Posterior Probabilities in Meta-Analysis:

An Intuitive Approach of Dealing with Publication Bias

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Meta-analysis & publication bias

- Meta-analysis: combining the results of multiple primary studies to:
  - Estimate effect size
  - Estimate heterogeneity

- Publication bias:
  - Overestimated effect sizes
  - Over- and underestimated levels of heterogeneity

Current methods often have problems providing accurate and intuitive results

Bayesian Meta Analytic Snapshot (BMAS)

Key message

- BMAS in an intuitive method that shows which models are most likely
- BMAS shows how much evidence there is for a model
- Provides insight in the level of (un)certainty
- Corrects for publication bias
- Sensitivity analysis to assess publication bias

Overview of today's presentation

- Introduce example
- BMAS without publication bias correction
- BMAS with correction

Example dataset

McCall & Carriger (1993)

Infant habituation & recognition memory performance as predictors of later IQ.

- 31 samples
- N differs between 11 and 143
- Correlation between r = .01 and r = .66

- 26 studies are statistically significant if tested two-sided
- 28 if tested one-sided

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McCall, R. B., & Carriger, M. S. (1993). A meta-analysis of infant habituation and recognition memory performance as predictors of later IQ. *Child development*, *64*(1), 57-79.

Random effects meta-analysis

Effect size: Medium to large

r = .407 [.341 : .469], p<.0001

Heterogeneity: Small to medium amount

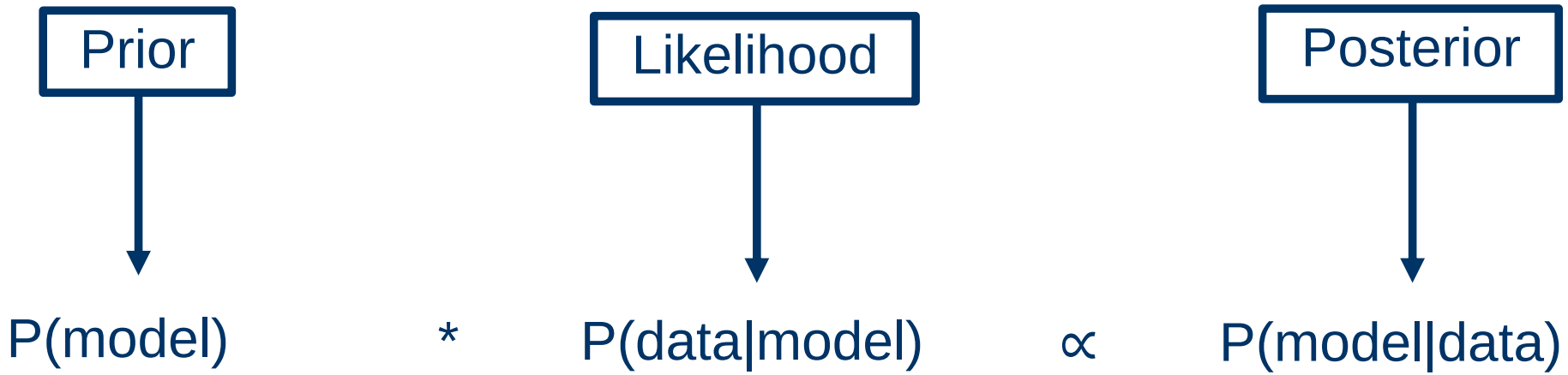
Q (30) = 49.57, p = .0137

I^2 = 39.5% [2.6% : 55.3%]

Bayesian Meta Analytic Snapshot (BMAS)

Bayesian Meta Analytic Snapshot

Bayes theorem

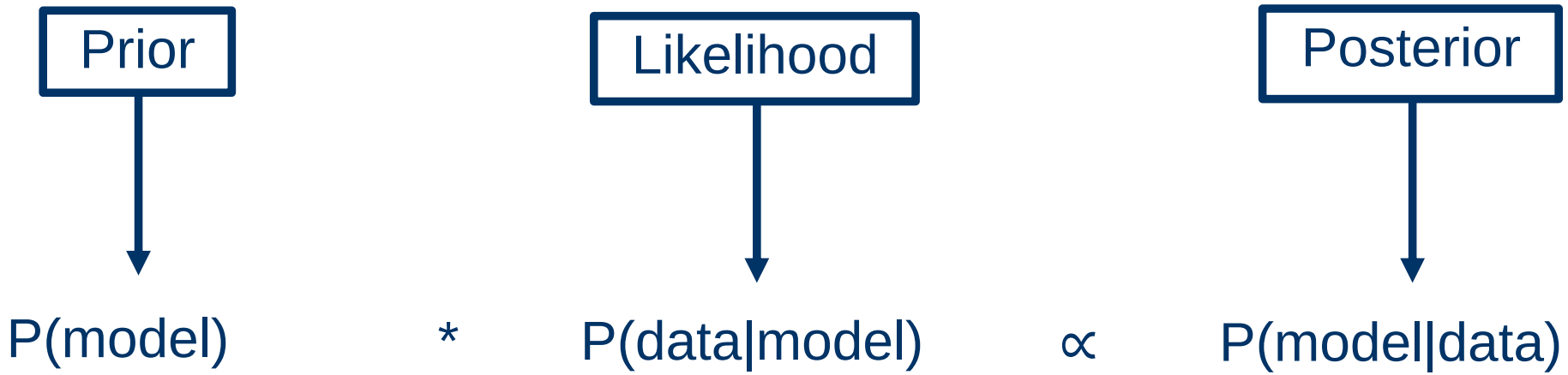


Bayesian Meta Analytic Snapshot

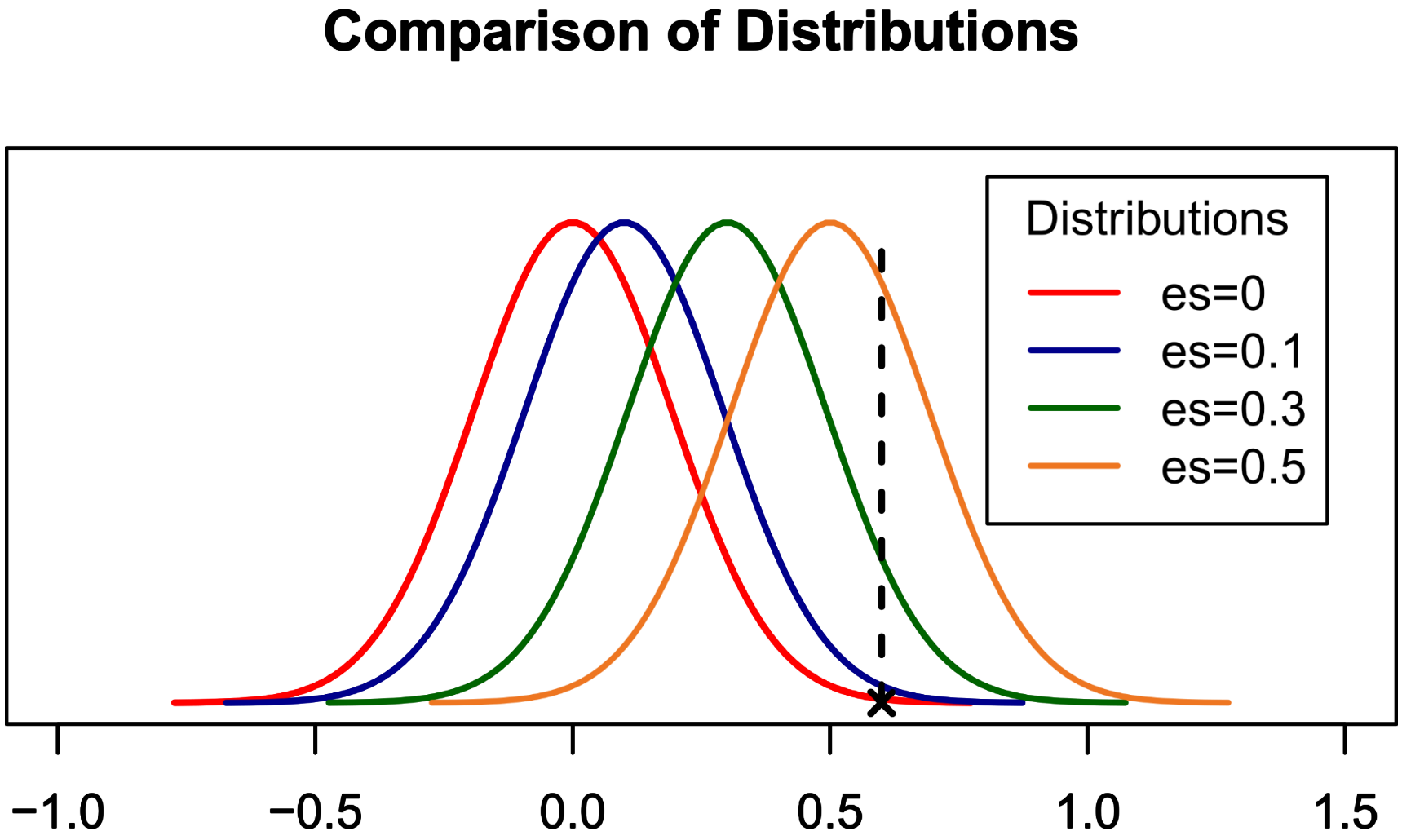
- Provide the posterior probability of 16 (4x4) models
  - Effect size (none, small, medium, large)
  - Heterogeneity (none, small, medium, large)

Bayesian Meta Analytic Snapshot

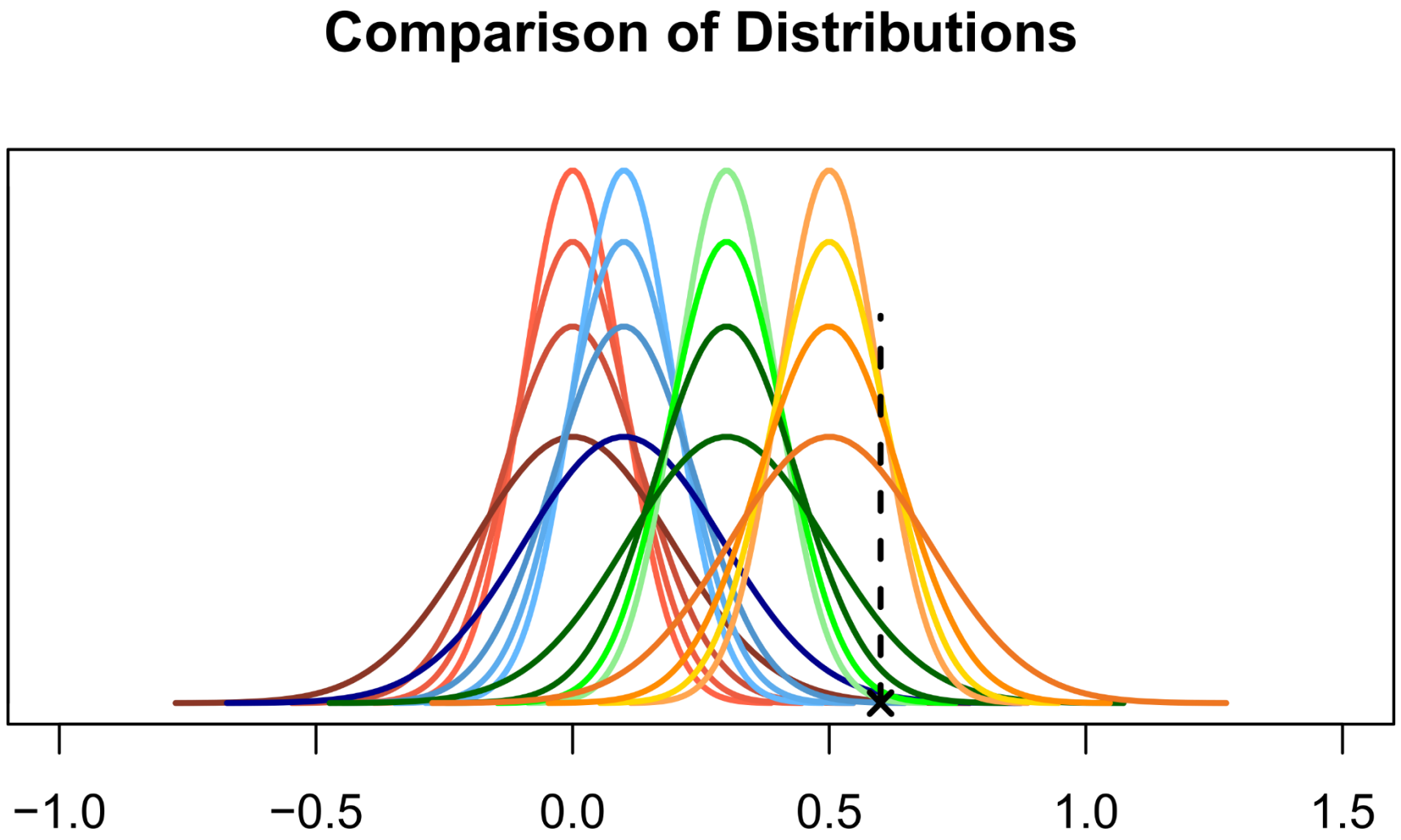
Bayes theorem



Bayesian Meta Analytic Snapshot

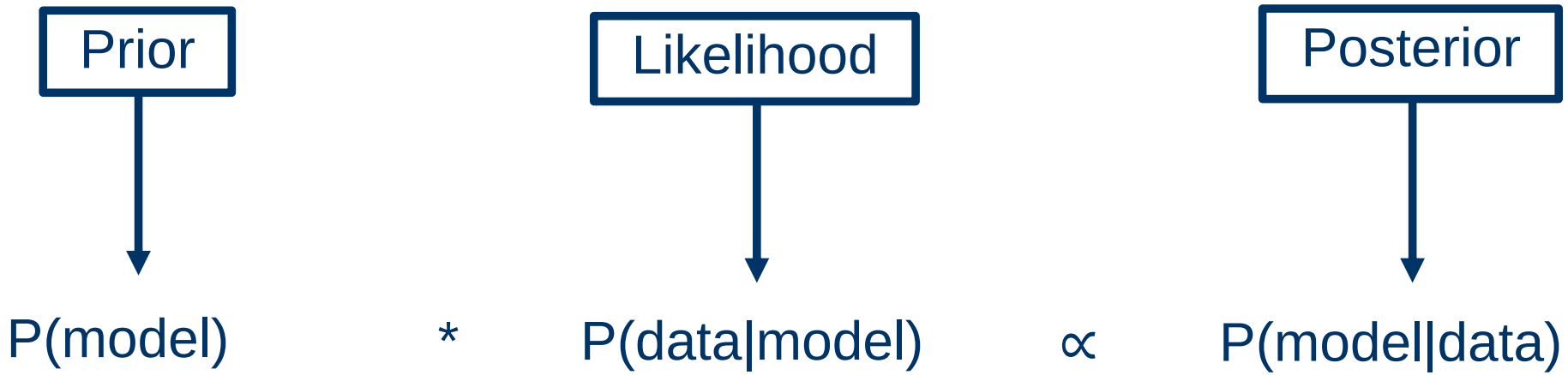


Bayesian Meta Analytic Snapshot



Bayesian Meta Analytic Snapshot

Bayes theorem



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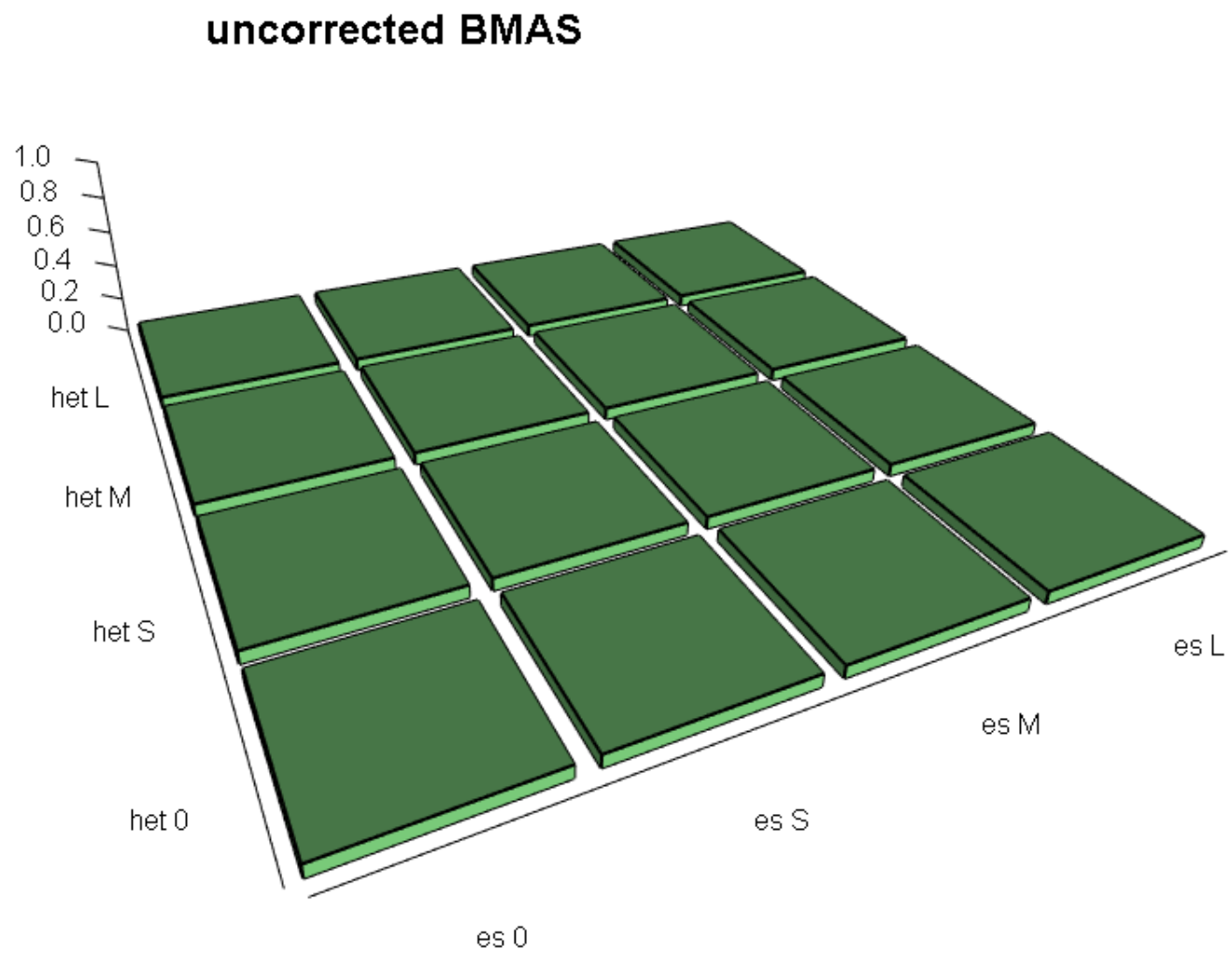

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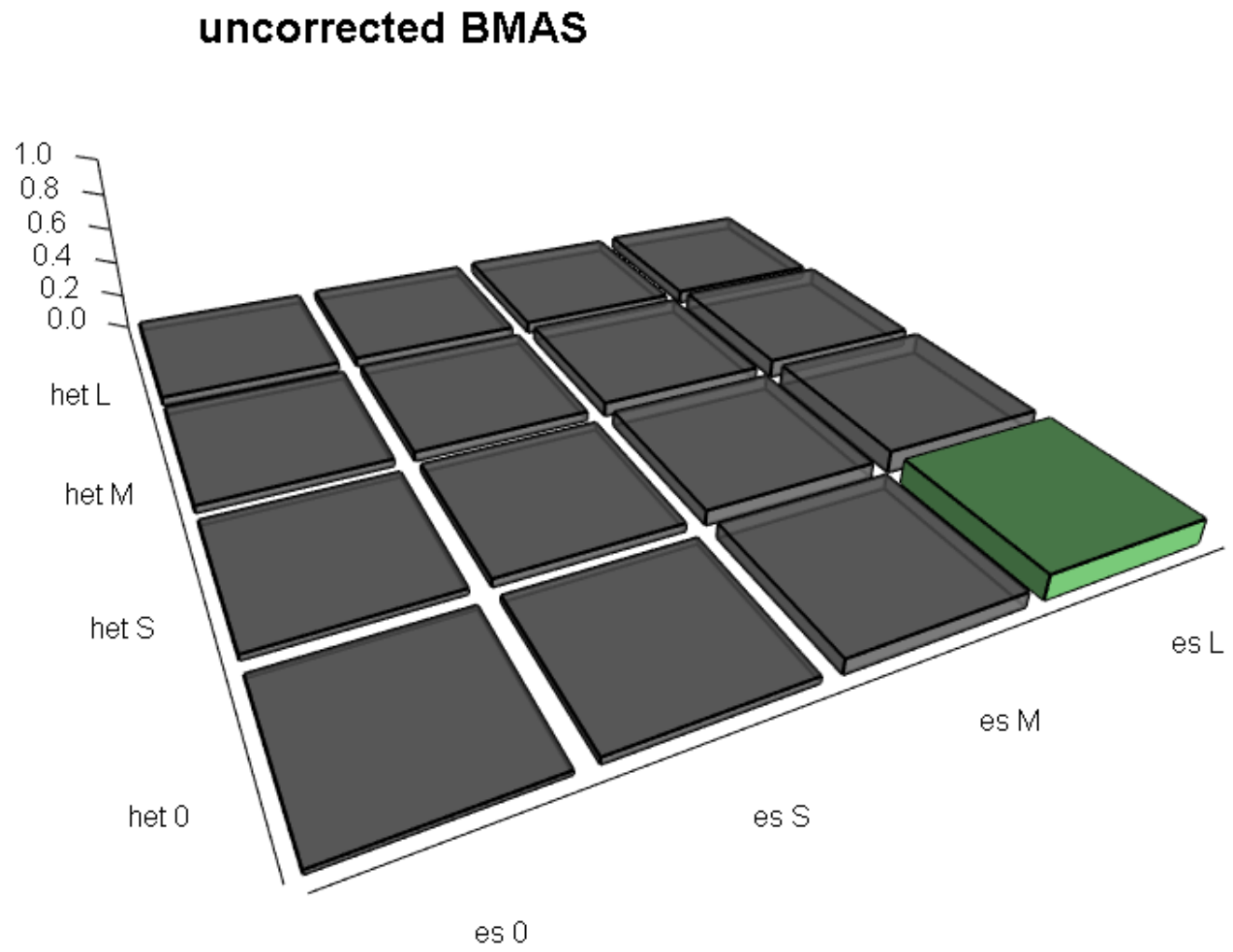
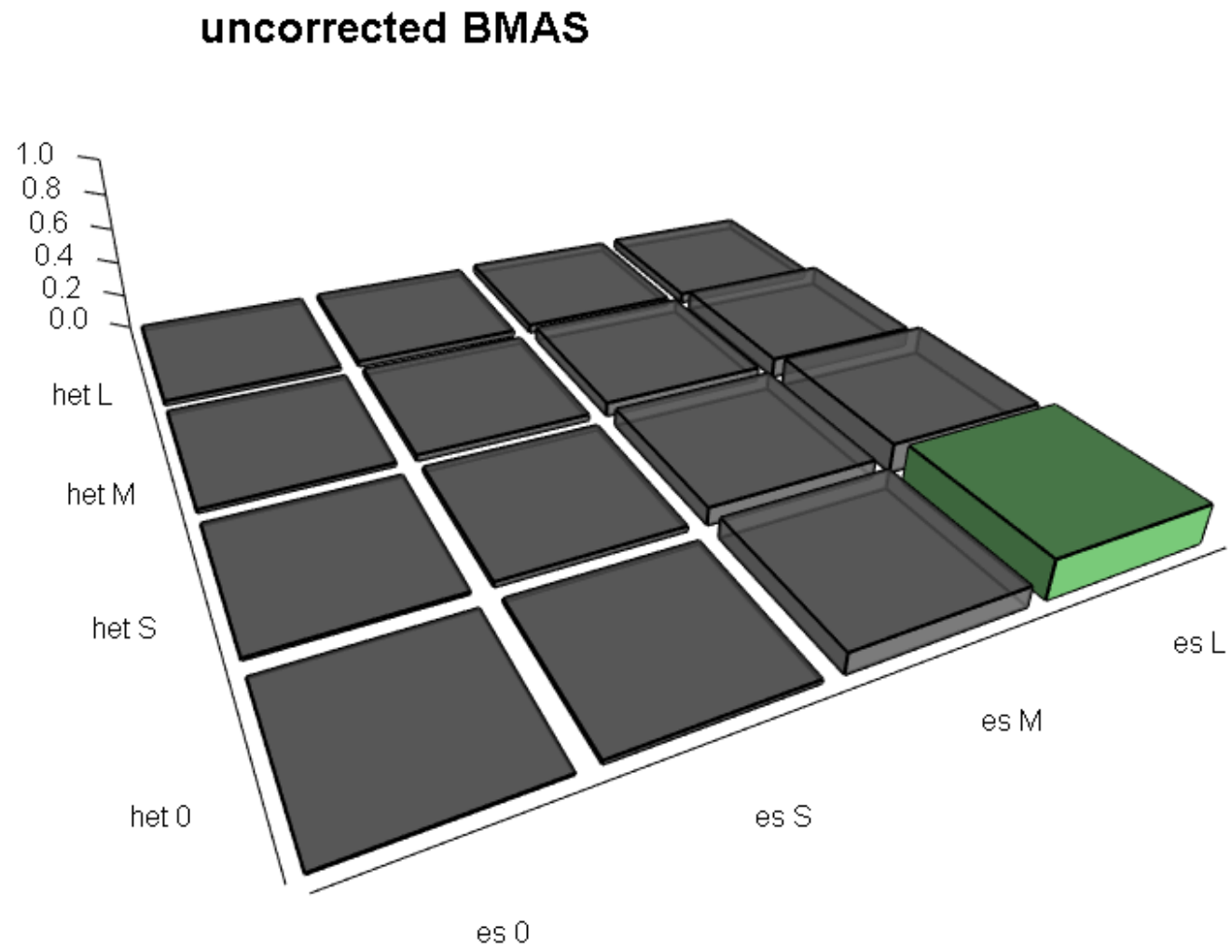
First datapoint:

r = 0.61, N = 11



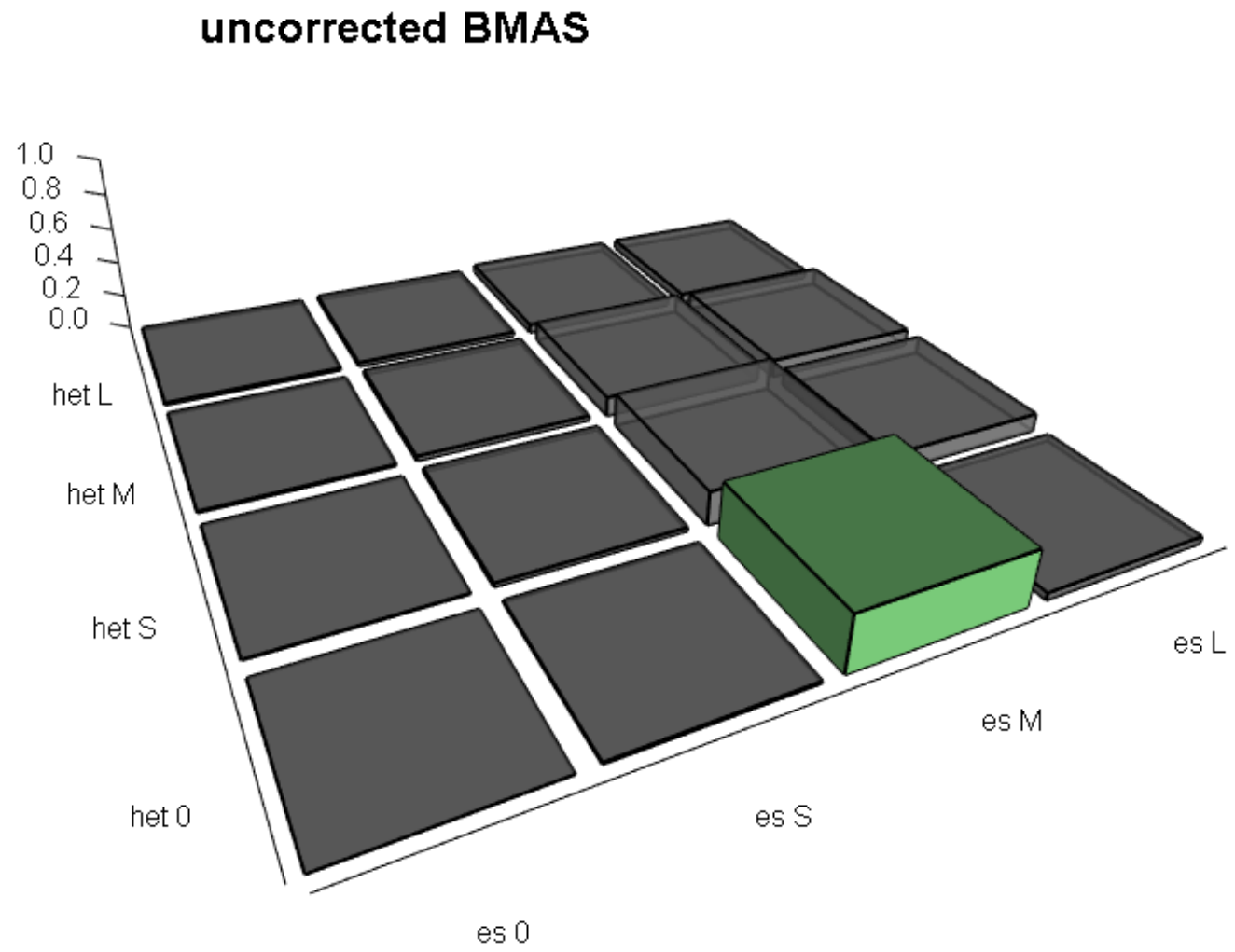
Second datapoint:

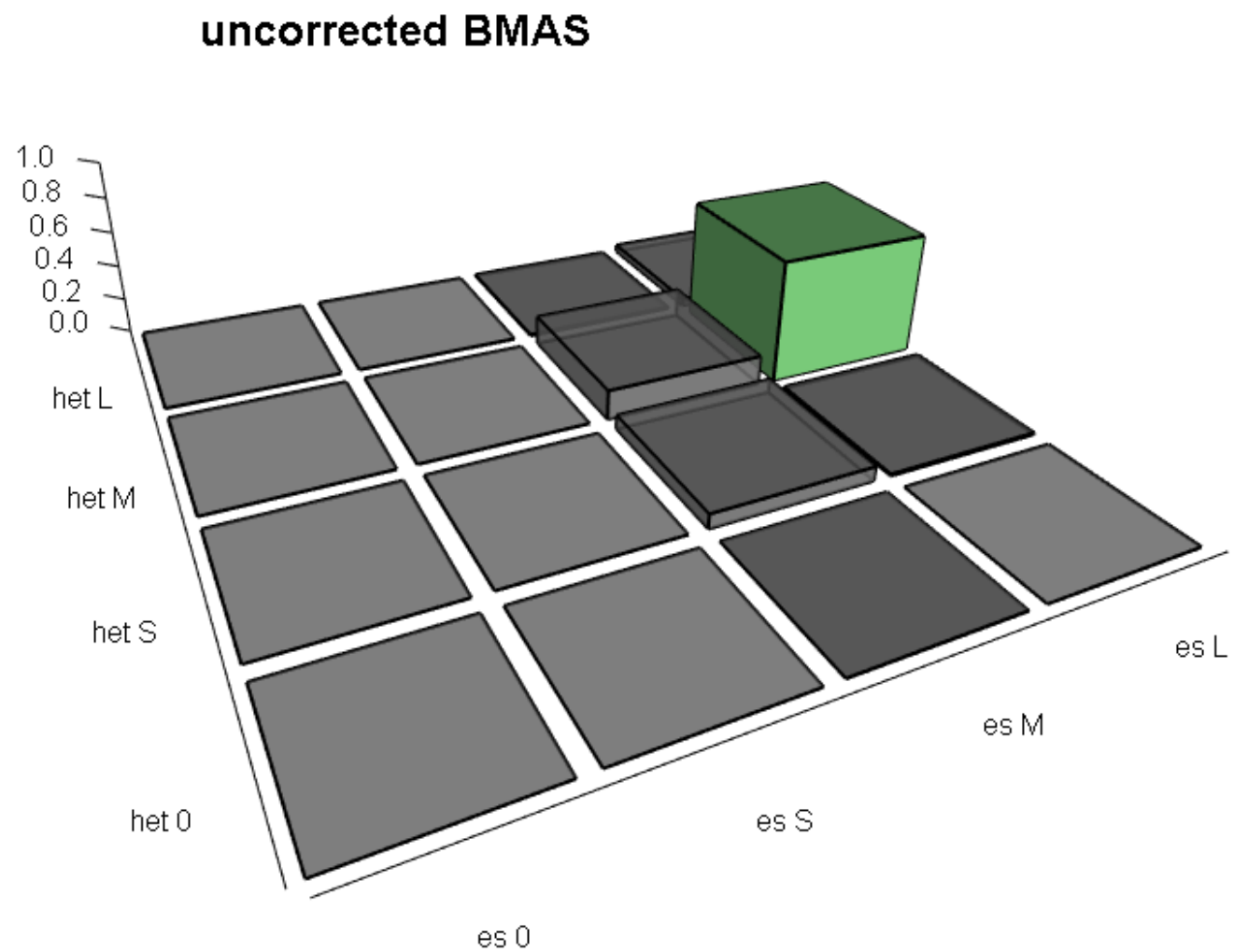
r = 0.43, N = 21



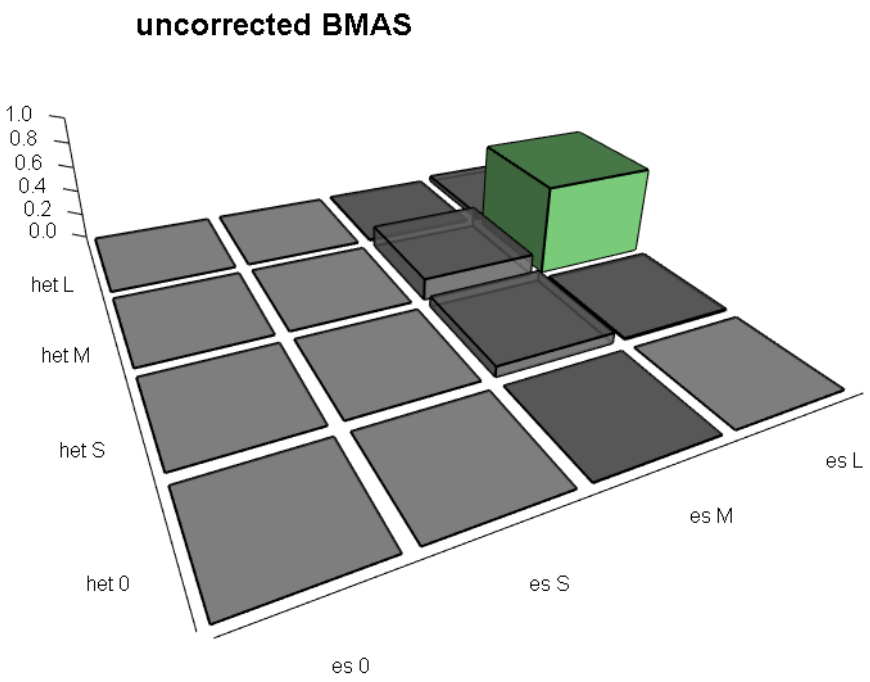
Third datapoint:

r = 0.29, N = 91




uncorrected BMAS
1.0
0.8
0.6
0.4
0.2
0.0
het L
het M
het S
het 0
es 0
es S
es M
es L

Bayesian Meta Analytic Snapshot: Uncorrected



	uncorrected BMAS				
model	**es0**	**esS**	**esM**	**esL**	**cummulative**
het 0	0	0	0.0017	0	0.0017
het S	0	0	0.0796	0.0099	0.0894
het M	0	0	0.1662	**0.6932**	**0.8594**
het L	0	0	0.0066	0.0429	0.0494
cummulative	0	0	0.2541	**0.7459**	1

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Publication bias

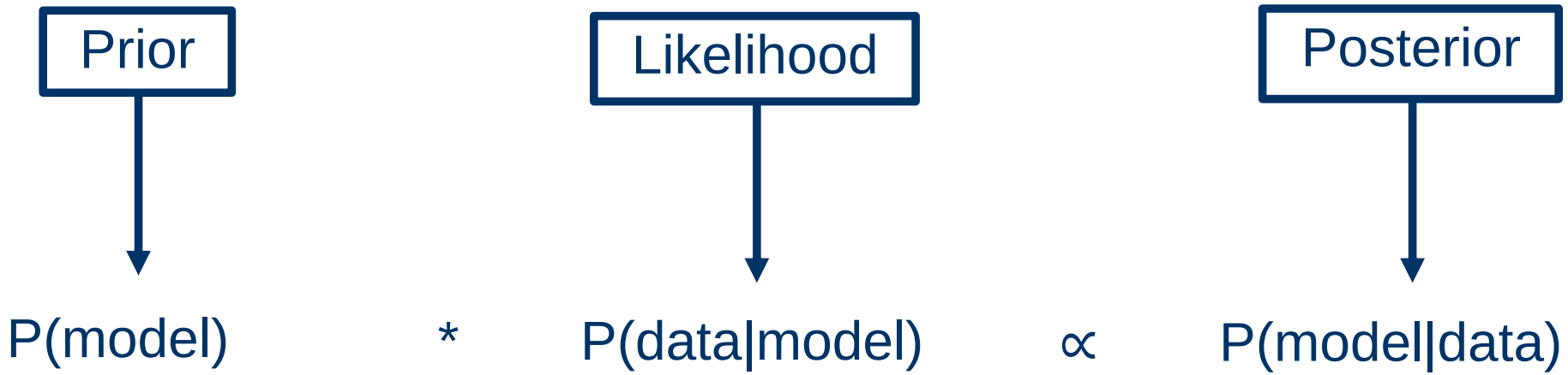
- Is there publication bias?

- Overestimated effect size?
- Incorrect estimate of heterogeneity?

- Correction needed!

Bayesian Meta Analytic Snapshot

Bayes theorem



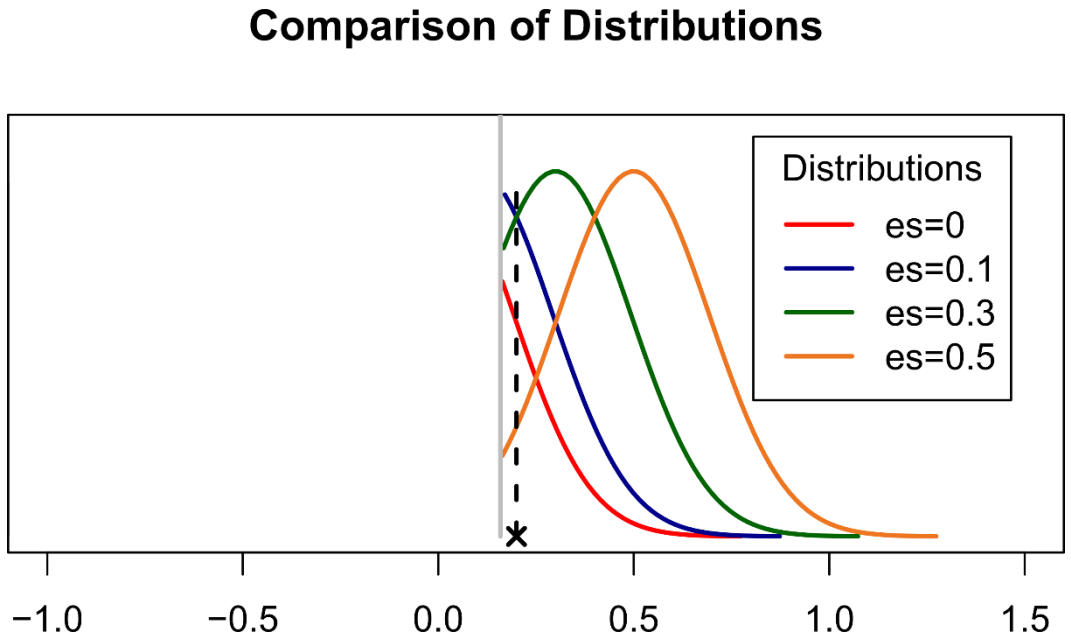
Bayesian Meta Analytic Snapshot: Corrected

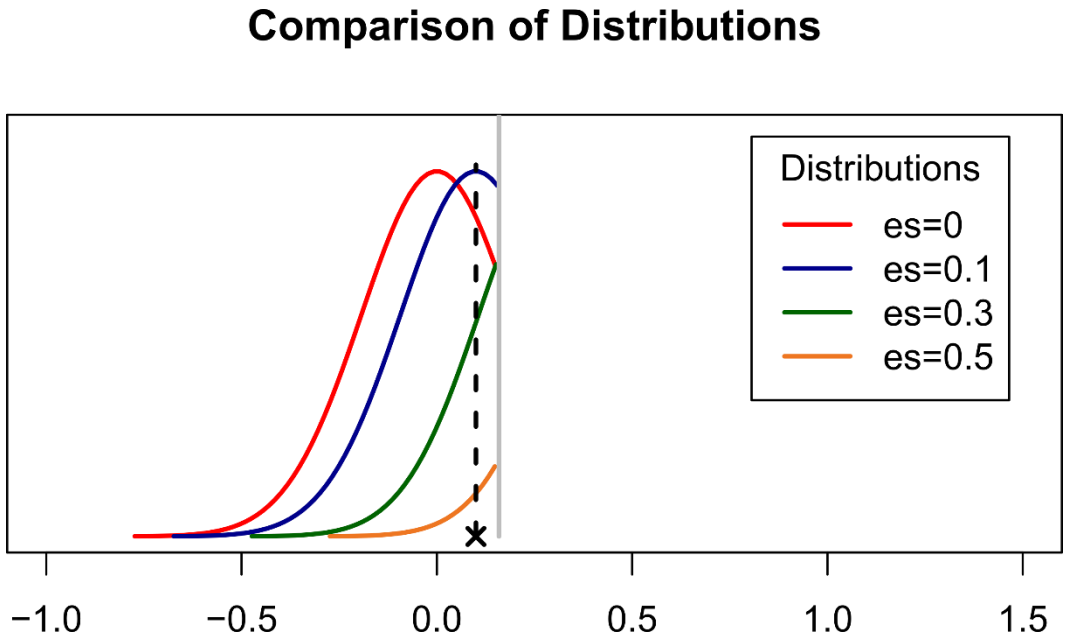
r =.20

Significant

r =.10

Non-significant





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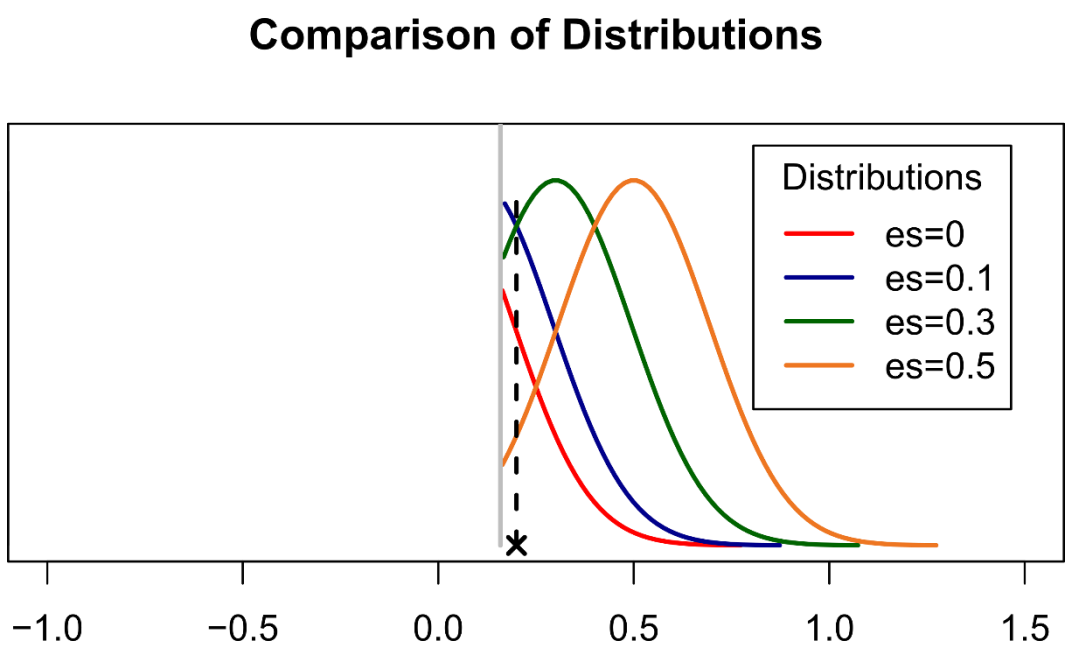
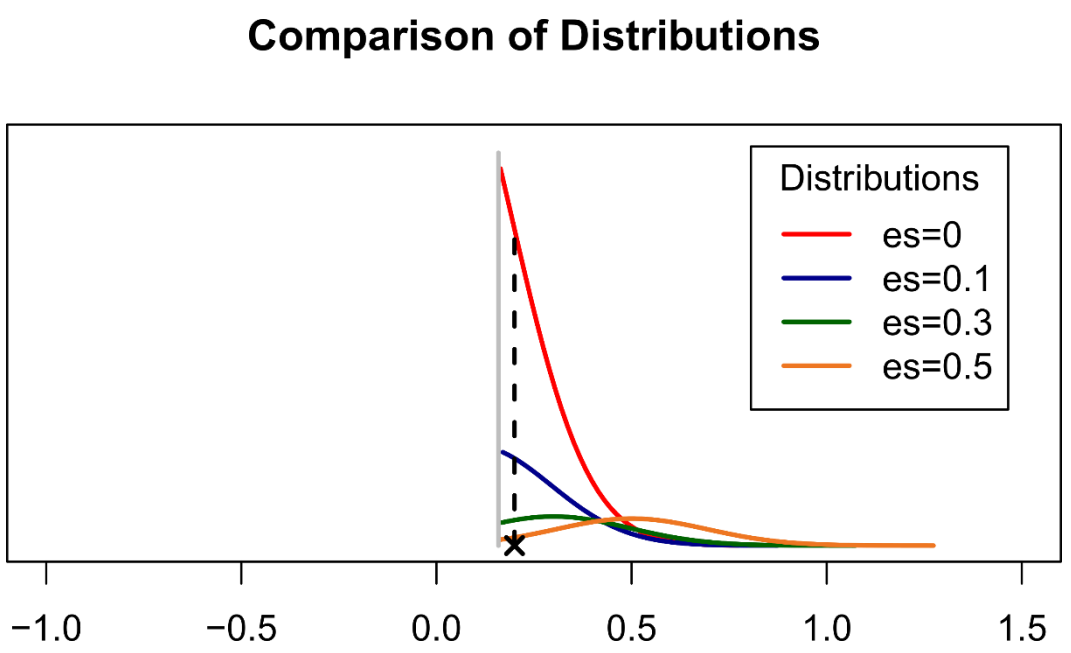
Bayesian Meta Analytic Snapshot: Corrected





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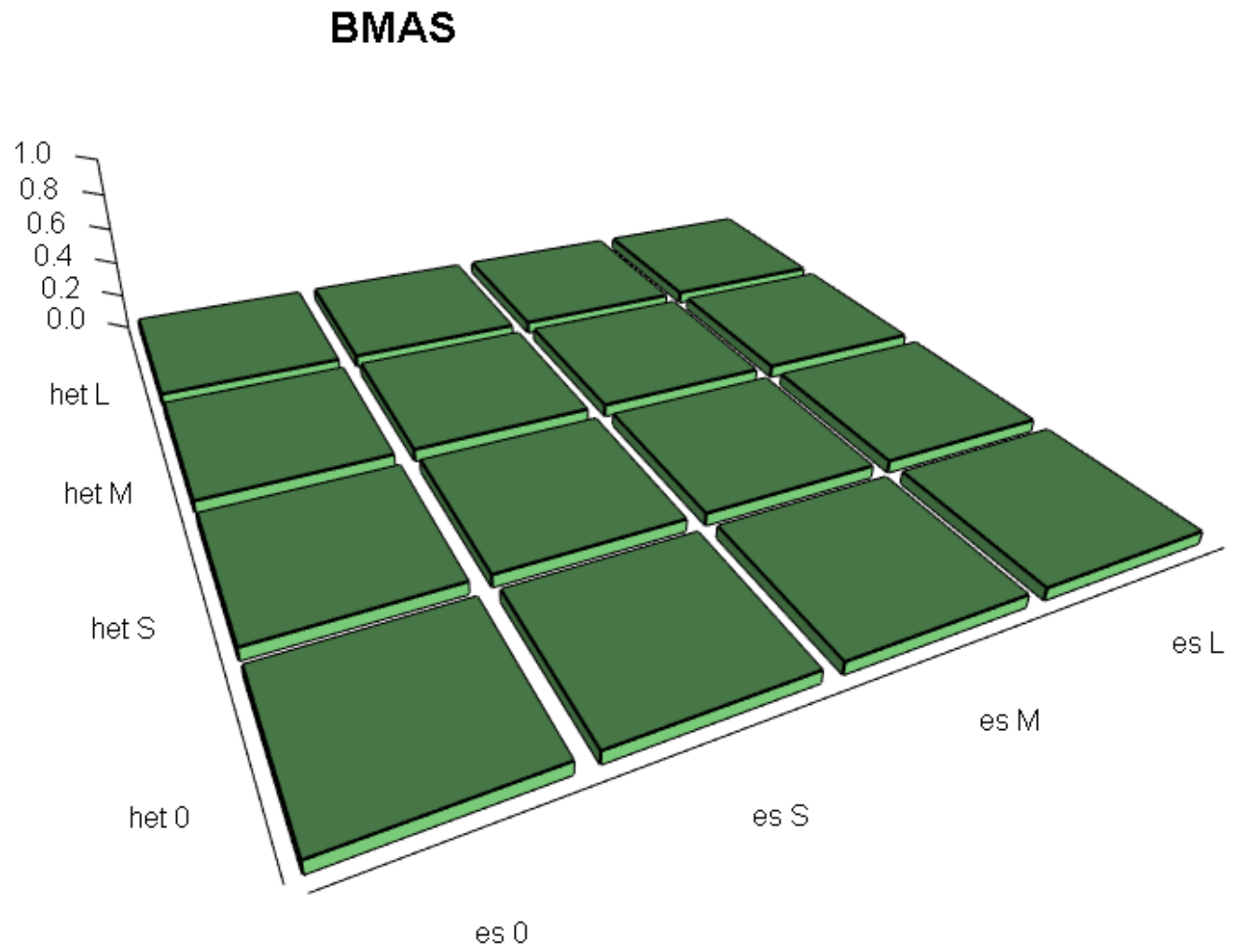

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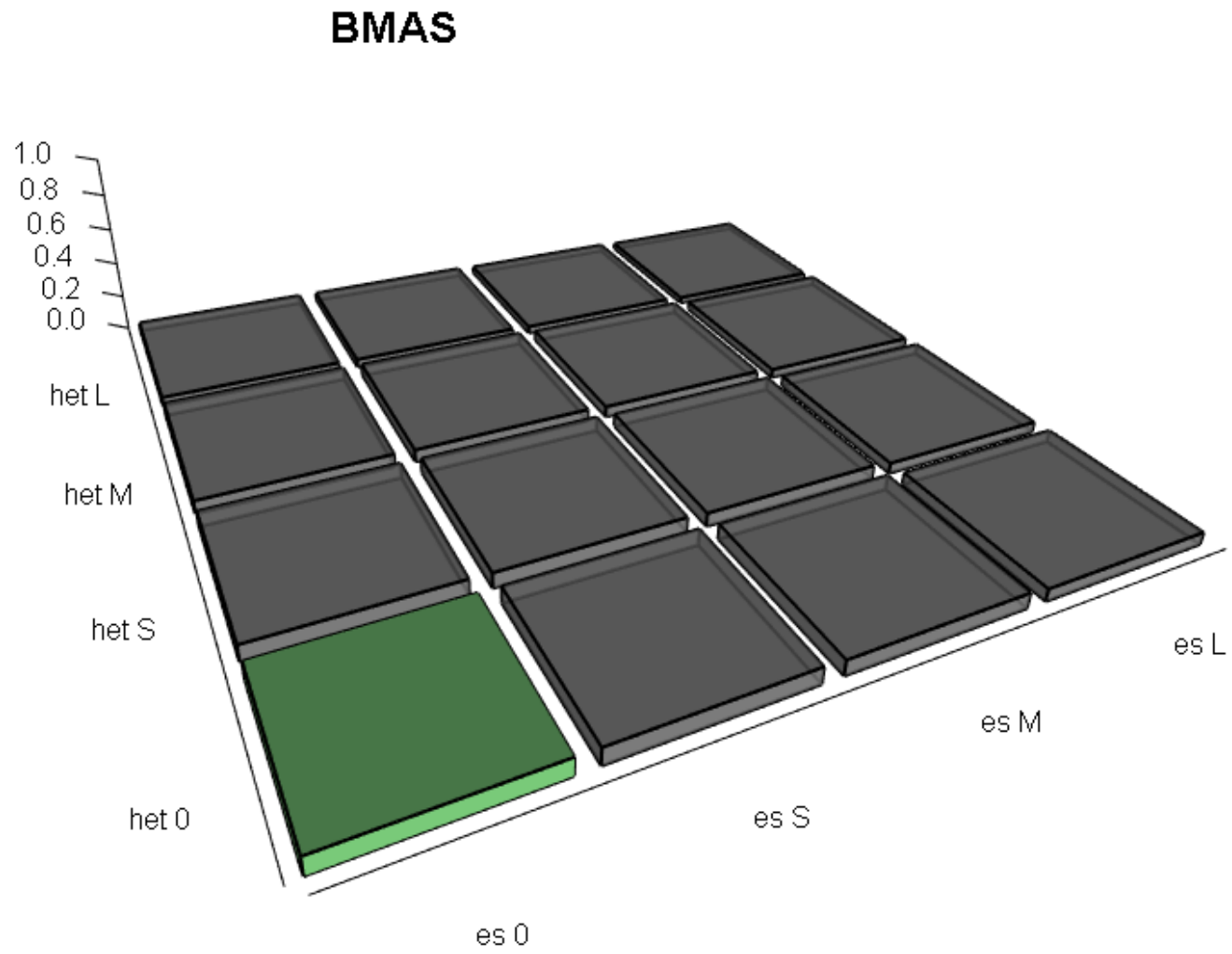
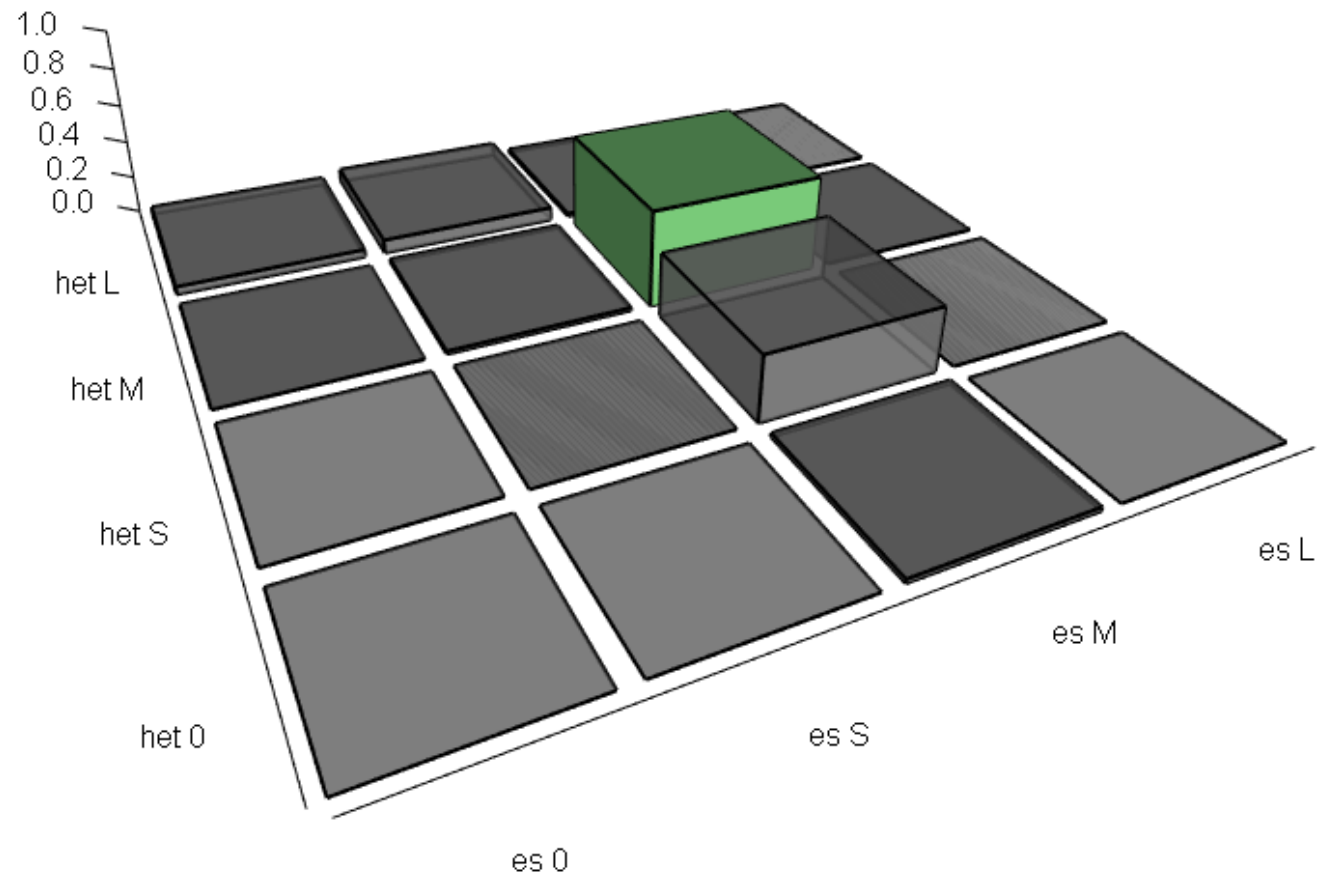
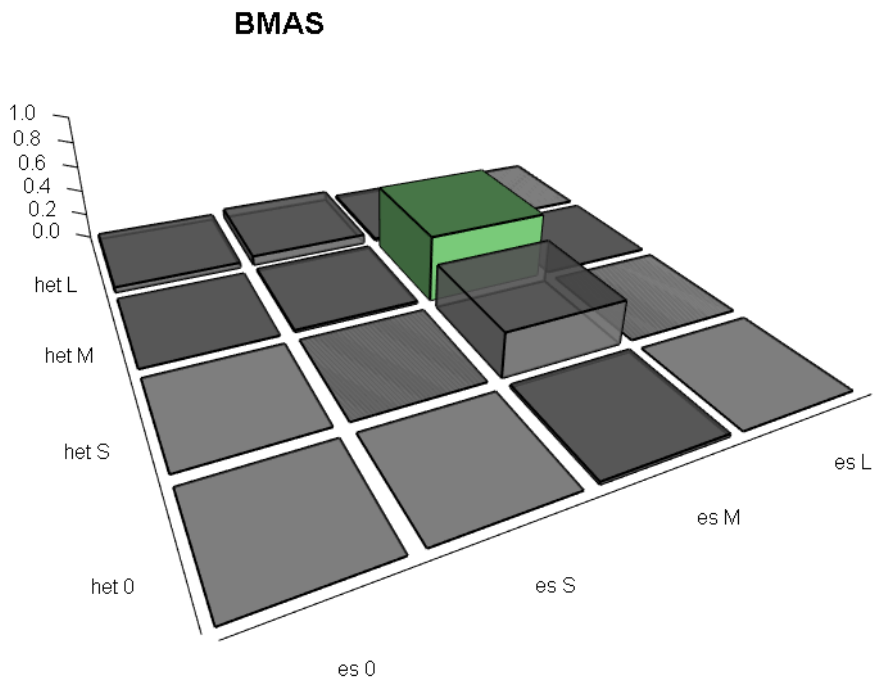


BMAS



Bayesian Meta Analytic Snapshot: Corrected



	BMAS				
model	**es0**	**esS**	**esM**	**esL**	**cummulative**
het 0	0	0	0.0199	0	0.0199
het S	0	0	0.3349	0	0.3349
het M	2e-04	0.0147	**0.5015**	1e-04	**0.5166**
het L	0.0401	0.0717	0.0167	0	0.1285
cummulative	0.0403	0.0864	**0.8731**	2e-04	1

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Result overview

Random effects:

- Medium to large effect (r = .41)
- Small to medium amount of heterogeneity (I^2 = 39.5%)

Uncorrected BMAS:

- Large effect size
- Medium amount of heterogeneity

Corrected BMAS:

- Medium effect size (large effect very unlikely)
- Small to medium amount of heterogeneity

Key message

- BMAS in an intuitive method that shows which models are most likely
- BMAS shows how much evidence there is for a model
- Provides insight in the level of (un)certainty
- Corrects for publication bias
- Sensitivity analysis to assess publication bias

Future work

- Paper on properties of BMAS
- R package / Shiny app
- Other (non-uniform) priors
- Continuous version using 16 intervals?

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