

Test

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Overview

The following script illustrates how explained variance (R square) and power change if gender is analyzed as a dichotomized variable, given that the predictor of interest is in truth a continuous gender variable and that it is this continuous gender variable that is associated with the outcome, and not sex as a categorical variable, which is often used in research. We simulate data for

1. *varying difference in gender between male/man/masculine and female/woman/feminine*: going from a large gender difference to a non-existent gender difference. For the purpose of this study, we measure gender on a scale from 0 to 10, where 0 is the extreme for female/woman/feminine and 10 is the extreme for male/man/masculine:
 - CASE 1: Difference = 10 SDs (most extreme difference in sex/gender variable)
 - CASE 2: Difference = 8 SDs
 - CASE 3: Difference = 6 SDs
 - CASE 4: Difference = 4 SDs
 - CASE 5: Difference = 2 SDs
 - CASE 6: Difference = 0 SDs (no difference in sex/gender variable)
2. *varying strength of association between sex/gender and outcome*: going from no association (Outcome = $0 + 0\text{gender} + \text{error}$) to a strong negative or positive association (Outcome = $0 + \beta\text{gender} + \text{error}$), with the error term being identical across simulations for comparability.

Simulate Data

Simulate Gender Data (independent variable)

```

# Simulate Gender Data
## define function to set means of normal distribution at different locations

sim.gender <- function(x, Cohens=NULL){
  #Female/woman/feminine
  set.seed(135); f <- sample(x, 10000, replace=T)
  gender_f <- 0 + Cohens/2 +f
  data_f <- data.frame(gender=gender_f, sex=factor(rep("female", 10000),
                                                    levels=c("female", "male")))

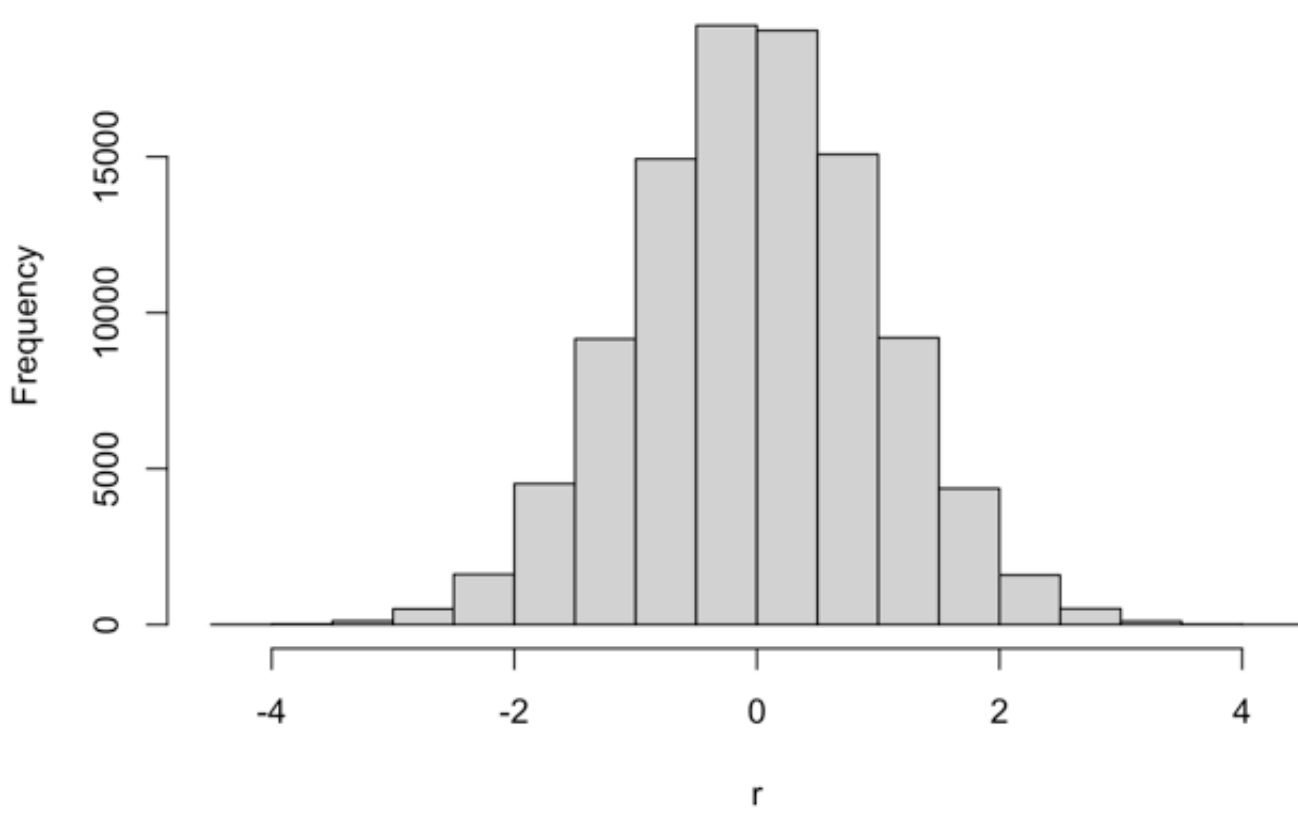
  #Male/man/masculine
  set.seed(246); m <- sample(x, 10000, replace=T)
  gender_m <- m - (Cohens/2)
  #gender_m <- ifelse(gender_m>10, male_values-m, gender_m)
  data_m <- data.frame(gender=gender_m, sex=factor(rep("male", 10000),
                                                    levels=c("female", "male")))

  #Combine
  mydata <- rbind(data_f, data_m)
  return(mydata)
}

## Set parameters
### normal distributions to sample from (M=0, SD=1)
set.seed(111); r <- rnorm(100000, mean=0, sd=1)
hist(r)

```

Histogram of r



```

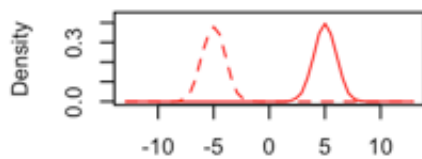
diff <- c(10, 8, 6, 4, 3, 2, 1, 0.5, 0)
colores <- c("red", "orange", "yellow", "green", "darkgreen", "turquoise", "blue", "purple", "magenta")

### create empty vessel object
mylist_UV <- as.list(diff) # 9 CASES

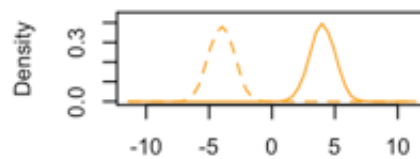
## Run simulations
for (i in 1:length(diff)){
  mydata <- sim.gender(r, Cohens=diff[i])
  mylist_UV[[i]] <- mydata
}

###Plot distributions at various differences (9 CASES)
par(mfrow=c(3,3))
for (i in 1:length(diff)){
  mydata <- mylist_UV[[i]]
  mydata <- mydata[complete.cases(mydata),]
  plot_name <- paste ("F/W/F (straight) vs M/M/M (dashed) Distribution")
  sm.density.compare(mydata$gender, mydata$sex, xlab=plot_name, col=c(colores[i], colores[i]), lty=c(1,2), main=paste("Diff =", diff[i]))
}

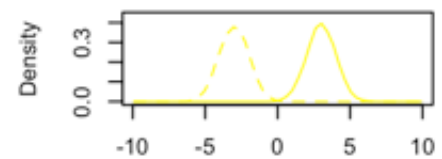
```



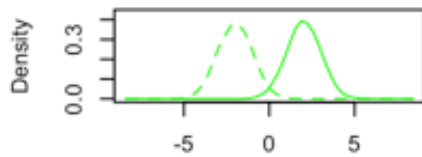
F/W/F (straight) vs M/M/M (dashed) Distributi



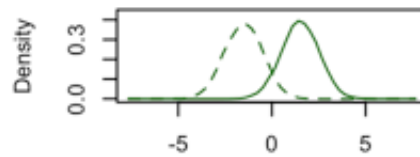
F/W/F (straight) vs M/M/M (dashed) Distributi



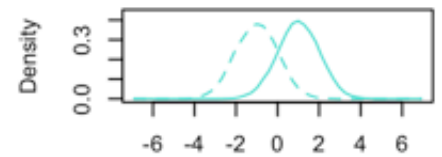
F/W/F (straight) vs M/M/M (dashed) Distributi



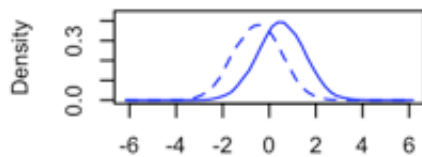
F/W/F (straight) vs M/M/M (dashed) Distributi



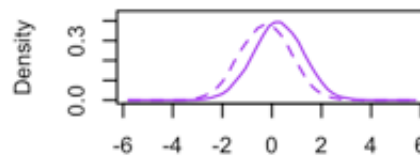
F/W/F (straight) vs M/M/M (dashed) Distributi



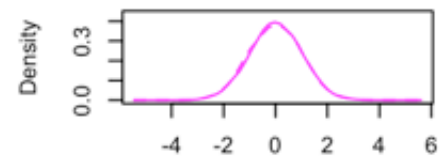
F/W/F (straight) vs M/M/M (dashed) Distributi



F/W/F (straight) vs M/M/M (dashed) Distributi



F/W/F (straight) vs M/M/M (dashed) Distributi



F/W/F (straight) vs M/M/M (dashed) Distributi

Missclassification Problem

The more overlap between the two distributions, the more misclassification we might see if a dichotomous predictor is used instead of a continuous predictor. If the two distributions do not overlap, then there is no danger of misclassification (CASE 1, and CASE 2). However, if the distributions are completely overlapping, then ~50% of the participants would be misclassified.

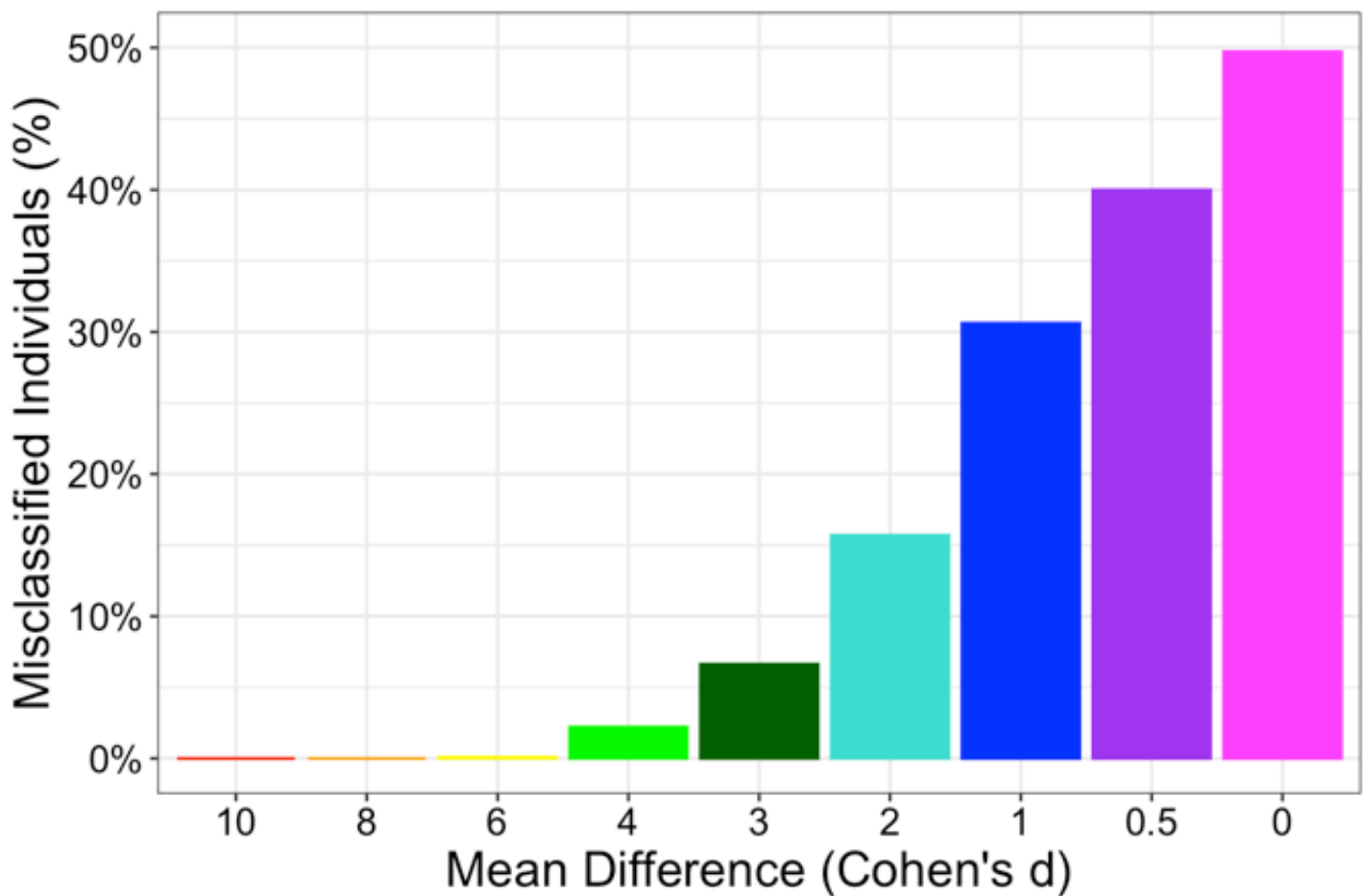
```

# Misclassification
tab_misclass <- data.frame(difference=factor(diff, levels=diff), misclassified = rep(
NA, times=length(diff)))

for (i in 1:length(diff)){
  mydata <- mylist_UV[[i]]
  mydata$classification <- as.factor(ifelse(mydata$gender<0, "classified male/man/m
asculine", "classified female/woman/feminine"))
  tab <- table(mydata$classification, mydata$sex)
  misclass <- prop.table(tab)[1,2] + prop.table(tab)[2,1]
  tab_misclass[i,2] <- misclass*100
}

b <- ggplot(tab_misclass, aes(x=difference, y=misclassified))
b + geom_bar(stat="identity", color=colores, fill=colores) +
  labs(title="", x="Mean Difference (Cohen's d)", y="Misclassified Individuals (%)")
+
  theme_bw() +
  theme(text = element_text(size = 18, color = "black"),
        axis.text.x = element_text(color = "black", size = 14),
        axis.text.y = element_text(color = "black", size = 14)) +
  scale_y_continuous(breaks = c(0, 10, 20, 30, 40, 50, 60), labels = c("0%", "10%", "
20%", "30%", "40%", "50%", "60%"), limits = c(0,50))

```



Simulate Outcome

The outcome data is simulated based on the assumption that there is a linear relationship between a continuous sex/gender variable and an outcome, with varying degrees of strength in the association between sex/gender and outcome, such that the smallest regression coefficient starts at 0 (no association) and ends with 2 (strong association) with scaled gender data (mean = 0, sd = 1).

```
# Simulate outcome data
## Define function to simulate outcome measures
sim.outcome <- function(df, effsize=NULL) {
  for (i in 1:length(effsize)){
    outcome <- as.numeric(scale(c(effsize[i] * scale(df$gender) + error)))
    name <- paste0("outcome_", effsize[i])
    df[2+i] <- outcome; names(df)[2+i] <- name
  }
  return(df)
}

## Set parameters
### define error term (constant for comparability)
set.seed(456); error <- rnorm(20000, mean=0, sd=1)
```

```

#### define effect sizes
ES=seq(from=0, to=2, by = 0.05)

### create empty vessel objects
#gender
beta <- rep(NA, times=length(ES))
betas <- as.data.frame(matrix(ncol = length(diff), nrow = length(ES)))
names(betas) <- paste0("Difference_", diff)

## run sim.outcome function for all 8 CASES
mylist_DV <- as.list(1:length(diff))
for (i in 1:length(diff)){
  mydata <- sim.outcome(mylist_UV[[i]], ES)
  mylist_DV[[i]] <- mydata
}

mylist_deltabeta <- as.list(1:length(mylist_DV))
deltabeta <- rep(NA, length(ES))
mylist_deltabeta.p <- as.list(1:length(mylist_DV))
deltabeta.p <- rep(NA, length(ES))
mylist_R2 <- as.list(1:length(mylist_DV))
Rsquare <- rep(NA, length(ES))

for (j in 1:length(mylist_deltabeta)){
  # Select Dataframe
  mydata <- mylist_DV[[j]]

  # Models gender & sex
  for (i in 1:(ncol(mydata)-2)){
    #continuous sex/gender
    #gender <- mydata$gender
    #beta.g <- cor(as.matrix(cbind(gender, mydata[,i+2])),
    #              use="complete.obs")[1,2]
    beta.g <- cor(mydata$gender, as.numeric(mydata[,i+2]))
    beta.g.R2 <- beta.g*beta.g

    #dichotomous sex/gender
    #sex <- as.numeric(mydata$sex)
    beta.s <- cor(ifelse(mydata$sex=="female", 1, 0), mydata[,i+2])
    beta.s.R2 <- beta.s*beta.s

    deltabeta[i] <- beta.g-beta.s #difference
    deltabeta.p[i] <- deltabeta[i]/beta.g #difference(%)

    Rsquare[i] <- beta.g.R2 #R2
  }
  mylist_deltabeta.p[[j]] <- deltabeta.p
  mylist_deltabeta[[j]] <- deltabeta
  mylist_R2[[j]] <- Rsquare
  names(mylist_deltabeta)[j] <- paste0("Diff_", diff[j])
}

```



```

names(mylist_deltabeta.p)[j] <- paste0("Diff_", diff[j])
names(mylist_R2)[j] <- paste0("Diff_", diff[j])
}

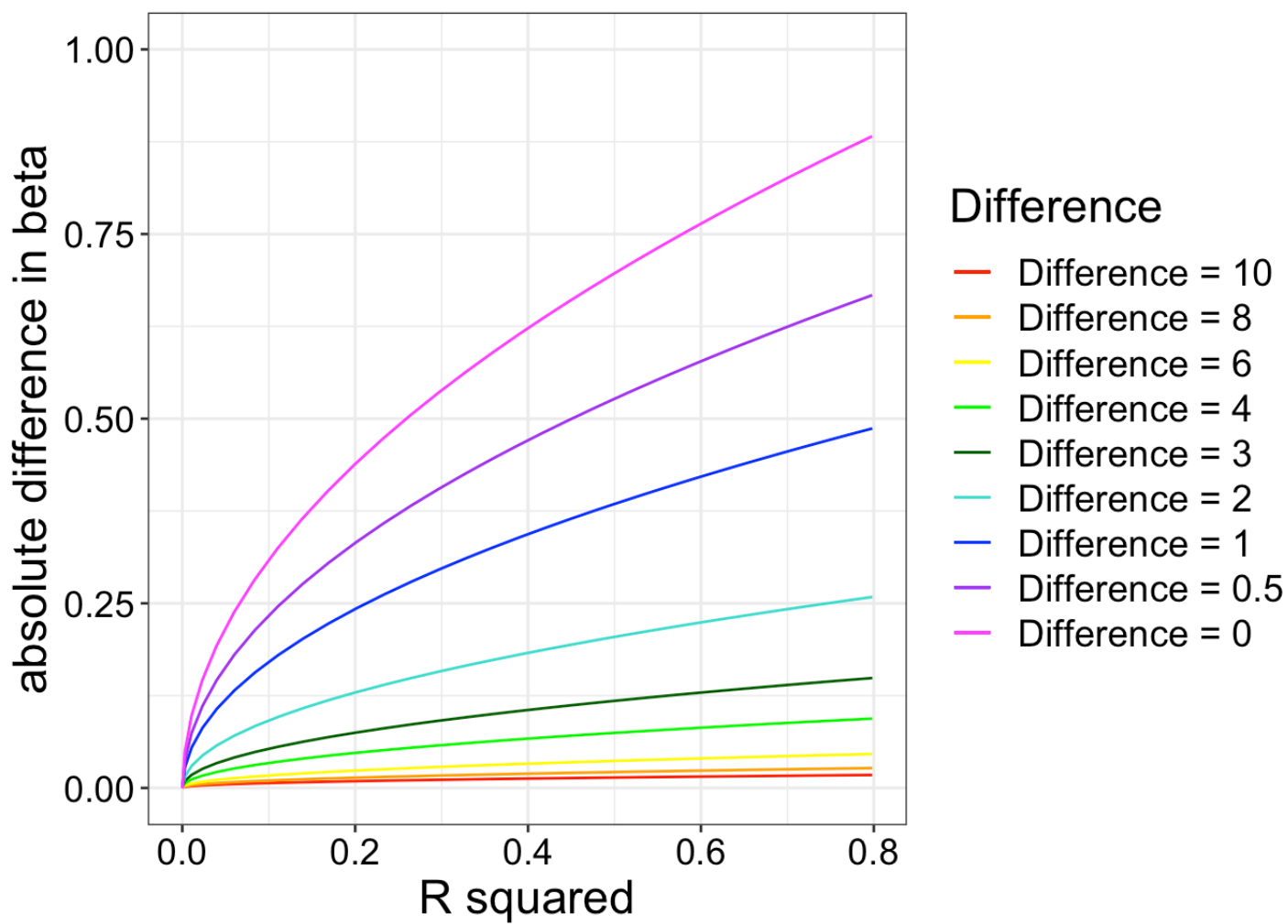
mylist_deltabeta.df <- data.frame(mylist_deltabeta)
mylist_deltabeta.df$ES <- ES
#head(mylist_deltabeta.df)

mylist_deltabeta.p.df <- data.frame(mylist_deltabeta.p)
mylist_deltabeta.p.df$ES <- ES
#head(mylist_deltabeta.p.df)

mylist_R2.df <- data.frame(mylist_R2)
mylist_R2.df$ES <- ES
#head(mylist_R2.df)

###Graph deltabetas
g1 <- ggplot(data=mylist_deltabeta.df, aes(x=mylist_R2.df[,1], y=mylist_deltabeta.df[,1], min=0, max=1, color=colores[1]))
g1 +
  geom_line() +
  geom_line(aes(x=mylist_R2.df[,2], y=mylist_deltabeta.df[,2], color=colores[2])) +
  geom_line(aes(x=mylist_R2.df[,3], y=mylist_deltabeta.df[,3], color=colores[3])) +
  geom_line(aes(x=mylist_R2.df[,4], y=mylist_deltabeta.df[,4], color=colores[4])) +
  geom_line(aes(x=mylist_R2.df[,5], y=mylist_deltabeta.df[,5], color=colores[5])) +
  geom_line(aes(x=mylist_R2.df[,6], y=mylist_deltabeta.df[,6], color=colores[6])) +
  geom_line(aes(x=mylist_R2.df[,7], y=mylist_deltabeta.df[,7], color=colores[7])) +
  geom_line(aes(x=mylist_R2.df[,8], y=mylist_deltabeta.df[,8], color=colores[8])) +
  geom_line(aes(x=mylist_R2.df[,9], y=mylist_deltabeta.df[,9], color=colores[9])) +
  labs(x="R squared", y="absolute difference in beta") +
  theme_bw() +
  theme(text = element_text(size = 18, color = "black"),
        axis.text.x = element_text(color = "black", size = 14),
        axis.text.y = element_text(color = "black", size = 14)) +
  scale_colour_manual(name = 'Difference',
                      values = c('red'='red', 'orange'='orange',
                                'yellow'='yellow', 'green'='green',
                                'darkgreen'='darkgreen',
                                'turquoise'='turquoise', 'blue'='blue',
                                'purple'='purple', 'magenta'='magenta'),
                      breaks = c('red', 'orange', 'yellow', 'green',
                                'darkgreen', 'turquoise', 'blue', 'purple',
                                'magenta'),
                      labels=paste0("Difference = ", diff),
                      guide = "legend")

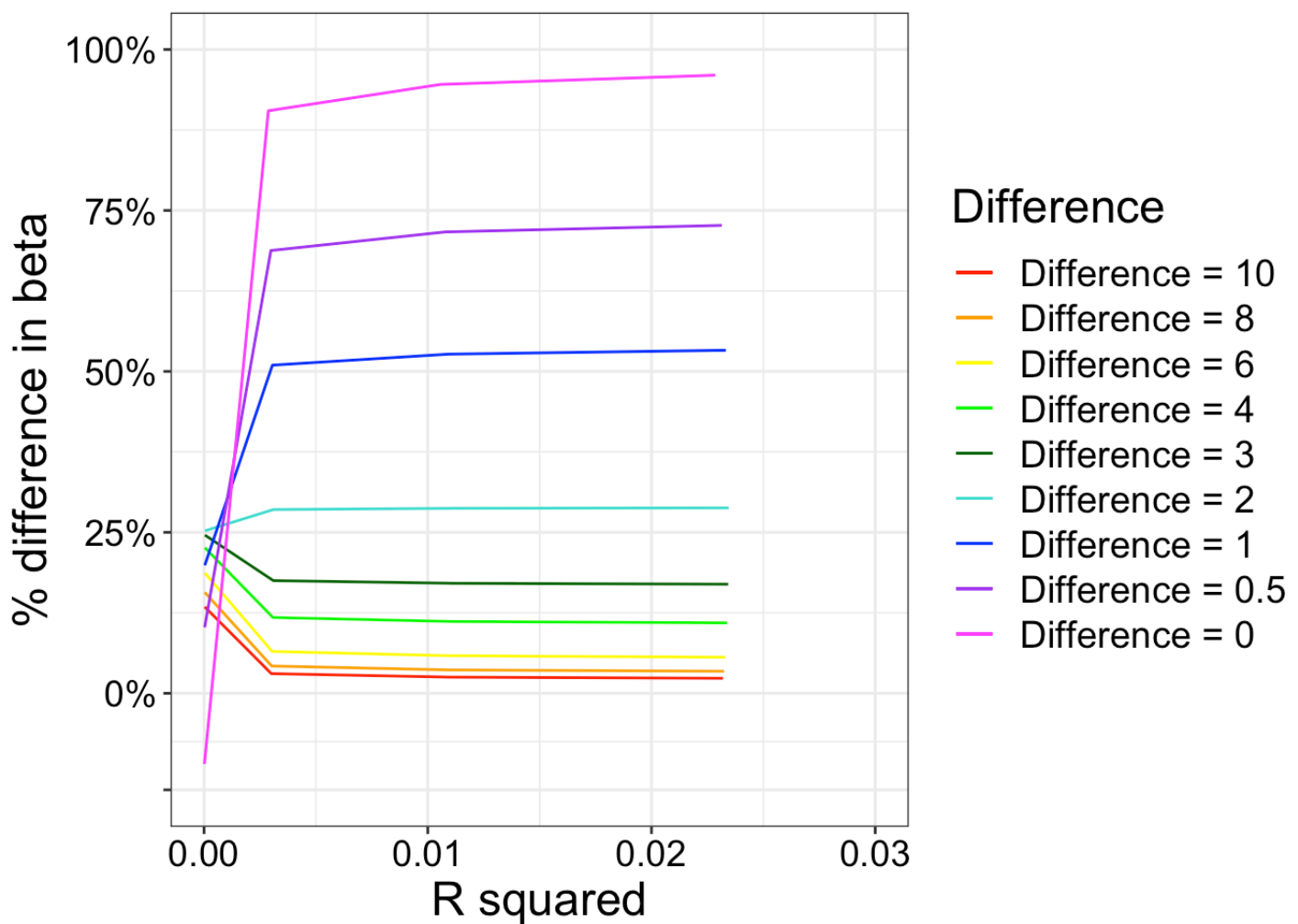
```



```

g2 <- ggplot(data=mylist_deltabeta.p.df, aes(x=mylist_R2.df[,1], y=mylist_deltabeta.p
.df[,1], min=0, max=max(mylist_deltabeta.p.df[,1:length(diff)]), color=colores[1]))
g2 +
  geom_line() +
  geom_line(aes(x=mylist_R2.df[,2], y=mylist_deltabeta.p.df[,2], color=colores[2])) +
  geom_line(aes(x=mylist_R2.df[,3], y=mylist_deltabeta.p.df[,3], color=colores[3])) +
  geom_line(aes(x=mylist_R2.df[,4], y=mylist_deltabeta.p.df[,4], color=colores[4])) +
  geom_line(aes(x=mylist_R2.df[,5], y=mylist_deltabeta.p.df[,5], color=colores[5])) +
  geom_line(aes(x=mylist_R2.df[,6], y=mylist_deltabeta.p.df[,6], color=colores[6])) +
  geom_line(aes(x=mylist_R2.df[,7], y=mylist_deltabeta.p.df[,7], color=colores[7])) +
  geom_line(aes(x=mylist_R2.df[,8], y=mylist_deltabeta.p.df[,8], color=colores[8])) +
  geom_line(aes(x=mylist_R2.df[,9], y=mylist_deltabeta.p.df[,9], color=colores[9])) +
  labs(x="R squared", y="% difference in beta") +
  theme_bw() +
  xlim(0, 0.03) +
  scale_y_continuous(breaks = c(-0.15, 0, 0.25, 0.5, 0.75, 1.0), labels = c("", "0%",
"25%", "50%", "75%", "100%"), limits = c(-0.15,1))+
  theme(text = element_text(size = 18, color = "black"),
        axis.text.x = element_text(color = "black", size = 14),
        axis.text.y = element_text(color = "black", size = 14)) +
  scale_colour_manual(name = 'Difference',
                      values =c('red'='red', 'orange'='orange',
                                'yellow'='yellow', 'green'='green',
                                'darkgreen'='darkgreen',
                                'turquoise'='turquoise', 'blue'='blue',
                                'purple'='purple', 'magenta'='magenta'),
                      breaks =c('red', 'orange', 'yellow', 'green',
                                'darkgreen', 'turquoise', 'blue', 'purple',
                                'magenta'),
                      labels=paste0("Difference = ", diff),
                      guide = "legend")

```



Compare Continous Sex/Gender vs. Dichotomous Sex/Gender Effect Sizes (explained variance, R²) and Power (PWR)

Calculation of Difference in R² and Power between Dichotomous Sex/Gender and Continous Sex/Gender

The differences are calculated for R-squared and the Power estimates from the linear models, predicting the outcome by Dichotomous Sex/Gender minus predicting the outcome by Continous Sex/Gender:

$$\text{delta} = \text{lm}(\text{outcome} = \text{sex} + \text{error}) - \text{lm}(\text{outcome} = \text{gender} + \text{error})$$

Random Sample Selection of N=100

The sample is drawn from the simulated data generated at various degrees of differences in the continuous sex/gender variable between dichotomous sex/gender variable. From this simulated data (let's assume the datasets of the 6 CASES are the population of interest), we draw random samples of n=100 to generate a random data sets. For each set, the identical samples are drawn to make the model outcomes (R square and Power) comparable. To obtain 95% confidence intervals, we repeated the sampling 1000 times.

```
# Random Data Sampling
## Set Parameters
### generate matrix with 1000 random samples (rows), each consisting of n=100 cases (
columns)
boots <- 1000 #number of bootstraps
sample.n <- 100 #number of bootstraps

indices <- matrix(nrow=boots, ncol=sample.n)
set.seed(123); seed_number <- sample(1:10000, boots, replace = F) #generate constant
seeds with sample index from the n=20'000 file

for(i in 1:boots){
  set.seed(seed_number[i]); indices[i,] <- sample(1:nrow(mylist_DV[[1]]), sample.n, r
eplace = F)
}

#Comment: the seeds were pseudo-randomly generated, to obtain the same model paramete
rs if rerunning the script!

### Create empty vessel objects
difference <- rep(NA, times = boots)
diff_R2 <- difference; diff_R2_p <- difference; diff_PWR <- difference; diff_p <- dif
ference; diff_sig <- difference

p_vals_gender <- difference
p_vals_sex <- difference

ES_name <- paste("ES", ES, sep="_")
dfdifff <- as.data.frame(matrix(nrow = boots, ncol=length(ES))); names(dfdifff) <- ES_n
ame
dfdifff_R2 <- dfdifff; dfdifff_R2_p <- dfdifff; dfdifff_PWR <- dfdifff; dfdifff_p <- dfdifff;
dfdifff_sig <- dfdifff

dfpvals_g <- dfdifff
dfpvals_s <- dfdifff

listdfdifff <- as.list(paste0("Difference=", diff))
listdfdifff_R2 <- listdfdifff; listdfdifff_R2_p <- listdfdifff; listdfdifff_PWR <- listdfdif
ff; listdfdifff_p <- listdfdifff; listdfdifff_sig <- listdfdifff

listdf_pvals_g <- listdfdifff
listdf_pvals_s <- listdfdifff

is.sig <- function(x){return(ifelse(x < 0.05, 1, 0))}
```

```

### draw 1000 bootstrapping samples * 41 effect sizes * 9 Differences
for(i in 1:length(diff)){
  mydata <- mylist_DV[[i]]
  for(j in 1:length(ES)){
    y <- names(mydata)[j+2]
    for(k in 1:boots){
      case_idx <- indices[k,] # select n=100
      d <- mydata[case_idx, ] # sample selection
      outcome <- d[,which(names(d)==y)]
      fit_g <- lm(outcome~d$gender)
      R2_g <- summary(fit_g)$r.squared
      f2_g <- R2_g/(1-R2_g)
      pwr_g <- pwr.f2.test(u=1, v=fit_g$df.residual, f2=f2_g, sig.level=0.05)$pow
er

      p_g <- summary(fit_g)$coefficients[2,4]
      sig_g <- is.sig(p_g)
      #Dichotomous Model
      fit_s <- lm(outcome~d$sex)
      R2_s <- summary(fit_s)$r.squared
      f2_s <- R2_s/(1-R2_s)
      pwr_s <- pwr.f2.test(u=1, v=fit_s$df.residual, f2=f2_s, sig.level=0.05)$pow
er

      p_s <- summary(fit_s)$coefficients[2,4]
      sig_s <- is.sig(p_s)
      #Differences
      diff_R2[k]<- R2_s - R2_g #Difference R square
      diff_R2_p[k]<- (R2_g-R2_s)/R2_s
      diff_PWR[k]<- pwr_s - pwr_g #Difference Power
      diff_p[k] <- p_s - p_g #for p-value Hackers
      diff_sig[k] <- sig_s - sig_g
      p_vals_gender[k] <- p_g
      p_vals_sex[k] <- p_s
    }
    dfdiff_R2[,j] <- diff_R2
    dfdiff_R2_p[,j] <- diff_R2_p
    dfdiff_PWR[,j] <- diff_PWR
    dfdiff_p[,j] <- diff_p
    dfdiff_sig[,j] <- diff_sig
    dfpvals_g[,j] <- p_vals_gender
    dfpvals_s[,j] <- p_vals_sex
  }
  listdfdiff_R2[[i]] <- dfdiff_R2
  listdfdiff_R2_p[[i]] <- dfdiff_R2_p
  listdfdiff_PWR[[i]] <- dfdiff_PWR
  listdfdiff_p[[i]] <- dfdiff_p
  listdfdiff_sig[[i]] <- dfdiff_sig
  listdf_pvals_g[[i]] <- dfpvals_g
  listdf_pvals_s[[i]] <- dfpvals_s
}

```

Plotting Differences in R square and Power

Here, the difference in R square and power are plotted as a function of effect size. More negative values mean that the loss in R square/Power is greater if dichotomous sex/gender is used instead of continuous sex/gender.

```
# Plotting Differences in R square and Power
## Define function to generate means, standard-deviations, standard errors and confidence intervals for plotting
### calculate betas
BETAS <- as.data.frame(matrix(ncol = length(diff), nrow = length(ES)))
names(BETAS) <- paste0("Diff_", diff)
rownames(BETAS) <- ES
beta <- rep(NA, length(ES))

# continous sex/gender
for(i in 1:length(diff)){
  mydata <- mylist_DV[[i]]
  for(j in 1:length(ES)){
    beta[j] <- coef(lm(mydata[,j+2]~ scale(mydata$gender) - 1))
  }
  BETAS[,i] <- round(beta, digits=4)
}

desc.fun <- function(data){
  ES <- seq(from=-2, to = 2, by=0.1)
  mean <- rowMeans(data)
  sd <- apply(data, 1, sd)
  error <- apply(data, 1, function(x) (qnorm(0.975)*sd(x))/sqrt(length(x)))
  ci_upper <- mean+error
  ci_lower <- mean-error
  desc <- data.frame(RegCoeff=BETAS[,2],
                    mean=mean, se=error,
                    ci_up=ci_upper, ci_lo=ci_lower)

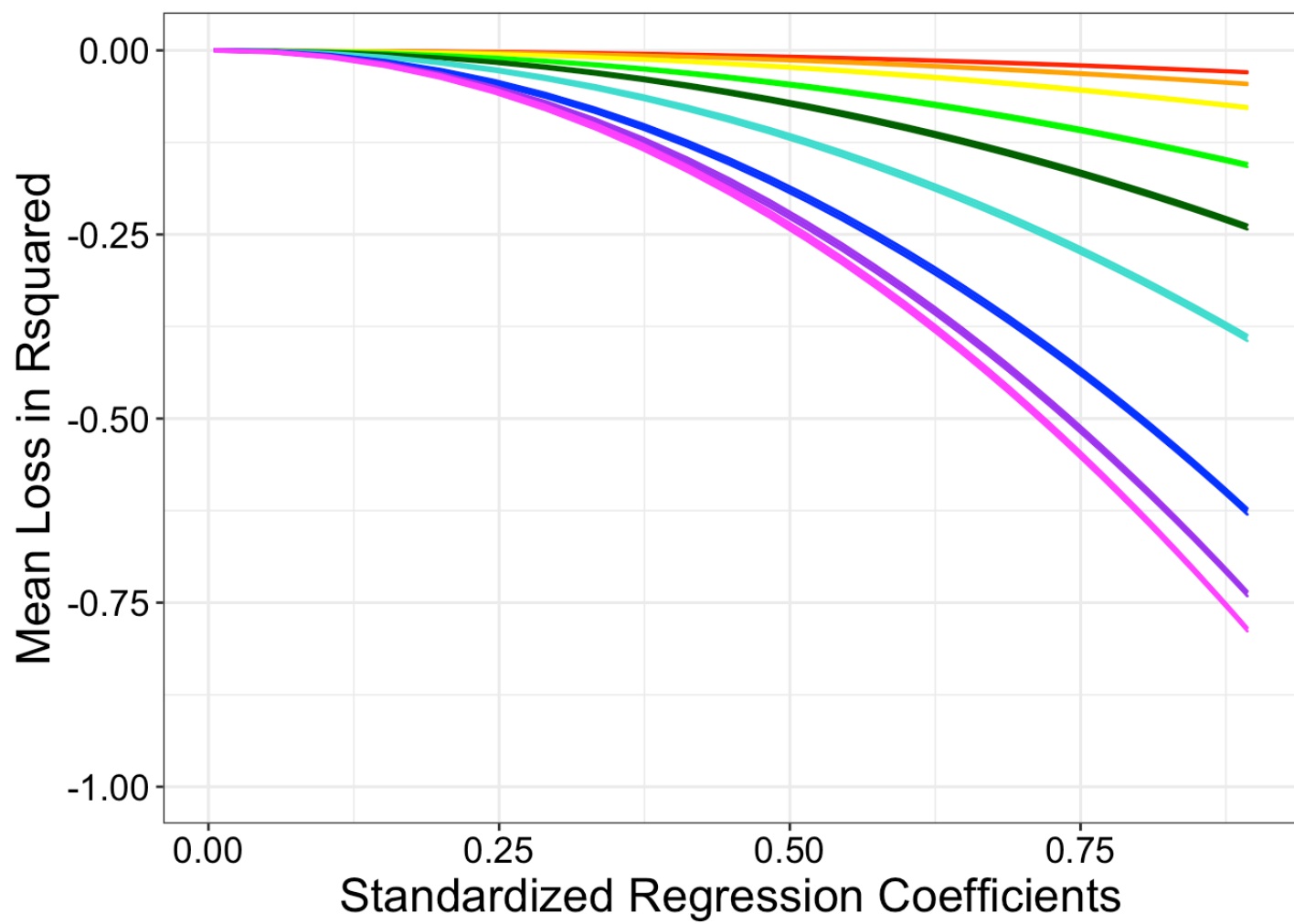
  return(desc)
}

## Set Parameters
### Create empty vessel objects
list.desc <- as.list(1:length(diff))
list.desc_R2 <- list.desc; list.desc_R2_p <- list.desc; list.desc_PWR <- list.desc

## Calculate descriptive values for plotting
for(i in 1:length(diff)){
  list.desc_R2[[i]] <- desc.fun(t(listdfdiff_R2[[i]]))
  list.desc_R2_p[[i]] <- desc.fun(t(listdfdiff_R2_p[[i]]))
  list.desc_PWR[[i]] <- desc.fun(t(listdfdiff_PWR[[i]]))
}
```

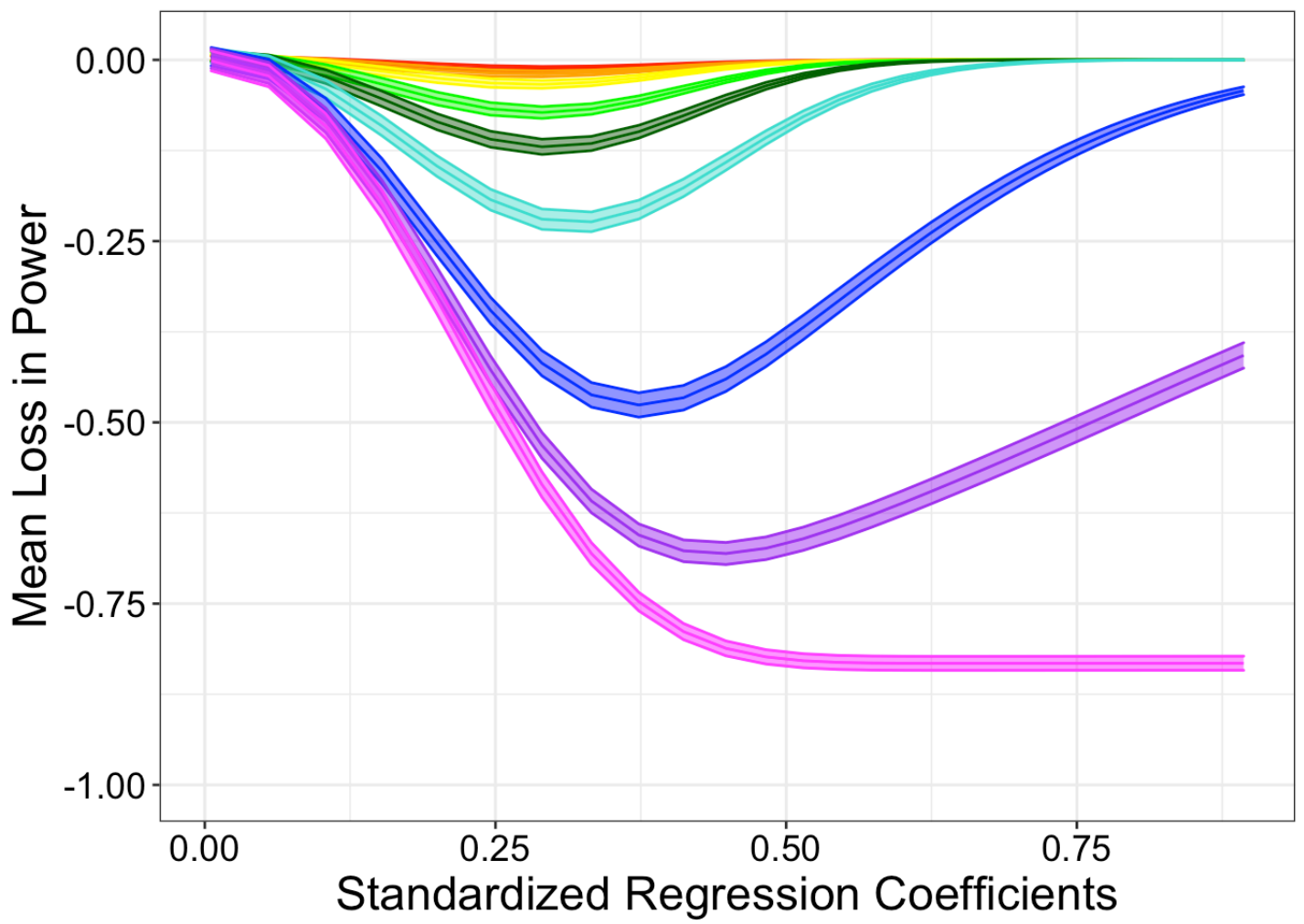
#Graph for R square:

```
g <- ggplot(data=list.desc_R2[[1]], aes(x=RegCoeff, y=mean, min=-1, max=0, color=colores[1]))
g +
  geom_line(color=colores[1]) +
  geom_ribbon(data=list.desc_R2[[1]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[1], fill=colores[1]) +
  geom_line(data = list.desc_R2[[2]], aes(x=RegCoeff, y=mean), color=colores[2]) +
  geom_ribbon(data=list.desc_R2[[2]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[2], fill=colores[2]) +
  geom_line(data = list.desc_R2[[3]], aes(x=RegCoeff, y=mean), color=colores[3]) +
  geom_ribbon(data=list.desc_R2[[3]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[3], fill=colores[3]) +
  geom_line(data = list.desc_R2[[4]], aes(x=RegCoeff, y=mean), color=colores[4]) +
  geom_ribbon(data=list.desc_R2[[4]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[4], fill=colores[4]) +
  geom_line(data = list.desc_R2[[5]], aes(x=RegCoeff, y=mean), color=colores[5]) +
  geom_ribbon(data=list.desc_R2[[5]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[5], fill=colores[5]) +
  geom_line(data = list.desc_R2[[6]], aes(x=RegCoeff, y=mean), color=colores[6]) +
  geom_ribbon(data=list.desc_R2[[6]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[6], fill=colores[6]) +
  geom_line(data = list.desc_R2[[7]], aes(x=RegCoeff, y=mean), color=colores[7]) +
  geom_ribbon(data=list.desc_R2[[7]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[7], fill=colores[7]) +
  geom_line(data = list.desc_R2[[8]], aes(x=RegCoeff, y=mean), color=colores[8]) +
  geom_ribbon(data=list.desc_R2[[8]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[8], fill=colores[8]) +
  geom_line(data = list.desc_R2[[9]], aes(x=RegCoeff, y=mean), color=colores[9]) +
  geom_ribbon(data=list.desc_R2[[9]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=colores[9], fill=colores[9]) +
  theme_bw() +
  labs(x = "Standardized Regression Coefficients", y="Mean Loss in Rsquared")+
  theme(text = element_text(size = 18, color = "black"),
        axis.text.x = element_text(color = "black", size = 14),
        axis.text.y = element_text(color = "black", size = 14))
```

#Graph for PWR:

```
g <- ggplot(data=list.desc_PWR[[1]], aes(x=RegCoeff, y=mean, min=-1, max=0, colour =
colores[1]))
g +
  geom_line(color=colores[1]) +
  geom_ribbon(data=list.desc_PWR[[1]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[1], fill=colores[1]) +
  geom_line(data = list.desc_PWR[[2]], aes(x=RegCoeff, y=mean), color=colores[2]) +
  geom_ribbon(data=list.desc_PWR[[2]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[2], fill=colores[2]) +
  geom_line(data = list.desc_PWR[[3]], aes(x=RegCoeff, y=mean), color=colores[3]) +
  geom_ribbon(data=list.desc_PWR[[3]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[3], fill=colores[3]) +
  geom_line(data = list.desc_PWR[[4]], aes(x=RegCoeff, y=mean), color=colores[4]) +
  geom_ribbon(data=list.desc_PWR[[4]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[4], fill=colores[4]) +
  geom_line(data = list.desc_PWR[[5]], aes(x=RegCoeff, y=mean), color=colores[5]) +
  geom_ribbon(data=list.desc_PWR[[5]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[5], fill=colores[5]) +
  geom_line(data = list.desc_PWR[[6]], aes(x=RegCoeff, y=mean), color=colores[6]) +
  geom_ribbon(data=list.desc_PWR[[6]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[6], fill=colores[6]) +
  geom_line(data = list.desc_PWR[[7]], aes(x=RegCoeff, y=mean), color=colores[7]) +
  geom_ribbon(data=list.desc_PWR[[7]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[7], fill=colores[7]) +
  geom_line(data = list.desc_PWR[[8]], aes(x=RegCoeff, y=mean), color=colores[8]) +
  geom_ribbon(data=list.desc_PWR[[8]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[8], fill=colores[8]) +
  geom_line(data = list.desc_PWR[[9]], aes(x=RegCoeff, y=mean), color=colores[9]) +
  geom_ribbon(data=list.desc_PWR[[9]], aes(ymin=ci_lo,ymax=ci_up), alpha=0.5, color=c
olores[9], fill=colores[9]) +
  theme_bw() +
  labs(x = "Standardized Regression Coefficients", y="Mean Loss in Power") +
  theme(text = element_text(size = 18, color = "black"),
        axis.text.x = element_text(color = "black", size = 14),
        axis.text.y = element_text(color = "black", size = 14)) +
  scale_colour_manual(name = 'Difference',
                      values = c('red'='red', 'orange'='orange',
                                'yellow'='yellow', 'green'='green',
                                'darkgreen'='darkgreen',
                                'turquoise'='turquoise', 'blue'='blue',
                                'purple'='purple', 'magenta' = 'magenta'),
                      breaks = c('red', 'orange', 'yellow', 'green',
                                'darkgreen', 'turquoise', 'blue', 'purple', 'magenta'
                                ),
                      labels=paste0("Difference = ", diff),
                      guide = "legend")
```



sessionInfo()

```
## R version 4.0.2 (2020-06-22)
## Platform: x86_64-apple-darwin17.0 (64-bit)
## Running under: macOS Catalina 10.15.5
##
## Matrix products: default
## BLAS:   /Library/Frameworks/R.framework/Versions/4.0/Resources/lib/libRblas.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/4.0/Resources/lib/libRlapack.dylib
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats      graphics  grDevices  utils      datasets  methods   base
##
## other attached packages:
## [1] QuantPsyc_1.5 MASS_7.3-51.6 boot_1.3-25   ggplot2_3.3.2 pwr_1.3-0
## [6] sm_2.2-5.6
##
## loaded via a namespace (and not attached):
## [1] pillar_1.4.4      compiler_4.0.2    tools_4.0.2       digest_0.6.25
## [5] evaluate_0.14     lifecycle_1.0.0  tibble_3.0.2      gtable_0.3.0
## [9] pkgconfig_2.0.3   rlang_0.4.10     yaml_2.2.1        xfun_0.15
## [13] withr_2.4.1       stringr_1.4.0    dplyr_1.0.0       knitr_1.29
## [17] generics_0.0.2    vctrs_0.3.1      grid_4.0.2        tidyselect_1.1.0
## [21] glue_1.4.1        R6_2.4.1         tcltk_4.0.2       rmarkdown_2.3
## [25] purrr_0.3.4       farver_2.0.3     magrittr_1.5      scales_1.1.1
## [29] codetools_0.2-16  ellipsis_0.3.1   htmltools_0.5.0   colorspace_1.4-1
## [33] labeling_0.3      stringi_1.4.6    munsell_0.5.0     crayon_1.3.4
```