Visible Aesthetics
Aesthetics?  Attributes!

<table>
<thead>
<tr>
<th>Type</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Red</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>10</td>
</tr>
</tbody>
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<thead>
<tr>
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<tbody>
<tr>
<td>Shape</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Species</td>
</tr>
</tbody>
</table>

**mapping** Species on colour
Mapping

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) +
  geom_point()
```
Attribute

> `ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width)) + geom_point(col = "red")`
Mapping onto color

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width,
                   col = Species)) +
  geom_point()
```

Data frame column mapped onto visible aesthetic

Aesthetics in `aes()`, attributes in `geom_()`
Mapping onto color (2)

```r
> ggplot(iris) +
  geom_point(aes(x = Sepal.Length, y = Sepal.Width,
               col = Species))
```

Only if different data sources

- Setosa
- Versicolor
- Virginica
## Typical Aesthetics

<table>
<thead>
<tr>
<th>Aesthetic</th>
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</tr>
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<tbody>
<tr>
<td>x</td>
<td>X axis position</td>
</tr>
<tr>
<td>y</td>
<td>Y axis position</td>
</tr>
<tr>
<td>colour</td>
<td>Colour of dots, outlines of other shapes</td>
</tr>
<tr>
<td>fill</td>
<td>Fill colour</td>
</tr>
<tr>
<td>size</td>
<td>Diameter of points, thickness of lines</td>
</tr>
<tr>
<td>alpha</td>
<td>Transparency</td>
</tr>
<tr>
<td>linetype</td>
<td>Line dash pattern</td>
</tr>
<tr>
<td>labels</td>
<td>Text on a plot or axes</td>
</tr>
<tr>
<td>shape</td>
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</tr>
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</table>
DATA VISUALIZATION WITH GGPOLOT2

Let’s practice!
Aesthetics

Best Practices
Which Aesthetic?

- Be creative
- Clear guidelines
- Jacques Bertin
- William Cleveland
  - Perception of visual elements (90s)
Form follows Function

- Data
- Scientist
- Reader

Explore
Confirm and Analyse

Explain
Inform and Persuade
# Aesthetics

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Aesthetics - Continuous Variables

```r
> ggplot(iris.1, aes(x = Sepal.Length,
>                  y = Sepal.Width,
>                  col = Species)) +
>     geom_point()
```

![Data Visualization with ggplot2](Image)
Aesthetics - Continuous Variables

```r
> ggplot(iris.1, aes(col = Sepal.Length,
    y = Sepal.Width,
    x = Species)) +
    geom_point()
```
## Aesthetics - Continuous Variables

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Guide - Continuous Variables

Efficiency and Accuracy of Decoding

- Colour Spectrum
- Monochromatic Spectrum
- Grey-Scale Spectrum
- Area
- Angle
- Length
- Position - on same, but unaligned, scale
- Position - on a common scale

Image adapted from Wong, B, Nat Met, 7 (9), 2010, p665
Unaligned y axes
Common y axis

The image shows a data visualization with ggplot2, comparing the measurements of three parts: Setosa, Versicolor, and Virginica. The y-axis represents the value, and the x-axis represents the measure of length and width. The graph uses different colors to distinguish between petal and sepal measurements.
Aesthetics - Categorical Variables

```r
> ggplot(iris.1, aes(x = Sepal.Length,
              y = Sepal.Width,
              col = Species)) +
  geom_point()
```
Aesthetics - Categorical Variables

```r
> ggplot(iris.1, aes(x = Sepal.Length,

   y = Sepal.Width,

   shape = Species)) +

   geom_point()
```
Aesthetics - Categorical Variables

```r
> ggplot(iris.1, aes(x = Sepal.Length, y = Sepal.Width,
    shape = Species, col = Species)) +
  geom_point()
```
## Aesthetics - Categorical Variables

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Aesthetics - Categorical Variables

Efficiency in Decoding Separate Groups

- Low
  - Filled Shapes
  - Hatching
  - Line Width
- High
  - Sequential Colours
  - Shape Outlines
  - Line Type
  - Qualitative Colours
  - Labels
  - Line Width
  - Line Type
  - Line Colours

Image adapted from Wong, B, Nat Met, 7 (9), 2010, p665
Let’s practice!
DATA VISUALIZATION WITH GGPILOT2

Modifying Aesthetics
Positions

- identity
- dodge
- stack
- fill
- jitter
- jitterdodge
position identity (default)

> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) + geom_point()
position identity (default)

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "identity")
```
position jitter

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter")
```
Data Visualization with ggplot2

position jitter (2)

```r
> posn.j <- position_jitter(width = 0.1)
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = posn.j)
```

Set specific arguments for the position
Consistency in jitter across plots
Scale Functions

- `scale_x`
- `scale_y`
- `scale_color`
- `scale_fill`
- `scale_shape`
- `scale_linetype`
Scale Functions

- `scale_x_continuous`
- `scale_y`
- `scale_color_discrete`
- `scale_fill`
- `scale_color`
- `scale_shape`
- `scale_linetype`
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter") +
  scale_x_continuous("Sepal Length") +
  scale_color_discrete("Species")
limit

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter") +
  scale_x_continuous("Sepal Length", limits = c(2, 8)) +
  scale_color_discrete("Species")
```
Data Visualization with ggplot2

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter") +
  scale_x_continuous("Sepal Length", limits = c(2, 8),
                    breaks = seq(2, 8, 3)) +
  scale_color_discrete("Species")
```
expand

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter") +
  scale_x_continuous("Sepal Length", limits = c(2, 8),
                   breaks = seq(2, 8, 3), expand = c(0, 0)) +
  scale_color_discrete("Species")
```
labels

```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter") +
  scale_x_continuous("Sepal Length", limits = c(2, 8),
                    breaks = seq(2, 8, 3), expand = c(0, 0)) +
  scale_color_discrete("Species",
                     labels = c("Setosa", "Versicolour", "Virginica"))
```
```r
> ggplot(iris, aes(x = Sepal.Length, y = Sepal.Width, col = Species)) +
  geom_point(position = "jitter") +
  labs(x = "Sepal Length", y = "Sepal Width", col = "Species")
```
Let’s practice!