

Study 2 Analysis: Men's Voices

Kelsey Neuenswander

9/20/2021

Introduction

This study investigates the social evaluative implications of sensory adaptation to men's voices.

Stimuli. Test stimuli were audio recordings of 20 young adult men reciting the sentence "Hi, I'm a student at UCLA". Samples were recorded digitally (M-Audio Microtrack recorder, 16-bit amplitude resolution, 44.1 kHz sampling rate) using an AKG E535 condenser microphone placed approximately 15cm from the mouth. Stimuli varied naturally in duration, fundamental frequency (f_o), and voice quality.

Adapting stimuli. Adaptors included both masculinized and feminized exemplars that would be gender-typical and gender-atypical, respectively, relative to test stimuli. Adaptors were generated from recordings of 5 young adult men producing the same sentence as test stimuli. These recordings were manipulated to be more masculine or more feminine using the VT-Change script in Praat (Boersma & Weenink, 2021). We altered f_o , a well-established sexually dimorphic aspect of voice, using PSOLA (Pitch Synchronous Overlap Add) resynthesis. For masculinized versions, f_o values were lowered to 90% of baseline. For feminized versions, f_o was increased to 175% of baseline.

Procedure. We recruited U.S. residents from Prolific. After providing consent, participants were randomly assigned to either the gender-atypical (feminized) or gender-typical (masculinized) adaptation condition. On each trial, participants first heard an adapting voice followed by a test voice which they judged for attractiveness and masculinity (1 = *Not at all* to 9 = *Extremely*). We also collected perceptions of likability, friendliness, and typicality for future exploratory analyses not reported here. To maintain attention, participants also completed a secondary task rating whether the pitch of each adaptor was higher, lower, or identical to the previous adaptor. In total, participants completed 20 trials in pseudo-randomized order, with each adaptor presented four times.

Hypotheses. Variability in vocal tract length and laryngeal cavity size create large differences in fundamental frequency for male and female voices (Hillenbrand et al., 1995). Perceivers evaluate men and women with regard to these differences, rating men as more attractive when their voices have low fundamental frequency but women as more attractive when their voices have high fundamental frequency (Puts, 2005; Puts, Barndt, Welling, Dawood, & Burriss, 2011). Therefore, we predicted that adaptation to feminized voices would produce contrastive aftereffects, making neutral male test voices sound more gender-typical and therefore more attractive. Conversely, adaptation to masculinized voices should make neutral male test voices sound less gender-typical and therefore less attractive. We also collected measures of perceived likability, friendliness, and typicality for future exploratory analyses not tested here.

Analysis

Load Data

```
data <- read.csv("study2_data.csv", header = TRUE)
```

Factor

```

# participant ID
data$ID <- factor(data$ID)

# condition
data$condition <- as.factor(data$condition)

# participant sex
data$Sex <- as.factor(data$Sex)

```

Filter

There were only 3 participants who did not identify as male or female. Because we were interested in investigating the interaction between condition and participant sex, we filtered out participants who did not identify as male or female since the power for detecting an effect with a sample size of 3 is too low.

```
nrow(data)/20 # divide by number of trials since data is long formed
```

```
## [1] 179
```

```

data <- data %>%
  filter(Sex == "1" | Sex == "2")
nrow(data)/20

```

```
## [1] 175
```

Check Data Quality

Group by participant ID and filter out participants with a response range of 1 on any of the dependent variables.

```

# sample size before filtering
nrow(data)/20 # divide by number of trials since data is long form

```

```
## [1] 175
```

```

# attraction
data <- data %>%
  group_by(ID) %>%
  filter((max(attraction) - min(attraction) > 1))

# masculinity
data <- data %>%
  group_by(ID) %>%
  filter((max(masculinity) - min(masculinity) > 1))

# likability
data <- data %>%
  group_by(ID) %>%
  filter((max(likability) - min(likability) > 1))

# friends
data <- data %>%
  group_by(ID) %>%

```

```

    filter((max(friends) - min(friends) > 1))

# typicality
data <- data %>%
  group_by(ID) %>%
  filter((max(typicality) - min(typicality) > 1))

# sample size after filtering
nrow(data)/20

```

```
## [1] 166
```

The original sample size was 175. After filtering participants whose responses did not meet our requirements, the final sample size is 166.

Demographics

After filtering participants, calculate the demographics of the final sample.

Sex

```

# 1 = male, 2 = female, 3 = other
table(data$Sex)/20

```

```

##
##   1   2   3
## 30 136   0

```

The majority of the sample is female (81.93%).

Race

```

# 1 = Asian, 2 = Black, 3 = Latino, 4 = White, 5 = Biracial/Other
table(data$Race)/20

```

```

##
##   1   2   3   4   5
## 10  14  17 113  12

```

The majority of the sample is White (68.07%)

Age

```
stat.desc(data$Age)
```

```

##      nbr.val      nbr.null      nbr.na      min      max
## 3320.000000    0.000000    0.000000  18.000000  72.000000
##      range      sum      median      mean      SE.mean
## 54.000000 84160.000000  23.000000  25.3493976  0.1472108
## CI.mean.0.95      var      std.dev      coef.var
## 0.2886331  71.9477851  8.4822040  0.3346117

```

The average age is 25.35 years old, with a range from 18 - 72.

Multilevel Analyses

The following analyses are done in a step-wise fashion.

Attraction

Main Effect: Attraction by Condition (Atypical/Typical)

```
# reference group = atypical condition
data$condition <- relevel(data$condition, ref = "atypical")

# multilevel model
model.1 <- lmer(attraction ~ condition + (1 | ID) + (1 | trial), data = data,
  na.action = "na.exclude", control = lmerControl(optimizer = "optimx",
    calc.derivs = FALSE, optCtrl = list(method = "nlminb")))

## Loading required namespace: optimx

summary(model.1)

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: attraction ~ condition + (1 | ID) + (1 | trial)
## Data: data
## Control:
## lmerControl(optimizer = "optimx", calc.derivs = FALSE, optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: 13758.6
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.03988 -0.68186  0.02833  0.69512  2.75984
##
## Random effects:
## Groups   Name                Variance Std.Dev.
## ID       (Intercept)  1.0979     1.0478
## trial    (Intercept)  0.2737     0.5231
## Residual                    3.2805     1.8112
## Number of obs: 3320, groups: ID, 166; trial, 20
##
## Fixed effects:
##              Estimate Std. Error    df t value      Pr(>|t|)
## (Intercept)    5.5655     0.1694  64.8571  32.848 < 0.0000000000000002 ***
## conditiontypical -0.6466     0.1744 164.0000  -3.708    0.000286 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr)
## condntntypcl -0.508
```

```
# confidence interval
ci.1 <- confint(model.1, method = "Wald", level = 0.95)
ci.1
```

```
##                2.5 %      97.5 %
## .sig01          NA        NA
## .sig02          NA        NA
## .sigma          NA        NA
## (Intercept)    5.2333986  5.8975538
## conditiontypical -0.9883759 -0.3047716
```

```
# group means
attraction_condition <- data %>%
  group_by(condition) %>%
  summarise(mean = mean(attraction), sd = sd(attraction), n = n(), se = sd(attraction)/sqrt(n()))
attraction_condition
```

```
## # A tibble: 2 x 5
##   condition mean    sd    n    se
##   <fct>      <dbl> <dbl> <int> <dbl>
## 1 atypical  5.57  2.17  1680 0.0531
## 2 typical   4.92  2.13  1640 0.0525
```

Test voices were rated as more attractive after adaptation to feminized voices ($M = 5.57$, $SD = 2.17$) relative to masculinized voices ($M = 4.92$, $SD = 2.13$), $t(164) = -3.71$, $p < .001$.

Main Effect: Attraction by Participant Sex (Male/Female)

```
# reference group = female participants
data$Sex <- relevel(data$Sex, ref = "2")

# multilevel model
model.2 <- lmer(attraction ~ Sex + (1 | ID) + (1 | trial), data = data,
  na.action = "na.exclude", control = lmerControl(optimizer = "optimx",
    calc.derivs = FALSE, optCtrl = list(method = "nlminb")))
summary(model.2)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: attraction ~ Sex + (1 | ID) + (1 | trial)
## Data: data
## Control:
## lmerControl(optimizer = "optimx", calc.derivs = FALSE, optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: 13760.5
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.00845 -0.67281  0.03536  0.70415  2.74799
##
## Random effects:
## Groups   Name                Variance Std.Dev.
```

```
## ID (Intercept) 1.1168 1.0568
## trial (Intercept) 0.2737 0.5231
## Residual 3.2805 1.8112
## Number of obs: 3320, groups: ID, 166; trial, 20
##
## Fixed effects:
## Estimate Std. Error df t value Pr(>|t|)
## (Intercept) 5.1085 0.1520 44.9564 33.610 < 0.0000000000000002 ***
## Sex1 0.7615 0.2283 163.9986 3.336 0.00105 **
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
## (Intr)
## Sex1 -0.271
```

```
# confidence interval
ci.2 <- confint(model.2, method = "Wald", level = 0.95)
ci.2
```

```
## 2.5 % 97.5 %
## .sig01 NA NA
## .sig02 NA NA
## .sigma NA NA
## (Intercept) 4.810558 5.406354
## Sex1 0.314126 1.208962
```

```
# group means
attraction_Sex <- data %>%
  group_by(Sex) %>%
  summarise(mean = mean(attraction), sd = sd(attraction), n = n(), se = sd(attraction)/sqrt(n()))
attraction_Sex
```

```
## # A tibble: 2 x 5
## Sex mean sd n se
## <fct> <dbl> <dbl> <int> <dbl>
## 1 2 5.11 2.17 2720 0.0416
## 2 1 5.87 2.10 600 0.0856
```

Male participants ($M = 5.87$, $SD = 2.10$) rated test voices as significantly more attractive than female participants ($M = 5.11$, $SD = 2.17$), $t(164) = 3.34$, $p = .001$.

Interaction: Attraction by Condition (Atypical/Typical) and Participant Sex (Male/Female)

```
# multilevel model
model.3 <- lmer(attraction ~ condition * Sex + (1|ID) + (1|trial), data=data, na.action = 'na.exclude',
summary(model.3)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: attraction ~ condition * Sex + (1 | ID) + (1 | trial)
## Data: data
```

```
## Control:
## lmerControl(optimizer = "optimx", calc.derivs = FALSE, optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: 13746.2
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.02936 -0.68547  0.03129  0.69776  2.76663
##
## Random effects:
##   Groups   Name                Variance Std.Dev.
##   ID       (Intercept)  1.0135     1.0067
##   trial    (Intercept)  0.2737     0.5231
##   Residual                    3.2805     1.8112
## Number of obs: 3320, groups:  ID, 166; trial, 20
##
## Fixed effects:
##              Estimate Std. Error      df t value      Pr(>|t|)
## (Intercept)      5.4846      0.1761   72.9144   31.150 < 0.0000000000000002
## conditiontypical -0.7522      0.1861  162.0007   -4.042    0.0000817
## Sex1              0.4248      0.3015  162.0007    1.409      0.161
## conditiontypical:Sex1  0.6678      0.4386  162.0007    1.523      0.130
##
## (Intercept)      ***
## conditiontypical  ***
## Sex1
## conditiontypical:Sex1
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
##              (Intr) cndtnt Sex1
## condntntypcl -0.528
## Sex1         -0.326  0.309
## cndntntyp:S1  0.224 -0.424 -0.688
```

```
#confidence interval
ci.3 <- confint(model.3,method="Wald", level=0.95)
ci.3
```

```
##              2.5 %      97.5 %
## .sig01          NA          NA
## .sig02          NA          NA
## .sigma          NA          NA
## (Intercept)      5.1394731  5.8296445
## conditiontypical -1.1169549 -0.3874569
## Sex1            -0.1661447  1.0157771
## conditiontypical:Sex1 -0.1917372  1.5273989
```

```
# group means
attraction_total <- data %>% group_by(condition, Sex) %>%
  summarise(mean = mean(attraction),
            sd = sd(attraction),
```

```
n = n(),
se = sd(attraction)/sqrt(n()))
```

'summarise()' has grouped output by 'condition'. You can override using the '.groups' argument.

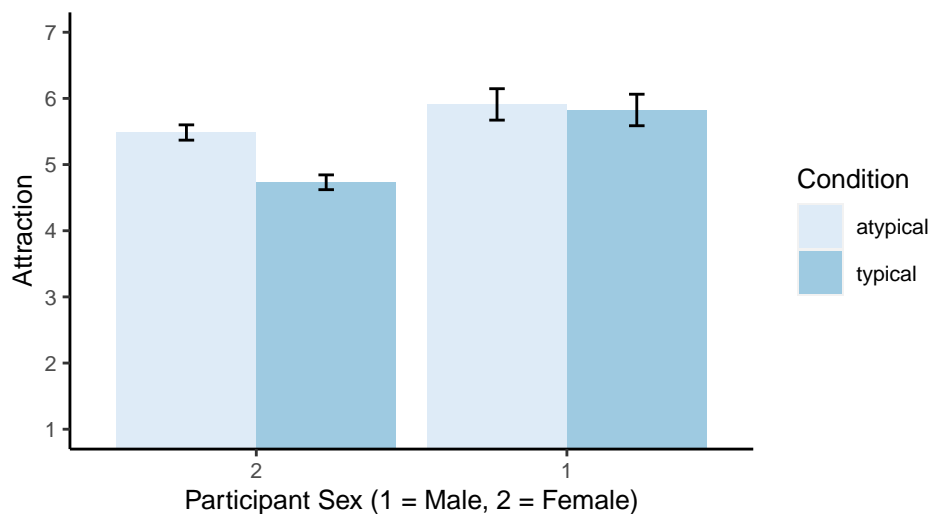
```
attraction_total
```

```
## # A tibble: 4 x 6
## # Groups:   condition [2]
##   condition Sex    mean    sd     n    se
##   <fct>      <fct> <dbl> <dbl> <int> <dbl>
## 1 atypical  2      5.48  2.17  1360 0.0589
## 2 atypical  1      5.91  2.16   320 0.121
## 3 typical   2      4.73  2.10  1360 0.0569
## 4 typical   1      5.82  2.03   280 0.121
```

```
#plot with 95% CI
```

```
attraction_plot <- data %>%
  group_by(condition, Sex) %>%
  phe_mean(x = attraction, type = "full", confidence = 0.95) %>%
  ggplot(aes(x=Sex, y=value, fill=condition)) +
  geom_bar(stat = "identity", position = "dodge", width = .90) +
  geom_errorbar(aes(ymin = lowercl, ymax = uppercl), position = position_dodge(.90), width = 0.1) +
  scale_y_continuous(limits=c(1,7), breaks=seq(1,7,by=1), oob = rescale_none) +
  scale_fill_brewer(palette = 1) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
        panel.background = element_blank(), axis.line = element_line(colour = "black"),
        text = element_text(size = 10)) + # apply custom minimal theme
  labs(title = "", x="Participant Sex (1 = Male, 2 = Female)", y="Attraction", fill="Condition")
```

```
attraction_plot
```



The interaction between condition and participant sex is not significant, $t(162) = 1.52$, $p = .130$.

Masculinity

Main Effect: Masculinity by Condition

```
model.4 <- lmer(masculinity ~ condition + (1 | ID) + (1 | trial), data = data,
  na.action = "na.exclude", control = lmerControl(optimizer = "optimx",
    calc.derivs = FALSE, optCtrl = list(method = "nlsminb")))
summary(model.4)

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: masculinity ~ condition + (1 | ID) + (1 | trial)
## Data: data
## Control:
## lmerControl(optimizer = "optimx", calc.derivs = FALSE, optCtrl = list(method = "nlsminb"))
##
## REML criterion at convergence: 12858.3
##
## Scaled residuals:
## Min 1Q Median 3Q Max
## -4.0522 -0.6320 0.0302 0.6474 3.2915
##
## Random effects:
## Groups Name Variance Std.Dev.
## ID (Intercept) 0.9611 0.9803
## trial (Intercept) 0.1593 0.3992
## Residual 2.4890 1.5777
## Number of obs: 3320, groups: ID, 166; trial, 20
##
## Fixed effects:
## Estimate Std. Error df t value Pr(>|t|)
## (Intercept) 5.9119 0.1445 87.0086 40.904 < 0.0000000000000002 ***
## conditiontypical -0.9747 0.1617 164.0008 -6.026 0.0000000107 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
## (Intr)
## condntntypcl -0.553

# confidence interval
ci.4 <- confint(model.4, method = "Wald", level = 0.95)
ci.4

## 2.5 % 97.5 %
## .sig01 NA NA
## .sig02 NA NA
## .sigma NA NA
## (Intercept) 5.628630 6.1951793
## conditiontypical -1.291722 -0.6576974
```

```
# group means
masculinity_condition <- data %>%
  group_by(condition) %>%
  summarise(mean = mean(masculinity), sd = sd(masculinity), n = n(),
            se = sd(masculinity)/sqrt(n()))
masculinity_condition
```

```
## # A tibble: 2 x 5
##   condition mean    sd     n    se
##   <fct>      <dbl> <dbl> <int> <dbl>
## 1 atypical  5.91  1.90  1680 0.0463
## 2 typical   4.94  1.89  1640 0.0467
```

Test voices were rated as more masculine after adaptation to feminized voices ($M = 5.91$, $SD = 1.90$) relative to masculinized voices ($M = 4.94$, $SD = 1.89$), $t(164) = -6.03$, $p < .001$.

Main Effect: Masculinity by Participant Sex

```
# reference group = female
data$Sex <- relevel(data$Sex, ref = "2")

# multilevel model
model.5 <- lmer(masculinity ~ Sex + (1 | ID) + (1 | trial), data = data,
               na.action = "na.exclude", control = lmerControl(optimizer = "optimx",
               calc.derivs = FALSE, optCtrl = list(method = "nlminb")))
summary(model.5)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: masculinity ~ Sex + (1 | ID) + (1 | trial)
## Data: data
## Control:
## lmerControl(optimizer = "optimx", calc.derivs = FALSE, optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: 12882.8
##
## Scaled residuals:
##   Min       1Q   Median       3Q      Max
## -4.0323 -0.6384  0.0294  0.6424  3.2786
##
## Random effects:
## Groups Name Variance Std.Dev.
## ID      (Intercept) 1.1400  1.0677
## trial   (Intercept) 0.1594  0.3992
## Residual                2.4890  1.5777
## Number of obs: 3320, groups: ID, 166; trial, 20
##
## Fixed effects:
##              Estimate Std. Error    df t value      Pr(>|t|)
## (Intercept)   5.3147     0.1314 65.8453  40.447 < 0.0000000000000002 ***
## Sex1          0.6403     0.2268 163.9989   2.823    0.00535 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
## Correlation of Fixed Effects:
##      (Intr)
## Sex1 -0.312
```

```
# confidence interval
ci.5 <- confint(model.5, method = "Wald", level = 0.95)
ci.5
```

```
##              2.5 %    97.5 %
## .sig01         NA        NA
## .sig02         NA        NA
## .sigma         NA        NA
## (Intercept) 5.057166 5.572245
## Sex1         0.195738 1.084850
```

```
# group means
masculinity_Sex <- data %>%
  group_by(Sex) %>%
  summarise(mean = mean(masculinity), sd = sd(masculinity), n = n(),
            se = sd(masculinity)/sqrt(n()))
masculinity_Sex
```

```
## # A tibble: 2 x 5
##   Sex    mean    sd      n    se
##   <fct> <dbl> <dbl> <int> <dbl>
## 1 2      5.31  1.94  2720 0.0373
## 2 1      5.96  1.93   600 0.0787
```

Male participants ($M = 5.96$, $SD = 1.93$) rated test voices as significantly more masculine than female participants ($M = 5.31$, $SD = 1.94$), $t(164) = 2.82$, $p = .005$.

Interaction: Masculinity by Condition and Participant Sex

```
# multilevel model
model.6 <- lmer(masculinity ~ condition * Sex + (1|ID) + (1|trial), data=data, na.action = 'na.exclude')
summary(model.6)
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: masculinity ~ condition * Sex + (1 | ID) + (1 | trial)
## Data: data
## Control:
## lmerControl(optimizer = "optimx", calc.derivs = FALSE, optCtrl = list(method = "nlsminb"))
##
## REML criterion at convergence: 12847.7
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -4.0408 -0.6345  0.0325  0.6434  3.3000
##
## Random effects:
```

```
## Groups Name Variance Std.Dev.
## ID (Intercept) 0.8974 0.9473
## trial (Intercept) 0.1594 0.3992
## Residual 2.4890 1.5777
## Number of obs: 3320, groups: ID, 166; trial, 20
##
## Fixed effects:
## Estimate Std. Error df t value Pr(>|t|)
## (Intercept) 5.8632 0.1516 98.0136 38.665 < 0.0000000000000002
## conditiontypical -1.0971 0.1734 161.9996 -6.328 0.00000000233
## Sex1 0.2555 0.2809 161.9996 0.910 0.3643
## conditiontypical:Sex1 0.7462 0.4085 161.9996 1.826 0.0696
##
## (Intercept) ***
## conditiontypical ***
## Sex1
## conditiontypical:Sex1 .
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
## (Intr) cndtnt Sex1
## condntypcl -0.572
## Sex1 -0.353 0.309
## cndntyp:S1 0.243 -0.424 -0.688
```

```
#confidence interval
ci.6 <- confint(model.6,method="Wald", level=0.95)
ci.6
```

```
## 2.5 % 97.5 %
## .sig01 NA NA
## .sig02 NA NA
## .sigma NA NA
## (Intercept) 5.56602046 6.1604501
## conditiontypical -1.43683541 -0.7572822
## Sex1 -0.29498628 0.8060157
## conditiontypical:Sex1 -0.05455211 1.5468840
```

```
# group means
masculinity_total <- data %>% group_by(condition, Sex) %>%
  summarise(mean = mean(masculinity),
            sd = sd(masculinity),
            n = n(),
            se = sd(masculinity)/sqrt(n()))
```

'summarise()' has grouped output by 'condition'. You can override using the '.groups' argument.

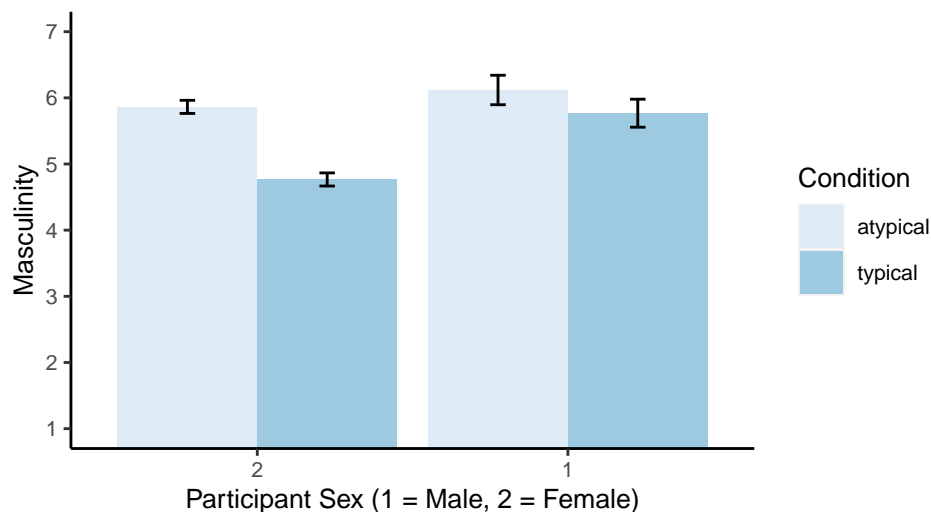
```
masculinity_total
```

```
## # A tibble: 4 x 6
## # Groups: condition [2]
```

```
##   condition Sex   mean   sd    n    se
##   <fct>      <fct> <dbl> <dbl> <int> <dbl>
## 1 atypical  2     5.86  1.86  1360 0.0505
## 2 atypical  1     6.12  2.02   320 0.113
## 3 typical   2     4.77  1.87  1360 0.0506
## 4 typical   1     5.77  1.80   280 0.107
```

```
#plot with 95% CI
masc_plot <- data %>%
  group_by(condition, Sex) %>%
  phe_mean(x = masculinity, type = "full", confidence = 0.95) %>%
  ggplot(aes(x=Sex, y=value, fill=condition)) +
  geom_bar(stat = "identity", position = "dodge", width = .90) +
  geom_errorbar(aes(ymin = lowercl, ymax = uppercl), position = position_dodge(.90), width = 0.1) +
  scale_y_continuous(limits=c(1,7), breaks=seq(1,7,by=1), oob = rescale_none) +
  scale_fill_brewer(palette = 1) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
        panel.background = element_blank(), axis.line = element_line(colour = "black"),
        text = element_text(size = 10)) + # apply custom minimal theme
  labs(title = "", x="Participant Sex (1 = Male, 2 = Female)", y="Masculinity", fill="Condition")

masc_plot
```



The interaction between condition and participant sex is not significant, $t(162) = 1.83$, $p = .070$.

Mediation

Relationship Between Perceived Attractiveness and Masculinity

```
# center masculinity (predictor)
data$masculinity.centered <- as.numeric(scale(data$masculinity, center = TRUE,
  scale = TRUE))
```

```

model.7 <- lmer(attraction ~ masculinity + (1 | ID) + (1 | trial), data = data,
  na.action = "na.exclude", control = lmerControl(optimizer = "optimx",
    calc.derivs = FALSE, optCtrl = list(method = "nlminb")))
summary(model.7)

## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: attraction ~ masculinity + (1 | ID) + (1 | trial)
## Data: data
## Control:
## lmerControl(optimizer = "optimx", calc.derivs = FALSE, optCtrl = list(method = "nlminb"))
##
## REML criterion at convergence: 12606.5
##
## Scaled residuals:
## Min 1Q Median 3Q Max
## -4.2559 -0.5767 0.0231 0.6216 3.8216
##
## Random effects:
## Groups Name Variance Std.Dev.
## ID (Intercept) 0.5395 0.7345
## trial (Intercept) 0.2013 0.4486
## Residual 2.3519 1.5336
## Number of obs: 3320, groups: ID, 166; trial, 20
##
## Fixed effects:
## Estimate Std. Error df t value Pr(>|t|)
## (Intercept) 1.86306 0.14856 77.40002 12.54 <0.0000000000000002 ***
## masculinity 0.62298 0.01652 3204.64069 37.71 <0.0000000000000002 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Correlation of Fixed Effects:
## (Intr)
## masculinity -0.604

# confidence interval
ci.7 <- confint(model.7, method = "Wald", level = 0.95)
ci.7

```

```

## 2.5 % 97.5 %
## .sig01 NA NA
## .sig02 NA NA
## .sigma NA NA
## (Intercept) 1.5718867 2.1542312
## masculinity 0.5905972 0.6553559

```

Multilevel Mediation - The Effect of Condition on Attractiveness Mediated by Perceived Masculinity

```

# detach lmerTest package (will not run otherwise)
detach("package:lmerTest", unload = TRUE)

# mediator model
med.fit <- lmer(masculinity ~ condition + (1 | ID), data = data)

# outcome model
out.fit <- lmer(attraction ~ condition + masculinity + (1 | ID), data = data)

# function to calculate indirect effect (ACME) and direct effect
# (ADE)
med.out <- mediate(med.fit, out.fit, treat = "condition", mediator = "masculinity",
  sims = 1000)

```

```

## Warning in mediate(med.fit, out.fit, treat = "condition", mediator =
## "masculinity", : treatment and control values do not match factor levels; using
## atypical and typical as control and treatment, respectively

```

```
summary(med.out)
```

```

##
## Causal Mediation Analysis
##
## Quasi-Bayesian Confidence Intervals
##
## Mediator Groups: ID
##
## Outcome Groups: ID
##
## Output Based on Overall Averages Across Groups
##
##           Estimate 95% CI Lower 95% CI Upper           p-value
## ACME           -0.6118    -0.8163      -0.41 <0.0000000000000002 ***
## ADE            -0.0393    -0.2796       0.21          0.72
## Total Effect   -0.6511    -0.9636     -0.34 <0.0000000000000002 ***
## Prop. Mediated  0.9432      0.6678       1.57 <0.0000000000000002 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Sample Size Used: 3320
##
##
## Simulations: 1000

```

The effect of condition on attraction ratings was fully mediated via perceived masculinity. The indirect effect is -.61 (ACME), which is significant insofar as the confidence interval does not contain zero [-0.80, -0.42].