

# IQ\_Math

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## 1 Preparation

```
## Load packages & Customized R functions
library(metafor)      # package for meta-analyses
library(robumeta)     # package for meta-analyses
library(xlsx)         # read in .xlsx files
library(psychmeta)    # range restriction and unreliability correction
library(clubSandwich) # Multivariate meta-analysis with dependent effect sizes

## set working directory
wd <- "D:/Research/2020/Meta Child/2024/RCode"
setwd(wd)             # set working directory

## Read in data
dall = read.xlsx('ASD meta-analysis data0405all.xlsx',1)
#summary(dall)        # take a look at the data
```

## 2 Correlation between full IQ and math scores

### 2.1 Data preparation

```
#### Data Preparation
# remove studies not reporting correlations
var.sel = c('control.group.corr_fsiq_math','control_NOT')
del = which(is.na(dall[,var.sel]),arr.ind = T)
del = unique(del[,1])
```

```

dsub = dall[-del,]

# Compute effect sizes
Nstudy = nrow(dsub)      # number of primary studies
ri = dsub$corr_fsiq_math # effect sizes
ni = dsub$n               # sample sizes
vi = (1-ri^2)^2/(ni-1)   # sampling variances of effect sizes
sei = sqrt(vi)           # standard error observed correlations
id = dsub$id             # study labels

#### Organize moderators
Age = dsub$age
Age = Age-mean(Age,na.rm = T)

PubYear = dsub$PubYear-min(dsub$PubYear)

modsl = list(Age = Age,Publication.Year = PubYear)

```

### 2.1.1 Meta-analysis of correlation with RVE

```

dat.rmathfIQo = data.frame(ri,vi,id)
sel.id = which(is.na(ri)==F)
dat.rmathfIQ = dat.rmathfIQo[sel.id,]
fit0 = robu(formula = ri ~ 1, data = dat.rmathfIQ,
            studynum = id,var.eff.size = vi,
            modelweights = "CORR", small = TRUE)
fit0$reg_table

##          labels          b.r          SE          t          dfs          prob          CI.L
## 1 X.Intercept. 0.4656821 0.1895247 2.457105 1.871583 0.1417976 -0.4058134
##          CI.U sig
## 1 1.337178

# Forest plot: Visualize the meta-analytic results

png(filename = paste0('ForestTD.','MathXfIQ','_.png'))
forest.robu(fit0,es.lab = 'ri', study.lab = 'id')
dev.off()

## pdf
## 2

```

## 2.2 Moderator Analysis (meta-regression) with RVE

```

mods.names = names(modsl)
Mod.res = matrix(NA,1,9)
colnames(Mod.res) = c("labels","b.r","SE","t",
                    "dfs" ,"prob","CI.L","CI.U","sig" )
Mod.res = as.data.frame(Mod.res)
for(mi in 1:length(mods.names)){
  mod = as.matrix(modsl[[mi]])
  dat.tmp = cbind(dat.rmathfIQo,mod)
  sel.id = which(is.na(dat.tmp$ri)==F)
  dat.tmp= dat.tmp[sel.id,]
}

```

```

fit.tmp = robu(formula = ri ~ 1 + mod, data = dat.tmp,
               studynum = id, var.eff.size = vi,
               modelweights = "CORR", small = TRUE)
res.tmp = fit.tmp$reg_table
res.tmp[1,1] = 'Intercept'
nmod = ncol(mod)
if(nmod == 1){
  res.tmp[2,1] = mods.names[mi]
}else{
  res.tmp[2:(nmod+1),1] = colnames(mod)
}
Mod.res = rbind(Mod.res, res.tmp)
}
Mod.res[1,] = fit0$reg_table
Mod.res[1,1] = 'No moderator'
Mod.res

##          labels          b.r          SE          t          dfs          prob
## 1      No moderator  0.46568212  0.18952469   2.457105  1.871583  0.1417976
## 2          Intercept  0.63073130  0.05628571  11.205888  1.000000  0.0566611
## 3              Age   0.20889902  0.05913993   3.532284  1.000000  0.1756331
## 4          Intercept  0.64384756  0.14647151   4.395719  1.000000  0.1424036
## 5 Publication.Year -0.08095393  0.04444350  -1.821502  1.000000  0.3196297
##          CI.L          CI.U sig
## 1 -0.4058134  1.3371776
## 2 -0.0844464  1.3459090  *
## 3 -0.5425451  0.9603431
## 4 -1.2172494  2.5049445
## 5 -0.6456621  0.4837542

write.xlsx(Mod.res, 'CorrelationTD.xlsx', sheetName = 'MathfIQ', append = T)

```

## 3 Correlation Between Verbal IQ and Math Scores

### 3.1 Data preparation

```

# Data preparation
# remove studies not reporting correlations
var.sel = c('control.group.corr_viq_math', 'control_NOT')
del = which(is.na(dall[, var.sel]), arr.ind = T)
del = unique(del[, 1])
dsub = dall[-del,]

Nstudy = nrow(dsub)          # number of primary studies
ri = dsub$corr_viq_math      # effect sizes
ni = dsub$n                  # sample sizes
vi = (1-ri^2)^2/(ni-1)       # sampling variances of effect sizes
sei = sqrt(vi)               # standard error observed correlations
id = dsub$id                  # study labels

#### Organize moderators
Age = dsub$age
Age = Age - mean(Age, na.rm = T)

```

```

PubYear = dsub$PubYear-min(dsub$PubYear)

modsl = list(Age = Age,Publication.Year = PubYear)

```

## 3.2 Meta-analysis of correlation with RVE

```

dat.rmathvIQo = data.frame(ri,vi,id)
sel.id = which(is.na(ri)==F)
dat.rmathvIQ = dat.rmathvIQo[sel.id,]
fit0 = robu(formula = ri ~ 1, data = dat.rmathvIQ,
            studynum = id,var.eff.size = vi,
            modelweights = "CORR", small = TRUE)
fit0$reg_table

##          labels          b.r          SE          t          dfs          prob          CI.L
## 1 X.Intercept. 0.4288718 0.1965534 2.181961 1.900289 0.1674745 -0.46081
##          CI.U sig
## 1 1.318554

# Forest plot: Visualize the meta-analytic results
png(filename = paste0('ForestTD.','MathXvIQ','png'))
forest.robust(fit0,es.lab = 'ri',study.lab = 'id')
dev.off()

## pdf
## 2

```

## 3.3 Moderator Analysis (meta-regression) with RVE

```

mods.names = names(modsl)
Mod.res = matrix(NA,1,9)
colnames(Mod.res) = c("labels","b.r","SE","t",
                    "dfs","prob","CI.L","CI.U","sig")
Mod.res = as.data.frame(Mod.res)
for(mi in 1:length(mods.names)){
  mod = as.matrix(modsl[[mi]])
  dat.tmp = cbind(dat.rmathvIQo,mod)
  sel.id = which(is.na(dat.tmp$ri)==F)
  dat.tmp = dat.tmp[sel.id,]
  fit.tmp = robu(formula = ri ~ 1 + mod, data = dat.tmp,
                studynum = id,var.eff.size = vi,
                modelweights = "CORR", small = TRUE)
  res.tmp = fit.tmp$reg_table
  res.tmp[1,1] = 'Intercept'
  nmod = ncol(mod)
  if(nmod == 1){
    res.tmp[2,1] = mods.names[mi]
  }else{
    res.tmp[2:(nmod+1),1] = colnames(mod)
  }
  Mod.res = rbind(Mod.res,res.tmp)
}

```

```
Mod.res[1,] = fit0$reg_table
Mod.res[1,1] = 'No moderator'
Mod.res
```

```
##          labels          b.r          SE          t          dfs          prob
## 1      No moderator  0.42887181 0.19655340  2.1819608 1.900289 0.16747453
## 2          Intercept  0.43836063 0.22253698  1.9698327 1.000000 0.29905512
## 3              Age   0.14047032 0.16899475  0.8312111 1.000000 0.55851404
## 4          Intercept  0.73503778 0.03583913 20.5093626 1.000000 0.03101588
## 5 Publication.Year -0.07958567 0.01124511 -7.0773608 1.000000 0.08936004
##          CI.L          CI.U sig
## 1 -0.4608100 1.31855359
## 2 -2.3892398 3.26596108
## 3 -2.0068116 2.28775223
## 4  0.2796584 1.19041714  **
## 5 -0.2224683 0.06329695  *
```

```
write.xlsx(Mod.res, 'CorrelationTD.xlsx', sheetName = 'MathvIQ', append = T)
```

## 4 Correlation Between Nonverbal IQ and Math Scores

### 4.1 Data preparation

```
#### Data Preparation
# remove studies not reporting correlations
var.sel = c('control.group.corr_nviq_math', 'control_NOT')
del = which(is.na(dall[,var.sel]), arr.ind = T)
del = unique(del[,1])
dsub = dall[-del,]

Nstudy = nrow(dsub)      # number of primary studies
ri = dsub$corr_nviq_math # effect sizes
ni = dsub$n              # sample sizes
vi = (1-ri^2)/(ni-1)     # sampling variances of effect sizes
sei = sqrt(vi)          # standard error observed correlations
id = dsub$id             # study labels

#### Organize moderators
Age = dsub$age
Age = Age - mean(Age, na.rm = T)

PubYear = dsub$PubYear - min(dsub$PubYear)

Severity = dsub$calibrated.severity.scores
Severity = Severity - mean(Severity, na.rm = T)

gender = dsub$gender.ratio
gender = gender - mean(gender, na.rm = T)

modsl = list(Age = Age, Publication.Year = PubYear)
```

## 4.2 Meta-analysis of correlation with RVE

```
dat.rmathnvIQo = data.frame(ri,vi,id)
sel.id = which(is.na(ri)==F)
dat.rmathnvIQ = dat.rmathnvIQo[sel.id,]
fit0 = robu(formula = ri ~ 1, data = dat.rmathnvIQ,
            studynum = id,var.eff.size = vi,
            modelweights = "CORR", small = TRUE)
fit0$reg_table

##          labels          b.r          SE          t          dfs          prob          CI.L
## 1 X.Intercept. 0.4831805 0.08498392 5.685553 1.551407 0.05078964 -0.005071721
##          CI.U sig
## 1 0.9714328  *

# Forest plot: Visualize the meta-analytic results
png(filename = paste0('ForestTD.','MathXnvIQ','.png'))
  forest.robust(fit0,es.lab = 'ri',study.lab = 'id')
dev.off()

## pdf
## 2
```

## 4.3 Moderator Analysis (meta-regression) with RVE

```
mods.names = names(mods1)
Mod.res = matrix(NA,1,9)
colnames(Mod.res) = c("labels","b.r","SE","t",
                    "dfs" ,"prob","CI.L","CI.U","sig" )
Mod.res = as.data.frame(Mod.res)
for(mi in 1:length(mods.names)){
  mod = as.matrix(mods1[[mi]])
  dat.tmp = cbind(dat.rmathnvIQo,mod)
  sel.id = which(is.na(dat.tmp$ri)==F)
  dat.tmp = dat.tmp[sel.id,]
  fit.tmp = try( robu(formula = ri ~ 1 + mod, data = dat.tmp,
                    studynum = id,var.eff.size = vi,
                    modelweights = "CORR", small = TRUE) )
  if( inherits(fit.tmp,'try-error') ){
    res.tmp = c(mods.names[mi],rep(NA,8))
  }else{
    res.tmp = fit.tmp$reg_table
    res.tmp[1,1] = 'Intercept'
    nmod = ncol(mod)
    if(nmod == 1){
      res.tmp[2,1] = mods.names[mi]
    }else{
      res.tmp[2:(nmod+1),1] = colnames(mod)
    }
  }
}
Mod.res = rbind(Mod.res,res.tmp)
}
Mod.res[1,] = fit0$reg_table
Mod.res[1,1] = 'No moderator'
Mod.res
```

```
##          labels          b.r          SE          t          dfs          prob
## 1      No moderator  0.483180539 0.08498392  5.68555255 1.551407 0.05078964
## 2          Intercept  0.414601508 0.22973382  1.80470384 1.000000 0.32212408
## 3              Age -0.007464028 0.07975907 -0.09358219 1.000000 0.94059674
## 4          Intercept  0.499263337 0.35856760  1.39238274 1.000000 0.39650728
## 5 Publication.Year -0.013034618 0.04542220 -0.28696582 1.000000 0.82209256
##          CI.L          CI.U sig
## 1 -0.005071721 0.9714328  *
## 2 -2.504443458 3.3336465
## 3 -1.020899084 1.0059710
## 4 -4.056769994 5.0552967
## 5 -0.590178335 0.5641091
```

```
write.xlsx(Mod.res,'CorrelationTD.xlsx',sheetName = 'MathnvIQ',append = T)
```