A meta-analysis of mental rotation ability in the first years of life

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Commit ec3e55c

Introduction

```
## [1] 32
```

```
## [1] 1776
```

```
## [1] 3.690371
```

```
## [1] 16.82184
```

```
## [1] 7.171171
```

```
gender %>%
  mutate(
    experiment = str_c(year, article, group, seq = ", "),
    # Convert mean sample age from days to months and center
    age_months = age_mean / 30.417,
    age_months_c = age_months - mean(age_months, na.rm = TRUE),
    # Add d_z from paired t test of condition means (Rosenthal, 1991)
    d_s_t = t * sqrt(1 / female_n + 1 / male_n),
    # Add d_z from ANOVA F value via conversion to a t value
    d_s_f = sqrt(as.numeric(f)) * sqrt(1 / female_n + 1 / male_n),
    # Add d_z from mean and standard deviation of the difference
    d_s_diff = (mean_diff_males_mean - mean_diff_females_mean) / sqrt(((male_n - 1) * (mean_diff_males_s
    # Add d_av from mean difference and standard devations (assumes r = 0.5)
    # (Cumming, 2012)
    # Add d from one-sample t test of novelty preference scores
    d_s_nov_pref = (novelty_pref_males_mean - novelty_pref_females_mean) / sqrt(((male_n - 1) * (novelty

    # Choose one type of outcome variable for each experiment
    di = case_when(
      # 1. If d was reported directed
      !is.na(d) ~ d,
      # 2. If a paired sample t test was reported
      !is.na(d_s_t) ~ d_s_t,
      # 3. If ANOVA was reported
      !is.na(d_s_f) ~ d_s_f,
      # 4. If the difference between means and its SD were reported
      !is.na(d_s_diff) ~ d_s_diff,
      # 6. If a novelty preference score and its SD were reported
      !is.na(d_s_nov_pref) ~ d_s_nov_pref
    ),
    # Keep track which type of outcome measure was chosen for each article
    di_type = case_when(
```

```
      # 1. If d was reported directly
      !is.na(d) ~ "d",
      # 2. If a paired sample t test was reported
      !is.na(d_s_t) ~ "d_s_t",
      # 3. If ANOVA was reported
      !is.na(d_s_f) ~ "d_s_f",
      # 4. If the difference between means and its SD were reported
      !is.na(d_s_diff) ~ "d_s_diff",
      # 6. If a novelty preference score and its SD were reported
      !is.na(d_s_nov_pref) ~ "d_s_nov_pref"
    ) %>%
      factor(levels = c("d", "d_s_t", "d_s_f", "d_s_diff", "d_s_nov_pref")),
    # As per Lankens et. al. 2013, the formula for Hedge's is as follows, is this even correct? Can we
    # g = d_i * (1 - (3 / (4 * (female_n + male_n) - 9))),
    # Apply small sample correction using Hedges' exact method
    # See http://dx.doi.org/10.20982/tqmp.14.4.p242
    df = (male_n + female_n - 2),
    j = exp(lgamma(df / 2) - log(sqrt(df / 2)) - lgamma((df - 1) / 2)),
    gi = di * j,
    # Compute empirical correlation based on sd_z and condition SDs
    d_s = case_when(
      !is.na(d_s_t) ~ d_s_t,
      !is.na(d_s_f) ~ d_s_f,
      !is.na(d_s_diff) ~ d_s_diff,
      !is.na(d_s_nov_pref) ~ d_s_nov_pref
    ),
    # harmonic mean od the sample sizes has to be taken hear
    n_h = (female_n * male_n) / (female_n + male_n),
    sei = sqrt((df * 2 * (1 + (gi^2 * n_h * 0.5))) / ((df - 2) * n_h) - (gi^2 / j^2))
  ) %>%
  arrange(experiment) -> dat
```

```
dat %>%
  select(
    article,
    group,
    group_long,
    experiment,
    gi,
    di,
    di_type,
    d,
    d_s_t,
    d_s_f,
    d_s_diff,
    sei
  ) %>%
  print(n = Inf)
```

```
## # A tibble: 32 x 12
##    article    group group_long experiment       gi     di di_type     d
##    <chr>      <chr> <chr>      <chr>         <dbl>  <dbl> <fct>   <dbl>
##  1 Rochat & ~ Exp.~ Experimen~ "1996Roch~  0        0     d_s_f   NA
##  2 Rochat & ~ Exp.~ Experimen~ "1996Roch~  0        0     d_s_f   NA
```

```
##  3 Hespos & ~ Exp.~ Experimen~ "1997Hesp~  0        0     d_s_f   NA
##  4 Hespos & ~ Exp.~ Experimen~ "1997Hesp~  0        0     d_s_f   NA
##  5 Hespos & ~ Exp.~ Experimen~ "1997Hesp~  0        0     d_s_f   NA
##  6 Hespos & ~ Exp.~ Experimen~ "1997Hesp~  0        0     d_s_f   NA
##  7 Hespos & ~ Exp.~ Experimen~ "1997Hesp~  0        0     d_s_f   NA
##  8 Hespos & ~ Exp.~ Experimen~ "1997Hesp~  0        0     d_s_f   NA
##  9 Moore & J~ All   Full samp~ "2008Moor~  0.647    0.66  d        0.66
## 10 Quinn & L~ All   Full samp~ "2008Quin~  1.28     1.32  d_s_t   NA
## 11 Moore & J~ All   Full samp~ "2011Moor~  0.797    0.813 d_s_f   NA
## 12 Frick & M~ All   Full samp~ "2013Fric~  0.472    0.482 d_s_f   NA
## 13 Möhring &~ All   Full samp~ "2013Möhr~ NA       NA     <NA>    NA
## 14 Schwarzer~ All   Full samp~ "2013Schw~  0        0     d_s_f   NA
## 15 Schwarzer~ All   Full samp~ "2013Schw~ NA       NA     <NA>    NA
## 16 Frick & W~ Exp.~ Experimen~ "2014Fric~  0        0     d_s_f   NA
## 17 Frick & W~ Exp.~ Experimen~ "2014Fric~  0        0     d_s_f   NA
## 18 Frick & W~ Exp.~ Experimen~ "2014Fric~  0        0     d_s_f   NA
## 19 Quinn & L~ Exp.~ Experimen~ "2014Quin~  1.21     1.23  d_s_f   NA
## 20 Erdmann 2~ 5 mo. 5-months-~ "2015Erdm~  0.00996  0.01  d        0.01
## 21 Erdmann 2~ 9 mo. 9-months-~ "2015Erdm~  0.0299   0.03  d        0.03
## 22 Lauer et ~ All   Full samp~ "2015Laue~  0.537    0.545 d_s_f   NA
## 23 Antrilli ~ All   Full samp~ "2016Antr~  0        0     d_s_f   NA
## 24 Christodo~ All   Full samp~ "2016Chri~  0        0     d_s_f   NA
## 25 Constanti~ All   Full samp~ "2016Cons~  0.631    0.64  d        0.64
## 26 Gerhard &~ All   Full samp~ "2018Gerh~  0        0     d_s_f   NA
## 27 Slone et ~ All   Full samp~ "2018Slon~  0        0     d_s_f   NA
## 28 Kaaz & He~ Exp.~ Experimen~ "2020Kaaz~  0.0199   0.02  d        0.02
## 29 Kaaz & He~ Exp.~ Experimen~ "2020Kaaz~  0.446    0.45  d        0.45
## 30 Gerhard-S~ All   Full samp~ "2021Gerh~  0        0     d_s_f   NA
## 31 Kelch et ~ Exp.~ Experimen~ "2021Kelc~  0.425    0.440 d_s_f   NA
## 32 Kelch et ~ Exp.~ Experimen~ "2021Kelc~ NA       NA     <NA>    NA
## # ... with 4 more variables: d_s_t <dbl>, d_s_f <dbl>, d_s_diff <dbl>,
## #   sei <dbl>
```

```
dat$sei
```

```
##  [1] 0.5560256 0.7032108 0.8976553 0.6592727 0.6995670 0.7319251
##  [7] 0.6741999 0.7032108 0.4660499 0.6410455 0.4694193 0.4629853
## [13]        NA 0.4188805        NA 0.5621141 0.5695794 0.5621141
## [19] 0.4377461 0.1970758 0.2195507 0.3888732 0.5185630 0.4174236
## [25] 0.3979975 0.3299480 0.3203616 0.1672546 0.2936809 0.4574746
## [31] 0.6292969        NA
```

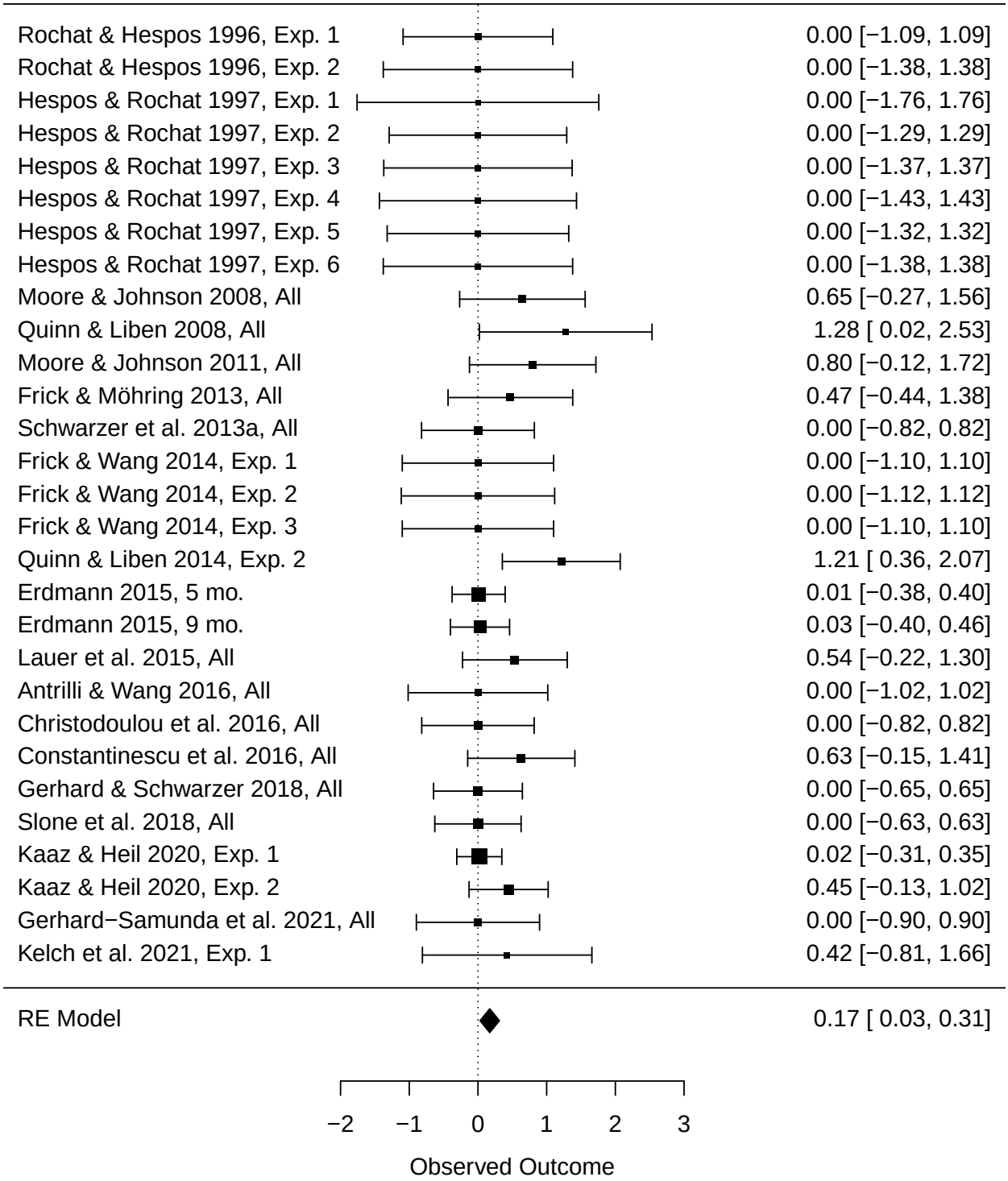
```
dat %>%
  mutate(
    ni = sample_size,
    vi = sei^2
  ) %>%
  filter(!is.na(gi)) %>%
  select(
    article, group, experiment, gi, ni, vi, sei, age_mean, age_sd, age_months_c, female_n, sample_size,
  ) %>%
  arrange(experiment) -> dat_r

# Three-level model
res_ml <- rma.mv(
```

```
  gi, vi,
  random = ~ 1 | article / experiment,
  data = dat_r,
  slab = paste(article, group, sep = ", ")
)
print(res_ml)
```

```
##
## Multivariate Meta-Analysis Model (k = 29; method: REML)
##
## Variance Components:
##
##             estim    sqrt  nlvls  fixed              factor
## sigma^2.1  0.0000  0.0000     19     no             article
## sigma^2.2  0.0000  0.0000     29     no  article/experiment
##
## Test for Heterogeneity:
## Q(df = 28) = 18.9538, p-val = 0.8996
##
## Model Results:
##
## estimate      se    zval    pval   ci.lb   ci.ub
##   0.1715  0.0714  2.4009  0.0164  0.0315  0.3115  *
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# jpeg("forest_between_three_level.jpg")
forest(res_ml)
```




```
# (i2 <- dmetar::var.comp(res_ml))
# plot(i2)

# Check share of variance at each level of the model
round(res_ml$sigma2[1] / sum(res_ml$sigma2), 3) # Between-article (ICC)
```

```
## [1] 0.914
```

```r
round(res_ml$sigma2[2] / sum(res_ml$sigma2), 3) # Within-article (between-exp.)
```

```
## [1] 0.086
```

```r
# # Profile likelihodd plots for checking that REML has converged
# profile(res_ml)
# dev.off()
```

```r
# for the SE of the t distribution, non central method shall be considered
# Specify priors
prior_c <- c(
  set_prior("normal(0, 1)", class = "b"),
  set_prior("cauchy(0, 0.3)", class = "sd")
)
# Run prior predictive simulation
n_iter <- 20000
res_prior <- brm(
  gi | se(sei) ~ 0 + Intercept + (1 | article / experiment),
  data = dat_r,
  prior = prior_c,
  sample_prior = "only",
  save_pars = save_pars(all = TRUE),
  chains = 4,
  iter = n_iter,
  warmup = 1000,
  cores = 4,
  control = list(adapt_delta = 0.99)
)
```

-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/-|/- Running MCMC with 4 parallel chains...

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All 4 chains finished successfully. Mean chain execution time: 4.8 seconds. Total execution time: 5.1 seconds.

```
summary(res_prior)
```

Family: gaussian Links: mu = identity; sigma = identity Formula: gi | se(sei) ~ 0 + Intercept + (1 | article/experiment) Data: dat_r (Number of observations: 29) Draws: 4 chains, each with iter = 19000; warmup = 0; thin = 1; total post-warmup draws = 76000

Group-Level Effects: ~article (Number of levels: 19) Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS sd(Intercept) 2.35 86.91 0.01 7.64 1.00 122455 Tail_ESS sd(Intercept) 41087

~article:experiment (Number of levels: 29) Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS sd(Intercept) 3.42 172.81 0.01 7.80 1.00 132752 Tail_ESS sd(Intercept) 40984

Population-Level Effects: Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS Intercept 0.00 1.01 -1.97 1.96 1.00 151526 53423

Family Specific Parameters: Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS sigma 0.00 0.00 0.00 0.00 NA NA NA

Draws were sampled using sample(hmc). For each parameter, Bulk_ESS and Tail_ESS are effective sample size measures, and Rhat is the potential scale reduction factor on split chains (at convergence, Rhat = 1).

```
# plot(res_prior)

# Run Bayesian multilevel model
res_brm <- update(res_prior, sample_prior = FALSE)
```

Running MCMC with 4 chains, at most 12 in parallel…

Chain 1 Iteration: 1 / 20000 [0%] (Warmup) Chain 1 Iteration: 100 / 20000 [0%] (Warmup) Chain 1 Iteration: 200 / 20000 [1%] (Warmup) Chain 1 Iteration: 300 / 20000 [1%] (Warmup) Chain 1 Iteration: 400 / 20000 [2%] (Warmup) Chain 1 Iteration: 500 / 20000 [2%] (Warmup) Chain 1 Iteration: 600 / 20000 [3%] (Warmup) Chain 2 Iteration: 1 / 20000 [0%] (Warmup) Chain 2 Iteration: 100 / 20000 [0%] (Warmup) Chain 2 Iteration: 200 / 20000 [1%] (Warmup) Chain 2 Iteration: 300 / 20000 [1%] (Warmup) Chain 2 Iteration: 400 / 20000 [2%] (Warmup) Chain 2 Iteration: 500 / 20000 [2%] (Warmup) Chain 3 Iteration: 1 / 20000 [0%] (Warmup) Chain 3 Iteration: 100 / 20000 [0%] (Warmup) Chain 3 Iteration: 200 / 20000 [1%] (Warmup) Chain 3 Iteration: 300 / 20000 [1%] (Warmup) Chain 3 Iteration: 400 / 20000 [2%] (Warmup) Chain 4 Iteration: 1 / 20000 [0%] (Warmup) Chain 4 Iteration: 100 / 20000 [0%] (Warmup) Chain 4 Iteration: 200 / 20000 [1%] (Warmup) Chain 4 Iteration: 300 / 20000 [1%] (Warmup) Chain 1 Iteration: 700 / 20000 [3%] (Warmup) Chain 1 Iteration: 800 / 20000 [4%] (Warmup) Chain 1 Iteration: 900 / 20000 [4%] (Warmup) Chain 1 Iteration: 1000 / 20000 [5%] (Warmup) Chain 1 Iteration: 1001 / 20000 [5%] (Sampling) Chain 1 Iteration: 1100 / 20000 [5%] (Sampling) Chain 1 Iteration: 1200 / 20000 [6%] (Sampling) Chain 2 Iteration: 600 / 20000 [3%] (Warmup) Chain 2 Iteration: 700 / 20000 [3%] (Warmup) Chain 2 Iteration: 800 / 20000 [4%] (Warmup) Chain 2 Iteration: 900 / 20000 [4%] (Warmup) Chain 2 Iteration: 1000 / 20000 [5%] (Warmup) Chain 2 Iteration: 1001 / 20000 [5%] (Sampling) Chain 2 Iteration: 1100 / 20000 [5%] (Sampling) Chain 2 Iteration: 1200 / 20000 [6%] (Sampling) Chain 3 Iteration: 500 / 20000 [2%] (Warmup) Chain 3 Iteration: 600 / 20000 [3%] (Warmup) Chain 3 Iteration: 700 / 20000 [3%] (Warmup) Chain 3 Iteration: 800 / 20000 [4%] (Warmup) Chain 3 Iteration: 900 / 20000 [4%] (Warmup) Chain 3 Iteration: 1000 / 20000 [5%] (Warmup) Chain 3 Iteration: 1001 / 20000 [5%] (Sampling) Chain 3 Iteration: 1100 / 20000 [5%] (Sampling) Chain 4 Iteration: 400 / 20000 [2%] (Warmup) Chain 4 Iteration: 500 / 20000 [2%] (Warmup) Chain 4 Iteration: 600 / 20000 [3%] (Warmup) Chain 4 Iteration: 700 / 20000 [3%] (Warmup) Chain 4 Iteration: 800 / 20000 [4%] (Warmup) Chain 4 Iteration: 900 / 20000 [4%] (Warmup) Chain 1 Iteration: 1300 / 20000 [6%] (Sampling) Chain 1 Iteration: 1400 / 20000 [7%] (Sampling) Chain 1 Iteration: 1500 / 20000 [7%] (Sampling) Chain 1 Iteration: 1600 / 20000 [8%] (Sampling) Chain 2 Iteration: 1300 / 20000 [6%] (Sampling) Chain 2 Iteration: 1400 / 20000 [7%] (Sampling) Chain 2 Iteration: 1500 / 20000 [7%] (Sampling) Chain 2 Iteration: 1600 / 20000 [8%] (Sampling) Chain 3 Iteration: 1200 / 20000 [6%] (Sampling) Chain 3 Iteration: 1300 / 20000 [6%] (Sampling) Chain 3 Iteration: 1400 / 20000 [7%] (Sampling) Chain 3 Iteration: 1500 / 20000 [7%] (Sampling) Chain 4 Iteration: 1000 / 20000 [5%] (Warmup) Chain 4 Iteration: 1001 / 20000 [5%] (Sampling) Chain 4 Iteration: 1100 / 20000 [5%] (Sampling) Chain 4 Iteration: 1200 / 20000 [6%] (Sampling) Chain 4 Iteration: 1300 / 20000 [6%] (Sampling) Chain 1 Iteration: 1700 / 20000 [8%] (Sampling) Chain 1 Iteration: 1800 / 20000 [9%] (Sampling) Chain 1 Iteration: 1900 / 20000 [9%] (Sampling) Chain 1 Iteration: 2000 / 20000 [10%] (Sampling) Chain 2 Iteration: 1700 / 20000 [8%] (Sampling) Chain 2 Iteration: 1800 / 20000 [9%] (Sampling) Chain 2 Iteration: 1900 / 20000 [9%] (Sampling) Chain 2 Iteration: 2000 / 20000 [10%] (Sampling) Chain 3 Iteration: 1600 /

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All 4 chains finished successfully. Mean chain execution time: 5.6 seconds. Total execution time: 5.9 seconds.

```
summary(res_brm)
```

```
## Warning: There were 2 divergent transitions after warmup.
## Increasing adapt_delta above may help. See http://mc-stan.org/misc/
## warnings.html#divergent-transitions-after-warmup
```

Family: gaussian Links: mu = identity; sigma = identity Formula: gi | se(sei) ~ 0 + Intercept + (1 | article/experiment) Data: dat_r (Number of observations: 29) Draws: 4 chains, each with iter = 19000; warmup = 0; thin = 1; total post-warmup draws = 76000

Group-Level Effects: ~article (Number of levels: 19) Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS sd(Intercept) 0.11 0.09 0.00 0.32 1.00 37393 Tail_ESS sd(Intercept) 35807

~article:experiment (Number of levels: 29) Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS sd(Intercept) 0.10 0.07 0.00 0.28 1.00 42582 Tail_ESS sd(Intercept) 36607

Population-Level Effects: Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS Intercept 0.20 0.09 0.03 0.39 1.00 72093 49365

Family Specific Parameters: Estimate Est.Error l-95% CI u-95% CI Rhat Bulk_ESS Tail_ESS sigma 0.00 0.00 0.00 0.00 NA NA NA

Draws were sampled using sample(hmc). For each parameter, Bulk_ESS and Tail_ESS are effective sample size measures, and Rhat is the potential scale reduction factor on split chains (at convergence, Rhat = 1).

```
# Compute probabilities of the meta-analytic being greater than 0
# hypothesis(res_brm, "Intercept > 0")$hypothesis
# Summarise fixed effects (incl. Bayes factors)
describe_posterior(
  res_brm,
  centrality = "mean", ci = 0.95, ci_method = "ETI",
  test = c("p_direction", "rope", "bayesfactor"),
  rope_range = c(-0.1, 0.1)
)
```

Summary of Posterior Distribution

Parameter	Mean	95% CI	pd	ROPE	% in ROPE	Rhat	ESS	BF
(Intercept)	0.20	[0.03, 0.39]	98.93%	[-0.10, 0.10]	10.94%	1.000	69426.00	1.29

```
# Compute by-experiment variance
var_experiment <- as.matrix(
  res_brm,
  variable = "sd_article:experiment__Intercept"
)^2
mean_qi(var_experiment)
```

```
       y         ymin       ymax .width .point .interval
```

1 0.01487582 1.498386e-05 0.07569403 0.95 mean qi

```
# Compute by-article variance
var_article <- as.matrix(
  res_brm,
  variable = "sd_article__Intercept"
)^2
mean_qi(var_article)
```

```
       y        ymin      ymax .width .point .interval
```

1 0.01938775 1.71046e-05 0.1030046 0.95 mean qi

```
# Compute intra-class correlation
var_total <- (var_experiment + var_article)
icc_draws <- var_article / var_total
mean_qi(icc_draws)
```

```
      y        ymin      ymax .width .point .interval
```

1 0.5265618 0.001898055 0.9987187 0.95 mean qi

```
## Warning: There were 2 divergent transitions after warmup.
## Increasing adapt_delta above may help. See http://mc-stan.org/misc/
## warnings.html#divergent-transitions-after-warmup

## Warning: There were 2 divergent transitions after warmup.
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## warnings.html#divergent-transitions-after-warmup
```

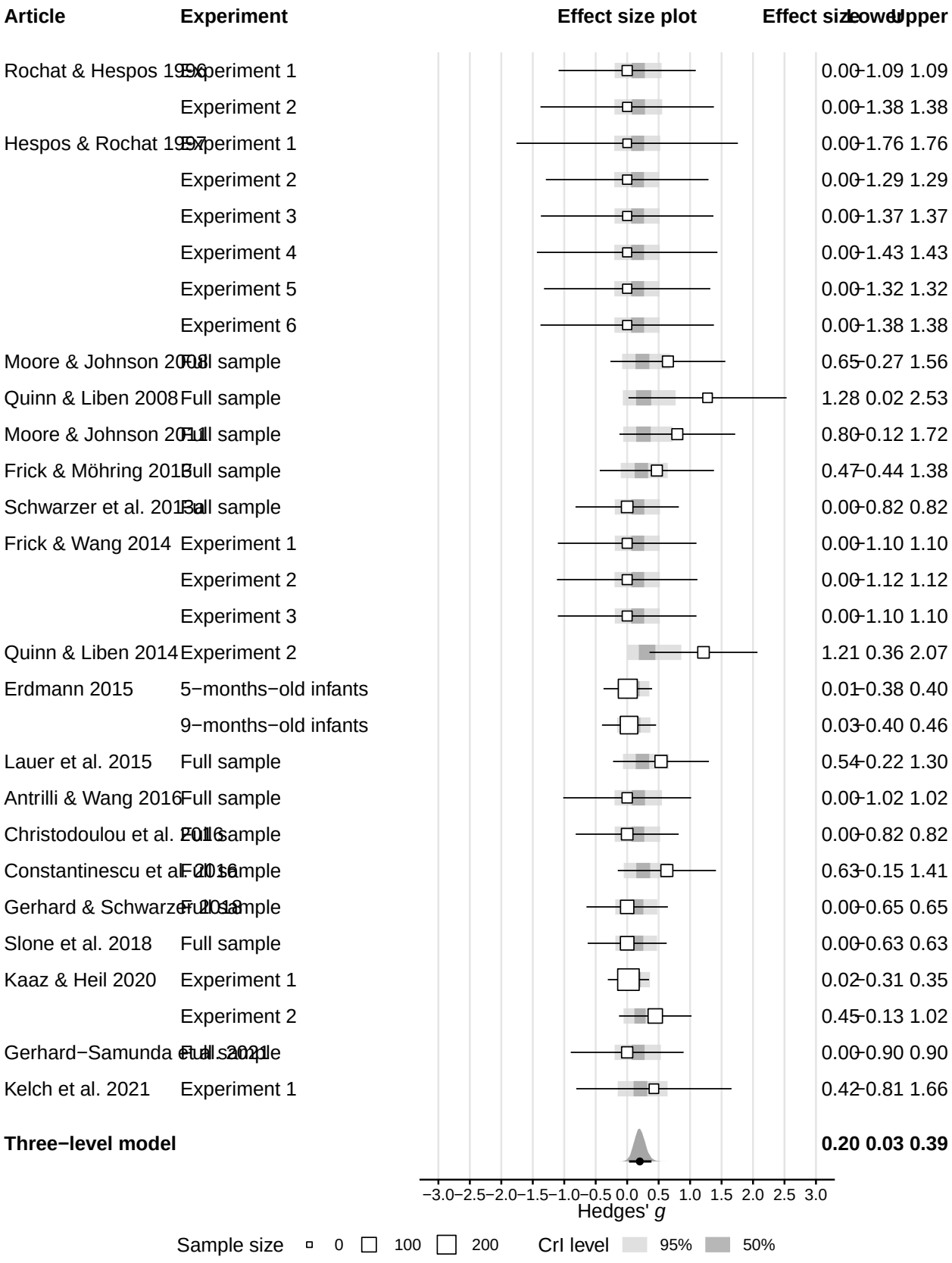
Article
Experiment
Effect size plot
Effect size
Lower
Upper
Rochat & Hespos 1996 Experiment 1 0.00 -1.09 1.09
Experiment 2 0.00 -1.38 1.38
Hespos & Rochat 1997 Experiment 1 0.00 -1.76 1.76
Experiment 2 0.00 -1.29 1.29
Experiment 3 0.00 -1.37 1.37
Experiment 4 0.00 -1.43 1.43
Experiment 5 0.00 -1.32 1.32
Experiment 6 0.00 -1.38 1.38
Moore & Johnson 2008 Full sample 0.65 -0.27 1.56
Quinn & Liben 2008 Full sample 1.28 0.02 2.53
Moore & Johnson 2011 Full sample 0.80 -0.12 1.72
Frick & Möhring 2013 Full sample 0.47 -0.44 1.38
Schwarzer et al. 2013a Full sample 0.00 -0.82 0.82
Frick & Wang 2014 Experiment 1 0.00 -1.10 1.10
Experiment 2 0.00 -1.12 1.12
Experiment 3 0.00 -1.10 1.10
Quinn & Liben 2014 Experiment 2 1.21 0.36 2.07
Erdmann 2015 5−months−old infants 0.01 -0.38 0.40
9−months−old infants 0.03 -0.40 0.46
Lauer et al. 2015 Full sample 0.54 -0.22 1.30
Antrilli & Wang 2016 Full sample 0.00 -1.02 1.02
Christodoulou et al. 2016 Full sample 0.00 -0.82 0.82
Constantinescu et al. 2016 Full sample 0.63 -0.15 1.41
Gerhard & Schwarzer 2018 Full sample 0.00 -0.65 0.65
Slone et al. 2018 Full sample 0.00 -0.63 0.63
Kaaz & Heil 2020 Experiment 1 0.02 -0.31 0.35
Experiment 2 0.45 -0.13 1.02
Gerhard−Samunda et al. 2021 Full sample 0.00 -0.90 0.90
Kelch et al. 2021 Experiment 1 0.42 -0.81 1.66
Three−level model 0.20 0.03 0.39
−3.0 −2.5 −2.0 −1.5 −1.0 −0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0
Hedges' g
Sample size 0 100 200
CrI level 95% 50%

```r
# Prior sensitivity analysis
list(
  "Intercept U(-10,10)" = c(
    set_prior("uniform(-10, 10)", class = "Intercept"),
    set_prior("cauchy(0, 0.3)", class = "sd")
  ),
  "Intercept N(0,0.2)" = c(
    set_prior("normal(0, 0.2)", class = "Intercept"),
    set_prior("cauchy(0, 0.3)", class = "sd")
  ),
  "SD U(0,10)" = c(
    set_prior("normal(0, 1)", class = "Intercept"),
    set_prior("uniform(0, 10)", class = "sd")
  ),
  "SD Student-t(10,0,0.2)" = c(
    set_prior("normal(0, 1)", class = "Intercept"),
    set_prior("student_t(10, 0, 0.2)", class = "sd")
  )
) %>%
  # Re-run the meta-analysis with different priors
  map(
    function(prior_sens) update(res_brm, prior = prior_sens, refresh = 0)
  ) -> res_prior_sens
```

```
## Running MCMC with 4 chains, at most 12 in parallel...
##
## Chain 1 finished in 5.5 seconds.
## Chain 2 finished in 5.5 seconds.
## Chain 3 finished in 5.6 seconds.
## Chain 4 finished in 5.5 seconds.
##
## All 4 chains finished successfully.
## Mean chain execution time: 5.5 seconds.
## Total execution time: 5.7 seconds.
## Running MCMC with 4 chains, at most 12 in parallel...
##
## Chain 1 finished in 6.4 seconds.
## Chain 2 finished in 6.4 seconds.
## Chain 3 finished in 6.5 seconds.
## Chain 4 finished in 6.5 seconds.
##
## All 4 chains finished successfully.
## Mean chain execution time: 6.5 seconds.
## Total execution time: 6.8 seconds.
```

```
## Warning: It appears as if you have specified an upper bounded prior on a parameter that has no natura
## If this is really what you want, please specify argument 'ub' of 'set_prior' appropriately.
## Warning occurred for prior
## sd ~ uniform(0, 10)
```

```
## Warning: It appears as if you have specified an upper bounded prior on a parameter that has no natura
## If this is really what you want, please specify argument 'ub' of 'set_prior' appropriately.
## Warning occurred for prior
## sd ~ uniform(0, 10)
```

```
## -\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\| Running MCMC
##
## Chain 1 finished in 5.5 seconds.
## Chain 3 finished in 5.4 seconds.
## Chain 2 finished in 5.5 seconds.
## Chain 4 finished in 5.4 seconds.
##
## All 4 chains finished successfully.
## Mean chain execution time: 5.5 seconds.
## Total execution time: 5.8 seconds.
## -\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/-\|/ Running MCMC with 4 cha
##
## Chain 2 finished in 5.9 seconds.
## Chain 4 finished in 5.9 seconds.
## Chain 1 finished in 6.2 seconds.
## Chain 3 finished in 6.0 seconds.
##
## All 4 chains finished successfully.
## Mean chain execution time: 6.0 seconds.
## Total execution time: 6.2 seconds.
```

```r
# Create a table summarizing all sensitivity analyses
map2_dfr(
  res_prior_sens,
  names(res_prior_sens),
  function(res, name) {

    # Compute ICC
    var_experiment <- as.matrix(
      res,
      variable = "sd_article:experiment__Intercept"
    )^2
    var_article <- as.matrix(
      res,
      variable = "sd_article__Intercept"
    )^2
    var_total <- var_experiment + var_article
    icc <- var_article / var_total
    icc_row <- mean_qi(icc) %>%
      rename(Estimate = y, `l-95% CI` = ymin, `u-95% CI` = ymax)

    # Create a data frame row of summary statistics
    with(summary(res), bind_rows(fixed, bind_rows(random))) %>%
      bind_rows(icc_row) %>%
      transmute(
        parameter = c("Hedges' g", "SD_{article}", "SD_{experiment}", "ICC"),
        Estimate = print_ci(Estimate, `l-95% CI`, `u-95% CI`)
      ) %>%
      pivot_wider(names_from = parameter, values_from = Estimate) %>%
      bind_cols(Simulation = name, .)
  }
) -> tab_sens
```

```
## Warning: There were 11 divergent transitions after warmup.
## Increasing adapt_delta above may help. See http://mc-stan.org/misc/
```

```
## warnings.html#divergent-transitions-after-warmup

## Warning: There were 11 divergent transitions after warmup.
## Increasing adapt_delta above may help. See http://mc-stan.org/misc/
## warnings.html#divergent-transitions-after-warmup

## Warning: There were 3 divergent transitions after warmup.
## Increasing adapt_delta above may help. See http://mc-stan.org/misc/
## warnings.html#divergent-transitions-after-warmup

## Warning: There were 7 divergent transitions after warmup.
## Increasing adapt_delta above may help. See http://mc-stan.org/misc/
## warnings.html#divergent-transitions-after-warmup
```

```
# Save the table
write_csv(tab_sens, file = here(tables_dir, "between_sensitivity_analysis.csv"))
```