

IQ_Math

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1 Preparation

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

## 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 Math ability: ASD versus Normal controls

2.1 Meta-analysis of Standardized mean difference (SMD)

2.1.1 Data preparation

```
#### Data Preparation
#-----
# ### Only studies with control groups were included
# remove studies not available to compute hedges g
var.sel = c('mathscores', 'SDmathscores', 'n', 'corr_fsiq_math',
            'control.group.mathscores.mean',
            'control.group.mathscores.SD', 'control.group.N',
            'control.group.corr_fsiq_math', 'standardization_NOT')
del = which(is.na(dall[,var.sel]),arr.ind = T)
del = unique(del[,1])
dsub = dall[-del,]

# Compute effect sizes for math
```

```

rr.math = dsub$Cronbach_math
id = dsub$id # study labels
Nstudy = nrow(dsub) # number of primary studies
x1pre = dsub$fsiq # group means
x1post = dsub$mathscores
x2pre = dsub$control.group.fsiq
x2post = dsub$control.group.mathscores.mean
n1 = dsub$n # sample sizes
n2 = dsub$control.group.N
s1pre = dsub$SDfsiq # group SDs
s2pre = dsub$control.group.SDfsiq
ripre = dsub$corr_fsiq_math
ripost = dsub$control.group.corr_fsiq_math
datT <- escalc(measure="SMCR", m1i=x1post, m2i=x1pre, sd1i=s1pre,
               ni=n1, ri=ripre)
datC <- escalc(measure="SMCR", m1i=x2post, m2i=x2pre, sd1i=s2pre,
               ni=n2, ri=ripost)
dat <- data.frame(yi = datT$yi - datC$yi, vi = datT$vi + datC$vi)
hedgesgmath = dat$yi # unbiased effect sizes for math: hedge's g
vimath = dat$vi # sampling variances of effect sizes for math

group = dsub$group #For Multivariate meta-analysis with dependent effect sizes

#### Compute effect sizes for IQs

## For fIQ
id = dsub$id # study labels
Nstudy = nrow(dsub) # number of primary studies
x1 = dsub$fsiq # group means
x2 = dsub$control.group.fsiq
n1 = dsub$n # sample sizes
n2 = dsub$control.group.N
s1 = dsub$SDfsiq # group SDs
s2 = dsub$control.group.SDfsiq
sp = sqrt(((n1-1)*s1^2+(n2-1)*s2^2)/(n1+n2-2))
tmp = escalc(measure = 'SMD', m1i = x1, sd1i = s1, n1i=n1,
             m2i = x2, sd2i = s2, n2i=n2)
hedgesg = tmp$yi # unbiased effect sizes: hedge's g
vi = tmp$vi # sampling variances of effect sizes
fIQ.hedgesg.c = hedgesg

## For vIQ
id = dsub$id # study labels
Nstudy = nrow(dsub) # number of primary studies
x1 = as.numeric(dsub$viq) # group means
x2 = dsub$control.group.viq
n1 = dsub$n # sample sizes
n2 = dsub$control.group.N
s1 = dsub$SDviq # group SDs
s2 = dsub$control.group.SDviq
sp = sqrt(((n1-1)*s1^2+(n2-1)*s2^2)/(n1+n2-2))
tmp = escalc(measure = 'SMD', m1i = x1, sd1i = s1, n1i=n1,
             m2i = x2, sd2i = s2, n2i=n2)

```

```

hedgesg = tmp$yi          # unbiased effect sizes: hedge's g
vi = tmp$vi              # sampling variances of effect sizes
vIQ.hedgesg.c = hedgesg

## For nvIQ
id = dsub$id              # study labels
Nstudy = nrow(dsub)       # number of primary studies
x1 = dsub$nviq            # group means
x2 = dsub$control.group.nviq
n1 = dsub$n               # sample sizes
n2 = dsub$control.group.N
s1 = dsub$SDnviq          # group SDs
s2 = dsub$control.group.SDnviq
sp = sqrt(((n1-1)*s1^2+(n2-1)*s2^2)/(n1+n2-2))
tmp = escalc(measure = 'SMD', m1i = x1, sd1i = s1, n1i=n1,
              m2i = x2, sd2i = s2, n2i=n2)
hedgesg = tmp$yi          # unbiased effect sizes: hedge's g
vi = tmp$vi              # sampling variances of effect sizes
nvIQ.hedgesg.c = hedgesg

#### 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)

fIQASD = dsub$fsiq-100
vIQASD = as.numeric(dsub$viq)-100
nvIQASD = dsub$nviq-100

fIQTD = dsub$control.group.fsiq-100
vIQTD = as.numeric(dsub$control.group.viq)-100
nvIQTD = dsub$control.group.nviq-100

bg.fIQ = data.frame(ASD=fIQASD, TD = fIQTD)
bg.vIQ = data.frame(ASD=vIQASD, TD = vIQTD)
bg.nvIQ = data.frame(ASD=nvIQASD, TD = nvIQTD)

AgexfIQ = data.frame(Age = scale(Age), fIQASD = scale(fIQASD),
                     Inter = scale(Age)*scale(fIQASD))
AgexvIQ = data.frame(Age = scale(Age), vIQASD = scale(vIQASD),
                     Inter = scale(Age)*scale(vIQASD))
AgexnvIQ = data.frame(Age = scale(Age), nvIQASD = scale(nvIQASD),
                      Inter = scale(Age)*scale(nvIQASD))

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

modsl = list(Age = Age, Publication.Year = PubYear, ASD.Severity = Severity,

```

```
genderratio = gender,
fIQASD = fIQASD, vIQASD = vIQASD, nvIQASD = nvIQASD)
```

2.1.2 Meta-analysis with RVE

```
dat.hedgesgmth = data.frame(hedgesgmth,vimath,id)
fit0 = robu(formula = hedgesgmth ~ 1, data = dat.hedgesgmth,
            studynum = id,var.eff.size = vimath,
            modelweights = "CORR", small = TRUE)
fit0$reg_table
```

```
##          labels          b.r          SE          t          dfs          prob          CI.L
## 1 X.Intercept. 0.1089675 0.3310751 0.3291322 1.89051 0.7749155 -1.397589
##          CI.U sig
## 1 1.615524
```

2.1.3 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.hedgesgmth,mod)
  fit.tmp = try( robu(formula = hedgesgmth ~ 1 + mod, data = dat.tmp,
                    studynum = id,var.eff.size = vimath,
                    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)
}
```

```
## Error in solve.default(sumXWX) :
## Lapack dgesv: : U[2,2] = 0
```

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

```
##          labels          b.r          SE          t
## 1 No moderator 0.108967461728111 0.331075101301545 0.329132155513146
## 2 Intercept 0.141752987576017 0.224453441541054 0.631547400667007
```

```

## 3      Age -0.395847957726949  0.210092319709667 -1.88416196400698
## 4      Intercept -0.238220665332614  0.192981876944016 -1.23441987975753
## 5      Publication.Year  0.154910484736585  0.066560267424608  2.32737172986947
## 6      ASD.Severity      <NA>      <NA>      <NA>
## 7      Intercept  0.182088098775846  0.465253381911057  0.391374046606405
## 8      genderratio -1.36152670071765  2.63160186959594 -0.517375639699897
## 9      Intercept -0.0852795823978962  0.493928794004545 -0.172655620472111
## 10     fIQASD  0.0351582025332607  0.043668259097473  0.805120315302316
## 11     Intercept -0.107131601365446  0.665160106434438 -0.161061375042049
## 12     vIQASD  0.0341804343765489  0.0618700851682744  0.552454943024321
## 13     Intercept -0.24121088233946  0.352897347076046 -0.683515714521599
## 14     nvIQASD  0.0578797015100605  0.0392685658257907  1.47394487913909
##      dfs      prob      CI.L      CI.U      sig
## 1  1.89051014381228  0.774915533546964 -1.3975890495798  1.61552397303602
## 2      1  0.641396086586363 -2.71019839438363  2.99370436953567
## 3      1  0.31062975069256 -3.06532398545585  2.27362807000195
## 4      1  0.433453697001767 -2.69028790415455  2.21384657348932
## 5      1  0.258352312520775 -0.690817900455024  1.00063886992819
## 6      <NA>      <NA>      <NA>      <NA> <NA>
## 7      1  0.762510162709657 -5.72951662598368  6.09369282353537
## 8      1  0.696045062906513 -34.7991988399036  32.0761454384683
## 9      1  0.891157086851502 -6.3612399641115  6.19068079931571
## 10     1  0.568463915229526 -0.51969963803155  0.590016043098072
## 11     1  0.898338206025931 -8.55879209605717  8.34452889332628
## 12     1  0.678681416947158 -0.751953534816111  0.820314403569209
## 13     1  0.61829755308489 -4.72519682514057  4.24277506046165
## 14     1  0.379499847612059 -0.441074735568389  0.55683413858851

```

```
write.xlsx(Mod.res, 'Discrepancy.xlsx', sheetName = 'vsNorm', append = T)
```