The Effects of a 16-week Aerobic Exercise and Mindfulness-based Intervention on Chronic Psychosocial Stress: A Nonrandomized Pilot and Feasibility Trial

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This R Markdown document reproduces the results found in the above manuscript and provides instructions for independent reproduction.

Note: data from the original publication are not publicly available on the advice of the Monash University Human Research Ethics Committee. This is because the approved ethics application did not include provisions for public access to data. The deidentified data are available from the corresponding author, upon a reasonable request.

1 Instructions

Follow these instructions to independently reproduce all analyses in the above publication via an R Markdown file.

1. Install requisite software:

- R (v-3.5.1)
- R Studio (v-1.1.463)

Note: These analyses were performed using using Windows 10 and have not been tested on Unix systems.

2. Download the analysis pipeline:

- Download or clone the git repository for this analysis: https://github.com/[repository_name_here] (https://github.com/%5Brepository_name_here%5D)
- The files within this repository must be saved to a single directory

3. Open the R Studio project file:

- Open `analysis.Rproj` to begin an R Studio session in your current working directory

4. Install required packages:

- This analysis pipeline requires the following packages:

```
install.packages("ggplot2")
install.packages("MBESS")
install.packages("scales")
install.packages("HLMdiag")
install.packages("userfriendlyscience")
install.packages("lmerTest")
install.packages("emmeans")
install.packages("ggpubr")
install.packages("boot")
install.packages("pbapply")
install.packages("here")
install.packages("kableExtra")
```

5. Knit the R Markdown file to reproduce all analyses:

- Open `markdown.rmd` in R Studio and select **Knit**
- This action will reproduce this document and all associated analyses

2 Prepare R Workspace

The scripts below are evaluated by R Markdown to reproduce all analyses.

1. Load and attach required packages

- R Markdown will load and attach the required packages by sourcing the `libraries.R` file
- Robust statistical analysis scripts are sourced from the Rallfun-v35 script file
    - Wilcox, R. R. (2018). Rallfun-v35. Retrieved from https://dornsife.usc.edu/labs/rwilcox/software/ (https://dornsife.usc.edu/labs/rwilcox/software/)

```
source("libraries.R")
source("Rallfun-v35.txt")
```

2. Import data

- R Markdown will source the `import_data.R` script file
- This file imports the one-*df* and multi-*df* data, and sorts it into a form required for analysis. This includes:
    - Sorting the data into both long and wide format
    - Defining variables classes
    - Removing data with incomplete cases for the analysis of aerobic economy
- This file also imports the results of an accuracy in parameter estimation sample size analysis which have been computed via simulation

```
source("import_data.R")
```

3. Source the analysis scripts

- R Markdown will source the analysis script file for this project: `ProchFun_stress-v1.R`

- This file includes all scripts required for reproducing all analyses

```
source("ProcFun_stress-v1.R")
```

```
## # MIT License
## #
## # ProcFun_stress-v1: R functions for stress trial mansuscript.
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## #
## # Contact
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## # Last update: May 2019
## #
## # Cite as:
## # Prochilo, G. A. (2019). ProcFun_stress-v1: R functions for stress trial mansusc
ript.
## # Retrieved from https://github.com/gprochilo
```

3 Reproduce Results Tables

3.1 Table 1

- Reproduce Table 1: Baseline demographic characteristics of participants
- Use the following function:

`bl.table()`

```
bl.table() %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	All	by declined	by increased/no change
pss.ch	17 (100.00%)	12 (70.59%)	5 (29.41%)

	All	by declined	by increased/no change
pss.0	20.12 (7.56)	23.50 (5.35)	12.00 (5.74)
age.0	22.88 (2.71)	23.08 (2.84)	22.40 (2.61)
male.0	8 (47.06%)	5 (29.41%)	3 (17.65%)
male.01	9 (52.94%)	7 (41.18%)	2 (11.76%)
caucasian.0	11 (64.71%)	7 (41.18%)	4 (23.53%)
caucasian.01	6 (35.29%)	5 (29.41%)	1 (5.88%)
working.0	12 (70.59%)	10 (58.82%)	2 (11.76%)
vo2max.0	45.34 (7.44)	45.81 (5.58)	44.20 (11.54)
bmi.0	23.29 (2.65)	23.96 (2.45)	21.68 (2.64)

3.2 Table 2

- Reproduce Table 2: Summarized dosage results
- Use the the following function:

```
descrip.res(dv.list = dos.vars, df = "dat.wide", round = TRUE, sav2csv = TRUE, name = "baseline")
```

```
descrip.res(dv.list = dos.vars, df = "dat.wide", round = TRUE, sav2csv = TRUE, name
 = "baseline") %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	M (SD)	Range
attendance.pcnt.1	79.41 (11.64)	62.50 - 100.00
meditation.tot.1	24.81 (2.69)	19.33 - 29.42
runs.tot.1	34.76 (5.39)	25.00 - 42.00
mean.pcnt.vo2max.1	70.54 (6.69)	56.78 - 82.15
distance.km.tot.1	228.10 (81.67)	143.80 - 474.27
runtime.tot.1	24.50 (6.82)	17.99 - 45.37

3.3 Table 3

- Reproduce Table 3: Summarized results for pre-test (T0), post-test (T1), and gains (T1-T0) for psychosocial stress factors, mindfulness, emotion regulation factors, and maximal aerobic capacity
- Use the following function:

```
pair.table()
```

```
pair.table() %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	T0: M (SD)	T1: M (SD)	Gain: M (SD) [95% CI]	dav [95% CI]	p	pR
pss	20.12 (7.56)	15.88 (4.54)	-4.24 (7.01) [-7.84, -0.63]	-0.68 [-1.25, -0.09]	.024	.020
sdass	28.59 (6.07)	24.00 (5.87)	-4.59 (4.17) [-6.73, -2.44]	-0.77 [-1.18, -0.34]	<.001	<.001
adass	19.88 (4.82)	20.00 (6.60)	0.12 (4.55) [-2.22, 2.46]	0.02 [-0.35, 0.39]	.916	.789
ddass	23.76 (7.21)	19.76 (4.63)	-4.00 (6.32) [-7.25, -0.75]	-0.66 [-1.20, -0.11]	.019	.015
who	54.35 (18.55)	64.00 (12.65)	9.65 (15.75) [1.55, 17.75]	0.61 [0.08, 1.12]	.023	.028
maas	3.78 (0.70)	4.00 (0.66)	0.22 (0.75) [-0.17, 0.60]	0.32 [-0.23, 0.85]	.256	.225
erq.cr	4.31 (1.46)	5.18 (1.18)	0.86 (1.04) [0.33, 1.39]	0.65 [0.21, 1.08]	.003	.003
rrs.br	11.00 (4.14)	9.59 (3.36)	-1.41 (2.55) [-2.72, -0.10]	-0.37 [-0.72, -0.02]	.037	.051
pswq	50.12 (16.19)	43.94 (11.26)	-6.18 (10.05) [-11.34, -1.01]	-0.44 [-0.81, -0.06]	.022	.012
vo2max	45.34 (7.44)	45.58 (8.91)	0.25 (5.98) [-2.83, 3.32]	0.03 [-0.32, 0.38]	.868	.642

3.4 Table 4

- Reproduce Table 4: Summarized Type III ANOVA table and follow-up pairwise contrasts of the linear mixed model (fit by REML) for each aerobic economy outcome. F and t tests use Satterthwaite's degrees of freedom.
- Use the following function:

`lmm.table()`

```
lmm.table() %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

```
## NOTE: Results may be misleading due to involvement in interactions
## NOTE: Results may be misleading due to involvement in interactions
## NOTE: Results may be misleading due to involvement in interactions
## NOTE: Results may be misleading due to involvement in interactions
```

var	effect	SS	MS	df	F/t	p
vo2	time	0.49	0.49	1,84	7.57	.007
vo2	samp	40.23	13.41	3,84	209.18	<.001
vo2	time:samp	0.23	0.08	3,84	1.20	.316
vo2	T1-T0	-0.14 [-0.24, -0.04]	0.05	84	-2.75	.007
pcnt.vo2	time	495.99	495.99	1,84	16.09	<.001
pcnt.vo2	samp	35315.81	11771.94	3,84	381.90	<.001

var	effect	SS	MS	df	F/t	p
pcnt.vo2	time:samp	175.98	58.66	3,84	1.90	.135
pcnt.vo2	T1-T0	-4.37 [-6.53, -2.20]	1.09	84	-4.01	<.001
hr	time	541.73	541.73	1,84	8.13	.005
hr	samp	47653.51	15884.50	3,84	238.43	<.001
hr	time:samp	51.82	17.27	3,84	0.26	.855
hr	T1-T0	-4.56 [-7.75, -1.38]	1.60	84	-2.85	.005
rpe	time	13.16	13.16	1,84	13.93	<.001
rpe	samp	673.57	224.52	3,84	237.52	<.001
rpe	time:samp	1.49	0.50	3,84	0.53	.666
rpe	T1-T0	-0.71 [-1.09, -0.33]	0.19	84	-3.73	<.001

3.5 Table 5

- Reproduce Table 5: Range of sample sizes required to estimate PSS-10 effects for a confirmatory RCT comparing aerobic exercise, mindfulness, combination training, and a control arm
- Use the following function:

```
aipe.res(retention.rate = 0.7083, trial.reps = 10)
```

```
aipe.res(retention.rate = 0.7083, trial.reps = 10, assurance = 0.99) %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	MoE	N	N Adjusted	Recruitment Rate
dz_0.60	0.3	62	88	9
dz_0.37	0.19	131	185	19
ds_0.8	0.4	58	82	9
ds_0.7	0.35	72	102	11
ds_0.6	0.3	96	136	14
ds_0.5	0.25	132	186	19
ds_0.4	0.2	202	285	29
ds_0.3	0.15	350	494	50
ds_0.2	0.1	778	1098	110

4 Reproduce In-text Statistics

The following statistics are reported in the text of the main manuscript but outside of tables.

4.1 Critical *t* and *d* value for *N* = 17

- Reproduce calculation of the critical *t* and *d* values reported in the Methods section for justification of sample size
- This function reports the critical *t*, critical *d*, confidence limits for critical *d*, the margin-of-error on critical *d*, and a summary of results

```
critical.t(n = 17, type = "dz", alpha = 0.2, twotailed = TRUE)
```

```
## $t.crit
## [1] 1.336757
##
## $d.crit
## [1] 0.3242112
##
## $d.ci.LL
## [1] -0.17
##
## $d.ci.UL
## [1] 0.81
##
## $MoE
## [1] 0.4882453
##
## $res
## [1] "t(16) = 1.34, p = 0.200, d = 0.32, 95% CI [-0.17, 0.81]"
```

4.2 Common language effect size for PSS-10 gain scores

- The common language effect size is computed with the following formula: `CL = 1 - pnorm(mu/sd.ch)`
- It quantifies the chance that a participant picked at random at T1 will have a lower PSS-10 score than at T0
- It is written into the `pair.test()` function which analyzes 1-*df* effects

```
pair.test(x = "pss", df.wide = "dat.wide", df.long = "dat.long", plotit = FALSE)$CL
```

```
## [1] 0.7270334
```

4.3 Sensitivity test for survivorship bias in PSS-10 gain score analyses

- This test assigns a PSS-10 gain score of zero for seven participants and re-runs the 1-*df* test analysis

```
pair.test.sensitivity("pss", dropout.n = 7, df.wide = "dat.wide")$res
```

```
## [1] "M (SD) = -3.00 (6.17), 95% CI [-5.61, -0.39], p = 0.026, pR = 0.018"
```

4.4 Feasibility Rates

- Reproduce the feasibility rates

```
feasibility(give = "feas.rates")
```

```
## $`Retention Rate`
##      n.nonrandomized n.completed retention.rate
## [1,]              24          17       70.83333
##
## $`Dropout Rate`
##      n.nonrandomized n.dropout dropout.rate
## [1,]              24         7     29.16667
##
## $`Questionnaire response rate`
##      n.quest response.rate.quest
## [1,]      17                 100
##
## $`VO2max response rate`
##      n.vo2max response.rate.vo2max
## [1,]       17                  100
##
## $`Aerobic Economy rate: 6 km/h`
##      n.economy.6km ae.rate.6km
## [1,]            17         100
##
## $`Aerobic Economy rate: 8 km/h`
##      n.economy.8km ae.rate.8km
## [1,]            17         100
##
## $`Aerobic Economy rate: 10 km/h`
##      n.economy.10km ae.rate.10km
## [1,]             14     82.35294
##
## $`Aerobic Economy rate: 12 km/h`
##      n.economy.12km ae.rate.12km
## [1,]             13     76.47059
##
## $`Aerobic Economy rate: 14 km/h`
##      n.economy.14km ae.rate.14km
## [1,]              4     23.52941
##
## $`Recruitment Rate`
##      n.applied n.nonrandomized recruitment.rate
## [1,]        45              24         53.33333
##
## $`Eligibility inclusion rate`
##      n.applied n.eligible elig.rate
## [1,]        45         28  62.22222
##
## $`Primary reasons for ineligibility`
##
Reason
## 7 Engagement in regular meditation practice within six months prior to the first
assessment
## 3                                    Current diagnosis of a neurological or menta
l disorder
## 8    Engagement in regular running training within six months prior to the first
assessment
##   Freq     %
## 7    4 23.53
## 3    2 11.76
## 8    2 11.76
```

4.5 Safeguard effect size

- Reproduce the safeguard effect size computation for PSS-10 gain scores

```
safeguard.ES(dv = "pss", df = "dat.wide")
```

```
##           dz.LL        MoE
## est  -0.6038652 0.30193258
## 0.8  -0.3716281 0.18581406
## 0.85 -0.3202632 0.16013159
## 0.9  -0.2556906 0.12784531
## 0.95 -0.1600997 0.08004984
```

5 Reproduce Supp. Results Tables

5.1 Supplementary Results Table 1

- Reproduce Supplementary Results Table 1: Summarized results for gains (T1-T0) at multiple confidence limits for psychosocial stress factors, mindfulness, emotion regulation factors, and maximal aerobic capacity
- Use the following function:

```
pair.supp()
```

```
pair.supp() %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	Gain	X80..CI	X85..CI	X90..CI	X95..CI	p
pss_M	-4.24	[-6.51, -1.96]	[-6.81, -1.66]	[-7.21, -1.27]	[-7.84, -0.63]	.024
pss_dav	-0.68	[-1.05, -0.29]	[-1.10, -0.24]	[-1.16, -0.18]	[-1.25, -0.09]	
sdass_M	-4.59	[-5.94, -3.24]	[-6.12, -3.06]	[-6.35, -2.82]	[-6.73, -2.44]	<.001
sdass_dav	-0.77	[-1.03, -0.48]	[-1.07, -0.45]	[-1.11, -0.40]	[-1.18, -0.34]	
adass_M	0.12	[-1.36, 1.59]	[-1.55, 1.79]	[-1.81, 2.05]	[-2.22, 2.46]	.916
adass_dav	0.02	[-0.23, 0.27]	[-0.26, 0.30]	[-0.29, 0.33]	[-0.35, 0.39]	
ddass_M	-4.00	[-6.05, -1.95]	[-6.32, -1.68]	[-6.68, -1.32]	[-7.25, -0.75]	.019
ddass_dav	-0.66	[-1.01, -0.29]	[-1.05, -0.25]	[-1.11, -0.19]	[-1.20, -0.11]	
who_M	9.65	[4.54, 14.75]	[3.87, 15.42]	[2.98, 16.32]	[1.55, 17.75]	.023
who_dav	0.61	[0.26, 0.94]	[0.22, 0.98]	[0.17, 1.03]	[0.08, 1.12]	
maas_M	0.22	[-0.03, 0.46]	[-0.06, 0.49]	[-0.10, 0.53]	[-0.17, 0.60]	.256
maas_dav	0.32	[-0.04, 0.67]	[-0.08, 0.71]	[-0.14, 0.77]	[-0.23, 0.85]	
erq.cr_M	0.86	[0.53, 1.20]	[0.48, 1.24]	[0.42, 1.30]	[0.33, 1.39]	.003
erq.cr_dav	0.65	[0.36, 0.93]	[0.32, 0.96]	[0.28, 1.01]	[0.21, 1.08]	

	Gain	X80..CI	X85..CI	X90..CI	X95..CI	p
rrs.br_M	-1.41	[-2.24, -0.58]	[-2.35, -0.48]	[-2.49, -0.33]	[-2.72, -0.10]	.037
rrs.br_dav	-0.37	[-0.60, -0.14]	[-0.62, -0.11]	[-0.66, -0.08]	[-0.72, -0.02]	
pswq_M	-6.18	[-9.44, -2.92]	[-9.86, -2.49]	[-10.43, -1.92]	[-11.34, -1.01]	.022
pswq_dav	-0.44	[-0.68, -0.19]	[-0.71, -0.16]	[-0.75, -0.12]	[-0.81, -0.06]	
vo2max_M	0.25	[-1.69, 2.19]	[-1.95, 2.44]	[-2.29, 2.78]	[-2.83, 3.32]	.868
vo2max_dav	0.03	[-0.20, 0.26]	[-0.23, 0.28]	[-0.26, 0.32]	[-0.32, 0.38]	

5.2 Supplementary Results Table 2

- Reproduce Supplementary Results Table 2: Summarized results for follow-up pairwise contrast gains (T1-T0) at multiple confidence limits for the fixed effect of time (absolute oxygen cost, relative oxygen cost, heart rate, and perceived exertion) and interaction (relative oxygen cost)
- Use the following function:

```
supp.lmm()
```

```
supp.lmm() %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

```
## NOTE: Results may be misleading due to involvement in interactions
## NOTE: Results may be misleading due to involvement in interactions
## NOTE: Results may be misleading due to involvement in interactions
## NOTE: Results may be misleading due to involvement in interactions
```

name	gain	80% CI	85% CI	90% CI	95% CI	p
vo2.time	-0.14	[-0.20, -0.07]	[-0.21, -0.06]	[-0.22, -0.05]	[-0.24, -0.04]	.007
pcnt.vo2.time	-4.37	[-5.77, -2.96]	[-5.95, -2.79]	[-6.18, -2.56]	[-6.53, -2.20]	<.001
pcnt.vo2.int	-1.42	[-4.23, 1.40]	[-4.58, 1.75]	[-5.04, 2.21]	[-5.75, 2.91]	.517
pcnt.vo2.int	-2.34	[-5.15, 0.48]	[-5.50, 0.83]	[-5.96, 1.29]	[-6.67, 1.99]	.286
pcnt.vo2.int	-5.91	[-8.72, -3.09]	[-9.07, -2.74]	[-9.53, -2.28]	[-10.24, -1.57]	.008
pcnt.vo2.int	-7.81	[-10.63, -5.00]	[-10.98, -4.65]	[-11.43, -4.19]	[-12.14, -3.48]	.001
hr.time	-4.56	[-6.63, -2.50]	[-6.89, -2.24]	[-7.23, -1.90]	[-7.75, -1.38]	.005
rpe.time	-0.71	[-0.96, -0.47]	[-0.99, -0.43]	[-1.03, -0.39]	[-1.09, -0.33]	<.001

5.3 Supplementary Results Table 3

- Reproduce Supplementary Results Table 3: Summarized results of the linear mixed model for absolute oxygen cost (OC)
- Use the following function:

```
supp.model("vo2.dv")
```

```
res = supp.model("vo2.dv")

res$delete %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	logLik	AIC	LRT	Df	Pr(>Chisq)
<none>	-38.17	96.34	NA	NA	NA
(1 | id)	-78.74	175.48	81.14	1	<.001

```
res$model %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	2.10	0.11	12.00	18.90	<.001
time1	0.07	0.02	84.00	2.75	.007
samp1	-0.90	0.04	84.00	-20.88	<.001
samp2	-0.20	0.04	84.00	-4.69	<.001
samp3	0.33	0.04	84.00	7.69	<.001
time1:samp1	-0.05	0.04	84.00	-1.28	.205
time1:samp2	-0.03	0.04	84.00	-0.79	.430
time1:samp3	0.03	0.04	84.00	0.60	.552

```
res$variance %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	V1	**V2**
RFX	Variance	SD
RFX (intercept)	0.15	0.39
Residual	0.06	0.25

5.4 Supplementary Results Table 4

- Reproduce Supplementary Results Table 4: Summarized results of the linear mixed model for relative oxygen cost (% VO2max) cost (OC)
- Use the following function:

```
supp.model("pcnt.vo2.dv")
```

```
res = supp.model("pcnt.vo2.dv")

res$delete %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	logLik	AIC	LRT	Df	Pr(>Chisq)
<none>	-327.68	675.36	NA	NA	NA
(1 | id)	-341.19	700.38	27.02	1	<.001

```
res$model %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	61.31	1.37	12.00	44.66	<.001
time1	2.18	0.54	84.00	4.01	<.001
samp1	-26.54	0.94	84.00	-28.14	<.001
samp2	-6.12	0.94	84.00	-6.49	<.001
samp3	9.86	0.94	84.00	10.46	<.001
time1:samp1	-1.48	0.94	84.00	-1.56	.121
time1:samp2	-1.02	0.94	84.00	-1.08	.284
time1:samp3	0.77	0.94	84.00	0.82	.417

```
res$variance %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	V1	**V2**
RFX	Variance	SD
RFX (intercept)	20.65	4.54
Residual	30.82	5.55

5.5 Supplementary Results Table 5

- Reproduce Supplementary Results Table 5: Summarized results of the linear mixed model for heart rate (beats/min)
- Use the following function:

```
supp.model("hr.dv")
```

```
res = supp.model("hr.dv")

res$delete %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	logLik	AIC	LRT	Df	Pr(>Chisq)
<none>	-369.37	758.75	NA	NA	NA
(1 | id)	-399.71	817.42	60.67	1	<.001

```
res$model %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	154.93	2.99	12.00	51.89	<.001
time1	2.28	0.80	84.00	2.85	.005
samp1	-31.73	1.39	84.00	-22.89	<.001
samp2	-5.78	1.39	84.00	-4.17	<.001
samp3	12.07	1.39	84.00	8.70	<.001
time1:samp1	-0.94	1.39	84.00	-0.68	.498
time1:samp2	-0.13	1.39	84.00	-0.09	.926
time1:samp3	0.03	1.39	84.00	0.02	.982

```
res$variance %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	V1	**V2**
RFX	Variance	SD
RFX (intercept)	107.56	10.37
Residual	66.62	8.16

5.6 Supplementary Results Table 6

- Reproduce Supplementary Results Table 6: Summarized results of the linear mixed model for perceived exertion (RPE)
- Use the following function:

```
supp.model("rpe.dv")
```

```
res = supp.model("rpe.dv")

res$delete %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	logLik	AIC	LRT	Df	Pr(>Chisq)
<none>	-160.46	340.92	NA	NA	NA
(1 | id)	-174.08	366.16	27.24	1	<.001

```
res$model %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

1	Estimate	Std. Error	df	t value	Pr(>|t|)
(Intercept)	10.91	0.24	12.00	45.25	<.001
time1	0.36	0.10	84.00	3.73	<.001
samp1	-3.53	0.17	84.00	-21.37	<.001
samp2	-0.91	0.17	84.00	-5.53	<.001
samp3	1.05	0.17	84.00	6.35	<.001
time1:samp1	-0.20	0.17	84.00	-1.22	.225
time1:samp2	0.11	0.17	84.00	0.64	.524
time1:samp3	0.07	0.17	84.00	0.41	.685

```
res$variance %>%
  kable() %>%
  kable_styling(bootstrap_options = c("striped", "hover", "condensed"))
```

	V1	**V2**
RFX	Variance	SD
RFX (intercept)	0.64	0.80
Residual	0.95	0.97

6 Reproduce Figures

6.1 Figure 1

- Figure 1 was produced in Adobe Illustrator
- The data within this figure can be reproduced using the following function:

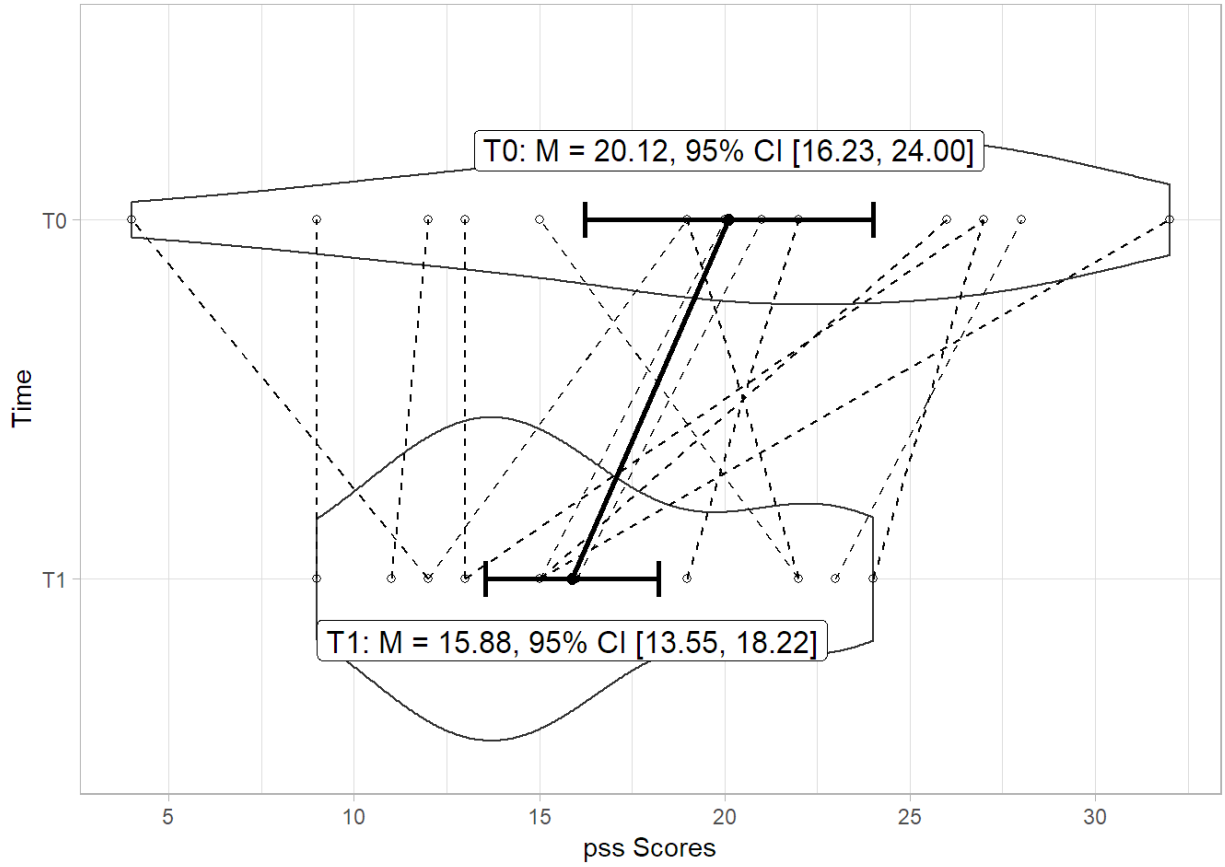
```
feasibility(give = "participant.flow")
```

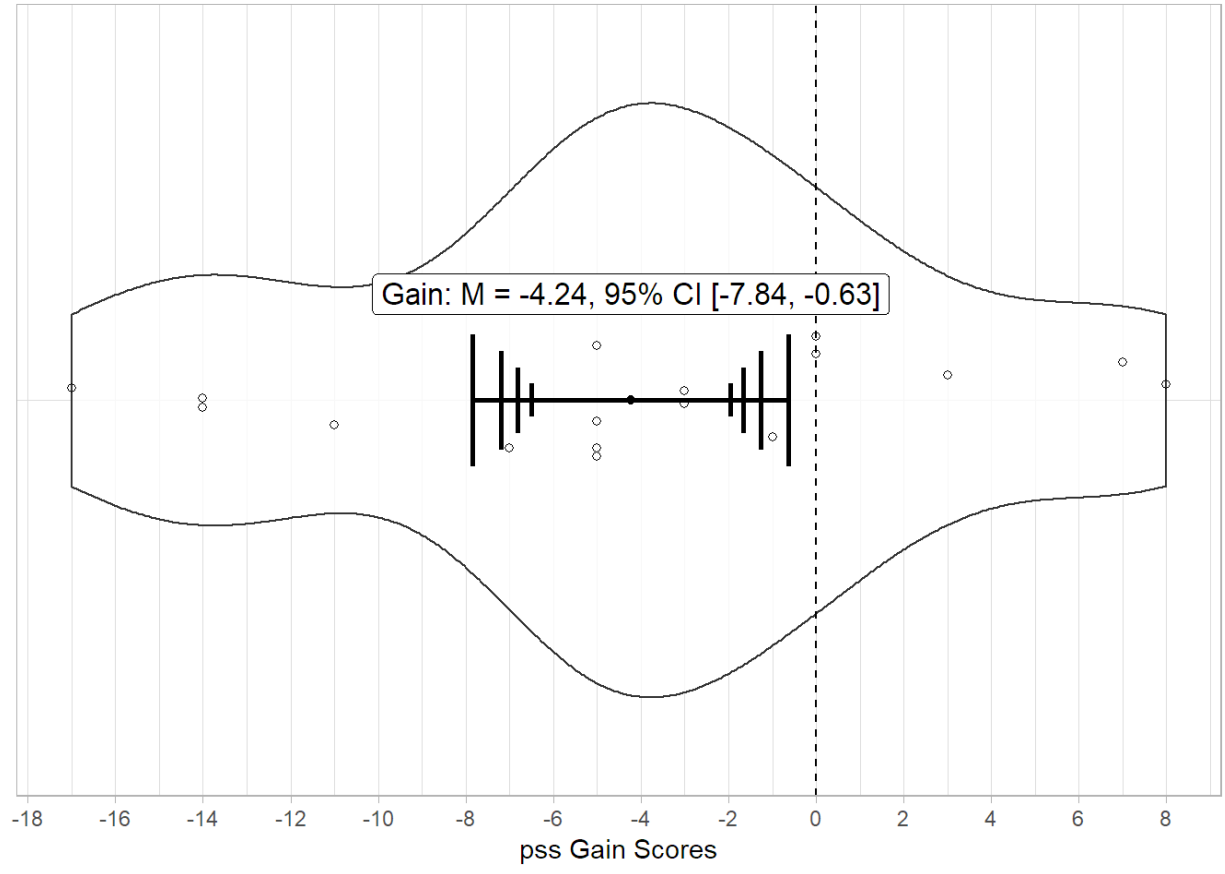
```
## $`Assessed for eligibility`
## [1] 45
##
## $Excluded
## [1] 21
##
## $`Not meeting inclusion criteria`
## [1] 17
##
## $`Declined to participate`
## [1] 4
##
## $Nonrandomized
## [1] 24
##
## $`Allocated to intervention`
## [1] 24
##
## $`Did not receive allocated intervention`
## [1] 0
##
## $`Completed intervention`
## [1] 17
##
## $`Discontinued intervention`
## [1] 7
##
## $`Reasons for discontinuation`
##                                                    Reason Freq     %
## 3                                              Time burden    4 57.14
## 2                                           Running injury    2 28.57
## 1 Injury unrelated to intervention that prevented running    1 14.29
##
## $`N included in analysis (questionnaire)`
## [1] 17
##
## $`N excluded (questionnaire)`
## [1] 0
##
## $`N included in analysis (vo2max)`
## [1] 17
##
## $`N excluded (vo2max)`
## [1] 0
##
## $`N included in analysis (economy)`
## [1] 13
##
## $`N excluded (economy)`
## [1] 4
##
## $`N excluded (economy) reason`
## [1] "4 did not attain a steady-state velocity across all of 6, 7, 10, and 12 km/
h"
```

6.2 Figure 2A/2B

- Reproduce Figure 2A and 2B (PSS-10 scores)

```
fig2AB = pair.test(x = "pss", df.wide = "dat.wide", df.long = "dat.long", plotit = T
RUE)
```

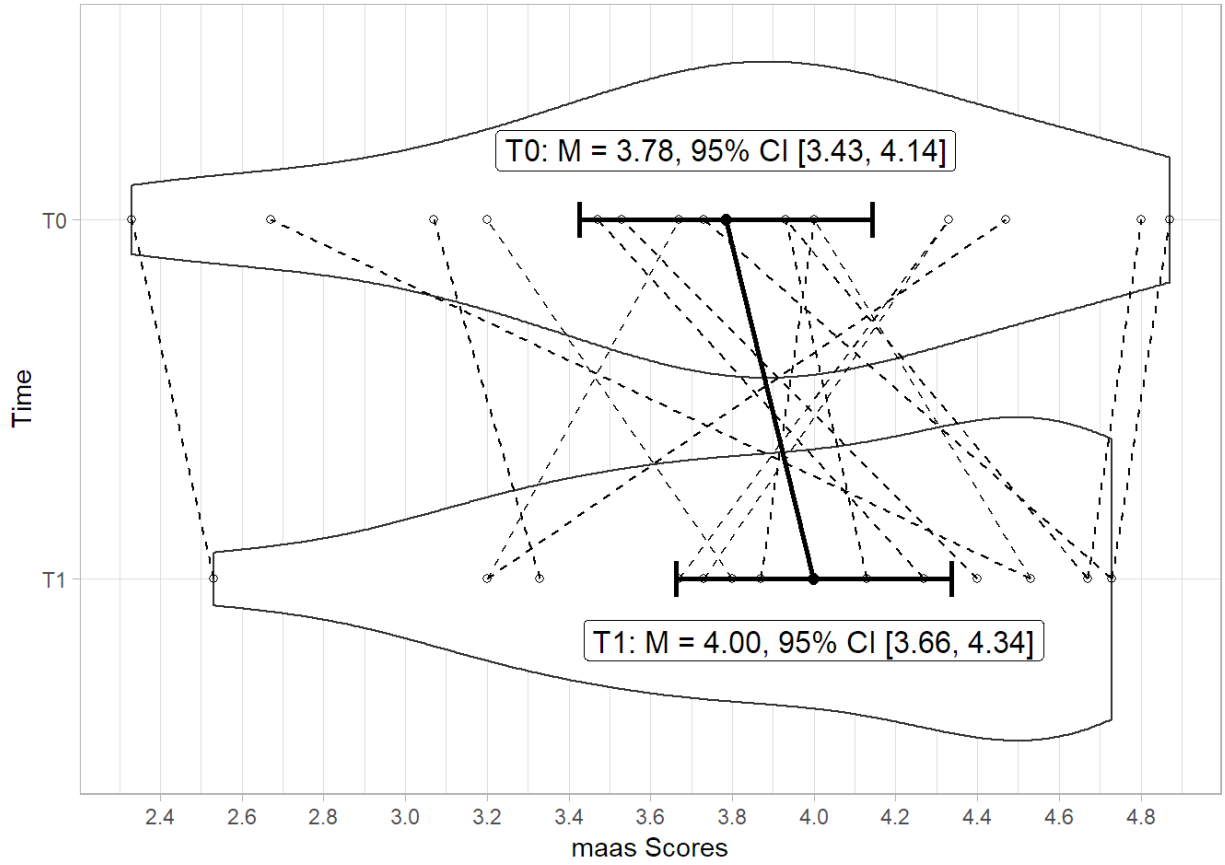


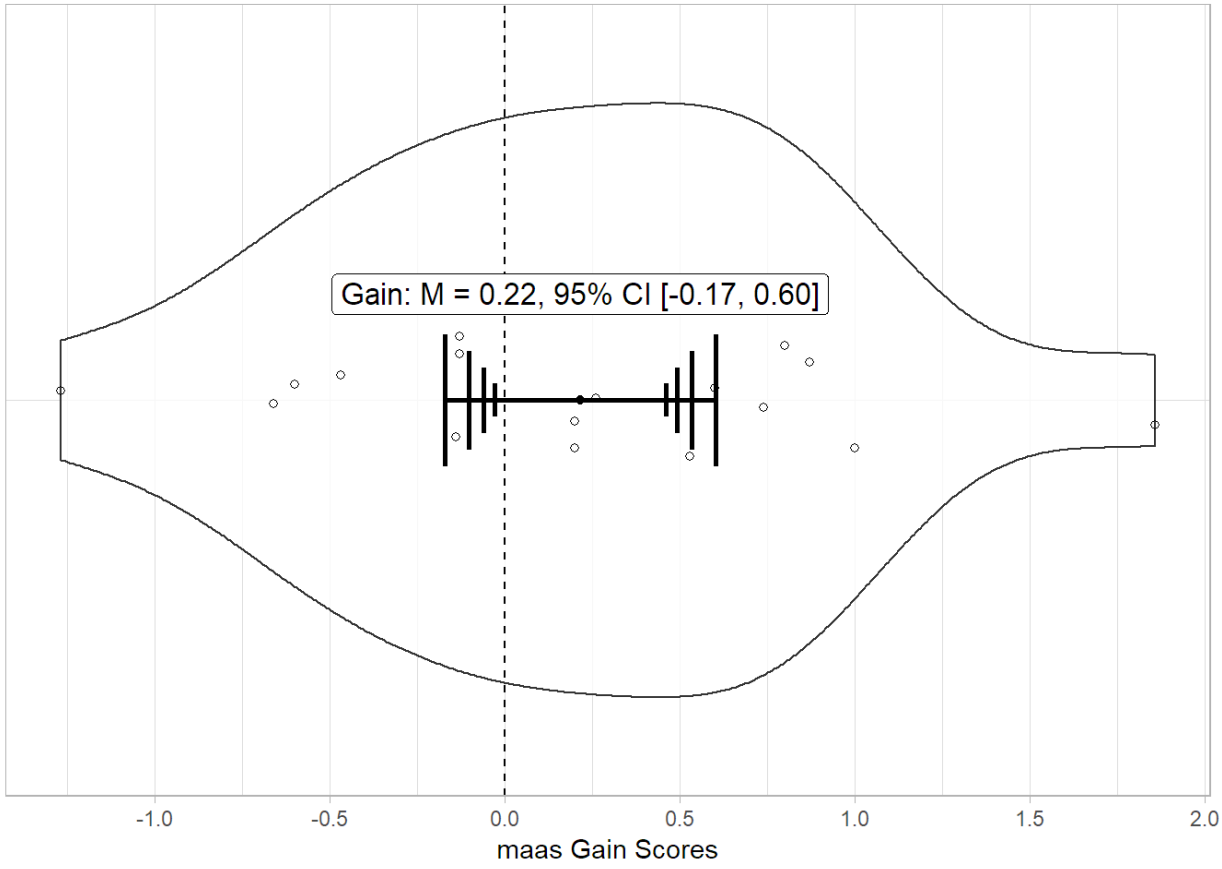


6.3 Figure 2C

- Reproduce Figure 2C (MAAS scores)

```
fig2C = pair.test(x = "maas", df.wide = "dat.wide", df.long = "dat.long", plotit = T
RUE)
```

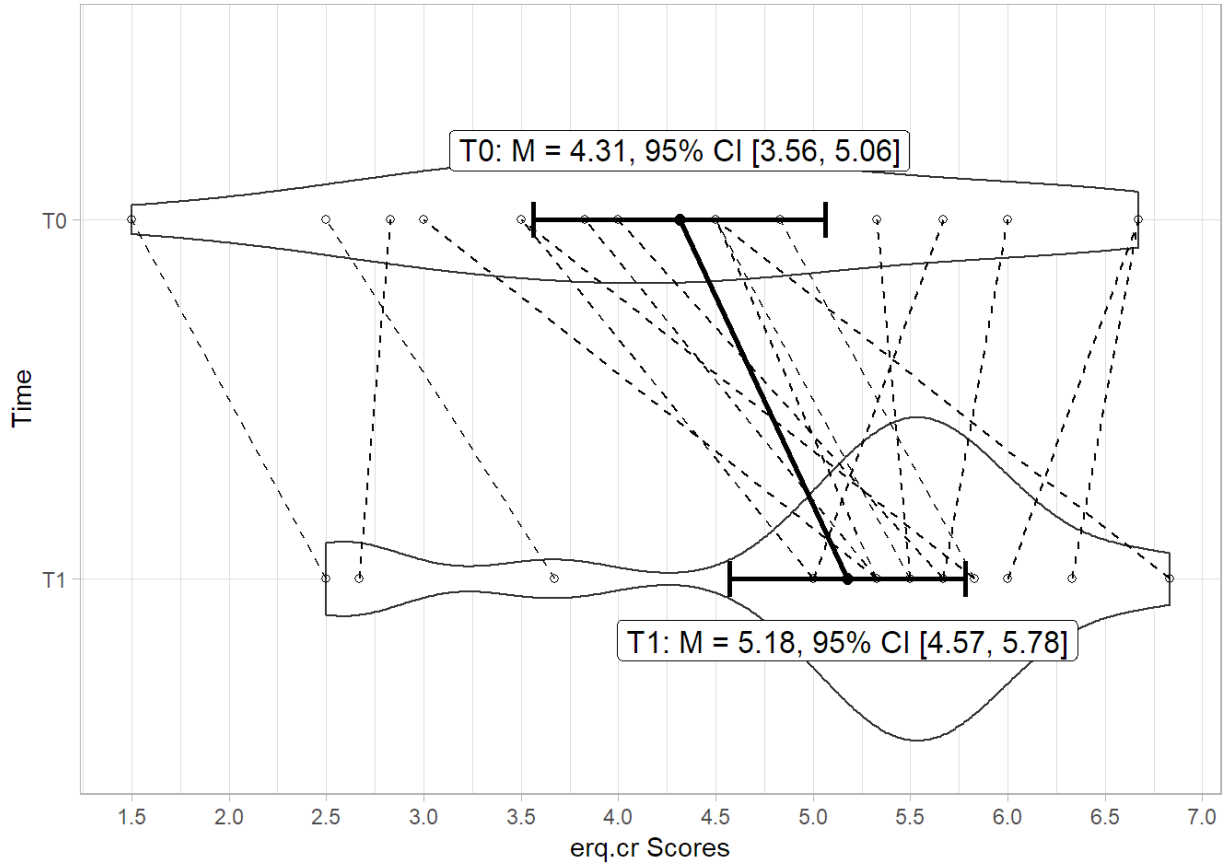


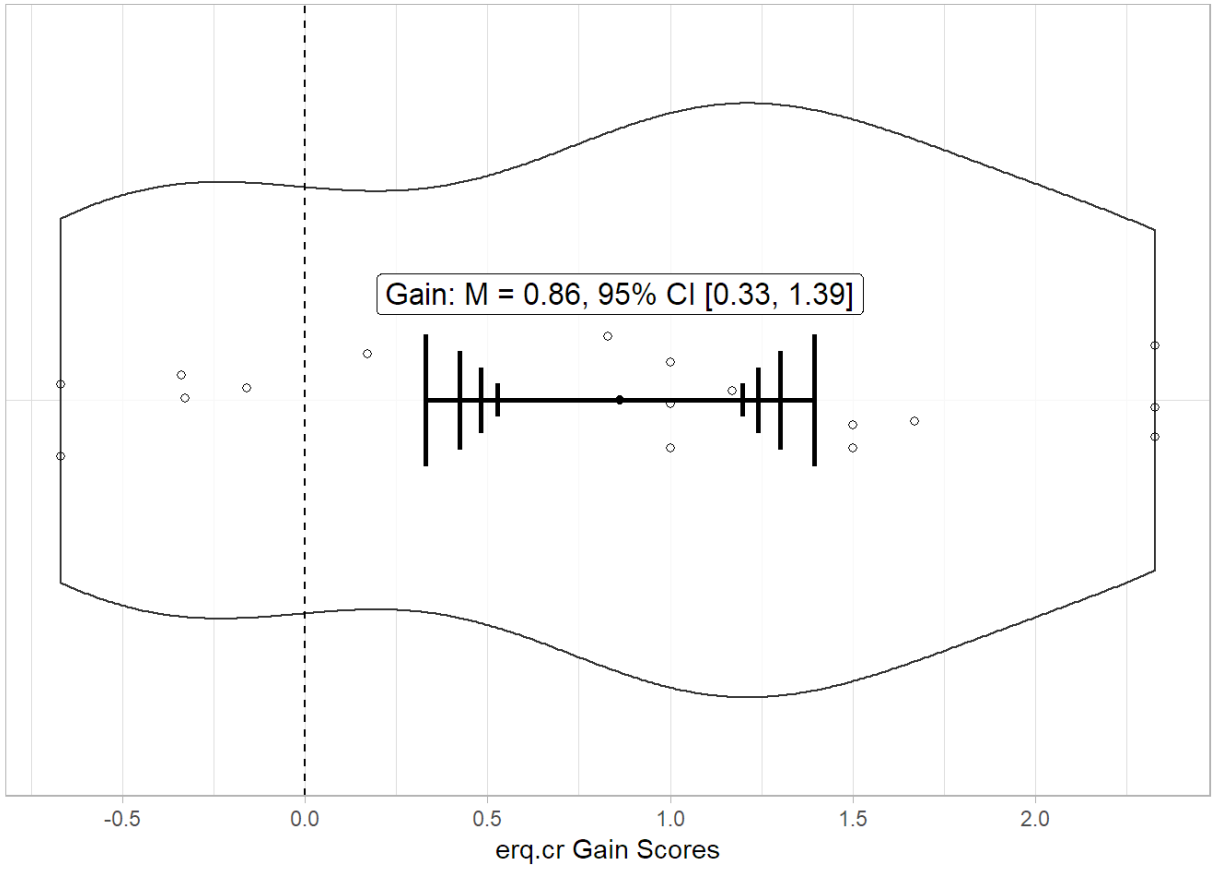


6.4 Figure 2D

- Reproduce Figure 2D (ERQ-CR scores)

```
fig2D = pair.test(x = "erq.cr", df.wide = "dat.wide", df.long = "dat.long", plotit = TRUE)
```

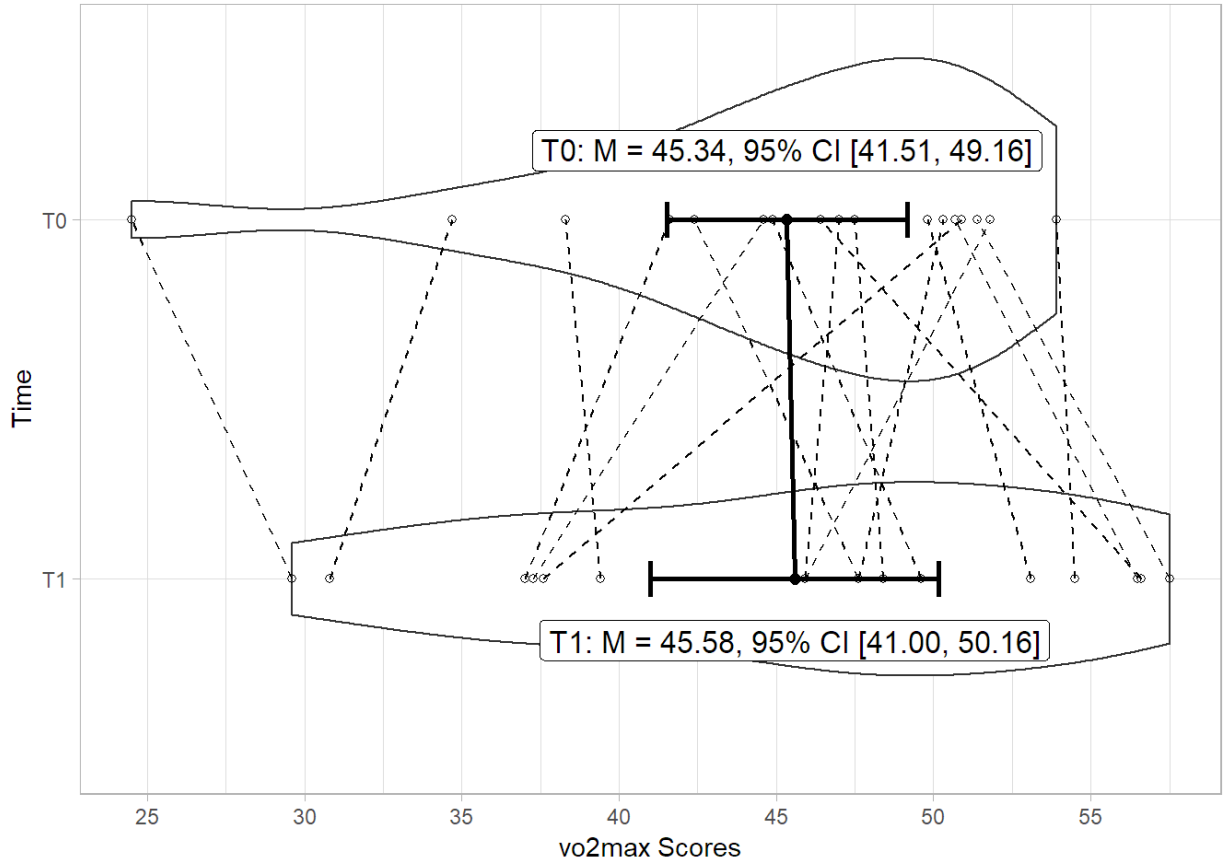


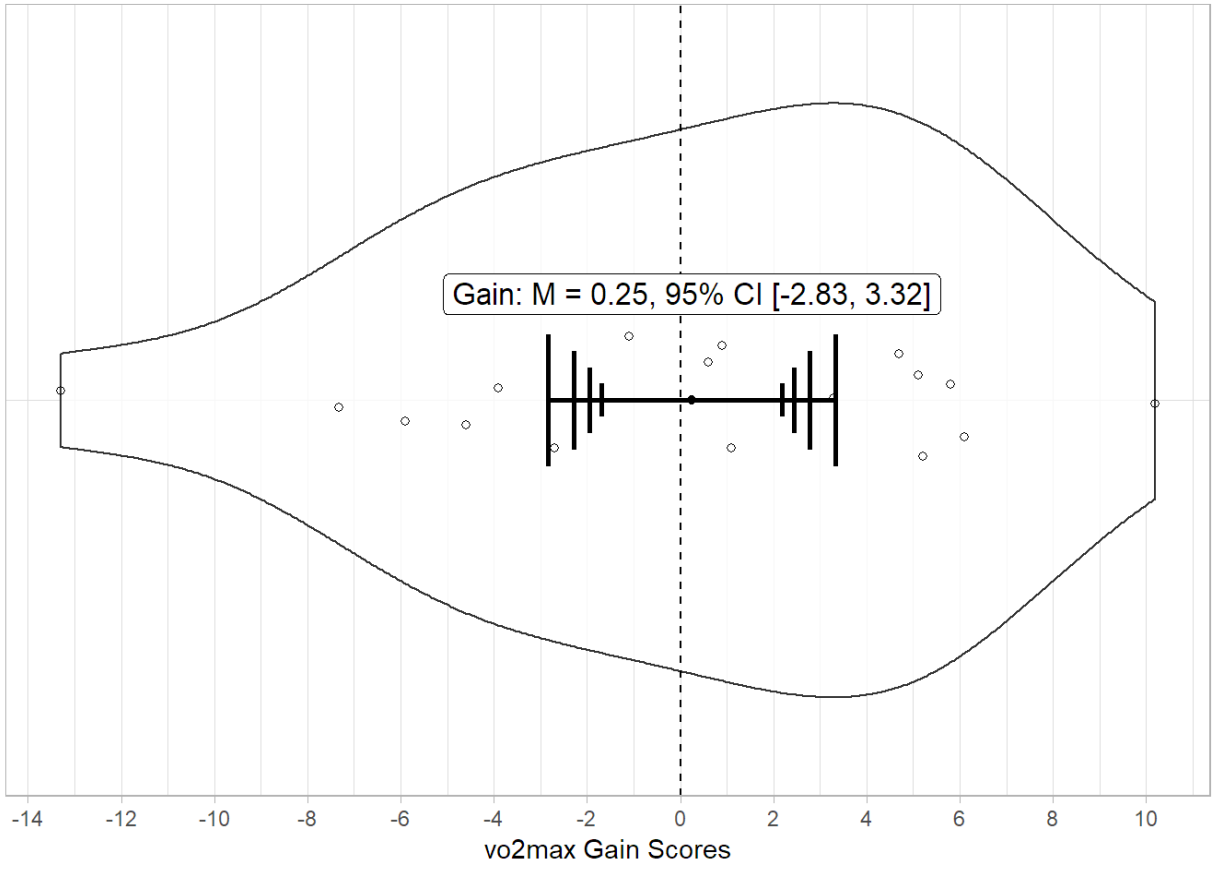


6.5 Figure 2E

- Reproduce Figure 2E (VO2max scores)

```
fig2E = pair.test(x = "vo2max", df.wide = "dat.wide", df.long = "dat.long", plotit = TRUE)
```



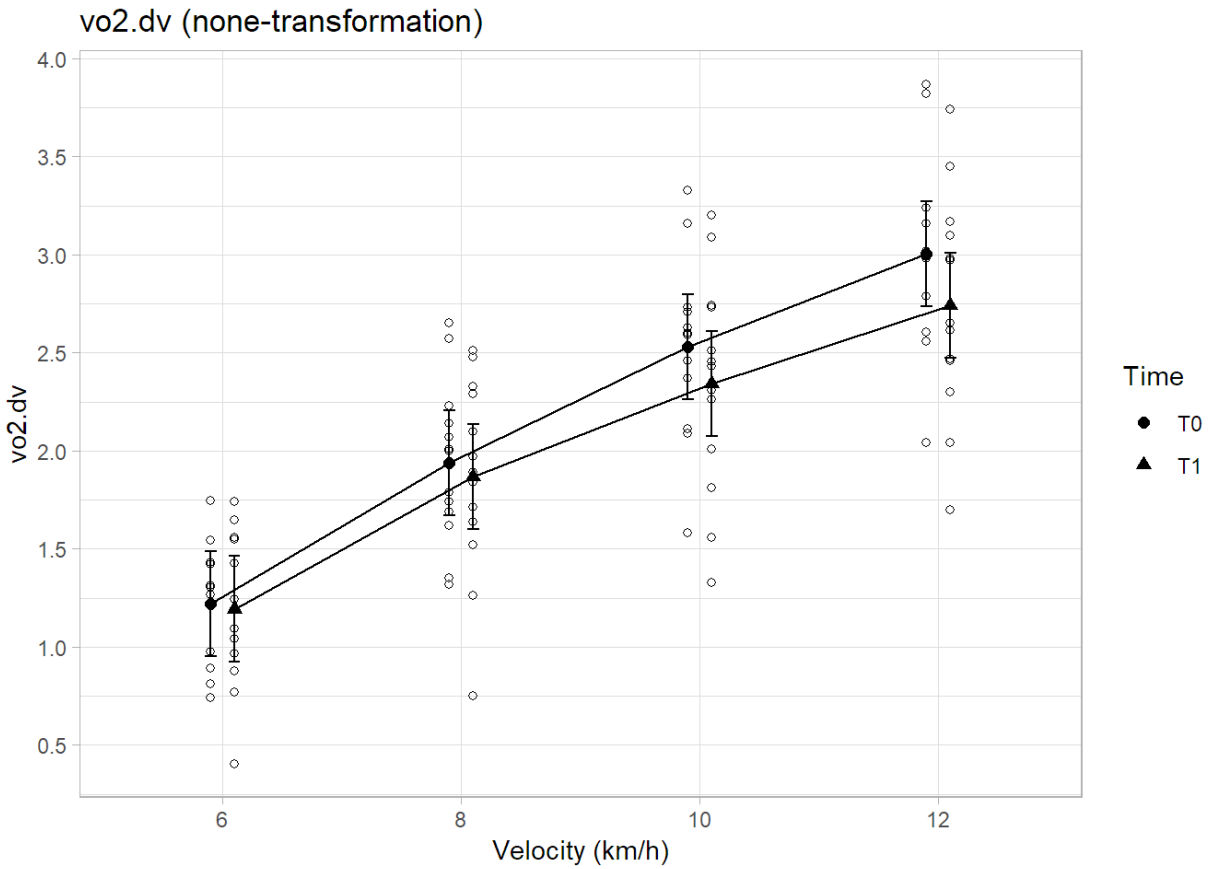


6.6 Figure 3A

- Reproduce Figure 3A: Dot plots of aerobic economy data across velocity and time for absolute oxygen cost (VO2 L/min)

```
fig3A = emm.test(econ = "vo2.dv", df = "dat.econ.long", transf = "none", effect = "time")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

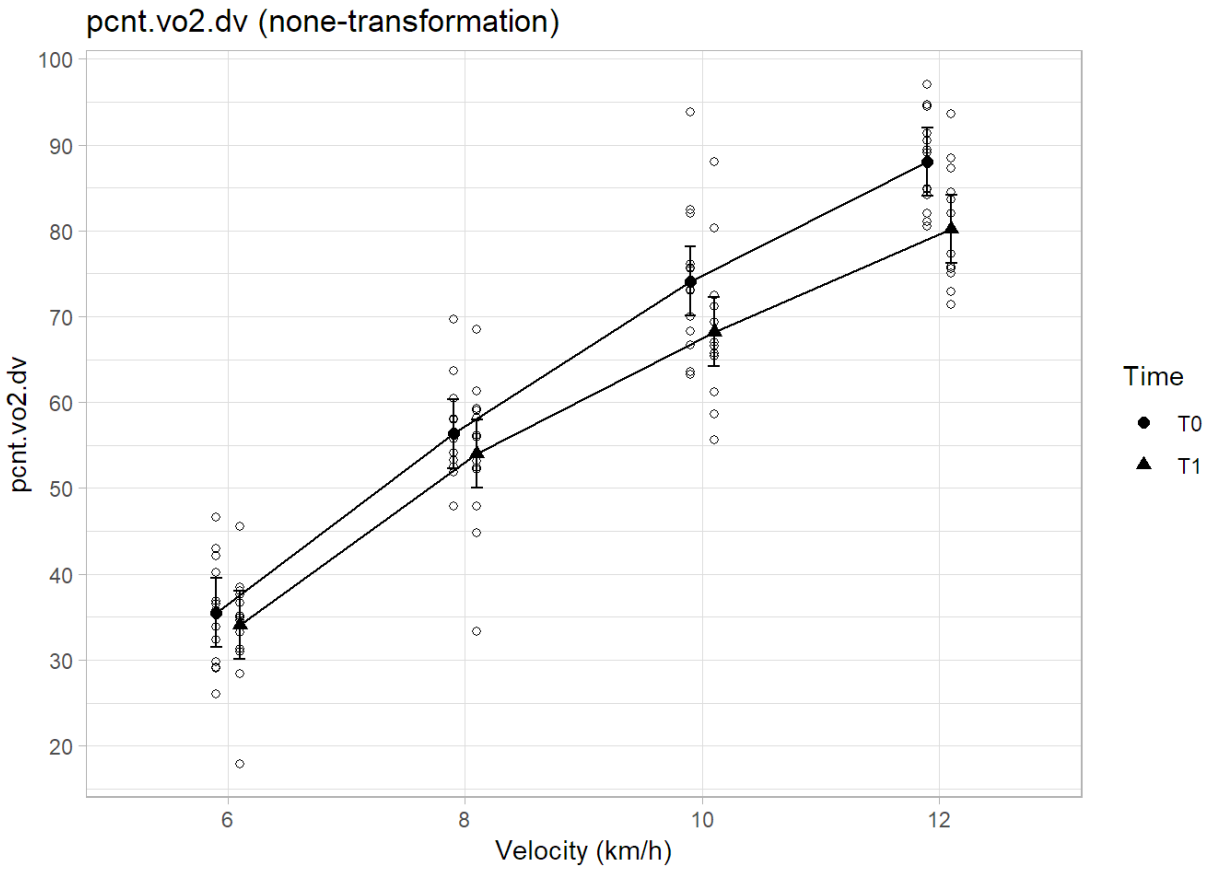


6.7 Figure 3B

- Reproduce Figure 3B: Dot plots of aerobic economy data across velocity and time for relative oxygen cost (% VO2max)

```
fig3B = emm.test(econ = "pcnt.vo2.dv", df = "dat.econ.long", transf = "none", effect = "time")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

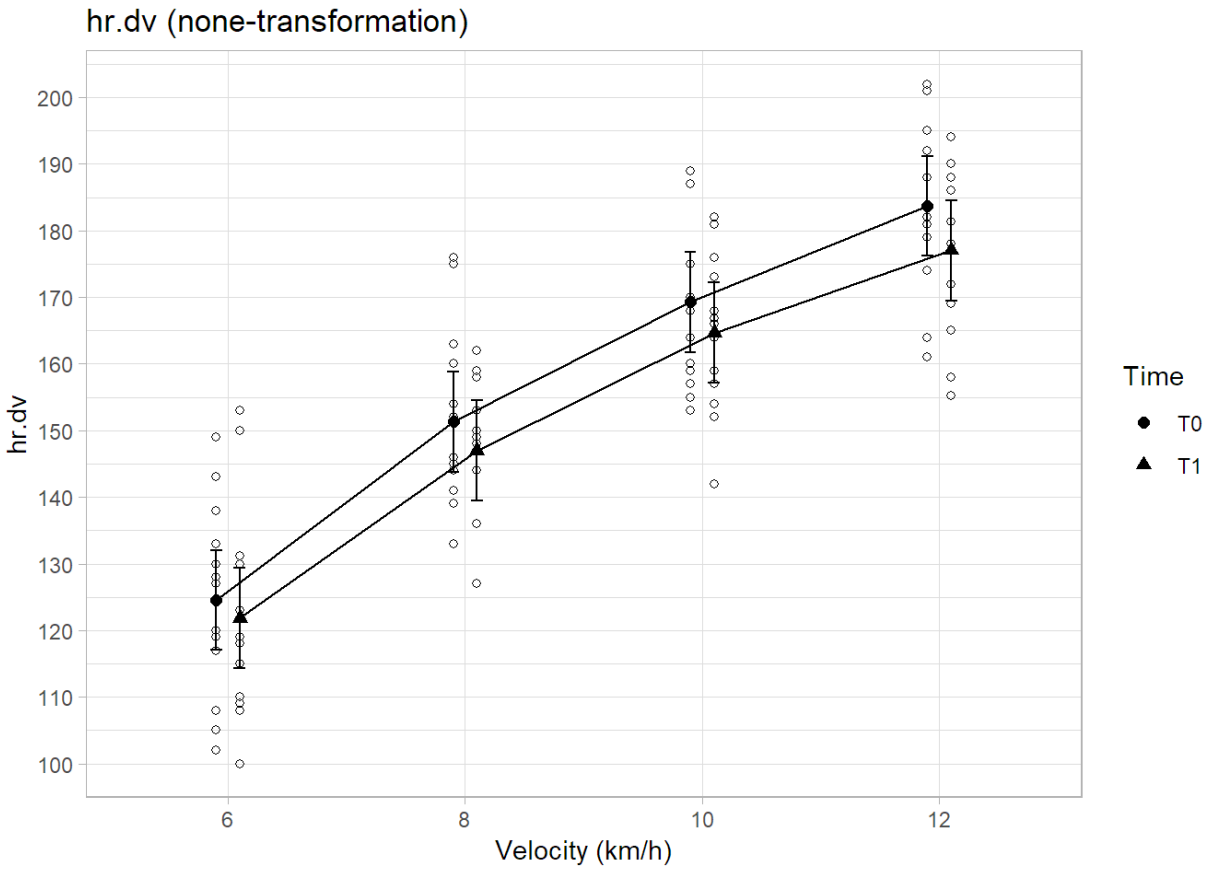


6.8 Figure 3C

- Reproduce Figure 3C: Dot plots of aerobic economy data across velocity and time for heart rate

```
fig3C = emm.test(econ = "hr.dv", df = "dat.econ.long", transf = "none", effect = "ti
me")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

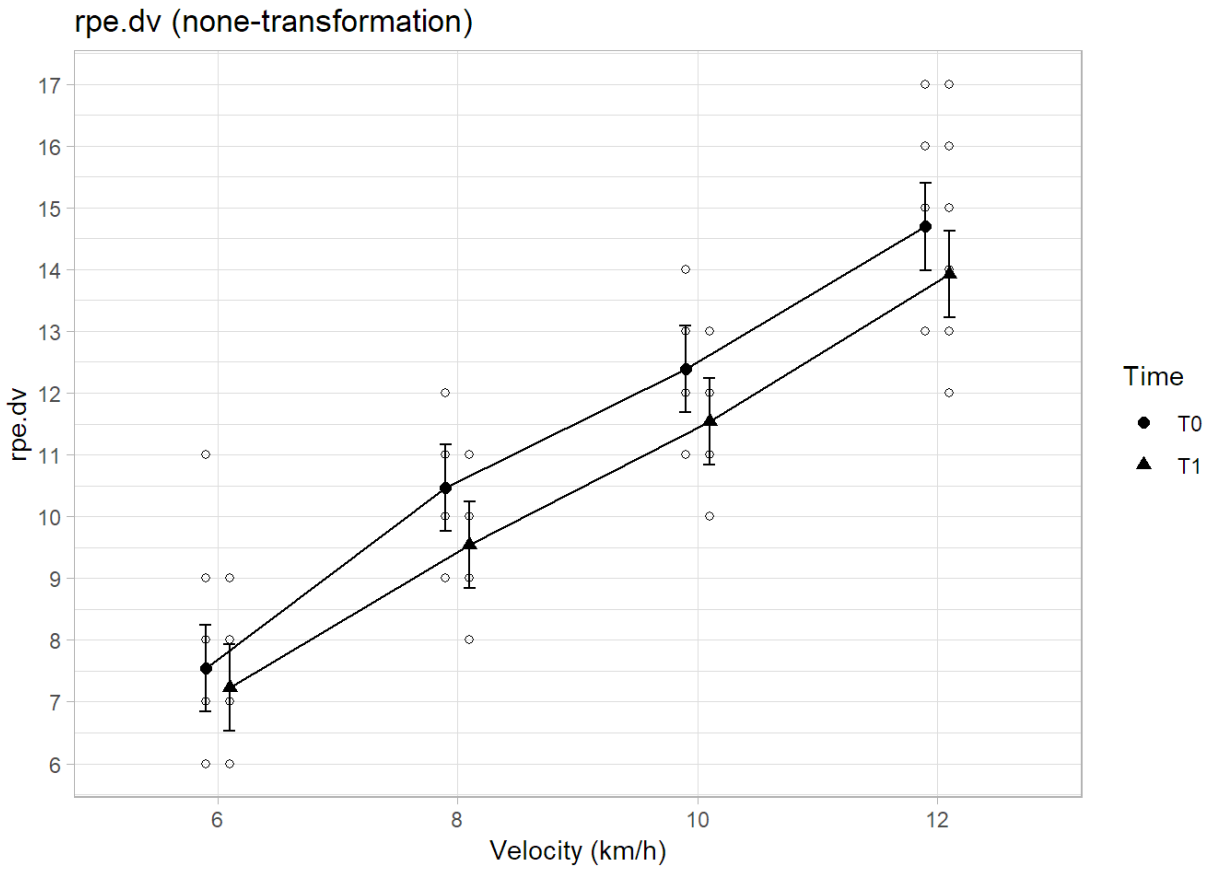


6.9 Figure 3D

- Reproduce Figure 3D: Dot plots of aerobic economy data across velocity and time for perceived exertion (RPE)

```
fig3D = emm.test(econ = "rpe.dv", df = "dat.econ.long", transf = "none", effect = "t
ime")
```

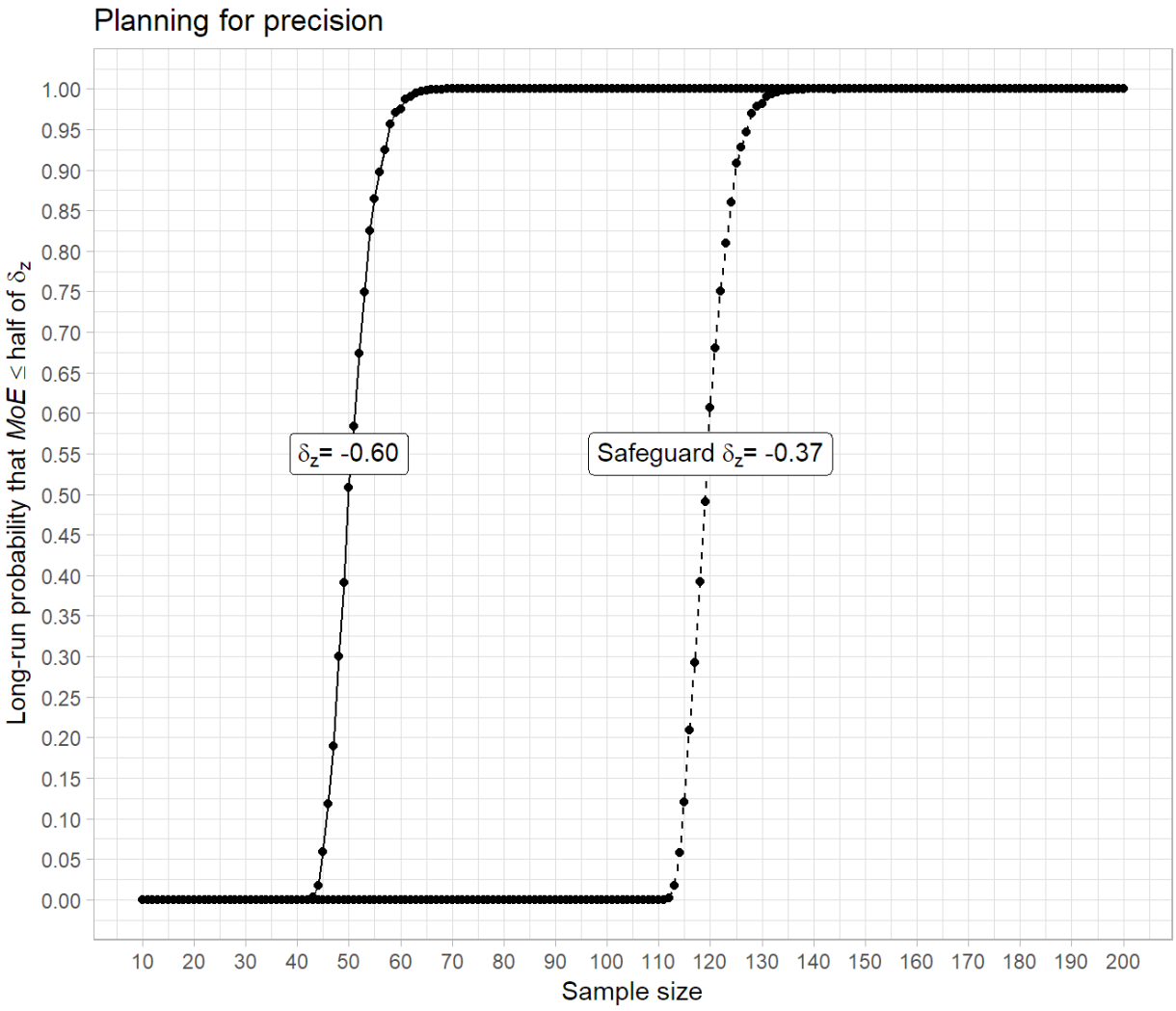
```
## NOTE: Results may be misleading due to involvement in interactions
```



6.10 Figure 4

- Reproduce Figure 4: Sample size curves for within-group changes in PSS-10 using the pilot estimation of effect size (dz) and a safeguard estimate of effect size (safeguard dz)

```
precPLOT.pair()
```



6.11 AIPE with assurance simulations

- These simulations are not run in this markdown file because each can take hours at a time.
- To independently reproduce our AIPE with assurance results you may run each of the following functions (note: these results will be identical to those reported in the manuscript because a seed has been set):

6.11.1 dz = -0.60

```
aipe.assurance(d = as.numeric(safeguard.ES(dv = "pss", df = "dat.wide")["est",][1]),
               reps = 2000,
               n.seq = c(10,200,1),
               effect = "dz",
               seed = TRUE)
```

6.11.2 Safeguard dz = -0.37

```
aipe.assurance(d = as.numeric(safeguard.ES(dv = "pss", df = "dat.wide")["0.8",][1]),
               reps = 2000,
               n.seq = c(10,200,1),
               effect = "dz",
               seed = TRUE)
```

6.11.3 Between-group effect sizes ds

```
aipe.assurance(d = 0.8, reps = 2000, n.seq = c(10,900,1), effect = "ds", seed = TRUE
)
aipe.assurance(d = 0.7, reps = 2000, n.seq = c(10,900,1), effect = "ds", seed = TRUE
)
aipe.assurance(d = 0.6, reps = 2000, n.seq = c(10,900,1), effect = "ds", seed = TRUE
)
aipe.assurance(d = 0.5, reps = 2000, n.seq = c(10,900,1), effect = "ds", seed = TRUE
)
aipe.assurance(d = 0.4, reps = 2000, n.seq = c(10,900,1), effect = "ds", seed = TRUE
)
aipe.assurance(d = 0.3, reps = 2000, n.seq = c(10,900,1), effect = "ds", seed = TRUE
)
aipe.assurance(d = 0.2, reps = 2000, n.seq = c(10,900,1), effect = "ds", seed = TRUE
)
```