CACHET Technical Report Template

A nice standard XeLaTeX template for technical reports written and published by the Copenhagen Center for Health Technology.

John D. Doe

cachet | Copenhagen
Center for
Health Technology

Summary

This is a XeLaTeX template for technical reports written in the Copenhagen Center for Health Technology (CACHET)[1].

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[1] www.cachet.dk

Preface

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Acknowledgements

This template is based on the Laursen's DTU Thesis template.

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Todo list

CHAPTER 1

Introduction

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CHAPTER 2

Heading on Level 0 (chapter)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

2.1 Heading on Level 1 (section)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

2.1.1 Heading on Level 2 (subsection)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written

in of the original language. There is no need for special content, but the length of words should match the language.

2.1.1.1   Heading on Level 3 (subsubsection)

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Heading on Level 4 (paragraph)   Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

2.2   Lists

2.2.1   Example for list (itemize)

- First item in a list
- Second item in a list
- Third item in a list
- Fourth item in a list
- Fifth item in a list

2.2.1.1   Example for list (4*itemize)

- First item in a list
  - First item in a list
    - First item in a list
      · First item in a list

      · Second item in a list

    ∗ Second item in a list

  – Second item in a list

• Second item in a list

2.2.2 Example for list (enumerate)

1. First item in a list

2. Second item in a list

3. Third item in a list

4. Fourth item in a list

5. Fifth item in a list

2.2.2.1 Example for list (4*enumerate)

1. First item in a list

   a) First item in a list

      i. First item in a list

        A. First item in a list

        B. Second item in a list

      ii. Second item in a list

   b) Second item in a list

2. Second item in a list

2.2.3 Example for list (description)

First item in a list

Second item in a list

Third item in a list

Fourth item in a list

Fifth item in a list

2.2.3.1   Example for list (4*description)

First item in a list

> **First** item in a list
>> **First** item in a list
>>> **First** item in a list
>>> **Second** item in a list
>> **Second** item in a list
> **Second** item in a list

Second item in a list

CHAPTER 3

Example Chapter

- Upright shape

- *Italic shape*

- *Slanted shape*

- SMALL CAPS SHAPE

- Medium series

- **Bold sereies**

- Roman family

- Sans serif family

- `Typewriter family`

I love to write special characters like øæå indside my TEX document. Also á, à, ü, û, ë, ê, î, ï could be nice. So waht about the " " chracter. What about ° é ® † ¥ ü | œ ' @ ö ä ¬ ‹ « © f ß ª Ω … ç √ ñ µ , · ¡ " £ ∞ ™ [ ] ± '.

Some dashes - – —, and the latex form - – —

$$x = \mathbf{x}, \mathbf{x}, x, x_{1_{2_{3_4}}}^{1^{2^{3^4}}} \cdot hello * \text{hello worldmy world\r{u}third world} t$$

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> 3.0 (2) Do it now

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3.1   Torquent Arcu

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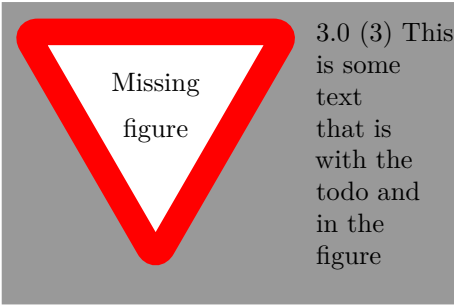**Figure 3.1:** This is my special figure. Aliquam ultricies, arcu quis tempor rhoncus, tellus nisl tempus justo, condimentum tempor erat odio ac purus. Integer quis ipsum felis. Aliquam volutpat, leo ac consequat egestas, lectus lacus adipiscing quam, id iaculis dolor quam in erat. Phasellus tempor interdum arcu quis vestibulum.

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Table 3.1: This is a caption to the table.

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3.1.1   Vestibulum

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```
# This is a comment
import easy
str = "I am a string"
str2 = "Now i have an awsome string with ´ '' `` which are not TeX'ed"
str3 = "What about awsome unicode characters? Like ", , ", Ω, ç. \" This"
def fib(n):
    if n == 0:
        return 0
    elif n == 1:
        return 1
    else:
        return fib(n-1) + fib(n-2)
str4 = "Yes it is possible with 80 charactes. Which this string proves. Wiiii."
str5 = "It adjusts according to the spine"
```

Listing 3.1: Fibonacci.

3.2   Luctus

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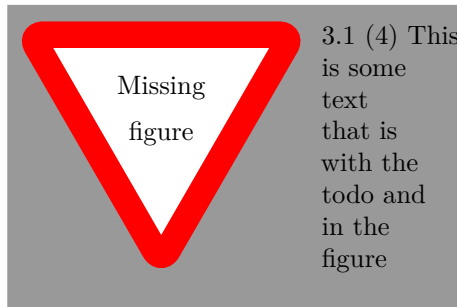
(a) 1 pass
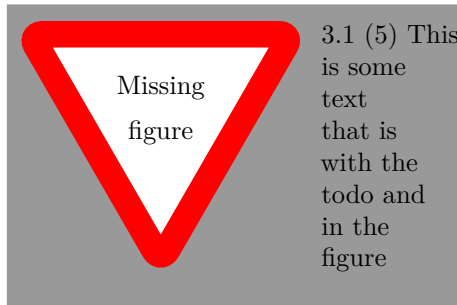
(b) 5 passes

Figure 3.2: loop performance comparison.

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Algorithm 1 Modified mini-batch K-means

1: Given: K, mini-batch size B, iterations T, dataset X, correlation matrix P.
2: Initialize $C = \{\mathbf{c}^{(1)}, \mathbf{c}^{(2)}, \ldots, \mathbf{c}^{(K)}\}$ with random $\mathbf{x}$'es picked from X.
3: $A \leftarrow B \cdot T$ sorted random indexes to X, denoted $a_1, a_2, \ldots, a_{B \cdot T}$.
4: $X' \leftarrow \{\mathbf{x}^{(a_1)}, \mathbf{x}^{(a_2)}, \ldots, \mathbf{x}^{(a_{B \cdot T})}\}$ ▷ Cache all points
5: $\mathbf{size} \leftarrow 0$
6: **for** $i = 1$ to T **do**
7:      $M \leftarrow B$ examples picked randomly from X'
8:      **for** $\mathbf{x} \in M$ **do**   ▷ *Assignment step*
9:          $\mathbf{d}[\mathbf{x}] \leftarrow f(C, \mathbf{x}, \mathrm{P})$ ▷ Cache closest center
10:     **end for**
11:     **for** $\mathbf{x} \in M$ **do**   ▷ *Update step*
12:         $\mathbf{c} \leftarrow \mathbf{d}[\mathbf{x}]$ ▷ Get cached center for current $\mathbf{x}$
13:         $\mathbf{size}[\mathbf{c}] \leftarrow \mathbf{size}[\mathbf{c}] + 1$ ▷ Update cluster size
14:         $\eta \leftarrow \frac{1}{\mathbf{size}[\mathbf{c}]}$ ▷ Get learning rate
15:         $\mathbf{c} \leftarrow (1 - \eta)\mathbf{c} + \eta\mathbf{x}$ ▷ Take gradient step
16:     **end for**
17: **end for**
18: **return** C, $\mathbf{size}$
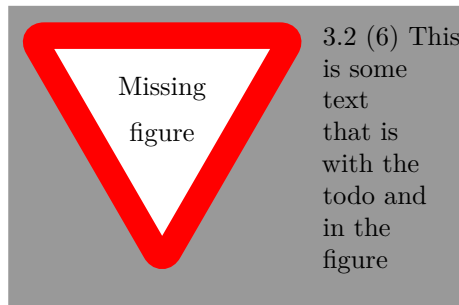
Figure 3.3: This is the caption I wrote.

3.3   Sollicitudin vestibulum

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consectetur lacinia dolor at gravida. Phasellus ipsum arcu, vulputate fermentum
ultricies eget, tempor eu odio. Aenean accumsan vestibulum risus a mattis.

```
1  # This is a comment
2  import easy
3  str = "I am a string"
4  str2 = "Now i have an awsome string with ´ '' `` which are not TeX'ed"
5  str3 = "What about awsome unicode characters? Like ",  , ", Ω, ç. \" This"
6  def fib(n):
7      if n == 0:
8          return 0
9      elif n == 1:
10          return 1
11      else:
12          return fib(n-1) + fib(n-2)
13  str4 = "Yes it is possible with 80 charactes. Which this string proves. Wiiii."
14  str5 = "It adjusts according to the spine"
```

Listing 3.2: Fibonacci2.

CHAPTER 4

Analysis of Data

This chapter provides some examples of tables and graphs. Examples are from the CACHET Unified Methodology for Assessment of Clinical Feasibility (CUMACF) methodology.

4.1 Usage Adherence Data

Table 4.1 shows a fictive data set for usage adherence. All number are days. Using the following simple formula, adherence pr. participant can be calculated, as shown in the last column of Table 4.1:

$$adherence = \frac{usage}{length - downtime}$$

Note that the *instructed* number of days are not included in the calculation of adherence. However, if the actual length of study for each participant is unavailable, the instructed length may substitute this. This will, off course, provide a lower adherence rate. Note also, that the *total adherence* is calculated using the formula above – in this case it is 92%. Using the average of each participant's adherence rate is, however, misleading as the overall adherence rate. This is illustrated in Table 4.1, where the average adherence rate is 87%. This is lower, since the adherence rate for the 'short' studies (P7 and P8) are low.

Table 4.1: Example of usage adherence data collected. In this example, all reported number are days of a study..

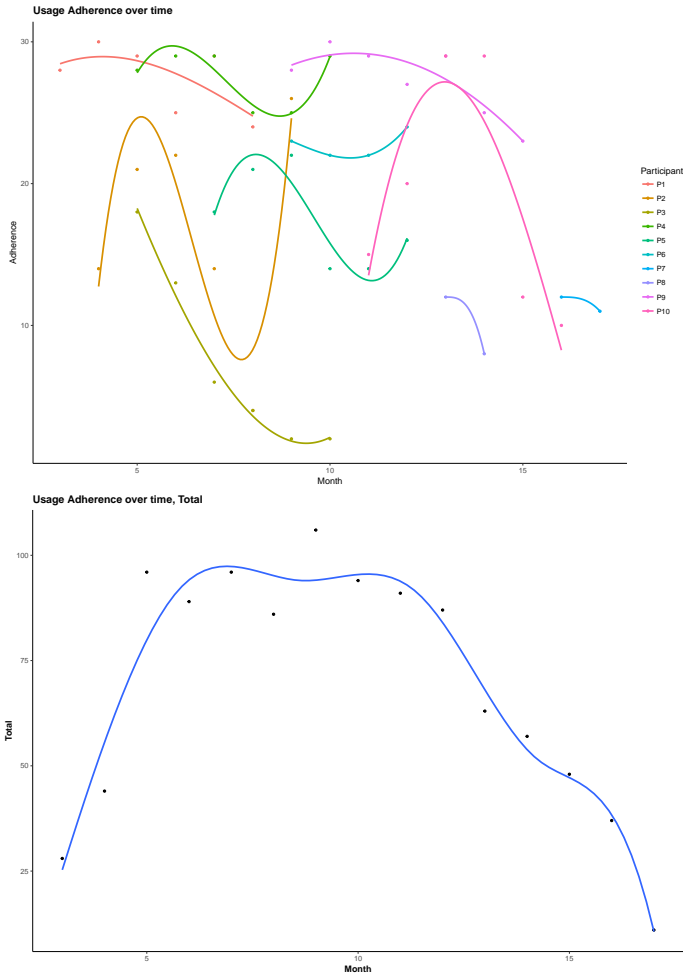| participant	instr.	lenght	downtime	usage	adherence
P1	183	170	3	165	99%
P2	183	120	2	101	86%
P3	183	73	2	45	63%
P4	183	173	1	156	91%
P5	183	108	1	105	98%
P6	122	93	1	91	99%
P7	61	45	2	23	53%
P8	30	23	0	20	87%
P9	183	194	1	191	99%
P10	183	118	3	115	100%
total		1.117	16	1.012	**92%**
avg.					**87%**

Figure 4.1: Usage of a system over time. Top: Usage patterns for each of the ten
participants. Bottom: Total usage pattern.

Figure 4.1 provides an example of how to illustrate usage adherence over time. In
this example, the usage from the ten participants listed in Table 4.1 is shown on a
monthly basis over a period of 15 month (month 3 to 17). The top figure shows the
usage patterns for each of the ten participants with a smoothed curve fitted to the
data points. Participants show different usage patterns. For example, P2 initially
starts using the system, but ends up with limited use of the system, whereas P10
starts out low, but gradually increase her/his usage. The bottom figure shows the
overall usage. This latter figure can illustrate the overall diffusion of the technology.

According to the theory of diffusion of technology (innovation), this should be a normal distribution over time [**rogers2003diffusion**]. This trend is recognized in Figure 4.1; usage gradually grows from month 3, raising to a plateau in months 7 to 12, after which it declines. This patterns is, of course, contingent to the specific details of the study; in our example, the study period is 6 months and participants did not use the system beyond this period. Figure 4.1 is generated from an R script, which is available in Appendix B.

4.2   Perceived Usefulness and Usability Data

The CUMACF questionnaire is applying a 5-point Likert scale of; 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree', and 'strongly agree', with numerical scores from 1–5. The question is how to represent the results of a survey using such a 5-point Likert. One common practice is to take the mean. However, as pointed out by Robbins et al. [**robbins2011plotting**], it is controversial since there is no assurance that there is even spacing between the descriptions of attitude. There is no reason to assume that the distance between agree and strongly agree is the same as the distance from agree to neither agree nor disagree. However, even if it were acceptable to take means, it is not very useful. For example, if we look at the example survey data in Table 4.2, the first three questions (HE1–3) provides the same mean (24.0), but there is a big difference between HE1 where respondents are concentrated at both ends of the scale, and HE2 in which all respondents are all neutral. Hence, based on the response to HE1 it would be very wrong to conclude that "on average, respondents were *neutral* as to whether the system would be useful for handling diabetes".

Table 4.2: Example of survey data from the CUMACF perceived usefulness and usability questionnaire. The center figures are the number of respondents in each category, and total and average scores are on the right..

#	Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Scores Total	Avg.
HE1	Usefulness	20	0	0	0	20	120	24.0
HE2	Adherence	0	0	40	0	0	120	24.0
HE3	Behavior	10	10	0	10	10	120	24.0
HE4	Health	12	2	4	6	23	167	33.4
HE5	Efficiency	2	14	32	21	3	225	45,0
HE6	Productivity	32	2	3	12	2	103	20.6
HE7	Quality	10	2	4	1	23	145	29.0
HE8	Safety	4	14	2	33	3	185	37.0
EE1	Usability	12	2	5	2	3	54	10.8
EE2	Understandable	10	2	4	6	23	165	33.0
EE3	Learning	4	2	23	12	11	180	36.0
EE4	Easy	28	11	5	4	3	96	19.2
EE5	Skillful	18	2	4	6	11	113	22.6
EE6	Information	4	14	32	15	3	203	40.6
EE7	Interface	5	21	5	4	3	92	18.6
EE8	Pleasure	12	14	11	3	4	105	21.0
EE9	Features	4	4	3	44	12	257	51.4

Robbins et al. [**robbins2011plotting**] discuss different ways to present and visualize Likert scale data and recommend to present data in (i) a table and (ii) as a so-called 'diverging stacked bar chart' As an example, we can look at the data in Table 4.2, which is visualized in a diverging stacked bar chart in Figure 4.2. Figure 4.2 is generated from an R script (originally proposed by Heiberger & Robbins [**heiberger2014design**]). The R script is available in Appendix B.
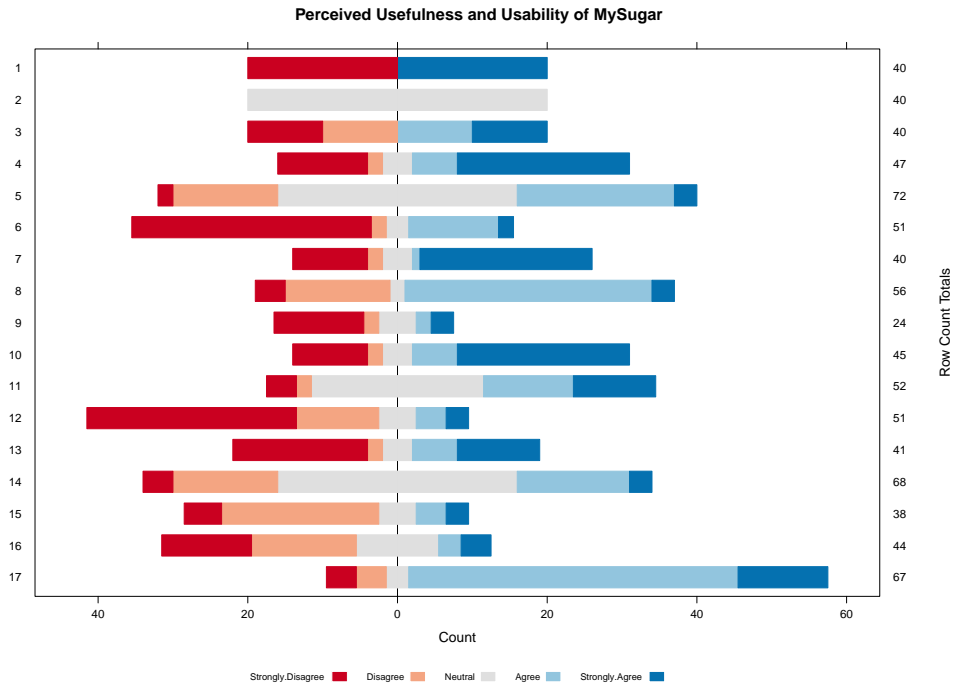

Figure 4.2: Diverging stacked bar chart of the data in Table 4.2.

CHAPTER 5

Conclusion

Morbi pharetra ligula integer mollis mi nec neque ultrices vitae volutpat leo ullamcorper. In at tellus magna. Curabitur quis posuere purus. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Suspendisse tristique placerat feugiat. Aliquam vitae est at enim auctor ultrices eleifend a urna. Donec non tincidunt felis. Maecenas at suscipit orci.

The Simple Usability Scale (SUS)

The Simple Usability Scale (SUS) was designed at Digital Equipment Corporation (DEC) in 1986 and is a simple, ten-item scale giving a global view of subjective assessments of usability [**brooke1996sus**]. It covers a variety of aspects of system usability, such as the need for support, training, and complexity, and thus has a high level of face validity for measuring usability of a system. The SUS scale is generally used after the respondent has had an opportunity to use the system being evaluated, but before any debriefing or discussion takes place.

The so-called *SUS score* yields a single number representing a composite measure of the overall usability of the system being studied. Note that scores for individual items are not meaningful on their own. To calculate the SUS score, first sum the score contributions from each item. Each item's score contribution will range from 0 to 4. For items 1,3,5,7,and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10, the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall SUS score [0–100].

	Strongly disagree				Strongly agree

1. I think that I would like to use this system frequently

1	2	3	4	5

2. I found the system unnecessarily complex

1	2	3	4	5

3. I thought the system was easy to use

1	2	3	4	5

4. I think that I would need the support of a technical person to be able to use this system

1	2	3	4	5

5. I found the various functions in this system were well integrated

1	2	3	4	5

6. I thought there was too much inconsistency in this system

1	2	3	4	5

7. I would imagine that most people would learn to use this system very quickly

1	2	3	4	5

8. I found the system very cumbersome to use

1	2	3	4	5

9. I felt very confident using the system

1	2	3	4	5

10. I needed to learn a lot of things before I could get going with this system

1	2	3	4	5

Figure A.1: The Simple Usability Scale (SUS) Questionnaire.

R Script for Plotting Data

B.1 Plotting Usage Adherence Data

The following matrix shown the raw adherence scores used in the example shown in Table 4.1 and plotted in Figure 4.1.

```
#  Month P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 Total
1      3 28 NA NA NA NA NA NA NA NA  NA    28
2      4 30 14 NA NA NA NA NA NA NA  NA    44
3      5 29 21 18 28 NA NA NA NA NA  NA    96
4      6 25 22 13 29 NA NA NA NA NA  NA    89
5      7 29 14  6 29 18 NA NA NA NA  NA    96
6      8 24 12  4 25 21 NA NA NA NA  NA    86
7      9 NA 11  2 20 22 23 NA NA 28  NA   106
8     10 NA 12  2 14 14 22 NA NA 30  NA    94
9     11 NA 11 NA NA 14 22 NA NA 29  15    91
10    12 NA NA NA NA 16 24 NA NA 27  20    87
11    13 NA NA NA NA NA NA NA 12 29  22    63
12    14 NA NA NA NA NA NA NA  8 25  24    57
13    15 NA NA NA NA NA NA NA NA 23  25    48
14    16 NA NA NA NA NA NA 12 NA NA  25    37
15    17 NA NA NA NA NA NA 11 NA NA  NA    11
```

The following R scrips is used to generate the plots in Figure 4.1.

```
1 # A simple example of plotting fitted curves for usage adherence pr.
      participant and in total
2 # Jakob E. Bardram, 2017
3
4 library(ggplot2)
5 library(xts)
6 library(zoo)
7
8 #loading adherence data
```

```
 9  adherence <- read.csv("~/Dropbox/WRITINGS/2017.CACHET.User.Study.Methodology
        /method/adherence.csv", sep=";")
10  adh_data <- adherence
11
12  # stacking the data into three columns [Month, Adherence, Participant] which
         is to be used by ggplot next
13  # note that the first and last columns of the adherence data are not
        included (Month and Total)
14  col_count <- ncol(adh_data) - 1
15  adh_frame <- data.frame(adh_data["Month"],stack(data.frame(coredata(adh_data
        [c(2:col_count)]))))
16  names(adh_frame) <- c("Month", "Adherence", "Participant")
17
18  # creating a theme for the graphs
19  t <-    theme(panel.background=element_rect(fill = "white"),
20              panel.grid.minor = element_blank(),
21              panel.grid.major = element_blank(),
22              axis.line = element_line(colour = "black", size = 0.3),
23              legend.background=element_rect(fill = "white"),
24              legend.key=element_rect(fill = "white"),
25              title = element_text(lineheight=.8, face="bold")
26  )
27
28  # plotting the data for all participants - showing both points and a smooth
        'spline' trend line
29  plot <- ggplot(adh_frame, aes(x=Month, y=Adherence, color=Participant))
30  plot <- plot + geom_point(aes(x=Month, y=Adherence, color=Participant), size
        = 1)
31  plot <- plot + geom_smooth(method = "lm", formula = y ~ splines::bs(x, 4),
        se = FALSE)
32  plot <- plot + ggtitle("Usage Adherence over time")
33  plot <- plot + t
34  plot
35
36  #stacking the Total column
37  adh_total <- data.frame(adh_data["Month"],data.frame(adh_data["Total"]))
38
39  #plotting the Total adherence over time, smooth
40  plot2 <- ggplot(adh_total, aes(x=Month, y=Total))
41  plot2 <- plot2 + geom_point(aes(x=Month, y=Total), size = 1)
42  plot2 <- plot2 + geom_smooth(method = "lm", formula = y ~ splines::bs(x, 7),
        se = FALSE)
43  plot2 <- plot2 + ggtitle("Usage Adherence over time, Total")
44  plot2 <- plot2 + t
45  plot2
46
47  # a plot of the data as a stacked area chart -- not smoothing, so not so
        nice...
48  plot3 <- ggplot(adh_frame, aes(x=Month, y=Adherence, color=Participant))
49  plot3 <- plot3 +
50    geom_area(aes(colour = Participant, fill= Participant), position = 'stack'
        )
51  plot3 <- plot3 +
52    theme(panel.background=element_rect(fill = "white"),
53          panel.grid.minor = element_blank(),
```

```
54         panel.grid.major = element_blank(),
55         axis.line = element_line(colour = "black", size = 0.3),
56         legend.background=element_rect(fill = "white"),
57         legend.key=element_rect(fill = "white"),
58         plot.title = element_text(lineheight=.8, face="bold")
59     )
60
61  plot3
```

.

B.2 Generating Diverging Stacked Bar Charts for Likert Scale Data

The R script generating the so-called 'Diverging Stacked Bar Charts' for Likert scales visualization was originally proposed by Heiberger & Robbins [**heiberger2014design**]). The following R script is used to generate Figure 4.2 from the data in Table 4.2 (without the 'Total' and 'Avg.' columns). The script is adopted from a script proposed by ´Wesley' at r-bloggers.com[1].

```
1   # A simple example of a 'Diverging Stacked Bar Chart' for Likert Scale data
        on perceived usefulness and usability
2   # Based on example from https://www.r-bloggers.com/plotting-likert-scales/
3   # Jakob E. Bardram, 2017
4
5   require(grid)
6   require(lattice)
7   require(latticeExtra)
8   require(HH)
9
10  #loading survey data
11  sgbar.likert<- survey
12  title<-"Perceived Usefulness and Usability of MySugar"
13
14  # A very simple plot -- out of the box
15  plot.likert(sgbar.likert, main=title)
16
17  # Changing the color palette
18  pal<-brewer.pal((numlevels-1),"RdBu")
19  pal[ceiling(numlevels/2)]<-"#DFDFDF"
20  # A slightly more tailored plot
21  plot.likert(sgbar.likert,
22          main=title,
23          col=pal,
24          reference.line.col=c('black'),
25          strip.left=FALSE,
26          rightAxis=TRUE,
27          sub="5-point Likert Scale"
```

[1]https://www.r-bloggers.com/plotting-likert-scales/

```
28 )
```

.

APPENDIX C

Acronyms

CACHET Copenhagen Center for Health Technology

EBM evidence-based medicine

RCT randomized controlled trial

JMIR Journal of Medical Internet Research

HCI human-computer interaction

CUMACF CACHET Unified Methodology for Assessment of Clinical Feasibility

UTAUT Unified Theory of Acceptance and Use of Technology

PSSUQ Post-Study System Usability Questionnaire

BCW Behavior Change Wheel

SUS Simple Usability Scale

TAM Technology Acceptance Model

SCAN Schedules for Clinical Assessment in Neuropsychiatry

PHQ Patient Health Questionnaire

HRV heart rate variability