Polishing Your Plots

```
scale_<MAPPING>_<KIND>()
```

MORE ABOUT SCALE FUNCTIONS

BUILD YOUR PLOTS A PIECE AT A TIME

```r
head(asasec)
```

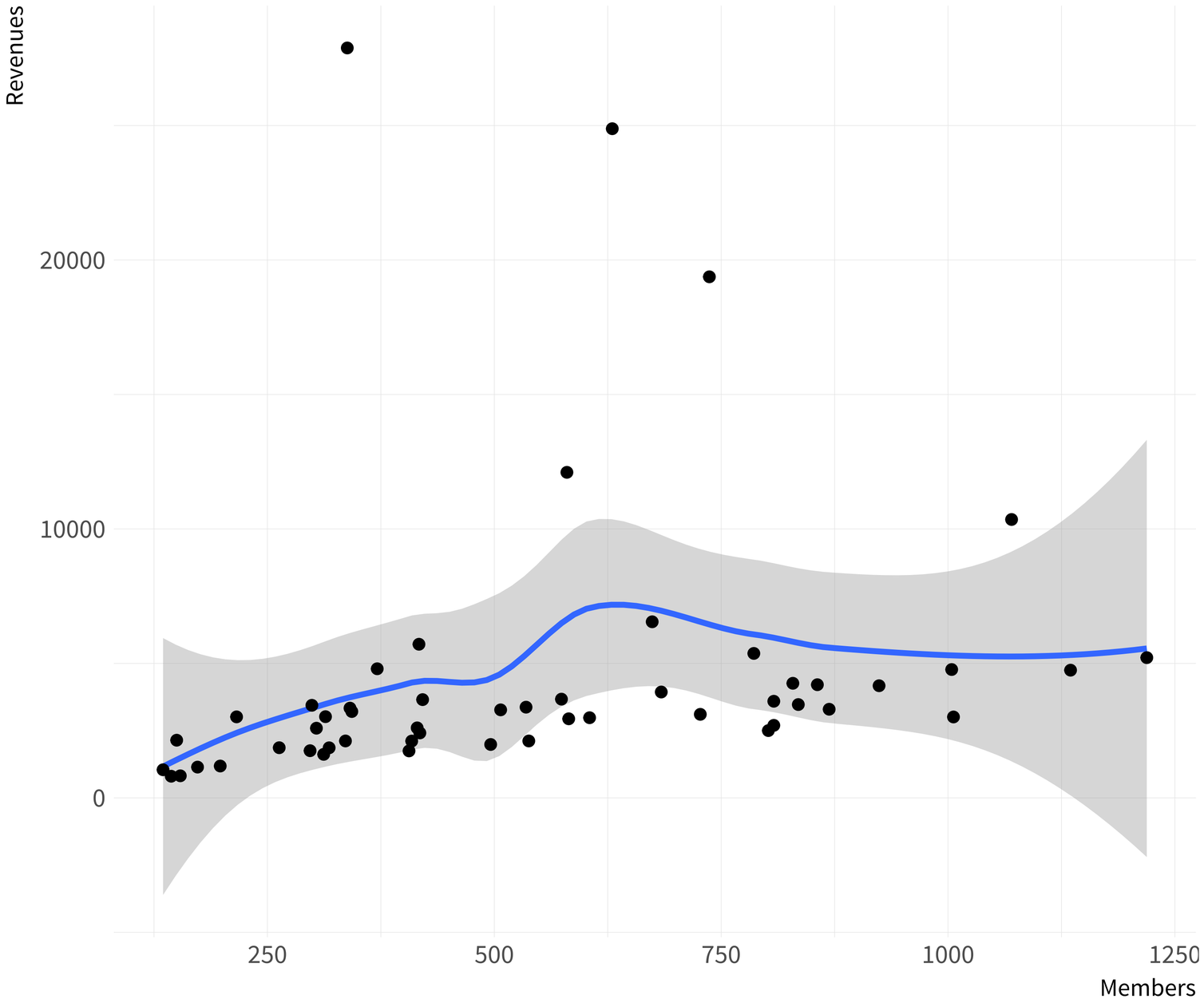
```
##                                Section         Sname Beginning Revenues Expenses Ending Journal Year Members
## 1      Aging and the Life Course (018)         Aging     12752    12104    12007  12849      No 2005     598
## 2     Alcohol, Drugs and Tobacco (030) Alcohol/Drugs     11933     1144      400  12677      No 2005     301
## 3 Altruism and Social Solidarity (047)      Altruism      1139     1862     1875   1126      No 2005      NA
## 4            Animals and Society (042)       Animals       473      820     1116    177      No 2005     209
## 5             Asia/Asian America (024)          Asia      9056     2116     1710   9462      No 2005     365
## 6            Body and Embodiment (048)          Body      3408     1618     1920   3106      No 2005      NA
```

```r
dim(asasec)
```

```
## [1] 572   9
```

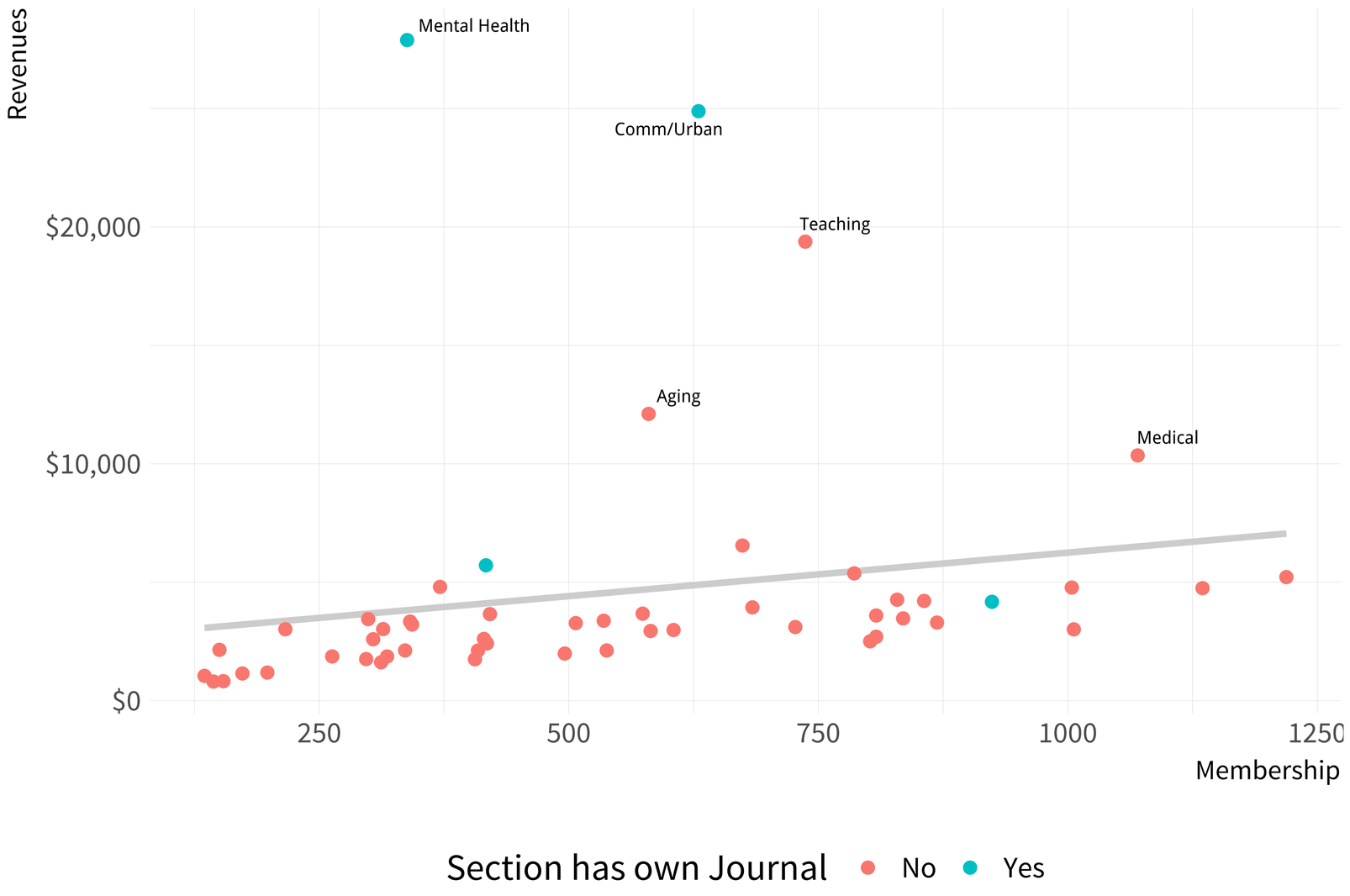
```r
p <- ggplot(subset(asasec, Year == 2014),
            mapping = aes(x = Members, y = Revenues, label = Sname))
p + geom_smooth() + geom_point()
```

```
## `geom_smooth()` using method = 'loess'
```

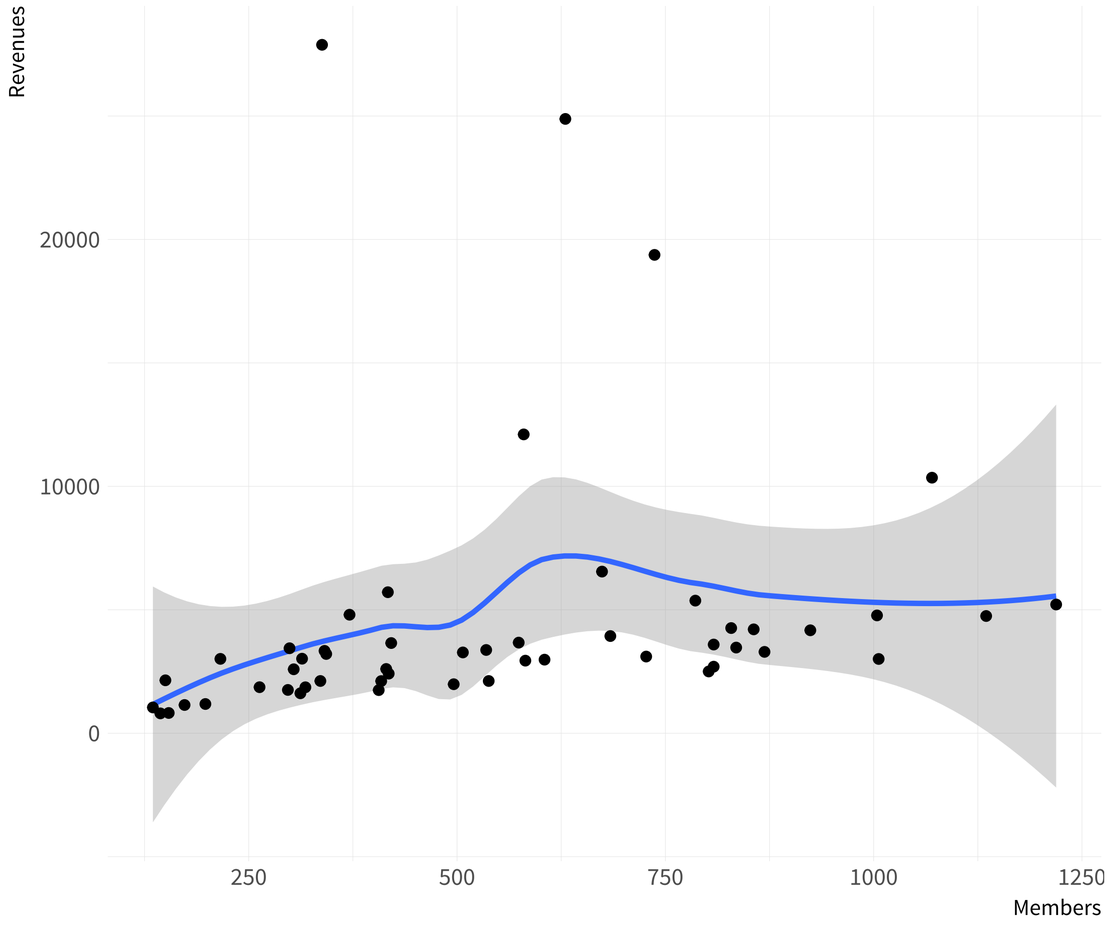

Revenues
20000
10000
0
250
500
750
1000
1250
Members

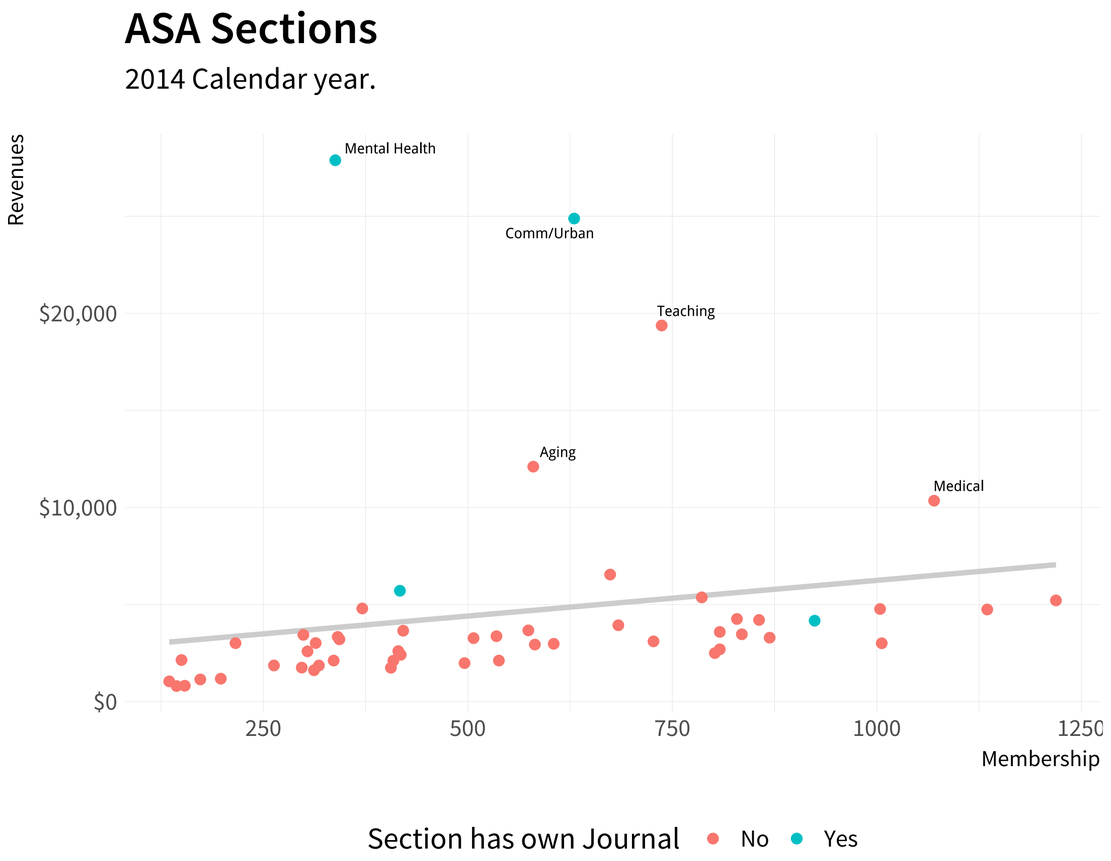
ASA Sections

2014 Calendar year.



Source: ASA annual report.


Revenues
20000
10000
0
250
500
750
1000
1250
Members


ASA Sections
2014 Calendar year.
Revenues
Mental Health
Comm/Urban
Teaching
Aging
Medical
$20,000
$10,000
$0
250
500
750
1000
1250
Membership
Section has own Journal
No
Yes
Source: ASA annual report.

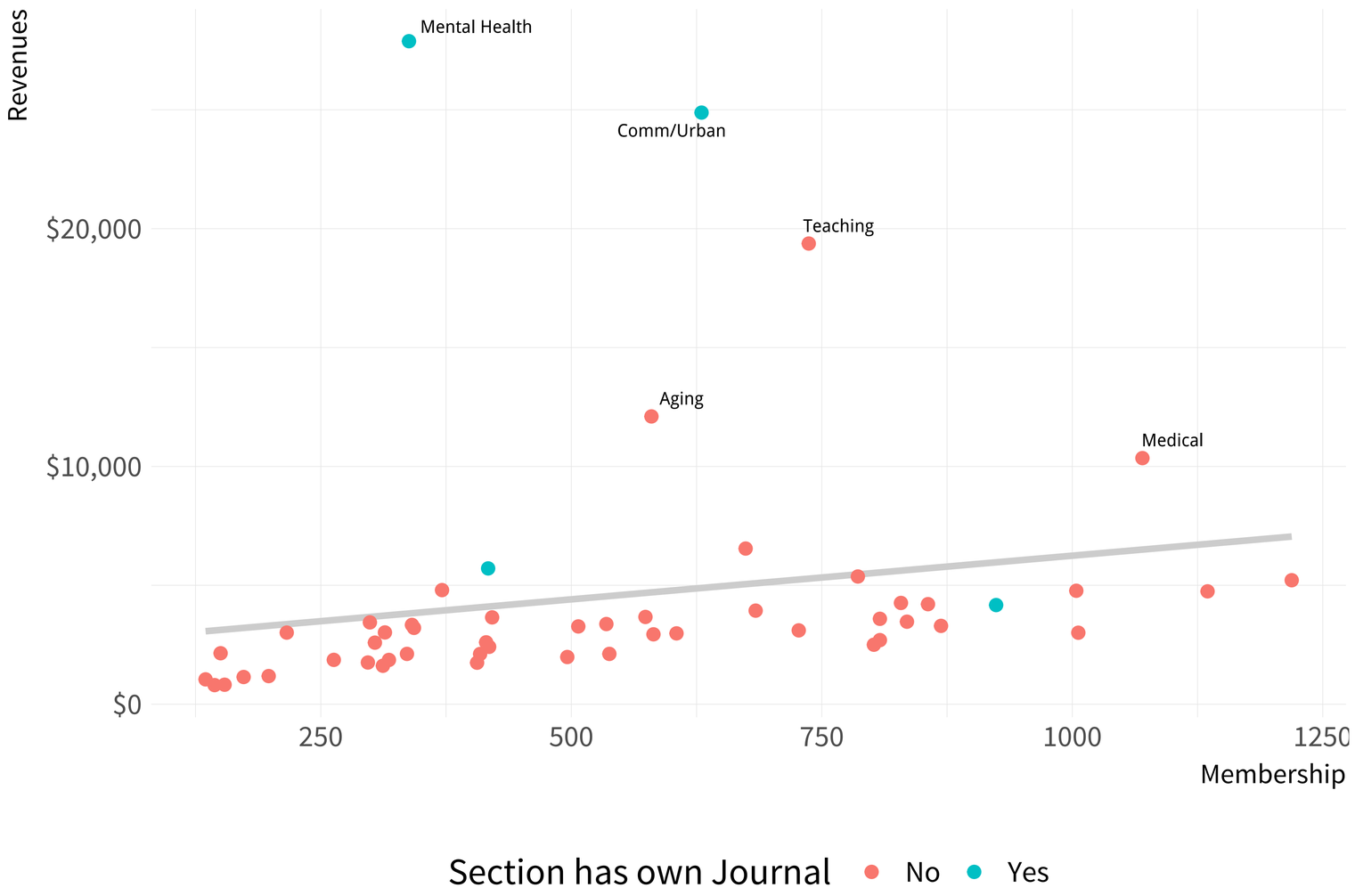
```r
p <- ggplot(subset(asasec, Year == 2014),
            mapping = aes(x = Members, y = Revenues, label = Sname))

p + geom_smooth(method = "lm", se = FALSE, color = "gray80") +
    geom_point(mapping = aes(color = Journal)) +
    geom_text_repel(data=subset(asasec,
                                Year == 2014 & Revenues > 7000))
```

```r
p0 <- ggplot(subset(asasec, Year == 2014),
             mapping = aes(x = Members, y = Revenues, label = Sname))

p1 <- p0 + geom_smooth(method = "lm", se = FALSE, color = "gray80") +
    geom_point(mapping = aes(color = Journal))

p2 <- p1 + geom_text_repel(data=subset(asasec,
                                       Year == 2014 & Revenues > 7000),
                           size = 2)
```

```r
p3 <- p2 + labs(x="Membership",
         y="Revenues",
         color = "Section has own Journal",
         title = "ASA Sections",
         subtitle = "2014 Calendar year.",
         caption = "Source: ASA annual report.")
p4 <- p3 + scale_y_continuous(labels = scales::dollar) +
     theme(legend.position = "bottom")
p4
```

ASA Sections

2014 Calendar year.



Source: ASA annual report.

USE COLOR TO YOUR ADVANTAGE

color and fill
SCALE FUNCTIONS

```
scale_<MAPPING>_<KIND>(<ARGUMENTS>)
```

```
p <- ggplot(data = organdata,
            mapping = aes(x = roads,
                          y = donors,
                          color = world))
```

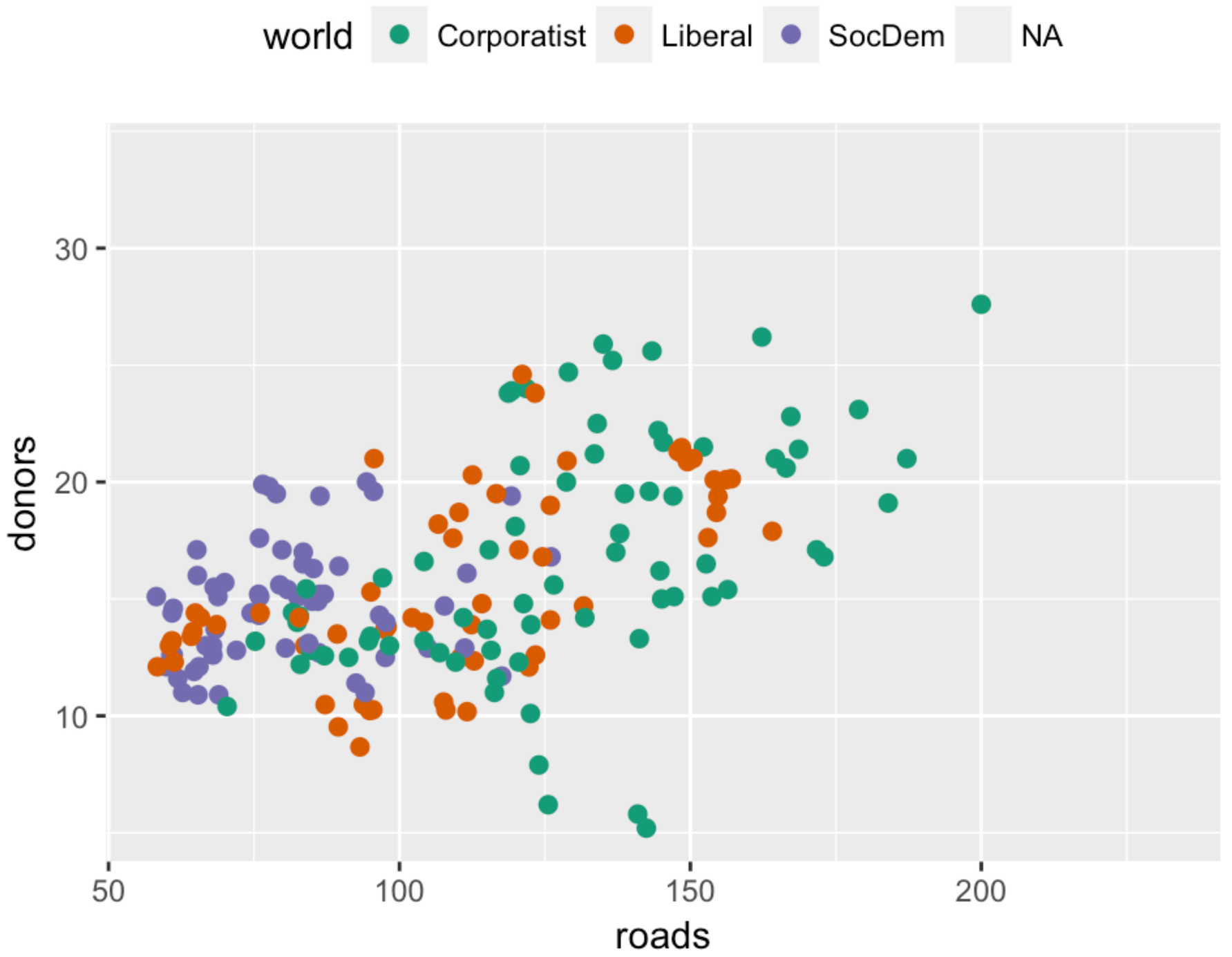
```
p + geom_point() + scale_color_hue(l = 40,
                                   c = 40)
```

You can choose values directly, but it's better to use RColorBrewer or colorspace

```
scale_<MAPPING>_<KIND>(<ARGUMENTS>)
```

```
p + geom_point(size = 2) + scale_color_brewer(palette = "Set2") +
    theme(legend.position = "top")

p + geom_point(size = 2) + scale_color_brewer(palette = "Pastel2") +
        theme(legend.position = "top")

p + geom_point(size = 2) + scale_color_brewer(palette = "Dark2") +
    theme(legend.position = "top")

p + geom_point(size = 2) + scale_color_brewer(palette = "Accent") +
    theme(legend.position = "top")
```

Remember color refers to the mapping

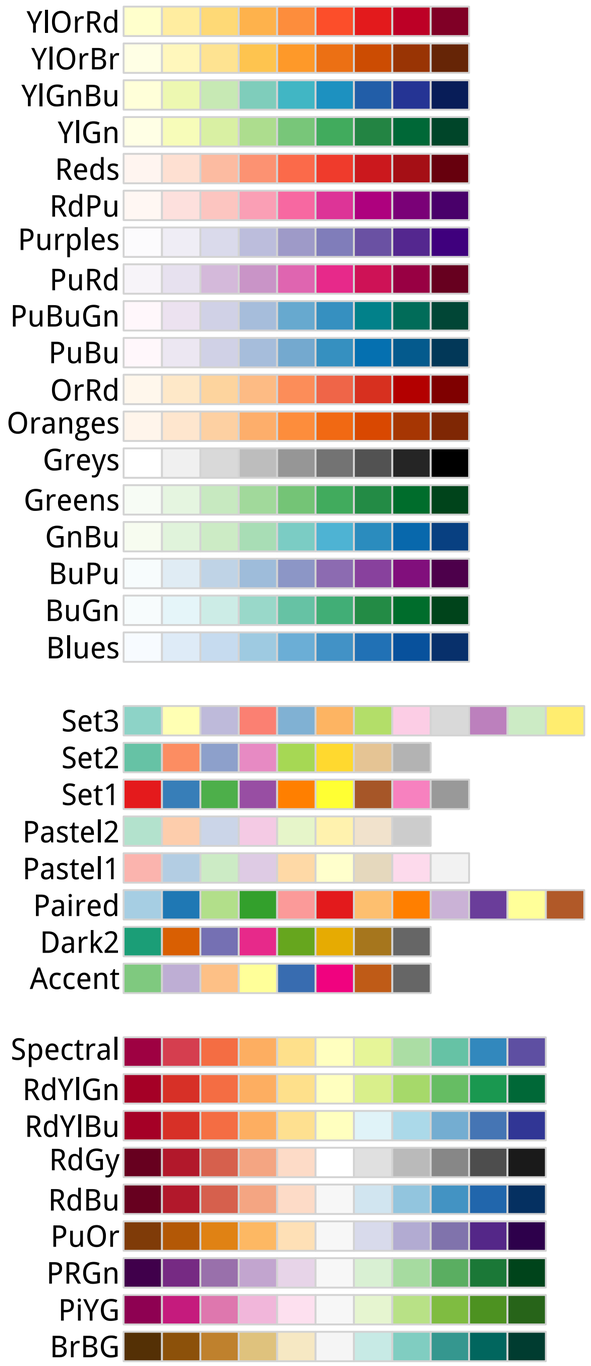

world
Corporatist
Liberal
SocDem
NA
30
20
10
donors
50
100
150
200
roads

```r
library(RColorBrewer)
display.brewer.all()
```

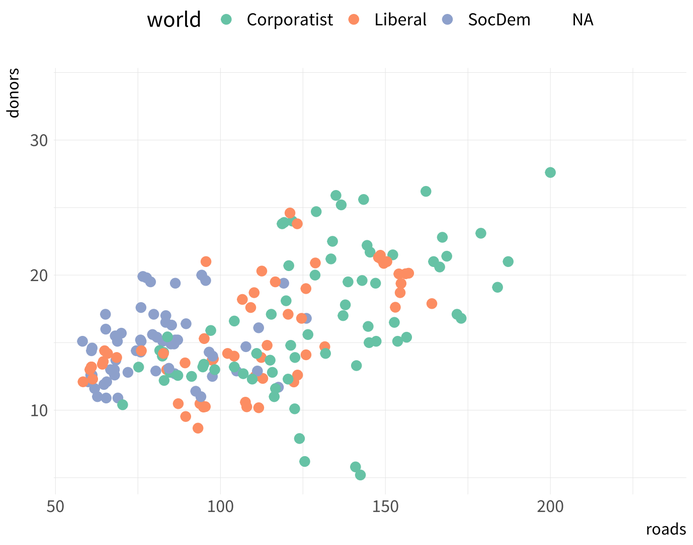
```r
scale_color_brewer()
```

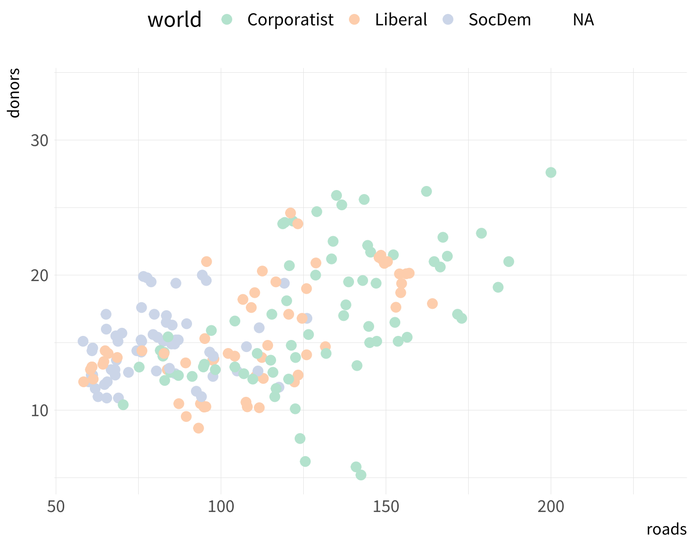
```r
scale_fill_brewer()
```

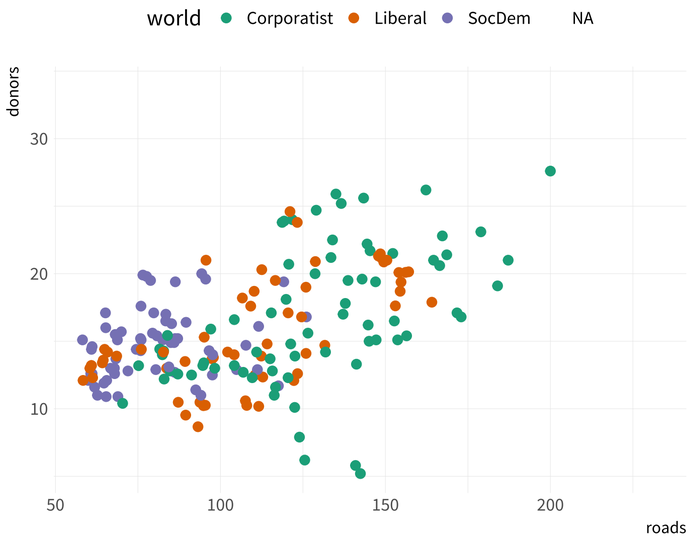
```r
scale_fill_manual(values = <NAME>)
```

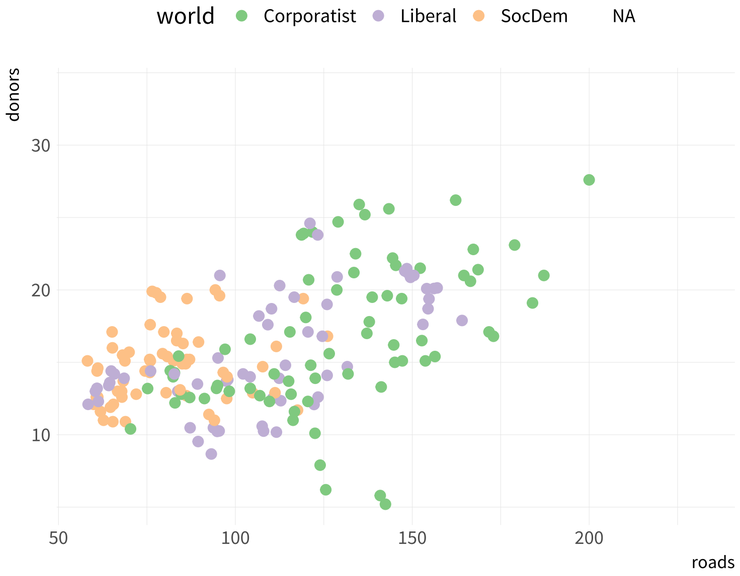


```r
p <- ggplot(data = organdata,
            mapping = aes(x = roads, y = donors, color = world))

p + geom_point(size = 2) + scale_color_brewer(palette = "Set2") +
    theme(legend.position = "top")

p + geom_point(size = 2) + scale_color_brewer(palette = "Pastel2") +
        theme(legend.position = "top")

p + geom_point(size = 2) + scale_color_brewer(palette = "Dark2") +
    theme(legend.position = "top")

p + geom_point(size = 2) + scale_color_brewer(palette = "Accent") +
    theme(legend.position = "top")
```


world
Corporatist
Liberal
SocDem
NA
donors
30
20
10
50
100
150
200
roads


world
Corporatist
Liberal
SocDem
NA
donors
30
20
10
50
100
150
200
roads


world
Corporatist
Liberal
SocDem
NA
donors
30
20
10
50
100
150
200
roads


world
Corporatist
Liberal
SocDem
NA
donors
30
20
10
50
100
150
200
roads

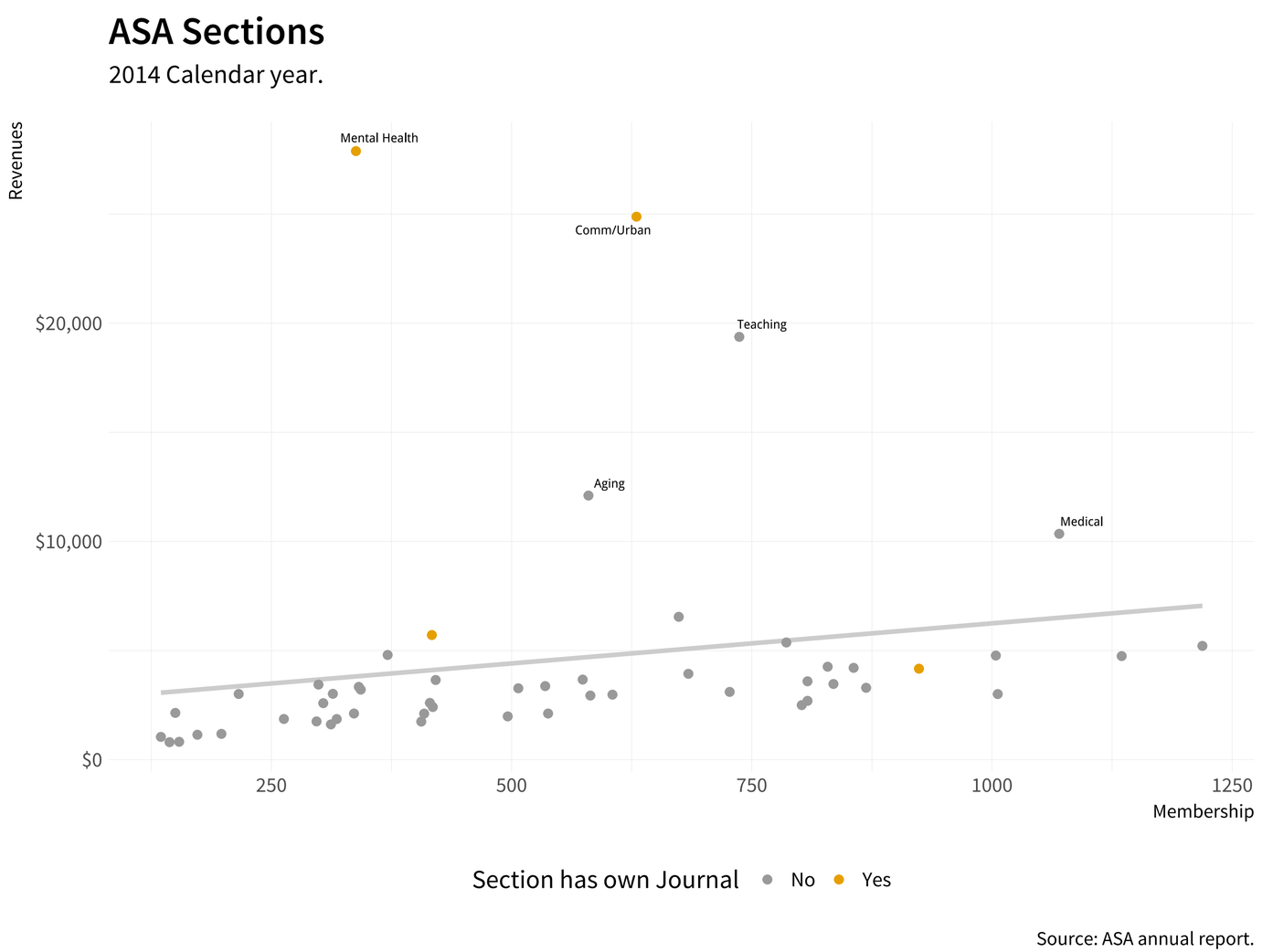
```r
library("colorspace")
hcl_palettes(plot = TRUE)
```

```r
library("colorspace")
hcl_palettes(plot = TRUE)
```

```
scale_<mapping>_<kind>_<colorscale>()
```

[scale_color_continuous_diverging](#)
[scale_color_continuous_divergingx](#)
[scale_color_continuous_qualitative](#)
[scale_color_continuous_sequential](#)
[scale_color_discrete_diverging](#)
[scale_color_discrete_divergingx](#)
[scale_color_discrete_qualitative](#)
[scale_color_discrete_sequential](#)
[scale_colour_continuous_diverging](#)
[scale_colour_continuous_divergingx](#)
[scale_colour_continuous_qualitative](#)
[scale_colour_continuous_sequential](#)
[scale_colour_discrete_diverging](#)
[scale_colour_discrete_divergingx](#)
[scale_colour_discrete_qualitative](#)
[scale_colour_discrete_sequential](#)
[scale_fill_continuous_diverging](#)
[scale_fill_continuous_divergingx](#)
[scale_fill_continuous_qualitative](#)
[scale_fill_continuous_sequential](#)
[scale_fill_discrete_diverging](#)
[scale_fill_discrete_divergingx](#)
[scale_fill_discrete_qualitative](#)
[scale_fill_discrete_sequential](#)

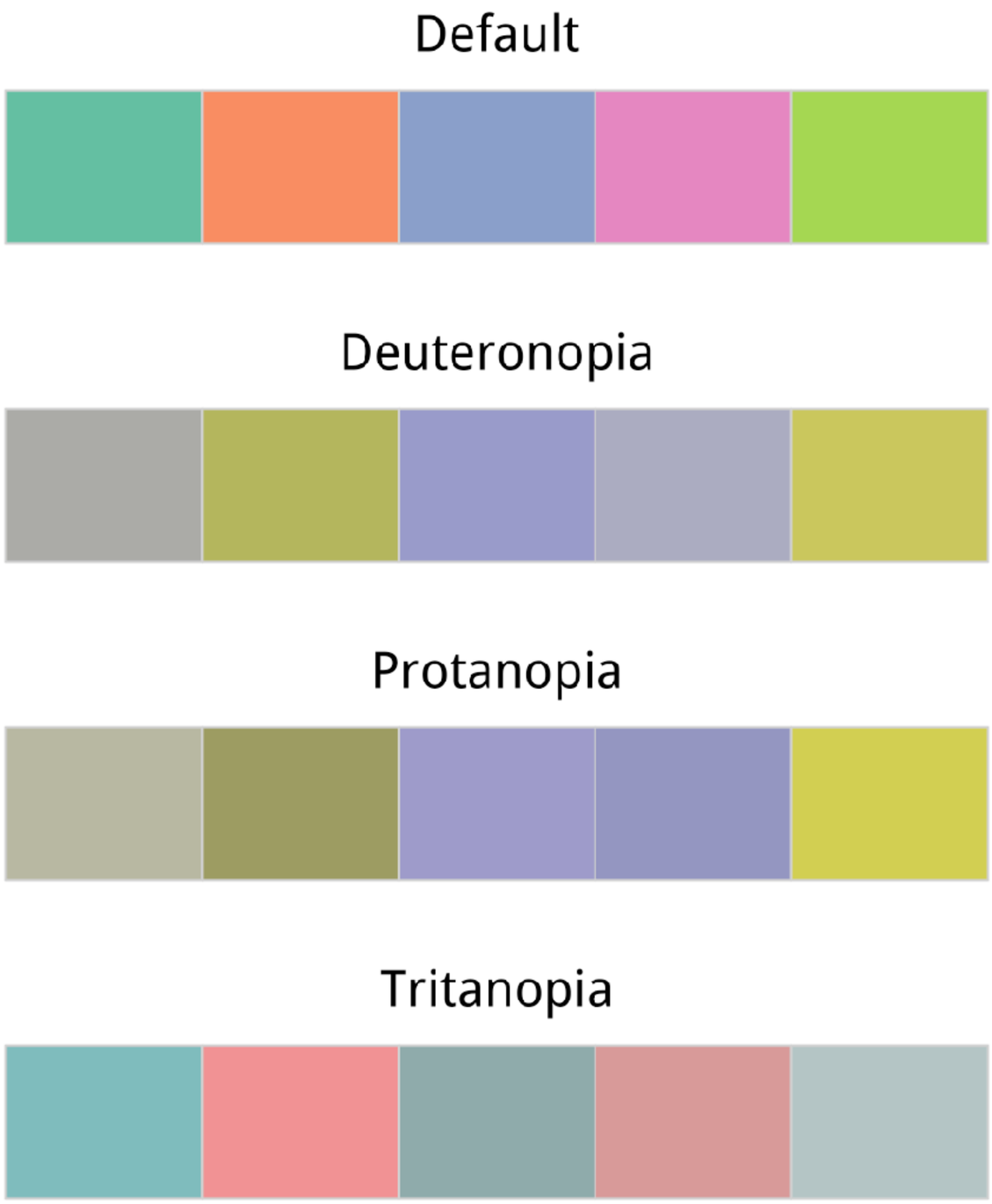
```r
cb_palette <- c("#999999", "#E69F00", "#56B4E9", "#009E73",
                "#F0E442", "#0072B2", "#D55E00", "#CC79A7")

p4 + scale_color_manual(values = cb_palette)
```



```r
Default <- brewer.pal(5, "Set2")

library(dichromat)

types <- c("deutan", "protan", "tritan")
names(types) <- c("Deuteronopia", "Protanopia", "Tritanopia")

color_table <- types %>%
    purrr::map(~ dichromat(Default, .x)) %>%
    as_tibble() %>%
    add_column(Default, .before = TRUE)

color_table
```

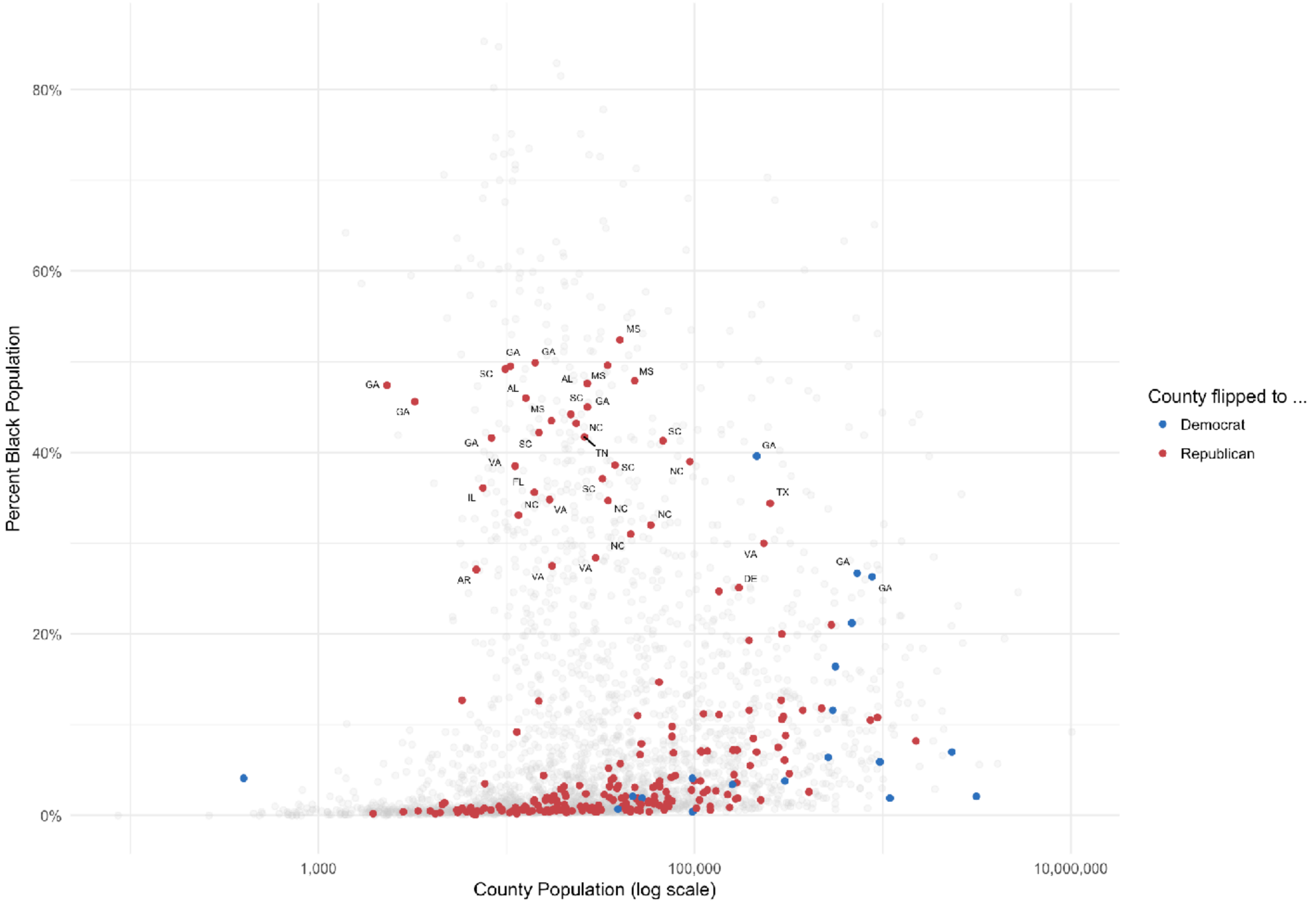
```
## # A tibble: 5 x 4
##   Default Deuteronopia Protanopia Tritanopia
##   <chr>   <chr>        <chr>      <chr>
## 1 #66C2A5 #AEAEA7      #BABAA5    #82BDBD
## 2 #FC8D62 #B6B661      #9E9E63    #F29494
## 3 #8DA0CB #9C9CCB      #9E9ECB    #92ABAB
## 4 #E78AC3 #ACACC1      #9898C3    #DA9C9C
## 5 #A6D854 #CACA5E      #D3D355    #B6C8C8
```

```r
color_comp(color_table)
```



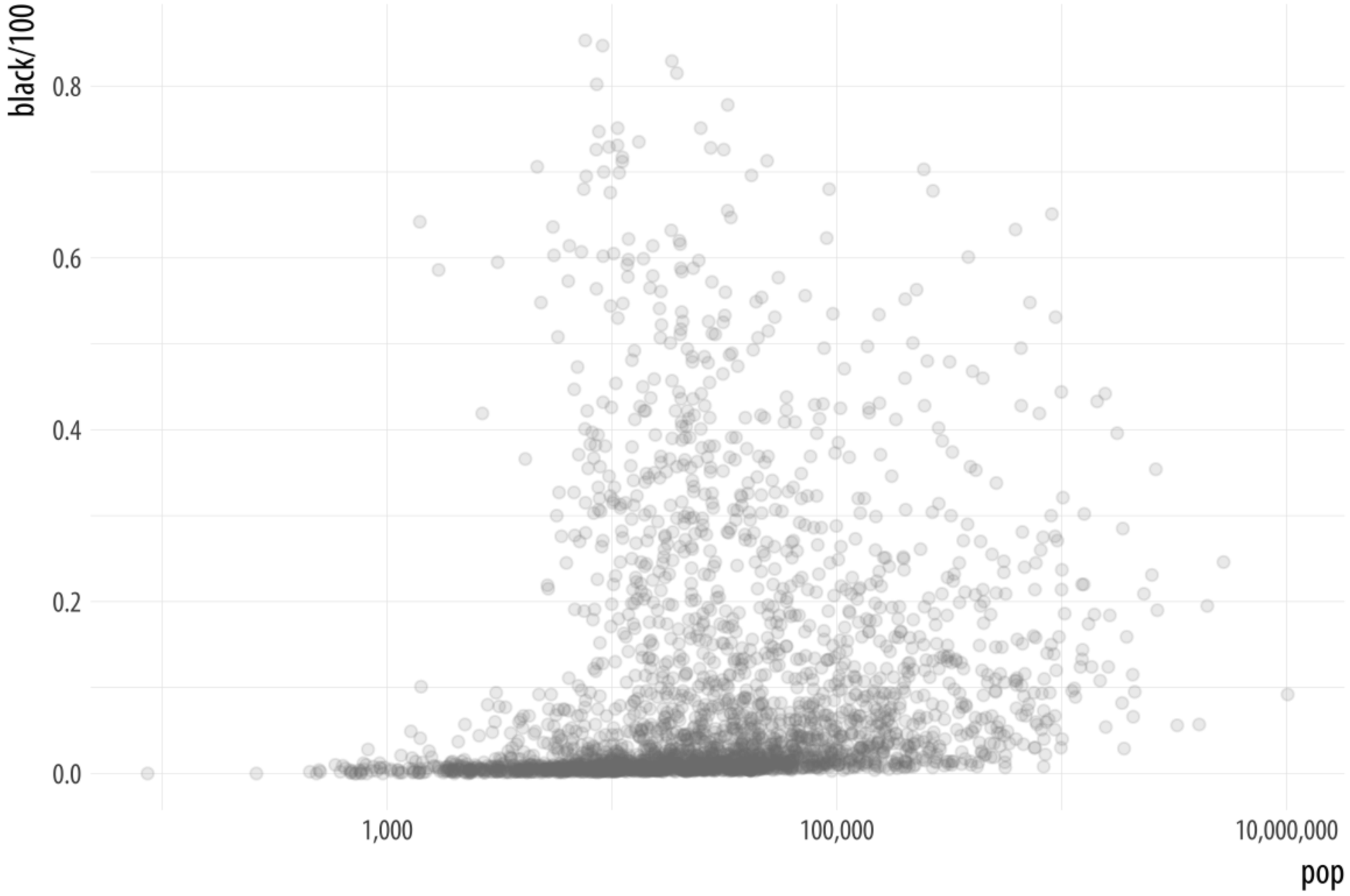
Layer Color and Text Together

Flipped counties, 2016

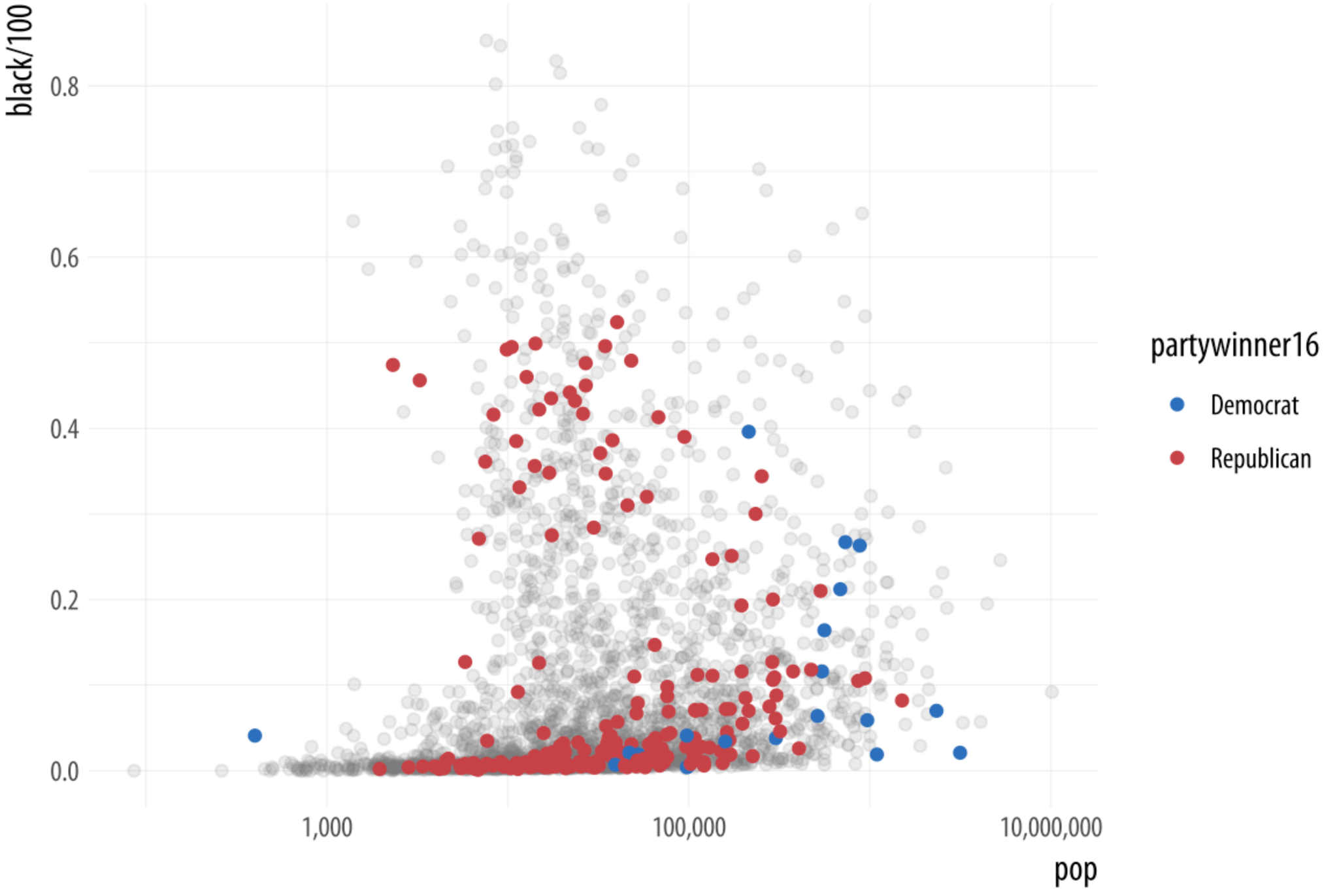


Counties in gray did not flip between 2012 and 2016

```r
# Democrat Blue and Republican Red
party_colors <- c("#2E74C0", "#CB454A")

p0 <- ggplot(data = subset(county_data,
                           flipped == "No"),
             mapping = aes(x = pop,
                           y = black/100))

p1 <- p0 + geom_point(alpha = 0.15, color = "gray50") +
    scale_x_log10(labels=scales::comma)

p1
```

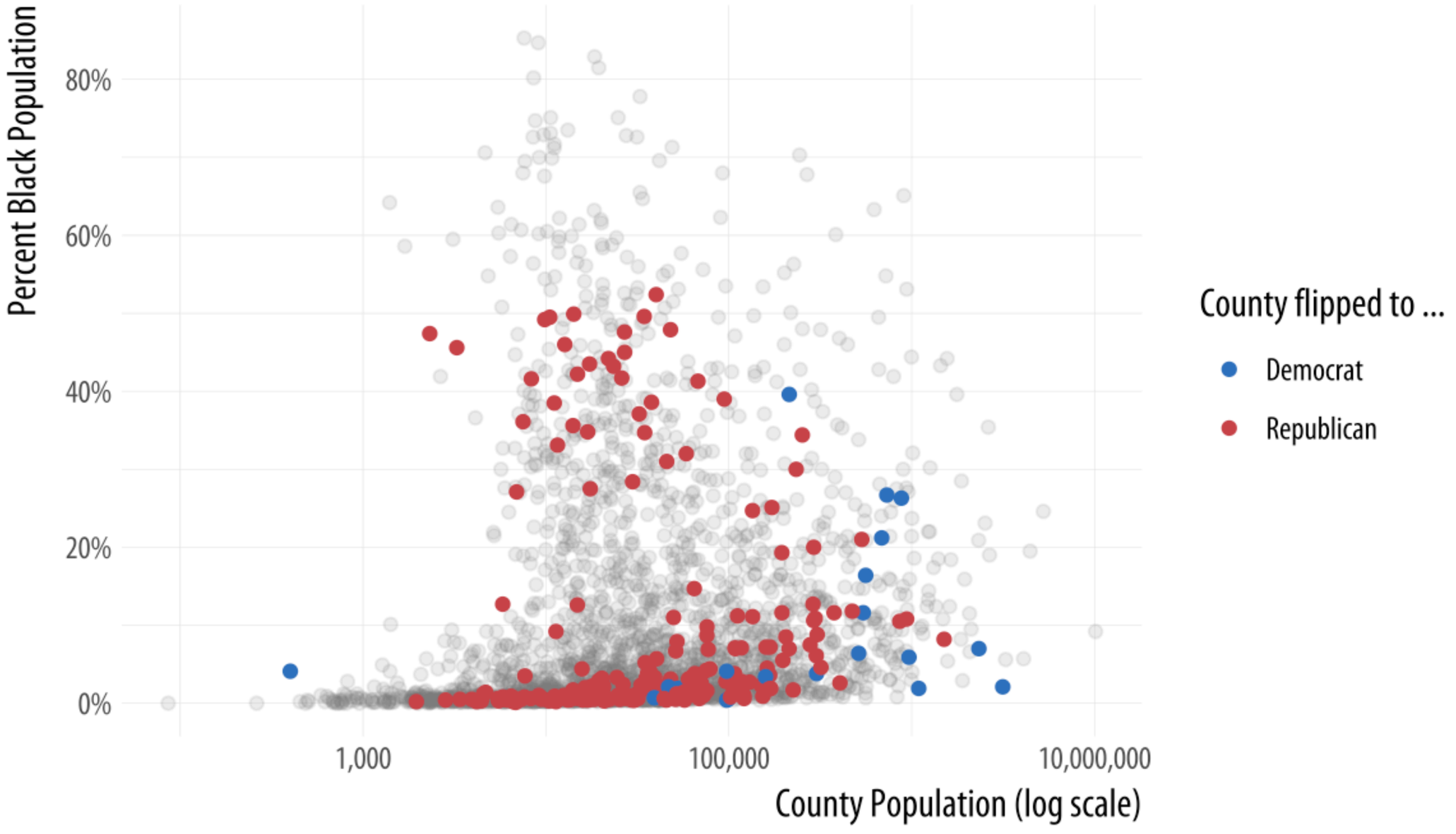

black/100
0.8
0.6
0.4
0.2
0.0
1,000
100,000
10,000,000
pop

```r
p2 <- p1 + geom_point(data = subset(county_data,
                                    flipped == "Yes"),
                      mapping = aes(x = pop, y = black/100,
                                    color = partywinner16)) +
    scale_color_manual(values = party_colors)

p2
```


black/100
0.8
0.6
0.4
0.2
0.0
1,000
100,000
10,000,000
pop
partywinner16
Democrat
Republican

```r
p3 <- p2 + scale_y_continuous(labels=scales::percent) +
    labs(color = "County flipped to ... ",
         x = "County Population (log scale)",
         y = "Percent Black Population",
         title = "Flipped counties, 2016",
         caption = "Counties in gray did not flip.")

p3
```

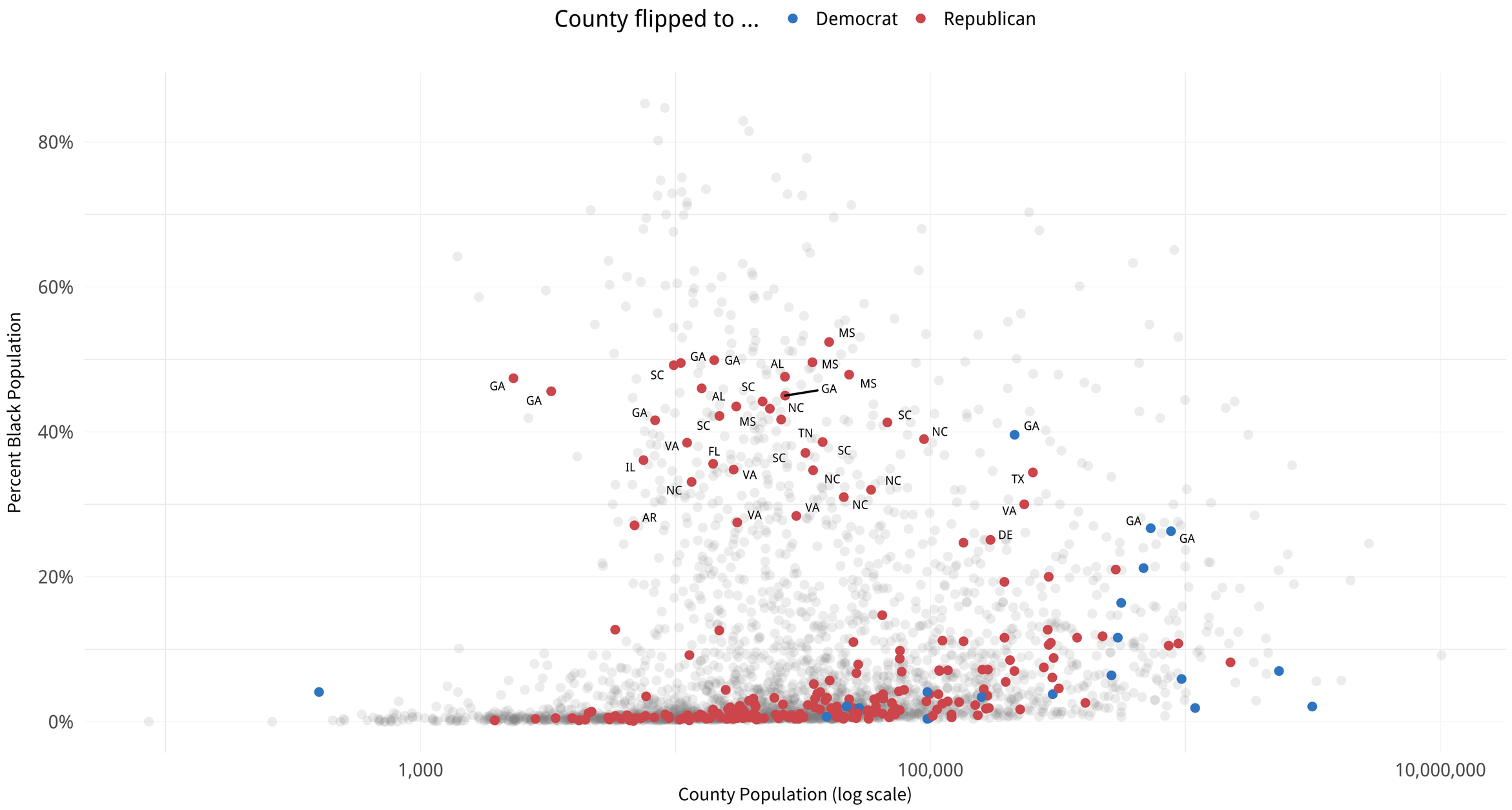
Flipped counties, 2016



Counties in gray did not flip.

```r
p4 <- p3 + geom_text_repel(data = subset(county_data,
                                         flipped == "Yes" &
                                         black  > 25),
                           mapping = aes(x = pop,
                                         y = black/100,
                                         label = state), size = 2)

p4 + theme_minimal() +
    theme(legend.position="top")
```

Flipped counties, 2016



Counties in gray did not flip.

THEMES

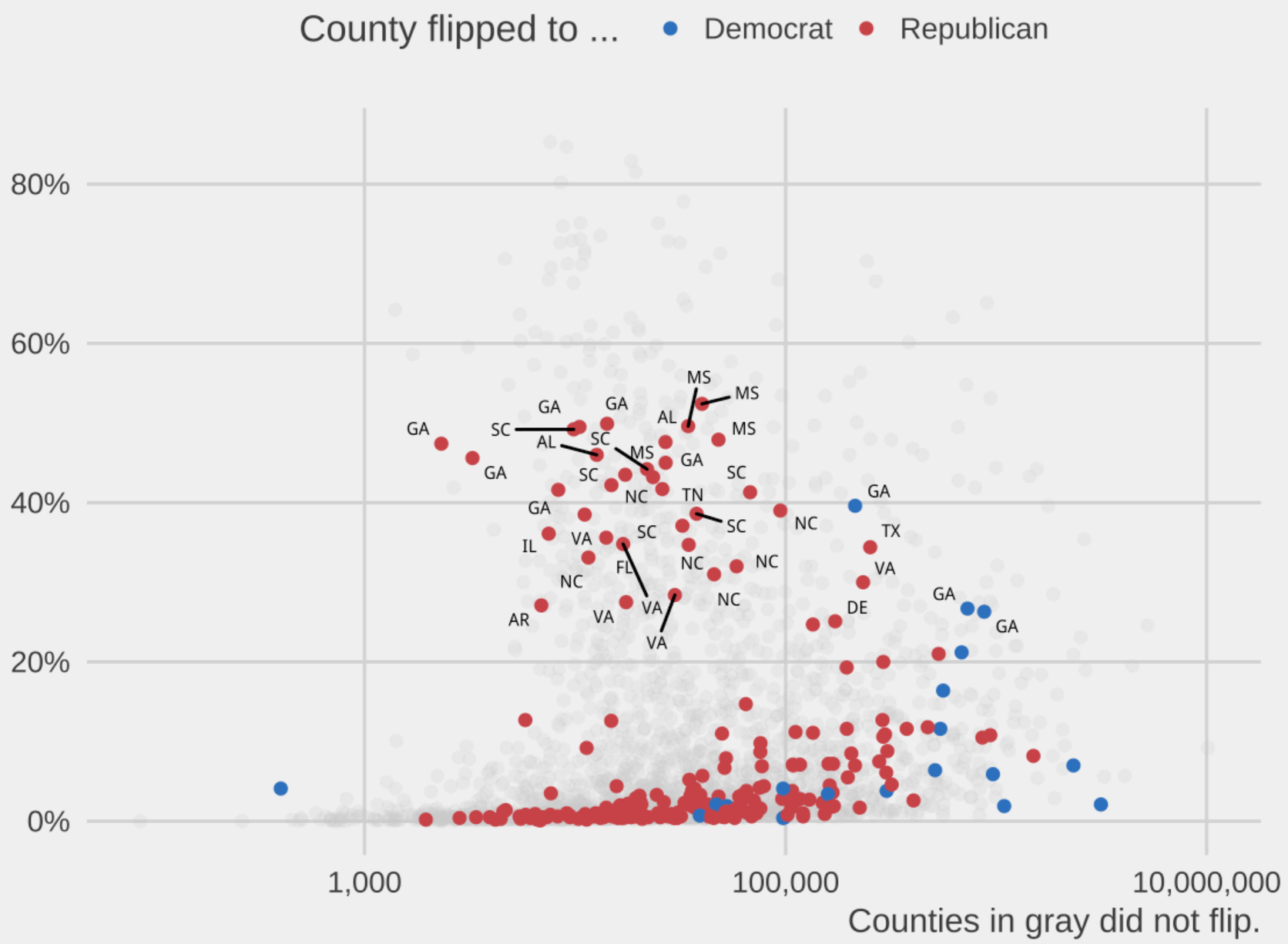
```r
theme_set(theme_bw())
p4 + theme(legend.position="top")

theme_set(theme_dark())
p4 + theme(legend.position="top")
```

Built-in Themes can be added per plot or globally set

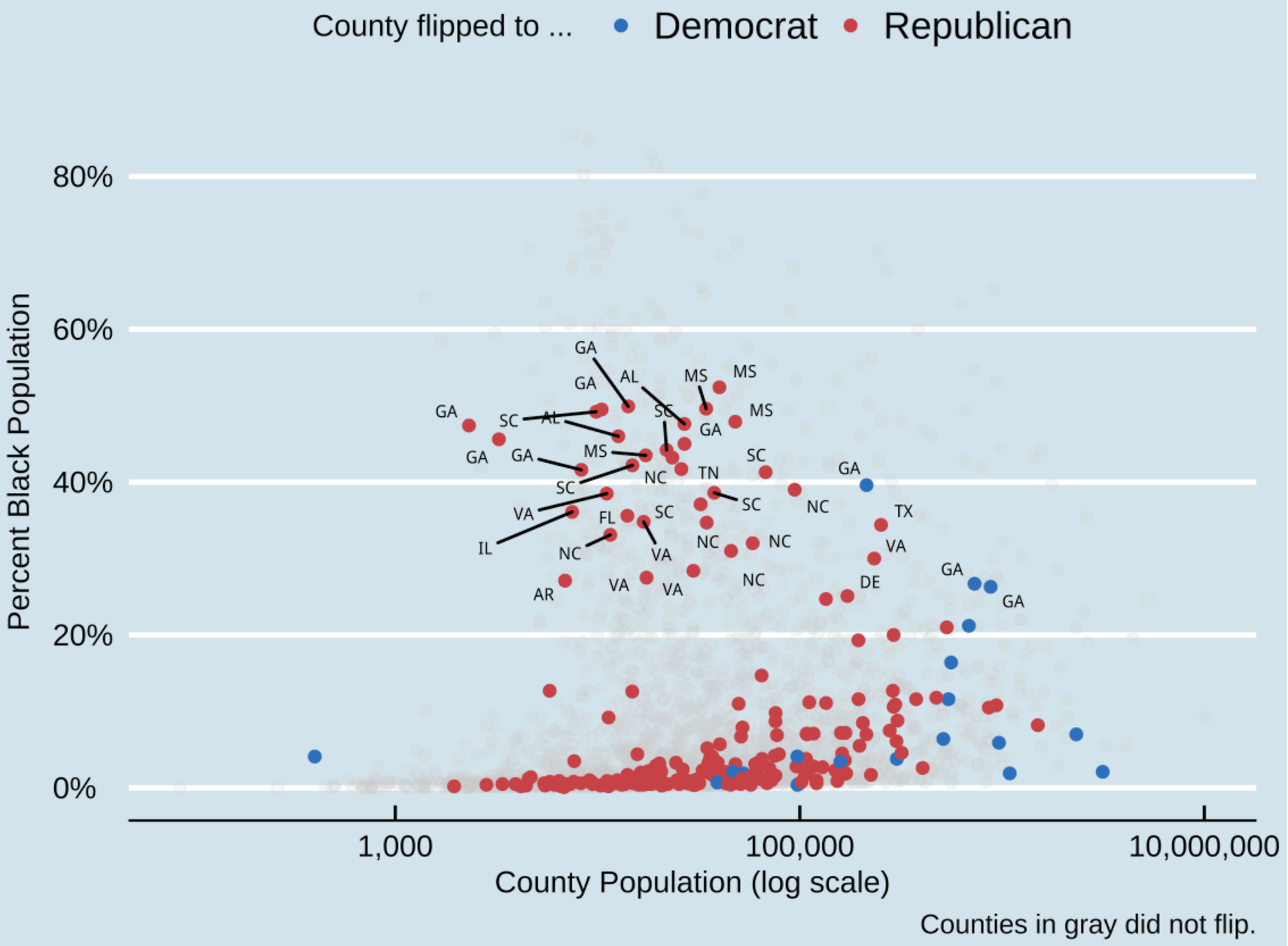
```r
install.packages("ggthemes")
library(ggthemes)

theme_set(theme_fivethirtyeight())
p4

theme_set(theme_economist())
p4
```

The ggthemes library provides several additional alternatives

Flipped counties, 2016

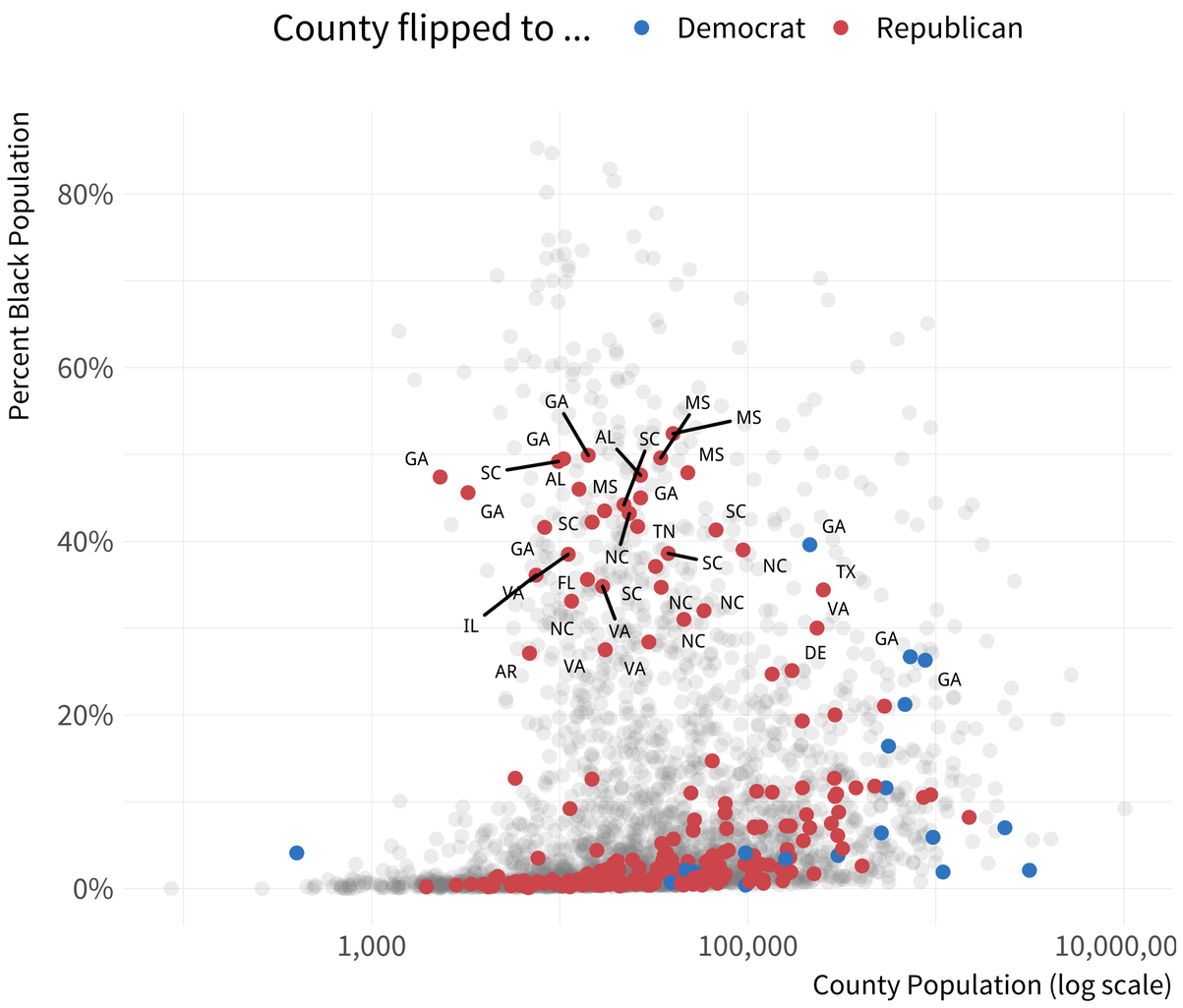


Flipped counties, 2016



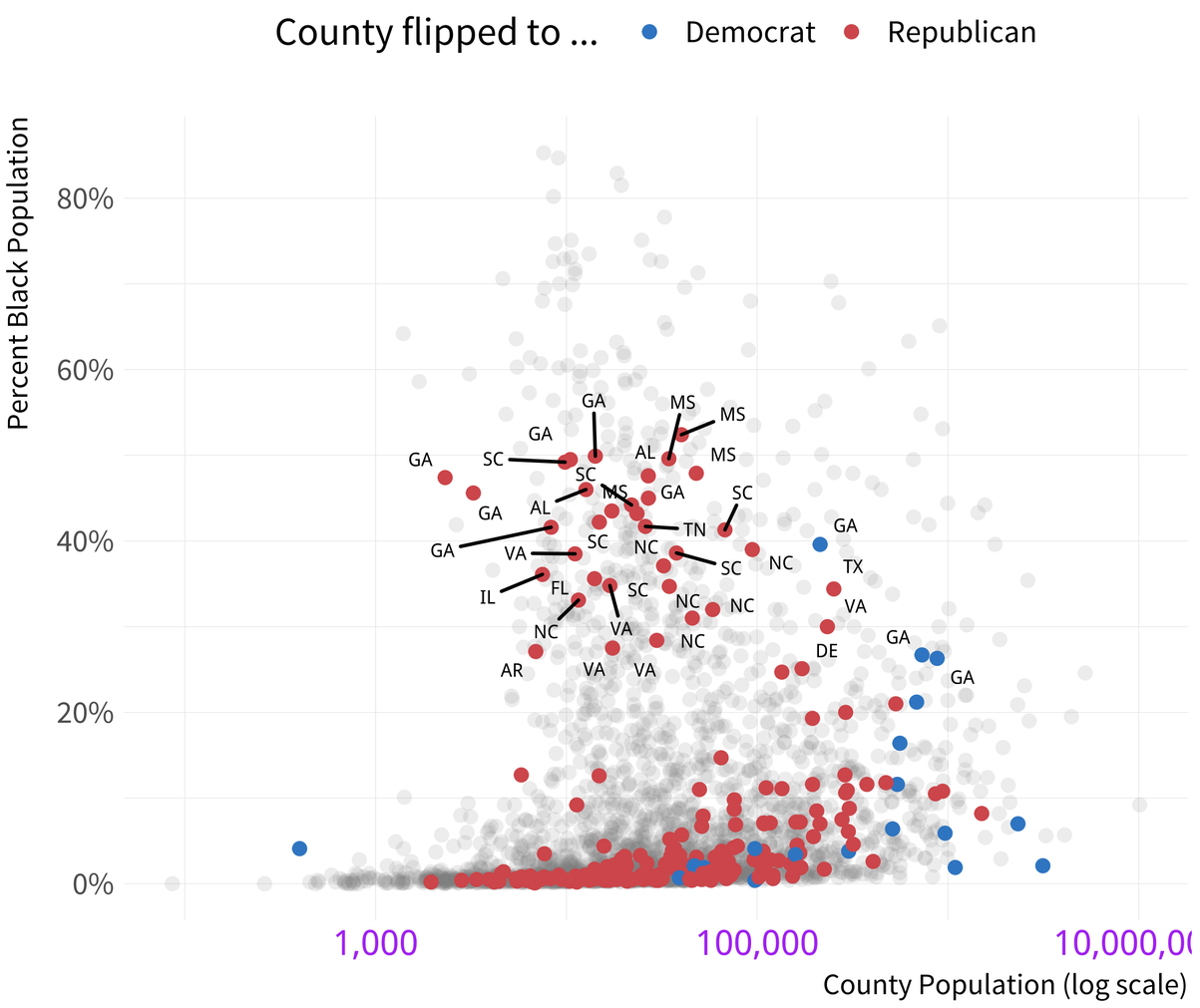
```r
p4 + theme(legend.position = "top")

p4 + theme(legend.position = "top",
           plot.title = element_text(size=rel(2),
                                     lineheight=.5,
                                     family="Times",
                                     face="bold.italic",
                                     colour="orange"),
           axis.text.x = element_text(size=rel(1.1),
                                      family="Courier",
                                      face="bold",
                                      color="purple"))
```

Flipped counties, 2016



Counties in gray did not flip.

Flipped counties, 2016



Counties in gray did not flip.

```r
install.packages("cowplot")

install.packages("hrbrthemes")
```

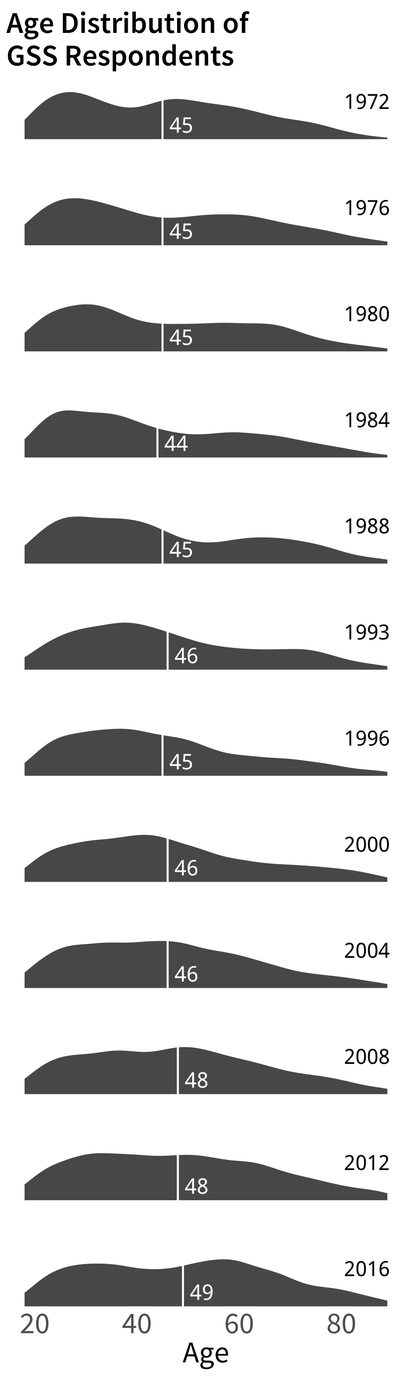
Other theming to check out: cowplot and hrbrthemes

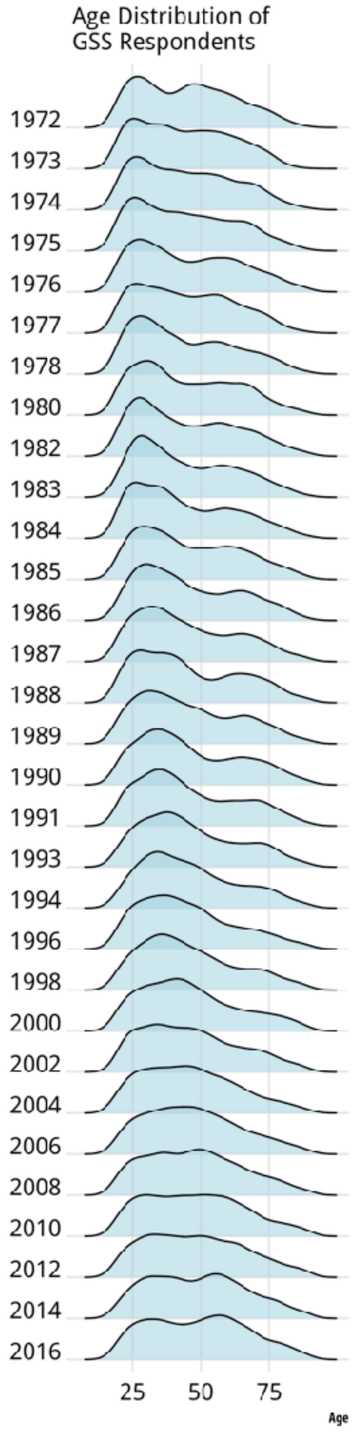
Use Thematic Elements in a Substantive Way

```r
p <- ggplot(subset(gss_lon, year %in% yrs), aes(x = age))

p1 <- p + geom_density(fill = "gray20", color = FALSE,
                       alpha = 0.9, mapping = aes(y = ..scaled..)) +
    geom_vline(data = subset(mean_age, year %in% yrs),
               aes(xintercept = xbar), color = "white", size = 0.5) +
    geom_text(data = subset(mean_age, year %in% yrs),
              aes(x = xbar, y = y, label = xbar), nudge_x = 6,
              color = "white", size = 4, hjust = 1) +
    geom_text(data = subset(yr_labs, year %in% yrs),
              aes(x = x, y = y, label = year)) +
    facet_grid(year ~ ., switch = "y")
```

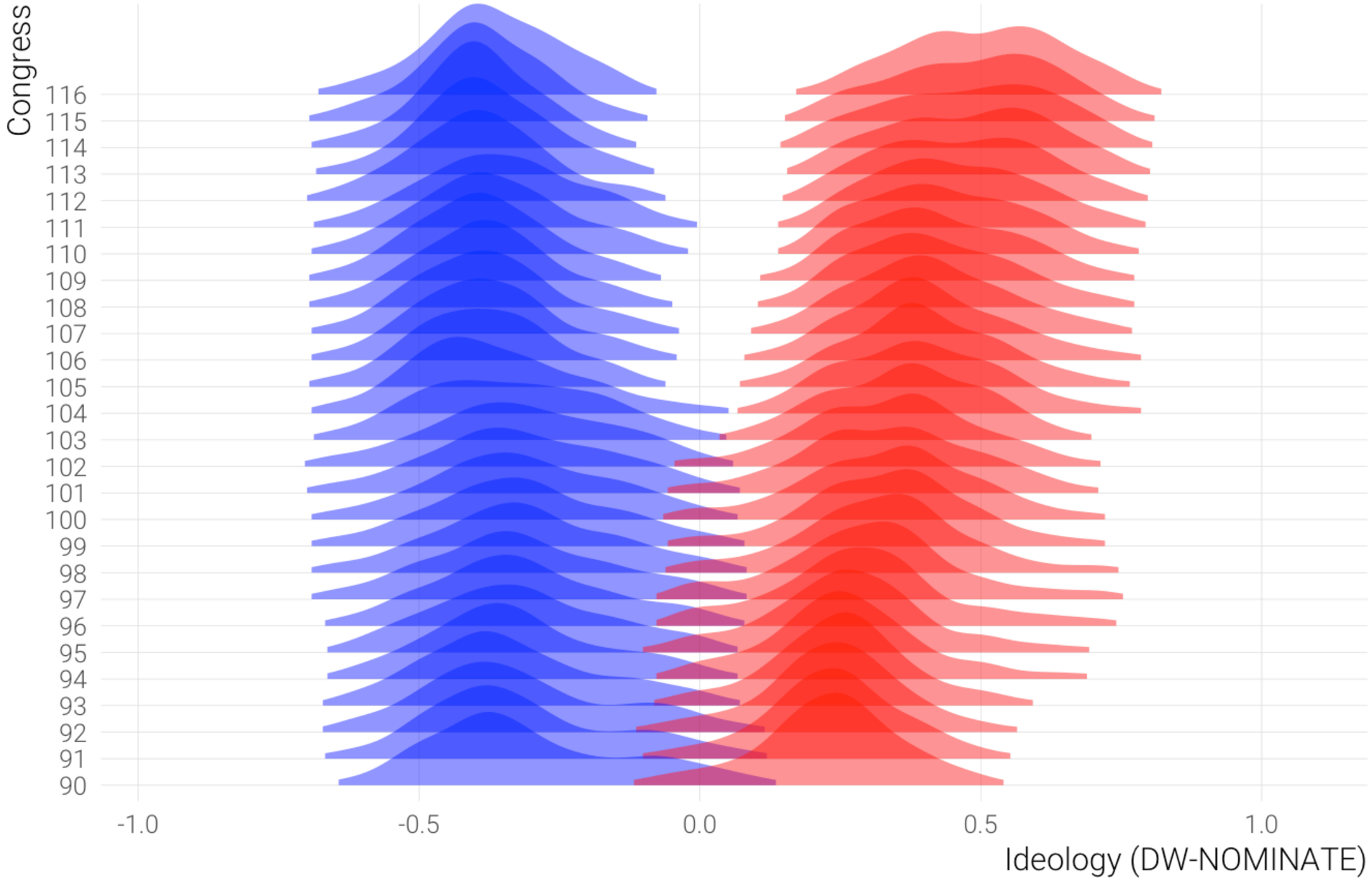
```r
yrs <- c(seq(1972, 1988, 4), 1993, seq(1996, 2016, 4))

mean_age <- gss_lon %>%
    filter(age %nin% NA && year %in% yrs) %>%
    group_by(year) %>%
    summarize(xbar = round(mean(age, na.rm = TRUE), 0))
mean_age$y <- 0.3

yr_labs <- data.frame(x = 85, y = 0.8,
                      year = yrs)
```

```r
library(hrbrthemes)

p1 + theme_ipsum(base_size = 10, plot_title_size = 10,
                 strip_text_size = 32, panel_spacing = unit(0.1, "lines")) +
    theme(plot.title = element_text(size = 16),
          axis.text.x= element_text(size = 16),
          axis.title.x= element_text(size = 16, hjust = 0.5),
          axis.title.y=element_blank(),
          axis.text.y=element_blank(),
          axis.ticks.y = element_blank(),
          strip.background = element_blank(),
          strip.text.y = element_blank(),
          panel.grid.major = element_blank(),
          panel.grid.minor = element_blank()) +
    labs(x = "Age",
         y = NULL,
         title = "Age Distribution of\nGSS Respondents")
```


Age Distribution of
GSS Respondents
1972
45
1976
45
1980
45
1984
44
1988
45
1993
46
1996
45
2000
46
2004
46
2008
48
2012
48
2016
49
20
40
60
80
Age


Age Distribution of
GSS Respondents
1972
1973
1974
1975
1976
1977
1978
1980
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1993
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
25
50
75
Age

Polarization Between House Members, 1960-2018



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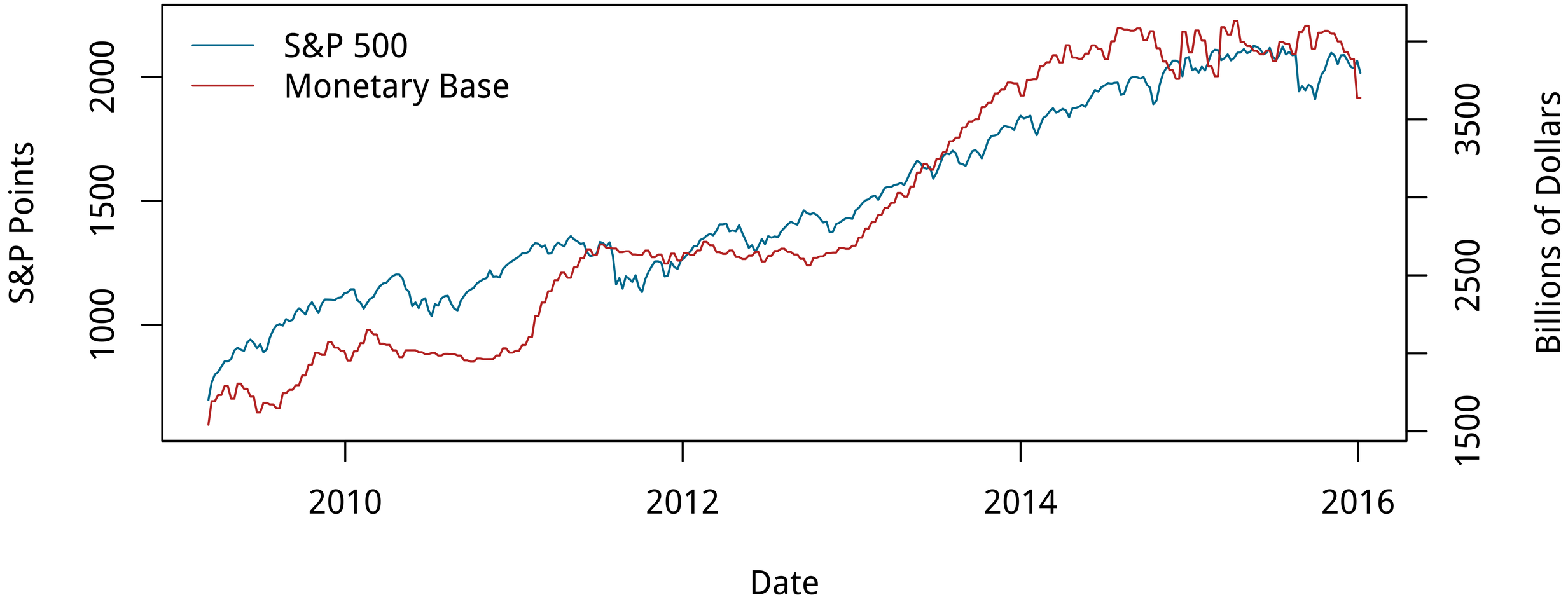
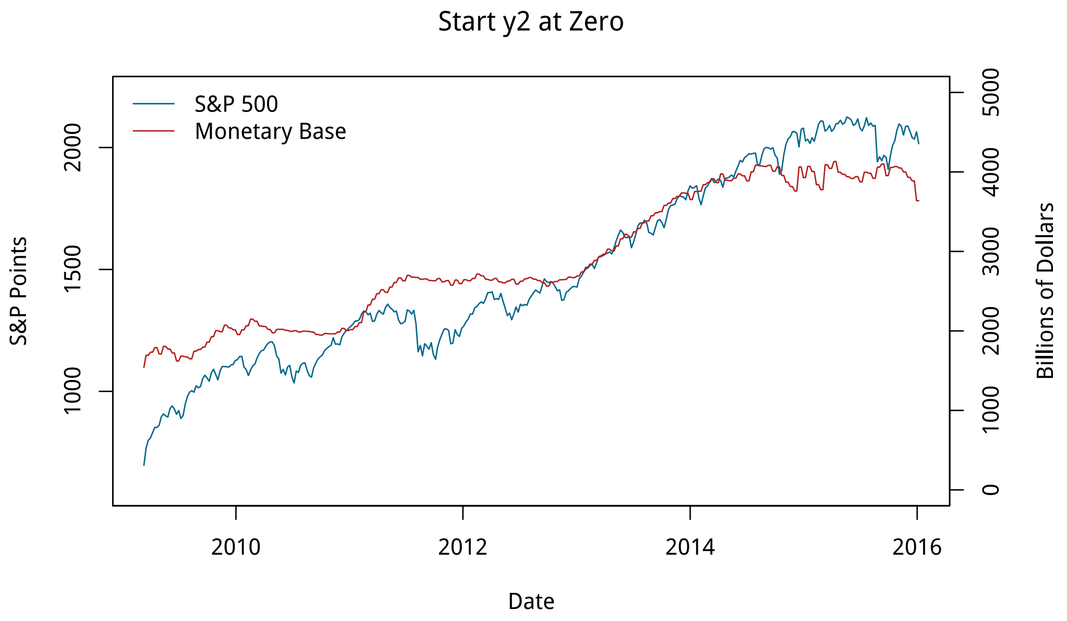
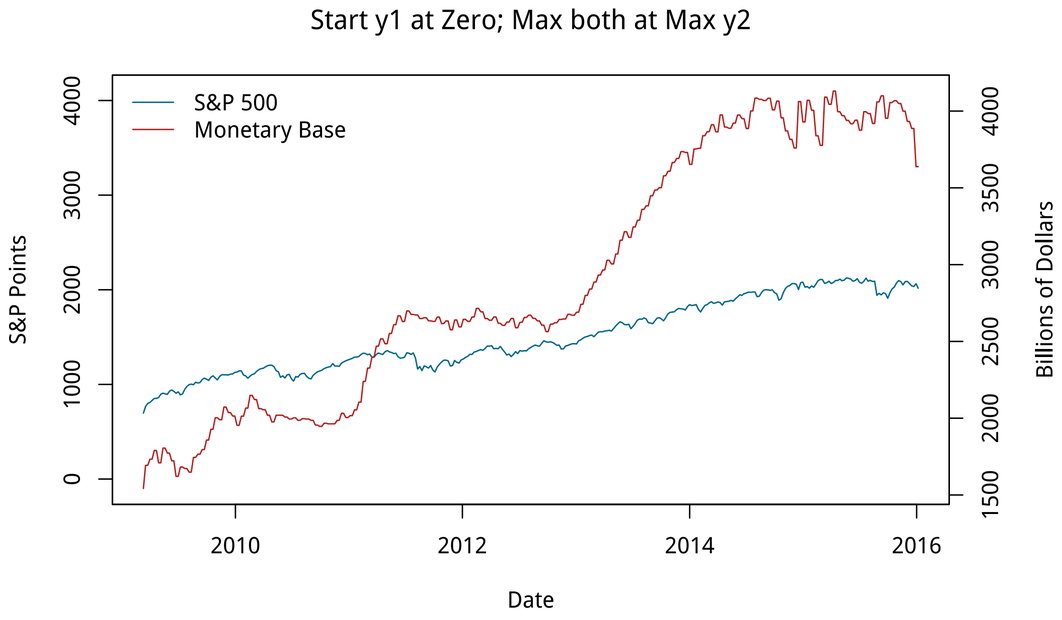
CASE STUDIES

Two Y-Axes

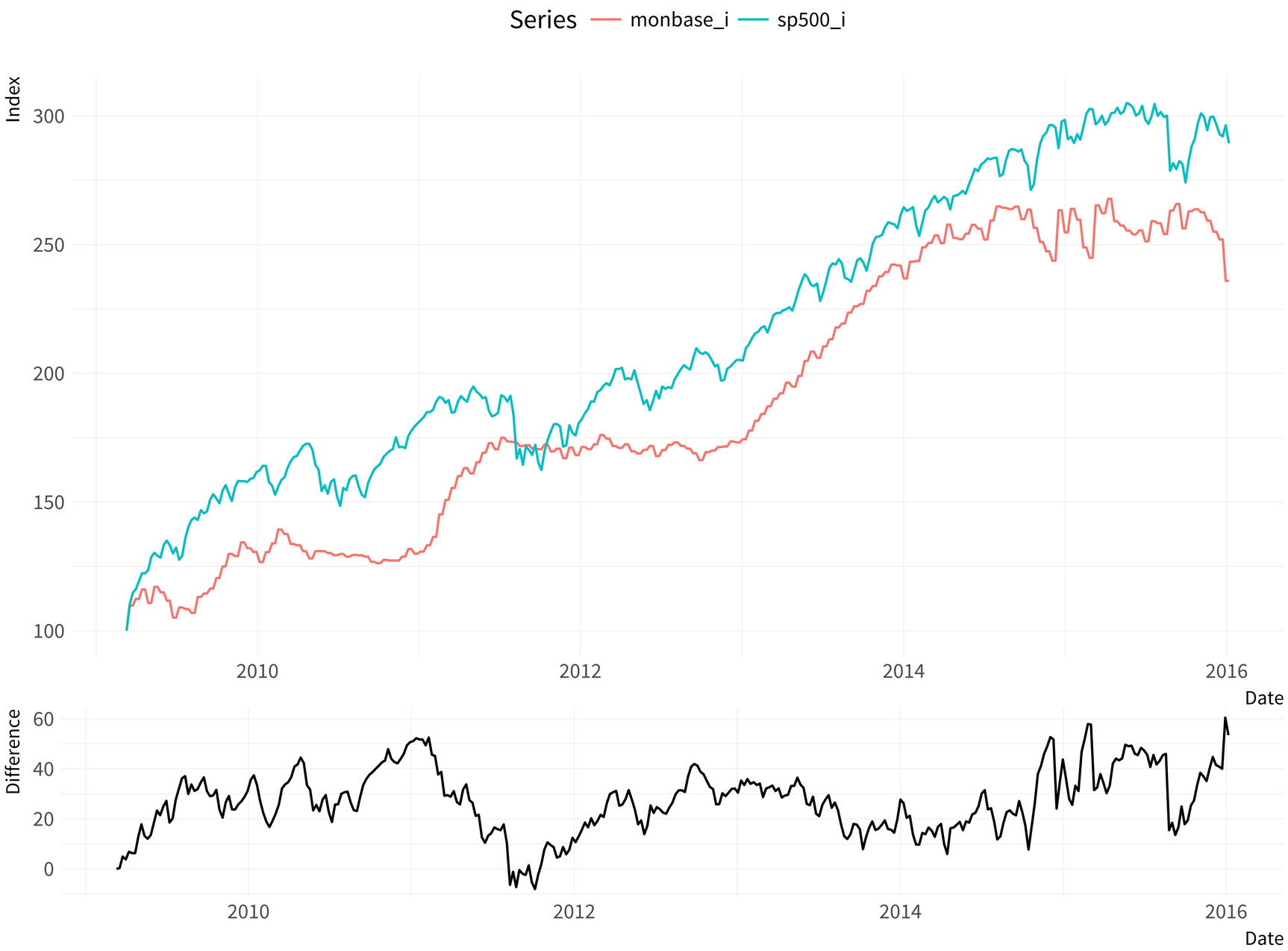

S&P 500
Monetary Base
S&P Points
1000
1500
2000
Billions of Dollars
1500
2500
3500
2010
2012
2014
2016
Date


Start y2 at Zero
S&P 500
Monetary Base
S&P Points
1000
1500
2000
Billions of Dollars
0
1000
2000
3000
4000
5000
2010
2012
2014
2016
Date


Start y1 at Zero; Max both at Max y2
S&P 500
Monetary Base
S&P Points
0
1000
2000
3000
4000
Billions of Dollars
1500
2000
2500
3000
3500
4000
2010
2012
2014
2016
Date

```r
## Tidy the data with 'gather()'
fredts_m <- fredts %>% select(date, sp500_i, monbase_i) %>%
    gather(key = series, value = score, sp500_i:monbase_i)

p <- ggplot(data = fredts_m,
            mapping = aes(x = date, y = score,
                          group = series,
                          color = series))
p1 <- p + geom_line() + theme(legend.position = "top") +
    labs(x = "Date",
         y = "Index",
         color = "Series")

p <- ggplot(data = fredts,
            mapping = aes(x = date, y = sp500_i - monbase_i))

p2 <- p + geom_line() +
    labs(x = "Date",
         y = "Difference")
```

```r
library(gridExtra)
grid.arrange(p1, p2, nrow = 2, heights = c(0.75, 0.25))
```


Series
monbase_i
sp500_i
Index
300
250
200
150
100
2010
2012
2014
2016
Date
Difference
60
40
20
0
2010
2012
2014
2016
Date

Multiple Plots

```r
drat::addRepo("kjhealy")
install.packages("demog")
library(demog)
```

demog
Birth and Death rate data

```
> okboomer
# A tibble: 1,644 x 12
    year month n_days births total_pop births_pct births_pct_day date       seasonal trend remainder country
   <dbl> <dbl>  <dbl>  <dbl>     <dbl>      <dbl>          <dbl> <date>        <dbl> <dbl>     <dbl> <chr>
 1  1938     1     31  51820  41215000    0.00126           40.6 1938-01-01   -0.684  41.5   -0.287  England and Wales
 2  1938     2     28  47421  41215000    0.00115           41.1 1938-02-01    0.703  41.5   -1.09   England and Wales
 3  1938     3     31  54887  41215000    0.00133           43.0 1938-03-01    2.13   41.4   -0.605  England and Wales
 4  1938     4     30  54623  41215000    0.00133           44.2 1938-04-01    1.42   41.4    1.37   England and Wales
 5  1938     5     31  56853  41215000    0.00138           44.5 1938-05-01    1.82   41.3    1.34   England and Wales
 6  1938     6     30  53145  41215000    0.00129           43.0 1938-06-01    1.03   41.3    0.668  England and Wales
 7  1938     7     31  53214  41215000    0.00129           41.6 1938-07-01    0.391  41.2    0.0163 England and Wales
 8  1938     8     31  50444  41215000    0.00122           39.5 1938-08-01   -0.801  41.2   -0.916  England and Wales
 9  1938     9     30  50545  41215000    0.00123           40.9 1938-09-01    0.438  41.2   -0.714  England and Wales
10  1938    10     31  50079  41215000    0.00122           39.2 1938-10-01   -1.62   41.1   -0.269  England and Wales
# … with 1,634 more rows
```

```r
library(patchwork)
```

Patchwork is a ludicrously convenient package

```r
title_txt <-  "Average births per month per million people in the United States, 1933-73”
start_date <-  "1935-01-01"
end_date <-  "1973-12-01"
end_year <- 1974
by_unit <-  "year"
bar_width <-  0.5
p_col <-  "gray30"

break_vec <- seq(from=as.Date(start_date), to=as.Date(end_date), by = by_unit)
break_vec <- break_vec[seq(1, length(break_vec), 5)]

p <- ggplot(subset(okboomer, country == "United States" & year < end_year),
            mapping = aes(x = date, y = births_pct_day))
p1 <- p + geom_line(color = p_col) + ylab("Data") + xlab("") +
  scale_x_date(breaks = break_vec) +
  theme(axis.text.x = element_blank(),
        axis.title.y = element_text(size = rel(0.8)),
        plot.title = element_text(size = rel(1))) +
  ggtitle(title_txt)
```

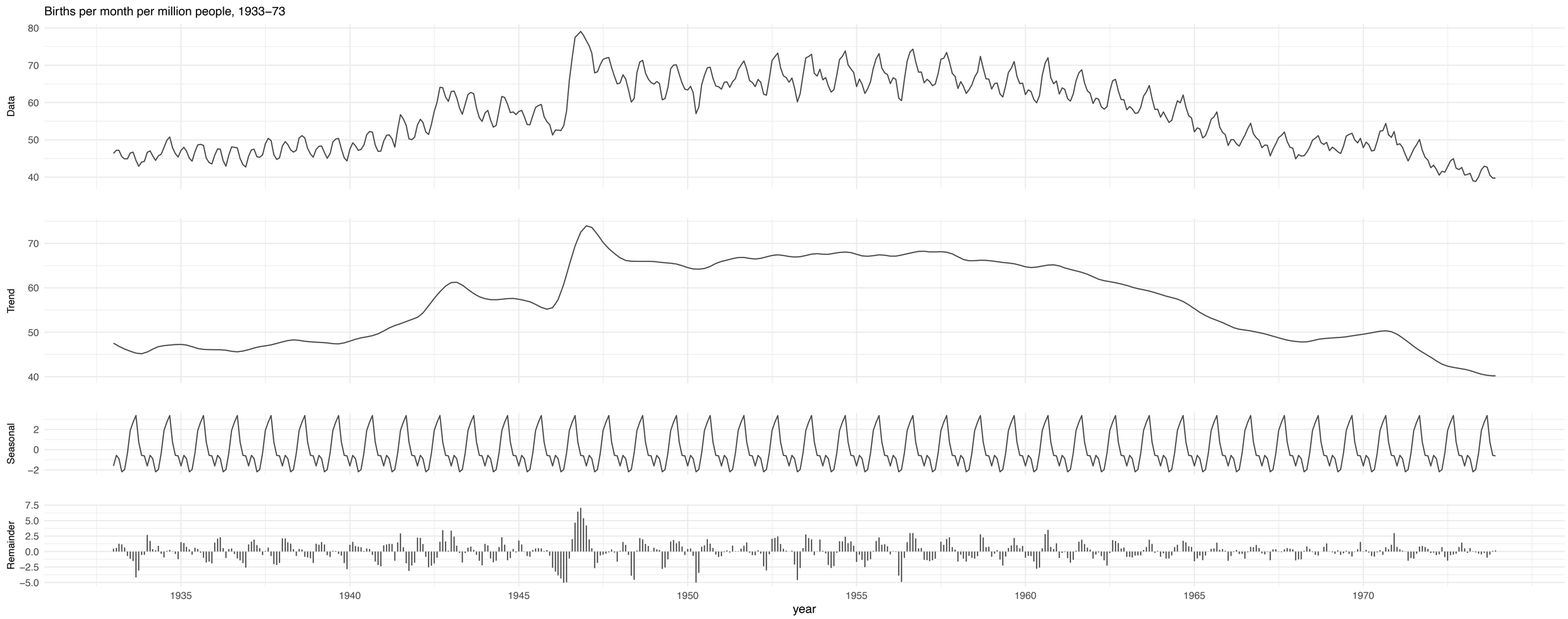
```r
p <- ggplot(subset(okboomer, country == "United States" & year < end_year),
            mapping = aes(x = date, y = trend))
p2 <- p + geom_line(color = p_col) + ylab("Trend") + xlab("") +
  scale_x_date(breaks = break_vec) +
  theme(axis.text.x = element_blank(),
        axis.title.y = element_text(size = rel(0.8)))

p <- ggplot(subset(okboomer, country == "United States" & year < end_year),
            mapping = aes(x = date, y = seasonal))
p3 <- p + geom_line(color = p_col) + ylab("Seasonal") + xlab("") +
  scale_x_date(breaks = break_vec) +
  theme(axis.text.x = element_blank(),
        axis.title.y = element_text(size = rel(0.8)))

p <- ggplot(subset(okboomer, country == "United States" & year < end_year),
            mapping = aes(x = date, ymax = remainder, ymin = 0))
p4 <- p + geom_linerange(size = bar_width, color = p_col) +
  scale_x_date(breaks = break_vec, date_labels = "%Y") +
  ylab("Remainder") + xlab(by_unit) +
  theme(axis.title.y = element_text(size = rel(0.8)))
```

```r
patch_plot <- (p1 / p2 / p3 / p4)
```

Vertically stack the plots! Automatically aligned!

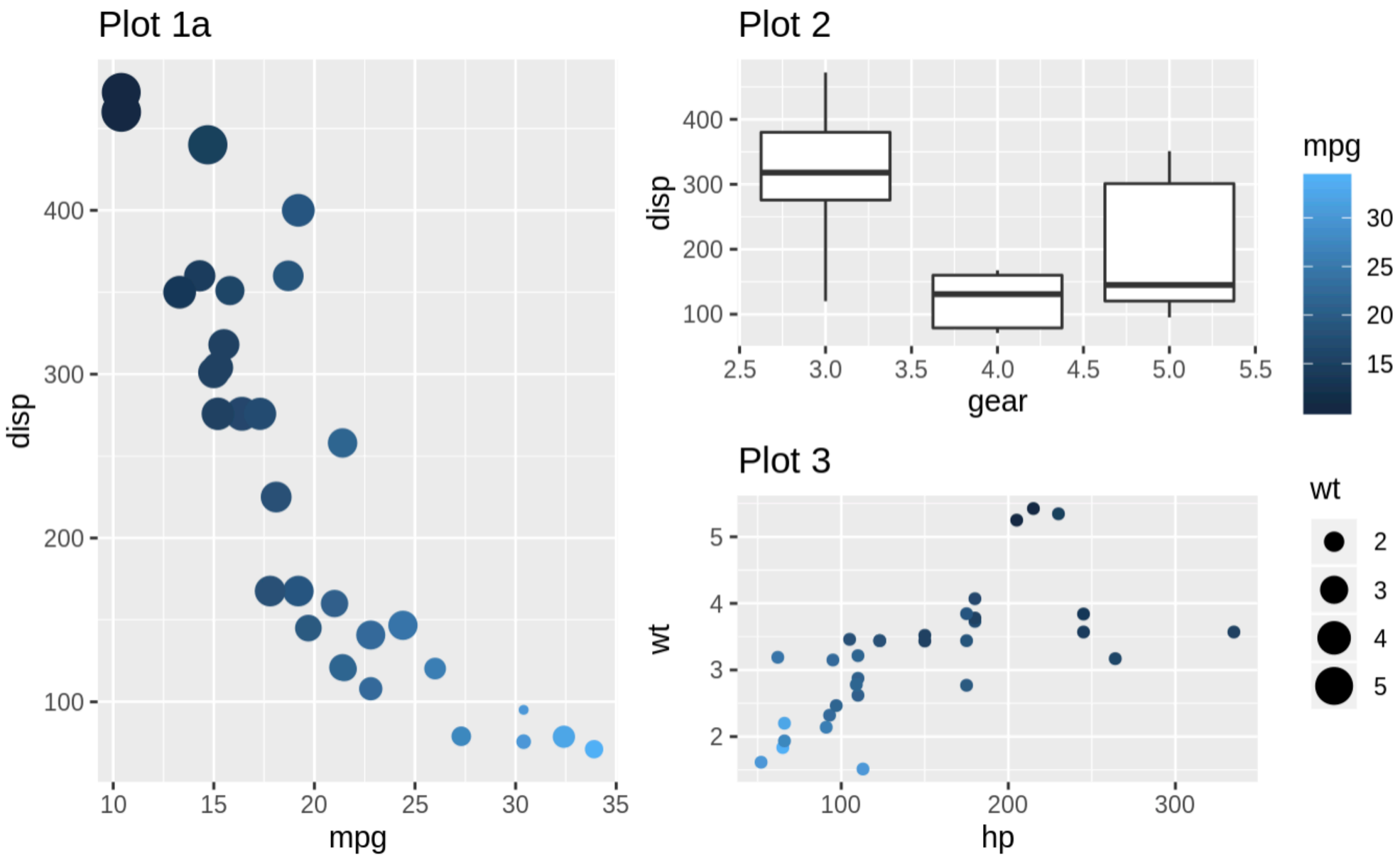
```r
patch_plot + plot_layout(heights = c(2, 2, 0.75, 1))
```

Specify relative heights

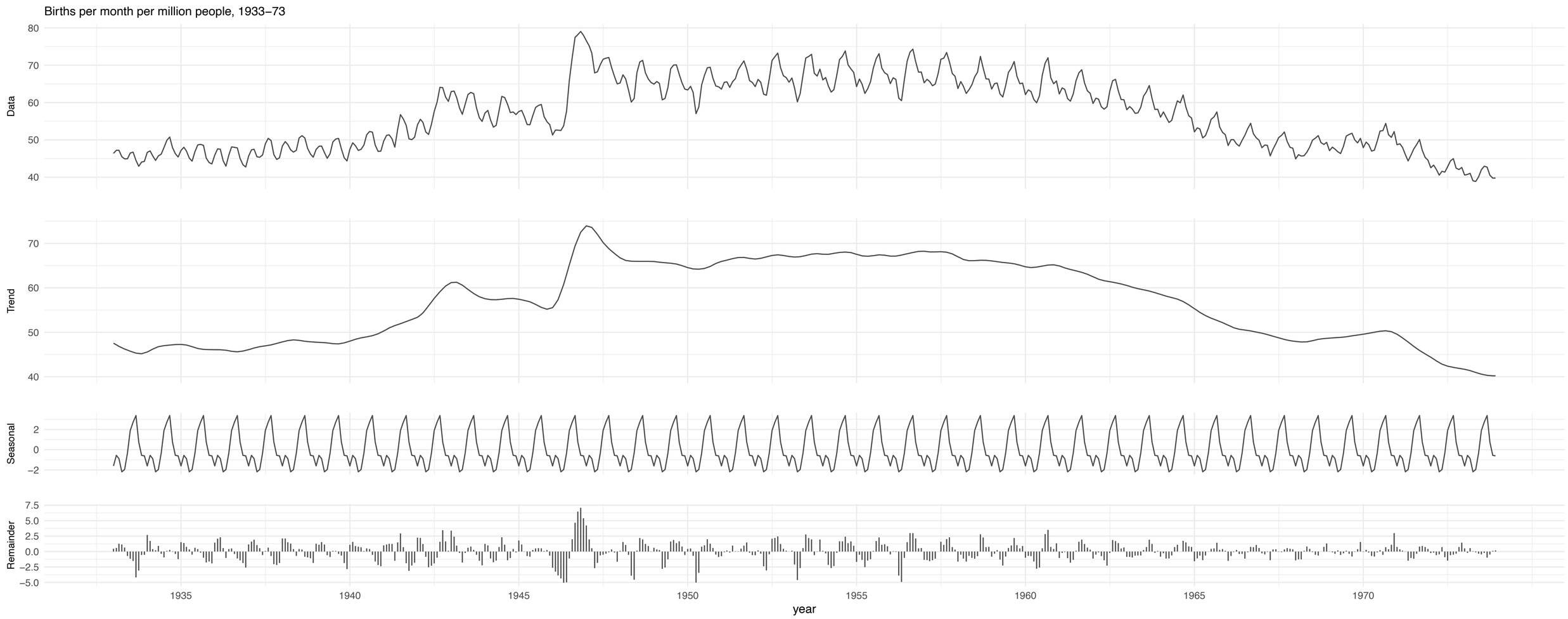


```
(p1a | (p2 / p3)) + plot_layout(guides = 'collect')
```

I told you it was ludicrously useful



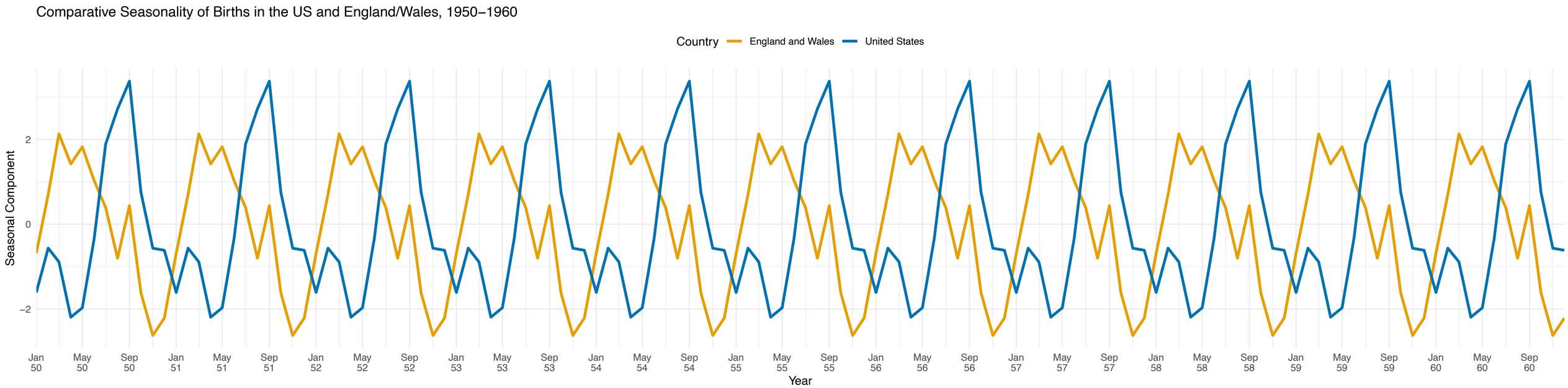
```r
patch_plot + plot_layout(heights = c(2, 2, 0.75, 1))
```

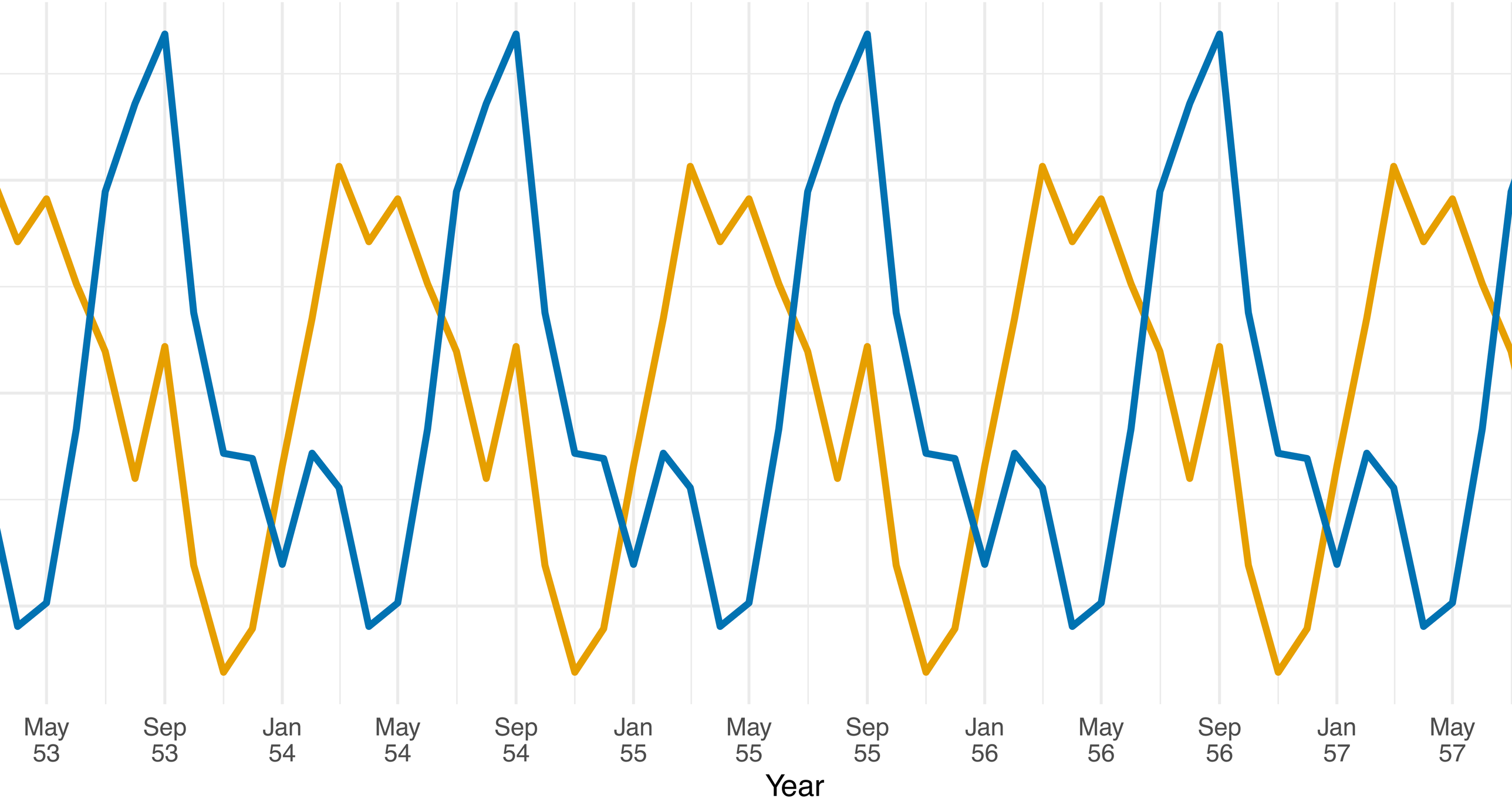


```r
(p_out <- okboomer %>%
  filter(date > lubridate::ymd("1949-12-01"),
         date < lubridate::ymd("1961-01-01")) %>%
  ggplot(mapping = aes(x = date, y = seasonal, color = country)) +
  geom_line(size = 1.2) +
  scale_x_date(date_breaks = "4 months",
               date_labels = "%b\n%y", expand = expand_scale()) +
  scale_color_manual(values = my_colors("bly")) +
  theme(legend.position = "top") +
  labs(x = "Year",
       y = "Seasonal Component",
       color = "Country",
       title = "Comparative Seasonality of Births in the US and England/Wales, 1950-1960")
)
```

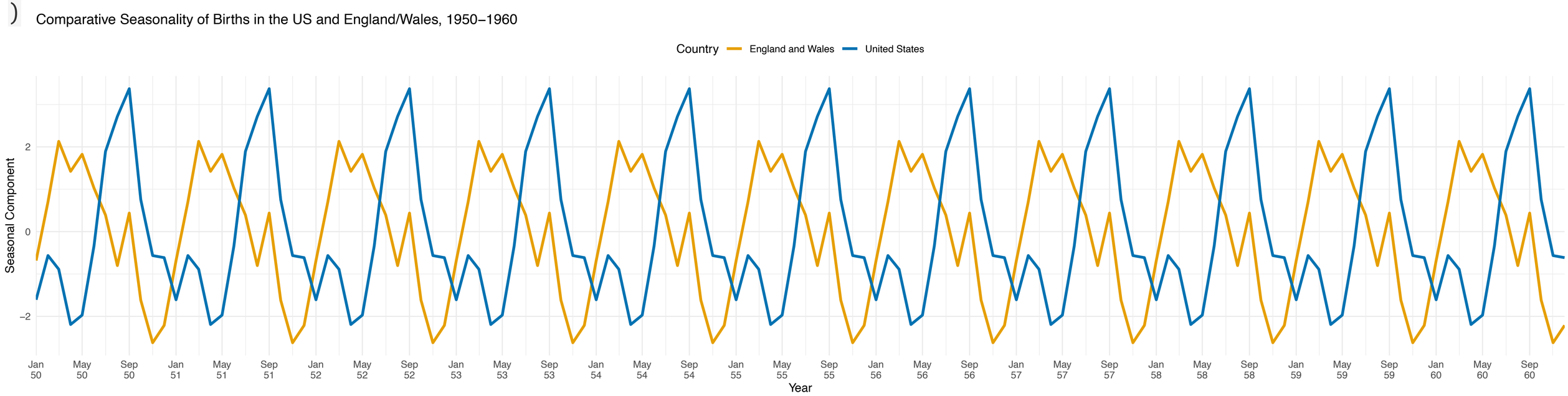
Date coercion with lubridate

Breaks and labels

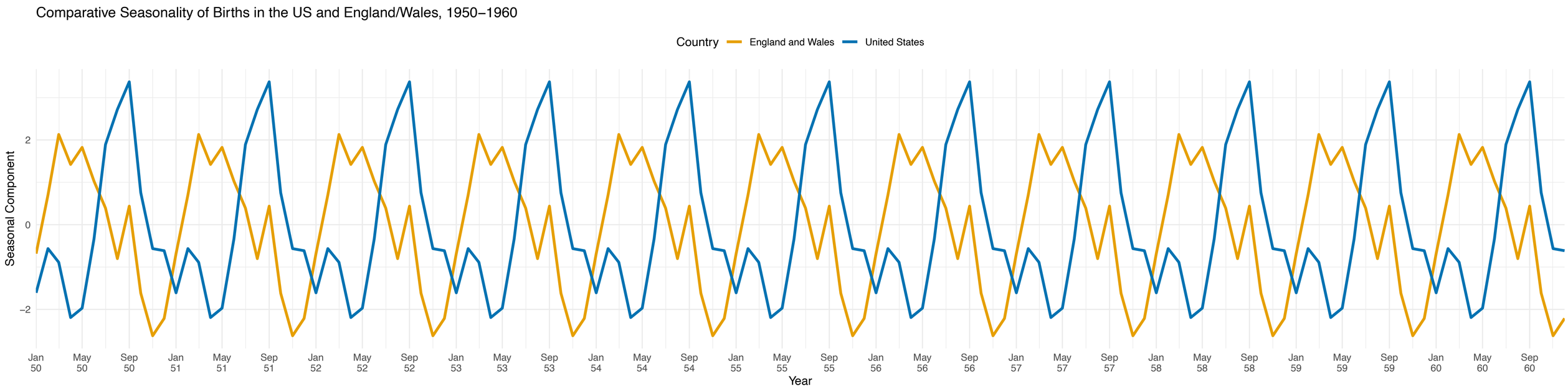



May 53
Sep 53
Jan 54
May 54
Sep 54
Jan 55
May 55
Sep 55
Jan 56
May 56
Sep 56
Jan 57
May 57
Year

```r
(p_out <- okboomer %>%
  filter(date > lubridate::ymd("1949-12-01"),
         date < lubridate::ymd("1961-01-01")) %>%
  ggplot(mapping = aes(x = date, y = seasonal, color = country)) +
  geom_line(size = 1.2) +
  scale_x_date(date_breaks = "4 months",
               date_labels = "%b\n%y", expand = expand_scale()) +
  scale_color_manual(values = my_colors("bly")) +
  theme(legend.position = "top") +
  labs(x = "Year",
       y = "Seasonal Component",
       color = "Country",
       title = "Comparative Seasonality of Births in the US and England/Wales, 1950-1960")
)
```

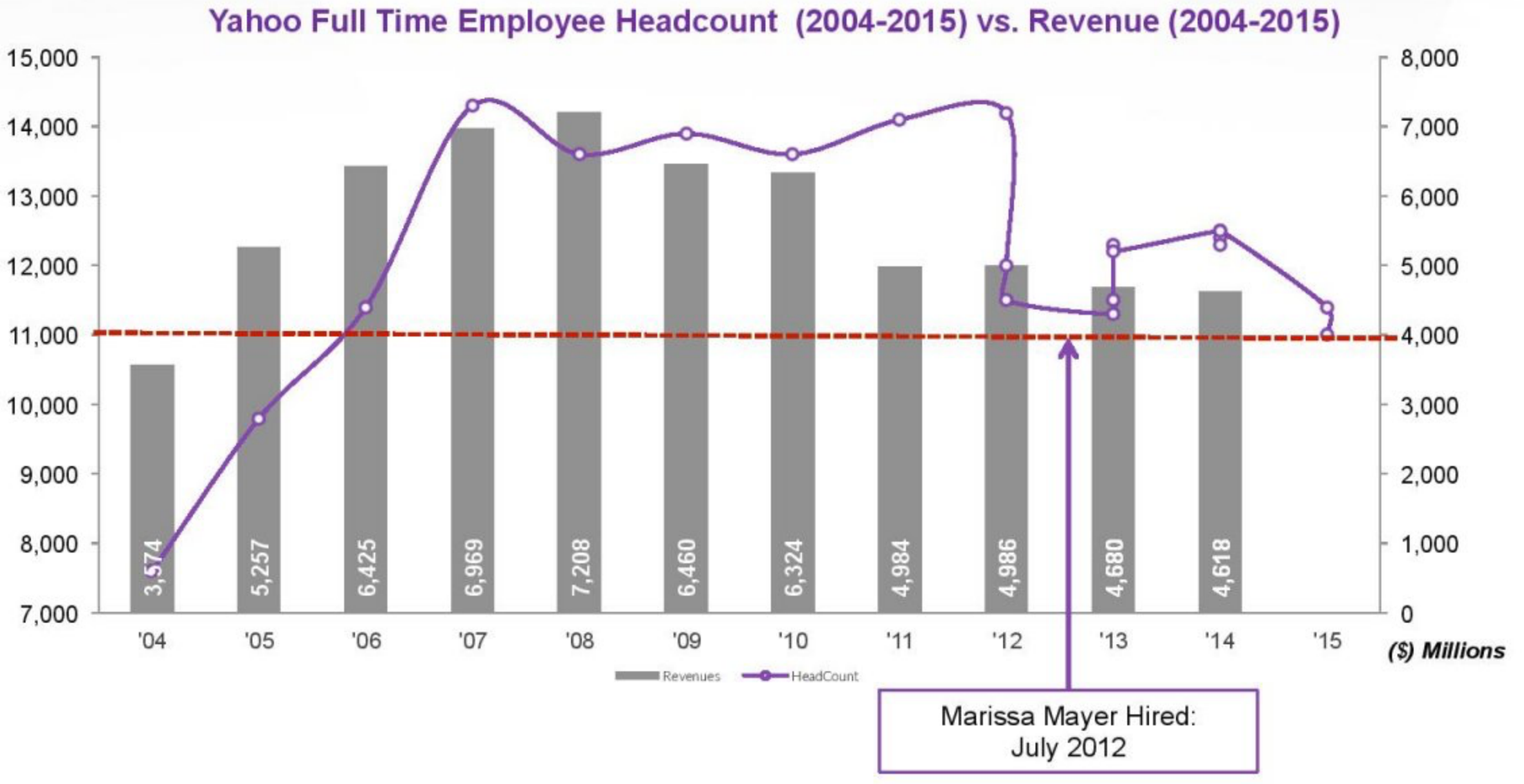


%a Abbreviated weekday name in the current locale on this platform.
%A Full weekday name in the current locale.
%b Abbreviated month name in the current locale on this platform.**%B** Full month name in the current locale.
%c Date and time. Locale-specific on output, "%a %b %e %H:%M:%S %Y" on input.
%C Century (00-99): the integer part of the year divided by 100.
%d Day of the month as decimal number (01-31).
%D Date format such as %m/%d/%y: the C99 standard says it should be that exact format (but not all OSes comply).
%e Day of the month as decimal number (1-31), with a leading space for a single-digit number.
%F Equivalent to %Y-%m-%d (the ISO 8601 date format).
%g The last two digits of the week-based year (see %V). (Accepted but ignored on input.)
%G The week-based year (see %V) as a decimal number. (Accepted but ignored on input.)
%h Equivalent to %b.
%H Hours as decimal number (00-23).
%I Hours as decimal number (01-12).
%j Day of year as decimal number (001-366).



Redrawing a Bad Slide

Yahoo's Headcount Still Excessively High Given Revenues:



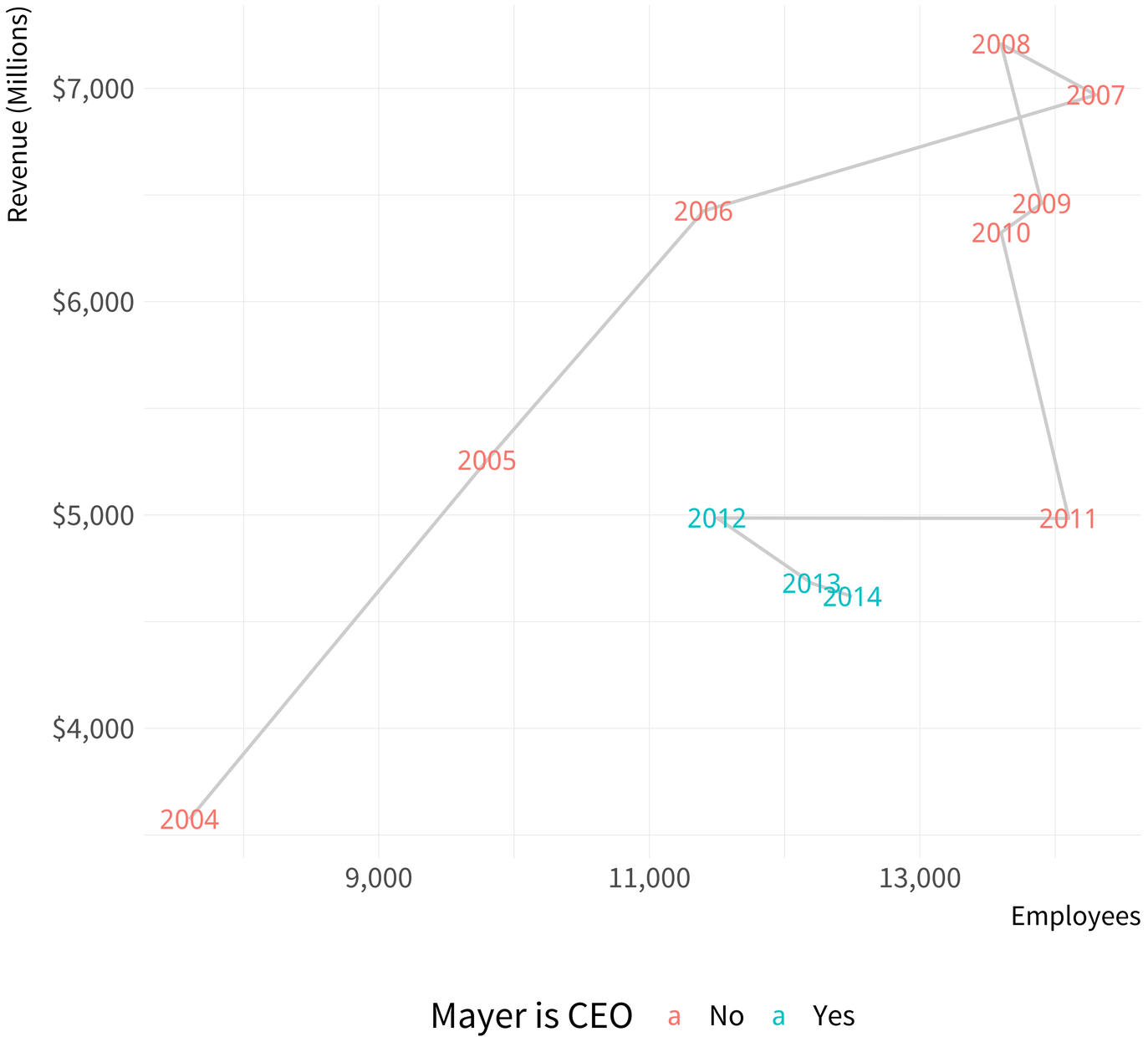
Source: Company Filings (10K), Analyst calls

```r
head(yahoo)
```

```
##   Year Revenue Employees Mayer
## 1 2004    3574      7600    No
## 2 2005    5257      9800    No
## 3 2006    6425     11400    No
## 4 2007    6969     14300    No
## 5 2008    7208     13600    No
## 6 2009    6460     13900    No
```

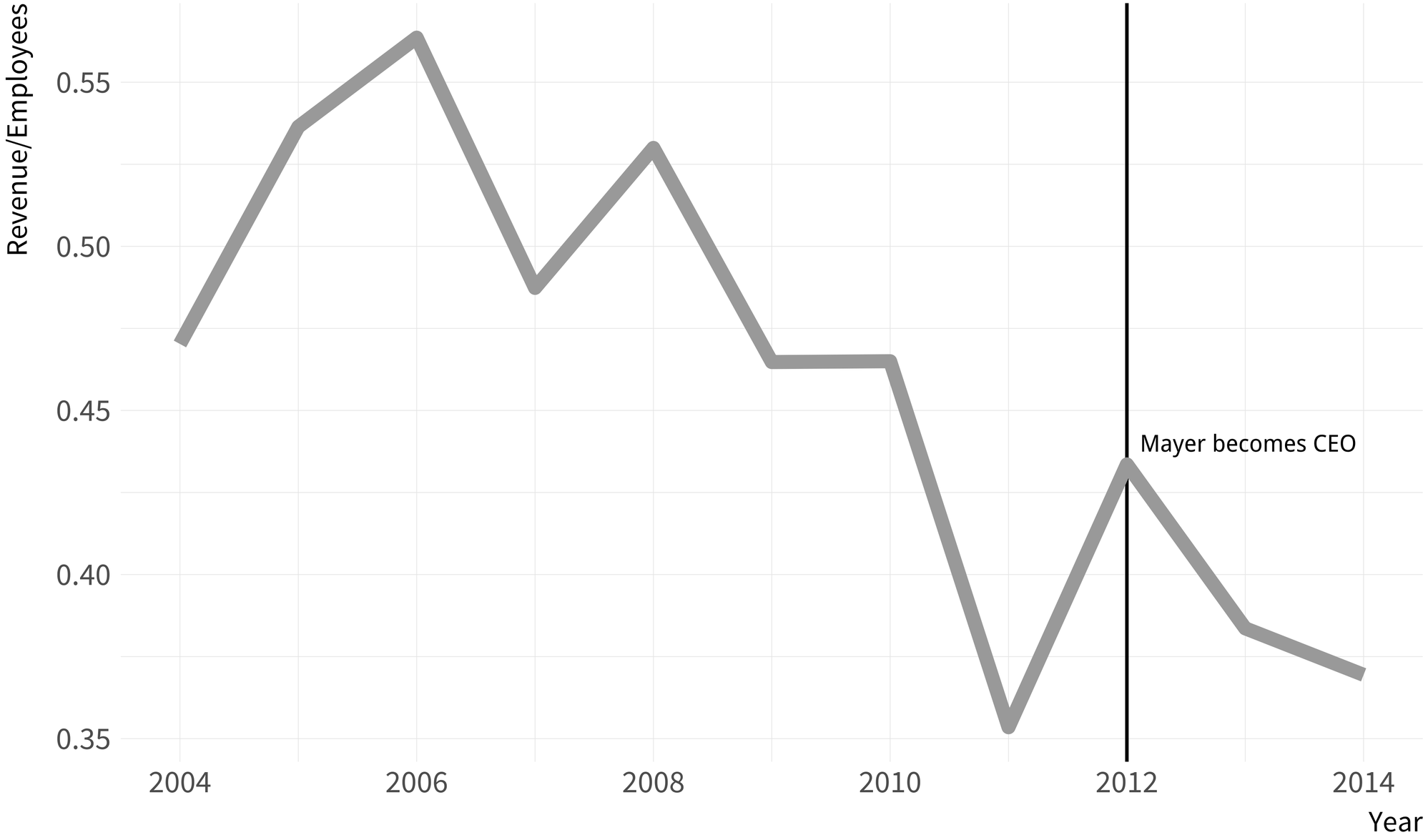
```r
p <- ggplot(data = yahoo,
            mapping = aes(x = Employees, y = Revenue))

p + geom_path(color = "gray80") +
    geom_text(aes(color = Mayer, label = Year),
              size = 3, fontface = "bold") +
    theme(legend.position = "bottom") +
    labs(color = "Mayer is CEO",
         x = "Employees", y = "Revenue (Millions)",
         title = "Yahoo Employees vs Revenues, 2004-2014") +
    scale_y_continuous(labels = scales::dollar) +
    scale_x_continuous(labels = scales::comma)
```

Yahoo Employees vs Revenues, 2004-201

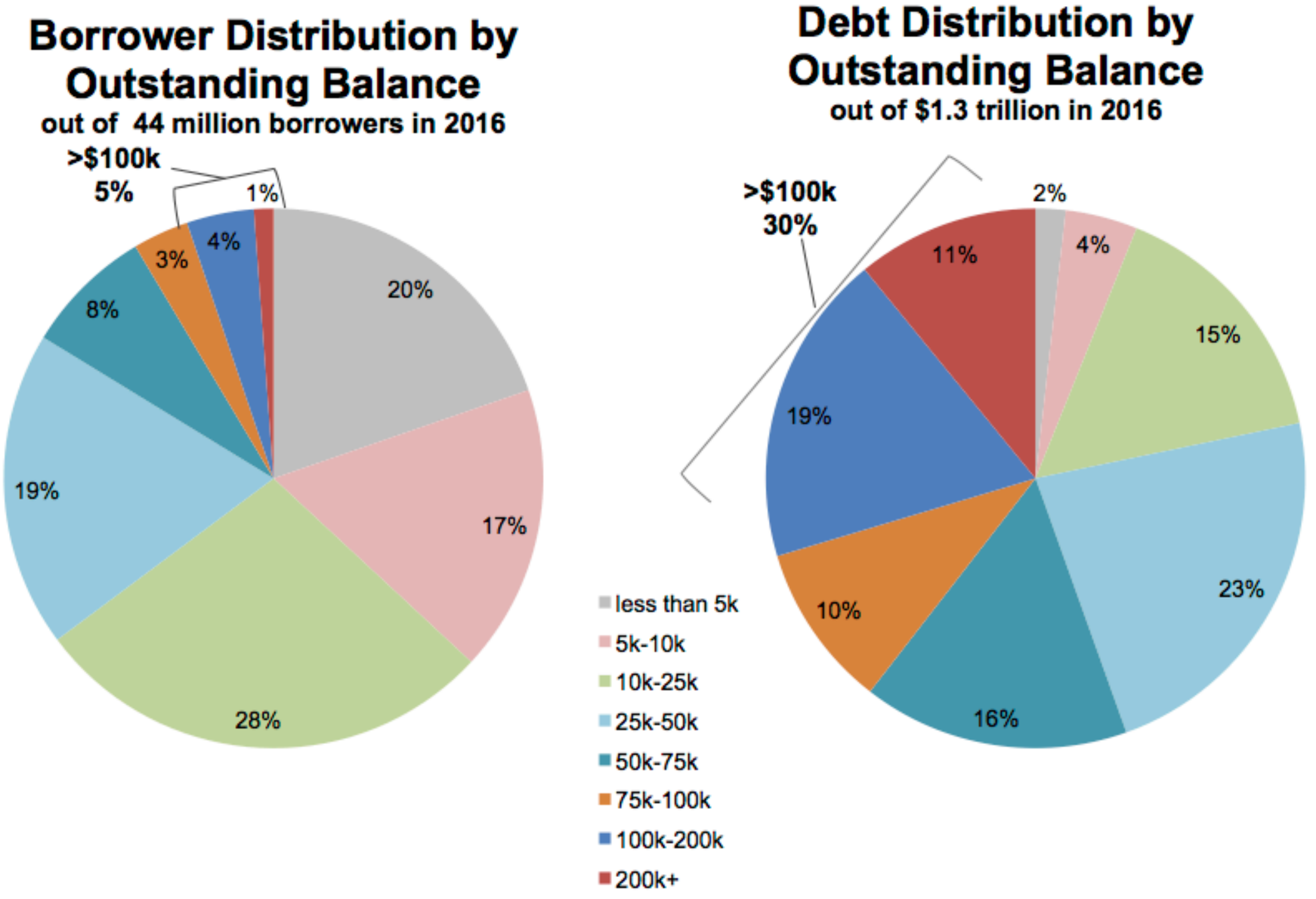


```r
p <- ggplot(data = yahoo,
            mapping = aes(x = Year, y = Revenue/Employees))

p + geom_vline(xintercept = 2012) +
    geom_line(color = "gray60", size = 2) +
    annotate("text", x = 2013, y = 0.44,
             label = " Mayer becomes CEO", size = 2.5) +
    labs(x = "Year\n",
         y = "Revenue/Employees",
         title = "Yahoo Revenue to Employee Ratio, 2004-2014")
```

Yahoo Revenue to Employee Ratio, 2004-2014



Say No to Pie


Borrower Distribution by Outstanding Balance
out of 44 million borrowers in 2016
>$100k
5%
1%
4%
3%
8%
20%
19%
17%
28%
Debt Distribution by Outstanding Balance
out of $1.3 trillion in 2016
>$100k
30%
2%
4%
11%
15%
19%
23%
10%
16%
less than 5k
5k-10k
10k-25k
25k-50k
50k-75k
75k-100k
100k-200k
200k+

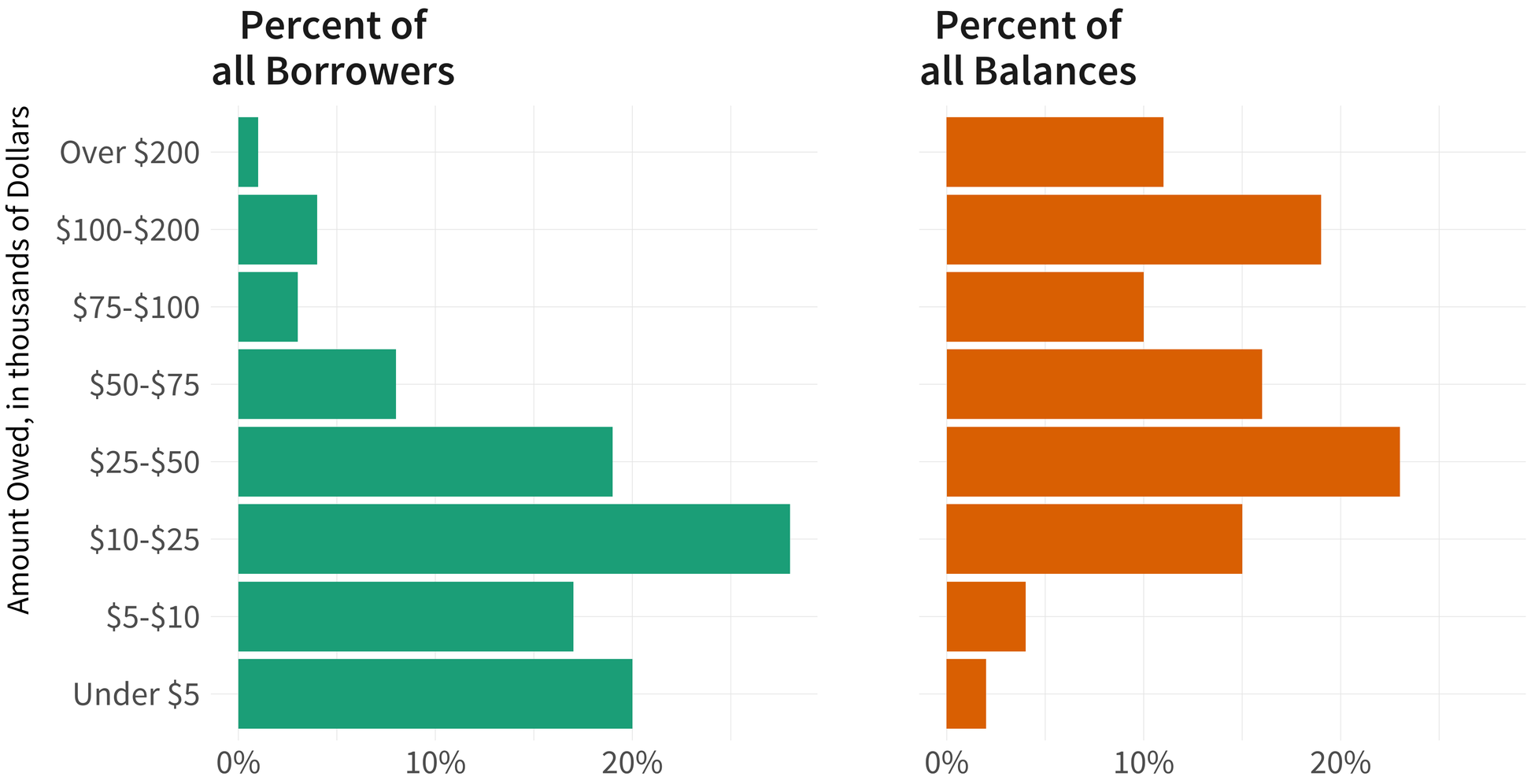
```r
head(studebt)
```

```
## # A tibble: 6 x 4
##       Debt      type   pct   Debtrc
##      <ord>    <fctr> <int>    <ord>
## 1 Under $5 Borrowers    20 Under $5
## 2   $5-$10 Borrowers    17   $5-$10
## 3  $10-$25 Borrowers    28  $10-$25
## 4  $25-$50 Borrowers    19  $25-$50
## 5  $50-$75 Borrowers     8  $50-$75
## 6 $75-$100 Borrowers     3 $75-$100
```

```r
p_xlab <- "Amount Owed, in thousands of Dollars"
p_title <- "Outstanding Student Loans"
p_subtitle <- "44 million borrowers owe a total of $1.3 trillion"
p_caption <- "Source: FRB NY"

f_labs <- c(Borrowers = "Percent of\nall Borrowers",
            Balances = "Percent of\nall Balances")

p <- ggplot(data = studebt,
            mapping = aes(x = Debt, y = pct/100, fill = type))
p + geom_bar(stat = "identity") +
    scale_fill_brewer(type = "qual", palette = "Dark2") +
    scale_y_continuous(labels = scales::percent) +
    guides(fill = FALSE) +
    theme(strip.text.x = element_text(face = "bold")) +
    labs(y = NULL, x = p_xlab,
      caption = p_caption,
      title = p_title,
      subtitle = p_subtitle) +
    facet_grid(~ type, labeller = as_labeller(f_labs)) +
    coord_flip()
```

Outstanding Student Loans

44 million borrowers owe a total of $1.3 trillion

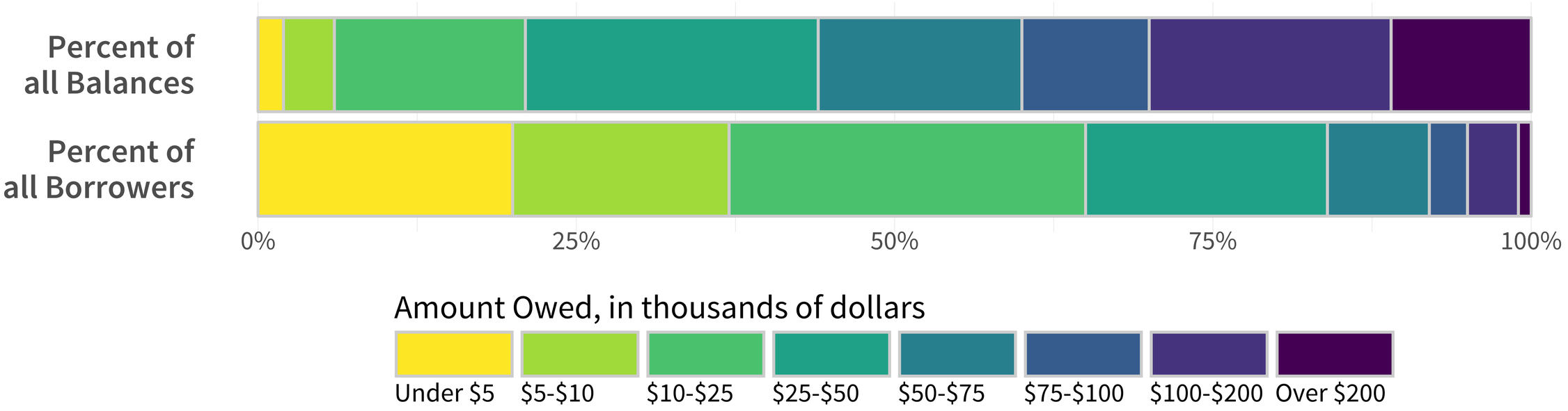


Source: FRB NY

```r
library(viridis)

p <- ggplot(studebt, aes(y = pct/100, x = type, fill = Debtrc))
p + geom_bar(stat = "identity", color = "gray80") +
  scale_x_discrete(labels = as_labeller(f_labs)) +
  scale_y_continuous(labels = scales::percent) +
  scale_fill_viridis(discrete = TRUE) +
  guides(fill = guide_legend(reverse = TRUE,
                             title.position = "top",
                             label.position = "bottom",
                             keywidth = 3,
                             nrow = 1)) +
  labs(x = NULL, y = NULL,
       fill = "Amount Owed, in thousands of dollars",
       caption = p_caption,
       title = p_title,
       subtitle = p_subtitle) +
  theme(legend.position = "bottom",
        axis.text.y = element_text(face = "bold", hjust = 1, size = 12),
        axis.ticks.length = unit(0, "cm"),
        panel.grid.major.y = element_blank()) +
  coord_flip()
```

Outstanding Student Loans

44 million borrowers owe a total of $1.3 trillion



Source: FRB NY

```r
p <- ggplot(studebt, aes(y = pct/100, x = type, fill = Debtrc))
p + geom_bar(stat = "identity", color = "gray80") +
  scale_x_discrete(labels = as_labeller(f_labs)) +
  scale_y_continuous(labels = scales::percent) +
  scale_fill_viridis_d() +
  guides(fill = guide_legend(reverse = TRUE,
                             title.position = "top",
                             label.position = "bottom",
                             keywidth = 3,
                             nrow = 1)) +
  labs(x = NULL, y = NULL,
       fill = "Amount Owed, in thousands of dollars",
       caption = p_caption,
       title = p_title,
       subtitle = p_subtitle) +
  theme(legend.position = "bottom",
        axis.text.y = element_text(face = "bold", hjust = 1, size = 12),
        axis.ticks.length = unit(0, "cm"),
        panel.grid.major.y = element_blank()) +
  coord_flip()
```

Three GSS Plots

gssr

The General Social Survey, 1972-2018

```r
install.packages("drat")
drat::addRepo("kjhealy")
install.packages("gssr")
library(gssr)
data(gss_all)
```

```
> gss_all
# A tibble: 64,814 x 6,108
    year    id wrkstat  hrs1  hrs2   evwork   occ prestige  wrkslf wrkgovt commute industry occ80 prestg80 indus80 indus07 occonet   found      occ10
   <dbl> <dbl> <dbl+l> <dbl> <dbl> <dbl+lb> <dbl> <dbl+lb> <dbl+l> <dbl+l> <dbl+l> <dbl+lb> <dbl> <dbl+lb> <dbl+l> <dbl+l> <dbl+l> <dbl+l>  <dbl+lbl>
 1  1972     1 1 [WOR…    NA    NA NA         205       50 2 [SOM…      NA      NA      609    NA       NA      NA      NA      NA 1 [Fou…  520 [Who…
 2  1972     2 5 [RET…    NA    NA  1 [YES]   441       45 2 [SOM…      NA      NA      338    NA       NA      NA      NA      NA 1 [Fou… 7700 [Fir…
 3  1972     3 2 [WOR…    NA    NA NA         270       44 2 [SOM…      NA      NA      718    NA       NA      NA      NA      NA 0 [Not… 4920 [Rea…
 4  1972     4 1 [WOR…    NA    NA NA           1       57 2 [SOM…      NA      NA      319    NA       NA      NA      NA      NA 1 [Fou…  800 [Acc…
 5  1972     5 7 [KEE…    NA    NA  1 [YES]   385       40 2 [SOM…      NA      NA      448    NA       NA      NA      NA      NA 1 [Fou… 5020 [Tel…
 6  1972     6 1 [WOR…    NA    NA NA         281       49 2 [SOM…      NA      NA      209    NA       NA      NA      NA      NA 1 [Fou… 4850 [Sal…
 7  1972     7 1 [WOR…    NA    NA NA         522       41 2 [SOM…      NA      NA       69    NA       NA      NA      NA      NA 0 [Not… 6440 [Pip…
 8  1972     8 1 [WOR…    NA    NA NA         314       36 2 [SOM…      NA      NA      587    NA       NA      NA      NA      NA 1 [Fou… 5350 [Ord…
 9  1972     9 2 [WOR…    NA    NA NA         912       26 2 [SOM…      NA      NA      669    NA       NA      NA      NA      NA 0 [Not… 4020 [Coo…
10  1972    10 1 [WOR…    NA    NA NA         984       18 2 [SOM…      NA      NA      769    NA       NA      NA      NA      NA 1 [Fou… 4230 [Mai…
# … with 64,804 more rows, and 6,089 more variables: occindv <dbl+lbl>, occstatus <dbl+lbl>, occtag <dbl+lbl>, prestg10 <dbl+lbl>,
#   prestg105plus <dbl+lbl>, indus10 <dbl+lbl>, indstatus <dbl+lbl>, indtag <dbl+lbl>, marital <dbl+lbl>, martype <dbl+lbl>, agewed <dbl+lbl>,
#   divorce <dbl+lbl>, widowed <dbl+lbl>, spwrksta <dbl+lbl>, sphrs1 <dbl+lbl>, sphrs2 <dbl+lbl>, spevwork <dbl+lbl>, cowrksta <dbl+lbl>,
#   cowrkslf <dbl+lbl>, coevwork <dbl+lbl>, cohrs1 <dbl+lbl>, cohrs2 <dbl+lbl>, spocc <dbl+lbl>, sppres <dbl+lbl>, spwrkslf <dbl+lbl>, spind <dbl+lbl>,
#   spocc80 <dbl+lbl>, sppres80 <dbl+lbl>, spind80 <dbl+lbl>, spocc10 <dbl+lbl>, spoccindv <dbl+lbl>, spoccstatus <dbl+lbl>, spocctag <dbl+lbl>,
```

```r
library(ggrepel)
library(forcats)
library(haven)
```

For help cleaning some Stata elements

```r
library(survey)
```

Thomas Lumley's survey library, and Grad Freedman Ellis's compatibility layer

```r
options(survey.lonely.psu = "adjust")
options(na.action="na.pass")
```

Set some survey options relevant to the GSS

```r
my_colors <- function (palette = "cb"){
  cb_palette <- c("#000000", "#E69F00", "#56B4E9", "#009E73",
                  "#F0E442", "#0072B2", "#D55E00", "#CC79A7")
  rcb_palette <- rev(cb_palette)
  bly_palette <- c("#E69F00", "#0072B2", "#000000", "#56B4E9",
                   "#009E73", "#F0E442", "#D55E00", "#CC79A7")
  error <- "Choose cb, rcb, or bly only."
  case_when(
    palette == "cb" ~ cb_palette,
    palette == "rcb" ~ rcb_palette,
    palette == "bly" ~ bly_palette
  )
}
```

A very rough custom colors function

```r
convert_agegrp <- function(x){
  x <- stringr::str_replace_all(x, "\\(", "")
  x <- stringr::str_replace_all(x, "\\[", "")
  x <- stringr::str_replace_all(x, "\\]", "")
  x <- stringr::str_replace_all(x, ",", "-")
  x <- stringr::str_replace_all(x, "-89", "+")
  regex <- "^(.*$)"
  x <- stringr::str_replace_all(x, regex, "Age \\1")
  x
}
```

A rough label-cleaning function

```r
cont_vars <- c("year", "id", "ballot", "age")

cat_vars <- c("race", "sex", "fefam")

wt_vars <- c("vpsu",
             "vstrat",
             "oversamp",
             "formwt",              # weight to deal with experimental randomization
             "wtssall",             # weight variable
             "sampcode",            # sampling error code
             "sample")              # sampling frame and method

vars <- c(cont_vars, cat_vars, wt_vars)
```

The variables that we want from the big GSS file. Categorical, Continuous, and Weights

```r
quintiles <- quantile(as.numeric(gss_all$age),
                      probs = seq(0, 1, 0.2),
                      na.rm = TRUE)
```

Calculate the breaks for Age quintiles

```r
gss_svy <- gss_all %>%
  select(vars) %>%
  filter(year > 1974) %>%
  modify_at(vars(), zap_missing) %>%
  modify_at(wt_vars, as.numeric) %>%
  modify_at(cat_vars, as_factor) %>%
  mutate(agequint = cut(x = age, breaks = unique(quintiles), include.lowest = TRUE),
         agequint = fct_relabel(agequint, convert_agegrp),
         year_f = droplevels(factor(year)),
         young = ifelse(age < 26, "Yes", "No"),
         fefam = fct_recode(fefam, NULL = "IAP", NULL = "DK", NULL = "NA"),
         fefam = fct_relabel(fefam, snakecase::to_title_case),
         fefam_d = fct_recode(fefam,
                              Agree = "Strongly Agree",
                              Disagree = "Strongly Disagree"))
```

Select the variables we want, and do some recoding

```r
gss_svy
```

```
## # A tibble: 60,213 x 18
##     year    id ballot   age race  sex   fefam  vpsu vstrat oversamp formwt
##    <dbl> <dbl> <dbl+> <dbl> <fct> <fct> <fct> <dbl>  <dbl>    <dbl>  <dbl>
##  1  1975     1     NA    38 WHITE MALE  <NA>      1   7001        1      1
##  2  1975     2     NA    20 WHITE FEMA… <NA>      1   7001        1      1
##  3  1975     3     NA    61 WHITE FEMA… <NA>      1   7001        1      1
##  4  1975     4     NA    19 WHITE MALE  <NA>      1   7001        1      1
##  5  1975     5     NA    28 WHITE MALE  <NA>      1   7001        1      1
##  6  1975     6     NA    28 WHITE FEMA… <NA>      1   7002        1      1
##  7  1975     7     NA    35 WHITE FEMA… <NA>      1   7002        1      1
##  8  1975     8     NA    64 WHITE FEMA… <NA>      1   7002        1      1
##  9  1975     9     NA    53 WHITE MALE  <NA>      1   7002        1      1
## 10  1975    10     NA    34 WHITE FEMA… <NA>      1   7002        1      1
## # … with 60,203 more rows, and 7 more variables: wtssall <dbl>, sampcode <dbl>,
## #   sample <dbl>, agequint <fct>, year_f <fct>, young <chr>, fefam_d <fct>
```

```r
gss_svy <- gss_svy %>%
  mutate(compwt = oversamp * formwt * wtssall,
         samplerc = ifelse(sample %in% 3:4, 3,
                           ifelse(sample %in% 6:7, 6,
                                  sample)))
```

More GSS-specific weight recoding

```r
gss_svy <- gss_svy %>%
  drop_na(fefam_d) %>%
  mutate(stratvar = interaction(year, vstrat)) %>%
  as_survey_design(id = vpsu,
                   strata = stratvar,
                   weights = wtssall,
                   nest = TRUE)
gss_svy
```

Now make the tibble a survey object

```
## Stratified 1 - level Cluster Sampling design (with replacement)
## With (3585) clusters.
## Called via srvyr
## Sampling variables:
##  - ids: vpsu
##  - strata: stratvar
##  - weights: wtssall
## Data variables: year (dbl), id (dbl), ballot (dbl+lbl), age (dbl+lbl), race
##   (fct), sex (fct), fefam (fct), vpsu (dbl), vstrat (dbl), oversamp (dbl),
##   formwt (dbl), wtssall (dbl), sampcode (dbl), sample (dbl), agequint (fct),
##   year_f (fct), young (chr), fefam_d (fct), compwt (dbl), samplerc (dbl),
##   stratvar (fct)
```

```r
out_ff <- gss_svy %>%
  group_by(year, sex, young, fefam_d) %>%
  summarize(prop = survey_mean(na.rm = TRUE,
                               vartype = "ci")) %>%
  drop_na()
```

Calculate survey-weighted means and confidence intervals for subgroups

```r
out_ff
```

```
## # A tibble: 168 x 7
##     year sex    young fefam_d   prop prop_low prop_upp
##    <dbl> <fct>  <chr> <fct>    <dbl>    <dbl>    <dbl>
##  1  1977 MALE   No    Agree    0.726    0.685    0.766
##  2  1977 MALE   No    Disagree 0.274    0.234    0.315
##  3  1977 MALE   Yes   Agree    0.551    0.469    0.633
##  4  1977 MALE   Yes   Disagree 0.449    0.367    0.531
##  5  1977 FEMALE No    Agree    0.674    0.639    0.709
##  6  1977 FEMALE No    Disagree 0.326    0.291    0.361
##  7  1977 FEMALE Yes   Agree    0.415    0.316    0.514
##  8  1977 FEMALE Yes   Disagree 0.585    0.486    0.684
##  9  1985 MALE   No    Agree    0.542    0.496    0.587
## 10  1985 MALE   No    Disagree 0.458    0.413    0.504
## # … with 158 more rows
```

Hurray! A tidy table of results

Survey-weighted trends, by sex and young/old groups

```r
facet_names <- c("No" = "Age Over 25 when surveyed",
                 "Yes" = "Age 18-25 when surveyed")

p <- ggplot(subset(out_ff, fefam_d == "Disagree"),
            aes(x = year, y = prop,
                ymin = prop_low, ymax = prop_upp,
                color = sex, group = sex, fill = sex)) +
  geom_line(size = 1.2) +
  geom_ribbon(alpha = 0.3, color = NA) +
  scale_x_continuous(breaks = seq(1978, 2018, 4)) +
  scale_y_continuous(labels = scales::percent_format(accuracy = 1)) +
  scale_color_manual(values = my_colors("bly")[2:1],
                     labels = c("Men", "Women"),
                     guide = guide_legend(title=NULL)) +
  scale_fill_manual(values = my_colors("bly")[2:1],
                    labels = c("Men", "Women"),
                    guide = guide_legend(title=NULL)) +
  facet_wrap(~ young, labeller = as_labeller(facet_names),
             ncol = 1) +
  labs(x = "Year",
       y = "Percent Disagreeing",
       subtitle = "Disagreement with the statement, ‘It is much better for\neveryone involved if the man is the achiever outside the\nhome and the woman takes care of the home and family’”,
       caption = "Kieran Healy http://socviz.co.\nData source: General Social Survey") +
  theme(legend.position = "bottom")
```

Nicer facet labels

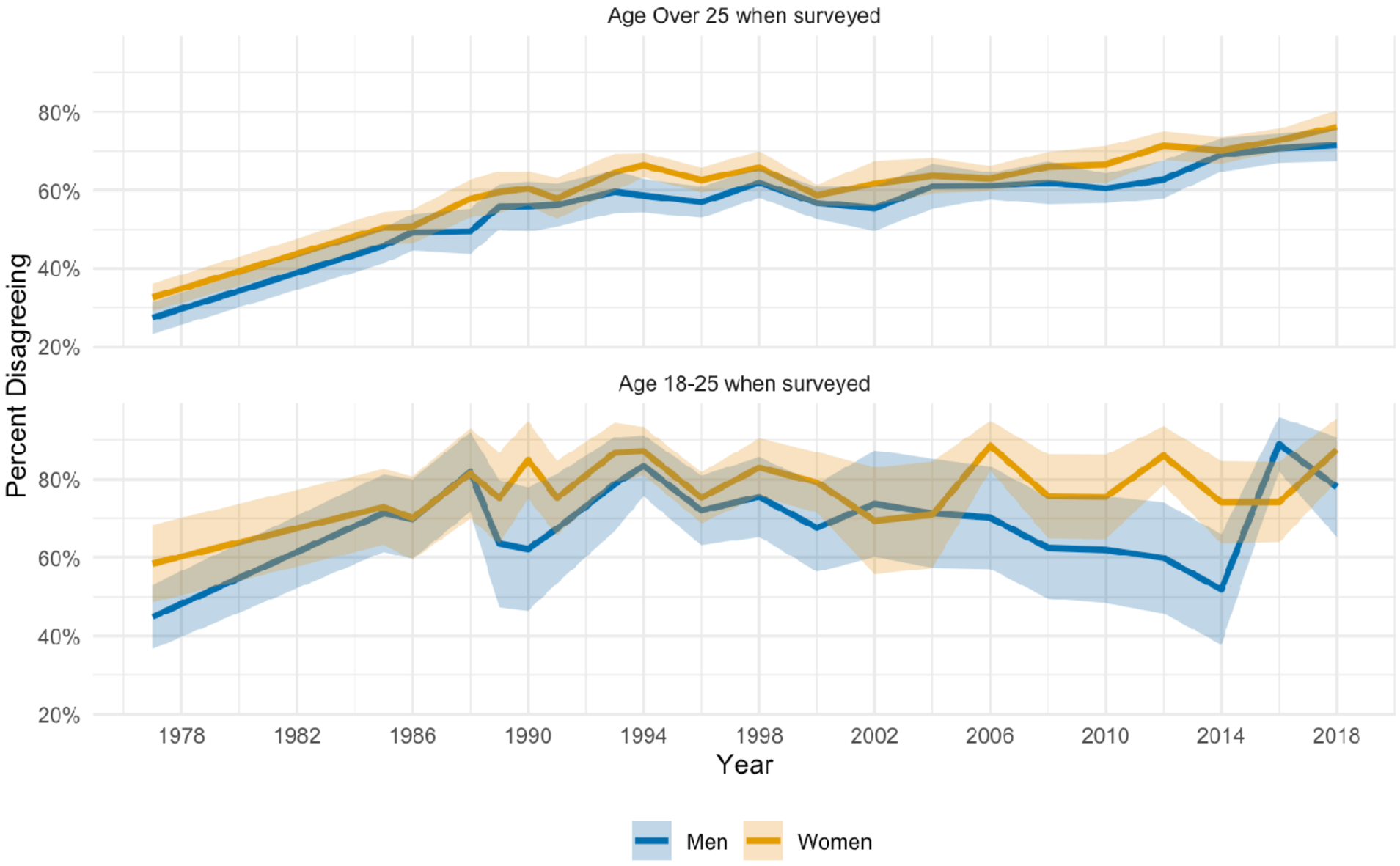
Subset to “Disagree”, then map both color and fill

Manually set x-axis breaks

Manually set color and fill, remember you need to do both, or you’ll get two guides

Use our nicer facet labels

Disagreement with the statement, 'It is much better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family'



Kieran Healy http://socviz.co.
Data source: General Social Survey

```r
out_ff_agequint <- gss_svy %>%
  group_by(year, agequint, fefam_d) %>%
  summarize(prop = survey_mean(na.rm = TRUE, vartype = "se")) %>%
  mutate(end_label = if_else(year == max(year),
                             socviz::prefix_strip(as.character(agequint), "Age "),
                             NA_character_),
         start_label = if_else(year == min(year),
                               socviz::prefix_strip(as.character(agequint), "Age "),
                               NA_character_))
```

See how we calculate start and end labels here

```
> out_ff_agequint
# A tibble: 247 x 7
    year agequint  fefam_d   prop prop_se end_label start_label
   <dbl> <fct>     <fct>    <dbl>   <dbl> <chr>     <chr>
 1  1977 Age 18-29 Agree    0.477  0.0244 NA        18-29
 2  1977 Age 18-29 Disagree 0.523  0.0244 NA        18-29
 3  1977 Age 29-38 Agree    0.527  0.0365 NA        29-38
 4  1977 Age 29-38 Disagree 0.473  0.0365 NA        29-38
 5  1977 Age 38-49 Agree    0.667  0.0293 NA        38-49
 6  1977 Age 38-49 Disagree 0.333  0.0293 NA        38-49
 7  1977 Age 49-63 Agree    0.812  0.0228 NA        49-63
 8  1977 Age 49-63 Disagree 0.188  0.0228 NA        49-63
 9  1977 Age 63+   Agree    0.885  0.0237 NA        63+
10  1977 Age 63+   Disagree 0.115  0.0237 NA        63+
# … with 237 more rows
```

Survey-Weighted trend by Age Quintiles

```r
man_cols <- RColorBrewer::brewer.pal(9, "Blues")
man_cols <- man_cols[4:9]


p <- ggplot(subset(out_ff_agequint, fefam_d == "Disagree"),
            aes(x = year, y = prop, ymin = prop - prop_se, ymax = prop + prop_se,
                color = agequint, group = agequint, fill = agequint)) +
  geom_line(size = 1.2) +
  geom_ribbon(alpha = 0.3, color = NA) +
  scale_x_continuous(breaks = seq(1978, 2018, 4)) +
  scale_y_continuous(labels = scales::percent_format(accuracy = 1)) +
  scale_fill_manual(values = man_cols) +
  scale_color_manual(values = man_cols) +
  guides(fill = FALSE, color = FALSE) +
  annotate("text", x = 1974.5, y = 0.58, label = "Age at time\nof survey",
           size = 3, hjust = 0, fontface = "bold", lineheight = 0.9) +
  annotate("text", x = 2020.8, y = 0.95, label = "Age at time\nof survey",
           size = 3, hjust = 1, fontface = "bold", lineheight = 0.8) +
  geom_label_repel(aes(label = end_label), color = "white", nudge_x = 1) +
  geom_label_repel(aes(label = start_label), color = "white", nudge_x = -1) +
  coord_cartesian(xlim = c(1976, 2019)) +
  labs(x = “Year", y = "Percent",
       title = "Changing Attitudes to Gender Roles, by Age Quintiles",
       subtitle = "Percent Disagreeing with the statement, ‘It is much better for everyone involved if the man is the\nachiever outside the home and the woman takes care of the home and family’",
       caption = "Kieran Healy http://socviz.co.\nData source: General Social Survey. Shaded ranges are population-adjusted standard errors for each age group.") +
  theme(legend.position = "right")
```

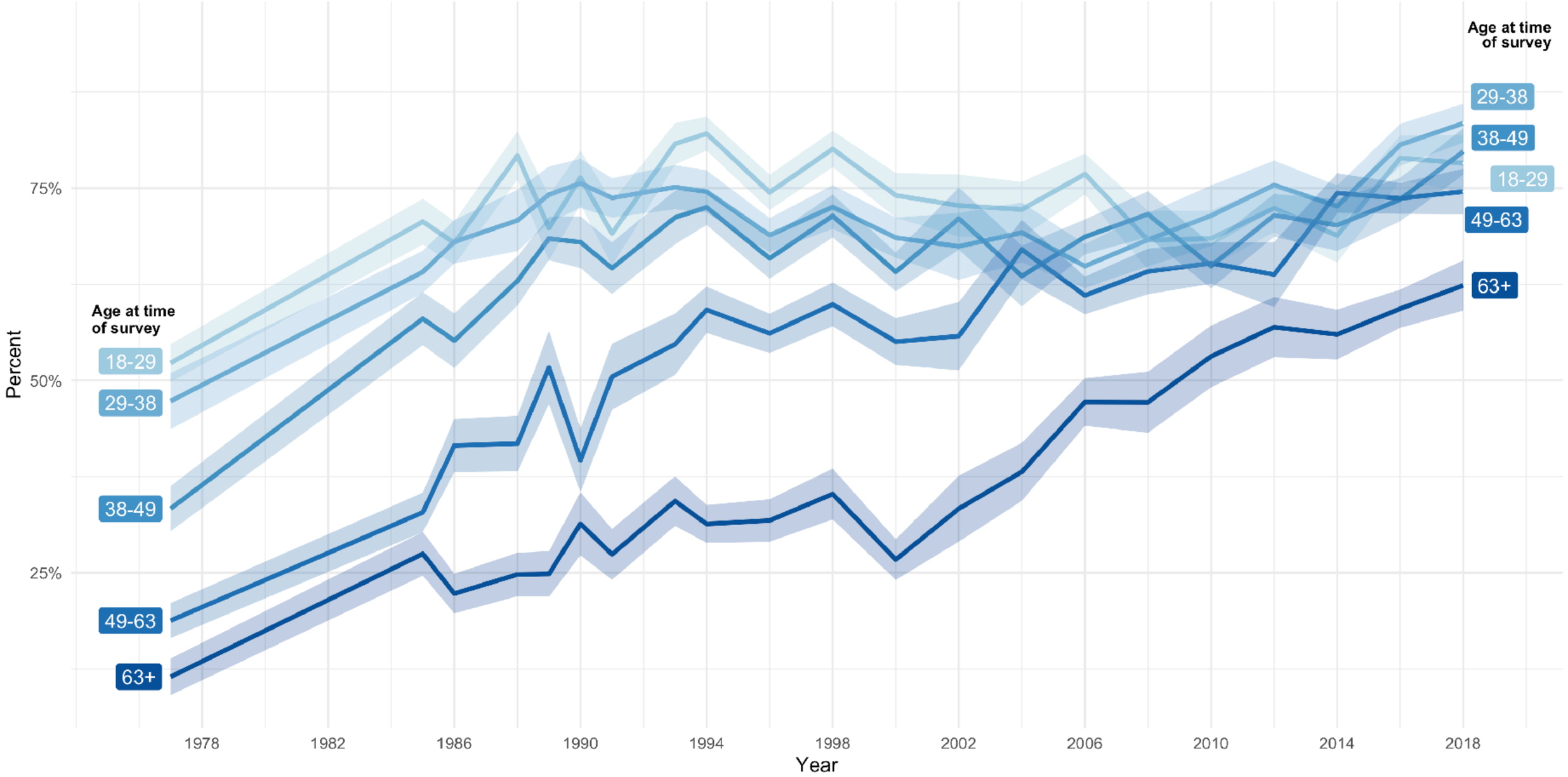
annotate() for a helpful note

geom_label_repel() for the labels

coord_cartesian() to make space

Changing Attitudes to Gender Roles, by Age Quintiles

Percent Disagreeing with the statement, 'It is much better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family'



Kieran Healy http://socviz.co.

Data source: General Social Survey. Shaded ranges are population-adjusted standard errors for each age group.

Quasi-Cohort Comparison

```r
cohort_comp <- gss_svy %>%
  filter(year %in% c(1977, 2018) &
           agequint %in% c("Age 18-29", "Age 63+")) %>%
  mutate(cohort = interaction(agequint, year),
         cohort = droplevels(cohort)) %>%
  group_by(cohort, fefam) %>%
  summarize(prop = survey_mean(na.rm = TRUE, vartype = "se")) %>%
  mutate(cohort = fct_relabel(cohort, ~ stringr::str_replace_all(.x, "\\.", " in ")),
         cohort = factor(cohort,
                         levels = c("Age 18-29 in 2018", "Age 63+ in 1977",
                                    "Age 18-29 in 1977", "Age 63+ in 2018"),
                         ordered = TRUE),
         compare = case_when(cohort %in% c("Age 18-29 in 1977",
                                           "Age 63+ in 2018") ~ "Comparing Approximately the Same
                                                                 Cohort in 1977 and 2018",
                             cohort %in% c("Age 18-29 in 2018",
                                           "Age 63+ in 1977") ~ "Comparing the Old in 1977 vs
                                                                 the Young in 2018"),
         end_label = if_else(fefam == "Strongly Disagree",
                             socviz::prefix_strip(as.character(cohort), "Age "), NA_character_))
```

case_when() is very handy

Quasi-Cohort Comparison

Here we've done a lot of the plot setup inside the tibble

In the actual plot we'll use compare as a facet, and this will make end_label work as expected.

```
> cohort_comp
# A tibble: 16 x 6
   cohort            fefam                 prop prop_se compare                                                  end_label
   <ord>             <fct>                <dbl>   <dbl> <chr>                                                    <chr>
 1 Age 18-29 in 1977 Strongly Agree    0.101   0.0171  Comparing Approximately the Same Cohort in 1977 and 2018 NA
 2 Age 18-29 in 1977 Agree             0.377   0.0225  Comparing Approximately the Same Cohort in 1977 and 2018 NA
 3 Age 18-29 in 1977 Disagree          0.435   0.0268  Comparing Approximately the Same Cohort in 1977 and 2018 NA
 4 Age 18-29 in 1977 Strongly Disagree 0.0879  0.0178  Comparing Approximately the Same Cohort in 1977 and 2018 18-29 in 1977
 5 Age 63+ in 1977   Strongly Agree    0.372   0.0372  Comparing the Old in 1977 vs the Young in 2018           NA
 6 Age 63+ in 1977   Agree             0.513   0.0448  Comparing the Old in 1977 vs the Young in 2018           NA
 7 Age 63+ in 1977   Disagree          0.108   0.0237  Comparing the Old in 1977 vs the Young in 2018           NA
 8 Age 63+ in 1977   Strongly Disagree 0.00703 0.00524 Comparing the Old in 1977 vs the Young in 2018           63+ in 1977
 9 Age 18-29 in 2018 Strongly Agree    0.0504  0.0167  Comparing the Old in 1977 vs the Young in 2018           NA
10 Age 18-29 in 2018 Agree             0.167   0.0314  Comparing the Old in 1977 vs the Young in 2018           NA
11 Age 18-29 in 2018 Disagree          0.472   0.0382  Comparing the Old in 1977 vs the Young in 2018           NA
12 Age 18-29 in 2018 Strongly Disagree 0.310   0.0355  Comparing the Old in 1977 vs the Young in 2018           18-29 in 2018
13 Age 63+ in 2018   Strongly Agree    0.0947  0.0166  Comparing Approximately the Same Cohort in 1977 and 2018 NA
14 Age 63+ in 2018   Agree             0.282   0.0296  Comparing Approximately the Same Cohort in 1977 and 2018 NA
15 Age 63+ in 2018   Disagree          0.413   0.0272  Comparing Approximately the Same Cohort in 1977 and 2018 NA
16 Age 63+ in 2018   Strongly Disagree 0.210   0.0257  Comparing Approximately the Same Cohort in 1977 and 2018 63+ in 2018
```

Quasi-Cohort Comparison

```r
p <- ggplot(cohort_comp,
            aes(x = fefam, y = prop, group = cohort,
                color = cohort, fill = cohort,
                ymin = prop - prop_se,
                ymax = prop + prop_se)) +
  geom_point(size = 3) +
  geom_line(size = 1.2) +
  geom_ribbon(alpha = 0.2, color = NA) +
  scale_color_manual(values = my_colors()) +
  scale_fill_manual(values = my_colors()) +
  guides(fill = FALSE, color = FALSE) +
  scale_y_continuous(labels = scales::percent_format(accuracy = 1)) +
  geom_label_repel(aes(label = end_label), fill = "white",
                   size = 2.2, segment.colour = NA, nudge_x = 0.7) +
  facet_wrap(~ compare) +
  labs(y = "Percent", x = NULL,
       title = "Generational Replacement, or, People Don't Change Much, They Just Get Old",
       subtitle = "Responses to the statement ‘It is much better for everyone involved if the man is the\nachiever outside the home and the woman takes care of the home and family’”,
       caption = "Kieran Healy http://socviz.co.\nData source: General Social Survey. Shaded ranges are population-adjusted standard errors for each age group.")
```

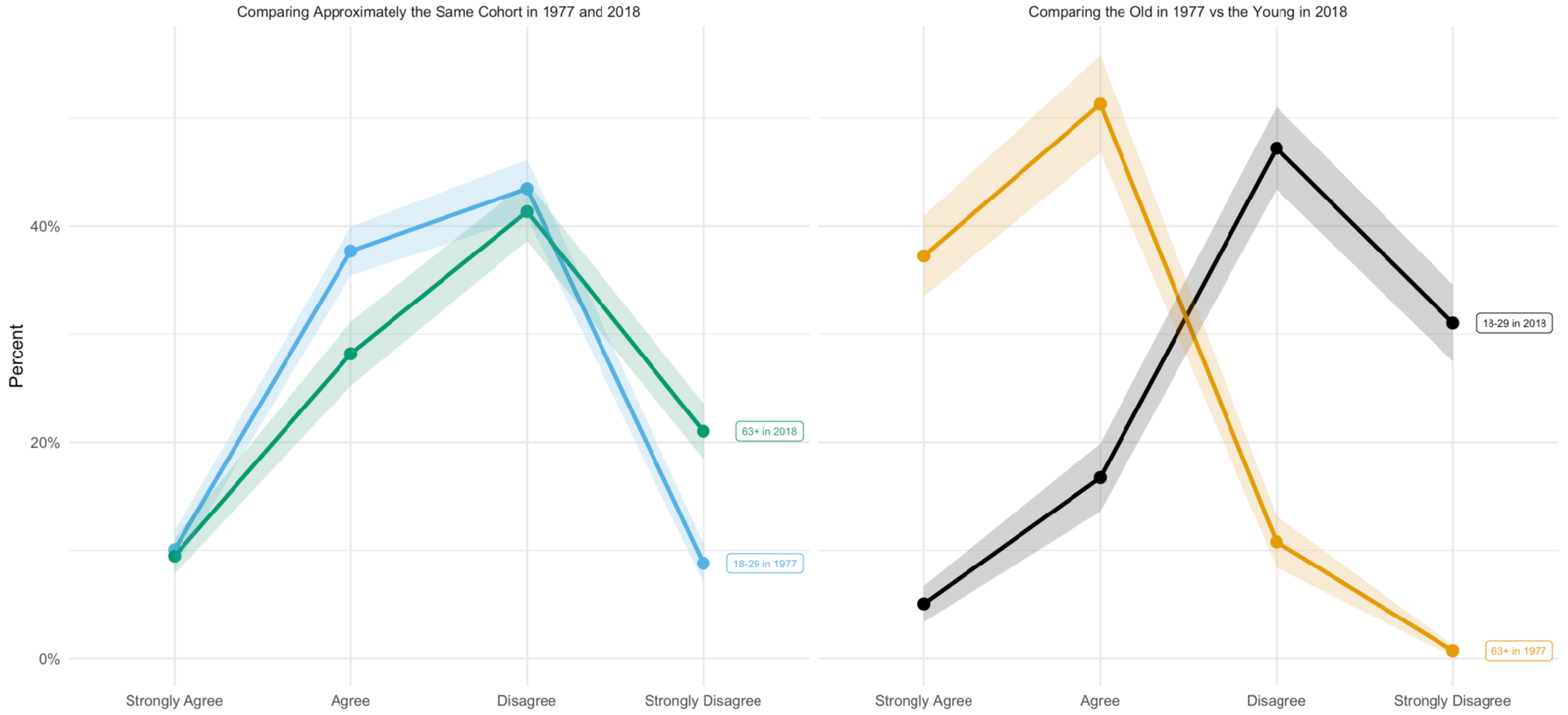
Turn off the ribbon border

Manual color and fill palette again

Tweak the end-labels

Generational Replacement, or, People Don't Change Much, They Just Get Old

Responses to the statement ‘It is much better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family’



Kieran Healy http://socviz.co.

Data source: General Social Survey. Shaded ranges are population-adjusted standard errors for each age group.

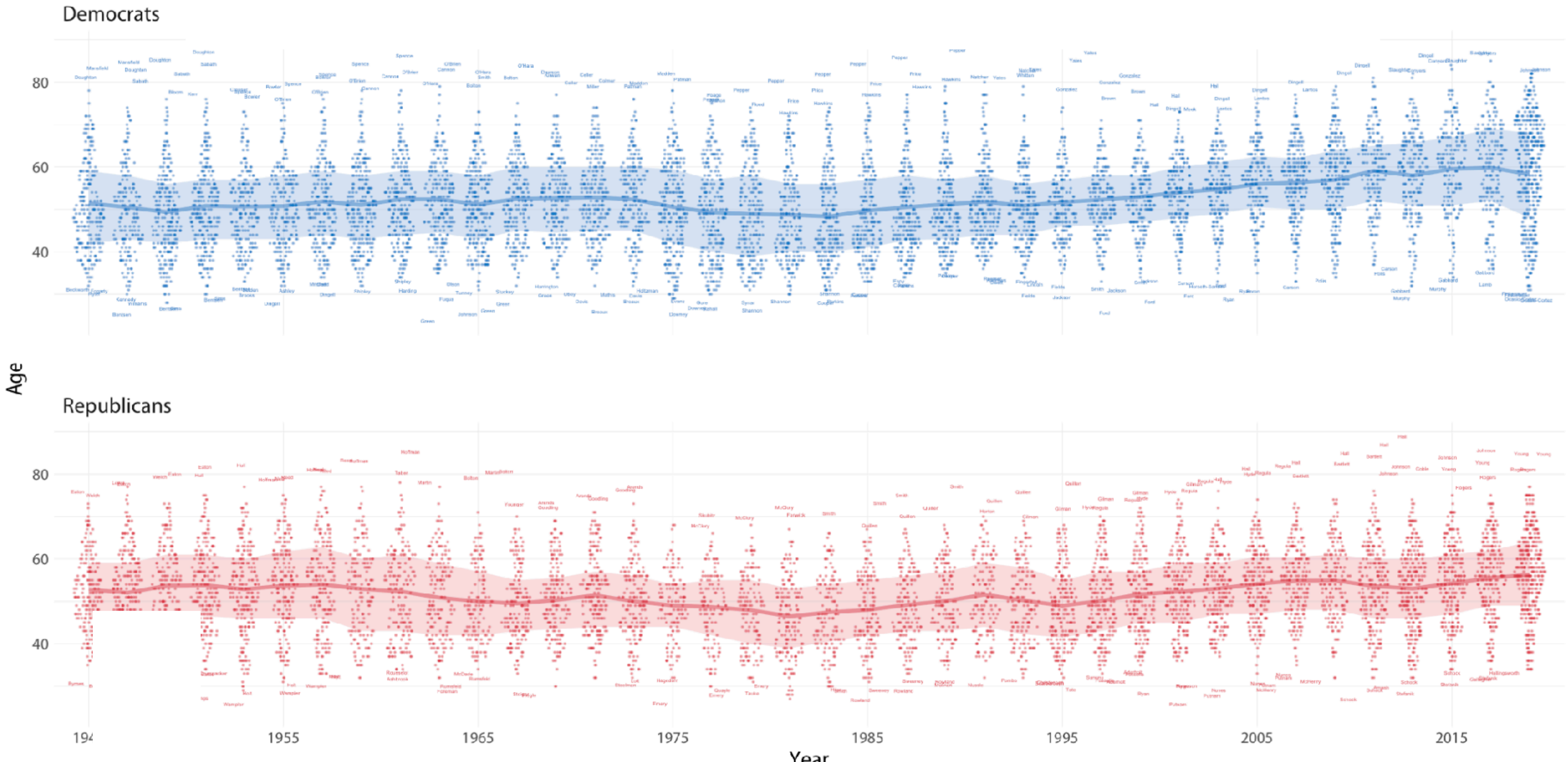
But I want a Pony

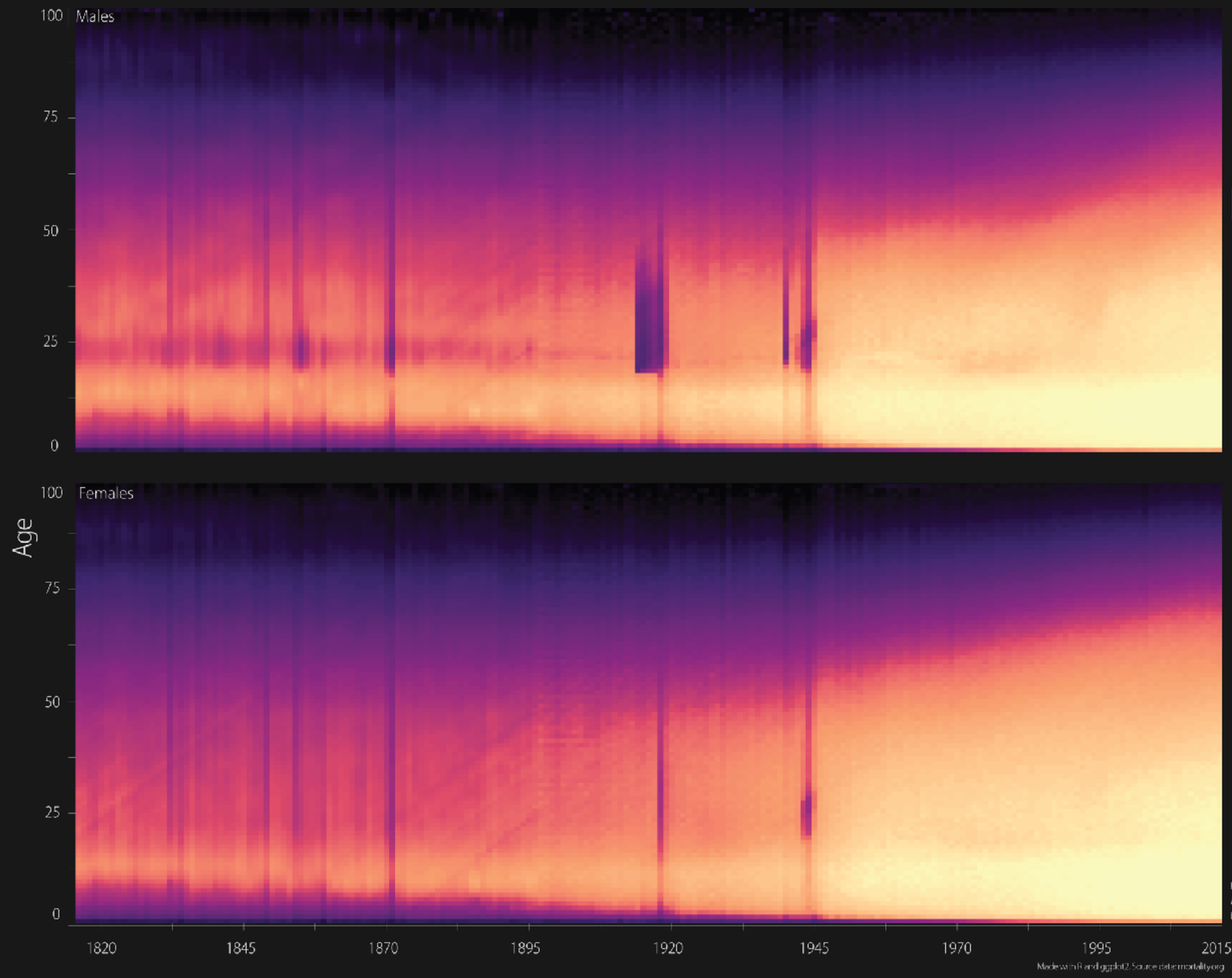
Show Ponies

Age Distribution of Congressional Representatives, 1945-2019

Trend line is mean age; bands are 25th and 75th percentiles of the range.

Youngest and oldest percentiles are named instead of being shown by points.





MORTALITY IN FRANCE 1816 – 2016

Death Rate Percentile

25 50 75 100

Mortality rates are calculated for each age in each year and binned by percentile. The darker the color at any particular point, the more people of that age die in that year. The lighter the color, the more people of that age survive in that year.

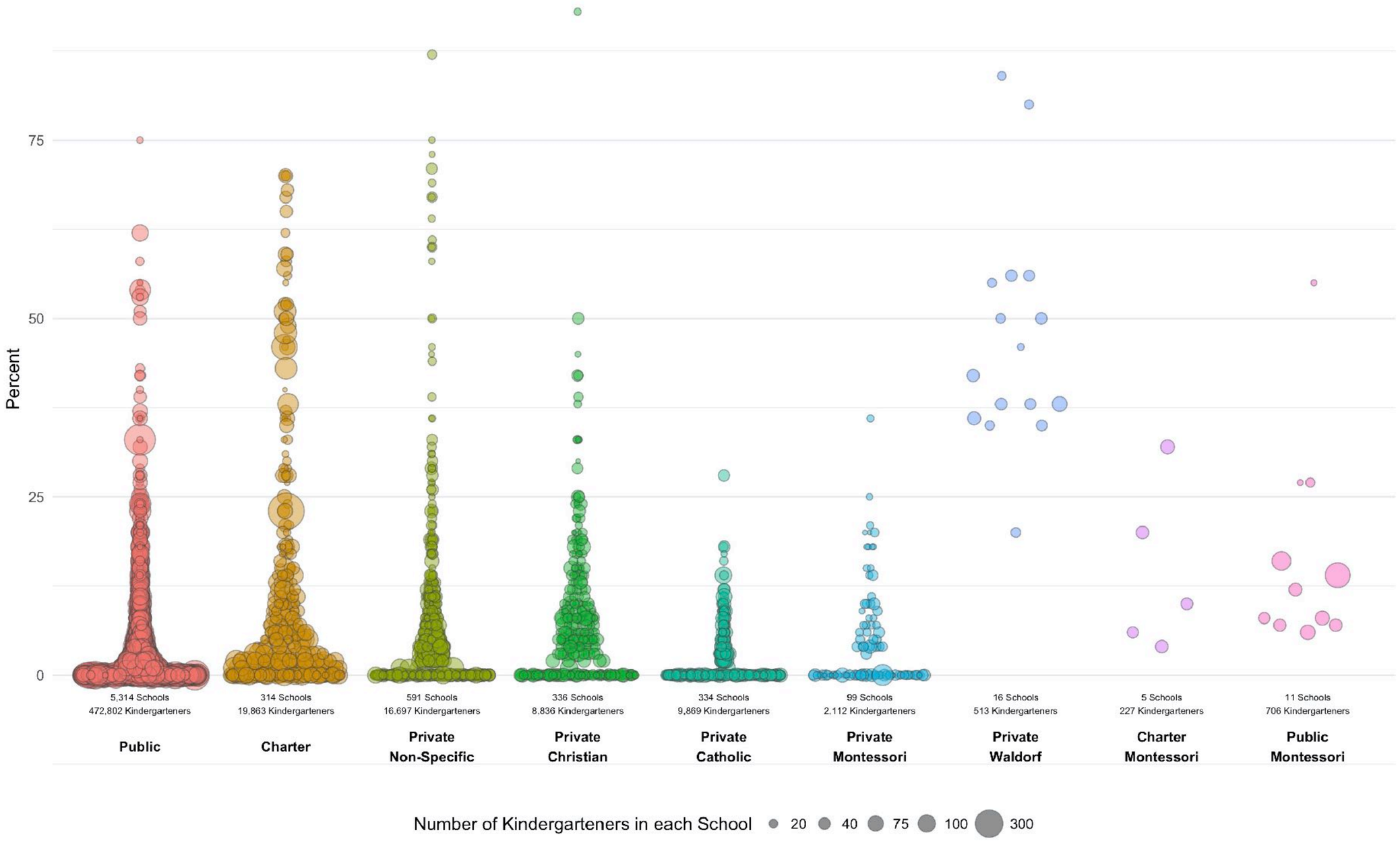
Historical trends are visible, such as the rapid decrease in infant mortality rates after World War II, as well as increased life expectancy overall. Specific events show up as vertical streaks in the graph. The death toll due to wars is evident for Males. Pandemics are also visible, most notably the 1918 Influenza pandemic and the death toll due to Smallpox outbreaks after the Franco-Prussian war of 1870.

Diagonal streaks in the data are visible in some parts of the graph. These are artifacts due to the estimation of the mortality rate in some years. Single-year-of-age figures prior to 1900 are calculated from five-year age groups, as no single-year data is available in the original mortality tabulations from which the rates were derived.

Kieran Healy / socviz.co
Data Visualization: A Practical Introduction
is published by Princeton University Press

Vaccination Exemption Rates in California Kindergartens

Percent of Kindergarteners with a Personal Belief Exemption, by Type and Size of School.



Show Ponies

Age Distribution of Congressional Representatives, 1945-2019

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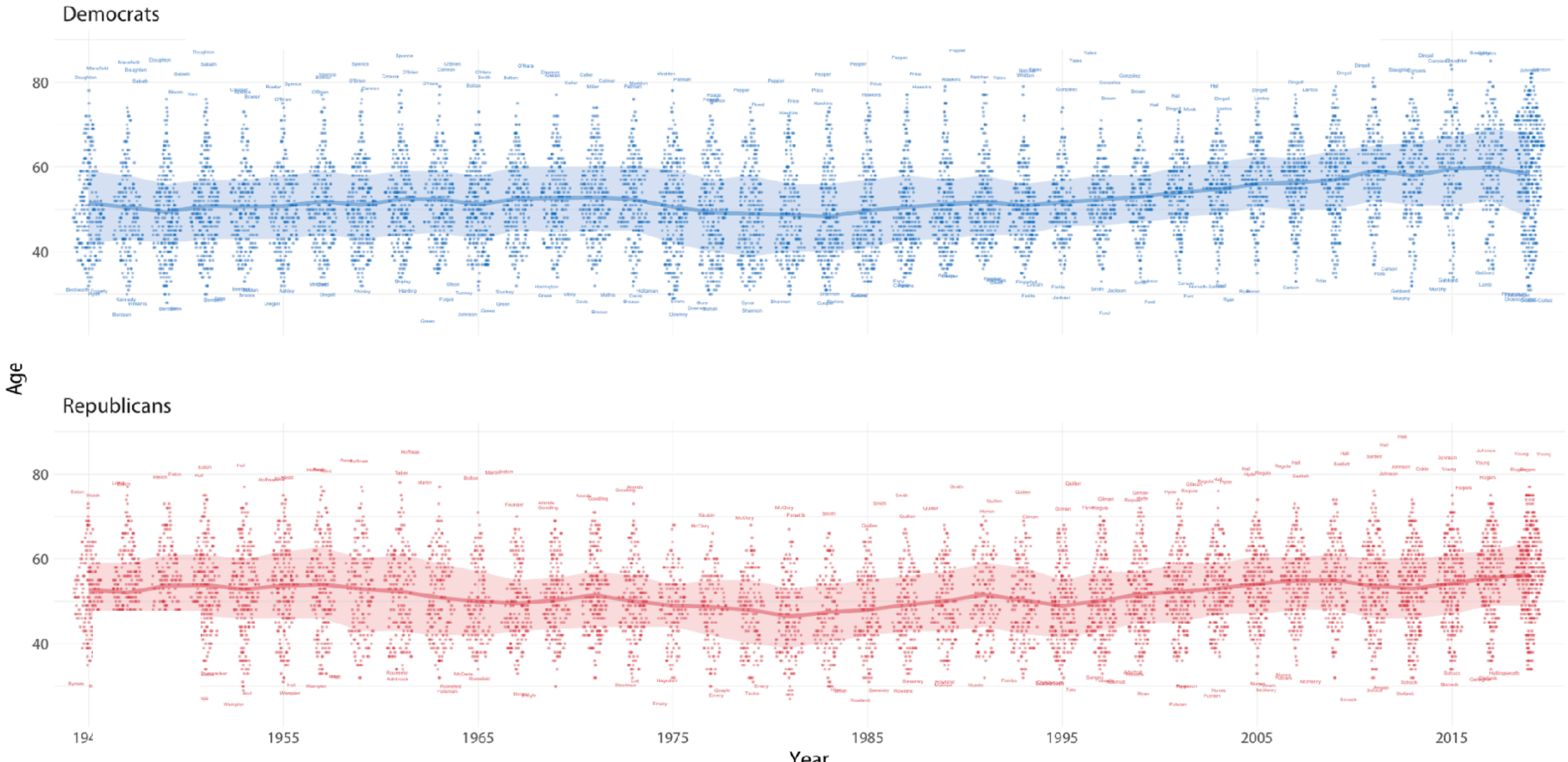


```r
install.packages("drat")
drat::addRepo("kjhealy")
install.packages("congress")
library(congress)
```

congress

Representatives and Senators since 1945

```
> congress
# A tibble: 21,009 x 38
   congress last  first middle suffix nickname born       death      sex   position party state district start      end   religion race
      <dbl> <chr> <chr> <chr>  <chr>  <chr>    <date>     <date>     <chr> <chr>    <chr> <chr> <chr>    <date>     <chr> <chr>    <chr>
 1       79 Aber… Thom… Gerst… NA     NA       1903-05-16 1953-01-23 M     U.S. Re… Demo… MS    4        1945-01-03 01/0… Methodi… White
 2       79 Adams Sher… NA     NA     NA       1899-01-08 1986-10-27 M     U.S. Re… Repu… NH    2        1945-01-03 01/0… Not spe… White
 3       79 Aiken Geor… David  NA     NA       1892-08-20 1984-11-19 M     U.S. Se… Repu… VT    NA       1945-01-03 01/0… Protest… White
 4       79 Allen Asa   Leona… NA     NA       1891-01-05 1969-01-05 M     U.S. Re… Demo… LA    8        1945-01-03 01/0… Not spe… White
 5       79 Allen Leo   Elwood NA     NA       1898-10-05 1973-01-19 M     U.S. Re… Repu… IL    13       1945-01-03 01/0… Presbyt… White
 6       79 Almo… J.    Linds… Jr.    NA       1898-06-15 1986-04-14 M     U.S. Re… Demo… VA    6        1946-02-04 04/1… Lutheran White
 7       79 Ande… Herm… Carl   NA     NA       1897-01-27 1978-07-26 M     U.S. Re… Repu… MN    7        1945-01-03 01/0… Lutheran White
 8       79 Ande… Clin… Presba NA     NA       1895-10-23 1975-11-11 M     U.S. Re… Demo… NM    AL       1941-01-03 06/3… Presbyt… White
 9       79 Ande… John  Zuing… NA     NA       1904-03-22 1981-02-09 M     U.S. Re… Repu… CA    8        1945-01-03 01/0… Not spe… White
10       79 Andr… Augu… Herman NA     NA       1890-10-11 1958-01-14 M     U.S. Re… Repu… MN    1        1945-01-03 01/1… Not spe… White
# … with 20,999 more rows, and 21 more variables: educational_attainment <chr>, job_type_1 <chr>, job_type_2 <chr>, job_type_3 <chr>,
#   job_type_4 <chr>, job_type_5 <chr>, mil_1 <chr>, mil_2 <chr>, mil_3 <chr>, start_year <date>, end_year <date>, name_dob <chr>,
#   pid <dbl>, start_age <int>, poc <chr>, days_old <dbl>, months_old <int>, full_name <chr>, end_career <date>, entry_age <int>,
#   yr_fac <fct>
>
```

```r
library(lubridate)
library(tidyverse)
library(ggbeeswarm)
library(ggrepel)
library(congress)
```

```r
oldest_group_by_year <- congress %>%
  filter(party %in% c("Democrat", "Republican"),
         position == "U.S. Representative") %>%
    group_by(congress, party) %>%
  filter(start_age > quantile(start_age, 0.99, na.rm = TRUE))
```

```
> oldest_group_by_year
# A tibble: 181 x 32
# Groups:   congress, party [75]
   congress   pid last  first middle suffix born       death      sex   position party state district start      end
      <dbl> <dbl> <chr> <chr> <chr>  <chr>  <date>     <date>     <chr> <chr>    <chr> <chr> <chr>    <date>     <chr>
 1       79   136 Doug… Robe… Lee    NA     1863-11-07 1954-10-01 M     U.S. Re… Demo… NC    9        1945-01-03 01/0…
 2       79   146 Eaton Char… Aubrey NA     1868-03-29 1953-01-23 M     U.S. Re… Repu… NJ    5        1945-01-03 01/0…
 3       79   326 Mans… Jose… J.     NA     1861-02-09 1947-07-12 M     U.S. Re… Demo… TX    9        1917-04-02 07/1…
 4       79   529 Welch Rich… Joseph NA     1869-02-13 1949-09-10 M     U.S. Re… Repu… CA    5        1926-08-31 09/1…
 5       80   136 Doug… Robe… Lee    NA     1863-11-07 1954-10-01 M     U.S. Re… Demo… NC    9        1945-01-03 01/0…
 6       80   146 Eaton Char… Aubrey NA     1868-03-29 1953-01-23 M     U.S. Re… Repu… NJ    5        1945-01-03 01/0…
 7       80   624 Lewis Will… NA     NA     1868-09-22 1959-08-08 M     U.S. Re… Repu… KY    9        1948-05-03 01/0…
 8       80   326 Mans… Jose… J.     NA     1861-02-09 1947-07-12 M     U.S. Re… Demo… TX    9        1917-04-02 07/1…
 9       80   449 Saba… Adol… Joach… NA     1866-04-04 1952-11-06 M     U.S. Re… Demo… IL    5        1945-01-03 01/0…
10       81    43 Bloom Sol   NA     NA     1870-03-09 1949-03-07 M     U.S. Re… Demo… NY    20       1923-01-30 03/0…
# … with 171 more rows, and 17 more variables: religion <chr>, race <chr>, education <chr>, occ1 <chr>, occ2 <chr>,
#   occ3 <chr>, mil1 <chr>, mil2 <chr>, mil3 <chr>, start_year <date>, end_year <date>, start_age <int>, poc <chr>,
#   days_old <dbl>, entry_age <int>, end_career <date>, yr_fac <fct>
```

```r
youngest_group_by_year <- congress %>%
  filter(party %in% c("Democrat", "Republican"),
         position == "U.S. Representative") %>%
    group_by(congress, party) %>%
  filter(start_age < quantile(start_age, 0.01, na.rm = TRUE))
```

```
> youngest_group_by_year
# A tibble: 164 x 32
# Groups:   congress, party [71]
   congress   pid last  first middle suffix born       death      sex   position party state district start      end
      <dbl> <dbl> <chr> <chr> <chr>  <chr>  <date>     <date>     <chr> <chr>    <chr> <chr> <chr>    <date>     <chr>
 1       79    33 Beck… Lind… Gary   NA     1913-06-30 1984-03-09 M     U.S. Re… Demo… TX    3        1945-01-03 01/0…
 2       79    37 Benn… Mari… Tinsl… NA     1914-06-06 2000-09-06 M     U.S. Re… Repu… MO    6        1945-01-03 01/0…
 3       79    75 Byrn… John  Willi… NA     1913-06-12 1985-01-12 M     U.S. Re… Repu… WI    8        1945-01-03 01/0…
 4       79   167 Foga… John  Edward NA     1913-03-23 1967-01-10 M     U.S. Re… Demo… RI    2        1945-01-03 01/1…
 5       79   448 Ryter John  Franc… NA     1914-02-04 1978-02-05 M     U.S. Re… Demo… CT    AL       1945-01-03 01/0…
 6       80   563 Bent… Lloyd Milla… Jr.    1921-02-11 2006-05-23 M     U.S. Re… Demo… TX    15       1948-12-04 01/0…
 7       80   621 Kenn… John  Fitzg… NA     1917-05-29 1963-11-22 M     U.S. Re… Demo… MA    11       1947-01-03 01/0…
 8       80   656 Nodar Robe… Joseph Jr.    1916-03-23 1974-09-11 M     U.S. Re… Repu… NY    6        1947-01-03 01/0…
 9       80   664 Pott… Char… Edward NA     1916-10-30 1979-11-23 M     U.S. Re… Repu… MI    11       1947-08-26 11/0…
10       80   677 Sarb… Geor… Willi… Jr.    1919-09-30 1973-03-04 M     U.S. Re… Repu… PA    5        1947-01-03 01/0…
# … with 154 more rows, and 17 more variables: religion <chr>, race <chr>, education <chr>, occ1 <chr>, occ2 <chr>,
#   occ3 <chr>, mil1 <chr>, mil2 <chr>, mil3 <chr>, start_year <date>, end_year <date>, start_age <int>, poc <chr>,
#   days_old <dbl>, entry_age <int>, end_career <date>, yr_fac <fct>
```

```r
mean_age_swarm <- congress %>%
    filter(position == "U.S. Representative",
           party %in% c("Democrat", "Republican")) %>%
    group_by(congress, party) %>%
    summarize(year = first(start_year),
              mean_age = mean(start_age, na.rm = TRUE),
              lo = quantile(start_age, 0.25, na.rm = TRUE),
              hi = quantile(start_age, 0.75, na.rm = TRUE)) %>%
    mutate(yr_fac = as.factor(year(year)))
> mean_age_swarm
# A tibble: 76 x 7
# Groups:   congress [38]
   congress party      year       mean_age    lo    hi yr_fac
      <dbl> <chr>      <date>        <dbl> <dbl> <dbl> <chr>
 1       79 Democrat   1945-01-03     51.5  42      59 1945
 2       79 Republican 1945-01-03     52.8  46      59 1945
 3       80 Democrat   1947-01-03     50.5  43      58 1947
 4       80 Republican 1947-01-03     52.0  45      59 1947
 5       81 Democrat   1949-01-03     49.4  42      56 1949
 6       81 Republican 1949-01-03     53.7  47      61 1949
 7       82 Democrat   1951-01-03     50.8  43      57 1951
 8       82 Republican 1951-01-03     53.8  46.5    61 1951
 9       83 Democrat   1953-01-03     50.7  43      57 1953
10       83 Republican 1953-01-03     52.9  46      60 1953
# … with 66 more rows
```

```
##   [1]  136  146  326  529  136  146  624  326  449   43  136  146  449  529  136
##  [16]  146  260  288  449  920  117  260  477  920  249  979  378  423  477  920
##  [31]  249  979  378  423  477   80  249  378  423  477   80  249  378  477  492
##  [46]   80  329  378  788   44  711  329  788  471   44  711  788 1013   15   88
##  [61]  124 1252  294   15   88  106 1252  354   15 1252  320  389  320  389  322
##  [76] 1349  392  402 1372  166 1349  392 1776 1336 1349  392  406 1336  392  406
##  [91] 1837 1336  392  406 1362 1837 1336  392  406 1362 1837 1336  392 1362 1837
## [106] 1337  978 1362  829 1690  978 1362  535  829 1690 1251 1362  829 1313 1690
## [121] 1251 1796 1728  829 1313 1690 1251 2057 1796 1728 1030 1690 2057 1796 2485
## [136] 1728 1030 2057 2057 1796 2068 1728 1030 2057 1796 2068 1728 2400 1030 2057
## [151] 2068 1728 2400 1030 2057 2400 1030 2057 2366 2203 1405 1030 2057 2366 2290
## [166] 1405 2366 2090 2290 1748 1405 2366 2090 2290 1748 2459 2090 1748 1748 2090
## [181] 2459   33   37   75  167  448  563  621  656  664  677  700  707  563  664
## [196]  808  707  563  852  865  808  563  922  957  994 1007 1016 1030  957 1007
## [211] 1082 1030  957 1107 1112 1007 1217 1233 1256 1291 1217 1325 1328  202 1358
## [226] 1368  202 1431 1350 1368 1472  202 1530 1539 1540  202 1577 1590 1616 1625
## [241] 1641 1616 1625 1699 1712 1736 1768 1772 1774 1784 1768 1772 1876 1908 1909
## [256] 1772 2003 2013 2014 2003 2129 2063 2168 2003 2099 2129 2168 2226 2232 2129
## [271] 2251 2168 2226 2232 2129 2318 2168 2226 2342 2373 2382 2386 2433 2435 2472
## [286] 2493 2535 2433 2566 2589 2595 2607 2630 2631 2566 2677 2682 2607 2630 2631
## [301] 2566 2721 2677 2745 2755 2630 2781 2721 2630 2829 2842 2781 2849 2856 2881
```

```r
party_names <- c(`Democrat` = "Democrats",
                 `Republican` = "Republicans")

party_names

##      Democrat    Republican
##   "Democrats" "Republicans"

# Hex color codes for Dem Blue and Rep Red
party_colors <- c("#2E74C0", "#CB454A")


p <- ggplot(data = subset(congress,
                          party %in% c("Democrat", "Republican") &
                          position == "U.S. Representative" &
                          pid %nin% exclude_pid),
            mapping = aes(x = yr_fac,
                          y = start_age,
                          color = party,
                          label = last))
```

```r
p_out <- p + geom_quasirandom(size = 0.1, alpha = 0.4,
                      method = "pseudorandom", dodge.width = 1) +
    geom_line(data = mean_age_swarm,
              mapping = aes(x = yr_fac, y = mean_age,
                            color = party, group = party),
              inherit.aes = FALSE, size = 1, alpha = 0.5) +
    geom_ribbon(data = mean_age_swarm,
              mapping = aes(x = yr_fac,
                            ymin = lo,
                            ymax = hi,
                            color = NULL,
                            fill = party,
                            group = party),
              inherit.aes = FALSE, alpha = 0.2) +
    geom_text(data = oldest_group_by_year,
            size = 0.9, alpha = 1,
            position = position_jitter(width = 0.4, height = 0.4)) +
    geom_text(data = youngest_group_by_year,
            size = 0.9, alpha = 1,
            position = position_jitter(width = 0.4, height = 0.4)) +
    scale_x_discrete(breaks = levels(congress$yr_fac)[c(T, rep(F, 4))]) +
    scale_color_manual(values = party_colors) +
    scale_fill_manual(values = party_colors) +
    guides(color = FALSE, fill = FALSE) +
    labs(x = "Year", y = "Age",
         title = "Age Distribution of Congressional Representatives, 1945-2019",
         subtitle = "Trend line is mean age; bands are 25th and 75th percentiles
                     of the range.\n\n Youngest and oldest percentiles are named
                     instead of being shown by points.") +
    facet_wrap( ~ party, ncol = 1,
              labeller = as_labeller(party_names)) +
    theme(plot.subtitle = element_text(size = 10))
```

The yearly point swarms

The mean age line

The hi-lo age ribbon

The oldsters

The youngsters

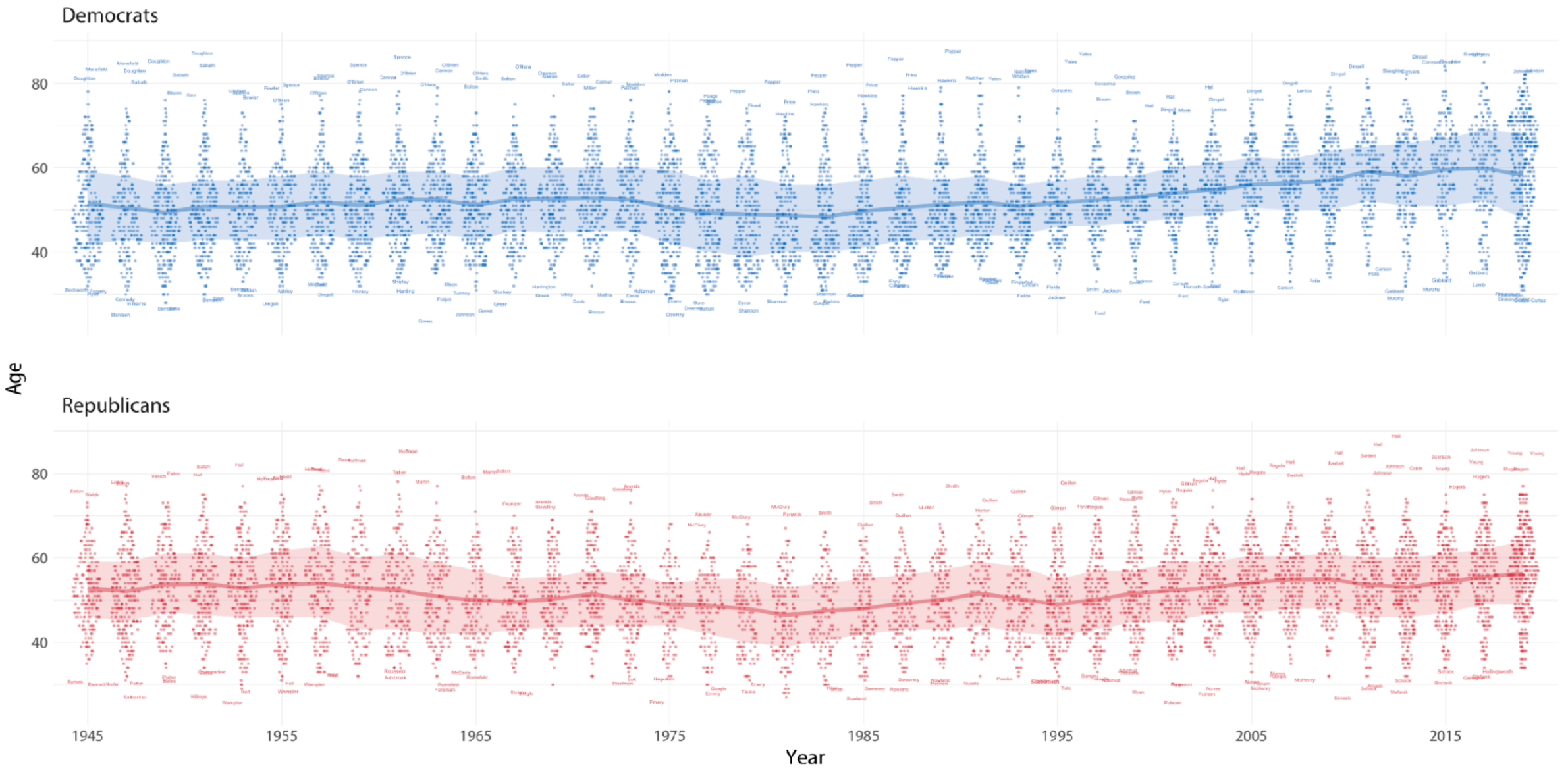
Slightly hacky scale adjustment

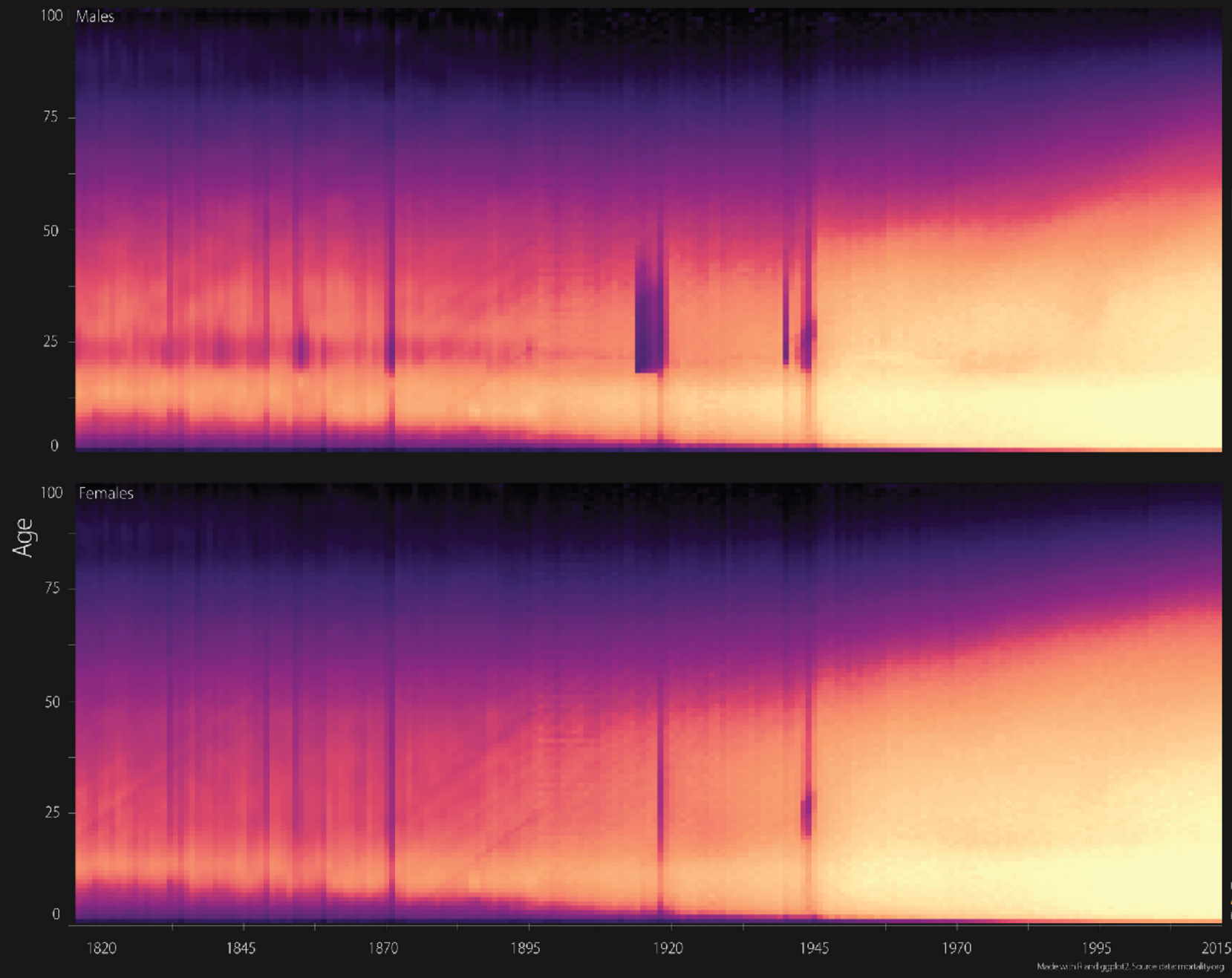
Facet and label

Age Distribution of Congressional Representatives, 1945-2019

Trend line is mean age; bands are 25th and 75th percentiles of the range.

Youngest and oldest percentiles are named instead of being shown by points.





MORTALITY IN FRANCE 1816 – 2016

Death Rate Percentile

25 50 75 100

Mortality rates are calculated for each age in each year and binned by percentile. The darker the color at any particular point, the more people of that age die in that year. The lighter the color, the more people of that age survive in that year.

Historical trends are visible, such as the rapid decrease in infant mortality rates after World War II, as well as increased life expectancy overall. Specific events show up as vertical streaks in the graph. The death toll due to wars is evident for Males. Pandemics are also visible, most notably the 1918 Influenza pandemic and the death toll due to Smallpox outbreaks after the Franco-Prussian war of 1870.

Diagonal streaks in the data are visible in some parts of the graph. These are artifacts due to the estimation of the mortality rate in some years. Single-year-of-age figures prior to 1900 are calculated from five-year age groups, as no single-year data is available in the original mortality tabulations from which the rates were derived.

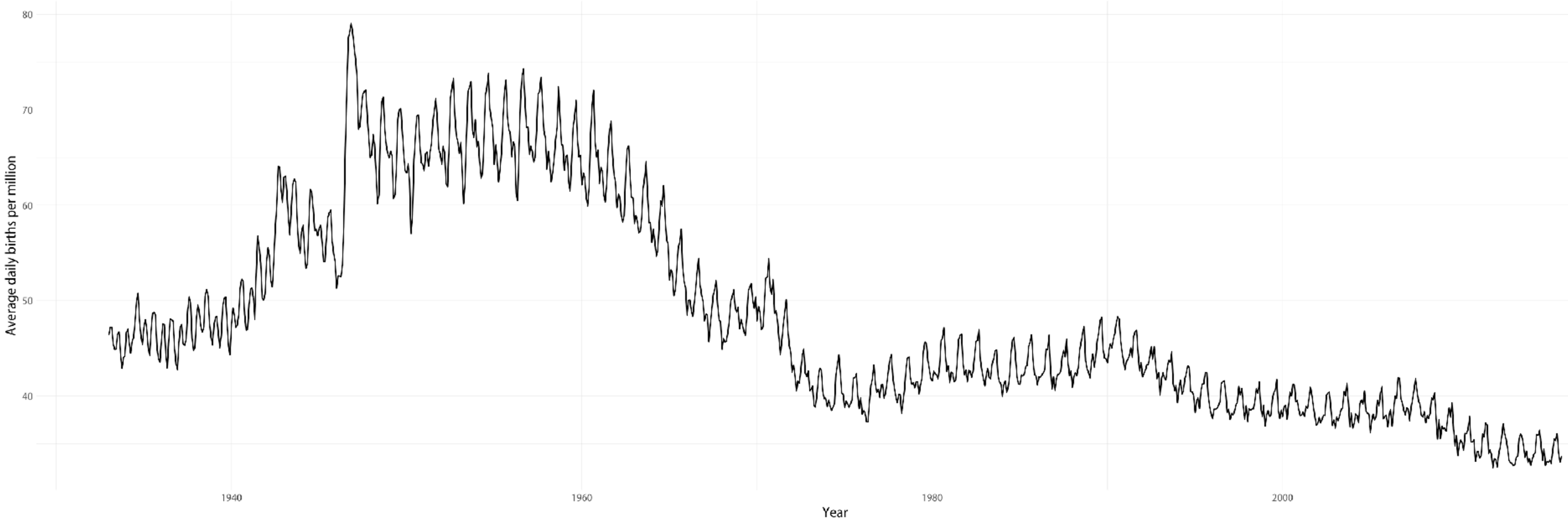
Kieran Healy / socviz.co
Data Visualization: A Practical Introduction
is published by Princeton University Press

```r
drat::addRepo("kjhealy")
install.packages("demog")
library(demog)
```

demog
Birth and Death rate data

```
> okboomer
# A tibble: 1,644 x 12
    year month n_days births total_pop births_pct births_pct_day date       seasonal trend remainder country
   <dbl> <dbl>  <dbl>  <dbl>     <dbl>      <dbl>          <dbl> <date>        <dbl> <dbl>     <dbl> <chr>
 1  1938     1     31  51820  41215000    0.00126           40.6 1938-01-01   -0.684  41.5   -0.287  England and Wales
 2  1938     2     28  47421  41215000    0.00115           41.1 1938-02-01    0.703  41.5   -1.09   England and Wales
 3  1938     3     31  54887  41215000    0.00133           43.0 1938-03-01    2.13   41.4   -0.605  England and Wales
 4  1938     4     30  54623  41215000    0.00133           44.2 1938-04-01    1.42   41.4    1.37   England and Wales
 5  1938     5     31  56853  41215000    0.00138           44.5 1938-05-01    1.82   41.3    1.34   England and Wales
 6  1938     6     30  53145  41215000    0.00129           43.0 1938-06-01    1.03   41.3    0.668  England and Wales
 7  1938     7     31  53214  41215000    0.00129           41.6 1938-07-01    0.391  41.2    0.0163 England and Wales
 8  1938     8     31  50444  41215000    0.00122           39.5 1938-08-01   -0.801  41.2   -0.916  England and Wales
 9  1938     9     30  50545  41215000    0.00123           40.9 1938-09-01    0.438  41.2   -0.714  England and Wales
10  1938    10     31  50079  41215000    0.00122           39.2 1938-10-01   -1.62   41.1   -0.269  England and Wales
# … with 1,634 more rows
```

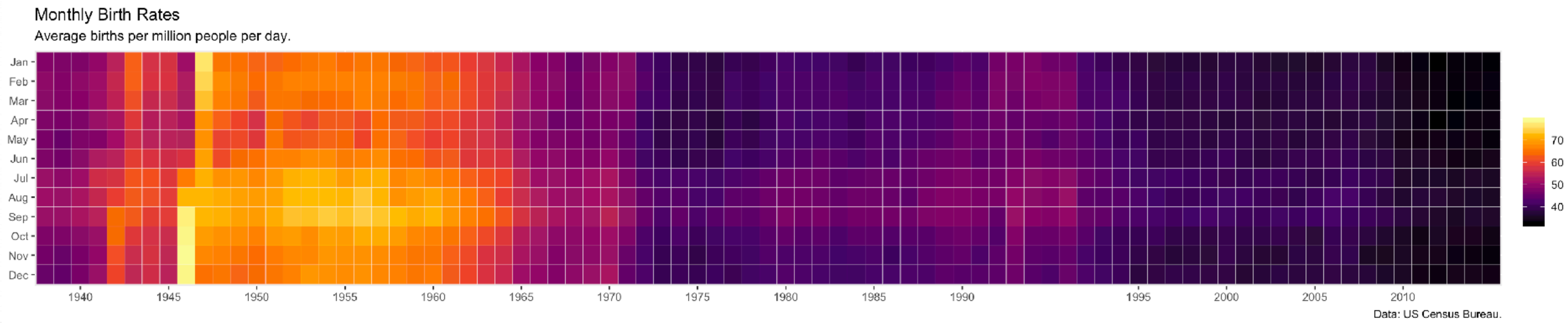
```r
okboomer %>%
    filter(country == "United States") %>%
    ggplot(aes(x = date, y = births_pct_day)) +
    geom_line(size = 0.5) +
    labs(x = "Year",
         y = "Average daily births per million")
```



```r
okboomer <- okboomer %>%
    mutate(year_fct = factor(year,
                             levels = unique(year),
                             ordered = TRUE),
           month_fct = factor(month,
                              levels = rev(c(1:12)),
                              labels = rev(c("Jan", "Feb", "Mar", "Apr",
                                             "May", "Jun", "Jul", "Aug",
                                             "Sep", "Oct", "Nov", "Dec")),
                              ordered = TRUE)) %>%
    select(year, month,
           year_fct, month_fct, everything())
```

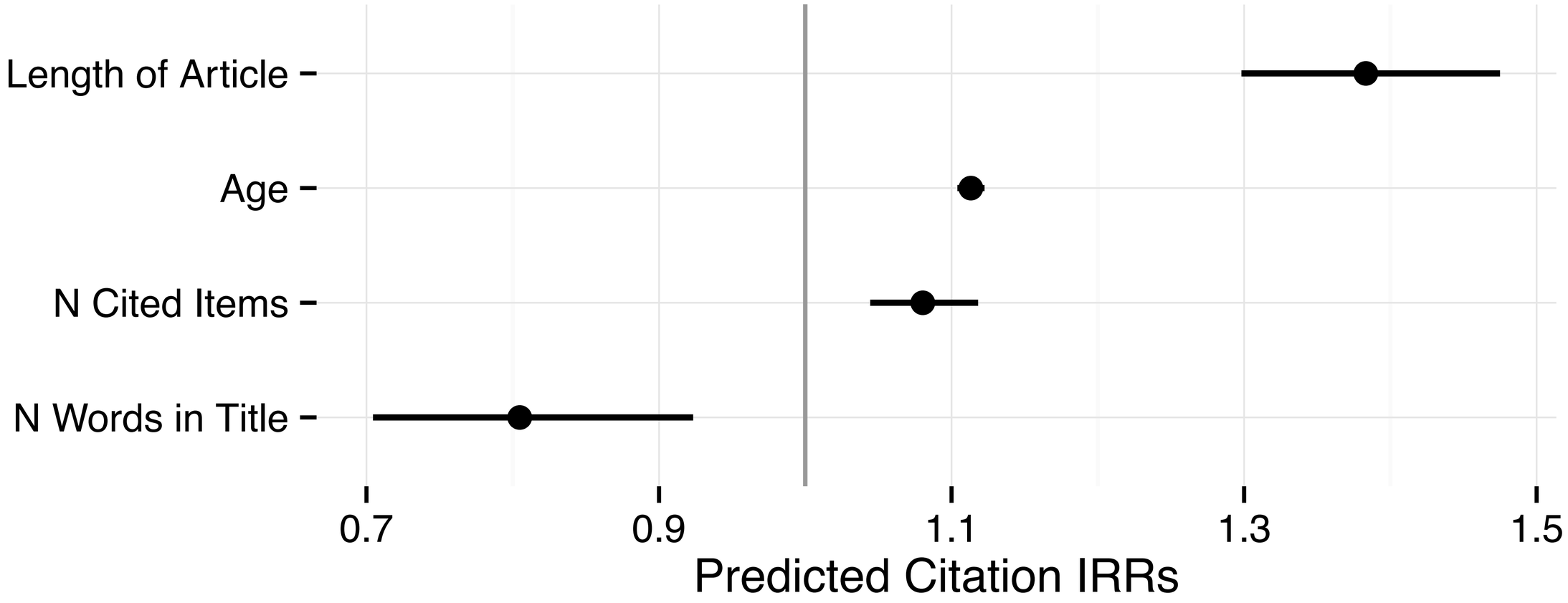
```
> okboomer
# A tibble: 1,644 x 14
   year month year_fct month_fct n_days births total_pop births_pct births_pct_day date       seasonal trend remainder country
  <dbl> <dbl> <ord>    <ord>      <dbl>  <dbl>     <dbl>      <dbl>          <dbl> <date>        <dbl> <dbl>     <dbl> <chr>
1  1938     1 1938     Jan           31  51820  41215000    0.00126           40.6 1938-01-01   -0.684  41.5   -0.287  England and Wales
2  1938     2 1938     Feb           28  47421  41215000    0.00115           41.1 1938-02-01    0.703  41.5   -1.09   England and Wales
3  1938     3 1938     Mar           31  54887  41215000    0.00133           43.0 1938-03-01    2.13   41.4   -0.605  England and Wales
4  1938     4 1938     Apr           30  54623  41215000    0.00133           44.2 1938-04-01    1.42   41.4    1.37   England and Wales
5  1938     5 1938     May           31  56853  41215000    0.00138           44.5 1938-05-01    1.82   41.3    1.34   England and Wales
6  1938     6 1938     Jun           30  53145  41215000    0.00129           43.0 1938-06-01    1.03   41.3    0.668  England and Wales
7  1938     7 1938     Jul           31  53214  41215000    0.00129           41.6 1938-07-01    0.391  41.2    0.0163 England and Wales
8  1938     8 1938     Aug           31  50444  41215000    0.00122           39.5 1938-08-01   -0.801  41.2   -0.916  England and Wales
9  1938     9 1938     Sep           30  50545  41215000    0.00123           40.9 1938-09-01    0.438  41.2   -0.714  England and Wales
10 1938    10 1938     Oct           31  50079  41215000    0.00122           39.2 1938-10-01   -1.62   41.1   -0.269  England and Wales
# … with 1,634 more rows
>
```

```r
okboomer %>%
    filter(country == "United States") %>%
    ggplot(aes(x = year_fct, y = month_fct)) +
    geom_tile(mapping = aes(fill = births_pct_day),
              color = "white") +
   scale_x_discrete(breaks = seq(1940, 2010, 5)) +
   scale_y_discrete(position = "top") +
    scale_fill_viridis_c(option = "B") +
    labs(x = NULL, y = NULL, fill = NULL, title = "Monthly Birth Rates",
         subtitle = "Average births per million people per day.",
         caption = "Data: US Census Bureau.")
```



PRESENTING RESULTS

Leverage ggplot's grammar, and its layered approach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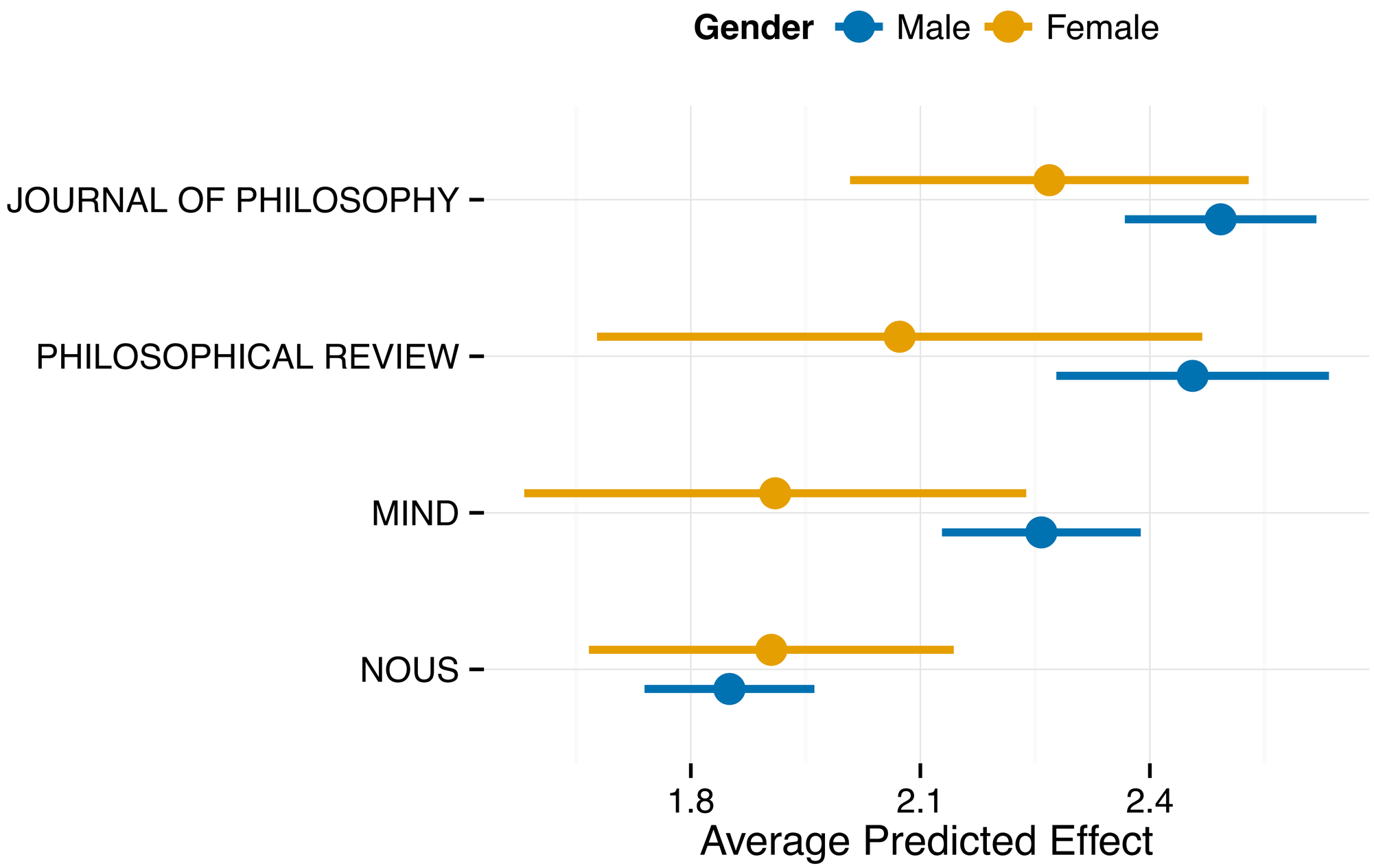
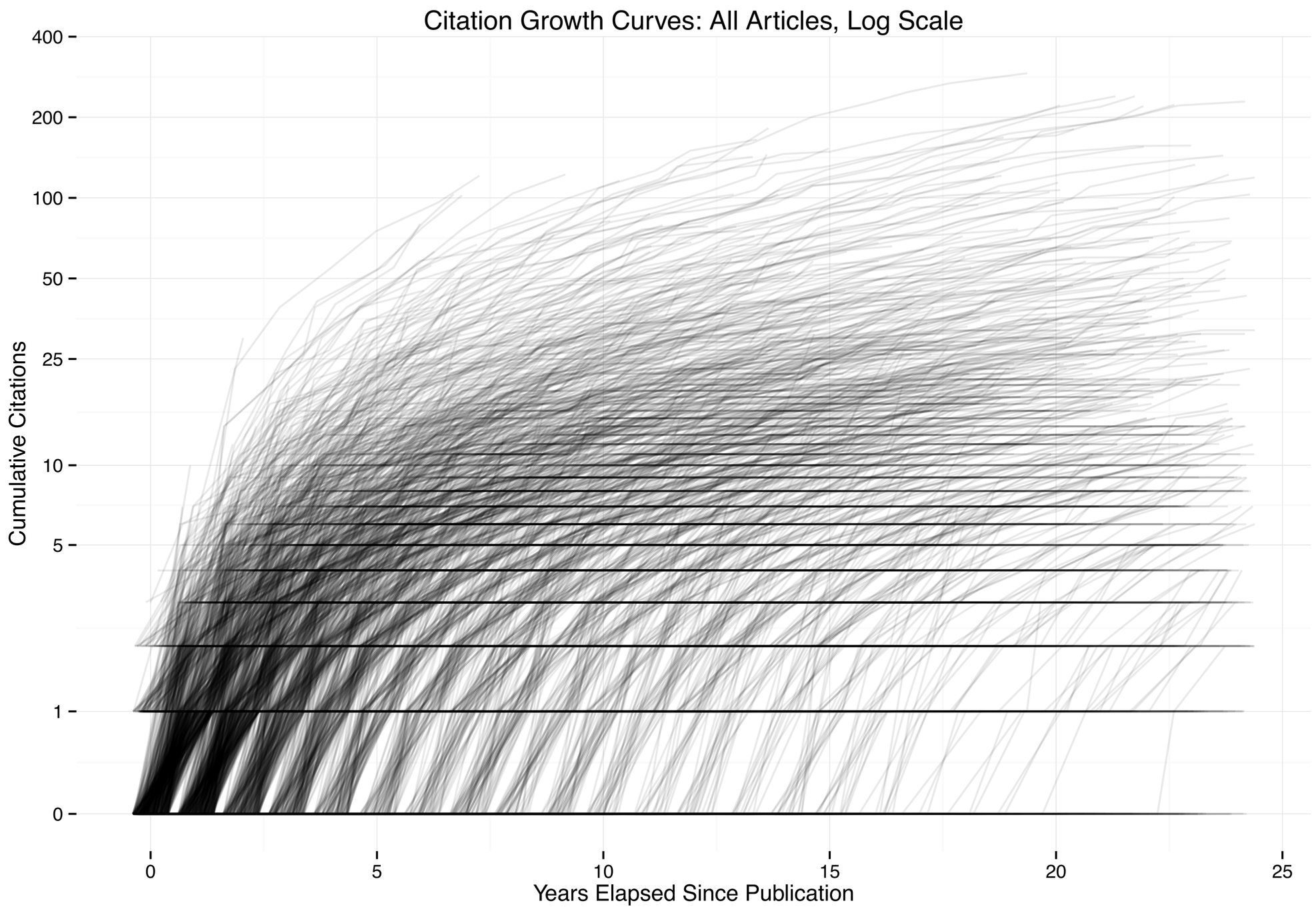
Age
N Cited Items
N Words in Title
0.7
0.9
1.1
1.3
1.5
Predicted Citation IRRs


Gender
Male
Female
JOURNAL OF PHILOSOPHY
PHILOSOPHICAL REVIEW
MIND
NOUS
1.8
2.1
2.4
Average Predicted Effect


Citation Growth Curves: All Articles, Log Scale
Cumulative Citations
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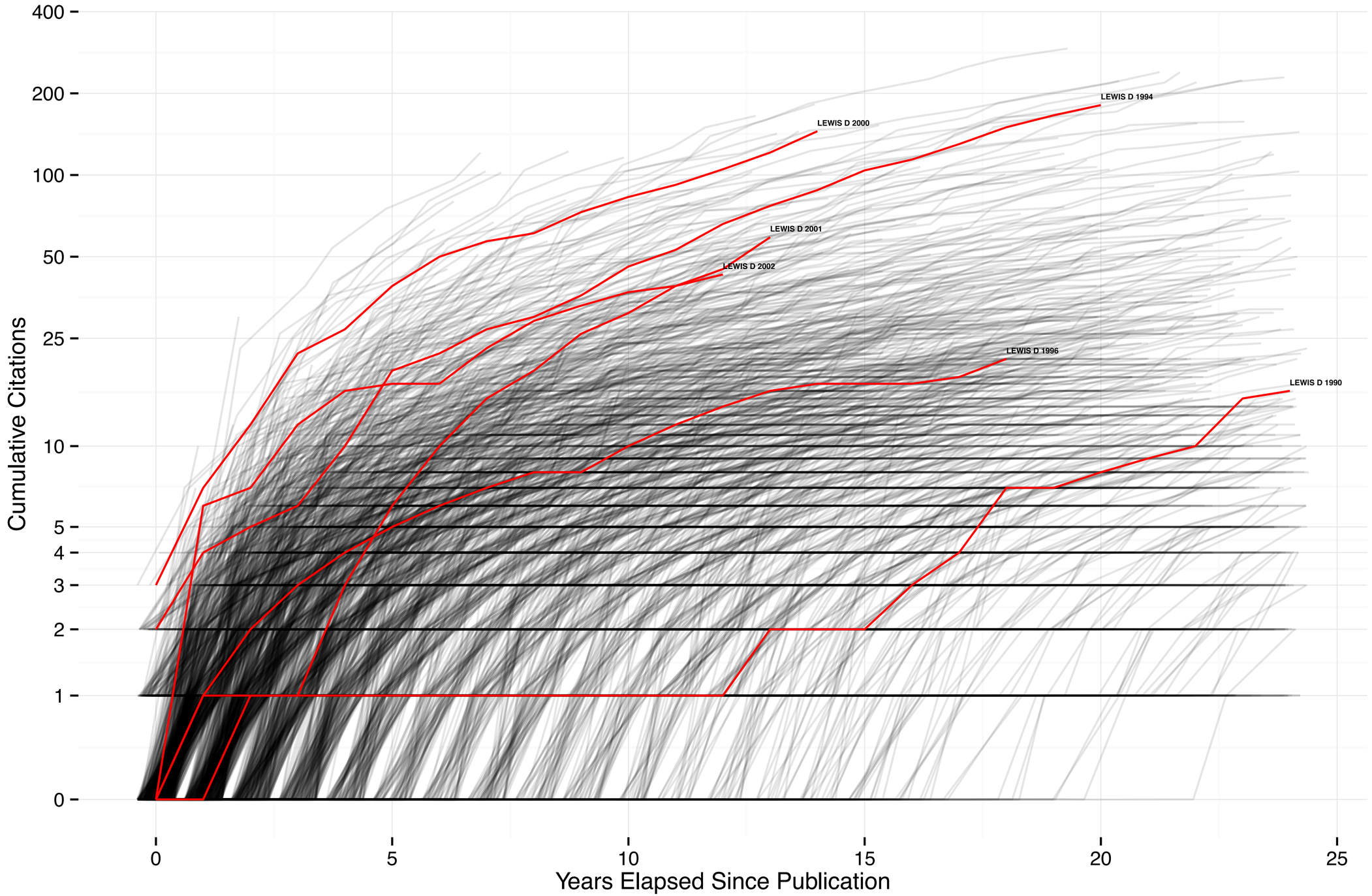
200
100
50
25
10
5
1
0
0
5
10
15
20
25
Years Elapsed Since Publication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LEWIS D 2000
LEWIS D 2001
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LEWIS D 1990
Cumulative Citations
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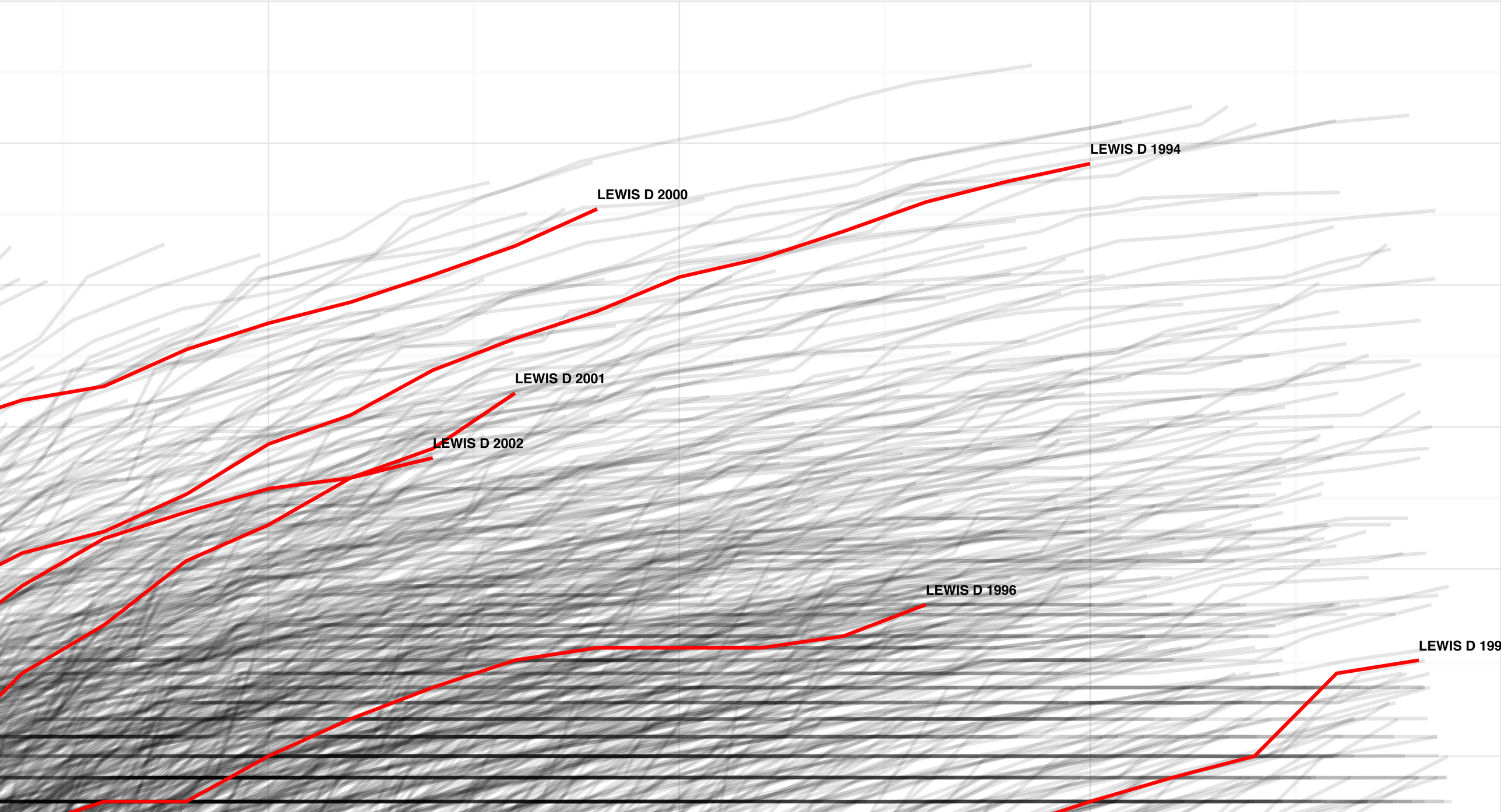
25
Years Elapsed Since Publication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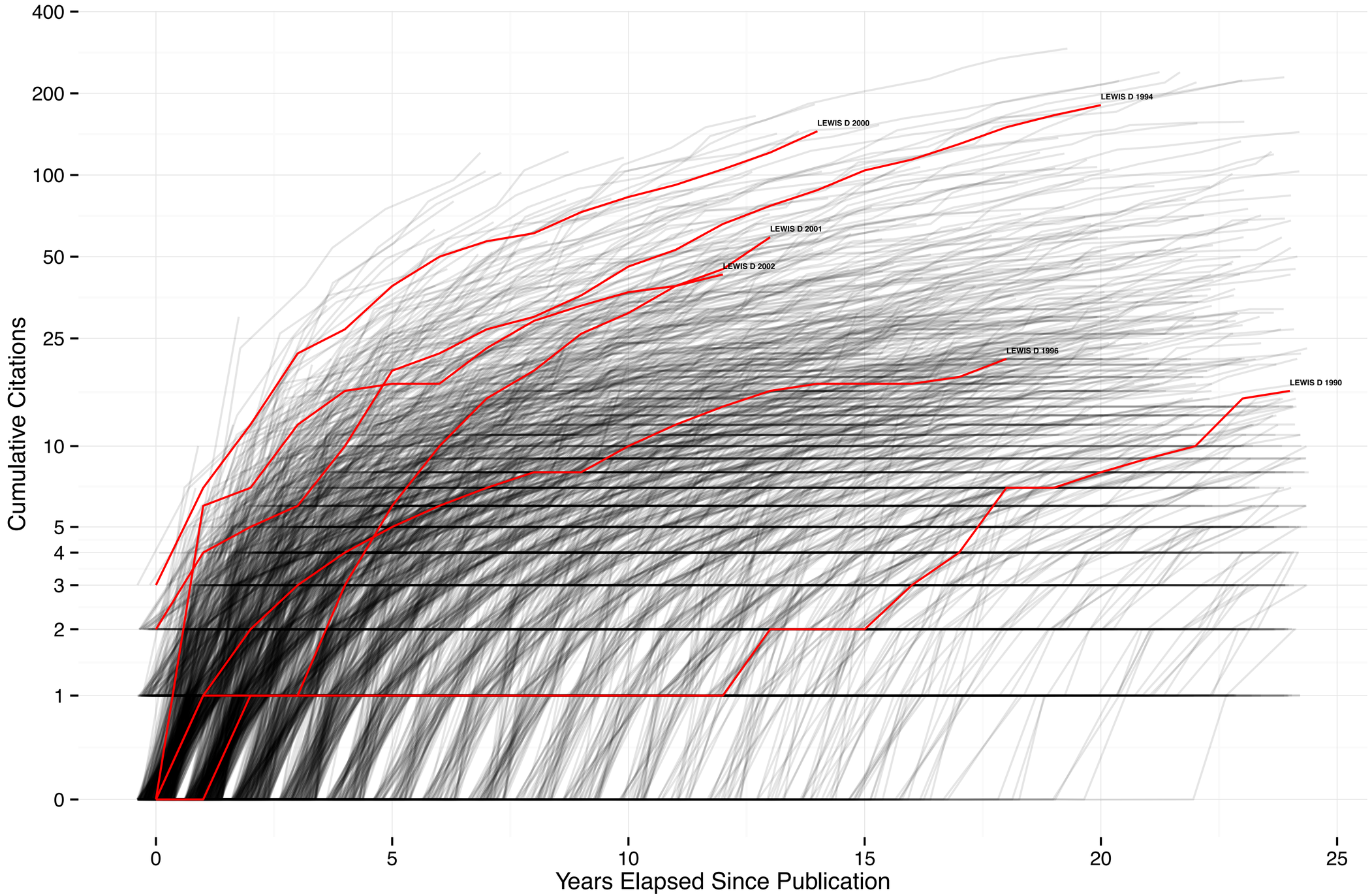
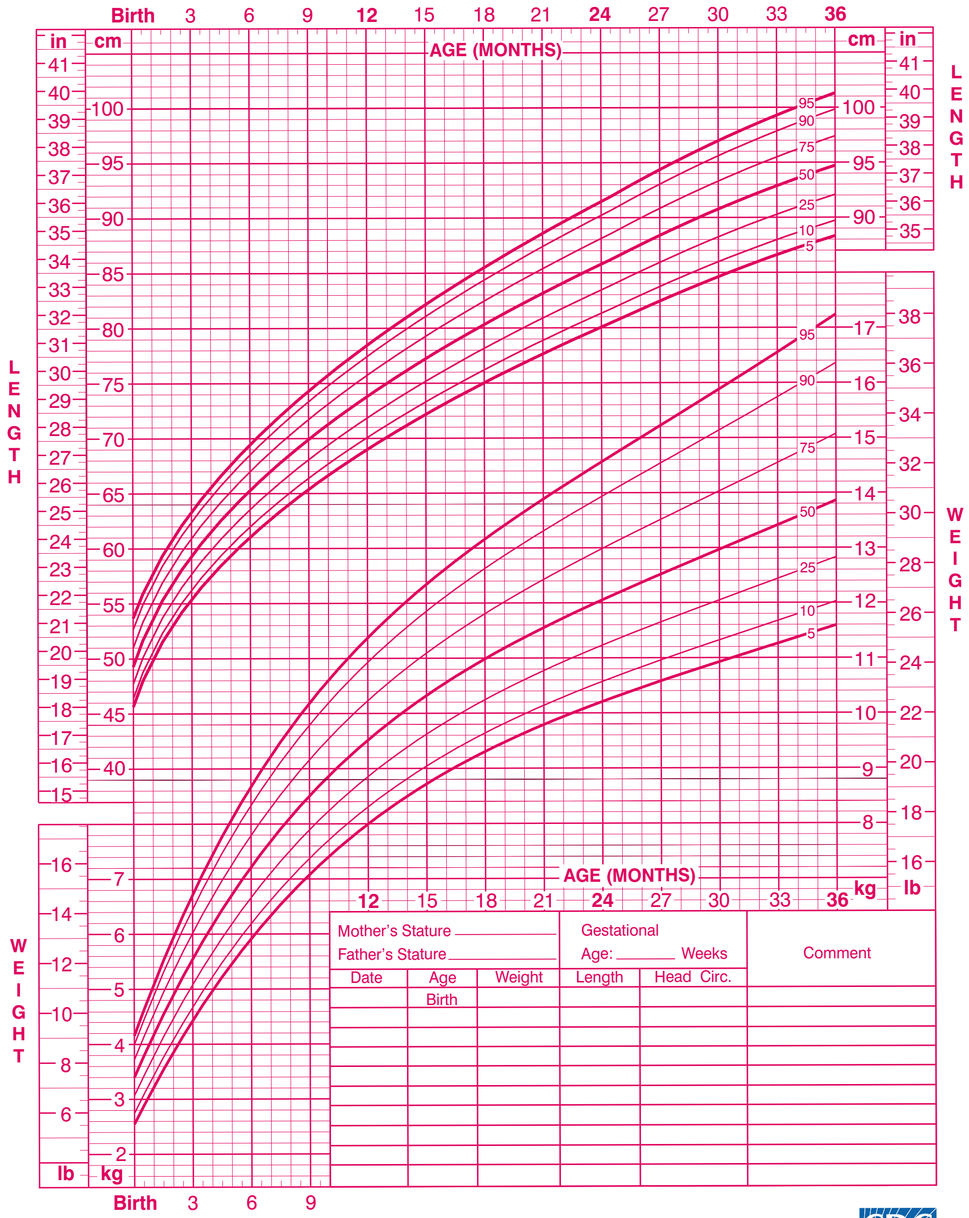
LEWIS D 199


LEWIS D 1994
LEWIS D 2000
LEWIS D 2001
LEWIS D 2002
LEWIS D 1996
LEWIS D 1990
Cumulative Citations
400
200
100
50
25
10
5
4
3
2
1
0
0
5
10
15
20
25
Years Elapsed Since Publication

Birth to 36 months: Girls
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Mother's Stature _____			Gestational Age: _____ Weeks		Comment
Father's Stature _____					
Date	Age	Weight	Length	Head Circ.	
	Birth				

Published May 30, 2000 (modified 4/20/01).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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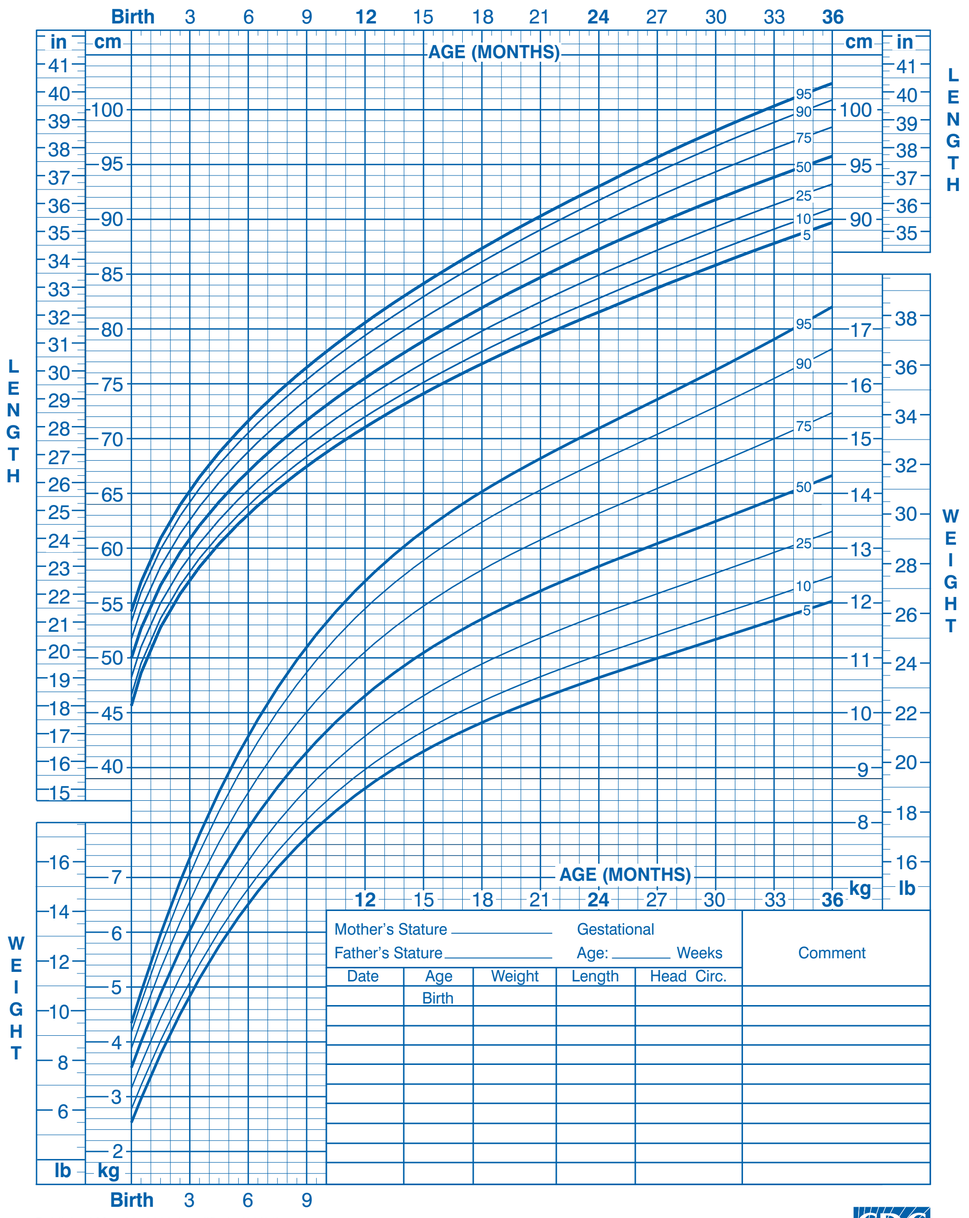
Birth to 36 months: Boys
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Mother's Stature _____			Gestational Age: _____ Weeks		Comment
Father's Stature _____					
Date	Age	Weight	Length	Head Circ.	
	Birth				

Published May 30, 2000 (modified 4/20/01).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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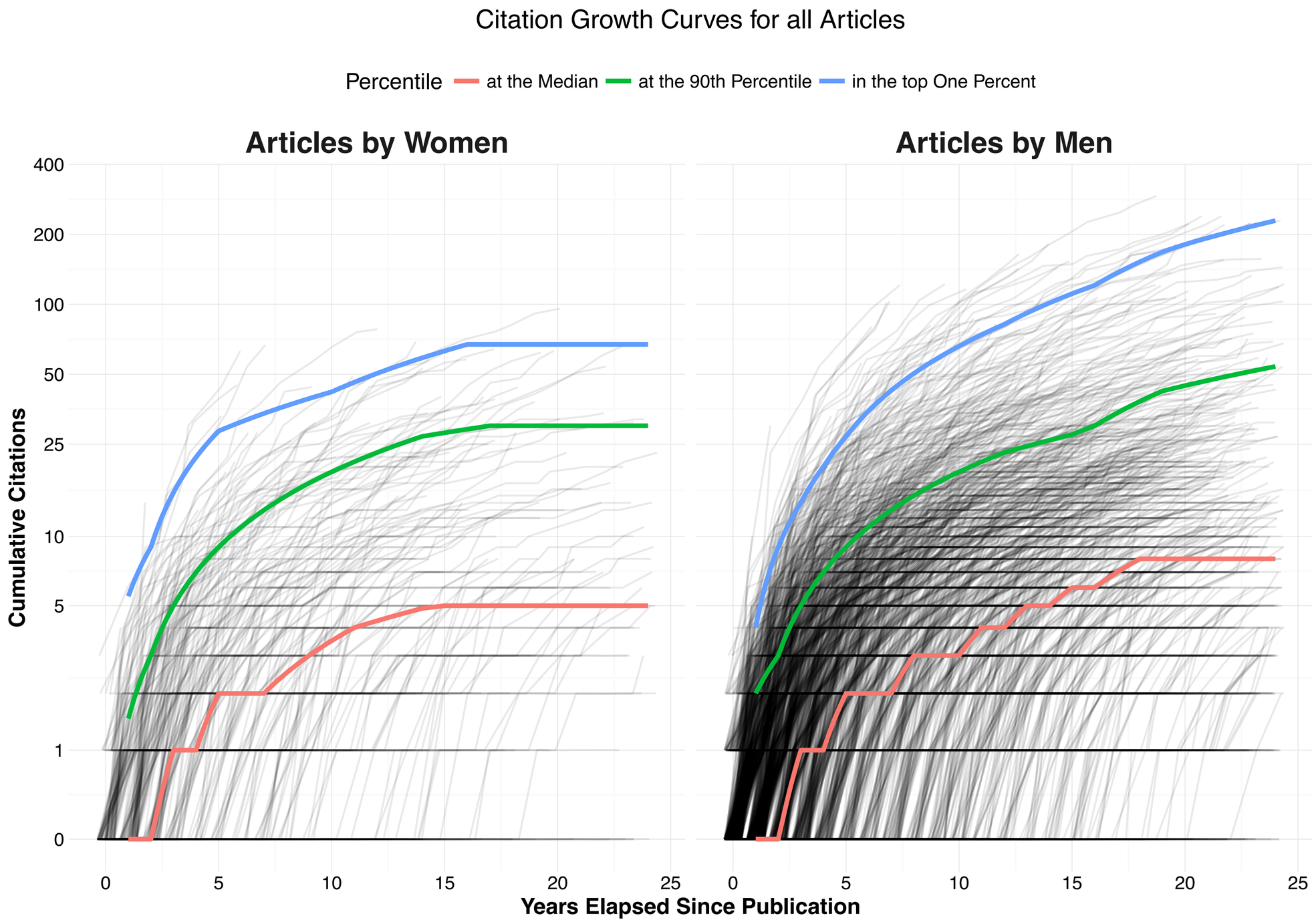
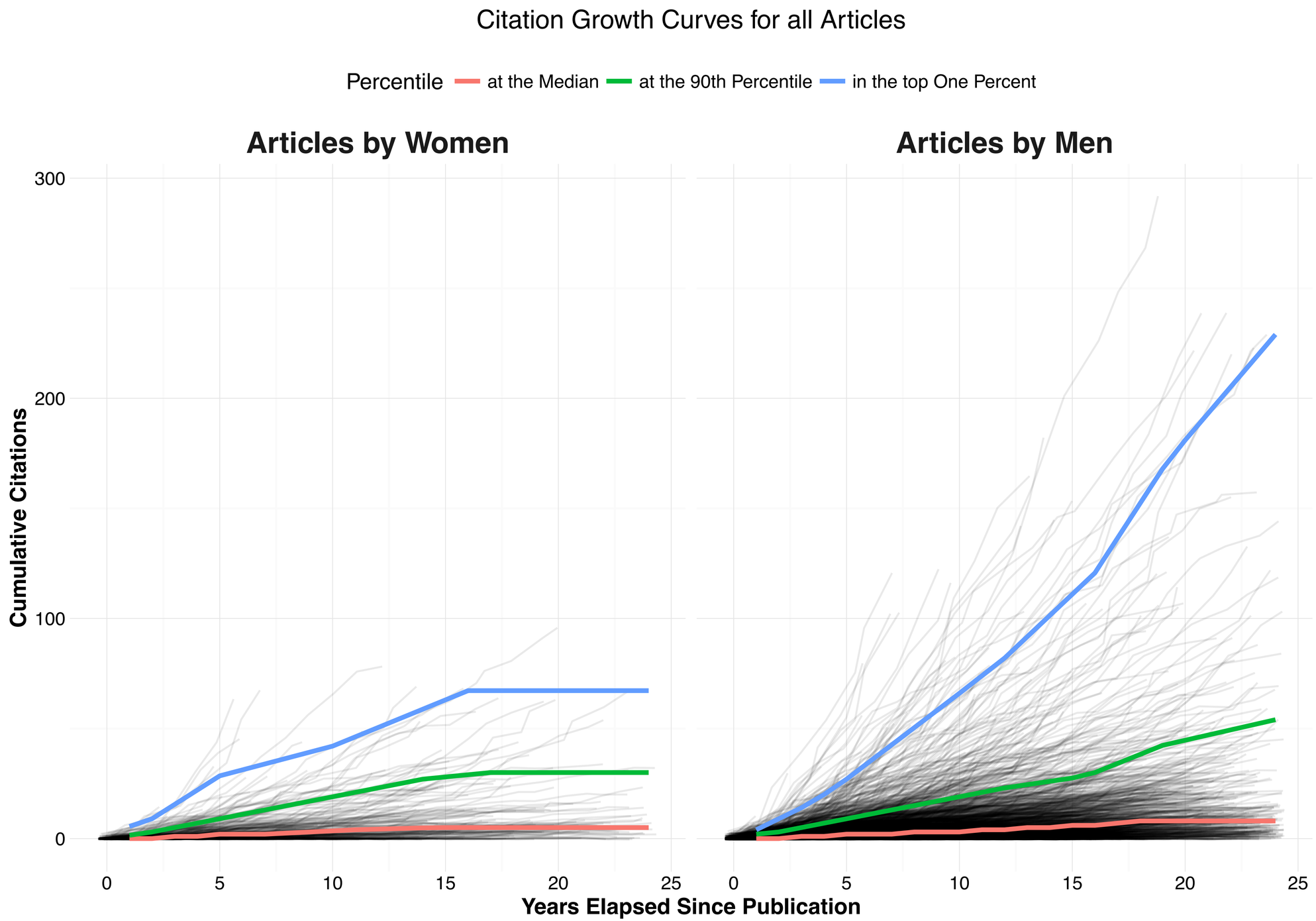

Citation Growth Curves for all Articles
Percentile
at the Median
at the 90th Percentile
in the top One Percent
Articles by Women
Articles by Men
Cumulative Citations
400
200
100
50
25
10
5
1
0
0
5
10
15
20
25
Years Elapsed Since Publication

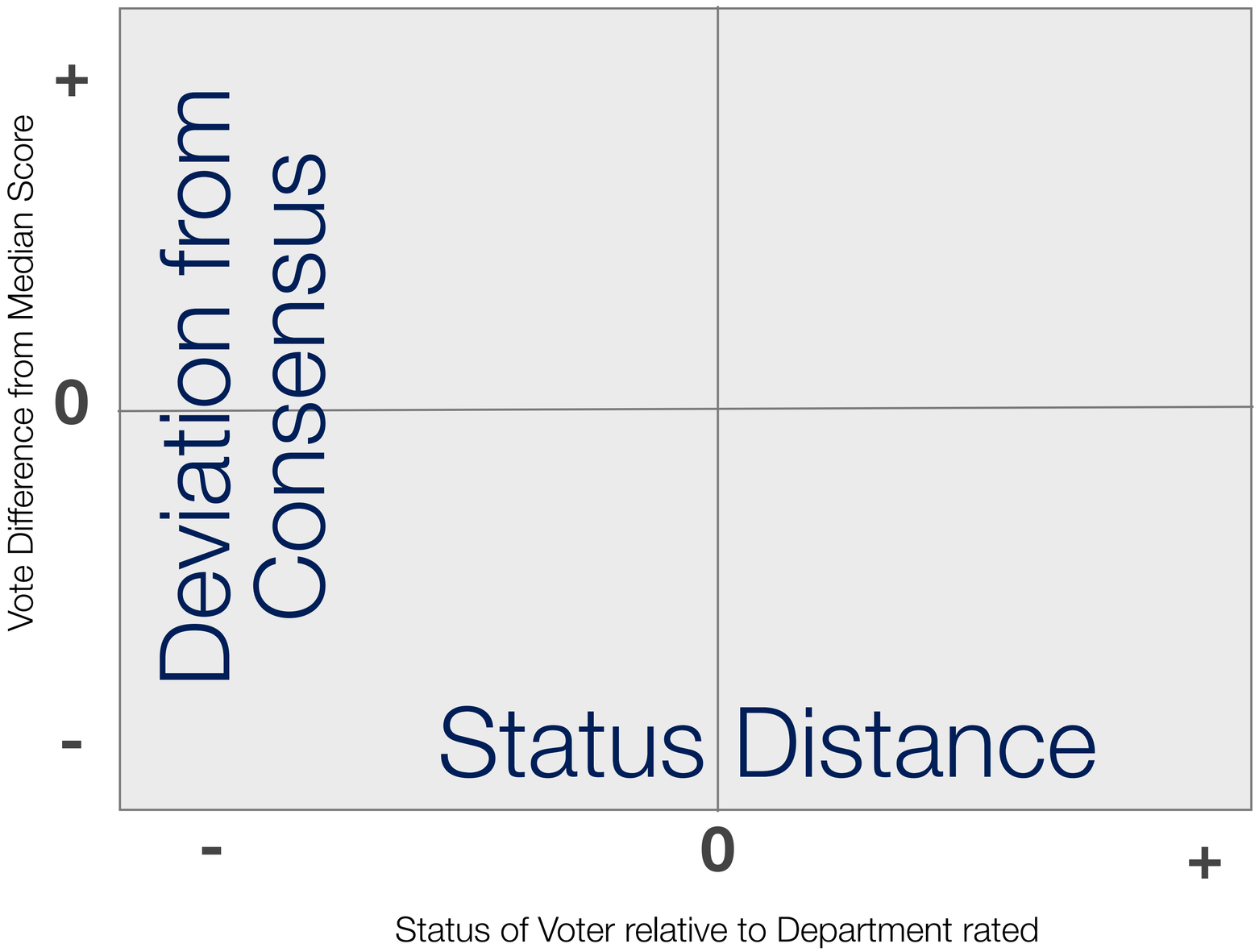

Citation Growth Curves for all Articles
Percentile
at the Median
at the 90th Percentile
in the top One Percent
Articles by Women
Articles by Men
Cumulative Citations
300
200
100
0
0
5
10
15
20
25
Years Elapsed Since Publication

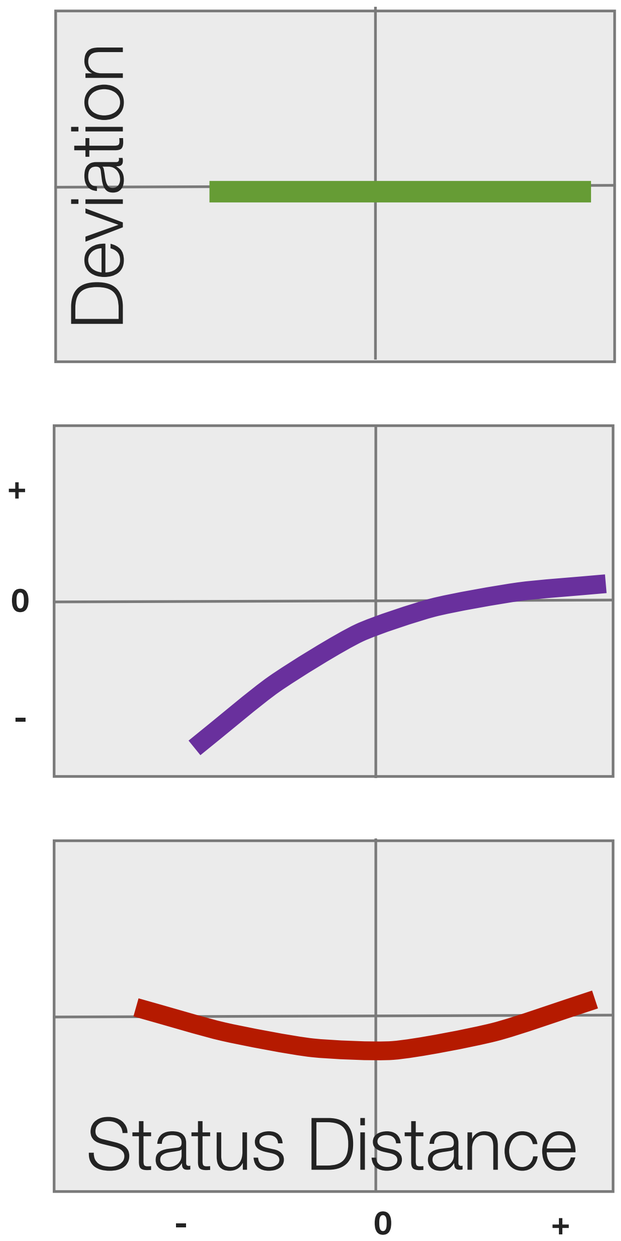
Layer

Highlight

Repeat

Build from Ideas to Data



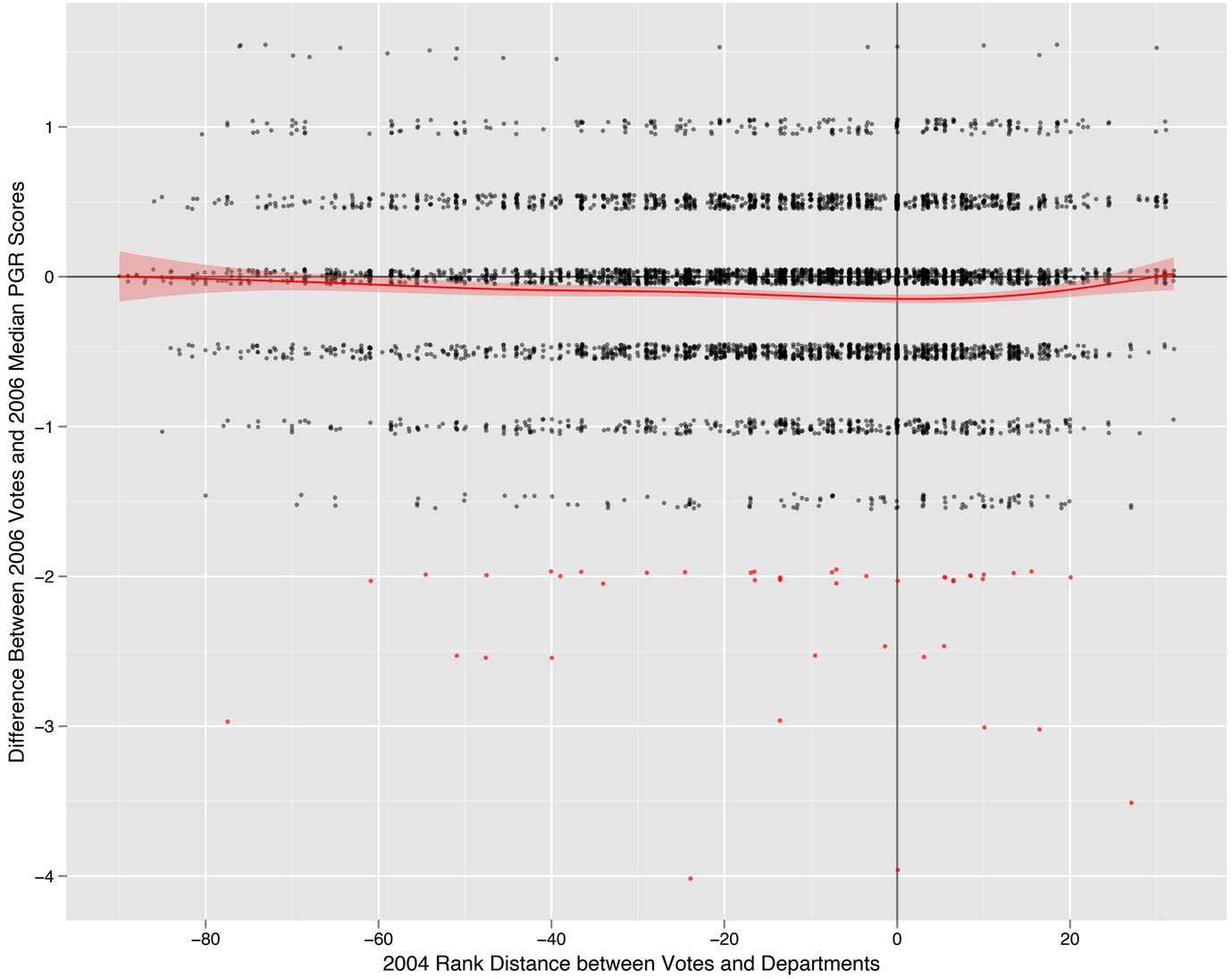


1. Pure Objectivity

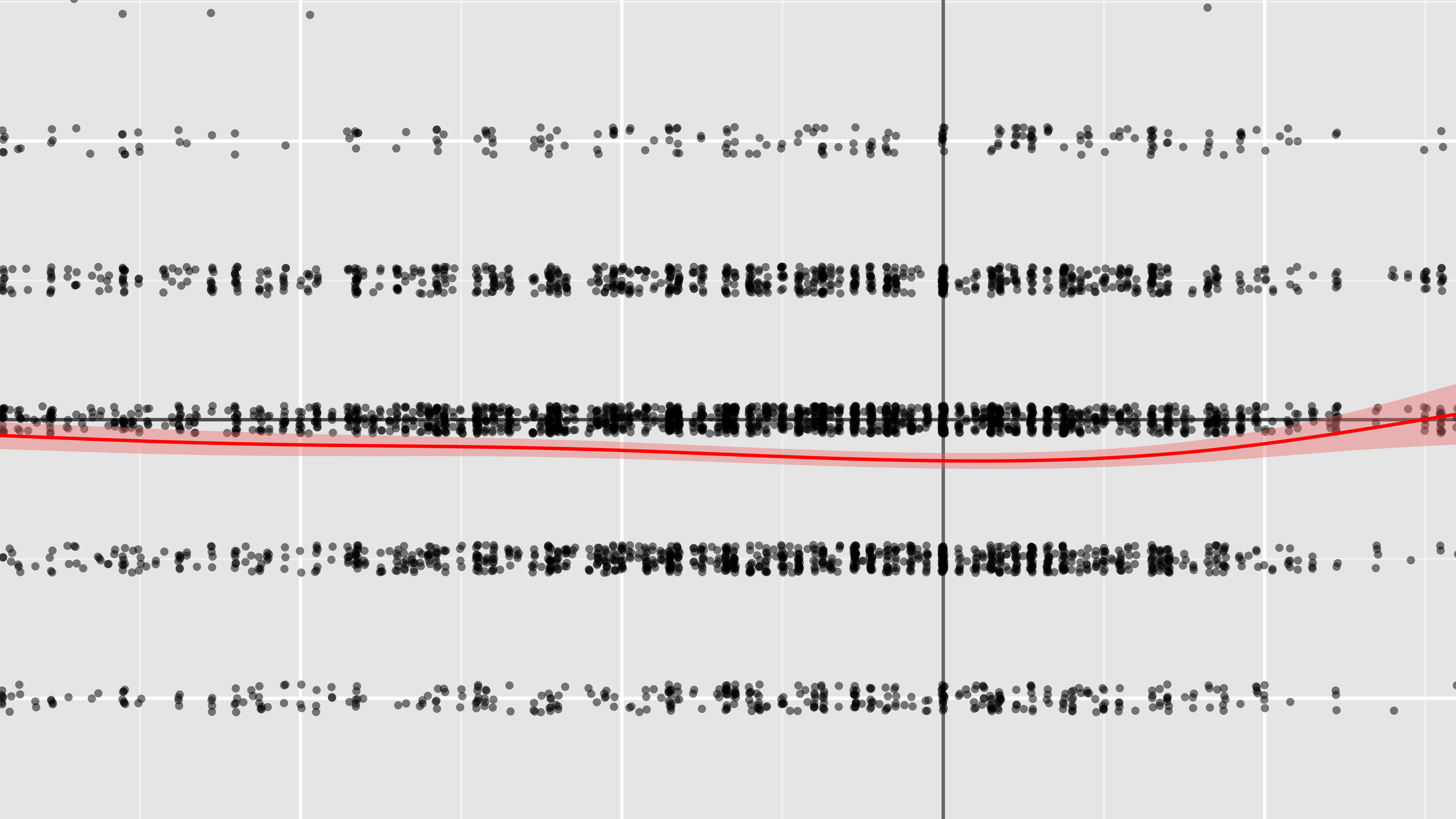
2. Distant Envy

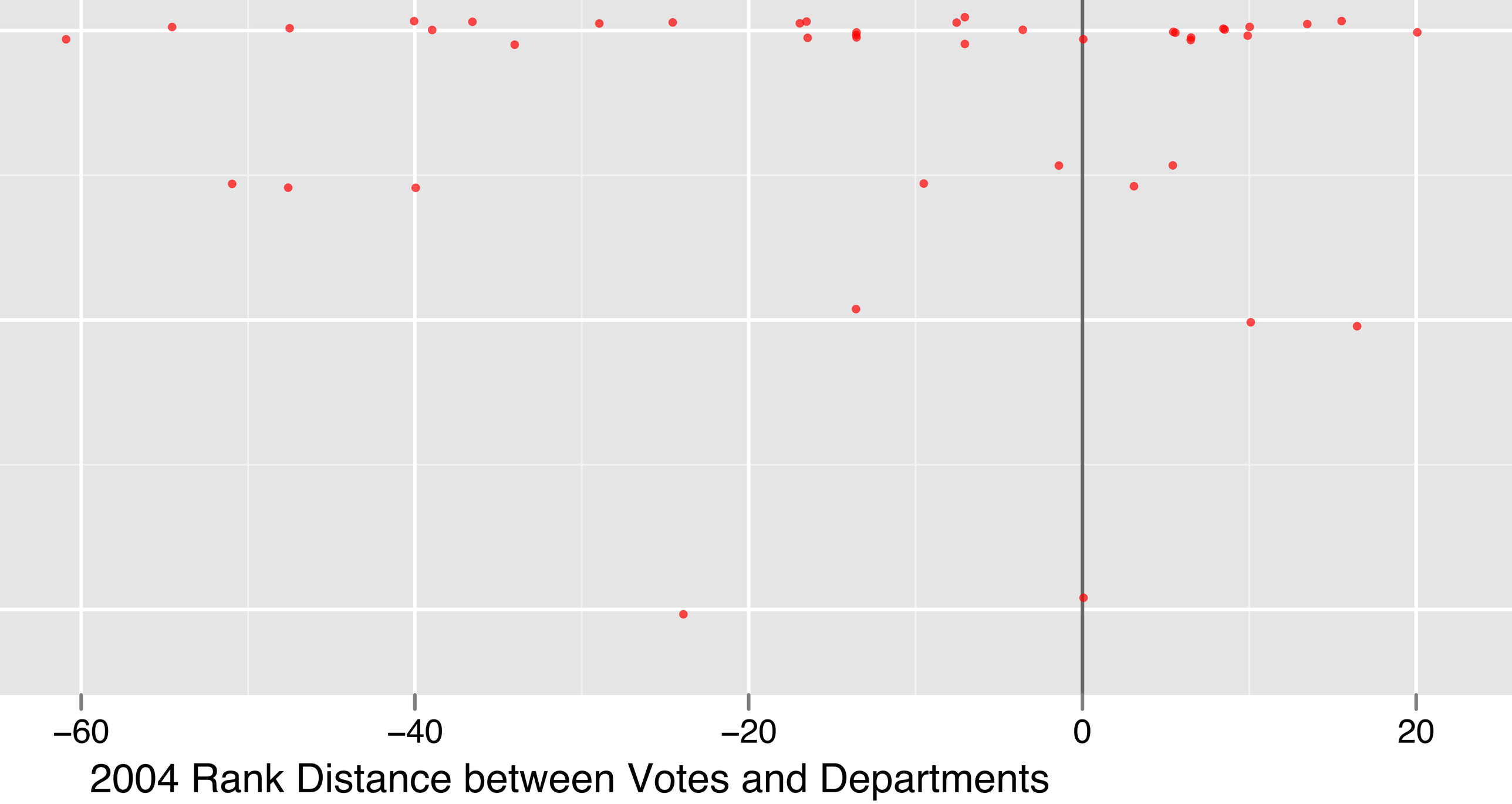
3. Local Competition

Deviation

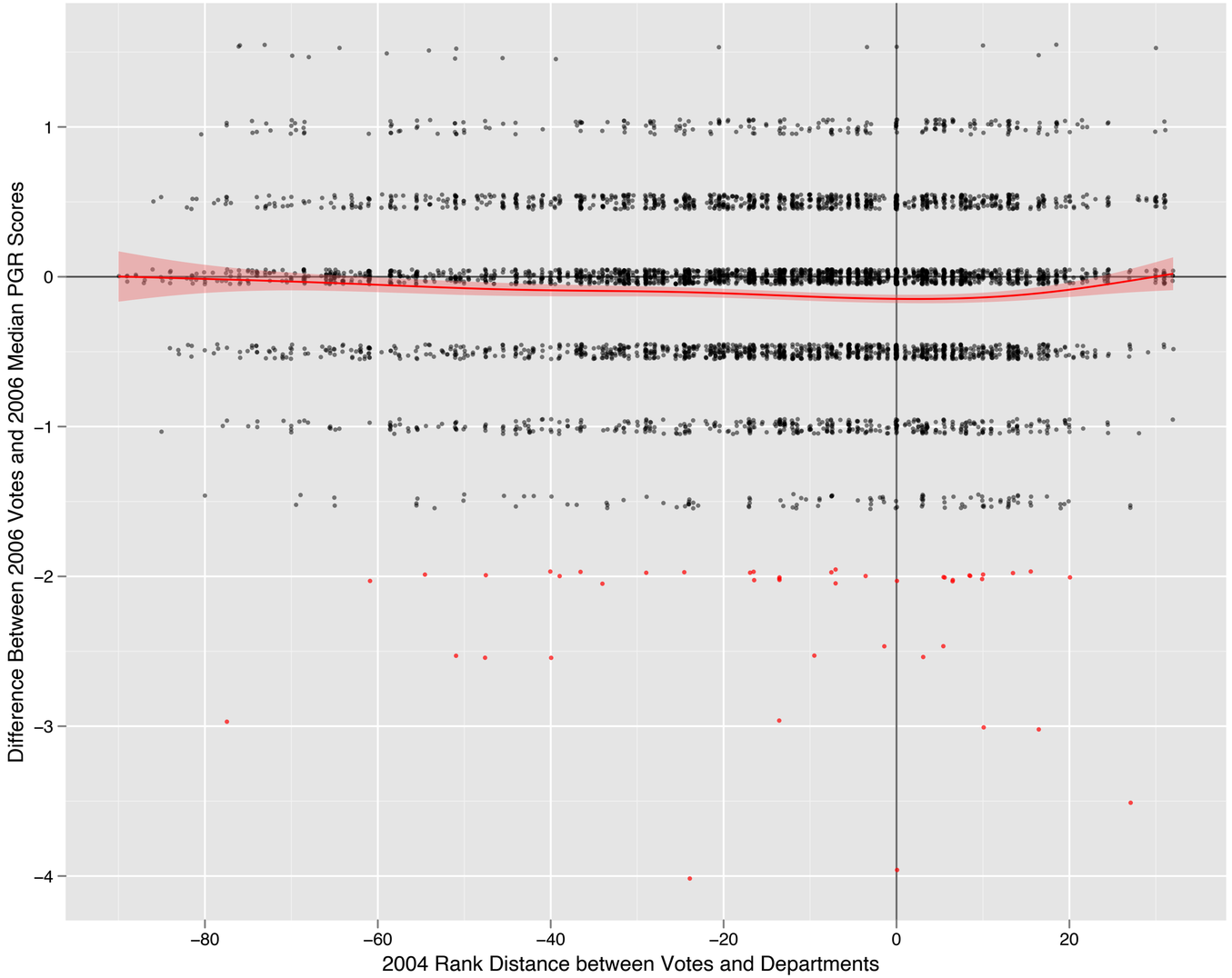


Status Distance



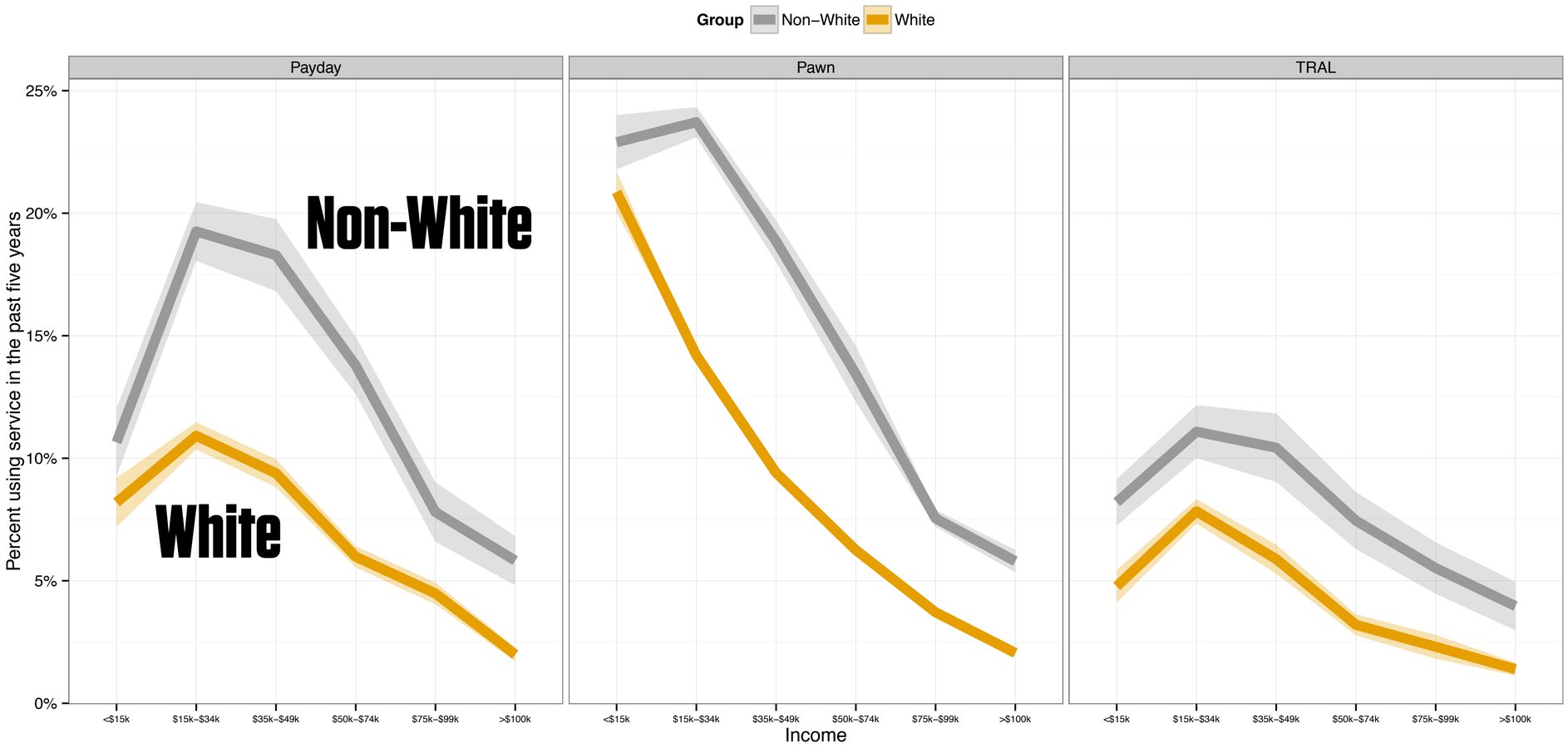

–60
–40
–20
0
20
2004 Rank Distance between Votes and Departments

Deviation



Status Distance

Categorical Gaps: Alternative Financial Services

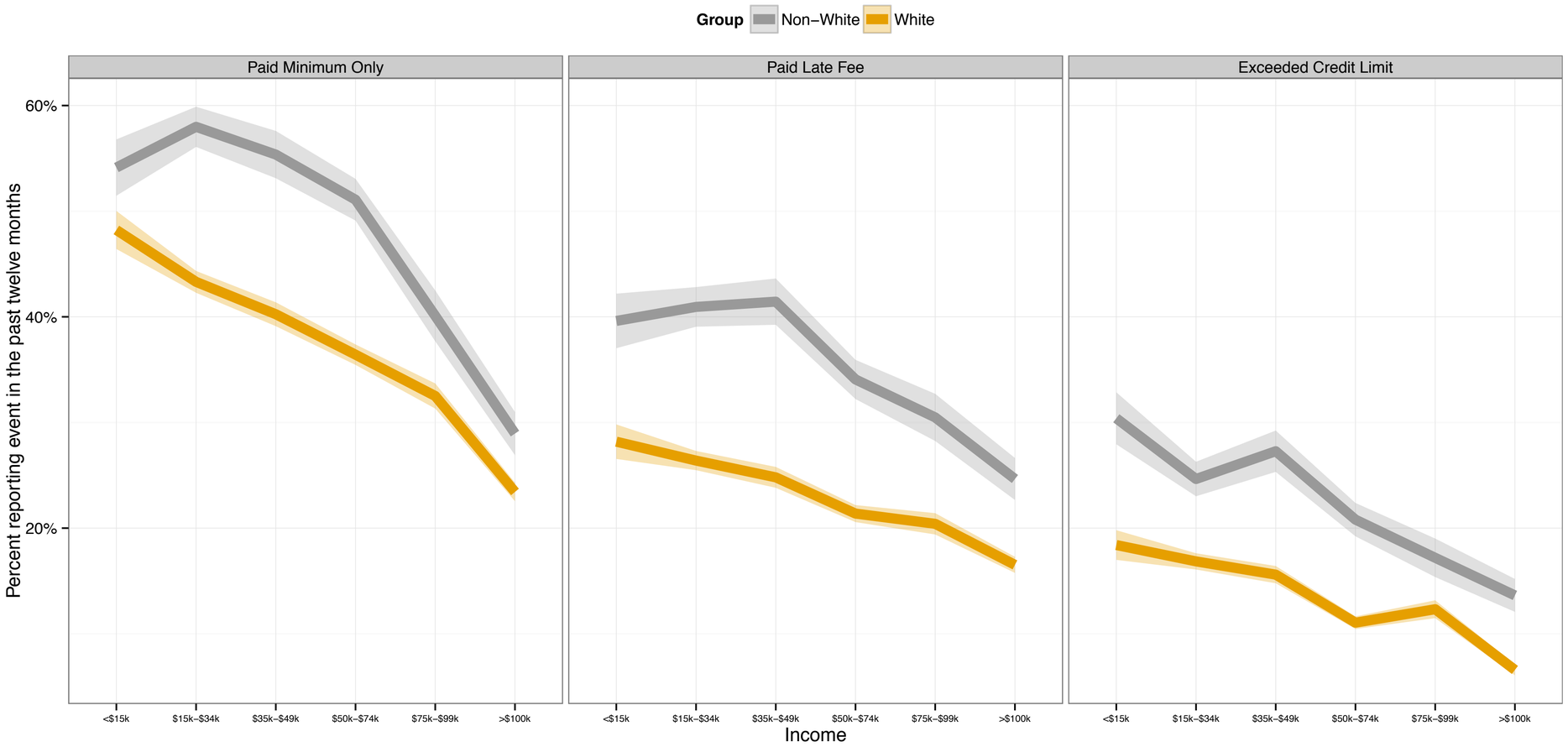


Payday Loan

Pawn Shop

TRAL

Categorical Gaps: Adverse Credit Events



Minimum Only

Late Fee

Over Limit