

A motivating  
example

Ecological fallacies

Why is measuring  
welfare so difficult?

Multi-level models

Network analysis

$N = 1$

Summary

# From between-individual to within-individual differences:

What can we learn from individual-oriented analyses?

Conor Goold & Ruth C. Newberry

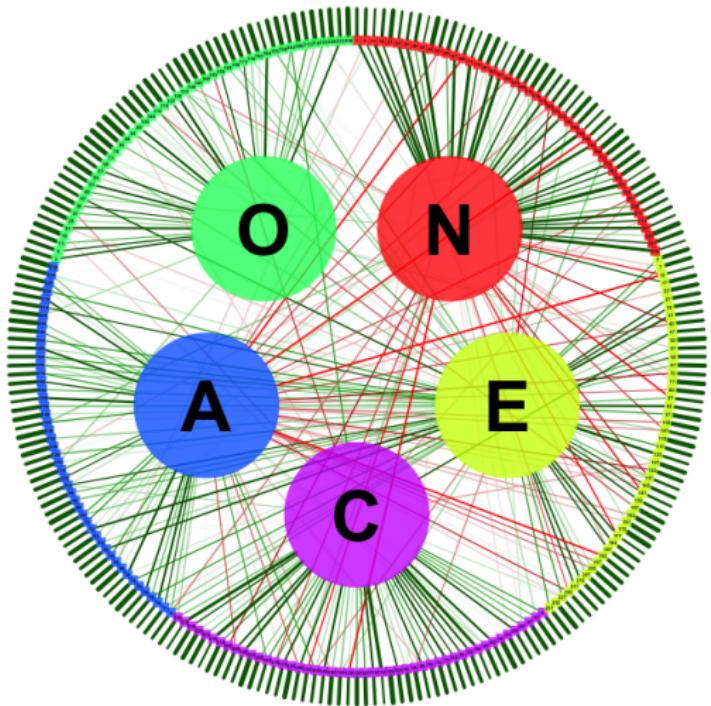
Norwegian University of Life Sciences, Ås, Norway



28th June, 2017

## The Five Factor model (FFM)

**Openness, Neuroticism, Extraversion, Conscientiousness, Agreeableness**



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# A Manifesto on Psychology as Idiographic Science: Bringing the Person Back Into Scientific Psychology, This Time Forever

Peter C. M. Molenaar  
*Department of Psychology*  
*University of Amsterdam*

Psychology is focused on variation between cases (interindividual variation). Results thus obtained are considered to be generalizable to the understanding and explanation of variation within single cases (intraindividual variation). It is indicated, however, that the direct consequences of the classical ergodic theorems for psychology

Molenaar (2004)

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# The FFM is an incomplete description of within-individual behaviour

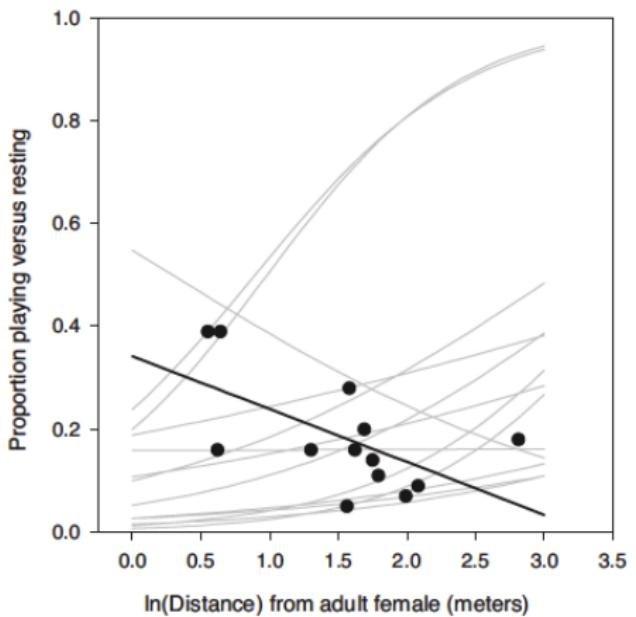
**“** *The time series analysis of some participants obey a two-factor model, of others a three-factor model, and again others a four factor model.* **”**

Molenaar (2004)

Aggregating data across individuals may mask patterns and processes at the individual level.

# Ecological fallacy or Simpson's 'paradox'

Relationship between probability of playing vs. resting in juvenile baboons and distance from adult female



Pollet *et al.* (2015)

# How ‘*non-ergodic*’ are you?

## 2017 : WHAT SCIENTIFIC TERM OR CONCEPT OUGHT TO BE MORE WIDELY KNOWN?

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**Stuart A. Kauffman**

Professor of Biological Sciences, Physics, Astronomy, University of Calgary; Author, *Reinventing the Sacred*

### Non Ergodic

“Non ergodic” is a fundamental but too little known scientific concept. Non-ergodicity stands in contrast to “ergodicity.” “Ergodic” means that the system in question visits all its possible states. In Statistical Mechanics this is based on the famous “ergodic hypothesis, which, mathematically, gives up integration of Newton’s equations of motion for the system. Ergodic systems have no deep sense of “history.” Non-ergodic systems do not visit all of their possible states. In physics perhaps the most familiar case of a non-ergodic system is a spin glass which “breaks” ergodicity and visits only a tiny subset of its possible states, hence exhibits history in a deep sense.

Even more profoundly, the evolution of life in our biosphere is profoundly “non-ergodic” and historical. The universe will not create all possible life forms. This, together with heritable variation, is the substantial basis for Darwin, without yet specifying the means of heritable variation, whose basis Darwin did not know. Non-ergodicity gives us history.

June 17th (2017)

<https://www.edge.org/response-detail/27104>

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# Why is measuring welfare difficult?

Animal welfare is a “*state within the animal*” [Hemsworth et al. \(2015\)](#)



# Perils of data aggregation known but remains commonplace

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Welfare at the group-level may not indicate heterogeneity at the individual level

Broom (1986)

Data ‘pooling’ may appear attractive in some cases, but requires unlikely assumptions

- ▶ Mean and variance stable across individuals

Leder & Didrichsons (1994)

# Remedies

1. Study change at the lowest statistical unit
2. Test mechanistic models

Kievit *et al.* (2013)

## Three methods:

- ▶ Multi-level models
- ▶ Network perspectives
- ▶  $N = 1$  designs

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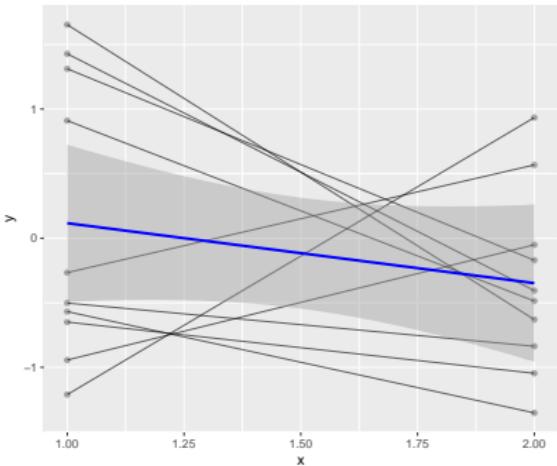
$N = 1$

Summary

# 1. Multi-level modelling

Regression parameters are varied across statistical units

So-called '**random effects**' allow parameters to be estimated at both individual- and group-levels



# Example: behavioural reaction norms

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## Sociability in shelter dogs over days since arrival

- ▶ personality, plasticity and predictability

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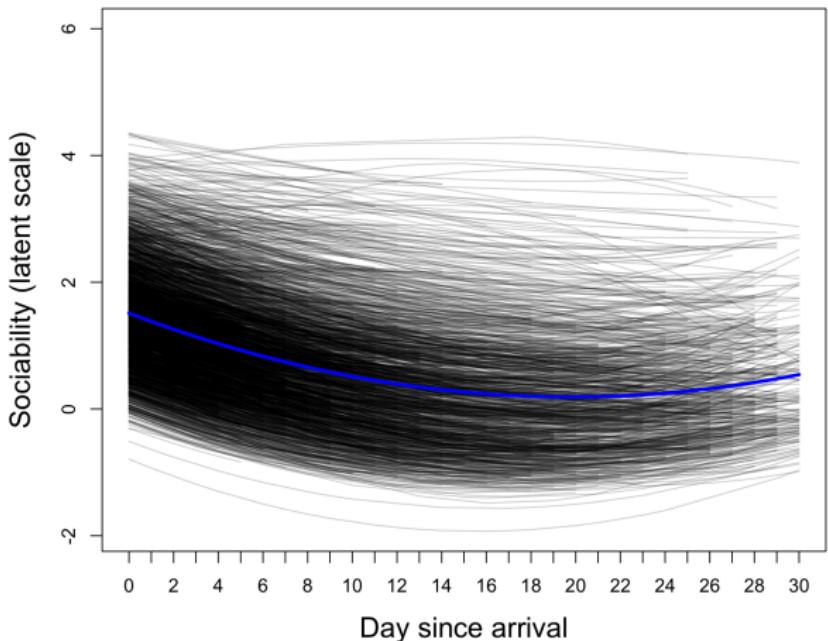
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Bayesian multi-level models

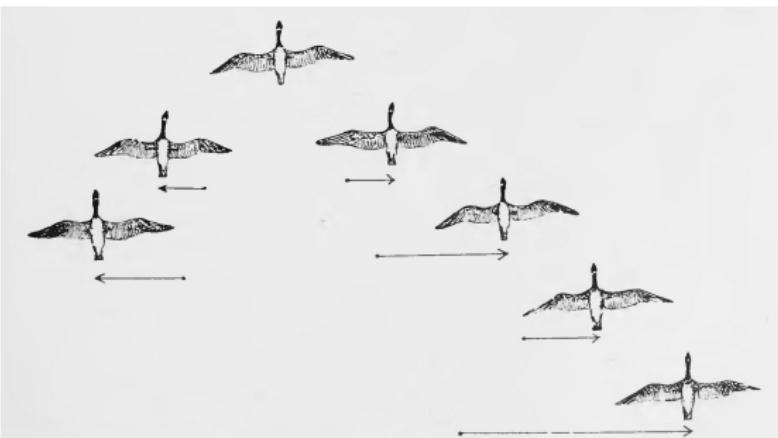
3,263 dogs; 19,281 interactions

(lower scores = higher sociability)

Goold & Newberry (2017)

<http://biorxiv.org/content/early/2017/06/04/145367>

<https://github.com/ConorGoold>

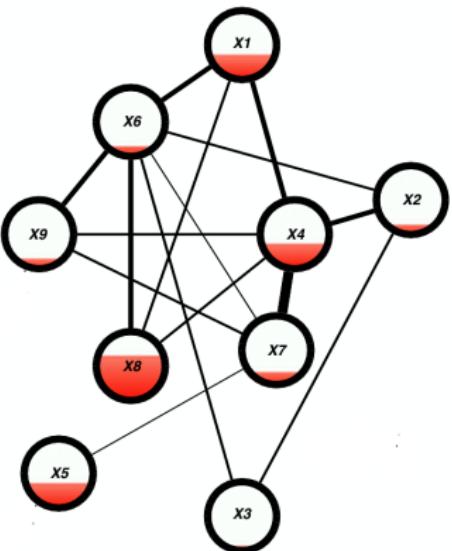


Permitted for reuse: Wikipedia Commons

# Example: Major Depression Cramer et al. (2016)

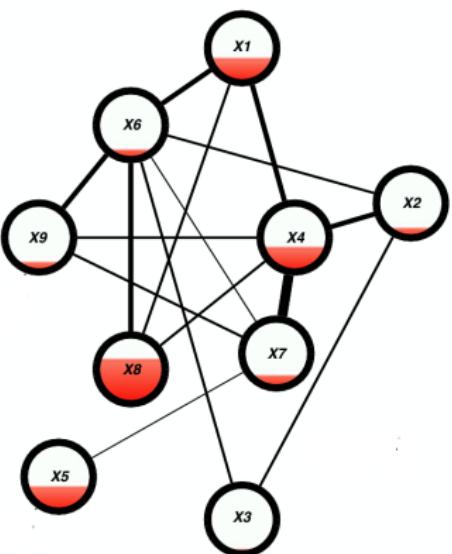
A network of depression symptoms

- ▶ E.g. lack of sleep  $\implies$  loss of concentration



# Example: Major Depression Cramer et al. (2016)

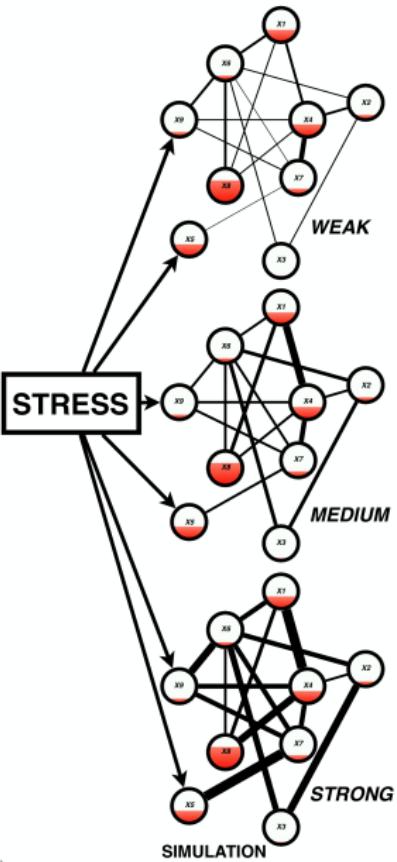
Depression = high total activation of symptoms



## Example: Major Depression Cramer *et al.* (2016)

Cramer *et al.* (2016)

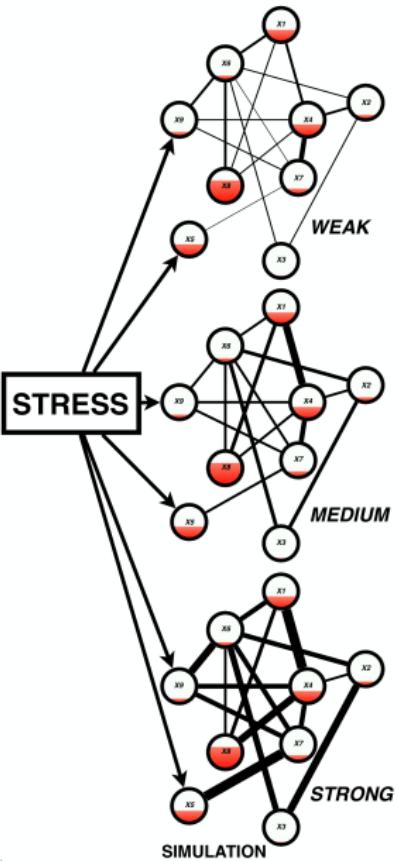
- Stress  $\Rightarrow$  depression in strongly connected networks



## Example: Major Depression Cramer *et al.* (2016)

## Network analysis

- ▶ Stress  $\Rightarrow$  depression in strongly connected networks
  - ▶ More strongly connected systems struggle to recover



### 3. Individual dynamics from $N = 1$ studies

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Summary

Identify general patterns of cognitive and affective states from studying individuals intensively

Time-series data collection

- ▶ Ecological momentary assessments

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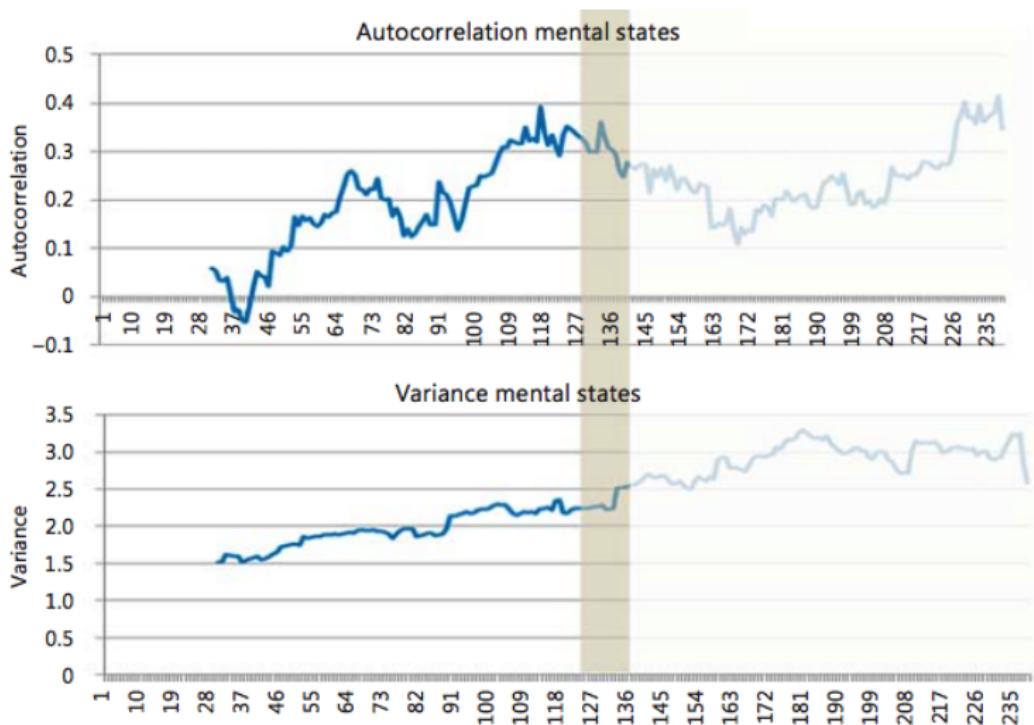
$N = 1$

Summary

# Example: early warning signs of depression

- ▶ 1,474 observations of daily life from 1 patient (up to 10 times/day; 239 days)

# Example: early warning signs of depression



Wichers *et al.* (2016)  
<https://doi.org/10.1159/000441458>

# What can we learn from individual-oriented approaches?

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Summary

- ▶ Between- and within-individual processes are rarely the same
- ▶ Methodology is available to adopt within-individual perspectives
- ▶ If understanding individual-level welfare is the goal, individual-oriented perspectives are required.