Modeling Psychopathology: From Data Models to Formal Theories

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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 Models as Theories?

<table>
<thead>
<tr>
<th>Feedback Loops</th>
<th>Asymmetric Relationships</th>
<th>Different Time Scales</th>
<th>Higher-order Interactions</th>
<th>Multiple Stable States</th>
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VAR Model

GGM

Ising Model

(Haslbeck*, Ryan*, Robinaugh*, et al., accepted)
Target systems, Theories, Data and Data Models

Target System

C1 → C3 → C5
C2 → C3 → C4
Theory

C5

Data Model

V1

V2

V3

V4

Data

V1

V2

V3

V4

Data Model

V1

1.58

2.83

4.82

0.64

5.11

V2

3.00

6.13

3.46

5.72

4.49

V3

2.47

4.89

6.73

3.91

2.27

V4

4.01

2.33

5.44

2.54

4.03

Represents

Measure

Estimate

Equal

(Haslbeck*, Ryan*, Robinaugh*, et al., accepted)
Target systems, Theories, Data and Data Models

(Haslbeck*, Ryan*, Robinaugh*, et al., accepted)
Infer Theories from Data Models?

- Arousal
- Perceived Threat
- Escape
- Arousal Schema
- Context

Panic Disorder

VAR Model
Ising Model
GGM

Generate
Estimate
Try to infer true formal theory

Panic Attacks

(Robinaugh et al., 2020; Haslbeck*, Ryan*, Robinaugh*, et al., accepted)
Infer Theories from Data Models?

(a) True Local Dependence

(b) VAR Model

(c) Gaussian Graphical Model

(d) Ising Model

(Haslbeck*, Ryan*, Robinaugh*, et al., accepted)
Alternative: Abductive Theory Construction

Implied Ising Model

\[
\begin{align*}
\alpha &= -170.08 \\
\alpha &= -88.38 \\
\alpha &= -88.38
\end{align*}
\]

Empirical Ising Model

\[
\begin{align*}
\alpha &= -6.14 \\
\alpha &= 6.12 \\
\alpha &= -6.14
\end{align*}
\]

Simulated Data

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CPES Data

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Measurement

Estimate

Context

Avoid

Escape

Perceived Threat

Arousal

Panic Disorder

Arousal Schema

Formal Theory

Represents

Target System

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


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