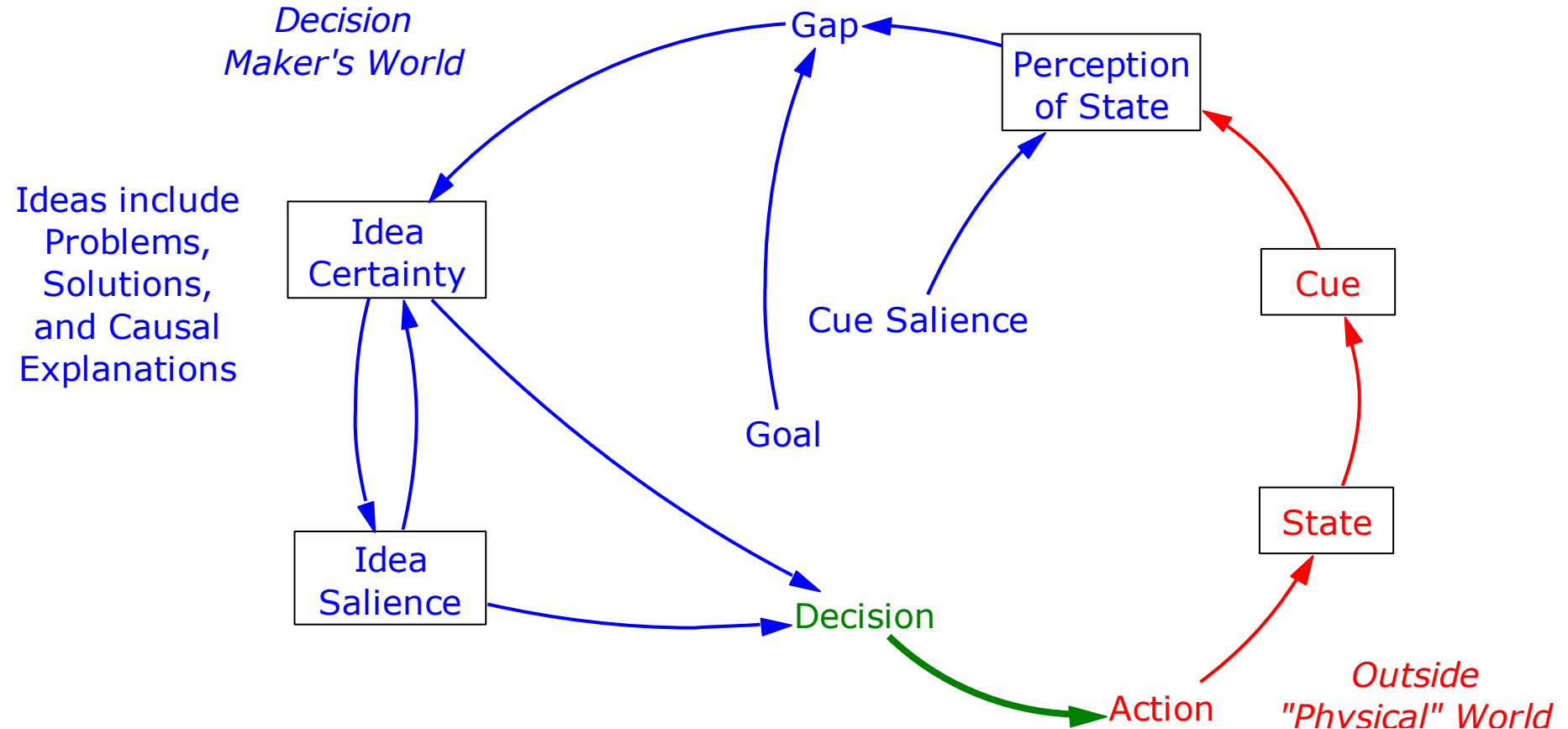
Causal Loop Diagram: Cue Perception & Interpretation

*Decision
Maker's World*

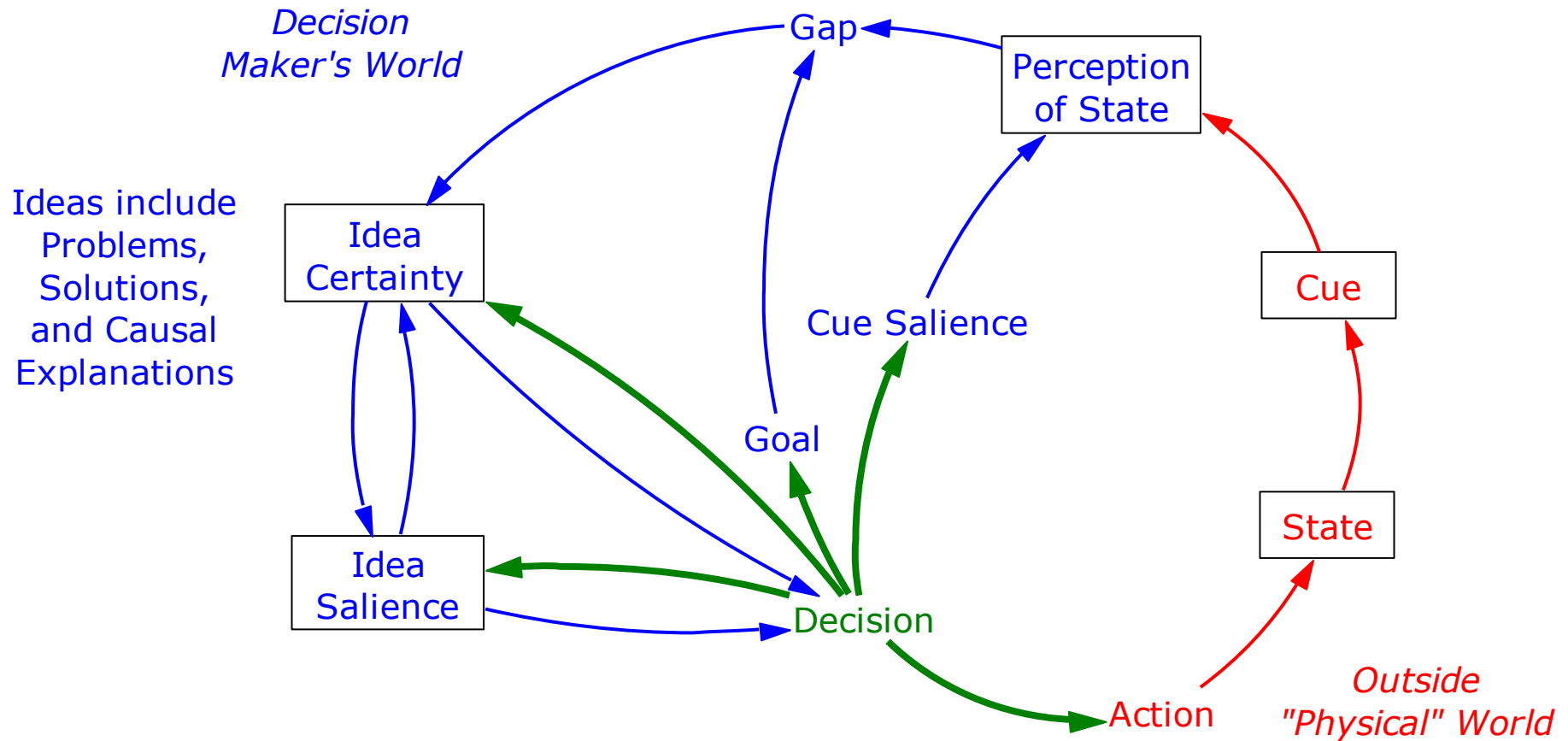


*Outside
"Physical" World*

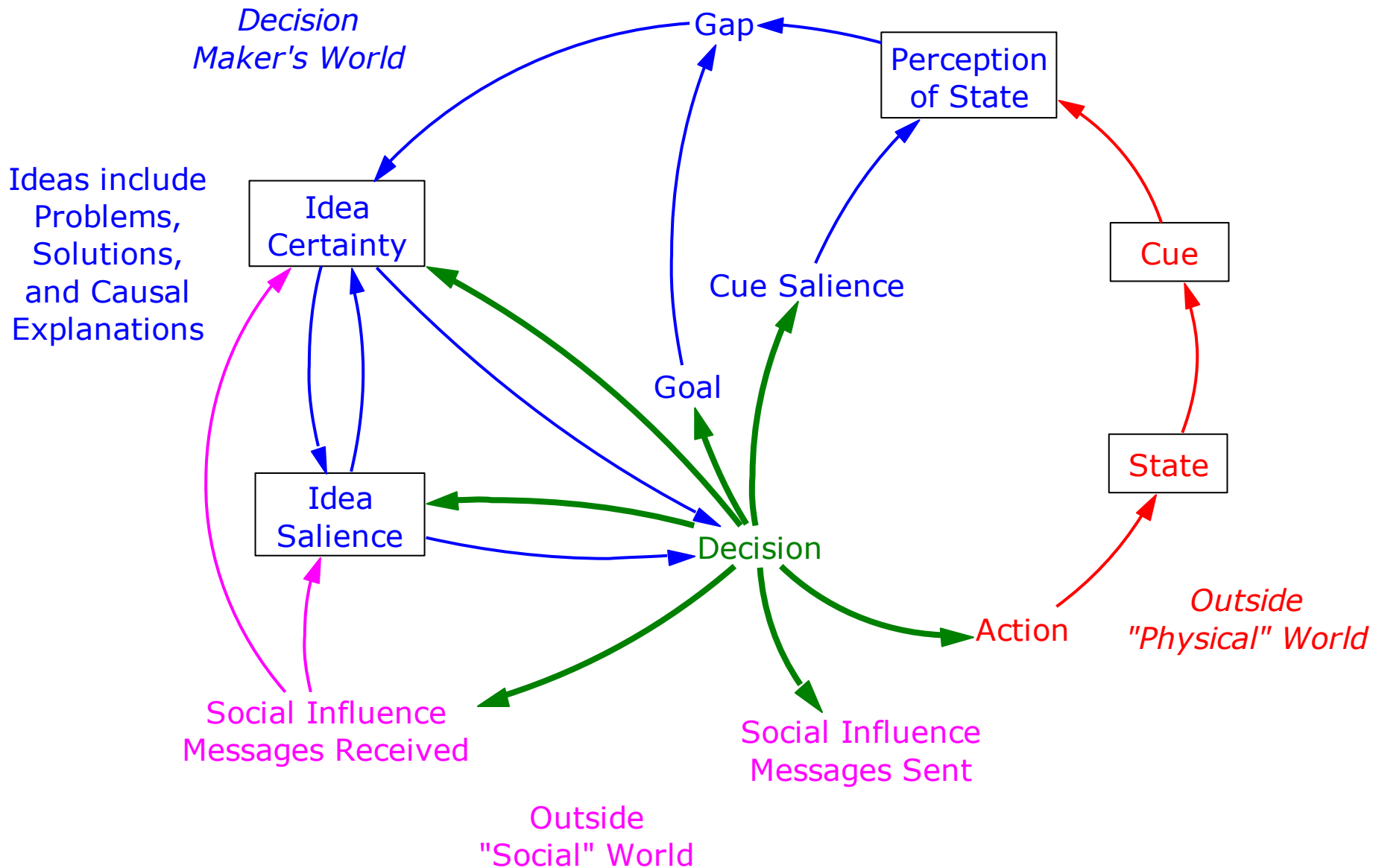
Causal Loop Diagram: Mental Models



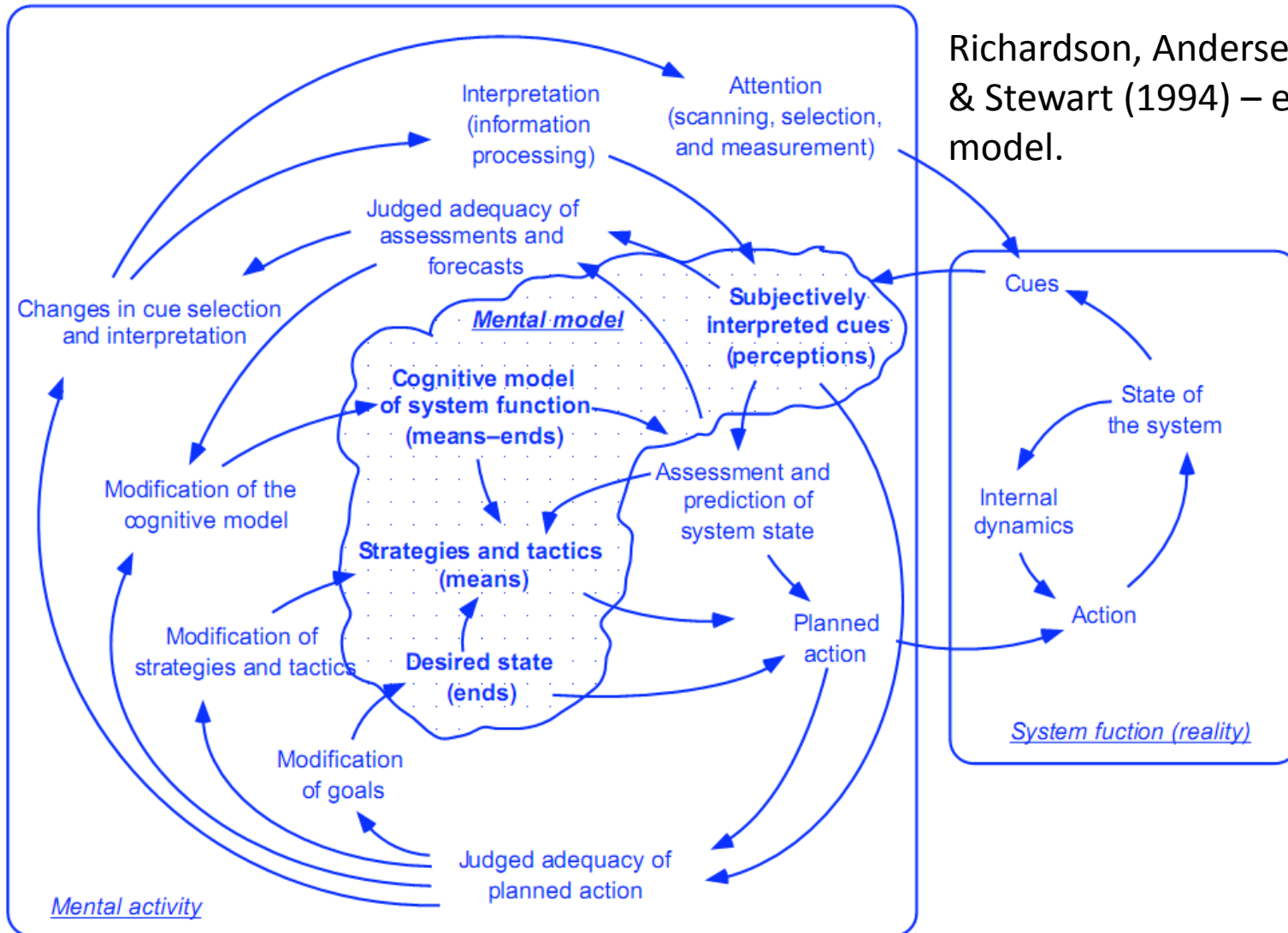
Causal Loop Diagram: Decision-Making



Causal Loop Diagram: Social Influence



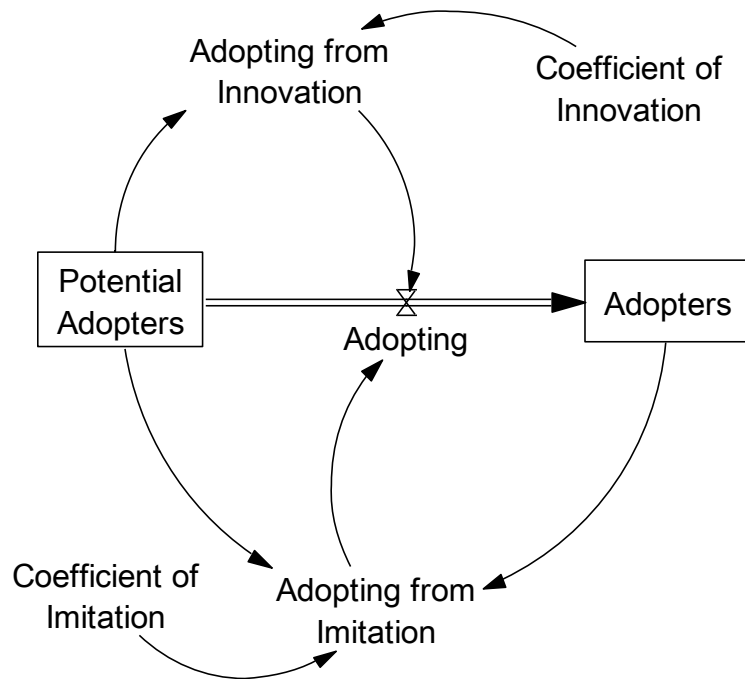
Theory/Inspiration: Richardson et al.'s Decision Making CLD



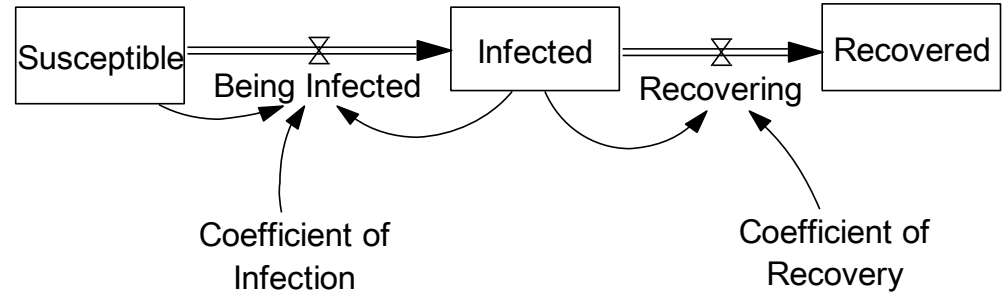
Richardson, Andersen, Maxwell,
& Stewart (1994) – expanded
model.

Theory/Inspiration: Social Influence Models

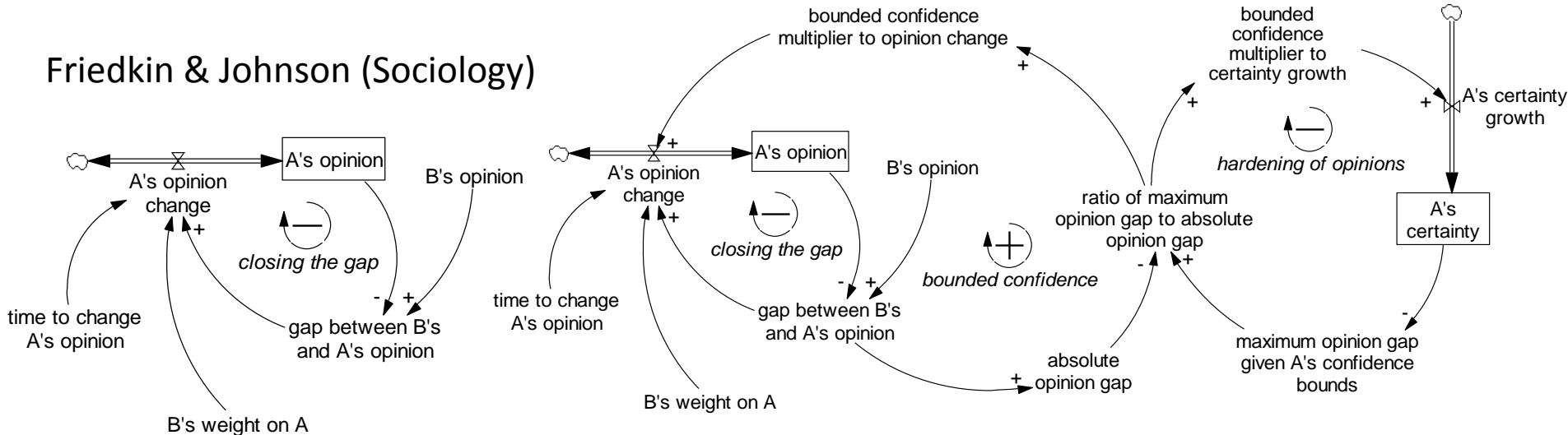
Simplified Bass Diffusion (Marketing)



Susceptible Infectious Recovered (Epidemiology)

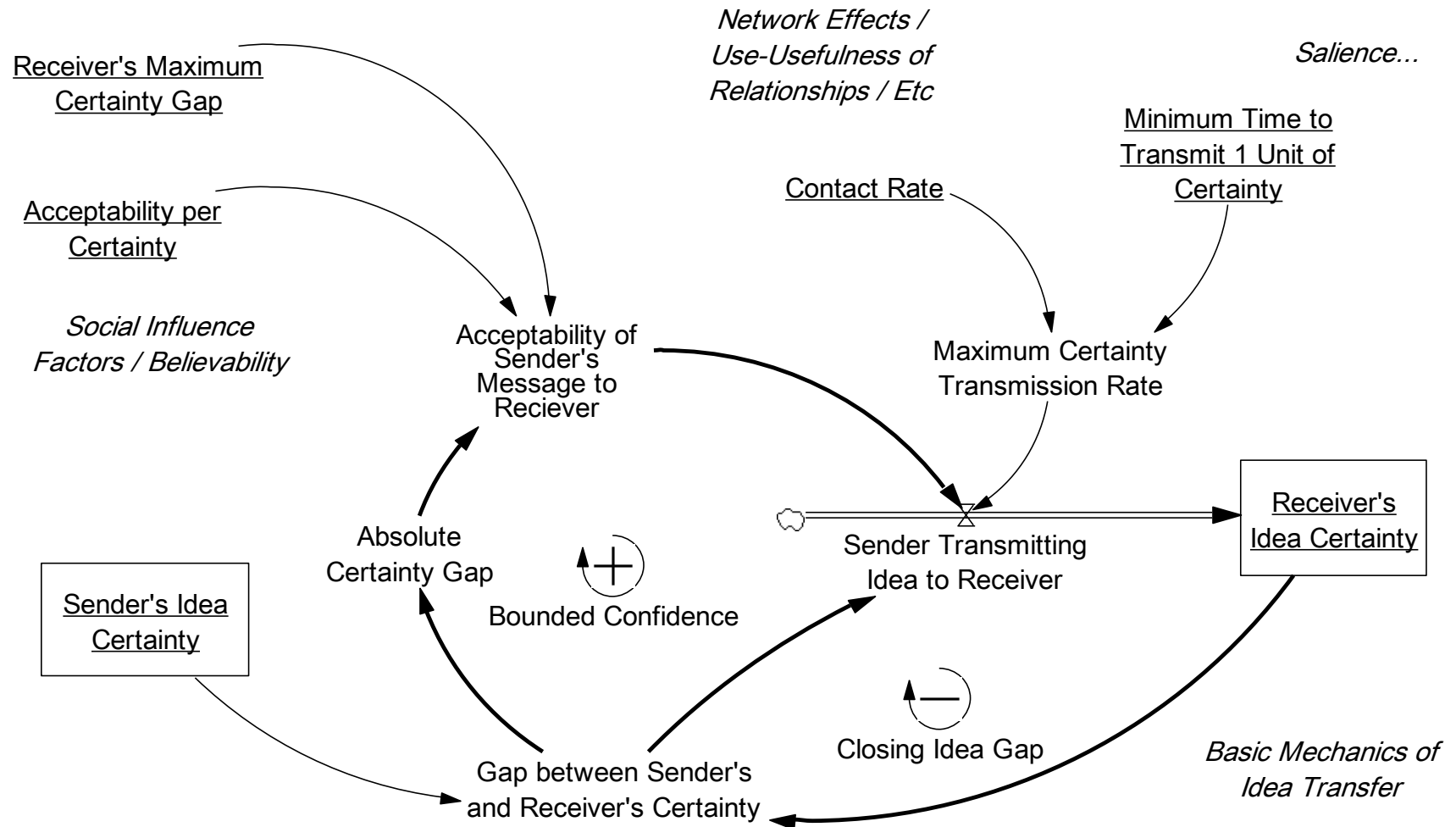


Friedkin & Johnson (Sociology)



Initial SD Simulation of Mental Models and Social Influence

The italic text comments indicate possibilities for expansion of the model to represent more of the theory in the causal loop diagrams...



Simulation Subscripted to Run “Agents” based on Global Terrorism Database Data

Idea (Problem, Solution, Causality)

| Number | |
|--------|-----------------|
| | Name |
| 1 | UseEFP |
| 2 | UseCarbomb |
| 3 | UseMortar |
| 4 | UseRPG |
| 5 | UseCamera |
| 6 | UseDaisyChain |
| 7 | UseIED |
| 8 | UseAssaultRifle |

Person to Person
(Connection)

| Number | To... | | 1 | 2 |
|---------|-----------|----------|-----------|---|
| From... | Name | Abdullah | Zaitullah | |
| 1 | Abdullah | 0 | 1 | |
| 2 | Zaitullah | 1 | 0 | |

Person to Person (Contact Rate)

| Number | To... | | 1 | 2 |
|---------|-----------|----------|-----------|---|
| From... | Name | Abdullah | Zaitullah | |
| 1 | Abdullah | 0 | 1 | |
| 2 | Zaitullah | 1 | 0 | |

