Comparison of the performance of methods to assess publication bias in real data

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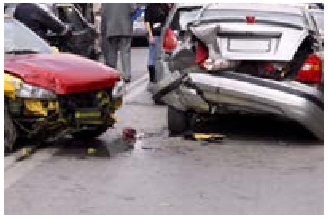
Open Science Conference

Leibniz Institute, Trier, 14.03.2019

Publication bias assessment in real data

- **Why posttraumatic stress disorder (PTSD)?**
    - Severe mental disorder
    - 9,8% (life-time) prevalence





Diagnostic Criteria (DSM-5)

- Exposure to actual or threatened death, serious injury, or sexual violence
- Intrusion symptoms
- Persistent avoidance of stimuli associated with the traumatic event(s)
- Negative cognitions and mood
- Alterations in arousal and reactivity

(American Psychiatric Association, 2013; Kilpatrick et al., 2013)

Publication bias assessment in real data

- **Why posttraumatic stress disorder (PTSD)?**
  - Evidence-based psychotherapy
  - Scientist-practitioner model
  - Treatment studies since 1980
  - Publication bias not assessed
  - Biased effect estimates can overestimate the efficacy

  - Treatments include exposure to the traumatic event
  - Potential detrimental effects

(Bisson et al., 2013; Driessen et al., 2017; Ioanndis, 2008; Shapiro & Forrest, 2001)

Publication bias assessment in real data

Assessment in psychotherapy research

- Assessment in published meta-analyses
- Extent in whole fields of research and with multiple methods
- Assessment in 1 of 46 (2.17%) meta-analyses for treatment of schizophrenia and 12 of 85 (14.12%) for depression
- 15 % of meta-analyses for schizophrenia and depression affected by bias
- Rank-correlation test, Egger´s regression test, trim and fill
- Simulation studies show that methods differ in statistical properties

(Banks et al., 2012; Begg & Mazumdar, 1994; Carter et al., 2017; Coburn & Vevea, 2015; Duval & Tweedie, 2000a, 2000b; Egger et al., 1997; Ioannidis, 2009; Ioannidis & Trikalinos, 2007; Kepes et al., 2012; McShane et al., 2016; Niemeyer et al., 2012, 2013; Simonsohn et al., 2014; van Assen et al., 2015)

Study design

Aims

1. Investigate the degree and impact of publication bias in meta-analyses for the treatment of PTSD
2. Compare the performance of publication bias methods

Inclusion criteria

Meta-analyses

- Any form of psychotherapy
- Clinical or subclinical PTSD
- Adults
- 1980 - 09/2015
- English or German language
- Published and unpublished

Data sets

> 6 primary studies

Homogeneity (*Q*-test, I^2)

Summary effect size reported

(Rothstein, Sutton & Borenstein, 2005; Sterne, Becker, & Egger, 2005)

Study design

Literature search

- Data bases — *PsycINFO, Psyndex, PubMed and Cochrane Database*
- Search terms — *"metaana*" OR "meta-ana*" OR "review" OR "Übersichtsarbeit" AND "stress disorders, post traumatic" (MeSH) OR "post-trauma*" OR "posttrauma*" OR "posttraumatic stress disorder" OR "trauma*" OR "PTSD" OR "PTBS"*

- Snowball search system
- Contacted authors and retrieved primary studies if data not reported

- Three independent raters for
  - inclusion of studies
  - data extraction and
  - coding of treatment (standardized coding form)

(Lipsey & Wilson, 2001)

Study design

Six methods to assess publication bias

Examining the presence of publication bias

Egger's regression test

Rank correlation test

Test of excess significance (TES)

P-uniform

Testing the null hypothesis of no effect and correcting effect estimates for publication bias

Trim and fill

PET-PEESE

P-uniform

(Begg & Mazumdar, 1994; Duval & Tweedie, 2000a, 2000b; Egger, Davey Smith, Schneider & Minder, 1997; Ioannidis & Trikalinos, 2007; Stanley & Doucouliagos, 2012; van Assen et al., 2015)

Study design

Publication bias test

- Two-tailed hypothesis tests for Egger´s regression test and rank-correlation test
- One-tailed hypothesis tests for TES and *p*-uniform

Test of no effect and estimating corrected effect sizes

- Fixed (FE) or random-effects (RE) model depending on original meta-analysis
- Null hypothesis of no effect: two-tailed test
- Estimates transformed to Cohen´s *d* for effect size corrections
- Difference scores for each methods´ effect size estimate to estimate of traditional meta-analysis

- Alpha level of .05 for all analyses

Study design

Congruence of methods

Loevinger's H for dichotomous decision (statistically significant or not) of publication bias tests and test of no effect

		Method II		
		Not sig.	Sig.	
Method I	Not sig.	A	B	P1
	Sig.	C	D	Q1
	Total	P2	Q2	

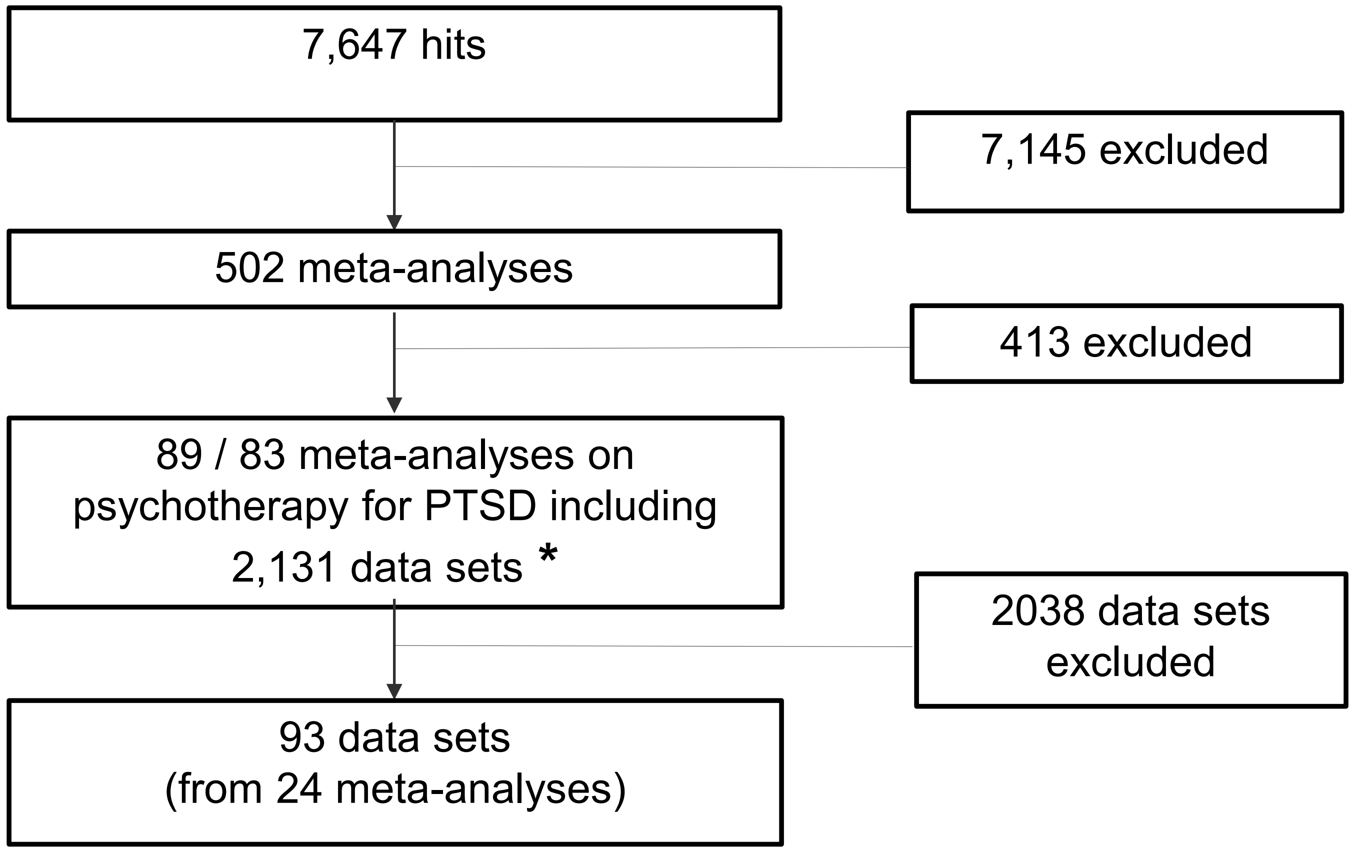
$$H = \frac{(A \times D - B \times C)}{\min(P1 \times Q2, P2 \times Q1)}.$$

R 3.3.0., metafor and puniform package

See OSF for more information, data and R code (https://osf.io/9b4df/, https://osf.io/m34wc/, https://osf.io/frm8h/)

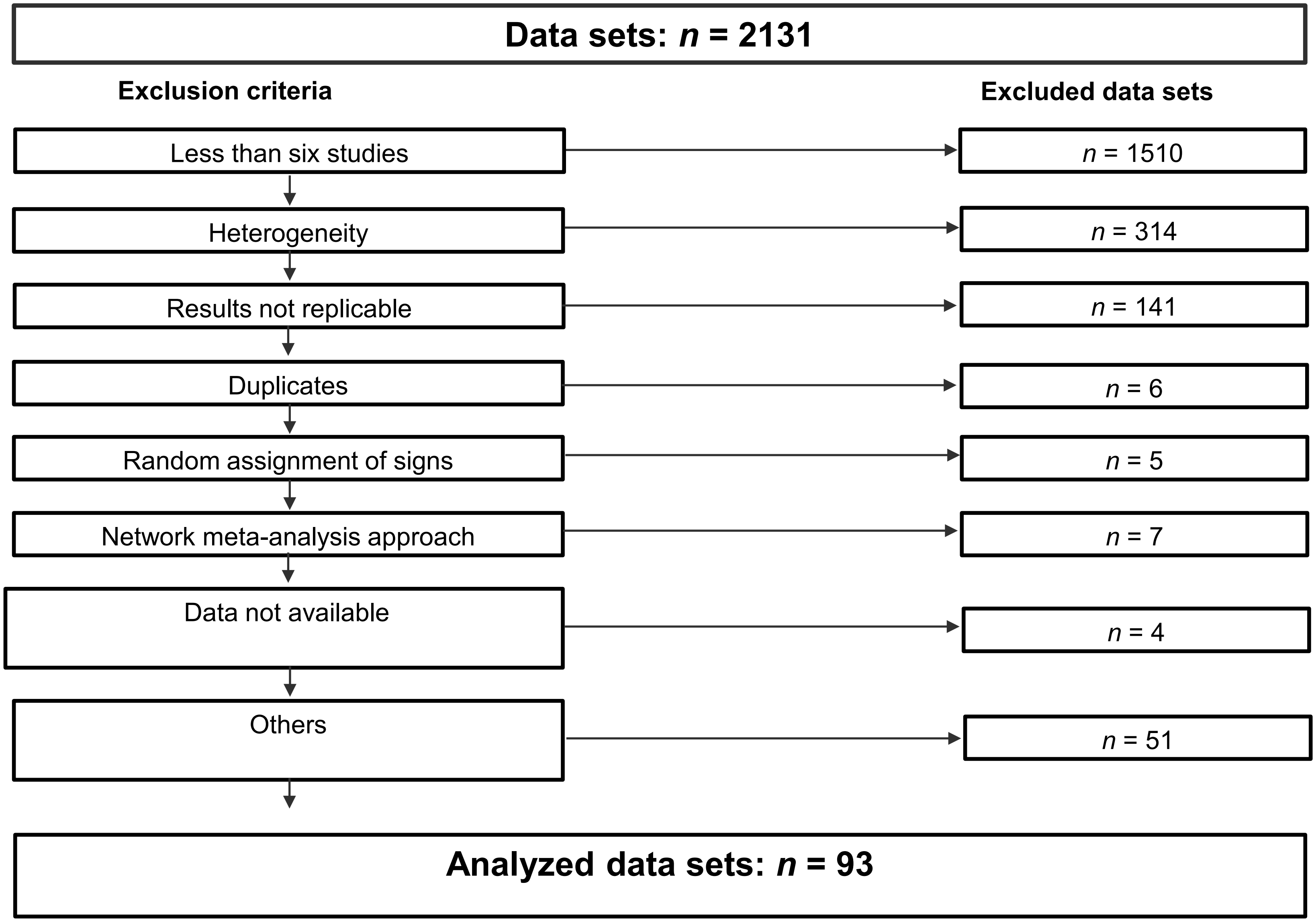
(Loevinger, 1948; Mokken, 1971; R Core Team, 2016; Viechtbauer, 2010)

Results of the literature search



- Primary studies n = 447
  See https://osf.io/pkzx8/

Selection of data sets



Results - descriptives

- Interrater reliability: Fleiss' Kappa $\kappa = .973$, $p < .001$
- 20 meta-analyses (24.14%) included unpublished studies
- Median number of effect sizes in a data set = 7 (first quartile 7, third quartile 10)
- Median number of statistically significant effect sizes = 3 (33.3%; first quartile 1 (10%), third quartile 6 (83.3%))
- 72 data sets (77.4%) included at least one significant effect size
- Median I^2-statistic = 12.5% (first quartile 0%, third quartile 36.3%)

(Fleiss, 1971)

Publication bias tests

Number of data sets and percentages where the tests were statistically significant

a)

		Rank correlation		
		Not sig.	Sig.	
Egger	Not sig.	74	2	76 (81.7%)
	Sig.	14	3	17 (18.3%)
	Total	88 (94.6%)	5 (5.4%)	H = .511

b)

		Rank correlation		
		Not sig.	Sig.	
TES	Not sig.	88	4	92 (98.9%)
	Sig.	0	1	1 (1.1%)
	Total	88 (94.6%)	5 (5.4%)	H = 1

c)

		Rank correlation		
		Not Sig.	Sig.	
p-uniform	Not sig.	64	5	69 (95.8%)
	Sig.	3	0	3 (4.2%)
	Total	67 (93.1%)	5 (6.9%)	H = -.075

d)

		Egger		
		Not Sig.	Sig.	
TES	Not sig.	75	17	92 (98.9%)
	Sig.	1	0	1 (1.1%)
	Total	76 (81.7%)	17 (18.3%)	H = -.224

Publication bias tests

e)		Egger		
		Not sig.	Sig.	
	Not sig.	52	17	69 (95.8%)
p-uniform	Sig.	3	0	3 (4.2%)
	Total	55 (76.4%)	17 (23.6%)	H = -.309

f)		TES		
		Not sig.	Sig.	
	Not sig.	68	1	69 (95.8%)
p-uniform	Sig.	3	0	3 (4.2%)
	Total	71 (98.6%)	1 (1.4%)	H = -.043

- Of all methods Egger's regression test detected publication bias the most, i.e. in 17 data sets (18.3%)
- At most two methods detected publication bias test in the same data set, which occurred in 4 data sets (4.3%)

Tests of no effect

Number of data sets where the null-hypothesis of no effect was rejected

a)

		Meta-analysis		
		Not sig.	Sig.	
T&F	Not sig.	24	4	28 (30.1%)
	Sig.	4	61	65 (69.9%)
	Total	28 (30.1%)	65 (69.9%)	H = .796

b)

		Meta-analysis		
		Not sig.	Sig.	
PET-PEESE	Not sig.	27	46	73 (78.5%)
	Sig.	1	19	20 (21.5%)
	Total	28 (30.1%)	65 (69.9%)	H = .831

c)

		Meta-analysis		
		Not sig.	Sig.	
p-uniform	Not sig.	8	23	31 (43.1%)
	Sig.	0	41	41 (56.9%)
	Total	8 (11.1%)	64 (88.9%)	H = 1

d)

		T&F		
		Not sig.	Sig.	
PET-PEESE	Not sig.	26	47	73 (78.5%)
	Sig.	2	18	20 (21.5%)
	Total	28 (30.1%)	65 (69.9%)	H = .668

Tests of no effect

e)		T & F		
		Not sig.	Sig.	
	Not sig.	10	21	31 (43.1%)
p-uniform	Sig.	0	41	41 (56.9%)
	Total	10 (13.9%)	62 (86.1%)	H = 1

f)		PET-PEESE		
		Not sig.	Sig.	
	Not sig.	29	2	31 (43.1)
p-uniform	Sig.	24	17	41 (56.9%)
	Total	53 (73.6%)	19 (26.4%)	H = .756

Estimating corrected effect sizes

Mean of difference in effect size estimates

		Meta-analysis
Mean of difference, median, (SD)	Trim and fill	-0.018, -0.018 (0.104)
	PET-PEESE (72 data sets)	-0.108, -0.009 (0.886). -0.158, -0.049 (0.971)
	p-uniform (72 data sets)	0.002, 0.043 (0.355)

		Positive meta-analytic estimates	Negative meta-analytic estimates
Mean, median, [min.; max.], (SD) of estimates	Meta-analysis	.574, 0.405, [0.015;1.683], (0.509)	-0.614, -0.573, [-1.288;-0.092], (0.362)
	Trim and fill	0.533, 0.405, [-0.047;1.426], (0.446)	-0.6, -0.557, [-1.288;-0.095], (0.351)
	PET-PEESE	0.112, 0.033, [-1.656;3.075], (0.829)	-0.413, -0.358, [-1.965;1.074], (0.614)
	p-uniform	0.339, 0.791, [-6.681;1.884], (2.069)	-0.641, -0.673, [-2.158;2.938], (0.721)

Discussion

- Hardly any evidence for publication bias
- 20 (24.14%) meta-analyses included unpublished studies
- 22.6% of the data sets did not include a significant result
- Low power due to small number of primary studies
- Tests did not often result in the same conclusion for the same data sets
- No large differences between estimates of traditional meta-analysis and those corrected for publication bias
- Larger imprecision in effect size estimates of PET-PEESE and *p*-uniform
- Unrealistic if small number of (significant) studies and small variation in standard errors of studies

Discussion

Limitations

- Heterogeneous data sets excluded based on *Q*-test
- Low power when applied to a small number of effect sizes
- Questionable research practices may have further biased the results

Planned extensions

- Inclusion of data sets based on $I^2 < 50\%$
- Simulation study
- Selection model

(Hardy & Thompson, 1998; Simmons, Nelson, & Simonsohn, 2011; Thompson & Pocock, 1991)

Thank you very much for your attention!

Any questions?

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