

Virtual MathPsych/ICCM 2020

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## How computational modeling can force theory building in psychological science

Guest, Olivia<sup>1,2</sup>, and Martin, Andrea E.<sup>3,4</sup>

1: Research Centre on Interactive Media, Smart Systems and Emerging Technologies – RISE, Nicosia, Cyprus

2: Department of Experimental Psychology, UCL, UK

3: Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands

4: Donders Centre for Cognitive Neuroimaging, Radboud University, Nijmegen, The Netherlands

# Overview

Why

Pizza problems

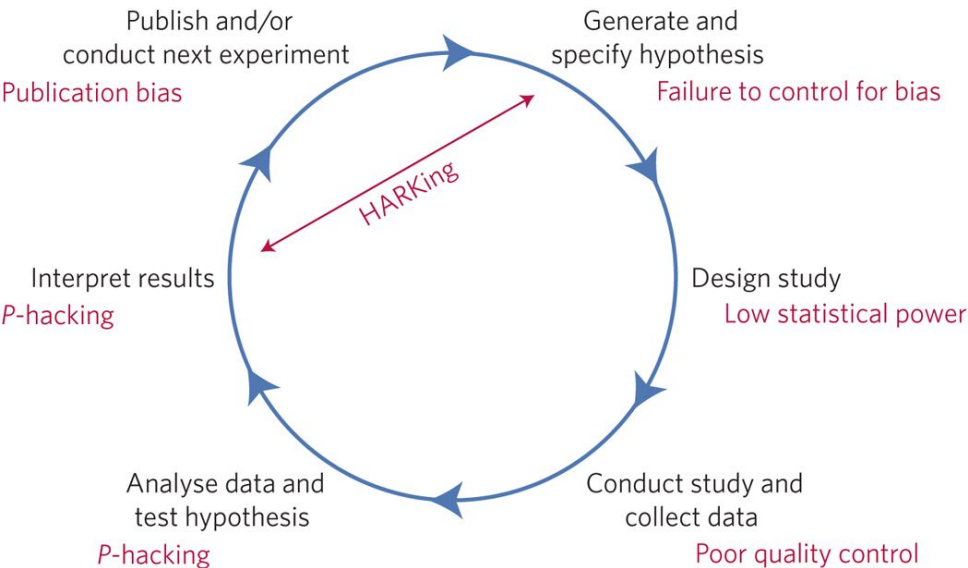
Path model of science

Future

Why?

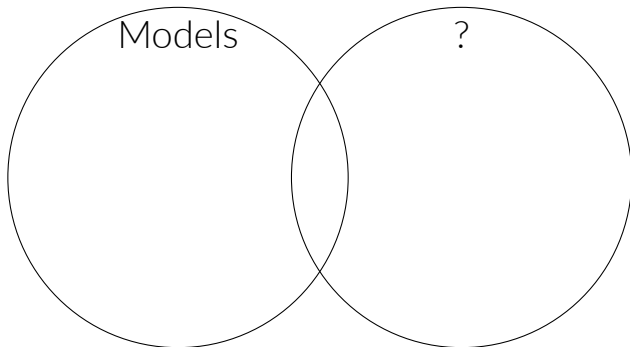






Munafò, M. R. et al. (2017). A manifesto for reproducible science. *Nature human behaviour*.

# Non-overlapping magisteria?



Olivia Guest is on the job market! | Ολίβια Γκεστ  
@o\_guest



Why we need computational modelling: even if everybody agrees what the area of a circle is defined as there are apparently people unwilling to execute the formal model itself and not only that but the results are counterintuitive. 😂



$$\text{Area} = \pi(18/2)^2 = 254 \text{ in}^2$$



$$\text{Area} = 2\pi(12/2)^2 = 226 \text{ in}^2$$

An 18-inch pizza has more pizza than two 12-inch pizzas, and people are losi...  
Math is important, people!  
[mashable.com](https://mashable.com)

7:47 AM · Oct 21, 2019 · [Twitter Web App](#)



# Specification

**a**

Two 12" pizzas



$$\text{Area} = 2 \times \pi 6^2 = 226 \text{ in}^2$$

**b**

One 18" pizza



$$\text{Area} = \pi 9^2 = 254 \text{ in}^2$$

# Implementation

```
import numpy as np
import math

def food(ds):
    return (math.pi * (ds/2)**2).sum()

two_pizzas = np.array([12, 12])

one_pizza = np.array([18])

print(food(two_pizzas) > food(one_pizza))
```

# Specification

$$\phi_i = \sum_{j=1}^N \pi R_j^2 \quad (1)$$

# Specification

$$\phi_i = \sum_{j=1}^N \pi R_j^2 \quad (1)$$

$$\omega(\phi_i, \phi_j) = \begin{cases} i, & \text{if } \phi_i > \phi_j \\ j, & \text{otherwise} \end{cases} \quad (2)$$

data





data



hypothesis



data



hypothesis



implementation



data



hypothesis



implementation



specification



data



hypothesis



implementation



specification



theory



data



hypothesis



implementation



specification



theory



framework



framework



framework



theory



framework



theory



specification





framework



theory



specification



implementation



framework



theory



specification



implementation



hypothesis



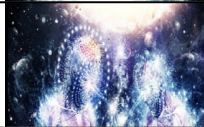
specification



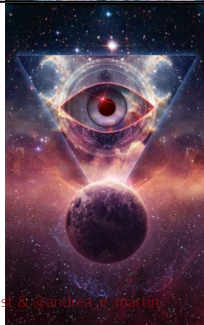
implementation

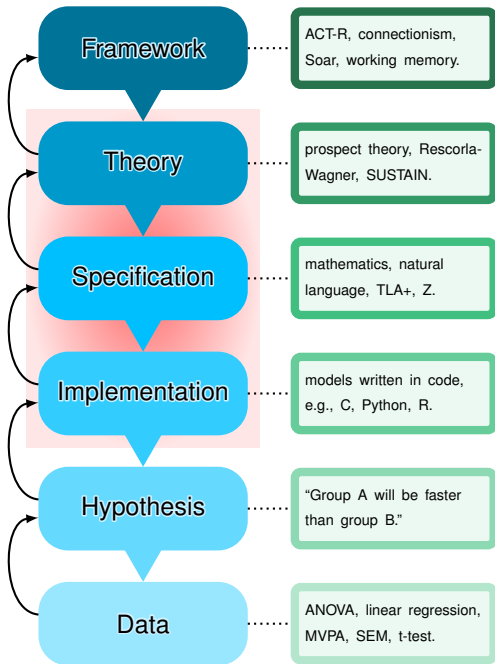


hypothesis



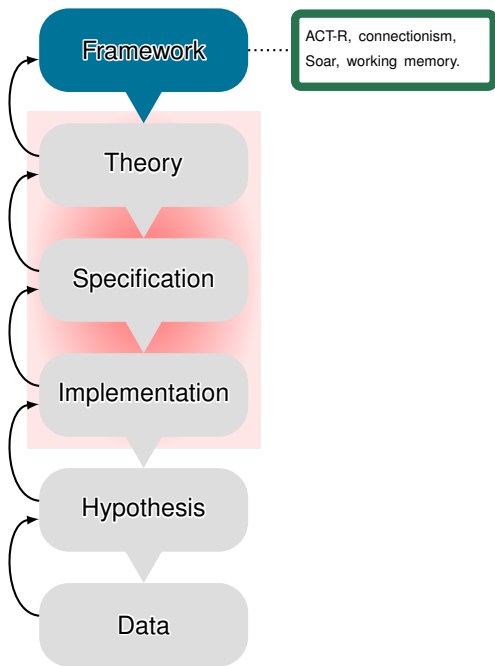
data

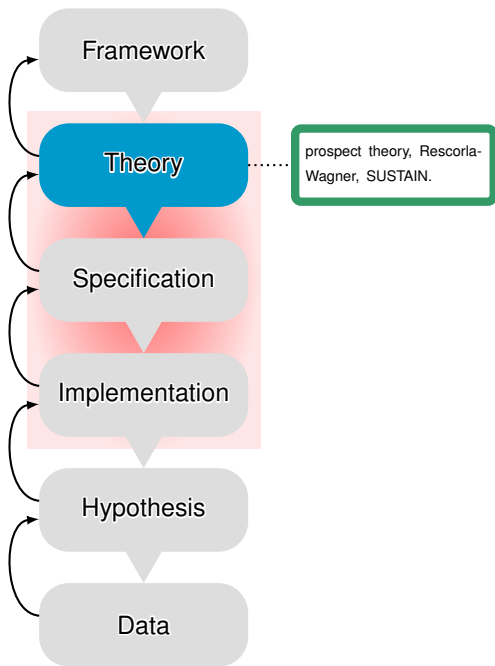


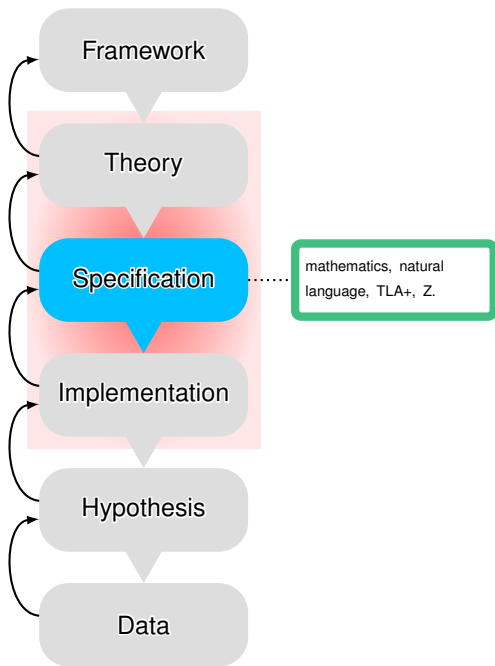


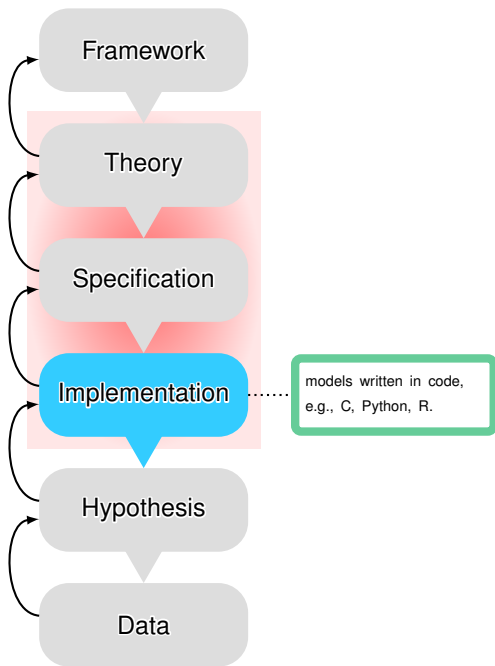
a) any point,  
move up

b) resolve  
violation,  
move down

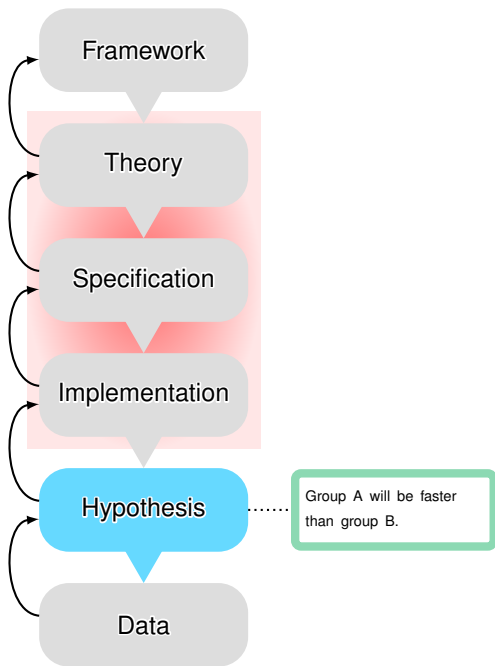


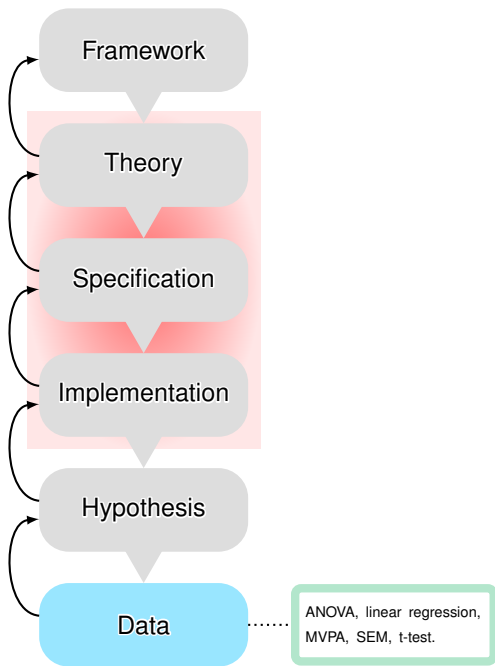




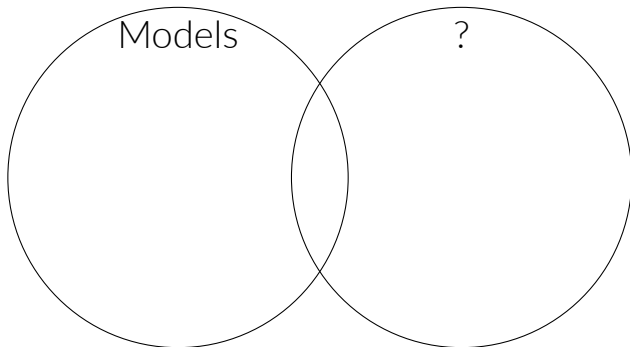






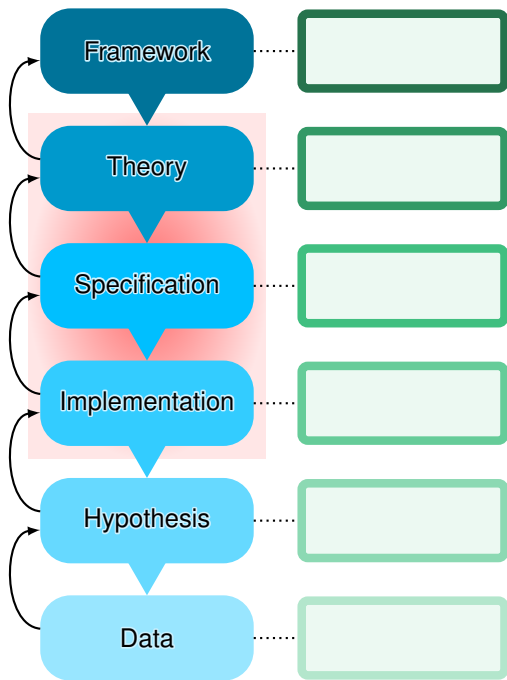


# Non-overlapping magisteria?



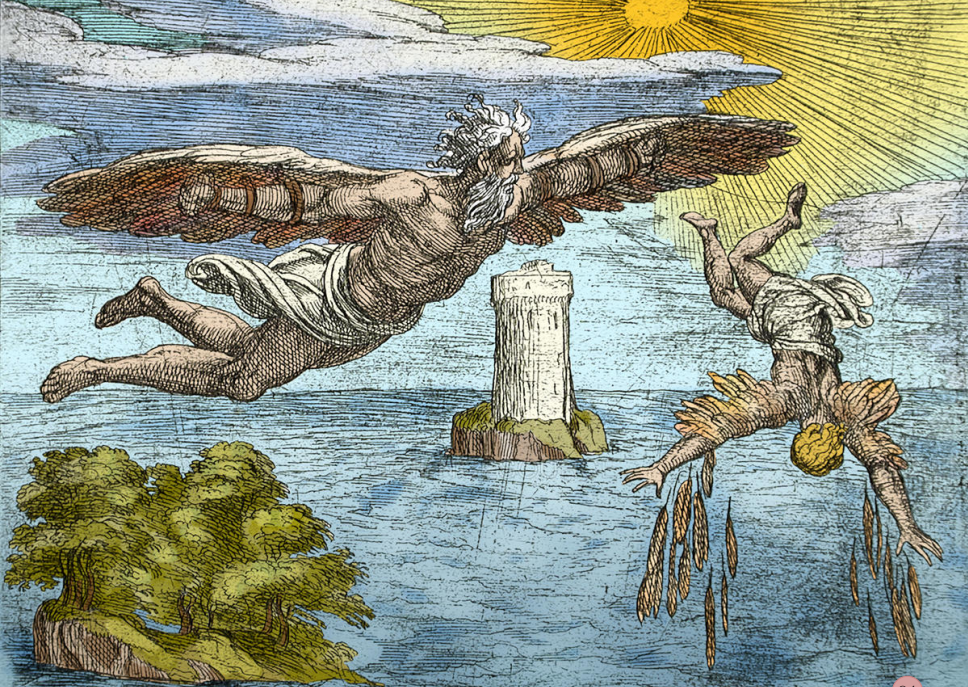
“Science is posthoc, with results, especially unexpected results, driving theory and new applications.”

Shiffrin, R., (2018). Symposium: Should Science Determine the Practice of Statistics or Should Statistics Determine the Practice of Science?. *Annual Psychonomics Meeting 2018*.

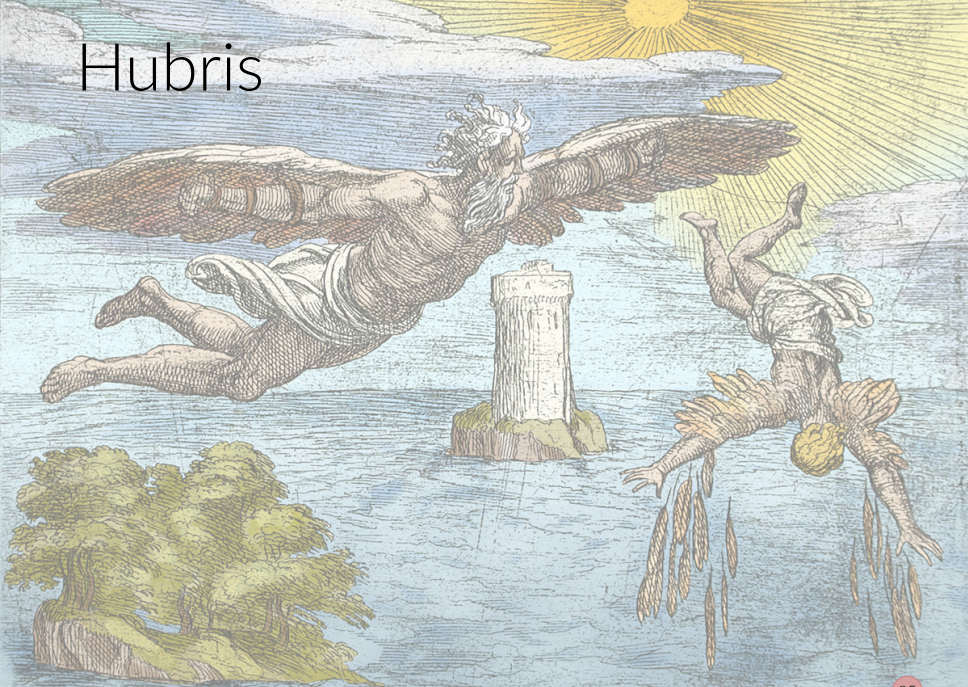


“nobody believes the result of a simulation, except the person who performed the simulation, and everybody believes the result of an experiment, except the person who ran the experiment.”

McClarren, R. G. (2018). *Uncertainty Quantification and Predictive Computational Science*.



# Hubris





# Thank you!

