Tidyverse Workshop

Data wrangling with `dplyr` & `tidyr`

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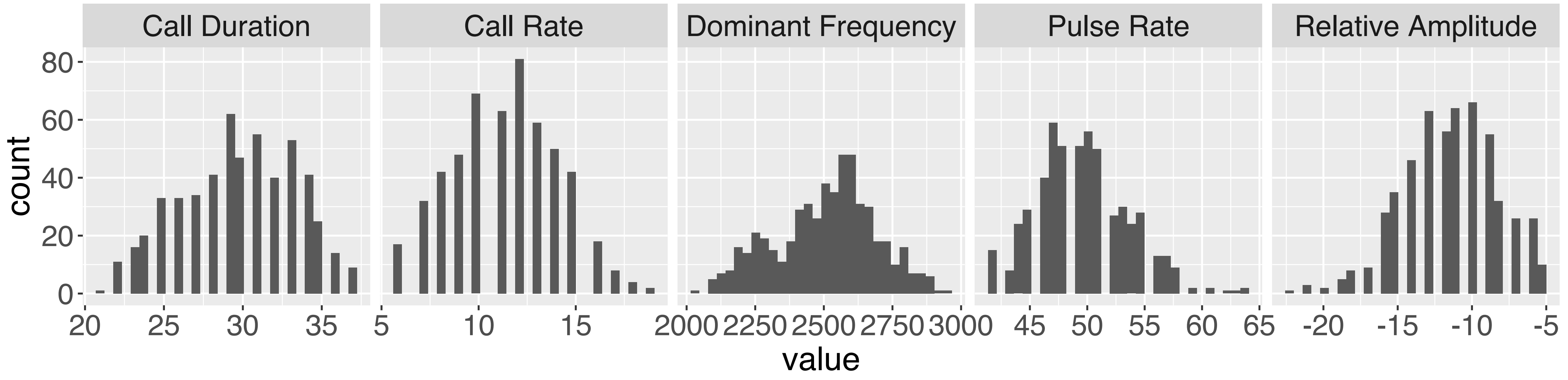
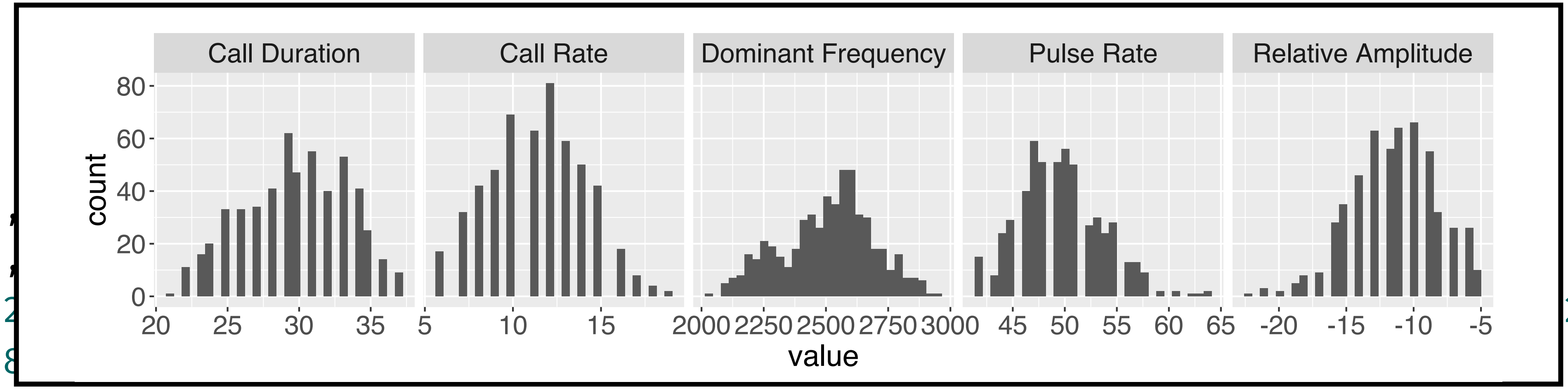
🎯 Aim: using this data, plot below graph

```
glimpse(dat)

  Observations: 535
  Variables: 5
  $ CD <dbl> 28, 27, 31, 33, 26, 31, 33, 28, 29, 34, 27, 29, 25, 33, 24, 30, 23, 34, 28, 2
  $ CR <dbl> 12, 15, 13, 15, 11, 6, 15, 12, 14, 12, 9, 8, 10, 7, 11, 10, 13, 14, 7, 16, 14
  $ DF <dbl> 2315, 2304, 2646, 2281, 2789, 2719, 2233, 2667, 2527, 2574, 2360, 2380, 2535,
  $ RA <dbl> -10, -8, -12, -7, -8, -6, -12, -16, -12, -10, -12, -12, -6, -15, -12, -10, -1
  $ PR <dbl> 46, 49, 43, 50, 57, 51, 46, 55, 56, 45, 47, 50, 57, 57, 52, 46, 51, 59, 44, 4
```



🤔 Mapping variable to aesthetic

```
glimpse(dat)

  Observations: 535
  Variables: 5
  $ CD <dbl> 28, 27,
  $ CR <dbl> 12, 15,
  $ DF <dbl> 2315, 2
  $ RA <dbl> -10, -8
  $ PR <dbl> 46, 49, 43, 50, 57, 51, 46, 55, 56, 45, 47, 50, 57, 57, 52, 46, 51, 59, 44, 44
```

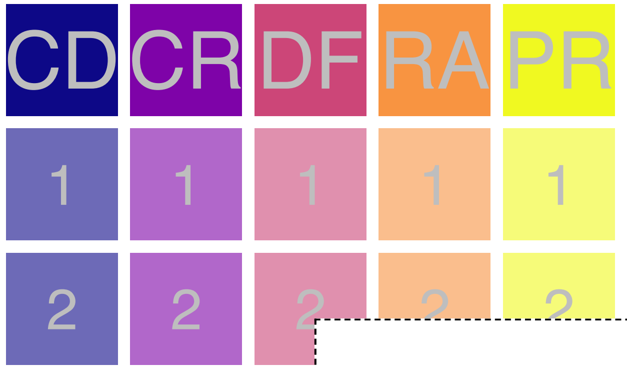


```
ggplot(<DATA>, aes(x = <VAR>)) +
  geom_histogram() +
  facet_wrap(~ <VAR>,
             scales = "free_x",
             nrow = 1)
```

🔧 Data wrangling

Raw data is hardly ever in a format ready for downstream analysis

The data we *have*



The data we *need*

```
ggplot(<DATA>, aes(x = value)) +
  geom_histogram() +
  facet_wrap(~ name,
             scales = "free_x",
             nrow = 1)
```

🔧 Data wrangling: tidyr::pivot_longer

The following commands all produce the same output on the right:

```r
pivot_longer(dat, cols = c("CD", "CR", "DF", "RA", "PR"))

pivot_longer(dat, cols = c(CD, CR, DF, RA, PR))

pivot_longer(dat, cols = CD:PR)

pivot_longer(dat, cols = everything())
```

Yup, that's all to take your data from wider form to longer form!

```
# A tibble: 2,67
   name  value
   <chr> <dbl>
 1 CD       28
 2 CR       12
 3 DF     2315
 4 RA      -10
 5 PR       46
 6 CD       27
 7 CR       15
 8 DF     2304
 9 RA       -8
10 PR       49
# … with 2,665 m
```

Tidy evalution

- `tidyverse` packages all employ **tidy evalution**, which includes **non-standard evaluation**, through `rlang` package
- It's the reason below are the same

```
pivot_longer(dat,
  cols = c("CD", "CR", "DF", "RA", "PR"))

pivot_longer(dat,
  cols = c(CD, CR, DF, RA, PR))
```

- You've actually been using tidy evalution in `ggplot`!

What would happen below?

```
vars <- c("CD", "CR", "DF", "RA", "PR")
pivot_longer(dat, cols = vars)
```

What if the object name is in the data?

```
CD <- c("CD", "CR", "DF", "RA", "PR")
pivot_longer(dat, cols = CD)
```

To "unquote", you need to use `!!` (pronounced bang-bang)

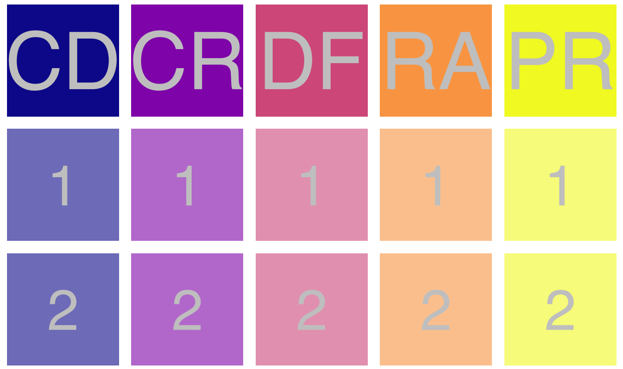
```
CD <- c("CD", "CR", "DF", "RA", "PR")
pivot_longer(dat, cols = !!CD)
```

`tidyselect`

Packages in `tidyverse` generally use `tidyselect`

```
pivot_longer(dat, cols = CD:PR)
```

Selects all variables starting from CD to PR.



CD	CR	DF	RA	PR
1	1	1	1	1
2	2	2	2	2

```
pivot_longer(dat, cols = everything())
```

signal_dat

Frog ID	CD	CR	DF	RA	PR	Standard1	Standard2	Standard3	Alternative1	Alternativ
13196	28	12	2315	-10	46	47	46	42	28	
13197	27	15	2304	-8	49	69	44	36	33	
13198	31	13	2646	-12	43	139	102	85	227	1
13206	33	15	2281	-7	50	112	112	117	101	
13207	26	11	2789	-8	57	101	101	80	126	
13208	31	6	2719	-6	51	90	68	73	143	1

Previous 1 2 3 4 5 … 90 Next

Note: the header is slightly modified from original.

Tanner, Jessie C.; Ward, Jessica L.; Shaw, Ruth G.; Bee, Mark A. (2017), Data from: Multivariate phenotypic selection on a complex sexual signal, Dataset, https://doi.org/10.5061/dryad.n50cr

Non-syntatic variable names

- **Syntatic** names consist of letters, digits, `.` and `_` only and begin with letters or `.` AND also cannot be in reserved words list (`?Reserved`)
- You need to surround non-syntatic names with backticks if you wish to refer to them
- E.g. in `signal_dat`, "`Frog ID`" is a variable with non-syntatic name because it has a space in it
- To select "`Frog ID`", we use

```
signal_dat$`Frog ID`
```

```
   [1] 13196 13197 13198 13206 13207 13208 13211 13275 1
```

Rename variable names with `dplyr::rename`

- Working with non-syntatic names is often a pain!
- You can rename a variable using `dplyr::rename`

```
signal_cdat <- rename(signal_dat,
    frog_id            = `Frog ID`,
    two_choice_latency = `Two Choice Latency`,
    two_choice         = `Two Choice`,
    phonotaxis_score   = `Phonotaxis Score`,
    speaker_position   = `Speaker Position`,
    first_presented    = `First Presented`)
```

Clean variable names

- But it's still a pain to rename one-by-one
- The `janitor` package is fantastic way to clean at once

```
signal_cdat <- janitor::clean_names(signal_dat)
```

```
glimpse(signal_cdat)
```

```
Observations: 535
Variables: 18
$ frog_id          <dbl> 13196, 13197, 13198, 13206, 13207, 13208, 13211, 13275, 13276,
$ cd               <dbl> 28, 27, 31, 33, 26, 31, 33, 28, 29, 34, 27, 29, 25, 33, 24, 30
$ cr               <dbl> 12, 15, 13, 15, 11, 6, 15, 12, 14, 12, 9, 8, 10, 7, 11, 10, 13
$ df               <dbl> 2315, 2304, 2646, 2281, 2789, 2719, 2233, 2667, 2527, 2574, 23
$ ra               <dbl> -10, -8, -12, -7, -8, -6, -12, -16, -12, -10, -12, -12, -6, -1
$ pr               <dbl> 46, 49, 43, 50, 57, 51, 46, 55, 56, 45, 47, 50, 57, 57, 52, 46
```

Note `janitor` is *not* part of `tidyverse` but it's one of my favorites!

Quick skim of the data

```
skimr::skim(signal_cdat)
```

```
Skim summary statistics
 n obs: 535
 n variables: 18

── Variable type:character ──────────────────────────────────────
         variable missing complete    n min max empty n_unique
  first_presented       0      535 535   8  11     0        2
 speaker_position     161      374 535   4   5     0        2
       two_choice       1      534 535   8  11     0        2

── Variable type:numeric ────────────────────────────────────────
           variable missing complete   n     mean     sd       p0      p25        p50
       alternative1       0      535 535    83.77  43.91    20       52       76        1
       alternative2       1      534 535    78.01  40.21    17       51       67        9
```

Note skimr is *not* part of tidyverse but it's also one of my favorites!

Make new variables with `dplyr::mutate`

Aim: create a new variable of phonotaxis score

```
signal_cdat2 <- mutate(signal_cdat,
   # rounding needed to get the same result as paper
   xbara = round((alternative1 + alternative2 + alternative3) / 3),
   xbars = round((standard1 + standard2 + standard3) / 3),
   # defintion of phonotaxis score
   score = (xbars - xbara) / (xbars + xbara))
```

Think `mutate` as in for biology when a string of DNA is modified by mutation 🧬

Select variables with dplyr::select

```r
select(signal_cdat2,
  # below is using tidyselect
  c(starts_with("standard"), starts_with("alt"),
    starts_with("xbar"), score, starts_with("pho")))
```

```
# A tibble: 535 x 10
   standard1 standard2 standard3 alternative1 alternative2 alternative3 xbara x
       <dbl>     <dbl>     <dbl>        <dbl>        <dbl>        <dbl> <dbl> <
 1        47        46        42           28           48           43    40
 2        69        44        36           33           27           37    32
 3       139       102        85          227          111          126   155
 4       112       112       117          101           81           61    81
```

Subsetting data with dplyr::filter

```r
signal_cdatm <- filter(signal_cdat2, is.na(speaker_position))
glimpse(select(signal_cdatm, speaker_position))
```

```
Observations: 161
Variables: 1
$ speaker_position <chr> NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA, NA
```

- Note: `dplyr::filter` conflicts with `stats::filter`
- Usually loading `tidyverse` displays this conflict

```r
tidyverse_conflicts()
```

```
── Conflicts ────────────────────────── tidyverse_conflicts() ──
✖ dplyr::filter() masks stats::filter()
✖ dplyr::lag()    masks stats::lag()
```

Summarising data with dplyr::summarise usually coupled with dplyr::group_by

```
signal_cdatg <- group_by(signal_cdatm, two_choice)
signal_cdats <- summarise(signal_cdatg,
                          avg_score = mean(score, na.rm = TRUE),
                           sd_score = sd(score, na.rm = TRUE),
                           nmissing = sum(is.na(score)),
                                  n = n())

signal_cdats
```

```
# A tibble: 2 x 5
  two_choice  avg_score sd_score nmissing     n
  <chr>           <dbl>    <dbl>    <int> <int>
1 Alternative    0.0407    0.122        0    60
2 Standard      -0.0386    0.152        1   101
```

The full code to get to the table summary

```r
signal_cdat <- janitor::clean_names(signal_dat)
signal_cdat2 <- mutate(signal_cdat,
   xbara = round((alternative1 + alternative2 + alternative3) / 3),
   xbars = round((standard1 + standard2 + standard3) / 3),
   score = (xbars - xbara) / (xbars + xbara))
signal_cdatm <- filter(signal_cdat2, is.na(speaker_position))
signal_cdatg <- group_by(signal_cdatm, two_choice)
signal_cdats <- summarise(signal_cdatg,
                          avg_score = mean(score, na.rm = TRUE),
                           sd_score = sd(score, na.rm = TRUE),
                           nmissing = sum(is.na(score)),
                                  n = n())
```

😩 The *pain point* - you have to think of a new variable name each time OR risk using the same and accidentally overwrite when unknowingly missed a sequence

The pipe operator from `magrittr`

%>%

```
<data> %>% <function>(<argA>, <argB>)
```

is the same as

```
<function>(<data>, <argA>, <argB>)
```

E.g. `filter(signal_cdat2, is.na(speaker_position))`

is the same as

```
signal_cdat2 %>% filter(is.na(speaker_position))
```

Chain of pipes

```
signal_dat %>%
  janitor::clean_names() %>%
  mutate(xbara = round((alternative1 + alternative2 + alternative3) / 3),
         xbars = round((standard1 + standard2 + standard3) / 3),
         score = (xbars - xbara) / (xbars + xbara)) %>%
  filter(is.na(speaker_position)) %>%
  group_by(two_choice) %>%
  summarise(avg_score = mean(score, na.rm = TRUE),
            sd_score = sd(score, na.rm = TRUE),
            nmissing = sum(is.na(score)),
                   n = n())

  # A tibble: 2 x 5
    two_choice  avg_score sd_score nmissing     n
    <chr>           <dbl>    <dbl>    <int> <int>
  1 Alternative    0.0407    0.122        0    60
```

Main `dplyr` verbs

- `mutate()` - create new or overwrite existing variables based on existing variables
- `select()` - select and rename variables (reduces column)
- `filter()` - subset data (reduces rows)
- `summarise()` - reduce data to a summary statistics
- `arrange()` - ???
- `group_by()` coupled with `ungroup()` - group operations

What does `arrange()` do?

Special extensions `*_if()`, `*_at()` and `*_all()`

`mutate_if()`	`summarise_if()`
`mutate_at()`	`summarise_at()`
`mutate_all()`	`summarise_all()`
`select_if()`	`group_by_if()`
`select_at()`	`group_by_at()`
`select_all()`	`group_by_all()`
`filter_if()`	`arrange_if()`
`filter_at()`	`arrange_at()`
`filter_all()`	`arrange_all()`

`*_if()`

```r
signal_cdat %>%
  mutate_if(is.character, as.factor) %>%
  select_if(is.factor)
```

```
# A tibble: 535 x 3
   two_choice  speaker_position first_presented
   <fct>       <fct>            <fct>
 1 Standard    left             Alternative
 2 Alternative left             Alternative
 3 Alternative left             Alternative
 4 Standard    left             Standard
 5 Alternative left             Standard
 6 Standard    left             Standard
 7 Alternative left             Alternative
 8 Alternative left             Standard
```

`*_at()`

```
scale2 <- function(x, na.rm = FALSE)
  (x - mean(x, na.rm = na.rm)) / sd(x, na
signal_cdat2 %>%
  mutate_at("score", scale2)
```

To use `tidyselect`, the variables need to be wrapped with `vars()` function:

```
signal_cdat2 %>%
  mutate_at(vars(cd:pr), scale2)
```

`*_all()`

Applies function to all variables

```
signal_cdat2 %>%
  mutate_all(I)
```

Open and go through:

`challenge-04-wrangling.Rmd`

For answers go to (but don't look until trying!):

`challenge-04-wrangling-solution.Rmd`

Session Information

```
devtools::session_info()

  ─ Session info ──────────────────────────────────────
   setting  value
   version  R version 3.6.0 (2019-04-26)
   os       macOS Mojave 10.14.6
   system   x86_64, darwin15.6.0
   ui       X11
   language (EN)
   collate  en_AU.UTF-8
```