Getting it right with meta-analysis: Correcting effect size for publication bias in meta-analyses from psychology and medicine

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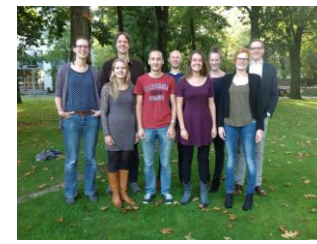

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The Message

- Evidence for publication bias in various fields
- Methods exist to examine publication bias: *p*-uniform accurate estimation in the presence of publication bias and homogeneous true effect size
- Apply methods to meta-analyses in psychology and medicine: surprisingly little evidence for publication bias
- Further development needed of methods to examine publication bias

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Overview

1. Publication bias and its consequences
2. Publication bias methods
3. Publication bias in psychology and medicine
4. Results
5. Conclusion and discussion

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1. Publication bias

- Publication bias is 'the selective publication of studies with a statistically significant outcome'
- Overwhelming evidence of publication bias:
  - 95% of published articles contain significant results in psychology
- Consequences of publication bias:
  - False impression that effect exists
  - Overestimation of effect sizes
  - Questionable research practices

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2. Publication bias methods

- Publication bias tests:
  - Egger's test
  - Rank-correlation test
  - Test of Excess Significance (TES)
  - *P*-uniform
- No publication bias detected does not imply that no publication bias exist → low statistical power
- Demand for methods that accurately estimate effect size in the presence of publication bias

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2. Publication bias methods

- Traditional meta-analysis: accurate and most precise if no or small amount publication bias
- Trim-and-fill method: should not be used because imputes studies when none are missing (van Assen et al., 2015; Simonsohn et al., 2014; Moreno et al., 2009)
- PET-PEESE: topic of further research → does not perform well if studies' sample sizes are similar
- Selection models: mathematically complex and require substantial number of effect sizes (>30)

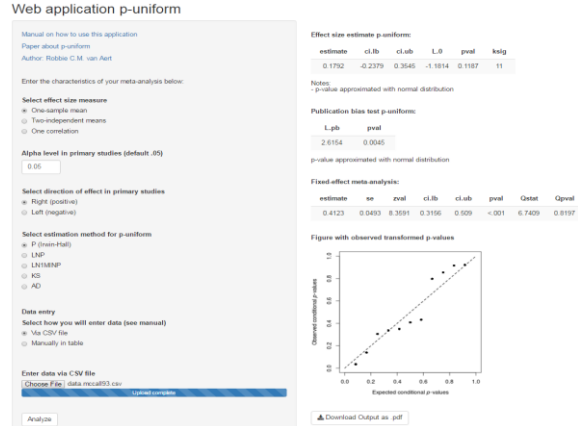
2. Publication bias methods: *p*-uniform/*p*-curve

- *P*-uniform and *p*-curve were independently developed and are based on the same methodology
- Distribution of *p*-values at the true effect size is uniform
- *P*-uniform can also be used for:
  - Estimate a confidence interval
  - Test the null hypothesis of no effect
  - Test for publication bias
- Assumptions:
  - Significant effect sizes have equal probability of getting published
  - Effect sizes are statistically independent

2. Publication bias methods: *p*-uniform/*p*-curve

- Limitations of the methods in its current implementation:
  - Overestimation caused by moderate to large heterogeneity
  - Sensitivity to *p*-values close to .05 → set estimate to zero if in other direction than meta-analysis (van Aert et al. 2016)
  - If small number of significant effect sizes → methods are accurate (unbiased) but imprecise
- Future research:
  - Extend *p*-uniform such that it can deal with heterogeneity
  - Bayesian version of *p*-uniform
- R package "puniform" on GitHub and web application:
  https://rvanaert.shinyapps.io/p-uniform/

Web application p-uniform



3. Publication bias in psychology and medicine

- Goal: Studying prevalence and overestimation caused by publication bias in psychology and medicine
- Medicine was compared to psychology because of more attention for publication bias and preregistration
- All meta-analyses published in Psychological Bulletin between 2004 and 2014 from which data could be obtained were included (84)
- Homogeneous (I^2<50%) subsets of *five or more* effect sizes were created based on reported moderators: 370 subsets

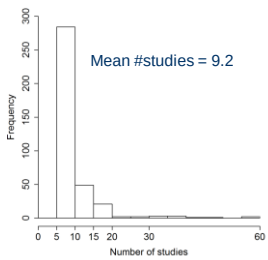
3. Publication bias in psychology and medicine

- Systematic reviews were randomly sampled from Cochrane Library published between 2004-2014
- Homogeneous subsets were created and sampling was continued till 370 subsets were obtained

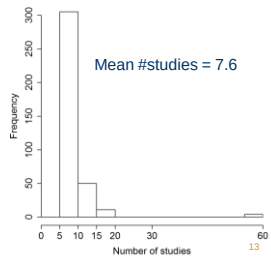
3. Publication bias in psychology and medicine

Number of studies per subset:

Psychology



Medicine



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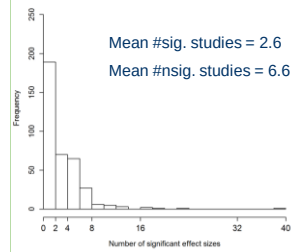
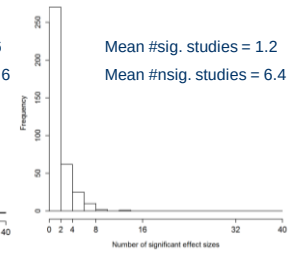
3. Publication bias in psychology and medicine

Number of significant effect sizes per subset:

Psychology



Medicine



4. Results: Prevalence

Publication bias tests:

- *P*-uniform's publication bias test could not always be applied (71.4%)

Method	*P*-uniform	Egger	Rank	TES
Psychology	28.3% (30/106)	13.5% (50/370)	12.5% (46/367)	6.5% (24/370)
Medicine	11.3% (22/194)	10.3% (38/370)	6.6% (24/362)	3.0% (11/370)

- Results suggest more publication bias in psychology

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4. Results: Overestimation?

- All effect sizes were transformed to Cohen's *d*
- Only subsets with significant effect sizes were included
- *P*-uniform's estimate was set equal to zero if estimate was in opposite direction than meta-analytic estimate
- Overestimation in effect size was studied by comparing estimate of random-effects meta-analysis with *p*-uniform's estimate

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4. Results: Overestimation?

Effect size overestimation:

	1st quartile	Median	3rd quartile
Psychology	-0.089	0.019	0.141
Medicine	-0.107	0.048	0.178

- Slight overestimation in effect size for psychology and medicine
- Overestimation is slightly larger in medicine than psychology
- Conclusion: Small amount of publication bias in psychology and medicine?

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4. Results: Alternative explanations

- Meta-analyses in fields where publication bias is not a large problem?
- Selection for homogeneous subsets led to relatively many subsets with nonsignificant results?
- Meta-analyses were not about the main results of primary studies
- Authors of meta-analyses included many unpublished manuscripts?

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5. Conclusion and discussion

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- Methods exist to examine publication bias: *p*-uniform accurately estimates effect size in the presence of publication bias and homogeneity
- Apply methods to meta-analyses in psychology and medicine: surprisingly little evidence for publication bias
- Further development needed of methods to examine publication bias
- Future research: Extending *p*-uniform such that it can deal with heterogeneous true effect size

Thank you for your attention

Questions?