ALL-IN meta-analysis

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Centrum Wiskunde & Informatica


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To Glenn Shafer, Stephen Senn, Peter Grünwald and Daniel Lakens

Subsets of you taught me the importance of fundamentals and history, the beauty of clinical trials, and – especially when a mathematical concept is necessary to make a point – the power of storytelling.

Origin of the material

The dissertation is based on the following earlier (pre-print) publications:

Chapter 1 is based on a paper that is under review at F1000 and available on ArXiv:

> Judith ter Schure and Peter Grünwald. ALL-IN Meta-analysis: Breathing Life into Living Systematic Reviews. arXiv:2109.12141. 2021.

Chapter 2 is based on a paper that is available on ArXiv:

> Judith ter Schure, Muriel F. Pérez-Ortiz, Alexander Ly and Peter Grünwald. The Safe Logrank Test: Error Control under Continuous Monitoring with Unlimited Horizon. arXiv:2011.06931. 2020.

Chapter 3 is based on a paper that is published at F1000 Research:

> Judith ter Schure and Peter Grünwald. Accumulation Bias in Meta-analysis: The Need to Consider Time in Error Control [version 1; peer review: 2 approved]. *F1000Research*, 2019.

Chapter 4 is based on a blogpost at The Replication Network:

> Judith ter Schure. Accumulation Bias: How to Handle It ALL-IN. *The Replication Network*. 2020.

Chapter 5 is based on a blogpost at The Replication Network:

> Judith ter Schure and Peter Grünwald. Accumulation Bias: How to Handle It As a Bayesian. *The Replication Network*. 2022.

Chapter 6 is based on a paper published in STAtOR, the society magazine of the Netherlands Society for Statistics and Operations Research VVSOR:

> Judith ter Schure, Peter Grünwald and Alexander Ly. Pandemic Preparedness in Data Sharing: Lessons Learned from Collaborating in a Live Meta-Analysis. *STAtOR*, 2021, 22.4: 47-52.

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Preface

This Ph.D. research had its origin in a bar; a typical bar in Utrecht, in a historic wharf cellar at the central canal. On Wednesday, April 20th 2016, this bar served as the scenery for the Young Statisticians to host their night of beers and statistical discussion on the (ab)use of p-values in research: "*To p or not to p?*" It was there that I heard Professor Peter Grünwald speak about how p-values are misunderstood and how much better we could do if we thought of statistics a bit more like gambling. I enjoyed every minute of it – also thanks to the great atmosphere that evening – and, fortunately, I still do.

Later that year I finished my Master's *Statistical Science for the Life and Behavioural Science* while staying in contact with Peter. I was very lucky that the timing of my graduation matched with Peter's procurement of funding for Ph.D. students. As a contender for a position, I had the advantage to have already made my job interview impression that day in that bar. Peter remembers it as quite unorthodox in mathematics for a student to simply walk up to him and state something along the lines of "This is so cool! Can I spend a Ph.D. studying this?".

Now, almost four years of Ph.D. research[1] later, I am still not bored with p-value discussions. What is more, friends refer to my Ph.D. research as "the nemesis of the p-value", and they have a point. What else could be the final blow to "science by p-value" than a paper (Ter Schure and Grünwald (2019), Chapter 3) that points out that in the cumulative science we idolize – "standing on the shoulders of giants" – the p-value is impossible to calculate correctly unless we do clinical trials and meta-analyses for random reasons?

[1] Four full-time equivalent years: between May 1st, 2017 and February 1th, 2022 I spent 44 months working 80% of my working week ($\approx$ 35 weeks full-time equivalent) on this Ph.D. research and 13 months working 100%, so 48 full-time months in total.


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