Yu et al Psych Science - Data Analysis

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SAMPLE SIZES

TOTAL

- Young = 85
  - 39 female
  - 46 males
- Old = 66
  - 40 females
  - 26 males

LOOP:

- Young = 52
  - 25 females
  - 27 males
- Old = 56
  - 33 females
  - 23 males

MAZE:

- Young = 50
  - 26 females
  - 24 males
- Old = 39
  - 25 females
  - 14 males

DSP:

- Young = 54
  - 26 females
  - 28 males
- Old = 40
  - 19 females
  - 21 males

LOOP

Position Error

Length of the straight line distance between the actual start of the circle and where participants thought was the start of the circle.

Expressed in meters (m).

```r
#Read dataframe
df_loop <- read.csv("LOOP_ALL_2020_removed.csv")
names(df_loop)[1] <- "SubjectID"
df_loop$SubjectID <- as.factor(df_loop$SubjectID)
```

```r
#Load the data and show some random ros by groups
set.seed(123)
df_loop %>% sample_n_by(Group, Sex, size=1)
```

```
## # A tibble: 4 x 25
##   SubjectID Group   Age Sex   Status Radius Total_trials mean_dist1
##   <fct>     <fct> <int> <fct> <fct>   <int>        <int>      <dbl>
## 1 371       Midl~    46 Fema~ pre         1            8      0.709
## 2 359       Midl~    48 Male  men         1           10      1.19
## 3 86S       Young    18 Fema~ ""          1           10      0.472
## 4 75S       Young    18 Male  ""          1            6      0.618
## # ... with 17 more variables: mean_dist2 <dbl>, mean_dist3 <dbl>,
## #   pstd_dist1 <dbl>, pstd_dist2 <dbl>, pstd_dist3 <dbl>,
## #   mean_angl1 <dbl>, mean_angl2 <dbl>, mean_angl3 <dbl>,
## #   pstd_angl1 <dbl>, pstd_angl2 <dbl>, pstd_angl3 <dbl>,
## #   mean_degrees1 <dbl>, mean_degrees2 <dbl>, mean_degrees3 <dbl>,
## #   pstd_degrees1 <dbl>, pstd_degrees2 <dbl>, pstd_degrees3 <dbl>
```

```r
#Gather columns meandist1,2,3 into long format

#convert SubjectID into factor

df_loop <- df_loop %>%
  gather(key="Radius", value="PE", mean_dist1, mean_dist2, mean_dist3) %>%
  convert_as_factor(SubjectID, Radius)

#Inspect some random rows of the data by groups
set.seed(123)
df_loop %>% sample_n_by(Group, Sex, Radius, size=1)
```

```
## # A tibble: 12 x 23
##    SubjectID Group   Age Sex   Status Total_trials pstd_dist1 pstd_dist2
##    <fct>     <fct> <int> <fct> <fct>         <int>      <dbl>      <dbl>
##  1 371       Midl~    46 Fema~ pre               8      0.371      1.30
##  2 338       Midl~    54 Fema~ post              7      0.438      0.698
##  3 347       Midl~    49 Fema~ pre              10      0.298      0.386
##  4 357       Midl~    50 Male  men              10      0.279      0.816
##  5 321       Midl~    51 Male  men               2     NA          0.773
##  6 346       Midl~    55 Male  men               5      0.261      1.13
##  7 76S       Young    19 Fema~ ""               10      0.553      1.08
##  8 94S       Young    19 Fema~ ""               10      0.228      0.558
##  9 518       Young    18 Fema~ ""                8      0.340      0.471
## 10 516       Young    19 Male  ""               10      0.258      0.729
## 11 83S       Young    19 Male  ""                8      0.350      0.556
## 12 75S       Young    18 Male  ""                6      0.517      0.404
## # ... with 15 more variables: pstd_dist3 <dbl>, mean_angl1 <dbl>,
```

```
## #   mean_angl2 <dbl>, mean_angl3 <dbl>, pstd_angl1 <dbl>,
## #   pstd_angl2 <dbl>, pstd_angl3 <dbl>, mean_degrees1 <dbl>,
## #   mean_degrees2 <dbl>, mean_degrees3 <dbl>, pstd_degrees1 <dbl>,
## #   pstd_degrees2 <dbl>, pstd_degrees3 <dbl>, Radius <fct>, PE <dbl>
```

```
aov_pe <- anova_test(
  data=df_loop, dv=PE, wid=SubjectID,
  within=c(Radius),
  between=c(Group, Sex),
  effect.size = "pes"
  )
```

```
## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98,113,124,143,14
## Removing this rows before the analysis.
```

```
## Warning: The 'wid' column contains duplicate ids across between-subjects
## variables. Automatic unique id will be created
```

```
#get_anova_table(aov_pe)
aov_pe
```

```
## ANOVA Table (type III tests)
##
## $ANOVA
##             Effect DFn DFd       F         p p<.05   pes
## 1            Group   1  85   0.918 3.41e-01       0.011
## 2              Sex   1  85   2.840 9.60e-02       0.032
## 3           Radius   2 170 328.573 3.92e-59     * 0.794
## 4        Group:Sex   1  85   1.211 2.74e-01       0.014
## 5     Group:Radius   2 170   4.152 1.70e-02     * 0.047
## 6       Sex:Radius   2 170   7.127 1.00e-03     * 0.077
## 7 Group:Sex:Radius   2 170   2.675 7.20e-02       0.031
##
## $`Mauchly's Test for Sphericity`
##             Effect     W        p p<.05
## 1           Radius 0.711 6.05e-07     *
## 2     Group:Radius 0.711 6.05e-07     *
## 3       Sex:Radius 0.711 6.05e-07     *
## 4 Group:Sex:Radius 0.711 6.05e-07     *
##
## $`Sphericity Corrections`
##             Effect   GGe      DF[GG]    p[GG] p[GG]<.05   HFe       DF[HF]
## 1           Radius 0.776 1.55, 131.9 1.67e-46         * 0.788 1.58, 133.89
## 2     Group:Radius 0.776 1.55, 131.9 2.70e-02         * 0.788 1.58, 133.89
## 3       Sex:Radius 0.776 1.55, 131.9 3.00e-03         * 0.788 1.58, 133.89
## 4 Group:Sex:Radius 0.776 1.55, 131.9 8.60e-02           0.788 1.58, 133.89
##      p[HF] p[HF]<.05
## 1 3.63e-47         *
## 2 2.60e-02         *
## 3 3.00e-03         *
## 4 8.50e-02
```

```
library(apaTables)
```

```
## Warning: package 'apaTables' was built under R version 3.6.3
```

```
##
```

```
## Attaching package: 'apaTables'

## The following objects are masked from 'package:WRS2':
##
##     goggles, viagra
```

```r
get.ci.partial.eta.squared(5.46, 1, 36, conf.level = .95)
```

```
## $LL
## [1] 0
##
## $UL
## [1] 0.3328341
```

Post-hoc

Sex:Radius

```r
# Two-way ANOVA at each age group level
# Effect of Sex at each level of Radius
one.way <- df_loop %>%
  group_by(Radius) %>%
  anova_test(dv = PE, wid = SubjectID, between = Sex) %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98.
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects
## variables. Automatic unique id will be created

## Coefficient covariances computed by hccm()

## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98.
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects variables. Automatic unique

## Coefficient covariances computed by hccm()

## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98.
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects variables. Automatic unique

## Coefficient covariances computed by hccm()
```

```r
one.way
```

```
## # A tibble: 3 x 9
##   Radius     Effect   DFn   DFd     F     p `p<.05`   ges p.adj
##   <fct>      <chr>  <dbl> <dbl> <dbl> <dbl> <chr>   <dbl> <dbl>
## 1 mean_dist1 Sex        1    87 0.114 0.736 ""      0.001  1
## 2 mean_dist2 Sex        1    87 0.453 0.503 ""      0.005  1
## 3 mean_dist3 Sex        1    87 5.60  0.02  *       0.06   0.06
```

Group:Radius

```r
# Two-way ANOVA at each age group level
# Effect of Group at each level of Radius
one.way2 <- df_loop %>%
  group_by(Radius) %>%
  anova_test(dv = PE, wid = SubjectID, between = Group) %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98.
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects
## variables. Automatic unique id will be created

## Coefficient covariances computed by hccm()

## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98.
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects variables. Automatic unique

## Coefficient covariances computed by hccm()

## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98.
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects variables. Automatic unique

## Coefficient covariances computed by hccm()
```

```r
one.way2
```

```
## # A tibble: 3 x 9
##   Radius     Effect   DFn   DFd     F     p `p<.05`   ges p.adj
##   <fct>      <chr>  <dbl> <dbl> <dbl> <dbl> <chr>   <dbl> <dbl>
## 1 mean_dist1 Group      1    87 1.42  0.237 ""      0.016 0.711
## 2 mean_dist2 Group      1    87 0.123 0.727 ""      0.001 1
## 3 mean_dist3 Group      1    87 2.05  0.156 ""      0.023 0.468
```

Position Error Variability

```r
#Read dataframe
df_loop1.1 <- read.csv("LOOP_ALL_2020_removed.csv")
names(df_loop1.1)[1] <- "SubjectID"
```

```r
#Load the data and show some random ros by groups
set.seed(123)
df_loop1.1 %>% sample_n_by(Group, Sex, size=1)
```

```
## # A tibble: 4 x 25
##   SubjectID Group   Age Sex   Status Radius Total_trials mean_dist1
##   <fct>     <fct> <int> <fct> <fct>   <int>        <int>      <dbl>
## 1 371       Midl~    46 Fema~ pre         1            8      0.709
## 2 359       Midl~    48 Male  men         1           10      1.19
## 3 86S       Young    18 Fema~ ""          1           10      0.472
## 4 75S       Young    18 Male  ""          1            6      0.618
## # ... with 17 more variables: mean_dist2 <dbl>, mean_dist3 <dbl>,
## #   pstd_dist1 <dbl>, pstd_dist2 <dbl>, pstd_dist3 <dbl>,
```

```
## #   mean_angl1 <dbl>, mean_angl2 <dbl>, mean_angl3 <dbl>,
## #   pstd_angl1 <dbl>, pstd_angl2 <dbl>, pstd_angl3 <dbl>,
## #   mean_degrees1 <dbl>, mean_degrees2 <dbl>, mean_degrees3 <dbl>,
## #   pstd_degrees1 <dbl>, pstd_degrees2 <dbl>, pstd_degrees3 <dbl>
```

```r
#Gather columns meandist1,2,3 into long format

#convert SubjectID into factor

df_loop1.1 <- df_loop1.1 %>%
  gather(key="Radius", value="PE_pstd", pstd_dist1, pstd_dist2, pstd_dist3) %>%
  convert_as_factor(SubjectID, Radius)

#Inspect some random rows of the data by groups
set.seed(123)
df_loop1.1 %>% sample_n_by(Group, Sex, Radius, size=1)
```

```
## # A tibble: 12 x 23
##    SubjectID Group   Age Sex   Status Total_trials mean_dist1 mean_dist2
##    <fct>     <fct> <int> <fct> <fct>         <int>      <dbl>      <dbl>
##  1 371       Midl~    46 Fema~ pre               8      0.709      2.02
##  2 338       Midl~    54 Fema~ post              7      0.851      1.76
##  3 347       Midl~    49 Fema~ pre              10      0.427      0.842
##  4 357       Midl~    50 Male  men              10      0.735      2.11
##  5 321       Midl~    51 Male  men               2     NA          1.23
##  6 346       Midl~    55 Male  men               5      0.481      1.78
##  7 76S       Young    19 Fema~ ""               10      0.976      2.31
##  8 94S       Young    19 Fema~ ""               10      0.378      0.972
##  9 518       Young    18 Fema~ ""                8      0.861      1.10
## 10 516       Young    19 Male  ""               10      0.659      0.998
## 11 83S       Young    19 Male  ""                8      0.753      1.40
## 12 75S       Young    18 Male  ""                6      0.618      0.513
## # ... with 15 more variables: mean_dist3 <dbl>, mean_angl1 <dbl>,
## #   mean_angl2 <dbl>, mean_angl3 <dbl>, pstd_angl1 <dbl>,
## #   pstd_angl2 <dbl>, pstd_angl3 <dbl>, mean_degrees1 <dbl>,
## #   mean_degrees2 <dbl>, mean_degrees3 <dbl>, pstd_degrees1 <dbl>,
## #   pstd_degrees2 <dbl>, pstd_degrees3 <dbl>, Radius <fct>, PE_pstd <dbl>
```

```r
aov_pestd <- anova_test(
  data=df_loop1.1, dv=PE_pstd, wid=SubjectID,
  within=c(Radius),
  between=c(Group, Sex),
  effect.size = "pes"
  )
```

```
## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98,113,124,143,14
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects
## variables. Automatic unique id will be created
```

```r
#get_anova_table(aov_pe)
aov_pestd
```

```
## ANOVA Table (type III tests)
##
## $ANOVA
```

```
##              Effect DFn DFd       F        p p<.05      pes
## 1             Group   1  85   0.454 5.02e-01       0.005000
## 2               Sex   1  85   0.080 7.79e-01       0.000935
## 3            Radius   2 170 452.006 8.96e-69     * 0.842000
## 4         Group:Sex   1  85   2.306 1.33e-01       0.026000
## 5      Group:Radius   2 170   1.196 3.05e-01       0.014000
## 6        Sex:Radius   2 170   1.258 2.87e-01       0.015000
## 7 Group:Sex:Radius   2 170   1.031 3.59e-01       0.012000
##
## $`Mauchly's Test for Sphericity`
##              Effect     W     p p<.05
## 1            Radius 0.871 0.003     *
## 2      Group:Radius 0.871 0.003     *
## 3        Sex:Radius 0.871 0.003     *
## 4  Group:Sex:Radius 0.871 0.003     *
##
## $`Sphericity Corrections`
##              Effect   GGe       DF[GG]    p[GG] p[GG]<.05   HFe
## 1            Radius 0.886 1.77, 150.64 2.90e-61         * 0.904
## 2      Group:Radius 0.886 1.77, 150.64 3.02e-01           0.904
## 3        Sex:Radius 0.886 1.77, 150.64 2.85e-01           0.904
## 4  Group:Sex:Radius 0.886 1.77, 150.64 3.52e-01           0.904
##          DF[HF]    p[HF] p[HF]<.05
## 1 1.81, 153.61 2.04e-62         *
## 2 1.81, 153.61 3.02e-01
## 3 1.81, 153.61 2.85e-01
## 4 1.81, 153.61 3.53e-01
```

Degrees Traveled

```r
#Read dataframe
df_loop2 <- read.csv("LOOP_ALL_2020_removed.csv")
names(df_loop2)[1] <- "SubjectID"
```

```r
#Load the data and show some random ros by groups
set.seed(123)
df_loop2 %>% sample_n_by(Group, Sex, size=1)
```

```
## # A tibble: 4 x 25
##   SubjectID Group   Age Sex   Status Radius Total_trials mean_dist1
##   <fct>     <fct> <int> <fct> <fct>   <int>        <int>      <dbl>
## 1 371       Midl~    46 Fema~ pre         1            8      0.709
## 2 359       Midl~    48 Male  men         1           10      1.19
## 3 86S       Young    18 Fema~ ""          1           10      0.472
## 4 75S       Young    18 Male  ""          1            6      0.618
## # ... with 17 more variables: mean_dist2 <dbl>, mean_dist3 <dbl>,
## #   pstd_dist1 <dbl>, pstd_dist2 <dbl>, pstd_dist3 <dbl>,
## #   mean_angl1 <dbl>, mean_angl2 <dbl>, mean_angl3 <dbl>,
## #   pstd_angl1 <dbl>, pstd_angl2 <dbl>, pstd_angl3 <dbl>,
## #   mean_degrees1 <dbl>, mean_degrees2 <dbl>, mean_degrees3 <dbl>,
## #   pstd_degrees1 <dbl>, pstd_degrees2 <dbl>, pstd_degrees3 <dbl>
```

```r
#Gather columns meandegrees1,2,3 into long format

#convert SubjectID into factor
```

```r
df_loop2 <- df_loop2 %>%
  gather(key="Radius", value="DE", mean_degrees1, mean_degrees2, mean_degrees3) %>%
  convert_as_factor(SubjectID, Radius)

#Inspect some random rows of the data by groups
set.seed(123)
df_loop2 %>% sample_n_by(Group, Sex, Radius, size=1)
```

```
## # A tibble: 12 x 23
##    SubjectID Group   Age Sex   Status Total_trials mean_dist1 mean_dist2
##    <fct>     <fct> <int> <fct> <fct>         <int>      <dbl>      <dbl>
##  1 371       Midl~    46 Fema~ pre               8      0.709      2.02
##  2 338       Midl~    54 Fema~ post              7      0.851      1.76
##  3 347       Midl~    49 Fema~ pre              10      0.427      0.842
##  4 357       Midl~    50 Male  men              10      0.735      2.11
##  5 321       Midl~    51 Male  men               2     NA          1.23
##  6 346       Midl~    55 Male  men               5      0.481      1.78
##  7 76S       Young    19 Fema~ ""               10      0.976      2.31
##  8 94S       Young    19 Fema~ ""               10      0.378      0.972
##  9 518       Young    18 Fema~ ""                8      0.861      1.10
## 10 516       Young    19 Male  ""               10      0.659      0.998
## 11 83S       Young    19 Male  ""                8      0.753      1.40
## 12 75S       Young    18 Male  ""                6      0.618      0.513
## # ... with 15 more variables: mean_dist3 <dbl>, pstd_dist1 <dbl>,
## #   pstd_dist2 <dbl>, pstd_dist3 <dbl>, mean_angl1 <dbl>,
## #   mean_angl2 <dbl>, mean_angl3 <dbl>, pstd_angl1 <dbl>,
## #   pstd_angl2 <dbl>, pstd_angl3 <dbl>, pstd_degrees1 <dbl>,
## #   pstd_degrees2 <dbl>, pstd_degrees3 <dbl>, Radius <fct>, DE <dbl>
```

```r
aov_de <- anova_test(
  data=df_loop2, dv=DE, wid=SubjectID,
  within=c(Radius),
  between=c(Group, Sex),
  effect.size = "pes"
  )
```

```
## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98,113,124,143,14
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects
## variables. Automatic unique id will be created
```

```r
#get_anova_table(aov_de)
aov_de
```

```
## ANOVA Table (type III tests)
##
## $ANOVA
##             Effect DFn DFd     F        p p<.05   pes
## 1            Group   1  85 0.611 0.437000       0.007
## 2              Sex   1  85 5.816 0.018000     * 0.064
## 3           Radius   2 170 9.326 0.000144     * 0.099
## 4        Group:Sex   1  85 0.328 0.568000       0.004
## 5     Group:Radius   2 170 0.120 0.887000       0.001
```

```
## 6       Sex:Radius   2 170 1.165 0.315000       0.014
## 7 Group:Sex:Radius   2 170 2.066 0.130000       0.024
##
## $`Mauchly's Test for Sphericity`
##             Effect     W        p p<.05
## 1           Radius 0.637 6.03e-09     *
## 2     Group:Radius 0.637 6.03e-09     *
## 3       Sex:Radius 0.637 6.03e-09     *
## 4 Group:Sex:Radius 0.637 6.03e-09     *
##
## $`Sphericity Corrections`
##             Effect   GGe       DF[GG]    p[GG] p[GG]<.05   HFe       DF[HF]
## 1           Radius 0.734 1.47, 124.75 0.000722         * 0.744 1.49, 126.4
## 2     Group:Radius 0.734 1.47, 124.75 0.823000           0.744 1.49, 126.4
## 3       Sex:Radius 0.734 1.47, 124.75 0.303000           0.744 1.49, 126.4
## 4 Group:Sex:Radius 0.734 1.47, 124.75 0.144000           0.744 1.49, 126.4
##     p[HF] p[HF]<.05
## 1 0.00068         *
## 2 0.82600
## 3 0.30400
## 4 0.14300
```

Degrees Traveled Variability

```r
#Read dataframe
df_loop2.1 <- read.csv("LOOP_ALL_2020_removed.csv")
names(df_loop2.1)[1] <- "SubjectID"
```

```r
#Load the data and show some random ros by groups
set.seed(123)
df_loop2.1 %>% sample_n_by(Group, Sex, size=1)
```

```
## # A tibble: 4 x 25
##   SubjectID Group   Age Sex   Status Radius Total_trials mean_dist1
##   <fct>     <fct> <int> <fct> <fct>   <int>        <int>      <dbl>
## 1 371       Midl~    46 Fema~ pre         1            8      0.709
## 2 359       Midl~    48 Male  men         1           10      1.19
## 3 86S       Young    18 Fema~ ""          1           10      0.472
## 4 75S       Young    18 Male  ""          1            6      0.618
## # ... with 17 more variables: mean_dist2 <dbl>, mean_dist3 <dbl>,
## #   pstd_dist1 <dbl>, pstd_dist2 <dbl>, pstd_dist3 <dbl>,
## #   mean_angl1 <dbl>, mean_angl2 <dbl>, mean_angl3 <dbl>,
## #   pstd_angl1 <dbl>, pstd_angl2 <dbl>, pstd_angl3 <dbl>,
## #   mean_degrees1 <dbl>, mean_degrees2 <dbl>, mean_degrees3 <dbl>,
## #   pstd_degrees1 <dbl>, pstd_degrees2 <dbl>, pstd_degrees3 <dbl>
```

```r
#Gather columns meandegrees1,2,3 into long format

#convert SubjectID into factor


df_loop2.1 <- df_loop2.1 %>%
  gather(key="Radius", value="DE_pstd", pstd_degrees1, pstd_degrees2, pstd_degrees3) %>%
  convert_as_factor(SubjectID, Radius)
```

```r
#Inspect some random rows of the data by groups
set.seed(123)
df_loop2.1 %>% sample_n_by(Group, Sex, Radius, size=1)
```

```
## # A tibble: 12 x 23
##    SubjectID Group   Age Sex   Status Total_trials mean_dist1 mean_dist2
##    <fct>     <fct> <int> <fct> <fct>         <int>      <dbl>      <dbl>
##  1 371       Midl~    46 Fema~ pre               8      0.709      2.02
##  2 338       Midl~    54 Fema~ post              7      0.851      1.76
##  3 347       Midl~    49 Fema~ pre              10      0.427      0.842
##  4 357       Midl~    50 Male  men              10      0.735      2.11
##  5 321       Midl~    51 Male  men               2     NA          1.23
##  6 346       Midl~    55 Male  men               5      0.481      1.78
##  7 76S       Young    19 Fema~ ""               10      0.976      2.31
##  8 94S       Young    19 Fema~ ""               10      0.378      0.972
##  9 518       Young    18 Fema~ ""                8      0.861      1.10
## 10 516       Young    19 Male  ""               10      0.659      0.998
## 11 83S       Young    19 Male  ""                8      0.753      1.40
## 12 75S       Young    18 Male  ""                6      0.618      0.513
## # ... with 15 more variables: mean_dist3 <dbl>, pstd_dist1 <dbl>,
## #   pstd_dist2 <dbl>, pstd_dist3 <dbl>, mean_angl1 <dbl>,
## #   mean_angl2 <dbl>, mean_angl3 <dbl>, pstd_angl1 <dbl>,
## #   pstd_angl2 <dbl>, pstd_angl3 <dbl>, mean_degrees1 <dbl>,
## #   mean_degrees2 <dbl>, mean_degrees3 <dbl>, Radius <fct>, DE_pstd <dbl>
```

```r
aov_destd <- anova_test(
  data=df_loop2.1, dv=DE_pstd, wid=SubjectID,
  within=c(Radius),
  between=c(Group, Sex),
  effect.size = "pes"
  )
```

```
## Warning: NA detected in rows: 5,16,35,41,42,63,70,71,88,89,90,91,92,93,94,95,96,97,98,113,124,143,14
## Removing this rows before the analysis.

## Warning: The 'wid' column contains duplicate ids across between-subjects
## variables. Automatic unique id will be created
```

```r
#get_anova_table(aov_de)
aov_destd
```

```
## ANOVA Table (type III tests)
##
## $ANOVA
##               Effect DFn DFd     F        p p<.05      pes
## 1              Group   1  85 0.008 0.929000       9.46e-05
## 2                Sex   1  85 1.667 0.200000       1.90e-02
## 3             Radius   2 170 9.287 0.000149     * 9.80e-02
## 4          Group:Sex   1  85 3.078 0.083000       3.50e-02
## 5       Group:Radius   2 170 1.473 0.232000       1.70e-02
## 6         Sex:Radius   2 170 0.576 0.563000       7.00e-03
## 7   Group:Sex:Radius   2 170 0.053 0.949000       6.19e-04
##
## $`Mauchly's Test for Sphericity`
##               Effect     W     p p<.05
## 1             Radius 0.955 0.147
```

```
## 2     Group:Radius 0.955 0.147
## 3       Sex:Radius 0.955 0.147
## 4 Group:Sex:Radius 0.955 0.147
##
## $`Sphericity Corrections`
##             Effect   GGe       DF[GG]    p[GG] p[GG]<.05   HFe
## 1           Radius 0.957 1.91, 162.73 0.000192         * 0.979
## 2     Group:Radius 0.957 1.91, 162.73 0.233000           0.979
## 3       Sex:Radius 0.957 1.91, 162.73 0.556000           0.979
## 4 Group:Sex:Radius 0.957 1.91, 162.73 0.943000           0.979
##         DF[HF]    p[HF] p[HF]<.05
## 1 1.96, 166.39 0.000169         *
## 2 1.96, 166.39 0.233000
## 3 1.96, 166.39 0.560000
## 4 1.96, 166.39 0.946000
```

MAZE

```r
df_maze <- read.csv("MAZE_ALL_2020.csv")
```

Test against Chance Level

```r
#Young female
df_maze_yf <- df_maze %>% filter(Group == "Young" & Sex == "Female")
t.test(df_maze_yf$AvgAccuracy, mu=.1111, alternative="greater", conf.level=0.95)
```

```
##
##  One Sample t-test
##
## data:  df_maze_yf$AvgAccuracy
## t = 3.3816, df = 25, p-value = 0.001186
## alternative hypothesis: true mean is greater than 0.1111
## 95 percent confidence interval:
##  0.1647714       Inf
## sample estimates:
## mean of x
## 0.2195538
```

```r
mean(df_maze_yf$AvgAccuracy)
```

```
## [1] 0.2195538
```

```r
sd(df_maze_yf$AvgAccuracy)
```

```
## [1] 0.1635327
```

```r
CI(df_maze_yf$AvgAccuracy, ci = 0.95)
```

```
##     upper      mean     lower
## 0.2856061 0.2195538 0.1535015
```

```r
#Cohen's d: (mean - mu)/sd
(mean(df_maze_yf$AvgAccuracy) - .1111)/sd(df_maze_yf$AvgAccuracy)
```

```
## [1] 0.6631935
```

```r
cohen.d.ci((mean(df_maze_yf$AvgAccuracy) - .1111)/sd(df_maze_yf$AvgAccuracy),
           n1=26, alpha = 0.05)
```

```
##          lower    effect    upper
## [1,] 0.2321136 0.6631935 1.083447
```

```r
#Young male
df_maze_ym <- df_maze %>% filter(Group == "Young" & Sex == "Male")
t.test(df_maze_ym$AvgAccuracy, mu=.1111, alternative="greater", conf.level=0.95)
```

```
##
##  One Sample t-test
##
## data:  df_maze_ym$AvgAccuracy
## t = 8.7169, df = 23, p-value = 4.769e-09
## alternative hypothesis: true mean is greater than 0.1111
## 95 percent confidence interval:
##  0.5586763       Inf
## sample estimates:
## mean of x
## 0.6682125
```

```r
mean(df_maze_ym$AvgAccuracy)
```

```
## [1] 0.6682125
```

```r
sd(df_maze_ym$AvgAccuracy)
```

```
## [1] 0.3131015
```

```r
CI(df_maze_ym$AvgAccuracy, ci = 0.95)
```

```
##     upper      mean     lower
## 0.8004237 0.6682125 0.5360013
```

```r
#Cohen's d: (mean - mu)/sd
(mean(df_maze_ym$AvgAccuracy) - .1111)/sd(df_maze_ym$AvgAccuracy)
```

```
## [1] 1.779335
```

```r
cohen.d.ci((mean(df_maze_ym$AvgAccuracy) - .1111)/sd(df_maze_ym$AvgAccuracy),
           n1=24, alpha = 0.05)
```

```
##         lower   effect    upper
## [1,] 1.122767 1.779335 2.420741
```

```r
#Midlife female
df_maze_mf <- df_maze %>% filter(Group == "Midlife" & Sex == "Female")
t.test(df_maze_mf$AvgAccuracy, mu=.1111, alternative="greater", conf.level=0.95)
```

```
##
##  One Sample t-test
##
## data:  df_maze_mf$AvgAccuracy
## t = -1.2721, df = 24, p-value = 0.8922
## alternative hypothesis: true mean is greater than 0.1111
## 95 percent confidence interval:
##  0.0577265       Inf
```

```
## sample estimates:
##  mean of x
## 0.08833867
```

```
mean(df_maze_mf$AvgAccuracy)
```

```
## [1] 0.08833867
```

```
sd(df_maze_mf$AvgAccuracy)
```

```
## [1] 0.08946311
```

```
CI(df_maze_mf$AvgAccuracy, ci = 0.95)
```

```
##      upper       mean      lower
## 0.12526722 0.08833867 0.05141011
```

```
#Cohen's d: (mean - mu)/sd
(mean(df_maze_mf$AvgAccuracy) - .1111)/sd(df_maze_mf$AvgAccuracy)
```

```
## [1] -0.2544214
```

```
cohen.d.ci((mean(df_maze_mf$AvgAccuracy) - .1111)/sd(df_maze_mf$AvgAccuracy),
            n1=25, alpha = 0.05)
```

```
##          lower     effect     upper
## [1,] -0.650345 -0.2544214 0.1466089
```

```
#Midlife male
df_maze_mm <- df_maze %>% filter(Group == "Midlife" & Sex == "Male")
t.test(df_maze_mm$AvgAccuracy, mu=.1111, alternative="greater", conf.level=0.95)
```

```
##
##  One Sample t-test
##
## data:  df_maze_mm$AvgAccuracy
## t = 1.8569, df = 13, p-value = 0.04306
## alternative hypothesis: true mean is greater than 0.1111
## 95 percent confidence interval:
##  0.117946      Inf
## sample estimates:
## mean of x
## 0.2589286
```

```
mean(df_maze_mm$AvgAccuracy)
```

```
## [1] 0.2589286
```

```
sd(df_maze_mm$AvgAccuracy)
```

```
## [1] 0.2978704
```

```
CI(df_maze_mm$AvgAccuracy, ci = 0.95)
```

```
##      upper       mean      lower
## 0.43091380 0.25892857 0.08694334
```

```
#Cohen's d: (mean - mu)/sd
(mean(df_maze_mm$AvgAccuracy) - .1111)/sd(df_maze_mm$AvgAccuracy)
```

```
## [1] 0.4962849
```

```r
cohen.d.ci((mean(df_maze_mm$AvgAccuracy) - .1111)/sd(df_maze_mm$AvgAccuracy),
            n1=14, alpha = 0.05)
```

```
##             lower    effect    upper
## [1,] -0.06890445 0.4962849 1.044746
```

Wayfinding Success / Accuracy

```r
options(contrasts=c("contr.sum", "contr.poly"))
interaction_acc <- aov(AvgAccuracy~Group*Sex, data = df_maze)
Anova(interaction_acc, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: AvgAccuracy
##             Sum Sq Df  F value    Pr(>F)
## (Intercept) 7.9627  1 158.5503 < 2.2e-16 ***
## Group       1.5251  1  30.3668 3.755e-07 ***
## Sex         2.0019  1  39.8602 1.192e-08 ***
## Group:Sex   0.4037  1   8.0374  0.005724 **
## Residuals   4.2689 85
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
acc <- Anova(interaction_acc, type="III")
anova_stats(acc)
```

```
##          term sumsq meansq df statistic p.value etasq partial.etasq
## 1 (Intercept) 7.963  7.963  1   158.550   0.000 0.493         0.651
## 2       Group 1.525  1.525  1    30.367   0.000 0.094         0.263
## 3         Sex 2.002  2.002  1    39.860   0.000 0.124         0.319
## 4   Group:Sex 0.404  0.404  1     8.037   0.006 0.025         0.086
## 5   Residuals 4.269  0.050 85        NA      NA    NA            NA
##   omegasq partial.omegasq epsilonsq cohens.f power
## 1   0.488           0.636     0.490    1.366 1.000
## 2   0.091           0.246     0.091    0.598 1.000
## 3   0.120           0.302     0.121    0.685 1.000
## 4   0.022           0.073     0.022    0.308 0.809
## 5      NA              NA        NA       NA    NA
```

```r
#Based on bootstrapping
eta_sq(acc, partial = TRUE, ci.lvl = .95,
       n = 1000, method = "quantile")
```

```
##          term partial.etasq conf.low conf.high
## 1 (Intercept)         0.651    0.527     0.729
## 2       Group         0.263    0.115     0.401
## 3         Sex         0.319    0.163     0.452
## 4   Group:Sex         0.086    0.008     0.212
```

Post-hoc

```r
# Effect of treatment at each level of Group
df_maze %>%
  group_by(Group) %>%
```

```r
  anova_test(AvgAccuracy ~ Sex,
             type = "III",
             effect.size = "pes") %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Coefficient covariances computed by hccm()
## Coefficient covariances computed by hccm()

## # A tibble: 2 x 9
##   Group   Effect   DFn   DFd     F            p `p<.05`   pes       p.adj
##   <fct>   <chr>  <dbl> <dbl> <dbl>        <dbl> <chr>   <dbl>       <dbl>
## 1 Midlife Sex        1    37  7.18 0.011        *       0.163 0.022
## 2 Young   Sex        1    48 41.2  0.0000000565 *       0.462 0.000000113
```

```r
#Cohen's d

df_maze_midlife <- df_maze %>% filter(Group == "Midlife")
df_maze_young <- df_maze %>% filter(Group == "Young")
df_maze_female <- df_maze %>% filter(Sex == "Female")
df_maze_male <- df_maze %>% filter(Sex == "Male")

#Effect of Sex on Midlife
cohen.d(AvgAccuracy ~ Sex, group=Group, data=df_maze_midlife,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: -0.8945541 (large)
## 95 percent confidence interval:
##      lower      upper
## -1.6013669 -0.1877414
```

```r
#Effect of Sex on Young
cohen.d(AvgAccuracy ~ Sex, group=Group, data=df_maze_young,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: -1.818018 (large)
## 95 percent confidence interval:
##     lower     upper
## -2.494441 -1.141596
```

```r
mean(df_maze_midlife$AvgAccuracy)
```

```
## [1] 0.1495761
```

```r
sd(df_maze_midlife$AvgAccuracy)
```

```
## [1] 0.2056247
```

```r
CI(df_maze_midlife$AvgAccuracy, ci = 0.95)
```

```
##      upper       mean      lower
## 0.21623188 0.14957607 0.08292026
```

```r
mean(df_maze_young$AvgAccuracy)
```

```
## [1] 0.43491
```

```r
sd(df_maze_young$AvgAccuracy)
```

```
## [1] 0.3330588
```

```r
CI(df_maze_young$AvgAccuracy, ci = 0.95)
```

```
##     upper      mean     lower
## 0.5295643 0.4349100 0.3402557
```

```r
# Effect of treatment at each level of Sex
df_maze %>%
  group_by(Sex) %>%
  anova_test(AvgAccuracy ~ Group,
             type = "III",
             effect.size = "pes") %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Coefficient covariances computed by hccm()
## Coefficient covariances computed by hccm()
```

```
## # A tibble: 2 x 9
##   Sex    Effect   DFn   DFd     F        p `p<.05`   pes    p.adj
##   <fct>  <chr>  <dbl> <dbl> <dbl>    <dbl> <chr>   <dbl>    <dbl>
## 1 Female Group      1    49  12.5 0.000903 *       0.203 0.00181
## 2 Male   Group      1    36  15.6 0.000343 *       0.303 0.000686
```

```r
#Effect of Age on Female
cohen.d(AvgAccuracy ~ Group, group=Sex, data=df_maze_female,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: -0.9900701 (large)
## 95 percent confidence interval:
##      lower      upper
## -1.5864494 -0.3936909
```

```r
#Effect of Age on Male
cohen.d(AvgAccuracy ~ Group, group=Sex, data=df_maze_male,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: -1.33019 (large)
## 95 percent confidence interval:
##     lower     upper
## -2.079149 -0.581230
```

```r
mean(df_maze_female$AvgAccuracy)
```

```
## [1] 0.1552327
```

```r
sd(df_maze_female$AvgAccuracy)
```

```
## [1] 0.1469761
```

```r
CI(df_maze_female$AvgAccuracy, ci = 0.95)
```

```
##     upper      mean     lower
## 0.1965704 0.1552327 0.1138950
```

```r
mean(df_maze_male$AvgAccuracy)
```

```
## [1] 0.5174237
```

```r
sd(df_maze_male$AvgAccuracy)
```

```
## [1] 0.3635176
```

```r
CI(df_maze_male$AvgAccuracy, ci = 0.95)
```

```
##     upper      mean     lower
## 0.6369090 0.5174237 0.3979384
```

Moves

Correlation

```r
#95% CI here is for the estimate (correlation)
cor.test(df_maze$Moves, df_maze$AvgAccuracy, method="pearson")
```

```
##
##  Pearson's product-moment correlation
##
## data:  df_maze$Moves and df_maze$AvgAccuracy
## t = 3.3184, df = 87, p-value = 0.001323
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.1364572 0.5079852
## sample estimates:
##       cor
## 0.3351885
```

```r
#needs alternative and conf level
cor.test(df_maze$Moves, df_maze$AvgAccuracy, method="pearson",
         alternative="two.sided", conf.level = .95)
```

```
##
##  Pearson's product-moment correlation
##
## data:  df_maze$Moves and df_maze$AvgAccuracy
## t = 3.3184, df = 87, p-value = 0.001323
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.1364572 0.5079852
## sample estimates:
##       cor
## 0.3351885
```

Mean and SD

```r
describe.by(df_maze$Moves)
```

```
## Warning: describe.by is deprecated. Please use the describeBy function

## Warning in describeBy(x = x, group = group, mat = mat, type = type, ...):
## no grouping variable requested

##    vars  n   mean    sd median trimmed   mad min max range  skew kurtosis
## X1    1 89 268.08 39.94    273   269.7 45.96 185 345   160 -0.32    -0.92
##      se
## X1 4.23
```

```r
#95% CI for mean
CI(df_maze$Moves, ci = 0.95)
```

```
##    upper     mean    lower
## 276.4911 268.0787 259.6662
```

```r
#By Groups: Young vs Midlife
mean(df_maze_young$Moves)
```

```
## [1] 286.14
```

```r
sd(df_maze_young$Moves)
```

```
## [1] 31.90868
```

```r
CI(df_maze_young$Moves, ci = 0.95)
```

```
##    upper     mean    lower
## 295.2083 286.1400 277.0717
```

```r
mean(df_maze_midlife$Moves)
```

```
## [1] 244.9231
```

```r
sd(df_maze_midlife$Moves)
```

```
## [1] 37.4281
```

```r
CI(df_maze_midlife$Moves, ci = 0.95)
```

```
##    upper     mean    lower
## 257.0559 244.9231 232.7903
```

```r
#By Sex: Female vs Male
mean(df_maze_female$Moves)
```

```
## [1] 262.4314
```

```r
sd(df_maze_female$Moves)
```

```
## [1] 39.07391
```

```r
CI(df_maze_female$Moves, ci = 0.95)
```

```
##    upper     mean    lower
## 273.4211 262.4314 251.4417
```

```r
mean(df_maze_male$Moves)
```

```
## [1] 275.6579
```

```r
sd(df_maze_male$Moves)
```

```
## [1] 40.33527
```

```r
CI(df_maze_male$Moves, ci = 0.95)
```

```
##    upper     mean    lower 
## 288.9158 275.6579 262.4000
```

ANOVA

```r
options(contrasts=c("contr.sum", "contr.poly"))
interaction_moves <- aov(Moves~Group*Sex, data = df_maze)
Anova(interaction_moves, type="III")
```

```
## Anova Table (Type III tests)
## 
## Response: Moves
##              Sum Sq Df   F value    Pr(>F)    
## (Intercept) 5937593  1 4998.9636 < 2.2e-16 ***
## Group         32057  1   26.9895 1.383e-06 ***
## Sex            1790  1    1.5070    0.2230    
## Group:Sex       674  1    0.5675    0.4533    
## Residuals    100960 85                        
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
moves1 <- Anova(interaction_moves, type="III")
anova_stats(moves1)
```

```
##          term       sumsq      meansq df statistic p.value etasq
## 1 (Intercept) 5937592.884 5937592.884  1  4998.964   0.000 0.978
## 2       Group   32057.189   32057.189  1    26.990   0.000 0.005
## 3         Sex    1789.947    1789.947  1     1.507   0.223 0.000
## 4   Group:Sex     674.054     674.054  1     0.567   0.453 0.000
## 5   Residuals  100960.006    1187.765 85        NA      NA    NA
##   partial.etasq omegasq partial.omegasq epsilonsq cohens.f power
## 1         0.983   0.977           0.982     0.977    7.669 1.000
## 2         0.241   0.005           0.224     0.005    0.563 0.999
## 3         0.017   0.000           0.006     0.000    0.133 0.233
## 4         0.007   0.000          -0.005     0.000    0.082 0.117
## 5            NA      NA              NA        NA       NA    NA
```

```r
#Based on bootstrapping
eta_sq(moves1, partial = TRUE, ci.lvl = .95,
       n = 1000, method = "quantile")
```

```
##          term partial.etasq conf.low conf.high
## 1 (Intercept)         0.983    0.976     0.987
## 2       Group         0.241    0.098     0.379
## 3         Sex         0.017    0.000     0.105
## 4   Group:Sex         0.007    0.000     0.078
```

ANCOVA

On Wayfinding Success/Accuracy controlling for Moves

```r
options(contrasts=c("contr.sum", "contr.poly"))
interaction_acc2 <- aov(AvgAccuracy~Moves + Group*Sex, data = df_maze)
Anova(interaction_acc2, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: AvgAccuracy
##             Sum Sq Df F value    Pr(>F)
## (Intercept) 0.0192  1  0.3832  0.537590
## Moves       0.0520  1  1.0364  0.311585
## Group       0.9291  1 18.5084 4.545e-05 ***
## Sex         1.8834  1 37.5185 2.804e-08 ***
## Group:Sex   0.4248  1  8.4630  0.004637 **
## Residuals   4.2168 84
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
acc2 <-Anova(interaction_acc2, type="III")
anova_stats(acc2)
```

```
##          term sumsq meansq df statistic p.value etasq partial.etasq
## 1 (Intercept) 0.019  0.019  1     0.383   0.538 0.003         0.005
## 2       Moves 0.052  0.052  1     1.036   0.312 0.007         0.012
## 3       Group 0.929  0.929  1    18.508   0.000 0.123         0.181
## 4         Sex 1.883  1.883  1    37.518   0.000 0.250         0.309
## 5   Group:Sex 0.425  0.425  1     8.463   0.005 0.056         0.092
## 6   Residuals 4.217  0.050 84        NA      NA    NA            NA
##   omegasq partial.omegasq epsilonsq cohens.f power
## 1  -0.004          -0.007    -0.004    0.068 0.095
## 2   0.000           0.000     0.000    0.111 0.175
## 3   0.116           0.163     0.117    0.469 0.990
## 4   0.242           0.289     0.244    0.668 1.000
## 5   0.049           0.077     0.050    0.317 0.829
## 6      NA              NA        NA       NA    NA
```

```r
#Based on bootstrapping
eta_sq(acc2, partial = TRUE, ci.lvl = .95,
       n = 1000, method = "quantile")
```

```
##          term partial.etasq conf.low conf.high
## 1 (Intercept)         0.005    0.000     0.071
## 2       Moves         0.012    0.000     0.094
## 3       Group         0.181    0.054     0.320
## 4         Sex         0.309    0.153     0.443
## 5   Group:Sex         0.092    0.009     0.219
```

Post-hoc effect sizes with adjusted means

```r
#Adjusted means of wayfinding with associated 95%CI and SE
#Adjusted for the effect of the covariate Moves
adjustedmeans <- effect("Group*Sex", interaction_acc2, se=T)
summary(adjustedmeans)
```

```
##
##  Group*Sex effect
```

```
##          Sex
## Group        Female      Male
##   Midlife 0.1088111 0.2686762
##   Young   0.2078208 0.6539117
##
##  Lower 95 Percent Confidence Limits
##          Sex
## Group         Female      Male
##   Midlife 0.01113781 0.1480834
##   Young   0.11748420 0.5587694
##
##  Upper 95 Percent Confidence Limits
##          Sex
## Group        Female      Male
##   Midlife 0.2064844 0.3892689
##   Young   0.2981574 0.7490540
```

```
adjustedmeans$se
```

```
## [1] 0.04911638 0.04542702 0.06064174 0.04784363
```

SE order = midlife female, midlife male, young female, young male

```
#Adjusted SD from adjusted means for Group*Sex
adjustedmeans$se*sqrt(c(25, 14, 26, 24))
```

```
## [1] 0.2455819 0.1699723 0.3092134 0.2343850
```

```
#Effect size and CI for Simple efect of Sex - Midlife (midlife women and men)

#Effect sizes for the difference between midlife women and men
mes( 0.1088111, 0.2686762, 0.2455819, 0.1699723, 25, 14)
```

```
## Mean Differences ES:
##
##  d [ 95 %CI] = -0.72 [ -1.42 , -0.02 ]
##   var(d) = 0.12
##   p-value(d) = 0.04
##   U3(d) = 23.57 %
##   CLES(d) = 30.53 %
##   Cliff's Delta = -0.39
##
##  g [ 95 %CI] = -0.71 [ -1.39 , -0.02 ]
##   var(g) = 0.11
##   p-value(g) = 0.04
##   U3(g) = 24.02 %
##   CLES(g) = 30.89 %
##
##  Correlation ES:
##
##  r [ 95 %CI] = -0.33 [ -0.59 , 0 ]
##   var(r) = 0.02
##   p-value(r) = 0.05
##
##  z [ 95 %CI] = -0.34 [ -0.68 , 0 ]
##   var(z) = 0.03
##   p-value(z) = 0.05
```

```
##
##  Odds Ratio ES:
##
##  OR [ 95 %CI] = 0.27 [ 0.08 , 0.96 ]
##   p-value(OR) = 0.04
##
##  Log OR [ 95 %CI] = -1.31 [ -2.57 , -0.04 ]
##   var(lOR) = 0.39
##   p-value(Log OR) = 0.04
##
##  Other:
##
##  NNT = -7.1
##  Total N = 39
```

```
#Effect size and CI for Simple efect of Sex - Young (young women and men)

#Effect sizes for the difference between young women and men
mes( 0.2078208, 0.6539117, 0.3092134, 0.2343850, 26, 24)
```

```
## Mean Differences ES:
##
##  d [ 95 %CI] = -1.62 [ -2.27 , -0.96 ]
##   var(d) = 0.11
##   p-value(d) = 0
##   U3(d) = 5.3 %
##   CLES(d) = 12.65 %
##   Cliff's Delta = -0.75
##
##  g [ 95 %CI] = -1.59 [ -2.24 , -0.95 ]
##   var(g) = 0.1
##   p-value(g) = 0
##   U3(g) = 5.58 %
##   CLES(g) = 13.02 %
##
##  Correlation ES:
##
##  r [ 95 %CI] = -0.63 [ -0.77 , -0.42 ]
##   var(r) = 0.01
##   p-value(r) = 0
##
##  z [ 95 %CI] = -0.74 [ -1.03 , -0.45 ]
##   var(z) = 0.02
##   p-value(z) = 0
##
##  Odds Ratio ES:
##
##  OR [ 95 %CI] = 0.05 [ 0.02 , 0.17 ]
##   p-value(OR) = 0
##
##  Log OR [ 95 %CI] = -2.93 [ -4.12 , -1.74 ]
##   var(lOR) = 0.35
##   p-value(Log OR) = 0
##
##  Other:
```

```
##
##  NNT = -5.18
##  Total N = 50
```

```r
#Effect size and CI for Simple efect of age - women (young and midlife women)

#Effect sizes for the difference between midlife and yong women
mes(0.1088111, 0.2078208, 0.2455819, 0.3092134, 25, 26)
```

```
## Mean Differences ES:
##
##  d [ 95 %CI] = -0.35 [ -0.92 , 0.21 ]
##   var(d) = 0.08
##   p-value(d) = 0.22
##   U3(d) = 36.18 %
##   CLES(d) = 40.12 %
##   Cliff's Delta = -0.2
##
##  g [ 95 %CI] = -0.35 [ -0.91 , 0.21 ]
##   var(g) = 0.08
##   p-value(g) = 0.22
##   U3(g) = 36.38 %
##   CLES(g) = 40.27 %
##
##  Correlation ES:
##
##  r [ 95 %CI] = -0.17 [ -0.43 , 0.11 ]
##   var(r) = 0.02
##   p-value(r) = 0.23
##
##  z [ 95 %CI] = -0.18 [ -0.47 , 0.11 ]
##   var(z) = 0.02
##   p-value(z) = 0.23
##
##  Odds Ratio ES:
##
##  OR [ 95 %CI] = 0.53 [ 0.19 , 1.47 ]
##   p-value(OR) = 0.22
##
##  Log OR [ 95 %CI] = -0.64 [ -1.67 , 0.39 ]
##   var(lOR) = 0.26
##   p-value(Log OR) = 0.22
##
##  Other:
##
##  NNT = -11.9
##  Total N = 51
```

```r
#Effect size and CI for Simple efect of age - men (young and midlife men)

#Effect sizes for the difference between midlife and yong men
mes(0.2686762, 0.6539117, 0.1699723, 0.2343850, 14, 24)
```

```
## Mean Differences ES:
##
```

```
##  d [ 95 %CI] = -1.81 [ -2.61 , -1 ]
##   var(d) = 0.16
##   p-value(d) = 0
##   U3(d) = 3.55 %
##   CLES(d) = 10.09 %
##   Cliff's Delta = -0.8
##
##  g [ 95 %CI] = -1.77 [ -2.55 , -0.98 ]
##   var(g) = 0.15
##   p-value(g) = 0
##   U3(g) = 3.86 %
##   CLES(g) = 10.57 %
##
##  Correlation ES:
##
##  r [ 95 %CI] = -0.66 [ -0.81 , -0.42 ]
##   var(r) = 0.01
##   p-value(r) = 0
##
##  z [ 95 %CI] = -0.79 [ -1.13 , -0.44 ]
##   var(z) = 0.03
##   p-value(z) = 0
##
##  Odds Ratio ES:
##
##  OR [ 95 %CI] = 0.04 [ 0.01 , 0.16 ]
##   p-value(OR) = 0
##
##  Log OR [ 95 %CI] = -3.27 [ -4.73 , -1.82 ]
##   var(lOR) = 0.51
##   p-value(Log OR) = 0
##
##  Other:
##
##  NNT = -5.1
##  Total N = 38
```

Post-hoc

```r
# Effect of treatment at each level of Group
df_maze %>%
  group_by(Group) %>%
  anova_test(AvgAccuracy ~ Moves + Sex,
             type = "III",
             effect.size = "pes") %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Coefficient covariances computed by hccm()
## Coefficient covariances computed by hccm()
```

```
## # A tibble: 4 x 9
##   Group   Effect   DFn   DFd     F           p `p<.05`   pes       p.adj
##   <fct>   <chr>  <dbl> <dbl> <dbl>       <dbl> <chr>   <dbl>       <dbl>
## 1 Midlife Moves      1    36  4.77  0.035          *       0.117 0.14
```

```
## 2 Midlife Sex        1    36  5.46  0.025        *       0.132 0.1
## 3 Young   Moves      1    47  0.098 0.756        ""      0.002 1
## 4 Young   Sex        1    47 40.6   0.0000000741 *       0.463 0.000000296
```

```
# Pairwise comparisons at level of Group
pwc.cov1 <- df_maze %>%
  group_by(Group) %>%
  emmeans_test(
    AvgAccuracy ~ Sex, covariate = Moves,
    p.adjust.method = "bonferroni",
    detailed = TRUE
    )
pwc.cov1
```

```
## # A tibble: 2 x 13
##   Group .y.   group1 group2 estimate     se    df conf.low conf.high
## * <fct> <chr> <chr>  <chr>     <dbl>  <dbl> <dbl>    <dbl>     <dbl>
## 1 Midl~ AvgA~ Female Male     -0.160 0.0755    84   -0.310  -0.00967
## 2 Young AvgA~ Female Male     -0.446 0.0635    84   -0.572  -0.320
## # ... with 4 more variables: statistic <dbl>, p <dbl>, p.adj <dbl>,
## #   p.adj.signif <chr>
```

```
# Effect of treatment at each level of Sex
df_maze %>%
  group_by(Sex) %>%
  anova_test(AvgAccuracy ~ Moves + Group,
             type="III",
             effect.size = "pes")  %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Coefficient covariances computed by hccm()
## Coefficient covariances computed by hccm()
```

```
## # A tibble: 4 x 9
##   Sex    Effect   DFn   DFd      F     p `p<.05`   pes p.adj
##   <fct>  <chr>  <dbl> <dbl>  <dbl> <dbl> <chr>   <dbl> <dbl>
## 1 Female Moves      1    48  1.41  0.241 ""      0.029 0.964
## 2 Female Group      1    48  4.86  0.032 *       0.092 0.128
## 3 Male   Moves      1    35  0.285 0.597 ""      0.008 1
## 4 Male   Group      1    35 11.3   0.002 *       0.244 0.008
```

```
# Pairwise comparisons at level of Sex
pwc.cov2 <- df_maze %>%
  group_by(Sex) %>%
  emmeans_test(
    AvgAccuracy_Percent ~ Group, covariate = Moves,
    p.adjust.method = "bonferroni"
    )
pwc.cov2
```

```
## # A tibble: 2 x 9
##   Sex    .y.     group1 group2    df statistic       p   p.adj p.adj.signif
## * <fct>  <chr>   <chr>  <chr>  <dbl>     <dbl>   <dbl>   <dbl> <chr>
## 1 Female AvgAcc~ Midli~ Young     84     -1.41 1.63e-1 1.63e-1 ns
## 2 Male   AvgAcc~ Midli~ Young     84     -4.88 5.01e-6 5.01e-6 ****
```

DSP

Solution Index

Propensity (proportion) or preference to take more shortcuts (range is 0-1); expressed in %

More likely to take shortcuts = >0.50

Less likely to take shortcuts = <0.50

Formula: (# of STRICT shortcuts/# of successful trials)

```r
#Read dataframe
df_dsp <- read.csv("DSP_ALL_2020_removed.csv")
```

```r
options(contrasts=c("contr.sum", "contr.poly"))
interaction_SI <- aov(SI_strict~Group*Sex, data = df_dsp)
Anova(interaction_SI, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: SI_strict
##             Sum Sq Df  F value    Pr(>F)
## (Intercept) 3.6479  1 228.7033 < 2.2e-16 ***
## Group       0.1249  1   7.8334  0.006274 **
## Sex         0.0580  1   3.6385  0.059646 .
## Group:Sex   0.1051  1   6.5912  0.011898 *
## Residuals   1.4355 90
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
aov_si <- Anova(interaction_SI, type="III")
anova_stats(aov_si)
```

```
##          term sumsq meansq df statistic p.value etasq partial.etasq
## 1 (Intercept) 3.648  3.648  1   228.703   0.000 0.679         0.718
## 2       Group 0.125  0.125  1     7.833   0.006 0.023         0.080
## 3         Sex 0.058  0.058  1     3.639   0.060 0.011         0.039
## 4   Group:Sex 0.105  0.105  1     6.591   0.012 0.020         0.068
## 5   Residuals 1.436  0.016 90        NA      NA    NA            NA
##   omegasq partial.omegasq epsilonsq cohens.f power
## 1   0.674           0.706     0.676    1.594 1.000
## 2   0.020           0.067     0.020    0.295 0.799
## 3   0.008           0.027     0.008    0.201 0.479
## 4   0.017           0.056     0.017    0.271 0.728
## 5      NA              NA        NA       NA    NA
```

```r
#Based on bootstrapping
eta_sq(aov_si, partial = TRUE, ci.lvl = .95,
       n = 1000, method = "quantile")
```

```
##          term partial.etasq conf.low conf.high
## 1 (Intercept)         0.718    0.616     0.780
```

```
## 2       Group          0.080    0.007     0.200
## 3         Sex          0.039    0.000     0.141
## 4   Group:Sex          0.068    0.003     0.184
```

Post-hoc

```r
# Effect of treatment at each level of Group
df_dsp %>%
  group_by(Group) %>%
  anova_test(SI_strict ~ Sex,
             type = "III",
             effect.size = "pes") %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Coefficient covariances computed by hccm()
## Coefficient covariances computed by hccm()
```

```
## # A tibble: 2 x 9
##   Group   Effect   DFn   DFd      F     p `p<.05`   pes p.adj
##   <fct>   <chr>  <dbl> <dbl>  <dbl> <dbl> <chr>   <dbl> <dbl>
## 1 Midlife Sex        1    38  0.228 0.636 ""      0.006 1
## 2 Young   Sex        1    52 10.5   0.002 *       0.168 0.004
```

```r
df_dsp_yf <- df_dsp %>% filter(Group == "Young" & Sex == "Female")
df_dsp_ym <- df_dsp %>% filter(Group == "Young" & Sex == "Male")
df_dsp_mf <- df_dsp %>% filter(Group == "Midlife" & Sex == "Female")
df_dsp_mm <- df_dsp %>% filter(Group == "Midlife" & Sex == "Male")
df_dsp_female <- df_dsp %>% filter(Sex == "Female")
df_dsp_male <- df_dsp %>% filter(Sex == "Male")
df_dsp_young <- df_dsp %>% filter(Group == "Young")
df_dsp_midlife <- df_dsp %>% filter(Group == "Midlife")

mean(df_dsp_young$SI_strict)
```

```
## [1] 0.2385115
```

```r
sd(df_dsp_young$SI_strict)
```

```
## [1] 0.1454005
```

```r
CI(df_dsp_young$SI_strict, ci = 0.95)
```

```
##     upper      mean     lower
## 0.2781982 0.2385115 0.1988249
```

```r
mean(df_dsp_midlife$SI_strict)
```

```
## [1] 0.1620774
```

```r
sd(df_dsp_midlife$SI_strict)
```

```
## [1] 0.1138854
```

```r
CI(df_dsp_midlife$SI_strict, ci = 0.95)
```

```
##     upper      mean     lower
## 0.1984998 0.1620774 0.1256551
```

```r
mean(df_dsp_male$SI_strict)
```

```
## [1] 0.2346812
```

```r
sd(df_dsp_male$SI_strict)
```

```
## [1] 0.1476932
```

```r
CI(df_dsp_male$SI_strict, ci = 0.95)
```

```
##     upper      mean     lower
## 0.2771036 0.2346812 0.1922587
```

```r
mean(df_dsp_female$SI_strict)
```

```
## [1] 0.174741
```

```r
sd(df_dsp_female$SI_strict)
```

```
## [1] 0.1195867
```

```r
CI(df_dsp_female$SI_strict, ci = 0.95)
```

```
##     upper      mean     lower
## 0.2106688 0.1747410 0.1388131
```

```r
#Effect of Age on Female
cohen.d(SI_strict ~ Group, group=Sex, data=df_dsp_female,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: -0.05048343 (negligible)
## 95 percent confidence interval:
##      lower      upper
## -0.6592487  0.5582819
```

```r
#Effect of Age on Male
cohen.d(SI_strict ~ Group, group=Sex, data=df_dsp_male,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: -1.080236 (large)
## 95 percent confidence interval:
##      lower      upper
## -1.7010809 -0.4593915
```

```r
# Effect of treatment at each level of Sex
df_dsp %>%
  group_by(Sex) %>%
  anova_test(SI_strict ~ Group,
             type = "III",
             effect.size = "pes") %>%
  get_anova_table() %>%
  adjust_pvalue(method = "bonferroni")
```

```
## Coefficient covariances computed by hccm()
```

```
## Coefficient covariances computed by hccm()
```

```
## # A tibble: 2 x 9
##   Sex    Effect   DFn   DFd      F        p `p<.05`     pes    p.adj
##   <fct>  <chr>  <dbl> <dbl>  <dbl>    <dbl> <chr>     <dbl>    <dbl>
## 1 Female Group      1    43  0.028 0.868    ""      0.00065 1
## 2 Male   Group      1    47 14.0   0.000496 *       0.23    0.000992
```

```
#Effect of Sex on Young
cohen.d(SI_strict ~ Sex, group=Group, data=df_dsp_young,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: -0.8811746 (large)
## 95 percent confidence interval:
##      lower      upper
## -1.4535629 -0.3087864
```

```
#Effect of Sex on Midlife
cohen.d(SI_strict ~ Sex, group=Group, data=df_dsp_midlife,
        conf.level=0.95, pooled=T, paired=F)
```

```
##
## Cohen's d
##
## d estimate: 0.151286 (negligible)
## 95 percent confidence interval:
##      lower      upper
## -0.4905993  0.7931713
```

Wayfinding Success / Proportion of successful trials

Number of trials they successed over total number of trials attempted which is usually 20 trials.

Expressed as a percent (range from 0-1).

```
options(contrasts=c("contr.sum", "contr.poly"))
interaction_success <- aov(Success_dec~Group*Sex, data = df_dsp)
Anova(interaction_success, type="III")
```

```
## Anova Table (Type III tests)
##
## Response: Success_dec
##             Sum Sq Df   F value    Pr(>F)
## (Intercept) 61.805  1 4300.6224 < 2.2e-16 ***
## Group        0.619  1   43.0398 3.319e-09 ***
## Sex          0.229  1   15.9545 0.0001324 ***
## Group:Sex    0.006  1    0.3849 0.5365720
## Residuals    1.293 90
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
success1 <-  Anova(interaction_success, type="III")
anova_stats(success1)
```

```
##          term  sumsq meansq df statistic p.value etasq partial.etasq
```

```
## 1 (Intercept) 61.805 61.805  1  4300.622   0.000 0.966         0.980
## 2       Group  0.619  0.619  1    43.040   0.000 0.010         0.324
## 3         Sex  0.229  0.229  1    15.955   0.000 0.004         0.151
## 4   Group:Sex  0.006  0.006  1     0.385   0.537 0.000         0.004
## 5   Residuals  1.293  0.014 90        NA      NA    NA            NA
##   omegasq partial.omegasq epsilonsq cohens.f power
## 1   0.966           0.978     0.966    6.913 1.000
## 2   0.009           0.307     0.009    0.692 1.000
## 3   0.003           0.136     0.003    0.421 0.979
## 4   0.000          -0.007     0.000    0.065 0.095
## 5      NA              NA        NA       NA    NA
```

```
#Based on bootstrapping
eta_sq(success1, partial = TRUE, ci.lvl = .95,
       n = 1000, method = "quantile")
```

```
##          term partial.etasq conf.low conf.high
## 1 (Intercept)         0.980    0.971     0.984
## 2       Group         0.324    0.172     0.453
## 3         Sex         0.151    0.039     0.283
## 4   Group:Sex         0.004    0.000     0.067
```

```
#95%CI

mean(df_dsp_young$Success_dec)
```

```
## [1] 0.9050926
```

```
sd(df_dsp_young$Success_dec)
```

```
## [1] 0.1091757
```

```
CI(df_dsp_young$Success_dec, ci = 0.95)
```

```
##     upper      mean     lower
## 0.9348918 0.9050926 0.8752934
```

```
mean(df_dsp_midlife$Success_dec)
```

```
## [1] 0.7408333
```

```
sd(df_dsp_midlife$Success_dec)
```

```
## [1] 0.1529832
```

```
CI(df_dsp_midlife$Success_dec, ci = 0.95)
```

```
##     upper      mean     lower
## 0.7897597 0.7408333 0.6919069
```

```
mean(df_dsp_female$Success_dec)
```

```
## [1] 0.7824074
```

```
sd(df_dsp_female$Success_dec)
```

```
## [1] 0.1520298
```

```
CI(df_dsp_female$Success_dec, ci = 0.95)
```

```
##     upper      mean     lower
```

```
## 0.8280822 0.7824074 0.7367326
```

```r
mean(df_dsp_male$Success_dec)
```

```
## [1] 0.8836735
```

```r
sd(df_dsp_male$Success_dec)
```

```
## [1] 0.1374575
```

```r
CI(df_dsp_male$Success_dec, ci = 0.95)
```

```
##     upper      mean     lower
## 0.9231559 0.8836735 0.8441911
```