

# TikZ annotations for ggplots with the ggtikz package

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# 1 Prerequisites

## 1.1 LaTeX side

As the name implies, `ggtikz` requires `tikz`, which must be loaded in the document's preamble. Furthermore, the `calc` `tikz` library is required.

Thus, the preamble must contain:

```
\usepackage{tikz}
\usetikzlibrary{calc}
```

## 1.2 R side

The `tikzDevice` package is required to render plots and `ggtikz` annotations to the `tikz` format. We also have to make some base plots, using `ggplot2`.

Here, we set the graphics device to `tikz` – `ggtikz` does not work with any other graphics device!

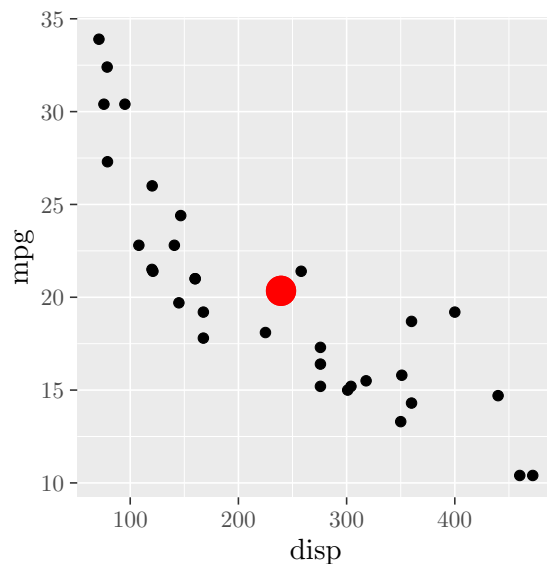
```
library(knitr)
library(ggplot2)
library(ggtikz)
opts_chunk$set(
  dev = "tikz",
  error = TRUE,
  cache = FALSE,
  external = TRUE,
  fig.path = "example-vignette-figures/",
  fig.width = 3,
  fig.height = 3,
  fig.align = "center"
)
```

# 2 Basic usage with `ggtikz()`

For simple one-step annotations, the `ggtikz` helper function is available.

It accepts a `ggplot` object as its first argument. Further arguments are passed on to `ggtikzAnnotation` (see section 3).

```
p <- ggplot(mtcars, aes(displacement, mpg)) + geom_point()
ggtikz(p, "\\fill[red] (0.5,0.5) circle (2mm);", xy="plot")
```



### 3 Advanced usage with canvases and annotations

With `ggtikz()`, only a single annotation can be added to a plot. If multiple annotations are needed, then we first need to create a `ggtikzCanvas()`, to which one or more `ggtikzAnnotation()` can be added.

#### 3.1 Single-panel plots

Let's create a single-panel plot for annotation.

```
p <- ggplot(mtcars, aes(dis, mpg)) +
  geom_point() +
  theme(plot.background=element_rect(color = "black", size = 1))
```

We can then set up an annotation canvas and add `tikz` annotations. Note that first, we print the base plot to the device <sup>1</sup>, and then the annotation canvas. The annotation canvas does not take care of drawing the annotated plot (the `ggtikz()` helper does handle this with the `draw = TRUE` parameter).

##### 3.1.1 Annotation relative to the whole plot

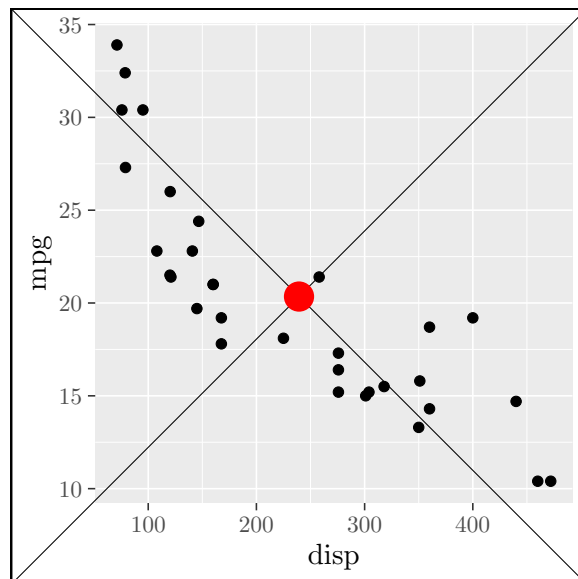
---

<sup>1</sup>no explicit calls to `tikz()` and `dev.off()` are needed, because knitr opens and closes the device automatically.

```

canvas <- ggtikzCanvas(p)
annotation <- ggtikzAnnotation(
  "
  \\draw (0,0) -- (1,1);
  \\draw (0,1) -- (1,0);
  \\fill[red] (0.5,0.5) circle (2mm);
  ",
  xy = "plot"
)
p
canvas + annotation # first draw the plot
                     # then draw the annotations

```

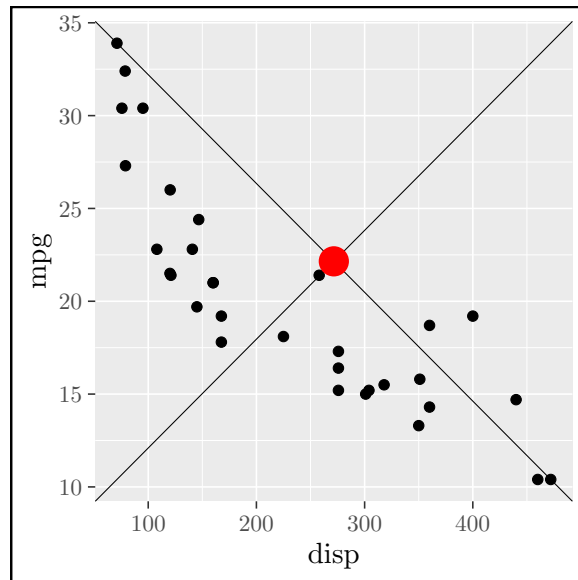


### 3.1.2 Annotation relative to the panel

```

canvas <- ggtikzCanvas(p)
annotation <- ggtikzAnnotation(
  "
  \\draw (0,0) -- (1,1);
  \\draw (0,1) -- (1,0);
  \\fill[red] (0.5,0.5) circle (2mm);
  ",
  xy = "panel",
  panelx = 1, panely = 1
)
p
canvas + annotation

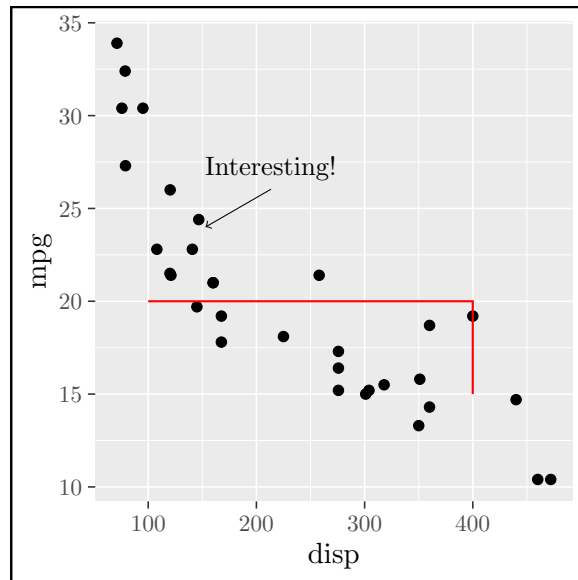
```



### 3.1.3 Annotation relative to data coordinates

In addition to unitless tikz coordinates, you can also use absolute lengths, such as the 1 cm in the example below.

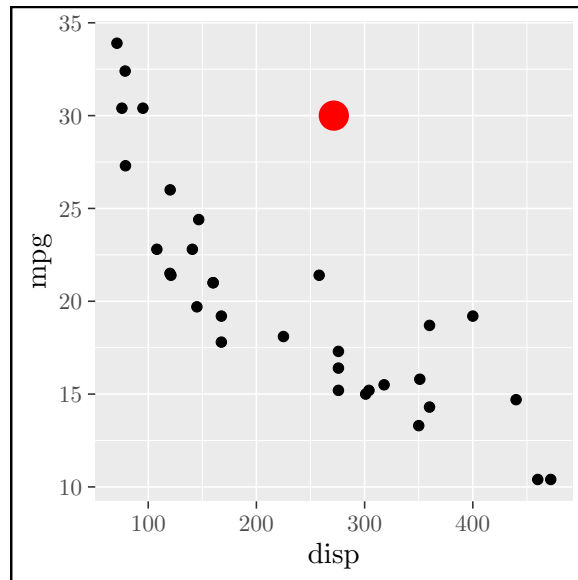
```
canvas <- ggtikzCanvas(p)
annotation <- ggtikzAnnotation(
  "
    \\draw[thick,red] (100,20) -| (400,15);
    \\draw[<-] (153,24) -- ++(30:1cm) node[at end, anchor=south]
      {Interesting!};
  ",
  xy = "data",
  panelx = 1, panely = 1
)
p
canvas + annotation
```



### 3.1.4 Mixing panel and data references

The reference frames for x and y coordinates can be separately assigned as **data** or **panel**. However, note that the **plot** reference frame must be given for both x and y directions (with the **xy** argument), and cannot be mixed!

```
canvas <- ggtikzCanvas(p)
annotation <- ggtikzAnnotation(
  "\\fill[red] (0.5,30) circle (2mm);",
  x = "panel", y = "data",
  panelx = 1, panely = 1
)
p
canvas + annotation
```



### 3.1.5 Turning off clipping

It is possible to turn off clipping for annotations, in order to draw outside of the plot area.

```

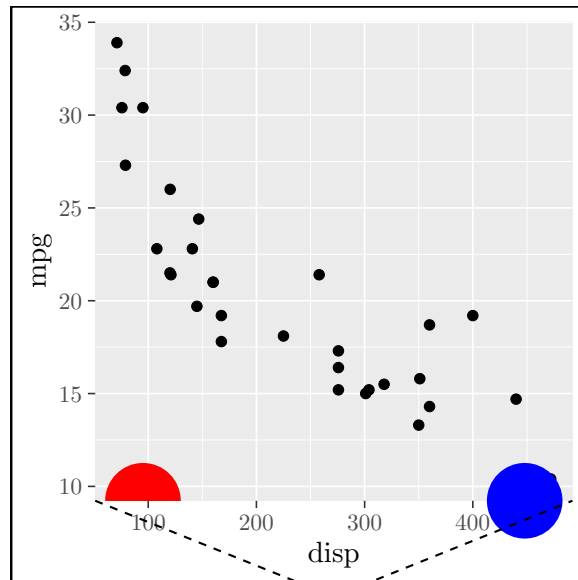
canvas <- ggtikzCanvas(p)
annotation_clip <- ggtikzAnnotation(
  "\\fill[red] (0.1,0) circle (5mm);",
  xy = "panel",
  panelx = 1, panely = 1
)

annotation_unclip <- ggtikzAnnotation(
  "\\fill[blue] (0.9,0) circle (5mm);",
  xy = "panel",
  panelx = 1, panely = 1,
  clip = "off"
)

annotation_unclip2 <- ggtikzAnnotation(
  "\\draw[thick, dashed] (0,0) -- (0.5,-0.2) -- (1,0);",
  xy = "panel",
  panelx = 1, panely = 1,
  clip = "off"
)

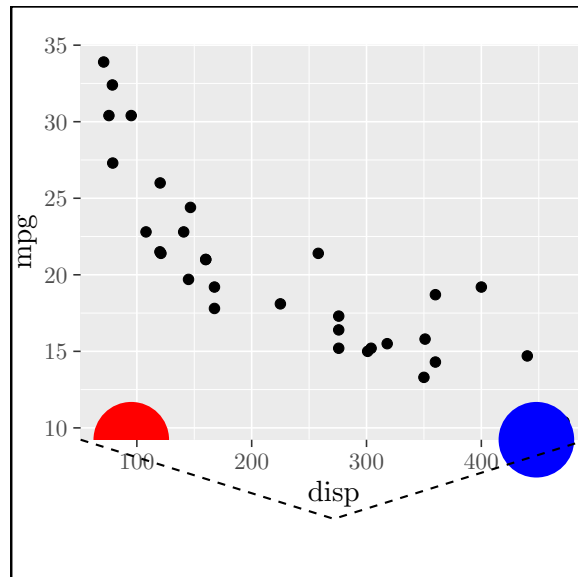
p
canvas + annotation_clip + annotation_unclip + annotation_unclip2

```



However, note that the surrounding plot area is not automatically unclipped to accommodate for the annotations. This can be alleviated manually by increasing the plot margins.

```
p + theme(plot.margin = margin(t=0.5, b = 1, unit = "cm"))
canvas + annotation_clip + annotation_unclip + annotation_unclip2
```



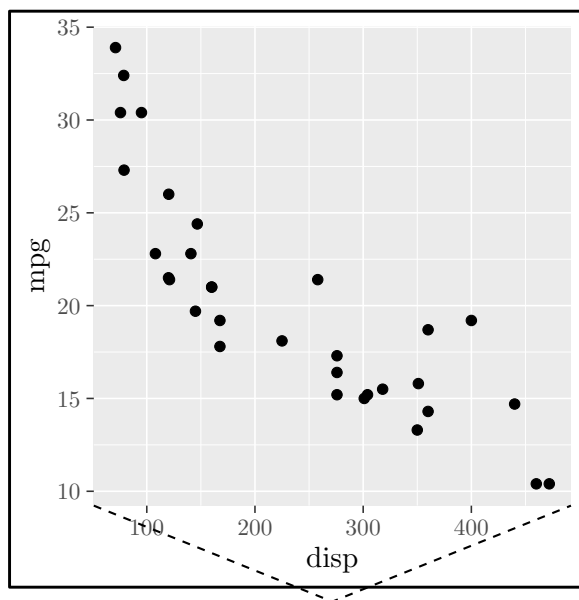


Alternatively, `ggtikz` comes with a knitr hook to automatically unclip TikZ files:

```
set_ggtikz_unclip_hook()
```

Now clipping can be disabled for chunks with the *chunk option* `unclip = TRUE` – however, this only works in conjunction with `external = FALSE`. If the option `external = TRUE`, then the resulting file is immediately compiled to pdf and not accessible for further post-processing.

```
# chunk options: external=FALSE, unclip=TRUE
p
canvas + annotation_unclip2
```



Unset the hook to restore the default clipping behavior:

```
unset_ggtikz_unclip_hook()
```

## 3.2 Multi-panel plots: wrap

```
p_wrap <- p + facet_wrap(~cyl, scales="free", ncol=2)
```

### 3.2.1 Annotations in separate panels, relative to data or panel coordinates

```

canvas <- ggtikzCanvas(p_wrap)

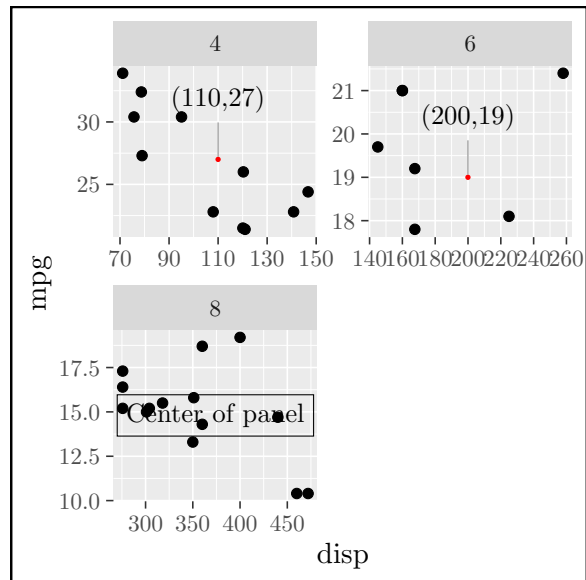
# Relative to data coordinates
annotation1 <- ggtikzAnnotation(
  "
  \\node[pin={90:(110,27)}, circle, fill=red,
    inner sep=0, outer sep=0, minimum size=2pt]
    at (110,27)
    {};
  ",
  xy = "data",
  panelx = 1, panely = 1
)

# Relative to data coordinates
annotation2 <- ggtikzAnnotation(
  "
  \\node[pin={90:(200,19)}, circle, fill=red,
    inner sep=0, outer sep=0, minimum size=2pt]
    at (200,19)
    {};
  ",
  xy = "data",
  panelx = 2, panely = 1
)

# Relative to panel coordinates
annotation3 <- ggtikzAnnotation(
  "
  \\node[draw, anchor=center] at (0.5, 0.5)
    {Center of panel};
  ",
  xy = "panel",
  panelx = 1, panely=2
)

p_wrap
canvas + annotation1 + annotation2 + annotation3

```

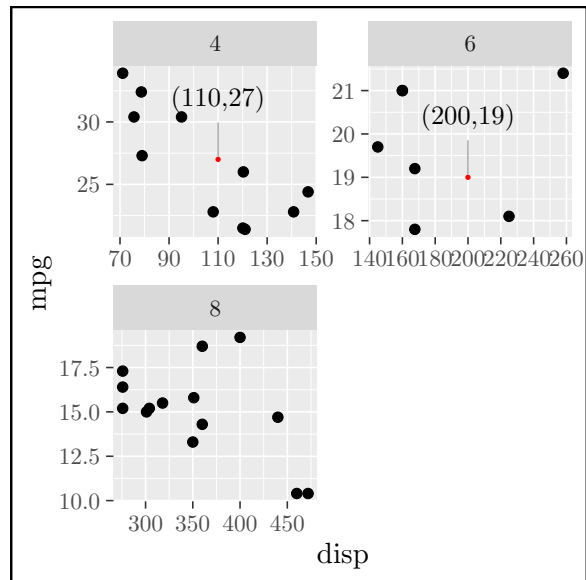


### 3.2.2 Annotations in separate panels, relative to data coordinates

```

canvas <- ggtikzCanvas(p_wrap)
annotation1 <- ggtikzAnnotation(
  "
    \\node[pin={90:(110,27)}, circle, fill=red,
      inner sep=0, outer sep=0, minimum size=2pt]
      at (110,27)
      {};
  ",
  xy = "data",
  panelx = 1, panely = 1
)
annotation2 <- ggtikzAnnotation(
  "
    \\node[pin={90:(200,19)}, circle, fill=red,
      inner sep=0, outer sep=0, minimum size=2pt]
      at (200,19)
      {};
  ",
  xy = "data",
  panelx = 2, panely = 1
)
p_wrap
canvas + annotation1 + annotation2

```



### 3.3 Multi-panel plots: grid

Annotations can also be made on individual panels of plots faceted with `facet_grid`.

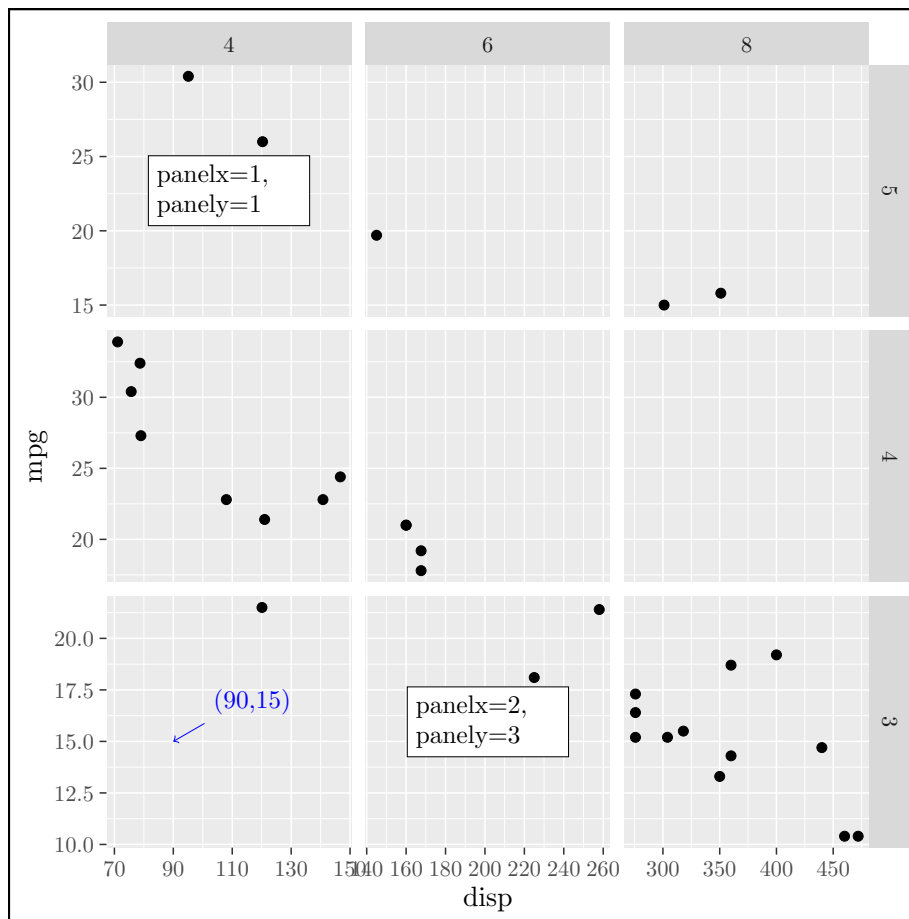
```
p_grid <- p + facet_grid(gear~cyl, scales="free", as.table=FALSE)
```

```
canvas <- ggtikzCanvas(p_grid)
annot_grid1 <- ggtikzAnnotation(
  "\\node[fill=white, draw, text width=2cm] at (0.5,0.5)
    {panelx=1, panely=1};",
  xy = "panel",
  panelx = 1, panely = 1
)
annot_grid2 <- ggtikzAnnotation(
  "\\node[fill=white, draw, text width=2cm] at (0.5,0.5)
    {panelx=2, panely=3};",
  xy = "panel",
  panelx = 2, panely = 3
)
annot_grid3 <- ggtikzAnnotation(
  "
  \\draw[<-, blue] (90,15) -- ++(30:5mm)
    node [at end, anchor=south west] {(90,15)};
  ",
  xy = "data",
```

```

    panelx = 1, panely = 3
  )
p_grid
canvas + annot_grid1 + annot_grid2 + annot_grid3

```



### 3.4 Re-using annotations

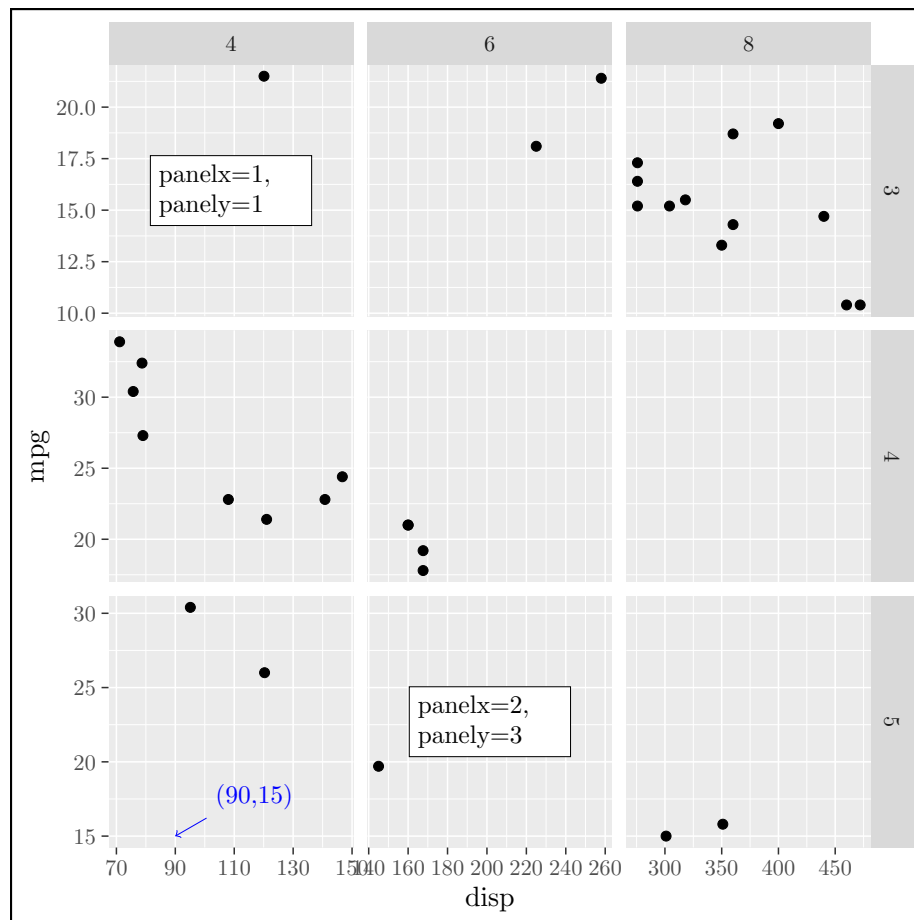
Annotations can be re-used between plots and `ggtikz` canvases. However, be aware that panel position specifications rely on the *visual position* of the panels, and *not on the value of the facet variables*.

```

p_grid2 <- p + facet_grid(gear~cyl, scales="free", as.table=TRUE)
canvas2 <- ggtikzCanvas(p_grid2)

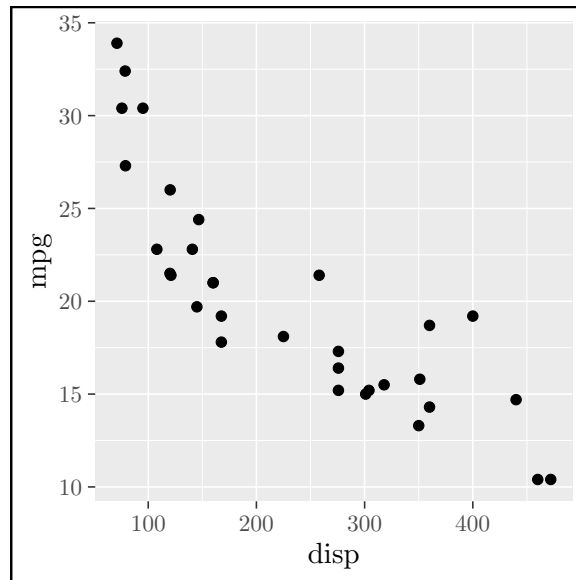
p_grid2
canvas2 + annot_grid1 + annot_grid2 + annot_grid3

```



It is also not possible to add annotations to a plot for which the requested panels are not available.

p



```
canvas <- ggtikzCanvas(p)
canvas + annot_grid2

## Error in get_annotation_valid.ggtikzCanvas(self, ggtikzAnnotation):
## Annotation wants to be placed in panelx = 2, but the plot only has
## 1.
```

## 4 Transformed scales

TikZ coordinates can automatically be transformed to accommodate transformed scales, such as log-transformed ones. This is activated by setting `transform = TRUE` in the call to `ggtikzAnnotation`. With `transform = FALSE`, annotations made with data coordinates are out of place in log plots, but the transformation calculation can be done manually.

```
p_log <- ggplot(mtcars, aes(mpg, disp)) +
  geom_point() +
  scale_x_continuous(trans="log10")
```

```
canvas_log <- ggtikzCanvas(p_log)
# Untransformed coordinates: wrong position
annot_log <- ggtikzAnnotation(
  "\\fill[red] (1,100) circle (2mm);
  \\node[anchor=west, text=red] at (1, 100)
```

```

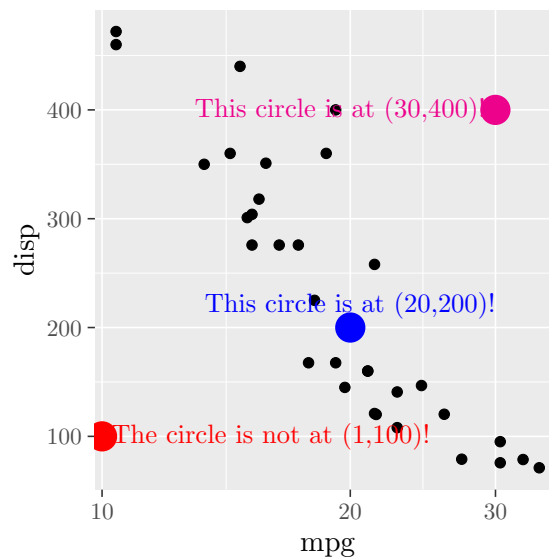
      {The circle is not at (1,100)!};
    ", xy = "data", transform = FALSE, panelx = 1, panely = 1
  )

# Transformed coordinates: correct position
# The literal coordinate in the node text was wrapped in an \mbox
# LaTeX command to prevent automatic transformation -- it can't
# distinguish between coordinates which are supposed to be text,
# and actual coordinates.
annot_log2 <- ggtikzAnnotation(
  "\\fill[blue] (20,200) circle (2mm);
  \\node[anchor=south, text=blue] at (20, 200)
    {This circle is at (\\mbox{20,200})!};
  ", xy = "data", transform = TRUE, panelx = 1, panely = 1
)

# Untransformed coordinates, calculated manually by hand:
# correct position
annot_log3 <- ggtikzAnnotation(
  "\\fill[magenta] (1.477,400) circle (2mm);
  \\node[anchor=east, text=magenta] at (1.477, 400)
    {This circle is at (30,400)!};
  ", xy = "data", transform = FALSE, panelx = 1, panely = 1
)

p_log
canvas_log + annot_log + annot_log2 + annot_log3

```

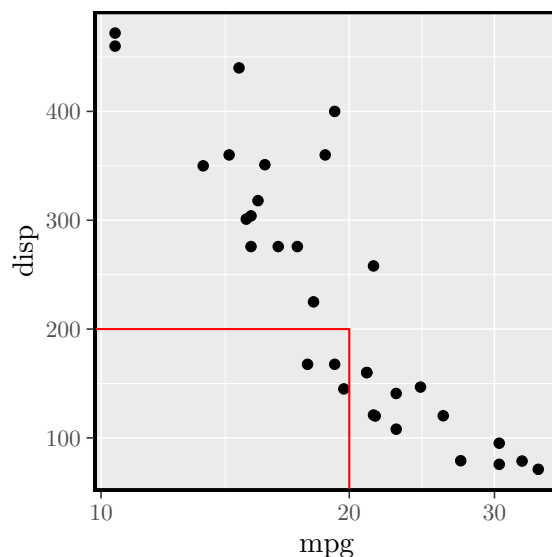




## 5 Using *Inf* and *-Inf* in annotations

In `ggplot2`, `-Inf` and `Inf` can be used to refer to the edge of a panel. This is also possible in `ggtikzAnnotations`, by setting `replace_inf = TRUE`. `-Inf` and `Inf` will then be automatically replaced to refer to the left/bottom or right/top edge of a panel, respectively.

```
p_log_border <- p_log + theme(panel.border = element_rect(fill=NA, size = 2))
canvas_log_border <- ggtikzCanvas(p_log_border)
annot_inf <- ggtikzAnnotation(
  "\\draw[red, thick] (-Inf,200) -| (20,-Inf);
  \\draw[green, thick] (-Inf,200) |- (20,-Inf);
  ", xy = "data", replace_inf = TRUE, panelx = 1, panely = 1
)
p_log_border
canvas_log_border + annot_inf
```

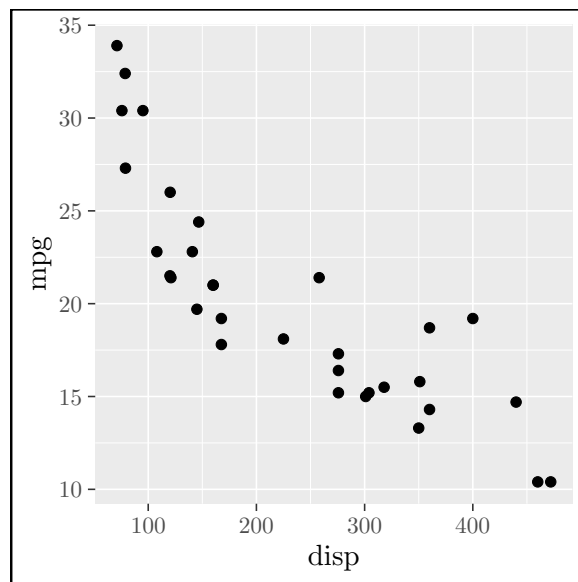


## 6 Using styles defined in the surrounding document

Annotations can access styles which are defined in the containing document before the relevant `.tikz` file is included, allowing you to re-use global styles. Note that by default, `knitr` sets the option `external` to `TRUE`. Therefore, `tikz` graphics are pre-compiled to pdf. In that case, the `tikzDevice` needs to know about these styles, or an error will occur during externalization.

```
\tikzset{loud/.style={
  draw=yellow,
  fill=red,
  text=blue
}}
```

p



```
canvas <- ggtikzCanvas(p)
styled_annot <- ggtikzAnnotation(
  "\\node[loud] at (0.5,0.5) {Look at me!};",
  xy = "plot"
)
p
canvas + styled_annot
```

