Divided we stand:

A tutorial on using variability in theory and data analysis

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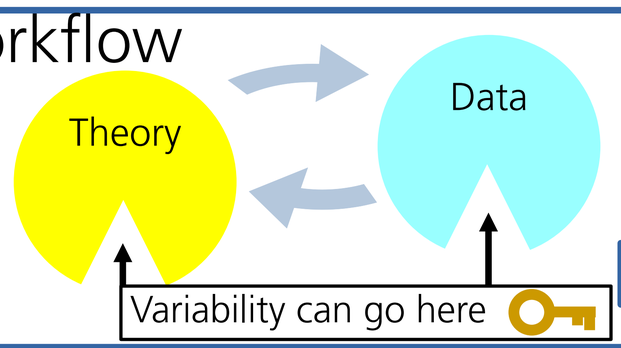
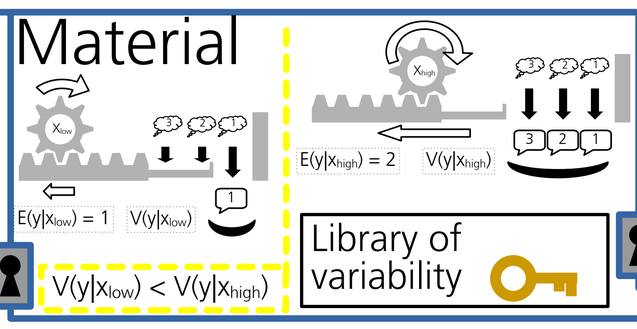
Intent: Using variability

E(y|x) AND V(y|x)!

Workflow



Material



Implementation

- Theoretical model
- Study design
- Data analysis

Publication?

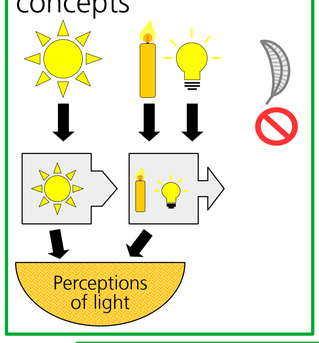
Workflow

Framework → Theoretical model → Predictions → Study design → Data analysis

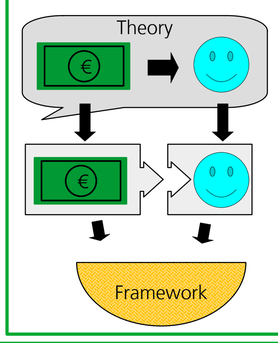
1 Framework

The meaningfully thinkable

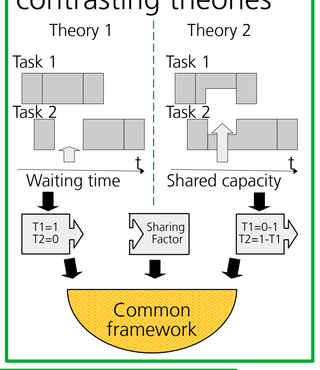
Select and collect relevant, meaningful concepts



Work backwards from theory



Commonly represent contrasting theories

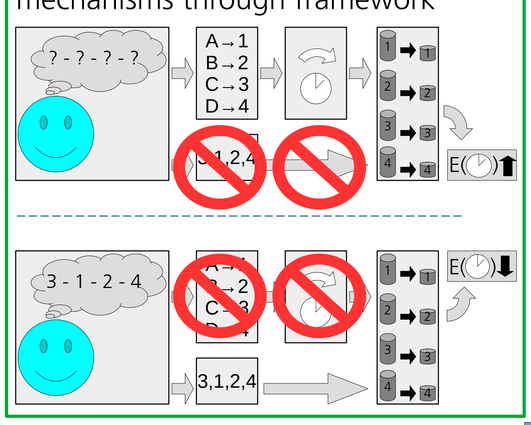


Check: Is variability a core concept?

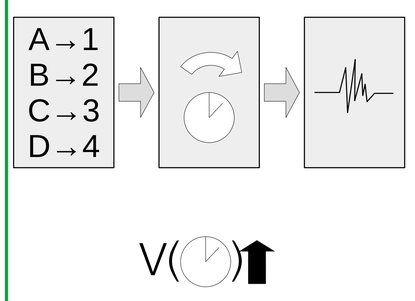
2 Theoretical model

The expressed thoughts

Express relationships implied by mechanisms through framework



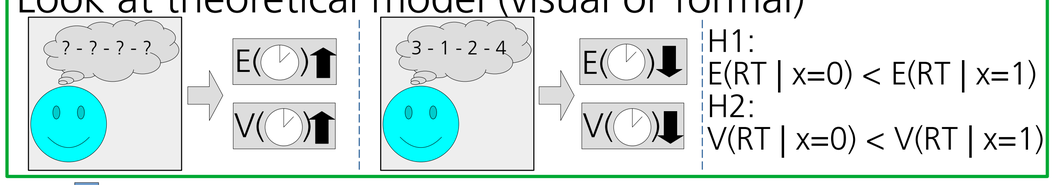
Check: Do the mechanisms also imply variability relationships?



3 Predictions The thoughts' implications

Symbolic / "Analytical"

Look at theoretical model (visual or formal)

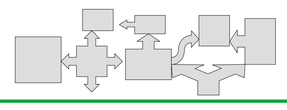


H1:
E(RT | x=0) < E(RT | x=1)
H2:
V(RT | x=0) < V(RT | x=1)

Numerical

Simulate theoretical model, look at simulation output

For complex theories



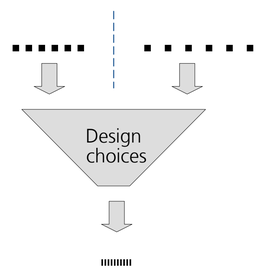
Test assumption dependence

Use novel formats?

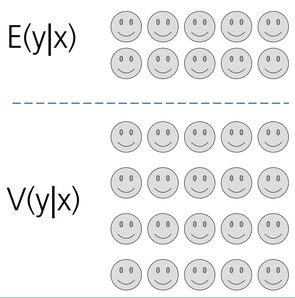
4 Study design

The trap for implications

Avoid constraints



High enough N (>50)



5 Data analysis

Numbers!

Variance function regression

High power

Vulnerable against outliers, asymmetric variances

For: Well-behaved data

Quantile regression

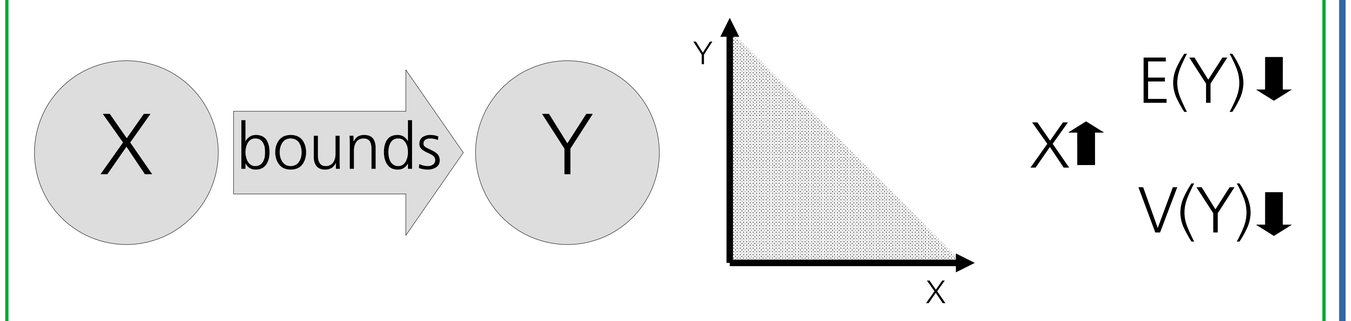
Deals well with outliers, „weirder" distributions

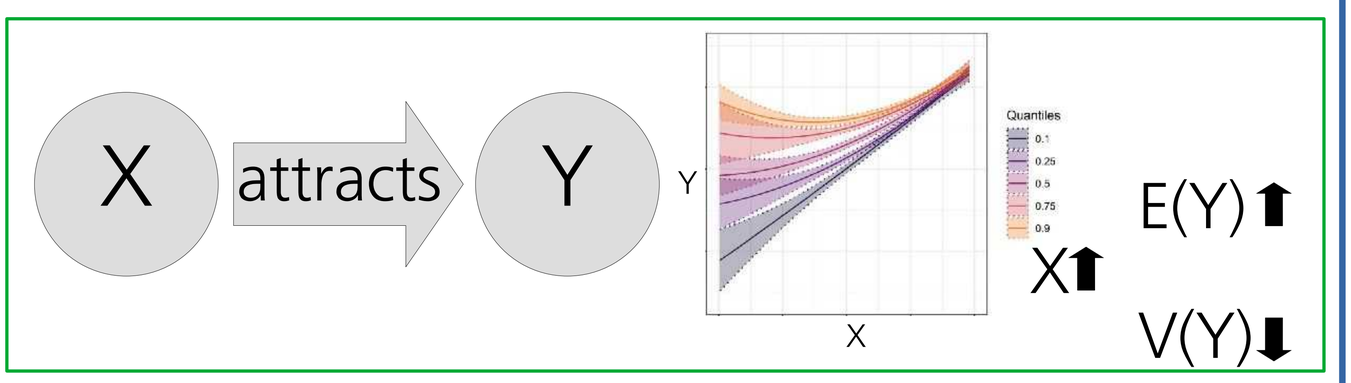
Hungry for sample size

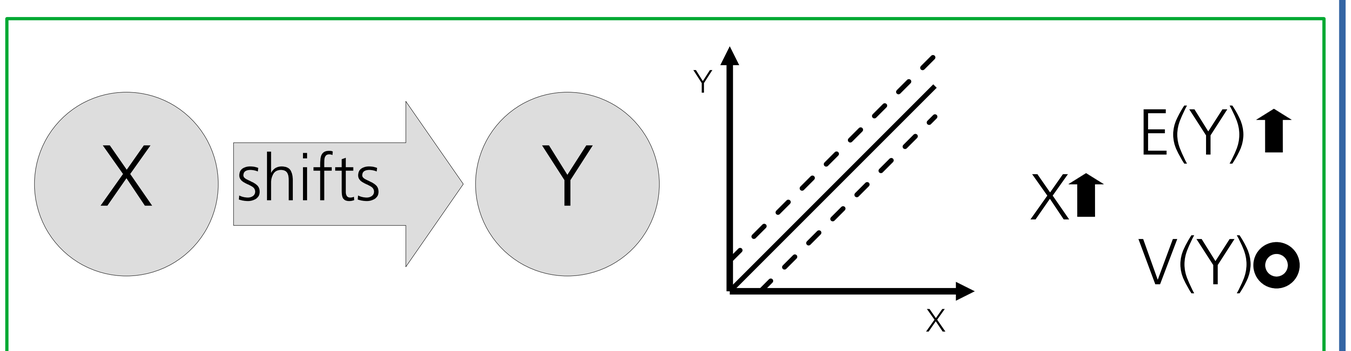
For: Rowdy but plentiful data

Proto-Mechanisms and variability

A starter pack







The tutorial itself

- A fictional researcher's path to variability
- R code examples for VFR and QR
- Expanding online material:
  - ➔mechanism-variability mappings
  - ➔examples of common use cases
  - ➔https://var-psy.github.io

Literature

Modeling and workflow:
Guest, O., & Martin, A. E. (2021). How Computational Modeling Can Force Theory Building in Psychological Science. Perspectives on Psychological Science, 16(4), 789–802. doi:10.1177/1745691620970585
Lundberg, I., Johnson, R., & Stewart, B. M. (2021). What Is Your Estimand? Defining the Target Quantity Connects Statistical Evidence to Theory. American Sociological Review, 86(3), 532-565. doi:10.1177/00031224211004187

Variance function regression:
Western, B., & Bloome, D. (2009). Variance Function Regressions for Studying Inequality. Sociological Methodology, 39(1), 263–326. doi:10.1111/j.1467-9531.2009.01222.x

Quantile regression:
Koenker, R. (Ed.). (2005b). Quantile Regression in R: A Vignette. In Quantile Regression (pp. 295–316). Cambridge University Press. doi:10.1017/CBO9780511754098.011, updated version: https://cran.r-project.org/web/packages/quantreg/vignettes/rq.pdf