# French lexicon project: illustrate dataset

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## Contents



```
# dependencies
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.4.4
```

```
library(cowplot)
```

```
## Warning: package 'cowplot' was built under R version 3.4.2
```

```
library(tibble)
```

```
## Warning: package 'tibble' was built under R version 3.4.3
```

```
library(HDInterval)
source("./functions/akerd.txt")
source("./functions/skew.txt")
```

```
sessionInfo()
```

```
## R version 3.4.0 (2017-04-21)
## Platform: x86_64-apple-darwin15.6.0 (64-bit)
## Running under: macOS  10.14.2
##
## Matrix products: default
## BLAS: /Library/Frameworks/R.framework/Versions/3.4/Resources/lib/libRblas.0.dylib
## LAPACK: /Library/Frameworks/R.framework/Versions/3.4/Resources/lib/libRlapack.dylib
##
## locale:
```

```
## [1] en_GB.UTF-8/en_GB.UTF-8/en_GB.UTF-8/C/en_GB.UTF-8/en_GB.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
## [1] HDInterval_0.1.3 tibble_1.4.2     cowplot_0.9.1    ggplot2_3.0.0
##
## loaded via a namespace (and not attached):
##  [1] Rcpp_0.12.19     rstudioapi_0.8   bindr_0.1.1      knitr_1.17
##  [5] magrittr_1.5     tidyselect_0.2.4 munsell_0.4.3    colorspace_1.3-2
##  [9] R6_2.3.0         rlang_0.2.2      stringr_1.2.0    plyr_1.8.4
## [13] dplyr_0.7.6      tools_3.4.0      grid_3.4.0       gtable_0.2.0
## [17] withr_2.1.0      htmltools_0.3.6  assertthat_0.2.0 yaml_2.1.15
## [21] lazyeval_0.2.1   rprojroot_1.2    digest_0.6.12    crayon_1.3.4
## [25] bindrcpp_0.2.2   purrr_0.2.5      glue_1.3.0       evaluate_0.10.1
## [29] rmarkdown_1.8    stringi_1.1.6    compiler_3.4.0   pillar_1.3.0
## [33] scales_0.5.0     backports_1.1.1  pkgconfig_2.0.2
```

## Lexical decision dataset

Data from the French Lexicon Project. Click on "French Lexicon Project trial-level results with R scripts.zip". The `.RData` dataset was created by applying the script `/code/getflprtdata.Rmd`.

```
# get data - tibble = `flp`
load("./data/french_lexicon_project_rt_data.RData")
# columns =
#1 = participant
#2 = rt
#3 = acc = accuracy 0/1
#4 = condition = word/non-word
```

N = 959 participants.

## Illustrate results for a few participants

Word / non-word comparison:

```
# select participants
p.list <- unique(flp$participant)
# sp <- p.list[seq(1, length(unique(flp$participant)), 25)]
# sp <- c(121, 144, 326)
sp <- p.list[121]

for(iter in 1:length(sp)){
# make KDE
flp.w <- sort(flp$rt[flp$participant==sp[iter] & flp$condition=="word"])
flp.nw <- sort(flp$rt[flp$participant==sp[iter] & flp$condition=="non-word"])
a.flp.w <- akerd(flp.w, pyhat = TRUE, plotit = FALSE)
a.flp.nw <- akerd(flp.nw, pyhat = TRUE, plotit = FALSE)

# create data frame
```

```
df <- tibble(`x`=c(flp.w,flp.nw),
             `y`=c(a.flp.w,a.flp.nw),
             `Condition`=c(rep.int("Word",length(flp.w)),
                           rep.int("Non-word",length(flp.nw))))
# make plot
df$Condition <- as.character(df$Condition)
df$Condition <- factor(df$Condition, levels=unique(df$Condition))

# make plot
p <- ggplot(df, aes(x,y, group=Condition)) + theme_classic() +
  geom_line(aes(colour=Condition), size = 1.5) + # linetype=Condition,
  # scale_size_manual(values=c(1,0.5)) +
  # scale_linetype_manual(values=c("solid","solid")) +
  scale_color_manual(values=c("grey30", "#E69F00")) + #, "#56B4E9","black")) +
  scale_x_continuous(limits=c(0,2000), breaks=seq(0,2000,500), minor_breaks = waiver()) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.text = element_text(size = 16),
        legend.title = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = c(0.75,0.8),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Reaction times", y = "Density") +
  ggtitle(paste0("Lexical decision: P",sp[iter]))
p
# save figure
# ggsave(filename=paste0('./figures/figure_flp_p',sp[iter],'.pdf'),width=10,height=7) #path=pathname
}
```

## Illustrate results for 100 participants

Superimpose all KDE (kernel density estimates), separately for Word and Non-Word conditions.

### Save KDE

```
# select participants
p.list <- unique(flp$participant)
Np <- length(p.list)
x <- seq(0, 2000)
a.flp.w <- matrix(ncol=Np, nrow=length(x))
a.flp.nw <- matrix(ncol=Np, nrow=length(x))

for(P in 1:Np){
# make KDE
flp.w <- sort(flp$rt[flp$participant==p.list[P] & flp$condition=="word"])
flp.nw <- sort(flp$rt[flp$participant==p.list[P] & flp$condition=="non-word"])
a.flp.w[,P] <- akerd(flp.w, pyhat = TRUE, plotit = FALSE, pts = x)
```

```
a.flp.nw[,P] <- akerd(flp.nw, pyhat = TRUE, plotit = FALSE, pts = x)
}
save(x, Np, p.list,
     a.flp.w,
     a.flp.nw,
     file = './data/flp_all_kde.RData')
```

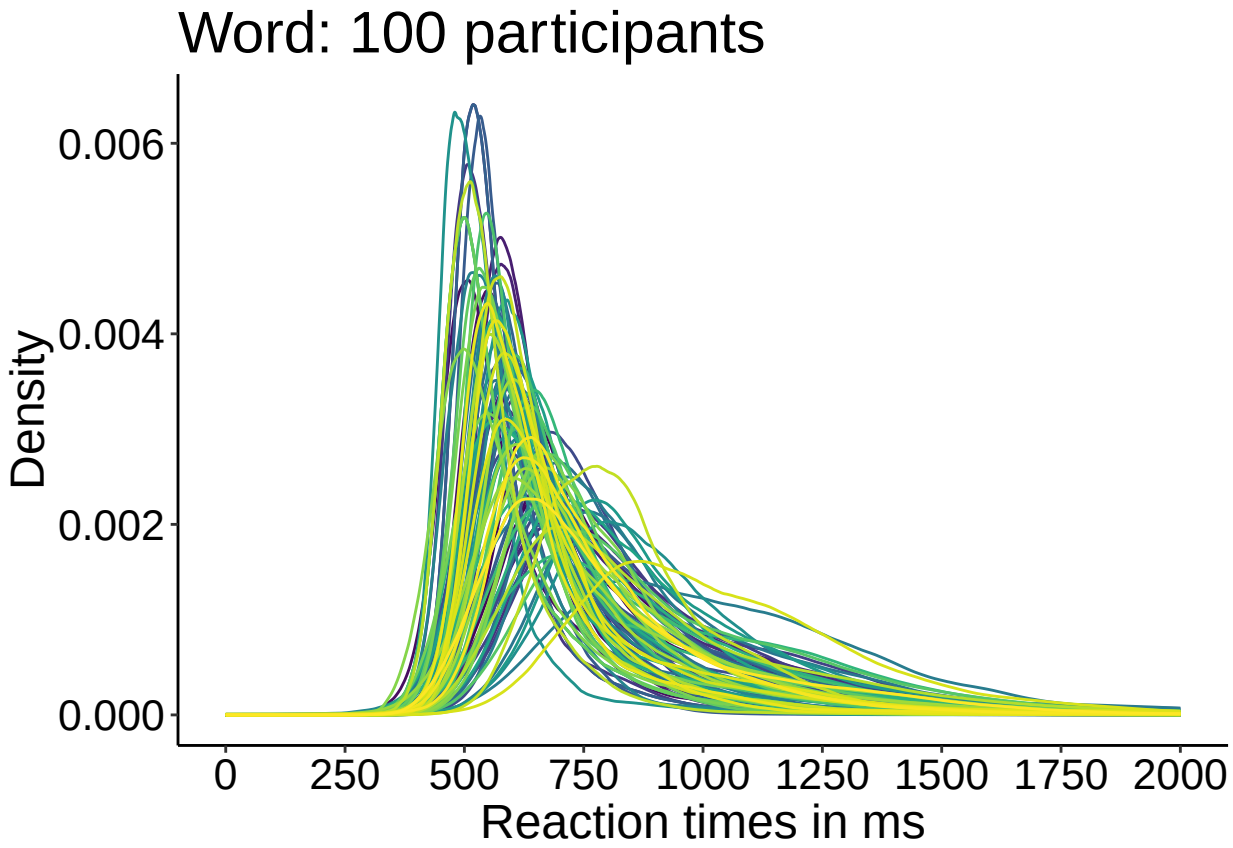
## Make figure: WORD

Was planning to make figure in one go using `facet_grid` and all participants superimposed, but the call to `tibble` keeps crashing R. So plotting 100 random participants for one condition instead.

```
load('./data/flp_all_kde.RData')

# create data frame
set.seed(21)
Np <- 100
a.flp.w <- as.vector(a.flp.w[,runif(Np, min = 1, max = 959)])
df <- tibble(kde = a.flp.w,
             x = rep(x, Np)
             )
df$participant = factor(rep(seq(1,Np), each = length(x)))
df$participant <- as.character(df$participant)
df$participant <- factor(df$participant, levels=unique(df$participant))

# make plot
p <- ggplot(df, aes(x, kde)) + theme_classic() +
  geom_line(aes(colour=participant), size = 0.5) + # linetype=Condition,
  scale_color_viridis_d() +
  scale_x_continuous(limits=c(0,2000), breaks=seq(0,2000,250), minor_breaks = waiver()) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.text = element_text(size = 16),
        legend.title = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = "none",#c(0.75,0.8),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Reaction times in ms", y = "Density") +
  ggtitle(paste0("Word: 100 participants"))
  # facet_grid(. ~ condition)
p
```




```
p.w100 <- p
# save figure
# ggsave(filename=paste0('./figures/figure_flp_w_100_kde.pdf'),width=10,height=7) #path=pathname
```

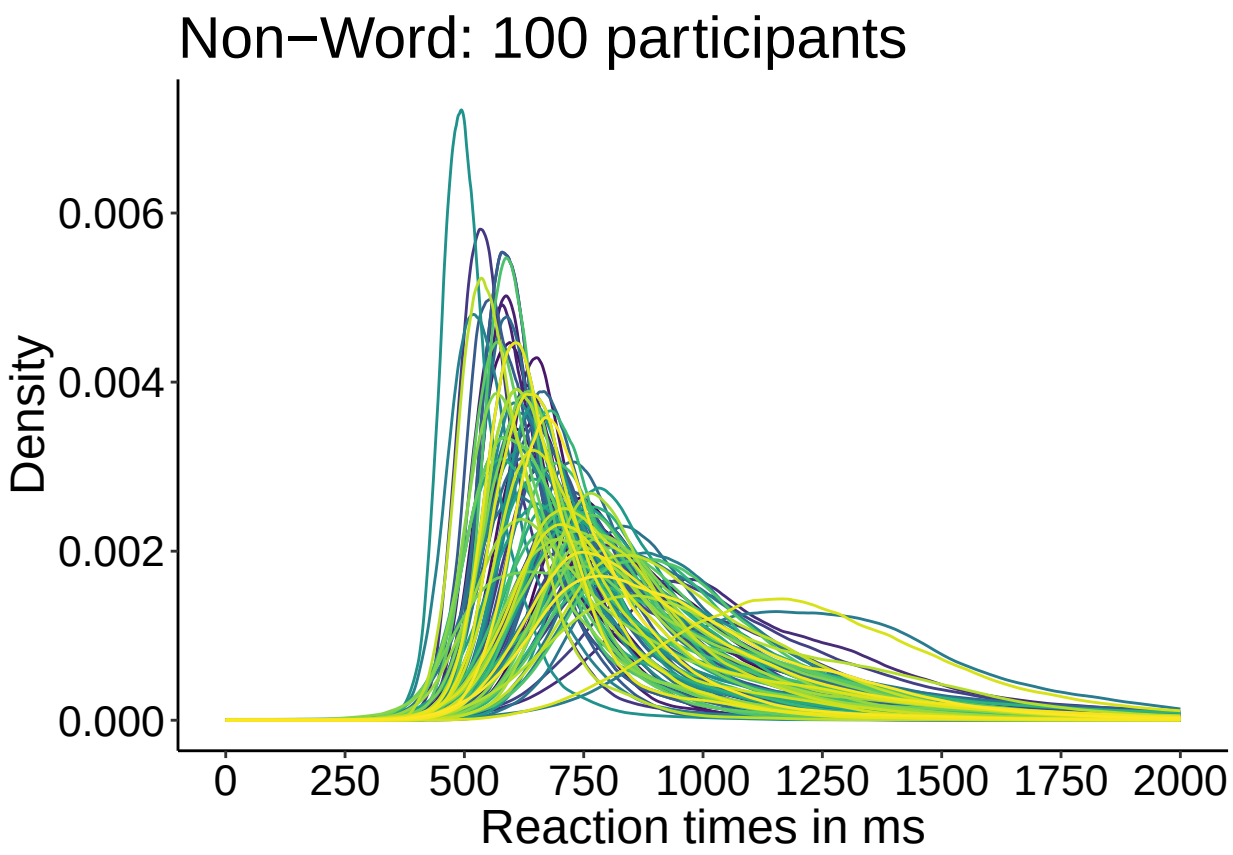
**Make figure: NON-WORD**

```
# load('./data/flp_all_kde.RData')

set.seed(21)
Np <- 100
a.flp.nw <- as.vector(a.flp.nw[,runif(Np, min = 1, max = 959)])
df <- tibble(kde = a.flp.nw,
             x = rep(x, Np)
             )
df$participant = factor(rep(seq(1,Np), each = length(x)))
df$participant <- as.character(df$participant)
df$participant <- factor(df$participant, levels=unique(df$participant))

# make plot
p <- ggplot(df, aes(x, kde)) + theme_classic() +
  geom_line(aes(colour=participant), size = 0.5) + # linetype=Condition,
  scale_color_viridis_d() +
  scale_x_continuous(limits=c(0,2000), breaks=seq(0,2000,250), minor_breaks = waiver()) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
```

```
        axis.title.y = element_text(size = 18),
        legend.text = element_text(size = 16),
        legend.title = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = "none",#c(0.75,0.8),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Reaction times in ms", y = "Density") +
  ggtitle(paste0("Non-Word: 100 participants"))
  # facet_grid(. ~ condition)
p
```




```
p.nw100 <- p
# save figure
# ggsave(filename=paste0('./figures/figure_flp_nw_100_kde.pdf'),width=10,height=7) #path=pathname
```

### Summary figure

```
# combine panels into one figure
cowplot::plot_grid(p.w100, p.nw100,
                           labels = c("A", "B"),
                           ncol = 1,
                           nrow = 2,
                           rel_widths = c(1, 1),
                           label_size = 20,
```

```
                          hjust = -1.5,
                          scale=.95,
                          align = "h")
# save figure
ggsave(filename='./figures/figure_flp_100.pdf',width=10,height=10)
```

## Summary results for all participants

```
# Number of trials
nres <- tapply(flp$rt, list(flp$participant, flp$condition), length)
summary(nres)
```

```
##       word           non-word
##  Min.   : 996.0   Min.   : 997
##  1st Qu.: 999.0   1st Qu.:1000
##  Median : 999.0   Median :1001
##  Mean   : 999.5   Mean   :1001
##  3rd Qu.:1000.0   3rd Qu.:1001
##  Max.   :1000.0   Max.   :1001
```

```
# get data: median RT for every participant
medres <- tapply(flp$rt, list(flp$participant, flp$condition), median)
summary(medres)
```

```
##       word           non-word
##  Min.   : 453.0   Min.   : 507.0
##  1st Qu.: 620.5   1st Qu.: 684.2
##  Median : 678.5   Median : 762.0
##  Mean   : 696.5   Mean   : 788.6
##  3rd Qu.: 762.2   3rd Qu.: 870.5
##  Max.   :1061.0   Max.   :1301.0
```

```
# get data: mean RT for every participant
meanres <- tapply(flp$rt, list(flp$participant, flp$condition), mean)
summary(meanres)
```

```
##       word           non-word
##  Min.   : 459.4   Min.   : 522.1
##  1st Qu.: 674.5   1st Qu.: 736.7
##  Median : 747.7   Median : 827.5
##  Mean   : 763.9   Mean   : 848.9
##  3rd Qu.: 845.4   3rd Qu.: 946.6
##  Max.   :1134.9   Max.   :1343.5
```

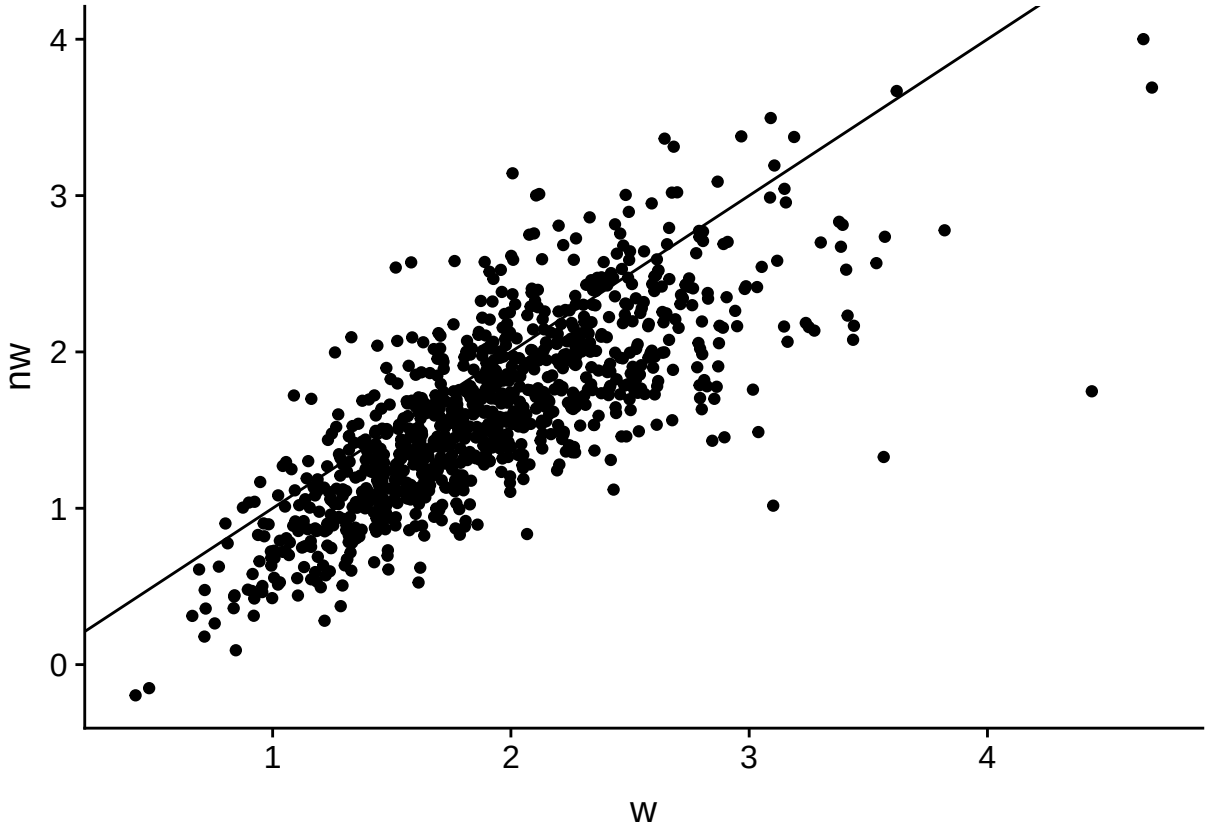
```
# get data: skewness for every participant
skewness <- function(x){
x=elimna(x)
m1<-mean(x)
m2<-var(x)
m3<-sum((x-m1)^3)/length(x)
sk<-m3/m2^1.5
sk
}
```

```
skewres <- tapply(flp$rt, list(flp$participant, flp$condition), skewness)
summary(skewres)
```

```
##       word           non-word
##  Min.   :0.4247   Min.   :-0.1966
##  1st Qu.:1.5171   1st Qu.: 1.2105
##  Median :1.8733   Median : 1.6004
##  Mean   :1.9123   Mean   : 1.6197
##  3rd Qu.:2.2643   3rd Qu.: 1.9991
##  Max.   :4.6905   Max.   : 4.0006
```

### Illustrate skewness

```
df <- tibble(`w` = skewres[,1],
             `nw` = skewres[,2])
ggplot(df, aes(x=w, y=nw)) + geom_point() + geom_abline(slope=1, intercept=0)
```



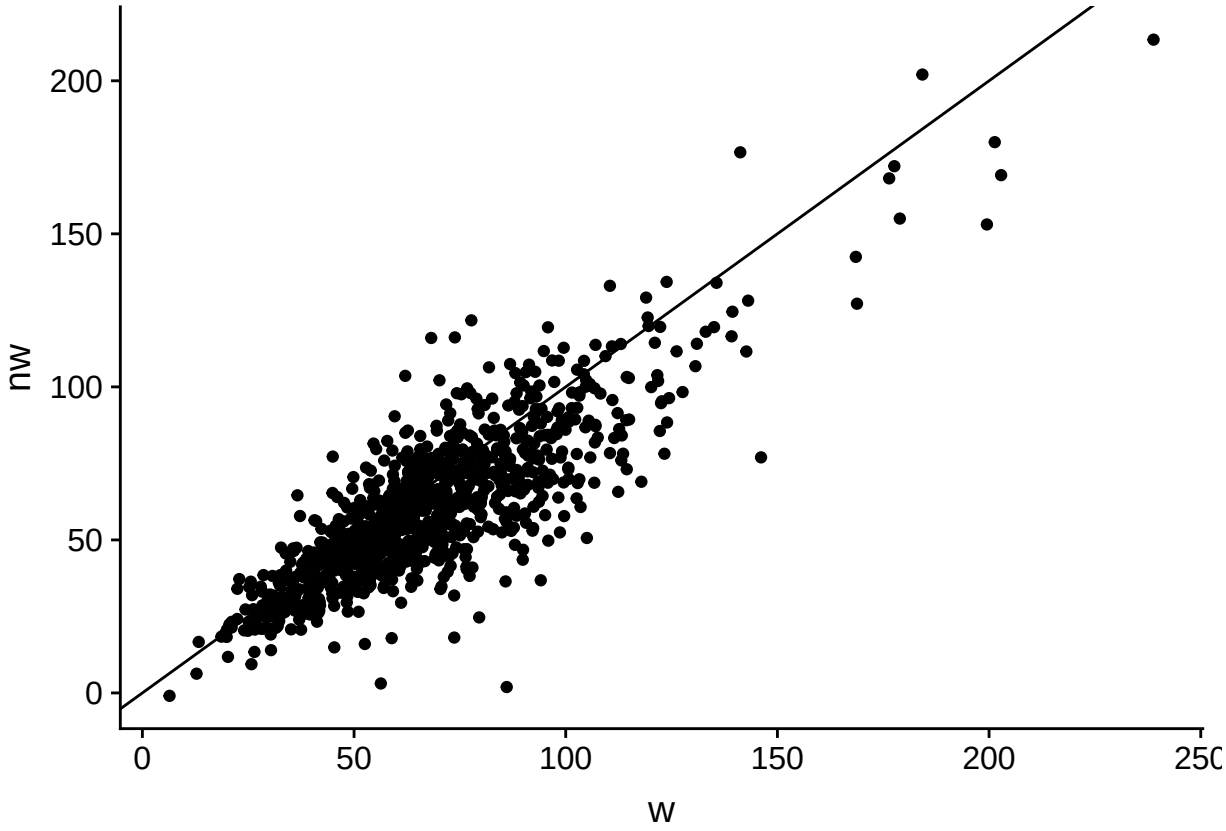

Proportion of participants with larger skewness in the Word condition:

```
sum((skewres[,1] - skewres[,2]) > 0) / length(skewres[,1])
```

```
## [1] 0.8008342
```

**Illustrate non-parametric skewness**

```
df <- tibble(`w` = meanres[,1] - medres[,1],
             `nw` = meanres[,2] - medres[,2])
ggplot(df, aes(x=w, y=nw)) + geom_point() + geom_abline(slope=1, intercept=0)
```




Only one participant in the non-word condition has negative skewness: -0.94.

Proportion of participants with larger non-parametric skewness in the Word condition:

```
sum((meanres[,1] - medres[,1]) - (meanres[,2] - medres[,2]) > 0) / length(skewres[,1])
```

```
## [1] 0.6976017
```

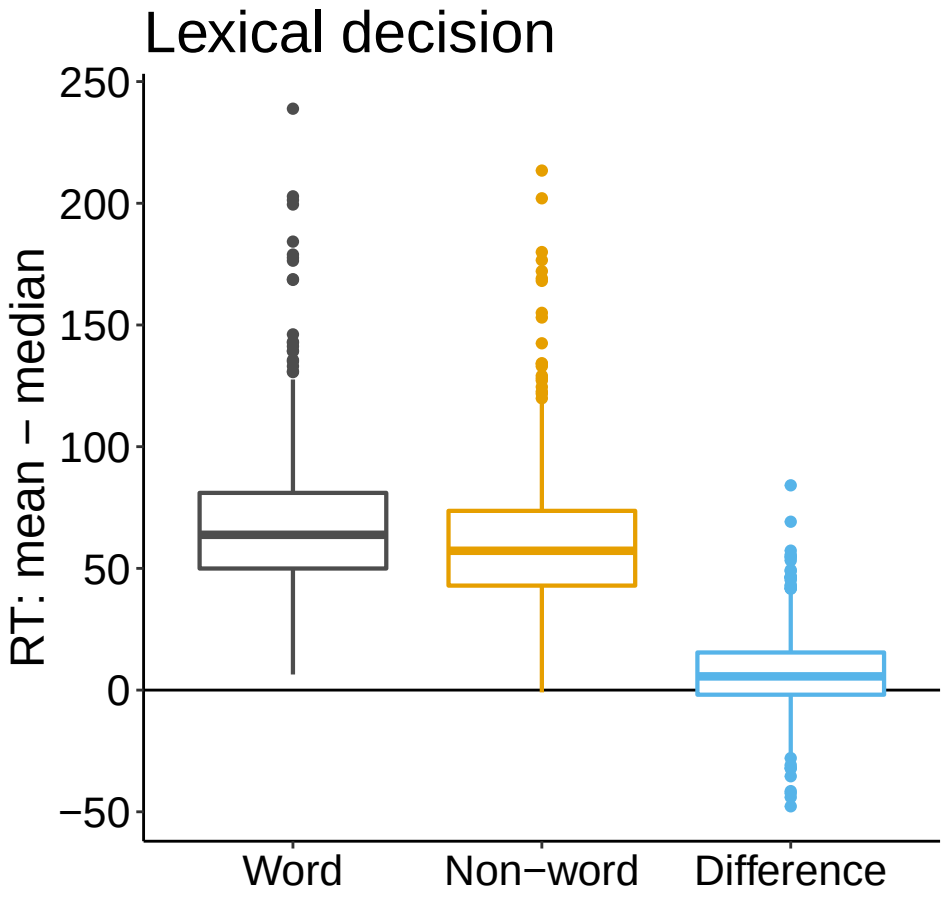
**Illustrate results: the mean is larger than the median in most participants**

```
diff.w <- sort(meanres[,1] - medres[,1])
diff.nw <- sort(meanres[,2] - medres[,2])
diff.wnw <- (meanres[,1]-meanres[,2]) - (medres[,1]-medres[,2])
# a.diff.w <- akerd(diff.w, pyhat = TRUE, plotit = FALSE)
# a.diff.nw <- akerd(diff.nw, pyhat = TRUE, plotit = FALSE)

# create data frame
df <- tibble(`x`=c(diff.w, diff.nw, diff.wnw),
             # `y`=c(a.diff.w,a.diff.nw),
             `Condition`=c(rep.int("Word",length(diff.w)),
                           rep.int("Non-word",length(diff.nw)),
```

```
                          rep.int("Difference",length(diff.wnw))))
# make plot
df$Condition <- as.character(df$Condition)
df$Condition <- factor(df$Condition, levels=unique(df$Condition))

# make plot
p <- ggplot(df, aes(x=Condition, y=x, group=Condition)) + theme_classic() +
  geom_hline(yintercept = 0) +
  # geom_line(aes(colour=Condition), size = 1.5) + # linetype=Condition,
  geom_boxplot(aes(colour=Condition), size = 0.75) + # linetype=Condition,
  # scale_size_manual(values=c(1,0.5)) +
  # scale_linetype_manual(values=c("solid","solid")) +
  scale_color_manual(values=c("grey30", "#E69F00", "#56B4E9")) + #, "#56B4E9","black")) + grey #999999
  # scale_x_continuous(limits=c(0,2000), breaks=seq(0,2000,500), minor_breaks = waiver()) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = "none", #c(0.75,0.8),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
  labs(y = "RT: mean - median", x="") +
  ggtitle("Lexical decision")
p
```



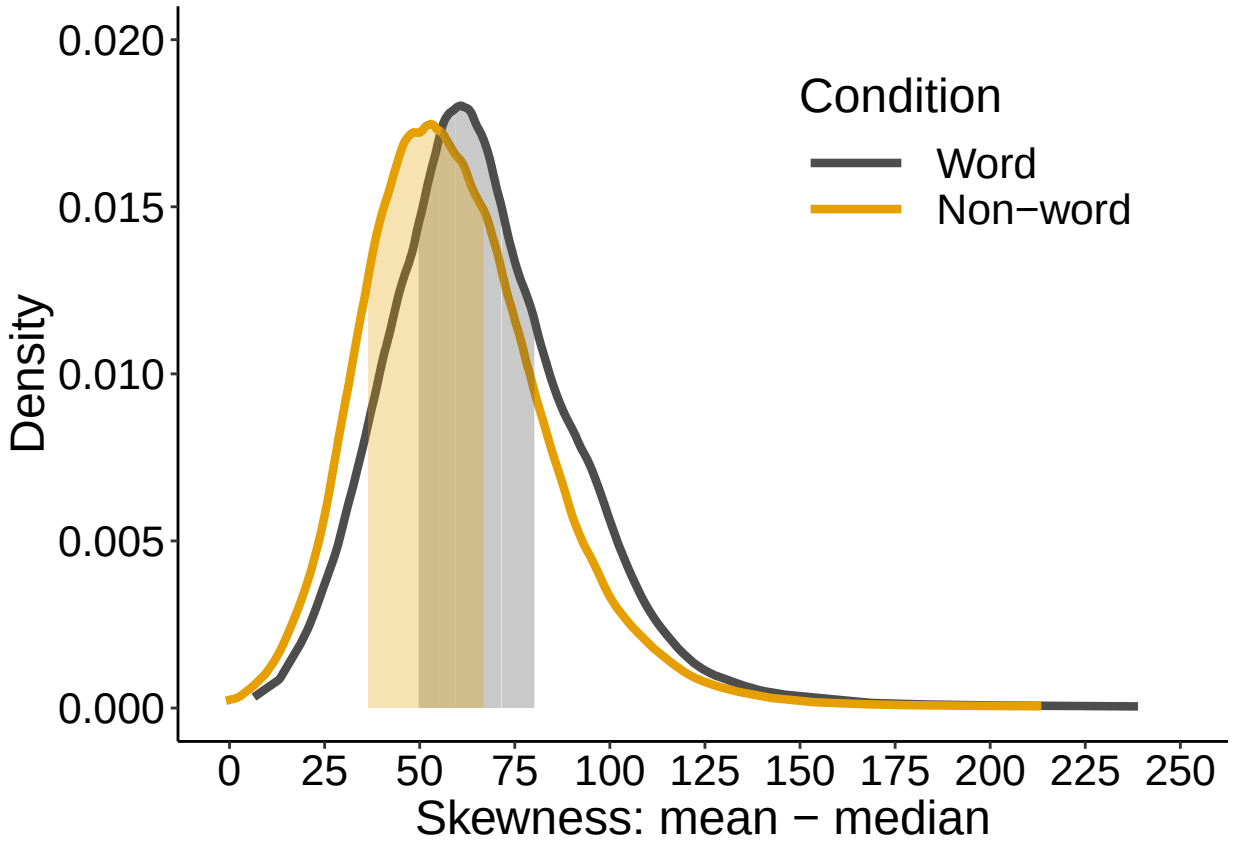
```
# save figure
# ggsave(filename='./figures/figure_flp_all_p_mean_median_diff.pdf',width=7,height=7) #path=pathname
```

**KDE of non-parametric skewness**

```
# make KDE
kde.w <- akerd(meanres[,1] - medres[,1], pyhat = TRUE, plotit = FALSE)
kde.nw <- akerd(meanres[,2] - medres[,2], pyhat = TRUE, plotit = FALSE)
# get HDI
hdi.w <- hdi(meanres[,1] - medres[,1], credMass=0.50)
hdi.nw <- hdi(meanres[,2] - medres[,2], credMass=0.50)
```

```
# create data frame
df <- tibble(`x`=c(sort(meanres[,1] - medres[,1]), sort(meanres[,2] - medres[,2])),
             `y`=c(kde.w, kde.nw),
             `Condition`=c(rep.int("Word",length(kde.w)),
                           rep.int("Non-word",length(kde.nw))))
# make plot
df$Condition <- as.character(df$Condition)
df$Condition <- factor(df$Condition, levels=unique(df$Condition))

diff <- sort(meanres[,1] - medres[,1])
df.area1 <- tibble(x = diff[diff>hdi.w[1] & diff<hdi.w[2]],
                   y = kde.w[diff>hdi.w[1] & diff<hdi.w[2]])
diff <- sort(meanres[,2] - medres[,2])
df.area2 <- tibble(x = diff[diff>hdi.nw[1] & diff<hdi.nw[2]],
                   y = kde.nw[diff>hdi.nw[1] & diff<hdi.nw[2]])
# make plot
p <- ggplot(df, aes(x,y)) + theme_classic() +
  geom_line(aes(colour=Condition), size = 1.5) + # linetype=Condition,
  scale_color_manual(values=c("grey30", "#E69F00")) + #, "#56B4E9","black")) +
# add HDI areas
geom_area(data=df.area1, aes(x=x, y=y), fill="grey30", alpha=0.3) +
  geom_area(data=df.area2, aes(x=x, y=y), fill="#E69F00", alpha=0.3) +
  scale_x_continuous(limits=c(-1,250), breaks=seq(0,250,25)) +
  scale_y_continuous(limits=c(0,0.02)) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.text = element_text(size = 16),
        legend.title = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = c(0.75,0.8),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Skewness: mean - median", y = "Density")
  # ggtitle(paste0("Lexical decision: P",sp[iter]))
p
```




```
# save figure
# ggsave(filename=paste0('./figures/figure_flp_p',sp[iter],'.pdf'),width=10,height=7) #path=pathname
```

## Distributions of median and mean RT

### Distributions of median RT

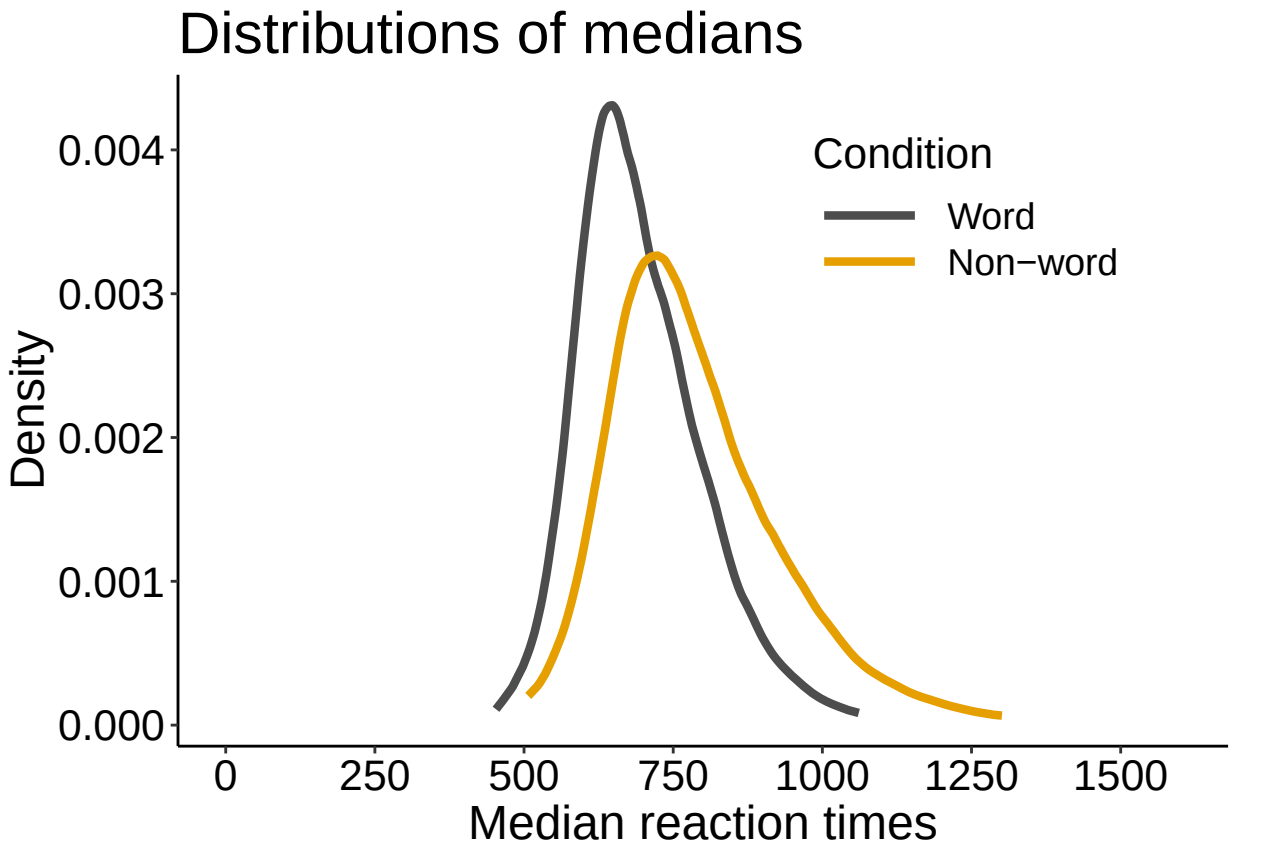
For words and non-words, across participants, the distributions of median RT are positively skewed.

Skewness: Word = 0.6890857 Non-Word = 0.8708904

```
# make KDE
flp.w <- sort(medres[,1])
flp.nw <- sort(medres[,2])
a.flp.w <- akerd(flp.w, pyhat = TRUE, plotit = FALSE)
a.flp.nw <- akerd(flp.nw, pyhat = TRUE, plotit = FALSE)

# create data frame
df <- tibble(`x`=c(flp.w,flp.nw),
             `y`=c(a.flp.w,a.flp.nw),
             `Condition`=c(rep.int("Word",length(flp.w)),
                           rep.int("Non-word",length(flp.nw))))
# make plot
df$Condition <- as.character(df$Condition)
df$Condition <- factor(df$Condition, levels=unique(df$Condition))
```

```r
# make plot
p <- ggplot(df, aes(x,y, group=Condition)) + theme_classic() +
  geom_line(aes(colour=Condition), size = 1.5) + # linetype=Condition,
  # scale_size_manual(values=c(1,0.5)) +
  # scale_linetype_manual(values=c("solid","solid")) +
  scale_color_manual(values=c("grey30", "#E69F00")) +
  scale_x_continuous(limits=c(0,1600), breaks=seq(0,1600,250), minor_breaks = waiver()) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = c(0.75,0.8),
        legend.title = element_text(size=16),
        legend.text = element_text(size = 14),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Median reaction times", y = "Density") +
  ggtitle("Distributions of medians")
p
```




```r
p.allmd <- p
# save figure
# ggsave(filename='./figures/figure_flp_all_p_median.pdf',width=10,height=7) #path=pathname
```

### Distributions of mean RT

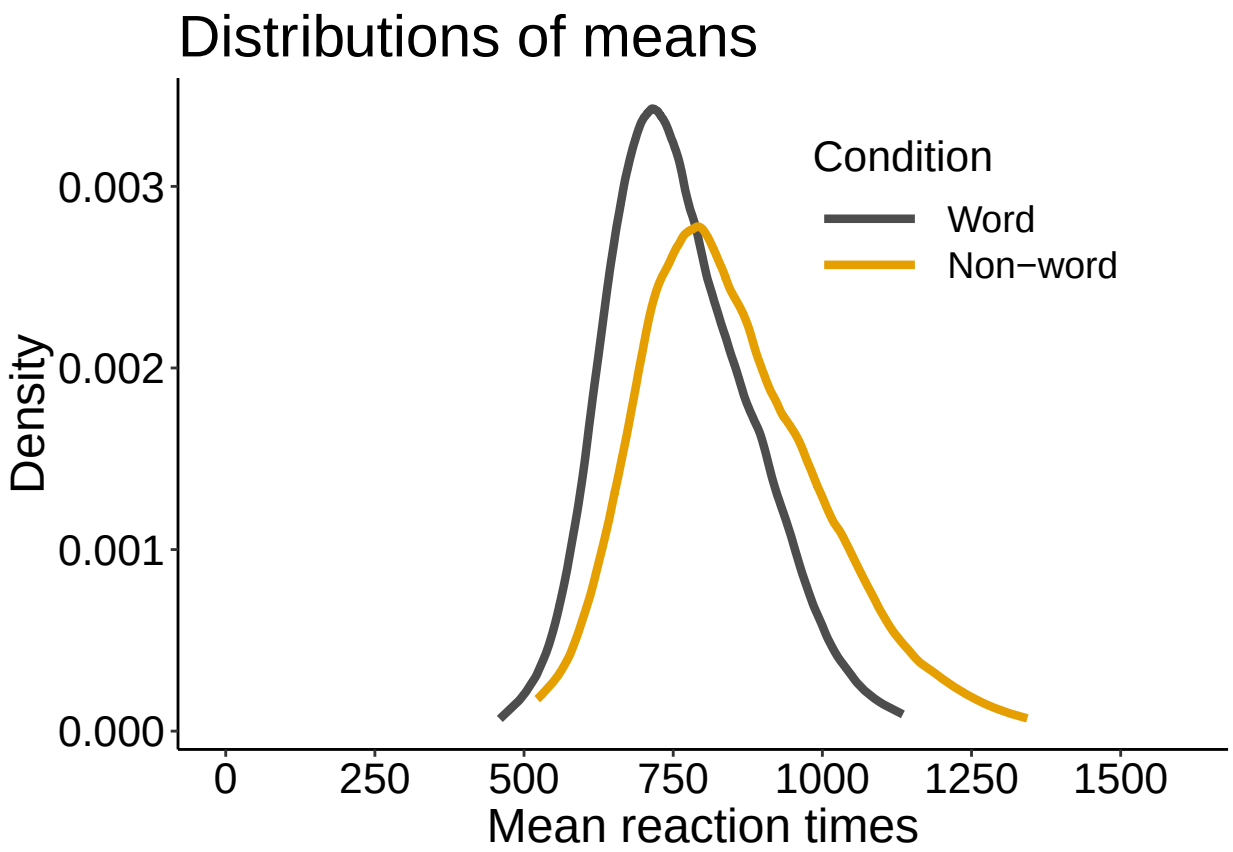
For words and non-words, across participants, the distributions of mean RT are also positively skewed.

Skewness: Word = 0.4290669 Non-Word = 0.5660932

```
# make KDE
flp.w <- sort(meanres[,1])
flp.nw <- sort(meanres[,2])
a.flp.w <- akerd(flp.w, pyhat = TRUE, plotit = FALSE)
a.flp.nw <- akerd(flp.nw, pyhat = TRUE, plotit = FALSE)

# create data frame
df <- tibble(`x`=c(flp.w,flp.nw),
             `y`=c(a.flp.w,a.flp.nw),
             `Condition`=c(rep.int("Word",length(flp.w)),
                           rep.int("Non-word",length(flp.nw))))
# make plot
df$Condition <- as.character(df$Condition)
df$Condition <- factor(df$Condition, levels=unique(df$Condition))

# make plot
p <- ggplot(df, aes(x,y, group=Condition)) + theme_classic() +
  geom_line(aes(colour=Condition), size = 1.5) + # linetype=Condition,
  # scale_size_manual(values=c(1,0.5)) +
  # scale_linetype_manual(values=c("solid","solid")) +
  scale_color_manual(values=c("grey30", "#E69F00")) + #, "#56B4E9","black")) + grey #999999
  scale_x_continuous(limits=c(0,1600), breaks=seq(0,1600,250), minor_breaks = waiver()) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = c(0.75,0.8),
        legend.title = element_text(size=16),
        legend.text = element_text(size = 14),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Mean reaction times", y = "Density") +
  ggtitle("Distributions of means")
p
```




```
p.allm <- p
# save figure
# ggsave(filename='./figures/figure_flp_all_p_mean.pdf',width=10,height=7) #path=pathname
```

### Distributions of pairwise differences between conditions

The distribution of mean and median differences are also positively skewed.

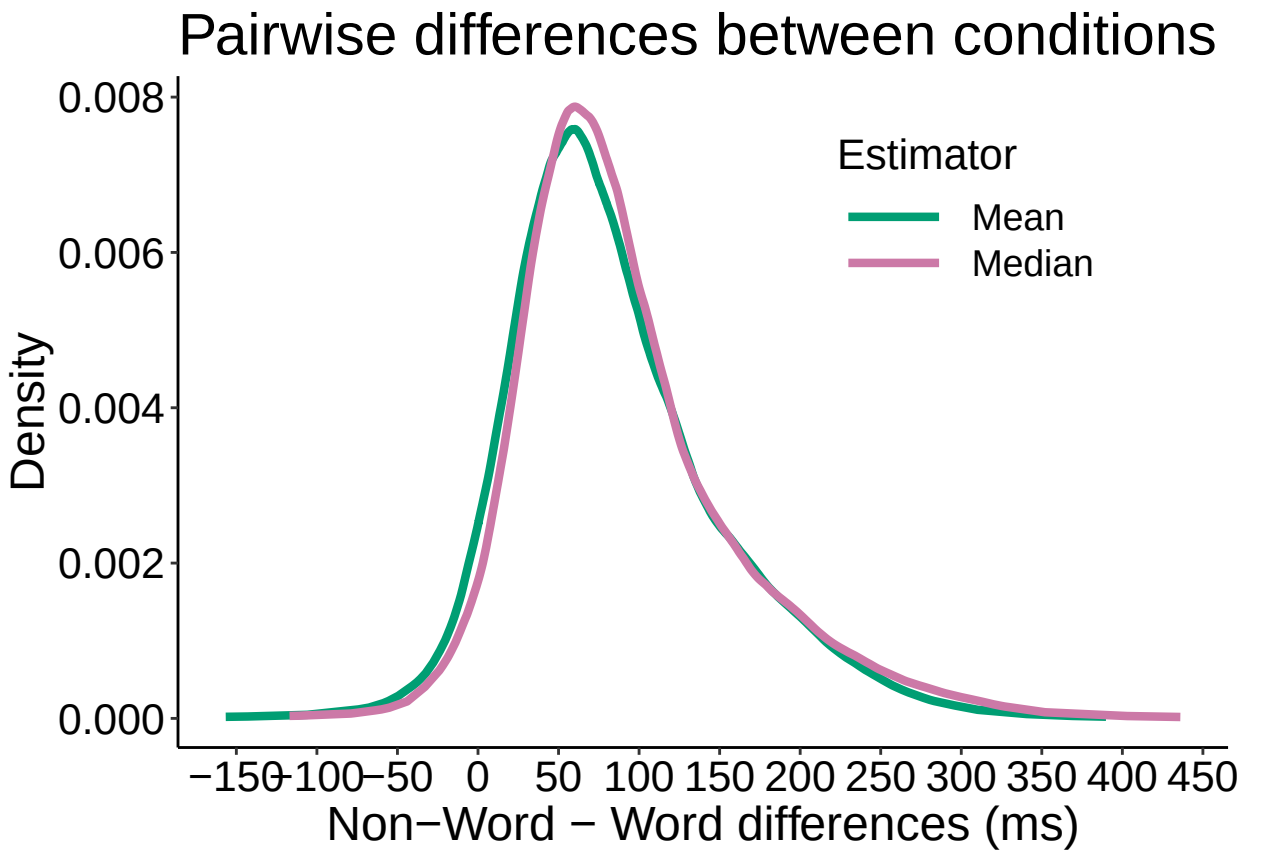
Skewness: Mean = 0.7041511 Median = 1.0082261

```
# make KDE
diff.m <- sort(meanres[,2] - meanres[,1])
a.diff.m <- akerd(diff.m, pyhat = TRUE, plotit = FALSE)
diff.md <- sort(medres[,2] - medres[,1])
a.diff.md <- akerd(diff.md, pyhat = TRUE, plotit = FALSE)

# create data frame
df <- tibble(`x`=c(diff.m,diff.md),
             `y`=c(a.diff.m,a.diff.md),
             `Estimator`=c(rep.int("Mean",length(flp.w)),
                           rep.int("Median",length(flp.nw))))

# make plot
p <- ggplot(df, aes(x,y)) + theme_classic() +
    geom_line(aes(colour=Estimator), size = 1.5) +
    scale_color_manual(values=c("#009E73", "#CC79A7")) +
  scale_x_continuous(breaks=seq(-200,500,50)) +
```

```
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = c(0.75,0.8),
        legend.title = element_text(size=16),
        legend.text = element_text(size = 14),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Non-Word - Word differences (ms)", y = "Density") +
  ggtitle("Pairwise differences between conditions")
p
```




```
p.diff <- p
# save figure
# ggsave(filename='./figures/figure_flp_all_p_diff.pdf',width=10,height=7) #path=pathname
```

The two distributions seem to have similar spread:

IQR of mean RT = 78
IQR of median RT = 79

MAD of mean RT = 57
MAD of median RT = 54

VAR of mean RT = 4507
VAR of median RT = 4785

**Proportions of participants with positive differences**

```
round(mean(diff.m>0), digits = 3)
```

```
## [1] 0.948
```

```
round(mean(diff.md>0), digits = 3)
```

```
## [1] 0.964
```

### Summary figure

```
# combine panels into one figure
cowplot::plot_grid(p.allmd, p.allm, p.diff,
                           labels = c("A", "B", "C"),
                           ncol = 1,
                           nrow = 3,
                           rel_widths = c(1, 1, 1),
                           label_size = 20,
                           hjust = -1.5,
                           scale=.95,
                           align = "h")
# save figure
ggsave(filename='./figures/figure_flp_dist.pdf',width=10,height=15)
```

## Percent correct data

Percent correct data are negatively skewed because of a ceiling effect, with most participants performing above 90% correct.

```
# get accuracy data
flp.acc <- tapply(flp$acc, list(flp$participant, flp$condition), mean)
summary(flp.acc)
```

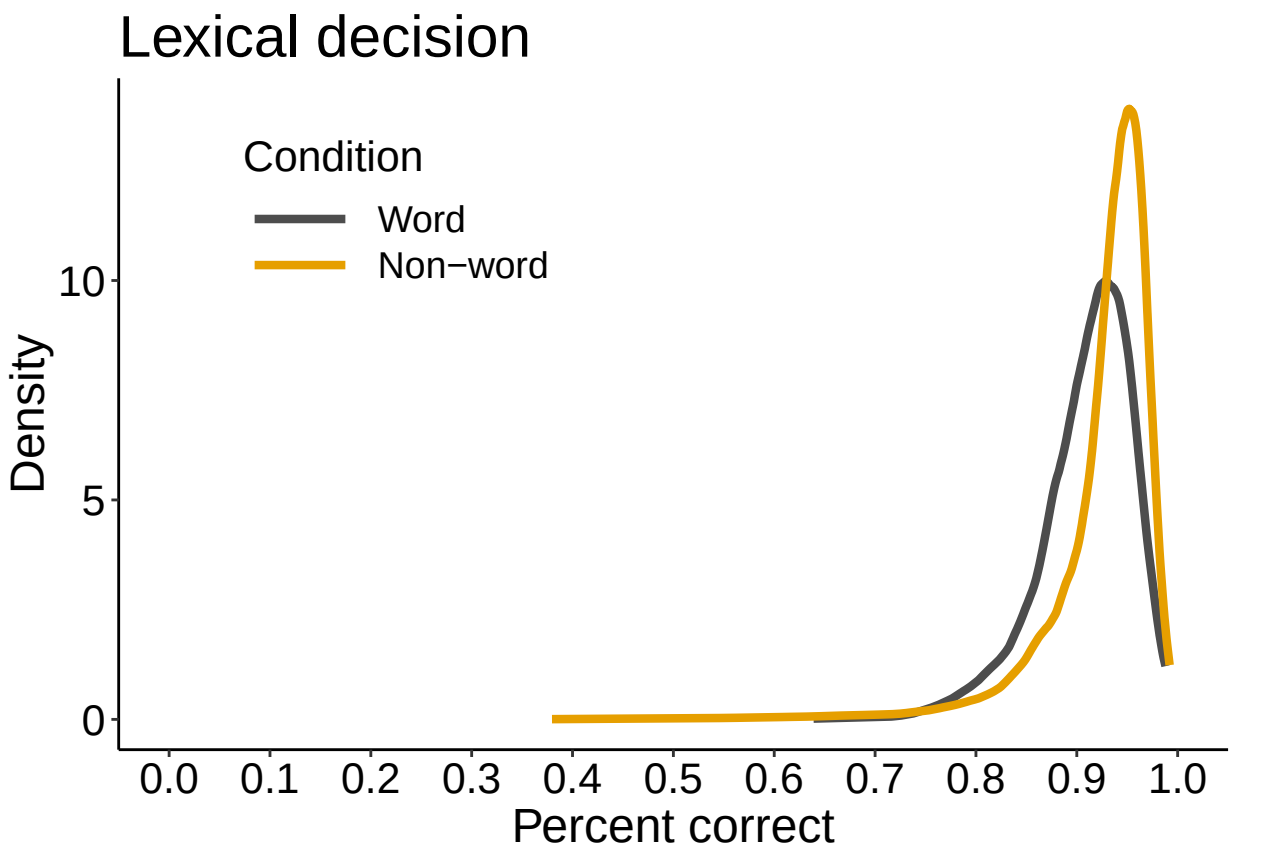
```
##       word          non-word
##  Min.   :0.6390   Min.   :0.3796
##  1st Qu.:0.8849   1st Qu.:0.9116
##  Median :0.9179   Median :0.9391
##  Mean   :0.9088   Mean   :0.9245
##  3rd Qu.:0.9429   3rd Qu.:0.9580
##  Max.   :0.9880   Max.   :0.9920
```

```
# make KDE
flp.w <- sort(flp.acc[,1])
flp.nw <- sort(flp.acc[,2])
a.flp.w <- akerd(flp.w, pyhat = TRUE, plotit = FALSE)
a.flp.nw <- akerd(flp.nw, pyhat = TRUE, plotit = FALSE)

# create data frame
df <- tibble(`x`=c(flp.w,flp.nw),
             `y`=c(a.flp.w,a.flp.nw),
             `Condition`=c(rep.int("Word",length(flp.w)),
                           rep.int("Non-word",length(flp.nw))))
```

```r
# make plot
df$Condition <- as.character(df$Condition)
df$Condition <- factor(df$Condition, levels=unique(df$Condition))

# make plot
p <- ggplot(df, aes(x,y, group=Condition)) + theme_classic() +
  geom_line(aes(colour=Condition), size = 1.5) + # linetype=Condition,
  # scale_size_manual(values=c(1,0.5)) +
  # scale_linetype_manual(values=c("solid","solid")) +
  scale_color_manual(values=c("grey30", "#E69F00")) + #, "#56B4E9","black")) + grey #999999
  scale_x_continuous(limits=c(0,1), breaks=seq(0,1,0.1), minor_breaks = waiver()) +
  theme(plot.title = element_text(size=22),
        axis.title.x = element_text(size = 18),
        axis.text = element_text(size = 16, colour = "black"),
        axis.title.y = element_text(size = 18),
        legend.key.width = unit(1.5,"cm"),
        legend.position = c(0.25,0.8),
        legend.title = element_text(size=16),
        legend.text = element_text(size = 14),
        strip.text.y = element_text(size = 18, face = "bold", angle = 0)) +
        # legend.position = c(0.25,0.9)) +
  labs(x = "Percent correct", y = "Density") +
  ggtitle("Lexical decision")
p
```




```r
# save figure
# ggsave(filename='./figures/figure_flp_all_p_acc.pdf',width=10,height=7) #path=pathname
```