Correcting for outcome reporting bias in a meta-analysis: A meta-regression approach

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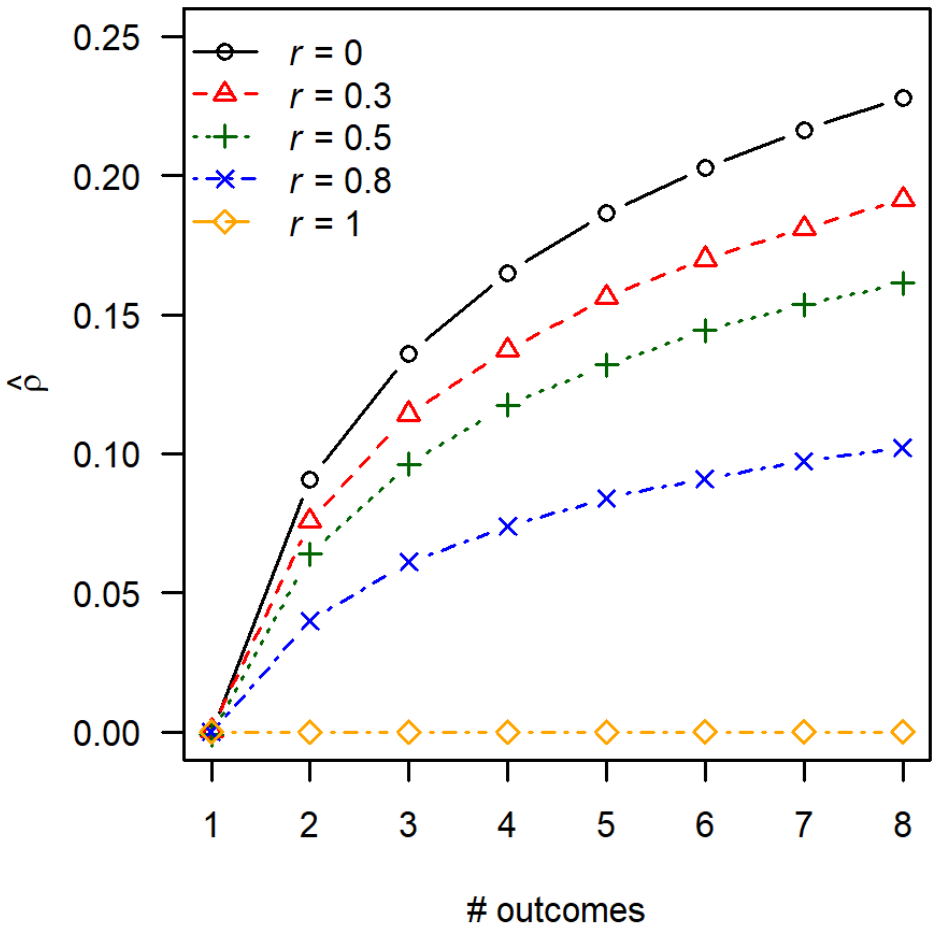
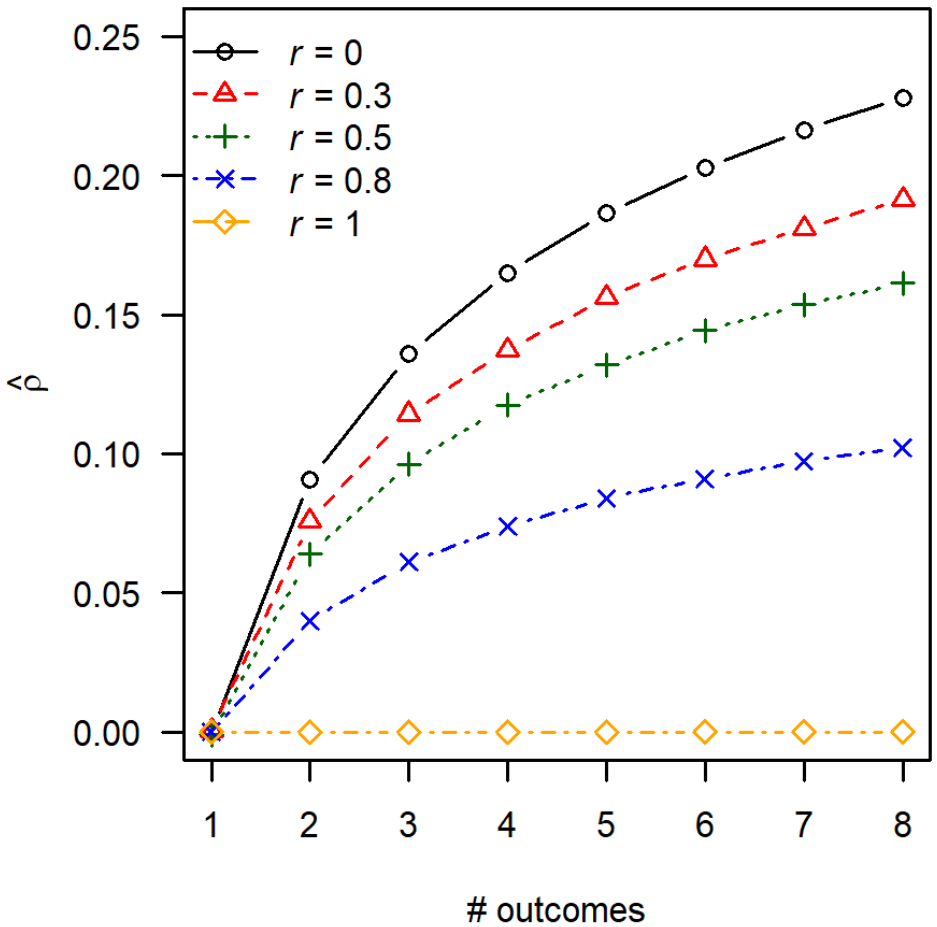
Introduction: Outcome reporting bias

- ORB is "bias caused by the reporting of outcomes that is driven by the significance and/or direction of the effect size"
- ORB vs. publication bias
- Not reporting all studied outcomes is common according to self-admission rates:
  - 63.4% in the US (John et al., 2012)
  - 47.9% in Italy (Agnoli et al., 2017)
- Not reporting all outcomes was also deemed as defensible

Consequences of ORB



Consequences of ORB



- Meta-analyzing studies affected by ORB also distorts the results of the meta-analysis

Basic idea: CORB method

- The **C**orecting for **O**utcome **R**eporting **B**ias method takes variability of the outcomes' effect size into account
- CORB includes an estimate of this variability as moderator in a meta-regression model
- Intercept of the meta-regression model is the effect size corrected for ORB $\rightarrow$ variability of the outcomes equals 0
- Important assumption: equal true effect size *within* each study
- Similarities with publication bias methods Egger's test and PET-PEESE

Estimating the variability of outcomes

- We need to estimate the variance of a single draw from a multivariate normal distribution
- When assuming equal sampling variances of the outcomes and correlations between the outcomes, we can estimate the variance of the outcomes

$$\sigma^2 - r\sigma^2$$

- σ^2 can be estimated based on the data but r cannot
- r is often unknown $\rightarrow$ *guestimate* or sensitivity analysis

Simulation study: Method

- Pearson correlation coefficient was used as effect size measure

- Conditions:
  - $\rho = 0; 0.3$
  - τ^2 was selected such that $I^2 = 0; 25; 50; 75\%$
  - Number of outcomes (dv) $= 2; 4; 6$
  - Correlation between outcomes $= 0.3; 0.5; 0.9$
  - Probability of non-reported outcome being included $= 0; 0.5; 1$
  - Number of studies $= 10; 40$
  - A vector of sample size per study: (20, 60, 100, 140, 180)

- Included methods:
  - (Multivariate) random-effects model
  - CORB method with estimated variance as moderator
  - CORB method with *square root* of the estimated variance as moderator

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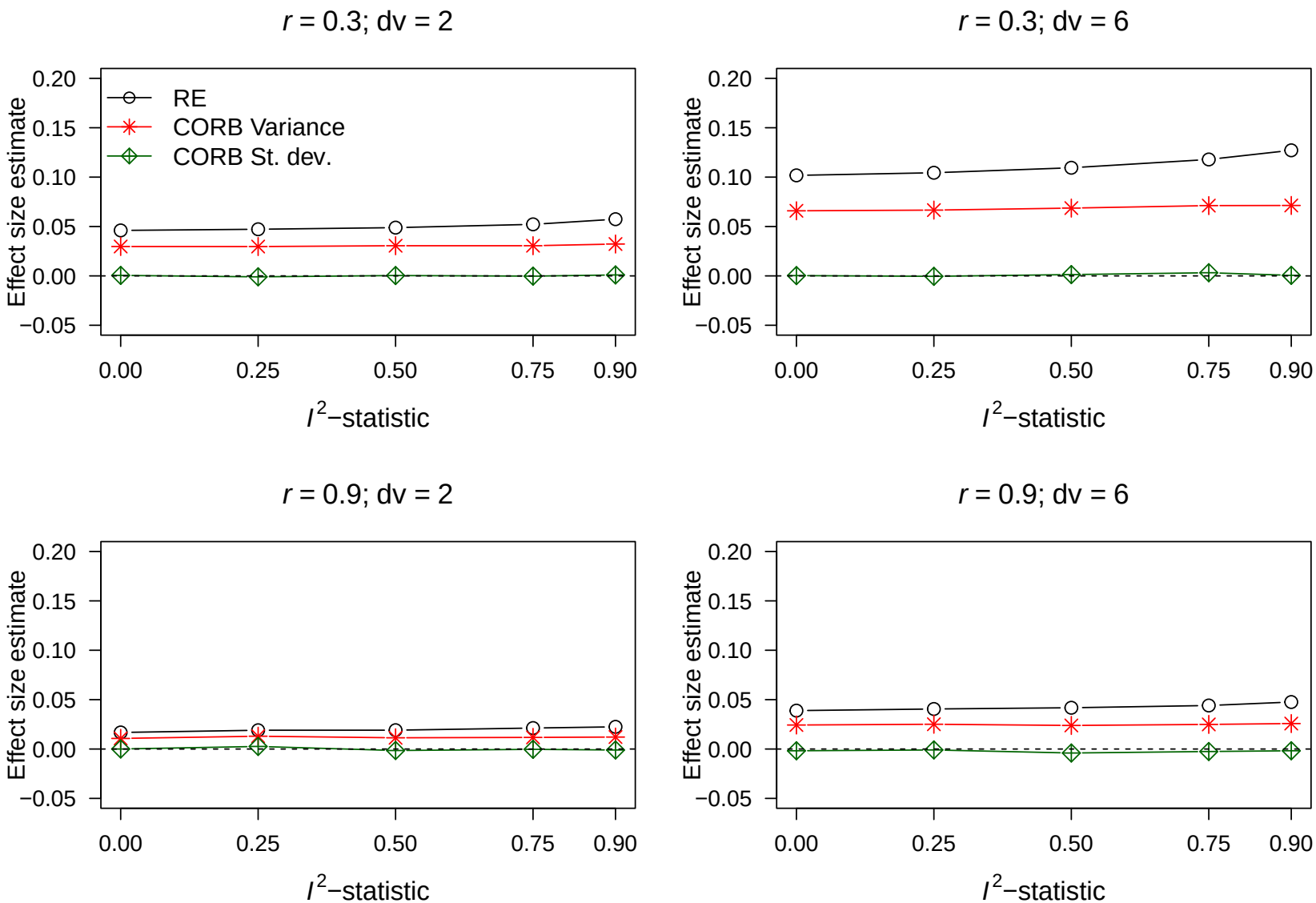
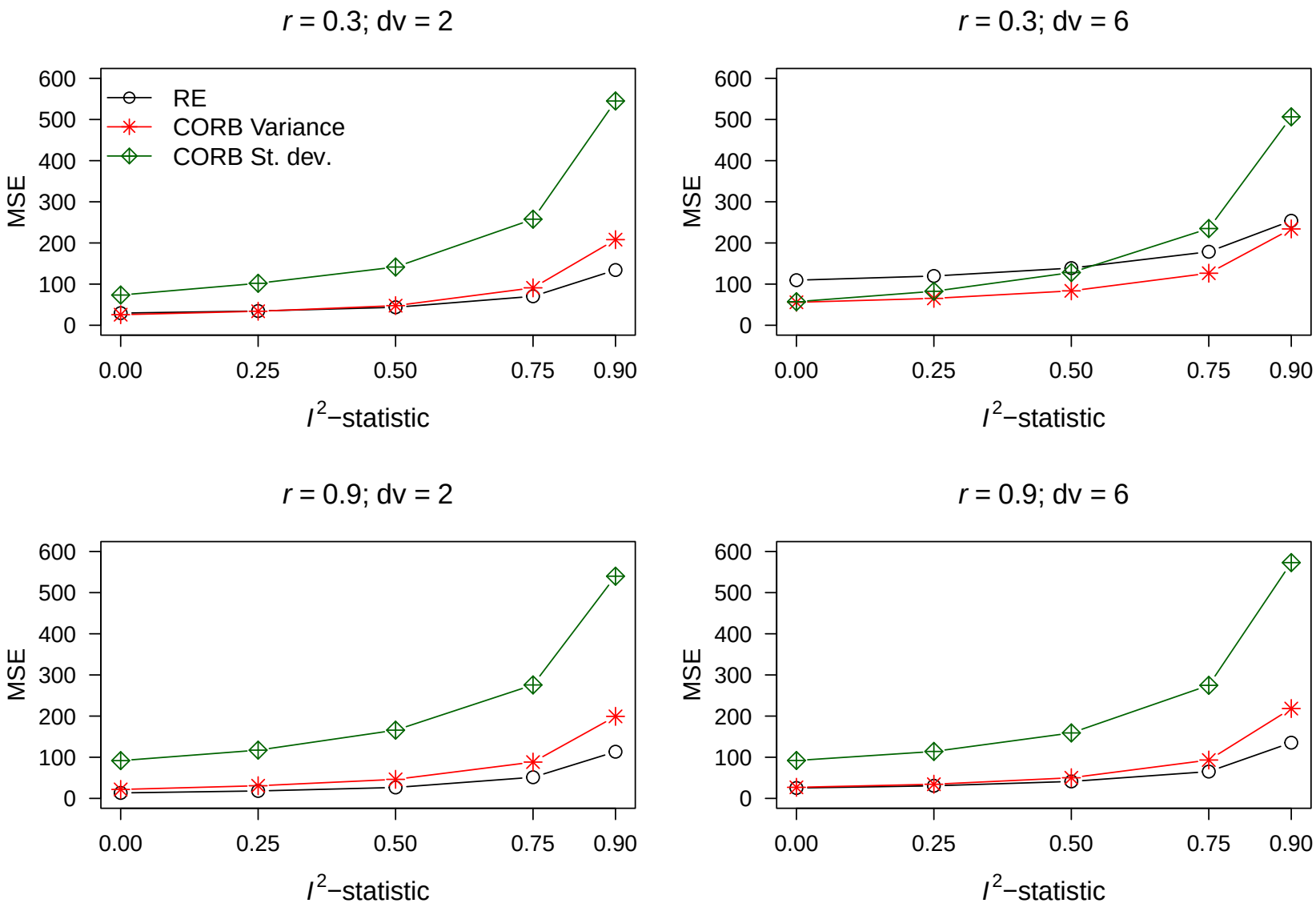
Simulation study: Bias



Simulation study: MSE



Simulation study: Other results

- Increasing the number of studies to 40
  - Hardly affected bias
  - Yielded a larger decrease in MSE of the CORB method
- Misspecifying r hardly affected the results
- In case ORB was absent
  - Bias of all methods was very small
  - MSE of the multivariate random-effects model was the lowest

Discussion

- ORB may severely bias the results of a meta-analysis
- The CORB method is an intuitive and easy-to-use method to correct for ORB
- R functions to estimate the variability in outcomes are included in the `puniform` package
- Future research:
  - Simultaneously correcting for ORB and publication bias
  - Starting point for a general framework to correct for bias caused by researcher degrees of freedom
  - Bayesian model averaging to take into account that r is based on an informed guess

Thank you for your attention

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