

Marijuana Survey Analysis  
Version 1  
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June 20, 2023

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# Chapter 1

## Preliminaries (R)

```
> library(xlsx)
> library(ggplot2)
> library(lawstat) ## has function brunner.munzel.test()
> library(dplyr)
> library(stringr)
> library(janitor) ## Had function tabyl()
> library(tidyr)
> library(RColorBrewer)
```

```
> ### Set the location "homedir" on the local machine
> (homedir <- getwd() )
```

```
[1] "C:/Users/shaknapp/OneDrive - Indiana University/ProjectsIUmisc/IlonzeOnyedika/MarijuanaSurvey"
```

```
> RPTNAME <- "MarijuanaSurveyRptV02"
>
> DATADIR <- paste0(homedir, "/Data/")
>
> OUTDIR <- "C:/Users/shaknapp/Indiana University/0365-BreathettStats - IlonzeOnyedika - IlonzeOnyedika/"
```

### Prep File for Output to Excel

```
> (timestamp = format(Sys.time(), "%Y-%m-%d %H:%M %Z"))

[1] "2023-06-20 07:50 PDT"

> write.xlsx(timestamp, file = paste0(OUTDIR, RPTNAME, "output.xlsx"), sheetName="DateTime",
+           append=FALSE, col.names=FALSE, row.names = FALSE, showNA=FALSE)
```

## Chapter 2

# Notes on Methods

Note: this section is static; that is, it is not automatically updated with changes to the data/methods. This is current as of 12 June 2023.

Notes on data cleaning/processing.

- Version of data used was from 6 June 2023 (see Section 3.1)
- For analysis, I divided the sample into those who answered that Cannabis is “Illegal in my state” (Illegal) and those that answered “Legal for medical and recreational use in my state” or “Legal for medical use in my state” (Legal). Those that did not answer this question were *excluded* from the analysis (See Section 3.2). This got the final sample down to 141 observations.
- One observation was removed because this person answered *none* of the survey questions (See Section 3.2). Note that this person would have been excluded anyway because they did not answer the Legal/Illegal question.
- For Q12, there were options for “Other” and “Neither agree nor disagree”. In order to make this a proper ordinal variable, I lumped those two responses (in a Table, you might want to label this level “Other / Neither agree nor disagree”, for the sake of transparency).
- For Q9, the first observation had the response = “2” which did not match any other options. This observation was changed to missing (NA)
- When I was looking over the Excel file with data, I noticed both *your* email address as well as Dr. Breathett’s email address. I don’t know if it is ethical to be counted as a subject (observation) in a survey/analysis for which you are an author. That strikes me as, at least, ethically questionable. However, I have not (at this point in time) removed those observations from the analysis. **As of 12 June 2023, I have excluded the observation with email address oilonze@iuhealth.org, this makes the final sample size 140 observations.**

Notes on analysis.

- For *ordinal*<sup>1</sup> variables, the Brunner-Munzel test (also known as the Generalized Wilcoxon test) was used to test for a difference in responses between groups (Legal/Illegal) in a way that accounts for the natural ordering of variables. See Section 8.2.1 for citations for this method. Please arrange a meeting with me (SMK) to discuss interpretation of these results.
- For *nominal* variables, Fisher’s exact test was used to test for a difference in responses between groups.

---

<sup>1</sup>An ordinal variable is one where there is a natural ordering to the factor levels, for example: (“Strongly disagree”, “Somewhat disagree”, “Neither agree nor disagree”, “Somewhat agree”, “Strongly agree”). This is in contrast to a *nominal* categorical variable, where there is no natural/inherent ordering of the levels, for example: (Cardiologist, Other, Pharmacist, Surgeon, Transplant Coordinator) or (Male, Female)

- The counts of those that did *not* answer a question were not included in the analyses (this should be made clear in the methods - especially if those that did not respond are shown in the Table); however, in the summary statistics (Section 4), those not answering are given (and counted in the percent over the whole group) - *if you want me to re-do the summary statistics to NOT count those that did not answer a question in the total percentage, please let me know.*
- I did not do any adjustments for multiple comparisons.

Please contact me if there is anything else you need for me to explain/clarify/etc.

# Chapter 3

## Data

### 3.1 Read-in Data File

The data file was sent to me via email on Tuesday, June 6, 2023 1:06 PM (PDT) by Onyedika Ilonze (oilonze@iu.edu)

This data file has 2 rows of headers and, thus, needs some cleaning and care to import.

Note: The original filename was: “Assessment of Heart Failure Patients who use Cannabis for Heart Transplant\_May 23, 2022\_11.14” but I was not able to read this is (I suspect due to the period in the file name) so I had to save the file under a new name (I made no changes to this file except for changing the name).

As of 20 June 2023 I’m not getting the error with the original file name (No idea what happened over the span of a few days...????)

```
> filename.original <- "Assessment of Heart Failure Patients who use Cannabis for Heart Transplant_June 6, 2023_14.04"
> file.mtime(paste0(DATADIR,filename.original,".xlsx"))
```

```
[1] "2023-06-20 06:11:57 PDT"
```

```
> dat.xls0.original <- read.xlsx(file=paste0(DATADIR,filename.original,".xlsx"), sheetName = "Sheet0")
```

```
> filename <- "DataRaw20230606"
> file.mtime(paste0(DATADIR,filename,".xlsx"))
```

```
[1] "2023-06-06 13:24:19 PDT"
```

Showing the file as read in raw

```
> dat.xls0 <- read.xlsx(file=paste0(DATADIR,filename,".xlsx"), sheetName = "Sheet0")
> dim(dat.xls0)
```

```
[1] 144 40
```

```
> names(dat.xls0)
```

```

[1] "StartDate"      "EndDate"      "Status"      "IPAddress"
[5] "Progress"      "Duration..in.seconds." "Finished"    "RecordedDate"
[9] "ResponseId"    "RecipientLastName" "RecipientFirstName" "RecipientEmail"
[13] "ExternalReference" "LocationLatitude" "LocationLongitude" "DistributionChannel"
[17] "UserLanguage"  "Q_RecaptchaScore" "Q1"          "Q1_5_TEXT"
[21] "Q2"            "Q3"            "Q3_5_TEXT"   "Q4"
[25] "Q5"            "Q6"            "Q7"          "Q8"
[29] "Q9"            "Q10"           "Q11"         "Q12"
[33] "Q12_6_TEXT"    "Q13"           "Q13_3_TEXT"  "Q14"
[37] "Q14_3_TEXT"    "Q15"           "Q15_4_TEXT"  "Q16"

```

```
> dat.xls0[1:5,1:10]
```

```

      StartDate      EndDate      Status      IPAddress Progress Duration..in.seconds. Finished
1      Start Date      End Date Response Type IP Address Progress Duration (in seconds) Finished
2 44551.5700925926 44551.575787037 IP Address 71.245.164.18 100 491 True
3 44551.7670138889 44551.7703819444 IP Address 208.38.250.141 100 291 True
4 44554.7140740741 44554.7165393519 IP Address 68.226.55.33 100 213 True
5 44567.5576157407 44567.5601851852 Survey Preview 100 221 True
      RecordedDate      ResponseId      RecipientLastName
1      Recorded Date      Response ID Recipient Last Name
2 44551.5757962037 R_1hZka1HboBmL2cR
3 44551.7704011806 R_10qt6gBY43UkTaB
4 44554.7165574306 R_3fGD0bjp9HaHqJz
5 44567.5601982176 R_erJboAGxIRXuUZH

```

```

> AnalysisVarCols <- c(12,19,21,22,24:32,34,36,38,40)
>
> dat0 <- read.xlsx(file=paste0(DATADIR,"DataRaw20230606.xlsx"), sheetIndex = 1,
+                   rowIndex=c(1,3:145),colIndex=AnalysisVarCols, stringsAsFactors=TRUE)

```

Note: in Q9 there was one response that was a “2” - I had Dr. Ilonze check this. He re-downloaded from Qualtrics and it was still there. I also asked about Q9 if there were only 3 choices (“Somewhat agree”, “Neither agree nor disagree”, and “Somewhat disagree”) or if “Strongly agree” and “Strongly disagree” were also choices and it was just the case that no one selected those. His response: “For question 9 I believe there were only three choices” (Tuesday, June 6, 2023 1:06 PM PDT).

```
> summary(dat0)
```

```

      RecipientEmail
      :119
abradford@iuhealth.org : 1
adrake6@iuhealth.org : 1
Albert.hicks3@gmail.com : 1
bforee@iuhealth.org : 1
bobhooker@email.arizona.edu: 1
(Other) : 19

Q1
: 1
Cardiologist - Heart Transplant or General Cardiology who takes care of HF and/or transplant patients:59
Other :27
Pharmacist :13
Surgeon :10
Transplant Coordinator :33

Q2 Q3
: 2 : 1
Illegal in my state :55 Do not ask, do not tell policy: 2
Legal for medical and recreational use in my state:29 History alone : 7
Legal for medical use in my state :57 History and toxicology :132

```

|                               |  |                               |  |                                         |  |
|-------------------------------|--|-------------------------------|--|-----------------------------------------|--|
|                               |  | Other                         |  | : 1                                     |  |
| Q4                            |  | Q5                            |  | Q6                                      |  |
| : 1                           |  | : 1                           |  | : 3                                     |  |
| Neither agree nor disagree:28 |  | Neither agree nor disagree:17 |  | Any frequency of use is acceptable :17  |  |
| Somewhat agree :42            |  | Somewhat agree :26            |  | Any frequency of use is unacceptable:66 |  |
| Somewhat disagree :21         |  | Somewhat disagree :43         |  | Daily :22                               |  |
| Strongly agree :40            |  | Strongly agree :13            |  | Multiple times per day :28              |  |
| Strongly disagree :11         |  | Strongly disagree :43         |  | Weekly : 7                              |  |
| Q8                            |  | Q9                            |  | Q10                                     |  |
| : 2                           |  | : 1                           |  | : 3                                     |  |
| Neither agree nor disagree:29 |  | 2                             |  | Definitely not :13                      |  |
| Somewhat agree :57            |  | Neither agree nor disagree:57 |  | Maybe:28                                |  |
| Somewhat disagree : 4         |  | Somewhat agree :21            |  | Definitely yes :41                      |  |
| Strongly agree :48            |  | Somewhat disagree :63         |  | No :80                                  |  |
| Strongly disagree : 3         |  |                               |  | Might or might not:25                   |  |
|                               |  |                               |  | Yes :32                                 |  |
|                               |  |                               |  | Probably not :15                        |  |
|                               |  |                               |  | Probably yes :46                        |  |
| Q12                           |  | Q13                           |  | Q14                                     |  |
| : 2                           |  | : 3                           |  | : 4                                     |  |
| Disagree :28                  |  | No : 32                       |  | No :78                                  |  |
| Neither agree nor disagree:18 |  | Other: 6                      |  | Other: 3                                |  |
| Other : 4                     |  | Yes :102                      |  | Yes :58                                 |  |
| Somewhat agree :37            |  |                               |  | 12 months                               |  |
| Strongly agree :45            |  |                               |  | 6 months                                |  |
| Strongly disagree : 9         |  |                               |  | Other                                   |  |
|                               |  |                               |  | : 12                                    |  |
|                               |  |                               |  | We transplant them anyway: 17           |  |
|                               |  |                               |  | Q15                                     |  |
|                               |  |                               |  | : 6                                     |  |
|                               |  |                               |  | Q16                                     |  |
|                               |  |                               |  | : 3                                     |  |
|                               |  |                               |  | Female                                  |  |
|                               |  |                               |  | :86                                     |  |
|                               |  |                               |  | Male                                    |  |
|                               |  |                               |  | :48                                     |  |
|                               |  |                               |  | Prefer not to say: 6                    |  |

The “2” in Q9 will have to be excluded as bad data.

There is also an “Other” option for Q12 that I will need to roll into the “Neither agree nor disagree” option to keep this as an Ordinal variable.

## 3.2 Clean Data

Need to convert most variables into *ordered* factors (with the proper ordering of levels) and also do the following.

- For Q1 shorten the response starting with “Cardiologist” to just be “Cardiologist”
- For Q9 want the “2” to just be missing (NA)
- For Q12 lump the response “Other” into “Neither agree nor disagree”. Treat “Disagree” as same in ordering as “Somewhat disagree” (which was not an option in this question)
- For Q16 I want to make “Prefer not to Say” just NA (Missing), otherwise it affects the Fisher’s Exact Test (new as of 20 June 2023)

```
> Order1 <- c("Strongly disagree","Somewhat disagree","Neither agree nor disagree","Somewhat agree","Strongly agree")
> Order2 <- c("Strongly disagree","Disagree","Neither agree nor disagree","Somewhat agree","Strongly agree")
>
> dat1 <- dat0 %>%
+   ### Count how many questions were blank
+   mutate(NumBlank = rowSums(."==" | is.na(.))) %>%
+   mutate(Q1 = ifelse(Q1=="",NA,
+     ifelse(str_starts(Q1,"Cardio"),"Cardiologist",as.character(Q1))),
+     Q3 = factor(ifelse(Q3=="",NA,as.character(Q3))),
+     Q4 = factor(Q4, levels=Order1, ordered=TRUE),
+     Q5 = factor(Q5, levels=Order1, ordered=TRUE),
+     Q6 = factor(Q6,levels=c("Any frequency of use is unacceptable","Weekly","Daily","Multiple times per day",
+       "Any frequency of use is acceptable"),ordered=TRUE),
+     Q7 = factor(ifelse(Q7=="",NA,as.character(Q7))),
+     Q8 = factor(Q8,levels=Order1,ordered=TRUE),
+     Q9.original = Q9,
+     Q9 = factor(Q9, levels=c("Somewhat disagree","Neither agree nor disagree","Somewhat agree"), ordered=TRUE),
+     Q10 = factor(Q10, levels=c("Definitely not","Probably not","Might or might not","Probably yes","Definitely yes"), ordered=TRUE),
+     Q11 = factor(Q11, levels=c("No","Maybe","Yes"), ordered = TRUE),
+     Q12.original = Q12,
+     Q12 = factor(ifelse(Q12=="Other","Neither agree nor disagree", as.character(Q12)), levels=Order2,ordered=TRUE),
+     Q13 = factor(ifelse(Q13=="",NA,as.character(Q13))),
+     Q14 = factor(ifelse(Q14=="",NA,as.character(Q14))),
+     Q15 = factor(ifelse(Q15=="",NA,as.character(Q15))),
+     Q16.original = Q16,
+     Q16 = factor(ifelse(Q16==" " | Q16=="Prefer not to say",NA,as.character(Q16))),
+   ) %>%
+   mutate(Legal = ifelse(Q2=="",NA,ifelse(str_starts(Q2,"Illegal"),"Illegal","Legal"))) %>%
+   mutate(one=1)
```

Breakdown of number of subjects that left 1, 2, 3, ... questions blank (note Q12 and Q12.fixed can be double counted)

```
> dat1 %>% tabyl(NumBlank)

NumBlank  n    percent
0      24 0.167832168
1     110 0.769230769
2       3 0.020979021
4       2 0.013986014
5       2 0.013986014
6       1 0.006993007
17      1 0.006993007
```

Check observation with NumBlank  $\geq 5$

```
> dat1 %>% filter(NumBlank >=5)
```

|   | RecipientEmail | Q1                         | Q2                                | Q3                                   | Q4             | Q5      | Q6   | Q7    | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | NumBlank |
|---|----------------|----------------------------|-----------------------------------|--------------------------------------|----------------|---------|------|-------|----|----|-----|-----|-----|-----|-----|-----|-----|----------|
| 1 |                | Pharmacist                 | Illegal in my state               | History and toxicology               |                |         |      |       |    |    |     |     |     |     |     |     |     | 6        |
| 2 |                | <NA>                       |                                   |                                      |                |         |      |       |    |    |     |     |     |     |     |     |     | 17       |
| 3 |                | Other                      | Legal for medical use in my state | History and toxicology               |                |         |      |       |    |    |     |     |     |     |     |     |     | 5        |
| 4 |                | Transplant Coordinator     | Illegal in my state               | History and toxicology               |                |         |      |       |    |    |     |     |     |     |     |     |     | 5        |
| 1 |                | Somewhat agree             | Strongly disagree                 | Any frequency of use is unacceptable | No             |         |      |       |    |    |     |     |     |     |     |     |     | 6        |
| 2 |                | <NA>                       | <NA>                              |                                      |                |         |      |       |    |    |     |     |     |     |     |     |     | 17       |
| 3 |                | Neither agree nor disagree | Somewhat disagree                 |                                      |                |         |      |       |    |    |     |     |     |     |     |     |     | 5        |
| 4 |                | Strongly agree             | Somewhat disagree                 |                                      |                |         |      |       |    |    |     |     |     |     |     |     |     | 5        |
| 1 |                | Somewhat agree             |                                   |                                      |                |         |      |       |    |    |     |     |     |     |     |     |     | 6        |
| 2 |                | <NA>                       | <NA>                              |                                      |                |         |      |       |    |    |     |     |     |     |     |     |     | 17       |
| 3 |                | Somewhat disagree          | Might or might not                | Maybe                                | Somewhat agree | Yes     | Yes  | Other |    |    |     |     |     |     |     |     |     | 5        |
| 4 |                | Neither agree nor disagree | Probably yes                      | No                                   | Strongly agree | <NA>    | <NA> | <NA>  |    |    |     |     |     |     |     |     |     | 5        |
| 1 |                | Q9.original                | Q12.original                      | Q16.original                         | Legal          | one     |      |       |    |    |     |     |     |     |     |     |     | 1        |
| 2 |                | Somewhat agree             |                                   |                                      | Illegal        |         |      |       |    |    |     |     |     |     |     |     |     | 1        |
| 3 |                | Somewhat disagree          | Somewhat agree                    |                                      | Legal          |         |      |       |    |    |     |     |     |     |     |     |     | 1        |
| 4 |                | Neither agree nor disagree | Strongly agree                    |                                      | Female         | Illegal |      |       |    |    |     |     |     |     |     |     |     | 1        |

I want to remove the person with ALL blank/missing responses

How many people didn't answer the Legal/Illegal Question?

```
> dat1 %>% count(Q2)
```

| Q2 | n  |
|----|----|
| 1  | 2  |
| 2  | 55 |
| 3  | 29 |
| 4  | 57 |

```
> dat1 %>% count(Legal)
```

| Legal | n  |
|-------|----|
| 1     | 55 |
| 2     | 86 |
| 3     | 2  |

FINALIZE data

- Remove observation with basically all responses missing
- Remove observations for which the question of legality was missing
- Removed observation with recipient email = "oilonze@iuhealth.org"

```
> dat <- dat1 %>%
+   filter(NumBlank < 17) %>%
+   filter(!is.na(Legal)) %>%
+   filter(RecipientEmail != "oilonze@iuhealth.org") %>%
+   select(-RecipientEmail)
>
> nrow(dat)
```



### 3.3 Variable Key

```
> VarKey <- data.frame(t(dat.xls0[1,AnalysisVarCols ]), stringsAsFactors = FALSE)
```

```
> for(i in 1:nrow(VarKey)){  
+   cat("\n",rownames(VarKey)[i],"\n")  
+   cat(writeLines(strwrap(VarKey[[i]], width = 120)))  
+ }
```

RecipientEmail  
Recipient Email

Q1  
I am a \_\_\_\_\_ - Selected Choice

Q2  
Cannabis is \_\_\_\_\_

Q3  
In your opinion, what is the best way of assessing potential heart transplant recipients for cannabis use? - Selected Choice

Q4  
Patients who use legal medical cannabis should be listed for transplant

Q5  
Patients who use legal recreational cannabis should be listed for heart transplant?

Q6  
What frequency of cannabis use should preclude a patient from heart transplant listing?

Q7  
Are you aware of any cannabis-use screening questionnaire to screen for cannabis use disorder?

Q8  
A validated cannabis use disorder screening questionnaire will help in the evaluation for cannabis using HF patients for heart transplant?

Q9  
Heart failure patients who use cannabis (alone) are non-compliant with medications?

Q10  
Do you feel comfortable accepting an excellent heart organ donor if the only contraindication is cannabis use for a potential heart transplant recipient?

Q11  
Does your program allow pre-transplant or post-transplant patients to use physician prescribed cannabis products?

Q12  
Heart failure patients using physician prescribed narcotics and physician prescribed cannabis-based products should be treated similarly (per local institution protocol) for heart transplant listing? - Selected Choice

Q13  
Does your heart transplant center's current selection criteria policy address recreational cannabis use in potential transplant candidates? - Selected Choice

Q14  
Does your heart transplant center's current selection criteria policy address medicinal cannabis use in potential transplant candidates? - Selected Choice

Q15  
If your program considers cannabis using HF patients for transplant, patients will be considered for transplant after being cannabis-free for? - Selected Choice

Q16  
I am

## Chapter 4

# Summary Statistics

Function to get Counts and Percentages by Group for Categorical Variable

```
> SumStatsCatFUNC <- function(GRPVAR,VARLIST,DAT){
+   for(v in 1:length(VARLIST)){
+     tempvar = VARLIST[v]
+     smry.temp <-
+       DAT %>% tabyl(!!as.name(tempvar),!!as.name(GRPVAR)) %>%
+       adorn_totals("col") %>%
+       adorn_percentages("col") %>% adorn_pct_formatting(digits=1) %>%adorn_ns(position = "front") %>%
+       mutate(Variable = tempvar , Level=as.character(!!as.name(tempvar))) %>%
+       select(-!!as.name(tempvar))
+
+     if(v == 1){
+       my.summary <- smry.temp
+     } else{
+       my.summary <- bind_rows(my.summary, smry.temp )
+     }
+   }### end of for-loop (v)
+
+   my.summary <- my.summary %>% relocate(Variable, Level)
+
+   return(my.summary)
+ } ### end of function: SumStatsCatFUNC
```

```
> SumStatsByLegal <-
+   SumStatsCatFUNC(GRPVAR = "Legal",
+                   VARLIST = c("one",intersect(names(dat0),names(dat)),"Q9.original","Q12.original","Q16.original"),
+                   DAT=dat)
```

Output to Excel

```
> write.xlsx(as.data.frame(SumStatsByLegal),file = paste0(OUTDIR,RPTNAME,"output.xlsx"),
+           sheetName="SumStatsByLegal",
+           append=TRUE, col.names=TRUE, row.names = FALSE, showNA=FALSE)
```

```
> SumStatsByLegal %>% print(.,row.names=FALSE)
```

| Variable | Level                                              | Illegal     | Legal       | Total        |
|----------|----------------------------------------------------|-------------|-------------|--------------|
| one      | 1                                                  | 54 (100.0%) | 86 (100.0%) | 140 (100.0%) |
| Q1       | Cardiologist                                       | 20 (37.0%)  | 38 (44.2%)  | 58 (41.4%)   |
| Q1       | Other                                              | 15 (27.8%)  | 11 (12.8%)  | 26 (18.6%)   |
| Q1       | Pharmacist                                         | 4 (7.4%)    | 9 (10.5%)   | 13 (9.3%)    |
| Q1       | Surgeon                                            | 3 (5.6%)    | 7 (8.1%)    | 10 (7.1%)    |
| Q1       | Transplant Coordinator                             | 12 (22.2%)  | 21 (24.4%)  | 33 (23.6%)   |
| Q2       |                                                    | 0 (0.0%)    | 0 (0.0%)    | 0 (0.0%)     |
| Q2       | Illegal in my state                                | 54 (100.0%) | 0 (0.0%)    | 54 (38.6%)   |
| Q2       | Legal for medical and recreational use in my state | 0 (0.0%)    | 29 (33.7%)  | 29 (20.7%)   |
| Q2       | Legal for medical use in my state                  | 0 (0.0%)    | 57 (66.3%)  | 57 (40.7%)   |
| Q3       | Do not ask, do not tell policy                     | 0 (0.0%)    | 2 (2.3%)    | 2 (1.4%)     |
| Q3       | History alone                                      | 1 (1.9%)    | 6 (7.0%)    | 7 (5.0%)     |
| Q3       | History and toxicology                             | 52 (96.3%)  | 78 (90.7%)  | 130 (92.9%)  |
| Q3       | Other                                              | 1 (1.9%)    | 0 (0.0%)    | 1 (0.7%)     |
| Q4       | Strongly disagree                                  | 4 (7.4%)    | 7 (8.1%)    | 11 (7.9%)    |
| Q4       | Somewhat disagree                                  | 9 (16.7%)   | 12 (14.0%)  | 21 (15.0%)   |
| Q4       | Neither agree nor disagree                         | 11 (20.4%)  | 15 (17.4%)  | 26 (18.6%)   |
| Q4       | Somewhat agree                                     | 17 (31.5%)  | 25 (29.1%)  | 42 (30.0%)   |
| Q4       | Strongly agree                                     | 13 (24.1%)  | 27 (31.4%)  | 40 (28.6%)   |
| Q5       | Strongly disagree                                  | 16 (29.6%)  | 26 (30.2%)  | 42 (30.0%)   |
| Q5       | Somewhat disagree                                  | 19 (35.2%)  | 23 (26.7%)  | 42 (30.0%)   |
| Q5       | Neither agree nor disagree                         | 6 (11.1%)   | 11 (12.8%)  | 17 (12.1%)   |
| Q5       | Somewhat agree                                     | 10 (18.5%)  | 16 (18.6%)  | 26 (18.6%)   |
| Q5       | Strongly agree                                     | 3 (5.6%)    | 10 (11.6%)  | 13 (9.3%)    |
| Q6       | Any frequency of use is unacceptable               | 31 (57.4%)  | 34 (39.5%)  | 65 (46.4%)   |
| Q6       | Weekly                                             | 4 (7.4%)    | 3 (3.5%)    | 7 (5.0%)     |
| Q6       | Daily                                              | 6 (11.1%)   | 16 (18.6%)  | 22 (15.7%)   |
| Q6       | Multiple times per day                             | 6 (11.1%)   | 21 (24.4%)  | 27 (19.3%)   |
| Q6       | Any frequency of use is acceptable                 | 6 (11.1%)   | 11 (12.8%)  | 17 (12.1%)   |
| Q6       | <NA>                                               | 1 (1.9%)    | 1 (1.2%)    | 2 (1.4%)     |
| Q7       | No                                                 | 50 (92.6%)  | 74 (86.0%)  | 124 (88.6%)  |
| Q7       | Yes                                                | 4 (7.4%)    | 11 (12.8%)  | 15 (10.7%)   |
| Q7       | <NA>                                               | 0 (0.0%)    | 1 (1.2%)    | 1 (0.7%)     |
| Q8       | Strongly disagree                                  | 2 (3.7%)    | 0 (0.0%)    | 2 (1.4%)     |
| Q8       | Somewhat disagree                                  | 4 (7.4%)    | 0 (0.0%)    | 4 (2.9%)     |
| Q8       | Neither agree nor disagree                         | 15 (27.8%)  | 14 (16.3%)  | 29 (20.7%)   |
| Q8       | Somewhat agree                                     | 18 (33.3%)  | 38 (44.2%)  | 56 (40.0%)   |
| Q8       | Strongly agree                                     | 15 (27.8%)  | 33 (38.4%)  | 48 (34.3%)   |
| Q8       | <NA>                                               | 0 (0.0%)    | 1 (1.2%)    | 1 (0.7%)     |
| Q9       | Somewhat disagree                                  | 21 (38.9%)  | 42 (48.8%)  | 63 (45.0%)   |
| Q9       | Neither agree nor disagree                         | 23 (42.6%)  | 32 (37.2%)  | 55 (39.3%)   |
| Q9       | Somewhat agree                                     | 10 (18.5%)  | 11 (12.8%)  | 21 (15.0%)   |
| Q9       | <NA>                                               | 0 (0.0%)    | 1 (1.2%)    | 1 (0.7%)     |
| Q10      | Definitely not                                     | 5 (9.3%)    | 7 (8.1%)    | 12 (8.6%)    |
| Q10      | Probably not                                       | 7 (13.0%)   | 8 (9.3%)    | 15 (10.7%)   |
| Q10      | Might or might not                                 | 6 (11.1%)   | 19 (22.1%)  | 25 (17.9%)   |
| Q10      | Probably yes                                       | 19 (35.2%)  | 26 (30.2%)  | 45 (32.1%)   |
| Q10      | Definitely yes                                     | 16 (29.6%)  | 25 (29.1%)  | 41 (29.3%)   |
| Q10      | <NA>                                               | 1 (1.9%)    | 1 (1.2%)    | 2 (1.4%)     |
| Q11      | No                                                 | 43 (79.6%)  | 36 (41.9%)  | 79 (56.4%)   |
| Q11      | Maybe                                              | 3 (5.6%)    | 25 (29.1%)  | 28 (20.0%)   |
| Q11      | Yes                                                | 7 (13.0%)   | 25 (29.1%)  | 32 (22.9%)   |
| Q11      | <NA>                                               | 1 (1.9%)    | 0 (0.0%)    | 1 (0.7%)     |
| Q12      | Strongly disagree                                  | 4 (7.4%)    | 4 (4.7%)    | 8 (5.7%)     |
| Q12      | Disagree                                           | 12 (22.2%)  | 16 (18.6%)  | 28 (20.0%)   |
| Q12      | Neither agree nor disagree                         | 10 (18.5%)  | 12 (14.0%)  | 22 (15.7%)   |
| Q12      | Somewhat agree                                     | 15 (27.8%)  | 21 (24.4%)  | 36 (25.7%)   |
| Q12      | Strongly agree                                     | 12 (22.2%)  | 33 (38.4%)  | 45 (32.1%)   |
| Q12      | <NA>                                               | 1 (1.9%)    | 0 (0.0%)    | 1 (0.7%)     |
| Q13      | No                                                 | 14 (25.9%)  | 18 (20.9%)  | 32 (22.9%)   |
| Q13      | Other                                              | 2 (3.7%)    | 4 (4.7%)    | 6 (4.3%)     |
| Q13      | Yes                                                | 36 (66.7%)  | 64 (74.4%)  | 100 (71.4%)  |
| Q13      | <NA>                                               | 2 (3.7%)    | 0 (0.0%)    | 2 (1.4%)     |
| Q14      | No                                                 | 40 (74.1%)  | 37 (43.0%)  | 77 (55.0%)   |

|              |                            |            |            |            |
|--------------|----------------------------|------------|------------|------------|
| Q14          | Other                      | 1 (1.9%)   | 2 (2.3%)   | 3 (2.1%)   |
| Q14          | Yes                        | 11 (20.4%) | 47 (54.7%) | 58 (41.4%) |
| Q14          | <NA>                       | 2 (3.7%)   | 0 (0.0%)   | 2 (1.4%)   |
| Q15          | 12 months                  | 5 (9.3%)   | 3 (3.5%)   | 8 (5.7%)   |
| Q15          | 6 months                   | 42 (77.8%) | 56 (65.1%) | 98 (70.0%) |
| Q15          | Other                      | 2 (3.7%)   | 10 (11.6%) | 12 (8.6%)  |
| Q15          | We transplant them anyway  | 1 (1.9%)   | 16 (18.6%) | 17 (12.1%) |
| Q15          | <NA>                       | 4 (7.4%)   | 1 (1.2%)   | 5 (3.6%)   |
| Q16          | Female                     | 37 (68.5%) | 48 (55.8%) | 85 (60.7%) |
| Q16          | Male                       | 15 (27.8%) | 32 (37.2%) | 47 (33.6%) |
| Q16          | <NA>                       | 2 (3.7%)   | 6 (7.0%)   | 8 (5.7%)   |
| Q9.original  |                            | 0 (0.0%)   | 0 (0.0%)   | 0 (0.0%)   |
| Q9.original  |                            | 2 0 (0.0%) | 1 (1.2%)   | 1 (0.7%)   |
| Q9.original  | Neither agree nor disagree | 23 (42.6%) | 32 (37.2%) | 55 (39.3%) |
| Q9.original  | Somewhat agree             | 10 (18.5%) | 11 (12.8%) | 21 (15.0%) |
| Q9.original  | Somewhat disagree          | 21 (38.9%) | 42 (48.8%) | 63 (45.0%) |
| Q12.original |                            | 1 (1.9%)   | 0 (0.0%)   | 1 (0.7%)   |
| Q12.original | Disagree                   | 12 (22.2%) | 16 (18.6%) | 28 (20.0%) |
| Q12.original | Neither agree nor disagree | 7 (13.0%)  | 11 (12.8%) | 18 (12.9%) |
| Q12.original | Other                      | 3 (5.6%)   | 1 (1.2%)   | 4 (2.9%)   |
| Q12.original | Somewhat agree             | 15 (27.8%) | 21 (24.4%) | 36 (25.7%) |
| Q12.original | Strongly agree             | 12 (22.2%) | 33 (38.4%) | 45 (32.1%) |
| Q12.original | Strongly disagree          | 4 (7.4%)   | 4 (4.7%)   | 8 (5.7%)   |
| Q16.original |                            | 1 (1.9%)   | 1 (1.2%)   | 2 (1.4%)   |
| Q16.original | Female                     | 37 (68.5%) | 48 (55.8%) | 85 (60.7%) |
| Q16.original | Male                       | 15 (27.8%) | 32 (37.2%) | 47 (33.6%) |
| Q16.original | Prefer not to say          | 1 (1.9%)   | 5 (5.8%)   | 6 (4.3%)   |

## Chapter 5

# Analysis

### 5.1 Ordinal Variables (Brunner-Munzel Tests)

Brunner-Munzel Test is also known as the Generalized Wilcoxon test.

```
> BMtest.FUNC <- function(VARLIST){
+   returndf <- data.frame(Variable=VARLIST)
+   ### Loop through the variables
+   for(var in 1:nrow(returndf)){
+
+     Legal <- subset(dat, Legal=="Legal")
+     Illegal <- subset(dat, Legal=="Illegal")
+
+     bmtest <- brunner.munzel.test(x=Legal[[returndf$Variable[var]]],
+                                  y=Illegal[[returndf$Variable[var]]],
+                                  alternative="two.sided")
+
+     returndf$RelativeEffect[var] <- bmtest$estimate
+     returndf$pval[var] <- round(bmtest$p.value,4)
+     returndf$n.Legal[var] <- sum(!is.na(Legal[[returndf$Variable[var]]]))
+     returndf$n.Illegal[var] <- sum(!is.na(Illegal[[returndf$Variable[var]]]))
+     returndf$ScaleSmallest[var] <- as.character(min(dat[[returndf$Variable[var]]], na.rm=TRUE))
+     returndf$ScaleBiggest[var] <- as.character(max(dat[[returndf$Variable[var]]], na.rm=TRUE))
+     returndf$BiggerValues[var] <- ifelse(bmtest$estimate > 0.5, "Illegal", "Legal")
+     returndf$LegalIsMore[var] <- ifelse(bmtest$estimate < 0.5, as.character(max(dat[[returndf$Variable[var]]], na.rm=TRUE)),
+                                          as.character(min(dat[[returndf$Variable[var]]], na.rm=TRUE)))
+   }### end of for-loop over variables (var)
+   return(returndf)
+ }### End of Function: BMtest.FUNC
>
> BMtests <- BMtest.FUNC(VARLIST=c("Q4", "Q5", "Q6", "Q8", "Q9", "Q10", "Q11", "Q12"))
```

Output to Excel

```
> write.xlsx(BMtests, file = paste0(OUTDIR, RPTNAME, "output.xlsx"),
+   sheetName="BMtests", append=TRUE, col.names=TRUE, row.names = FALSE, showNA=FALSE)
```

```
> print(BMtests)
```

|   | Variable | RelativeEffect | pval   | n.Legal | n.Illegal | ScaleSmallest                        | ScaleBiggest                       | BiggerValues | LegalIsMore                        |
|---|----------|----------------|--------|---------|-----------|--------------------------------------|------------------------------------|--------------|------------------------------------|
| 1 | Q4       | 0.4641473      | 0.4601 | 86      | 54        | Strongly disagree                    | Strongly agree                     | Legal        | Strongly agree                     |
| 2 | Q5       | 0.4673773      | 0.4970 | 86      | 54        | Strongly disagree                    | Strongly agree                     | Legal        | Strongly agree                     |
| 3 | Q6       | 0.3988901      | 0.0330 | 85      | 53        | Any frequency of use is unacceptable | Any frequency of use is acceptable | Legal        | Any frequency of use is acceptable |
| 4 | Q8       | 0.3761438      | 0.0111 | 85      | 54        | Strongly disagree                    | Strongly agree                     | Legal        | Strongly agree                     |
| 5 | Q9       | 0.5599129      | 0.1979 | 85      | 54        | Somewhat disagree                    | Somewhat agree                     | Illegal      | Somewhat disagree                  |
| 6 | Q10      | 0.5093230      | 0.8510 | 85      | 53        | Definitely not                       | Definitely yes                     | Illegal      | Definitely not                     |
| 7 | Q11      | 0.3146117      | 0.0000 | 86      | 53        | No                                   | Yes                                | Legal        | Yes                                |
| 8 | Q12      | 0.4132295      | 0.0723 | 86      | 53        | Strongly disagree                    | Strongly agree                     | Legal        | Strongly agree                     |

## 5.2 Nominal Variables (Fisher's Exact Tests)

```
> FishTest.Func <- function(VARLIST){
+   returndf <- data.frame(Variable=VARLIST)
+   ### Loop through the variables
+   for(var in 1:nrow(returndf)){
+
+     returndf$pval[var] <-
+       round(
+         fisher.test(x=dat[[returndf$Variable[var]]],
+                     y=dat$Legal)$p.value
+         ,4)
+
+   }### End of for-loop over variables (var)
+
+   return(returndf)
+
+ }### End of Function: FishTest.FUNC
>
> FisherTests <- FishTest.Func(VARLIST=c("Q1", "Q3", "Q7", "Q13", "Q14", "Q15", "Q16"))

> print(FisherTests)
```

|   | Variable | pval   |
|---|----------|--------|
| 1 | Q1       | 0.2957 |
| 2 | Q3       | 0.2075 |
| 3 | Q7       | 0.4049 |
| 4 | Q13      | 0.7612 |
| 5 | Q14      | 0.0001 |
| 6 | Q15      | 0.0025 |
| 7 | Q16      | 0.2002 |

Output to Excel

```
> write.xlsx(FisherTests,file = paste0(OUTDIR,RPTNAME,"output.xlsx"),
+           sheetName="FisherTests",
+           append=TRUE, col.names=TRUE, row.names = FALSE, showNA=FALSE)
```

## Chapter 6

# Figures - old

Right now these are DRAFT versions of the Figures. If needed for publication, I can output the final version of the figure to a file (e.g., a JPEG (\*.jpg) or BITMAP, (\*.bmp)). Different publications have different requirements for figures, so please check figure requirements for wherever you plan to submit this to and let me know

Reformat data for these plots. Only Ordinal variables with the agree - disagree scale.

Note to make this all work in one figure I had to make all the levels of the variables consistent

- In Q4, Q5, Q8, there are 5 levels of response (“Strongly disagree”, “Somewhat disagree”, “Neither agree nor disagree”, “Somewhat agree”, “Strongly agree”), but in Q12 there is a level “Disagree” instead of “Somewhat disagree”. To make everything consistent, I changed the second level to “Disagree / Somewhat disagree” for all of these questions.
- Q9 only had 3 levels, but I altered it to have the same 5 levels as the others (but no one can respond to the “Strongly” agree/disagree options as these did not exist)

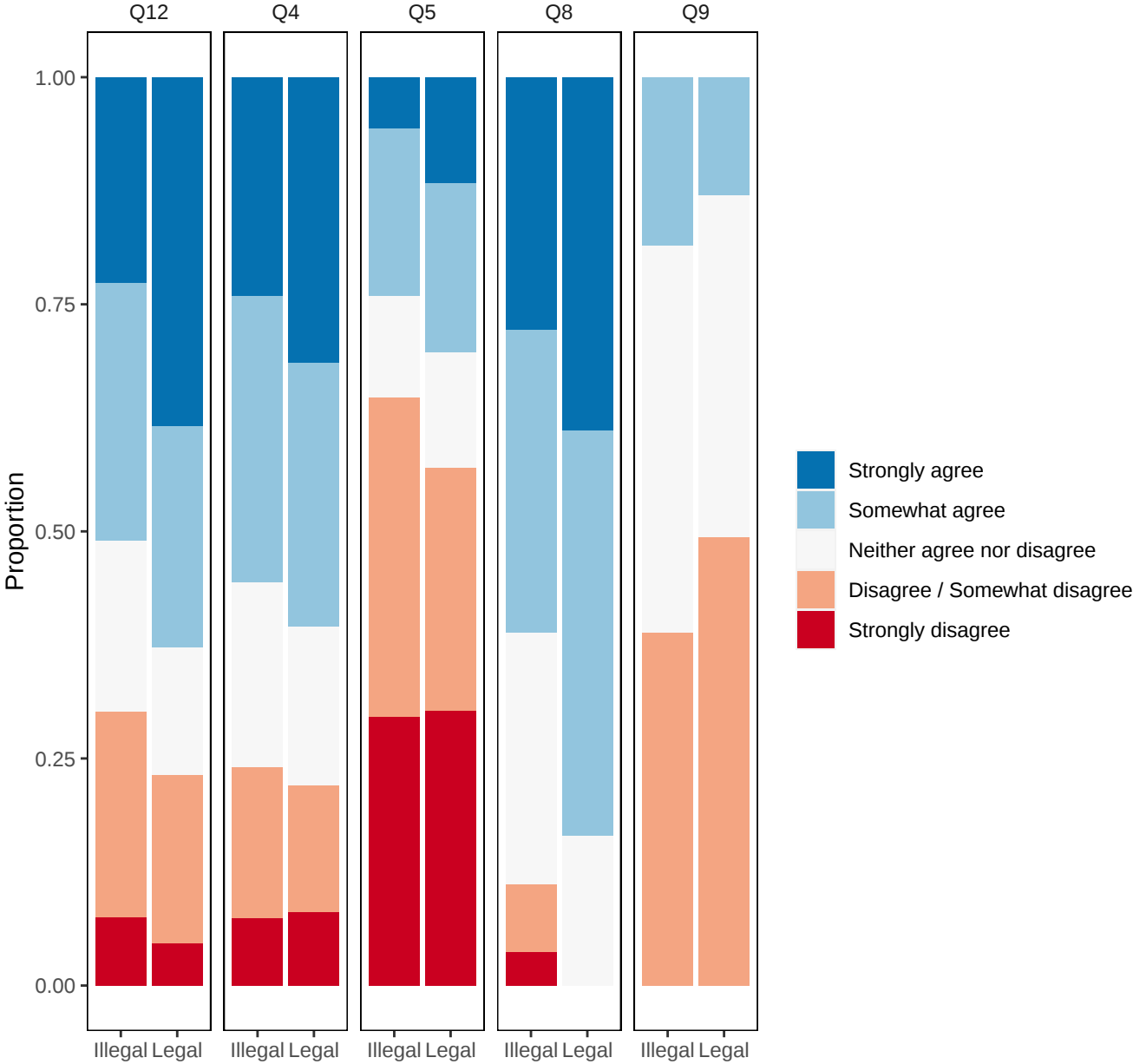
```
> Order1b <- c("Strongly disagree", "Disagree / Somewhat disagree", "Neither agree nor disagree", "Somewhat agree", "Strongly agree")
>
> dat.fig1 <- dat %>%
+   select(Legal, Q4, Q5, Q8, Q9, Q12) %>%
+
+   ### Need to make the levels of the responses consistent
+   mutate(
+     Q4 = factor(Q4, levels=Order1b, labels=Order1b, ordered=TRUE),
+     Q5 = factor(Q5, levels=Order1b, labels=Order1b, ordered=TRUE),
+     Q8 = factor(Q8, levels=Order1b, labels=Order1b, ordered=TRUE),
+     Q9 = factor(Q9, levels=Order1b, labels=Order1b, ordered=TRUE),
+     Q12 = factor(Q12, levels=Order2, labels=Order1b, ordered=TRUE)
+   ) %>%
+
+   pivot_longer(cols=c("Q4", "Q5", "Q8", "Q9", "Q12"),
+     names_to="Variable",
+     values_to="Response",
+     values_drop_na=TRUE) %>%
+
+   mutate(QuestionLabel = factor(Variable, levels=c("Q4", "Q5", "Q8", "Q9", "Q12"),
+     labels=c("Q4: List legal medical",
+       "Q5: List legal recreational",
+       "Q8: cannabis use disorder screening questionnaire",
+       "Q9: cannabis use = non-compliance",
+       "Q12: prescribed narcotics = prescribed cannabis"))) %>%
+   mutate(QuestionLabelLong = factor(Variable, levels=c("Q4", "Q5", "Q8", "Q9", "Q12"),
+     labels=c("Patients who use legal medical cannabis should be listed for transplant",
+       "Patients who use legal recreational cannabis should be listed for heart transplant",
```

+ "A validated cannabis use disorder screening questionnaire will help in the evaluation for  
+ "Heart failure patients who use cannabis (alone) are non-compliant with medications",  
+ "Heart failure patients using physician prescribed narcotics and physician prescribed canna

## Version 1

```
> dat.fig1 %>%
+   ggplot(aes(Legal)) +
+   geom_bar(aes(fill=Response),position = position_fill(reverse = TRUE))+
+
+   facet_wrap(~Variable, nrow=1)+
+
+   scale_fill_manual(values=brewer.pal(n=5, name="RdBu"), drop=FALSE, guide = guide_legend(reverse=TRUE))+
+   theme(panel.background=element_blank(),
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +
+   theme(strip.background = element_blank())+
+   #theme(legend.position = "bottom")+
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0))+
+   labs(x="",fill="",y="Proportion")+
+   ggtitle("Version 1")
```

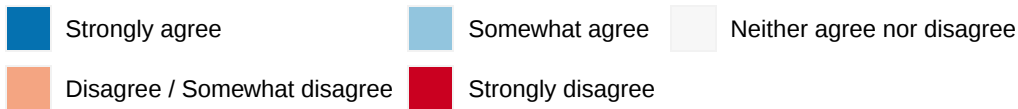
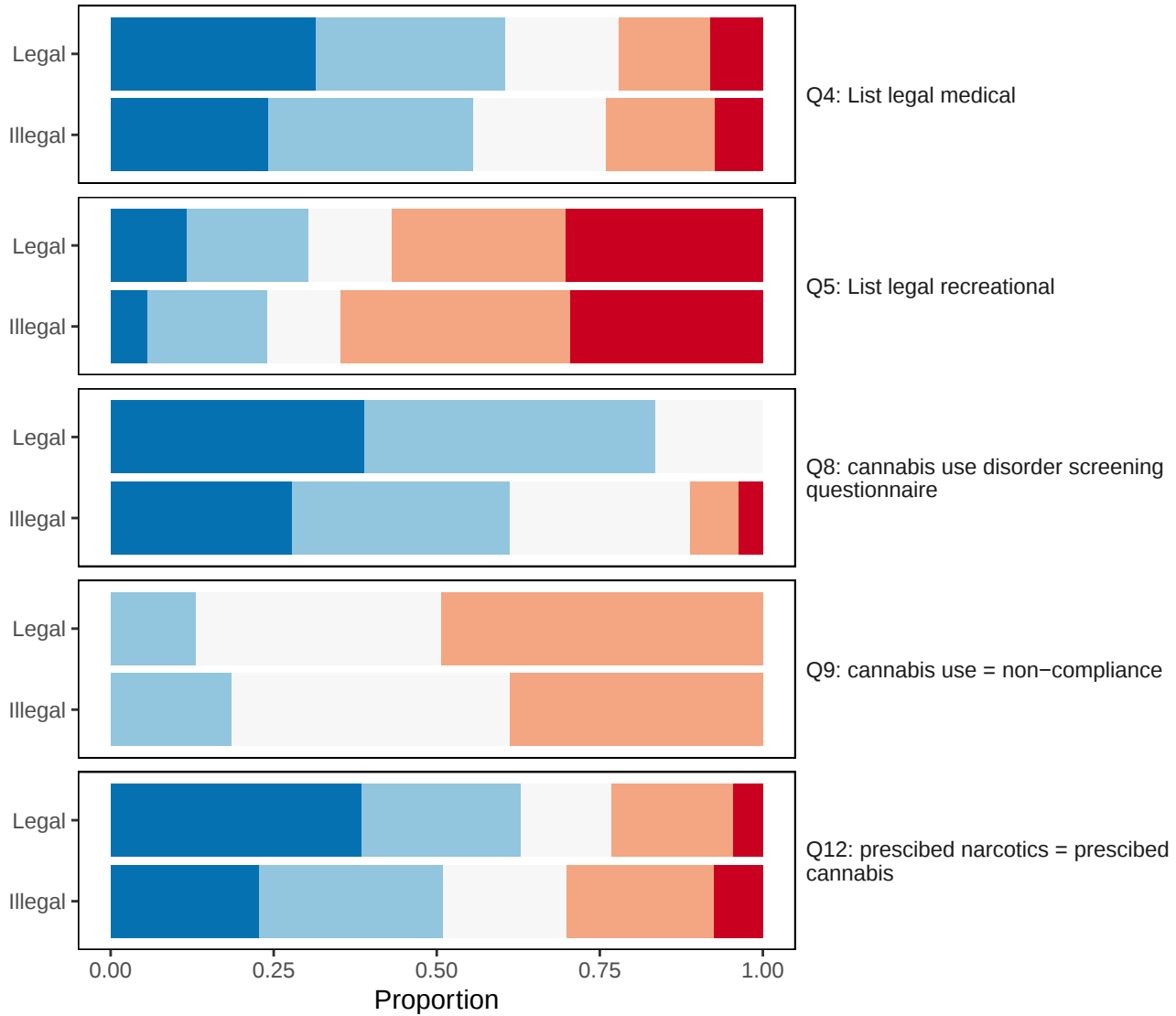
Version 1



## Version 2

```
> dat.fig1 %>%
+   ggplot(aes(Legal)) +
+   geom_bar(aes(fill=Response), position = position_fill(reverse = FALSE))+
+
+   facet_grid(QuestionLabel~., labeller = label_wrap_gen(width = 40, multi_line = TRUE))+
+   coord_flip()+
+
+   scale_fill_manual(values=brewer.pal(n=5, name="RdBu"), drop=FALSE, guide = guide_legend(reverse=TRUE,nrow=2,byrow=TRUE))+
+   theme(panel.background=element_blank(),
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +
+   theme(strip.background = element_blank())+
+   theme(legend.position = "bottom")+
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0))+
+   labs(x="",fill="",y="Proportion")+
+   ggtitle("Version 2")
```

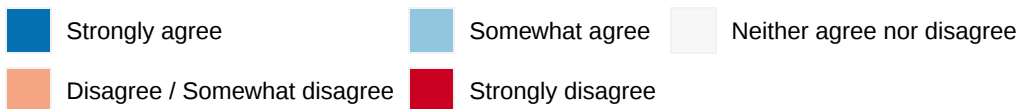
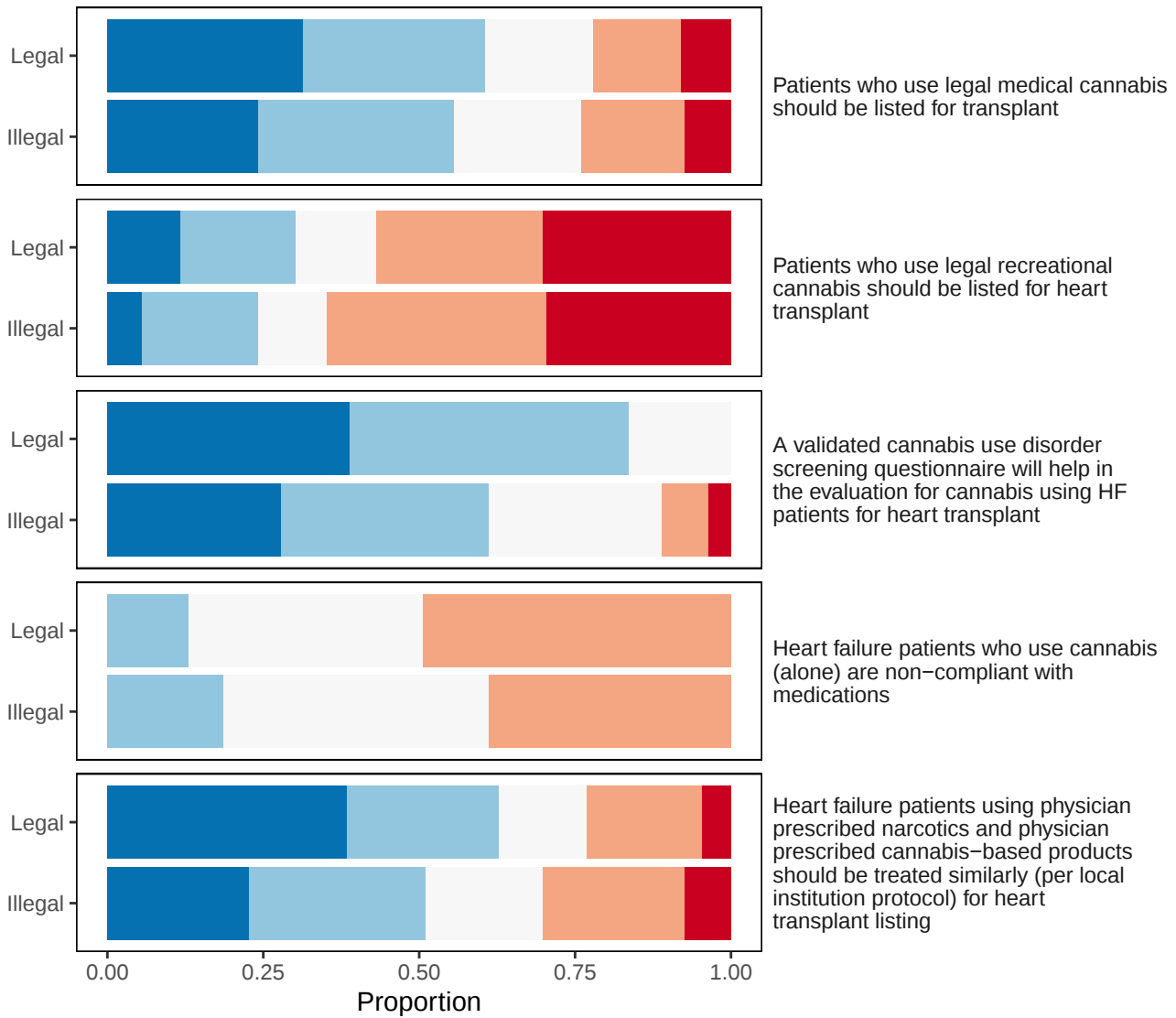
Version 2



## Version 3a

```
> dat.fig1 %>%
+   ggplot(aes(y=Legal)) +
+   geom_bar(aes(fill=Response),position = "fill")+
+
+   facet_grid(QuestionLabelLong~., labeller = label_wrap_gen(width = 40, multi_line = TRUE))+
+
+   scale_fill_manual(values=brewer.pal(n=5, name="RdBu"), drop=FALSE, guide = guide_legend(reverse=TRUE,nrow=2,byrow=TRUE))+
+   theme(panel.background=element_blank(),
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +
+   theme(strip.background = element_blank())+
+   theme(legend.position = "bottom")+
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0))+
+   labs(x="Proportion",fill="",y="")+
+   ggtitle("Version 3a")
```

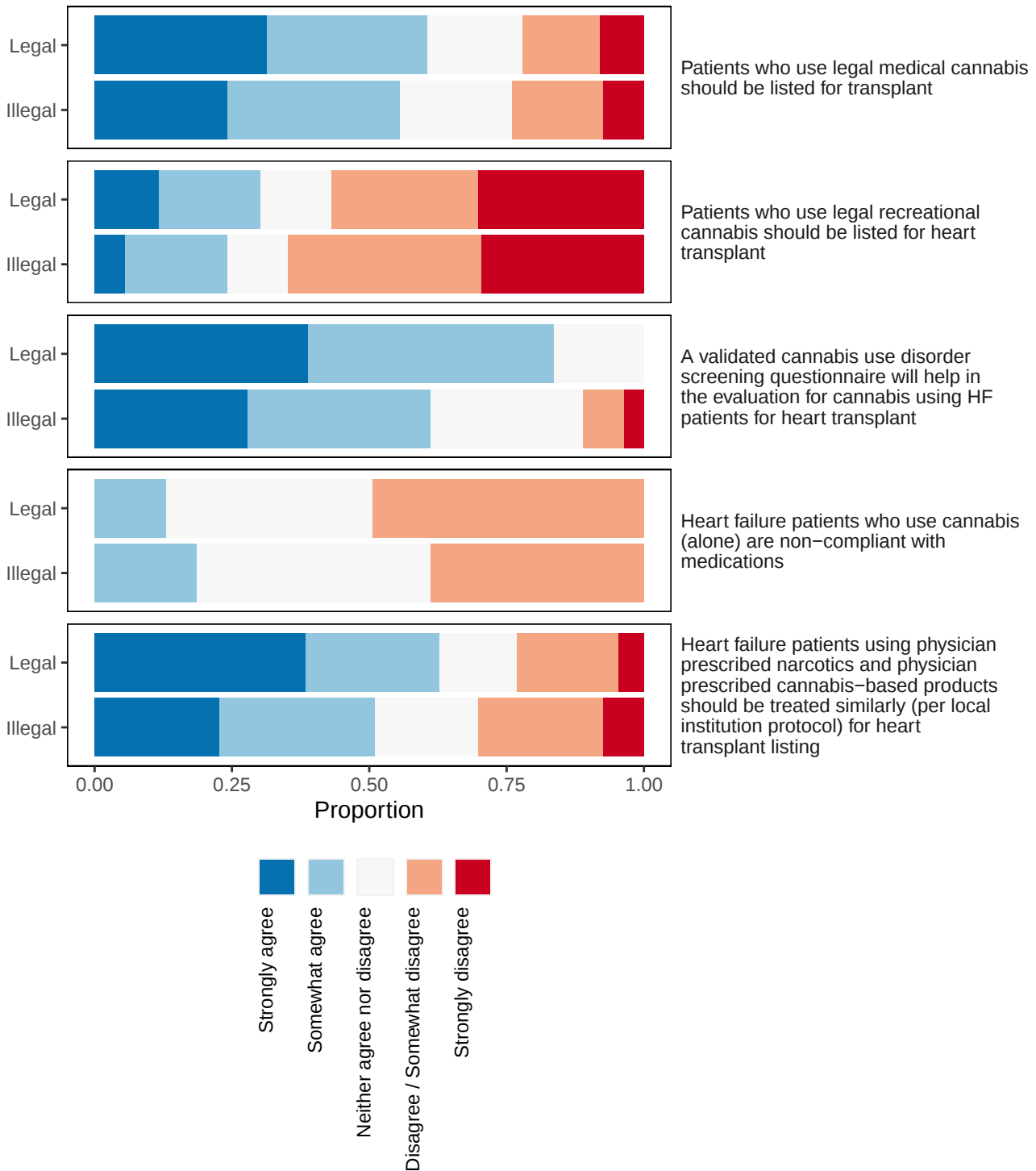
### Version 3a



## Version 3b

```
> dat.fig1 %>%
+   ggplot(aes(y=Legal)) +
+   geom_bar(aes(fill=Response),position = "fill")+
+
+   facet_grid(QuestionLabelLong~., labeller = label_wrap_gen(width = 40, multi_line = TRUE))+
+
+   scale_fill_manual(values=brewer.pal(n=5, name="RdBu"), drop=FALSE, guide = guide_legend(reverse=TRUE,label.position = "bottom"))+
+   theme(panel.background=element_blank(),
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +
+   theme(strip.background = element_blank())+
+   theme(legend.position = "bottom")+
+   theme(legend.direction="horizontal",legend.text=element_text(angle=90,hjust=1))+
+   #theme(legend.direction="horizontal",legend.text.align=0)+
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0))+
+   labs(x="Proportion",fill="",y="")+
+   ggtitle("Version 3b")
```

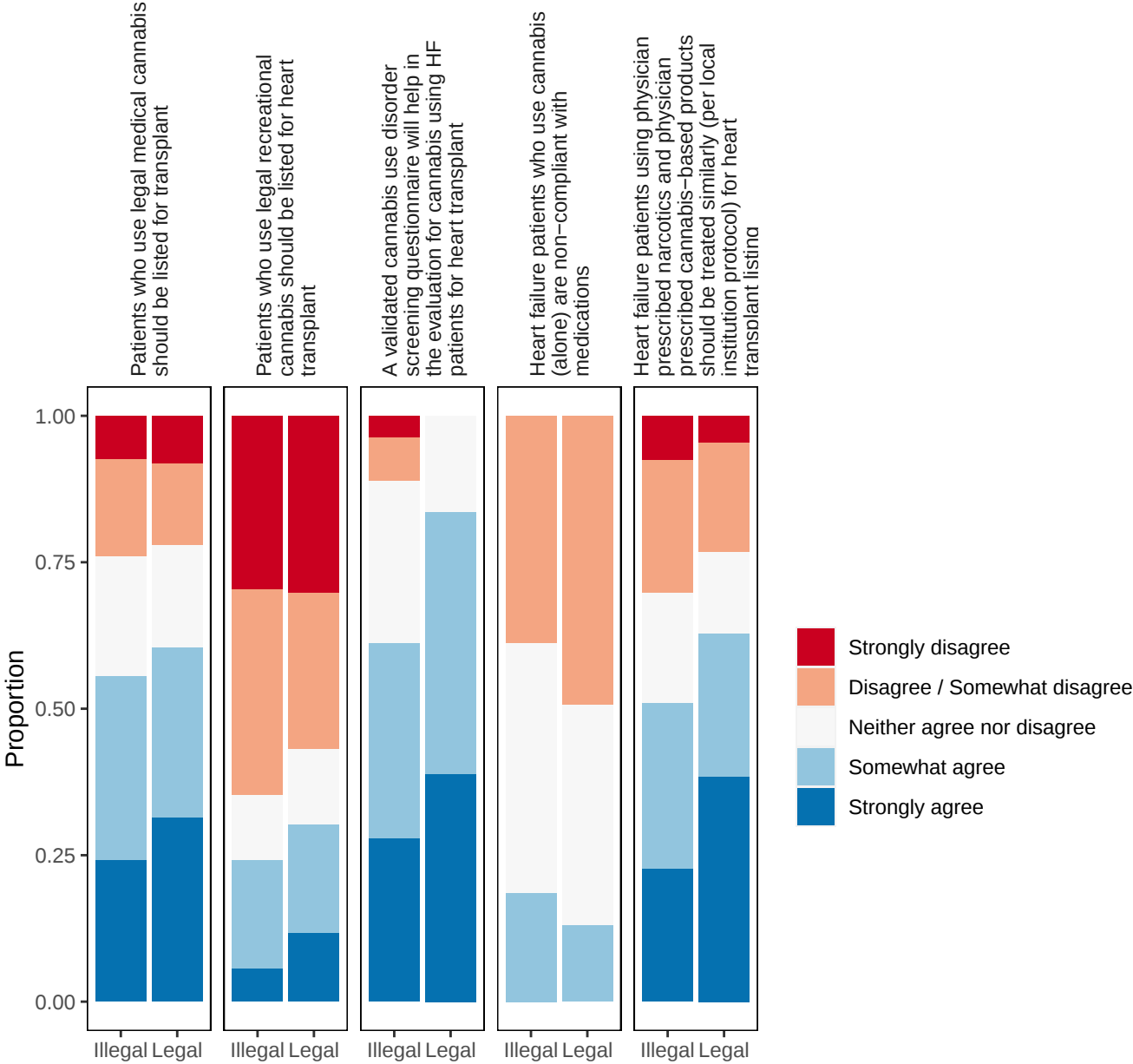
### Version 3b



## Version 4

```
> dat.fig1 %>%
+   ggplot(aes(x=Legal)) +
+   geom_bar(aes(fill=Response),position = "fill")+
+
+   facet_wrap(~QuestionLabelLong, nrow=1,labeller = label_wrap_gen(width = 40, multi_line = TRUE))+
+
+   scale_fill_manual(values=brewer.pal(n=5, name="RdBu"), drop=FALSE, guide = guide_legend(reverse=FALSE))+
+   theme(panel.background=element_blank(),
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +
+   theme(strip.background = element_blank())+
+   theme(legend.position = "right")+
+   theme(strip.text = element_text(angle = 90, hjust=0))+
+   labs(y="Proportion",fill="",x="")+
+   ggtitle("Version 4")
```

Version 4



## Chapter 7

# Figures - current

Right now these are DRAFT versions of the Figures. If needed for publication, I can output the final version of the figure to a file (e.g., a JPEG (\*.jpg) or BITMAP, (\*.bmp)). Different publications have different requirements for figures, so please check figure requirements for wherever you plan to submit this to and let me know

See notes about the plots at the top of each section. In the interest of minimizing the number of stand-alone plots, I had to make modifications. These modifications should be noted in the figure caption/footnote. To omit some of these details would be MISLEADING. For example, Q9 only had options for 3 levels: (“Somewhat disagree”, “Neither agree nor disagree”, “Somewhat agree”) but plotting this with Q4, Q5, Q8, and Q12 makes it look there were 5 options for response (i.e., that “Strongly agree” and “Strongly disagree” were options when they were not). Something similar was done with Q7 (only “Yes” and “No” were options, but to plot with the other Yes/No questions, it look slike “Other” and/or “Maybe” were options when they were not.)

### 7.1 A: 5-level Agree-to-Disagree Scale

Reformat data for these plots. Only Ordinal variables with the agree - disagree scale.

Note to make this all work in one figure I had to make all the levels of the variables consistent

- In Q4, Q5, Q8, there are 5 levels of response (“Strongly disagree”, “Somewhat disagree”, “Neither agree nor disagree”, “Somewhat agree”, “Strongly agree”), but in Q12 there is a level “Disagree” instead of “Somewhat disagree”. To make everything consistent, I changed the second level to “Disagree / Somewhat disagree” for all of these questions.
- Q9 only had 3 levels, but I altered it to have the same 5 levels as the others (but no one can respond to the “Strongly” agree/disagree options as these did not exist)

```
> OrderA <- c("Strongly disagree", "Disagree / Somewhat disagree", "Neither agree nor disagree", "Somewhat agree", "Strongly agree")
>
> dat.figA <- dat %>%
+   select(Legal, Q4, Q5, Q8, Q9, Q12) %>%
+
+   ### Need to make the levels of the responses consistent
+   mutate(
+     Q4 = factor(Q4, levels=Order1, labels=OrderA, ordered=TRUE),
+     Q5 = factor(Q5, levels=Order1, labels=OrderA, ordered=TRUE),
+     Q8 = factor(Q8, levels=Order1, labels=OrderA, ordered=TRUE),
+     Q9 = factor(Q9, levels=Order1, labels=OrderA, ordered=TRUE),
+     Q12 = factor(Q12, levels=Order2, labels=OrderA, ordered=TRUE)
```

```

+   ) %>%
+   pivot_longer(cols=c("Q4", "Q5", "Q8","Q9","Q12"),
+                 names_to="Variable",
+                 values_to="Response",
+                 values_drop_na=TRUE) %>%
+   mutate(Label = factor(Variable, levels=c("Q4","Q5","Q8","Q9","Q12"),
+                                     labels=c("A1","A2","A3","A4", "A5")))

```

```

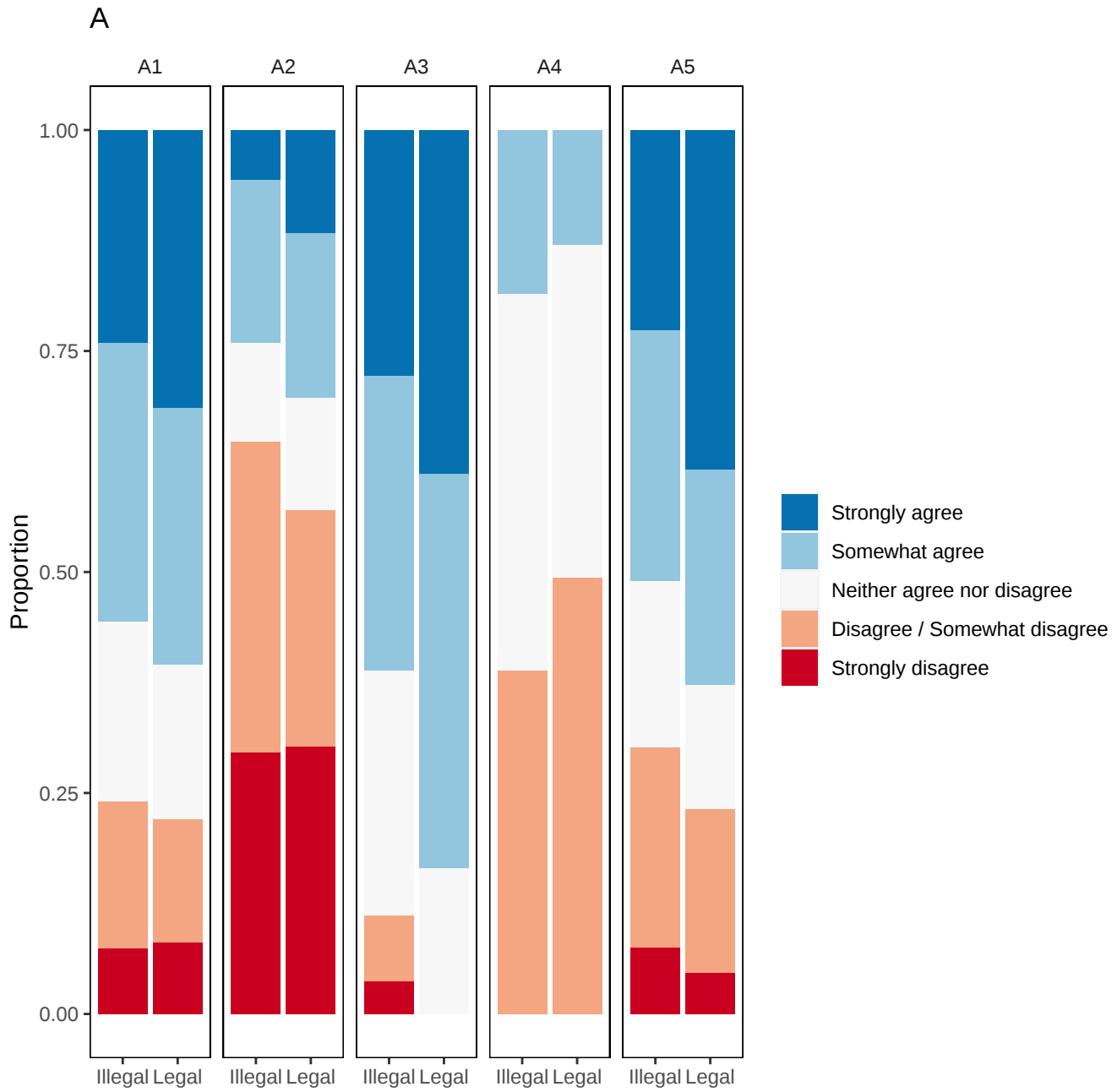
> ggA <-
+   dat.figA %>%
+   ggplot(aes(Legal)) +
+   geom_bar(aes(fill=Response),position = position_fill(reverse = TRUE))+
+
+   facet_wrap(~Label, nrow=1)+
+
+   scale_fill_manual(values=brewer.pal(n=5, name="RdBu"), drop=FALSE, guide = guide_legend(reverse=TRUE))+
+   theme(panel.background=element_blank(),
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +
+   theme(strip.background = element_blank())+
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0))+
+   labs(x="",fill="",y="Proportion")+
+   ggtitle("A")

```

```

> ggA

```



## 7.2 B: Yes/No (and Maybe/Other)

Note: to put all of these on the same plot, I needed to force consistent scales (that is, make all the questions have the same set of levels). Some had only Yes/No for options, some had Yes/No/Maybe, some had Yes/No/Other. So I forced all 3 to *artificially* have 3 levels: "Yes", "No", and "Maybe/Other".

```
> OrderB <- c("No", "Maybe/Other", "Yes")
>
> dat.figB <- dat %>%
+   select(Legal, Q7, Q11, Q8, Q13, Q14) %>%
+
+   ### Need to make the levels of the responses consistent
+   mutate(
+     Q7 = factor(Q7, levels=OrderB, labels=OrderB, ordered=TRUE),
+     Q11 = factor(Q11, levels=c("No", "Maybe", "Yes"), labels=OrderB, ordered=TRUE),
+     Q13 = factor(Q13, levels=c("No", "Other", "Yes"), labels=OrderB, ordered=TRUE),
+     Q14 = factor(Q14, levels=c("No", "Other", "Yes"), labels=OrderB, ordered=TRUE),
+   ) %>%
+
+   pivot_longer(cols=c("Q7", "Q11", "Q13", "Q14"),
+                 names_to="Variable",
+                 values_to="Response",
+                 values_drop_na=TRUE) %>%
+
+   mutate(Label = factor(Variable, levels=c("Q7", "Q11", "Q13", "Q14"),
+                         labels=c("B1", "B2", "B3", "B4")))
```

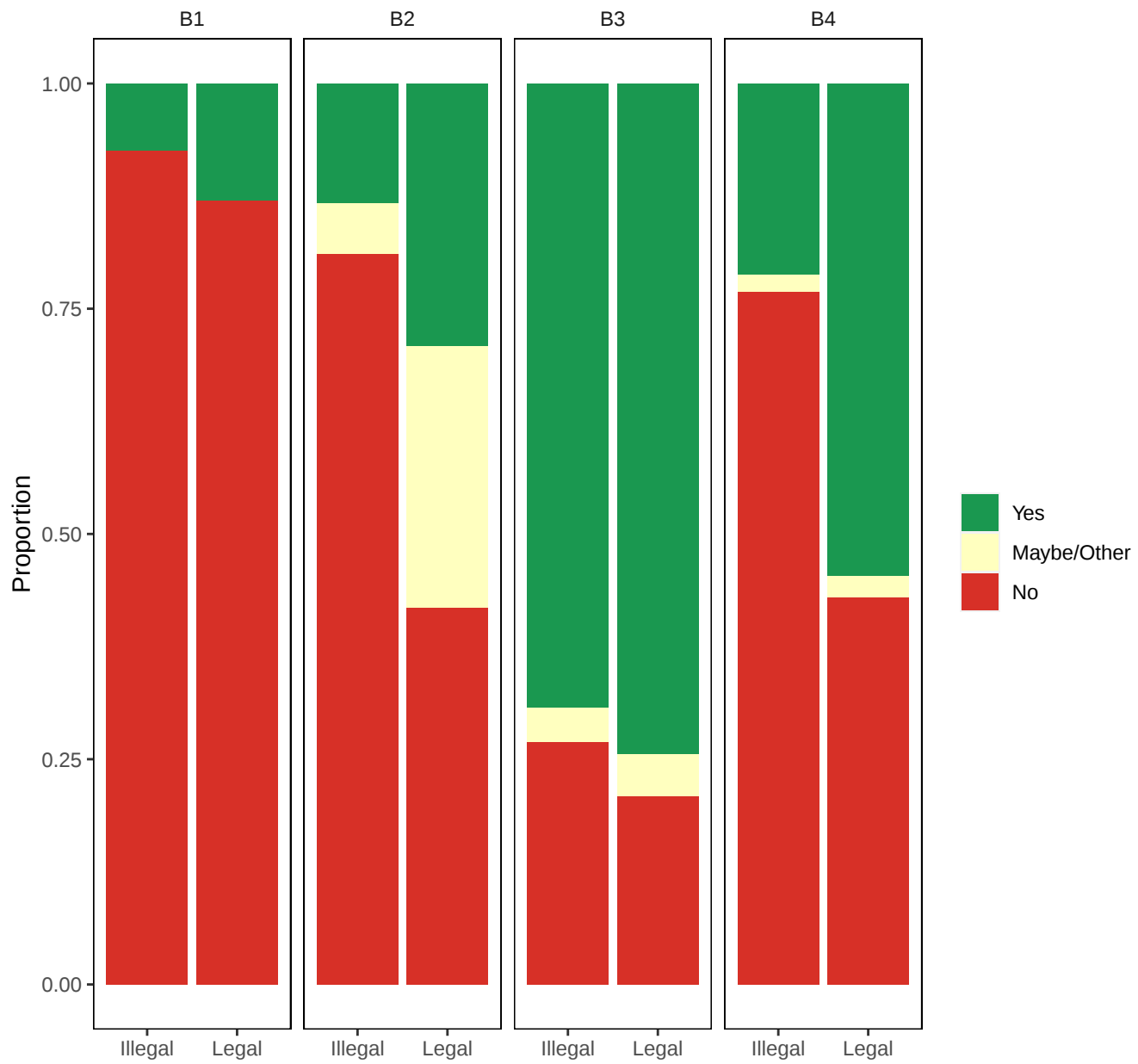
Extracting color scale

```
> #display.brewer.pal(5, "RdBu")
> #Colors.FigB <- brewer.pal(5, "RdBu")[c(1,3,5)]
>
> #display.brewer.pal(11, "RdBu")
> #Colors.FigB <- brewer.pal(11, "RdBu")[c(3,6,9)]
> Colors.FigB <- brewer.pal(11, "RdYlGn")[c(2,6,10)]
```

```
> ggB <-
+   dat.figB %>%
+   ggplot(aes(Legal)) +
+   geom_bar(aes(fill=Response), position = position_fill(reverse = TRUE)) +
+   facet_wrap(~Label, nrow=1) +
+   scale_fill_manual(values=Colors.FigB, drop=FALSE, guide = guide_legend(reverse=TRUE)) +
+   theme(panel.background=element_blank(),
+         panel.border = element_rect(fill=NA, color="black", linewidth=0.5, linetype="solid")) +
+   theme(strip.background = element_blank()) +
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0)) +
+   labs(x="", fill="", y="Proportion") +
+   ggtitle("B")
```

```
> ggB
```

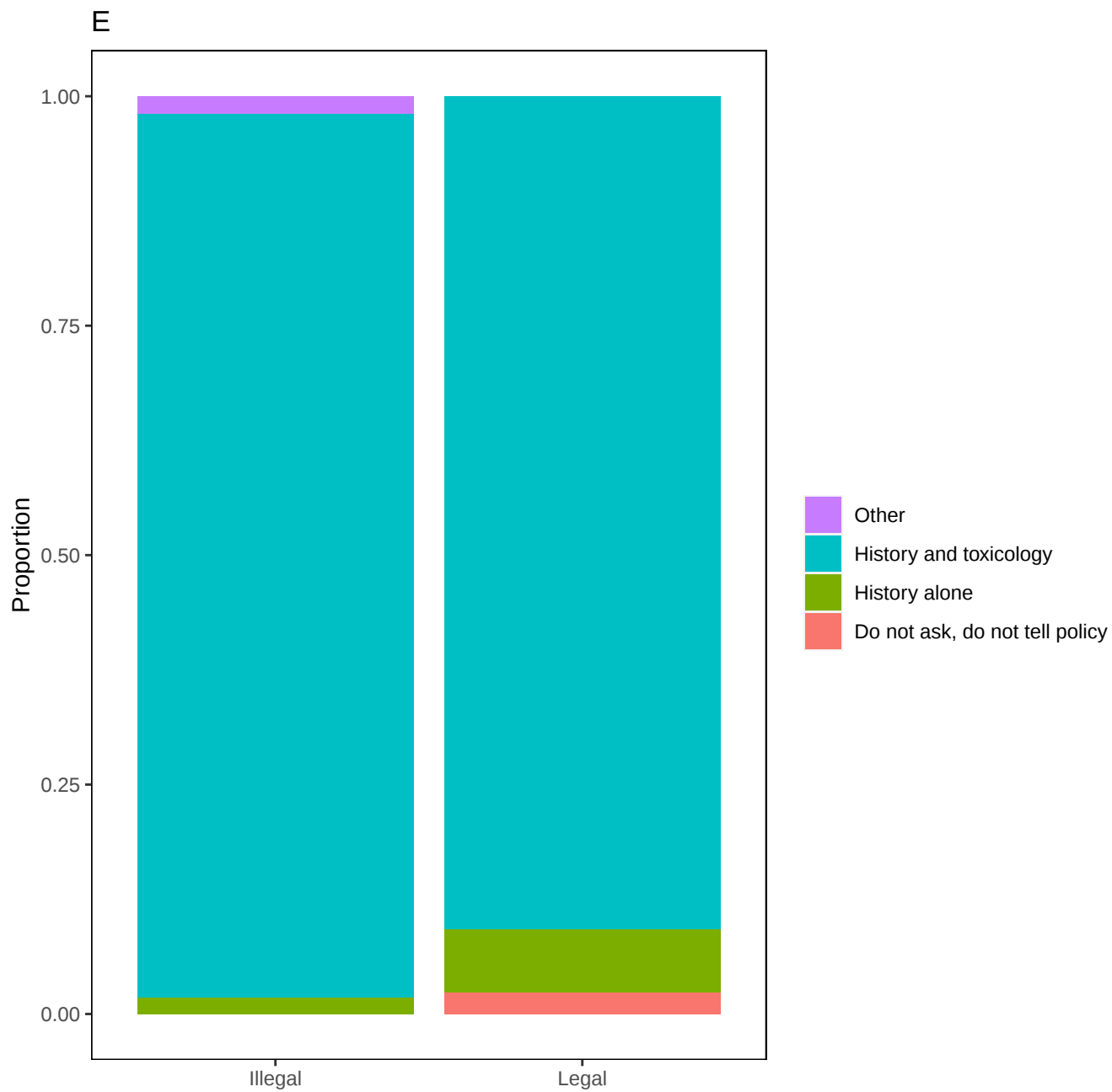
B



## 7.3 E (Q3-only)

```
> ggE <-  
+   dat %>%  
+     ggplot(aes(Legal))+  
+     geom_bar(aes(fill=Q3),position = position_fill(reverse = TRUE))+  
+     scale_fill_discrete(drop=FALSE, guide = guide_legend(reverse=TRUE))+  
+     theme(panel.background=element_blank(),  
+           panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +  
+     theme(strip.background = element_blank())+  
+     theme(strip.text.y.right = element_text(angle = 0, hjust=0))+  
+     labs(x="",fill="",y="Proportion")+  
+     ggtitle("E")
```

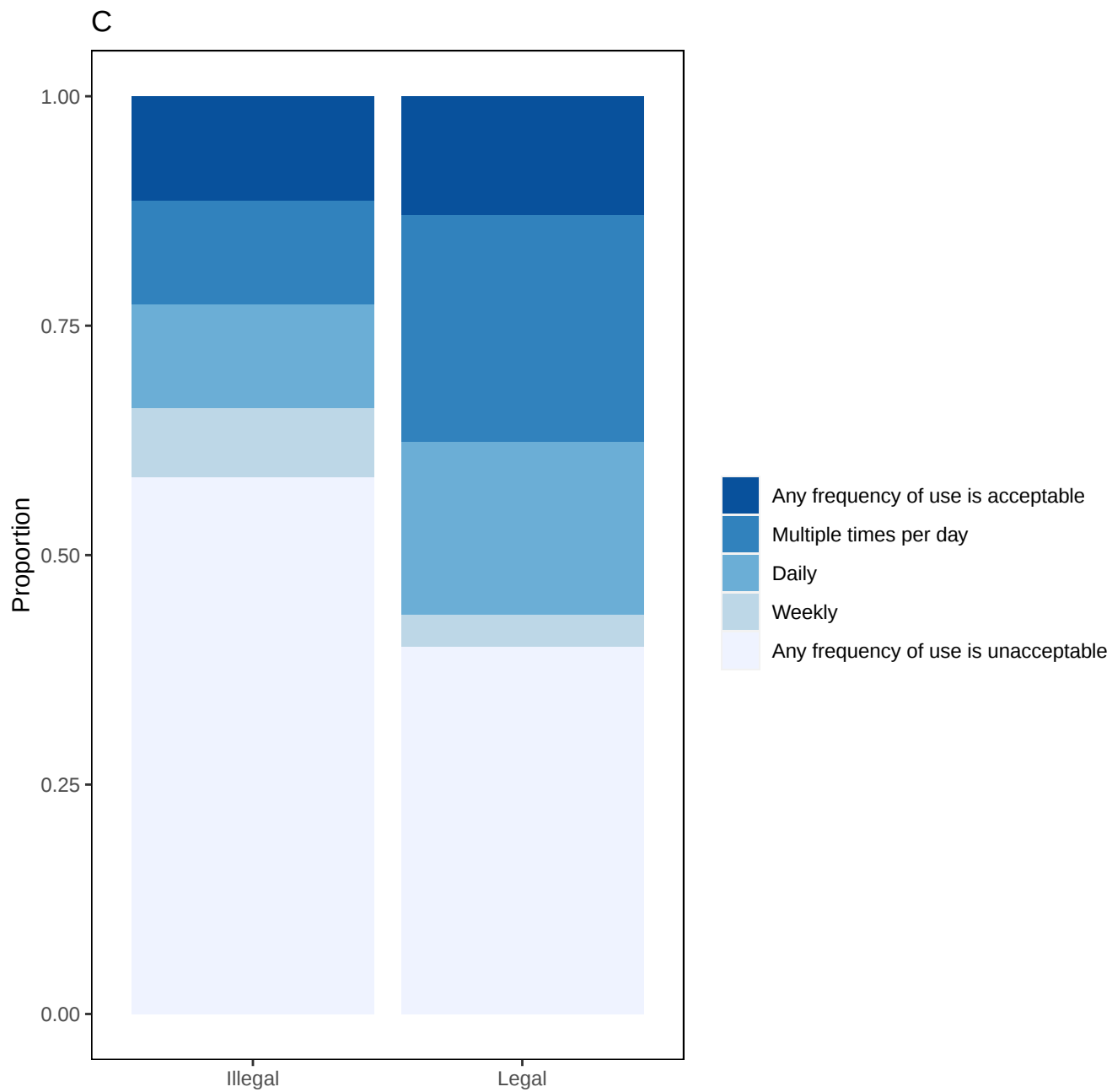
```
> ggE
```



## 7.4 C (Q6-only)

```
> ggC <-  
+   dat %>% filter(!is.na(Q6)) %>%  
+   ggplot(aes(Legal))+  
+   geom_bar(aes(fill=Q6), position = position_fill(reverse = TRUE))+  
+   scale_fill_brewer(drop=FALSE, guide = guide_legend(reverse=TRUE))+  
+   theme(panel.background=element_blank(),  
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +  
+   theme(strip.background = element_blank())+  
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0))+  
+   labs(x="", fill="", y="Proportion")+  
+   ggtitle("C")
```

```
> ggC
```

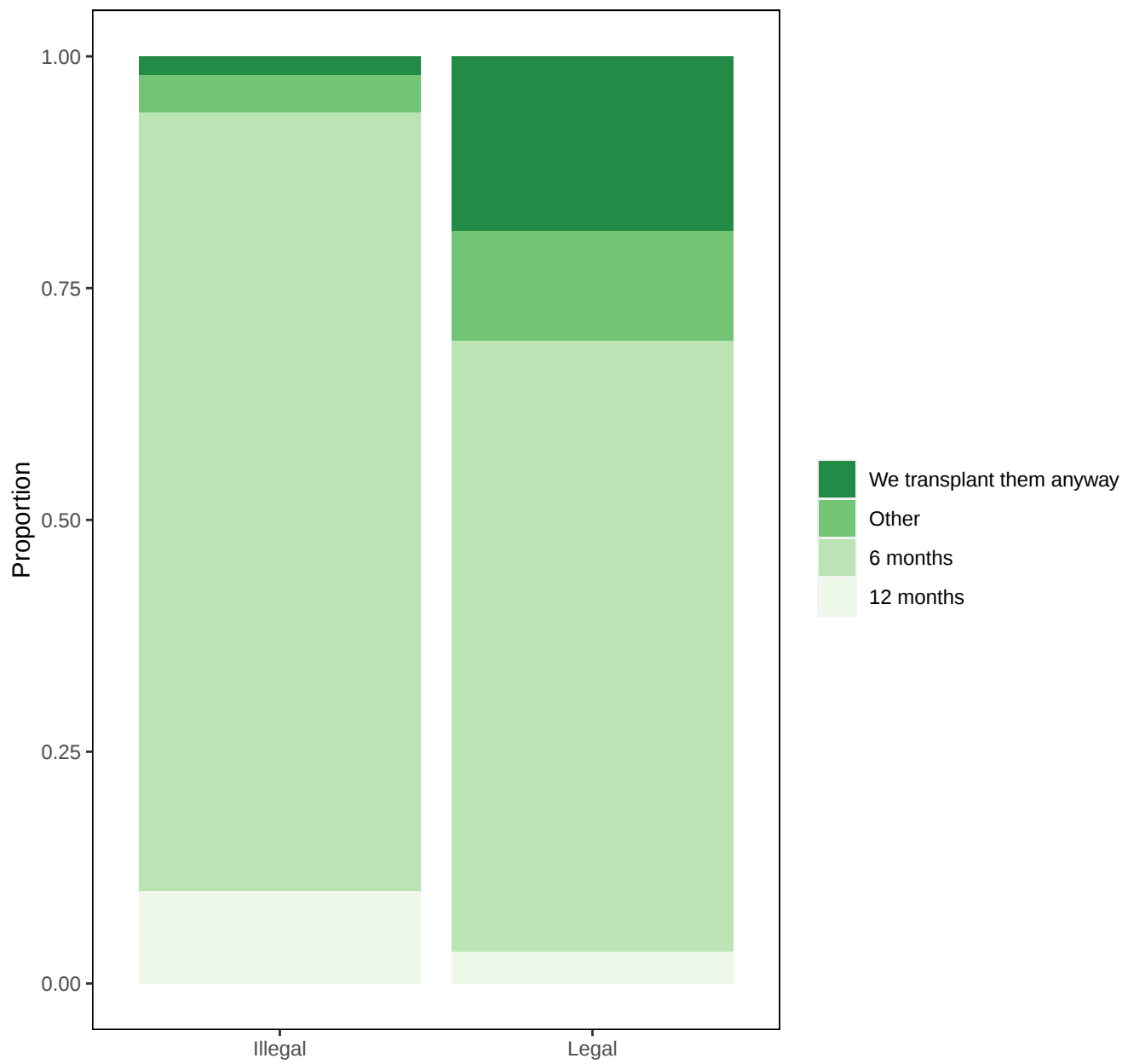


## 7.5 D (Q15-only)

```
> ggD <-  
+   dat %>% filter(!is.na(Q15)) %>%  
+   ggplot(aes(Legal))+  
+   geom_bar(aes(fill=Q15),position = position_fill(reverse = TRUE))+  
+   scale_fill_brewer(palette=5,drop=FALSE, guide = guide_legend(reverse=TRUE))+  
+   #scale_fill_grey(drop=FALSE, guide = guide_legend(reverse=TRUE))+  
+   theme(panel.background=element_blank(),  
+         panel.border = element_rect(fill=NA,color="black", linewidth=0.5, linetype="solid")) +  
+   theme(strip.background = element_blank())+  
+   theme(strip.text.y.right = element_text(angle = 0, hjust=0))+  
+   labs(x="",fill="",y="Proportion")+  
+   ggtitle("D")
```

```
> ggD
```

D



## 7.6 Combine Plots

Output BITMAP file to C:/Users/shaknapp/Indiana University/O365-BreathettStats - IlonzeOnyedika - IlonzeOnyedika/  
(Teams directory)

Version 1

```
> library(gridExtra)

Attaching package: 'gridExtra'

The following object is masked from 'package:dplyr':

  combine

> bmp(filename = paste0(OUTDIR,RPTNAME,"_ggv1.bmp"),width=18, height=12,units="in", res=300)
>
> grid.arrange(arrangeGrob(ggA,ggB, ncol=2),
+             arrangeGrob(ggC, ggD, ggE, ncol=3),
+             nrow=2)
>
> dev.off()

pdf
2
```

Version 2

```
> library(cowplot)
> bmp(filename = paste0(OUTDIR,RPTNAME,"_ggv2.bmp"),width=18, height=12,units="in", res=300)
>
> plot_grid(ggA,ggC,ggB, ggD, ncol=2, nrow=2, rel_widths = c(2/3,1/3))
>
> dev.off()

pdf
2
```

## Chapter 8

## Appendix

## 8.1 R Session Information

Current Report Generated:

```
> Sys.time()
```

```
[1] "2023-06-20 07:51:11 PDT"
```

The following gives the Session Information for this analysis. This includes the version of R used and the versions of all packages used.

```
> sessionInfo()
```

```
R version 4.2.3 (2023-03-15 ucrt)
```

```
Platform: x86_64-w64-mingw32/x64 (64-bit)
```

```
Running under: Windows 10 x64 (build 19045)
```

```
Matrix products: default
```

```
locale:
```

```
[1] LC_COLLATE=English_United States.utf8 LC_CTYPE=English_United States.utf8 LC_MONETARY=English_United States.utf8
```

```
[4] LC_NUMERIC=C LC_TIME=English_United States.utf8
```

```
attached base packages:
```

```
[1] stats graphics grDevices utils datasets methods base
```

```
other attached packages:
```

```
[1] cowplot_1.1.1 gridExtra_2.3 RColorBrewer_1.1-3 tidyr_1.3.0 janitor_2.1.0 stringr_1.5.0  
[7] dplyr_1.0.10 lawstat_3.6 ggplot2_3.4.2 xlsx_0.6.5 knitr_1.40
```

```
loaded via a namespace (and not attached):
```

```
[1] highr_0.9 pillar_1.9.0 compiler_4.2.3 tools_4.2.3 boot_1.3-28.1 timechange_0.1.1  
[7] lubridate_1.9.0 evaluate_0.18 lifecycle_1.0.3 tibble_3.1.8 gtable_0.3.1 pkgconfig_2.0.3  
[13] rlang_1.1.1 cli_3.4.1 DBI_1.1.3 rstudioapi_0.14 Kendall_2.2.1 mvtnorm_1.1-3  
[19] xfun_0.39 rJava_1.0-6 withr_2.5.0 generics_0.1.3 xlsxjars_0.6.1 vctrs_0.6.2  
[25] grid_4.2.3 tidyselect_1.2.0 snakecase_0.11.0 glue_1.6.2 R6_2.5.1 fansi_1.0.3  
[31] Rdpack_2.4 farver_2.1.1 purrr_1.0.1 magrittr_2.0.3 rbibutils_2.2.13 scales_1.2.1  
[37] colorspace_2.0-3 labeling_0.4.2 utf8_1.2.2 stringi_1.7.8 munsell_0.5.0
```

## 8.2 Citations

### 8.2.1 Citations (etc.) for Brunner-Munzel Test

Brunner, E. and U. Munzel (2000). "The nonparametric Behrens-Fisher Problem: Asymptotic Theory and a small sample approximation." Biometrical Journal 42(1): 17-25.

Neuber, Karin and Edgar Brunner. 2007. A studentized permutation test for the non-parametric BehrensFisher problem. Computational Statistics Data Analysis. Volume 51, Issue 10, 15 June 2007, Pages 5192-5204. <https://doi.org/10.1016/j.csda.2006.05.024>

The function used to do the Brunner-Munzel test is in the R package 'lawstat' (citation below)

To cite package 'lawstat' in publications use:

```
Gastwirth J, Gel Y, Hui W, Lyubchich V, Miao W, Noguchi K (2023). _lawstat: Tools for Biostatistics, Public Policy, and Law_. R package version 3.6, <https://CRAN.R-project.org/package=lawstat>.
```

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {lawstat: Tools for Biostatistics, Public Policy, and Law},
  author = {Joseph L. Gastwirth and Yulia R. Gel and W. L. Wallace Hui and Vyacheslav Lyubchich and Weiwen Miao and Kimihiro Noguchi},
  year = {2023},
  note = {R package version 3.6},
  url = {https://CRAN.R-project.org/package=lawstat},
}
```

Function documentation: <https://www.rdocumentation.org/packages/lawstat/versions/3.4/topics/brunner.munzel.test>

### 8.2.2 Citations for R and R-packages

Citation for R

To cite R in publications use:

```
R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.
```

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis. See also 'citation("pkgname")' for citing R packages.

Citation for R packages (libraries) used

```
=====
package: cowplot
-----
```

To cite package 'cowplot' in publications use:

Wilke C (2020). `_cowplot: Streamlined Plot Theme and Plot Annotations for 'ggplot2'`. R package version 1.1.1, <<https://CRAN.R-project.org/package=cowplot>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {cowplot: Streamlined Plot Theme and Plot Annotations for 'ggplot2'},
  author = {Claus O. Wilke},
  year = {2020},
  note = {R package version 1.1.1},
  url = {https://CRAN.R-project.org/package=cowplot},
}
```

```
=====
package: gridExtra
-----
```

To cite package 'gridExtra' in publications use:

Auguie B (2017). `_gridExtra: Miscellaneous Functions for "Grid" Graphics`. R package version 2.3, <<https://CRAN.R-project.org/package=gridExtra>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {gridExtra: Miscellaneous Functions for "Grid" Graphics},
  author = {Baptiste Auguie},
  year = {2017},
  note = {R package version 2.3},
  url = {https://CRAN.R-project.org/package=gridExtra},
}
```

```
=====
package: RColorBrewer
-----
```

To cite package 'RColorBrewer' in publications use:

Neuwirth E (2022). `_RColorBrewer: ColorBrewer Palettes`. R package version 1.1-3, <<https://CRAN.R-project.org/package=RColorBrewer>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {RColorBrewer: ColorBrewer Palettes},
  author = {Erich Neuwirth},
  year = {2022},
  note = {R package version 1.1-3},
  url = {https://CRAN.R-project.org/package=RColorBrewer},
}
```

```
=====
package: tidyr
-----
```

-----  
To cite package 'tidyr' in publications use:

Wickham H, Vaughan D, Girlich M (2023). `_tidyr: Tidy Messy Data_`. R package version 1.3.0,  
<<https://CRAN.R-project.org/package=tidyr>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {tidyr: Tidy Messy Data},
  author = {Hadley Wickham and Davis Vaughan and Maximilian Girlich},
  year = {2023},
  note = {R package version 1.3.0},
  url = {https://CRAN.R-project.org/package=tidyr},
}
```

=====

package: janitor

-----

To cite package 'janitor' in publications use:

Firke S (2021). `_janitor: Simple Tools for Examining and Cleaning Dirty Data_`. R package version 2.1.0,  
<<https://CRAN.R-project.org/package=janitor>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {janitor: Simple Tools for Examining and Cleaning Dirty Data},
  author = {Sam Firke},
  year = {2021},
  note = {R package version 2.1.0},
  url = {https://CRAN.R-project.org/package=janitor},
}
```

=====

package: stringr

-----

To cite package 'stringr' in publications use:

Wickham H (2022). `_stringr: Simple, Consistent Wrappers for Common String Operations_`. R package version 1.5.0, <<https://CRAN.R-project.org/package=stringr>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {stringr: Simple, Consistent Wrappers for Common String Operations},
  author = {Hadley Wickham},
  year = {2022},
  note = {R package version 1.5.0},
  url = {https://CRAN.R-project.org/package=stringr},
}
```

=====

package: dplyr

-----

To cite package 'dplyr' in publications use:

Wickham H, Francois R, Henry L, Mller K (2022). `_dplyr: A Grammar of Data Manipulation_`. R package version 1.0.10, <<https://CRAN.R-project.org/package=dplyr>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {dplyr: A Grammar of Data Manipulation},
  author = {Hadley Wickham and Romain Francois and Lionel Henry and Kirill Mller},
  year = {2022},
  note = {R package version 1.0.10},
  url = {https://CRAN.R-project.org/package=dplyr},
}
```

=====

package: lawstat

-----

To cite package 'lawstat' in publications use:

Gastwirth J, Gel Y, Hui W, Lyubchich V, Miao W, Noguchi K (2023). `_lawstat: Tools for Biostatistics, Public Policy, and Law_`. R package version 3.6, <<https://CRAN.R-project.org/package=lawstat>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {lawstat: Tools for Biostatistics, Public Policy, and Law},
  author = {Joseph L. Gastwirth and Yulia R. Gel and W. L. Wallace Hui and Vyacheslav Lyubchich and Weiwen Miao and Kimihiro Noguchi},
  year = {2023},
  note = {R package version 3.6},
  url = {https://CRAN.R-project.org/package=lawstat},
}
```

=====

package: ggplot2

-----

To cite ggplot2 in publications, please use

H. Wickham. `ggplot2: Elegant Graphics for Data Analysis`. Springer-Verlag New York, 2016.

A BibTeX entry for LaTeX users is

```
@Book{,
  author = {Hadley Wickham},
  title = {ggplot2: Elegant Graphics for Data Analysis},
  publisher = {Springer-Verlag New York},
  year = {2016},
  isbn = {978-3-319-24277-4},
  url = {https://ggplot2.tidyverse.org},
}
```

=====

package: xlsx

-----

To cite package 'xlsx' in publications use:

Dragulescu A, Arendt C (2020). `_xlsx: Read, Write, Format Excel 2007 and Excel 97/2000/XP/2003 Files_`. R package version 0.6.5, <<https://CRAN.R-project.org/package=xlsx>>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {xlsx: Read, Write, Format Excel 2007 and Excel 97/2000/XP/2003 Files},
  author = {Adrian Dragulescu and Cole Arendt},
  year = {2020},
  note = {R package version 0.6.5},
  url = {https://CRAN.R-project.org/package=xlsx},
}
```

```
=====
package: knitr
-----
```

To cite the 'knitr' package in publications use:

Yihui Xie (2022). `knitr: A General-Purpose Package for Dynamic Report Generation in R`. R package version 1.40.

Yihui Xie (2015) `Dynamic Documents with R and knitr`. 2nd edition. Chapman and Hall/CRC. ISBN 978-1498716963

Yihui Xie (2014) `knitr: A Comprehensive Tool for Reproducible Research in R`. In Victoria Stodden, Friedrich Leisch and Roger D. Peng, editors, `Implementing Reproducible Computational Research`. Chapman and Hall/CRC. ISBN 978-1466561595

To see these entries in BibTeX format, use `'print(<citation>, bibtex=TRUE)'`, `'toBibtex(.)'`, or set `'options(citation.bibtex.max=999)'`.

```
=====
package: stats
-----
```

The 'stats' package is part of R. To cite R in publications use:

R Core Team (2023). `R: A language and environment for statistical computing`. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis. See also `'citation("pkgname")'` for citing R packages.

```
=====
package: graphics
-----
```

The 'graphics' package is part of R. To cite R in publications use:

R Core Team (2023). `R: A language and environment for statistical computing`. R Foundation for Statistical

Computing, Vienna, Austria. URL <https://www.R-project.org/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis.  
See also 'citation("pkgname")' for citing R packages.

```
=====
package: grDevices
-----
```

The 'grDevices' package is part of R. To cite R in publications use:

R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis.  
See also 'citation("pkgname")' for citing R packages.

```
=====
package: utils
-----
```

The 'utils' package is part of R. To cite R in publications use:

R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis.  
See also 'citation("pkgname")' for citing R packages.

```
=====
package: datasets
-----
```

-----  
The 'datasets' package is part of R. To cite R in publications use:

R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis.  
See also 'citation("pkgname")' for citing R packages.

=====

```
package: methods
```

-----

The 'methods' package is part of R. To cite R in publications use:

R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis.  
See also 'citation("pkgname")' for citing R packages.

=====

```
package: base
```

-----

To cite R in publications use:

R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {R: A Language and Environment for Statistical Computing},
  author = {{R Core Team}},
  organization = {R Foundation for Statistical Computing},
  address = {Vienna, Austria},
  year = {2023},
  url = {https://www.R-project.org/},
}
```

We have invested a lot of time and effort in creating R, please cite it when using it for data analysis.

See also `'citation("pkgname")'` for citing R packages.