The full_join verb

JOINING DATA WITH DPLYR

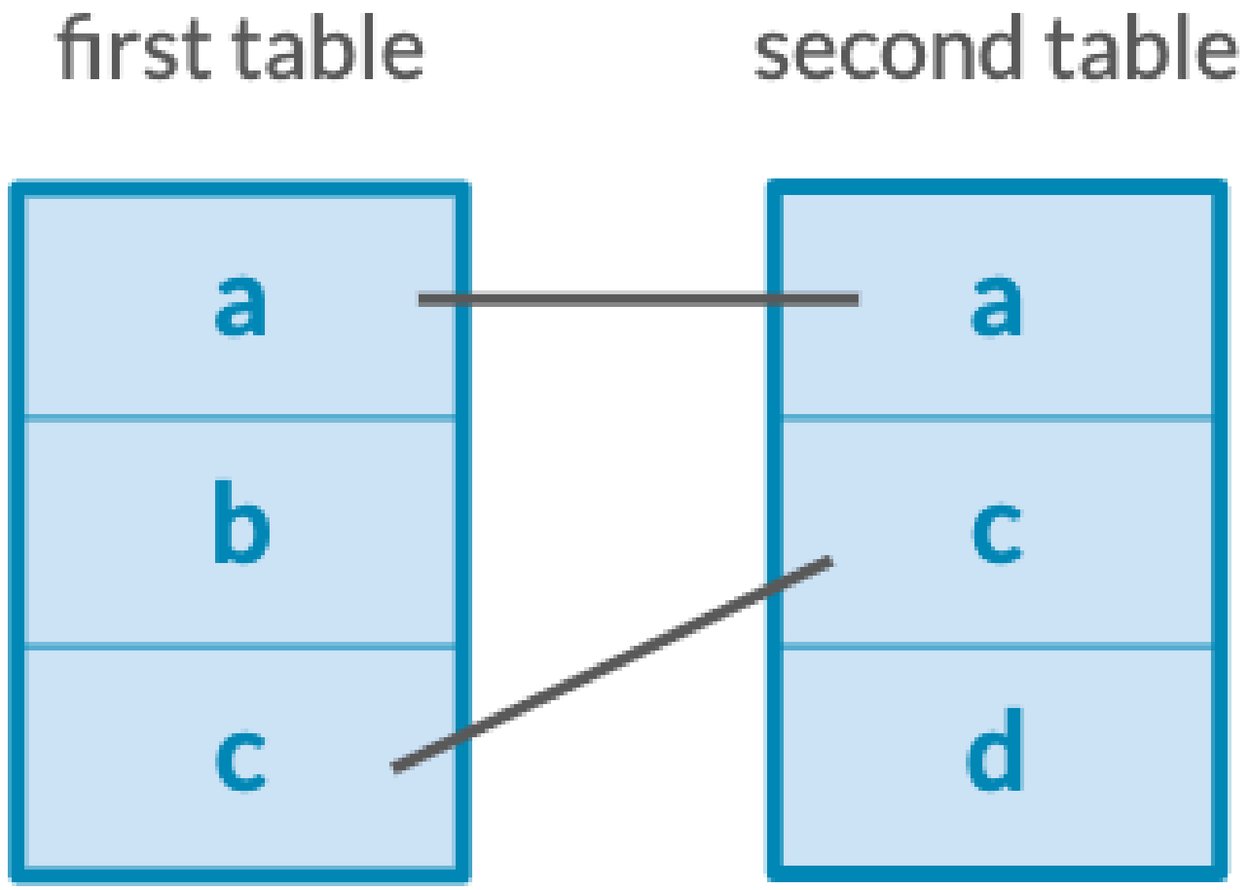
Chris Cardillo
Data Scientist at DataCamp

Left and right joins

```
batwing %>%
  left_join(batwing, by = c("part_num", "color_id"), suffix = c("_batmobile", "_batwing"))
```

```
# A tibble: 309 x 4
   part_num color_id quantity_batmobile quantity_batwing
   <chr>       <dbl>               <dbl>            <dbl>
 1 3023            0                  22               22
 2 3024            0                  22               22
 3 3623            0                  20               20
 4 11477           0                  18               18
 5 99207          71                  18               18
 6 2780            0                  17               17
 7 3666            0                  16               16
 8 22385           0                  14               14
 9 3710            0                  14               14
10 99563           0                  13               13
# … with 299 more rows
```

The full join



Joining and filtering

```
inventory_parts_joined <- inventories %>%
  inner_join(inventory_parts, by = c("id" = "inventory_id")) %>%
  arrange(desc(quantity)) %>%
  select(-id, -version)

batmobile <- inventory_parts_joined %>%
  filter(set_num == "7784-1") %>%
  select(-set_num)

batwing <- inventory_parts_joined %>%
  filter(set_num == "70916-1") %>%
  select(-set_num)
```

Batmobile vs. Batwing

```
batmobile
```

```
# A tibble: 173 x 3
   part_num color_id quantity
   <chr>       <dbl>    <dbl>
 1 3023           72       62
 2 2780            0       28
 3 50950           0       28
 4 3004           71       26
 5 43093           1       25
 6 3004            0       23
 7 3010            0       21
 8 30363           0       21
 9 32123b         14       19
10 3622            0       18
# … with 163 more rows
```

```
batwing
```

```
# A tibble: 309 x 3
   part_num color_id quantity
   <chr>       <dbl>    <dbl>
 1 3023            0       22
 2 3024            0       22
 3 3623            0       20
 4 11477           0       18
 5 99207          71       18
 6 2780            0       17
 7 3666            0       16
 8 22385           0       14
 9 3710            0       14
10 99563           0       13
# … with 299 more rows
```

Joining it all together

Left join: keep all batmobile

```
batmobile %>%
  left_join(batwing, by = c("part_num", "color_id"), suffix = c("_batmobile", "_batwing"))
```

Right join: keep all batwing

```
batmobile %>%
  right_join(batwing, by = c("part_num", "color_id"), suffix = c("_batmobile", "_batwing"))
```

Full join: keep all both

```
batmobile %>%
  full_join(batwing, by = c("part_num", "color_id"), suffix = c("_batmobile", "_batwing"))
```

Full join result

```
batmobile %>%
  full_join(batwing, by = c("part_num", "color_id"), suffix = c("_batmobile", "_batwing"))
```

```
# A tibble: 440 x 4
   part_num color_id quantity_batmobile quantity_batwing
   <chr>       <dbl>              <dbl>            <dbl>
 1 3023           72                 62               NA
 2 2780            0                 28               17
 3 50950           0                 28                2
 4 3004           71                 26                2
 5 43093           1                 25                6
 6 3004            0                 23                4
 7 3010            0                 21               NA
 8 30363           0                 21               NA
 9 32123b         14                 19               NA
10 3622            0                 18                2
# … with 430 more rows
```

Replace NA: multiple variables

```
library(tidyr)

batmobile %>%
  full_join(batwing, by = c("part_num", "color_id"), suffix = c("_batmobile", "_batwing")) %>%
  replace_na(list(quantity_batmobile = 0,
                  quantity_batwing = 0))
```

The semi- and anti-join verbs

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Mutating verbs

- `inner_join`
- `left_join`
- `right_join`
- `full_join`

Review: left join

```
batmobile %>%
  left_join(batwing, by = c("part_num", "color_id"), suffix = c("_batmobile", "_batwing"))
```

```
# A tibble: 173 x 4
   part_num color_id quantity_batmobile quantity_batwing
   <chr>       <dbl>               <dbl>             <dbl>
 1 3023           72                  62                NA
 2 2780            0                  28                17
 3 50950           0                  28                 2
 4 3004           71                  26                 2
 5 43093           1                  25                 6
 6 3004            0                  23                 4
 7 3010            0                  21                NA
 8 30363           0                  21                NA
 9 32123b         14                  19                NA
10 3622            0                  18                 2
# … with 163 more rows
```

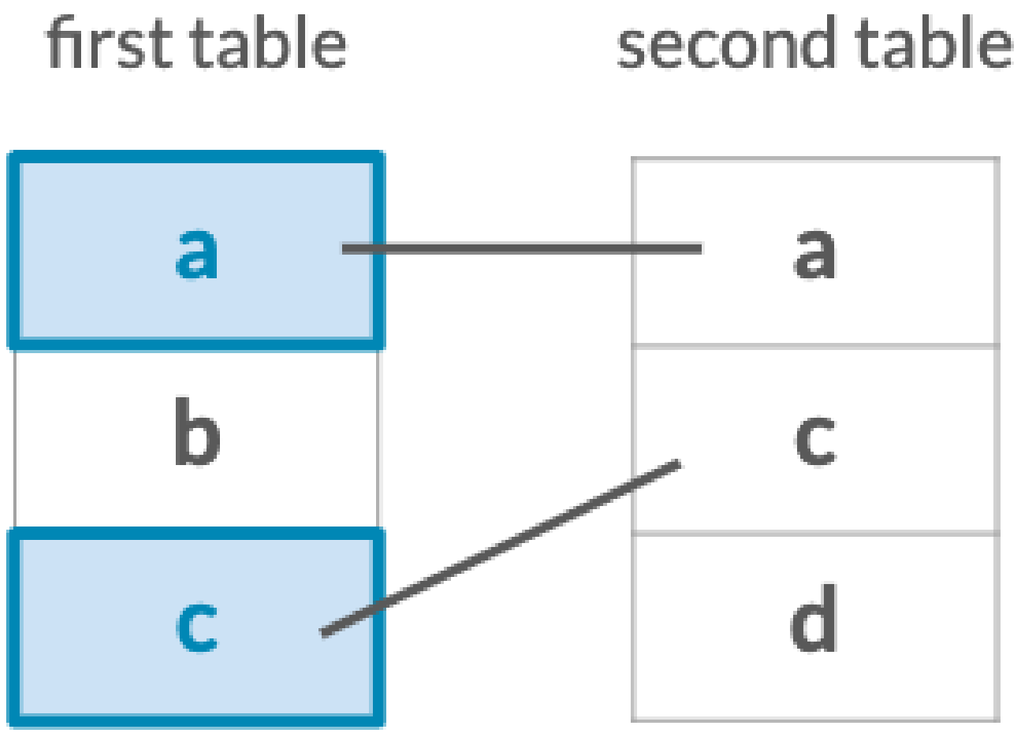
Filtering joins

- Keeps or removes observations from the first table
- Doesn't add new variables
- `semi_join()`
- `anti_join()`

Filtering joins

Semi join

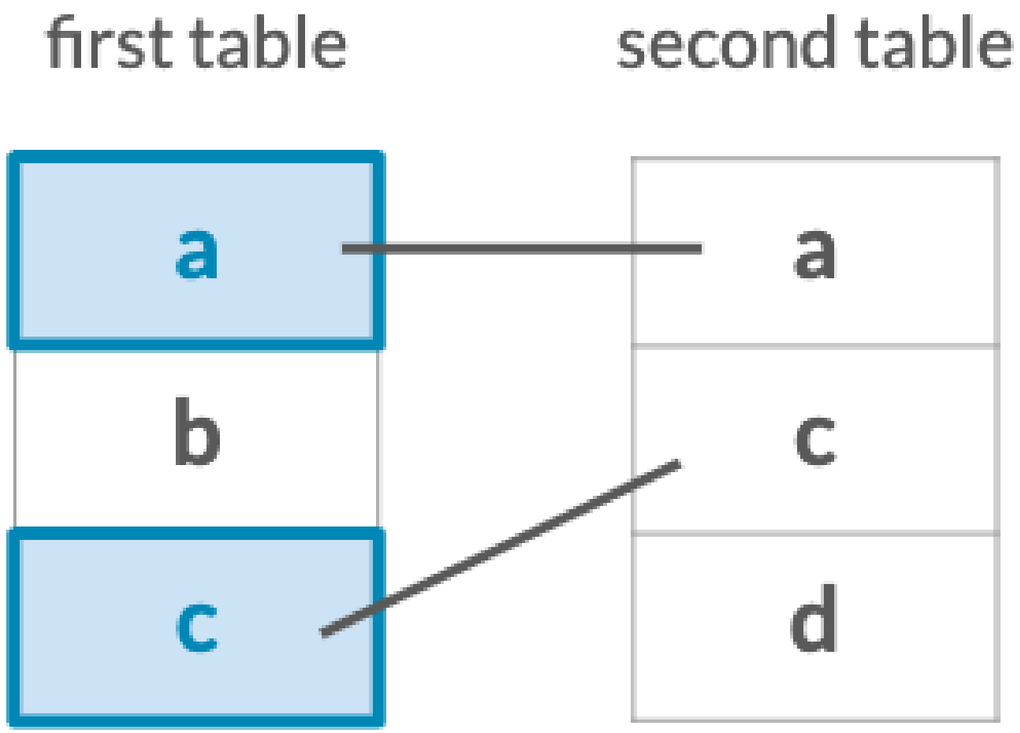
- What observations in X are **also** in Y?



Filtering joins

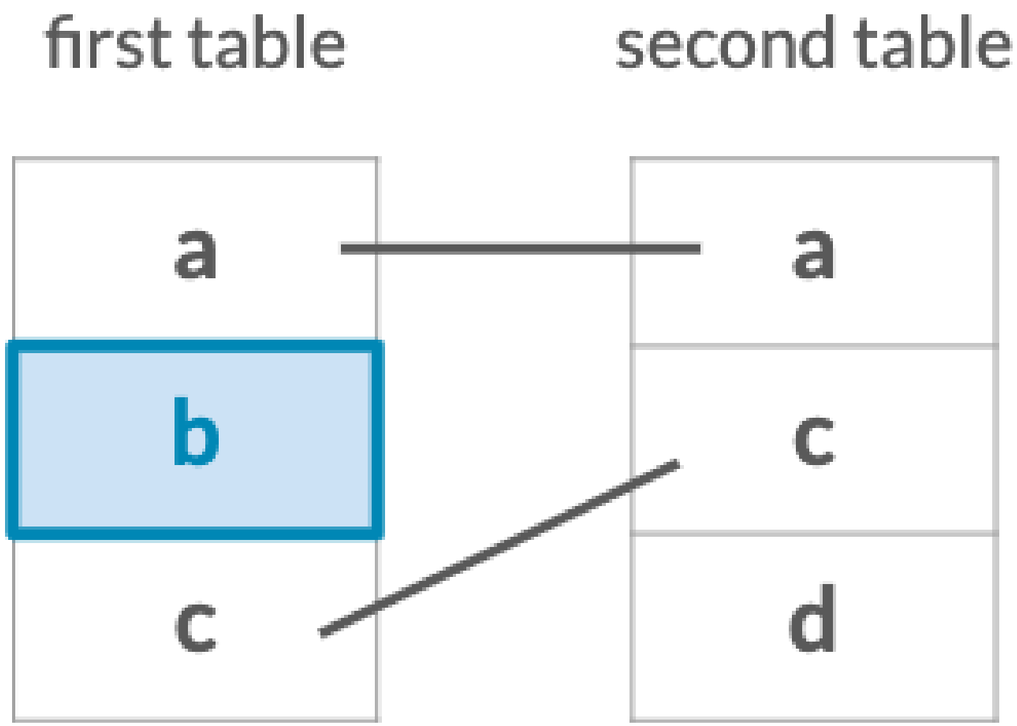
Semi join

- What observations in X are **also** in Y?



Anti join

- What observations in X are **not** in Y?



The semi join

```
batmobile %>%
  semi_join(batwing, by = c("color_id", "part_num"))
```

```
# A tibble: 45 x 3
   part_num color_id quantity
   <chr>       <dbl>    <dbl>
 1 2780            0       28
 2 50950           0       28
 3 3004           71       26
 4 43093           1       25
 5 3004            0       23
 6 3622            0       18
 7 4286            0       16
 8 3039            0       12
 9 4274           71       12
10 3001            0       11
# … with 35 more rows
```

The anti join

```
batmobile %>%
  anti_join(batwing, by = c("color_id", "part_num"))
```

```
# A tibble: 128 x 3
   part_num color_id quantity
   <chr>       <dbl>    <dbl>
 1 3023           72       62
 2 3010            0       21
 3 30363           0       21
 4 32123b         14       19
 5 50950         320       18
 6 6541            0       18
 7 3040b           0       14
 8 3298            0       14
 9 3660            0       14
10 42022           0       14
# … with 118 more rows
```

Filtering with semi join

```
themes %>%
  semi_join(sets, by = c("id" = "theme_id"))
```

```
# A tibble: 569 x 3
      id name           parent_id
   <dbl> <chr>              <dbl>
 1     1 Technic               NA
 2     2 Arctic Technic         1
 3     3 Competition            1
 4     4 Expert Builder         1
 5     5 Model                  1
 6     6 Airport                5
 7     7 Construction           5
 8     9 Fire                   5
 9    10 Harbor                 5
10    11 Off-Road               5
# … with 559 more rows
```

Filtering with anti join

```
themes %>%
  anti_join(sets, by = c("id" = "theme_id"))
```

```
# A tibble: 96 x 3
      id name         parent_id
   <dbl> <chr>            <dbl>
 1     8 Farm                 5
 2    24 Airport             23
 3    25 Castle              23
 4    26 Construction        23
 5    27 Race                23
 6    28 Harbor              23
 7    29 Train               23
 8    32 Robot               23
 9    34 Building            23
10    35 Cargo               23
# … with 86 more rows
```

The joining verbs

- `inner_join`
- `left_join`
- `right_join`
- `full_join`
- `semi_join`
- `anti_join`

Visualizing set differences

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Aggregating sets into colors

```
batmobile_colors <- batmobile %>%
  group_by(color_id) %>%
  summarize(total = sum(quantity))

batmobile_colors
```

```
# A tibble: 12 x 2
   color_id total
      <dbl> <dbl>
 1        0   543
 2        1    33
 3        4    16
 4       14    20
 5       15    16
 6       36    15
 7       57     8
 8       71   202
 9       72   160
10      182     8
# … with 2 more rows
```

```
batwing_colors <- batwing %>%
  group_by(color_id) %>%
  summarize(total = sum(quantity))

batwing_colors
```

```
# A tibble: 20 x 2
   color_id total
      <dbl> <dbl>
 1        0   418
 2        1    45
 3        4    81
 4       14    22
 5       15    22
 6       19    10
 7       25     1
 8       34     3
 9       36     9
10       46    21
# … with 10 more rows
```

Comparing color schemes of sets

```
batmobile_colors %>%
  full_join(batwing_colors, by = "color_id", suffix = c("_batmobile", "_batwing")) %>%
  replace_na(list(total_batmobile = 0, total_batwing = 0))
```

```
# A tibble: 22 x 3
   color_id total_batmobile total_batwing
      <dbl>           <dbl>         <dbl>
 1        0             543           418
 2        1              33            45
 3        4              16            81
 4       14              20            22
 5       15              16            22
 6       36              15             9
 7       57               8             3
 8       71             202           158
 9       72             160           213
10      182               8            14
# … with 12 more rows
```

Adding the color names

```
batmobile_colors %>%
  full_join(batwing_colors, by = "color_id", suffix = c("_batmobile", "_batwing")) %>%
  replace_na(list(total_batmobile = 0, total_batwing = 0)) %>%
  inner_join(colors, by = c("color_id" = "id"))
```

```
# A tibble: 22 x 5
   color_id total_batmobile total_batwing name             rgb
      <dbl>           <dbl>         <dbl> <chr>            <chr>
 1        0             543           418 Black            #05131D
 2        1              33            45 Blue             #0055BF
 3        4              16            81 Red              #C91A09
 4       14              20            22 Yellow           #F2CD37
 5       15              16            22 White            #FFFFFF
 6       36              15             9 Trans-Red        #C91A09
 7       57               8             3 Trans-Neon Orange #FF800D
 8       71             202           158 Light Bluish Gray #A0A5A9
 9       72             160           213 Dark Bluish Gray  #6C6E68
10      182               8            14 Trans-Orange     #F08F1C
# … with 12 more rows
```

Adding percentages

```
batmobile_colors %>%
  full_join(batwing_colors, by = "color_id", suffix = c("_batmobile", "_batwing")) %>%
  replace_na(list(total_batmobile = 0, total_batwing = 0)) %>%
  inner_join(colors, by = c("color_id" = "id")) %>%
  mutate(total_batmobile = total_batmobile / sum(total_batmobile),
         total_batwing = total_batwing / sum(total_batwing))
```

```
# A tibble: 22 x 5
   color_id total_batmobile total_batwing name             rgb
      <dbl>           <dbl>         <dbl> <chr>            <chr>
 1        0         0.516         0.397   Black            #05131D
 2        1         0.0314        0.0428  Blue             #0055BF
 3        4         0.0152        0.0770  Red              #C91A09
 4       14         0.0190        0.0209  Yellow           #F2CD37
 5       15         0.0152        0.0209  White            #FFFFFF
 6       36         0.0143        0.00856 Trans-Red        #C91A09
 7       57         0.00760       0.00285 Trans-Neon Orange #FF800D
 8       71         0.192         0.150   Light Bluish Gray #A0A5A9
 9       72         0.152         0.202   Dark Bluish Gray  #6C6E68
10      182         0.00760       0.0133  Trans-Orange     #F08F1C
# … with 12 more rows
```

The difference between fractions

```
colors_joined <- batmobile_colors %>%
  full_join(batwing_colors, by = "color_id", suffix = c("_batmobile", "_batwing")) %>%
  replace_na(list(total_batmobile = 0, total_batwing = 0)) %>%
  inner_join(colors, by = c("color_id" = "id")) %>%
  mutate(total_batmobile = total_batmobile / sum(total_batmobile),
         total_batwing = total_batwing / sum(total_batwing),
         difference = total_batmobile - total_batwing)

colors_joined
```

```
# A tibble: 22 x 6
   color_id total_batmobile total_batwing name             rgb     difference
      <dbl>           <dbl>         <dbl> <chr>            <chr>        <dbl>
 1        0         0.516         0.397   Black            #05131D    0.119
 2        1         0.0314        0.0428  Blue             #0055BF   -0.0114
 3        4         0.0152        0.0770  Red              #C91A09   -0.0618
 4       14         0.0190        0.0209  Yellow           #F2CD37   -0.00190
 5       15         0.0152        0.0209  White            #FFFFFF   -0.00570
 6       36         0.0143        0.00856 Trans-Red        #C91A09    0.00570
 7       57         0.00760       0.00285 Trans-Neon Orange #FF800D    0.00475
 8       71         0.192         0.150   Light Bluish Gray #A0A5A9    0.0418
 9       72         0.152         0.202   Dark Bluish Gray  #6C6E68   -0.0504
10      182         0.00760       0.0133  Trans-Orange     #F08F1C   -0.00570
# … with 12 more rows
```

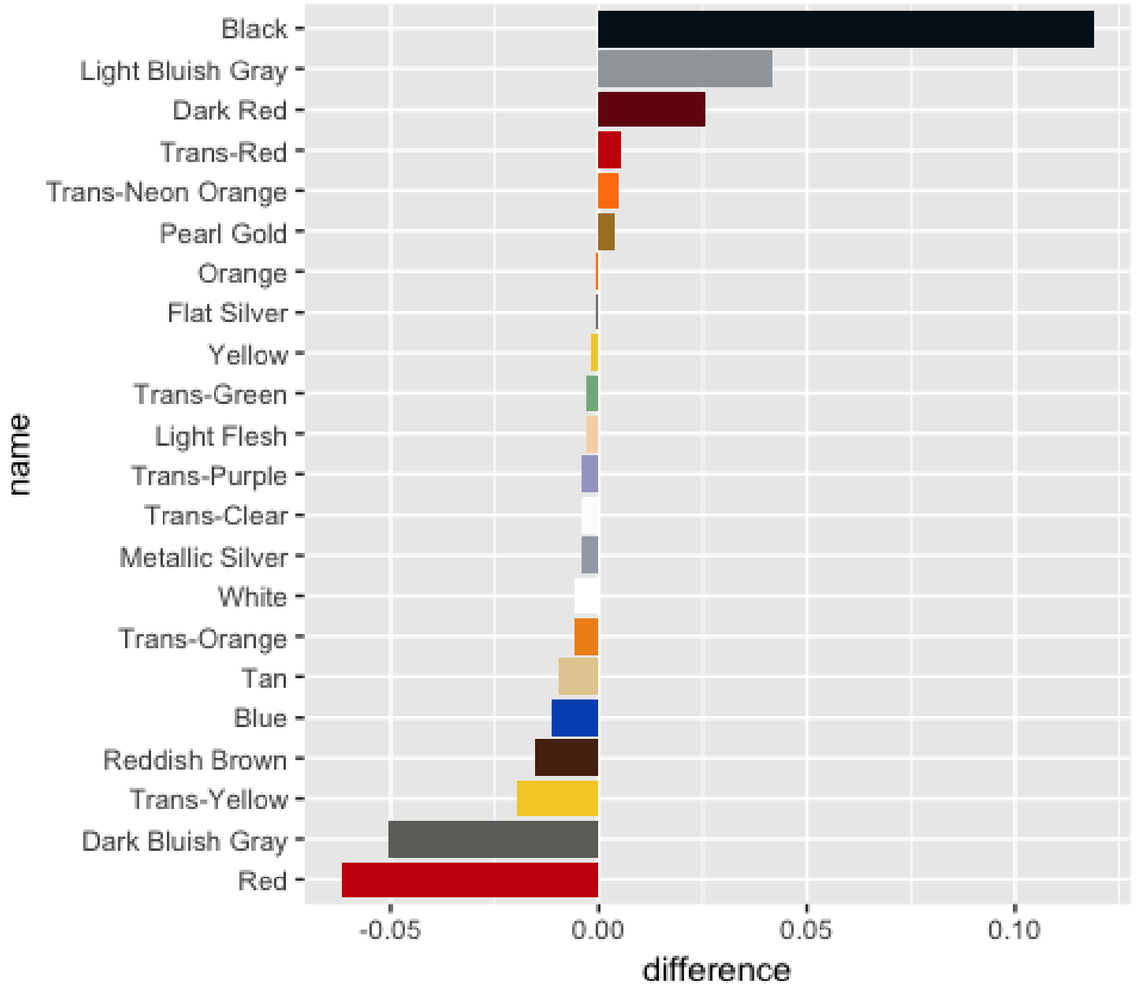
Visualizing the data

```
library(ggplot2)
library(forcats)

color_palette <- setNames(colors_joined$rgb, colors_joined$name)

colors_joined %>%
  mutate(name = fct_reorder(name, difference)) %>%
  ggplot(aes(name, difference, fill = name)) +
  geom_col() +
  coord_flip() +
  scale_fill_manual(values = color_palette, guide = FALSE)
```

Visualizing the data



Comparing Batman and Star Wars themes