

Sentiment Analysis using Twitter Data - georgefloyd

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```
packages <- c("readxl","tidytext","plyr","dplyr","tidyr","ggplot2","scales",
              "purrr","textdata","wordcloud","reshape2","stringr","igraph",
              "ggraph","widyrr","grid","arules","tm","topicmodels")
for(i in packages){
  if(!require(i,character.only = T, quietly = T)){
    install.packages(i)
  }
  library(i, character.only = T, quietly = T)
}

rm(list=ls())

set.seed(2020)
```

Loading Data

```
library(readr)
```

```
##
## Attaching package: 'readr'
```

```
## The following object is masked from 'package:scales':
##
##   col_factor
```

```
tweets1 <- read.csv("week2.csv", header = TRUE)
tweets2 <- read.csv("week3.csv", header = TRUE)
tweets3 <- read.csv("week5.csv", header = TRUE)
tweets4 <- read.csv("week6.csv", header = TRUE)
tweets5 <- read.csv("week11.csv", header = TRUE)
tweets6 <- read.csv("week12.csv", header = TRUE)
```

Data Wrangling

Data Clean Using Customized Functions

```
dfList<-list(tweets1,tweets2,tweets3,tweets4,tweets5,tweets6)
result_list <- lapply(dfList, function(x) {
  cat("Original column names:\n")
  print(colnames(x))
  english_tweets <- subset(x, x$`19: Language` == "English")

  cat("\nColumn names after subset:\n")
  print(colnames(english_tweets))
  if (nrow(english_tweets) > 0) {
    english_tweets$`tweet` <- english_tweets$`X2..Tweet`
    english_tweets <- english_tweets[, c("tweet")]
    cat("\nColumn names after adding 'tweet':\n")
    print(colnames(english_tweets))
    english_tweets$`tweetnumber` <- 1:nrow(english_tweets)

    cat("\nStructure of the cleaned dataframe:\n")
    print(str(english_tweets))

    return(english_tweets)
  } else {
    cat("\nNo English tweets remaining.\n")
    return(data.frame())
  }
})
```

```
## Original column names:
## [1] "X1..Date.Time"      "X2..Tweet"
## [3] "X3..Hashtags"       "X4..Type"
## [5] "X5..Reply.to"       "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"       "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"      "X18..Likes"
```

```

## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## Column names after subset:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## No English tweets remaining.
## Original column names:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## Column names after subset:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## No English tweets remaining.
## Original column names:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"

```

```

## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## Column names after subset:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## No English tweets remaining.
## Original column names:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## Column names after subset:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## No English tweets remaining.
## Original column names:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"

```

```

## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## Column names after subset:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## No English tweets remaining.
## Original column names:
## [1] "X1..Date.Time"          "X2..Tweet"
## [3] "X3..Hashtags"           "X4..Type"
## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## Column names after subset:
## [1] "X1..Date.Time"          "X2..Tweet"
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## [5] "X5..Reply.to"           "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone"  "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"           "X14..Tweets"
## [15] "X15..Profile.verified"  "X16..Profile.created"
## [17] "X17..Retweets"          "X18..Likes"
## [19] "X19..Language"          "X20..Source"
## [21] "X21..Tweet.coordinates"
##
## No English tweets remaining.

```

The function gives us 6 data sets with only 2 variables: tweet and tweetnumber and we want to keep tweetnumber to track down every word from the tweet text later.

Stop Words

```

data(stop_words)
custom_stop_words <- bind_rows(

```

```
tibble(word = c("t.co", "csun", "blm", "rt", "https",
               "BLM", "blacklivesmatter", "black",
               "georgefloyd", "2", "#blm", "#blacklivesmatter",
               "#georgefloyd", "august"),
       lexicon = c("custom")), stop_words)
```

We want to have some stop words for our analysis so that those wouldn't appear in our frequency table and interfere our judgment.

Extract Tokens

```
remove_reg <- "&|<|>|"
dfList2 <- list(tweets1, tweets2, tweets3, tweets4, tweets5, tweets6)
result_list2 <- lapply(dfList2, function(x) {
  print(colnames(x))

  x %>%
    mutate(tweet = str_remove_all(`X2..Tweet`, remove_reg)) %>%
    unnest_tokens(output = "word", input = "tweet") %>%
    filter(!word %in% custom_stop_words$word,
           !word %in% str_remove_all(custom_stop_words$word, "'"),
           str_detect(word, "[a-z]"))
})
```

```
## [1] "X1..Date.Time"      "X2..Tweet"
## [3] "X3..Hashtags"       "X4..Type"
## [5] "X5..Reply.to"       "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"        "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"       "X18..Likes"
## [19] "X19..Language"       "X20..Source"
## [21] "X21..Tweet.coordinates"

## [1] "X1..Date.Time"      "X2..Tweet"
## [3] "X3..Hashtags"       "X4..Type"
## [5] "X5..Reply.to"       "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"        "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"       "X18..Likes"
## [19] "X19..Language"       "X20..Source"
## [21] "X21..Tweet.coordinates"

## [1] "X1..Date.Time"      "X2..Tweet"
## [3] "X3..Hashtags"       "X4..Type"
## [5] "X5..Reply.to"       "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
```

```
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"              "X14..Tweets"
## [15] "X15..Profile.verified"     "X16..Profile.created"
## [17] "X17..Retweets"            "X18..Likes"
## [19] "X19..Language"            "X20..Source"
## [21] "X21..Tweet.coordinates"
## [1] "X1..Date.Time"            "X2..Tweet"
## [3] "X3..Hashtags"             "X4..Type"
## [5] "X5..Reply.to"             "X6..Author"
## [7] "X7..Author.s.real.name"    "X8..Author.s.location"
## [9] "X9..Author.s.timezone"     "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"              "X14..Tweets"
## [15] "X15..Profile.verified"     "X16..Profile.created"
## [17] "X17..Retweets"            "X18..Likes"
## [19] "X19..Language"            "X20..Source"
## [21] "X21..Tweet.coordinates"
## [1] "X1..Date.Time"            "X2..Tweet"
## [3] "X3..Hashtags"             "X4..Type"
## [5] "X5..Reply.to"             "X6..Author"
## [7] "X7..Author.s.real.name"    "X8..Author.s.location"
## [9] "X9..Author.s.timezone"     "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"              "X14..Tweets"
## [15] "X15..Profile.verified"     "X16..Profile.created"
## [17] "X17..Retweets"            "X18..Likes"
## [19] "X19..Language"            "X20..Source"
## [21] "X21..Tweet.coordinates"
## [1] "X1..Date.Time"            "X2..Tweet"
## [3] "X3..Hashtags"             "X4..Type"
## [5] "X5..Reply.to"             "X6..Author"
## [7] "X7..Author.s.real.name"    "X8..Author.s.location"
## [9] "X9..Author.s.timezone"     "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"              "X14..Tweets"
## [15] "X15..Profile.verified"     "X16..Profile.created"
## [17] "X17..Retweets"            "X18..Likes"
## [19] "X19..Language"            "X20..Source"
## [21] "X21..Tweet.coordinates"
```

```
tidy1 <- as.data.frame(result_list2[[1]])
tidy2 <- as.data.frame(result_list2[[2]])
tidy3 <- as.data.frame(result_list2[[3]])
tidy4 <- as.data.frame(result_list2[[4]])
tidy5 <- as.data.frame(result_list2[[5]])
tidy6 <- as.data.frame(result_list2[[6]])
```

Each single word in each tweet is considered as a token. By doing so, we can start to count frequency of each word or even each pair of words.

Data Analysis and Visualization

Visualize the Most Common Words

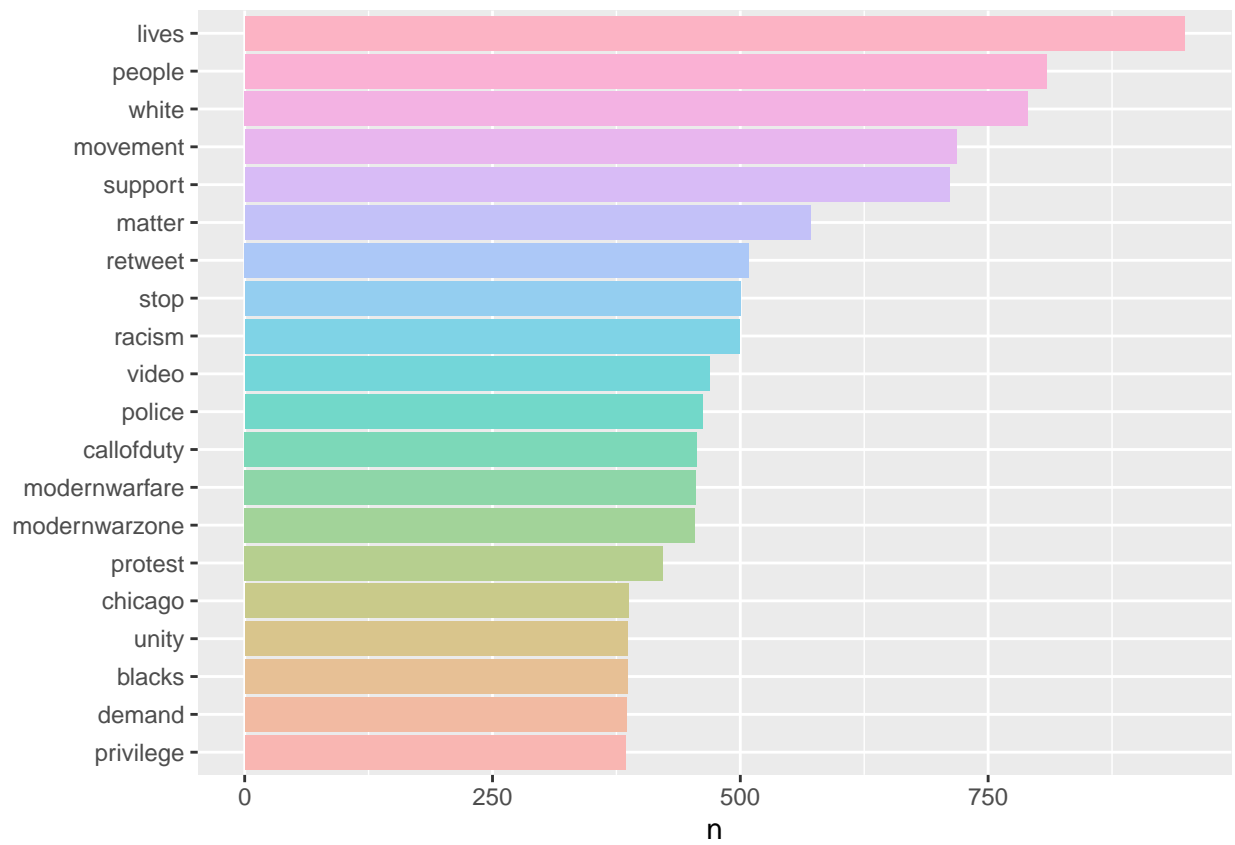
```
# Count the Frequency for Each Word
tidy_week11 <- tidy1 %>% dplyr::count(word, sort = TRUE)
tidy_week12 <- tidy2 %>% dplyr::count(word, sort = TRUE)
tidy_week21 <- tidy3 %>% dplyr::count(word, sort = TRUE)
tidy_week22 <- tidy4 %>% dplyr::count(word, sort = TRUE)
tidy_week31 <- tidy5 %>% dplyr::count(word, sort = TRUE)
tidy_week32 <- tidy6 %>% dplyr::count(word, sort = TRUE)

# Remove all non-english tokens
tidy1_english <- tidy_week11[which(!grepl("[^\x01-\x7F]", tidy_week11$word)),]
tidy2_english <- tidy_week12[which(!grepl("[^\x01-\x7F]", tidy_week12$word)),]
tidy3_english <- tidy_week21[which(!grepl("[^\x01-\x7F]", tidy_week21$word)),]
tidy4_english <- tidy_week22[which(!grepl("[^\x01-\x7F]", tidy_week22$word)),]
tidy5_english <- tidy_week31[which(!grepl("[^\x01-\x7F]", tidy_week31$word)),]
tidy6_english <- tidy_week32[which(!grepl("[^\x01-\x7F]", tidy_week32$word)),]

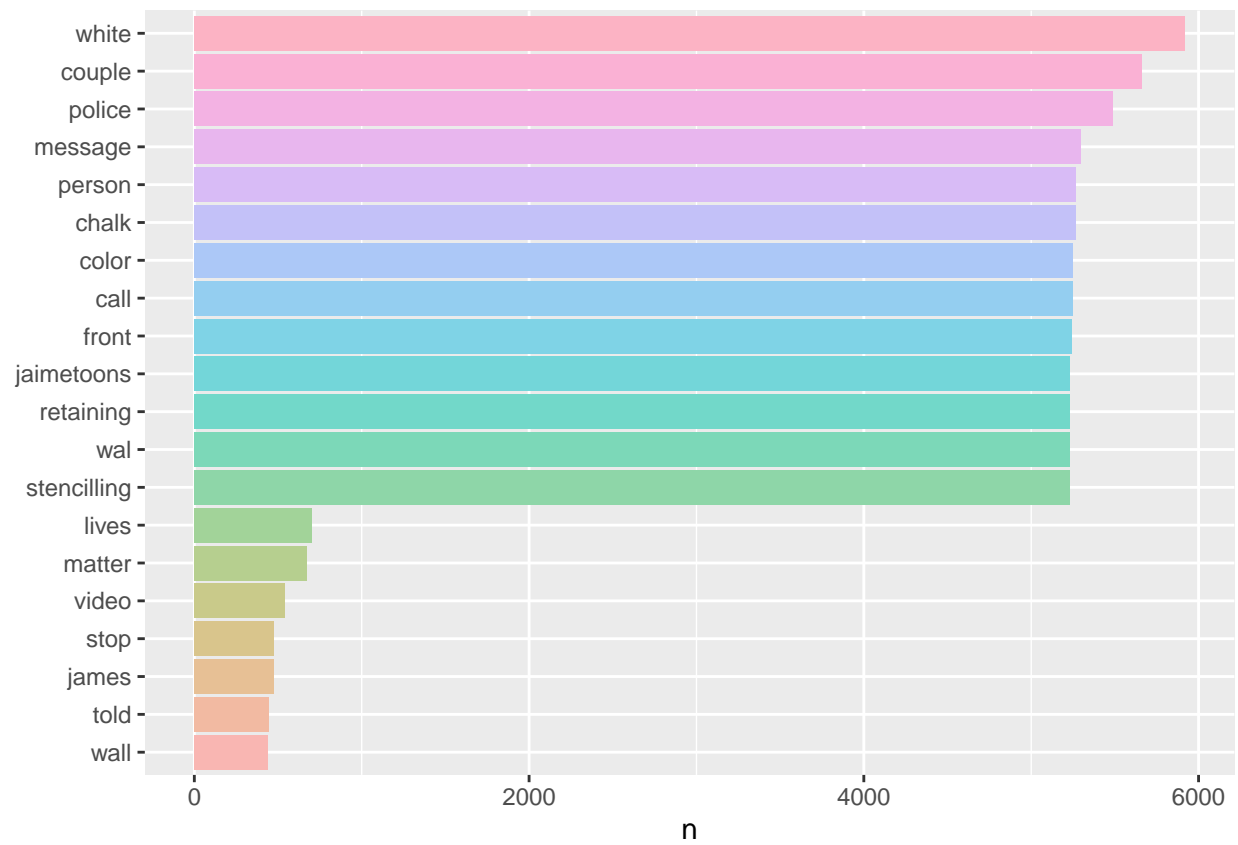
dfList3<-list(tidy1_english,tidy2_english,tidy3_english,tidy4_english,tidy5_english,tidy6_english)

result_list3 <-
  llply(dfList3, function(x) {
    plot <- x %>%
      dplyr::top_n(20) %>%
      dplyr::mutate(word = reorder(word, n)) %>%
      ggplot(aes(word, n, fill=word)) +
      geom_bar(stat="identity")+
      scale_fill_hue(c=45, l=80)+
      xlab(NULL) +
      coord_flip()+
      theme(legend.position="none")
    return(plot)}

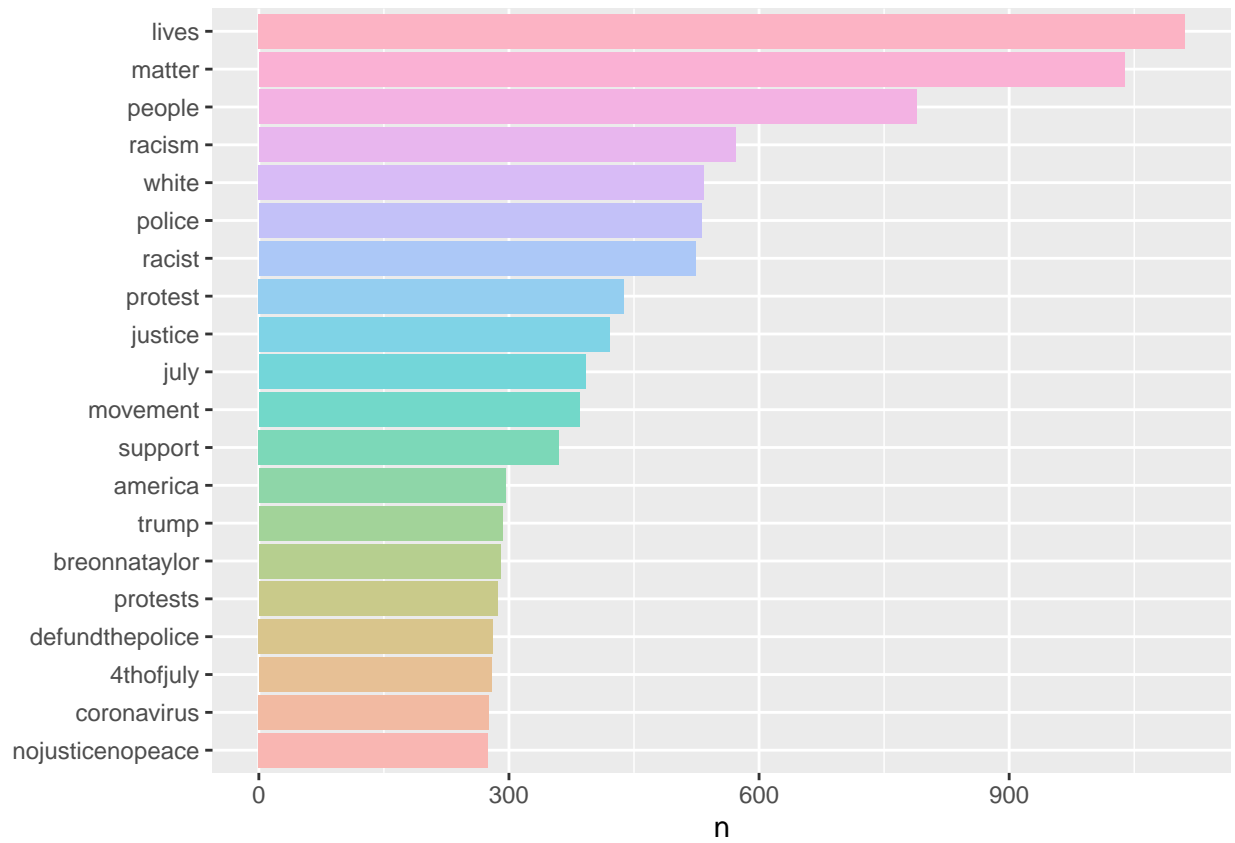
result_list3[[1]]
```

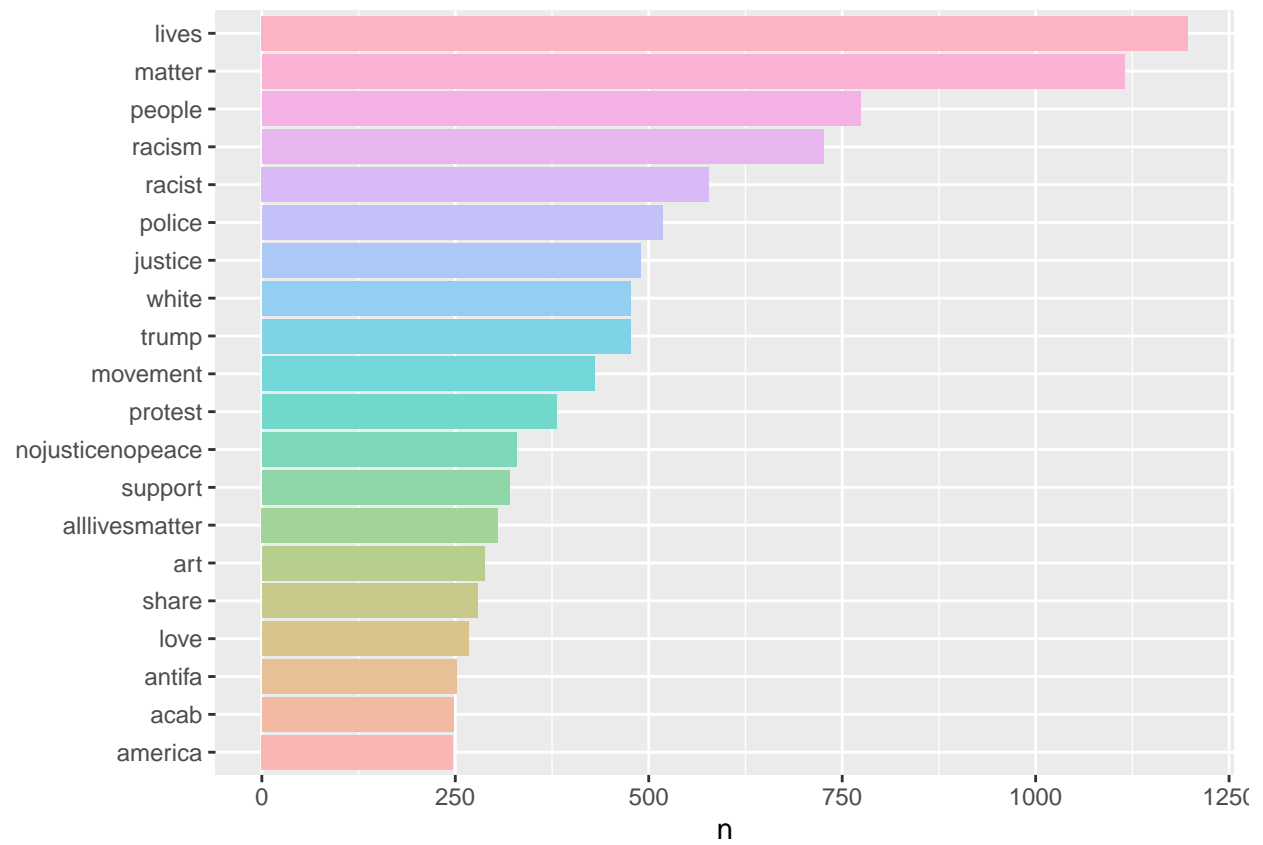
```
result_list3[[2]]
```



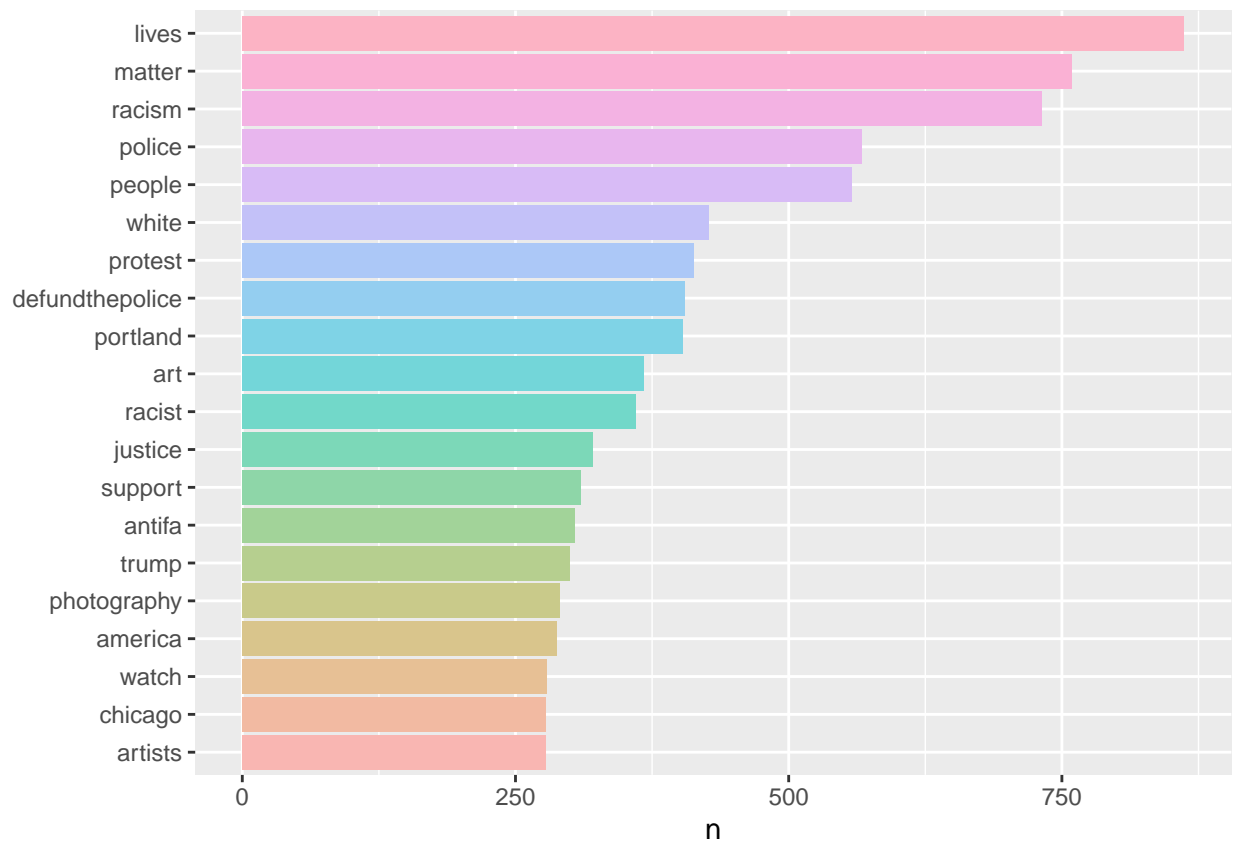
```
result_list3[[3]]
```



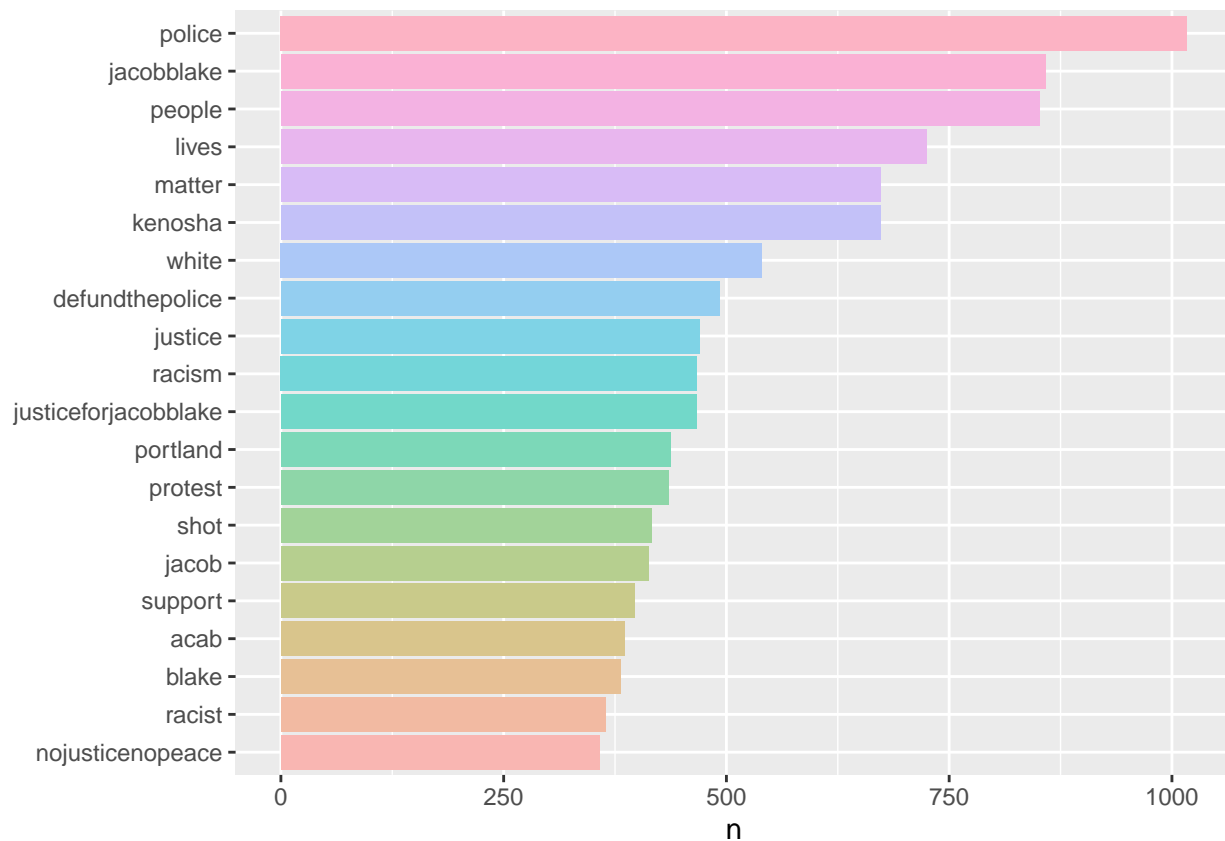
```
result_list3[[4]]
```



```
result_list3[[5]]
```



```
result_list3[[6]]
```



The most common words didn't change a lot over the 3 months. In order to dig more information, we can try to identify positive words and negative words from them.

```
dfList4<-list(tidy1,tidy2,tidy3,tidy4,tidy5,tidy6)
#visualize using Word clouds
result_list_wordclouds <-
  llply(dfList4, function(x) {
    plot <- x %>%
      inner_join(get_sentiments("bing")) %>%
      count(word, sentiment, sort = TRUE) %>%
      acast(word ~ sentiment, value.var = "n", fill = 0) %>%
      comparison.cloud(colors = c("gray20", "gray80"),max.words = 50)
    return(plot)} )
```

negative

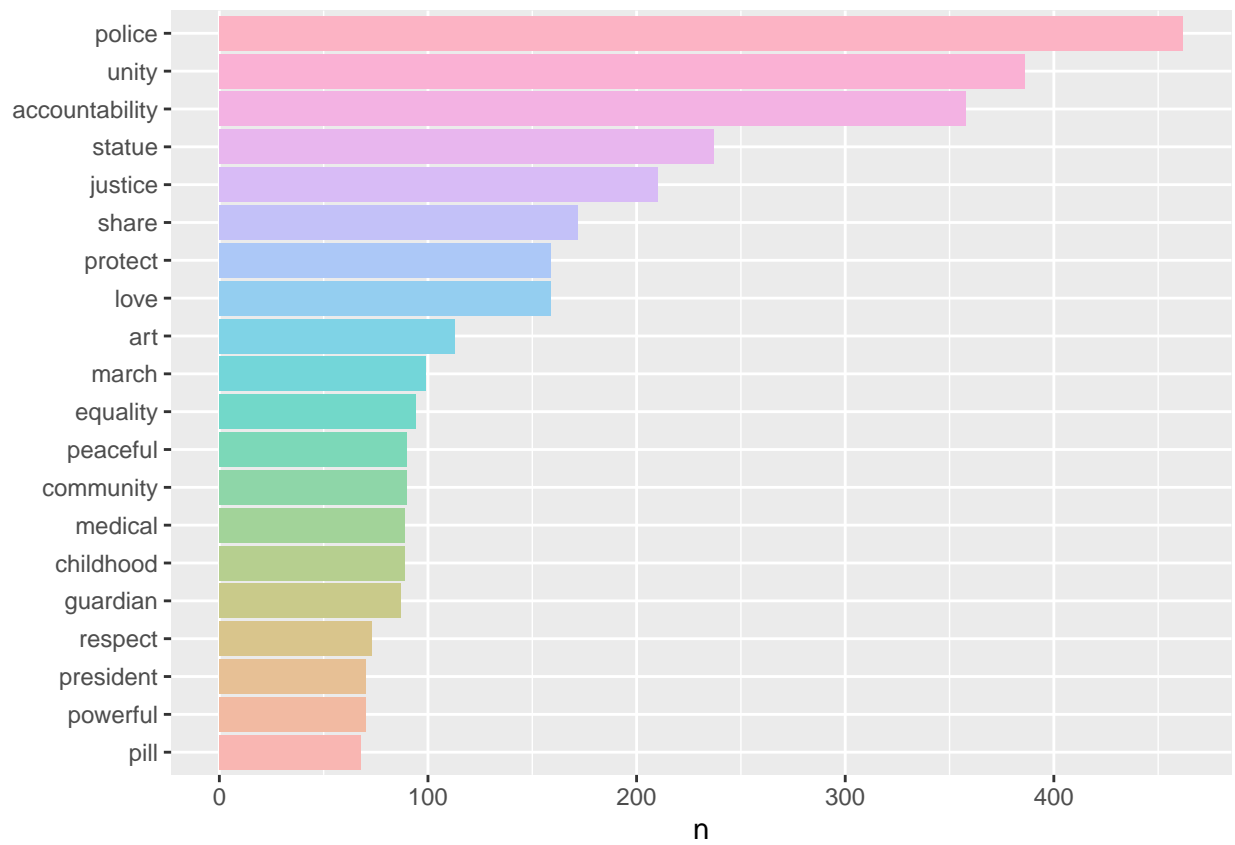


positive

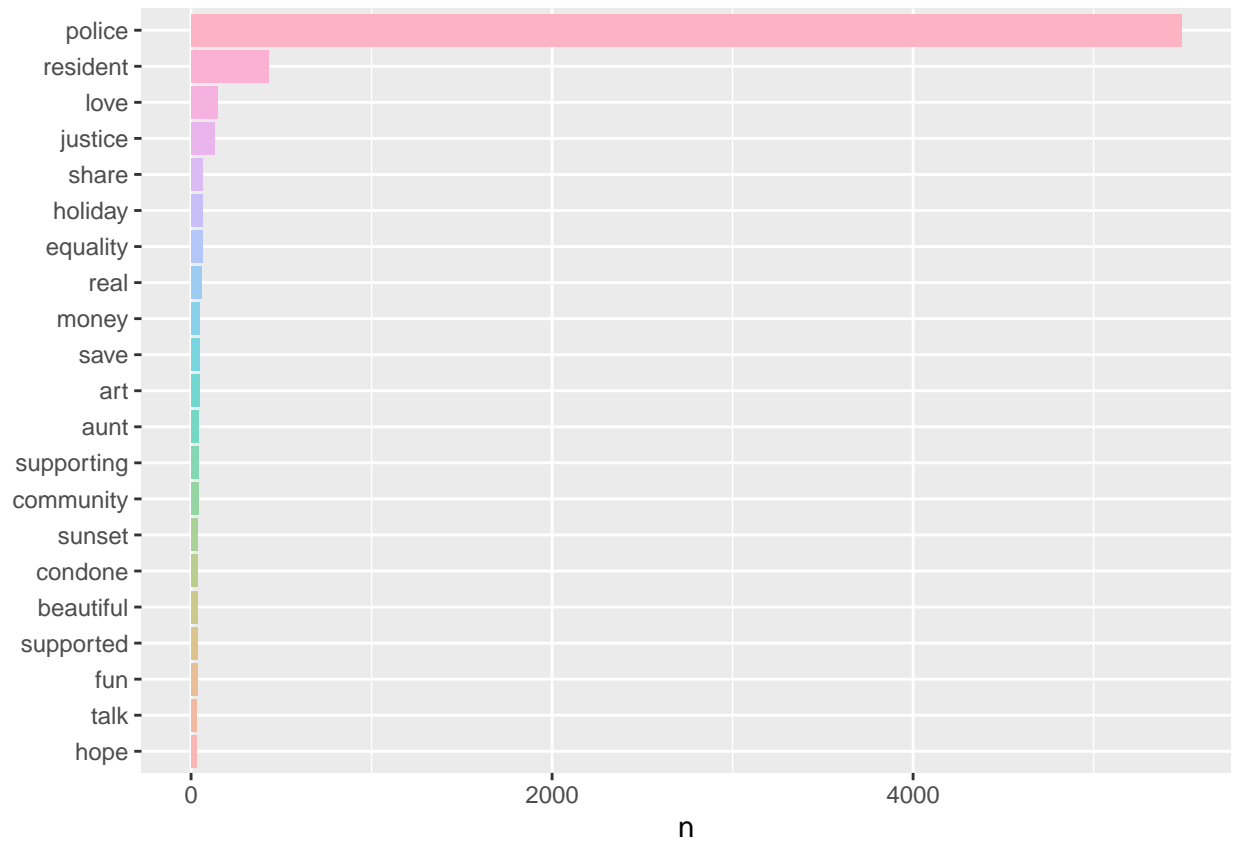
breaking wrong
protests racism
fraud hard
protest racist
support
love
trump
supporting
shit attack
slave bigotry
killed fuck
issue
hero
silent
beautiful patriot
privilege unity
free pride proud
fun supported
unreal freedom
hate
happy powerful
safe
helped
led
peaceful
solidarity

brutality protest
protests hard racist
die fuck crime
murder protesting hate racism fucking
racists shit damn
slave support death wrong
beauty safe pride killed bad killing
beautiful solidarity triumph ready
amazing supports celebrate supremacy
powerful love happy protect
respect freedom
proud silent

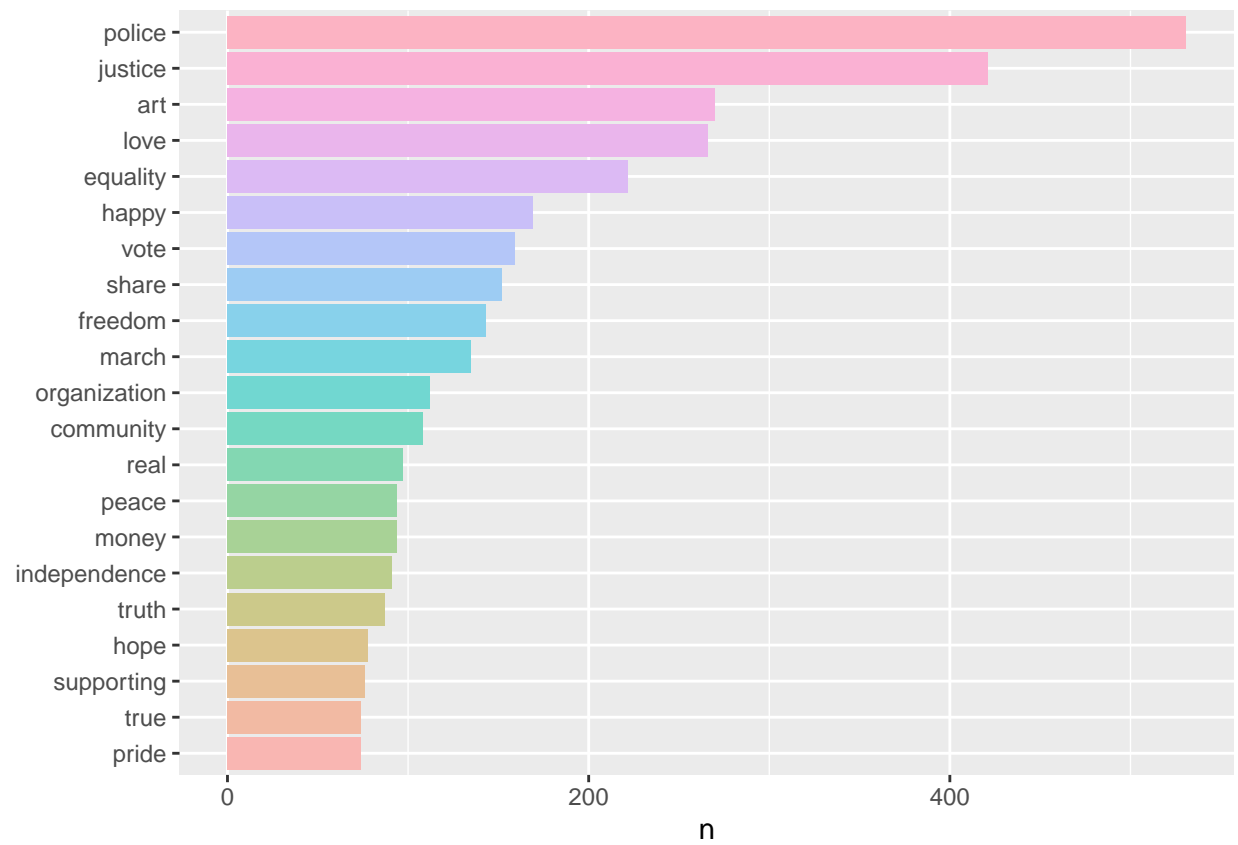
injustice
murder resistance
die death
bad racists fiction brutality
violent crime
protests racist
fucking hate
protest
amazing love
supporting free
privilege pride
supports respect
top peace
strong freedom
win
support
solidarity
peaceful
proud
beauty
worth
supremacy
illuminati
died
killed
wrong
shit
fuck slave
wow
safe
powerful



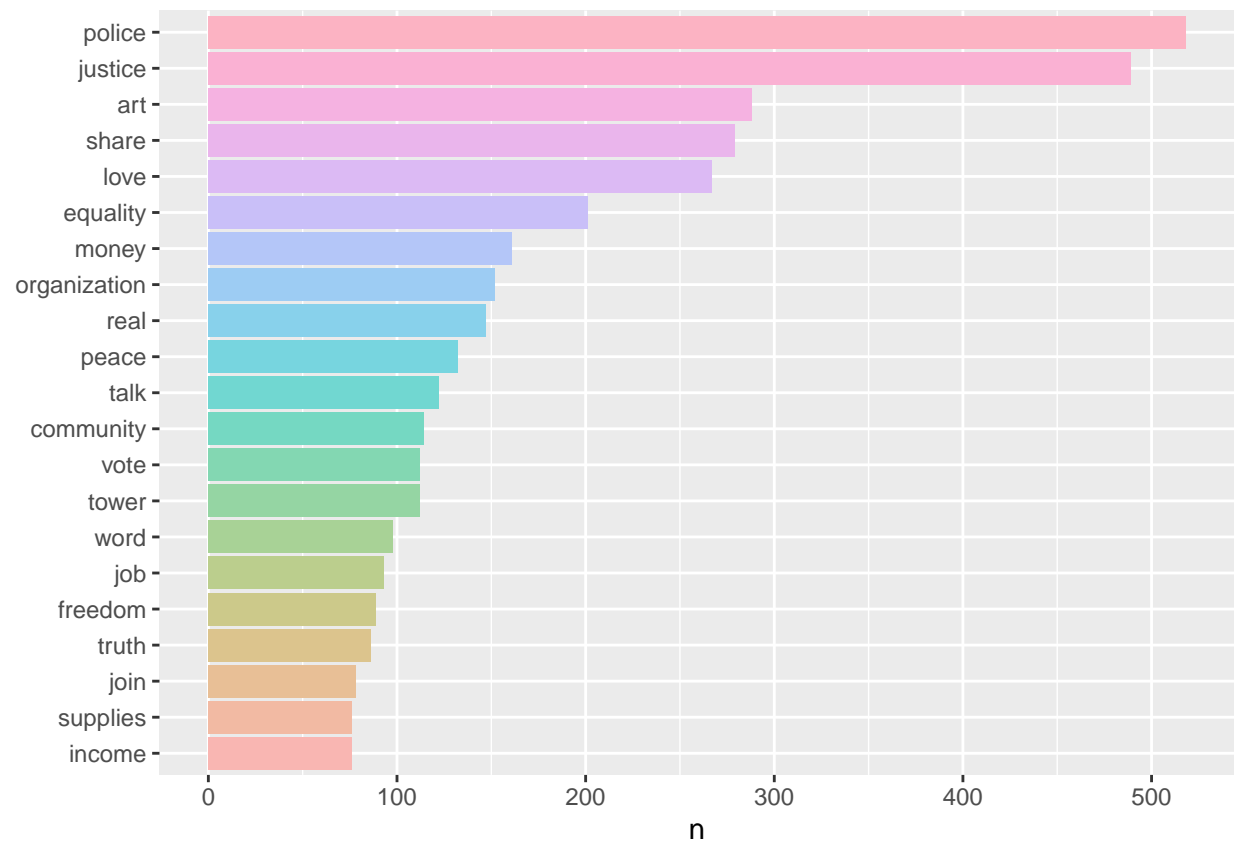
```
result_list4[[2]]
```



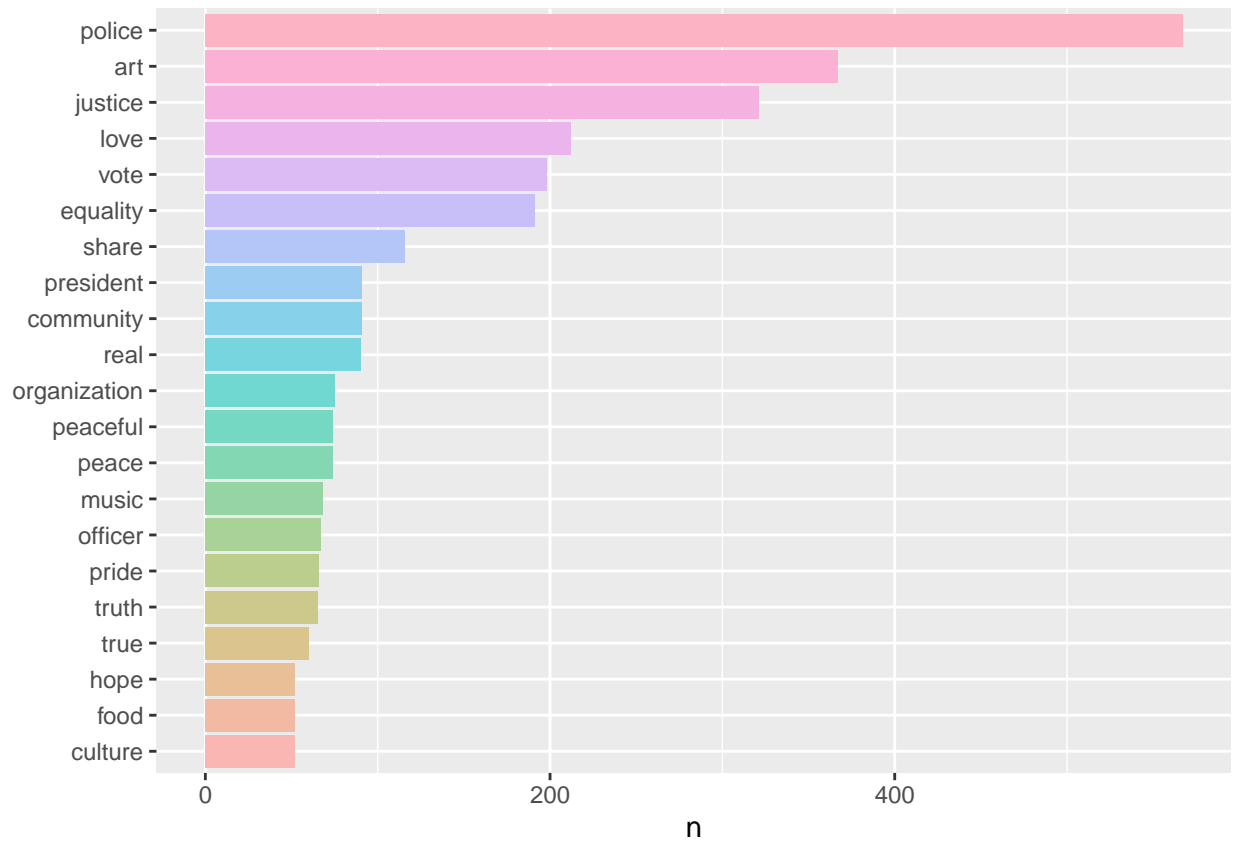
```
result_list4[[3]]
```



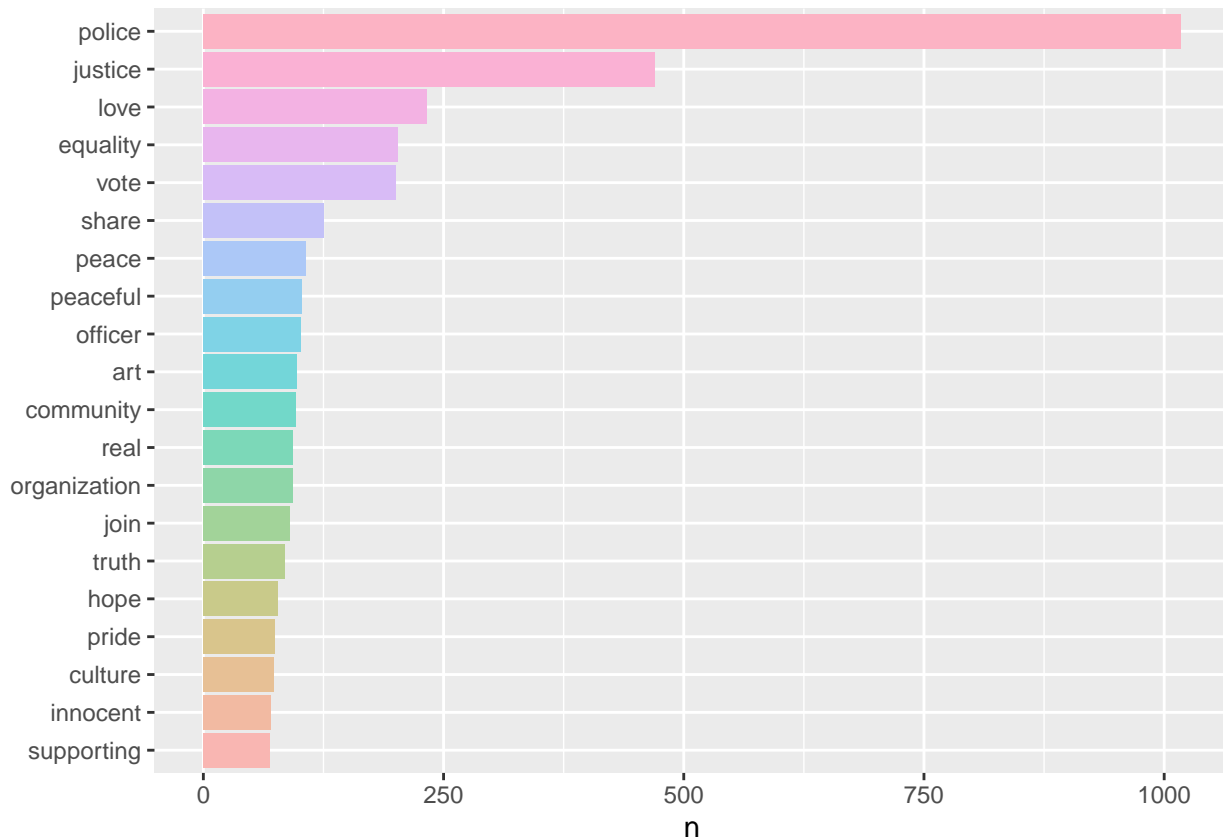
```
result_list4[[4]]
```



```
result_list4[[5]]
```

```
result_list4[[6]]
```

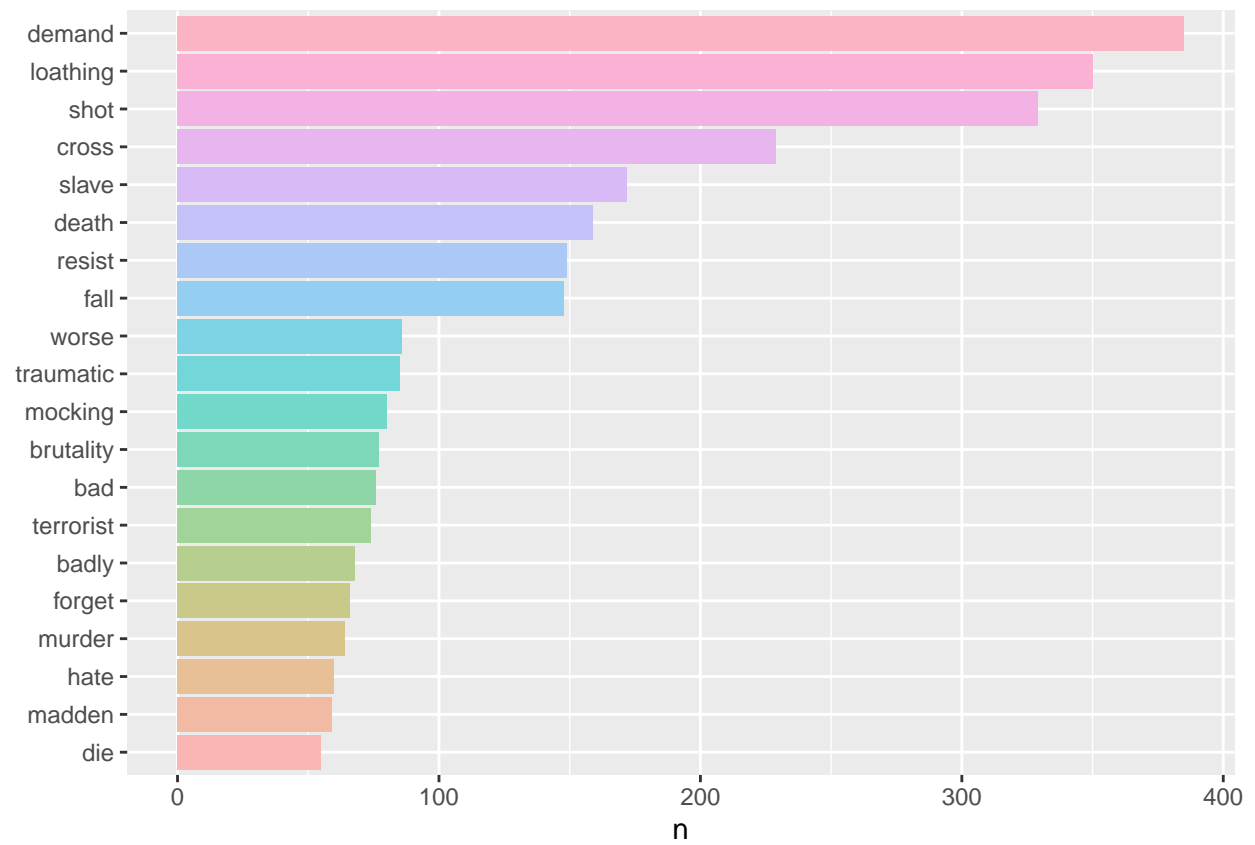


Overall trend: At first, people called on love, unity, and justice. Then they began to call on donations. Later, they tried to appeal on voting to pursue justice again. They wanted the government/legal authority to act upon this.

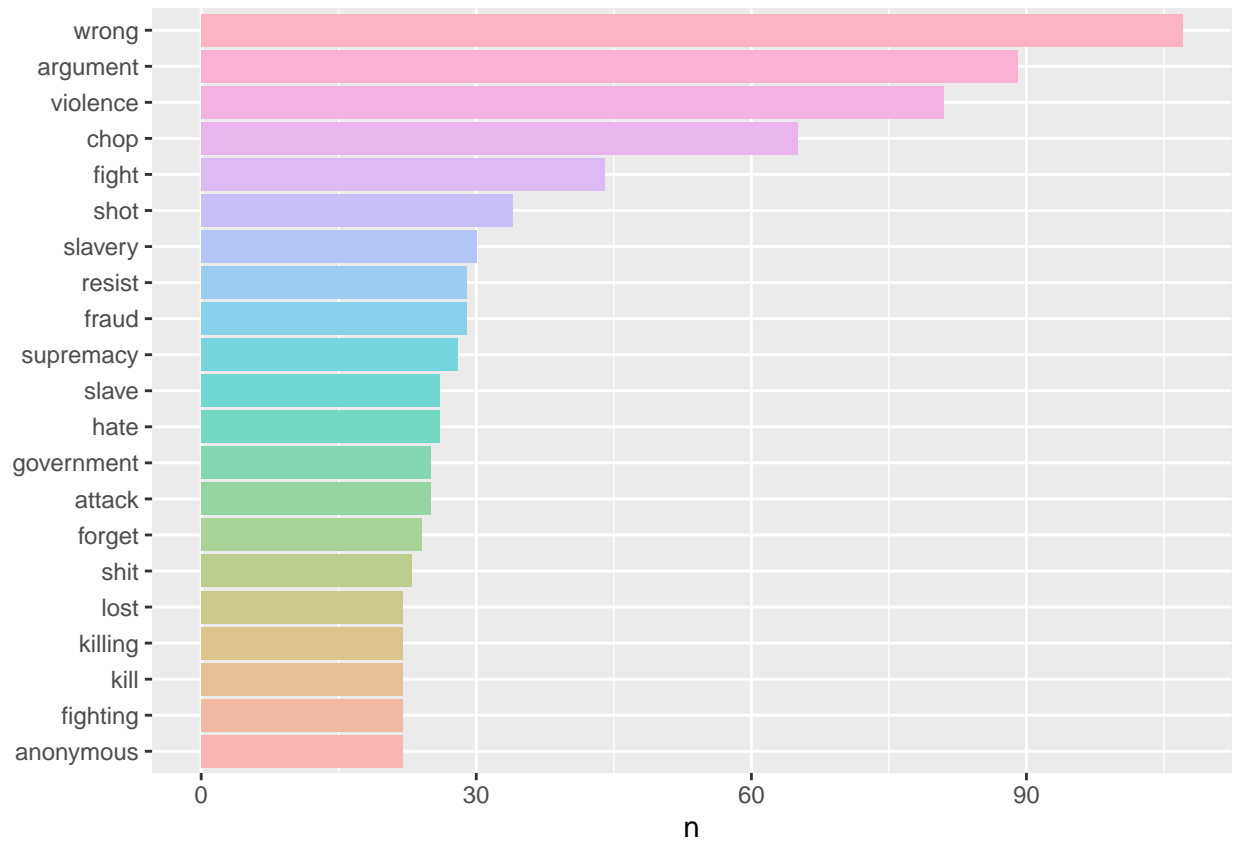
```
#Find the most common negative words using lexicon
nrc_negative <- get_sentiments("nrc") %>%
  filter(sentiment == "negative")

result_list5 <-
  llply(dfList4, function(x) {
    plot <- x %>%
      inner_join(nrc_negative) %>%
      dplyr::count(word, sort = TRUE) %>%
      dplyr::top_n(20) %>%
      dplyr::mutate(word = reorder(word, n)) %>%
      ggplot(aes(word, n, fill=word)) +
      geom_bar(stat="identity")+
      scale_fill_hue(c=45, l=80)+
      xlab(NULL) +
      coord_flip()+
      theme(legend.position="none")
    return(plot)}

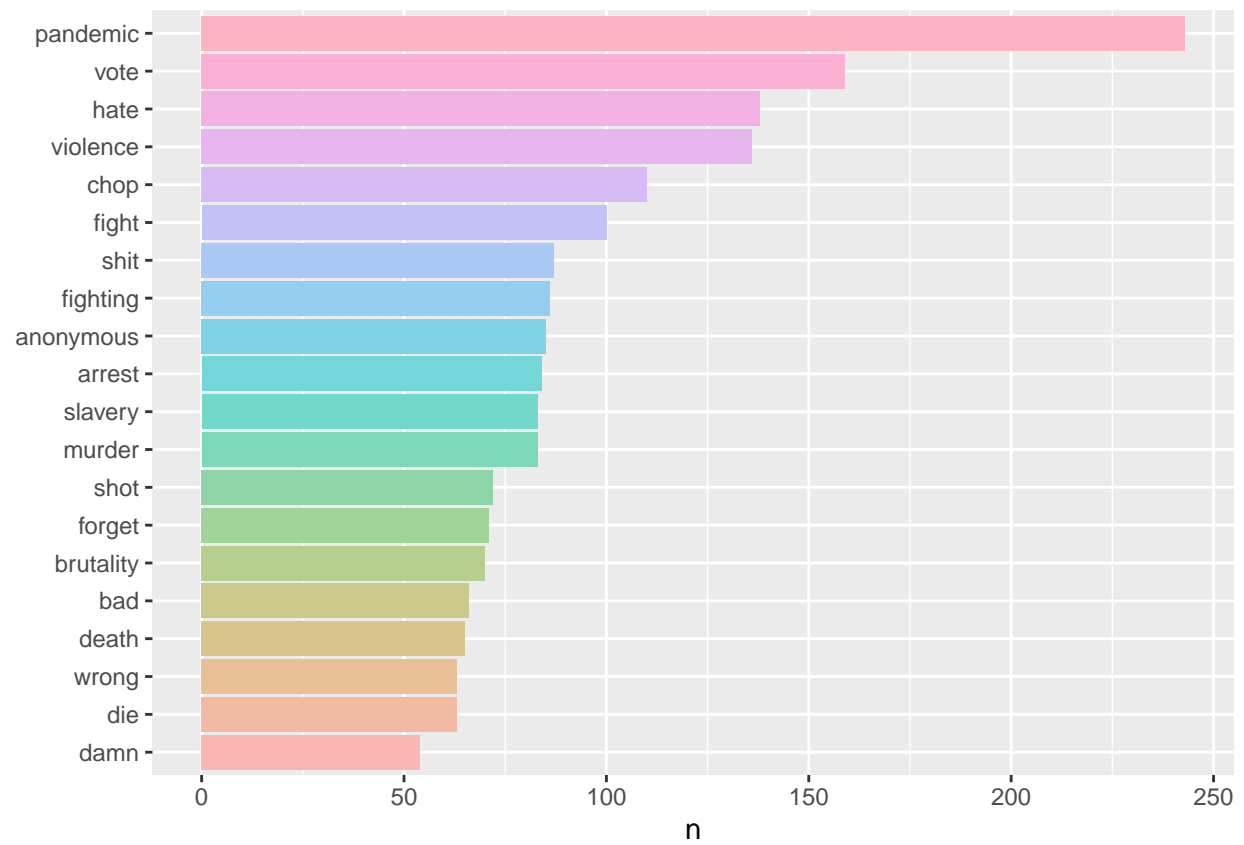
result_list5[[1]]
```



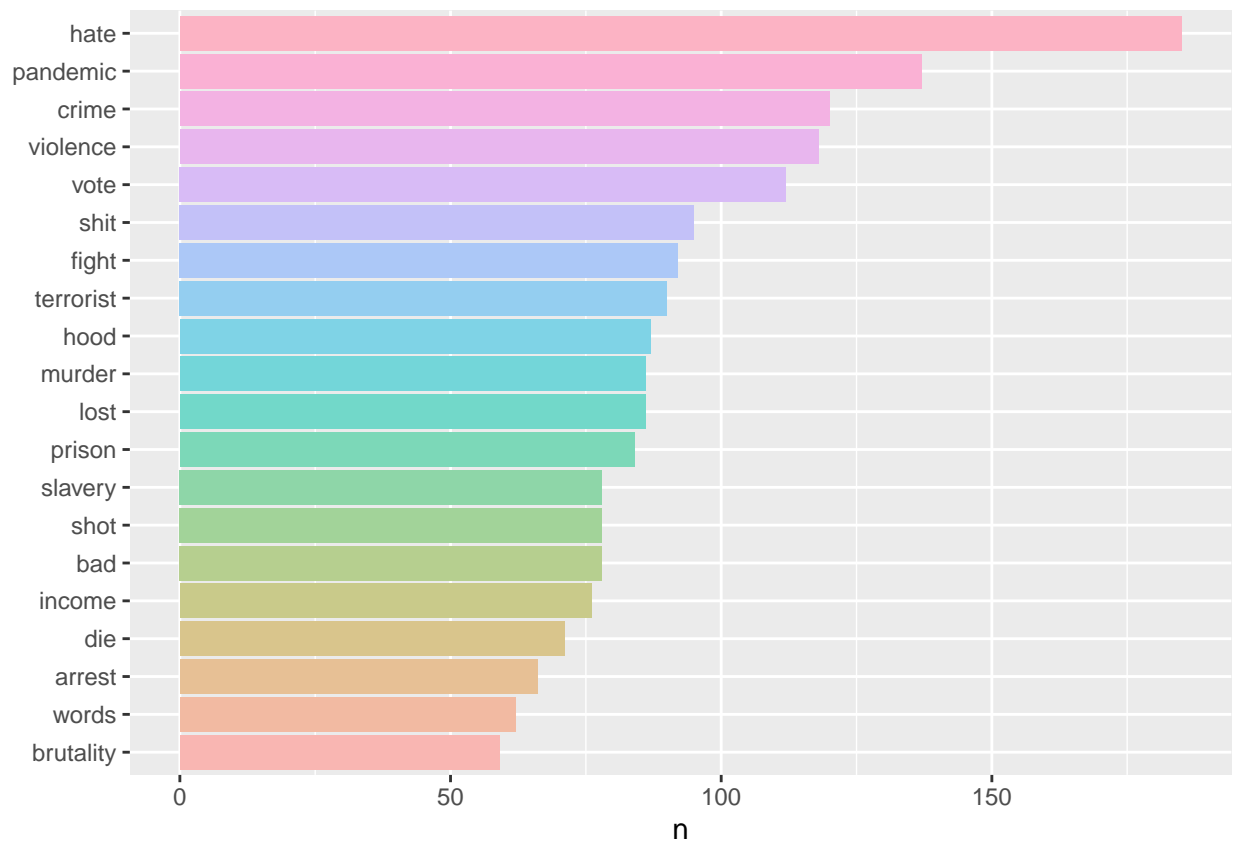
```
result_list5[[2]]
```



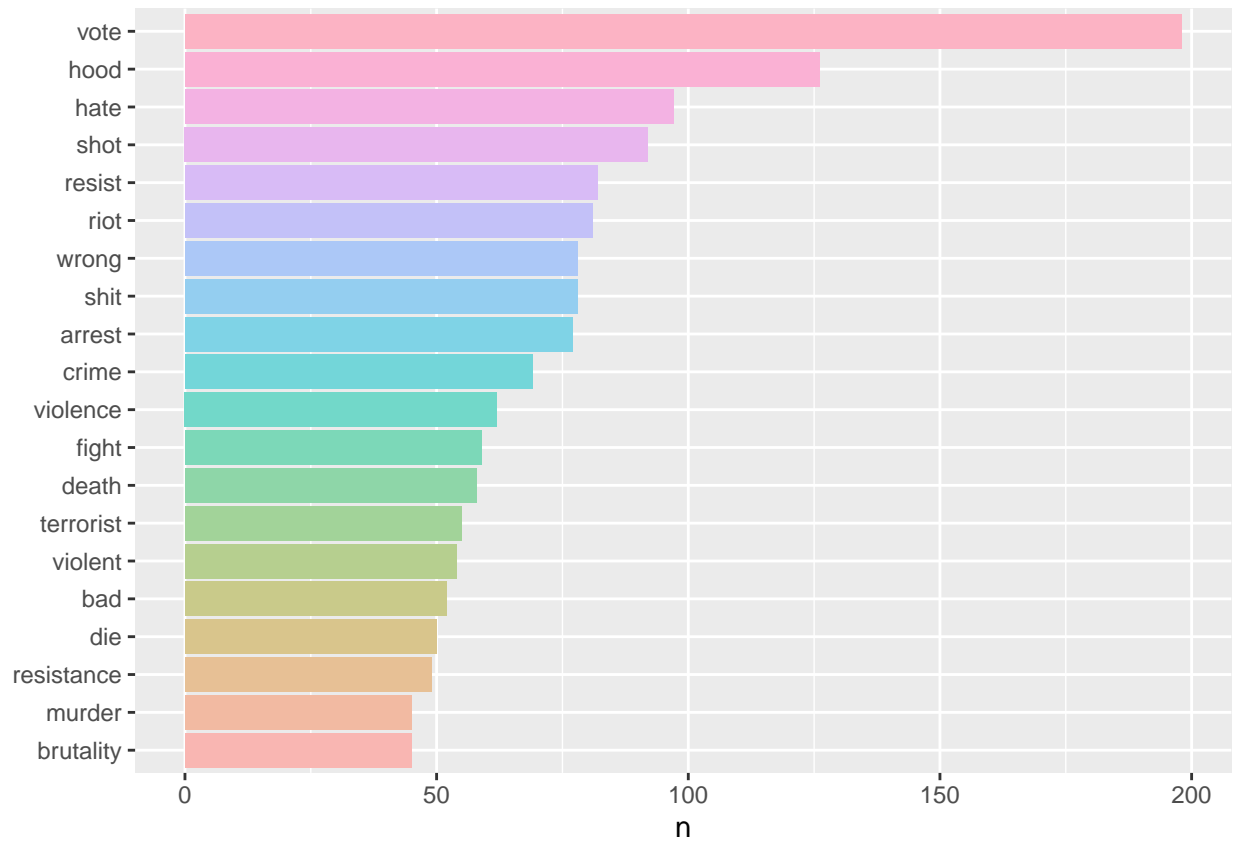
```
result_list5[[3]]
```



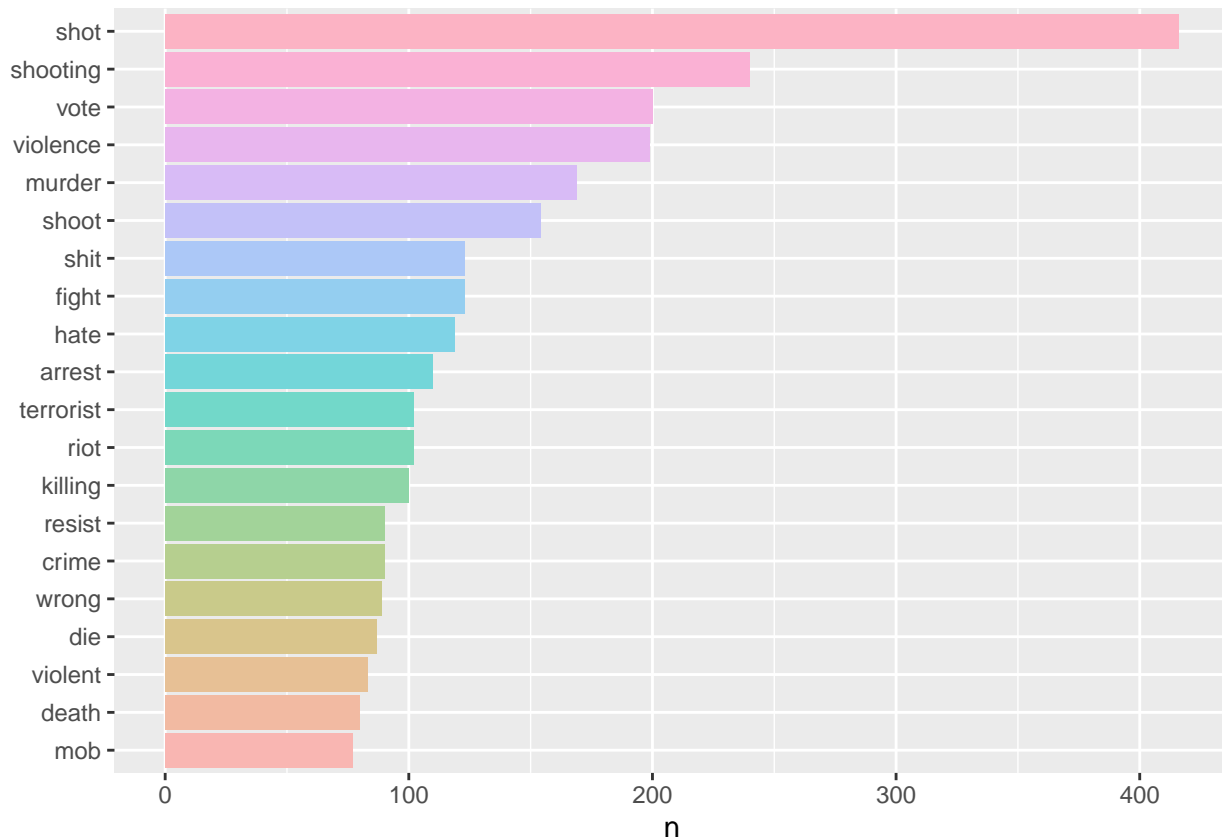
```
result_list5[[4]]
```



```
result_list5[[5]]
```

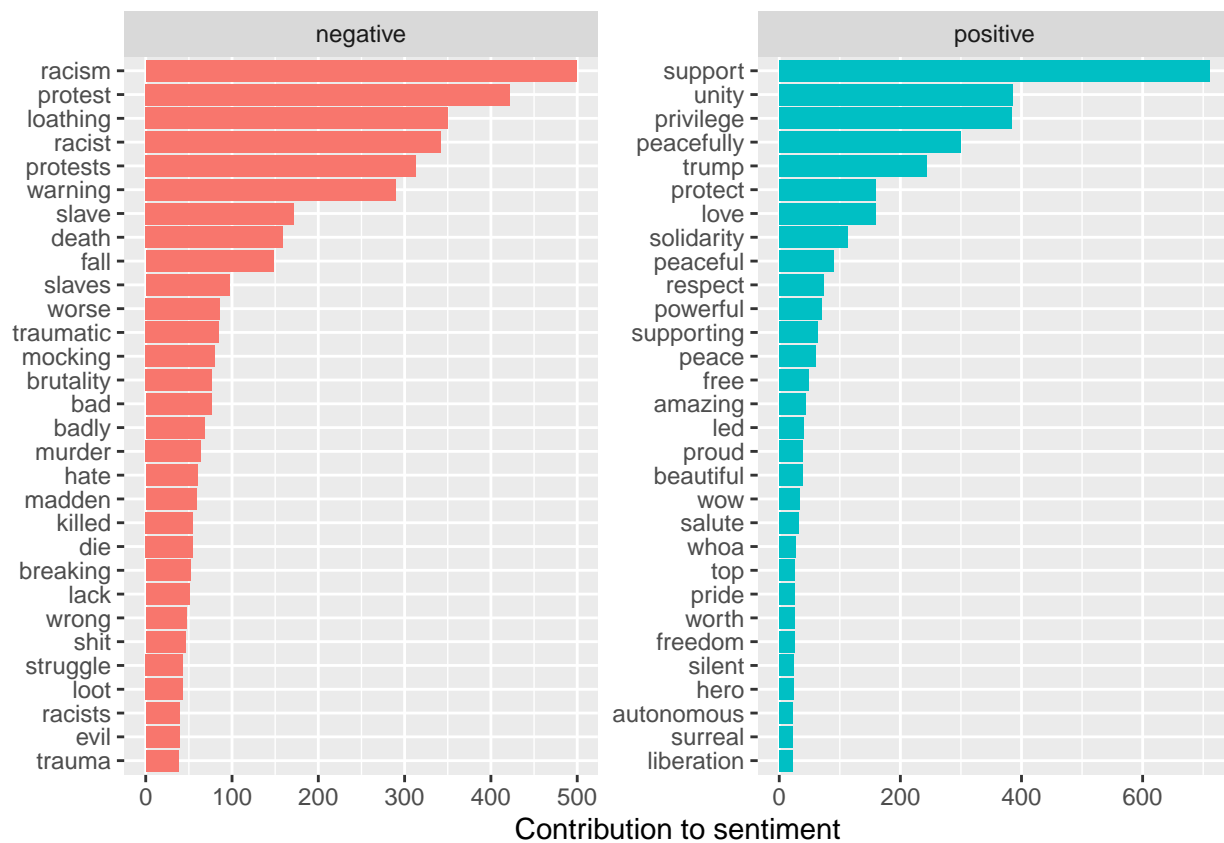


```
result_list5[[6]]
```

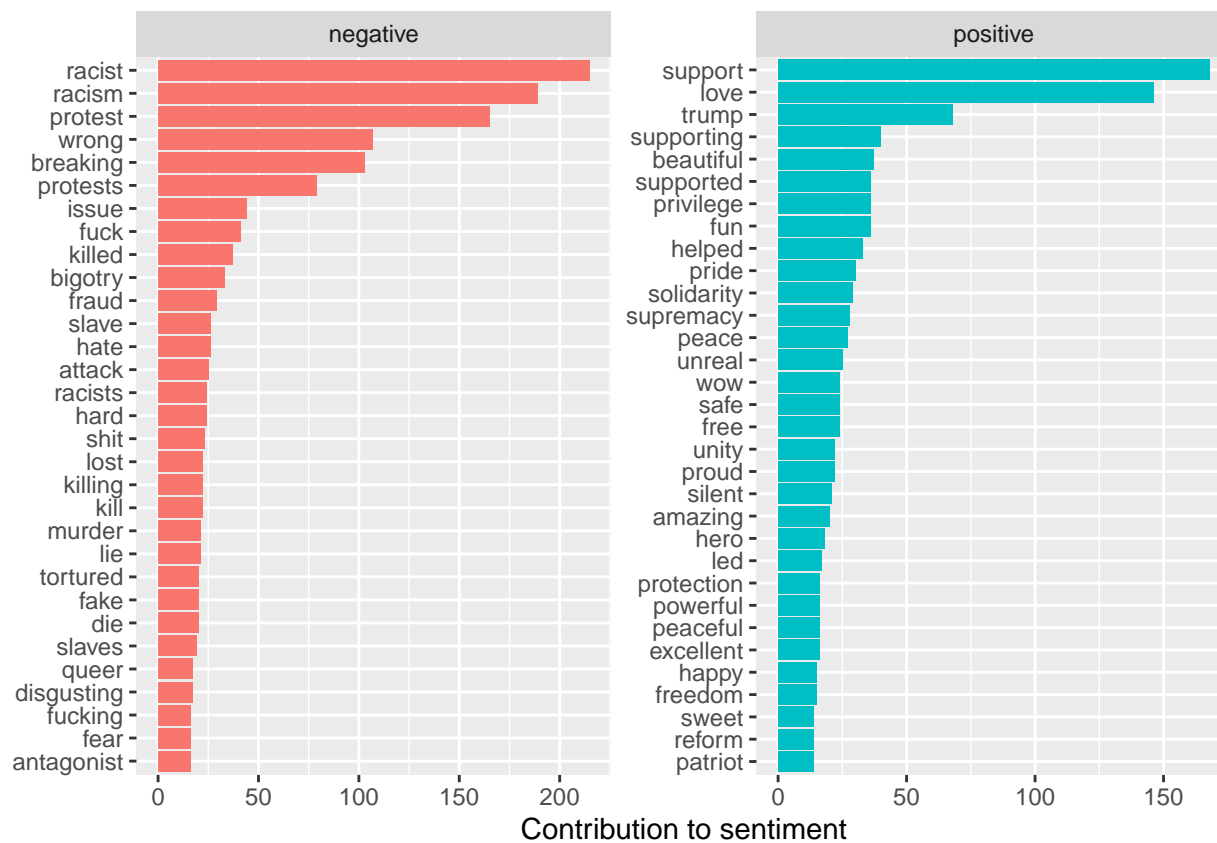


Overall trend: At first, people tweeted mostly about how they felt about George Floyd's death and the police. Then, people tweeted more about how they felt regarding loathing and violence. Later, people talked more about changing the situation through voting.

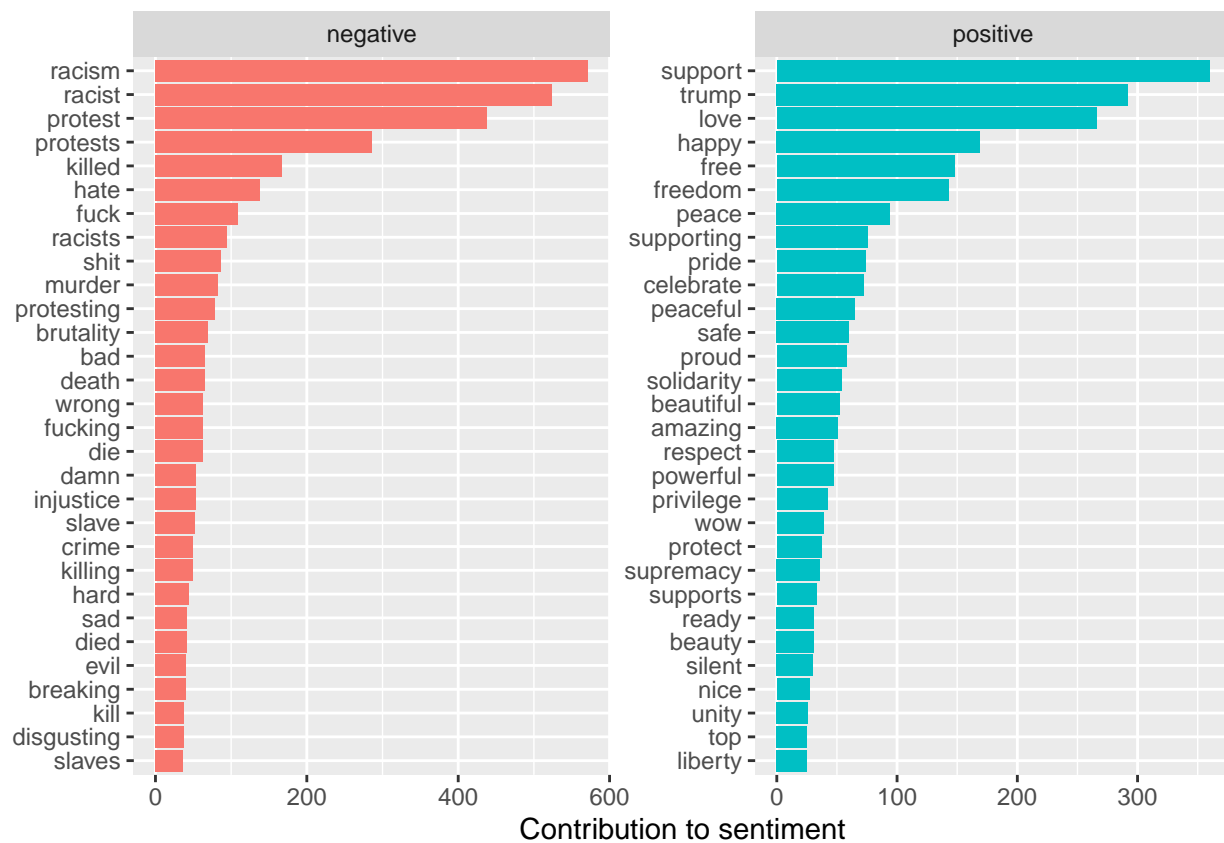
```
#how much each word contributed to each sentiment.
result_list_contribute <-
  llply(dfList4, function(x) {
    plot <- x %>%
      inner_join(get_sentiments("bing")) %>%
      dplyr::count(word, sentiment, sort = TRUE) %>%
      group_by(sentiment) %>%
      top_n(30) %>%
      mutate(word = reorder(word, n)) %>%
      ggplot(aes(word, n, fill = sentiment)) +
      geom_col(show.legend = FALSE) +
      facet_wrap(~sentiment, scales = "free") +
      labs(y = "Contribution to sentiment",
           x = NULL) +
      coord_flip()
    return(plot)}
result_list_contribute[[1]]
```

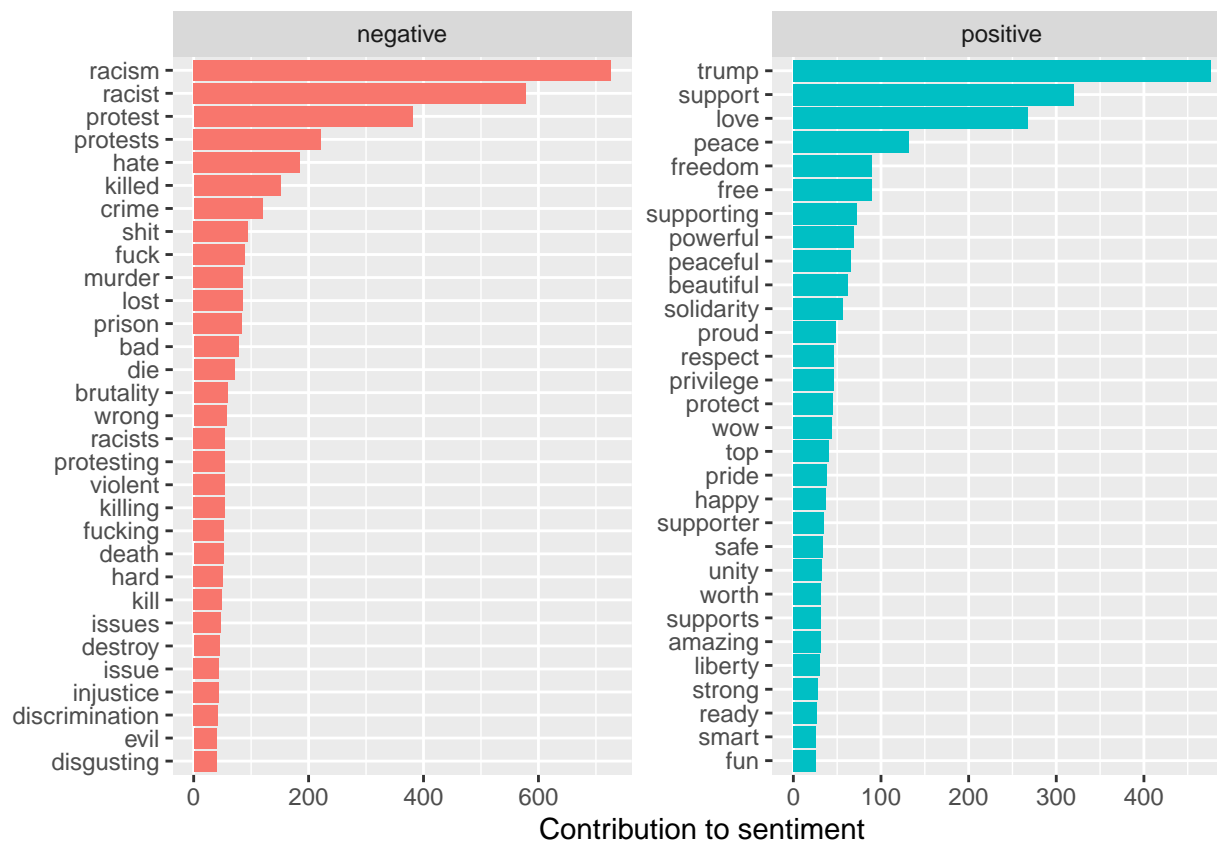
```
result_list_contribute[[2]]
```



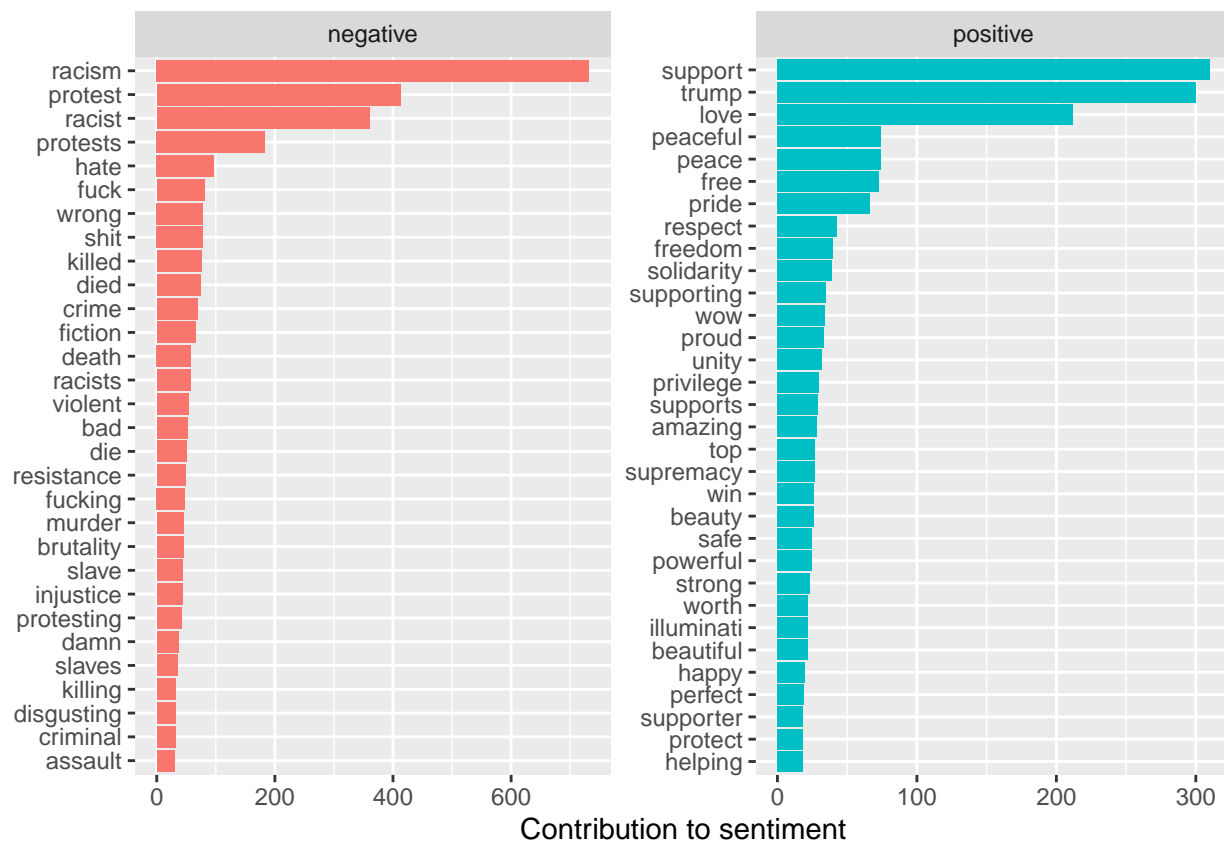
```
result_list_contribute[[3]]
```



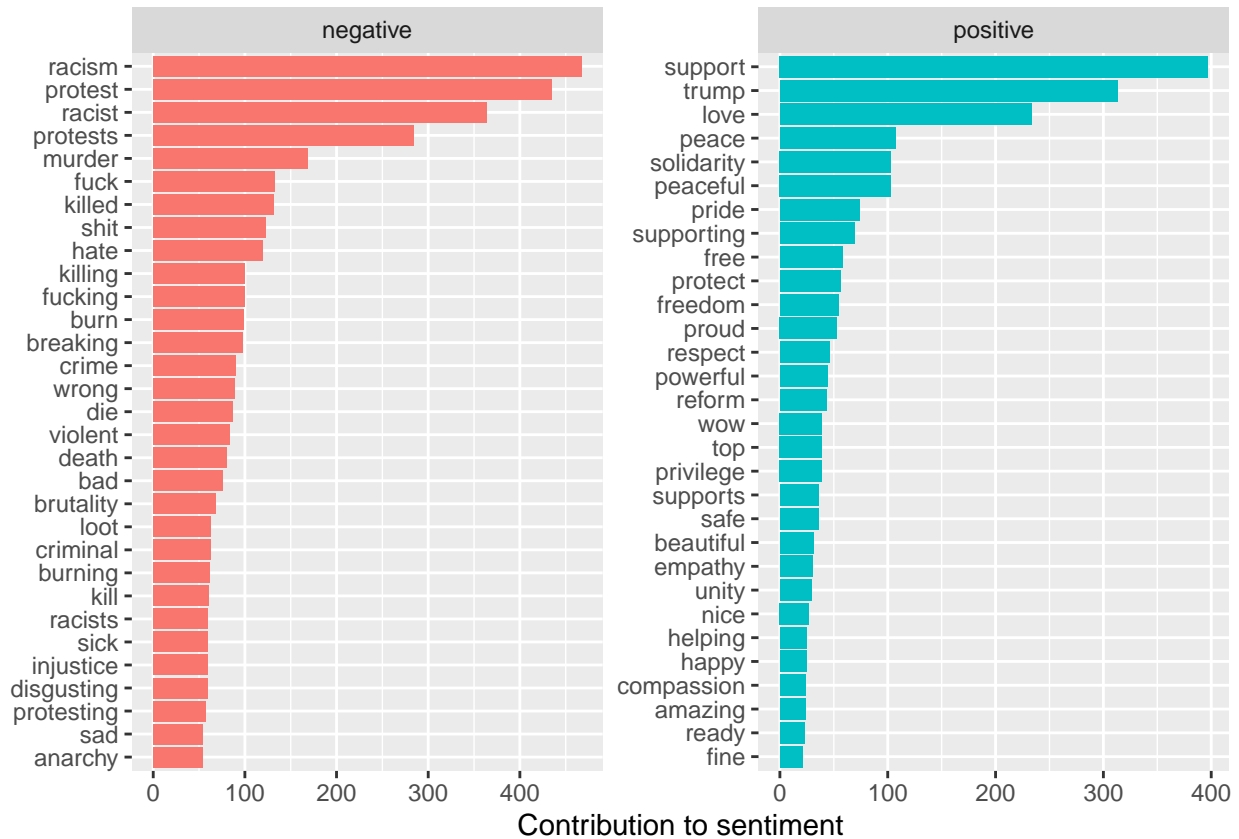
```
result_list_contribute[[4]]
```



```
result_list_contribute[[5]]
```

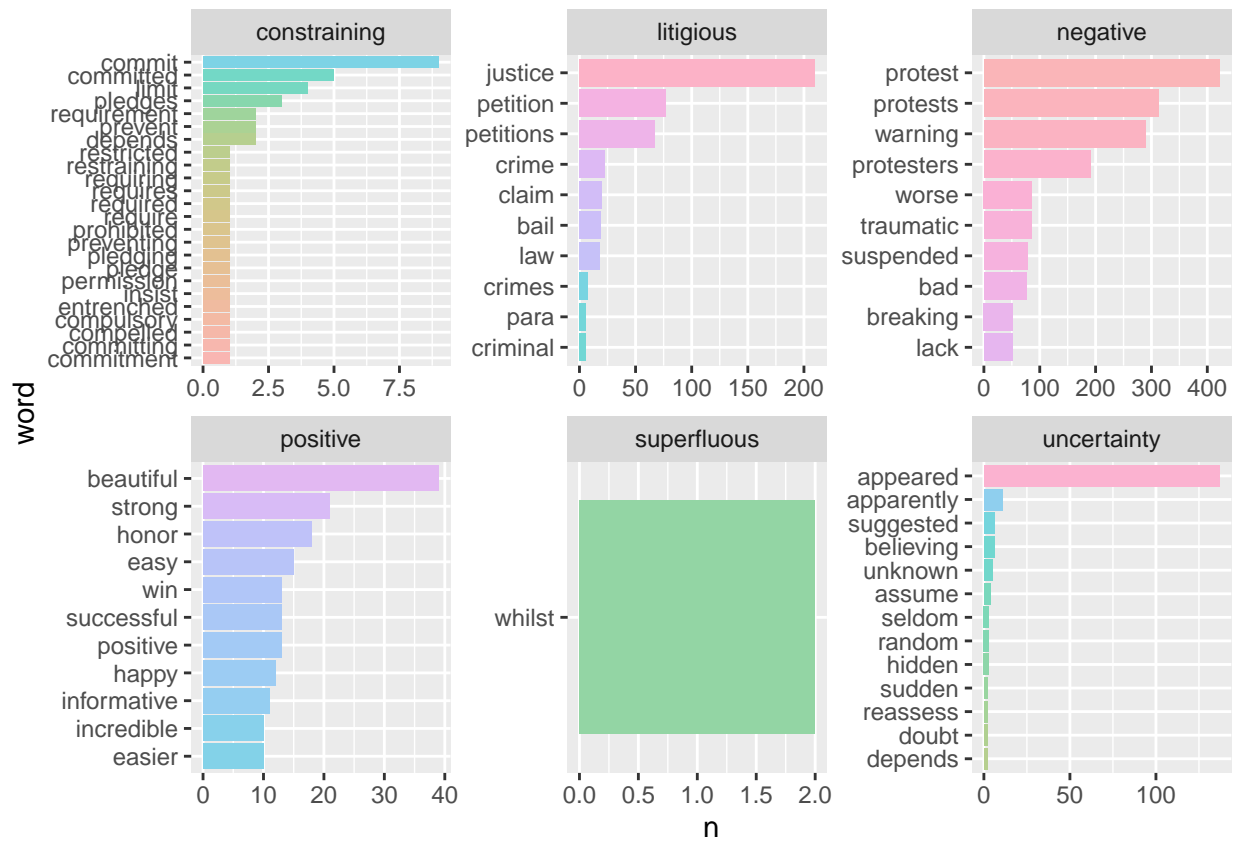


```
result_list_contribute[[6]]
```

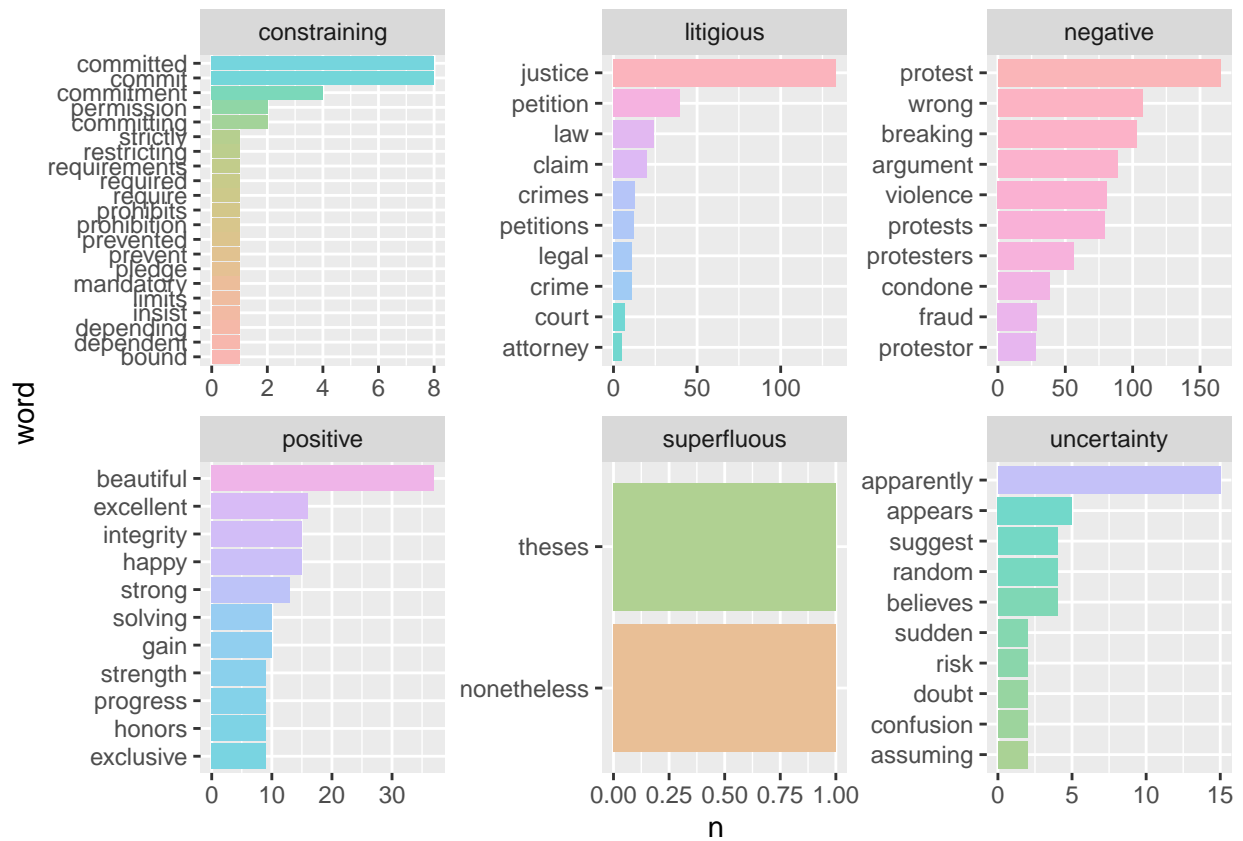


Visualize Using loughran Lexicon

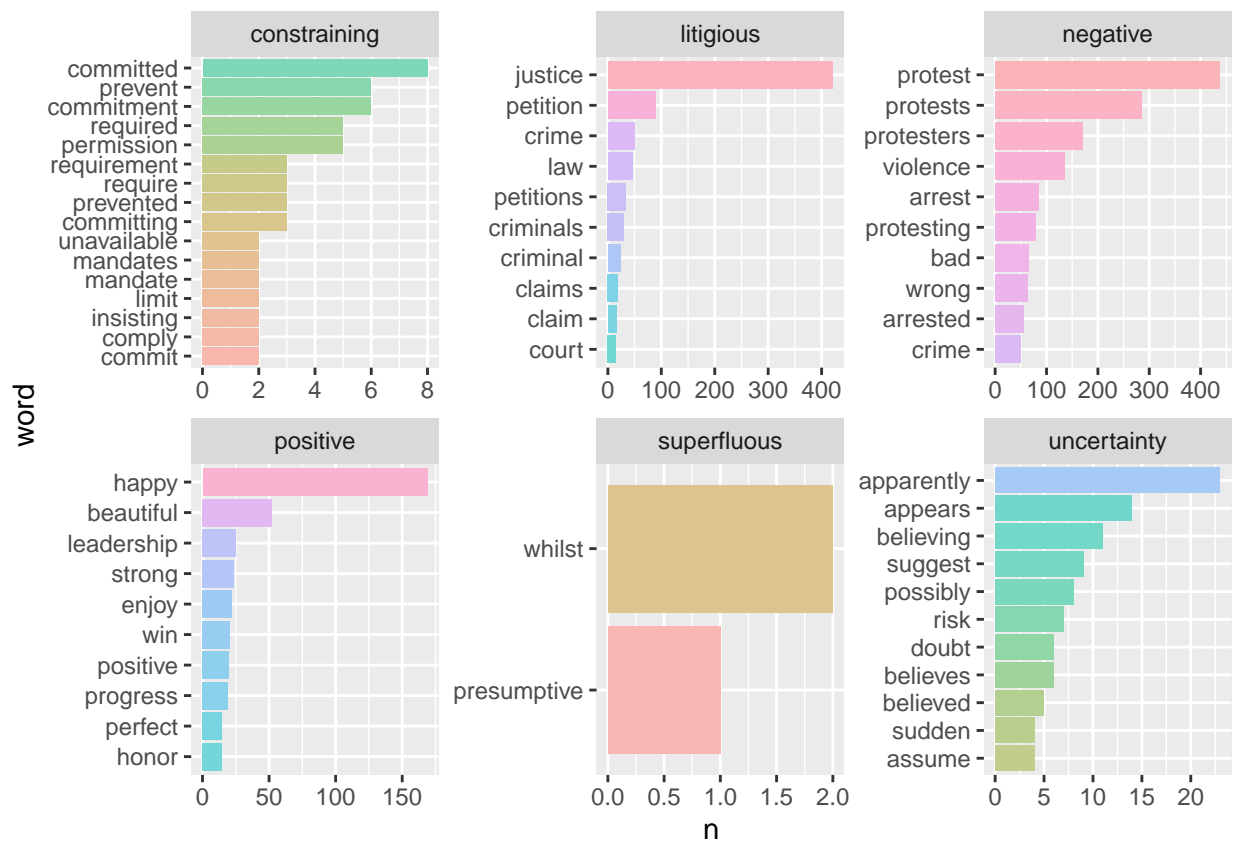
```
#Examine how sentiments changes
result_list7 <-
  llply(dfList4, function(x) {
    plot <- x %>%
      count(word) %>%
      inner_join(get_sentiments("loughran"), by = "word") %>%
      group_by(sentiment) %>%
      top_n(10, n) %>%
      ungroup() %>%
      mutate(word = reorder(word, n)) %>%
      ggplot(aes(word, n, fill=word)) +
      geom_bar(stat="identity") +
      scale_fill_hue(c=45, l=80) +
      coord_flip() +
      facet_wrap(~ sentiment, scales = "free") +
      theme(legend.position="none")
    return(plot)}
result_list7[[1]]
```



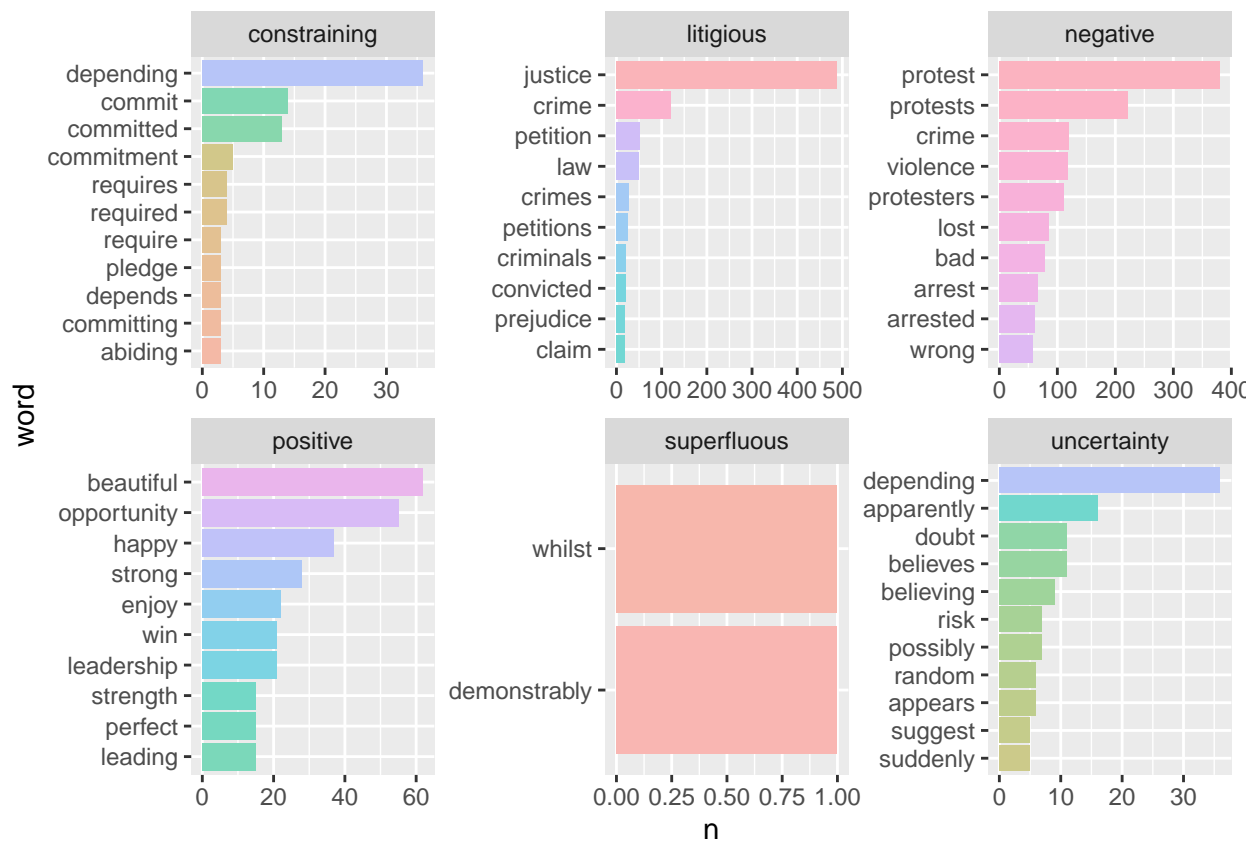
```
result_list7[[2]]
```



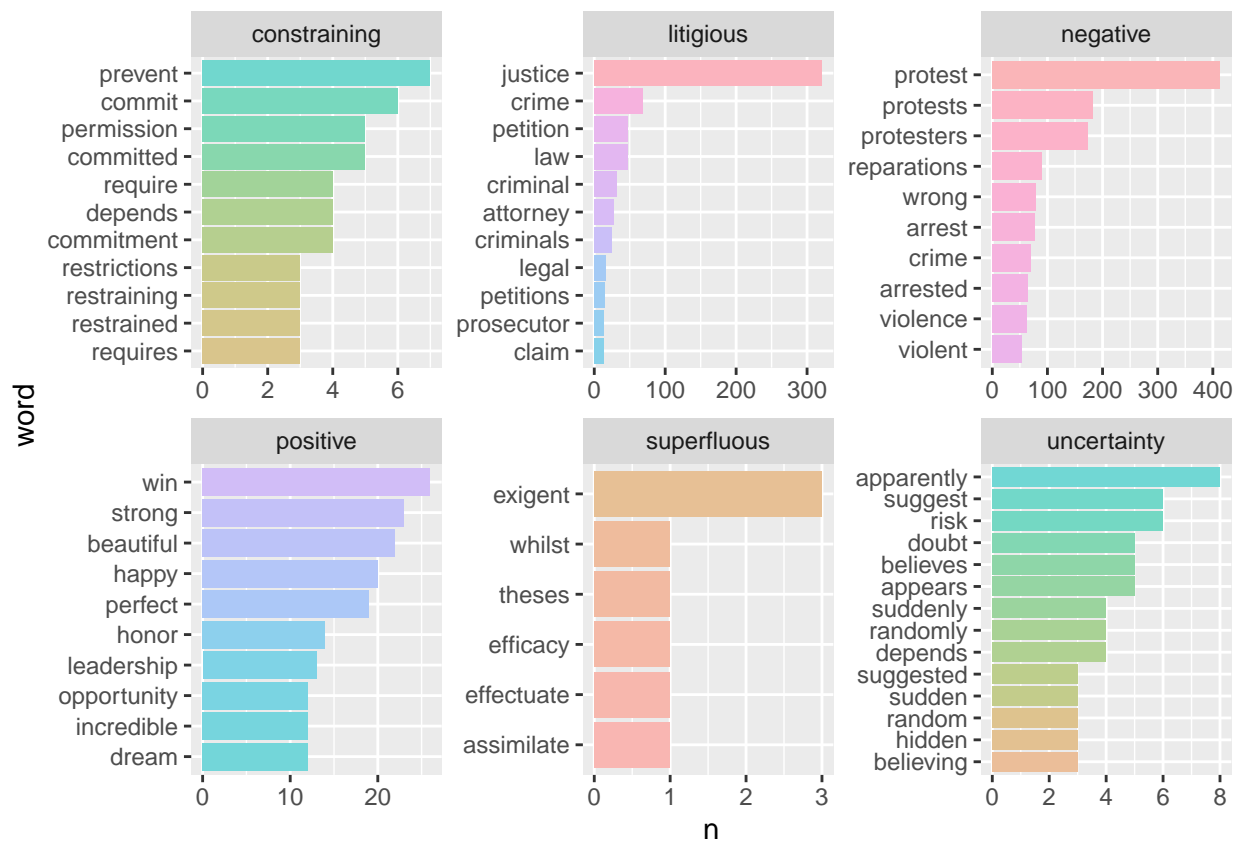
```
result_list7[[3]]
```

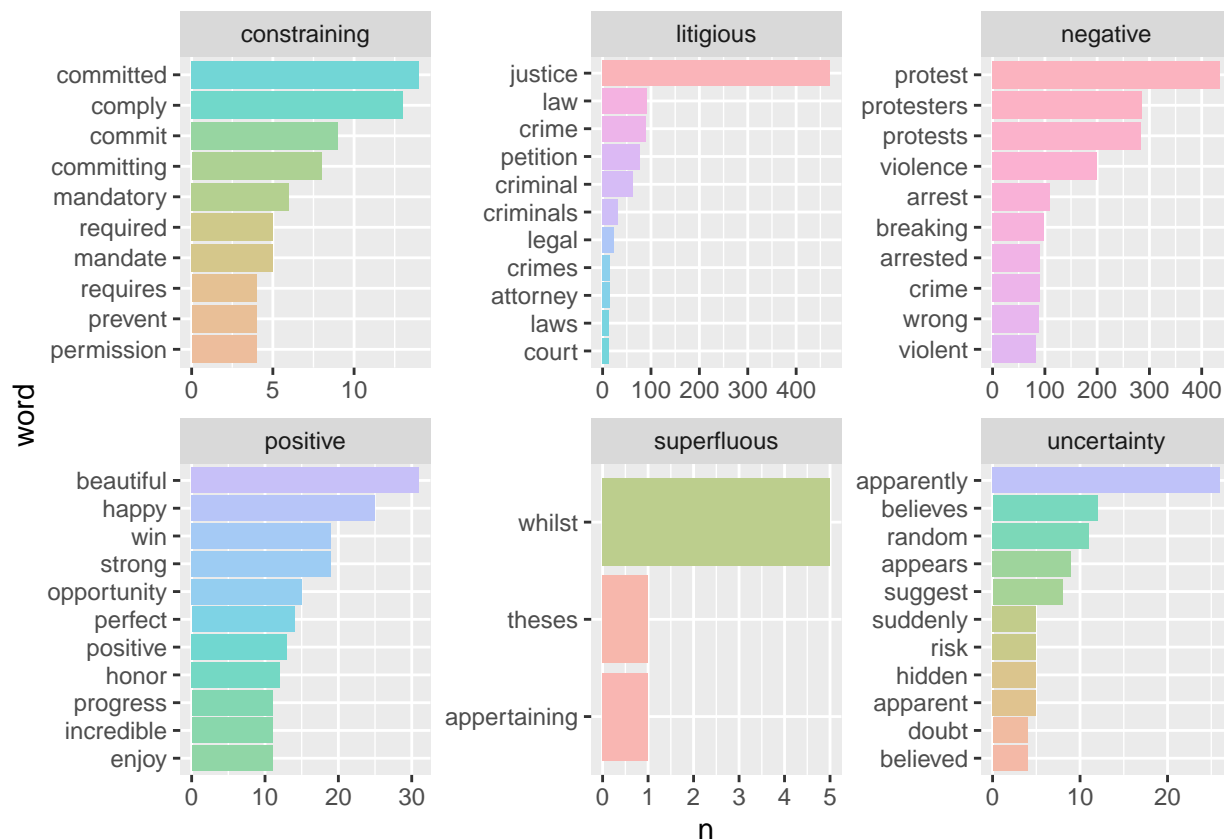
```
result_list7[[4]]
```



```
result_list7[[5]]
```



```
result_list7[[6]]
```



Running sentiment analysis using “loughran” lexicon, we can get the frequency of words in 6 categories. From the output, we can see (1) People’s litigious demand is increasing in magnitude over time. Legal complaint such as petitions starts to attract more and more attention. They called on petition for achieving justice. (2) The negative sentiments shrunk from June to July. But as soon as what happened to Jacob Blake in Wisconsin appeared on news, the negativity went back. And what they were mad the most was the ‘violence’ involved. (3) The sentiments in June is very similar with August. The first one was the reaction to George Floyd, the second was the reaction to Jacob Blake. (4) In June, the uncertainty was strong. People felt unsure and doubt so much. But over the 3 months, the uncertainty decreased. People got calmer, and their movement on seeking legal change probably helped.

Visualize Frequency Change of Key Words

```
# How many times do people mention about 'georgefloyd'
result_list14 <-
  llply(dfList2, function(x) {
    print(colnames(x))
    georgefloyd <- x %>%
      filter(str_detect(X2..Tweet, "georgefloyd")) %>%
      dplyr::select(X2..Tweet)

    le <- length(georgefloyd$X2..Tweet)
    return(le)
  })
```

```
## [1] "X1..Date.Time" "X2..Tweet"
```

```

## [3] "X3..Hashtags"          "X4..Type"
## [5] "X5..Reply.to"          "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"          "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"         "X18..Likes"
## [19] "X19..Language"         "X20..Source"
## [21] "X21..Tweet.coordinates"
## [1] "X1..Date.Time"         "X2..Tweet"
## [3] "X3..Hashtags"          "X4..Type"
## [5] "X5..Reply.to"          "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"          "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"         "X18..Likes"
## [19] "X19..Language"         "X20..Source"
## [21] "X21..Tweet.coordinates"
## [1] "X1..Date.Time"         "X2..Tweet"
## [3] "X3..Hashtags"          "X4..Type"
## [5] "X5..Reply.to"          "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"          "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"         "X18..Likes"
## [19] "X19..Language"         "X20..Source"
## [21] "X21..Tweet.coordinates"
## [1] "X1..Date.Time"         "X2..Tweet"
## [3] "X3..Hashtags"          "X4..Type"
## [5] "X5..Reply.to"          "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"          "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"         "X18..Likes"
## [19] "X19..Language"         "X20..Source"
## [21] "X21..Tweet.coordinates"
## [1] "X1..Date.Time"         "X2..Tweet"
## [3] "X3..Hashtags"          "X4..Type"
## [5] "X5..Reply.to"          "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"          "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"         "X18..Likes"
## [19] "X19..Language"         "X20..Source"
## [21] "X21..Tweet.coordinates"

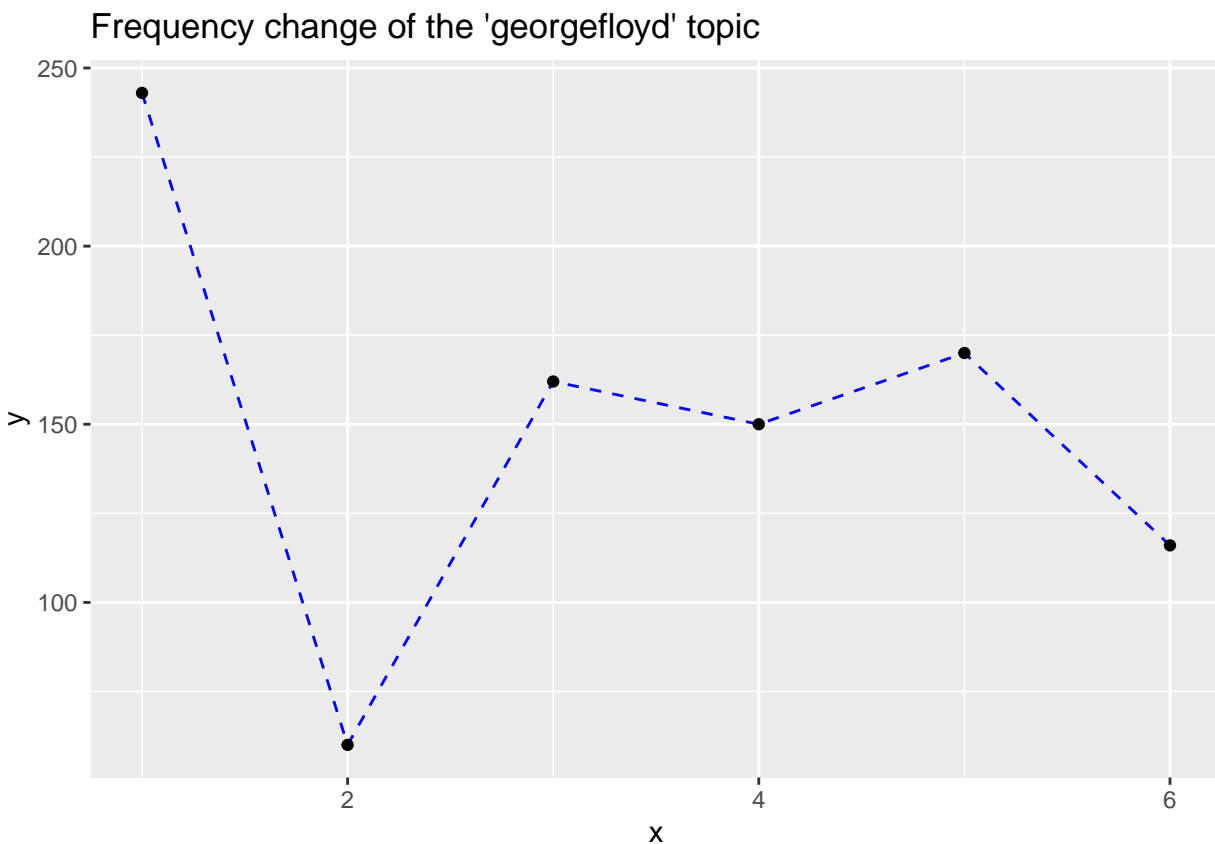
```

```
## [1] "X1..Date.Time"      "X2..Tweet"
## [3] "X3..Hashtags"       "X4..Type"
## [5] "X5..Reply.to"       "X6..Author"
## [7] "X7..Author.s.real.name" "X8..Author.s.location"
## [9] "X9..Author.s.timezone" "X10..Author.s.URL"
## [11] "X11..Author.s.description" "X12..Followers"
## [13] "X13..Follows"        "X14..Tweets"
## [15] "X15..Profile.verified" "X16..Profile.created"
## [17] "X17..Retweets"       "X18..Likes"
## [19] "X19..Language"       "X20..Source"
## [21] "X21..Tweet.coordinates"
```

```
georgefloyd1 <- result_list14[[1]]
georgefloyd2 <- result_list14[[2]]
georgefloyd3 <- result_list14[[3]]
georgefloyd4 <- result_list14[[4]]
georgefloyd5 <- result_list14[[5]]
georgefloyd6 <- result_list14[[6]]

georgefloyd_mat <- data.frame(x = c(1:6), y = c(georgefloyd1, georgefloyd2, georgefloyd3, georgefloyd4,
georgefloyd5, georgefloyd6))

ggplot(georgefloyd_mat, aes(x, y)) +
  geom_line(color = "blue", linetype = "dashed") +
  geom_point() +
  ggtitle("Frequency change of the 'georgefloyd' topic")
```



Overall, the number of times that people tweet about ‘georgefloyd’ decreased over the three months. The topic’s heat is cooling down.