

Modeling Psychopathology: From Data Models to Formal Theories

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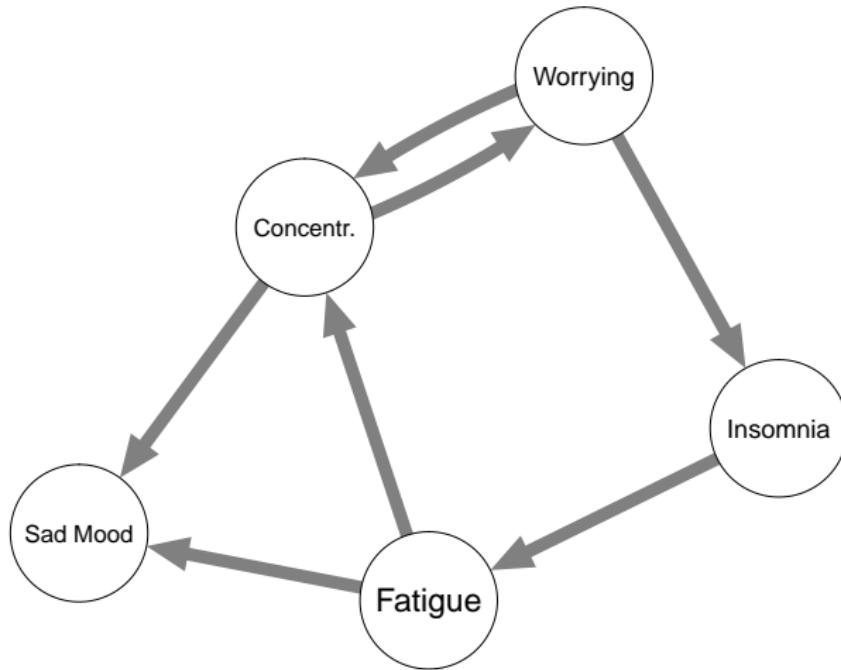
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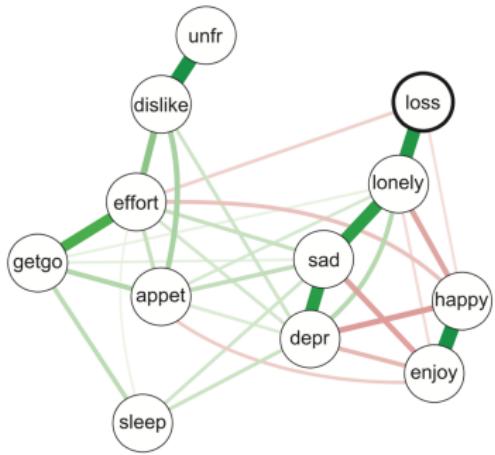
EAM 2021

Network Approach to Psychopathology



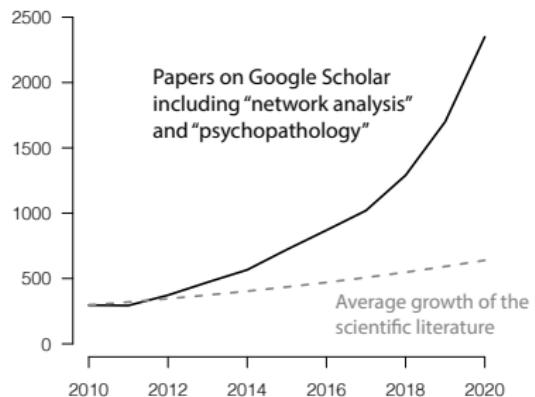
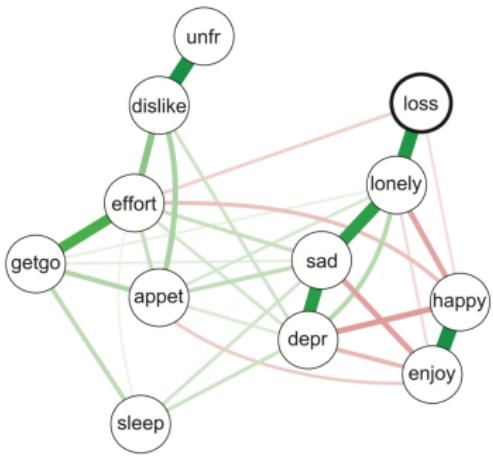
(Cramer et al, 2010; Borsboom et al. 2013; Schmittman et al, 2013; Borsboom, 2017)

Statistical Network Analysis



(Figure from Fried et al., 2015)

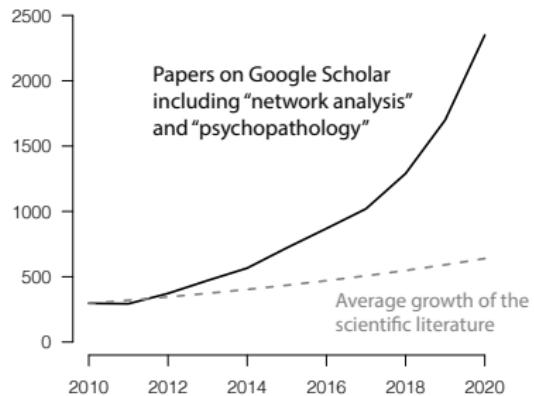
Statistical Network Analysis



(Figure from Fried et al., 2015)

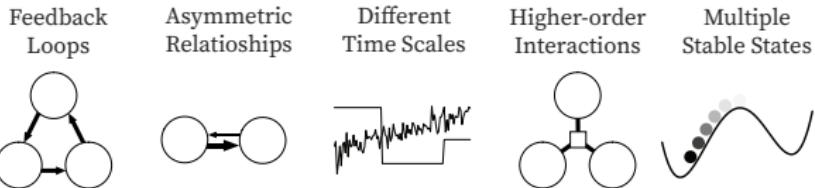
Statistical Network Analysis

Theories?



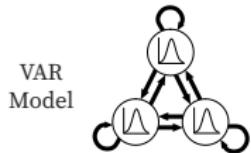
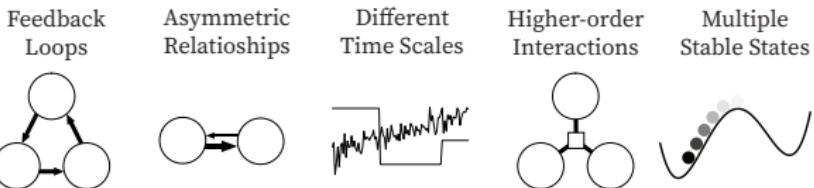
Statistical Network Models as Theories?

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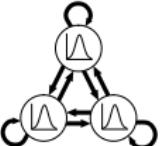
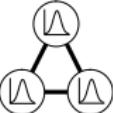
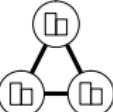
(Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

Statistical Network Models as Theories?



(Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

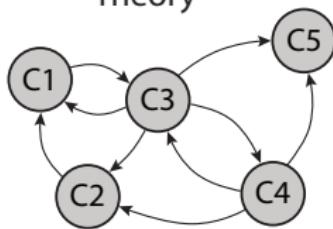
Statistical Network Models as Theories?

	Feedback Loops	Asymmetric Relationships	Different Time Scales	Higher-order Interactions	Multiple Stable States
VAR Model		✓	✓	✗	✗
GGM		✓	✗	✗	✗
Ising Model		✓	✗	✗	✓

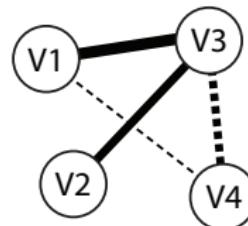
(Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

Target systems, Theories, Data and Data Models

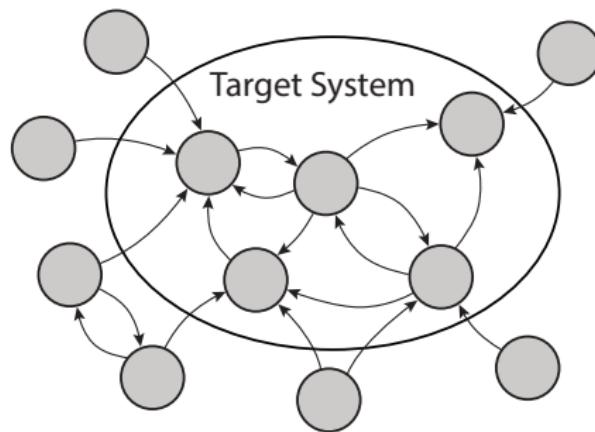
Theory



Data Model



Target System

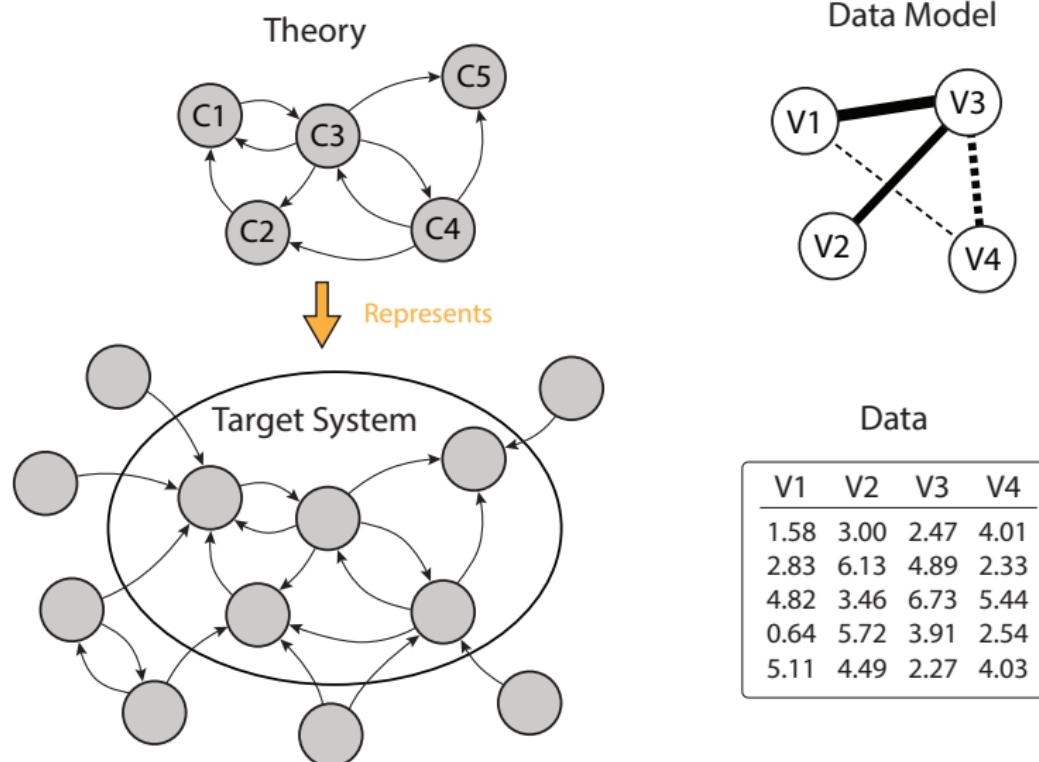


Data

V1	V2	V3	V4
1.58	3.00	2.47	4.01
2.83	6.13	4.89	2.33
4.82	3.46	6.73	5.44
0.64	5.72	3.91	2.54
5.11	4.49	2.27	4.03

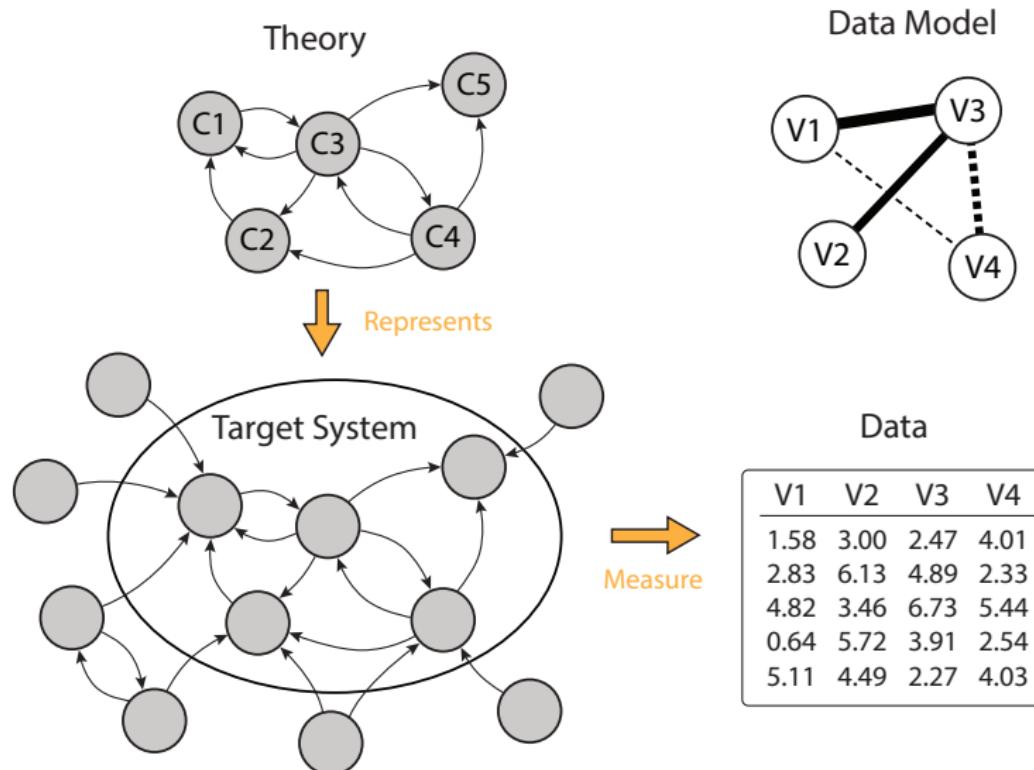
(Suárez & Pero, 2019; Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

Target systems, Theories, Data and Data Models



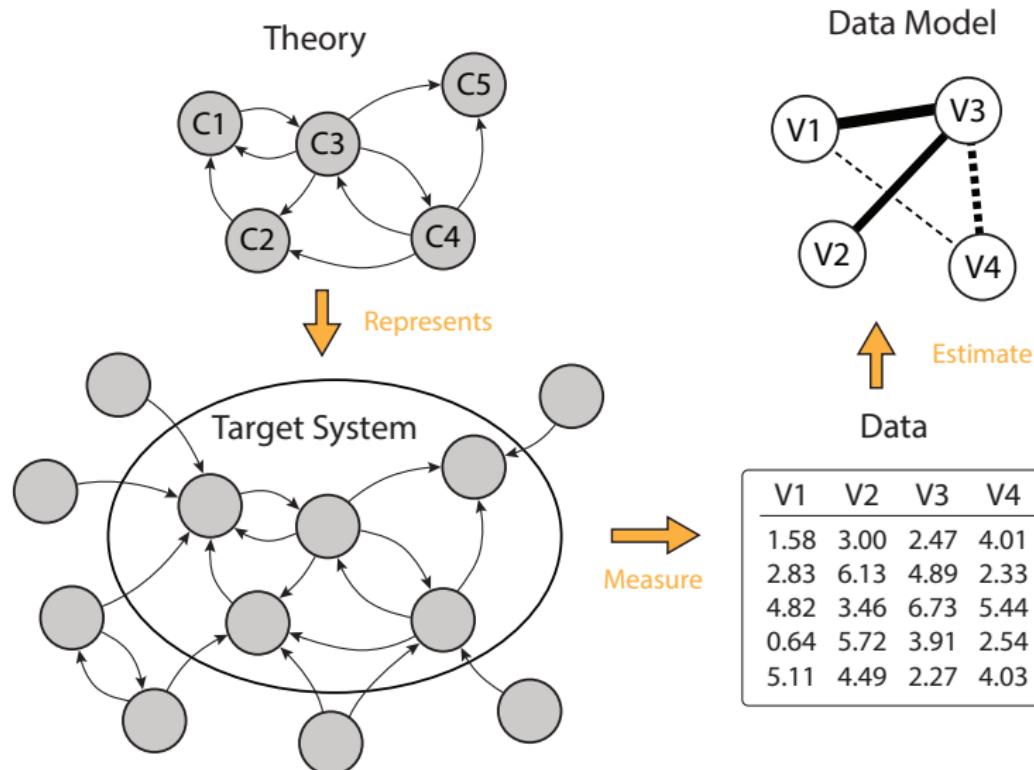
(Suárez & Pero, 2019; Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

Target systems, Theories, Data and Data Models



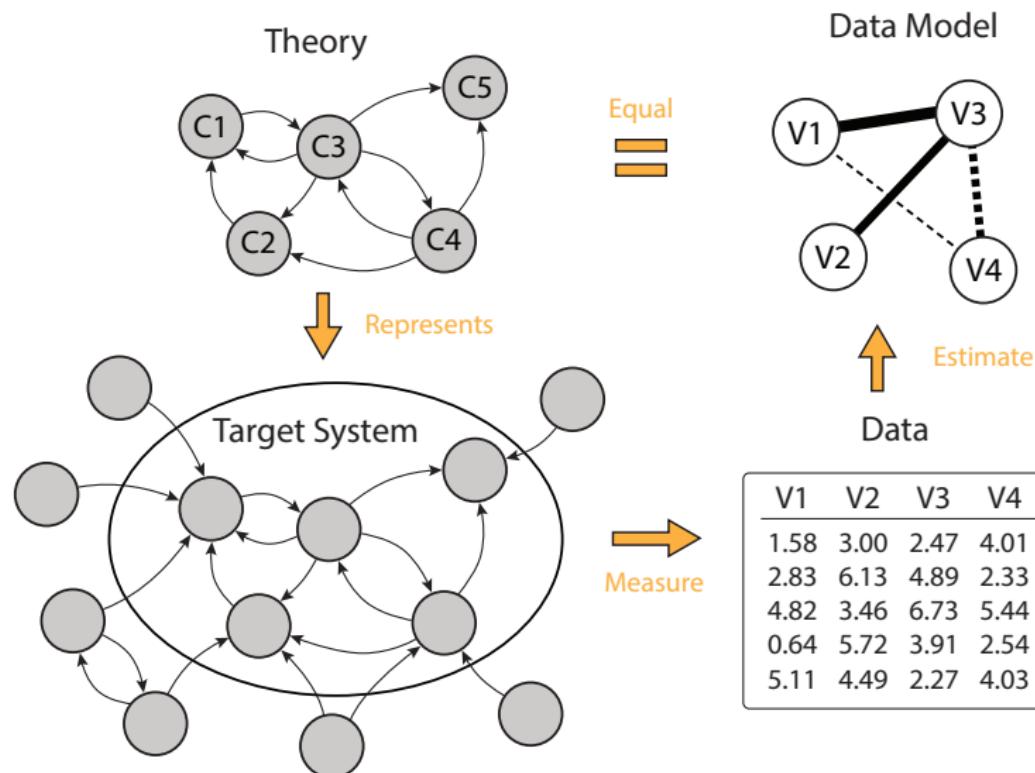
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Target systems, Theories, Data and Data Models



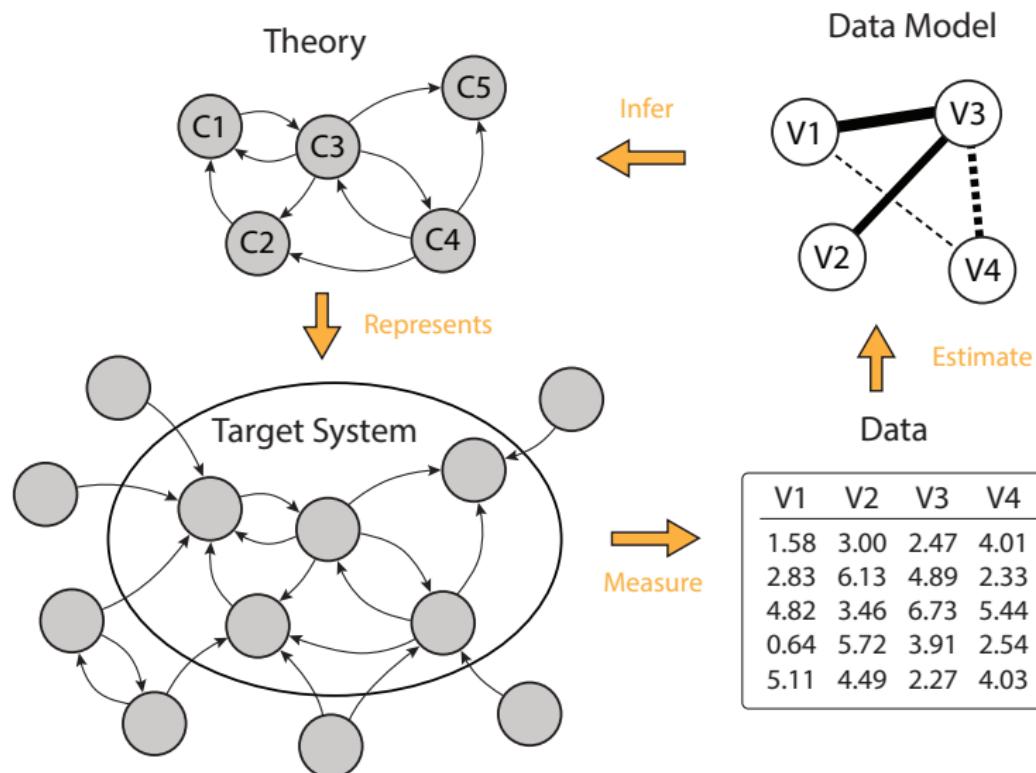
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Target systems, Theories, Data and Data Models



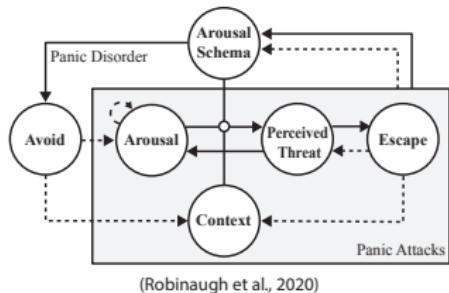
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Target systems, Theories, Data and Data Models

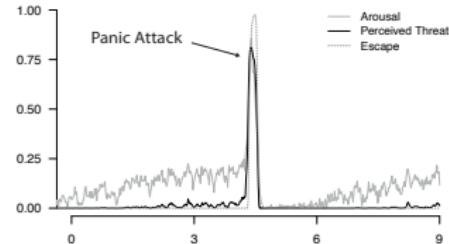


(Suárez & Pero, 2019; Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

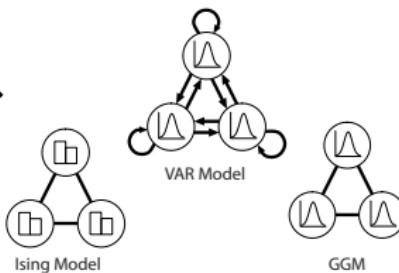
Infer Theories from Data Models?



Generate →



Try to infer
true formal theory

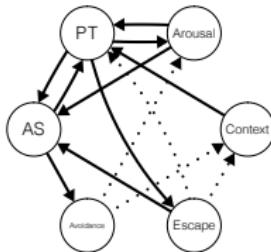


Estimate

(Robinaugh et al., 2020; Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

Infer Theories from Data Models?

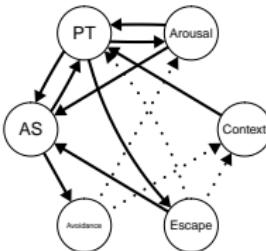
(a) True Local Dependence



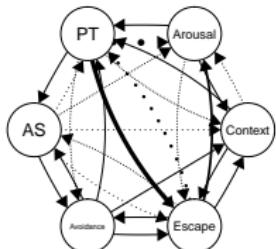
(Haslbeck*, Ryan*, Robinaugh*, et al., 2021; Ryan, Bringmann, Schuurman, 2020)

Infer Theories from Data Models?

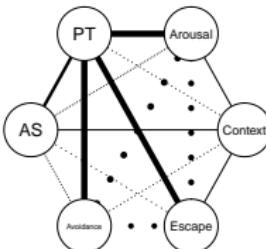
(a) True Local Dependence



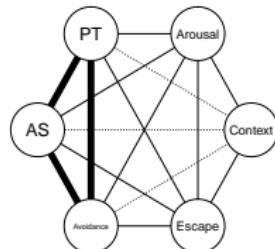
(b) VAR Model



(c) Gaussian Graphical Model

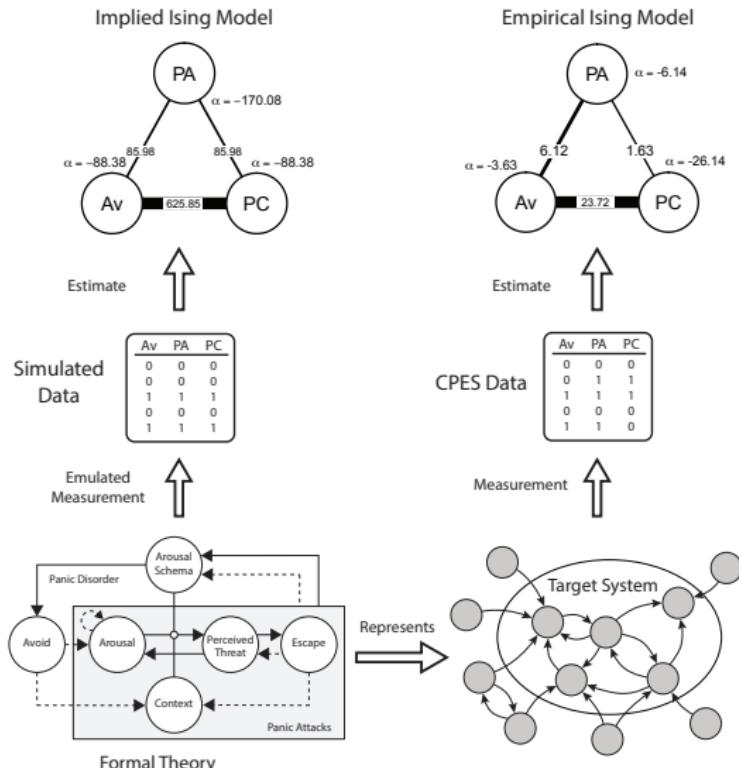


(d) Ising Model



(Haslbeck*, Ryan*, Robinaugh*, et al., 2021; Ryan, Bringmann, Schuurman, 2020)

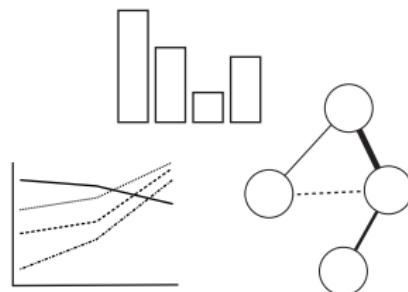
Alternative: Abductive Theory Construction



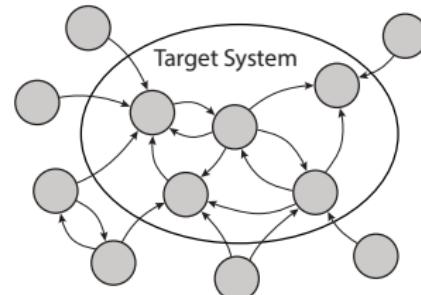
(Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

How to generate an initial theory?

Step 1: Specify phenomenon to be explained



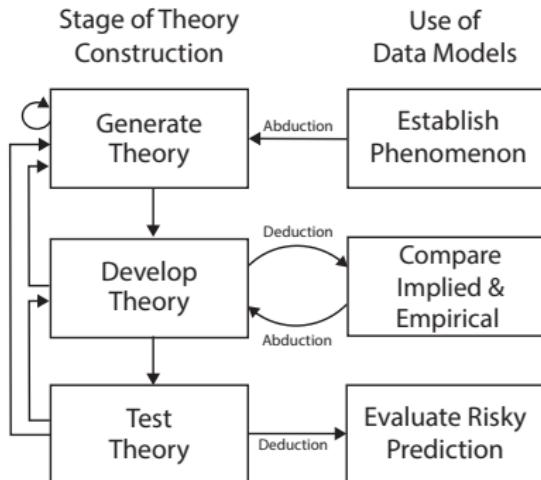
Step 2: Specify components and relations of target system



(Wimsat, 1987; Smaldino, 2017; Haslbeck*, Ryan*, Robinaugh*, et al., 2021)

From Data Models to Formal Theories

- ▶ Data models are unlikely to be good theories
- ▶ Naive inferences from data models to theories are highly problematic
- ▶ Abductive theory construction may be a powerful way forward



Haslbeck J. M. B.* , Ryan O.* , Robinaugh D. J.* , Waldorp L. J. , & Borsboom D. (accepted, 2021). Modeling Psychopathology: From Data Models to Formal Theories. *Psychological Methods*. PsyArXiv: <https://psyarxiv.com/jgm7f>

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Thanks to J Haslbeck for slides