# Multipanel Figures & Adding To Your Plot

#### **Last Time**

#### So much customization!

- Color palettes
- Themes
- Manually changing things

### This time

#### **Multipanel Plots**

- Faceting
- Combining separates into 1

#### **Adding Stuff**

- Lines
- Text

# **Faceting**

Faceting lets you break up your plot into multiple sub-plots. There are two main types:

- 1. facet\_grid
- 2. facet\_wrap

For both of these, we will read the tilde (~) as the word "by"...

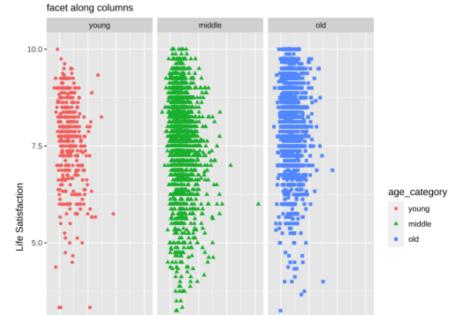
This is especially great when you have multiple factors to separate your graph on.

Like the name implies, facet\_grid is going to make a grid. Just like a matrix, the left is the rows and right is the columns (i.e., 2x3 matrix = 2 rows, 3 columns). You can put your factor on either side, but that will change the layout of your grid! For example:

- age\_category is read as "by age category", and is in the column position.
   There are 3 levels of the age\_category factor. Therefore, the result of ~
   age\_category is a 1x3 grid.
- age\_category ~ is read as "age category by". This doesn't work! You need something else to finish your "sentence". To indicate that you do not want to facet by any additional factor, use a period (.). So the correct syntax for faceting age\_category in the row position is age\_category ~ .. The result will be a 3x1 grid.

Let's see this in action...

#### Facet by age\_category

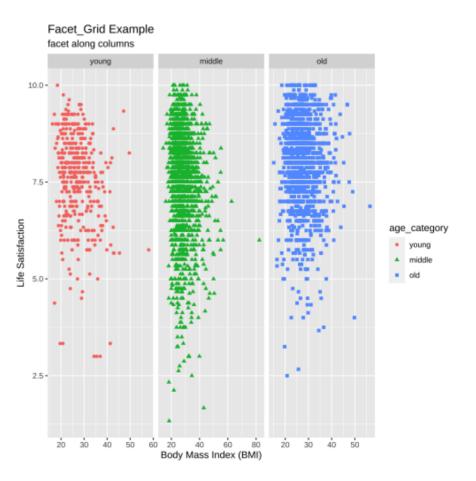


Body Mass Index (BMI)

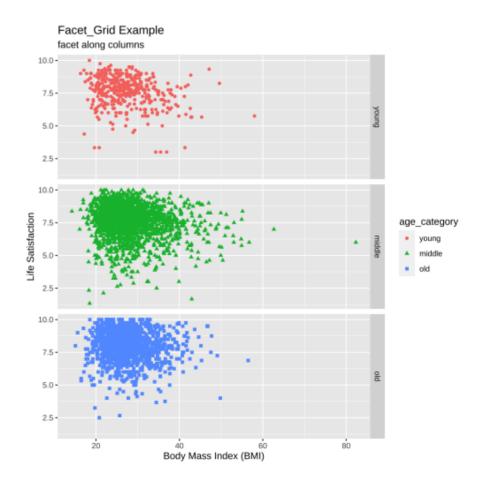
Facet Grid Example

2.5 -

Notice how the x-axis was the same for each of the 3 facets? What if we let them be specific to that particular facet?



#### Facet age\_category by.



# Faceting based on 2 variables

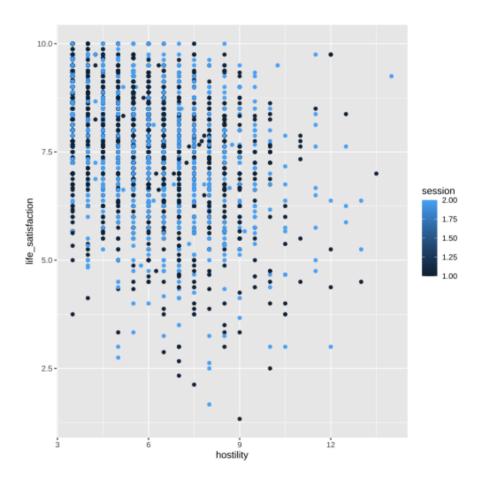
What happens when a categorical variable is treated continuously, and not as a factor?

The following creates a new variable called session and is scored as 1 and 2. We will make sure to treat this as a numeric variable

```
session <- c(rep(c(1, 2), times = 935))
midus["session"] <- rep(session, times = 2)
midus$session <- as.numeric(midus$session)
head(midus$session)</pre>
```

```
## [1] 1 2 1 2 1 2
```

If we plot this, check out the legend and colorings...

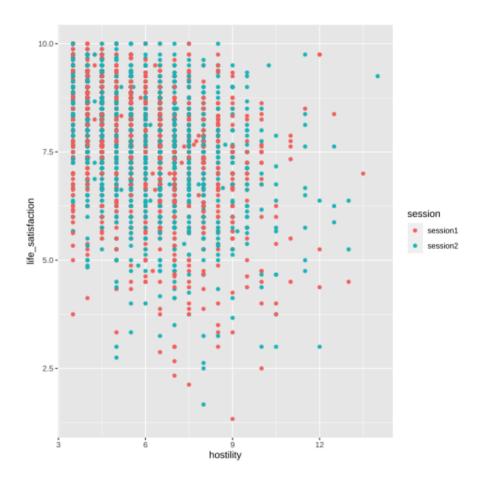


If you are working with categorical variables, it is strongly recommended that you tell R to treat it as a factor -- don't skimp on this step!

It is easier to keep categorical variables as words, rather than numeric codes. So instead of 1 and 2, let's change the scores to be session1 and session2 for our new session variable.

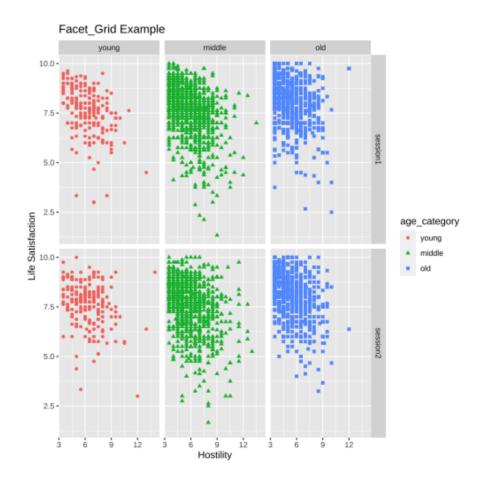
```
## [1] "factor"
```

#### Much better!



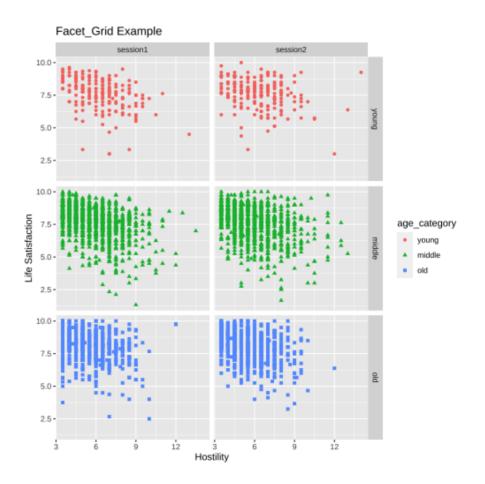
# Faceting based on 2 variables

#### Session x Age Category:



# Faceting based on 2 variables

#### Age Category x Session:



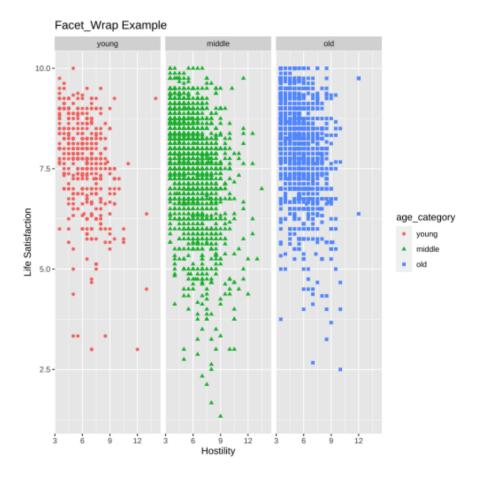
This basically creates a ribbon that will just continue on to the next row when ready.

This is useful for when you have categorical variables, but they don't necessarily need to be in a grid or matrix format.

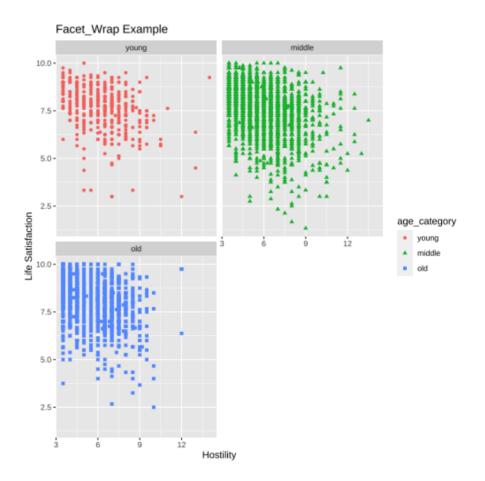
For instance, if one of the facet\_grid cells would be empty, you probably don't want to show an empty plot (a plot with no points/shapes – you'd rather it be just blank space).

This does not follow the rows by columns syntax – it will always just go to the next row.

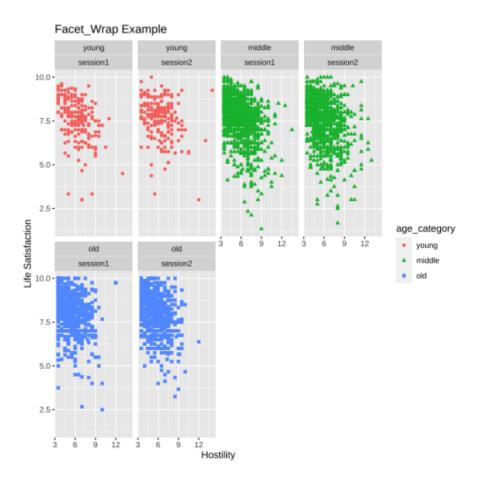
Since there are only 3 levels, by default it will look just like facet\_grid



But now, let's say there should only be 2 columns. What happens to our third subplot?



We can facet on 2 variables with facet\_wrap, but now we're adding rather than making a true grid.



Faceting is great because you're making the same plot but carved up based on some criteria.

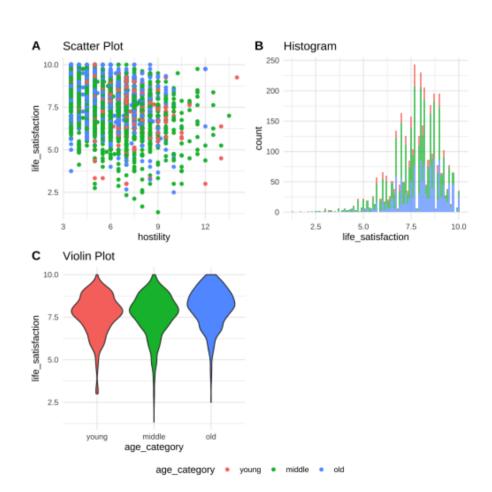
Now let's say you have 3 completely independent plots (not subplots!) that you want to arrange into a cohesive figure. You're arranging a **grid of plots**. To do this, we will use the <code>ggarrange()</code> function from the <code>ggpubr</code> package. If you do not already have this package installed, please do so now.

*Importantly*, you need to STORE these plots into your environment first (which means the plot won't immediately appear when you run the code). Then you can arrange the plots based on the names you assigned them.

Let's first create our plots. If we want a single legend for every plot (e.g., the colors are the same for all plots), then make sure you have coded this accordingly.

```
library(ggpubr)
# plot A - a scatter plot
plotA <- ggplot(data = midus, aes(x = hostility, y = life_satisfaction))</pre>
  geom_point(aes(color = age_category)) +
  theme minimal() +
  labs(title = "Scatter Plot")
# plot B - histogram
plotB <- ggplot(data = midus, aes(x = life_satisfaction)) +</pre>
  geom_histogram(binwidth = .1, aes(fill = age_category), alpha = .7) +
  theme minimal() +
  labs(title = "Histogram")
# plot C - violin plot
plotC <- ggplot(data = midus, aes(x = age_category, y = life_satisfaction)</pre>
  geom_violin(aes(fill = age_category)) +
  theme_minimal() +
  labs(title = "Violin Plot")
                                                                         21/38
```

Now that we created the 3 plots, let's arrange them with ggarrange()



This looks fine, but it's kind of smushed.

What you actually want to see is the bottom biolin plot taking up the entire 2 columns (e.g., spanning the entire width of this newly created plot).

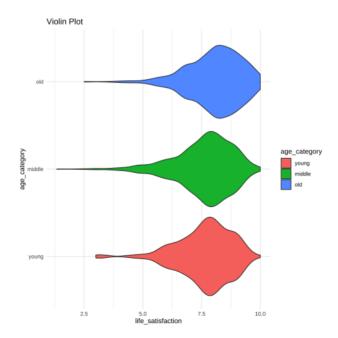
It would be even better if the violin plots had the distributions stacked vertically, rather than horizontally.

Let's do it!

To change the violin plot, all we need to do is flip the coordinates.

```
plotCNew <- ggplot(data = midus, aes(x = age_category, y = life_satisfaction)) +
  geom_violin(aes(fill = age_category)) +
  theme_minimal() +
  labs(title = "Violin Plot") +
  coord_flip()

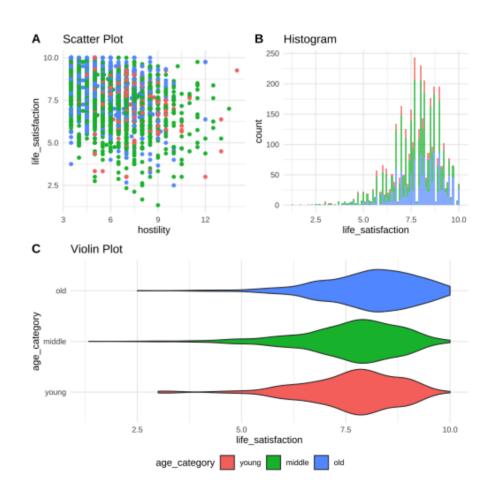
plotCNew</pre>
```



Ok, that looks good.

Now we are going to nest 2 ggarrange() functions:

- The 1st (inner most) ggarrange will combine plots A & B into a single figure. Here, we want 1 row, 2 columns.
- The 2nd (outer most) ggarrange will take the one from above, and combine it with our newly created flipped violin plot. We will keep this as 1 column, and 2 rows.
  - This means that C has to take up the full width



# **Arranging Plots**

A final note about ggarrange():

- It does not like it when either the ncol = or nrow = parameters are set to equal 1.
- If you want a plot with 1 column and 3 rows, do *NOT* specify ncol = 1. Instead, use nrow = 3.

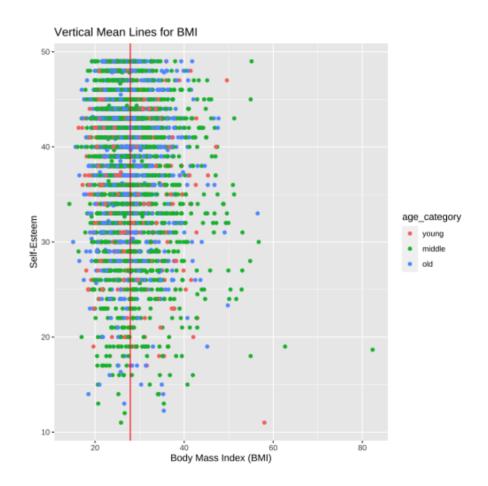
# **Adding Stuff**

- Lines
- Text

#### Horizontal and Vertical Lines

- Use geom\_vline or geom\_hline
- You'll need to specify an x or y intercept, respectively
  - This intercept is based on the actual scales on the graph!

### Horizontal and Vertical Lines



# By groups?

What if we wanted to make a vertical line that reflects the mean of some variable per level of a categorical variable?

We need to create a data.frame that contains the means for each level of the factor, store this information in an object, and then call that object from within the plot.

This is where tidyverse is extremely useful!

# By groups

<fct> <dbl>

5.49

## 1 young 6.26 ## 2 middle 5.90

##

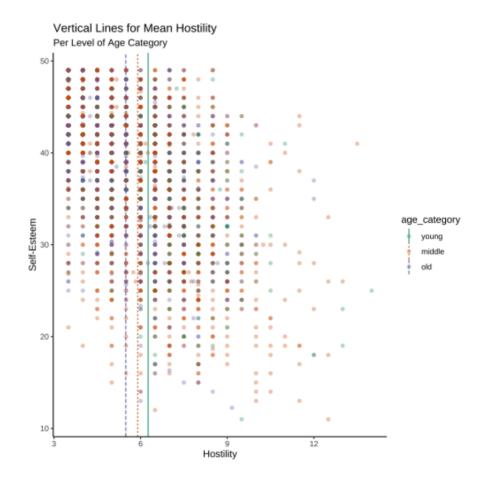
## 3 old

```
meansHostility <- midus %>%
   group_by(age_category) %>%
   summarize(xint = mean(hostility))

meansHostility

## # A tibble: 3 x 2
## age_category xint
```

# By groups



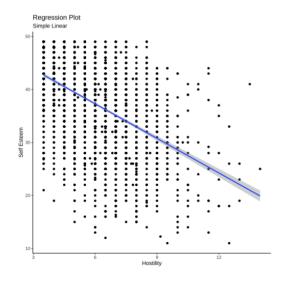
# **Regression Lines**

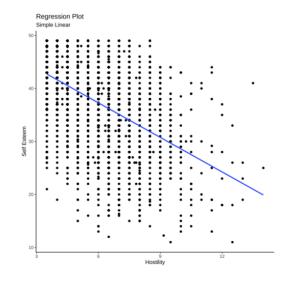
For simple linear regression, you only need to add geom\_smooth

- By default, it will add a Loess line -- usually kinda curvy
- For the most part, you'll want to specify that it's a linear model using the method = "lm" argument

For complex interactions from multiple regressions, check out the ggpredict() function from the ggeffects package (beyond our scope, sadly).

# **Regression Lines**





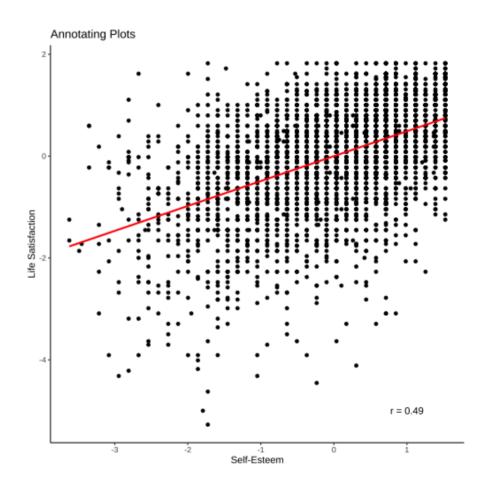
# Adding text

Sometimes you might want to add something like an  $\mathbb{R}^2$  value or a correlation coefficient or some sort of text to your plot, usually in a corner. We can do that!

Let's use a very nerdy stats example. The coefficient of a simple linear regression of 2 standardized variables is equal to the correlation of those variables.

# Adding text

```
# get correlation
corCoef <- round(x = cor(midus$self_esteem,</pre>
                         midus$life satisfa
                 digits = 2)
ggplot(data = midus,
      aes(x = scale(self_esteem),
          y = scale(life_satisfaction))) +
 geom_point() +
 geom_smooth(method = "lm",
              se = FALSE,
              color = "red") +
 theme_classic() +
 labs(title = "Annotating Plots",
      x = "Self-Esteem",
      y = "Life Satisfaction") +
 annotate(geom = "text",
           x = 1,
          y = -5,
          label = paste0("r = ", corCoef))
```



# Next up...

- Error bars
- Jittering
- Adding layers
- Debugging plots