Load necessary packages

```
library(tidyverse)
library(data.table)
library(reshape2)
library(ggpubr)
library(lmerTest)
library(stargazer)
library(lavaan)
library(semPlot)
theme_set(theme_classic(base_size = 10))
```

Scoring/cleaning functions

```
Read.Score <- function(file){
  dt <- fread(file)
  answers.cols <- names(dt)[grep('(a|b)$', names(dt))]

  dt[, (answers.cols) := lapply(.SD, function(x) case_when(x == 5 ~ 1,
                                                           x == 1 ~ -1,
                                                           TRUE ~ 0)),
     .SDcols = answers.cols]
  df <- dt[, -c('q40a', 'q40b')]

  df$student.score <- rowSums(df %>% select(grep("a$", names(.))))
  df$expert.score <- rowSums(df %>% select(grep("b$", names(.))))

  return(df)
}

Read.duplicate.cis <- function(file){
  cis.df <- read.csv(file)

  cis.noInfo <- cis.df[(cis.df$Q33 == '') | is.na(cis.df$Q33),]
  cis.FullInfo <- cis.df[(cis.df$Q33 != '') & !is.na(cis.df$Q33),]

  original.cols <- c('Q5', 'Q52',   'Q53', 'Q27', 'Q6', 'Q11', 'Q19',   'Q20', 'StartDate',
                     'anon_instructor_id', 'ResponseId', 'pre_survey_id', 'post_survey_id')

  cis.noInfo <- left_join(cis.noInfo, cis.FullInfo,
                          by = c('anon_university_id', 'Q18'),
                          suffix = c('.original', '.copy')) %>%
    select(anon_university_id, Q18, Q15.copy,   Q21.copy,   Q22_1.copy, Q22_2.copy, Q23.copy,
           Q29.copy, grep('Q(3|4)\\d_?\\d?\\.copy', names(.)),
           paste(original.cols, '.original', sep = '')) %>%
    filter(!duplicated(ResponseId.original) & !is.na(ResponseId.original)) %>%
    `colnames<-`(unlist(lapply(names(.), function (x) strsplit(x, '\\.')[[1]][1])))

  cis.df <- rbind(cis.FullInfo, cis.noInfo[, names(cis.df)])
```

```
  return(cis.df)
}
```

Read, score, and match

```
cis.df <- Read.duplicate.cis('C:/Users/Cole/Documents/GRA_Summer2020/eclass-public-master/anon_cis.csv')

#cis.df <- read.csv('C:/Users/Cole/Documents/GRA_Summer2020/eclass-public-master/anon_cis.csv')

pre.df <- Read.Score('C:/Users/Cole/Documents/GRA_Summer2020/eclass-public-master/anon_pre.csv')

cis.pre.df <- right_join(cis.df, pre.df, by = c('pre_survey_id' = 'survey_id'))
```

```
## Warning: Column `pre_survey_id`/`survey_id` joining factor and character
## vector, coercing into character vector
```

```
post.df <- Read.Score('C:/Users/Cole/Documents/GRA_Summer2020/eclass-public-master/anon_post.csv')

full.df <- full_join(cis.pre.df, post.df,
                     by = c('post_survey_id' = 'survey_id',
                            'anon_student_id'), suffix = c('.pre', '.post'))
```

```
## Warning: Column `post_survey_id`/`survey_id` joining factor and character
## vector, coercing into character vector
```

```
print('Total # of students in dataset...')
```

```
## [1] "Total # of students in dataset..."
```

```
nrow(full.df)
```

```
## [1] 67375
```

```
print('Total # of classes in dataset...')
```

```
## [1] "Total # of classes in dataset..."
```

```
length(unique(full.df$ResponseId))
```

```
## [1] 491
```

```
df.matched <- full.df %>%
  filter(!is.na(student.score.pre) & !is.na(student.score.post))

print('# of students in matched dataset...')
```

```
## [1] "# of students in matched dataset..."
```

```r
nrow(df.matched)
```

```
## [1] 34538
```

```r
print('# of classes in matched dataset...')
```

```
## [1] "# of classes in matched dataset..."
```

```r
length(unique(df.matched$ResponseId))
```

```
## [1] 440
```

Data processing

```r
# Replace declared major with intended major in cases where students intend to switch
df.matched[is.na(df.matched$Q48) | (df.matched$Q48 == 0),
           'Q48'] <- df.matched[is.na(df.matched$Q48) | (df.matched$Q48 == 0), 'Q47']

# When students select multiple race/ethnicity boxes, set to group with minimum membership
colSums(df.matched[, c('Q52_1', 'Q52_2', 'Q52_3', 'Q52_4', 'Q52_5', 'Q52_6', 'Q52_7')], na.rm = TRUE)
```

```
## Q52_1 Q52_2 Q52_3 Q52_4 Q52_5 Q52_6 Q52_7
##   260  6363  1593  2234   231 15570   734
```

```r
# Ethnicity set priority = Native Hawaiian/pacific islander, American indian/Alaska native, Other race/

df.matched <- df.matched %>%
  mutate(Major = case_when(
    Q48 == 1 ~ 'Physics',
    Q48 == 2 ~ 'Chemistry',
    Q48 == 3 ~ 'Biochemistry',
    Q48 == 4 ~ 'Biology',
    Q48 == 5 ~ 'Engineering',
    Q48 == 6 ~ 'Engineering Physics',
    Q48 == 7 ~ 'Astronomy',
    Q48 == 8 ~ 'Astrophysics',
    Q48 == 9 ~ 'Geology/geophysics',
    Q48 == 10 ~ 'Math/applied math',
    Q48 == 11 ~ 'Computer science',
    Q48 == 12 ~ 'Physiology',
    Q48 == 13 ~ 'Other science',
    Q48 == 14 ~ 'Non-science',
    Q48 == 15 ~ 'Open/undeclared',
    TRUE ~ NA_character_
  ),
  Gender = case_when(
    Q54 == 1 ~ 'Woman',
    Q54 == 2 ~ 'Man',
```

```
    Q54 == 3 ~ 'Other',
    TRUE ~ NA_character_
  ),
  Race.ethnicity = case_when(
    Q52_5 == 1 ~ 'Native Hawaiian or Pacific islander',
    Q52_1 == 1 ~ 'American indian or Alaska native',
    Q52_7 == 1 ~ 'Other',
    Q52_3 == 1 ~ 'Black or African american',
    Q52_4 == 1 ~ 'Hispanic/latinx',
    Q52_2 == 1 ~ 'Asian',
    Q52_6 == 1 ~ 'White',
    TRUE ~ NA_character_
  ),
  Lab.goal = Q33,
  Lab.level = case_when(
    Q18 == 'Beyond the first year lab' ~ 'BFY',
    Q27 == 'Calculus-based' ~ 'FY.calc',
    Q27 == 'Algebra-based' ~ 'FY.alg',
    TRUE ~ NA_character_
  ))
```

Data filtering

```
# Remove whole classes without goal and/or level information
df.matched <- df.matched %>%
  filter(!is.na(Lab.goal) & !is.na(Lab.level))

print('# of remaining students in matched dataset...')
```

```
## [1] "# of remaining students in matched dataset..."
```

```
nrow(df.matched)
```

```
## [1] 29497
```

```
print('# of remaining classes in matched dataset...')
```

```
## [1] "# of remaining classes in matched dataset..."
```

```
length(unique(df.matched$ResponseId))
```

```
## [1] 383
```

```
# Remove students without full race/ethnicity, gender, and major information
df.matched <- df.matched %>%
  filter(!is.na(Major) & !is.na(Gender) & !is.na(Race.ethnicity))

print('# of remaining students in matched dataset...')
```

```
## [1] "# of remaining students in matched dataset..."
```

```
nrow(df.matched)
```

```
## [1] 21777
```

```
print('# of remaining classes in matched dataset...')
```

```
## [1] "# of remaining classes in matched dataset..."
```

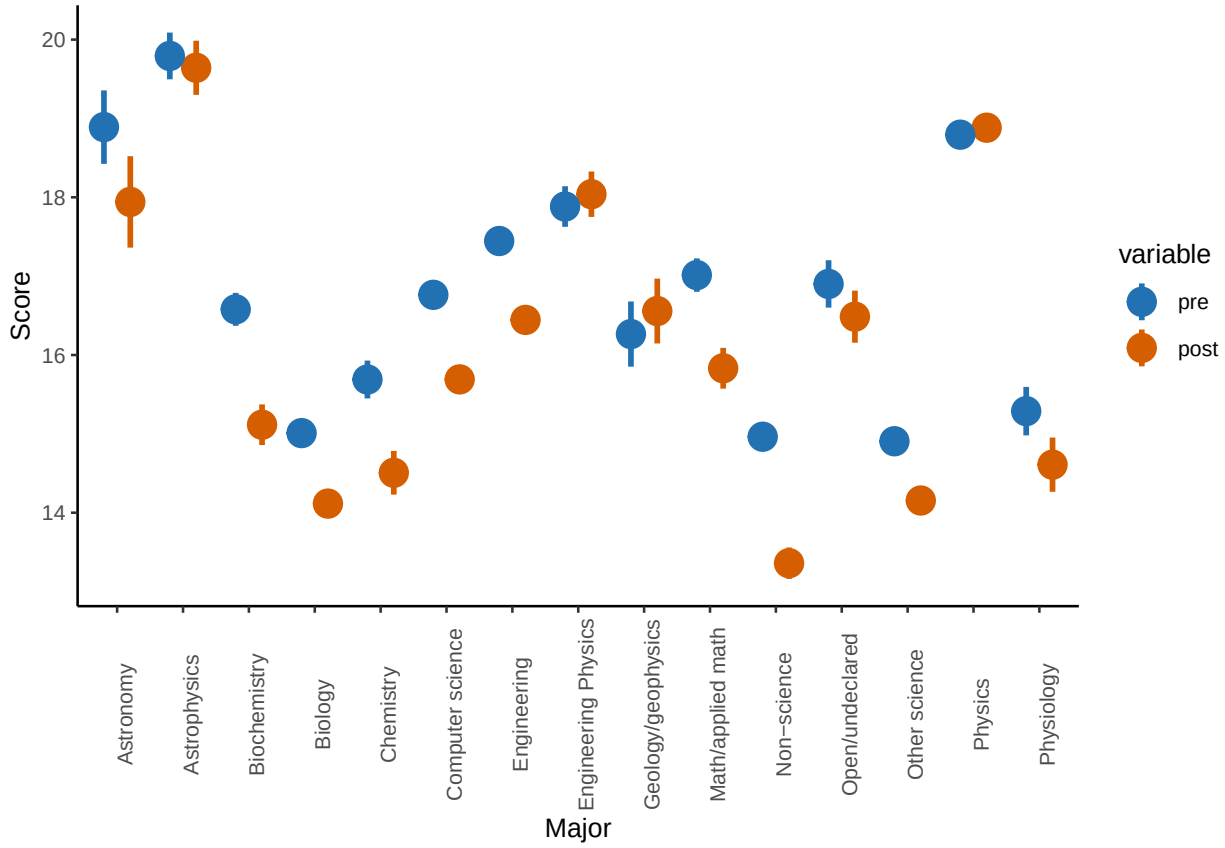
```
length(unique(df.matched$ResponseId))
```

```
## [1] 377
```

Descriptive statistics

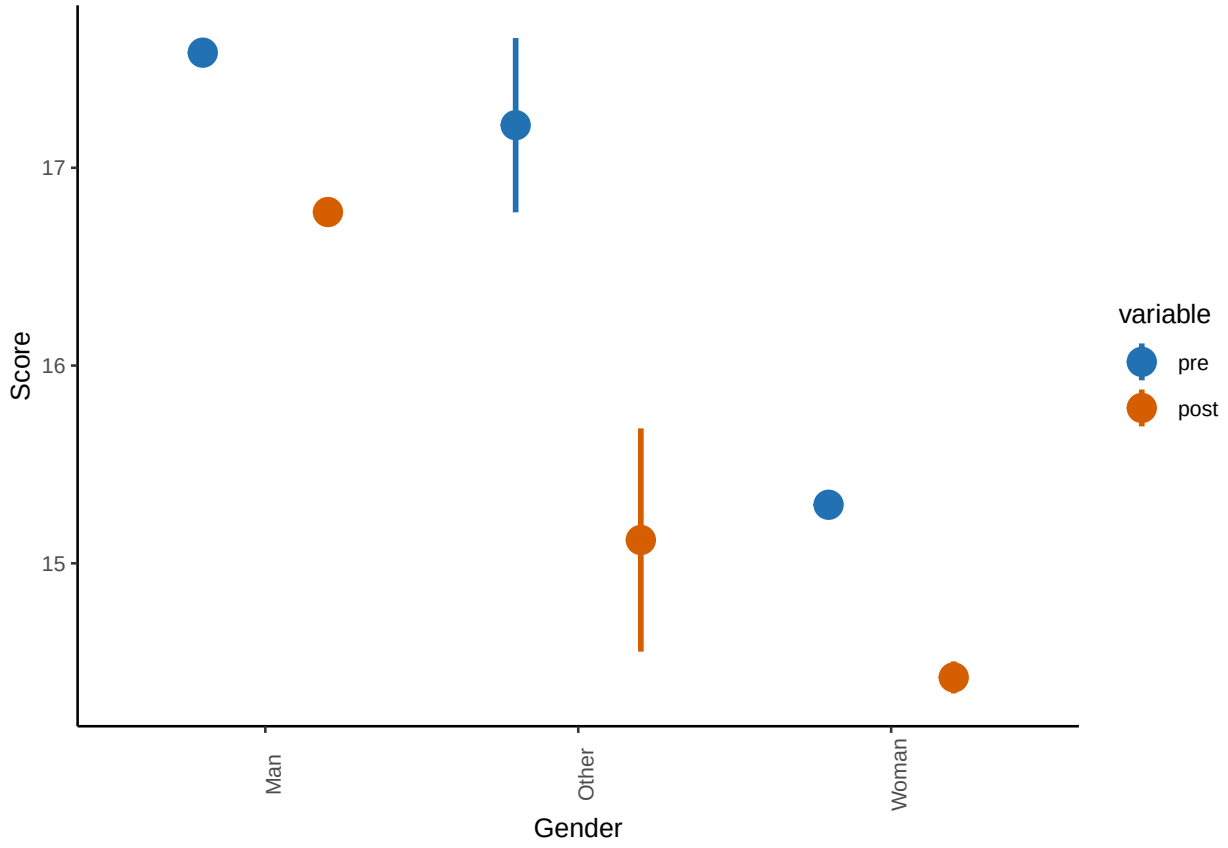
```
plot.pre.post <- function(df, var){
  print(table(df[, var]))
  df.matched.long <- reshape2::melt(df, measure.vars = c('student.score.pre',
                                                         'student.score.post'))

  p <- ggplot(df.matched.long, aes_string(x = var, y = 'value', group = 'variable', color = 'variable'))
  add_summary(p, fun = 'mean_se', group = c('variable')) +
    ylab('Score') +
    scale_color_manual(labels = c('pre', 'post'), values = c('#2271B2', '#D55E00')) +
    theme(axis.text.x = element_text(angle = 90))
}

plot.pre.post(df.matched, 'Major')
```

```
##
##           Astronomy        Astrophysics        Biochemistry
##                 137                 333                 982
##             Biology           Chemistry    Computer science
##                2709                 760                1809
##         Engineering Engineering Physics  Geology/geophysics
##                6141                 658                 226
##   Math/applied math         Non-science     Open/undeclared
##                 809                1539                 436
##       Other science             Physics          Physiology
##                2563                2245                 430
```



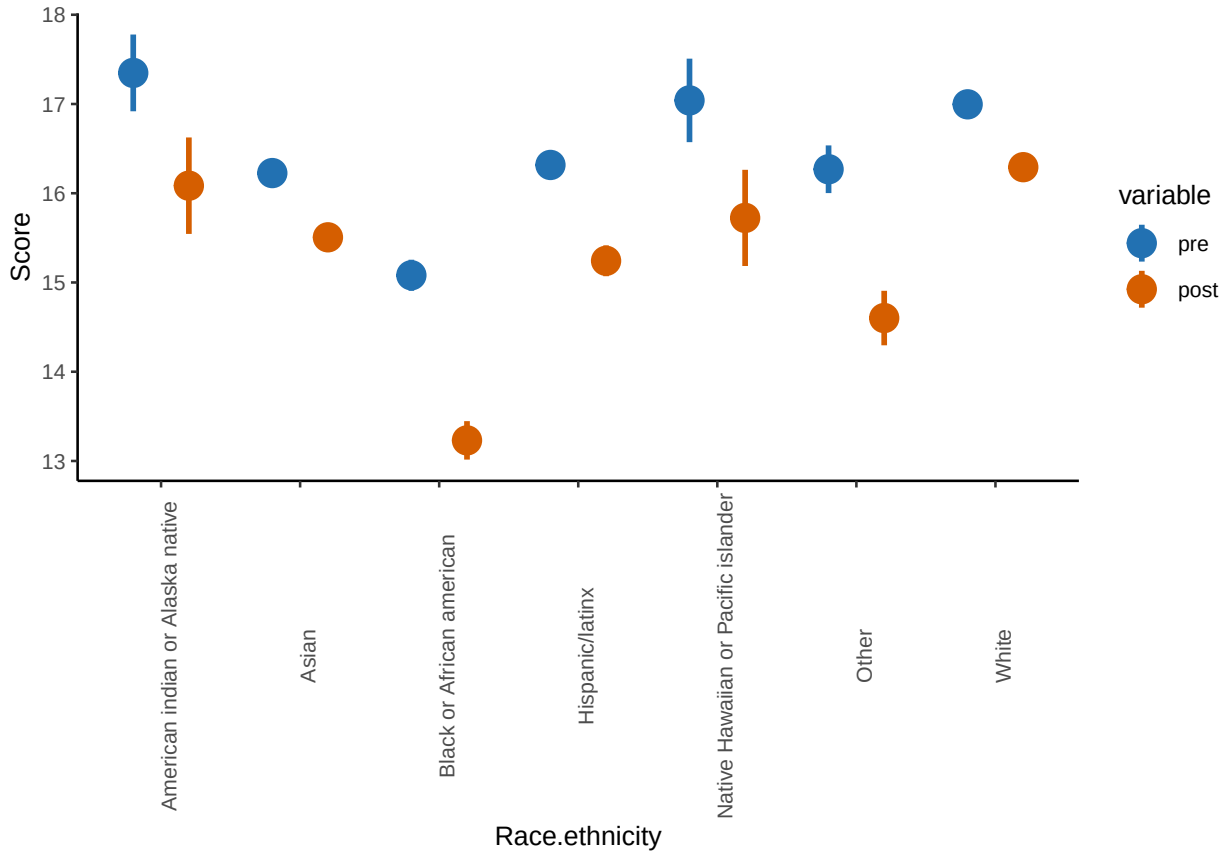

```
plot.pre.post(df.matched, 'Gender')
```

```
##
##   Man Other Woman
## 12470   246  9061
```



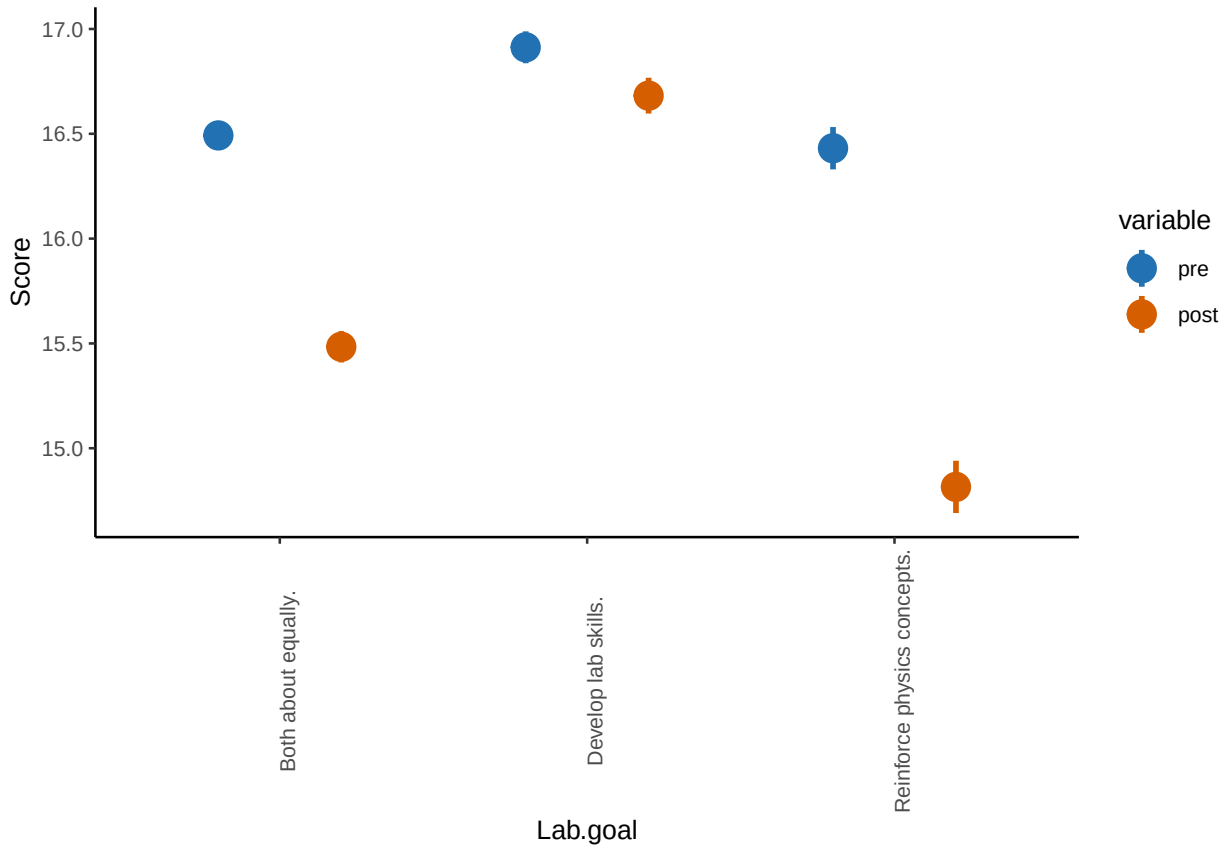

```
plot.pre.post(df.matched, 'Race.ethnicity')
```

```
##
##    American indian or Alaska native                            Asian
##                                 201                             4981
##           Black or African american                 Hispanic/latinx
##                                1360                             1808
## Native Hawaiian or Pacific islander                            Other
##                                 199                              625
##                               White
##                               12603
```




```
plot.pre.post(df.matched, 'Lab.goal')
```

```
##
##                                  Both about equally.
##                            0                    10300
##         Develop lab skills. Reinforce physics concepts.
##                         7545                     3932
```

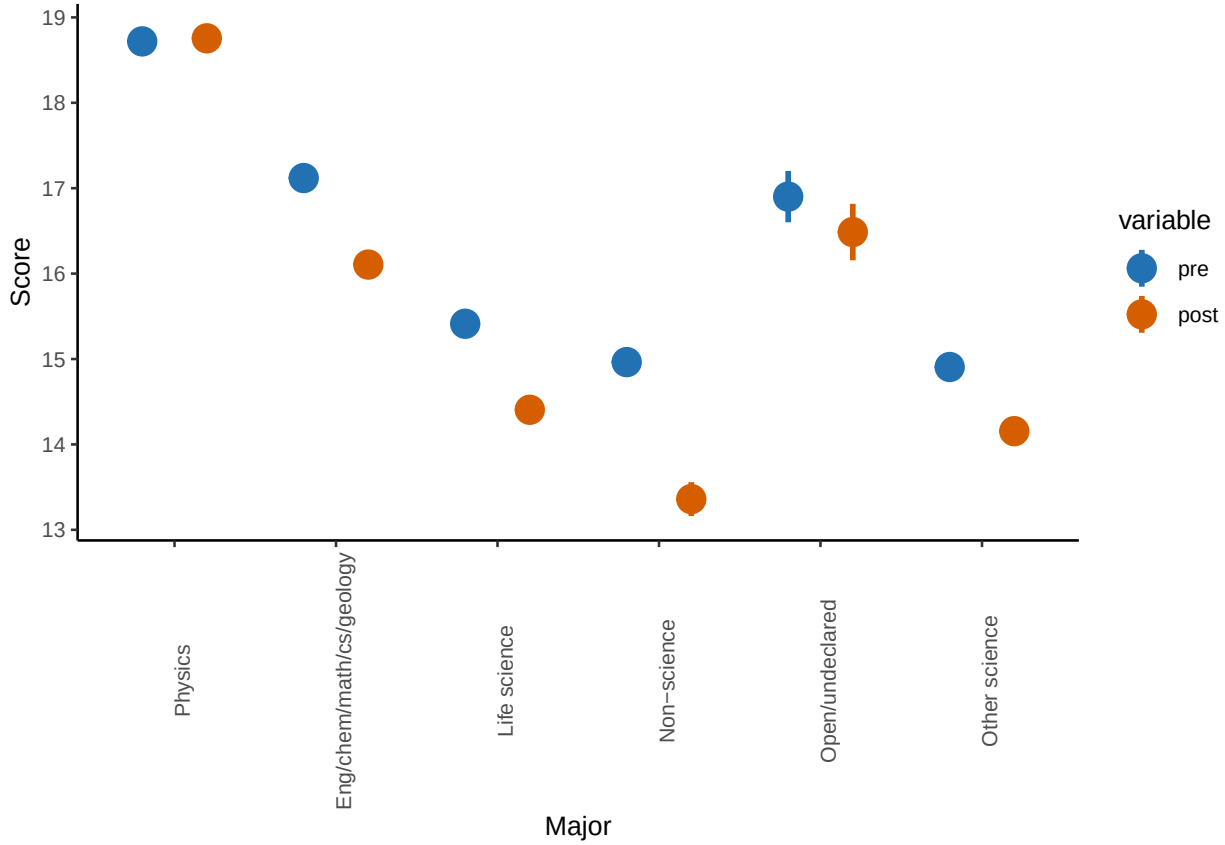


Collapse data

```
df.matched <- df.matched %>%
  mutate(Major = case_when(
    (Major == 'Physics') | (Major == 'Engineering Physics') | (Major == 'Astronomy') |
      (Major == 'Astrophysics') ~ 'Physics',
    (Major == 'Chemistry') | (Major == 'Engineering') | (Major == 'Geology/geophysics') |
      (Major == 'Math/applied math') | (Major == 'Computer science') ~ 'Eng/chem/math/cs/geology',
    (Major == 'Biochemistry') | (Major == 'Biology') |
      (Major == 'Physiology') ~ 'Life science',
    Major == 'Other science' ~ 'Other science',
    Major == 'Non-science' ~ 'Non-science',
    Major == 'Open/undeclared' ~ 'Open/undeclared',
  TRUE ~ NA_character_
  ),
  Race.ethnicity = case_when(
    (Race.ethnicity == 'American indian or Alaska native') |
      (Race.ethnicity == 'Native Hawaiian or Pacific islander') |
      (Race.ethnicity == 'Other') ~ 'Other',
    Race.ethnicity == 'Black or African american' ~ 'Black or African american',
    Race.ethnicity == 'Hispanic/latinx' ~ 'Hispanic/latinx',
    Race.ethnicity == 'Asian' ~ 'Asian',
    Race.ethnicity == 'White' ~ 'White',
```

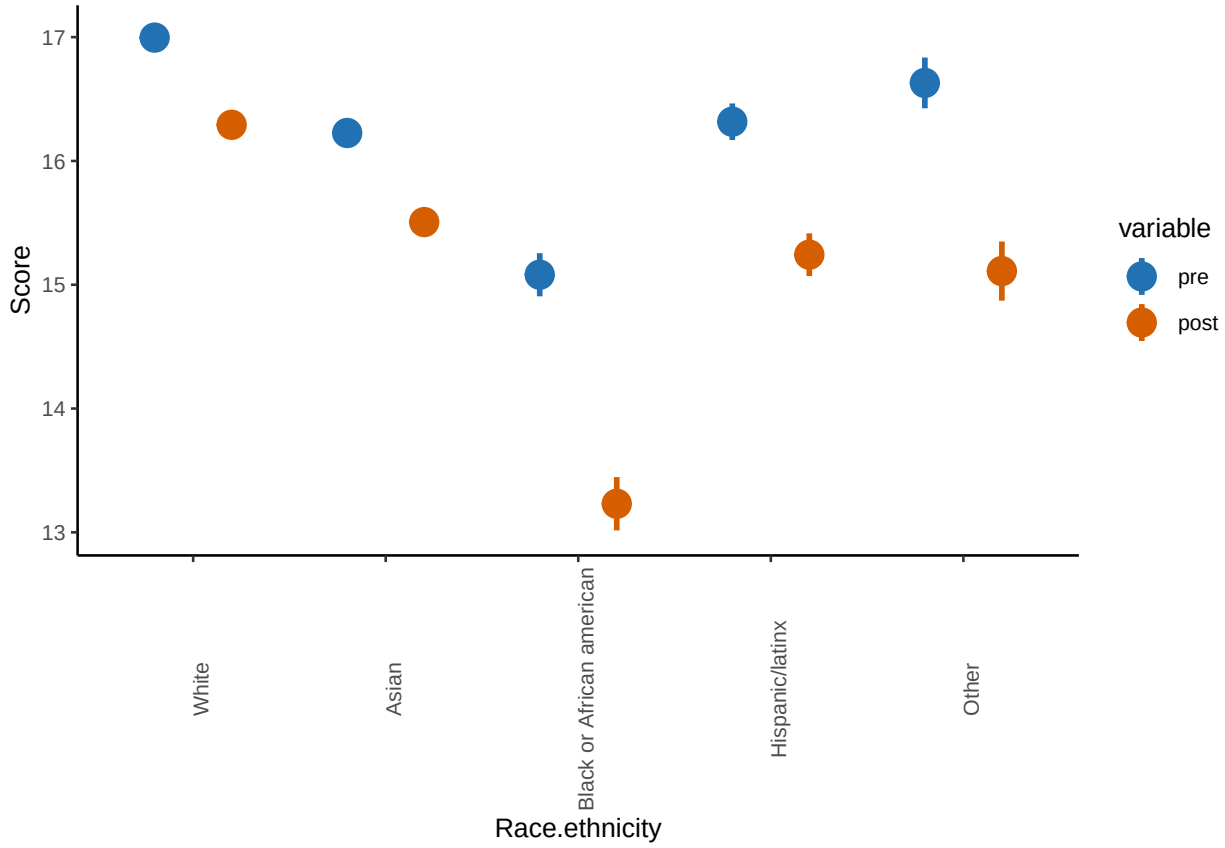
```
    TRUE ~ NA_character_
  )) %>%
  mutate(Major = relevel(as.factor(Major), ref = 'Physics'),
         Race.ethnicity = relevel(as.factor(Race.ethnicity), ref = 'White'),
         Gender = relevel(as.factor(Gender), ref = 'Man'),
         Lab.goal = relevel(Lab.goal, ref = 'Reinforce physics concepts.'))

plot.pre.post(df.matched, 'Major')
```

```
##
##                  Physics Eng/chem/math/cs/geology             Life science
##                     3373                     9745                     4121
##              Non-science          Open/undeclared          Other science
##                     1539                      436                     2563
```




```
plot.pre.post(df.matched, 'Race.ethnicity')
```

```
##
##                        White                        Asian
##                        12603                         4981
## Black or African american           Hispanic/latinx
##                         1360                         1808
##                        Other
##                         1025
```



Mixed-effects models

```
summary(lmer(student.score.post ~ student.score.pre + Lab.goal + Major +
               Gender + Race.ethnicity + (1 | ResponseId), df.matched))
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula:
## student.score.post ~ student.score.pre + Lab.goal + Major + Gender +
##     Race.ethnicity + (1 | ResponseId)
##    Data: df.matched
##
## REML criterion at convergence: 137854.8
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -6.3550 -0.5293  0.1169  0.6558  3.9039
##
## Random effects:
##  Groups     Name        Variance Std.Dev.
##  ResponseId (Intercept)  2.055   1.433
##  Residual               32.212   5.676
## Number of obs: 21777, groups:  ResponseId, 377
```

```
##
## Fixed effects:
##                                          Estimate Std. Error         df
## (Intercept)                             4.915e+00  2.838e-01  5.320e+02
## student.score.pre                       7.005e-01  6.185e-03  2.176e+04
## Lab.goalBoth about equally.             6.100e-01  2.652e-01  2.561e+02
## Lab.goalDevelop lab skills.             1.601e+00  2.951e-01  2.658e+02
## MajorEng/chem/math/cs/geology          -1.162e+00  1.366e-01  8.461e+03
## MajorLife science                      -1.631e+00  1.677e-01  6.384e+03
## MajorNon-science                       -2.387e+00  2.007e-01  1.170e+04
## MajorOpen/undeclared                   -6.091e-01  3.036e-01  2.041e+04
## MajorOther science                     -1.625e+00  1.842e-01  8.182e+03
## GenderOther                            -1.380e+00  3.705e-01  2.170e+04
## GenderWoman                            -4.030e-01  8.486e-02  2.176e+04
## Race.ethnicityAsian                     1.344e-01  1.024e-01  2.117e+04
## Race.ethnicityBlack or African american -6.825e-01  1.864e-01  1.619e+04
## Race.ethnicityHispanic/latinx          -2.706e-01  1.495e-01  2.168e+04
## Race.ethnicityOther                    -6.498e-01  1.873e-01  2.169e+04
##                                        t value Pr(>|t|)
## (Intercept)                             17.321  < 2e-16 ***
## student.score.pre                      113.269  < 2e-16 ***
## Lab.goalBoth about equally.              2.300 0.022261 *
## Lab.goalDevelop lab skills.              5.424 1.31e-07 ***
## MajorEng/chem/math/cs/geology           -8.506  < 2e-16 ***
## MajorLife science                       -9.730  < 2e-16 ***
## MajorNon-science                       -11.894  < 2e-16 ***
## MajorOpen/undeclared                    -2.006 0.044848 *
## MajorOther science                      -8.820  < 2e-16 ***
## GenderOther                             -3.724 0.000196 ***
## GenderWoman                             -4.749 2.05e-06 ***
## Race.ethnicityAsian                      1.313 0.189318
## Race.ethnicityBlack or African american -3.662 0.000251 ***
## Race.ethnicityHispanic/latinx           -1.810 0.070261 .
## Race.ethnicityOther                     -3.468 0.000525 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

##
## Correlation matrix not shown by default, as p = 15 > 12.
## Use print(x, correlation=TRUE)  or
##     vcov(x)        if you need it
```

```
summary(lmer(student.score.post ~ student.score.pre + Lab.goal * (Gender + Race.ethnicity)
             + Major + (1 | ResponseId), df.matched))
```

```
## Linear mixed model fit by REML. t-tests use Satterthwaite's method [
## lmerModLmerTest]
## Formula: student.score.post ~ student.score.pre + Lab.goal * (Gender +
##     Race.ethnicity) + Major + (1 | ResponseId)
##    Data: df.matched
##
## REML criterion at convergence: 137827
##
```

```
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -6.3671 -0.5287  0.1166  0.6560  3.8921
##
## Random effects:
##  Groups     Name        Variance Std.Dev.
##  ResponseId (Intercept)  2.018   1.420
##  Residual               32.192   5.674
## Number of obs: 21777, groups:  ResponseId, 377
##
## Fixed effects:
##                                                                  Estimate
## (Intercept)                                                     4.936e+00
## student.score.pre                                               7.006e-01
## Lab.goalBoth about equally.                                     6.362e-01
## Lab.goalDevelop lab skills.                                     1.486e+00
## GenderOther                                                    -2.310e+00
## GenderWoman                                                    -8.611e-01
## Race.ethnicityAsian                                             8.070e-01
## Race.ethnicityBlack or African american                        -4.002e-01
## Race.ethnicityHispanic/latinx                                   1.346e-01
## Race.ethnicityOther                                            -1.229e+00
## MajorEng/chem/math/cs/geology                                  -1.156e+00
## MajorLife science                                              -1.634e+00
## MajorNon-science                                               -2.394e+00
## MajorOpen/undeclared                                           -6.187e-01
## MajorOther science                                             -1.637e+00
## Lab.goalBoth about equally.:GenderOther                         7.344e-01
## Lab.goalDevelop lab skills.:GenderOther                         1.695e+00
## Lab.goalBoth about equally.:GenderWoman                         5.134e-01
## Lab.goalDevelop lab skills.:GenderWoman                         6.426e-01
## Lab.goalBoth about equally.:Race.ethnicityAsian                -8.298e-01
## Lab.goalDevelop lab skills.:Race.ethnicityAsian                -7.982e-01
## Lab.goalBoth about equally.:Race.ethnicityBlack or African american -2.741e-01
## Lab.goalDevelop lab skills.:Race.ethnicityBlack or African american -5.687e-01
## Lab.goalBoth about equally.:Race.ethnicityHispanic/latinx      -6.549e-01
## Lab.goalDevelop lab skills.:Race.ethnicityHispanic/latinx      -3.086e-01
## Lab.goalBoth about equally.:Race.ethnicityOther                 3.239e-01
## Lab.goalDevelop lab skills.:Race.ethnicityOther                 1.223e+00
##                                                                Std. Error
## (Intercept)                                                     3.103e-01
## student.score.pre                                               6.188e-03
## Lab.goalBoth about equally.                                     3.058e-01
## Lab.goalDevelop lab skills.                                     3.346e-01
## GenderOther                                                     8.548e-01
## GenderWoman                                                     1.906e-01
## Race.ethnicityAsian                                             2.481e-01
## Race.ethnicityBlack or African american                         3.459e-01
## Race.ethnicityHispanic/latinx                                   3.323e-01
## Race.ethnicityOther                                             4.764e-01
## MajorEng/chem/math/cs/geology                                   1.365e-01
## MajorLife science                                               1.676e-01
## MajorNon-science                                                2.005e-01
## MajorOpen/undeclared                                            3.035e-01
```

```
## MajorOther science                                                  1.841e-01
## Lab.goalBoth about equally.:GenderOther                             1.009e+00
## Lab.goalDevelop lab skills.:GenderOther                             1.068e+00
## Lab.goalBoth about equally.:GenderWoman                             2.256e-01
## Lab.goalDevelop lab skills.:GenderWoman                             2.388e-01
## Lab.goalBoth about equally.:Race.ethnicityAsian                     2.867e-01
## Lab.goalDevelop lab skills.:Race.ethnicityAsian                     3.067e-01
## Lab.goalBoth about equally.:Race.ethnicityBlack or African american 4.404e-01
## Lab.goalDevelop lab skills.:Race.ethnicityBlack or African american 5.175e-01
## Lab.goalBoth about equally.:Race.ethnicityHispanic/latinx           3.983e-01
## Lab.goalDevelop lab skills.:Race.ethnicityHispanic/latinx           4.214e-01
## Lab.goalBoth about equally.:Race.ethnicityOther                     5.451e-01
## Lab.goalDevelop lab skills.:Race.ethnicityOther                     5.732e-01
##                                                                            df
## (Intercept)                                                         7.087e+02
## student.score.pre                                                   2.175e+04
## Lab.goalBoth about equally.                                         4.295e+02
## Lab.goalDevelop lab skills.                                         4.201e+02
## GenderOther                                                         2.154e+04
## GenderWoman                                                         2.167e+04
## Race.ethnicityAsian                                                 2.133e+04
## Race.ethnicityBlack or African american                             4.351e+03
## Race.ethnicityHispanic/latinx                                       2.175e+04
## Race.ethnicityOther                                                 2.175e+04
## MajorEng/chem/math/cs/geology                                       8.457e+03
## MajorLife science                                                   6.337e+03
## MajorNon-science                                                    1.159e+04
## MajorOpen/undeclared                                                2.038e+04
## MajorOther science                                                  8.112e+03
## Lab.goalBoth about equally.:GenderOther                             2.161e+04
## Lab.goalDevelop lab skills.:GenderOther                             2.161e+04
## Lab.goalBoth about equally.:GenderWoman                             2.159e+04
## Lab.goalDevelop lab skills.:GenderWoman                             2.156e+04
## Lab.goalBoth about equally.:Race.ethnicityAsian                     2.119e+04
## Lab.goalDevelop lab skills.:Race.ethnicityAsian                     2.146e+04
## Lab.goalBoth about equally.:Race.ethnicityBlack or African american 8.479e+03
## Lab.goalDevelop lab skills.:Race.ethnicityBlack or African american 1.257e+04
## Lab.goalBoth about equally.:Race.ethnicityHispanic/latinx           2.171e+04
## Lab.goalDevelop lab skills.:Race.ethnicityHispanic/latinx           2.175e+04
## Lab.goalBoth about equally.:Race.ethnicityOther                     2.175e+04
## Lab.goalDevelop lab skills.:Race.ethnicityOther                     2.174e+04
##                                                                    t value
## (Intercept)                                                         15.907
## student.score.pre                                                  113.216
## Lab.goalBoth about equally.                                          2.081
## Lab.goalDevelop lab skills.                                          4.443
## GenderOther                                                         -2.702
## GenderWoman                                                         -4.517
## Race.ethnicityAsian                                                  3.253
## Race.ethnicityBlack or African american                             -1.157
## Race.ethnicityHispanic/latinx                                        0.405
## Race.ethnicityOther                                                 -2.580
## MajorEng/chem/math/cs/geology                                       -8.468
## MajorLife science                                                   -9.747
```

```
## MajorNon-science                                                  -11.942
## MajorOpen/undeclared                                               -2.039
## MajorOther science                                                 -8.893
## Lab.goalBoth about equally.:GenderOther                             0.728
## Lab.goalDevelop lab skills.:GenderOther                             1.587
## Lab.goalBoth about equally.:GenderWoman                             2.276
## Lab.goalDevelop lab skills.:GenderWoman                             2.691
## Lab.goalBoth about equally.:Race.ethnicityAsian                    -2.894
## Lab.goalDevelop lab skills.:Race.ethnicityAsian                    -2.602
## Lab.goalBoth about equally.:Race.ethnicityBlack or African american -0.622
## Lab.goalDevelop lab skills.:Race.ethnicityBlack or African american -1.099
## Lab.goalBoth about equally.:Race.ethnicityHispanic/latinx          -1.644
## Lab.goalDevelop lab skills.:Race.ethnicityHispanic/latinx          -0.732
## Lab.goalBoth about equally.:Race.ethnicityOther                     0.594
## Lab.goalDevelop lab skills.:Race.ethnicityOther                     2.133
##                                                                   Pr(>|t|)
## (Intercept)                                                        < 2e-16
## student.score.pre                                                  < 2e-16
## Lab.goalBoth about equally.                                        0.03806
## Lab.goalDevelop lab skills.                                       1.14e-05
## GenderOther                                                        0.00689
## GenderWoman                                                       6.31e-06
## Race.ethnicityAsian                                                0.00114
## Race.ethnicityBlack or African american                            0.24734
## Race.ethnicityHispanic/latinx                                      0.68543
## Race.ethnicityOther                                                0.00987
## MajorEng/chem/math/cs/geology                                      < 2e-16
## MajorLife science                                                  < 2e-16
## MajorNon-science                                                   < 2e-16
## MajorOpen/undeclared                                               0.04150
## MajorOther science                                                 < 2e-16
## Lab.goalBoth about equally.:GenderOther                            0.46659
## Lab.goalDevelop lab skills.:GenderOther                            0.11255
## Lab.goalBoth about equally.:GenderWoman                            0.02288
## Lab.goalDevelop lab skills.:GenderWoman                            0.00713
## Lab.goalBoth about equally.:Race.ethnicityAsian                    0.00381
## Lab.goalDevelop lab skills.:Race.ethnicityAsian                    0.00926
## Lab.goalBoth about equally.:Race.ethnicityBlack or African american 0.53374
## Lab.goalDevelop lab skills.:Race.ethnicityBlack or African american 0.27182
## Lab.goalBoth about equally.:Race.ethnicityHispanic/latinx          0.10014
## Lab.goalDevelop lab skills.:Race.ethnicityHispanic/latinx          0.46403
## Lab.goalBoth about equally.:Race.ethnicityOther                    0.55239
## Lab.goalDevelop lab skills.:Race.ethnicityOther                    0.03295
##
## (Intercept)                                                       ***
## student.score.pre                                                 ***
## Lab.goalBoth about equally.                                       *
## Lab.goalDevelop lab skills.                                       ***
## GenderOther                                                       **
## GenderWoman                                                       ***
## Race.ethnicityAsian                                               **
## Race.ethnicityBlack or African american
## Race.ethnicityHispanic/latinx
## Race.ethnicityOther                                               **
```

```
## MajorEng/chem/math/cs/geology                                    ***
## MajorLife science                                                ***
## MajorNon-science                                                 ***
## MajorOpen/undeclared                                             *
## MajorOther science                                               ***
## Lab.goalBoth about equally.:GenderOther
## Lab.goalDevelop lab skills.:GenderOther
## Lab.goalBoth about equally.:GenderWoman                          *
## Lab.goalDevelop lab skills.:GenderWoman                          **
## Lab.goalBoth about equally.:Race.ethnicityAsian                  **
## Lab.goalDevelop lab skills.:Race.ethnicityAsian                  **
## Lab.goalBoth about equally.:Race.ethnicityBlack or African american
## Lab.goalDevelop lab skills.:Race.ethnicityBlack or African american
## Lab.goalBoth about equally.:Race.ethnicityHispanic/latinx
## Lab.goalDevelop lab skills.:Race.ethnicityHispanic/latinx
## Lab.goalBoth about equally.:Race.ethnicityOther
## Lab.goalDevelop lab skills.:Race.ethnicityOther                  *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

##
## Correlation matrix not shown by default, as p = 27 > 12.
## Use print(x, correlation=TRUE)  or
##     vcov(x)        if you need it
```