Conference on Complex Systems 2019, Singapore

Complexity and the Issue of Implementation in Clinical Practice

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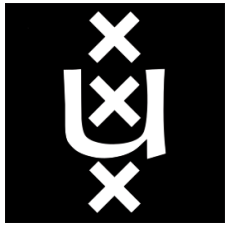

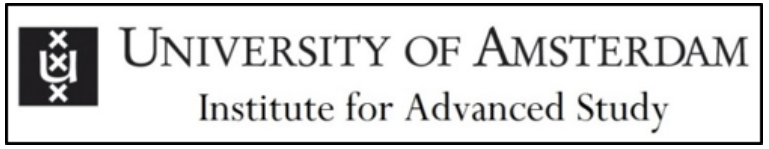

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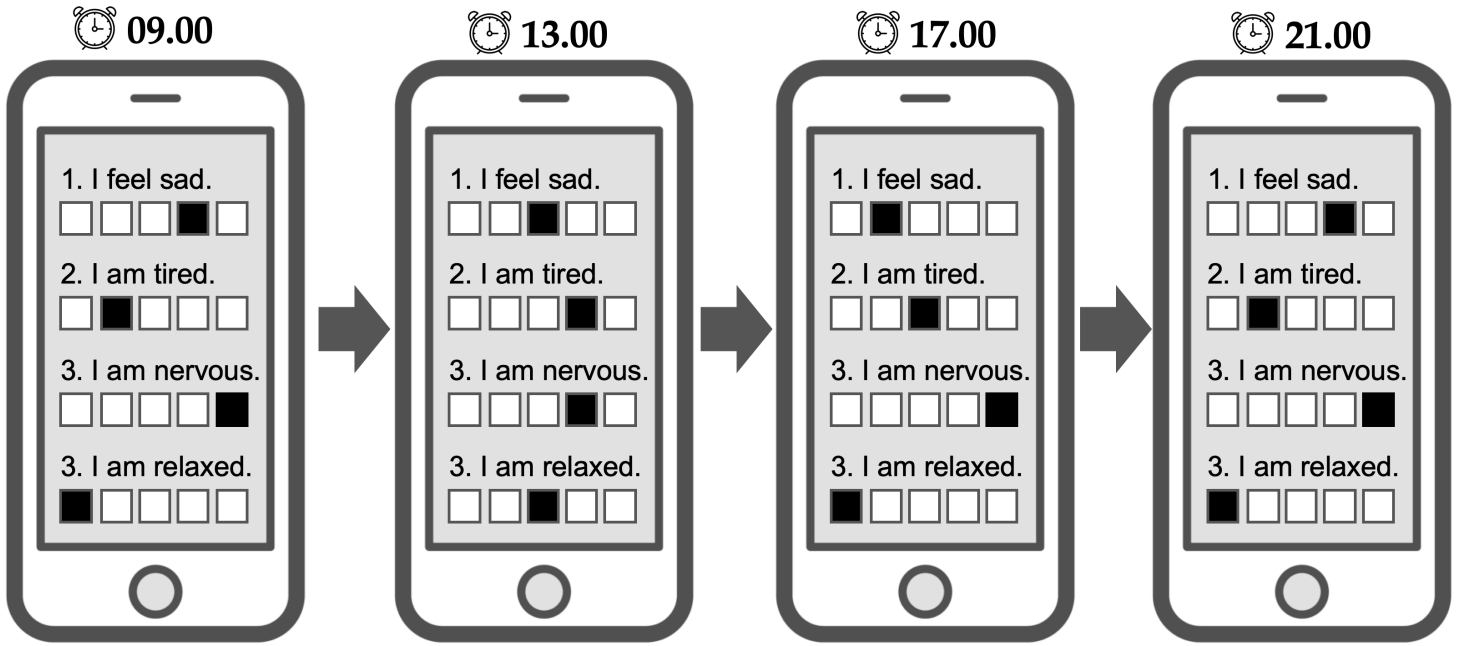
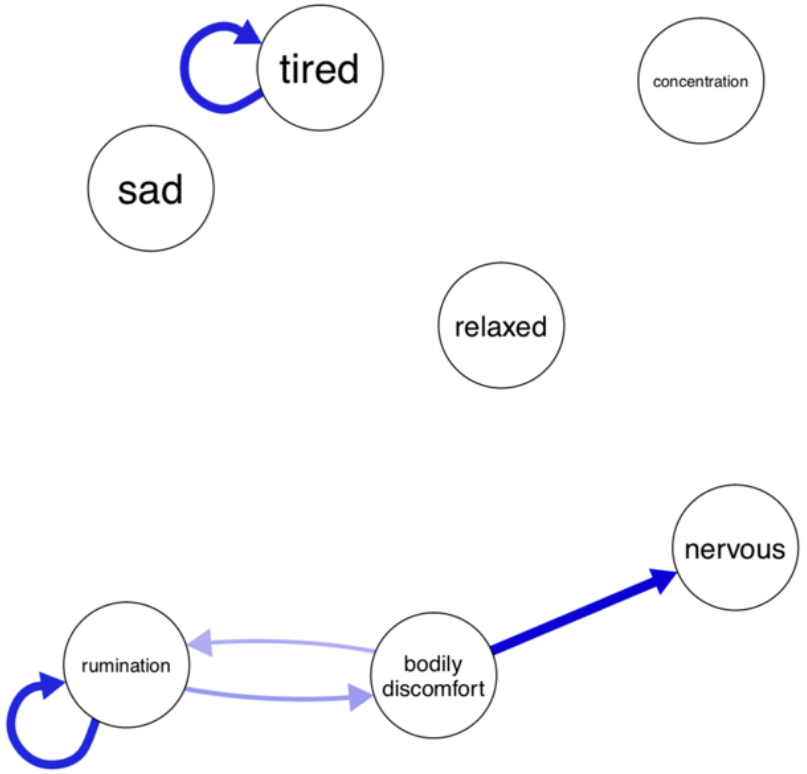
Network Models in Clinical Practice: *Idiography*

Personalized network modeling in Clinical Practice

- Estimated from ESM data.
- Personalized networks can support a patient's **case conceptualization.**





Epskamp et al. (2018)
https://doi.org/10.1177/2167702617744325

From Implementation Barriers to a Clinician's Wish-list

Differences between symptoms in amenability to treatment?

Clinical Theory?

Case specific background information/ knowledge?

Differences between symptoms in impact on psychosocial functioning?

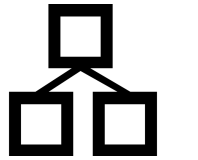
From Implementation Barriers to a Clinician's Wish-list

Formalizing Case Conceptualizations

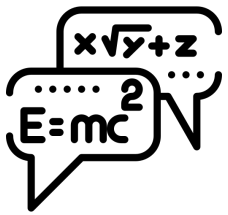
- Making use of *clinical theory* and *expertise*.
- A complex system *grounded in clinically relevant considerations*.
- Promising in targeting the *scientist-practitioner gap*.

Formalizing Case Conceptualizations

Step-by-step:



1.Schematic representation.



2.Deriving differential equations.

3.Formalizing interventions.

4.Simulating and visualizing theory-implied data.

5.Evaluating/adapting case conceptualization.

1. Schematic representation

Functional Analysis of Susan, diagnosed with Panic Disorder

Discriminat stimulus (*Sd*)
Susan experiences unusual bodily sensations in the cinema (heart-racing). Since heart-racing is a rather untypical event for being in a cinema, Susan infers that this is a sign of an upcoming heart-attack.

Reaction, cognitive (*Rc*)
"I am having a heart-attack and there is no way I can get medical assistance on time."

Reaction, emotional (*Re*)
Panic.

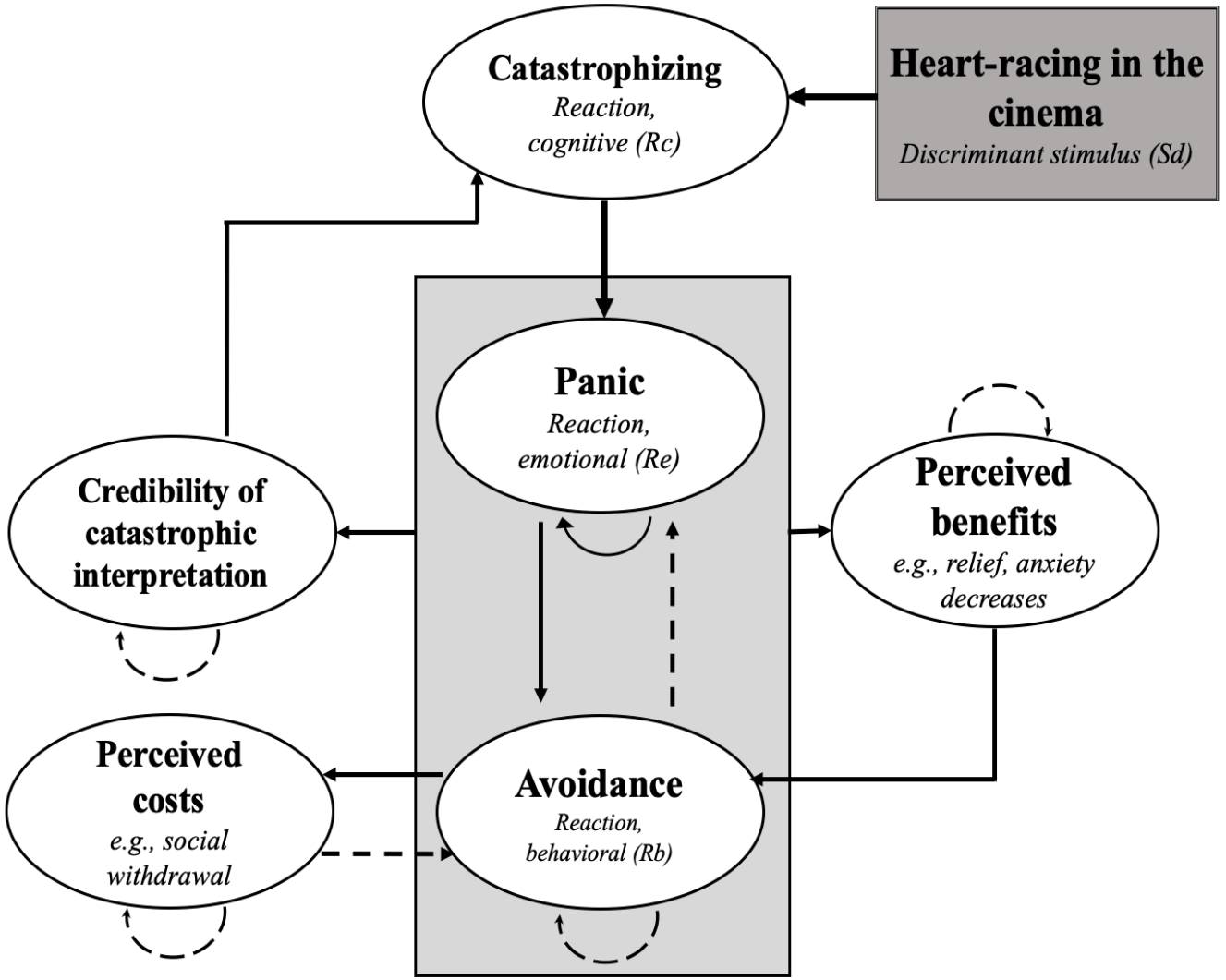
Reaction, behavioral (*Rb*)
Escaping out of the cinema.

Perceived benefits
Anxiety decreases, relief.

Perceived costs
Susan cannot falsify the dysfunctional cognition.

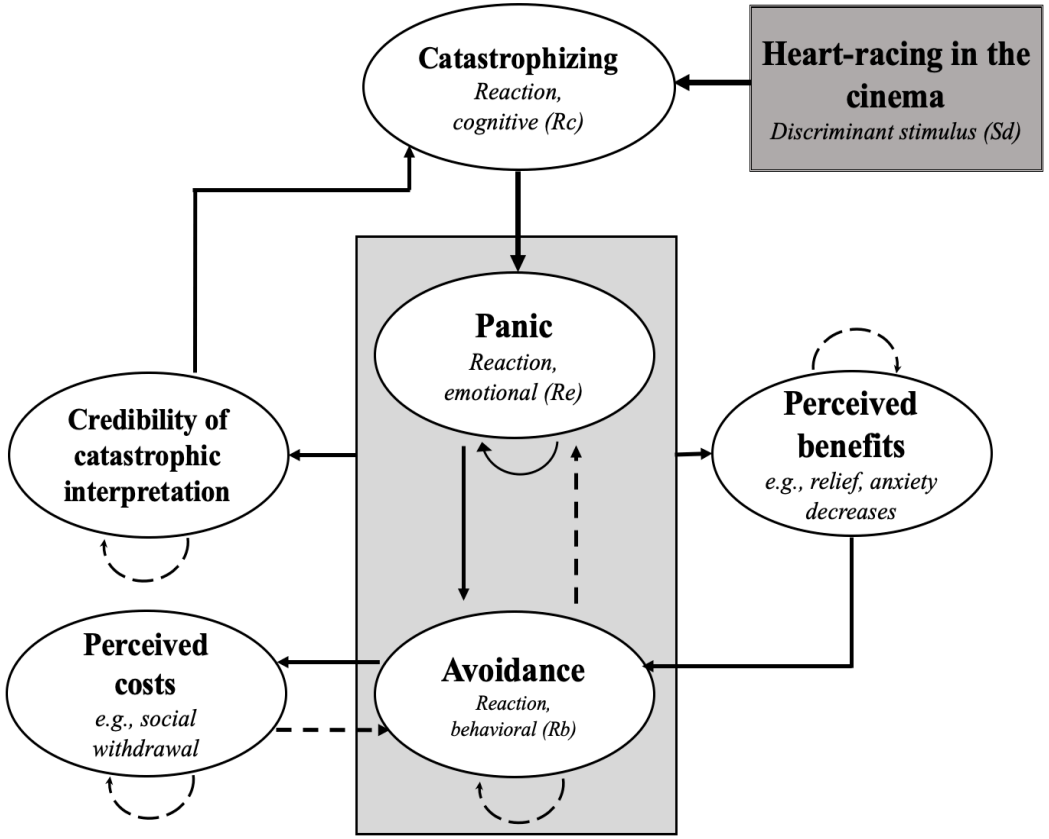
Social withdrawal, low self-sufficiency.

1. Schematic representation



2. Deriving Differential Equations

Differential equations capture ***the momentary rate of change*** for every system variable, depending on the ***current state of related variables***.



$$\frac{dCat}{dt} = a \cdot Sd + b \cdot Cred - c \cdot Cat$$

$$\frac{dPan}{dt} = d \cdot Cat - e \cdot Pan \cdot Av - f \cdot Pan$$

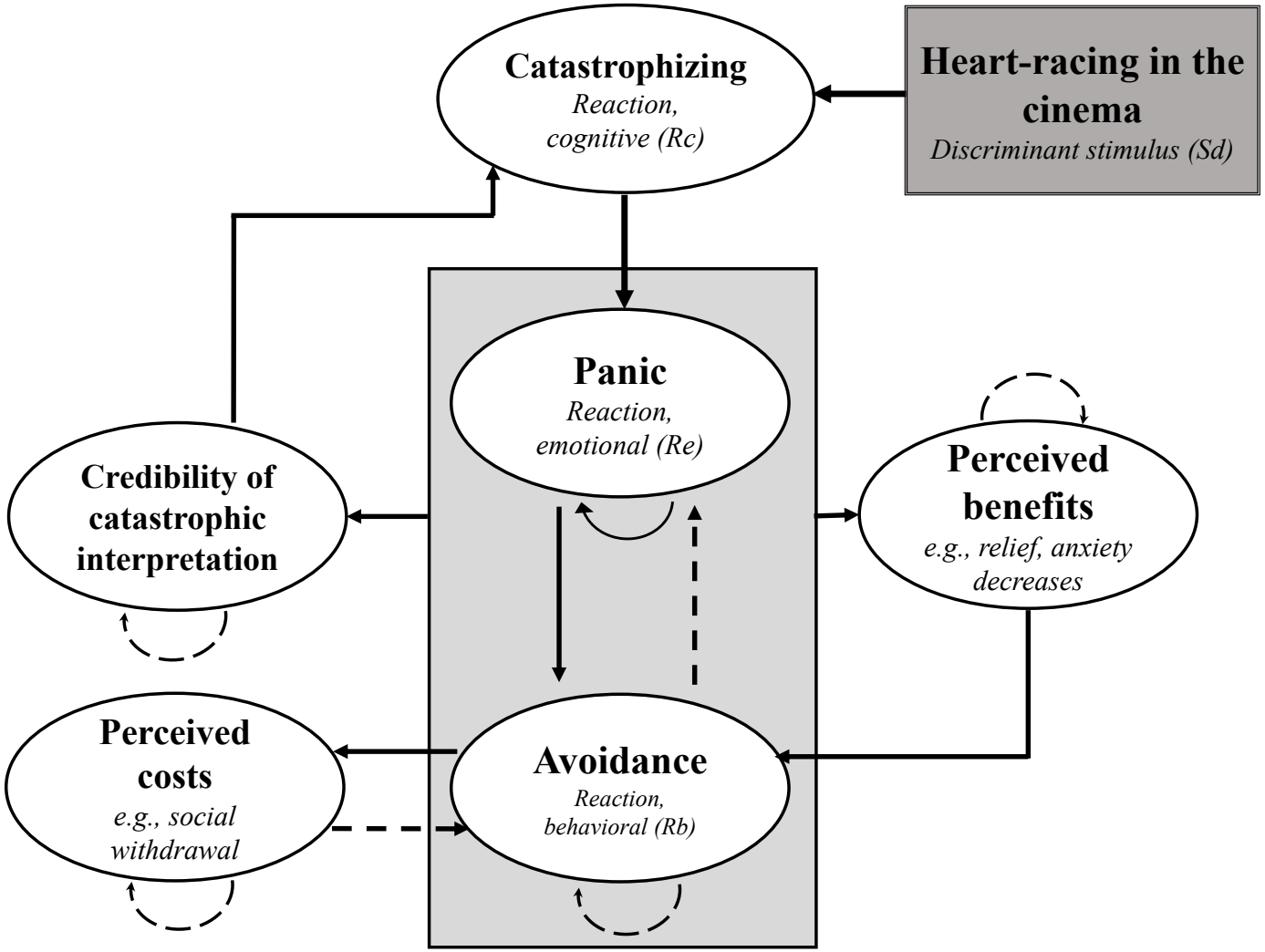
$$\frac{dAv}{dt} = -g \cdot Av + h \cdot Pan \cdot Av - i \cdot Cost + j \cdot Ben$$

$$\frac{dBen}{dt} = -k \cdot Ben + l\,((m \cdot Cat - n \cdot Pan \cdot Av - o \cdot Pan) \cdot Av)$$

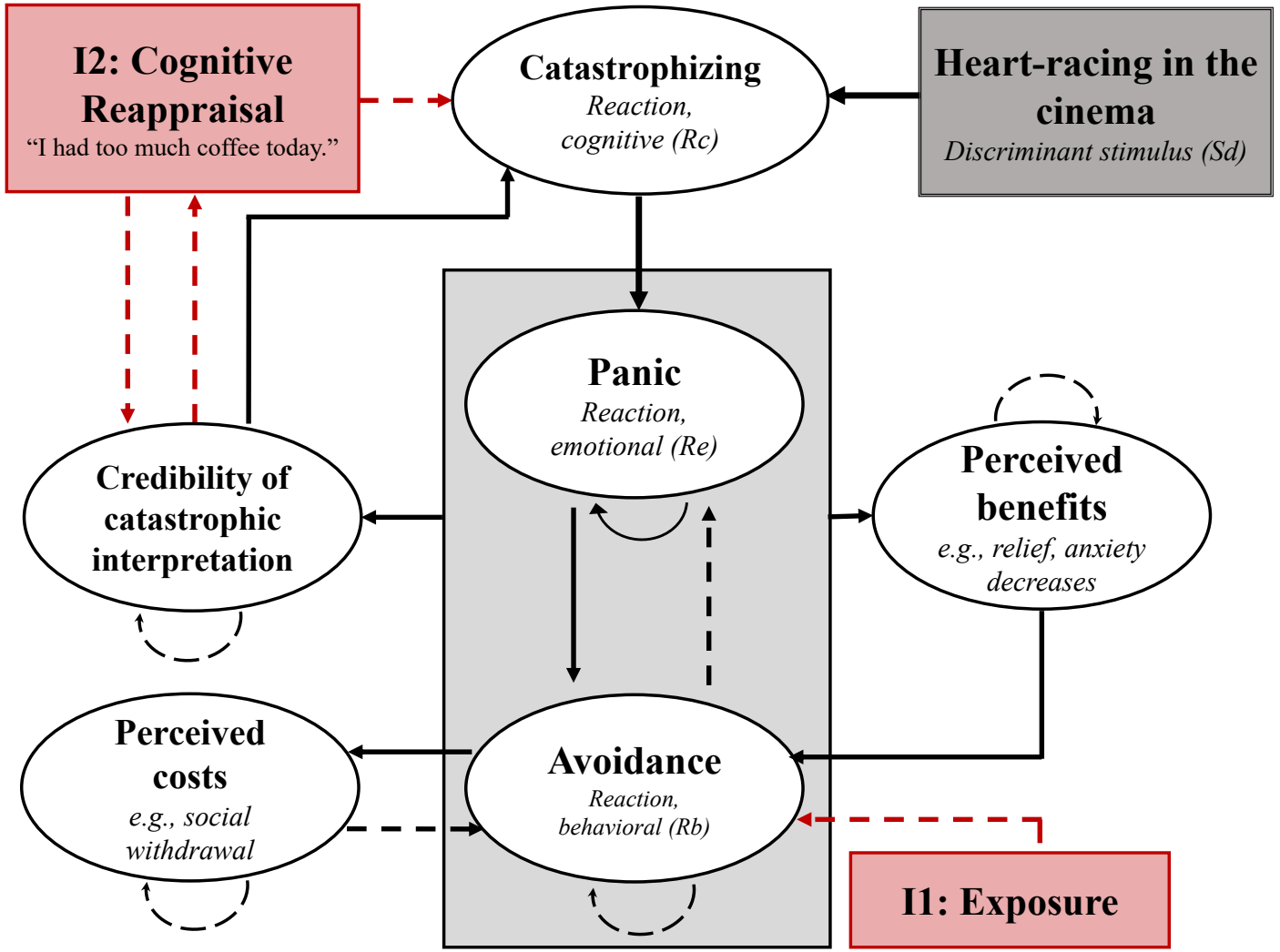
$$\frac{dCred}{dt} = -p \cdot Cred + q(-r \cdot Av + s \cdot Pan \cdot Av - t \cdot Cost + u \cdot Ben) \cdot Pan$$

$$\frac{dCost}{dt} = -v \cdot Cost + w \cdot Av$$

3. Formalizing Interventions

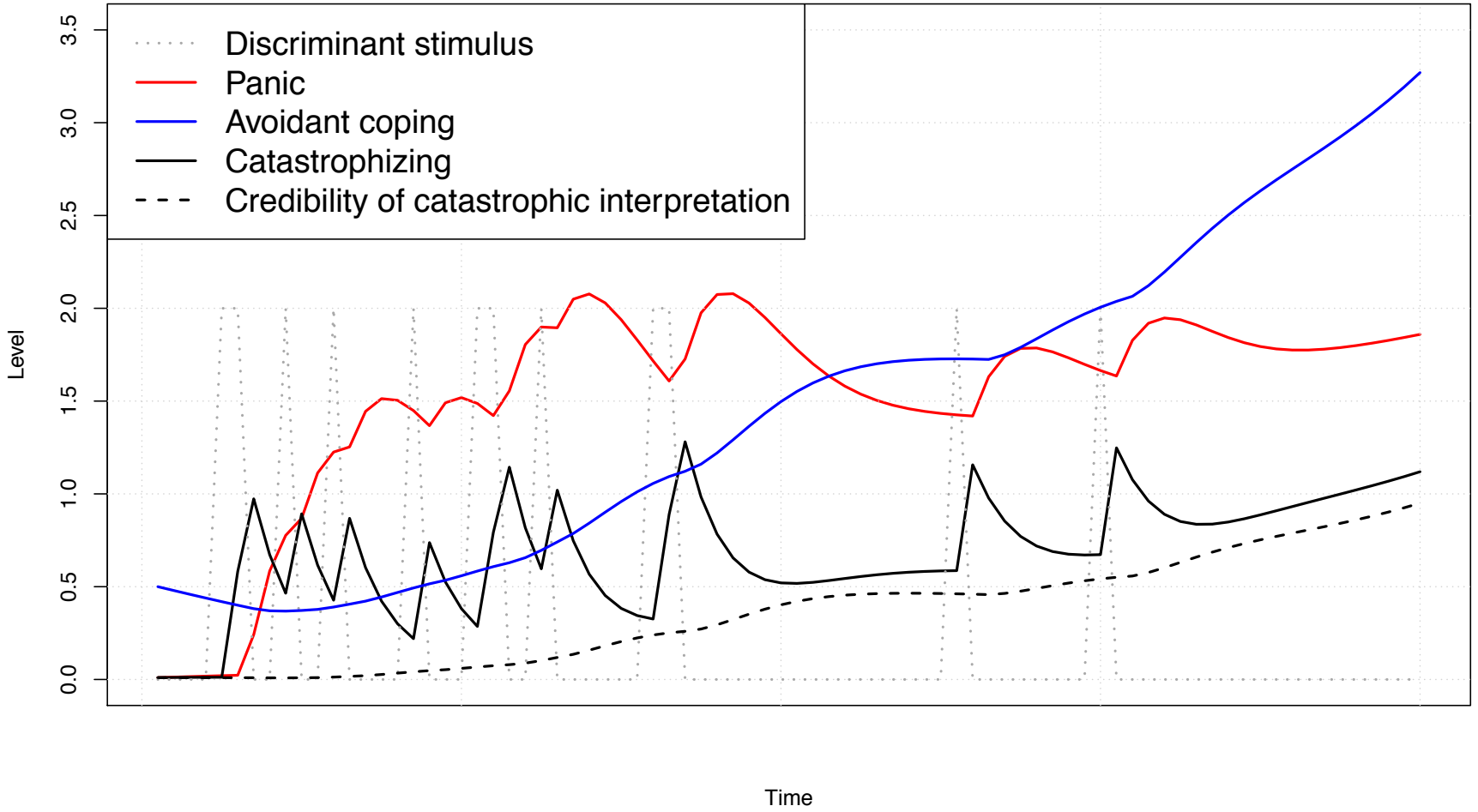


3. Formalizing Interventions



4. Simulating and Visualizing Data

Scenario 1: No intervention



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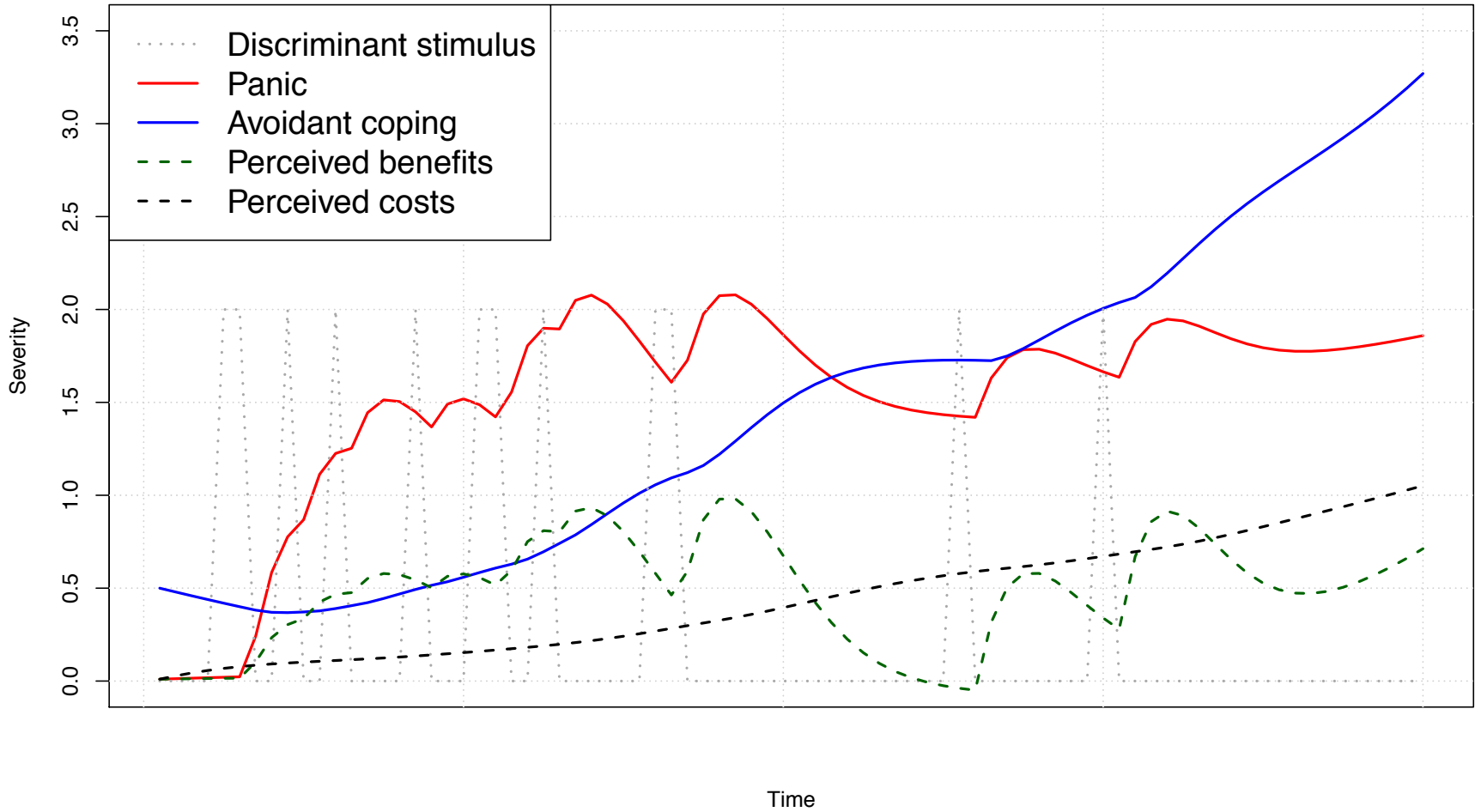
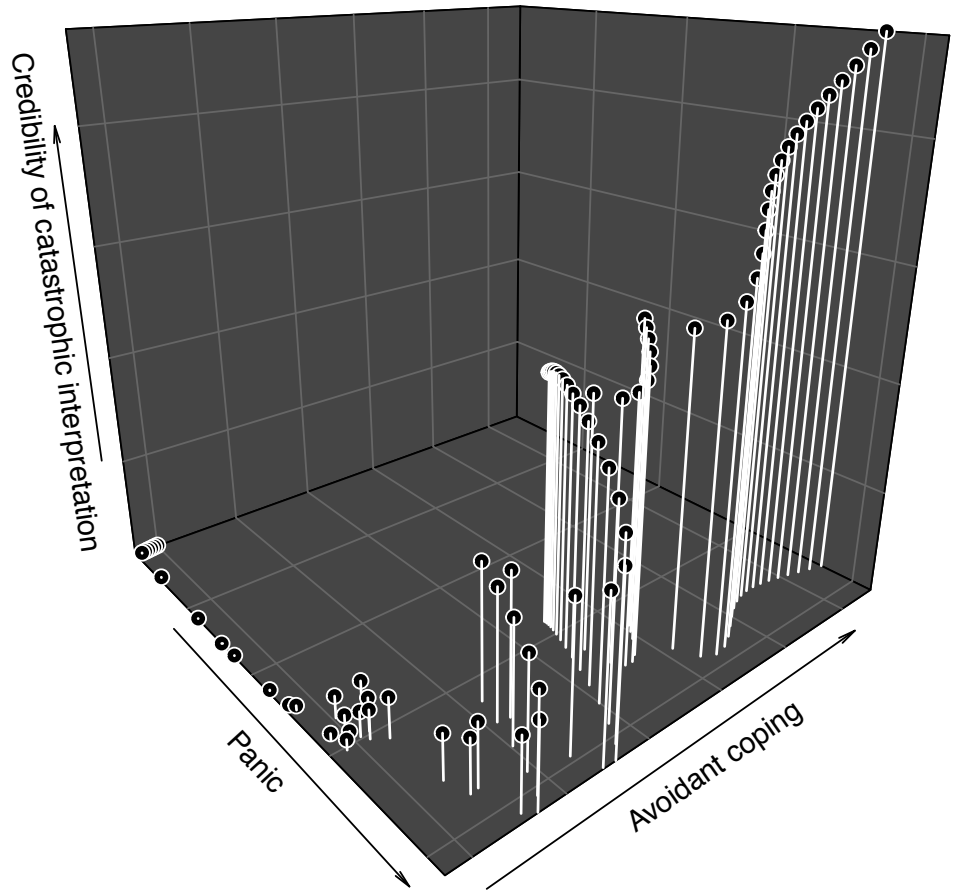


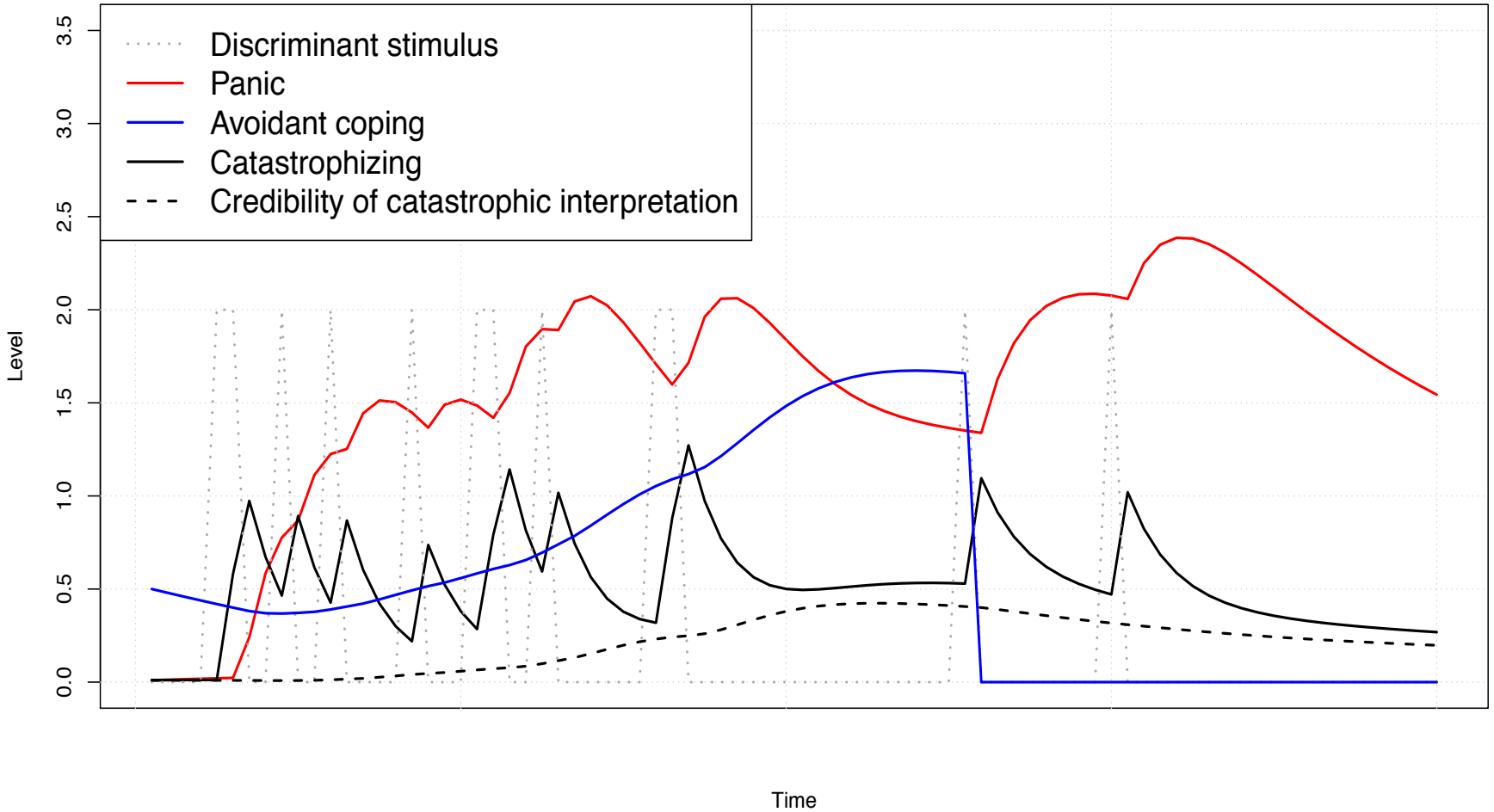
4. Simulating and Visualizing Data

Scenario 1: No intervention



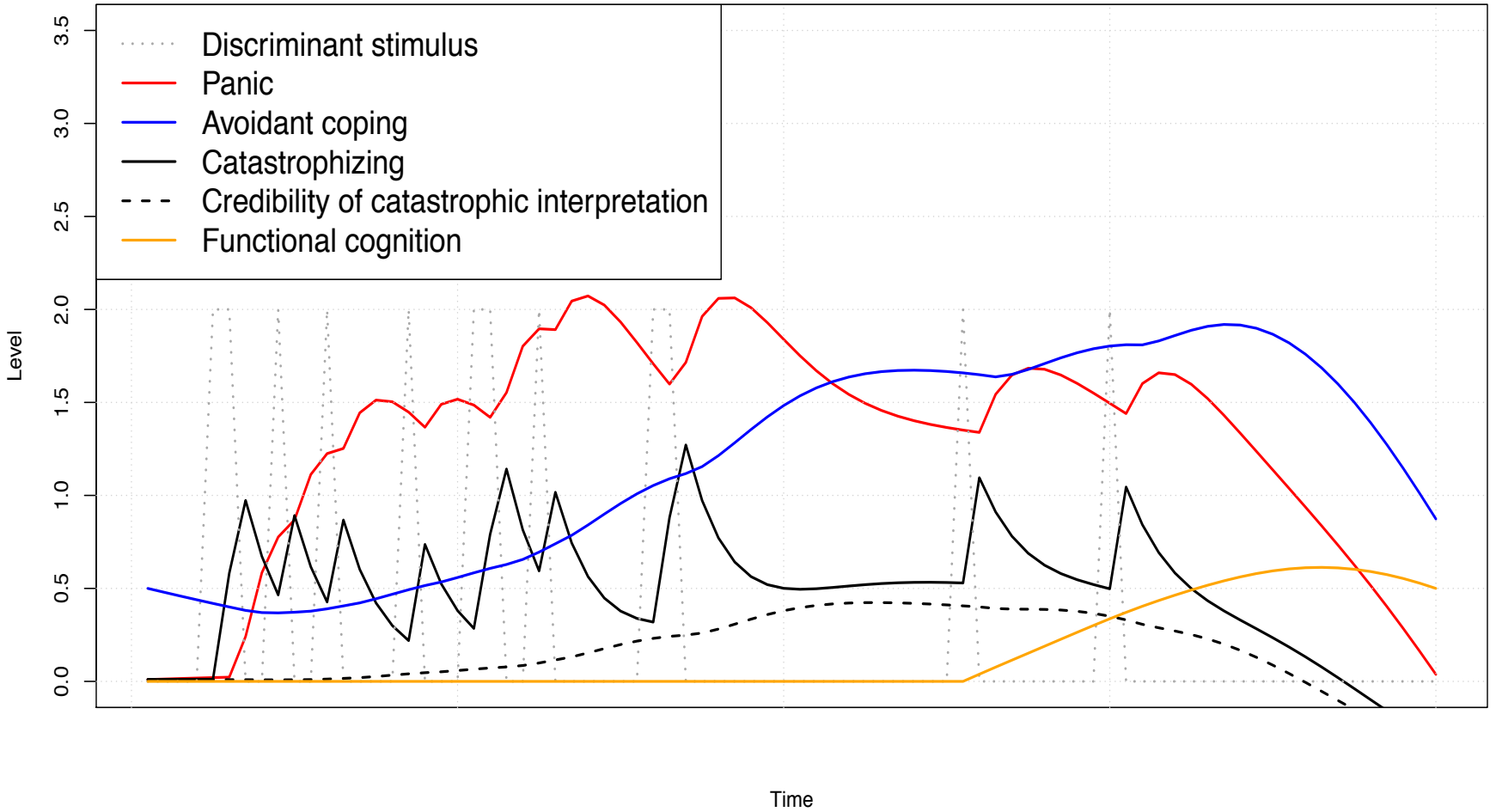
4. Simulating and Visualizing Data

Scenario 2: Behavioral Therapy (*Exposure*)



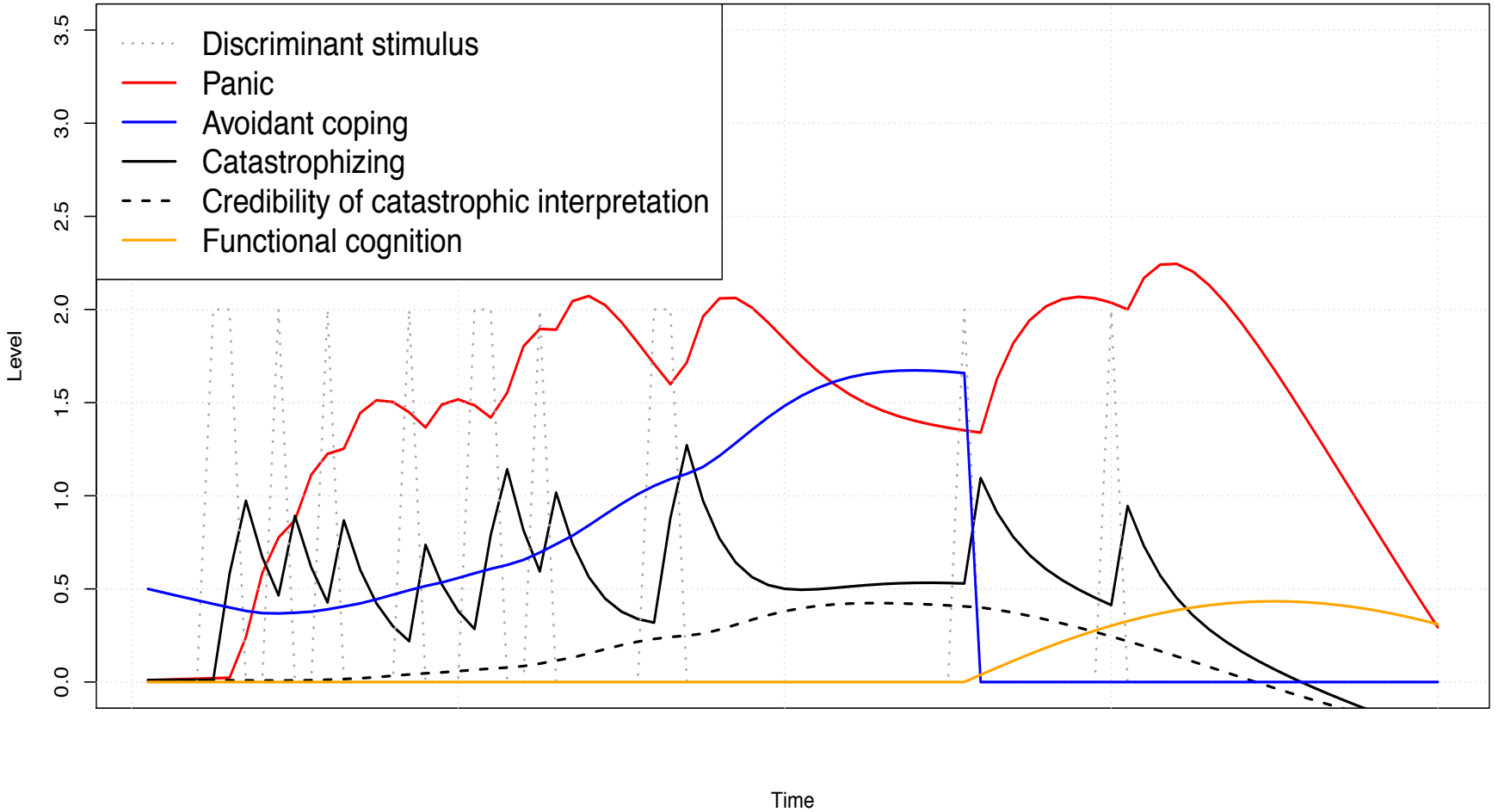
4. Simulating and Visualizing Data

Scenario 3: Cognitive Therapy (*Cognitive Reappraisal*)



4. Simulating and Visualizing Data

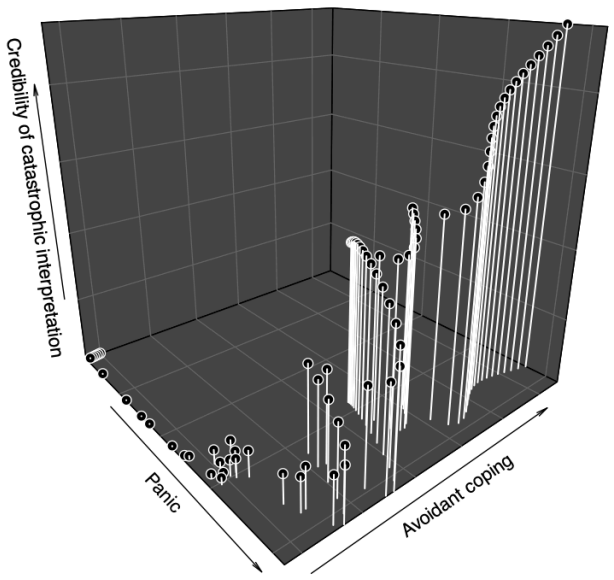
Scenario 4: CBT (*Exposure* + *Cognitive Reappraisal*)



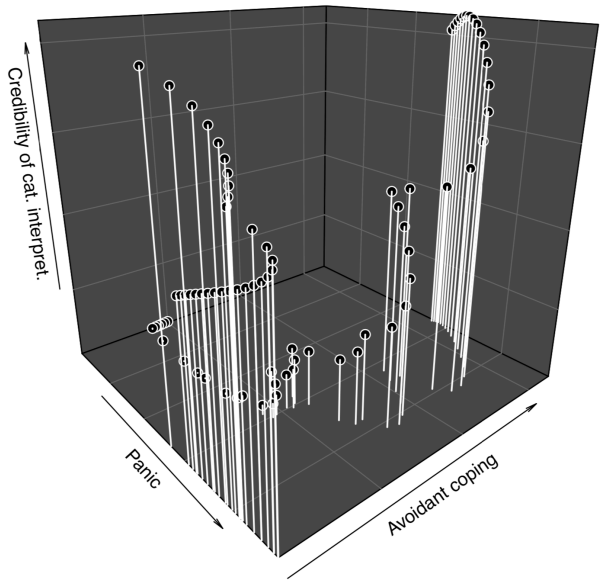
4. Simulating and Visualizing Data

Comparing Intervention Effects

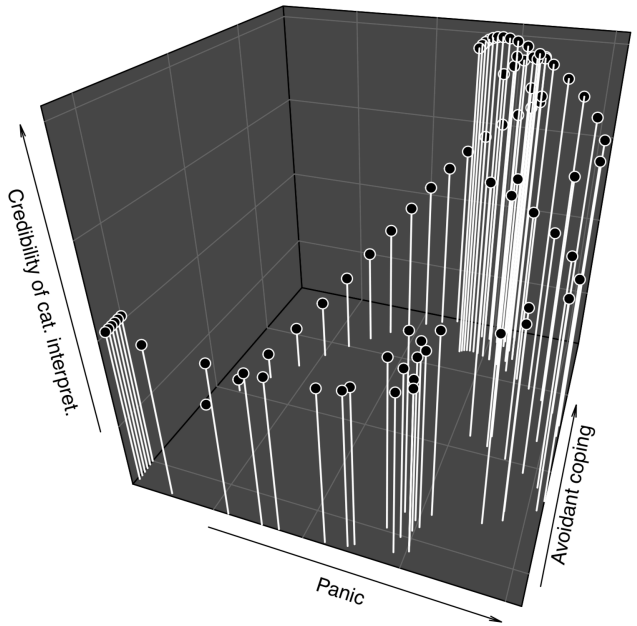
Scenario 1:
No Intervention



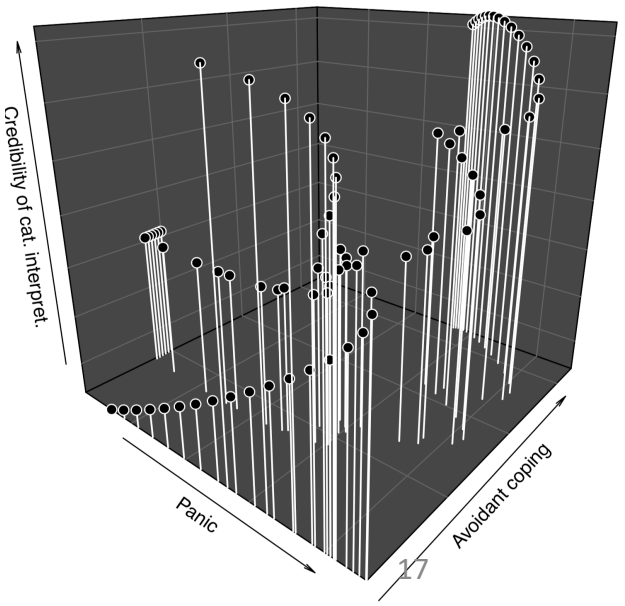
Scenario 2:
Behavioral Therapy



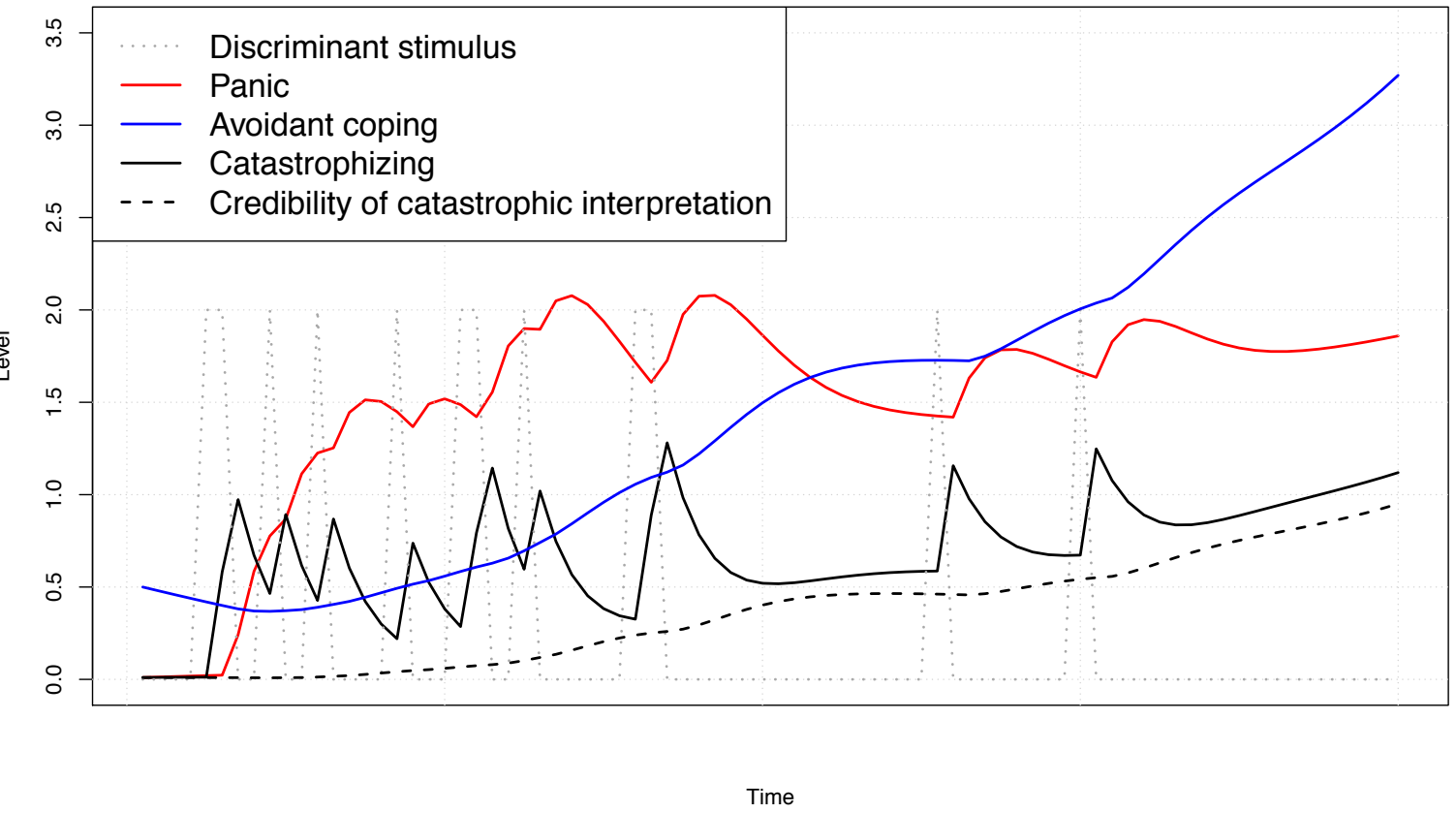
Scenario 3:
Cognitive Therapy



Scenario 4:
CBT



5. Evaluating Case Conceptualization



Can the case conceptualization explain…

… persistent application of avoidant coping?

Yes!

…the role of falsification in panic symptomatology?

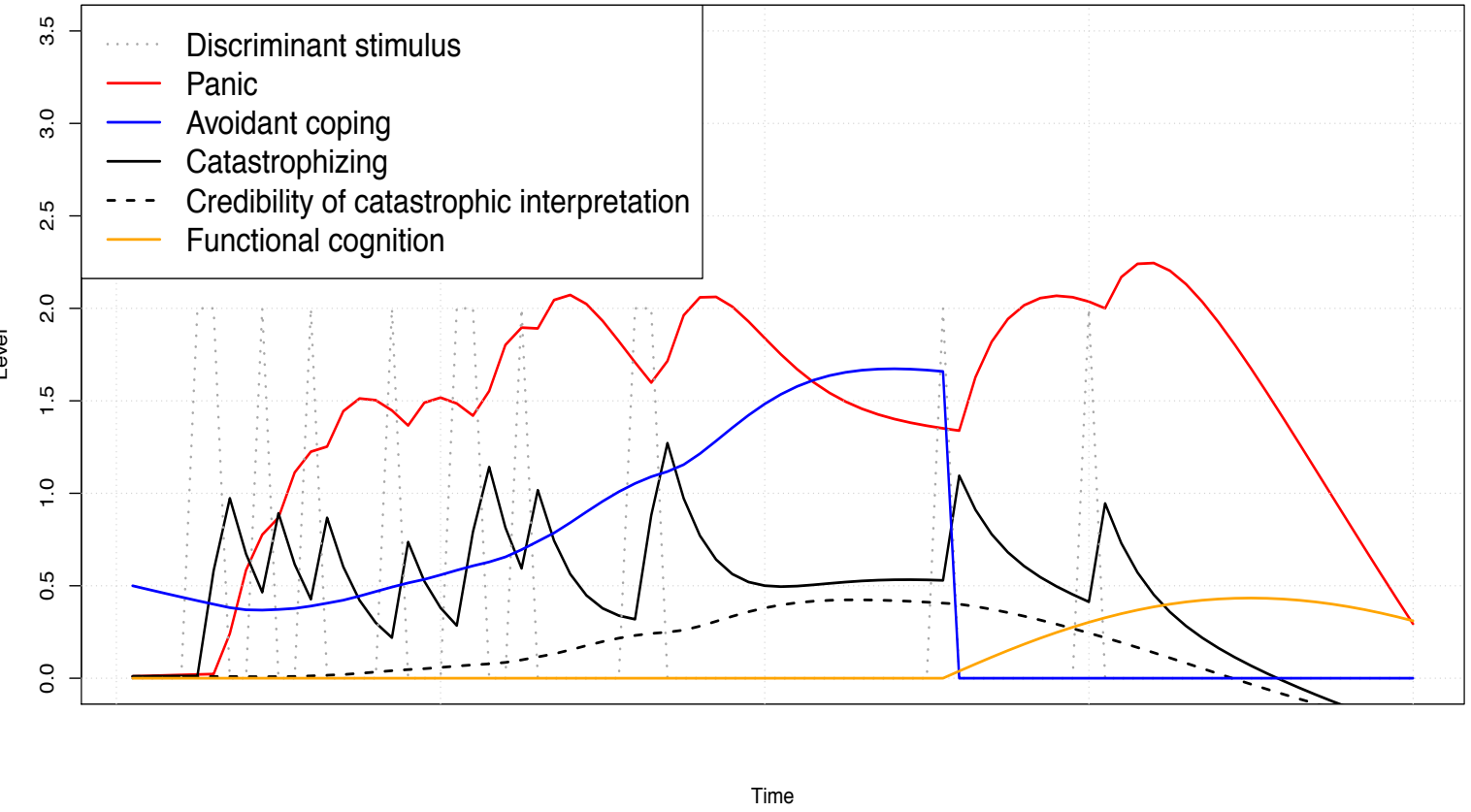
Yes!

…panic attacks?

No, rather *panic tendencies*.

Potentially model stronger decay for panic.

5. Evaluating Case Conceptualization

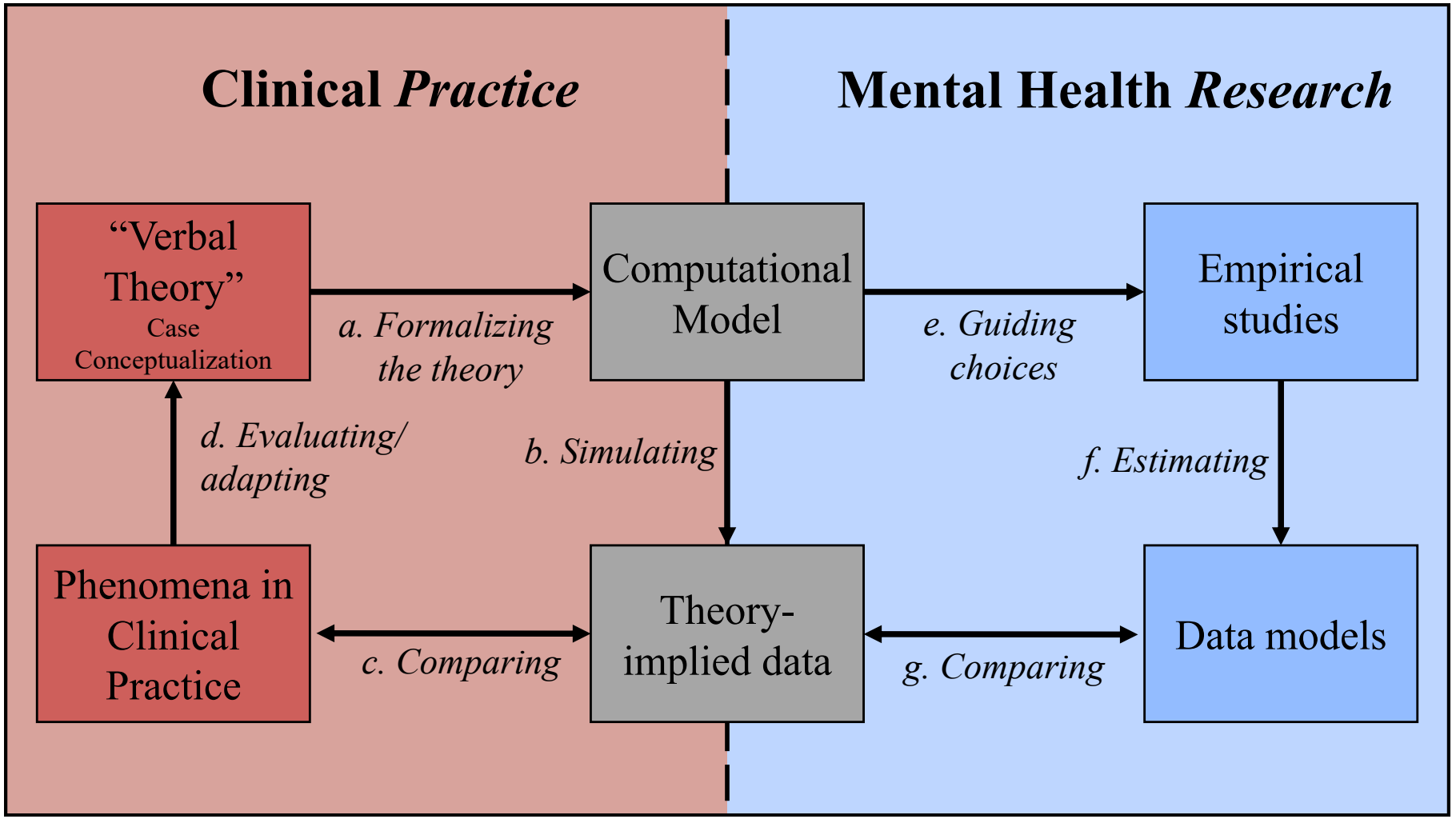


Can the case conceptualization explain…

… differential effects of CBT treatment approaches?

Yes!

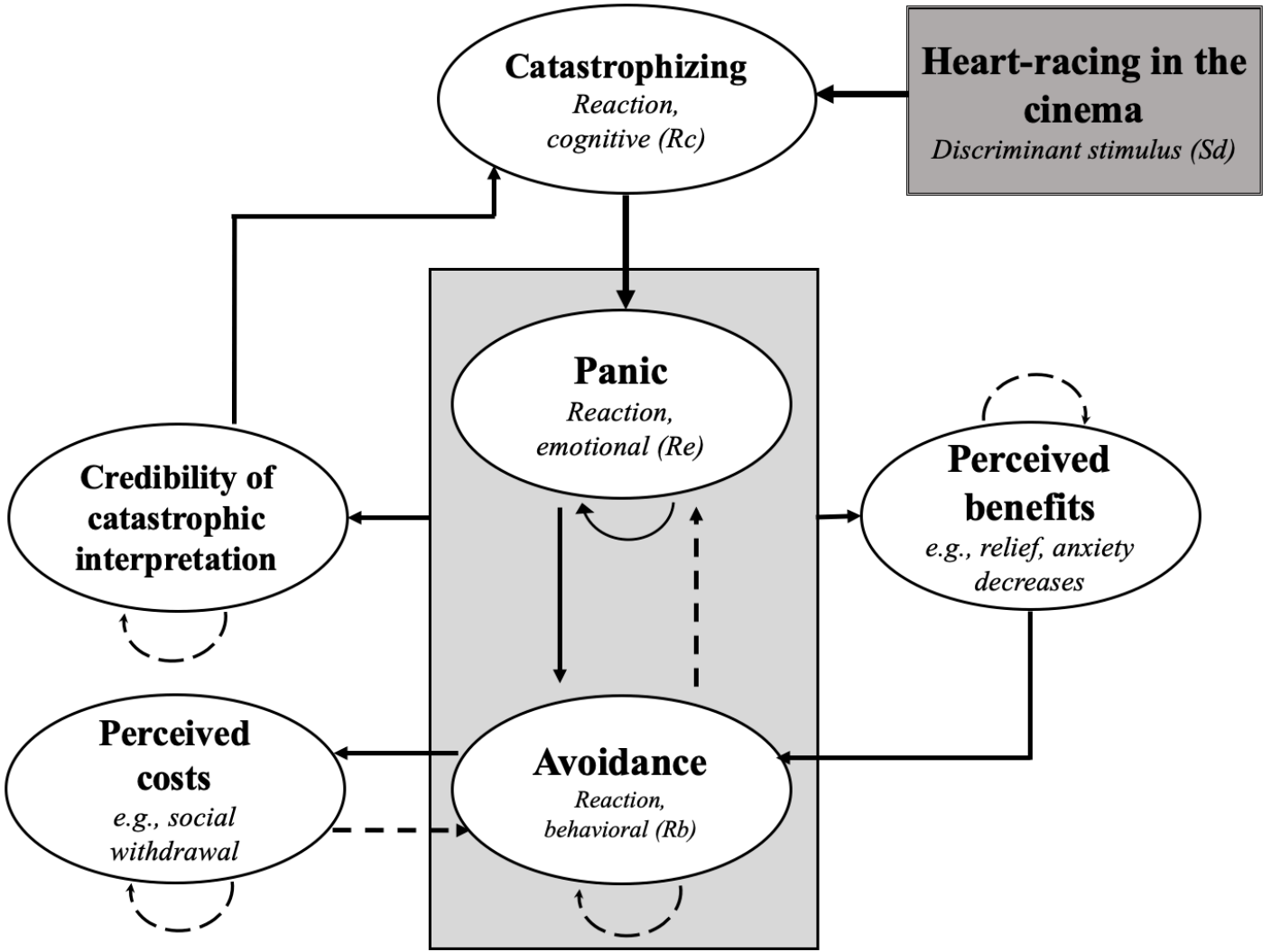
Bridging the Gap Between Clinical Practice and Mental Health Research?



Additional Benefits for Clinical Practice

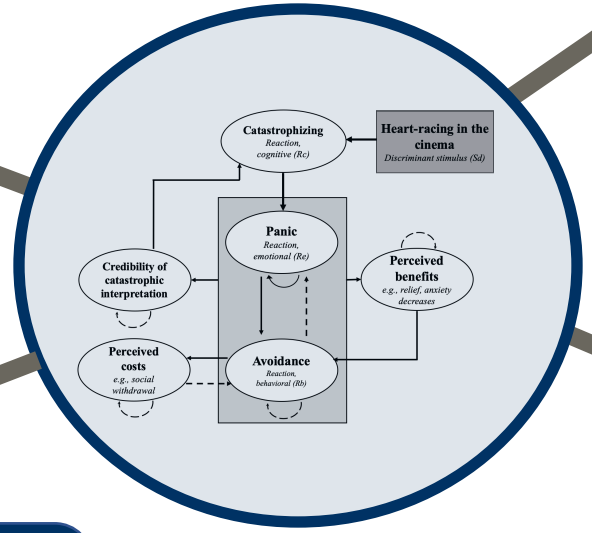
1. **Specification.**
   Enhancing *scientific rigor* in clinical practice.
2. **Explanation.**
   Models illustrate the *function* of symptoms and their role in maintenance.
3. **Prediction.**
   Prediction of *system behavior* and *interventions effects*.
4. **Didactics.**
   Interactive tool for psychoeducation *(patient)* as well as documentation *(therapist and health care institutes)*.
5. **Ideography.**
   Systems can be adapted to *patient-specific* characteristics.

Psychopathology and Social Environment

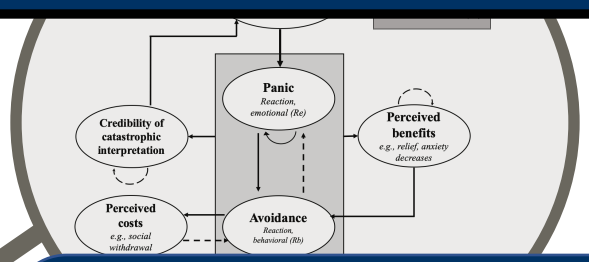


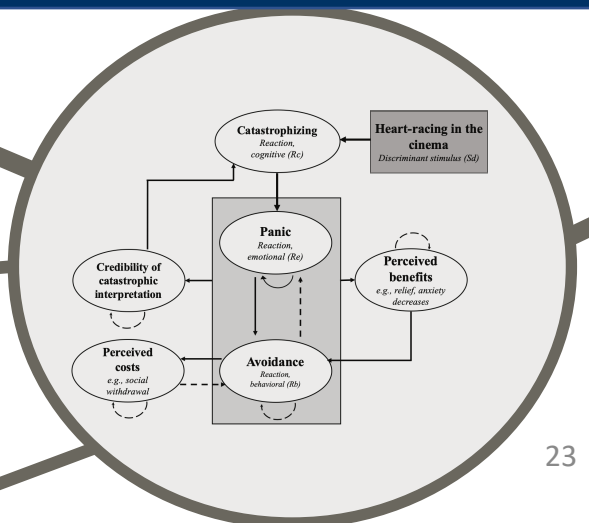
Psychopathology and Social Environment

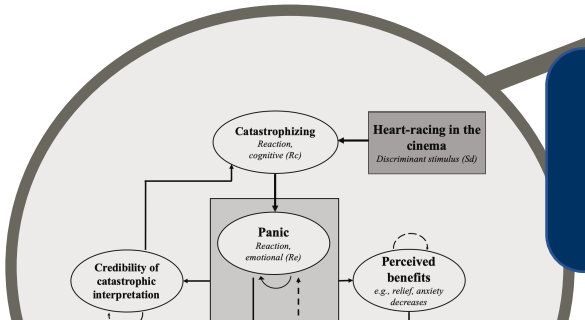
Role of *attachment* in coping?



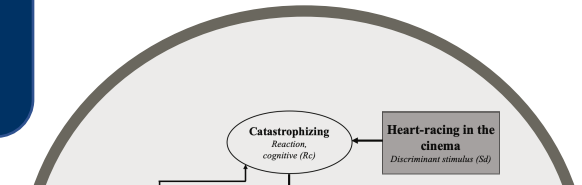
Role of *social learning* processes?







…?



Conclusions

- Personalized Network Models have potential to guide case conceptualizations, yet their **application in clinical practice is rather uncommon.**
- **Formalizing case conceptualizations** is promising in addressing the **scientist-practitioner gap**.
- Future work should look into how individual processes are influenced by the **social environment** of a patient.

Paper (pre-print coming soon)

RESEARCH

Bridging the Gap Between Complexity Science and Clinical Practice by Formalizing Idiographic Theories: A Computational Model of Functional Analysis

Julian Burger[1,2,3*], Date C van der Veen[2], Donald J Robinaugh[4], Rick Quax[3], Harriëtte Riese[2], Robert A Schoevers[2] and Sacha Epskamp[1,3]






References

Armour, C., Fried, E. I., Deserno, M. K., Tsai, J., & Pietrzak, R. H. (2017). A network analysis of DSM-5 posttraumatic stress disorder symptoms and correlates in US military veterans. *Journal of anxiety disorders*, *45*, 49-59. https://doi.org/10.1016/j.janxdis.2016.11.008

Fried, E. I., Epskamp, S., Nesse, R. M., Tuerlinckx, F., & Borsboom, D. (2016). What are'good'depression symptoms? Comparing the centrality of DSM and non-DSM symptoms of depression in a network analysis. *Journal of affective disorders*, *189*, 314-320. https://doi.org/10.1016/j.jad.2015.09.005

Epskamp, S., van Borkulo, C. D., van der Veen, D. C., Servaas, M. N., Isvoranu, A. M., Riese, H., & Cramer, A. O. (2018). Personalized network modeling in psychopathology: The importance of contemporaneous and temporal connections. *Clinical Psychological Science*, *6*(3), 416-427. https://**doi**.org/10.1177/2167702617744325

Some More Future Directions

1. Providing **set of functions** to help clinicians formalize case conceptualizations.
2. Estimating **parameter** from patient-data.
3. **Clinical guidelines** for deriving differential equations from case conceptualizations.
4. **Bayesian approach** to incorporating knowledge in symptom networks.