

# MRI Together

A global workshop on Open Science and Reproducibility  
December 2021

## A White Hat's Guide to P-Hacking

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@DXeniMRI



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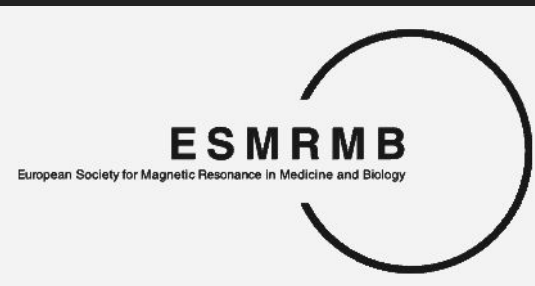
## Speaker name:

Dr. Xenia Deligianni, University of Basel, Switzerland

## Conflicts of interest regarding this presentation:

Nothing to disclose

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**ESMRMB**

European Society for Magnetic Resonance in Medicine and Biology



# LOOK! A NEW CONTINENT!\*



<https://publicdomainvectors.org/>

Photo by unsplash: graphicnode



- 1) <https://doi.org/10.1371/journal.pbio.1001863>, Distinguishing between Exploratory and Confirmatory Preclinical Research Will Improve Translation, Jonathan Kimmelman, Jeffrey S. Mogil, Ulrich Dirnagl
- 2) <https://doi.org/10.1111/1740-9713.01369>, **Different worlds Confirmatory versus exploratory research**  
Simon Schwab, Leonhard Held

\*)Senn, S. (2007) Statistical Issues in Drug Development. Chichester: John Wiley & Sons.



# Exploratory vs Confirmatory

- “small and flexible experiments”<sup>1</sup>
- “No hypothesis is required”<sup>2</sup>
- **Hypothesis can be vague**<sup>2</sup>
- “Neither the sequence of individual experiments, nor details of their design, is necessarily established at the outset of investigation.”<sup>1</sup>
- To “generate new hypothesis from the data”<sup>2</sup>
- **“Finding the unexpected”**<sup>2</sup>
- **“Confirmatory research** starts with a **clear hypothesis** & then collects data that may or may not support that hypothesis.”<sup>2</sup>
- “Clear hypothesis required”<sup>2</sup>
- “Suitable for establishing strong evidence.”<sup>2</sup>
- Minimize the risk of **false positives**.<sup>2</sup>

1) <https://doi.org/10.1371/journal.pbio.1001863>, Distinguishing between Exploratory and Confirmatory Preclinical Research Will Improve Translation, Jonathan Kimmelman, Jeffrey S. Mogil, Ulrich Dirnagl

2) <https://doi.org/10.1111/1740-9713.01369>, **Different worlds Confirmatory versus exploratory research** Simon Schwab, Leonhard Held



Would you like to know more?



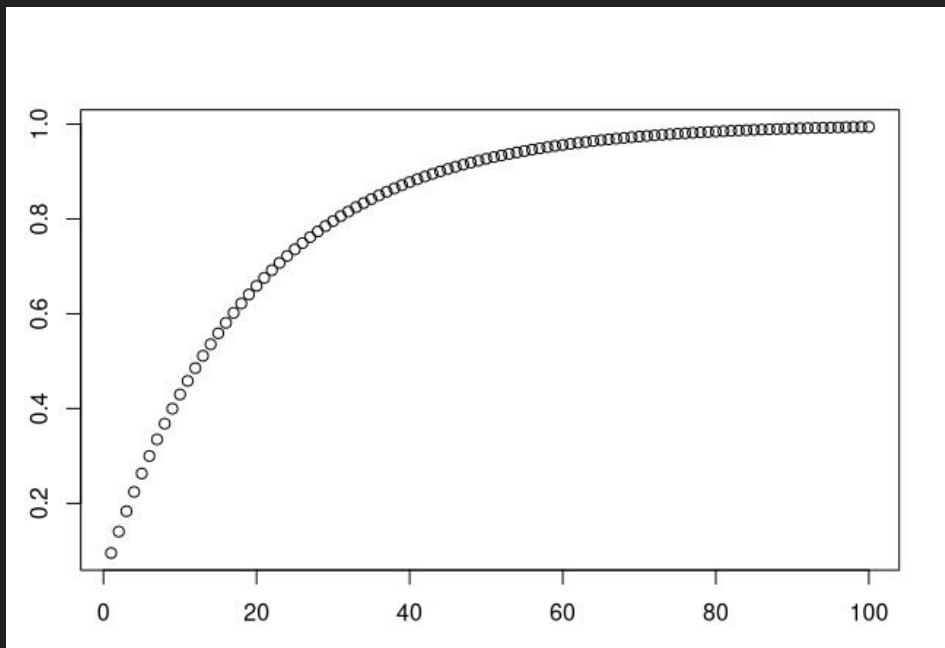
Photo by unsplash: Lucy M

<https://mybinder.org/v2/gh/XDeligianni/phacking/HEAD?labpath=pHacking.ipynb>



## Depiction of the increasing error rate of multiple comparisons

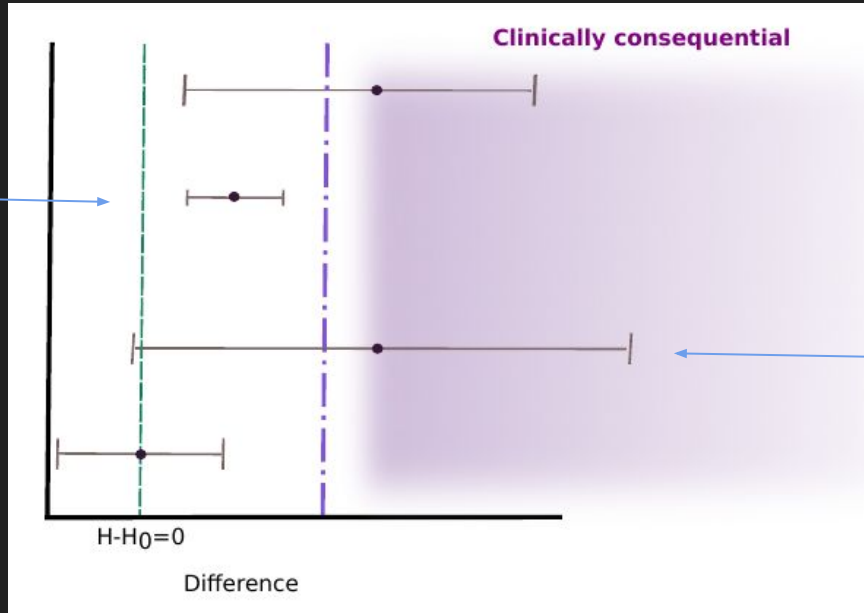
Probability of at least one  
p-value less than 0.05



Number of hypothesis tests

# Clinical vs Statistical Significance

Statistically  
significant, but not  
clinically  
consequential



Not statistically  
significant, but  
potentially clinically  
consequential





## TAKE HOME MESSAGES

- Do not follow the crowd!
- Describe/ **Visualize your data** before testing! Be careful with boxplot drawing<sup>1</sup>!
- Check your **assumptions**!
- Choose the appropriate test (beyond t-test/ p-value)
- Don't invent on the way!

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**THANK YOU!**



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