

# Visualization Literacy Analysis

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3/22/2022

## Read in data files

```
#grab files from google drive (only have to do this once)
# source("getFromGoogleDrive.R")

#get the first 6? characters of each data file
#get unique values of these
# this is list of subject ids

raw_file_names <- list.files("AccData")
first_six <- substr(raw_file_names, 1, 6)
sub_ids <- unique(first_six)

# fast_RTs <- data.frame(ParticipantId = character(),
#                        TrialName = character(),
#                        type = character(),
#                        time = numeric()
# )

all_data <- NULL

for (i in 1:length(sub_ids)){

  if (grepl("~$", sub_ids[i], fixed = T)){
    next
  }

  temp_file1 <- read_xlsx(paste0("AccData/", sub_ids[i], "_1.xlsx")) %>%
    slice(1:17) %>%
    select(-starts_with("Order")) %>%
    rename(correct = 8)

  temp_file2 <- read_xlsx(paste0("AccData/", sub_ids[i], "_2.xlsx")) %>%
    slice(1:17) %>%
    select(-starts_with("Order")) %>%
    rename(correct = 8)

  new_temp <- temp_file1 %>%
    bind_cols(temp_file2$correct) %>%
    rename(Correct_1 = correct, Correct_2 = "...9") %>%
    mutate(AnswerRT = TimeToBeginInput - TimeToReadQuestion)
```

```

all_data <- all_data %>%
  bind_rows(new_temp)
}

all_data <- all_data %>%
  rename(readRT = TimeToReadQuestion, totalRT = TimeToBeginInput)

#read in trialtype key (I created this from an early version of the previous paper)
trial_type_key <- read.csv("trial_type_key.csv", stringsAsFactors = F)

all_data <- all_data %>%
  mutate(TrialType = trial_type_key$TrialType[match(TrialName, trial_type_key$TrialName)]) %>%
  mutate(TrialType = paste0("Type", TrialType))

```

## Basic checks

```

#how many participants per condition
all_data %>%
  group_by(ParticipantId, Condition) %>%
  summarize(ntrials = n()) %>%
  group_by(Condition) %>%
  summarize(nsubs = n()) %>%
  kable()

```

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

Condition	nsubs
VR	50
VR Monitor	39
VR Monitor Stereo	33

*#why is the balance so off?*

## Remove outliers based on RT

```

#removing on trial-by-trial basis

#remove answerRTs below 2000ms first
all_data_remove <- all_data %>%
  filter(AnswerRT >= 2000)
dim(all_data)[1]

```

```
## [1] 2074
```

```
dim(all_data_remove)[1]
```

```
## [1] 2067
```

```
#drops 7 trials
```

```
rt_data_summary <- all_data %>%  
  group_by(TrialName) %>%  
  summarize(meanAnswerRT = mean(AnswerRT, na.rm = T),  
            sdAnswerRT = sd(AnswerRT, na.rm = T),  
            UB = meanAnswerRT + 3*sdAnswerRT,  
            LB = meanAnswerRT - 3*sdAnswerRT)  
rt_data_summary
```

```
## # A tibble: 17 x 5  
##   TrialName      meanAnswerRT sdAnswerRT      UB      LB  
##   <chr>          <dbl>      <dbl>    <dbl>  <dbl>  
## 1 BarChartQ1      27611.    14762.   71897. -16675.  
## 2 BarChartQ2      16921.    13338.   56935. -23093.  
## 3 BarChartQ3      15609.     9948.  45452. -14235.  
## 4 BarChartQ4      10288.     8978.  37222. -16646.  
## 5 LineChartQ1      49185.   29505. 137699. -39329.  
## 6 LineChartQ2      40127.   31660. 135107. -54854.  
## 7 LineChartQ3      27190.   17504.  79701. -25322.  
## 8 LineChartQ4      14779.   16568.  64483. -34925.  
## 9 LineChartQ5      27877.   17250.  79628. -23874.  
## 10 ScatterplotQ1    32801.   24294. 105682. -40080.  
## 11 ScatterplotQ2    29636.   23980. 101576. -42304.  
## 12 ScatterplotQ3    45580.   33014. 144623. -53463.  
## 13 ScatterplotQ4    35987.   25402. 112194. -40219.  
## 14 ScatterplotQ5    59805.   42684. 187859. -68248.  
## 15 SurfacePlotQ1    56608.   36042. 164733. -51516.  
## 16 SurfacePlotQ2    65110.   50062. 215297. -85076.  
## 17 SurfacePlotQ3    48373.   37424. 160646. -63900.
```

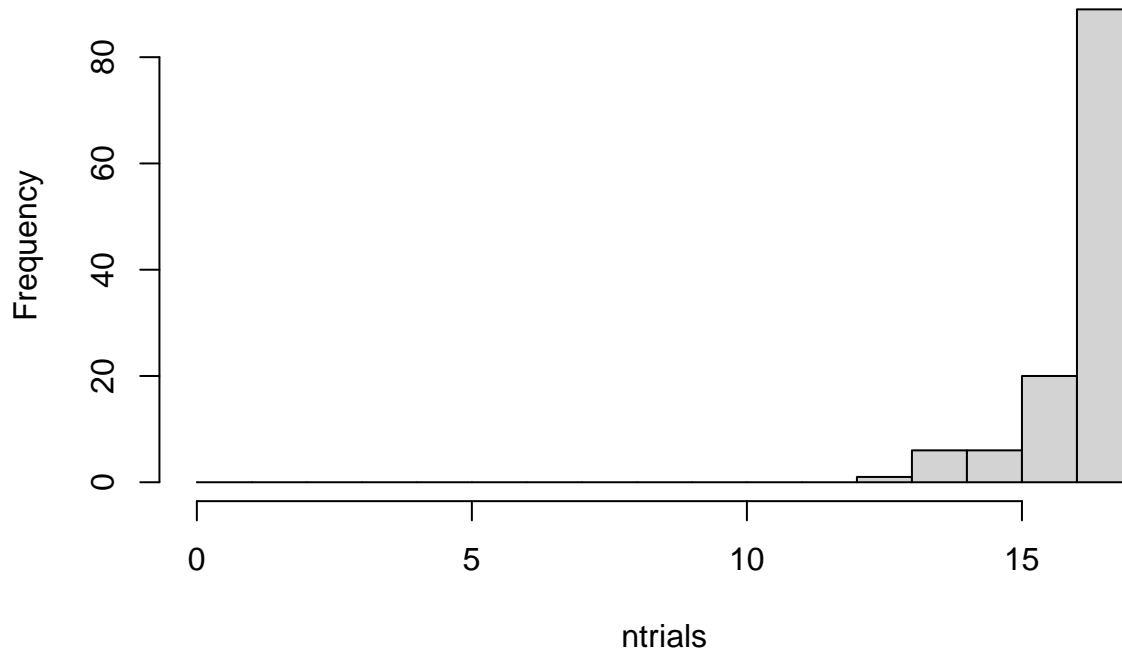
```
all_data_no_outliers <- all_data_remove %>%  
  group_by(TrialName) %>%  
  filter(!(abs(AnswerRT - mean(AnswerRT)) > 3*sd(AnswerRT)))  
dim(all_data_no_outliers)[1]
```

```
## [1] 2020
```

```
#drops 47 more trials
```

```
all_data_no_outliers %>%  
  group_by(ParticipantId) %>%  
  summarize(ntrials = n()) %>%  
  with(hist(ntrials, breaks = 0:17))
```

## Histogram of ntrials



*##maybe consider replacing outliers with means instead of removing them?*

Compare RTs for conditions and question type (three types: identify, relate, predict)

*#compare read times (should be no differences of condition)*  
*#compare answer times (potentially a difference)*

```
trial_type_means <- all_data_no_outliers %>%  
  group_by(ParticipantId, Condition, TrialType) %>%  
  summarize(mean_readRT = mean(readRT),  
            mean_answerRT = mean(AnswerRT),  
            n = n())
```

## `summarise()` has grouped output by 'ParticipantId', 'Condition'. You can override using  
## the `.groups` argument.

```
# first, make .csv files in wide format to double check in statview  
read_rt_type_wider <- trial_type_means %>%  
  select(ParticipantId, Condition, TrialType, mean_readRT) %>%  
  pivot_wider(names_from = TrialType, values_from = mean_readRT)  
answer_rt_type_wider <- trial_type_means %>%  
  select(ParticipantId, Condition, TrialType, mean_answerRT) %>%  
  pivot_wider(names_from = TrialType, values_from = mean_answerRT)  
write.csv(read_rt_type_wider, file = "readtypeRTs.csv", row.names = F)
```

```

write.csv(answer_rt_type_wider, file = "answertypeRTs.csv", row.names = F)

#### READ RTs ####

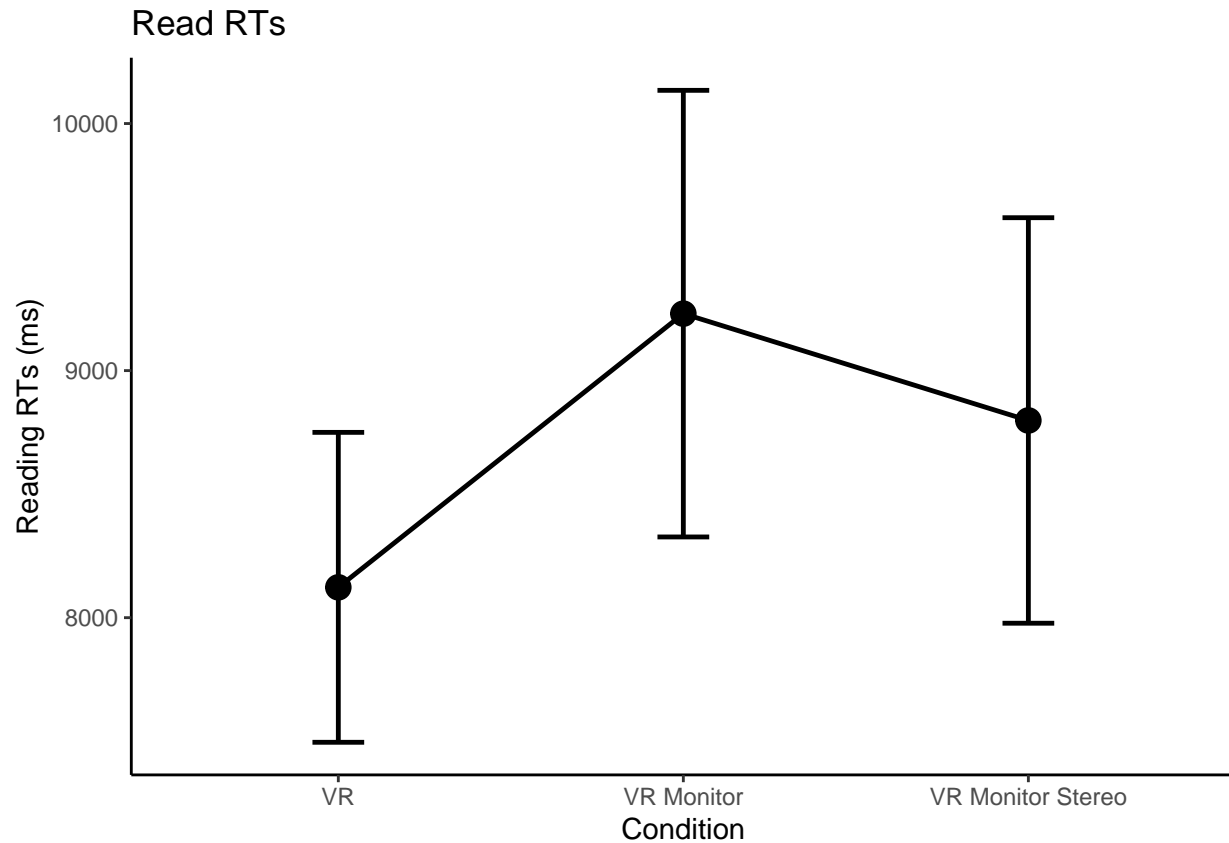
#make some plots

#just condition main effect
readplot1 <- all_data_no_outliers %>%
  group_by(ParticipantId, Condition) %>%
  summarize(overallmean = mean(readRT)) %>%
  group_by(Condition) %>%
  summarize(overall_condition_mean = mean(overallmean),
            se = std.error(overallmean),
            n = n(),
            CI = qt(0.975,df=n-1)*se)

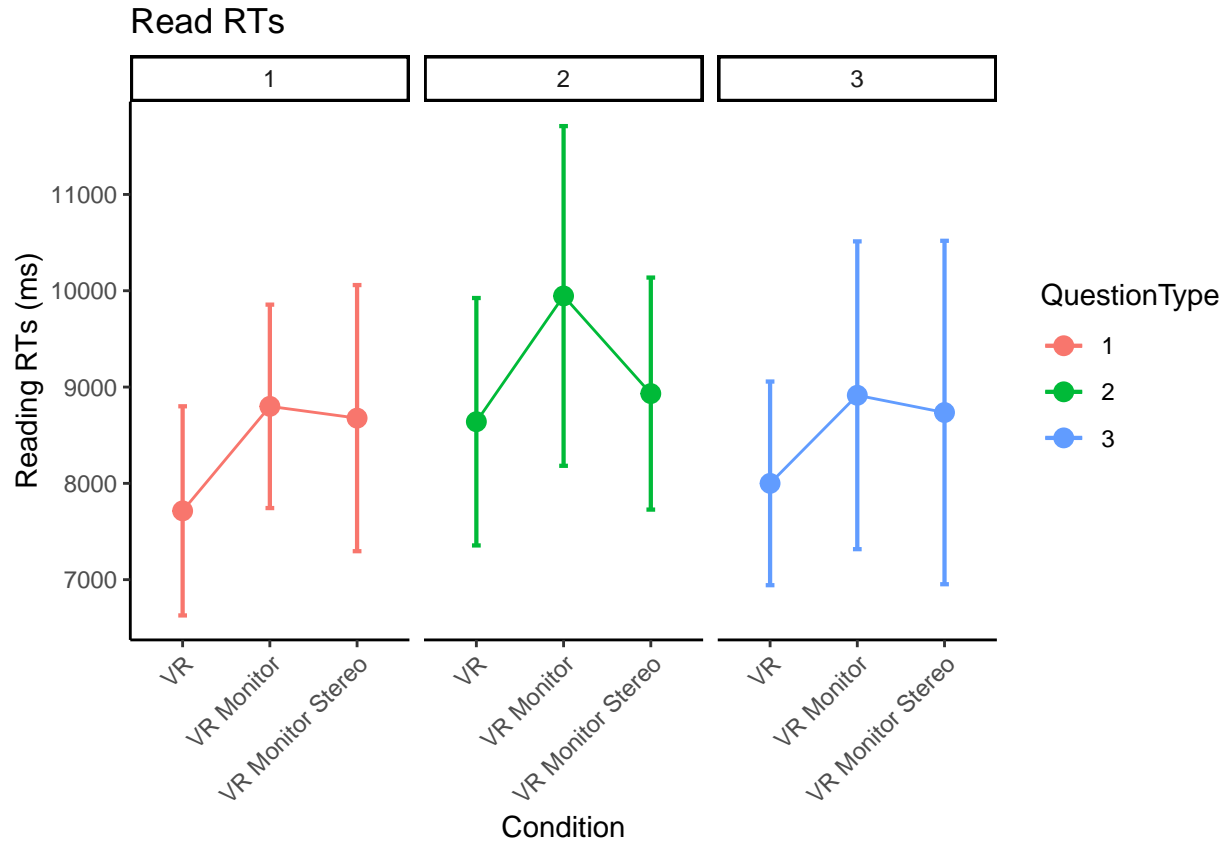
## `summarise()` has grouped output by 'ParticipantId'. You can override using the `.groups`
## argument.

ggplot(readplot1, aes(Condition,
                      overall_condition_mean,
                      group = 1,
                      ymin = overall_condition_mean - CI,
                      ymax = overall_condition_mean + CI)) +
  theme_classic() +
  geom_point(size = 4) +
  geom_errorbar(width = .15, size = 0.85) +
  geom_line(size = 0.85) +
  labs(y = "Reading RTs (ms)", title = "Read RTs")

```



```
#make a little plot using wide format
superbPlot(read_rt_type_wider,
  BSFactors = "Condition",
  WSFactors = "QuestionType(3)",
  variables = c("Type1", "Type2", "Type3"),
  statistic = "mean",
  errorbar = "CI",
  gamma = 0.95,
  adjustments = list(
    purpose = "difference"
  ),
  plotStyle = "line",
  factorOrder = c("Condition", "QuestionType")
) +
theme_classic() +
  theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1))+
facet_wrap(vars(QuestionType))+
labs(y = "Reading RTs (ms)", title = "Read RTs")
```



```
read_rt_type_anova <- aov_ez(id = "ParticipantId",
                             dv = "mean_readRT",
                             data = trial_type_means,
                             within = "TrialType",
                             between = "Condition",
                             anova_table = list(es = "pes") #might want to double-check these
)
```

```
## Converting to factor: Condition
## Contrasts set to contr.sum for the following variables: Condition
kable(nice(read_rt_type_anova))
```

Effect	df	MSE	F	pes	p.value
Condition	2, 119	18051925.11	2.28	.037	.107
TrialType	2.00, 237.70	4660052.21	4.30 *	.035	.015
Condition:TrialType	4.00, 237.70	4660052.21	0.52	.009	.723

```
#posthoc test for trial type
pairs(emmeans(read_rt_type_anova, "TrialType"), adjust = "Tukey")
```

```
## contrast      estimate SE df t.ratio p.value
## Type1 - Type2    -776 278 119  -2.786  0.0170
## Type1 - Type3    -153 285 119  -0.537  0.8534
## Type2 - Type3     623 277 119   2.247  0.0676
##
```

```
## Results are averaged over the levels of: Condition
## P value adjustment: tukey method for comparing a family of 3 estimates
```

```
#### ANSWER RTs ####
```

```
#make some plots
```

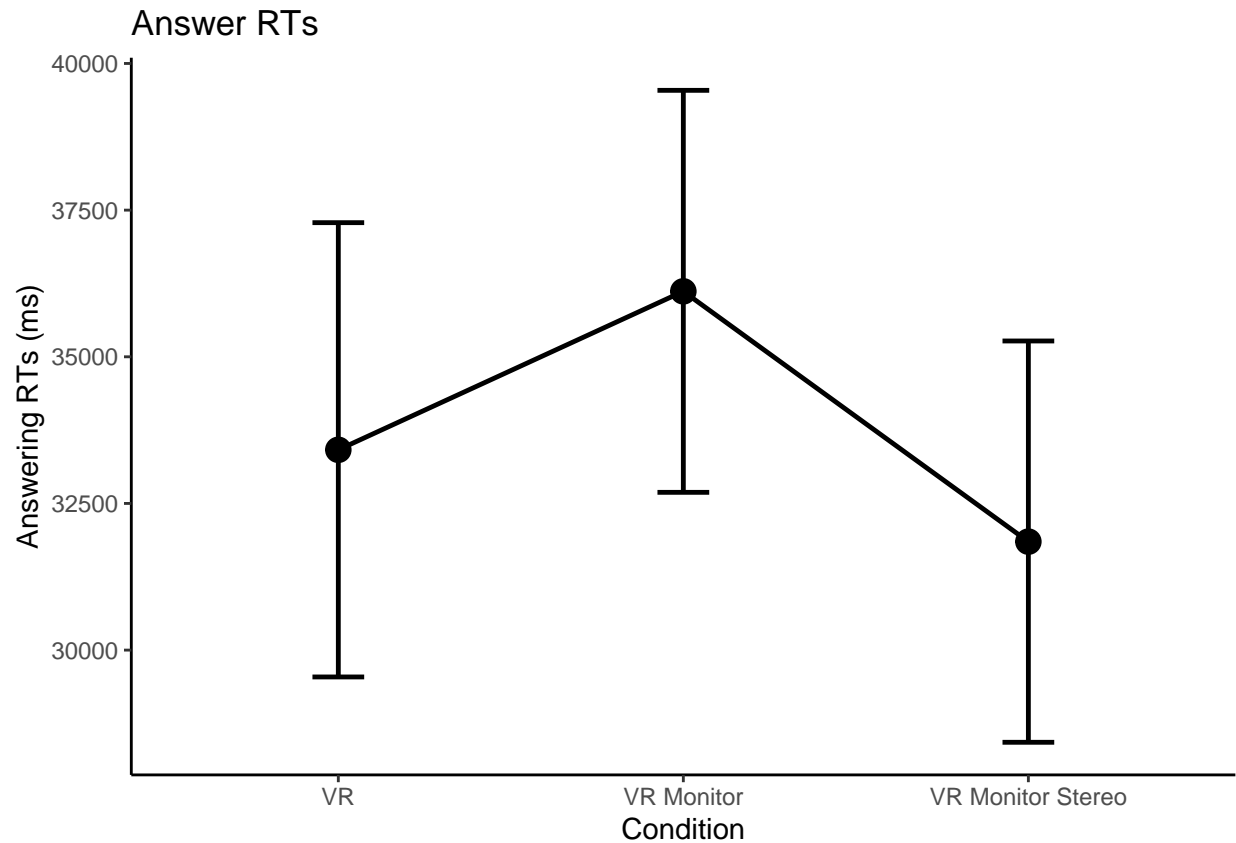
```
#just condition main effect
```

```
answerplot1 <- all_data_no_outliers %>%
  group_by(ParticipantId, Condition) %>%
  summarize(overallmean = mean(AnswerRT)) %>%
  group_by(Condition) %>%
  summarize(overall_condition_mean = mean(overallmean),
            se = std.error(overallmean),
            n = n(),
            CI = qt(0.975,df=n-1)*se)
```

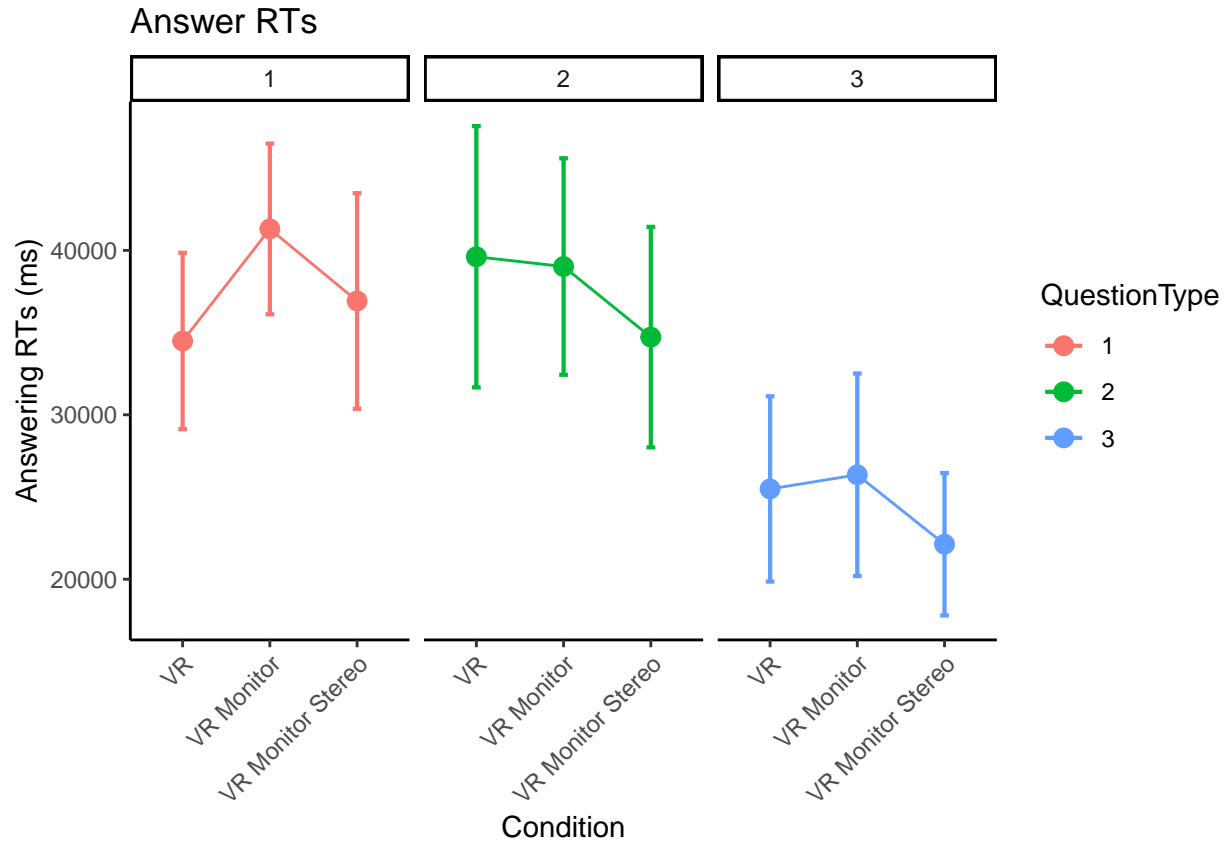
```
## `summarise()` has grouped output by 'ParticipantId'. You can override using the `groups`
## argument.
```

```
ggplot(answerplot1, aes(Condition,
                        overall_condition_mean,
                        group = 1,
                        ymin = overall_condition_mean - CI,
                        ymax = overall_condition_mean + CI)) +
  theme_classic() +
  geom_point(size = 4) +
  geom_errorbar(width = .15, size = 0.85) +
  geom_line(size = 0.85) +
  labs(y = "Answering RTs (ms)", title = "Answer RTs")
```





```
#make the little plot
superbPlot(answer_rt_type_wider,
  BSFactors = "Condition",
  WSFactors = "QuestionType(3)",
  variables = c("Type1", "Type2", "Type3"),
  statistic = "mean",
  errorbar = "CI",
  gamma = 0.95,
  adjustments = list(
    purpose = "difference"
  ),
  plotStyle = "line",
  factorOrder = c("Condition", "QuestionType")
) +
theme_classic() +
theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1))+
facet_wrap(vars(QuestionType))+
labs(y = "Answering RTs (ms)", title = "Answer RTs")
```



```
answer_rt_type_anova <- aov_ez(id = "ParticipantId",
  dv = "mean_answerRT",
  data = trial_type_means,
  within = "TrialType",
  between = "Condition",
  anova_table = list(es = "pes") #might want to double-check these
)
```

```
## Converting to factor: Condition
## Contrasts set to contr.sum for the following variables: Condition
kable(nice(answer_rt_type_anova))
```

Effect	df	MSE	F	pes	p.value
Condition	2, 119	415942756.23	1.21	.020	.303
TrialType	1.93, 229.53	92112713.90	75.40 ***	.388	<.001
Condition:TrialType	3.86, 229.53	92112713.90	2.52 *	.041	.044

```
#posthoc test for trial type
pairs(emmeans(answer_rt_type_anova, "TrialType"), adjust = "Tukey")
```

```
## contrast      estimate    SE df t.ratio p.value
## Type1 - Type2    -214 1188 119  -0.180  0.9824
## Type1 - Type3   12913 1142 119  11.304  <.0001
## Type2 - Type3   13127 1334 119   9.837  <.0001
##
```

```
## Results are averaged over the levels of: Condition
## P value adjustment: tukey method for comparing a family of 3 estimates
#Question Type 3 much faster than Type 1/Type 2 (this is answering times)

ref <- emmeans(answer_rt_type_anova, ~Condition|TrialType)

pairs(ref, adjust = "Tukey")

## TrialType = Type1:
## contrast estimate SE df t.ratio p.value
## VR - VR Monitor -6816 2704 119 -2.521 0.0346
## VR - VR Monitor Stereo -2434 2839 119 -0.857 0.6682
## VR Monitor - VR Monitor Stereo 4382 2994 119 1.464 0.3121
##
## TrialType = Type2:
## contrast estimate SE df t.ratio p.value
## VR - VR Monitor 595 3542 119 0.168 0.9846
## VR - VR Monitor Stereo 4887 3718 119 1.314 0.3900
## VR Monitor - VR Monitor Stereo 4292 3921 119 1.095 0.5192
##
## TrialType = Type3:
## contrast estimate SE df t.ratio p.value
## VR - VR Monitor -859 2690 119 -0.319 0.9453
## VR - VR Monitor Stereo 3364 2824 119 1.191 0.4608
## VR Monitor - VR Monitor Stereo 4223 2978 119 1.418 0.3350
##
## P value adjustment: tukey method for comparing a family of 3 estimates
#plot and interaction suggests that the conditions have different effects for different
#question types. posthoc tests indicate a difference between VR and VRMonitor for QType 1
```

## Accuracy

```
# do interrater reliability: Fits each trial as independent with two raters
# That is, this ignores participants (complete pooling, which may be problematic)
# 1410 trials from N = 85 participants, not exactly 17 trials per participant
# b/c of excluded trials
irr::icc(select(ungroup(all_data_no_outliers), Correct_1, Correct_2))

## Single Score Intraclass Correlation
##
## Model: oneway
## Type : consistency
##
## Subjects = 2020
## Raters = 2
## ICC(1) = 0.934
##
## F-Test, H0: r0 = 0 ; H1: r0 > 0
## F(2019,2020) = 29.5 , p = 0
##
## 95%-Confidence Interval for ICC Population Values:
## 0.929 < ICC < 0.94
```

```

head(all_data_no_outliers)

## # A tibble: 6 x 11
## # Groups:   TrialName [6]
##   ParticipantId Condition TrialNumber TrialName      readRT totalRT UserInput      Correct_1
##   <chr>          <chr>      <dbl> <chr>      <dbl>    <dbl> <chr>      <dbl>
## 1 AA0176        VR Monitor      1 LineChartQ1 16001.  70295. 1.0          0.5
## 2 AA0176        VR Monitor      2 LineChartQ2 14398.  98640. 6.0          1
## 3 AA0176        VR Monitor      3 LineChartQ3  9875.  52812. neighborhoo~ 0
## 4 AA0176        VR Monitor      4 LineChartQ4  8780.  13538. Neighborhoo~ 1
## 5 AA0176        VR Monitor      5 LineChartQ5 18755.  58351. neighborhoo~ 0
## 6 AA0176        VR Monitor      6 ScatterplotQ1 12366.  27154. High income 1
## # ... with 3 more variables: Correct_2 <dbl>, AnswerRT <dbl>, TrialType <chr>

# account for non-independence?
#Data has to be narrow
#https://cran.r-project.org/web/packages/cccrm/index.html
icc.dat.narrow <- all_data_no_outliers %>%
  pivot_longer(cols = c('Correct_1', 'Correct_2'))

colnames(icc.dat.narrow)[10] <- "Rater"
icc.dat.narrow$Rater <- as.factor(icc.dat.narrow$Rater)

#Longitudinal concordance for two raters
#By all 17 trials (by items)
icc.rm.trial.name <- ccclon(icc.dat.narrow,
  "value", "ParticipantId", "TrialName", "Rater")

## Warning in ccclon(icc.dat.narrow, "value", "ParticipantId", "TrialName", : NAs introduced
## by coercion

icc.rm.trial.name

## CCC estimated by variance components:
##           CCC   LL CI 95%   UL CI 95%      SE CCC
## 0.911213129 0.902891233 0.918852278 0.004067309

summary(icc.rm.trial.name)

## Linear mixed-effects model fit by REML
##   Data: dades
##           AIC      BIC    logLik
## 413.8561 653.087 -168.9281
##
## Random effects:
## Composite Structure: Blocked
##
## Block 1: (Intercept)
## Formula: ~1 | ind
##           (Intercept)
## StdDev: 0.1371422
##
## Block 2: metCorrect_1, metCorrect_2
## Formula: ~-1 + met | ind
## Structure: Multiple of an Identity
##           metCorrect_1 metCorrect_2

```

```

## StdDev: 1.263708e-05 1.263708e-05
##
## Block 3: timeBarChartQ1, timeBarChartQ2, timeBarChartQ3, timeBarChartQ4, timeLineChartQ1, timeLineC
## Formula: ~-1 + time | ind
## Structure: Multiple of an Identity
##      timeBarChartQ1 timeBarChartQ2 timeBarChartQ3 timeBarChartQ4 timeLineChartQ1
## StdDev:      0.3504545      0.3504545      0.3504545      0.3504545      0.3504545
##      timeLineChartQ2 timeLineChartQ3 timeLineChartQ4 timeLineChartQ5 timeScatterplotQ1
## StdDev:      0.3504545      0.3504545      0.3504545      0.3504545      0.3504545
##      timeScatterplotQ2 timeScatterplotQ3 timeScatterplotQ4 timeScatterplotQ5
## StdDev:      0.3504545      0.3504545      0.3504545      0.3504545
##      timeSurfacePlotQ1 timeSurfacePlotQ2 timeSurfacePlotQ3 Residual
## StdDev:      0.3504545      0.3504545      0.3504545 0.1158222
##
## Fixed effects: list(form)
##
##              Value Std.Error DF   t-value p-value
## (Intercept)    0.9607012 0.03592034 3885   26.745322 0.0000
## metCorrect_2   -0.0333333 0.01495258 3885   -2.229269 0.0259
## timeBarChartQ2 -0.0038669 0.04776296 3885   -0.080961 0.9355
## timeBarChartQ3 -0.0104475 0.04776277 3885   -0.218736 0.8269
## timeBarChartQ4  0.0031901 0.04787851 3885    0.066629 0.9469
## timeLineChartQ1 -0.1892704 0.04777230 3885   -3.961927 0.0001
## timeLineChartQ2 -0.2599970 0.04756487 3885   -5.466157 0.0000
## timeLineChartQ3 -0.4347017 0.04787831 3885   -9.079302 0.0000
## timeLineChartQ4 -0.1556339 0.04798588 3885   -3.243326 0.0012
## timeLineChartQ5 -0.5970560 0.04756487 3885  -12.552457 0.0000
## timeScatterplotQ1 -0.0356744 0.04786870 3885   -0.745255 0.4562
## timeScatterplotQ2 -0.4116019 0.04766763 3885   -8.634829 0.0000
## timeScatterplotQ3 -0.2833228 0.04787850 3885   -5.917538 0.0000
## timeScatterplotQ4 -0.5964378 0.04787911 3885  -12.457161 0.0000
## timeScatterplotQ5 -0.4080247 0.04787829 3885   -8.522122 0.0000
## timeSurfacePlotQ1 -0.4436177 0.04777251 3885   -9.286046 0.0000
## timeSurfacePlotQ2 -0.5912336 0.04766784 3885  -12.403196 0.0000
## timeSurfacePlotQ3 -0.6831899 0.04798548 3885  -14.237429 0.0000
## metCorrect_2:timeBarChartQ2  0.0333333 0.02119052 3885    1.573030 0.1158
## metCorrect_2:timeBarChartQ3  0.0249300 0.02119052 3885    1.176468 0.2395
## metCorrect_2:timeBarChartQ4  0.0333333 0.02123556 3885    1.569694 0.1166
## metCorrect_2:timeLineChartQ1 0.0333333 0.02119052 3885    1.573030 0.1158
## metCorrect_2:timeLineChartQ2 0.0333333 0.02110241 3885    1.579599 0.1143
## metCorrect_2:timeLineChartQ3 0.0248588 0.02123556 3885    1.170620 0.2418
## metCorrect_2:timeLineChartQ4 0.0333333 0.02128126 3885    1.566323 0.1174
## metCorrect_2:timeLineChartQ5 0.0168044 0.02110241 3885    0.796327 0.4259
## metCorrect_2:timeScatterplotQ1 0.0418079 0.02123556 3885    1.968769 0.0491
## metCorrect_2:timeScatterplotQ2 0.0333333 0.02114614 3885    1.576332 0.1150
## metCorrect_2:timeScatterplotQ3 0.0502825 0.02123556 3885    2.367844 0.0179
## metCorrect_2:timeScatterplotQ4 0.0248588 0.02123556 3885    1.170620 0.2418
## metCorrect_2:timeScatterplotQ5 -0.0641243 0.02123556 3885   -3.019666 0.0025
## metCorrect_2:timeSurfacePlotQ1 0.0039216 0.02119052 3885    0.185062 0.8532
## metCorrect_2:timeSurfacePlotQ2 -0.0333333 0.02114614 3885   -1.576332 0.1150
## metCorrect_2:timeSurfacePlotQ3 0.0461538 0.02128126 3885    2.168755 0.0302
## Correlation:
##
##              (Intr) mtCr_2 tmBCQ2 tmBCQ3 tmBCQ4 tmLCQ1 tmLCQ2 tmLCQ3
## metCorrect_2   -0.208
## timeBarChartQ2 -0.662  0.157

```

## timeBarChartQ3	-0.662	0.157	0.498					
## timeBarChartQ4	-0.661	0.156	0.497	0.497				
## timeLineChartQ1	-0.662	0.156	0.498	0.498	0.497			
## timeLineChartQ2	-0.665	0.157	0.500	0.500	0.499	0.500		
## timeLineChartQ3	-0.661	0.156	0.497	0.497	0.496	0.497	0.499	
## timeLineChartQ4	-0.659	0.156	0.495	0.495	0.495	0.496	0.498	0.494
## timeLineChartQ5	-0.665	0.157	0.500	0.500	0.499	0.500	0.502	0.499
## timeScatterplotQ1	-0.660	0.156	0.497	0.497	0.496	0.497	0.499	0.496
## timeScatterplotQ2	-0.664	0.157	0.499	0.499	0.498	0.499	0.501	0.498
## timeScatterplotQ3	-0.661	0.156	0.497	0.497	0.496	0.497	0.499	0.496
## timeScatterplotQ4	-0.661	0.156	0.497	0.497	0.496	0.497	0.499	0.496
## timeScatterplotQ5	-0.661	0.156	0.497	0.497	0.496	0.497	0.499	0.496
## timeSurfacePlotQ1	-0.662	0.156	0.498	0.498	0.497	0.498	0.500	0.497
## timeSurfacePlotQ2	-0.664	0.157	0.499	0.499	0.498	0.499	0.501	0.498
## timeSurfacePlotQ3	-0.659	0.156	0.496	0.496	0.494	0.496	0.498	0.495
## metCorrect_2:timeBarChartQ2	0.147	-0.706	-0.222	-0.110	-0.110	-0.110	-0.111	-0.110
## metCorrect_2:timeBarChartQ3	0.147	-0.706	-0.110	-0.222	-0.110	-0.110	-0.111	-0.110
## metCorrect_2:timeBarChartQ4	0.147	-0.704	-0.110	-0.110	-0.222	-0.110	-0.111	-0.110
## metCorrect_2:timeLineChartQ1	0.147	-0.706	-0.110	-0.110	-0.110	-0.222	-0.111	-0.110
## metCorrect_2:timeLineChartQ2	0.147	-0.709	-0.111	-0.111	-0.111	-0.111	-0.222	-0.111
## metCorrect_2:timeLineChartQ3	0.147	-0.704	-0.110	-0.110	-0.110	-0.110	-0.111	-0.222
## metCorrect_2:timeLineChartQ4	0.146	-0.703	-0.110	-0.110	-0.110	-0.110	-0.110	-0.110
## metCorrect_2:timeLineChartQ5	0.147	-0.709	-0.111	-0.111	-0.111	-0.111	-0.111	-0.111
## metCorrect_2:timeScatterplotQ1	0.147	-0.704	-0.110	-0.110	-0.110	-0.110	-0.111	-0.110
## metCorrect_2:timeScatterplotQ2	0.147	-0.707	-0.111	-0.111	-0.110	-0.111	-0.111	-0.110
## metCorrect_2:timeScatterplotQ3	0.147	-0.704	-0.110	-0.110	-0.110	-0.110	-0.111	-0.110
## metCorrect_2:timeScatterplotQ4	0.147	-0.704	-0.110	-0.110	-0.110	-0.110	-0.111	-0.110
## metCorrect_2:timeScatterplotQ5	0.147	-0.704	-0.110	-0.110	-0.110	-0.110	-0.111	-0.110
## metCorrect_2:timeSurfacePlotQ1	0.147	-0.706	-0.110	-0.110	-0.110	-0.110	-0.111	-0.110
## metCorrect_2:timeSurfacePlotQ2	0.147	-0.707	-0.111	-0.111	-0.110	-0.111	-0.111	-0.110
## metCorrect_2:timeSurfacePlotQ3	0.146	-0.703	-0.110	-0.110	-0.110	-0.110	-0.110	-0.110
##	tmLCQ4	tmLCQ5	tmScQ1	tmScQ2	tmScQ3	tmScQ4	tmScQ5	tmSPQ1
## metCorrect_2								
## timeBarChartQ2								
## timeBarChartQ3								
## timeBarChartQ4								
## timeLineChartQ1								
## timeLineChartQ2								
## timeLineChartQ3								
## timeLineChartQ4								
## timeLineChartQ5	0.498							
## timeScatterplotQ1	0.494	0.499						
## timeScatterplotQ2	0.497	0.501	0.498					
## timeScatterplotQ3	0.494	0.499	0.496	0.498				
## timeScatterplotQ4	0.495	0.499	0.496	0.498	0.496			
## timeScatterplotQ5	0.495	0.499	0.496	0.498	0.496	0.496		
## timeSurfacePlotQ1	0.496	0.500	0.497	0.499	0.497	0.497	0.497	
## timeSurfacePlotQ2	0.497	0.501	0.498	0.500	0.498	0.498	0.498	0.499
## timeSurfacePlotQ3	0.493	0.498	0.494	0.497	0.495	0.494	0.495	0.496
## metCorrect_2:timeBarChartQ2	-0.110	-0.111	-0.110	-0.111	-0.110	-0.110	-0.110	-0.110
## metCorrect_2:timeBarChartQ3	-0.110	-0.111	-0.110	-0.111	-0.110	-0.110	-0.110	-0.110
## metCorrect_2:timeBarChartQ4	-0.110	-0.111	-0.110	-0.110	-0.110	-0.110	-0.110	-0.110
## metCorrect_2:timeLineChartQ1	-0.110	-0.111	-0.110	-0.111	-0.110	-0.110	-0.110	-0.110
## metCorrect_2:timeLineChartQ2	-0.110	-0.111	-0.111	-0.111	-0.111	-0.111	-0.111	-0.111

```

## metCorrect_2:timeLineChartQ3 -0.110 -0.111 -0.110 -0.110 -0.110 -0.110 -0.110 -0.110
## metCorrect_2:timeLineChartQ4 -0.222 -0.110 -0.110 -0.110 -0.110 -0.110 -0.110 -0.110
## metCorrect_2:timeLineChartQ5 -0.110 -0.222 -0.111 -0.111 -0.111 -0.111 -0.111 -0.111
## metCorrect_2:timeScatterplotQ1 -0.110 -0.111 -0.222 -0.110 -0.110 -0.110 -0.110 -0.110
## metCorrect_2:timeScatterplotQ2 -0.110 -0.111 -0.110 -0.222 -0.110 -0.110 -0.110 -0.111
## metCorrect_2:timeScatterplotQ3 -0.110 -0.111 -0.110 -0.110 -0.222 -0.110 -0.110 -0.110
## metCorrect_2:timeScatterplotQ4 -0.110 -0.111 -0.110 -0.110 -0.110 -0.222 -0.110 -0.110
## metCorrect_2:timeScatterplotQ5 -0.110 -0.111 -0.110 -0.110 -0.110 -0.110 -0.222 -0.110
## metCorrect_2:timeSurfacePlotQ1 -0.110 -0.111 -0.110 -0.111 -0.110 -0.110 -0.110 -0.222
## metCorrect_2:timeSurfacePlotQ2 -0.110 -0.111 -0.110 -0.111 -0.110 -0.110 -0.110 -0.111
## metCorrect_2:timeSurfacePlotQ3 -0.109 -0.110 -0.110 -0.110 -0.110 -0.110 -0.110 -0.110
##
## tmSPQ2 tmSPQ3 mC_2:BCQ2 mC_2:BCQ3 mC_2:BCQ4 mC_2:LCQ1
## metCorrect_2
## timeBarChartQ2
## timeBarChartQ3
## timeBarChartQ4
## timeLineChartQ1
## timeLineChartQ2
## timeLineChartQ3
## timeLineChartQ4
## timeLineChartQ5
## timeScatterplotQ1
## timeScatterplotQ2
## timeScatterplotQ3
## timeScatterplotQ4
## timeScatterplotQ5
## timeSurfacePlotQ1
## timeSurfacePlotQ2
## timeSurfacePlotQ3 0.497
## metCorrect_2:timeBarChartQ2 -0.111 -0.110
## metCorrect_2:timeBarChartQ3 -0.111 -0.110 0.498
## metCorrect_2:timeBarChartQ4 -0.110 -0.110 0.497 0.497
## metCorrect_2:timeLineChartQ1 -0.111 -0.110 0.498 0.498 0.497
## metCorrect_2:timeLineChartQ2 -0.111 -0.110 0.500 0.500 0.499 0.500
## metCorrect_2:timeLineChartQ3 -0.110 -0.110 0.497 0.497 0.496 0.497
## metCorrect_2:timeLineChartQ4 -0.110 -0.109 0.496 0.496 0.495 0.496
## metCorrect_2:timeLineChartQ5 -0.111 -0.110 0.500 0.500 0.499 0.500
## metCorrect_2:timeScatterplotQ1 -0.110 -0.110 0.497 0.497 0.496 0.497
## metCorrect_2:timeScatterplotQ2 -0.111 -0.110 0.499 0.499 0.498 0.499
## metCorrect_2:timeScatterplotQ3 -0.110 -0.110 0.497 0.497 0.496 0.497
## metCorrect_2:timeScatterplotQ4 -0.110 -0.110 0.497 0.497 0.496 0.497
## metCorrect_2:timeScatterplotQ5 -0.110 -0.110 0.497 0.497 0.496 0.497
## metCorrect_2:timeSurfacePlotQ1 -0.111 -0.110 0.498 0.498 0.497 0.498
## metCorrect_2:timeSurfacePlotQ2 -0.222 -0.110 0.499 0.499 0.498 0.499
## metCorrect_2:timeSurfacePlotQ3 -0.110 -0.222 0.496 0.496 0.495 0.496
##
## mC_2:LCQ2 mC_2:LCQ3 mC_2:LCQ4 mC_2:LCQ5 mC_2:SQ1 mC_2:SQ2
## metCorrect_2
## timeBarChartQ2
## timeBarChartQ3
## timeBarChartQ4
## timeLineChartQ1
## timeLineChartQ2
## timeLineChartQ3
## timeLineChartQ4

```

```

## timeLineChartQ5
## timeScatterplotQ1
## timeScatterplotQ2
## timeScatterplotQ3
## timeScatterplotQ4
## timeScatterplotQ5
## timeSurfacePlotQ1
## timeSurfacePlotQ2
## timeSurfacePlotQ3
## metCorrect_2:timeBarChartQ2
## metCorrect_2:timeBarChartQ3
## metCorrect_2:timeBarChartQ4
## metCorrect_2:timeLineChartQ1
## metCorrect_2:timeLineChartQ2
## metCorrect_2:timeLineChartQ3    0.499
## metCorrect_2:timeLineChartQ4    0.498    0.495
## metCorrect_2:timeLineChartQ5    0.502    0.499    0.498
## metCorrect_2:timeScatterplotQ1  0.499    0.496    0.495    0.499
## metCorrect_2:timeScatterplotQ2  0.501    0.498    0.497    0.501    0.498
## metCorrect_2:timeScatterplotQ3  0.499    0.496    0.495    0.499    0.496    0.498
## metCorrect_2:timeScatterplotQ4  0.499    0.496    0.495    0.499    0.496    0.498
## metCorrect_2:timeScatterplotQ5  0.499    0.496    0.495    0.499    0.496    0.498
## metCorrect_2:timeSurfacePlotQ1  0.500    0.497    0.496    0.500    0.497    0.499
## metCorrect_2:timeSurfacePlotQ2  0.501    0.498    0.497    0.501    0.498    0.500
## metCorrect_2:timeSurfacePlotQ3  0.498    0.495    0.494    0.498    0.495    0.497
##                                     mC_2:SQ3 mC_2:SQ4 mC_2:SQ5 mC_2:SPQ1 mC_2:SPQ2
## metCorrect_2
## timeBarChartQ2
## timeBarChartQ3
## timeBarChartQ4
## timeLineChartQ1
## timeLineChartQ2
## timeLineChartQ3
## timeLineChartQ4
## timeLineChartQ5
## timeScatterplotQ1
## timeScatterplotQ2
## timeScatterplotQ3
## timeScatterplotQ4
## timeScatterplotQ5
## timeSurfacePlotQ1
## timeSurfacePlotQ2
## timeSurfacePlotQ3
## metCorrect_2:timeBarChartQ2
## metCorrect_2:timeBarChartQ3
## metCorrect_2:timeBarChartQ4
## metCorrect_2:timeLineChartQ1
## metCorrect_2:timeLineChartQ2
## metCorrect_2:timeLineChartQ3
## metCorrect_2:timeLineChartQ4
## metCorrect_2:timeLineChartQ5
## metCorrect_2:timeScatterplotQ1
## metCorrect_2:timeScatterplotQ2
## metCorrect_2:timeScatterplotQ3

```



```
## metCorrect_2:timeScatterplotQ4 0.496
## metCorrect_2:timeScatterplotQ5 0.496 0.496
## metCorrect_2:timeSurfacePlotQ1 0.497 0.497 0.497
## metCorrect_2:timeSurfacePlotQ2 0.498 0.498 0.498 0.499
## metCorrect_2:timeSurfacePlotQ3 0.495 0.495 0.495 0.496 0.497
##
```

```
## Standardized Within-Group Residuals:
```

```
##      Min      Q1      Med      Q3      Max
## -4.61204961 -0.14729994 0.01890441 0.13260950 4.79318660
##
```

```
## Number of Observations: 4040
```

```
## Number of Groups: 122
```

```
##
```

```
## CCC estimated by variance components
```

```
##      CCC  LL CI 95%  UL CI 95%      SE CCC
```

```
## 0.911213129 0.902891233 0.918852278 0.004067309
```

```
#By time using trial numbers (by time)
```

```
icc.rm.trial.number <- ccclon(icc.dat.narrow,
                             "value", "ParticipantId", "TrialNumber", "Rater" )
```

```
icc.rm.trial.number
```

```
## CCC estimated by variance components:
```

```
##      CCC  LL CI 95%  UL CI 95%      SE CCC
```

```
## 0.933188983 0.926936472 0.938923387 0.003054415
```

```
summary(icc.rm.trial.number)
```

```
## Linear mixed-effects model fit by REML
```

```
## Data: dades
```

```
##      AIC      BIC    logLik
```

```
## 1123.783 1363.013 -523.8913
```

```
##
```

```
## Random effects:
```

```
## Composite Structure: Blocked
```

```
##
```

```
## Block 1: (Intercept)
```

```
## Formula: ~1 | ind
```

```
##      (Intercept)
```

```
## StdDev: 0.1241834
```

```
##
```

```
## Block 2: metCorrect_1, metCorrect_2
```

```
## Formula: ~-1 + met | ind
```

```
## Structure: Multiple of an Identity
```

```
##      metCorrect_1 metCorrect_2
```

```
## StdDev: 9.696363e-06 9.696363e-06
```

```
##
```

```
## Block 3: time1, time2, time3, time4, time5, time6, time7, time8, time9, time10, time11, time12, time13, time14, time15, time16, time17
```

```
## Formula: ~-1 + time | ind
```

```
## Structure: Multiple of an Identity
```

```
##      time1      time2      time3      time4      time5      time6      time7      time8
```

```
## StdDev: 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062
```

```
##      time9      time10      time11      time12      time13      time14      time15      time16
```

```
## StdDev: 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062 0.4211062
```

```
##      time17 Residual
```

```
## StdDev: 0.4211062 0.1172055
```

```

##
## Fixed effects: list(form)
##
## Value Std.Error DF t-value p-value
## (Intercept) 0.7669986 0.04214805 3885 18.197724 0.0000
## metCorrect_2 -0.0172414 0.01538984 3885 -1.120310 0.2627
## time2 -0.2351213 0.05718669 3885 -4.111470 0.0000
## time3 -0.1998475 0.05769169 3885 -3.464060 0.0005
## time4 -0.0837630 0.05695015 3885 -1.470813 0.1414
## time5 -0.2254321 0.05718686 3885 -3.942025 0.0001
## time6 -0.0839962 0.05719564 3885 -1.468577 0.1420
## time7 -0.1155072 0.05695015 3885 -2.028217 0.0426
## time8 -0.1768346 0.05671137 3885 -3.118151 0.0018
## time9 0.0047584 0.05707216 3885 0.083375 0.9336
## time10 -0.0536614 0.05695048 3885 -0.942246 0.3461
## time11 -0.1112609 0.05671137 3885 -1.961879 0.0498
## time12 -0.1821879 0.05769204 3885 -3.157938 0.0016
## time13 -0.0644901 0.05682974 3885 -1.134795 0.2565
## time14 -0.0334820 0.05694998 3885 -0.587920 0.5566
## time15 -0.0200528 0.05707200 3885 -0.351360 0.7253
## time16 -0.0858059 0.05694133 3885 -1.506917 0.1319
## time17 -0.1485382 0.05707216 3885 -2.602638 0.0093
## metCorrect_2:time2 0.0172414 0.02167209 3885 0.795557 0.4263
## metCorrect_2:time3 0.0303993 0.02185976 3885 1.390650 0.1644
## metCorrect_2:time4 0.0047414 0.02158238 3885 0.219688 0.8261
## metCorrect_2:time5 0.0002922 0.02167209 3885 0.013484 0.9892
## metCorrect_2:time6 0.0087668 0.02167209 3885 0.404520 0.6859
## metCorrect_2:time7 -0.0035920 0.02158238 3885 -0.166430 0.8678
## metCorrect_2:time8 0.0090447 0.02149525 3885 0.420775 0.6739
## metCorrect_2:time9 -0.0037670 0.02162691 3885 -0.174182 0.8617
## metCorrect_2:time10 -0.0119253 0.02158238 3885 -0.552547 0.5806
## metCorrect_2:time11 -0.0073488 0.02149525 3885 -0.341879 0.7325
## metCorrect_2:time12 -0.0134604 0.02185976 3885 -0.615760 0.5381
## metCorrect_2:time13 0.0255058 0.02153850 3885 1.184198 0.2364
## metCorrect_2:time14 0.0047414 0.02158238 3885 0.219688 0.8261
## metCorrect_2:time15 0.0130397 0.02162691 3885 0.602939 0.5466
## metCorrect_2:time16 0.0089080 0.02158238 3885 0.412746 0.6798
## metCorrect_2:time17 -0.0205737 0.02162691 3885 -0.951303 0.3415
## Correlation:
## (Intr) mtCr_2 time2 time3 time4 time5 time6 time7 time8 time9
## metCorrect_2 -0.183
## time2 -0.684 0.135
## time3 -0.678 0.133 0.500
## time4 -0.687 0.135 0.507 0.502
## time5 -0.684 0.135 0.505 0.500 0.507
## time6 -0.685 0.135 0.504 0.500 0.507 0.504
## time7 -0.687 0.135 0.507 0.502 0.509 0.507 0.507
## time8 -0.690 0.136 0.509 0.504 0.511 0.509 0.509 0.511
## time9 -0.686 0.135 0.506 0.501 0.508 0.505 0.506 0.508 0.510
## time10 -0.687 0.135 0.507 0.502 0.509 0.507 0.507 0.509 0.511 0.508
## time11 -0.690 0.136 0.509 0.504 0.511 0.509 0.509 0.511 0.513 0.510
## time12 -0.678 0.133 0.500 0.495 0.502 0.500 0.500 0.502 0.504 0.501
## time13 -0.689 0.135 0.508 0.503 0.510 0.508 0.508 0.510 0.512 0.509
## time14 -0.687 0.135 0.507 0.502 0.509 0.507 0.507 0.509 0.511 0.508
## time15 -0.686 0.135 0.505 0.501 0.508 0.505 0.506 0.508 0.510 0.507

```

```

## time16      -0.687  0.135  0.506  0.502  0.509  0.506  0.507  0.509  0.511  0.508
## time17      -0.686  0.135  0.505  0.501  0.508  0.505  0.506  0.508  0.510  0.507
## metCorrect_2:time2  0.130 -0.710 -0.189 -0.095 -0.096 -0.096 -0.096 -0.096 -0.096 -0.096
## metCorrect_2:time3  0.129 -0.704 -0.095 -0.189 -0.095 -0.095 -0.095 -0.095 -0.096 -0.095
## metCorrect_2:time4  0.130 -0.713 -0.096 -0.095 -0.189 -0.096 -0.096 -0.096 -0.097 -0.096
## metCorrect_2:time5  0.130 -0.710 -0.096 -0.095 -0.096 -0.189 -0.096 -0.096 -0.096 -0.096
## metCorrect_2:time6  0.130 -0.710 -0.096 -0.095 -0.096 -0.096 -0.189 -0.096 -0.096 -0.096
## metCorrect_2:time7  0.130 -0.713 -0.096 -0.095 -0.096 -0.096 -0.096 -0.189 -0.097 -0.096
## metCorrect_2:time8  0.131 -0.716 -0.096 -0.095 -0.097 -0.096 -0.096 -0.097 -0.190 -0.097
## metCorrect_2:time9  0.130 -0.712 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.097 -0.189
## metCorrect_2:time10 0.130 -0.713 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.097 -0.096
## metCorrect_2:time11 0.131 -0.716 -0.096 -0.095 -0.097 -0.096 -0.096 -0.097 -0.097 -0.097
## metCorrect_2:time12 0.129 -0.704 -0.095 -0.094 -0.095 -0.095 -0.095 -0.095 -0.096 -0.095
## metCorrect_2:time13 0.130 -0.715 -0.096 -0.095 -0.097 -0.096 -0.096 -0.097 -0.097 -0.096
## metCorrect_2:time14 0.130 -0.713 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.097 -0.096
## metCorrect_2:time15 0.130 -0.712 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.097 -0.096
## metCorrect_2:time16 0.130 -0.713 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.097 -0.096
## metCorrect_2:time17 0.130 -0.712 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.097 -0.096
##              time10 time11 time12 time13 time14 time15 time16 time17 mC_2:2 mC_2:3
## metCorrect_2
## time2
## time3
## time4
## time5
## time6
## time7
## time8
## time9
## time10
## time11      0.511
## time12      0.502  0.504
## time13      0.510  0.512  0.503
## time14      0.509  0.511  0.502  0.510
## time15      0.508  0.510  0.501  0.509  0.508
## time16      0.509  0.511  0.502  0.510  0.509  0.508
## time17      0.508  0.510  0.501  0.509  0.508  0.507  0.508
## metCorrect_2:time2 -0.096 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.096
## metCorrect_2:time3 -0.095 -0.096 -0.094 -0.095 -0.095 -0.095 -0.095 -0.095  0.500
## metCorrect_2:time4 -0.096 -0.097 -0.095 -0.097 -0.096 -0.096 -0.096 -0.096  0.506  0.502
## metCorrect_2:time5 -0.096 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.096  0.504  0.500
## metCorrect_2:time6 -0.096 -0.096 -0.095 -0.096 -0.096 -0.096 -0.096 -0.096  0.504  0.500
## metCorrect_2:time7 -0.096 -0.097 -0.095 -0.097 -0.096 -0.096 -0.096 -0.096  0.506  0.502
## metCorrect_2:time8 -0.097 -0.097 -0.095 -0.097 -0.097 -0.097 -0.097 -0.097  0.508  0.504
## metCorrect_2:time9 -0.096 -0.097 -0.095 -0.096 -0.096 -0.096 -0.096 -0.096  0.505  0.501
## metCorrect_2:time10 -0.189 -0.097 -0.095 -0.097 -0.096 -0.096 -0.096 -0.096  0.506  0.502
## metCorrect_2:time11 -0.097 -0.190 -0.095 -0.097 -0.097 -0.097 -0.097 -0.097  0.508  0.504
## metCorrect_2:time12 -0.095 -0.096 -0.189 -0.095 -0.095 -0.095 -0.095 -0.095  0.500  0.496
## metCorrect_2:time13 -0.097 -0.097 -0.095 -0.190 -0.097 -0.096 -0.097 -0.096  0.507  0.503
## metCorrect_2:time14 -0.096 -0.097 -0.095 -0.097 -0.189 -0.096 -0.096 -0.096  0.506  0.502
## metCorrect_2:time15 -0.096 -0.097 -0.095 -0.096 -0.096 -0.189 -0.096 -0.096  0.505  0.501
## metCorrect_2:time16 -0.096 -0.097 -0.095 -0.097 -0.096 -0.096 -0.190 -0.096  0.506  0.502
## metCorrect_2:time17 -0.096 -0.097 -0.095 -0.096 -0.096 -0.096 -0.096 -0.189  0.505  0.501
##              mC_2:4 mC_2:5 mC_2:6 mC_2:7 mC_2:8 mC_2:9 mC_2:10 mC_2:11 mC_2:12
## metCorrect_2

```

```

## time2
## time3
## time4
## time5
## time6
## time7
## time8
## time9
## time10
## time11
## time12
## time13
## time14
## time15
## time16
## time17
## metCorrect_2:time2
## metCorrect_2:time3
## metCorrect_2:time4
## metCorrect_2:time5    0.506
## metCorrect_2:time6    0.506  0.504
## metCorrect_2:time7    0.508  0.506  0.506
## metCorrect_2:time8    0.511  0.508  0.508  0.511
## metCorrect_2:time9    0.507  0.505  0.505  0.507  0.509
## metCorrect_2:time10   0.508  0.506  0.506  0.508  0.511  0.507
## metCorrect_2:time11   0.511  0.508  0.508  0.511  0.513  0.509  0.511
## metCorrect_2:time12   0.502  0.500  0.500  0.502  0.504  0.501  0.502  0.504
## metCorrect_2:time13   0.510  0.507  0.507  0.510  0.512  0.508  0.510  0.512  0.503
## metCorrect_2:time14   0.508  0.506  0.506  0.508  0.511  0.507  0.508  0.511  0.502
## metCorrect_2:time15   0.507  0.505  0.505  0.507  0.509  0.506  0.507  0.509  0.501
## metCorrect_2:time16   0.508  0.506  0.506  0.508  0.511  0.507  0.508  0.511  0.502
## metCorrect_2:time17   0.507  0.505  0.505  0.507  0.509  0.506  0.507  0.509  0.501
##                               mC_2:13 mC_2:14 mC_2:15 mC_2:16
## metCorrect_2
## time2
## time3
## time4
## time5
## time6
## time7
## time8
## time9
## time10
## time11
## time12
## time13
## time14
## time15
## time16
## time17
## metCorrect_2:time2
## metCorrect_2:time3
## metCorrect_2:time4
## metCorrect_2:time5

```

```

## metCorrect_2:time6
## metCorrect_2:time7
## metCorrect_2:time8
## metCorrect_2:time9
## metCorrect_2:time10
## metCorrect_2:time11
## metCorrect_2:time12
## metCorrect_2:time13
## metCorrect_2:time14 0.510
## metCorrect_2:time15 0.508 0.507
## metCorrect_2:time16 0.510 0.508 0.507
## metCorrect_2:time17 0.508 0.507 0.506 0.507
##
## Standardized Within-Group Residuals:
##      Min      Q1      Med      Q3      Max
## -4.42360415 -0.13121079 0.02639034 0.13126188 4.32843966
##
## Number of Observations: 4040
## Number of Groups: 122
##
## CCC estimated by variance components
##      CCC  LL CI 95%  UL CI 95%  SE CCC
## 0.933188983 0.926936472 0.938923387 0.003054415

# A similar approach
# https://peerj.com/articles/9850/
# test.mod <-
# lcc(data = hue, subject = "Fruit", resp = "H_mean",
#      method = "Method", time = "Time", qf = 2, qr = 1)
# summary(test.mod)

# icc.dat.narrow$ParticipantId <- as.factor(icc.dat.narrow$ParticipantId)
# icc.dat.narrow$Rater <- as.factor(icc.dat.narrow$Rater)
#
#
# icc.rm.another <-
# lcc(data = icc.dat.narrow,
#      subject = "ParticipantId",
#      resp = "value",
#      method = "Rater",
#      time = "TrialNumber",
#      qf = 1, #polynomial trends (1 to 3)
#      qr = 0, #random effects (0 is random int only, default)
#      components = TRUE)
#
# #LCC = Longitudinal Concordance Correlation
# #LPC = Longitudinal Pearson Correlation
# #LA = Longitudinal Accuracy
# icc.rm.another
#
# #Model coefficients near 1 but only the the last one has a correctly
# #estimated model. Maybe because it's more or less flat over TrialNumber?
# lccPlot(icc.rm.another, type = "lpc")
# lccPlot(icc.rm.another, type = "lcc")

```

```
# lccPlot(icc.rm.another, type = "la")
```

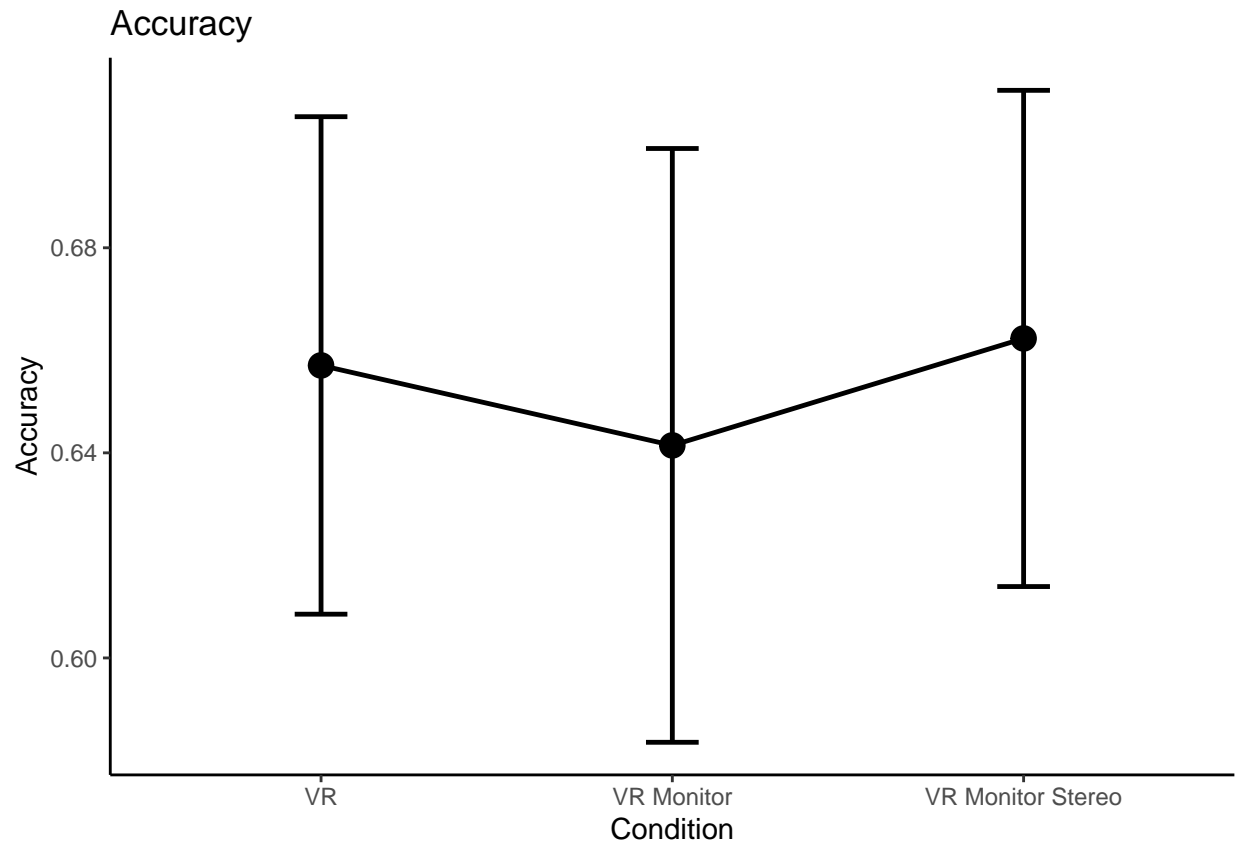
```
all_data_no_outliers <- all_data_no_outliers %>%  
  rowwise() %>%  
  mutate(Correct_Avg = mean(c(Correct_1, Correct_2)))
```

```
#just condition main effect
```

```
accplot1 <- all_data_no_outliers %>%  
  group_by(ParticipantId, Condition) %>%  
  summarize(overallmean = mean(Correct_Avg)) %>%  
  group_by(Condition) %>%  
  summarize(overall_condition_mean = mean(overallmean),  
            se = std.error(overallmean),  
            n = n(),  
            CI = qt(0.975,df=n-1)*se)
```

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

```
ggplot(accplot1, aes(Condition,  
                     overall_condition_mean,  
                     group = 1,  
                     ymin = overall_condition_mean - CI,  
                     ymax = overall_condition_mean + CI)) +  
  
  theme_classic() +  
  geom_point(size = 4) +  
  geom_errorbar(width = .15, size = 0.85) +  
  geom_line(size = 0.85) +  
  labs(y = "Accuracy", title = "Accuracy")
```



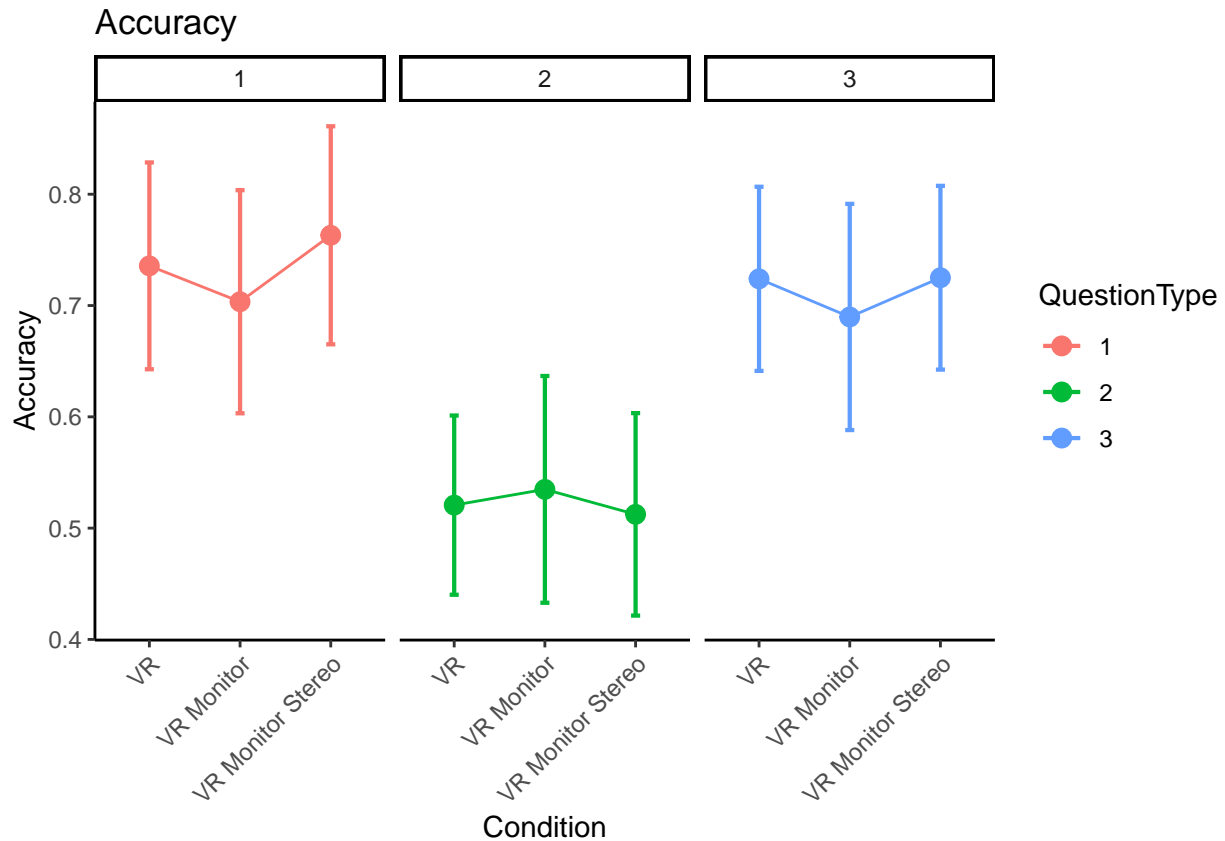
```
trial_type_mean_acc <- all_data_no_outliers %>%
  group_by(ParticipantId, Condition, TrialType) %>%
  summarize(mean_acc = mean(Correct_Avg),
            n = n())
```

## `summarise()` has grouped output by 'ParticipantId', 'Condition'. You can override using ## the `.groups` argument.

```
acc_type_wider <- trial_type_mean_acc %>%
  select(ParticipantId, Condition, TrialType, mean_acc) %>%
  pivot_wider(names_from = TrialType, values_from = mean_acc)
write.csv(acc_type_wider, file = "typeacc.csv", row.names = F)
```

```
#make the little plot
superbPlot(acc_type_wider,
  BSFactors = "Condition",
  WSFactors = "QuestionType(3)",
  variables = c("Type1", "Type2", "Type3"),
  statistic = "mean",
  errorbar = "CI",
  gamma = 0.95,
  adjustments = list(
    purpose = "difference"
  ),
  plotStyle = "line",
  factorOrder = c("Condition", "QuestionType")
) +
```

```
theme_classic() +
theme(axis.text.x = element_text(angle = 45, vjust = 1, hjust=1))+
facet_wrap(vars(QuestionType))+
labs(y = "Accuracy", title = "Accuracy")
```



```
acc_type_anova <- aov_ez(id = "ParticipantId",
  dv = "mean_acc",
  data = trial_type_mean_acc,
  within = "TrialType",
  between = "Condition",
  anova_table = list(es = "pes") #might want to double-check these
)
```

```
## Converting to factor: Condition
## Contrasts set to contr.sum for the following variables: Condition
kable(nice(acc_type_anova))
```

Effect	df	MSE	F	pes	p.value
Condition	2, 119	0.08	0.22	.004	.807
TrialType	1.98, 235.08	0.02	66.89 ***	.360	<.001
Condition:TrialType	3.95, 235.08	0.02	0.74	.012	.566



## Read in qualtrics data

```
qualtrics <- read_xlsx("04 28 22 Qualtrics Data BNT Coded.xlsx",
  skip = 3,
  col_names = c("ParticipantID",
    "gender",
    "age",
    "gaming.exp",
    paste0("game.ex", 1:5),
    "gaming.hrs.wk",
    "fps.exp",
    "fps.hrs.wk",
    "rts.exp",
    "rts.hrs.wk",
    "vr.exp",
    paste0("vr.times.",
      c("", "research", "gaming", "train", "dev", "other")),
    paste0("spes", 1:8),
    paste0(rep(c("bnt", "bnt.corr"), 4), rep(1:4, each = 2)),
    "bnt.tot.corr"))

#note, i think there's a typo in a participant ID. double check at some point
qualtrics <- qualtrics %>%
  mutate(ParticipantID = ifelse(ParticipantID == "U05531", "U05311", ParticipantID))

#remove participants who aren't in behavioral dataset
qualtrics <- qualtrics %>%
  mutate(ParticipantID = toupper(ParticipantID)) %>%
  filter(ParticipantID %in% toupper(all_data_no_outliers$ParticipantId))
```

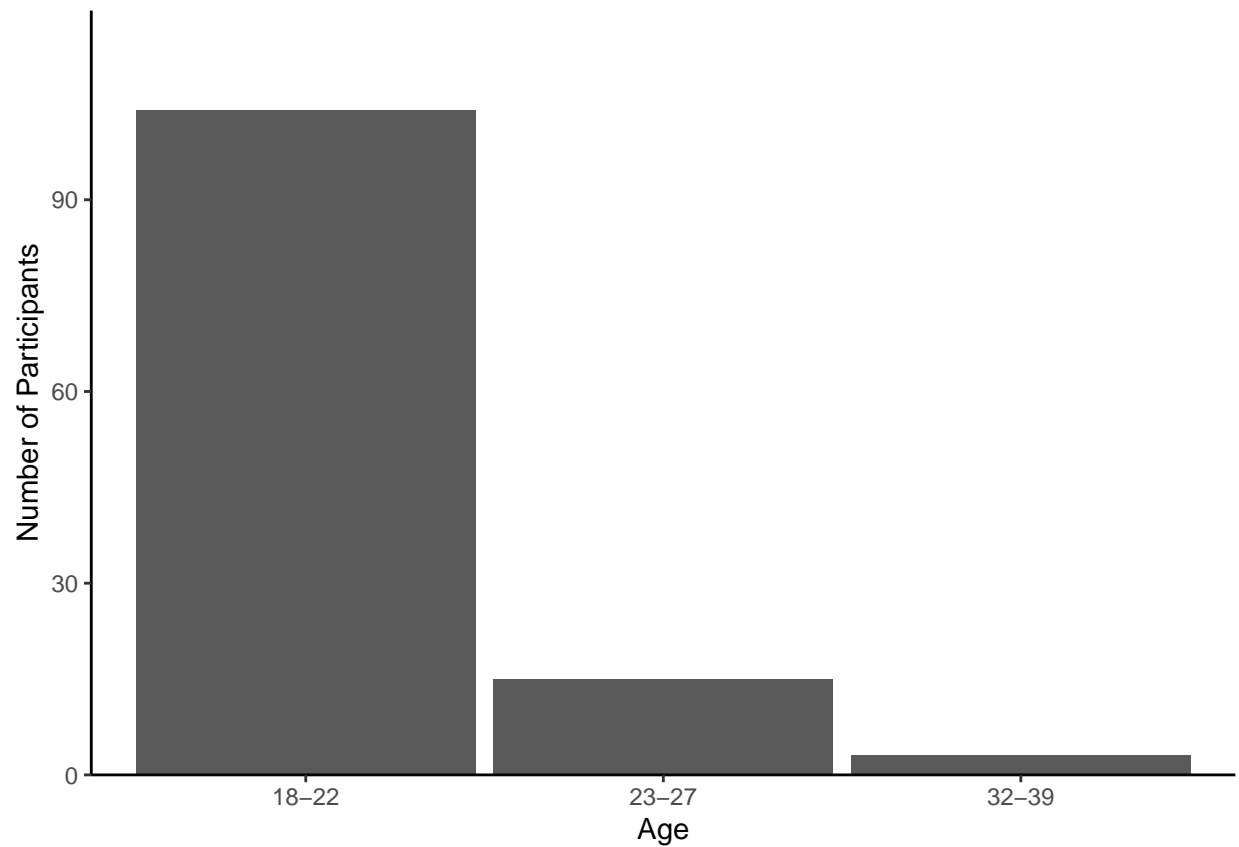
## Summarize qualtrics data

```
### Age
age_dat <- qualtrics %>%
  group_by(age) %>%
  summarize(n = n())

kable(age_dat)
```

age	n
18-22	104
23-27	15
32-39	3

```
ggplot(age_dat, aes(age, n)) +
  theme_classic() +
  geom_col(width = .95) +
  labs(y = "Number of Participants", x = "Age") +
  scale_y_continuous(expand=expansion(mult=c(0,0.15)))
```



### ### Gender

```
qualtrics %>%
  group_by(gender) %>%
  summarize(n = n()) %>%
  kable()
```

gender	n
Female	92
Male	30

### ### Gaming experience

```
qualtrics %>%
  group_by(gaming.exp) %>%
  summarize(n = n()) %>%
  kable()
```

gaming.exp	n
No	12
Yes	110

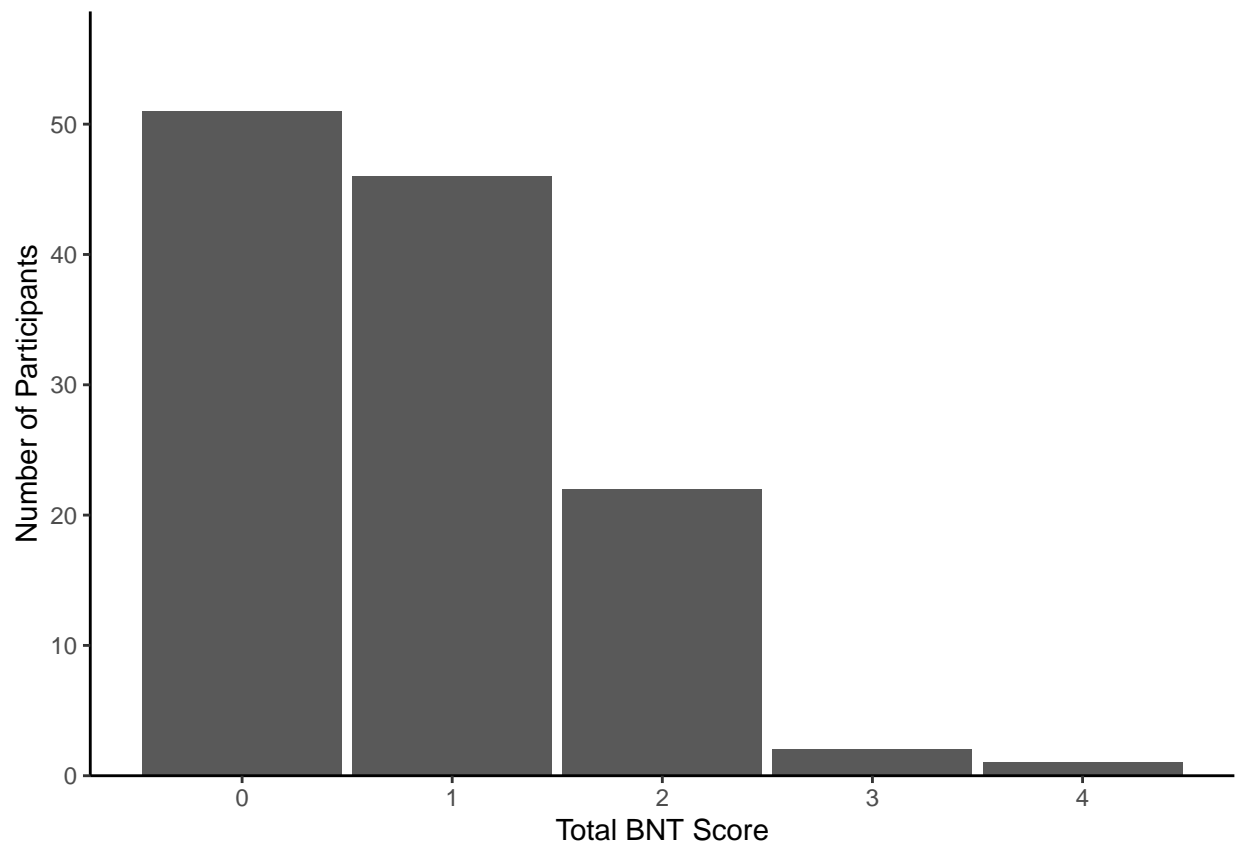
### ### BNT performance

```
bnt_dat <- qualtrics %>%
  group_by(bnt.tot.corr) %>%
```

```
summarize(n = n())
kable(bnt_dat)
```

bnt.tot.corr	n
0	51
1	46
2	22
3	2
4	1

```
ggplot(bnt_dat, aes(bnt.tot.corr, n)) +
  theme_classic() +
  geom_col(width = .95) +
  labs(y = "Number of Participants", x = "Total BNT Score") +
  scale_y_continuous(expand=expansion(mult=c(0,0.15)))
```



```
## SPES responses
## take the average? not sure how to score this
spes_key <- c("I fully disagree", "I somewhat disagree", "I neither disagree nor agree",
             "I somewhat agree", "I fully agree")
spes_dat <- qualtrics %>%
  mutate(across(starts_with("spes"), ~as.numeric(fct_relevel(as_factor(.), spes_key)))) %>%
  mutate(spes.avg = rowSums(across(starts_with("spes")))/8) %>%
  select(ParticipantID, spes.avg)
hist(spes_dat$spes.avg)
```

