Serotonin_DataAnalysis_Apr9

```
# Read in data
setwd("~/Desktop/Serotonin_Paper")
Sys.setlocale("LC_ALL", "C")
```

```
## [1] "C/C/C/C/C/en_US.UTF-8"
```

```
x <- read.csv("5-HT_Extract_Results_Apr8.csv", as.is = TRUE)

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
```

Overall

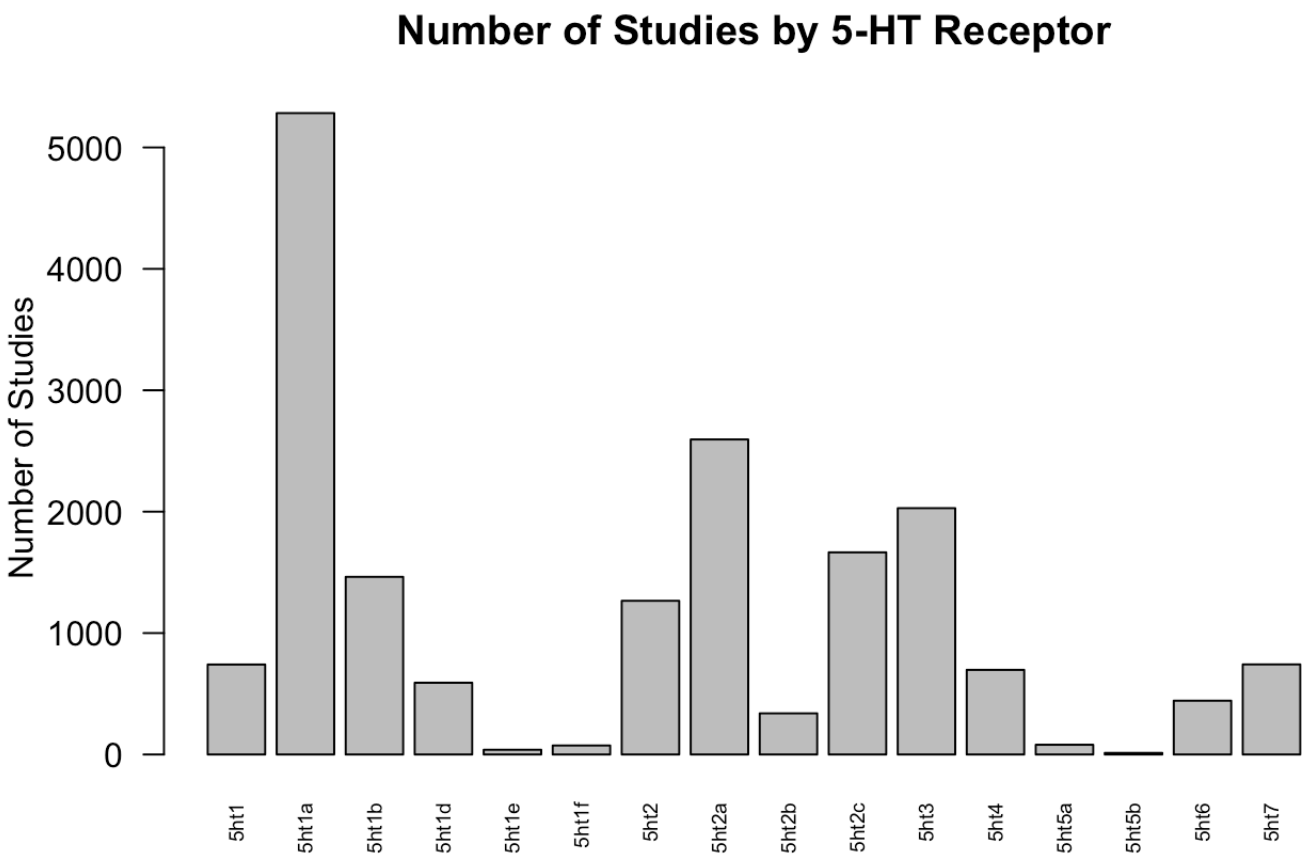
```
nrow(x)
```

```
## [1] 9631
```

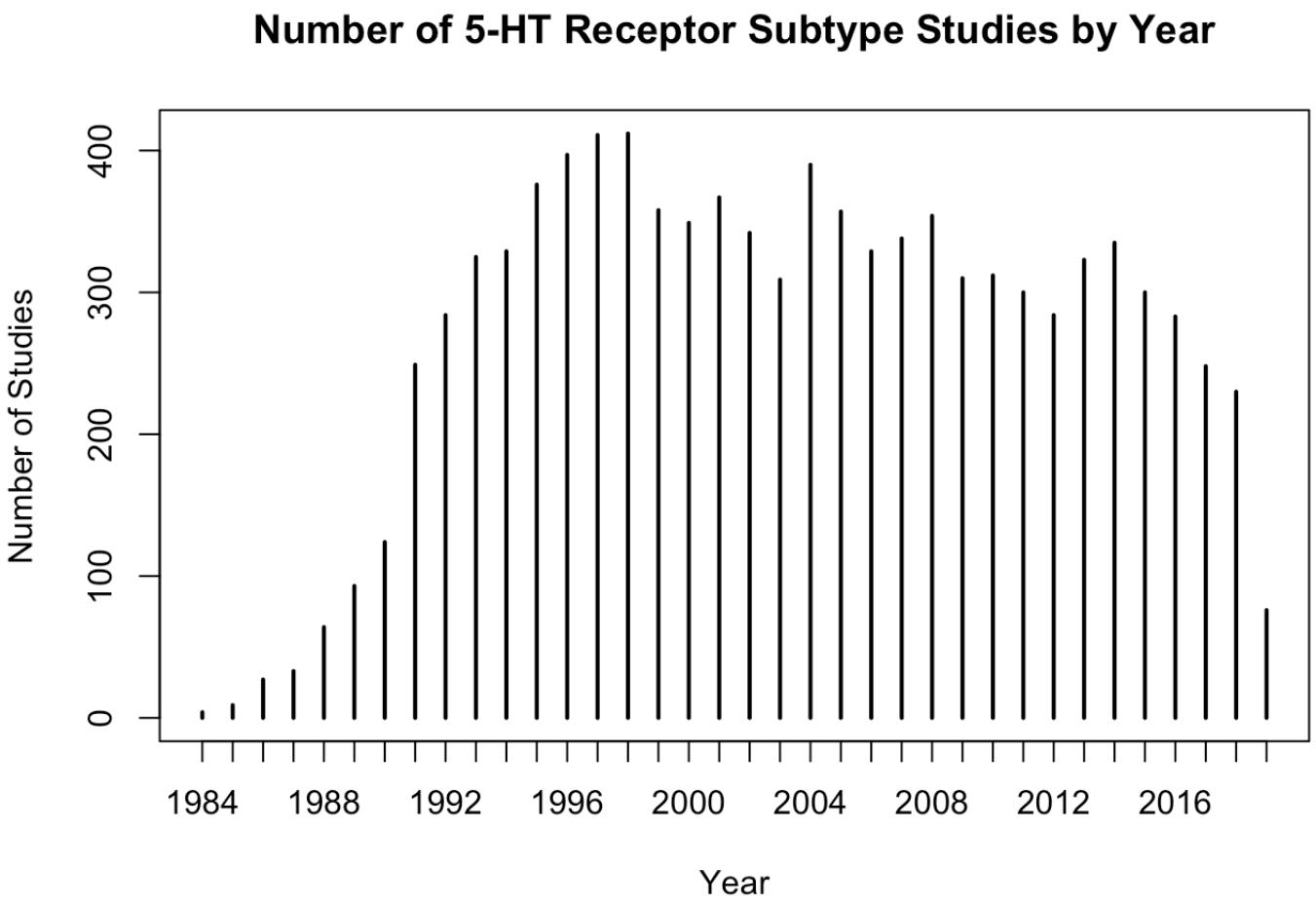
```
Receptors <- strsplit(x$Receptor, ";")

Receptors <- unlist(Receptors)
# 1c is really 2c
Receptors <- gsub("5ht1c","5ht2c", Receptors)

Receptors <- gsub("5ht3a", "5ht3", Receptors)
Receptors <- gsub("5ht3b", "5ht3", Receptors)
Receptors <- gsub("5ht3c", "5ht3", Receptors)
Receptors <- gsub("5ht3d", "5ht3", Receptors)
Receptors <- gsub("5ht3e", "5ht3", Receptors)
Receptors <- gsub("5ht3f", "5ht3", Receptors)

Receptors <- gsub("5ht4a", "5ht4", Receptors)
Receptors <- gsub("5ht4b", "5ht4", Receptors)
Receptors <- gsub("5ht4c", "5ht4", Receptors)
Receptors <- gsub("5ht4d", "5ht4", Receptors)
Receptors <- gsub("5ht4e", "5ht4", Receptors)
Receptors <- gsub("5ht4f", "5ht4", Receptors)

Receptors <- gsub("5ht6a", "5ht6", Receptors)
Receptors <- gsub("5ht6b", "5ht6", Receptors)
Receptors <- gsub("5ht6c", "5ht6", Receptors)
Receptors <- gsub("5ht6d", "5ht6", Receptors)
Receptors <- gsub("5ht6e", "5ht6", Receptors)
Receptors <- gsub("5ht6f", "5ht6", Receptors)

Receptors <- gsub("5ht7a", "5ht7", Receptors)
Receptors <- gsub("5ht7b", "5ht7", Receptors)
Receptors <- gsub("5ht7c", "5ht7", Receptors)
Receptors <- gsub("5ht7d", "5ht7", Receptors)
Receptors <- gsub("5ht7e", "5ht7", Receptors)
Receptors <- gsub("5ht7f", "5ht7", Receptors)

(receptors <- table(Receptors)[c(1:10,14,15,17,18,22,23)])
```

```
## Receptors
##  5ht1 5ht1a 5ht1b 5ht1d 5ht1e 5ht1f  5ht2 5ht2a 5ht2b 5ht2c  5ht3  5ht4
##   741  5283  1463   591    39    74  1266  2595   339  1665  2029   697
## 5ht5a 5ht5b  5ht6  5ht7
##    80    13   443   742
```

```
barplot(receptors, las = 2, cex.names=.6, main = "Number of Studies by 5-HT Receptor"
, ylab = "Number of Studies")
```



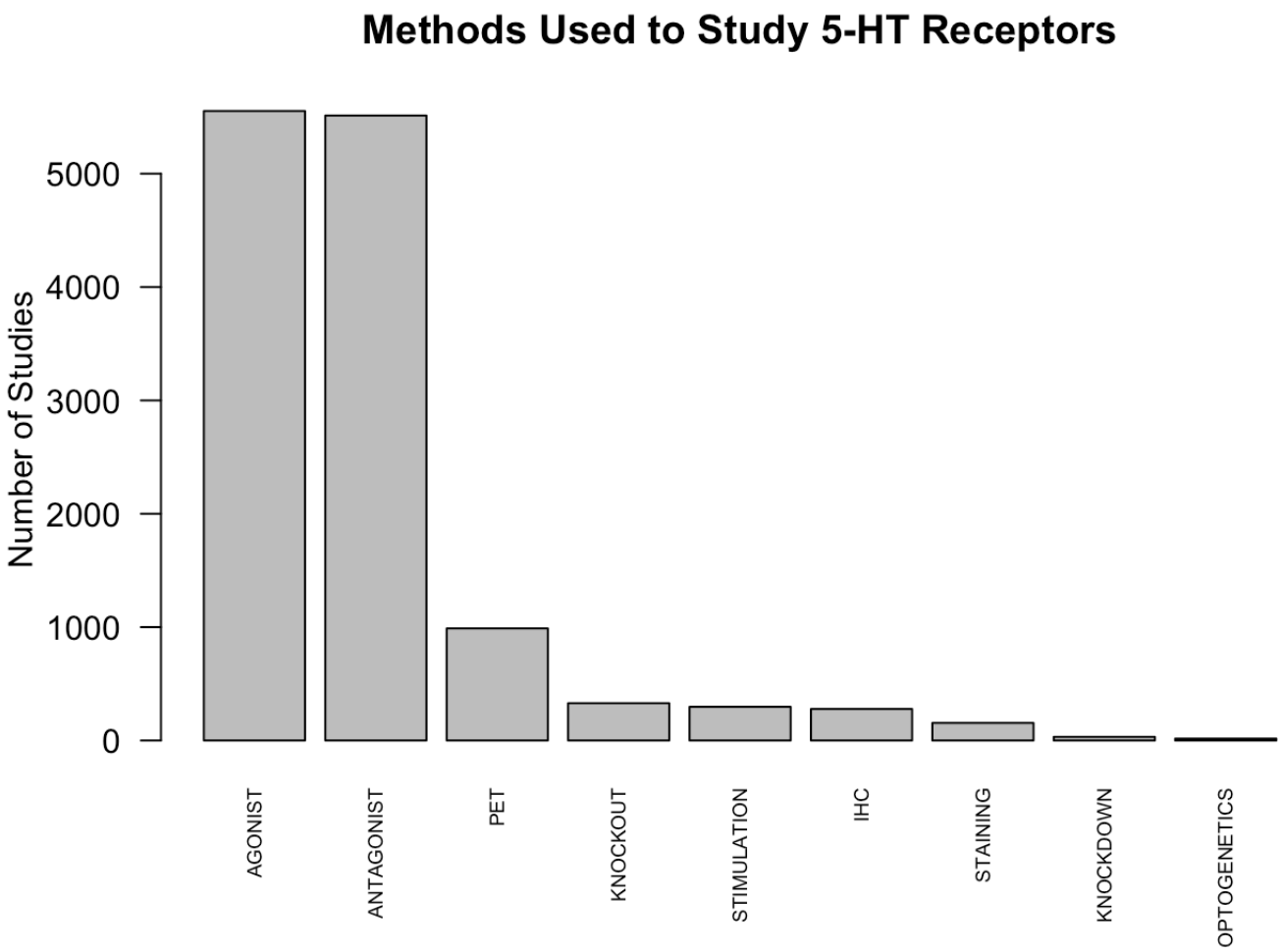

```
plot(table(x$Year), main = "Number of 5-HT Receptor Subtype Studies by Year", xlab =
"Year", ylab = "Number of Studies")
```




```
Methods <- strsplit(x$Methods, ";")

Methods <- unlist(Methods)

Methods <- gsub("Method.","", Methods)
Methods <- gsub("IMMUNOHISTOCHEMISTRY","IHC", Methods)

(methods <- sort(table(Methods), decreasing = TRUE))
```

```
## Methods
##      AGONIST   ANTAGONIST          PET     KNOCKOUT  STIMULATION
##         5553         5513          989          329          297
##          IHC     STAINING    KNOCKDOWN OPTOGENETICS
##          278          155           32           17
```

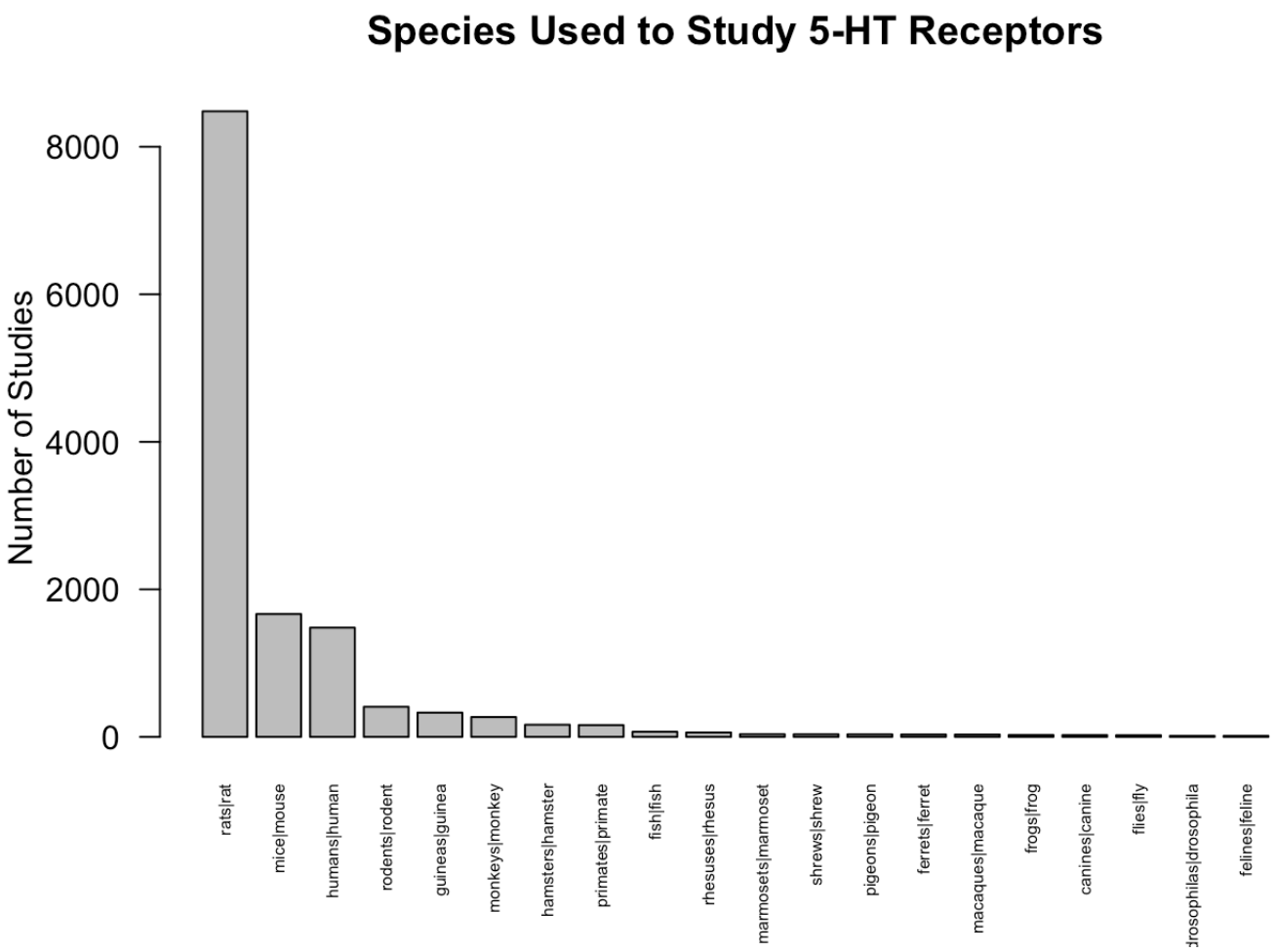
```
barplot(methods, las = 2, cex.names=.6, main = "Methods Used to Study 5-HT Receptors"
, ylab = "Number of Studies")
```




```
Species <- strsplit(x$Species, ";")

Species <- unlist(Species)

Species <- gsub(".*b","", Species)
Species <- gsub('.{2}$', '', Species)
Species <- gsub(".*\\(","", Species)
Species <- gsub('.{1}$', '', Species)

(species <- sort(table(Species), decreasing = TRUE)[c(2,21,27,53,59,64,80,84,112,118,
138,140,142,145,146,154,157,164,191,192)])
```

```
## Species
##                rats|rat               mice|mouse             humans|human
##                    8481                     1666                     1481
##          rodents|rodent          guineas|guinea          monkeys|monkey
##                     408                      329                      269
##        hamsters|hamster        primates|primate              fish|fish
##                     165                      160                       70
##         rhesuses|rhesus      marmosets|marmoset           shrews|shrew
##                      60                       37                       36
##          pigeons|pigeon          ferrets|ferret        macaques|macaque
##                      35                       33                       32
##              frogs|frog          canines|canine              flies|fly
##                      26                       25                       23
## drosophilas|drosophila          felines|feline
##                      14                       14
```

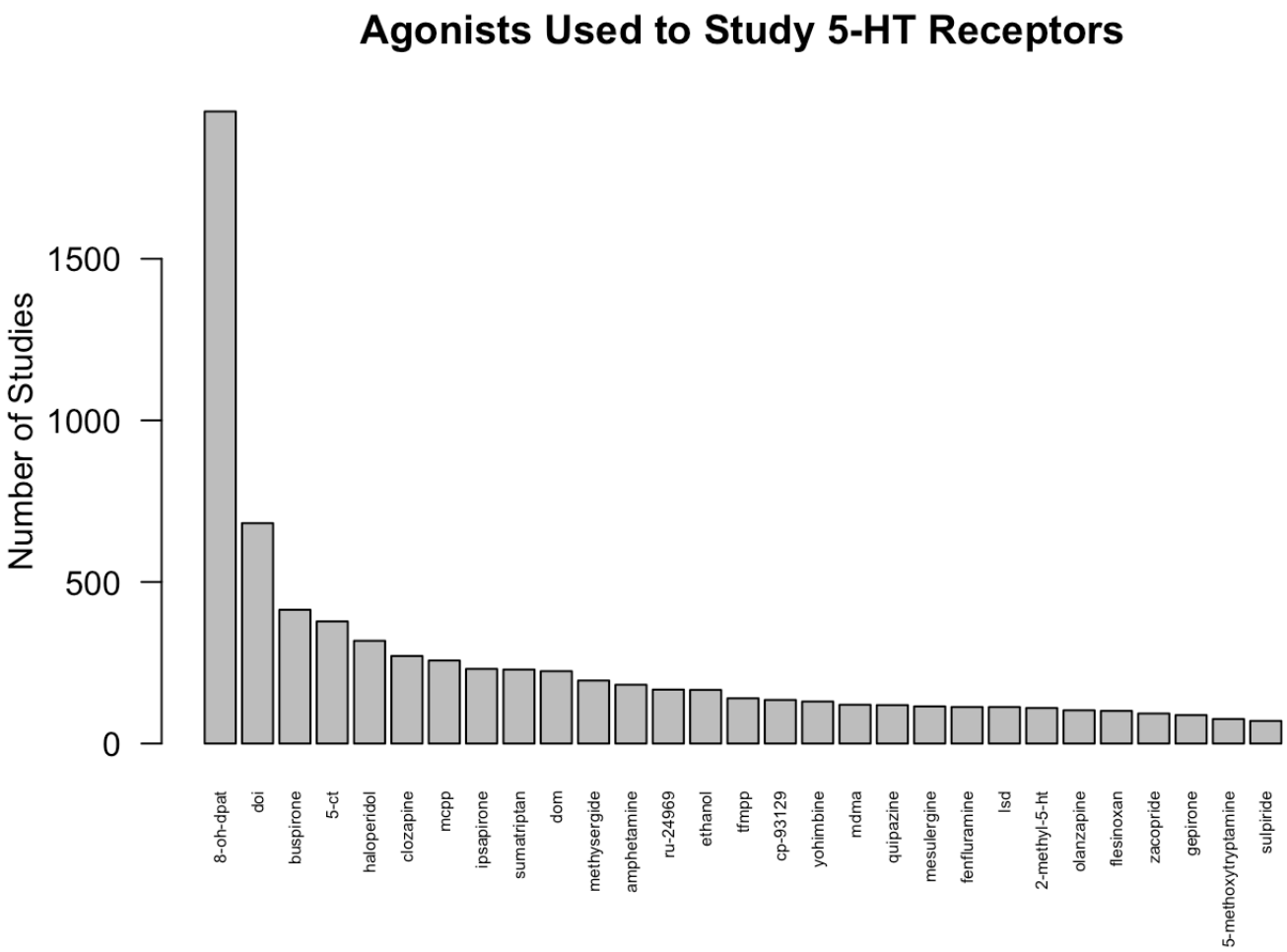
```
barplot(species, las = 2, cex.names=.5, main = "Species Used to Study 5-HT Receptors"
, ylab = "Number of Studies")
```



```
Agonists <- strsplit(x$Agonist, ";")

Agonists <- unlist(Agonists)
Agonists <- gsub(".*\\\\","", Agonists)
Agonists <- substring(Agonists, 2)
Agonists <- gsub('.{2}$', '', Agonists)
Agonists <- gsub("\\?", "-", Agonists)
Agonists <- gsub(" ", "", Agonists)

Agonists <- gsub("5-carboxamidotryptamine", "5-ct", Agonists)

(agonists <- sort(table(Agonists), decreasing = TRUE)[c(1, 3:30)])
```

```
## Agonists
##           8-oh-dpat                 doi           buspirone
##                1956                 682                 414
##                5-ct         haloperidol           clozapine
##                 378                 318                 271
##                mcpp          ipsapirone         sumatriptan
##                 257                 231                 229
##                 dom        methysergide         amphetamine
##                 224                 195                 182
##            ru-24969             ethanol               tfmpp
##                 167                 166                 140
##            cp-93129           yohimbine                mdma
##                 135                 130                 120
##           quipazine         mesulergine        fenfluramine
##                 119                 115                 113
##                 lsd       2-methyl-5-ht          olanzapine
##                 113                 110                 103
##          flesinoxan           zacopride            gepirone
##                 101                  93                  88
## 5-methoxytryptamine           sulpiride
##                  76                  70
```

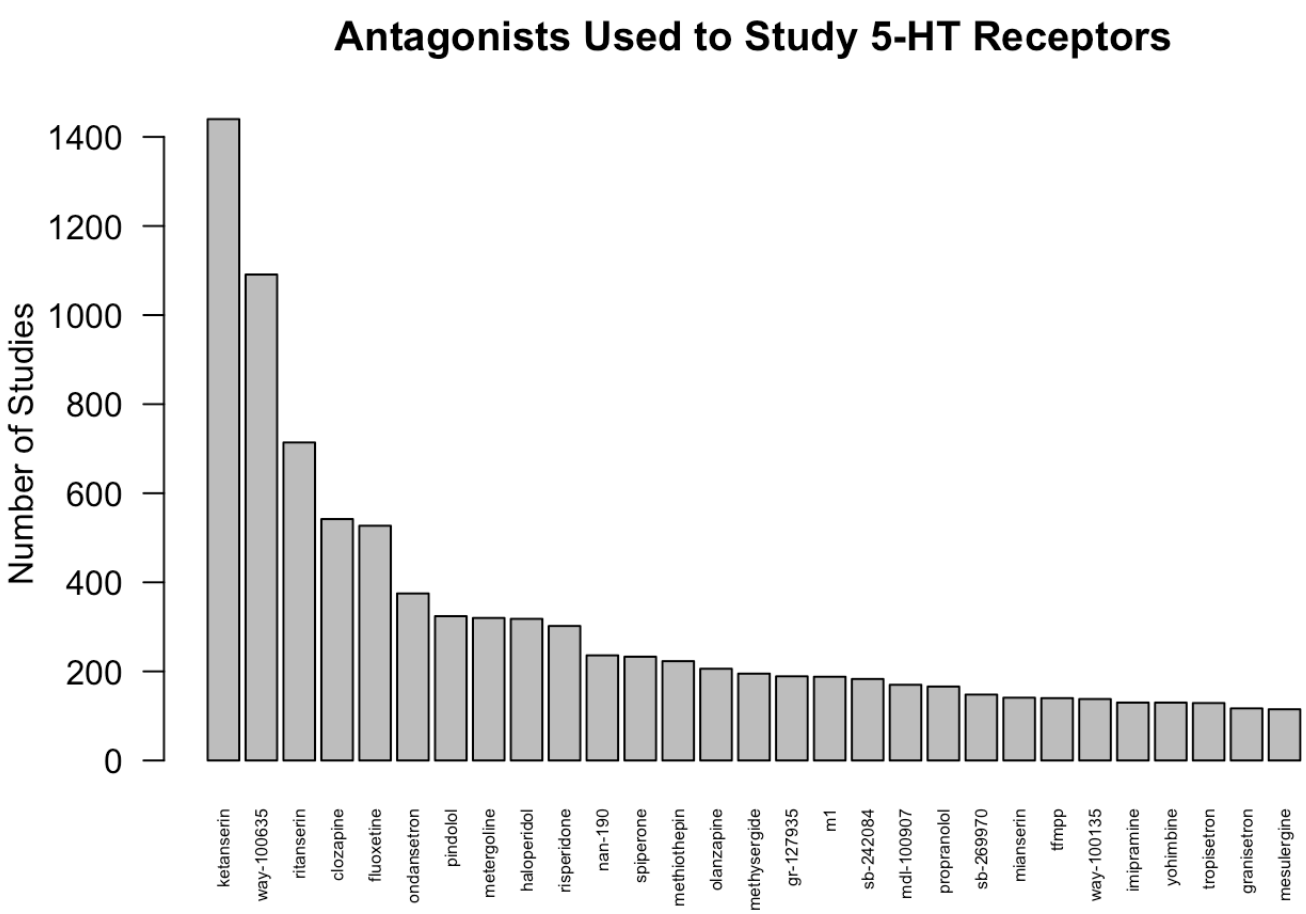
```
barplot(agonists, las = 2, cex.names=.5, main = "Agonists Used to Study 5-HT Receptor
s", ylab = "Number of Studies")
```




```
Antagonists <- strsplit(x$Antagonist, ";")

Antagonists <- unlist(Antagonists)

Antagonists <- gsub(".*\\\\","", Antagonists)
Antagonists <- substring(Antagonists, 2)
Antagonists <- gsub('.{2}$', '', Antagonists)
Antagonists <- gsub("\\?", "-", Antagonists)
Antagonists <- gsub(" ", "", Antagonists)

#a <- read.csv("Antagonists_List.csv", as.is = TRUE)
#sort(table(a$Antagonist))

(antagonists <- sort(table(Antagonists), decreasing = TRUE)[c(1:29)])
```

```
## Antagonists
##   ketanserin   way-100635   ritanserin    clozapine   fluoxetine
##         1440         1091          714          542          527
##  ondansetron     pindolol  metergoline  haloperidol  risperidone
##          375          324          320          318          302
##      nan-190    spiperone methiothepin   olanzapine methysergide
##          236          233          223          206          195
##    gr-127935           m1    sb-242084   mdl-100907  propranolol
##          189          188          183          170          166
##    sb-269970    mianserin        tfmpp   way-100135   imipramine
##          148          141          140          138          130
##    yohimbine  tropisetron  granisetron  mesulergine
##          130          129          117          115
```

```
barplot(antagonists, las = 2, cex.names=.5, main = "Antagonists Used to Study 5-HT Re
ceptors", ylab = "Number of Studies")
```

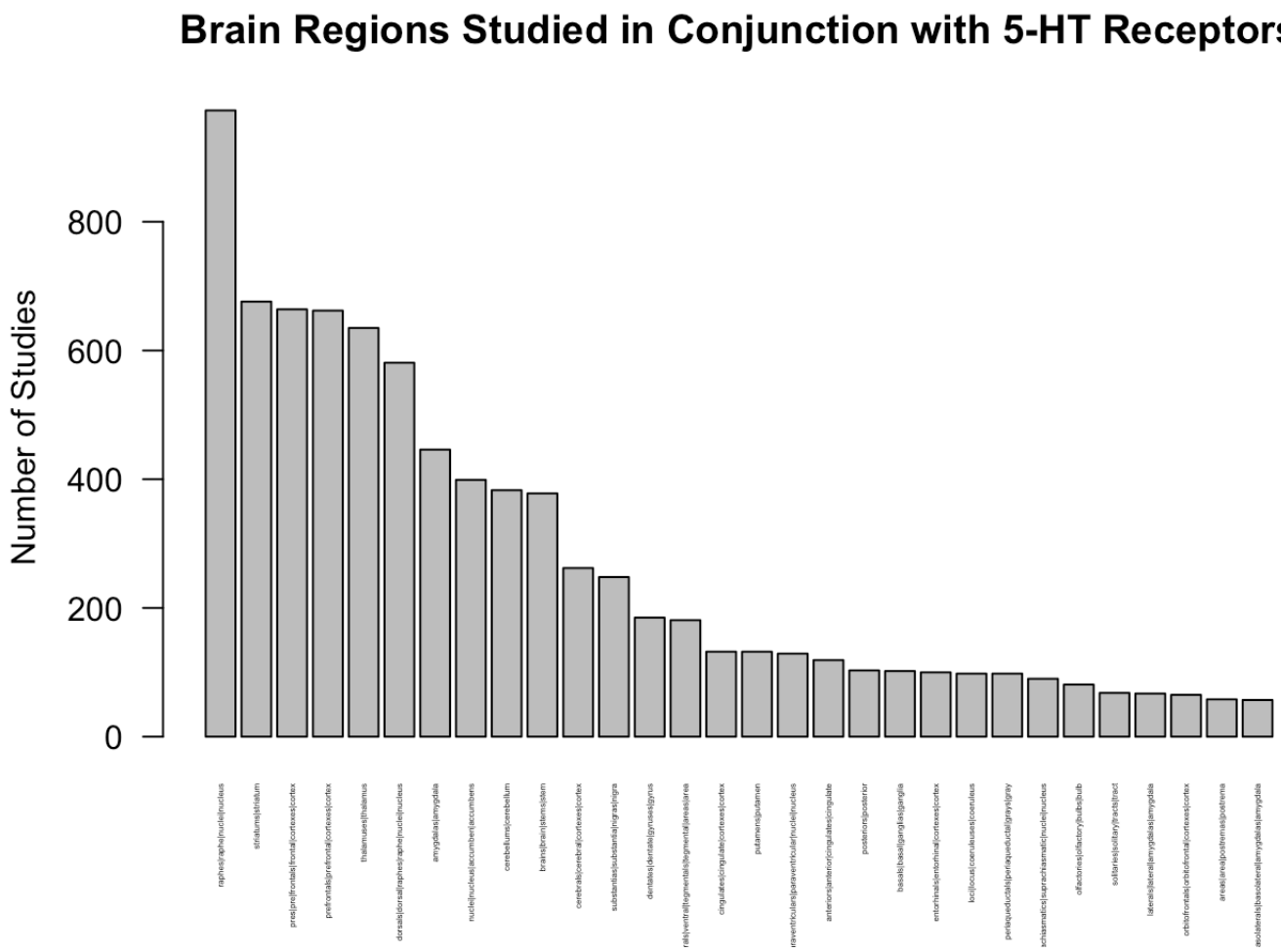


```
Regions <- strsplit(x$Brain_Regions, ";")

Regions <- unlist(Regions)

Regions <- gsub(".*i\\)\\(","", Regions)
Regions <- gsub("\\)\\(-","", Regions)
Regions <- gsub('.{3}$', '', Regions)
Regions <- gsub("\\\\","", Regions)
Regions <- gsub("\\+","", Regions)
Regions <- gsub("s\\)","", Regions)
Regions <- gsub("?\\(","", Regions)
Regions <- gsub("\\?","", Regions)


(regions <- sort(table(Regions), decreasing = TRUE)[c(2:31)])
```

```
## Regions
##                       raphes|raphe|nuclei|nucleus
##                                                973
##                                striatums|striatum
##                                                676
##         pres|pre|frontals|frontal|cortexes|cortex
##                                                664
##            prefrontals|prefrontal|cortexes|cortex
##                                                662
##                               thalamuses|thalamus
##                                                635
##       dorsals|dorsal|raphes|raphe|nuclei|nucleus
##                                                581
##                                amygdalas|amygdala
##                                                446
##                nuclei|nucleus|accumben|accumbens
##                                                399
##                             cerebellums|cerebellum
##                                                383
##                           brains|brain|stems|stem
##                                                378
##                cerebrals|cerebral|cortexes|cortex
##                                                262
##              substantias|substantia|nigras|nigra
##                                                248
##                   dentates|dentate|gyruses|gyrus
##                                                185
## ventrals|ventral|tegmentals|tegmental|areas|area
##                                                181
##              cingulates|cingulate|cortexes|cortex
```

```
##                                                 132
##                                  putamens|putamen
##                                                 132
##  paraventriculars|paraventricular|nuclei|nucleus
##                                                 129
##          anteriors|anterior|cingulates|cingulate
##                                                 119
##                             posteriors|posterior
##                                                 103
##                    basals|basal|ganglias|ganglia
##                                                 102
##           entorhinals|entorhinal|cortexes|cortex
##                                                 100
##                 loci|locus|coeruleuses|coeruleus
##                                                  98
##        periaqueductals|periaqueductal|grays|gray
##                                                  98
##  suprachiasmatics|suprachiasmatic|nuclei|nucleus
##                                                  90
##                olfactories|olfactory|bulbs|bulb
##                                                  81
##                solitaries|solitary|tracts|tract
##                                                  68
##             laterals|lateral|amygdalas|amygdala
##                                                  67
##     orbitofrontals|orbitofrontal|cortexes|cortex
##                                                  65
##                    areas|area|postremas|postrema
##                                                  58
##      basolaterals|basolateral|amygdalas|amygdala
##                                                  57
```

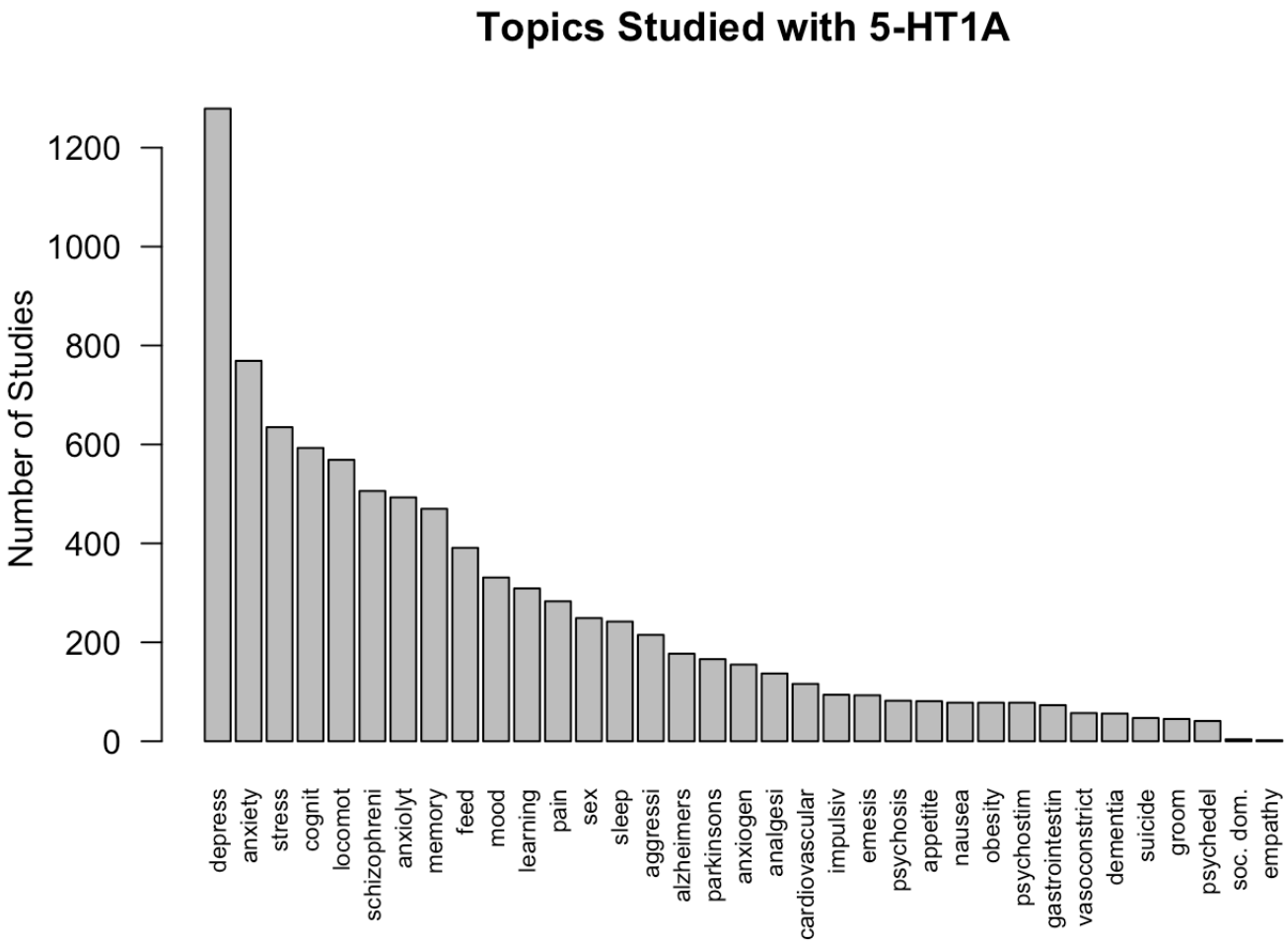
```
barplot(regions, las = 2, cex.names=.25, main = "Brain Regions Studied in Conjunction
with 5-HT Receptors", ylab = "Number of Studies")
```




```
Topics <- strsplit(x$Topic_Spec, ";")

Topics <- unlist(Topics)

Topics <- gsub(".*\\\\","", Topics)
Topics <- substring(Topics, 2)
Topics <- gsub('.{2}$', '', Topics)
Topics <- gsub("social dominance", "soc. dom.", Topics)

(topics <- sort(table(Topics), decreasing = TRUE))
```

```
## Topics
##        depress        anxiety         stress         cognit        locomot
##           1279            769            635            593            569
##   schizophreni       anxiolyt         memory           feed           mood
##            506            493            470            391            331
##       learning           pain            sex          sleep       aggressi
##            309            283            249            242            215
##     alzheimers     parkinsons       anxiogen       analgesi cardiovascular
##            177            166            155            137            116
##       impulsiv        emesis      psychosis       appetite         nausea
##             94             93             82             81             78
##        obesity     psychostim gastrointestin  vasoconstrict       dementia
##             78             78             73             57             56
##        suicide          groom      psychedel      soc. dom.        empathy
##             47             45             41              4              2
```

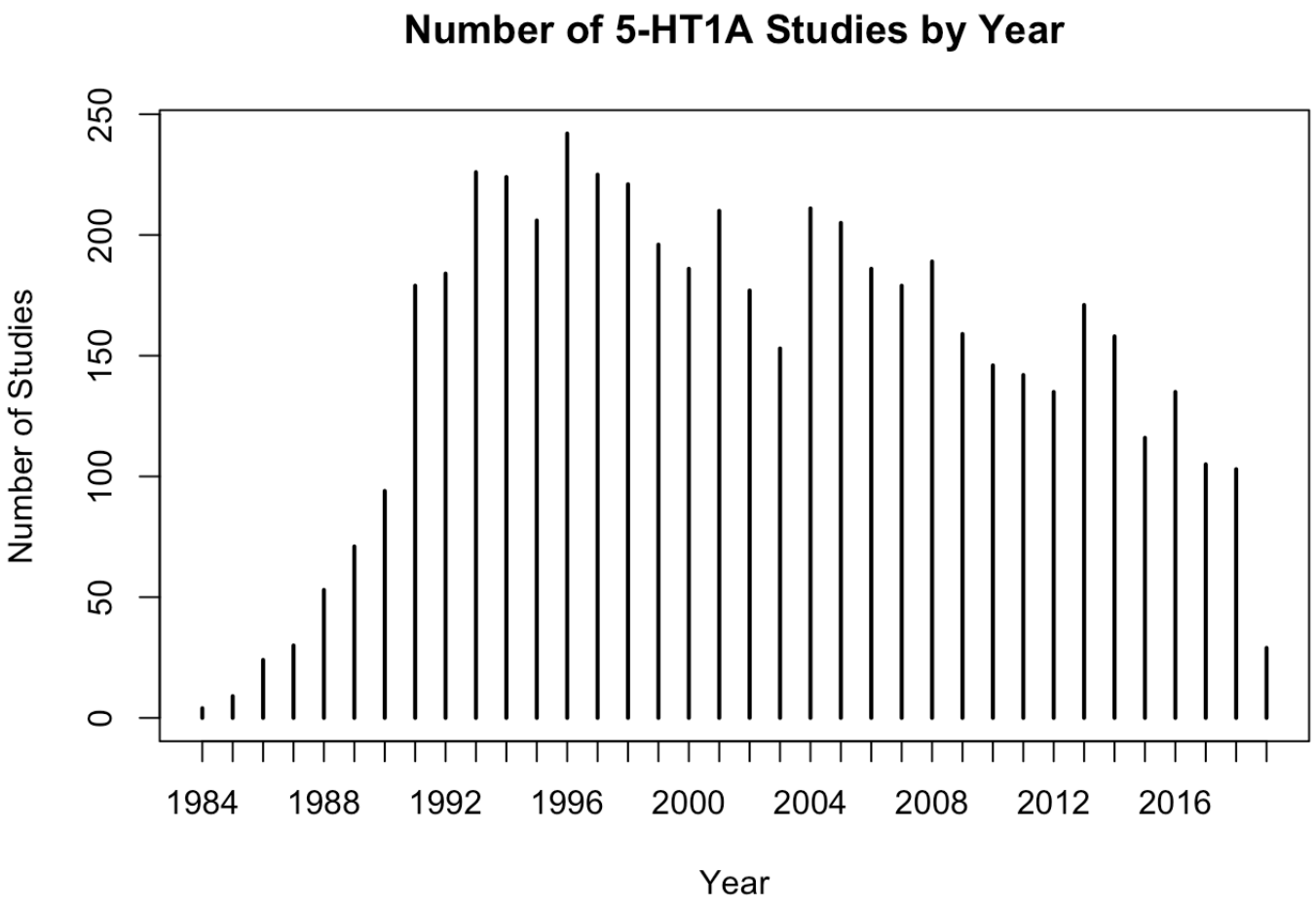
```
barplot(topics, las = 2, cex.names=.7, main = "Topics Studied with 5-HT1A", ylab = "N
umber of Studies")
```



5-HT1A

```
x1a <- subset(x, grepl("5ht1a", x$Receptor))
```

```
plot(table(x1a$Year), main = "Number of 5-HT1A Studies by Year", xlab = "Year", ylab
= "Number of Studies")
```



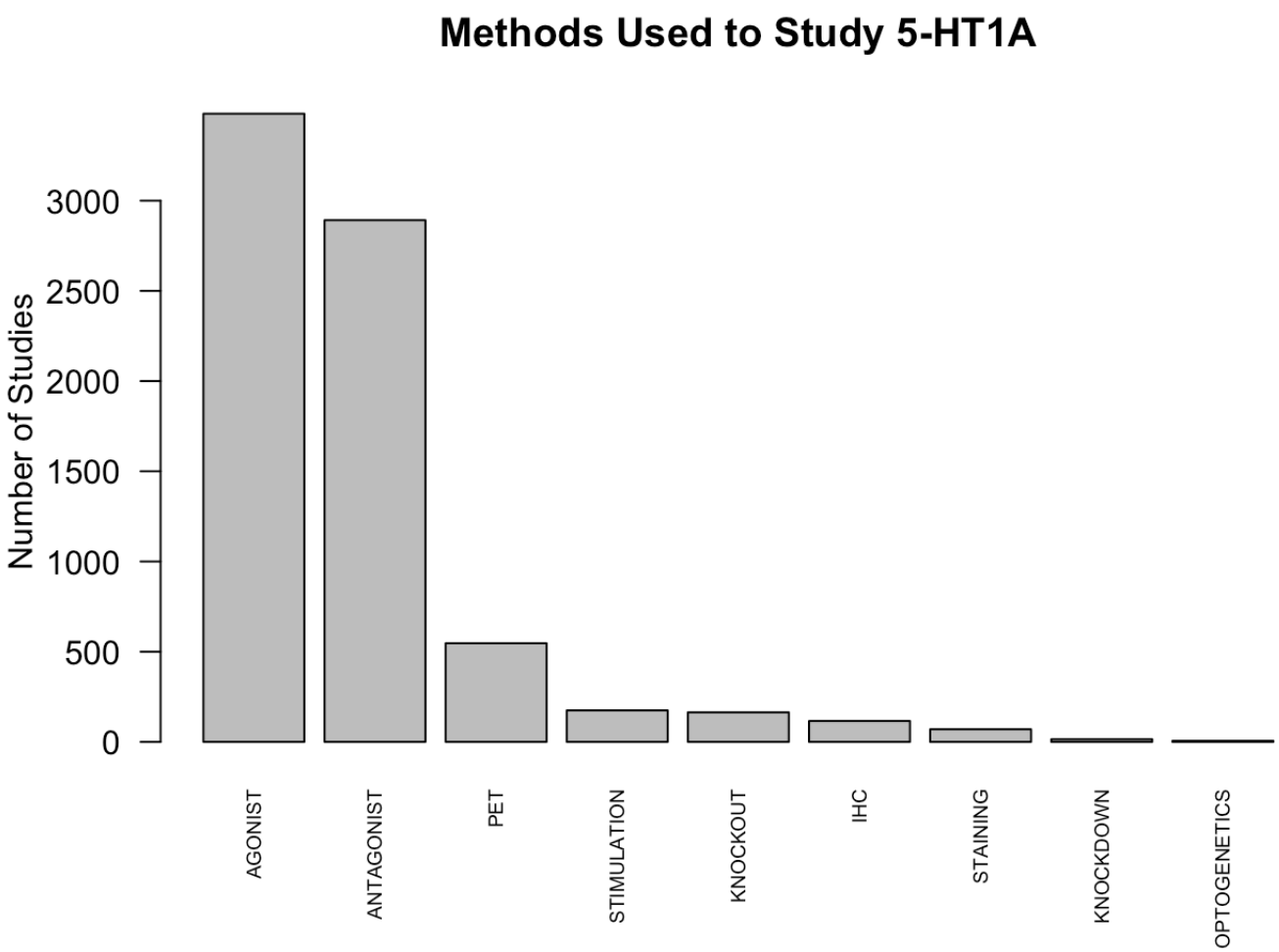

```
sort(table(x1a$Year), decreasing = TRUE)
```

```
##
## 1996 1993 1997 1994 1998 2004 2001 1995 2005 1999 2008 2000 2006 1992 1991
##  242  226  225  224  221  211  210  206  205  196  189  186  186  184  179
## 2007 2002 2013 2009 2014 2003 2010 2011 2012 2016 2015 2017 2018 1990 1989
##  179  177  171  159  158  153  146  142  135  135  116  105  103   94   71
## 1988 1987 2019 1986 1985 1984
##   53   30   29   24    9    4
```

```
Methods1a <- strsplit(x1a$Methods, ";")

Methods1a <- unlist(Methods1a)

Methods1a <- gsub("Method.","", Methods1a)
Methods1a <- gsub("IMMUNOHISTOCHEMISTRY","IHC", Methods1a)

(methods1a <- sort(table(Methods1a), decreasing = TRUE))
```

```
## Methods1a
##      AGONIST   ANTAGONIST          PET  STIMULATION     KNOCKOUT
##         3482         2892          547          175          164
##          IHC     STAINING    KNOCKDOWN OPTOGENETICS
##          116           70           15            6
```

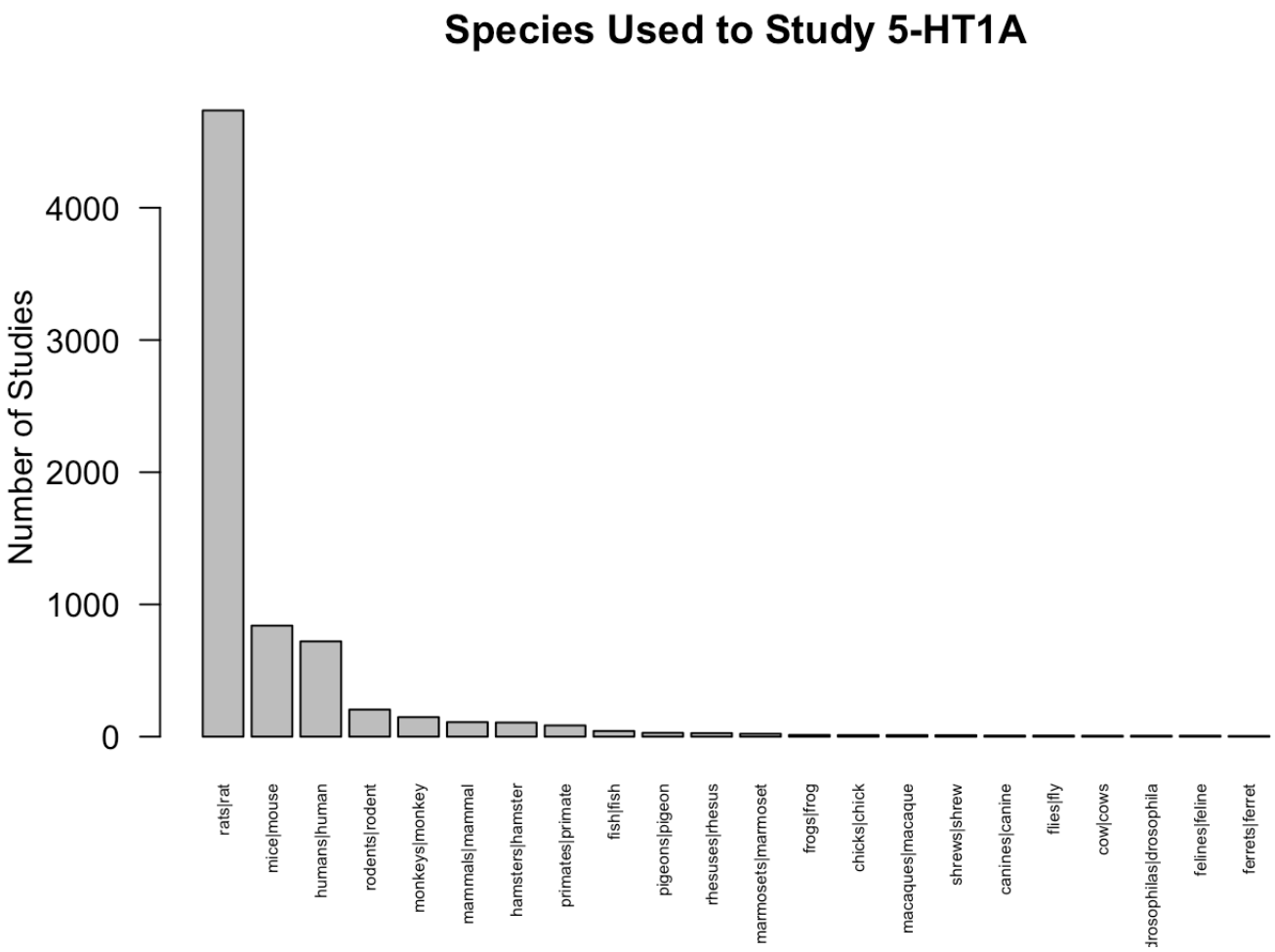
```
barplot(methods1a, las = 2, cex.names=.6, main = "Methods Used to Study 5-HT1A", ylab
= "Number of Studies")
```



```
Species1a <- strsplit(x1a$Species, ";")

Species1a <- unlist(Species1a)

Species1a <- gsub(".*b","", Species1a)
Species1a <- gsub('.{2}$', '', Species1a)
Species1a <- gsub(".*\\(","", Species1a)
Species1a <- gsub('.{1}$', '', Species1a)

#sort(table(Species1a), decreasing = TRUE)

(species1a <- sort(table(Species1a), decreasing = TRUE)[c(1, 24, 31, 54, 62, 71, 73,
83, 108, 120, 124, 133, 154, 163, 166, 168, 181, 185, 190, 191, 192, 207)])
```

```
## Species1a
##               rats|rat             mice|mouse           humans|human
##                   4736                    840                    721
##         rodents|rodent         monkeys|monkey         mammals|mammal
##                    205                    148                    110
##       hamsters|hamster       primates|primate              fish|fish
##                    107                     85                     43
##         pigeons|pigeon        rhesuses|rhesus     marmosets|marmoset
##                     29                     27                     22
##             frogs|frog          chicks|chick       macaques|macaque
##                     13                     12                     12
##           shrews|shrew         canines|canine              flies|fly
##                     11                      8                      8
##               cow|cows drosophilas|drosophila         felines|feline
##                      7                      7                      7
##         ferrets|ferret
##                      5
```

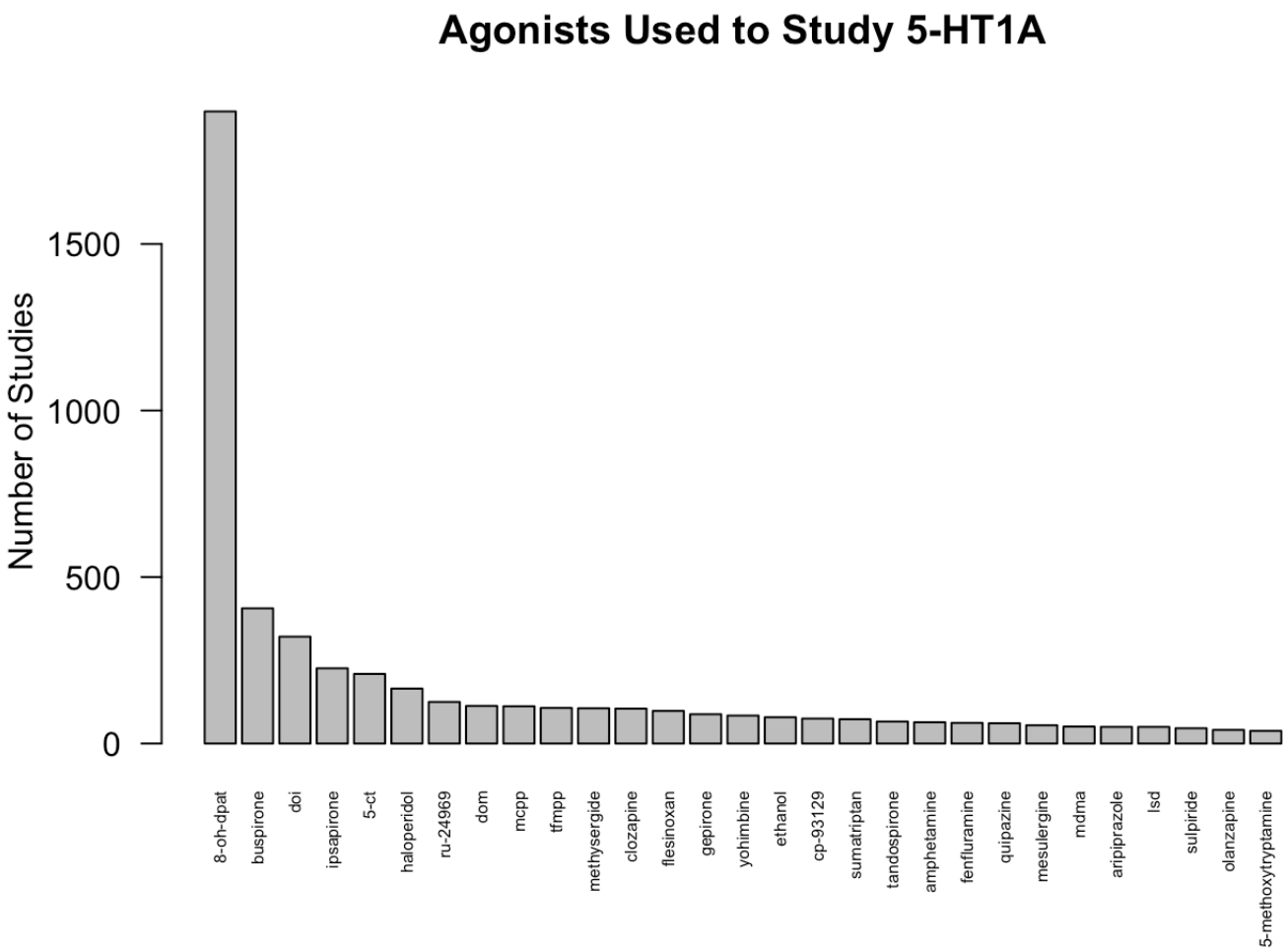
```
barplot(species1a, las = 2, cex.names=.5, main = "Species Used to Study 5-HT1A", ylab
= "Number of Studies")
```




```
Agonists1a <- strsplit(x1a$Agonist, ";")

Agonists1a <- unlist(Agonists1a)
Agonists1a <- gsub(".*\\\\","", Agonists1a)
Agonists1a <- substring(Agonists1a, 2)
Agonists1a <- gsub('.{2}$', '', Agonists1a)
Agonists1a <- gsub("\\?", "-", Agonists1a)
Agonists1a <- gsub(" ", "", Agonists1a)

Agonists1a <- gsub("5-carboxamidotryptamine", "5-ct", Agonists1a)

#sort(table(Agonists1a), decreasing = TRUE)
(agonists1a <- sort(table(Agonists1a), decreasing = TRUE)[c(1, 3:30)])
```

```
## Agonists1a
##           8-oh-dpat           buspirone                 doi
##                1898                 406                 321
##         ipsapirone               5-ct        haloperidol
##                 226                 209                 165
##           ru-24969                 dom                mcpp
##                 125                 113                 112
##              tfmpp        methysergide           clozapine
##                 107                 106                 105
##         flesinoxan            gepirone           yohimbine
##                  98                  88                  84
##            ethanol           cp-93129         sumatriptan
##                  79                  75                  73
##       tandospirone         amphetamine        fenfluramine
##                  66                  64                  62
##          quipazine         mesulergine                mdma
##                  61                  55                  51
##       aripiprazole                 lsd           sulpiride
##                  50                  50                  46
##         olanzapine 5-methoxytryptamine
##                  41                  38
```

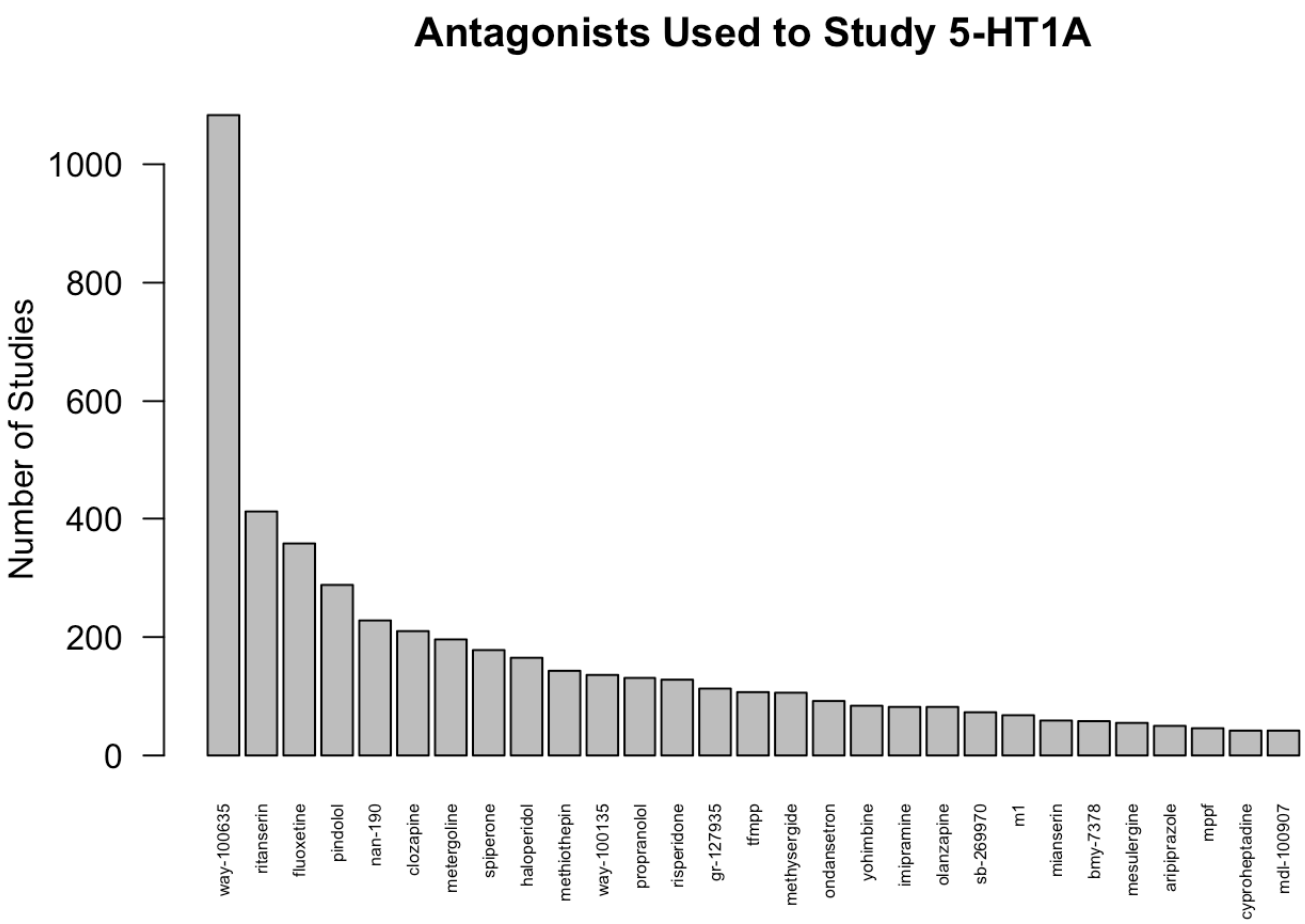
```
barplot(agonists1a, las = 2, cex.names=.5, main = "Agonists Used to Study 5-HT1A", yl
ab = "Number of Studies")
```




```
Antagonists1a <- strsplit(x1a$Antagonist, ";")

Antagonists1a <- unlist(Antagonists1a)

Antagonists1a <- gsub(".*\\\\","", Antagonists1a)
Antagonists1a <- substring(Antagonists1a, 2)
Antagonists1a <- gsub('.{2}$', '', Antagonists1a)
Antagonists1a <- gsub("\\?", "-", Antagonists1a)
Antagonists1a <- gsub(" ", "", Antagonists1a)


#sort(table(Antagonists1a), decreasing = TRUE)

#a <- read.csv("Antagonists_List.csv", as.is = TRUE)
#sort(table(a$Antagonist))

(antagonists1a <- sort(table(Antagonists1a), decreasing = TRUE)[c(1, 3:30)])
```

```
## Antagonists1a
##     way-100635     ritanserin     fluoxetine       pindolol        nan-190
##           1083            412            358            288            228
##      clozapine    metergoline      spiperone    haloperidol   methiothepin
##            210            196            178            165            143
##     way-100135    propranolol    risperidone      gr-127935          tfmpp
##            136            131            128            113            107
##   methysergide    ondansetron      yohimbine     imipramine     olanzapine
##            106             92             84             82             82
##      sb-269970             m1      mianserin       bmy-7378    mesulergine
##             73             68             59             58             55
##   aripiprazole           mppf cyproheptadine     mdl-100907
##             50             46             42             42
```

```
barplot(antagonists1a, las = 2, cex.names=.5, main = "Antagonists Used to Study 5-HT1
A", ylab = "Number of Studies")
```

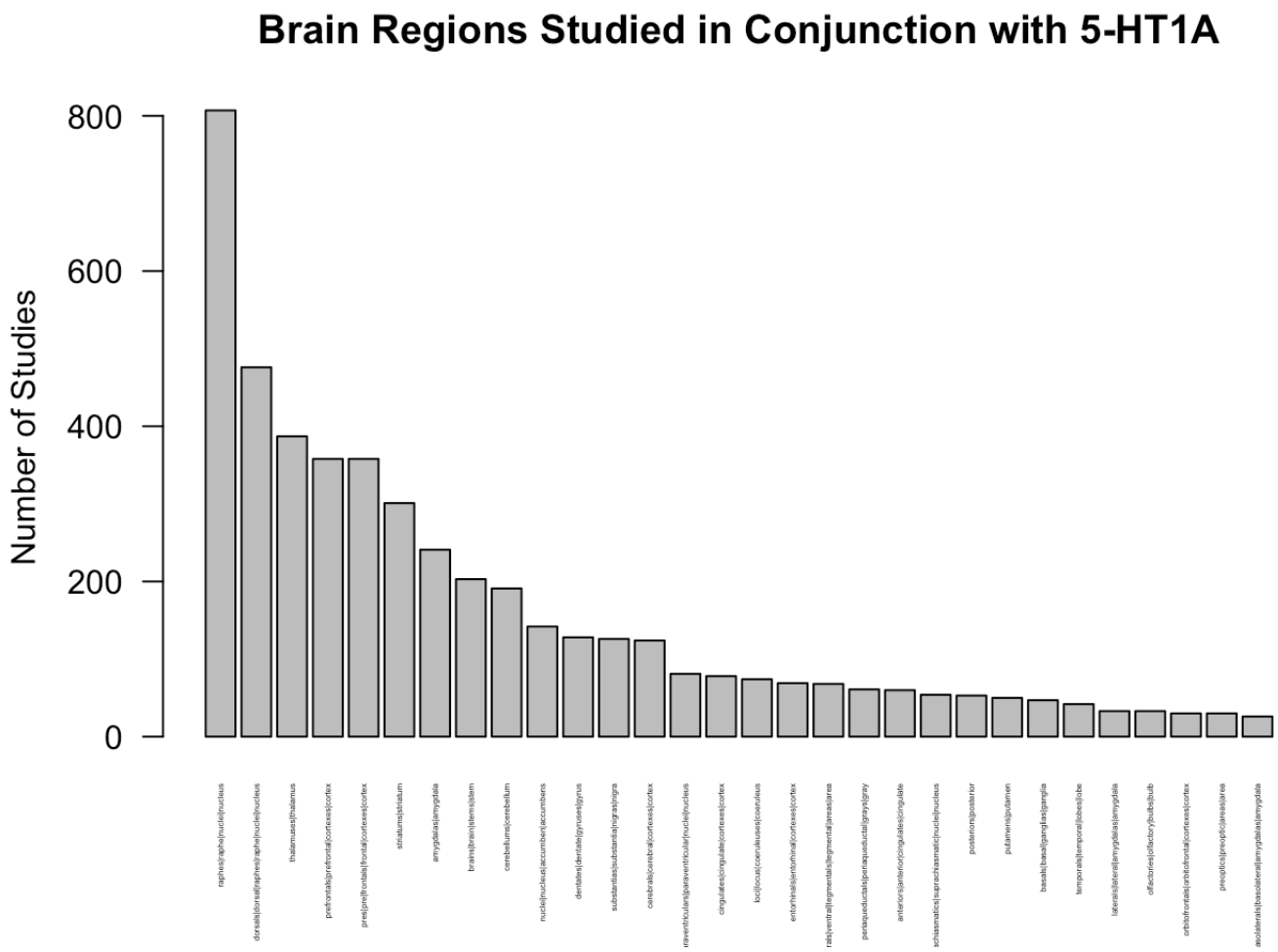


```
Regions1a <- strsplit(x1a$Brain_Regions, ";")

Regions1a <- unlist(Regions1a)

Regions1a <- gsub(".*i\\)\\(","", Regions1a)
Regions1a <- gsub("\\)\\(-","", Regions1a)
Regions1a <- gsub('.{3}$', '', Regions1a)
Regions1a <- gsub("\\\\","", Regions1a)
Regions1a <- gsub("\\+","", Regions1a)
Regions1a <- gsub("s\\)","", Regions1a)
Regions1a <- gsub("?\\(","", Regions1a)
Regions1a <- gsub("\\?","", Regions1a)



#sort(table(Regions1a), decreasing = TRUE)
(regions1a <- sort(table(Regions1a), decreasing = TRUE)[c(2:31)])
```

```
## Regions1a
##                       raphes|raphe|nuclei|nucleus
##                                                807
##       dorsals|dorsal|raphes|raphe|nuclei|nucleus
##                                                476
##                                thalamuses|thalamus
##                                                387
##           prefrontals|prefrontal|cortexes|cortex
##                                                358
##        pres|pre|frontals|frontal|cortexes|cortex
##                                                358
##                                striatums|striatum
##                                                301
##                                amygdalas|amygdala
##                                                241
##                           brains|brain|stems|stem
##                                                203
##                            cerebellums|cerebellum
##                                                191
##                nuclei|nucleus|accumben|accumbens
##                                                142
##                   dentates|dentate|gyruses|gyrus
##                                                128
##              substantias|substantia|nigras|nigra
##                                                126
##               cerebrals|cerebral|cortexes|cortex
##                                                124
##  paraventriculars|paraventricular|nuclei|nucleus
```

```
##                                                 81
##             cingulates|cingulate|cortexes|cortex
##                                                 78
##                 loci|locus|coeruleuses|coeruleus
##                                                 74
##           entorhinals|entorhinal|cortexes|cortex
##                                                 69
## ventrals|ventral|tegmentals|tegmental|areas|area
##                                                 68
##        periaqueductals|periaqueductal|grays|gray
##                                                 61
##          anteriors|anterior|cingulates|cingulate
##                                                 60
##  suprachiasmatics|suprachiasmatic|nuclei|nucleus
##                                                 54
##                              posteriors|posterior
##                                                 53
##                                 putamens|putamen
##                                                 50
##                   basals|basal|ganglias|ganglia
##                                                 47
##                   temporals|temporal|lobes|lobe
##                                                 42
##              laterals|lateral|amygdalas|amygdala
##                                                 33
##                olfactories|olfactory|bulbs|bulb
##                                                 33
##     orbitofrontals|orbitofrontal|cortexes|cortex
##                                                 30
##                   preoptics|preoptic|areas|area
##                                                 30
##      basolaterals|basolateral|amygdalas|amygdala
##                                                 26
```

```
barplot(regions1a, las = 2, cex.names=.25, main = "Brain Regions Studied in Conjuncti
on with 5-HT1A", ylab = "Number of Studies")
```




```
Topics1a <- strsplit(x1a$Topic_Spec, ";")

Topics1a <- unlist(Topics1a)

Topics1a <- gsub(".*\\\\","", Topics1a)
Topics1a <- substring(Topics1a, 2)
Topics1a <- gsub('.{2}$', '', Topics1a)
Topics1a <- gsub("social dominance", "soc. dom.", Topics1a)

(topics1a <- sort(table(Topics1a), decreasing = TRUE))
```

```
## Topics1a
##        depress        anxiety         stress       anxiolyt        locomot
##            821            486            401            365            299
##         cognit           feed   schizophreni         memory           mood
##            256            229            218            215            192
##            sex       learning          sleep       aggressi           pain
##            178            140            140            128            106
##       anxiogen     parkinsons cardiovascular       analgesi     alzheimers
##             94             94             71             66             53
##       impulsiv       dementia        suicide      psychosis     psychostim
##             35             34             33             28             27
##          groom       appetite  vasoconstrict         nausea gastrointestin
##             24             22             19             15             13
##        obesity      psychedel         emesis      soc. dom.
##             11              7              6              1
```

```
barplot(topics1a, las = 2, cex.names=.7, main = "Topics Studied with 5-HT1A", ylab =
"Number of Studies")
```