R Notebook

In this study, we are interested in how auditory distraction affects cognitive flexibility, which is the ability of brain to shift between thinking about different problem. In this experiment, different music is taken as different levels of auditory distraction and time records of stroop test taken when listening to those certain music represent cognitive flexibility.

Start EDA by taking a overall look at data.

```
stroop_data <- read.csv("sta490_cognitive_flexibility_data.csv")
library(ggplot2)
library(naniar)
library(stringr)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(plyr)
```

```
## ------------------------------------------------------------------------------

## You have loaded plyr after dplyr - this is likely to cause problems.
## If you need functions from both plyr and dplyr, please load plyr first, then dplyr:
## library(plyr); library(dplyr)

## ------------------------------------------------------------------------------

##
## Attaching package: 'plyr'

## The following objects are masked from 'package:dplyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize
```

```
library(reshape2)
stroop_data
```

```
##     X Have.you.ever.been.diagnosed.with.colour.blindness.
## 1   1                                                  No
## 2   2                                                  No
## 3   3                                                  No
## 4   4                                                  No
## 5   5                                                  No
## 6   6                                                  No
## 7   7                                                  No
## 8   8                                                  No
## 9   9                                                 Yes
## 10 10                                                  No
## 11 11                                                  No
## 12 12                                                  No
## 13 13                                                  No
## 14 14                                                  No
## 15 15                                                  No
## 16 16                                                  No
## 17 17                                                  No
## 18 18                                                  No
## 19 19                                                  No
## 20 20                                                  No
## 21 21                                                  No
## 22 22                                                  No
## 23 23                                                  No
## 24 24                                                  No
## 25 25                                                  No
## 26 26                                                  No
## 27 27                                                  No
## 28 28                                                  No
## 29 29                                                  No
## 30 30                                                  No
## 31 31                                                  No
## 32 32                                                  No
## 33 33                                                  No
## 34 34                                                  No
## 35 35                                                  No
## 36 36                                                  No
## 37 37                                                  No
## 38 38                                                  No
## 39 39                                                  No
## 40 40                                                  No
## 41 41                                                  No
## 42 42                                                  No
## 43 43                                                  No
## 44 44                                                  No
## 45 45                                                  No
## 46 46                                                  No
## 47 47                                                  No
## 48 48                                                  No
## 49 49                                                  No
## 50 50                                                  No
## 51 51                                                  No
## 52 52                                                  No
## 53 53                                                  No
```

```
## 54 54                                                                    No
## 55 55                                                                    No
## 56 56                                                                    No
## 57 57                                                                    No
## 58 58                                                                    No
## 59 59                                                                    No
## 60 60                                                                    No
## 61 61                                                                    No
## 62 62                                                                    No
## 63 63                                                                    No
## 64 64                                                                    No
## 65 65                                                                    No
## 66 66                                                                    No
## 67 67                                                                    No
## 68 68                                                                    No
## 69 69                                                                    No
## 70 70                                                                    No
## 71 71                                                                    No
## 72 72                                                                    No
##    How.many.years..including.this.year..have.you.studied.in.an.English.language.school.university.
## 1                                                                                                  12
## 2                                                                                                   7
## 3                                                                                                   4
## 4                                                                                                   5
## 5                                                                                                  18
## 6                                                                                                   4
## 7                                                                                                  17
## 8                                                                                              6 years
## 9                                                                                                   3
## 10                                                                                                  5
## 11                                                                                                  3
## 12                                                                                                 10
## 13                                                                                                  7
## 14                                                                                                 12
## 15                                                                                                 12
## 16                                                                                             8 years
## 17                                                                                                  6
## 18                                                                                                  7
## 19                                                                                                  8
## 20                                                                                                 16
## 21                                                                                                  5
## 22                                                                                                 19
## 23                                                                                                  7
## 24                                                                                                 15
## 25                                                                                               five
## 26                                                                                                  4
## 27                                                                                                  5
## 28                                                                                                  7
## 29                                                                                                  6
## 30                                                                                                 17
## 31                                                                                                  6
## 32                                                                                                  7
## 33                                                                                                  4
## 34                                                                                                  6
```

```
## 35                                                                    8
## 36                                                                   16
## 37                                                                    4
## 38                                                                    7
## 39                                                                    3
## 40                                                                    6
## 41                                                                    7
## 42                                                                    4
## 43                                                                    7
## 44                                                                    7
## 45                                                              3 years
## 46                                                              7 years
## 47                                                                   14
## 48                                                                    4
## 49                                                                   10
## 50                                                                    4
## 51                                                                    6
## 52                                                                    4
## 53                                                                    6
## 54                                                                    6
## 55                                                                   12
## 56                                                                   15
## 57                                                                    8
## 58                                                                    4
## 59                                                                    6
## 60                                                              6 years
## 61                                                                   18
## 62                                                                    6
## 63                                                                    4
## 64                                                                   15
## 65                                                                   16
## 66                                                                   15
## 67                                                                    6
## 68                                                                    4
## 69                                                                    4
## 70                                                                   17
## 71                                                                    4
## 72                                                                   18
##    Do.you.play.video.games.regularly.
## 1                                  No
## 2                                  No
## 3                                  No
## 4                                  No
## 5                                  No
## 6                                 Yes
## 7                                 Yes
## 8                                  No
## 9                                 Yes
## 10                                 No
## 11                                 No
## 12                                Yes
## 13                                 No
## 14                                Yes
## 15                                 No
```

```
## 16                                No
## 17                                No
## 18                               Yes
## 19                               Yes
## 20                                No
## 21                               Yes
## 22                               Yes
## 23                                No
## 24                                No
## 25                               Yes
## 26                               Yes
## 27                                No
## 28                               Yes
## 29                                No
## 30                                No
## 31                               Yes
## 32                                No
## 33                                No
## 34                                No
## 35                               Yes
## 36                                No
## 37                                No
## 38                               Yes
## 39                                No
## 40                                No
## 41                                No
## 42                               Yes
## 43                                No
## 44                               Yes
## 45                                No
## 46                                No
## 47                               Yes
## 48                                No
## 49                               Yes
## 50                                No
## 51                               Yes
## 52                                No
## 53                               Yes
## 54                               Yes
## 55                                No
## 56                                No
## 57                               Yes
## 58                               Yes
## 59                                No
## 60                                No
## 61                               Yes
## 62                                No
## 63                               Yes
## 64                                No
## 65                               Yes
## 66                                No
## 67                               Yes
## 68                               Yes
## 69                                No
```

```
## 70                                  Yes
## 71                                  Yes
## 72                                  Yes
##    What.device.did.you.use.to.do.the.Stroop.test.
## 1                                     iPhone / iPod
## 2                                     Android phone
## 3                                     iPhone / iPod
## 4                                       iPad tablet
## 5                                     Android phone
## 6                                     iPhone / iPod
## 7                                     iPhone / iPod
## 8                                     iPhone / iPod
## 9                                       iPad tablet
## 10                                      iPad tablet
## 11                                    iPhone / iPod
## 12                                    iPhone / iPod
## 13                                    iPhone / iPod
## 14                                    iPhone / iPod
## 15                                    iPhone / iPod
## 16                                    iPhone / iPod
## 17                                    Android phone
## 18                                    Android phone
## 19                                    iPhone / iPod
## 20                                    Android phone
## 21                                    iPhone / iPod
## 22                                    iPhone / iPod
## 23                                    iPhone / iPod
## 24                                      iPad tablet
## 25                                    iPhone / iPod
## 26                                      iPad tablet
## 27                                    iPhone / iPod
## 28                                    Android phone
## 29                                      iPad tablet
## 30                                      iPad tablet
## 31                                    iPhone / iPod
## 32                                      iPad tablet
## 33                                    iPhone / iPod
## 34                                    iPhone / iPod
## 35                                    Android phone
## 36                                    iPhone / iPod
## 37                                    iPhone / iPod
## 38                                    iPhone / iPod
## 39                                    iPhone / iPod
## 40                                    iPhone / iPod
## 41                                    iPhone / iPod
## 42                                    Android phone
## 43                                      iPad tablet
## 44                                    iPhone / iPod
## 45                                    iPhone / iPod
## 46                                    iPhone / iPod
## 47                                      iPad tablet
## 48                                    iPhone / iPod
## 49                                    Android phone
## 50                                      iPad tablet
```

```
## 51                                    iPhone / iPod
## 52                                    iPhone / iPod
## 53                                    iPhone / iPod
## 54                                    iPhone / iPod
## 55                                    iPhone / iPod
## 56                                    iPhone / iPod
## 57                                    iPhone / iPod
## 58                                    iPhone / iPod
## 59                                    iPhone / iPod
## 60                                    Android phone
## 61                                    iPhone / iPod
## 62                                    iPhone / iPod
## 63                                    Android phone
## 64                                    iPhone / iPod
## 65                                      iPad tablet
## 66                                    iPhone / iPod
## 67                                    iPhone / iPod
## 68                                      iPad tablet
## 69                                    iPhone / iPod
## 70                                    iPhone / iPod
## 71                                    iPhone / iPod
## 72                                    Android phone
##         What.kind.of.headphones.did.you.use.
## 1      Over-ear headphones; noise cancelling
## 2    In-ear headphones; not noise cancelling
## 3      Over-ear headphones; noise cancelling
## 4    In-ear headphones; not noise cancelling
## 5    In-ear headphones; not noise cancelling
## 6  Over-ear headphones; not noise cancelling
## 7      Over-ear headphones; noise cancelling
## 8    In-ear headphones; not noise cancelling
## 9        In-ear headphones; noise cancelling
## 10     Over-ear headphones; noise cancelling
## 11     Over-ear headphones; noise cancelling
## 12   In-ear headphones; not noise cancelling
## 13   In-ear headphones; not noise cancelling
## 14   In-ear headphones; not noise cancelling
## 15   In-ear headphones; not noise cancelling
## 16   In-ear headphones; not noise cancelling
## 17   In-ear headphones; not noise cancelling
## 18 Over-ear headphones; not noise cancelling
## 19       In-ear headphones; noise cancelling
## 20   In-ear headphones; not noise cancelling
## 21       In-ear headphones; noise cancelling
## 22   In-ear headphones; not noise cancelling
## 23   In-ear headphones; not noise cancelling
## 24     Over-ear headphones; noise cancelling
## 25   In-ear headphones; not noise cancelling
## 26 Over-ear headphones; not noise cancelling
## 27   In-ear headphones; not noise cancelling
## 28   In-ear headphones; not noise cancelling
## 29   In-ear headphones; not noise cancelling
## 30   In-ear headphones; not noise cancelling
## 31   In-ear headphones; not noise cancelling
```

```
## 32   In-ear headphones; not noise cancelling
## 33   In-ear headphones; not noise cancelling
## 34 Over-ear headphones; not noise cancelling
## 35       In-ear headphones; noise cancelling
## 36   In-ear headphones; not noise cancelling
## 37       In-ear headphones; noise cancelling
## 38     Over-ear headphones; noise cancelling
## 39   In-ear headphones; not noise cancelling
## 40   In-ear headphones; not noise cancelling
## 41   In-ear headphones; not noise cancelling
## 42 Over-ear headphones; not noise cancelling
## 43   In-ear headphones; not noise cancelling
## 44       In-ear headphones; noise cancelling
## 45   In-ear headphones; not noise cancelling
## 46   In-ear headphones; not noise cancelling
## 47   In-ear headphones; not noise cancelling
## 48 Over-ear headphones; not noise cancelling
## 49 Over-ear headphones; not noise cancelling
## 50 Over-ear headphones; not noise cancelling
## 51   In-ear headphones; not noise cancelling
## 52       In-ear headphones; noise cancelling
## 53   In-ear headphones; not noise cancelling
## 54       In-ear headphones; noise cancelling
## 55   In-ear headphones; not noise cancelling
## 56   In-ear headphones; not noise cancelling
## 57   In-ear headphones; not noise cancelling
## 58   In-ear headphones; not noise cancelling
## 59   In-ear headphones; not noise cancelling
## 60   In-ear headphones; not noise cancelling
## 61     Over-ear headphones; noise cancelling
## 62   In-ear headphones; not noise cancelling
## 63   In-ear headphones; not noise cancelling
## 64       In-ear headphones; noise cancelling
## 65   In-ear headphones; not noise cancelling
## 66   In-ear headphones; not noise cancelling
## 67   In-ear headphones; not noise cancelling
## 68       In-ear headphones; noise cancelling
## 69   In-ear headphones; not noise cancelling
## 70   In-ear headphones; not noise cancelling
## 71     Over-ear headphones; noise cancelling
## 72 Over-ear headphones; not noise cancelling
##             Put.these.levels.of.auditory.distraction.in.the.order.that.you.did.them.
## 1  Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 2
## 3
## 4  Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 5  Classical (Mozart);Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);
## 6  Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 7
## 8
## 9  Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 10 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 11 Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);Control (quiet);
## 12 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
```

```
## 13 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 14
## 15 Classical (Mozart);Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);
## 16 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 17
## 18 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 19 Classical (Mozart);Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);
## 20 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 21 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 22 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 23
## 24 Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 25
## 26 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 27
## 28 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 29 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 30 Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 31 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 32
## 33 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 34 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 35
## 36 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 37 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 38 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 39 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 40 Song with lyrics (Shape of You by Ed Sheeran);Control (quiet);Classical (Mozart);
## 41 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 42 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 43 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 44
## 45 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 46
## 47 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 48 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 49 Song with lyrics (Shape of You by Ed Sheeran);Control (quiet);Classical (Mozart);
## 50 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 51 Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);Control (quiet);
## 52 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 53 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 54 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 55
## 56 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 57
## 58 Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 59 Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 60 Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 61
## 62
## 63 Song with lyrics (Shape of You by Ed Sheeran);Control (quiet);Classical (Mozart);
## 64 Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 65 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 66 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
```

```
## 67 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 68 Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);Control (quiet);
## 69 Classical (Mozart);Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);
## 70 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 71 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
## 72 Control (quiet);Song with lyrics (Shape of You by Ed Sheeran);Classical (Mozart);
##    What.was.your.first.auditory.distraction.condition.
## 1                                                Quiet
## 2                                                quite
## 3                                                Quiet
## 4                                                Quiet
## 5                            Classical instrumental music
## 6           Music with lyrics (Ed Sheeran, Shape of You)
## 7                                     Quiet / no music
## 8                                       quiet condition
## 9                                                Quiet
## 10                                               Quiet
## 11                                           Classical
## 12                                               quiet
## 13                                               Quiet
## 14                                       Control(quiet)
## 15                                           Classical
## 16                                               Quiet
## 17                                               quiet
## 18                                               Quiet
## 19                                 Classicial Instrumental
## 20                                      Control (no music)
## 21                                               Quiet
## 22                                     Control (quiet)
## 23                                               Quiet
## 24                                        shape of you
## 25                                               Quiet
## 26                                               quiet
## 27                                               quiet
## 28                                               quiet
## 29                                               quiet
## 30                                         Ed Sheeran
## 31                                               quiet
## 32                                               quite
## 33                                               quiet
## 34                                             control
## 35                                               Quiet
## 36                                               quiet
## 37                                               Quiet
## 38                                               quite
## 39                                               quiet
## 40                                          Ed Sheeran
## 41                                       quiet (control)
## 42                                               Control
## 43                                               Quiet
## 44                                               quiet
## 45                                               quiet
## 46                                               Quiet
## 47                                             control
```

```
## 48                                                quiet
## 49                                    Music with lyrics
## 50                                                Quiet
## 51                          Classical instrumental music
## 52                                                Quiet
## 53                                                quiet
## 54                                     control(quiet)
## 55                                    Control (Quiet)
## 56                                                Quiet
## 57                                                quiet
## 58                                     Song of lyrics
## 59                                       shape of you
## 60           Music with lyrics(Ed Sheeran, Shape of You)
## 61                                                Quiet
## 62                                                quiet
## 63          Music with lyrics (Ed Sheeran, Shape of You)
## 64                                       with lyrics
## 65                                                quiet
## 66                                                quiet
## 67                                                Quiet
## 68                                                Quiet
## 69                                    classical music
## 70                                            Control
## 71                                              quite
## 72                                            Control
##    How.many.hours.of.sleep.did.you.get.the.night.before.doing.the.Stroop.test.with.this.level.of.audi
## 1
## 2
## 3
## 4
## 5
## 6
## 7
## 8
## 9
## 10
## 11
## 12
## 13
## 14
## 15
## 16
## 17
## 18
## 19
## 20
## 21
## 22
## 23
## 24
## 25
## 26
## 27
## 28
```

```
## 29
## 30
## 31
## 32
## 33
## 34
## 35
## 36
## 37
## 38
## 39
## 40
## 41
## 42
## 43
## 44
## 45
## 46
## 47
## 48
## 49
## 50
## 51
## 52
## 53
## 54
## 55
## 56
## 57
## 58
## 59
## 60
## 61
## 62
## 63
## 64
## 65
## 66
## 67
## 68
## 69
## 70
## 71
## 72
##    At.what.time.did.you.do.the.Stroop.test.with.this.level.of.auditory.distraction.
## 1                                                                                5 p.m.
## 2                                                                  Morning (10.49 Am)
## 3                                                                             1.00pm
## 4                                                                            12:05PM
## 5                                                                           11:25 am
## 6                                                                       1:23pm, Sep 17
## 7                                                                            4:40 PM
## 8                                                                           10:04 am
## 9                                                                            9:53 am
```

```
## 10                                                                3:49pm
## 11                                                                 16?00
## 12                                                                 10 pm
## 13                                                                 14:55
## 14                                                        Sep.13, 1:18pm
## 15                                                               8:31 PM
## 16                                                                6:08PM
## 17                                                                   8pm
## 18                                                                7:00pm
## 19                                                                 5 P.M.
## 20                                                               7:48 PM
## 21                                                              2.30p.m.
## 22                                                                8:30pm
## 23                                                                 21:35
## 24                                                       dinner time 7pm
## 25                                              sep.15, 2019/ 11:37 pm
## 26                                                                 20.44
## 27                                                                8:54AM
## 28                                                                 19:56
## 29                                                               11:08pm
## 30                                                         12pm Tuesday
## 31                                                                 7pm
## 32                                                               11:32am
## 33                                                                3:51pm
## 34                                                                8:40pm
## 35                                                                 5-6pm
## 36                                                          evening 8pm
## 37                                                                 3pm
## 38                                                                5:08pm
## 39                                                                8.20pm
## 40                                                                8:16pm
## 41                                                              11:08 am
## 42                                                             7:45 p.m.
## 43                                                                 21:15
## 44                                                                   4pm
## 45                                                            10:45 p.m.
## 46                                                                8:53pm
## 47                                                                7:10AM
## 48                                                                  8 pm
## 49                                                                   7pm
## 50                                                               10:45pm
## 51                                                              10:00 pm
## 52                                                                   7pm
## 53                                                                6:00pm
## 54                                                                  10pm
## 55                                                                   2PM
## 56                                                                  12PM
## 57                                                                 14?28
## 58                                                               11.51PM
## 59                                                              5:08p.m.
## 60                                                             01:13 p.m
## 61                                                                 6 PM
## 62                                                                6:11 pm
## 63                                                              11:02 a.m.
```

```
## 64                                                                    4:17 PM
## 65                                                                       20:15
## 66                                                                       23:00
## 67                                                                      3:31pm
## 68                                                                         4pm
## 69                                                                      8:18pm
## 70                                                                       11 am
## 71                                                                      8:10 PM
## 72                                                                       11 pm
##    OffTime  OnTime Total...of.runs.Stroop.Off Total...of.runs.Stroop.On
## 1   47.379  50.003                          6                         7
## 2   61.675 74.913s                          5                         5
## 3  75.542s 82.570s                          5                         5
## 4  62.823s 75.340s                          5                         5
## 5   48.707  61.569                          5                         5
## 6  55.982s 65.715s                          5                         5
## 7   40.780  44.449                         16                        21
## 8  54.597s 73.384s                          5                         5
## 9  65.122s 64.081s                          8                         5
## 10 59.321s 68.984s                          5                         5
## 11  64.064  79.917                          5                         5
## 12  11.840  13.741                          1                         1
## 13 52.476s 65.214s                          5                         5
## 14 53.057s 49.907s                          7                         5
## 15  57.410  60.796                          5                         7
## 16 70.689s 90.378s                          5                         5
## 17  49.166  55.254                          5                         5
## 18  58.410  68.398                          5                         5
## 19  46.513  46.738                          5                         6
## 20  58.707  60.834                          5                         5
## 21 64.422s 68.845s                          5                         5
## 22  44.871  54.092                          5                         6
## 23 48.333s 50.329s                         11                         8
## 24 53.592S  56.983                          7                        11
## 25  56.938  60.618                         11                        10
## 26  57.557  65.089                          7                         6
## 27 50.690s 58.225s                          5                         9
## 28  59.355  68.949                          5                         5
## 29 44.934s 48.164s                          9                         7
## 30 43.034s 49.521s                          5                         5
## 31      12      18                          2                         5
## 32 65.914s 82.242s                          5                         5
## 33 58.646s 72.688s                          5                         6
## 34  59.428  65.819                          5                         6
## 35  63.775  86.652                          6                         8
## 36  66.446  72.914                          6                         6
## 37  61.042  62.320                          7                         5
## 38 43.112s 49.378s                          6                         8
## 39 53.160s 66.096s                          5                         5
## 40 62.703s 63.815s                          5                         6
## 41 57.096s 73.209s                          5                         6
## 42  59.135  73.403                          5                         5
## 43 62.085s 76.320s                          5                         5
## 44  46.323  51.817                          6                         6
```

```
## 45 47.726s 50.895s                    6                     6
## 46 50.503s 60.853s                    8                     5
## 47 60.596s 56.876s                    6                     7
## 48 56.101s 62.819s                    9                     7
## 49  60.755  74.557                    5                     5
## 50 58.931s 82.433s                    5                     5
## 51 61.011s 68.933s                    7                    11
## 52  64.646  68.636                    5                     5
## 53   55.64  64.575                    6                     5
## 54 `64.852  60.342                    5                     5
## 55  62.161  78.418                    5                     5
## 56  52.937  72.799                    6                     5
## 57     49s 52.736s                    8                     6
## 58  53.561  55.167                    9                     5
## 59 51.108s  57.302                    8                     6
## 60  64.282  67.526                    5                     5
## 61  47.787  52.470                    5                     5
## 62 63.706s 62.831s                    5                     8
## 63  53.741  58.630                    5                     5
## 64 54.925s 71.675s                    5                     6
## 65  60.732  68.133                    6                     8
## 66  11.127  12.943                    2                     3
## 67 62.486s 69.903s                    5                     6
## 68  46.423  51.247                    9                     5
## 69  60.174  72.374                    5                     5
## 70  48.742  55.761                    5                     5
## 71 51.193s 57.235s                    5                     7
## 72  54.248  70.825                    5                     5
##    OnTime.minus.OffTime
## 1                 2.624
## 2               13.238s
## 3                7.028s
## 4               12.518s
## 5                12.862
## 6                9.733s
## 7                 3.670
## 8               18.787s
## 9                -1.041
## 10               9.663s
## 11               15.853
## 12                1.901
## 13              12.738s
## 14              -3.150s
## 15                3.387
## 16              19.689s
## 17                6.088
## 18                9.988
## 19                0.225
## 20                2.127
## 21               4.422s
## 22                9.221
## 23               1.996s
## 24                3.391
## 25                3.680
```

```
## 26                7.532
## 27               7.536s
## 28                9.594
## 29               3.230s
## 30               6.487s
## 31                    3
## 32              16.328s
## 33              14.043s
## 34                6.387
## 35               22.877
## 36                6.467
## 37                1.278
## 38               6.267s
## 39              12.936s
## 40               1.111s
## 41              16.113s
## 42               14.268
## 43              14.235s
## 44                5.494
## 45                3.17s
## 46              10.350s
## 47              -3.720s
## 48               6.718s
## 49               13.802
## 50              23.502s
## 51               7.922s
## 52                3.992
## 53                8.935
## 54               -4.510
## 55               16.257
## 56               19.863
## 57               2.836s
## 58                1.606
## 59               6.193s
## 60                3.244
## 61                4.683
## 62              -0.875s
## 63                4.889
## 64              16.750s
## 65                7.401
## 66                1.816
## 67               7.417s
## 68                4.824
## 69               12.200
## 70                7.019
## 71               6.042s
## 72               16.577
##                  What.was.your.second.auditory.distraction.condition.
## 1                                                          Ed sheeran
## 2                                                              MOZART
## 3                                                        Shape of You
## 4                                                  Music with lyrics
## 5                                                               Quiet
## 6  Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
```

```
## 7                                                    Classical music
## 8                                          classical instrumental music
## 9                                                    Music with lyrics
## 10                                         Classical instrumental music
## 11                                                   Song with Lyrics
## 12                                                           Mozart
## 13                                                       Shape of You
## 14                                                          classical
## 15                                                            Control
## 16                           Music with lyrics (Ed Sheeran, Shape of You)
## 17                                                          classical
## 18                                       Ed Sheeran, Shape of You
## 19                                                             Quiet
## 20                                                  Classical Music
## 21                                                     Shape of you
## 22                          Song with lyrics (Shape of You by Ed Sheeran)
## 23                           Music with lyrics (Ed Sheeran, Shape of You)
## 24                                                           Mozart
## 25                                       classical instrumental music
## 26                                                          classic
## 27                                     classical instrumental music
## 28                                                 music with lyrics
## 29                                                      Shape of You
## 30                                                           Mozart
## 31                                                          classical
## 32                                        Classical instrument music
## 33                           Music with lyrics (Ed Sheeran, Shape of You)
## 34                                                 Song with lyrics
## 35                                       Ed Sheeran - Shape of You
## 36                                                    Mozart-Classic
## 37                                                 Music with lyrics
## 38                                            classical instruments
## 39                                                     shape of you
## 40                                                           Silent
## 41                                                Music with lyrics
## 42                                          DIstraction with lyrics
## 43                           Music with lyrics (Ed Sheeran, Shape of You)
## 44                                                    shape of you
## 45                           Music with lyrics (Ed Sheeran, Shape of You)
## 46                                                 Music with lyrics
## 47                                                 music with lyrics
## 48                                       Ed Sheeran - Shape of You
## 49                                                 Control (Silence)
## 50                                       Classical instrumental music
## 51                                                 Music with lyrics
## 52                                                       shape of you
## 53                                                 Music with lyrics
## 54                                                          classical
## 55                           Music with lyrics (Ed Sheeran, Shape of You)
## 56                                         Ed Sheeran Shape of You
## 57                         music with lyrics  (Ed Sheeran - shape of you)
## 58                                       Classical instrumental music
## 59                                                            mozart
## 60     Classic instrumental music(Mozart Piano Sonata No.8 in A minor)
```

```
## 61                                      Classical Instrumental Music
## 62                                                            Mozart
## 63                                                             Quiet
## 64                                           with classical musics
## 65                                                            Mozart
## 66                                                           Classic
## 67                          Music with lyrics (Ed Sheeran, Shape of You)
## 68                                                       SHAPE of you
## 69                                                              quiet
## 70                                                  Music with lyrics
## 71                                                             lyrics
## 72                                                   Song With Lyrics
##    How.many.hours.of.sleep.did.you.get.the.night.before.doing.the.Stroop.test.with.this.level.of.audi
## 1
## 2
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## 69
## 70
## 71
## 72
##    At.what.time.did.you.do.the.Stroop.test.with.this.level.of.auditory.distraction.2
## 1                                                                                5:20 pm
## 2                                                                               11:42AM
## 3                                                                                1.30pm
## 4                                                                               12:12PM
## 5                                                                              11:30 am
## 6                                                                      1:35pm, Sep 17.
## 7                                                                                 4:53
## 8                                                                               10.10am
## 9                                                                              10:05 am
## 10                                                                               4:01pm
## 11                                                                                16:20
## 12                                                                                10 pm
## 13                                                                                15:02
## 14                                                                       Sep.13, 1:27pm
## 15                                                                              8:36 PM
## 16                                                                               6:15PM
## 17                                                                                  8pm
## 18                                                                               7:10pm
## 19                                                                             5:30 P.M.
## 20                                                                                7:55 PM
## 21                                                                               2.40p.m.
## 22                                                                                8:40pm
```

```
## 23                                                                          21:43
## 24                                                                 diner time 7pm
## 25                                                        sep.15, 2019/ 11:44pm
## 26                                                                          20.53
## 27                                                                         9:03AM
## 28                                                                          21:47
## 29                                                                          11:35
## 30                                                                   12pm Tuesday
## 31                                                                            8pm
## 32                                                                        11:39am
## 33                                                                         4:03pm
## 34                                                                         8:50pm
## 35                                                                         5-6pm
## 36                                                                        Evening
## 37                                                                         3:10pm
## 38                                                                         5:16pm
## 39                                                                         8.26pm
## 40                                                                         8:21pm
## 41                                                                        11:15am
## 42                                                                      7:54 p.m.
## 43                                                                          21:22
## 44                                                                            4pm
## 45                                                                     10:51 p.m.
## 46                                                                         9:04pm
## 47                                                                        7:15 AM
## 48                                                                         8.10pm
## 49                                                                            7pm
## 50                                                                        11:12pm
## 51                                                                        9:00 am
## 52                                                                            7pm
## 53                                                                         6:10pm
## 54                                                                        10:05pm
## 55                                                                         2.30PM
## 56                                                                           12PM
## 57                                                                          14:34
## 58                                                                        11.56PM
## 59                                                                      5:15p.m.
## 60                                                                     01:19 p.m
## 61                                                                        6:08 PM
## 62                                                                        6:23 pm
## 63                                                                     11:09 a.m.
## 64                                                                      4:22 PM 
## 65                                                                          20:25
## 66                                                                          14:00
## 67                                                                         3:39pm
## 68                                                                            4pm
## 69                                                                         8:27pm
## 70                                                                          11 am
## 71                                                                         4:17PM
## 72                                                                             11
##    OffTime2 OnTime2 Total...of.runs.Stroop.Off2 Total...of.runs.Stroop.On2
## 1    46.169  48.313                       5.000                          5
## 2   64.676s 64.676s                       6.000                          6
## 3   79.855s  88.525                       5.000                          5
```

```
## 4   65.072s 75.898s                6.000                5
## 5    50.179  54.965                5.000                5
## 6   54.149s 58.828s                6.000                5
## 7    44.229  45.964               14.000               16
## 8   58.037s 66.203s                5.000                6
## 9   59.274s 63.402s                6.000                7
## 10  57.499s 60.073s                5.000                5
## 11   64.075  70.041                5.000                5
## 12   12.042  11.512                1.000                1
## 13  54.443s 60.627s                5.000                6
## 14  50.013s 50.883s                5.000                5
## 15   55.584  62.405                5.000                5
## 16  74.808s 83.990s                5.000                5
## 17   51.532  54.891                5.000                5
## 18   56.341  64.575                5.000                5
## 19   38.728  46.292                7.000                6
## 20   51.562  55.042                5.000                5
## 21  70.973s 74.591s                5.000                5
## 22   42.520  50.446                5.000                6
## 23  49.112s 49.967s                6.000                7
## 24  55.440S 60.680s               11.000                6
## 25   51.240  52.274                7.000               10
## 26   58.263  55.857                5.000                5
## 27  57.703s 61.188s                5.000                8
## 28   57.370  58.717                5.000                5
## 29  41.127s 43.698s                8.000                9
## 30  43.178s 44.558s                6.000                5
## 31       14      18                2.000                5
## 32  67.873s 72.201s                7.000                5
## 33  60.809s 66.892s                6.000                7
## 34   56.561  63.715                5.000                5
## 35   58.253  76.497                5.000                5
## 36   58.412  74.849                8.000                7
## 37   60.624  66.755                5.000                7
## 38  42.012s 43.625s                7.000                7
## 39  51.967s 67.324s                5.000                6
## 40  59.879s 66.752s                5.000                5
## 41  72.522s 76.608s                6.000                5
## 42   57.638  65.235                5.000                5
## 43  62.450s 65.634s                5.000                5
## 44   43.001  47.800                7.000                5
## 45  47.448s 53.969s                5.000                6
## 46  49.129s 61.407s                6.000                5
## 47  55.827s 63.426s                5.000                9
## 48  53.515s 62.697s                8.000                9
## 49   62.438  75.747                5.000                5
## 50  68.291s 86.641s                5.000                5
## 51   60.08s 63.202s                7.000                6
## 52   65.343  70.544                5.000                5
## 53   51.421  53.795                5.000                6
## 54   64.789  67.472                5.000                5
## 55   60.980  86.616                5.000                6
## 56   64.355  65.455                5.000                6
## 57  42.085s 42.732s                5.000                6
```

```
## 58   48.986  59.549                    9.000                    9
## 59  45.032s 50.686s                    5.000                    5
## 60   62.878  74.753                    5.000                    6
## 61   43.332  47.893                    6.000                    6
## 62  58.762s 62.393s                    5.000                    7
## 63   51.668  55.224                    5.000                    5
## 64  61.895s 63.709s                    6.000                    5
## 65 55.163 S 61.198S                    7.000                    6
## 66   11.577  12.342                    1.000                    1
## 67  55.643s 67.244s                    5.000                    5
## 68   44.280  40.749                   -3.532                    5
## 69   61.929  61.739                    5.000                    5
## 70   45.960  53.425                    5.000                    5
## 71  47.983s 56.477s                    8.000                    9
## 72   52.843  74.112                    5.000                    6
##    OnTime.minus.OffTime2
## 1                  2.144
## 2                 25.934s
## 3                  8.670
## 4                 10.826s
## 5                  4.786
## 6                  4.679s
## 7                  1.735
## 8                  8.166s
## 9                  4.128s
## 10                 2.574s
## 11                 5.966
## 12                  0.53
## 13                 6.183
## 14                 0.869s
## 15                 6.821
## 16                 9.182s
## 17                 3.359
## 18                 8.234
## 19                11.564
## 20                 3.480
## 21                 3.618s
## 22                 7.926
## 23                 0.855s
## 24                 5.241
## 25                 1.034
## 26                -2.407
## 27                 3.485s
## 28                 1.347
## 29                 2.570s
## 30                1.3880s
## 31                      3
## 32                 4.329s
## 33                 6.082s
## 34                 7.154
## 35                18.244
## 36                16.436
## 37                 6.131
## 38                 1.613s
```

```
## 39               15.356s
## 40                6.873s
## 41                4.086s
## 42                 7.592
## 43                3.184s
## 44                 4.800
## 45                6.521s
## 46               12.277s
## 47                7.599s
## 48                9.182s
## 49                13.309
## 50               18.350s
## 51                3.121s
## 52                 5.201
## 53                 2.374
## 54                 2.683
## 55                25.636
## 56                 1.100
## 57                0.648s
## 58                10.563
## 59                5.653s
## 60                11.875
## 61                 4.561
## 62                3.631s
## 63                 3.556
## 64                1.814s
## 65               6.035 S
## 66                 0.772
## 67               11.601s
## 68                     5
## 69                -0.190
## 70                 7.465
## 71                8.494s
## 72                21.269
##                  What.was.your.third.auditory.distraction.condition.
## 1                                                          classical
## 2                                                        Ed Sherron
## 3                                                          Classical
## 4                                       Classical instrumental music
## 5                                                  Music with lyrics
## 6                                                    Quiet condition
## 7                                                     Lyrical Music 
## 8                                                  music with lyrics
## 9                                       Classical instrumental music
## 10                                                 Music with lyrics
## 11                                                             Quiet
## 12                                                   song with lyric
## 13                             Mozart Piano Sonata No. 8 in A minor
## 14                                                      Shape of you
## 15                                                   Song with lyric
## 16 Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
## 17                                                      shape of you
## 18                                                            Mozart
## 19                                                        Ed Sheeran
```

```
## 20                                                    Song with lyrics
## 21                                                          Classical
## 22                                                  Classical (Mozart)
## 23 Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
## 24                                                              Quiet
## 25                                                 music with lyrics
## 26                                                               song
## 27                                                 music with lyrics
## 28                                                 instrumental music
## 29                      Mozart - Piano Sonata No. 8 in A minor, K. 310
## 30                                                              Quite
## 31                                                   song with lyrics
## 32                                                   Music with lyric
## 33 Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
## 34                                                            Classic
## 35                                    Mozart - Piano Sonata No. 8 in A
## 36                                                        shape of you
## 37                                    Classical instrumental music
## 38                                                     lyric music
## 39                                                       classical
## 40                                                  Classical music
## 41                                    Classical instrumental music
## 42                                      Distraction without lyrics
## 43  Classical instrumental music (Mozart Piano Sonata No.8 in A minor)
## 44                                                            classic
## 45 Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
## 46                                    Classical Instrumental Music
## 47                                                            classic
## 48                                    Classical instrumental music
## 49                                            Music with no lyrics
## 50                                               Music with lyrics
## 51                                                              Quiet
## 52                                                            classic
## 53                                     Classical instrumental musi
## 54                                                   song with lyrics
## 55 Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
## 56                                              Classical Mozart Sonata
## 57                           music with classical music instrumental
## 58                                                              Quiet
## 59                                           quiet control condition
## 60                                                              Quiet
## 61                                                 Music with lyrics
## 62                                               lyrics - shape of you
## 63 Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
## 64                                                       no musics
## 65                                                    shape of you
## 66                                                 music with lyrics
## 67 Classical instrumental music (Mozart Piano Sonata No. 8 in A minor)
## 68                                                            mozart
## 69                                                 music with lyrics
## 70                                           Classical Instrumental
## 71                                                    instrumental
## 72                                                       Classical
##    How.many.hours.of.sleep.did.you.get.the.night.before.doing.the.Stroop.test.with.this.level.of.audi
```

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## 1
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## 71
## 72
##    At.what.time.did.you.do.the.Stroop.test.with.this.level.of.auditory.distraction.3
## 1                                                                                5:40 pm
## 2                                                                               11.53AM
## 3                                                                                1.00pm
## 4                                                                               12:18PM
## 5                                                                              11:35 am
## 6                                                                    1:42 pm, Sep 17.
## 7                                                                                 5:00
## 8                                                                               10.16am
## 9                                                                              10:18 am
## 10                                                                               4:09pm
## 11                                                                                16:26
## 12                                                                                10 pm
## 13                                                                                15:06
## 14                                                                 Sep. 13, 1:31pm
## 15                                                                               8:41 PM
## 16                                                                                6:27pm
## 17                                                                                   8pm
## 18                                                                                7:20pm
## 19                                                                                 6 P.M
## 20                                                                               8:01 PM
## 21                                                                              2.47p.m.
## 22                                                                                8:50pm
## 23                                                                                 21:48
## 24                                                                           dinner time
## 25                                                                 sep.15, 2019/ 11:50pm
## 26                                                                                20.59
## 27                                                                               9:10AM
## 28                                                                                21:55
## 29                                                                                11:40
## 30                                                                           12pm Tuesday
## 31                                                                                   8pm
## 32                                                                              11:44am
## 33                                                                               4:09pm
## 34                                                                                   9pm
## 35                                                                                6pm
```

```
## 36                                                                  Evening
## 37                                                                   3:20pm
## 38                                                                   5:21pm
## 39                                                                   8.36pm
## 40                                                                   8:26pm
## 41                                                                    11:45
## 42                                                                 8:00 p.m.
## 43                                                                    21:31
## 44                                                                   4:05pm
## 45                                                                10:56 p.m.
## 46                                                                   9:11pm
## 47                                                                     7:20
## 48                                                                   8.15pm
## 49                                                                      7pm
## 50                                                                  11:22pm
## 51                                                                 1:00 am 
## 52                                                                      7pm
## 53                                                                   6:20pm
## 54                                                                  10:11pm
## 55                                                                      3PM
## 56                                                                     12PM
## 57                                                                    14:41
## 58                                                                   12.01AM
## 59                                                                  5:20p.m.
## 60                                                                 01:24 p.m
## 61                                                                   6:15 PM
## 62                                                                   6:28 pm
## 63                                                                11:13 a.m.
## 64                                                                  7:15 AM 
## 65                                                                    20:30
## 66                                                                    15:30
## 67                                                                   3:44pm
## 68                                                                      4pm
## 69                                                                   8:33pm
## 70                                                                    11 am
## 71                                                                   4:22PM
## 72                                                                       11
##    OffTime3  OnTime3 Total...of.runs.Stroop.Off3
## 1    44.765   45.911                       6.000
## 2   70.651s  82.432s                       6.000
## 3   77.630s  83.015s                       5.000
## 4   64.517s  73.342s                       5.000
## 5    47.539   55.176                       5.000
## 6   54.655s  63.137s                       6.000
## 7    38.798   42.046                      10.000
## 8   57.470s  65.333s                       5.000
## 9   64.517s  61.536s                       5.000
## 10  57.778s  62.856s                       6.000
## 11   57.744   60.586                       5.000
## 12   11.877   12.093                       1.000
## 13  53.559s  52.176s                       5.000
## 14  47.418s  50.625s                       6.000
## 15   54.826   58.455                       5.000
## 16  74.808s  83.990s                       5.000
```

```
## 17   46.468   49.934                5.000
## 18   58.102   62.024                5.000
## 19   43.108   38.584                5.000
## 20   48.819   48.725                5.000
## 21  62.503s  66.603s                5.000
## 22   46.416   51.818                6.000
## 23  47.351s  47.836s                5.000
## 24  52.866s  57.312s                7.000
## 25   49.983   52.905                5.000
## 26   57.245   63.957                5.000
## 27  59.660s  66.343s                6.000
## 28   54.170   62.170                5.000
## 29  39.285s  45.737s                6.000
## 30  41.260s  43.353s                5.000
## 31       15       19                1.000
## 32  65.844s  85.561s                5.000
## 33  59.480s  61.530s                6.000
## 34   55.465   61.847                5.000
## 35   55.039   72.708                7.000
## 36   61.265   64.047                7.000
## 37   67.178   65.705                5.000
## 38  43.133s  43.771s                5.000
## 39  48.698s  56.265s                5.000
## 40  61.350s  63.202s                5.000
## 41  63.520s  71.390s                5.000
## 42   57.710   69.637                5.000
## 43  56.900s  64.779s                5.000
## 44   42.406   51.447                5.000
## 45  45.983s  48.044s                6.000
## 46  50.121s  54.166s                5.000
## 47  50.972s  59.825s                6.000
## 48  55.162s  59.435s                7.000
## 49   65.292   73.546                5.000
## 50  64.307s  69.609s                5.000
## 51  56.050s  62.180s                7.000
## 52   65.637   69.957                5.000
## 53   52.127   63.934                5.000
## 54   59.323   60.446                5.000
## 55   68.801   78.900                5.000
## 56   52.983   61.050                5.000
## 57  43.058s  52.059s                6.000
## 58   48.600   63.107                5.000
## 59  46.593s  45.332s                5.000
## 60   59.464   67.308                5.000
## 61   43.393   50.888                5.000
## 62  58.441s  70.672s                5.000
## 63   46.927   52.892                5.000
## 64  55.649s  68.191s                5.000
## 65 50.501 S 60.396 S                6.000
## 66           12.064               12.142
## 67  56.125s  62.655s                5.000
## 68   40.698   44.014                7.000
## 69   58.824   66.793                5.000
## 70   46.507   52.875                5.000
```

```
## 71  46.760s  51.594s                      6.000
## 72   49.804   73.300                      6.000
##    Total...of.runs.Stroop.On3 OnTime.minus.OffTime3 ID
## 1                           7                 1.146  1
## 2                           7                11.781  2
## 3                           5                5.385s  3
## 4                           6                8.825s  4
## 5                           5                 7.637  5
## 6                           5                8.482s  6
## 7                           9                 3.248  7
## 8                           5                7.863s  8
## 9                           6                -2.981  9
## 10                          6                5.079s 10
## 11                          5                 2.842 11
## 12                          1                 0.216 12
## 13                          6               -1.383s 13
## 14                          7                3.207s 14
## 15                          5                 3.628 15
## 16                          5                9.182s 16
## 17                          5                 3.466 17
## 18                          5                 3.922 18
## 19                          5                -4.524 19
## 20                          5                -0.094 20
## 21                          5                4.100s 21
## 22                          6                 5.402 22
## 23                          5                0.484s 23
## 24                         11                4.447s 24
## 25                          6                 2.922 25
## 26                          7                 6.713 26
## 27                         11                6.683s 27
## 28                          5                 8.000 28
## 29                          5                6.452s 29
## 30                          5                2.094s 30
## 31                          3                     2 31
## 32                          6               19.717s 32
## 33                          5                2.050s 33
## 34                          5                 6.382 34
## 35                          5                17.669 35
## 36                          6                 2.782 36
## 37                          6                -1.473 37
## 38                          7                0.637s 38
## 39                          5                7.568s 39
## 40                          5                1.852s 40
## 41                          5                7.870s 41
## 42                          5                11.927 42
## 43                          5                7.878s 43
## 44                          5                 9.041 44
## 45                          6                2.061s 45
## 46                          8                4.045s 46
## 47                          5                8.853s 47
## 48                          6                4.274s 48
## 49                          5                 8.254 49
## 50                          5                5.303s 50
## 51                          6                6.131s 51
```

```
## 52                          5                4.32 52
## 53                          5              11.807 53
## 54                          6               1.123 54
## 55                          6              10.099 55
## 56                          5               8.067 56
## 57                         11              9.002s 57
## 58                          5              14.507 58
## 59                          6             -1.261s 59
## 60                          7               7.844 60
## 61                          5               7.495 61
## 62                          5              12.231 62
## 63                          5               5.965 63
## 64                          5             12.543s 64
## 65                          8             9.895 S 65
## 66                          2                   2 66
## 67                          5              6.530s 67
## 68                          6               3.316 68
## 69                          5               7.969 69
## 70                          5               6.368 70
## 71                          7              4.834s 71
## 72                          5              23.496 72
```

Data comes in a extremely complicated form, conversion is supposed to be done before any further analysis. First convert column names to a easy-to-use form.

```
colnames(stroop_data)
```

```
##  [1] "X"
##  [2] "Have.you.ever.been.diagnosed.with.colour.blindness."
##  [3] "How.many.years..including.this.year..have.you.studied.in.an.English.language.school.university
##  [4] "Do.you.play.video.games.regularly."
##  [5] "What.device.did.you.use.to.do.the.Stroop.test."
##  [6] "What.kind.of.headphones.did.you.use."
##  [7] "Put.these.levels.of.auditory.distraction.in.the.order.that.you.did.them."
##  [8] "What.was.your.first.auditory.distraction.condition."
##  [9] "How.many.hours.of.sleep.did.you.get.the.night.before.doing.the.Stroop.test.with.this.level.of.a
## [10] "At.what.time.did.you.do.the.Stroop.test.with.this.level.of.auditory.distraction."
## [11] "OffTime"
## [12] "OnTime"
## [13] "Total...of.runs.Stroop.Off"
## [14] "Total...of.runs.Stroop.On"
## [15] "OnTime.minus.OffTime"
## [16] "What.was.your.second.auditory.distraction.condition."
## [17] "How.many.hours.of.sleep.did.you.get.the.night.before.doing.the.Stroop.test.with.this.level.of.a
## [18] "At.what.time.did.you.do.the.Stroop.test.with.this.level.of.auditory.distraction.2"
## [19] "OffTime2"
## [20] "OnTime2"
## [21] "Total...of.runs.Stroop.Off2"
## [22] "Total...of.runs.Stroop.On2"
## [23] "OnTime.minus.OffTime2"
## [24] "What.was.your.third.auditory.distraction.condition."
## [25] "How.many.hours.of.sleep.did.you.get.the.night.before.doing.the.Stroop.test.with.this.level.of.a
## [26] "At.what.time.did.you.do.the.Stroop.test.with.this.level.of.auditory.distraction.3"
```

```
## [27] "OffTime3"
## [28] "OnTime3"
## [29] "Total...of.runs.Stroop.Off3"
## [30] "Total...of.runs.Stroop.On3"
## [31] "OnTime.minus.OffTime3"
## [32] "ID"
```

```
new_colnames <- c("x",
  "colour_blind","yrs_English","video_games","device","headphones","order_of_levels",
  "level_1","sleep_1","start_hour_1","Offtime_1","Ontime_1","Offrun_1","Onrun_1","difference_1",
  "level_2","sleep_2","start_hour_2","Offtime_2","Ontime_2","Offrun_2","Onrun_2","difference_2",
  "level_3","sleep_3","start_hour_3","Offtime_3","Ontime_3","Offrun_3","Onrun_3","difference_3","ID")
colnames(stroop_data) <- (new_colnames)
colnames(stroop_data)
```

```
##  [1] "x"               "colour_blind"    "yrs_English"
##  [4] "video_games"     "device"          "headphones"
##  [7] "order_of_levels" "level_1"         "sleep_1"
## [10] "start_hour_1"    "Offtime_1"       "Ontime_1"
## [13] "Offrun_1"        "Onrun_1"         "difference_1"
## [16] "level_2"         "sleep_2"         "start_hour_2"
## [19] "Offtime_2"       "Ontime_2"        "Offrun_2"
## [22] "Onrun_2"         "difference_2"    "level_3"
## [25] "sleep_3"         "start_hour_3"    "Offtime_3"
## [28] "Ontime_3"        "Offrun_3"        "Onrun_3"
## [31] "difference_3"    "ID"
```

column **x** is redudant since we have column **ID**, both column contains same information. Don't know why this return warnings.

```
stroop_data <- subset(stroop_data, select = -c(x))
```

Since there is only one obs 'Yes' entry in colour blindness, it's impossible to take effect of colour blindness into account. But may I simply remove that observation? Or should I simply do not take coulour blindness as a predictor during analysis but keep other data of this observation during analysis? Since there is only one observation,even comparision between this measurement and mean of other observations seems meaningless.

```
stroop_data <- stroop_data[stroop_data$colour_blind != 'Yes' ,]
stroop_data <- subset(stroop_data,select = -c(colour_blind))
```

```
stroop_data$yrs_English
```

```
##  [1] 12      7       4       5       18      4       17      6 years
##  [9] 5       3       10      7       12      12      8 years 6
## [17] 7       8       16      5       19      7       15      five
## [25] 4       5       7       6       17      6       7       4
## [33] 6       8       16      4       7       3       6       7
## [41] 4       7       7       3 years 7 years 14      4       10
## [49] 4       6       4       6       6       12      15      8
## [57] 4       6       6 years 18      6       4       15      16
## [65] 15      6       4       4       17      4       18
## 19 Levels: 10 12 14 15 16 17 18 19 3 3 years 4 5 6 6 years 7 7 years ... five
```

Data in yrs_English has two different form, simply number and number + string. Nonetheless, different forms of data contains similar information, need to convert these values into same form.

```
class(stroop_data$yrs_English[1])
```

```
## [1] "factor"
```

```
as.character(stroop_data$years_English)
```

```
## character(0)
```

```
for (years in stroop_data$yrs_English) {
  if(is.na(as.numeric(years))){
    ####WARNING will raise if as.numeric() return NA, but I want to evaluate wether as.numeric() return
    ####so these warnings can be ignored
    years <- substring(years,1,2)
  }
}
```

```
## Warning:      NA

## Warning:      NA

## Warning:      NA

## Warning:      NA

## Warning:      NA

## Warning:      NA
```

```
stroop_data$yrs_English <- as.numeric(stroop_data$yrs_English)

stroop_data$yrs_English
```

```
##  [1]  2 15 11 12  7 11  6 14 12  9  1 15  2  2 18 13 15 17  5 12  8 15  4
## [24] 19 11 12 15 13  6 13 15 11 13 17  5 11 15  9 13 15 11 15 15 10 16  3
## [47] 11  1 11 13 11 13 13  2  4 17 11 13 14  7 13 11  4  5  4 13 11 11  6
## [70] 11  7
```

```
class(stroop_data$yrs_English)
```

```
## [1] "numeric"
```

Stroop test record data have the same problem as yrs_English. Also need to be converted into consistent form.

```
####1
stroop_data$Offtime_1 <- str_replace(stroop_data$Offtime_1, 's', '')
stroop_data$Offtime_1 <- as.numeric(stroop_data$Offtime_1)
####2
stroop_data$Ontime_1 <- str_replace(stroop_data$Ontime_1, 's', '')
stroop_data$Ontime_1 <- as.numeric(stroop_data$Ontime_1)
####3
stroop_data$Offtime_2 <- str_replace(stroop_data$Offtime_2, 's', '')
stroop_data$Offtime_2 <- as.numeric(stroop_data$Offtime_2)
####4
stroop_data$Ontime_2 <- str_replace(stroop_data$Ontime_2, 's', '')
stroop_data$Ontime_2 <- as.numeric(stroop_data$Ontime_2)
####5
stroop_data$Offtime_3 <- str_replace(stroop_data$Offtime_2, 's', '')
stroop_data$Offtime_3 <- as.numeric(stroop_data$Offtime_2)
####6
stroop_data$Ontime_3 <- str_replace(stroop_data$Ontime_3, 's', '')
stroop_data$Ontime_3 <- as.numeric(stroop_data$Ontime_3)
####7
stroop_data$difference_1 <- str_replace(stroop_data$difference_1, 's', '')
stroop_data$difference_1 <- as.numeric(stroop_data$difference_1)
####8
stroop_data$difference_2 <- str_replace(stroop_data$difference_2, 's', '')
stroop_data$difference_2 <- as.numeric(stroop_data$difference_2)
####9
stroop_data$difference_3 <- str_replace(stroop_data$difference_3, 's', '')
stroop_data$difference_3 <- as.numeric(stroop_data$difference_3)
```

sleep_x values are also not in consistent form.

```
stroop_data$sleep_1
```

```
##  [1] 8 hrs     8         9         7         8         7         7 hours
##  [8] 10 hours  7         10        7         9         7         9
## [15] 7 hours   8         7.5       9.5 Hours 8         8         7
## [22] 8 hours   6         10        8         7         5.5       8
## [29] 7 Hours   6         8         8         6         8         8
## [36] 7         10hrs     7         8.5       8 hours   12 hours  8
## [43] 6         7 hours   8 hours   9         8 hrs     5         7 hours
## [50] 7         8         7 hrs     10        7         7         6
## [57] 7         8         9 hours   6         9 hours   6         7 hours
## [64] 9 hours   7h        9         6         8         6         8
## [71] 9
## 21 Levels: 10 10 hours 10hrs 12 hours 5 5.5 6 7 7 hours ... 9.5 Hours
```

```
pattern_hour <- "([hH])"
for (col in c(stroop_data$sleep_1,stroop_data$sleep_2,stroop_data$sleep_3)) {
  for (time in col) {
    time <- str_split(time, pattern_hour[[1]][[1]])
  }
  as.numeric(col)
}
class(stroop_data$sleep_1)
```

```
## [1] "factor"
```

The above loop doesn't work. I will try another approach.

```
pattern_hour <- "([hH])"
as.character(stroop_data$sleep_1)
```

```
##  [1] "8 hrs"     "8"         "9"         "7"         "8"
##  [6] "7"         "7 hours"   "10 hours"  "7"         "10"
## [11] "7"         "9"         "7"         "9"         "7 hours"
## [16] "8"         "7.5"       "9.5 Hours" "8"         "8"
## [21] "7"         "8 hours"   "6"         "10"        "8"
## [26] "7"         "5.5"       "8"         "7 Hours"   "6"
## [31] "8"         "8"         "6"         "8"         "8"
## [36] "7"         "10hrs"     "7"         "8.5"       "8 hours"
## [41] "12 hours"  "8"         "6"         "7 hours"   "8 hours"
## [46] "9"         "8 hrs"     "5"         "7 hours "  "7"
## [51] "8"         "7 hrs"     "10"        "7"         "7"
## [56] "6"         "7"         "8"         "9 hours"   "6"
## [61] "9 hours"   "6"         "7 hours "  "9 hours"   "7h"
## [66] "9"         "6"         "8"         "6"         "8"
## [71] "9"
```

```
for (time in stroop_data$sleep_1) {
    time <- str_split(time, pattern_hour[[1]][[1]])
}
stroop_data$sleep_1 <- as.numeric(stroop_data$sleep_1)
class(stroop_data$sleep_1)
```

```
## [1] "numeric"
```

```
as.character(stroop_data$sleep_2)
```

```
##  [1] "8"         "8"         "9"         "7"         "8"
##  [6] "7"         "7"         "10 hours"  "7"         "10"
## [11] "7"         "9"         "7"         "9"         "7 hours"
## [16] "8"         "7.5"       "9.5 Hours" "8"         "8"
## [21] "7"         "8 hours"   "6"         "10"        "8"
## [26] "7"         "5.5"       "8"         "7 hours"   "6"
## [31] "8"         "8"         "6"         "8"         "8"
## [36] "7"         "10hrs"     "7"         "8.5"       "8 hours"
## [41] "12 hours"  "8"         "6"         "7 hours"   "8 hours"
## [46] "9"         "8 hours"   "5"         "7 hours "  "5"
## [51] "8"         "7"         "10"        "7"         "7"
## [56] "6"         "7"         "8"         "9 hours"   "6"
## [61] "9"         "6"         "7 hours "  "9 hours"   "7h"
## [66] "9"         "6"         "8"         "6"         "8"
## [71] "8"
```

```
for (time in stroop_data$sleep_2) {
    time <- str_split(time, pattern_hour[[1]][[1]])
}
stroop_data$sleep_2 <- as.numeric(stroop_data$sleep_2)
class(stroop_data$sleep_2)
```

```
## [1] "numeric"
```

```
as.character(stroop_data$sleep_3)
```

```
##  [1] "8"         "8"         "8"         "7"         "8"
##  [6] "7"         "7 "        "10 hours"  "7"         "10"
## [11] "7"         "9"         "7"         "9"         "7 hours"
## [16] "8"         "7.5"       "9.5 Hours" "8"         "8"
## [21] "7"         "8 hours"   "6"         "10"        "8"
## [26] "7"         "5.5"       "8"         "7 hours"   "6"
## [31] "8"         "8"         "6"         "8"         "8"
## [36] "7"         "10hrs"     "7"         "8.5 hours" "8 hours"
## [41] "12 hours"  "8"         "6"         "7 hours"   "8 hours"
## [46] "9"         "8 hours"   "5"         "7 hours "  "7"
## [51] "8"         "7"         "10"        "7"         "7"
## [56] "6"         "7"         "8"         "9 hours"   "6"
## [61] "9"         "6"         "9 hours "  "9 hours"   "7h"
## [66] "9"         "6"         "8"         "6"         "8"
## [71] "8"
```

```
for (time in stroop_data$sleep_3) {
    time <- str_split(time, pattern_hour[[1]][[1]])
}
stroop_data$sleep_3 <- as.numeric(stroop_data$sleep_3)
class(stroop_data$sleep_3)
```

```
## [1] "numeric"
```

So I'm assuming the outloop of first code chunk is not working, but why? How to make it work?

start_hour_x values are also complicated, and I don't think we need to analyze **start_hour_x** as numeric value, converting those value to levels like 'morning','afternoon','evening' is supposed to be better. However, I'm wondering how to identify the levels.

condition_x values also do not have consistent form. Here I'd like to define 'quiet' as level1, 'classic' as level2, 'lyrics' as level3.

```
distractionTolevel <- function(distractionColumn){
  distractionColumn <- as.character(distractionColumn)
  for(distraction in distractionColumn){
    if(str_detect(distraction,'[qQ]') | str_detect(distraction,'[Cc]on')){
      distraction <- 'Control (quiet)'
    }
    if(str_detect(distraction,'[Cc]lass') | str_detect(distraction,'[Mm]oz')){
      distraction <- 'Classical (Mozart)'
    }
```

```
    if(str_detect(distraction, '[Ss]ha') | str_detect(distraction, '[Ee]') | str_detect(distraction, '[
      distraction <- 'Song with lyrics (Shape of You by Ed Sheeran)'
    }
  }
  return(distractionColumn)
}

stroop_data$level_1 <- distractionTolevel(stroop_data$level_1)
stroop_data$level_1
stroop_data$level_2 <- distractionTolevel(stroop_data$level_2)
stroop_data$level_2
stroop_data$level_3 <- distractionTolevel(stroop_data$level_3)
stroop_data$level_3
```

Above code did not work, guess it's beause input variable are used by the function as a input value rather than a input object. Here come problem, how to make pointer to existing object in R?

Will try another approach to convert level data.

```
######level of first run
stroop_data$level_1 <- as.character(stroop_data$level_1)
class(stroop_data$level_1)
```

```
## [1] "character"
```

```
for(i in c(1:length(stroop_data$level_1))){
  if(str_detect(stroop_data$level_1[i],'([qQ][Uu])') | str_detect(stroop_data$level_1[i],'([Cc][Oo][Nn]
     str_detect(stroop_data$level_1[i],'([Ss][Ii][Li])') | str_detect(stroop_data$level_1[i], '([Nn][Oo
    stroop_data$level_1[i] <- 'Control(quiet)'
  }

  if(str_detect(stroop_data$level_1[i],'([Cc][Ll][Aa][Ss])') | str_detect(stroop_data$level_1[i],'([Mm]
     |str_detect(stroop_data$level_1[i], '([Ii][Nn][Ss][Tt])')){
    stroop_data$level_1[i] <- 'Classical(Mozart)'
  }

  if(str_detect(stroop_data$level_1[i], '([Ss][Hh][Aa])') | str_detect(stroop_data$level_1[i], '([Ee][D
     str_detect(stroop_data$level_1[i], '([Ll][Yy][Rr])')){
    stroop_data$level_1[i] <- 'Song with lyrics(Shape of You by Ed Sheeran)'
  }

}
as.factor(stroop_data$level_1)
```

```
##  [1] Control(quiet)
##  [2] Control(quiet)
##  [3] Control(quiet)
##  [4] Control(quiet)
##  [5] Classical(Mozart)
##  [6] Song with lyrics(Shape of You by Ed Sheeran)
##  [7] Control(quiet)
##  [8] Control(quiet)
```

```
##  [9] Control(quiet)
## [10] Classical(Mozart)
## [11] Control(quiet)
## [12] Control(quiet)
## [13] Control(quiet)
## [14] Classical(Mozart)
## [15] Control(quiet)
## [16] Control(quiet)
## [17] Control(quiet)
## [18] Classical(Mozart)
## [19] Control(quiet)
## [20] Control(quiet)
## [21] Control(quiet)
## [22] Control(quiet)
## [23] Song with lyrics(Shape of You by Ed Sheeran)
## [24] Control(quiet)
## [25] Control(quiet)
## [26] Control(quiet)
## [27] Control(quiet)
## [28] Control(quiet)
## [29] Song with lyrics(Shape of You by Ed Sheeran)
## [30] Control(quiet)
## [31] Control(quiet)
## [32] Control(quiet)
## [33] Control(quiet)
## [34] Control(quiet)
## [35] Control(quiet)
## [36] Control(quiet)
## [37] Control(quiet)
## [38] Control(quiet)
## [39] Song with lyrics(Shape of You by Ed Sheeran)
## [40] Control(quiet)
## [41] Control(quiet)
## [42] Control(quiet)
## [43] Control(quiet)
## [44] Control(quiet)
## [45] Control(quiet)
## [46] Control(quiet)
## [47] Control(quiet)
## [48] Song with lyrics(Shape of You by Ed Sheeran)
## [49] Control(quiet)
## [50] Classical(Mozart)
## [51] Control(quiet)
## [52] Control(quiet)
## [53] Control(quiet)
## [54] Control(quiet)
## [55] Control(quiet)
## [56] Control(quiet)
## [57] Song with lyrics(Shape of You by Ed Sheeran)
## [58] Song with lyrics(Shape of You by Ed Sheeran)
## [59] Song with lyrics(Shape of You by Ed Sheeran)
## [60] Control(quiet)
## [61] Control(quiet)
## [62] Song with lyrics(Shape of You by Ed Sheeran)
```

```
## [63] Song with lyrics(Shape of You by Ed Sheeran)
## [64] Control(quiet)
## [65] Control(quiet)
## [66] Control(quiet)
## [67] Control(quiet)
## [68] Classical(Mozart)
## [69] Control(quiet)
## [70] Control(quiet)
## [71] Control(quiet)
## 3 Levels: Classical(Mozart) ... Song with lyrics(Shape of You by Ed Sheeran)
```

```
######level of second run
stroop_data$level_2 <- as.character(stroop_data$level_2)
class(stroop_data$level_2)
```

```
## [1] "character"
```

```
for(i in c(1:length(stroop_data$level_2))){
  if(str_detect(stroop_data$level_2[i],'([qQ][Uu])') | str_detect(stroop_data$level_2[i],'([Cc][Oo][Nn]
     str_detect(stroop_data$level_2[i],'([Ss][Ii][Ll])') | str_detect(stroop_data$level_2[i], '([Nn][Oo
    stroop_data$level_2[i] <- 'Control(quiet)'
  }

  if(str_detect(stroop_data$level_2[i],'([Cc][Ll][Aa][Ss])') | str_detect(stroop_data$level_2[i],'([Mm]
     |str_detect(stroop_data$level_2[i], '([Ii][Nn][Ss][Tt])')){
    stroop_data$level_2[i] <- 'Classical(Mozart)'
  }

  if(str_detect(stroop_data$level_2[i], '([Ss][Hh][Aa])') | str_detect(stroop_data$level_2[i], '([Ee][D
                                                          | str_detect(stroop_data$level_2[i], '([Ll][Yy][R
    stroop_data$level_2[i] <- 'Song with lyrics(Shape of You by Ed Sheeran)'
  }
}
as.factor(stroop_data$level_2)
```

```
##  [1] Song with lyrics(Shape of You by Ed Sheeran)
##  [2] Classical(Mozart)
##  [3] Song with lyrics(Shape of You by Ed Sheeran)
##  [4] Song with lyrics(Shape of You by Ed Sheeran)
##  [5] Control(quiet)
##  [6] Classical(Mozart)
##  [7] Classical(Mozart)
##  [8] Classical(Mozart)
##  [9] Classical(Mozart)
## [10] Song with lyrics(Shape of You by Ed Sheeran)
## [11] Classical(Mozart)
## [12] Song with lyrics(Shape of You by Ed Sheeran)
## [13] Classical(Mozart)
## [14] Control(quiet)
## [15] Song with lyrics(Shape of You by Ed Sheeran)
## [16] Classical(Mozart)
## [17] Song with lyrics(Shape of You by Ed Sheeran)
## [18] Control(quiet)
```

```
## [19] Classical(Mozart)
## [20] Song with lyrics(Shape of You by Ed Sheeran)
## [21] Song with lyrics(Shape of You by Ed Sheeran)
## [22] Song with lyrics(Shape of You by Ed Sheeran)
## [23] Classical(Mozart)
## [24] Classical(Mozart)
## [25] Classical(Mozart)
## [26] Classical(Mozart)
## [27] Song with lyrics(Shape of You by Ed Sheeran)
## [28] Song with lyrics(Shape of You by Ed Sheeran)
## [29] Classical(Mozart)
## [30] Classical(Mozart)
## [31] Classical(Mozart)
## [32] Song with lyrics(Shape of You by Ed Sheeran)
## [33] Song with lyrics(Shape of You by Ed Sheeran)
## [34] Song with lyrics(Shape of You by Ed Sheeran)
## [35] Classical(Mozart)
## [36] Song with lyrics(Shape of You by Ed Sheeran)
## [37] Classical(Mozart)
## [38] Song with lyrics(Shape of You by Ed Sheeran)
## [39] Control(quiet)
## [40] Song with lyrics(Shape of You by Ed Sheeran)
## [41] Song with lyrics(Shape of You by Ed Sheeran)
## [42] Song with lyrics(Shape of You by Ed Sheeran)
## [43] Song with lyrics(Shape of You by Ed Sheeran)
## [44] Song with lyrics(Shape of You by Ed Sheeran)
## [45] Song with lyrics(Shape of You by Ed Sheeran)
## [46] Song with lyrics(Shape of You by Ed Sheeran)
## [47] Song with lyrics(Shape of You by Ed Sheeran)
## [48] Control(quiet)
## [49] Classical(Mozart)
## [50] Song with lyrics(Shape of You by Ed Sheeran)
## [51] Song with lyrics(Shape of You by Ed Sheeran)
## [52] Song with lyrics(Shape of You by Ed Sheeran)
## [53] Classical(Mozart)
## [54] Song with lyrics(Shape of You by Ed Sheeran)
## [55] Song with lyrics(Shape of You by Ed Sheeran)
## [56] Song with lyrics(Shape of You by Ed Sheeran)
## [57] Classical(Mozart)
## [58] Classical(Mozart)
## [59] Classical(Mozart)
## [60] Classical(Mozart)
## [61] Classical(Mozart)
## [62] Control(quiet)
## [63] Classical(Mozart)
## [64] Classical(Mozart)
## [65] Classical(Mozart)
## [66] Song with lyrics(Shape of You by Ed Sheeran)
## [67] Song with lyrics(Shape of You by Ed Sheeran)
## [68] Control(quiet)
## [69] Song with lyrics(Shape of You by Ed Sheeran)
## [70] Song with lyrics(Shape of You by Ed Sheeran)
## [71] Song with lyrics(Shape of You by Ed Sheeran)
## 3 Levels: Classical(Mozart) ... Song with lyrics(Shape of You by Ed Sheeran)
```

```
#####level of third run

stroop_data$level_3 <- as.character(stroop_data$level_3)
class(stroop_data$level_3)
```

```
## [1] "character"
```

```
for(i in c(1:length(stroop_data$level_3))){
  if(str_detect(stroop_data$level_3[i],'([qQ][Uu])') | str_detect(stroop_data$level_3[i],'([Cc][Oo][Nn]
     str_detect(stroop_data$level_3[i],'([Ss][Ii][Ll])') | str_detect(stroop_data$level_3[i], '([Nn][Oo
    stroop_data$level_3[i] <- 'Control(quiet)'
  }

  if(str_detect(stroop_data$level_3[i],'([Cc][Ll][Aa][Ss])') | str_detect(stroop_data$level_3[i],'([Mm]
     | str_detect(stroop_data$level_3[i], '([Ii][Nn][Ss][Tt])')){
    stroop_data$level_3[i] <- 'Classical(Mozart)'
  }

  if(str_detect(stroop_data$level_3[i], '([Ss][Hh][Aa])') | str_detect(stroop_data$level_3[i], '([Ee][D
     str_detect(stroop_data$level_3[i], '([Ll][Yy][Rr])') |str_detect(stroop_data$level_3[i],'([Ss][Oo]
    stroop_data$level_3[i] <- 'Song with lyrics(Shape of You by Ed Sheeran)'
  }
}
as.factor(stroop_data$level_3)
```

```
##  [1] Classical(Mozart)
##  [2] Song with lyrics(Shape of You by Ed Sheeran)
##  [3] Classical(Mozart)
##  [4] Classical(Mozart)
##  [5] Song with lyrics(Shape of You by Ed Sheeran)
##  [6] Control(quiet)
##  [7] Song with lyrics(Shape of You by Ed Sheeran)
##  [8] Song with lyrics(Shape of You by Ed Sheeran)
##  [9] Song with lyrics(Shape of You by Ed Sheeran)
## [10] Control(quiet)
## [11] Song with lyrics(Shape of You by Ed Sheeran)
## [12] Classical(Mozart)
## [13] Song with lyrics(Shape of You by Ed Sheeran)
## [14] Song with lyrics(Shape of You by Ed Sheeran)
## [15] Classical(Mozart)
## [16] Song with lyrics(Shape of You by Ed Sheeran)
## [17] Classical(Mozart)
## [18] Song with lyrics(Shape of You by Ed Sheeran)
## [19] Song with lyrics(Shape of You by Ed Sheeran)
## [20] Classical(Mozart)
## [21] Classical(Mozart)
## [22] Classical(Mozart)
## [23] Control(quiet)
## [24] Song with lyrics(Shape of You by Ed Sheeran)
## [25] Song with lyrics(Shape of You by Ed Sheeran)
## [26] Song with lyrics(Shape of You by Ed Sheeran)
## [27] Classical(Mozart)
```

```
## [28] Classical(Mozart)
## [29] Control(quiet)
## [30] Song with lyrics(Shape of You by Ed Sheeran)
## [31] Song with lyrics(Shape of You by Ed Sheeran)
## [32] Classical(Mozart)
## [33] Classical(Mozart)
## [34] Classical(Mozart)
## [35] Song with lyrics(Shape of You by Ed Sheeran)
## [36] Classical(Mozart)
## [37] Song with lyrics(Shape of You by Ed Sheeran)
## [38] Classical(Mozart)
## [39] Classical(Mozart)
## [40] Classical(Mozart)
## [41] Song with lyrics(Shape of You by Ed Sheeran)
## [42] Classical(Mozart)
## [43] Classical(Mozart)
## [44] Classical(Mozart)
## [45] Classical(Mozart)
## [46] Classical(Mozart)
## [47] Classical(Mozart)
## [48] Song with lyrics(Shape of You by Ed Sheeran)
## [49] Song with lyrics(Shape of You by Ed Sheeran)
## [50] Control(quiet)
## [51] Classical(Mozart)
## [52] Classical(Mozart)
## [53] Song with lyrics(Shape of You by Ed Sheeran)
## [54] Classical(Mozart)
## [55] Classical(Mozart)
## [56] Classical(Mozart)
## [57] Control(quiet)
## [58] Control(quiet)
## [59] Control(quiet)
## [60] Song with lyrics(Shape of You by Ed Sheeran)
## [61] Song with lyrics(Shape of You by Ed Sheeran)
## [62] Classical(Mozart)
## [63] Control(quiet)
## [64] Song with lyrics(Shape of You by Ed Sheeran)
## [65] Song with lyrics(Shape of You by Ed Sheeran)
## [66] Classical(Mozart)
## [67] Classical(Mozart)
## [68] Song with lyrics(Shape of You by Ed Sheeran)
## [69] Classical(Mozart)
## [70] Classical(Mozart)
## [71] Classical(Mozart)
## 3 Levels: Classical(Mozart) ... Song with lyrics(Shape of You by Ed Sheeran)
```

Originally, I did not add ***as.factor()** function in above code chunk. But the first run returns that there are some input I cannot have imaged, adding this **as.factor()** statement will return me with levels in the column, this really helps me out.

So basically, what I'm doing is that, writing down loop for level_1, run it, check inregular levels, add corresponding expressions in **if** statement, then do same for level_2 and level_3

Now take a initial look at the stroop data using boxplot.

```
par(mfrow=c(1,3))
boxplot(stroop_data$Offtime_1,stroop_data$Offtime_2,stroop_data$Offtime_3)
boxplot(stroop_data$Ontime_1,stroop_data$Ontime_2,stroop_data$Ontime_3)
boxplot(stroop_data$difference_1,stroop_data$difference_2,stroop_data$difference_3)
```

There are outliers data for all runs, and almost all of those outliers are smaller than Q1-3IQR. Take a closer look at original dataset.

There are 3 candidates (Id 12,31,66) who put in runtime records less than 15s, which is apparently too fast to complete 5 runs. These data looks more like run time of a single run for a 5-run set. Now I got 2 choices, first, ignoring these 3 observations when analyzing run time but included them when analyze other measurement or simply delete these 3 observations?

```
outlier_check <- subset(stroop_data,ID == 12 | ID == 31 | ID == 66)
outlier_check
```

```
##    yrs_English video_games        device
## 12           1         Yes iPhone / iPod
## 31          13         Yes iPhone / iPod
## 66           4          No iPhone / iPod
##                               headphones
## 12 In-ear headphones; not noise cancelling
## 31 In-ear headphones; not noise cancelling
## 66 In-ear headphones; not noise cancelling
##                                                                order_of_levels
## 12 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 31 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
## 66 Control (quiet);Classical (Mozart);Song with lyrics (Shape of You by Ed Sheeran);
##           level_1 sleep_1 start_hour_1 Offtime_1 Ontime_1 Offrun_1 Onrun_1
## 12 Control(quiet)       8        10 pm    11.840   13.741        1       1
## 31 Control(quiet)       7          7pm        12       18        2       5
## 66 Control(quiet)      14        23:00    11.127   12.943        2       3
##    difference_1           level_2 sleep_2 start_hour_2 Offtime_2 Ontime_2
## 12        1.901 Classical(Mozart)       8        10 pm    12.042   11.512
## 31            3 Classical(Mozart)       7          8pm        14       18
## 66        1.816 Classical(Mozart)      12        14:00    11.577   12.342
##    Offrun_2 Onrun_2 difference_2
## 12        1       1         0.53
## 31        2       5            3
## 66        1       1        0.772
##                                       level_3 sleep_3 start_hour_3
## 12 Song with lyrics(Shape of You by Ed Sheeran)       8        10 pm
## 31 Song with lyrics(Shape of You by Ed Sheeran)       7          8pm
## 66 Song with lyrics(Shape of You by Ed Sheeran)      13        15:30
##    Offtime_3 Ontime_3 Offrun_3 Onrun_3 difference_3 ID
## 12    11.877   12.093    1.000       1        0.216 12
## 31        15       19    1.000       3            2 31
## 66            12.064   12.142       2            2 66
```

(Question: when I run the above code in Rnotebook there is warning messages but when I run them in concole there is not such message, why?)

After a more careful look into these 3 observations, the on-off runtime difference value and numbers of on-off runs are also questionable. For example, there are **total number of runs** less than 5 and **integer on-off**

runtime difference value. Since each onrun or offrun requires 5 runs without failure, apparently **total number of runs** can not be 5. In addition, though **on-off runtime difference** may be a integer value, but it's unlikely that all 3 **difference** value of a single candidate are integer.

More specifically, **candidate 12** only have reasonable **on-off runtime difference** value. **Candidate 31** have no reasonable data. **Candidate 66** has data seems suitable for **difference_1** and **difference_2**. As for **difference_3** of **Candidate 66**, though it look like this candidate put value for difference in **offrun_3**, there is no exact evidence.

Since these 3 outliers observations only have reasonable **on-off runtime difference** value, we can't verify this value by compare this **difference_x** value to difference between Ontime and Offtime.

Therefore, I'd like to either set their value to N/A or simply remove these 3 observations.

```
stroop_data <- subset(stroop_data, ID != 12 & ID!= 31 &ID != 66)
```

I found several N/A, but when I looked back to the original dataset, they are not N/A. There must be something wrong with conversion code. Can't go further before fix this problem

```
stroop_data_checkNA <-read.csv("sta490_cognitive_flexibility_data.csv")
```

For **Offtime_1**, id24 and id54 are N/A. ID 24 is NA because I specify small replcae 's' in conversion code, need to change that. id54 is N/A because this data is in a strange form, it has a ' at its front.

In order to fix this problem, I set previous time record conversion, boxplot and outlier removal code chunks to eval = FALSE, write down the following code, and re-run all the code chunks.

```
pattern_record <- '[Ss]'
####1
#######Pre-process the strange entry of observation id54
stroop_data$Offtime_1 <- as.character(stroop_data$Offtime_1)
stroop_data$Offtime_1[stroop_data$ID == 54] <- str_replace(stroop_data$Offtime_1[stroop_data$ID == 54],
print(stroop_data$Offtime_1[stroop_data$ID == 54])
```

```
## [1] "64.852"
```

```
######Question: I have tried to assign stroop_data$Offtime_1[stroop_data$ID == 54] to a new variable
#################then perform operations on the new variable, as a result, the original entry is unaffec
#################I guess this might because I assign the value to the new variable instead of the object
#################then how to make a pointer in R?


#################Non-functional code provided below
#################strange_entry <- stroop_data$Offtime_1 <- as.character(stroop_data$Offtime_1)
#################strange_entry <- str_replace(strange_entry,'`','')
#################stroop_data$Offtime_1[stroop_data$ID == 54]

stroop_data$Offtime_1 <- str_replace(stroop_data$Offtime_1, pattern_record, '')
stroop_data$Offtime_1 <- as.numeric(stroop_data$Offtime_1)

################TRUE represent 1, so -TRUE = -1, if there is a -1 in -checkNA, which means a TRUE in che
################all(eval((-checkNA>=0))) will return FALSE
checkNA <- is.na(stroop_data$Offtime_1)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
####2
stroop_data$Ontime_1 <- as.character(stroop_data$Ontime_1)
stroop_data$Ontime_1 <- str_replace(stroop_data$Ontime_1, pattern_record, '')
stroop_data$Ontime_1 <- as.numeric(stroop_data$Ontime_1)
checkNA <- is.na(stroop_data$Ontime_1)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
####3
stroop_data$Offtime_2 <- as.character(stroop_data$Offtime_2)
stroop_data$Offtime_2 <- str_replace(stroop_data$Offtime_2, pattern_record, '')
stroop_data$Offtime_2 <- as.numeric(stroop_data$Offtime_2)
checkNA <- is.na(stroop_data$Offtime_2)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
####4
stroop_data$Ontime_2 <- as.character(stroop_data$Ontime_2)
stroop_data$Ontime_2 <- str_replace(stroop_data$Ontime_2, pattern_record, '')
stroop_data$Ontime_2 <- as.numeric(stroop_data$Ontime_2)
checkNA <- is.na(stroop_data$Ontime_2)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
####5
stroop_data$Offtime_3 <- as.character(stroop_data$Offtime_3)
stroop_data$Offtime_3 <- str_replace(stroop_data$Offtime_3, pattern_record, '')
stroop_data$Offtime_3 <- as.numeric(stroop_data$Offtime_3)
checkNA <- is.na(stroop_data$Offtime_3)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
####6
stroop_data$Ontime_3 <- as.character(stroop_data$Ontime_3)
stroop_data$Ontime_3 <- str_replace(stroop_data$Ontime_3, pattern_record, '')
stroop_data$Ontime_3 <- as.numeric(stroop_data$Ontime_3)
checkNA <- is.na(stroop_data$Ontime_3)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
####7
stroop_data$difference_1 <- as.character(stroop_data$difference_1)
stroop_data$difference_1 <- str_replace(stroop_data$difference_1, pattern_record, '')
stroop_data$difference_1 <- as.numeric(stroop_data$difference_1)
checkNA <- is.na(stroop_data$difference_1)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
#####8
stroop_data$difference_2 <- as.character(stroop_data$difference_2)
stroop_data$difference_2 <- str_replace(stroop_data$difference_2, pattern_record, '')
stroop_data$difference_2 <- as.numeric(stroop_data$difference_2)
checkNA <- is.na(stroop_data$difference_2)
all(eval((-checkNA>=0)))
```

```
## [1] TRUE
```

```
#####9
stroop_data$difference_3 <- as.character(stroop_data$difference_3)
stroop_data$difference_3 <- str_replace(stroop_data$difference_3, pattern_record, '')
stroop_data$difference_3 <- as.numeric(stroop_data$difference_3)
checkNA <- is.na(stroop_data$difference_3)
all(eval((-checkNA>=0)))
```

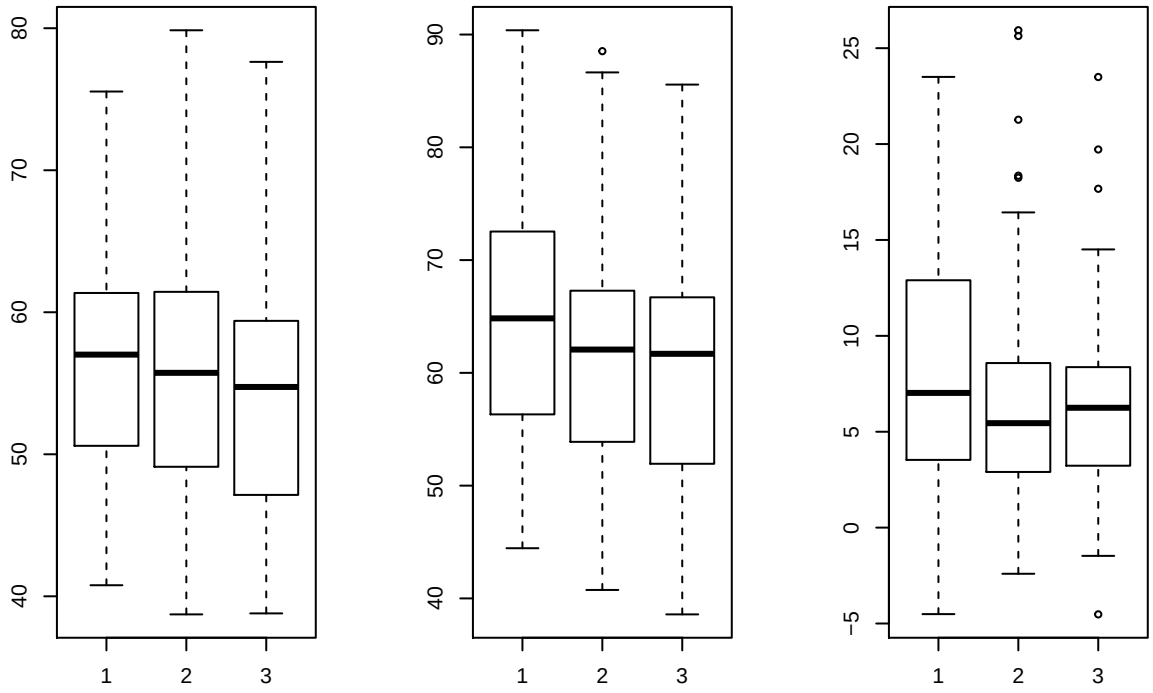
```
## [1] TRUE
```

There is one N/A entry persist with this new replace pattern, which is **Offtime_3** of id 66. Looked back to the original dataset, it is an empty entry. In addition, it's also one of the 3 meaningless observations, therefore, result from the new replcement pattern is adequate.

Finally realize that I can write a function instead of repeating all these code in the above chunk after I have done writting.

Re-create boxplot.

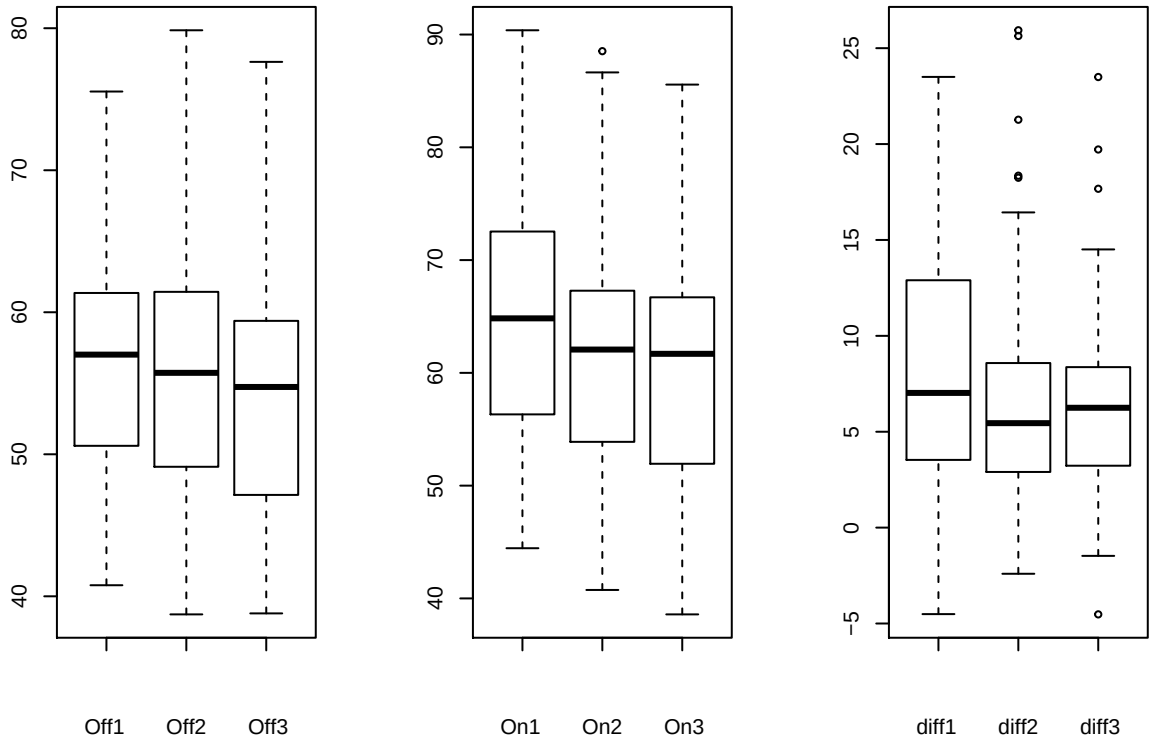
```
par(mfrow=c(1,3))
boxplot(stroop_data$Offtime_1,stroop_data$Offtime_2,stroop_data$Offtime_3)
boxplot(stroop_data$Ontime_1,stroop_data$Ontime_2,stroop_data$Ontime_3)
boxplot(stroop_data$difference_1,stroop_data$difference_2,stroop_data$difference_3)
```



Meaningless observations mentioned above is still outliers. Am I supposed to remove them?

```
stroop_data <- subset(stroop_data, ID != 12 & ID!= 31 &ID != 66)
```

```
par(mfrow=c(1,3))
boxplot(stroop_data$Offtime_1,stroop_data$Offtime_2,stroop_data$Offtime_3, xlab='Off1       Off2       O
boxplot(stroop_data$Ontime_1,stroop_data$Ontime_2,stroop_data$Ontime_3, xlab = 'On1       On2       On3
boxplot(stroop_data$difference_1,stroop_data$difference_2,stroop_data$difference_3,xlab='diff1       di
```



The boxplot is aginist my intuitive assumption: later runs will have better record than early runs. There are significant difference in sample mean of record from different runs. So the order of runs is not so important that we may not need to include it in further analysis to make the the model simplier.

Based discussion during lecture, need to convert the dataframe to a new form as a whole for further analysis.

```
data1 <- stroop_data %>%
  select(ID, colour_blind, yrs_English, video_games, device, headphones, order_of_levels,
         level_1, sleep_1, start_hour_1, Offtime_1, Ontime_1, Offrun_1, Onrun_1, difference_1) %>%
  mutate(order = 1);

data2 <- stroop_data %>%
  select(ID, colour_blind, yrs_English, video_games, device, headphones, order_of_levels,
         level_2, sleep_2, start_hour_2, Offtime_2, Ontime_2, Offrun_2, Onrun_2, difference_2) %>%
  mutate(order = 2);

data3 <- stroop_data %>%
  select(ID, colour_blind, yrs_English, video_games, device, headphones, order_of_levels,
         level_3, sleep_3, start_hour_3, Offtime_3, Ontime_3, Offrun_3, Onrun_3, difference_3) %>%
  mutate(order = 3);

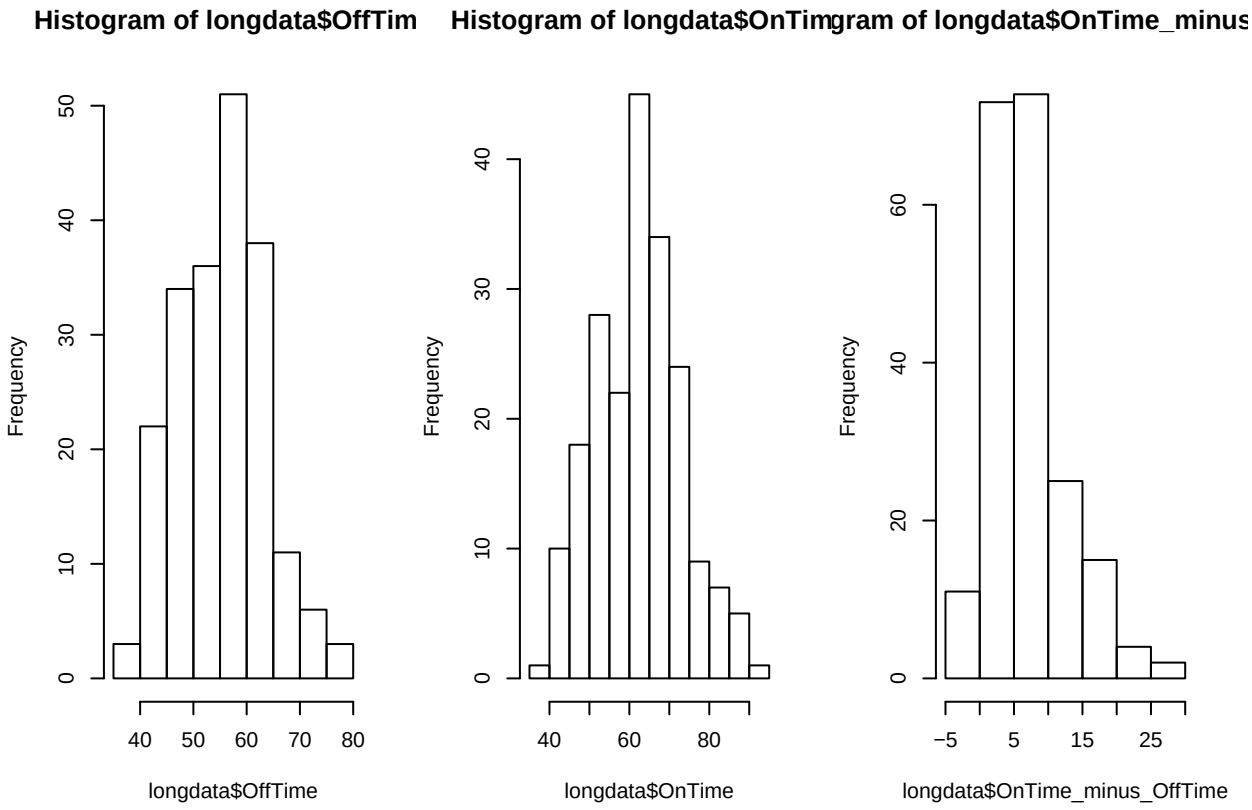

names(data1)[8:15] <- c("distraction_level", "sleep", "start_time", "OffTime", "OnTime", "Total_runs_Sti
names(data2)[8:15] <- c("distraction_level", "sleep", "start_time", "OffTime", "OnTime", "Total_runs_Sti
names(data3)[8:15] <- c("distraction_level", "sleep", "start_time", "OffTime", "OnTime", "Total_runs_Sti

longdata <- rbind(data1, data2, data3)
```

```r
#longdata <- longdata %>% mutate(distraction_level = factor(distraction_level, levels=c("control", "cla

longdata <- longdata %>% arrange(ID, order)
```

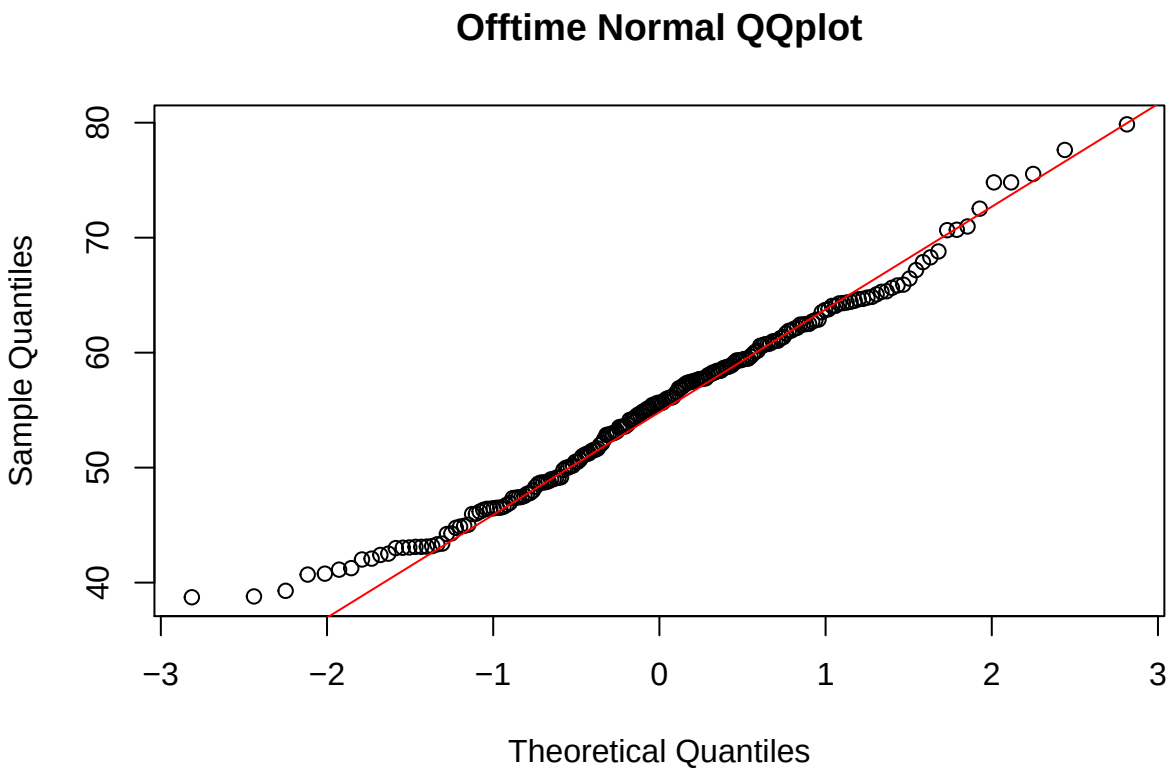
```r
data1 <- stroop_data %>%
  select(ID, yrs_English, video_games, device, headphones, order_of_levels,
         level_1, sleep_1, start_hour_1, Offtime_1, Ontime_1, Offrun_1, Onrun_1, difference_1) %>%
  mutate(order = 1);

data2 <- stroop_data %>%
  select(ID, yrs_English, video_games, device, headphones, order_of_levels,
         level_2, sleep_2, start_hour_2, Offtime_2, Ontime_2, Offrun_2, Onrun_2, difference_2) %>%
  mutate(order = 2);

data3 <- stroop_data %>%
  select(ID, yrs_English, video_games, device, headphones, order_of_levels,
         level_3, sleep_3, start_hour_3, Offtime_3, Ontime_3, Offrun_3, Onrun_3, difference_3) %>%
  mutate(order = 3);


names(data1)[7:14] <- c("distraction_level", "sleep", "start_time", "OffTime", "OnTime", "Total_runs_St
names(data2)[7:14] <- c("distraction_level", "sleep", "start_time", "OffTime", "OnTime", "Total_runs_St
names(data3)[7:14] <- c("distraction_level", "sleep", "start_time", "OffTime", "OnTime", "Total_runs_St

longdata <- rbind(data1, data2, data3)

#longdata <- longdata %>% mutate(distraction_level = factor(distraction_level, levels=c("control", "cla

longdata <- longdata %>% arrange(ID, order)
```

```r
par(mfrow = c(1,3))
hist(longdata$OffTime)
hist(longdata$OnTime)
hist(longdata$OnTime_minus_OffTime)
```

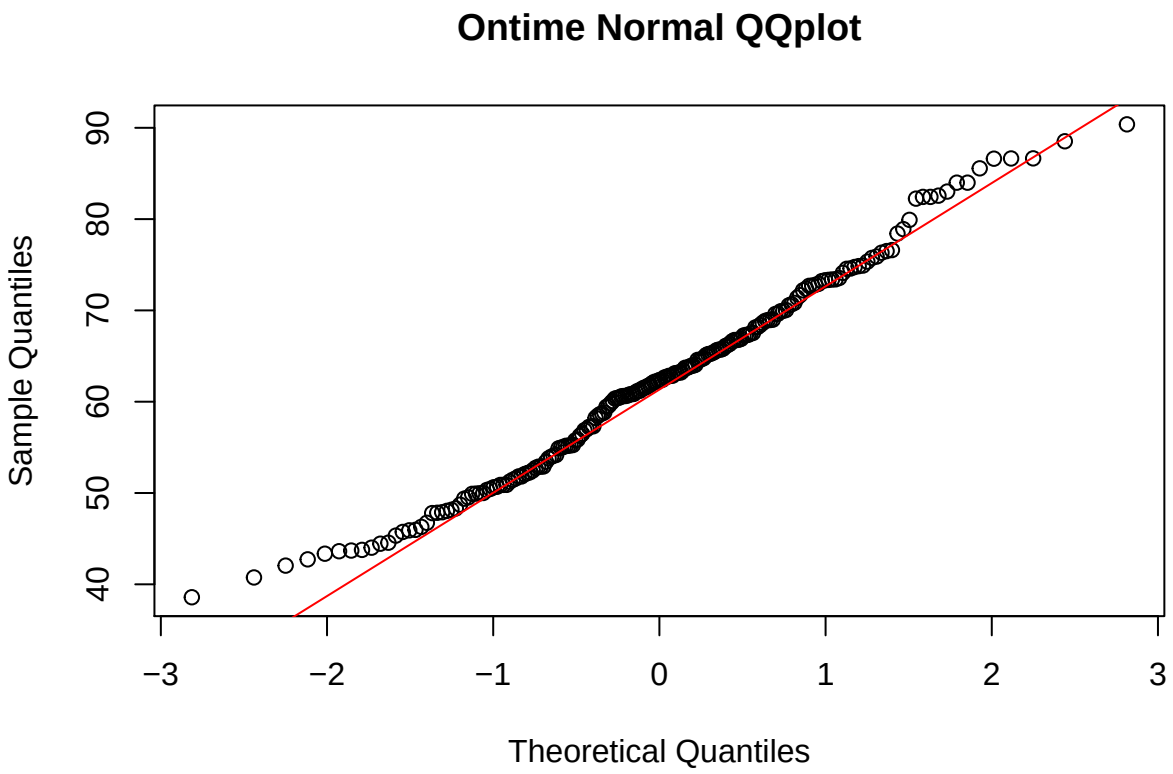


Besides the meaningless outliers mentioned above, histgram of offtime and Ontime look adequately normal distributed, while histgram of difference shows left-skewness. Try QQplot.

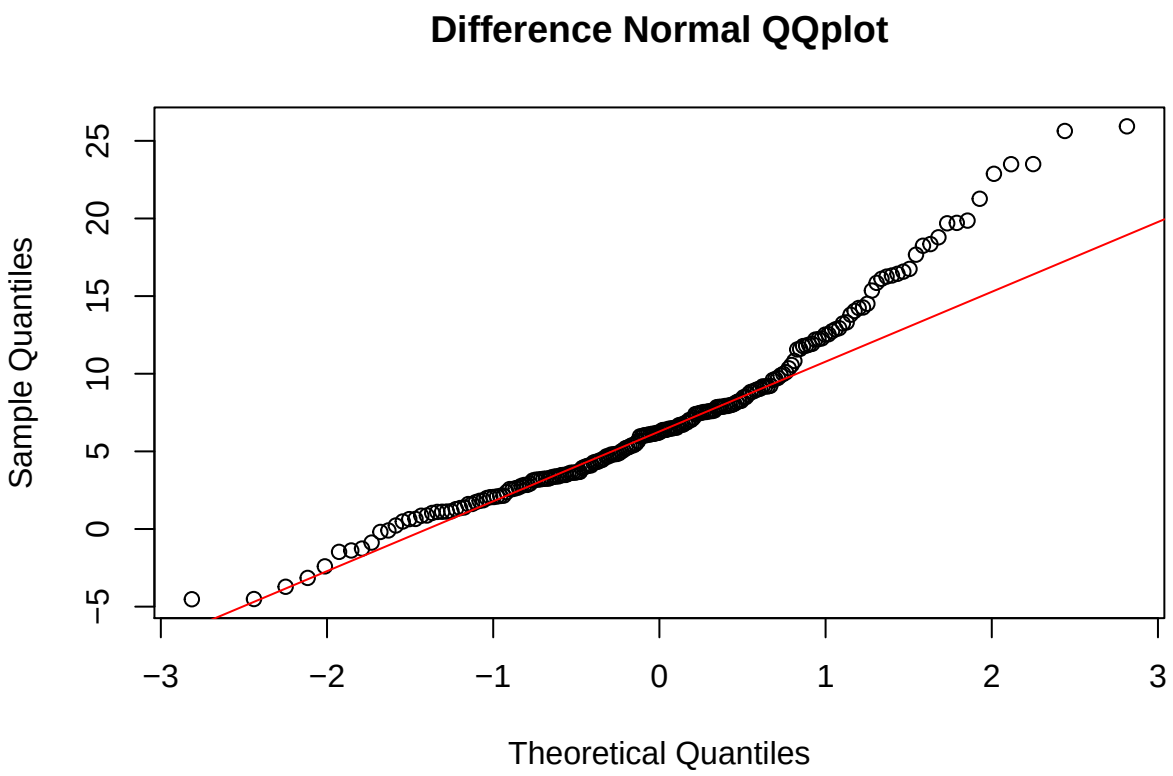
```
qqnorm(longdata$OffTime , main = 'Offtime Normal QQplot')
qqline(longdata$OffTime , col = 'red')
```




```
qqnorm(longdata$OnTime , main = 'Ontime Normal QQplot')
qqline(longdata$OnTime , col = 'red')
```



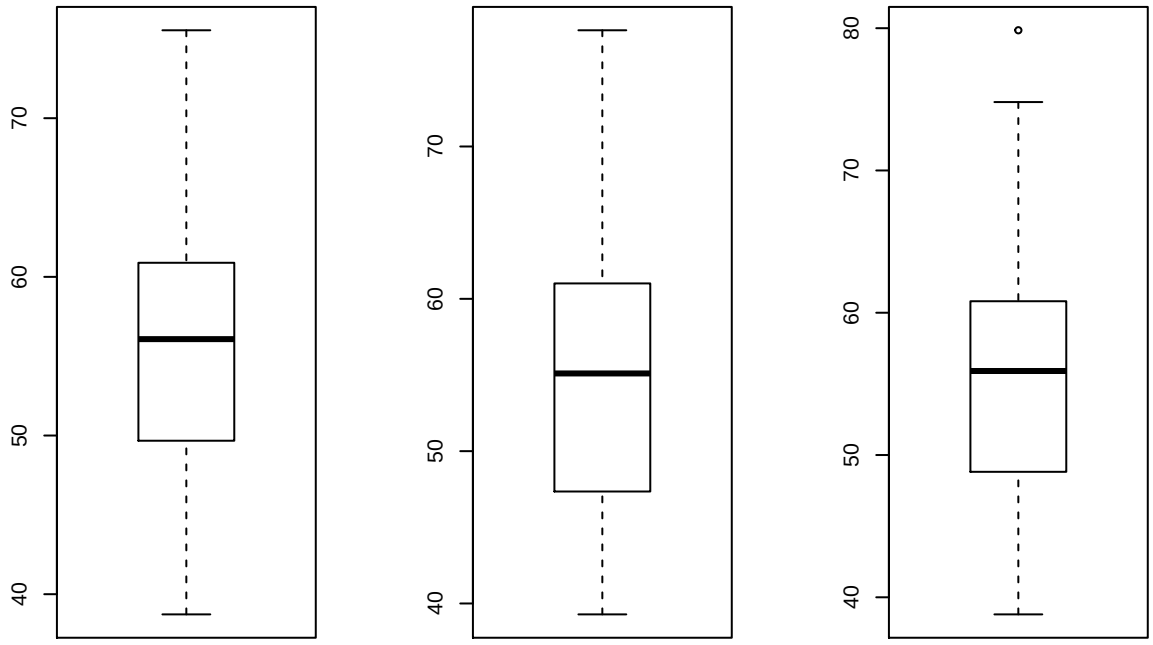

```
qqnorm(longdata$OnTime_minus_OffTime , main = 'Difference Normal QQplot')
qqline(longdata$OnTime_minus_OffTime , col = 'red')
```



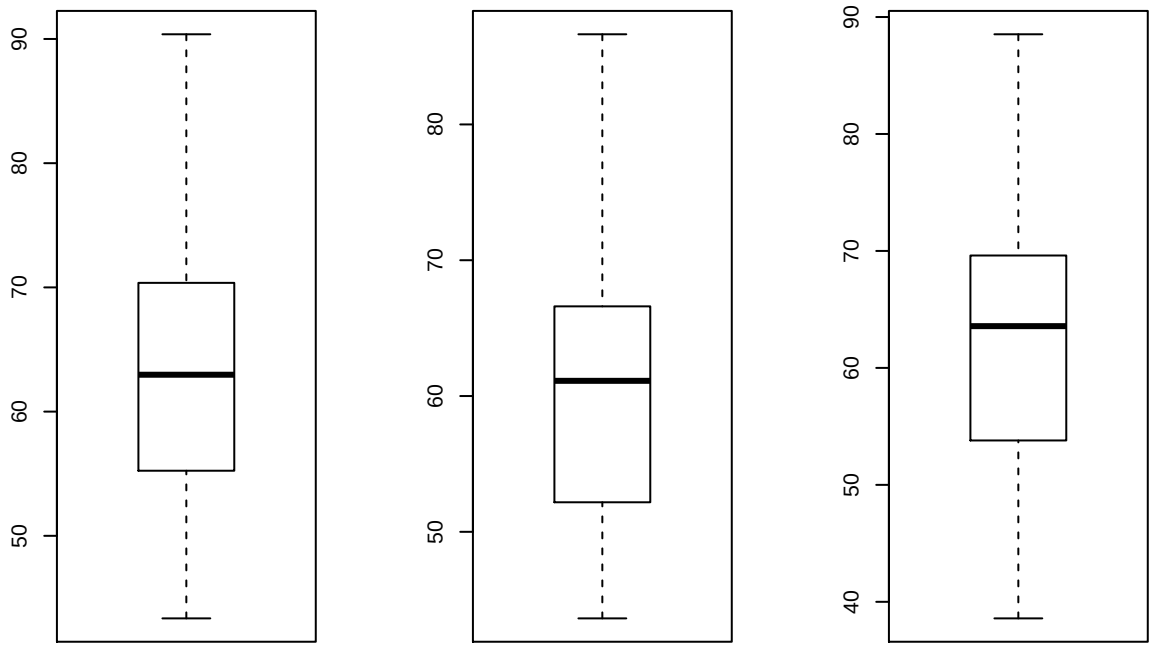
Based On QQplot, ignore outliers, even the difference qqplot looks adequately normal distributed. Linear regression could be a good choice for further analysis.

I have changed code chunk for data removal to **eval = TRUE** and created new qqplot, new plot is even more closer to normal.

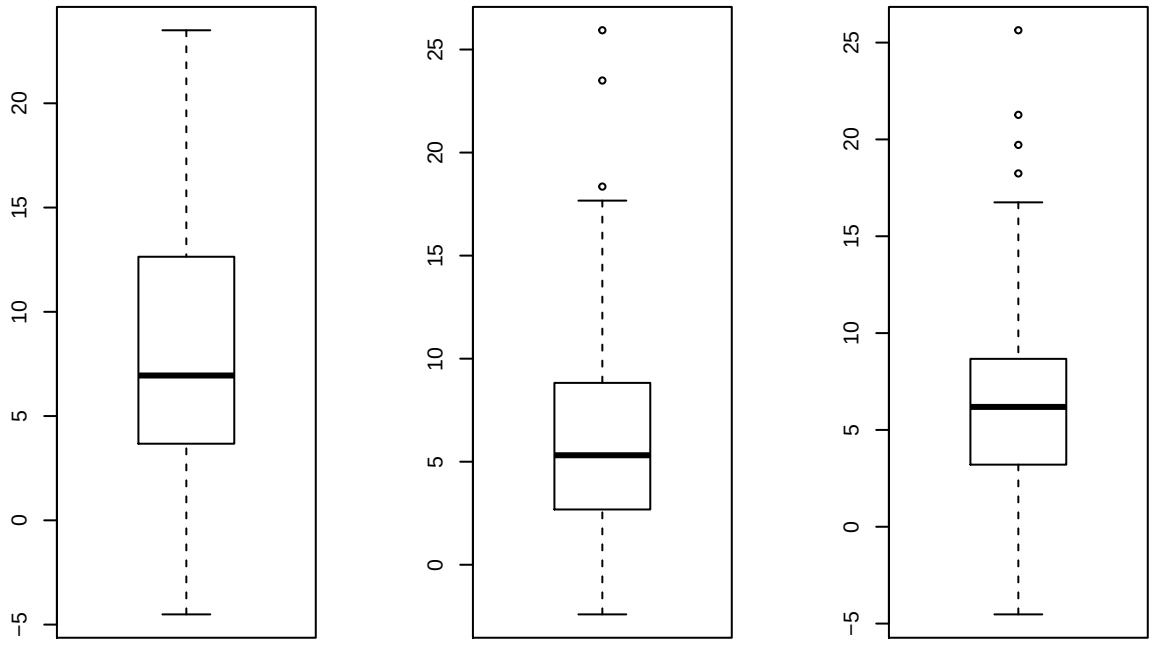
```
par(mfrow = c(1,3))
boxplot(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OffTime)
boxplot(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OffTime)
boxplot(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$
```



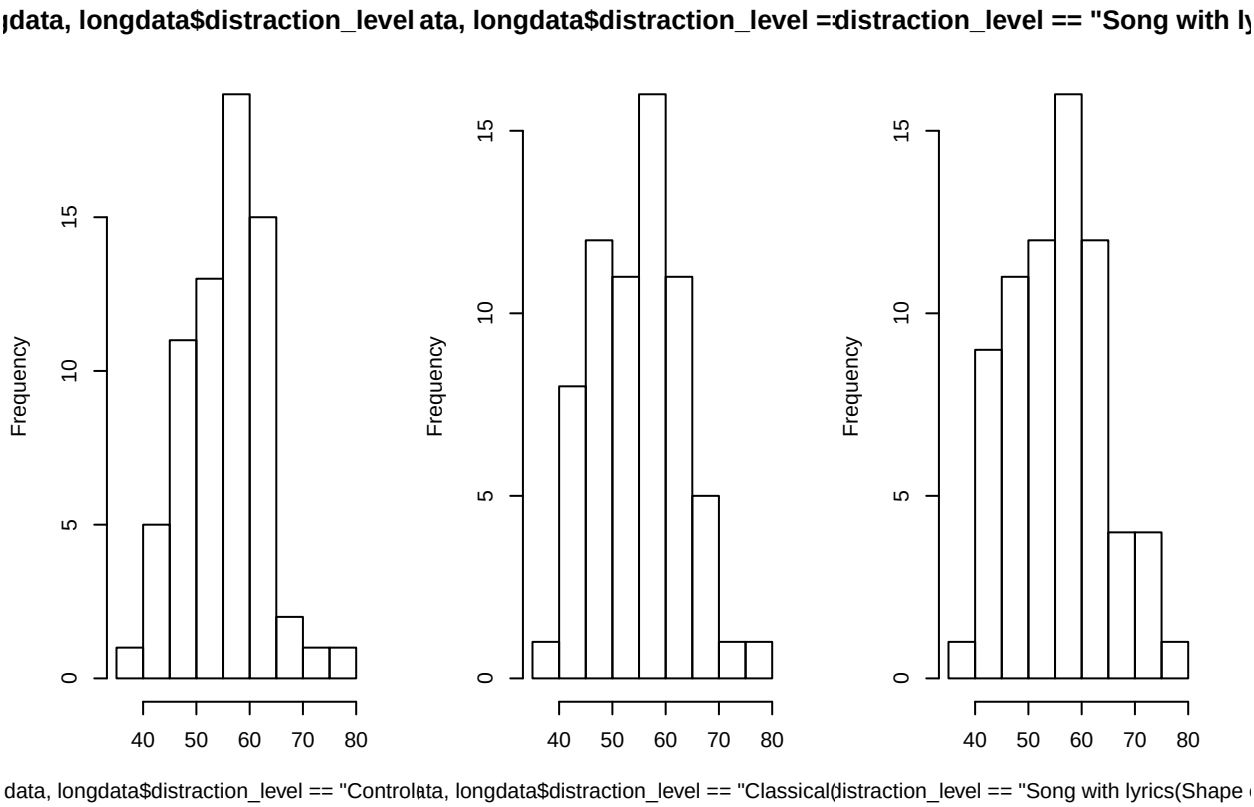

```
par(mfrow = c(1,3))
boxplot(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OnTime)
boxplot(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OnTime)
boxplot(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$
```



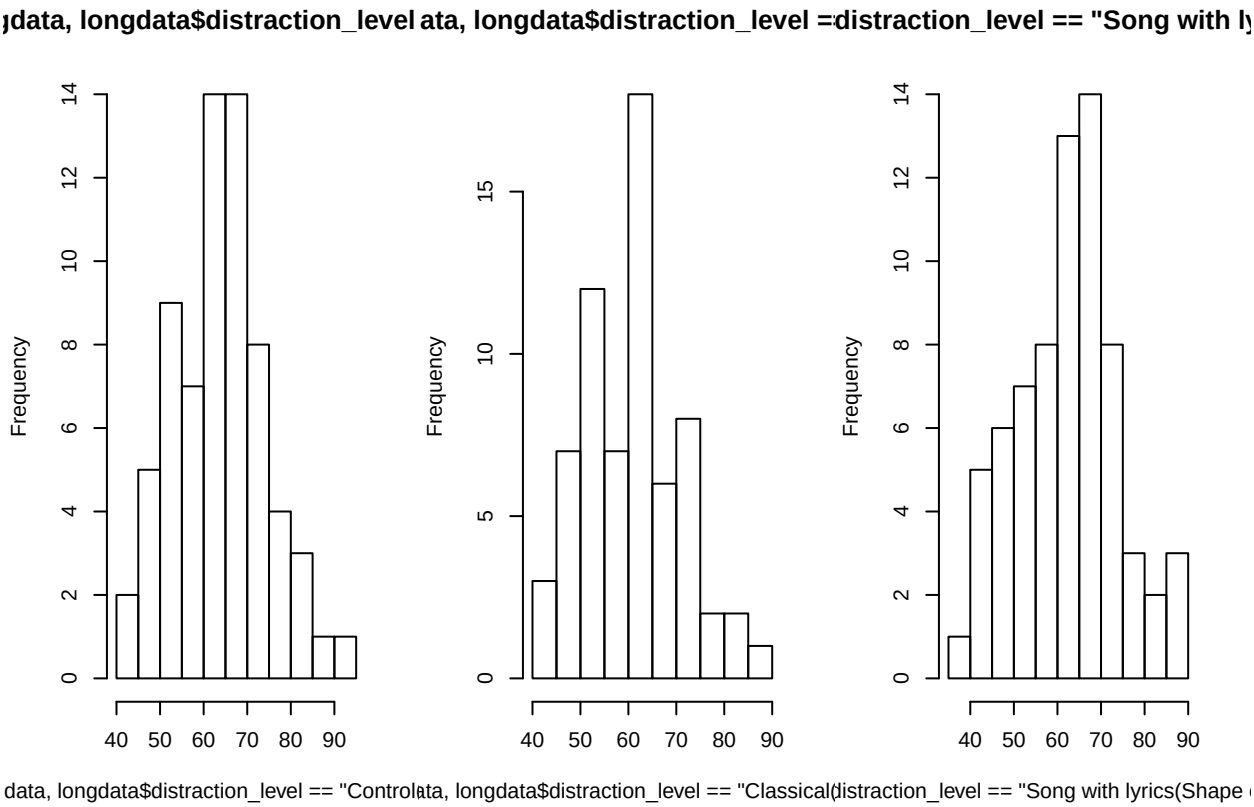

```
par(mfrow = c(1,3))
boxplot(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OnTime_minus_OffTime)
boxplot(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OnTime_minus_OffTime)
boxplot(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$
```



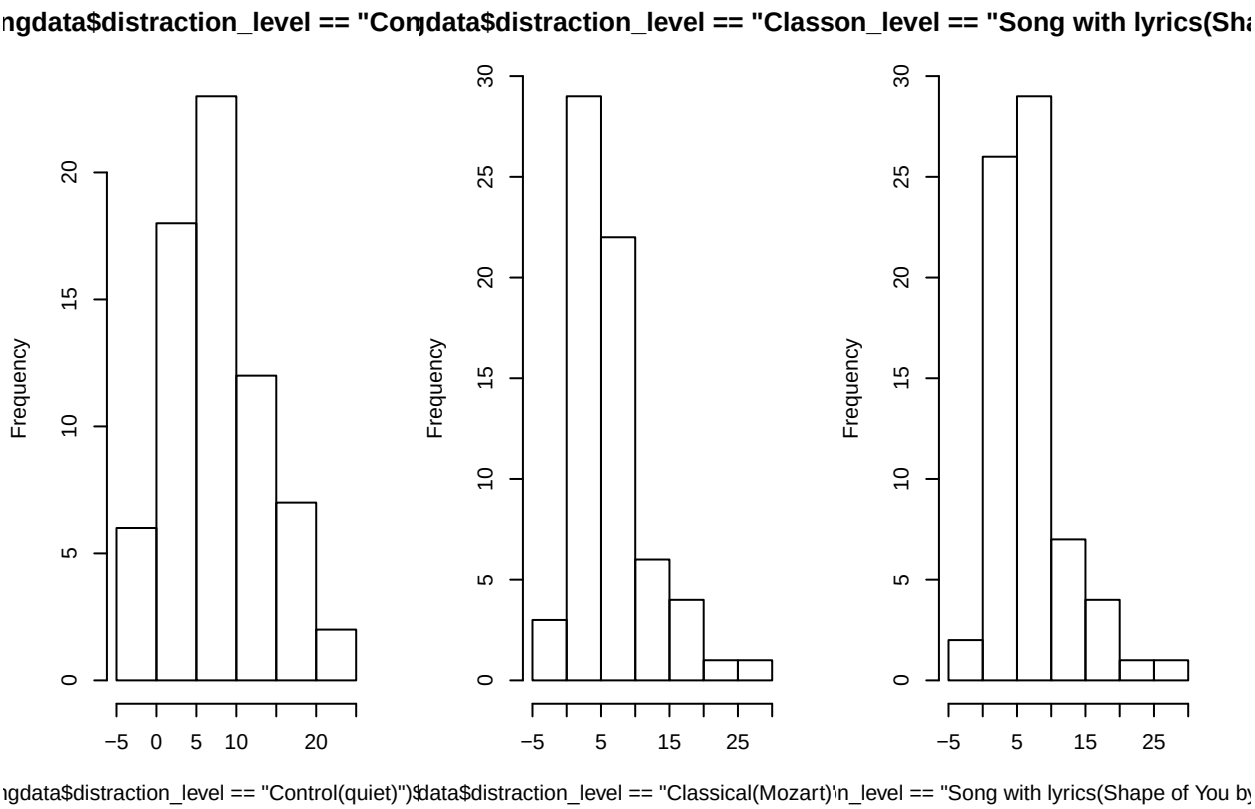

```
par(mfrow = c(1,3))
hist(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OffTime)
hist(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OffTime)
hist(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$Off
```



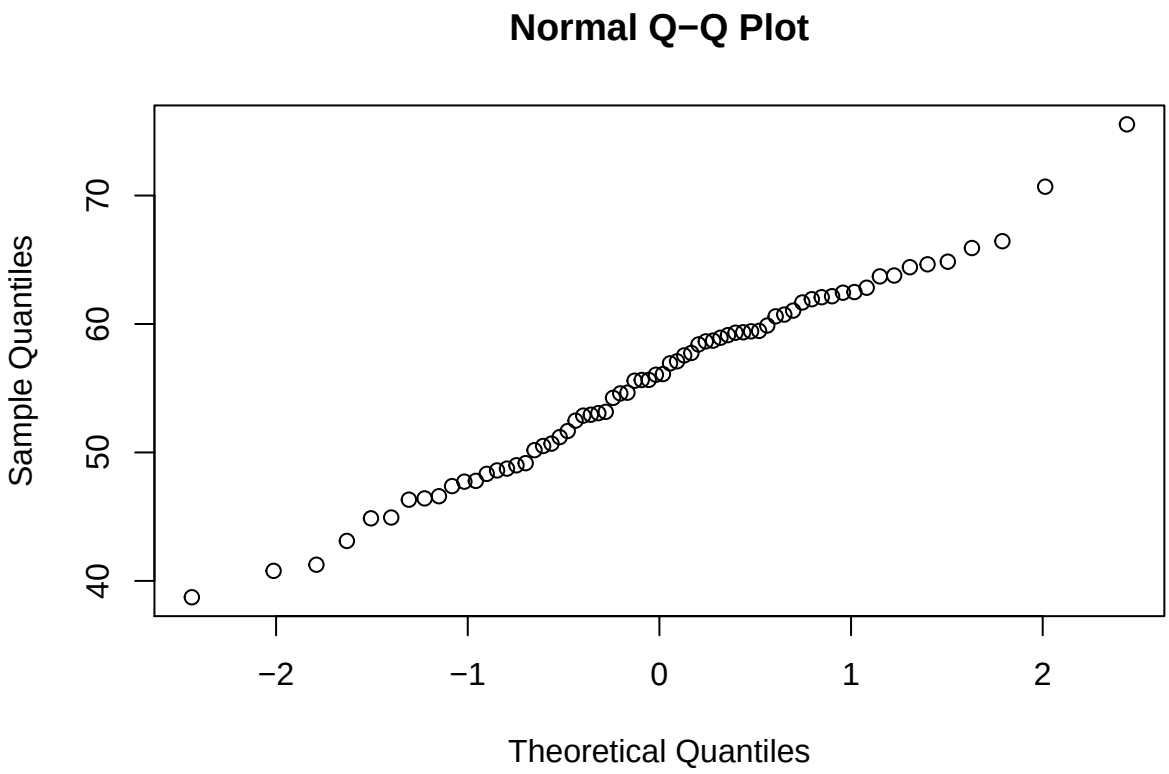

```
par(mfrow = c(1,3))
hist(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OnTime)
hist(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OnTime)
hist(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$OnT
```



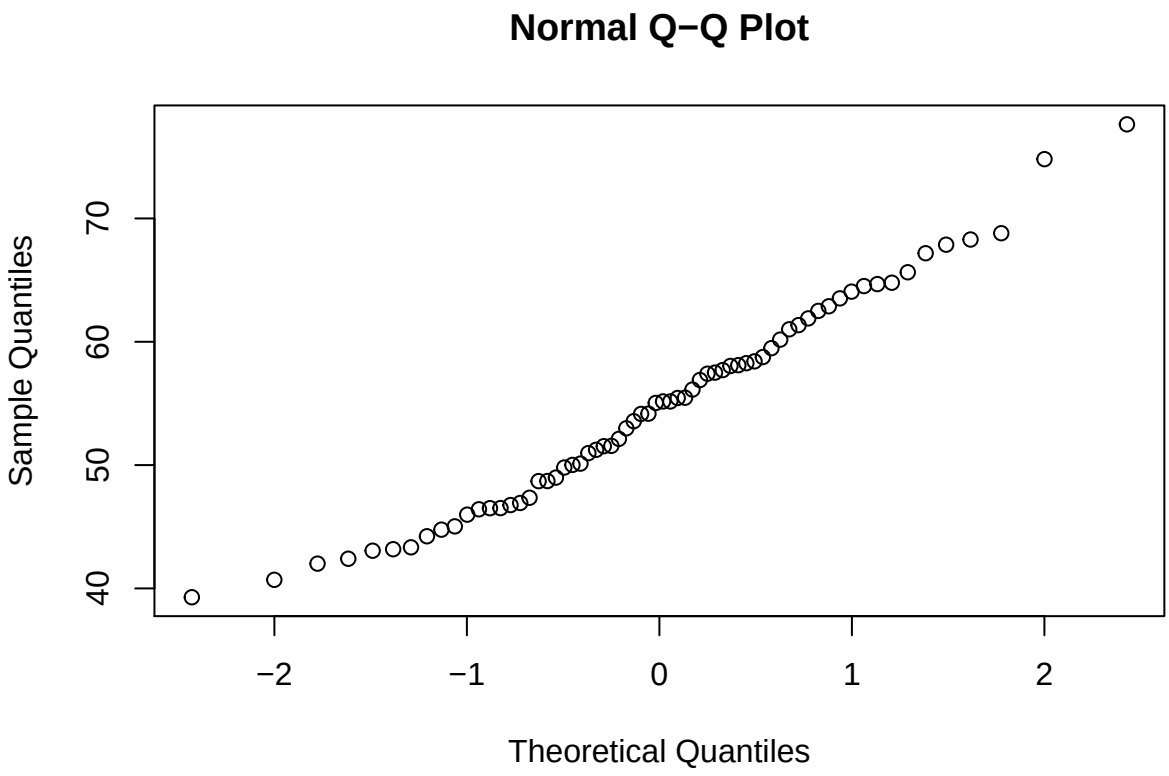

```
par(mfrow = c(1,3))
hist(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OnTime_minus_OffTime)
hist(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OnTime_minus_OffTime)
hist(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$OnT
```



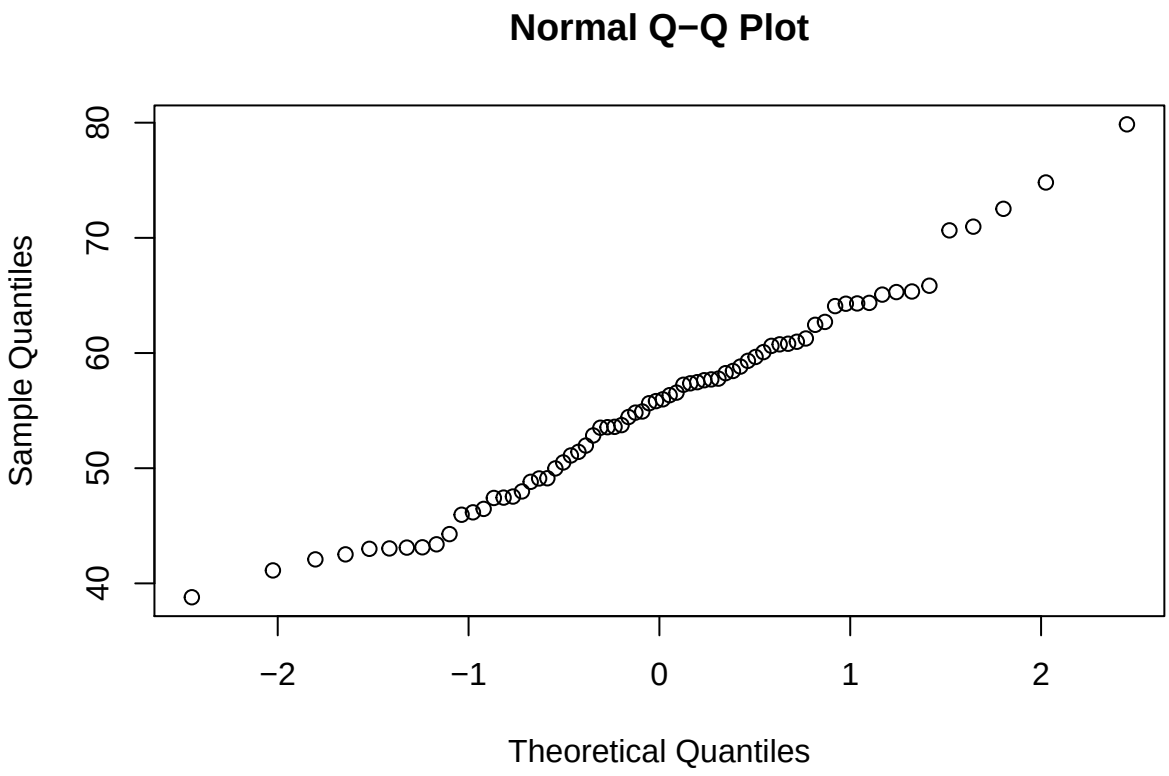

```
qqnorm(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OffTime)
```



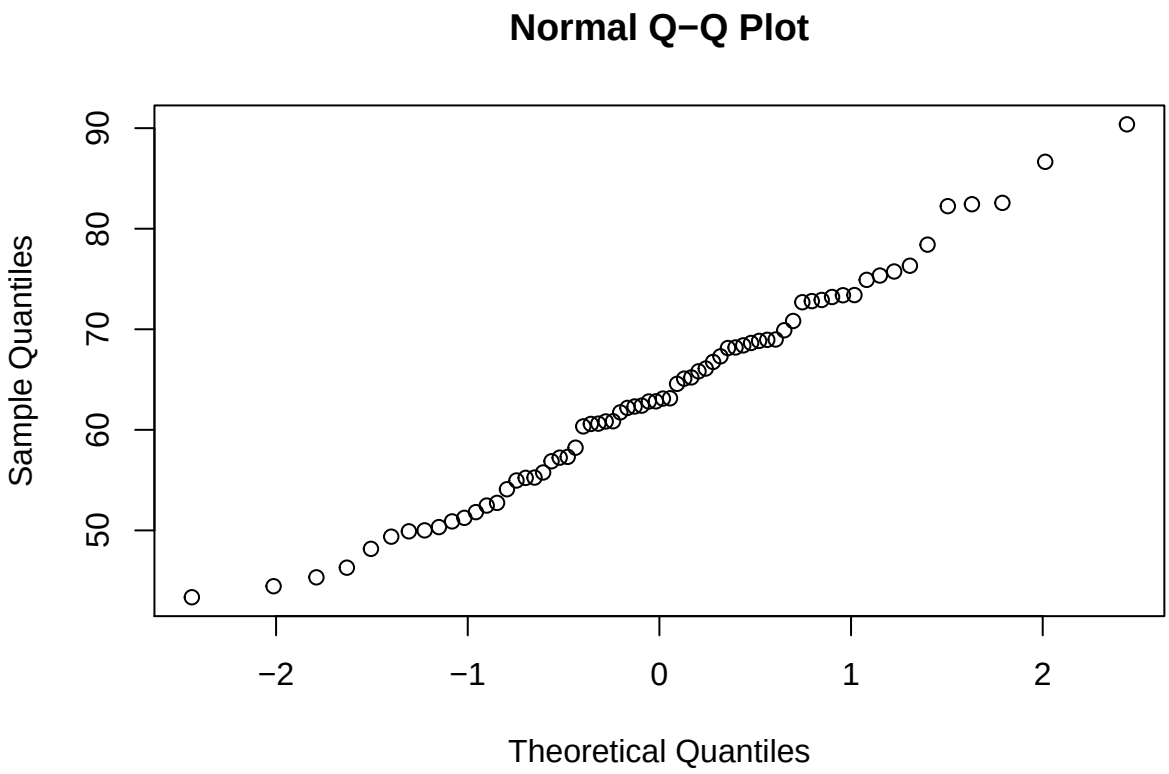

```
qqnorm(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OffTime)
```



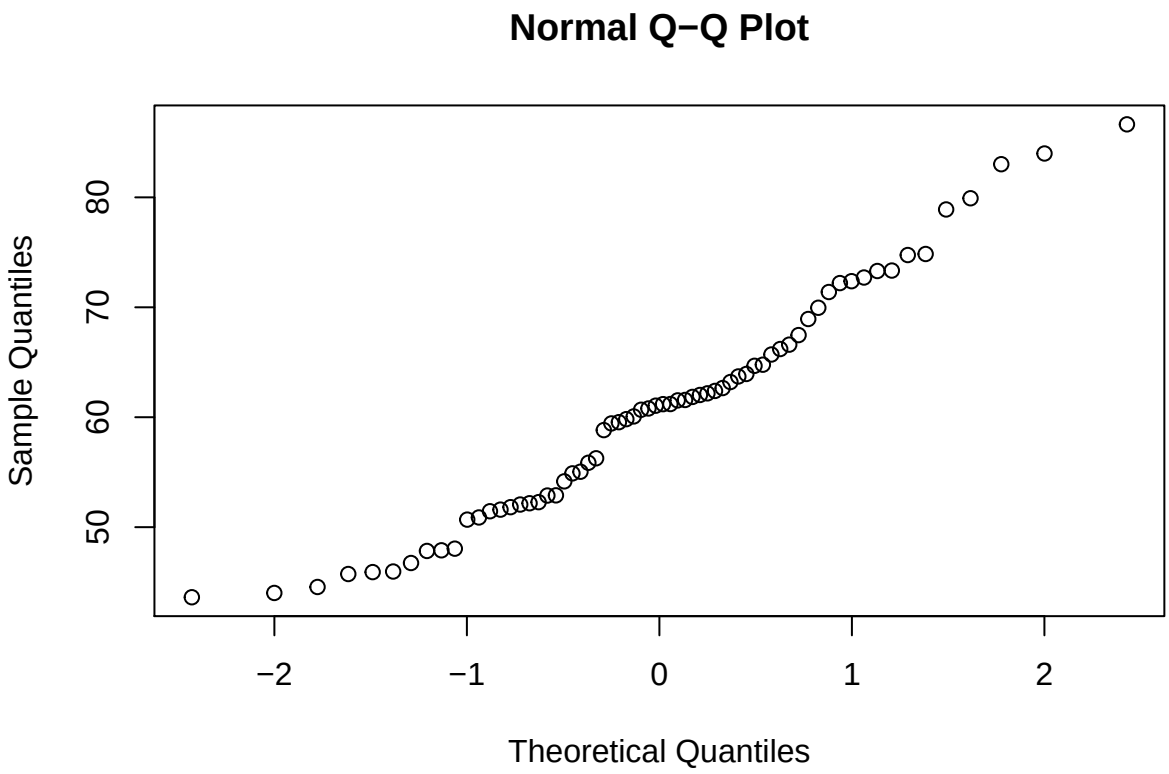

```
qqnorm(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$O
```



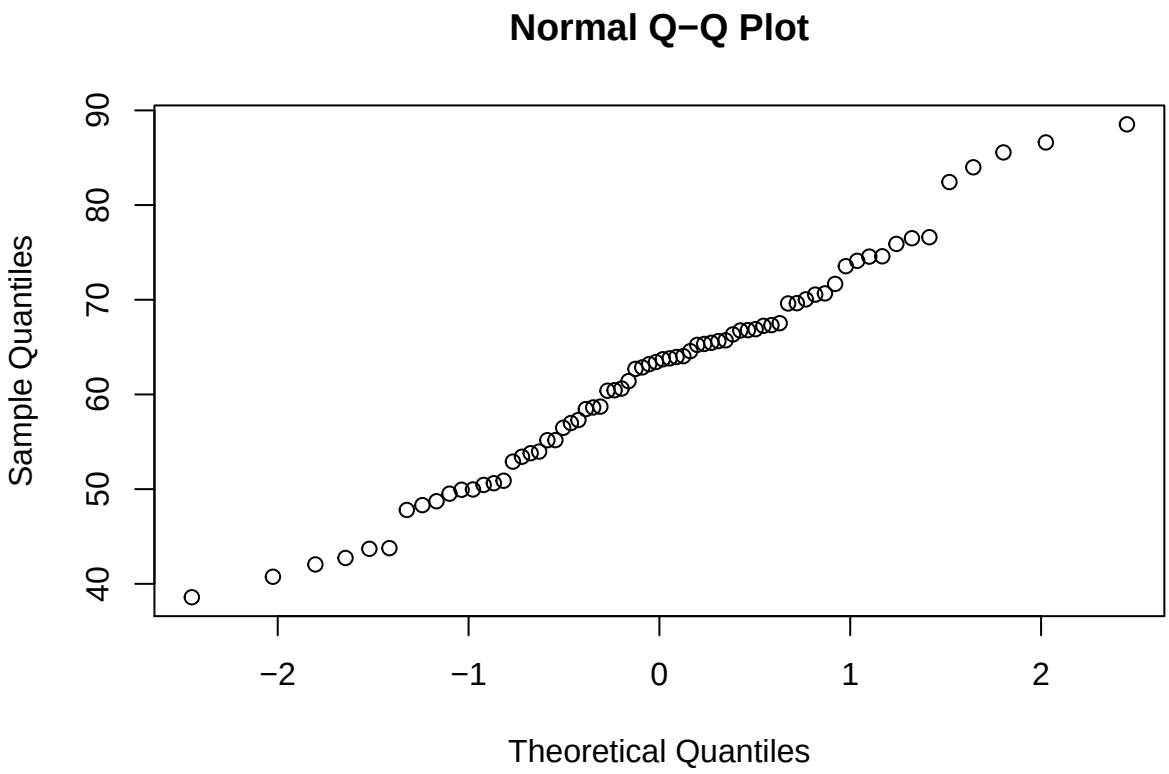

```
qqnorm(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OnTime)
```



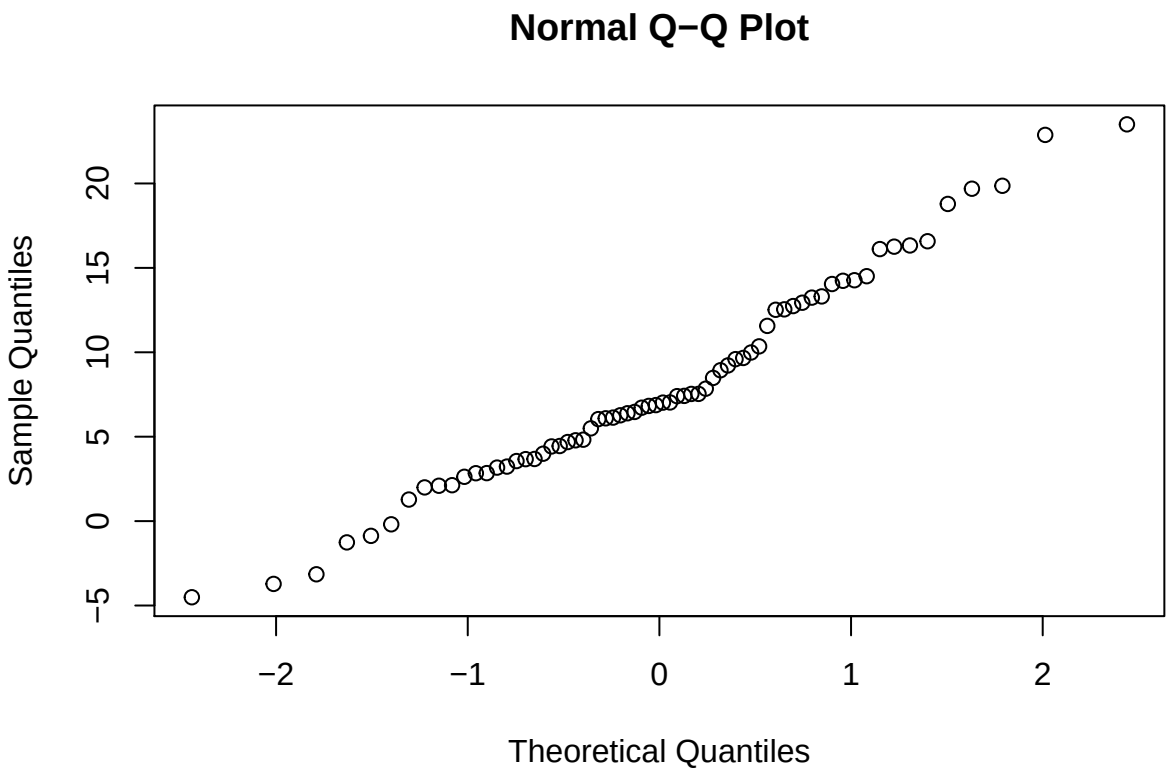

```
qqnorm(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OnTime)
```



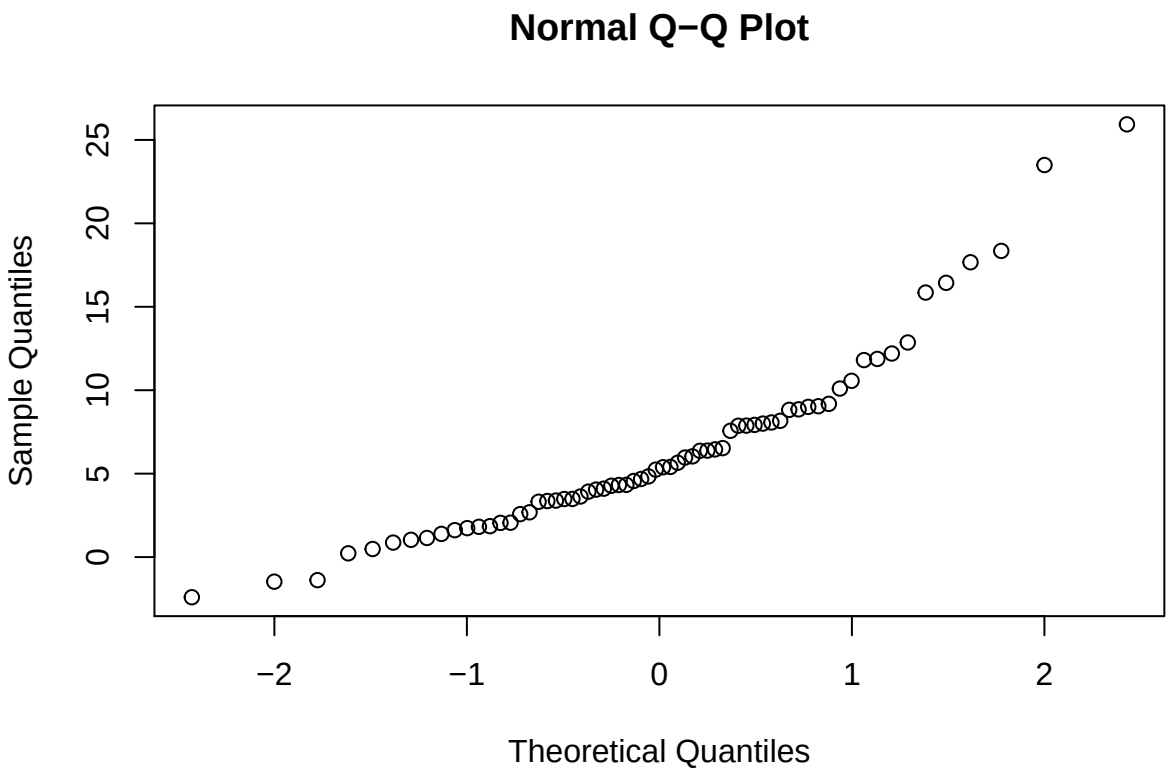

```
qqnorm(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$Or
```



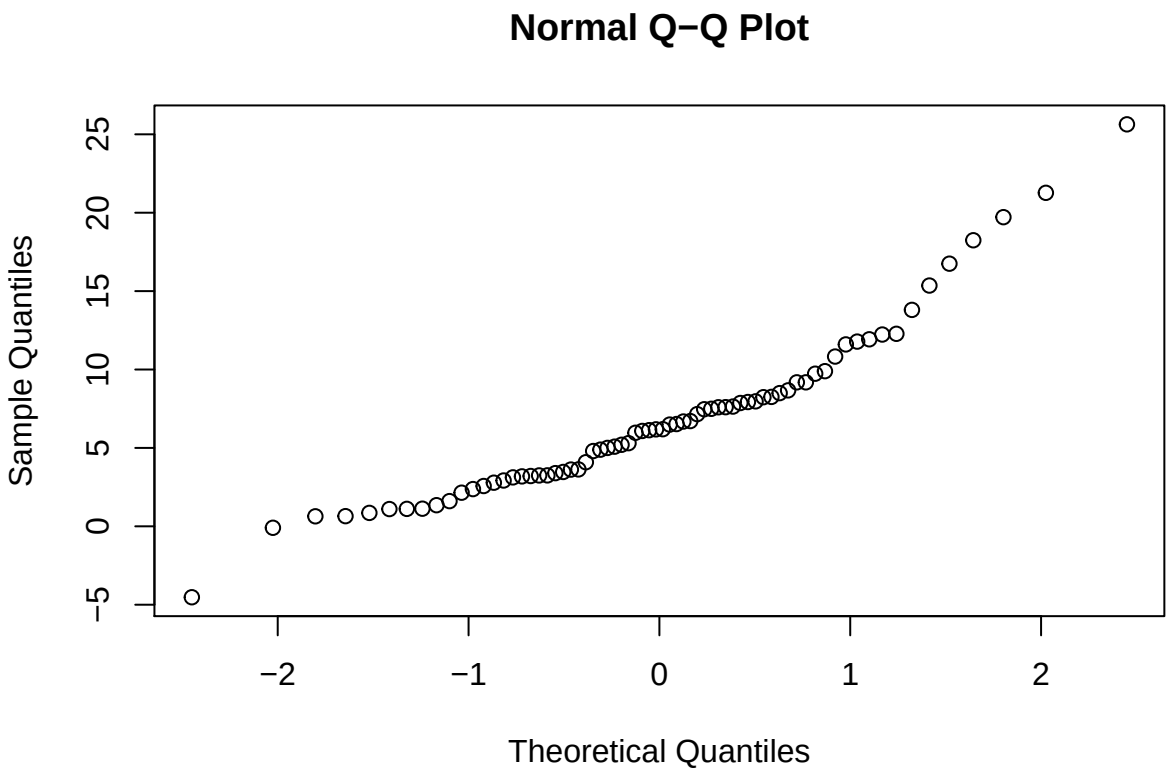

```
qqnorm(subset(longdata, longdata$distraction_level == 'Control(quiet)')$OnTime_minus_OffTime)
```




```
qqnorm(subset(longdata, longdata$distraction_level == 'Classical(Mozart)')$OnTime_minus_OffTime)
```




```
qqnorm(subset(longdata, longdata$distraction_level == 'Song with lyrics(Shape of You by Ed Sheeran)')$Or
```



Though based on histgram and qqplot normality asusmpition holds for different distraction levels, it seems data from different distraction levels also shows difference in sample mean. This is questionable. If there was no difference in result from different distration level, the analysis is done here. For furture analysis, a simple model is not suitale, need to consider complex model with more parameters. But first, a careful sample mean test should be performed.