Analysis EMG

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Contents

Cue & Target

```
EMG <- read_csv("EMG.csv") %>%
  pivot_longer(
    Reappraisal_Unexpected:Appraisal_Expected,
    names_to = "condition",
    values_to = "amplitude"
  ) %>%
  separate(
    condition,
    c("ER_Strategy", "Expectation"),
    sep = "_",
    remove = TRUE
  ) %>%
  mutate(
    Participant = as_factor(Participant),
    Believed_Story = as_factor(Believed_Story),
    Stimulus = as_factor(Stimulus),
    ER_Strategy = as_factor(ER_Strategy),
```

Table 1: Descriptive statistics of EMG amplitude, separately for each condition.

Stimulus	ER_Strategy	Expectation	median	mad
cue	Reappraisal	Unexpected	0.00129	0.0033
cue	Reappraisal	Expected	0.00069	0.0027
cue	Appraisal	Unexpected	-0.00065	0.0042
cue	Appraisal	Expected	0.00114	0.0040
target	Reappraisal	Unexpected	-0.00022	0.0030
target	Reappraisal	Expected	0.00055	0.0027
target	Appraisal	Unexpected	0.00129	0.0053
target	Appraisal	Expected	0.00054	0.0040

```
    Expectation = as_factor(Expectation)
  )

# summary
EMG_summary <-
  EMG %>%
  group_by(Stimulus, ER_Strategy, Expectation) %>%
  summarize(
    median = median(amplitude),
    mad = mad(amplitude)
  )

kable(
  EMG_summary,
  digits = c(0, 0, 0, 5, 5),
  caption = "Descriptive statistics of EMG amplitude, separately for each condition."
) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Plot

```
# plot
EMG %>%
  ggplot(
    aes(
      x = ER_Strategy,
      y = amplitude,
      color = Expectation,
      fill = Expectation
    )
  ) +
  geom_pirate(
    bars = FALSE,
    cis = TRUE,
    lines = TRUE, lines_params = list(color = "black", alpha = .3),
    points = TRUE, points_params = list(color = "black", shape = 21, size = 5, alpha = .2),
    violins = TRUE, violins_params = list(size = 1),
    show.legend = TRUE
  ) +
```

```
  scale_color_viridis_d(option = "cividis") +
  scale_fill_viridis_d(option = "cividis") +
  scale_y_continuous(limits = c(-.05, .05)) +
  ggtitle("EMG") +
  facet_wrap(. ~ Stimulus) +
  theme_custom +
  theme(
    legend.position = c(.55, .8),
    axis.title.x = element_blank()
  )
```

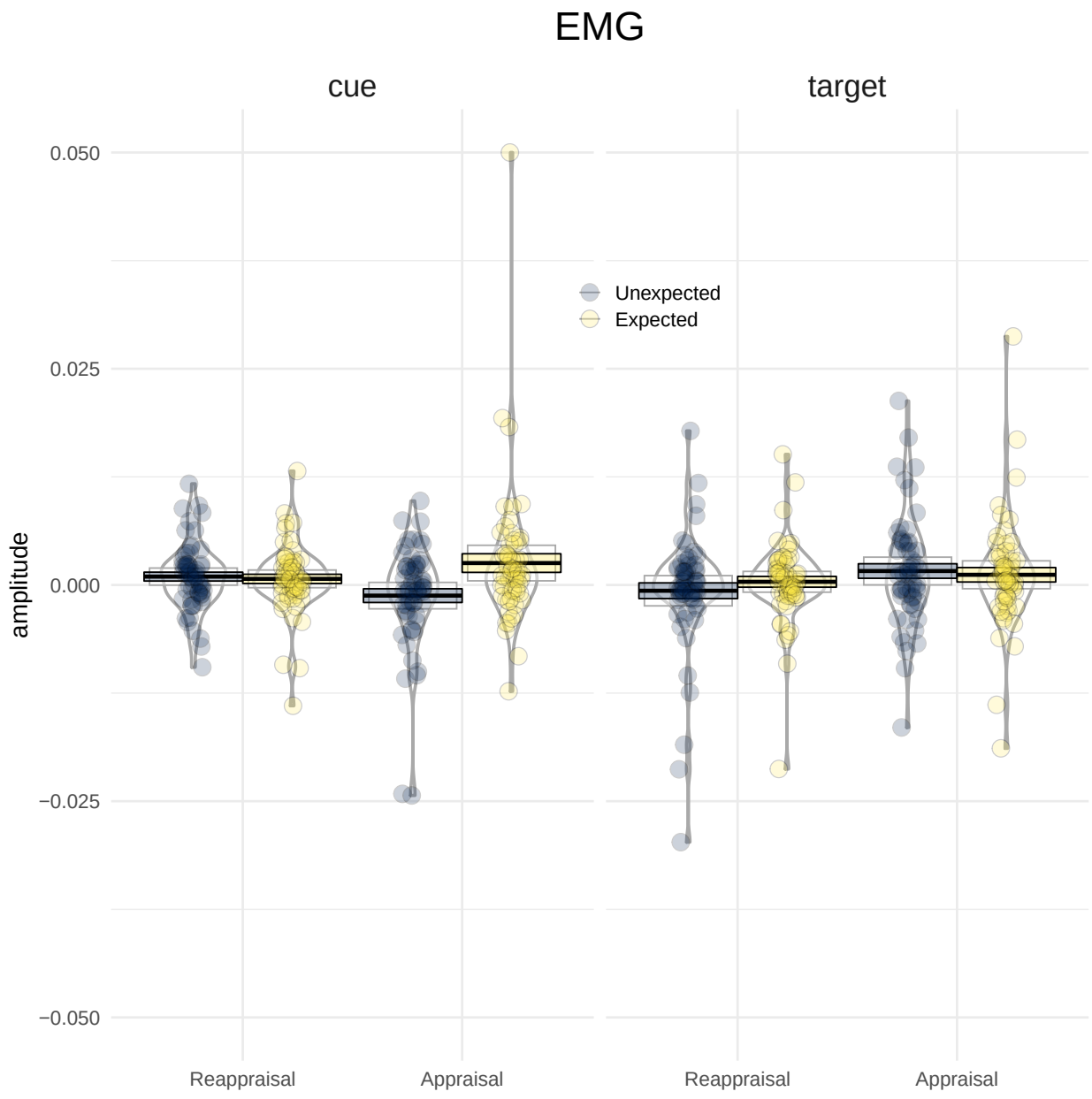


Figure 1: EMG amplitude in response to cue and target. **Note**: 18 values are outside the plot.

Table 2: Repeated measures nonparametric ANOVA (Aligned Rank Transform).

Term	Df	Df.res	F	p.value	eta.sq.part
Stimulus	1	420	1.7	0.199	0.004
ER_Strategy	1	420	1.5	0.223	0.004
Expectation	1	420	2.0	0.156	0.005
Stimulus:ER_Strategy	1	420	3.7	0.056	0.009
Stimulus:Expectation	1	420	1.3	0.248	0.003
ER_Strategy:Expectation	1	420	0.0	0.947	0.000
Stimulus:ER_Strategy:Expectation	1	420	11.2	0.001	0.026

Analysis

Repeated measures nonparametric ANOVA (Aligned Rank Transform).

```
# repeated measures nonparametric ANOVA, Aligned Rank Transform
all_ART <- anova(
  art(amplitude ~ Stimulus * ER_Strategy * Expectation + Error(Participant),
    data = EMG
  )
) %>%
  mutate(
    eta.sq.part = `Sum Sq` / (`Sum Sq` + `Sum Sq.res`) # partial eta squared
  )

all_ART %>%
  dplyr::select(`Term`, `Df`, `Df.res`, `F` = `F value`, p.value = `Pr(>F)`, `eta.sq.part`) %>%
  kable(.,
    digits = c(0, 0, 0, 2, 3, 3),
    caption = "Repeated measures nonparametric ANOVA (Aligned Rank Transform)."
  ) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Cue

Analyze EMG following cue presentation.

```
# keep only EMG in response to cue
EMG_cue <- filter(EMG, Stimulus == "cue") %>%
  dplyr::select(-Stimulus)
```

Plot

```
# plot
EMG_cue %>%
  ggplot(
    aes(
      x = ER_Strategy,
      y = amplitude,
      color = Expectation,
      fill = Expectation
    )
  ) +
```

Table 3: Repeated measures nonparametric ANOVA (Aligned Rank Transform).

Term	Df	Df.res	F	p.value	eta.sq.part
ER_Strategy	1	180	0.36	0.552	0.002
Expectation	1	180	4.51	0.035	0.024
ER_Strategy:Expectation	1	180	7.86	0.006	0.042

```
  geom_pirate(
    bars = FALSE,
    cis = TRUE,
    lines = TRUE, lines_params = list(color = "black", alpha = .3),
    points = TRUE, points_params = list(color = "black", shape = 21, size = 5, alpha = .2),
    violins = TRUE, violins_params = list(size = 1),
    show.legend = TRUE
  ) +
  scale_color_viridis_d(option = "cividis") +
  scale_fill_viridis_d(option = "cividis") +
  scale_y_continuous(limits = c(-.05, .05)) +
  ggtitle("Cue EMG") +
  theme_custom +
  theme(
    legend.position = c(.5, .15),
    axis.title.x = element_blank()
  )
```

Analysis

Repeated measures nonparametric ANOVA (Aligned Rank Transform), post-hoc Paired Samples Wilcoxon Tests.

```
# repeated measures nonparametric ANOVA, Aligned Rank Transform
cue_ART <- anova(
  art(amplitude ~ ER_Strategy * Expectation + Error(Participant),
    data = EMG_cue
  )
) %>%
  mutate(
    eta.sq.part = `Sum Sq` / (`Sum Sq` + `Sum Sq.res`) # partial eta squared
  )

cue_ART %>%
  dplyr::select(`Term`, `Df`, `Df.res`, `F` = `F value`, p.value = `Pr(>F)`, `eta.sq.part`) %>%
  kable(.,
    digits = c(0, 0, 0, 2, 3, 3),
    caption = "Repeated measures nonparametric ANOVA (Aligned Rank Transform)."
  ) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

```
## post-hoc analyses
# Appraisal, Expected vs. Unexpected
# Paired Samples Wilcoxon Test
EMG_Appraisal_ExpectedUnexpected_Wilcoxon <-
  wilcox.test(filter(EMG_cue, ER_Strategy == "Appraisal" & Expectation == "Expected")$amplitude,
```

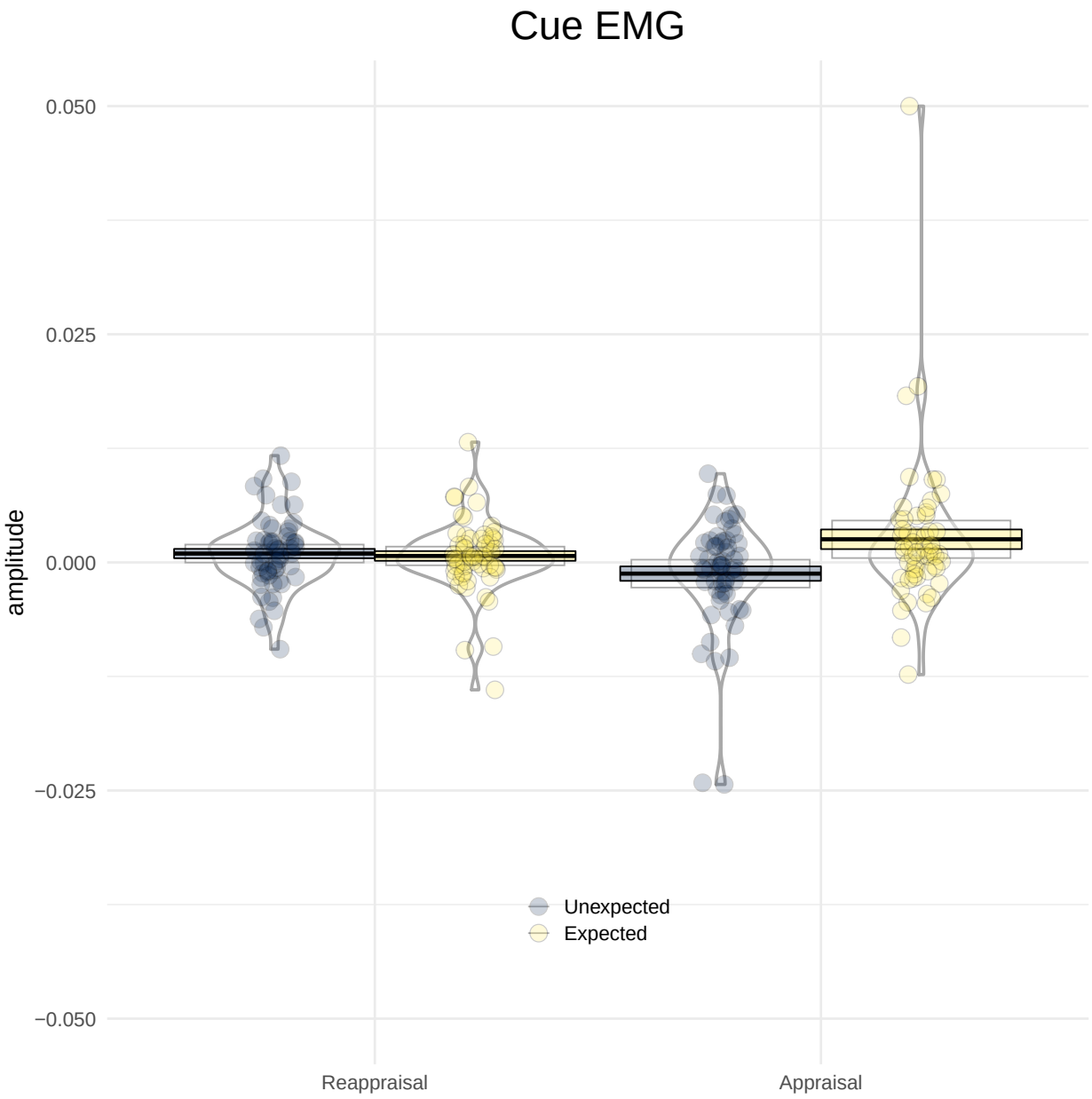


Figure 2: EMG amplitude in response to cue. **Note**: 9 values are outside the plot.

```
    filter(EMG_cue, ER_Strategy == "Appraisal" & Expectation == "Unexpected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
    conf.int = TRUE, conf.level = 0.95
  )

# effect size r
EMG_Appraisal_ExpectedUnexpected_r <-
  wilcoxonPairedR(filter(EMG_cue, ER_Strategy == "Appraisal" & Expectation %in% c("Expected", "Unexpecte
    filter(EMG_cue, ER_Strategy == "Appraisal" & Expectation %in% c("Expected", "Unexpected"))$Expectati
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# Reappraisal, Expected vs. Unexpected
# Paired Samples Wilcoxon Test
EMG_Reappraisal_ExpectedUnexpected_Wilcoxon <-
  wilcox.test(filter(EMG_cue, ER_Strategy == "Reappraisal" & Expectation == "Expected")$amplitude,
    filter(EMG_cue, ER_Strategy == "Reappraisal" & Expectation == "Unexpected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
    conf.int = TRUE, conf.level = 0.95
  )

# effect size r
EMG_Reappraisal_ExpectedUnexpected_r <-
  wilcoxonPairedR(filter(EMG_cue, ER_Strategy == "Reappraisal" & Expectation %in% c("Expected", "Unexpe
    filter(EMG_cue, ER_Strategy == "Reappraisal" & Expectation %in% c("Expected", "Unexpected"))$Expecta
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# Expected, Appraisal vs. Reappraisal
# Paired Samples Wilcoxon Test
EMG_Expected_AppraisalReappraisal_Wilcoxon <-
  wilcox.test(filter(EMG_cue, ER_Strategy == "Appraisal" & Expectation == "Expected")$amplitude,
    filter(EMG_cue, ER_Strategy == "Reappraisal" & Expectation == "Expected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
    conf.int = TRUE, conf.level = 0.95
  )
```

```r
# effect size r
EMG_Expected_AppraisalReappraisal_r <-
  wilcoxonPairedR(filter(EMG_cue, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "Expe
    filter(EMG_cue, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "Expected")$ER_Stra
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# Unexpected, Appraisal vs. Reappraisal
# Paired Samples Wilcoxon Test
EMG_Unexpected_AppraisalReappraisal_Wilcoxon <-
  wilcox.test(filter(EMG_cue, ER_Strategy == "Appraisal" & Expectation == "Unexpected")$amplitude,
    filter(EMG_cue, ER_Strategy == "Reappraisal" & Expectation == "Unexpected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
    conf.int = TRUE, conf.level = 0.95
  )

# effect size r
EMG_Unexpected_AppraisalReappraisal_r <-
  wilcoxonPairedR(filter(EMG_cue, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "Unexp
    filter(EMG_cue, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "Unexpected")$ER_Str
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# summary
cue_ART_posthoc <- tibble(
  "comparison" = c(
    "Appraisal, Expected vs. Unexpected", "Reappraisal, Expected vs. Unexpected",
    "Expected, Appraisal vs. Reappraisal", "Unexpected, Appraisal vs. Reappraisal"
  ),
  "V" = c(
    EMG_Appraisal_ExpectedUnexpected_Wilcoxon$statistic, EMG_Reappraisal_ExpectedUnexpected_Wilcoxon$sta
    EMG_Expected_AppraisalReappraisal_Wilcoxon$statistic, EMG_Unexpected_AppraisalReappraisal_Wilcoxon$s
  ),
  "p" = c(
    EMG_Appraisal_ExpectedUnexpected_Wilcoxon$p.value, EMG_Reappraisal_ExpectedUnexpected_Wilcoxon$p.val
    EMG_Expected_AppraisalReappraisal_Wilcoxon$p.value, EMG_Unexpected_AppraisalReappraisal_Wilcoxon$p.v
  ),
  "r" = c(
    EMG_Appraisal_ExpectedUnexpected_r$r, EMG_Reappraisal_ExpectedUnexpected_r$r,
    EMG_Expected_AppraisalReappraisal_r$r, EMG_Unexpected_AppraisalReappraisal_r$r
  ),
  "CI95_lower" = c(
    EMG_Appraisal_ExpectedUnexpected_r$lower.ci, EMG_Reappraisal_ExpectedUnexpected_r$lower.ci,
    EMG_Expected_AppraisalReappraisal_r$lower.ci, EMG_Unexpected_AppraisalReappraisal_r$lower.ci
  ),
```

Table 4: Post-hoc Repeated Samples Wilcoxon tests (Bonferroni-Holm p-value correction), bootstrapped effect size.

comparison	V	p	r	CI95_lower	CI95_upper
Appraisal, Expected vs. Unexpected	1369	0.008	-0.39	-0.58	-0.15
Reappraisal, Expected vs. Unexpected	919	0.853	0.02	-0.24	0.27
Expected, Appraisal vs. Reappraisal	1144	0.312	-0.18	-0.41	0.07
Unexpected, Appraisal vs. Reappraisal	660	0.120	0.26	0.00	0.47

```
  "CI95_upper" = c(
    EMG_Appraisal_ExpectedUnexpected_r$upper.ci, EMG_Reappraisal_ExpectedUnexpected_r$upper.ci,
    EMG_Expected_AppraisalReappraisal_r$upper.ci, EMG_Unexpected_AppraisalReappraisal_r$upper.ci
  )
) %>%
  mutate("p" = p.adjust(p, method = "holm")) # Bonferroni-Holm correction on post-hoc tests

kable(cue_ART_posthoc,
  digits = c(0, 0, 3, 2, 2, 2),
  caption = "Post-hoc Repeated Samples Wilcoxon tests (Bonferroni-Holm p-value correction), bootstrappe
) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Target

Analyze EMG following target presentation.

```
# keep only EMG in response to target
EMG_target <- filter(EMG, Stimulus == "target") %>%
  dplyr::select(-Stimulus)
```

Plot

```
# plot
EMG_target %>%
  ggplot(
    aes(
      x = ER_Strategy,
      y = amplitude,
      color = Expectation,
      fill = Expectation
    )
  ) +
  geom_pirate(
    bars = FALSE,
    cis = TRUE,
    lines = TRUE, lines_params = list(color = "black", alpha = .3),
    points = TRUE, points_params = list(color = "black", shape = 21, size = 5, alpha = .2),
    violins = TRUE, violins_params = list(size = 1),
    show.legend = TRUE
  ) +
  scale_color_viridis_d(option = "cividis") +
```

```
  scale_fill_viridis_d(option = "cividis") +
  scale_y_continuous(limits = c(-.05, .05)) +
  ggtitle("Cue EMG") +
  theme_custom +
  theme(
    legend.position = c(.5, .15),
    axis.title.x = element_blank()
  )
```

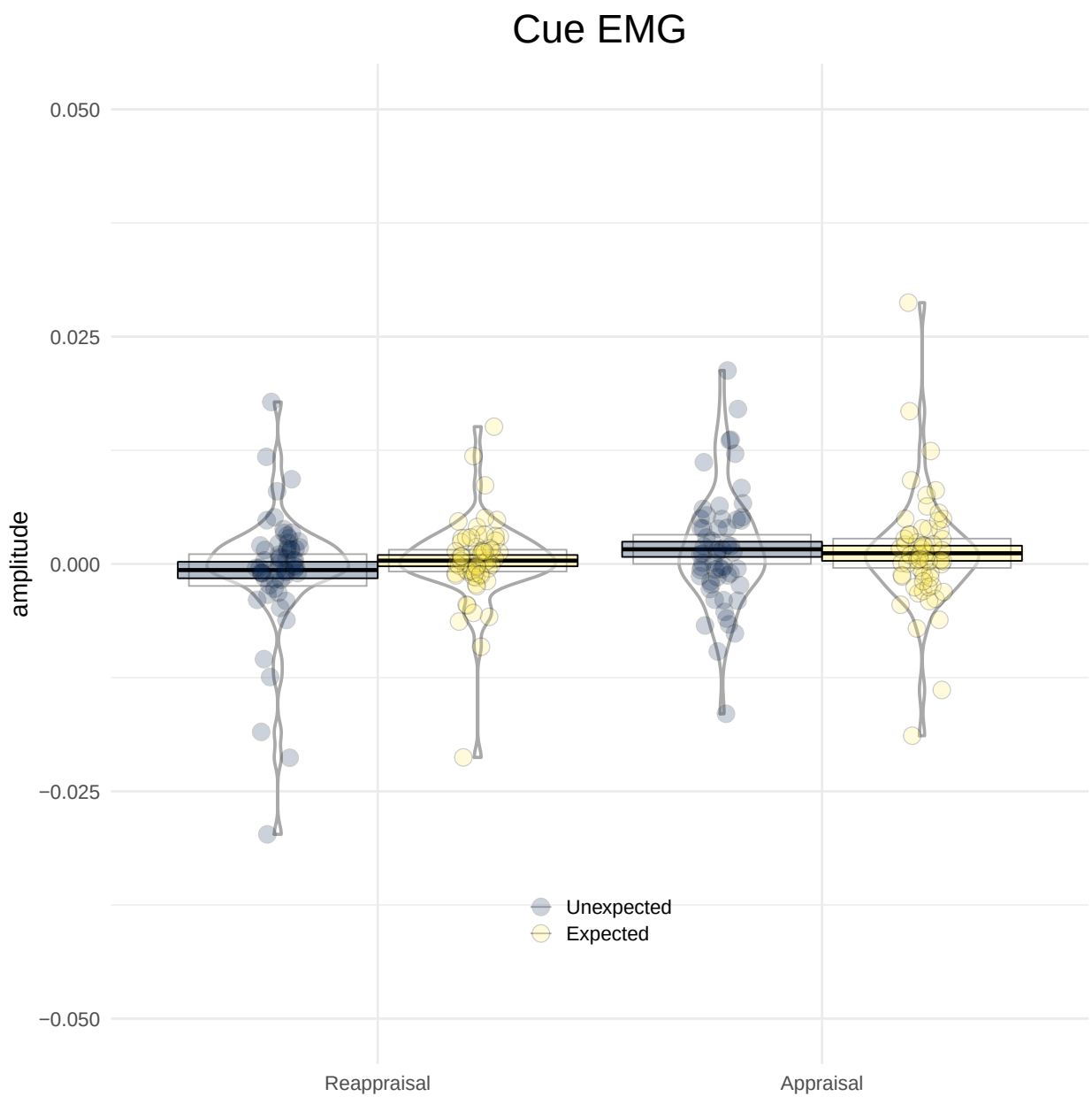


Figure 3: EMG amplitude in response to target. **Note**: 9 values are outside the plot.

Table 5: Repeated measures nonparametric ANOVA (Aligned Rank Transform).

Term	Df	Df.res	F	p.value	eta.sq.part
ER_Strategy	1	180	5.7	0.018	0.031
Expectation	1	180	0.0	0.987	0.000
ER_Strategy:Expectation	1	180	7.3	0.007	0.039

Analysis

Repeated measures nonparametric ANOVA (Aligned Rank Transform), post-hoc Paired Samples Wilcoxon Tests.

```
# repeated measures nonparametric ANOVA, Aligned Rank Transform
target_ART <- anova(
  art(amplitude ~ ER_Strategy * Expectation + Error(Participant),
    data = EMG_target
  )
) %>%
  mutate(
    eta.sq.part = `Sum Sq` / (`Sum Sq` + `Sum Sq.res`) # partial eta squared
  )

target_ART %>%
  dplyr::select(`Term`, `Df`, `Df.res`, `F` = `F value`, p.value = `Pr(>F)`, `eta.sq.part`) %>%
  kable(.,
    digits = c(0, 0, 0, 2, 3, 3),
    caption = "Repeated measures nonparametric ANOVA (Aligned Rank Transform)."
  ) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

```
## post-hoc analyses
# Appraisal, Expected vs. Unexpected
# Paired Samples Wilcoxon Test
EMG_Appraisal_ExpectedUnexpected_Wilcoxon <-
  wilcox.test(filter(EMG_target, ER_Strategy == "Appraisal" & Expectation == "Expected")$amplitude,
    filter(EMG_target, ER_Strategy == "Appraisal" & Expectation == "Unexpected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
    conf.int = TRUE, conf.level = 0.95
  )

# effect size r
EMG_Appraisal_ExpectedUnexpected_r <-
  wilcoxonPairedR(filter(EMG_target, ER_Strategy == "Appraisal" & Expectation %in% c("Expected", "Unexpe
    filter(EMG_target, ER_Strategy == "Appraisal" & Expectation %in% c("Expected", "Unexpected"))$Expec
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# Reappraisal, Expected vs. Unexpected
```

```r
# Paired Samples Wilcoxon Test
EMG_Reappraisal_ExpectedUnexpected_Wilcoxon <-
  wilcox.test(filter(EMG_target, ER_Strategy == "Reappraisal" & Expectation == "Expected")$amplitude,
    filter(EMG_target, ER_Strategy == "Reappraisal" & Expectation == "Unexpected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
    conf.int = TRUE, conf.level = 0.95
  )

# effect size r
EMG_Reappraisal_ExpectedUnexpected_r <-
  wilcoxonPairedR(filter(EMG_target, ER_Strategy == "Reappraisal" & Expectation %in% c("Expected", "Unex
    filter(EMG_target, ER_Strategy == "Reappraisal" & Expectation %in% c("Expected", "Unexpected"))$Expe
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# Expected, Appraisal vs. Reappraisal
# Paired Samples Wilcoxon Test
EMG_Expected_AppraisalReappraisal_Wilcoxon <-
  wilcox.test(filter(EMG_target, ER_Strategy == "Appraisal" & Expectation == "Expected")$amplitude,
    filter(EMG_target, ER_Strategy == "Reappraisal" & Expectation == "Expected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
    conf.int = TRUE, conf.level = 0.95
  )

# effect size r
EMG_Expected_AppraisalReappraisal_r <-
  wilcoxonPairedR(filter(EMG_target, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "Ex
    filter(EMG_target, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "Expected")$ER_St
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# Unexpected, Appraisal vs. Reappraisal
# Paired Samples Wilcoxon Test
EMG_Unexpected_AppraisalReappraisal_Wilcoxon <-
  wilcox.test(filter(EMG_target, ER_Strategy == "Appraisal" & Expectation == "Unexpected")$amplitude,
    filter(EMG_target, ER_Strategy == "Reappraisal" & Expectation == "Unexpected")$amplitude,
    alternative = "two.sided",
    mu = 0,
    paired = TRUE,
    exact = TRUE,
    correct = TRUE,
```

```
    conf.int = TRUE, conf.level = 0.95
  )

# effect size r
EMG_Unexpected_AppraisalReappraisal_r <-
  wilcoxonPairedR(filter(EMG_target, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "U
    filter(EMG_target, ER_Strategy %in% c("Appraisal", "Reappraisal") & Expectation == "Unexpected")$ER_
    ci = TRUE, conf = 0.95,
    type = "bca", R = 5000,
    cases = TRUE
  )

# summary
target_ART_posthoc <- tibble(
  "comparison" = c(
    "Appraisal, Expected vs. Unexpected", "Reappraisal, Expected vs. Unexpected",
    "Expected, Appraisal vs. Reappraisal", "Unexpected, Appraisal vs. Reappraisal"
  ),
  "V" = c(
    EMG_Appraisal_ExpectedUnexpected_Wilcoxon$statistic, EMG_Reappraisal_ExpectedUnexpected_Wilcoxon$sta
    EMG_Expected_AppraisalReappraisal_Wilcoxon$statistic, EMG_Unexpected_AppraisalReappraisal_Wilcoxon$s
  ),
  "p" = c(
    EMG_Appraisal_ExpectedUnexpected_Wilcoxon$p.value, EMG_Reappraisal_ExpectedUnexpected_Wilcoxon$p.val
    EMG_Expected_AppraisalReappraisal_Wilcoxon$p.value, EMG_Unexpected_AppraisalReappraisal_Wilcoxon$p.v
  ),
  "r" = c(
    EMG_Appraisal_ExpectedUnexpected_r$r, EMG_Reappraisal_ExpectedUnexpected_r$r,
    EMG_Expected_AppraisalReappraisal_r$r, EMG_Unexpected_AppraisalReappraisal_r$r
  ),
  "CI95_lower" = c(
    EMG_Appraisal_ExpectedUnexpected_r$lower.ci, EMG_Reappraisal_ExpectedUnexpected_r$lower.ci,
    EMG_Expected_AppraisalReappraisal_r$lower.ci, EMG_Unexpected_AppraisalReappraisal_r$lower.ci
  ),
  "CI95_upper" = c(
    EMG_Appraisal_ExpectedUnexpected_r$upper.ci, EMG_Reappraisal_ExpectedUnexpected_r$upper.ci,
    EMG_Expected_AppraisalReappraisal_r$upper.ci, EMG_Unexpected_AppraisalReappraisal_r$upper.ci
  )
) %>%
  mutate("p" = p.adjust(p, method = "holm")) # Bonferroni-Holm correction on post-hoc tests

kable(target_ART_posthoc,
  digits = c(0, 0, 3, 2, 2, 2),
  caption = "Post-hoc Repeated Samples Wilcoxon tests (Bonferroni-Holm p-value correction), bootstrappe
) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Exploratory Analysis

Block order

Participants with even numbers started with reappraisal blocks, participants with uneven numbers started with appraisal block. Does block order influence EMG amplitude?

Table 6: Post-hoc Repeated Samples Wilcoxon tests (Bonferroni-Holm p-value correction), bootstrapped effect size.

comparison	V	p	r	CI95_lower	CI95_upper
Appraisal, Expected vs. Unexpected	778	0.593	0.15	-0.10	0.39
Reappraisal, Expected vs. Unexpected	1126	0.593	-0.17	-0.40	0.09
Expected, Appraisal vs. Reappraisal	1038	0.593	-0.08	-0.34	0.18
Unexpected, Appraisal vs. Reappraisal	1377	0.007	-0.40	-0.59	-0.15

```
EMG <- EMG %>%
  mutate(
    start_block = as_factor(
      ifelse(
        as.numeric(Participant) %% 2 == 0,
        "start_Reappraisal",
        "start_Appraisal"
      )
    )
  )
```

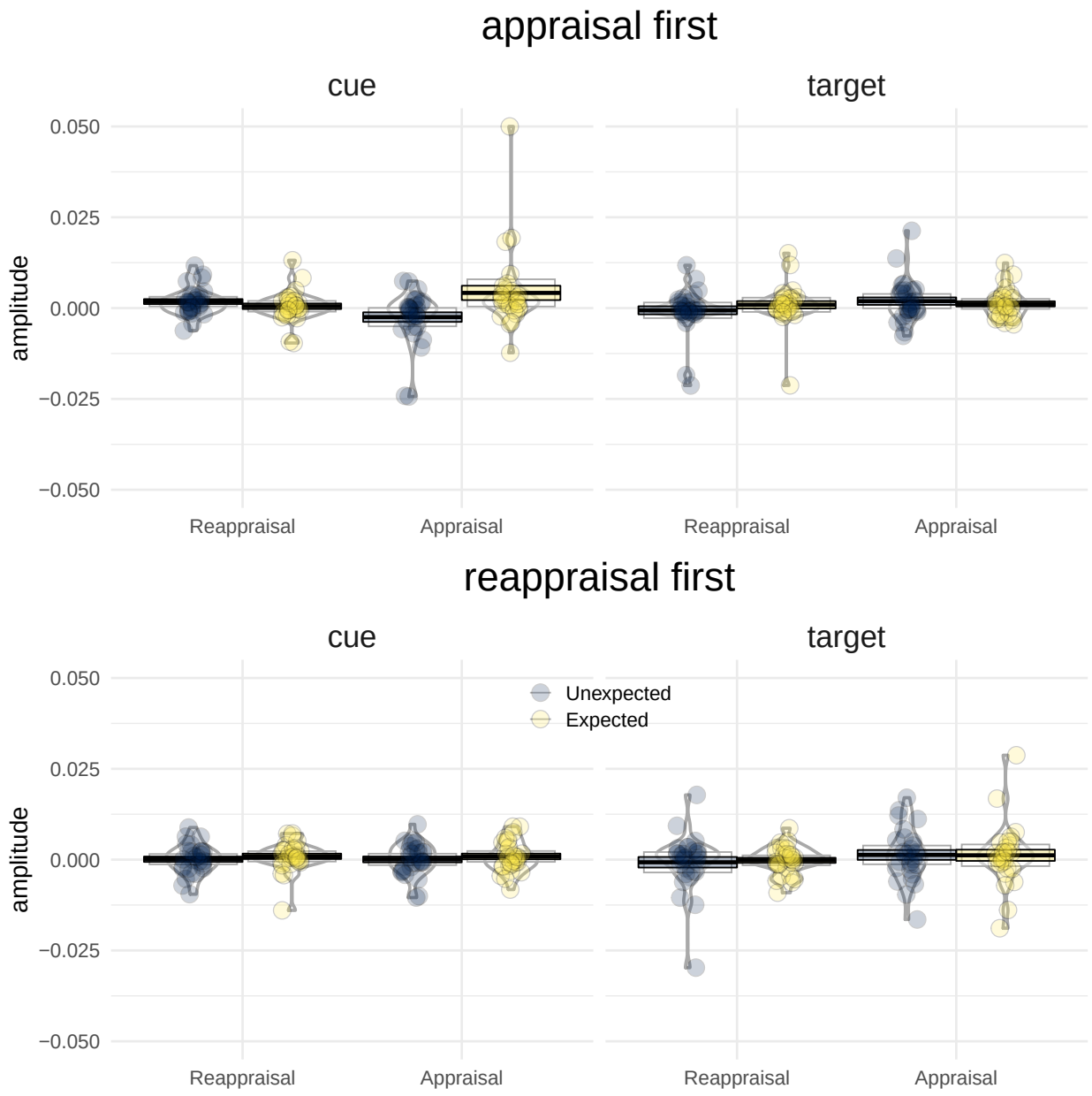
```
# plot start appraisal
plot_start_appraisal <-
  EMG %>%
  filter(start_block == "start_Appraisal") %>%
  ggplot(
    aes(
      x = ER_Strategy,
      y = amplitude,
      color = Expectation,
      fill = Expectation
    )
  ) +
  geom_pirate(
    bars = FALSE,
    cis = TRUE,
    lines = TRUE, lines_params = list(color = "black", alpha = .3),
    points = TRUE, points_params = list(color = "black", shape = 21, size = 5, alpha = .2),
    violins = TRUE, violins_params = list(size = 1),
    show.legend = TRUE
  ) +
  scale_color_viridis_d(option = "cividis") +
  scale_fill_viridis_d(option = "cividis") +
  scale_y_continuous(limits = c(-.05, .05)) +
  ggtitle("appraisal first") +
  facet_wrap(. ~ Stimulus) +
  theme_custom +
  theme(
    legend.position = c(.55, .8),
    axis.title.x = element_blank()
  )

# plot start reappraisal
```

```r
plot_start_reappraisal <-
  EMG %>%
  filter(start_block == "start_Reappraisal") %>%
  ggplot(
    aes(
      x = ER_Strategy,
      y = amplitude,
      color = Expectation,
      fill = Expectation
    )
  ) +
  geom_pirate(
    bars = FALSE,
    cis = TRUE,
    lines = TRUE, lines_params = list(color = "black", alpha = .3),
    points = TRUE, points_params = list(color = "black", shape = 21, size = 5, alpha = .2),
    violins = TRUE, violins_params = list(size = 1),
    show.legend = TRUE
  ) +
  scale_color_viridis_d(option = "cividis") +
  scale_fill_viridis_d(option = "cividis") +
  scale_y_continuous(limits = c(-.05, .05)) +
  ggtitle("reappraisal first") +
  facet_wrap(. ~ Stimulus) +
  theme_custom +
  theme(
    legend.position = c(.45, .2),
    axis.title.x = element_blank()
  )

# arrange plots in two columns
plot_block_data <- plot_grid(
  plot_start_appraisal + theme(legend.position = "none"),
  plot_start_reappraisal + theme(legend.position = c(.5, .9)),
  align = "vh",
  hjust = -1,
  nrow = 2
)

plot_block_data
```



The package `ARTool` does not handle split-plot designs, therefore we will run non-parametric permutation tests via the function `ezPerm` from the package `ez`.

```
block_ez <-
  ezPerm(
    data = EMG,
    dv = amplitude,
    wid = Participant,
    within = c(Stimulus, ER_Strategy, Expectation),
    between = start_block,
    perms = 1000
  )

saveRDS(block_ez, file = paste0(getwd(), "/block_ez.rds"), compress = "gzip")
```

Table 7: Split-plot ANOVA, control for block order (Appraisal first or Reappraisal first).

Effect	p	p<.05
start_block	0.701	
Stimulus	0.811	
ER_Strategy	0.112	
Expectation	0.936	
start_block:Stimulus	0.473	
start_block:ER_Strategy	0.411	
Stimulus:ER_Strategy	0.657	
start_block:Expectation	0.318	
Stimulus:Expectation	0.433	
ER_Strategy:Expectation	0.539	
start_block:Stimulus:ER_Strategy	0.097	
start_block:Stimulus:Expectation	0.954	
start_block:ER_Strategy:Expectation	0.734	
Stimulus:ER_Strategy:Expectation	0.015	*
start_block:Stimulus:ER_Strategy:Expectation	0.807	

```
block_ez <- readRDS(paste0(getwd(), "/block_ez.rds"))

block_ez %>%
  kable(.,
    digits = c(0, 3, 0),
    caption = "Split-plot ANOVA, control for block order (Appraisal first or Reappraisal first)."
  ) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

Results are **not** influenced by block order.

Correlation

Reviewer's comment:

> It seems as though the primary difference during the target phase is for unexpected negative feedback, and it is reduced for reappraised vs. appraised trials. Does something going on during anticipation predict this effect? For example, does the difference in reappraise vs. appraise during anticipation of unexpected feedback (or something else during anticipation) correlate/predict this effect?

```
EMG_Unexpected_corr <- EMG %>%
  filter(
    Expectation == "Unexpected"
  ) %>%
  dplyr::select(Participant, Stimulus, ER_Strategy, amplitude) %>%
  pivot_wider(id_cols = Participant,
              names_from = c(Stimulus, ER_Strategy),
              values_from = amplitude
  ) %>%
  mutate(
    cue_ReappraisalVsAppraisal = cue_Reappraisal - cue_Appraisal,
    target_ReappraisalVsAppraisal = target_Reappraisal - target_Appraisal
  ) %>%
```

Table 8:

rho	p-value
40138	0.64

```
  dplyr::select(Participant, cue_ReappraisalVsAppraisal, target_ReappraisalVsAppraisal)

# Spearman's correlation
corr <- cor.test(
  x = pull(EMG_Unexpected_corr, "cue_ReappraisalVsAppraisal"),
  y = pull(EMG_Unexpected_corr, "target_ReappraisalVsAppraisal"),
  method = "spearman",
  alternative = "two.sided",
  exact = TRUE,
  continuity = TRUE
)

tibble(
  "rho" = corr$statistic,
  "p-value" = corr$p.value
) %>%
  kable(.,
    digits = c(0, 3),
    caption = ""
  ) %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed", "responsive"))
```

The difference between Appraisal and Reappraisal during anticipation does **not** statistically correlate with the same difference during the target phase.

Session Info

```
sessionInfo()
```

```
## R version 3.6.3 (2020-02-29)
## Platform: x86_64-pc-linux-gnu (64-bit)
## Running under: Ubuntu 18.04.4 LTS
##
## Matrix products: default
## BLAS:   /usr/lib/x86_64-linux-gnu/blas/libblas.so.3.7.1
## LAPACK: /usr/lib/x86_64-linux-gnu/lapack/liblapack.so.3.7.1
##
## locale:
##  [1] LC_CTYPE=en_US.UTF-8       LC_NUMERIC=C
##  [3] LC_TIME=nl_NL.UTF-8        LC_COLLATE=en_US.UTF-8
##  [5] LC_MONETARY=nl_NL.UTF-8    LC_MESSAGES=en_US.UTF-8
##  [7] LC_PAPER=nl_NL.UTF-8       LC_NAME=C
##  [9] LC_ADDRESS=C               LC_TELEPHONE=C
## [11] LC_MEASUREMENT=nl_NL.UTF-8 LC_IDENTIFICATION=C
```

```
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] cowplot_1.0.0     ggpirate_0.1.1    viridis_0.5.1     viridisLite_0.3.0
##  [5] ez_4.4-0          ARTool_0.10.7     rcompanion_2.3.25 forcats_0.5.0
##  [9] stringr_1.4.0     dplyr_0.8.5       purrr_0.3.3       readr_1.3.1
## [13] tidyr_1.0.2       tibble_2.1.3      ggplot2_3.3.0     tidyverse_1.3.0
## [17] kableExtra_1.1.0  knitr_1.28
##
## loaded via a namespace (and not attached):
##  [1] nlme_3.1-144       matrixStats_0.56.0 fs_1.3.2           lubridate_1.7.4
##  [5] webshot_0.5.2      httr_1.4.1         tools_3.6.3        backports_1.1.5
##  [9] R6_2.4.1           mgcv_1.8-31        nortest_1.0-4      DBI_1.1.0
## [13] colorspace_1.4-1   withr_2.1.2        gridExtra_2.3      tidyselect_1.0.0
## [17] curl_4.3           compiler_3.6.3     cli_2.0.2          rvest_0.3.5
## [21] expm_0.999-4       xml2_1.2.5         sandwich_2.5-1     labeling_0.3
## [25] scales_1.1.0       lmtest_0.9-37      mvtnorm_1.1-0      multcompView_0.1-8
## [29] digest_0.6.25      minqa_1.2.4        foreign_0.8-75     rmarkdown_2.1
## [33] rio_0.5.16         pkgconfig_2.0.3    htmltools_0.4.0    lme4_1.1-21
## [37] highr_0.8          dbplyr_1.4.2       rlang_0.4.5        readxl_1.3.1
## [41] rstudioapi_0.11    farver_2.0.3       generics_0.0.2     zoo_1.8-7
## [45] jsonlite_1.6.1     zip_2.0.4          car_3.0-7          magrittr_1.5
## [49] modeltools_0.2-23  Matrix_1.2-18      Rcpp_1.0.4         DescTools_0.99.34
## [53] munsell_0.5.0      fansi_0.4.1        abind_1.4-5        lifecycle_0.2.0
## [57] stringi_1.4.6      multcomp_1.4-12    yaml_2.2.1         carData_3.0-3
## [61] MASS_7.3-51.5      plyr_1.8.6         grid_3.6.3         parallel_3.6.3
## [65] crayon_1.3.4       lattice_0.20-40    haven_2.2.0        splines_3.6.3
## [69] hms_0.5.3          pillar_1.4.3       EMT_1.1            boot_1.3-24
## [73] reshape2_1.4.3     codetools_0.2-16   stats4_3.6.3       reprex_0.3.0
## [77] glue_1.3.2         evaluate_0.14      data.table_1.12.8  modelr_0.1.6
## [81] nloptr_1.2.2.1     vctrs_0.2.4        cellranger_1.1.0   gtable_0.3.0
## [85] assertthat_0.2.1   xfun_0.12          openxlsx_4.1.4     coin_1.3-1
## [89] libcoin_1.0-5      broom_0.5.5        survival_3.1-11    ellipsis_0.3.0
## [93] TH.data_1.0-10
```