Metanalysis of flow state in condition of Stereotype Threat (stThreat)

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## Initial Variables and Loading Data

cond <- "stThreat"  
to\_remove <- c('S11')  
sub.groups <- c("age","ed.level","intervention","age:intervention",  
 "ed.level:intervention","age:ed.level:intervention")

dat <- read\_excel("../data/data-without-outliers.xlsx", sheet = "fss-cond-descriptive")  
dat <- dat[!dat$study %in% to\_remove, ]  
  
leg <- read\_excel("../data/data-without-outliers.xlsx", sheet = "legend")

## New names:  
## • `` -> `...10`

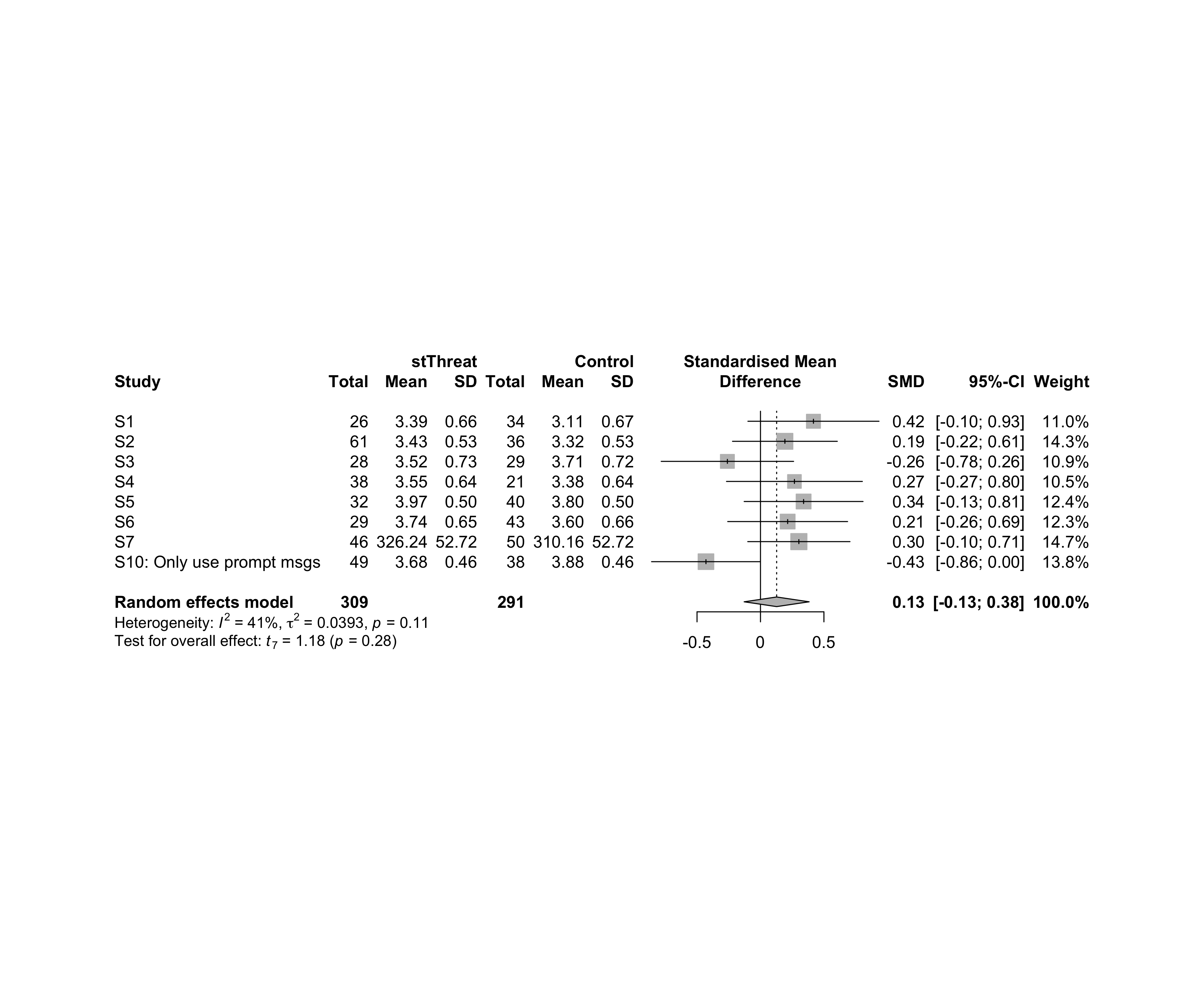
leg <- leg[!leg$study %in% to\_remove, ]  
  
idx.e <- which(dat$condition==cond)  
idx.c <- which(dat$condition=="control")  
  
data <- data.frame(  
 study = dat$study[idx.c],  
 n.e = dat$N[idx.e], mean.e = dat$M.emms[idx.e], sd.e = dat$SD.emms[idx.e],  
 n.c = dat$N[idx.c], mean.c = dat$M.emms[idx.c], sd.c = dat$SD.emms[idx.c]  
)  
for (cgroups in strsplit(sub.groups,":")) {  
 data[[paste0(cgroups, collapse = ":")]] <- sapply(data$study, FUN = function(x) {  
 paste0(sapply(cgroups, FUN = function(namecol) leg[[namecol]][which(x == leg$study)]), collapse = ":")  
 })  
}  
data[["lbl"]] <- sapply(data$study, FUN = function(x) leg$Note[which(x == leg$study)])

## Perform meta-analyses

m.cont <- metacont(  
 n.e = n.e, mean.e = mean.e, sd.e = sd.e, n.c = n.c, mean.c = mean.c, sd.c = sd.c,  
 studlab = lbl, data = data, sm = "SMD", method.smd = "Hedges",  
 fixed = F, random = T, method.tau = "REML", hakn = T, title = paste("Performance in",cond)  
)  
summary(m.cont)

## Review: Performance in stThreat  
##   
## SMD 95%-CI %W(random)  
## S1 0.4174 [-0.0990; 0.9338] 11.0  
## S2 0.1925 [-0.2204; 0.6053] 14.3  
## S3 -0.2607 [-0.7823; 0.2610] 10.9  
## S4 0.2676 [-0.2677; 0.8028] 10.5  
## S5 0.3398 [-0.1285; 0.8082] 12.4  
## S6 0.2142 [-0.2581; 0.6865] 12.3  
## S7 0.3025 [-0.1003; 0.7053] 14.7  
## S10: Only use prompt msgs -0.4296 [-0.8583; -0.0010] 13.8  
##   
## Number of studies combined: k = 8  
## Number of observations: o = 600  
##   
## SMD 95%-CI t p-value  
## Random effects model 0.1274 [-0.1287; 0.3835] 1.18 0.2778  
##   
## Quantifying heterogeneity:  
## tau^2 = 0.0393 [0.0000; 0.3290]; tau = 0.1981 [0.0000; 0.5736]  
## I^2 = 40.8% [0.0%; 73.9%]; H = 1.30 [1.00; 1.96]  
##   
## Test of heterogeneity:  
## Q d.f. p-value  
## 11.83 7 0.1063  
##   
## Details on meta-analytical method:  
## - Inverse variance method  
## - Restricted maximum-likelihood estimator for tau^2  
## - Q-profile method for confidence interval of tau^2 and tau  
## - Hartung-Knapp adjustment for random effects model  
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)

forest(m.cont, digits=2, digits.sd = 2, test.overall = T, label.e = cond)

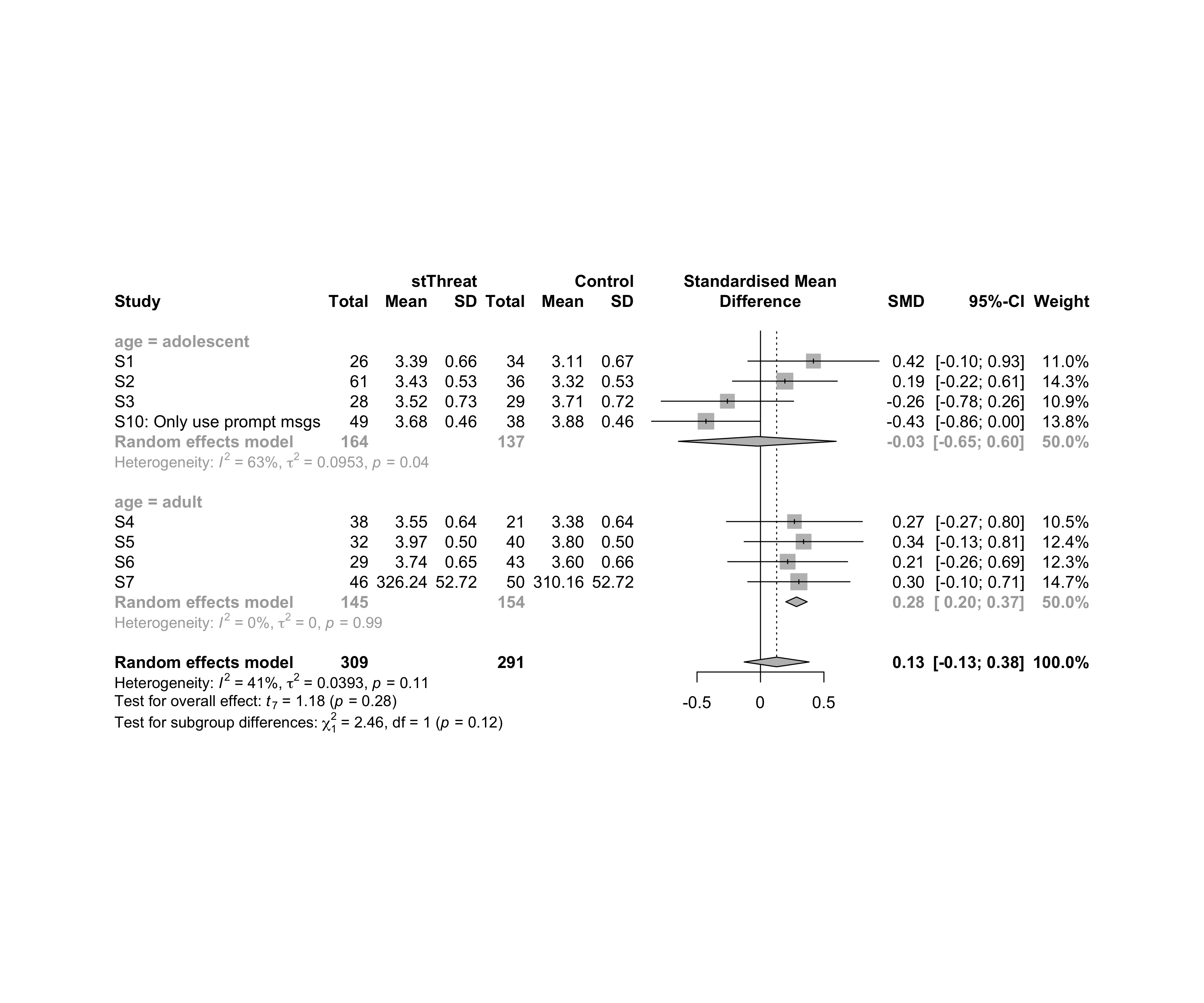


### Subgroup analysis by “age”

m.sg4sub <- update.meta(m.cont, subgroup = age, random = T, fixed = F)  
summary(m.sg4sub)

## Review: Performance in stThreat  
##   
## SMD 95%-CI %W(random) age  
## S1 0.4174 [-0.0990; 0.9338] 11.0 adolescent  
## S2 0.1925 [-0.2204; 0.6053] 14.3 adolescent  
## S3 -0.2607 [-0.7823; 0.2610] 10.9 adolescent  
## S4 0.2676 [-0.2677; 0.8028] 10.5 adult  
## S5 0.3398 [-0.1285; 0.8082] 12.4 adult  
## S6 0.2142 [-0.2581; 0.6865] 12.3 adult  
## S7 0.3025 [-0.1003; 0.7053] 14.7 adult  
## S10: Only use prompt msgs -0.4296 [-0.8583; -0.0010] 13.8 adolescent  
##   
## Number of studies combined: k = 8  
## Number of observations: o = 600  
##   
## SMD 95%-CI t p-value  
## Random effects model 0.1274 [-0.1287; 0.3835] 1.18 0.2778  
##   
## Quantifying heterogeneity:  
## tau^2 = 0.0393 [0.0000; 0.3290]; tau = 0.1981 [0.0000; 0.5736]  
## I^2 = 40.8% [0.0%; 73.9%]; H = 1.30 [1.00; 1.96]  
##   
## Test of heterogeneity:  
## Q d.f. p-value  
## 11.83 7 0.1063  
##   
## Results for subgroups (random effects model):  
## k SMD 95%-CI tau^2 tau Q I^2  
## age = adolescent 4 -0.0251 [-0.6469; 0.5968] 0.0953 0.3088 8.09 62.9%  
## age = adult 4 0.2839 [ 0.1999; 0.3680] 0 0 0.15 0.0%  
##   
## Test for subgroup differences (random effects model):  
## Q d.f. p-value  
## Between groups 2.46 1 0.1171  
##   
## Details on meta-analytical method:  
## - Inverse variance method  
## - Restricted maximum-likelihood estimator for tau^2  
## - Q-profile method for confidence interval of tau^2 and tau  
## - Hartung-Knapp adjustment for random effects model  
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)

forest(m.sg4sub, digits=2, digits.sd = 2, test.overall = T, label.e = cond)

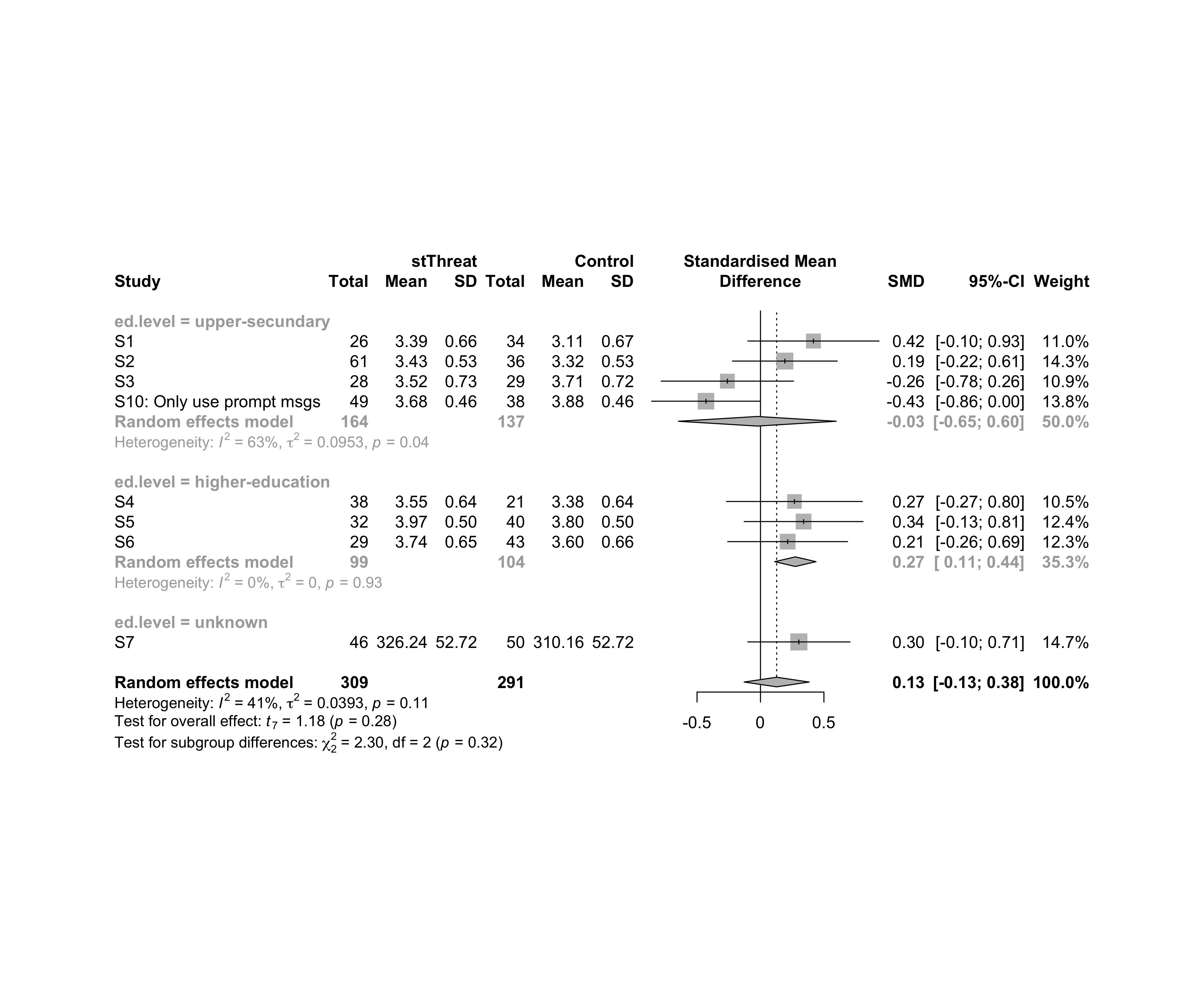


### Subgroup analysis by “ed.level”

m.sg4sub <- update.meta(m.cont, subgroup = ed.level, random = T, fixed = F)  
summary(m.sg4sub)

## Review: Performance in stThreat  
##   
## SMD 95%-CI %W(random) ed.level  
## S1 0.4174 [-0.0990; 0.9338] 11.0 upper-secundary  
## S2 0.1925 [-0.2204; 0.6053] 14.3 upper-secundary  
## S3 -0.2607 [-0.7823; 0.2610] 10.9 upper-secundary  
## S4 0.2676 [-0.2677; 0.8028] 10.5 higher-education  
## S5 0.3398 [-0.1285; 0.8082] 12.4 higher-education  
## S6 0.2142 [-0.2581; 0.6865] 12.3 higher-education  
## S7 0.3025 [-0.1003; 0.7053] 14.7 unknown  
## S10: Only use prompt msgs -0.4296 [-0.8583; -0.0010] 13.8 upper-secundary  
##   
## Number of studies combined: k = 8  
## Number of observations: o = 600  
##   
## SMD 95%-CI t p-value  
## Random effects model 0.1274 [-0.1287; 0.3835] 1.18 0.2778  
##   
## Quantifying heterogeneity:  
## tau^2 = 0.0393 [0.0000; 0.3290]; tau = 0.1981 [0.0000; 0.5736]  
## I^2 = 40.8% [0.0%; 73.9%]; H = 1.30 [1.00; 1.96]  
##   
## Test of heterogeneity:  
## Q d.f. p-value  
## 11.83 7 0.1063  
##   
## Results for subgroups (random effects model):  
## k SMD 95%-CI tau^2 tau Q I^2  
## ed.level = upper-secundary 4 -0.0251 [-0.6469; 0.5968] 0.0953 0.3088 8.09 62.9%  
## ed.level = higher-education 3 0.2748 [ 0.1118; 0.4377] 0 0 0.14 0.0%  
## ed.level = unknown 1 0.3025 [-0.1003; 0.7053] -- -- 0.00 --  
##   
## Test for subgroup differences (random effects model):  
## Q d.f. p-value  
## Between groups 2.30 2 0.3160  
##   
## Details on meta-analytical method:  
## - Inverse variance method  
## - Restricted maximum-likelihood estimator for tau^2  
## - Q-profile method for confidence interval of tau^2 and tau  
## - Hartung-Knapp adjustment for random effects model  
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)

forest(m.sg4sub, digits=2, digits.sd = 2, test.overall = T, label.e = cond)

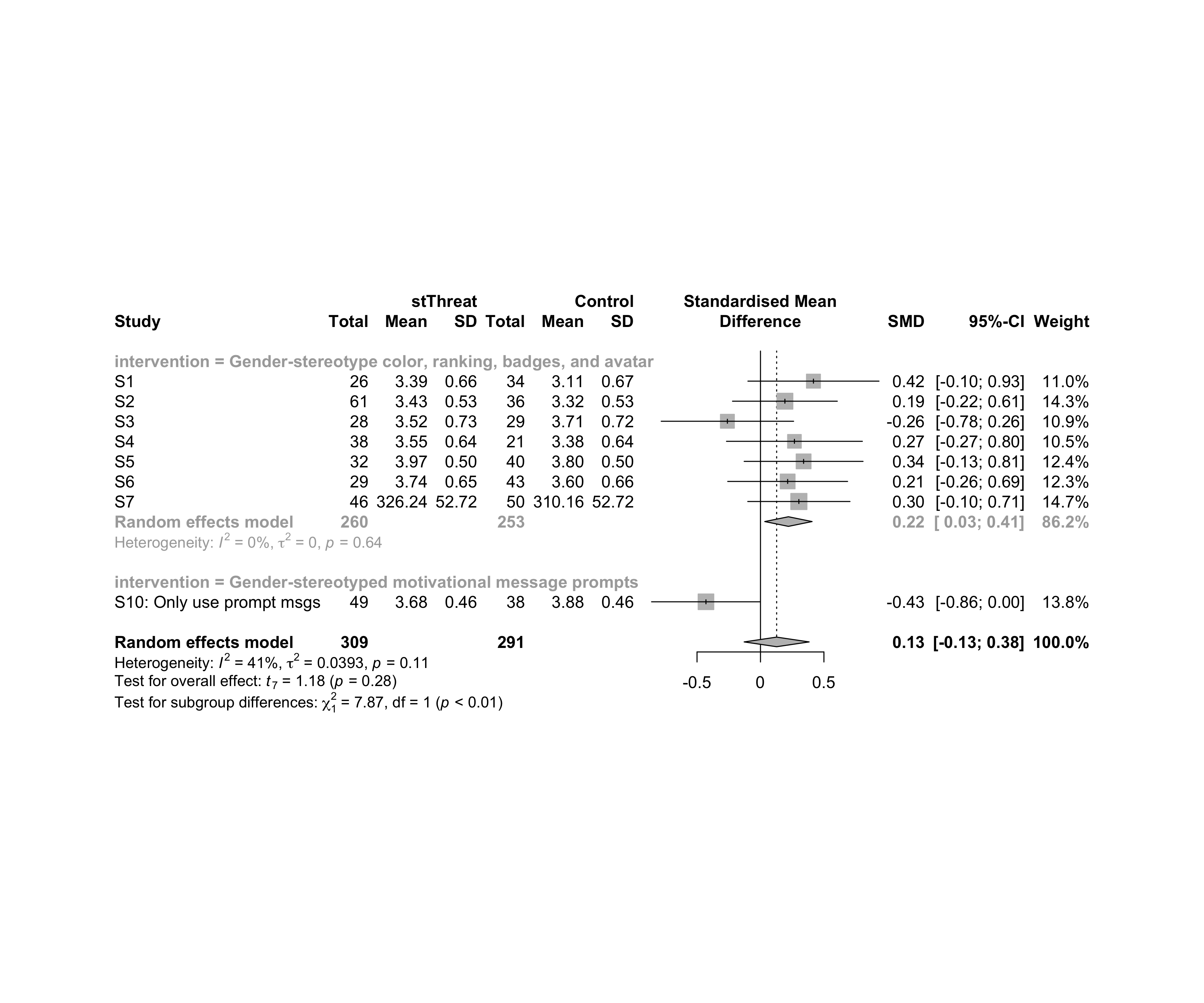


### Subgroup analysis by “intervention”

m.sg4sub <- update.meta(m.cont, subgroup = intervention, random = T, fixed = F)  
summary(m.sg4sub)

## Review: Performance in stThreat  
##   
## SMD 95%-CI %W(random)  
## S1 0.4174 [-0.0990; 0.9338] 11.0  
## S2 0.1925 [-0.2204; 0.6053] 14.3  
## S3 -0.2607 [-0.7823; 0.2610] 10.9  
## S4 0.2676 [-0.2677; 0.8028] 10.5  
## S5 0.3398 [-0.1285; 0.8082] 12.4  
## S6 0.2142 [-0.2581; 0.6865] 12.3  
## S7 0.3025 [-0.1003; 0.7053] 14.7  
## S10: Only use prompt msgs -0.4296 [-0.8583; -0.0010] 13.8  
## intervention  
## S1 Gender-stereotype color, ranking, badges, and avatar  
## S2 Gender-stereotype color, ranking, badges, and avatar  
## S3 Gender-stereotype color, ranking, badges, and avatar  
## S4 Gender-stereotype color, ranking, badges, and avatar  
## S5 Gender-stereotype color, ranking, badges, and avatar  
## S6 Gender-stereotype color, ranking, badges, and avatar  
## S7 Gender-stereotype color, ranking, badges, and avatar  
## S10: Only use prompt msgs Gender-stereotyped motivational message prompts  
##   
## Number of studies combined: k = 8  
## Number of observations: o = 600  
##   
## SMD 95%-CI t p-value  
## Random effects model 0.1274 [-0.1287; 0.3835] 1.18 0.2778  
##   
## Quantifying heterogeneity:  
## tau^2 = 0.0393 [0.0000; 0.3290]; tau = 0.1981 [0.0000; 0.5736]  
## I^2 = 40.8% [0.0%; 73.9%]; H = 1.30 [1.00; 1.96]  
##   
## Test of heterogeneity:  
## Q d.f. p-value  
## 11.83 7 0.1063  
##   
## Results for subgroups (random effects model):  
## k SMD 95%-CI tau^2 tau Q I^2  
## intervention = Gender-stereotype color, rankin ... 7 0.2202 [ 0.0337; 0.4067] 0 0 4.28 0.0%  
## intervention = Gender-stereotyped motivational ... 1 -0.4296 [-0.8583; -0.0010] -- -- 0.00 --  
##   
## Test for subgroup differences (random effects model):  
## Q d.f. p-value  
## Between groups 7.87 1 0.0050  
##   
## Details on meta-analytical method:  
## - Inverse variance method  
## - Restricted maximum-likelihood estimator for tau^2  
## - Q-profile method for confidence interval of tau^2 and tau  
## - Hartung-Knapp adjustment for random effects model  
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)

forest(m.sg4sub, digits=2, digits.sd = 2, test.overall = T, label.e = cond)

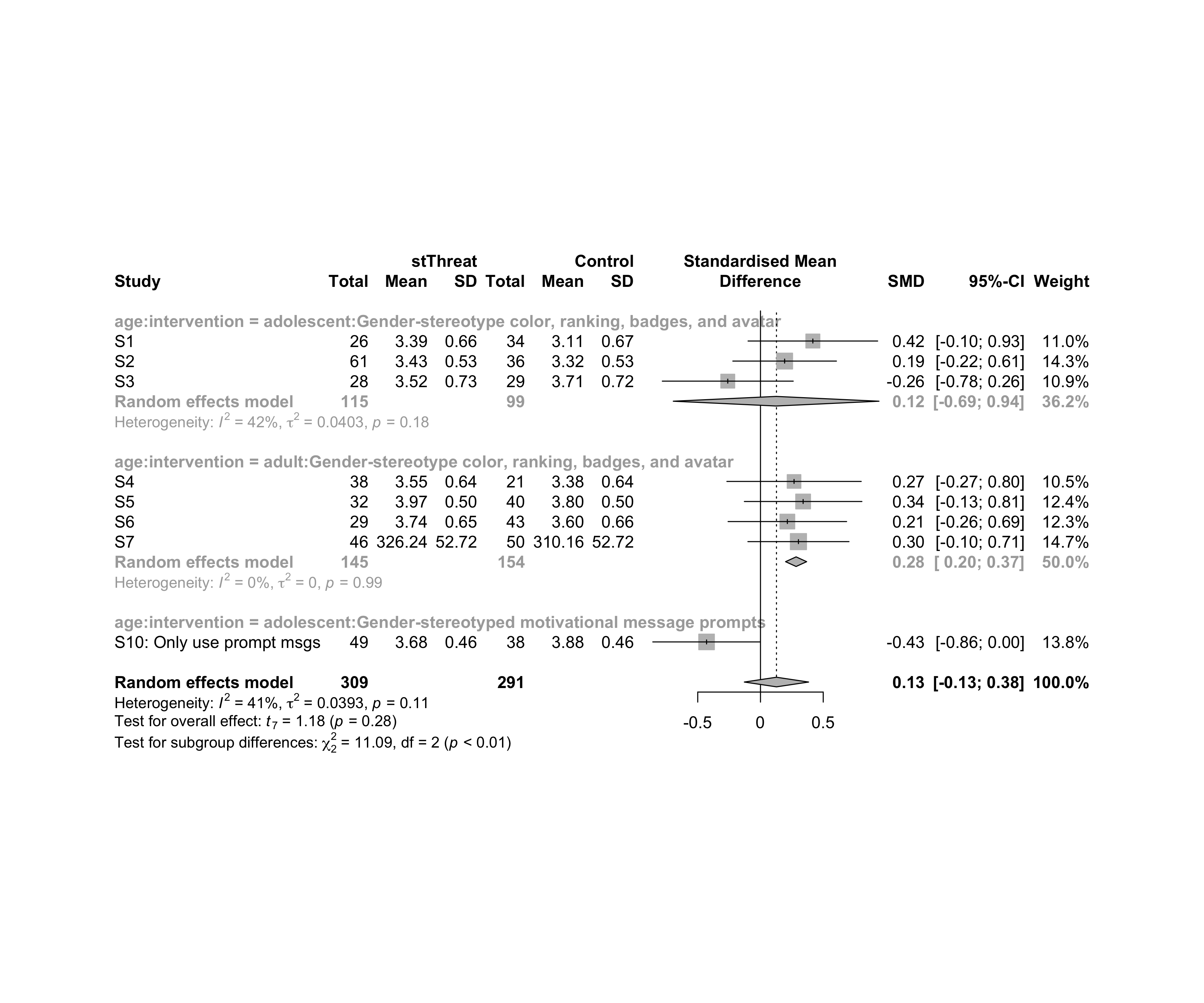


### Subgroup analysis by “age:intervention”

m.sg4sub <- update.meta(m.cont, subgroup = `age:intervention`, random = T, fixed = F)  
summary(m.sg4sub)

## Review: Performance in stThreat  
##   
## SMD 95%-CI %W(random)  
## S1 0.4174 [-0.0990; 0.9338] 11.0  
## S2 0.1925 [-0.2204; 0.6053] 14.3  
## S3 -0.2607 [-0.7823; 0.2610] 10.9  
## S4 0.2676 [-0.2677; 0.8028] 10.5  
## S5 0.3398 [-0.1285; 0.8082] 12.4  
## S6 0.2142 [-0.2581; 0.6865] 12.3  
## S7 0.3025 [-0.1003; 0.7053] 14.7  
## S10: Only use prompt msgs -0.4296 [-0.8583; -0.0010] 13.8  
## age:intervention  
## S1 adolescent:Gender-stereotype color, ranking, badges, and avatar  
## S2 adolescent:Gender-stereotype color, ranking, badges, and avatar  
## S3 adolescent:Gender-stereotype color, ranking, badges, and avatar  
## S4 adult:Gender-stereotype color, ranking, badges, and avatar  
## S5 adult:Gender-stereotype color, ranking, badges, and avatar  
## S6 adult:Gender-stereotype color, ranking, badges, and avatar  
## S7 adult:Gender-stereotype color, ranking, badges, and avatar  
## S10: Only use prompt msgs adolescent:Gender-stereotyped motivational message prompts  
##   
## Number of studies combined: k = 8  
## Number of observations: o = 600  
##   
## SMD 95%-CI t p-value  
## Random effects model 0.1274 [-0.1287; 0.3835] 1.18 0.2778  
##   
## Quantifying heterogeneity:  
## tau^2 = 0.0393 [0.0000; 0.3290]; tau = 0.1981 [0.0000; 0.5736]  
## I^2 = 40.8% [0.0%; 73.9%]; H = 1.30 [1.00; 1.96]  
##   
## Test of heterogeneity:  
## Q d.f. p-value  
## 11.83 7 0.1063  
##   
## Results for subgroups (random effects model):  
## k SMD 95%-CI tau^2 tau Q  
## age:intervention = adolescent:Gender-stereotype co ... 3 0.1247 [-0.6949; 0.9444] 0.0403 0.2008 3.43  
## age:intervention = adult:Gender-stereotype color, ... 4 0.2839 [ 0.1999; 0.3680] 0 0 0.15  
## age:intervention = adolescent:Gender-stereotyped m ... 1 -0.4296 [-0.8583; -0.0010] -- -- 0.00  
## I^2  
## age:intervention = adolescent:Gender-stereotype co ... 41.7%  
## age:intervention = adult:Gender-stereotype color, ... 0.0%  
## age:intervention = adolescent:Gender-stereotyped m ... --  
##   
## Test for subgroup differences (random effects model):  
## Q d.f. p-value  
## Between groups 11.09 2 0.0039  
##   
## Details on meta-analytical method:  
## - Inverse variance method  
## - Restricted maximum-likelihood estimator for tau^2  
## - Q-profile method for confidence interval of tau^2 and tau  
## - Hartung-Knapp adjustment for random effects model  
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)

forest(m.sg4sub, digits=2, digits.sd = 2, test.overall = T, label.e = cond)

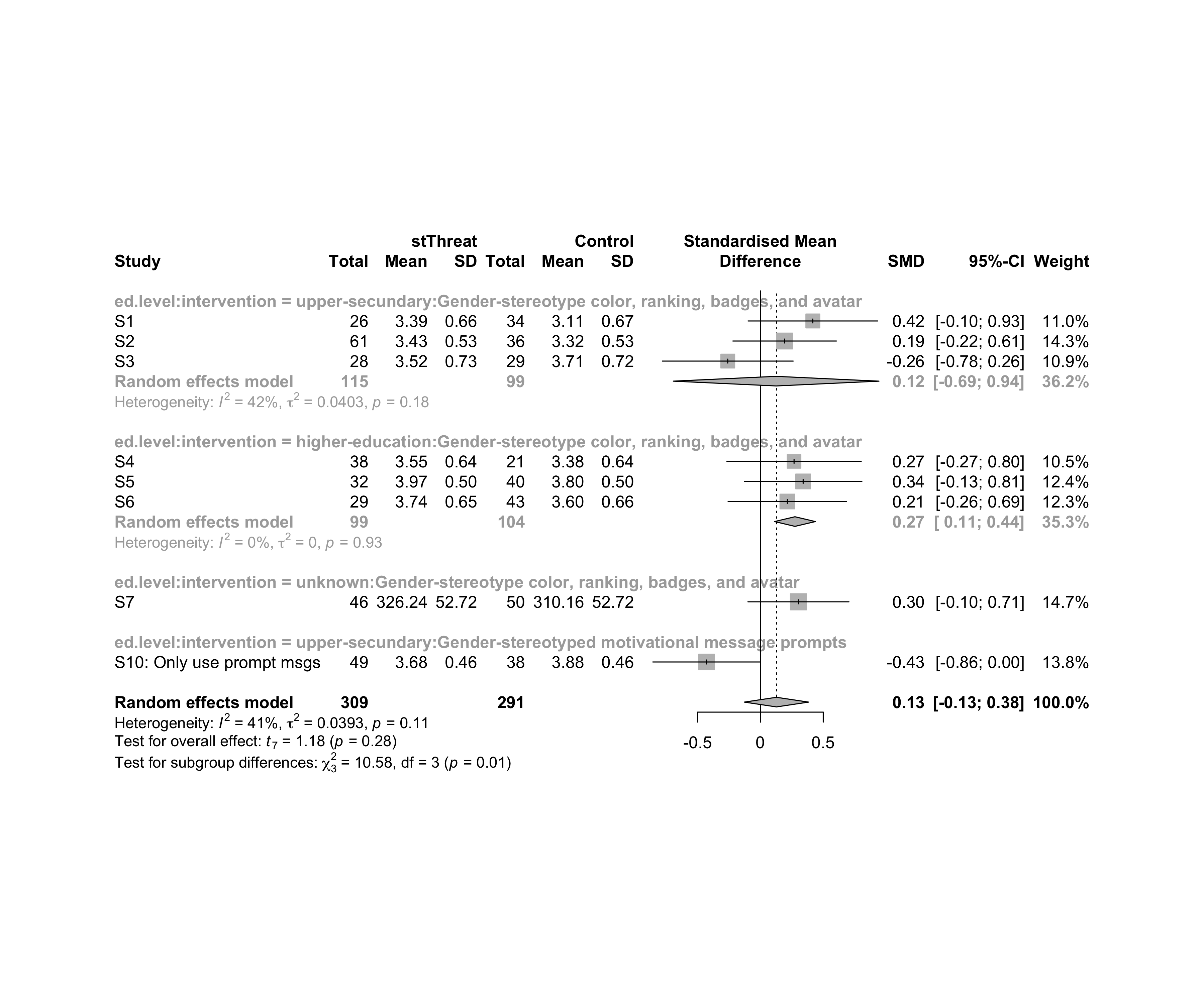


### Subgroup analysis by “ed.level:intervention”

m.sg4sub <- update.meta(m.cont, subgroup = `ed.level:intervention`, random = T, fixed = F)  
summary(m.sg4sub)

## Review: Performance in stThreat  
##   
## SMD 95%-CI %W(random)  
## S1 0.4174 [-0.0990; 0.9338] 11.0  
## S2 0.1925 [-0.2204; 0.6053] 14.3  
## S3 -0.2607 [-0.7823; 0.2610] 10.9  
## S4 0.2676 [-0.2677; 0.8028] 10.5  
## S5 0.3398 [-0.1285; 0.8082] 12.4  
## S6 0.2142 [-0.2581; 0.6865] 12.3  
## S7 0.3025 [-0.1003; 0.7053] 14.7  
## S10: Only use prompt msgs -0.4296 [-0.8583; -0.0010] 13.8  
## ed.level:intervention  
## S1 upper-secundary:Gender-stereotype color, ranking, badges, and avatar  
## S2 upper-secundary:Gender-stereotype color, ranking, badges, and avatar  
## S3 upper-secundary:Gender-stereotype color, ranking, badges, and avatar  
## S4 higher-education:Gender-stereotype color, ranking, badges, and avatar  
## S5 higher-education:Gender-stereotype color, ranking, badges, and avatar  
## S6 higher-education:Gender-stereotype color, ranking, badges, and avatar  
## S7 unknown:Gender-stereotype color, ranking, badges, and avatar  
## S10: Only use prompt msgs upper-secundary:Gender-stereotyped motivational message prompts  
##   
## Number of studies combined: k = 8  
## Number of observations: o = 600  
##   
## SMD 95%-CI t p-value  
## Random effects model 0.1274 [-0.1287; 0.3835] 1.18 0.2778  
##   
## Quantifying heterogeneity:  
## tau^2 = 0.0393 [0.0000; 0.3290]; tau = 0.1981 [0.0000; 0.5736]  
## I^2 = 40.8% [0.0%; 73.9%]; H = 1.30 [1.00; 1.96]  
##   
## Test of heterogeneity:  
## Q d.f. p-value  
## 11.83 7 0.1063  
##   
## Results for subgroups (random effects model):  
## k SMD 95%-CI tau^2 tau  
## ed.level:intervention = upper-secundary:Gender-stereoty ... 3 0.1247 [-0.6949; 0.9444] 0.0403 0.2008  
## ed.level:intervention = higher-education:Gender-stereot ... 3 0.2748 [ 0.1118; 0.4377] 0 0  
## ed.level:intervention = unknown:Gender-stereotype color ... 1 0.3025 [-0.1003; 0.7053] -- --  
## ed.level:intervention = upper-secundary:Gender-stereoty ... 1 -0.4296 [-0.8583; -0.0010] -- --  
## Q I^2  
## ed.level:intervention = upper-secundary:Gender-stereoty ... 3.43 41.7%  
## ed.level:intervention = higher-education:Gender-stereot ... 0.14 0.0%  
## ed.level:intervention = unknown:Gender-stereotype color ... 0.00 --  
## ed.level:intervention = upper-secundary:Gender-stereoty ... 0.00 --  
##   
## Test for subgroup differences (random effects model):  
## Q d.f. p-value  
## Between groups 10.58 3 0.0142  
##   
## Details on meta-analytical method:  
## - Inverse variance method  
## - Restricted maximum-likelihood estimator for tau^2  
## - Q-profile method for confidence interval of tau^2 and tau  
## - Hartung-Knapp adjustment for random effects model  
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)

forest(m.sg4sub, digits=2, digits.sd = 2, test.overall = T, label.e = cond)

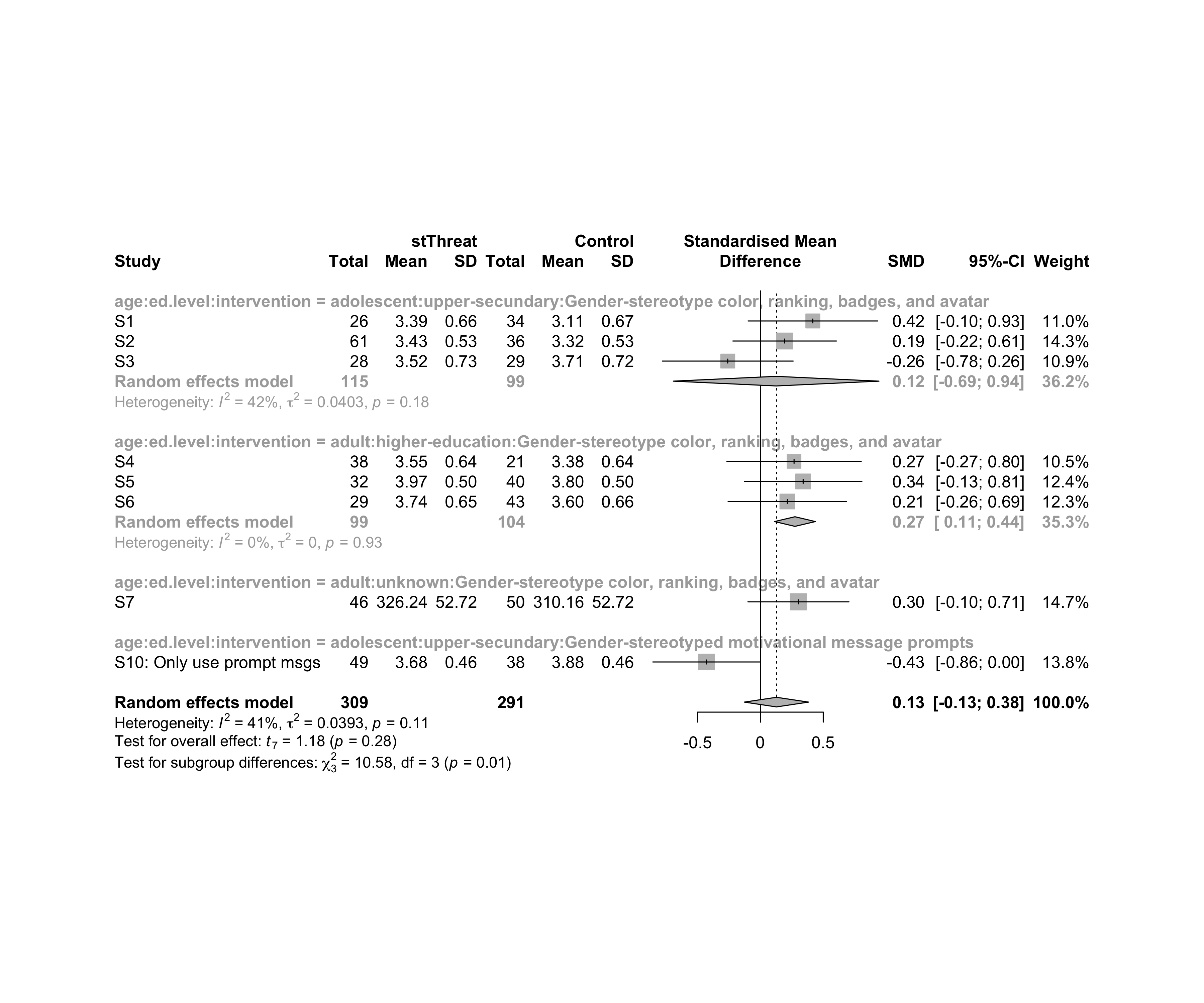


### Subgroup analysis by “age:ed.level:intervention”

m.sg4sub <- update.meta(m.cont, subgroup = `age:ed.level:intervention`, random = T, fixed = F)  
summary(m.sg4sub)

## Review: Performance in stThreat  
##   
## SMD 95%-CI %W(random)  
## S1 0.4174 [-0.0990; 0.9338] 11.0  
## S2 0.1925 [-0.2204; 0.6053] 14.3  
## S3 -0.2607 [-0.7823; 0.2610] 10.9  
## S4 0.2676 [-0.2677; 0.8028] 10.5  
## S5 0.3398 [-0.1285; 0.8082] 12.4  
## S6 0.2142 [-0.2581; 0.6865] 12.3  
## S7 0.3025 [-0.1003; 0.7053] 14.7  
## S10: Only use prompt msgs -0.4296 [-0.8583; -0.0010] 13.8  
## age:ed.level:intervention  
## S1 adolescent:upper-secundary:Gender-stereotype color, ranking, badges, and avatar  
## S2 adolescent:upper-secundary:Gender-stereotype color, ranking, badges, and avatar  
## S3 adolescent:upper-secundary:Gender-stereotype color, ranking, badges, and avatar  
## S4 adult:higher-education:Gender-stereotype color, ranking, badges, and avatar  
## S5 adult:higher-education:Gender-stereotype color, ranking, badges, and avatar  
## S6 adult:higher-education:Gender-stereotype color, ranking, badges, and avatar  
## S7 adult:unknown:Gender-stereotype color, ranking, badges, and avatar  
## S10: Only use prompt msgs adolescent:upper-secundary:Gender-stereotyped motivational message prompts  
##   
## Number of studies combined: k = 8  
## Number of observations: o = 600  
##   
## SMD 95%-CI t p-value  
## Random effects model 0.1274 [-0.1287; 0.3835] 1.18 0.2778  
##   
## Quantifying heterogeneity:  
## tau^2 = 0.0393 [0.0000; 0.3290]; tau = 0.1981 [0.0000; 0.5736]  
## I^2 = 40.8% [0.0%; 73.9%]; H = 1.30 [1.00; 1.96]  
##   
## Test of heterogeneity:  
## Q d.f. p-value  
## 11.83 7 0.1063  
##   
## Results for subgroups (random effects model):  
## k SMD 95%-CI tau^2  
## age:ed.level:intervention = adolescent:upper-secundary:Gend ... 3 0.1247 [-0.6949; 0.9444] 0.0403  
## age:ed.level:intervention = adult:higher-education:Gender-s ... 3 0.2748 [ 0.1118; 0.4377] 0  
## age:ed.level:intervention = adult:unknown:Gender-stereotype ... 1 0.3025 [-0.1003; 0.7053] --  
## age:ed.level:intervention = adolescent:upper-secundary:Gend ... 1 -0.4296 [-0.8583; -0.0010] --  
## tau Q I^2  
## age:ed.level:intervention = adolescent:upper-secundary:Gend ... 0.2008 3.43 41.7%  
## age:ed.level:intervention = adult:higher-education:Gender-s ... 0 0.14 0.0%  
## age:ed.level:intervention = adult:unknown:Gender-stereotype ... -- 0.00 --  
## age:ed.level:intervention = adolescent:upper-secundary:Gend ... -- 0.00 --  
##   
## Test for subgroup differences (random effects model):  
## Q d.f. p-value  
## Between groups 10.58 3 0.0142  
##   
## Details on meta-analytical method:  
## - Inverse variance method  
## - Restricted maximum-likelihood estimator for tau^2  
## - Q-profile method for confidence interval of tau^2 and tau  
## - Hartung-Knapp adjustment for random effects model  
## - Hedges' g (bias corrected standardised mean difference; using exact formulae)

forest(m.sg4sub, digits=2, digits.sd = 2, test.overall = T, label.e = cond)



## Funnel Plot

m.cont <- update.meta(m.cont, studlab = data$study)  
summary(eggers.test(x = m.cont))

## Eggers' test of the intercept   
## =============================   
##   
## intercept 95% CI t p  
## 0.883 -8.52 - 10.28 0.184 0.86  
##   
## Eggers' test does not indicate the presence of funnel plot asymmetry.

funnel(m.cont, xlab = "Hedges' g", studlab = T, legend=T, addtau2 = T)

