TR
Technical Report

QIM Technical Report Template

A nice standard XeLaTeX template for technical reports written and published by the Center for Quantification of Imaging Data from MAX IV.

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Summary

This is a XeLaTeX template for technical reports written in the Center for Quantification of Imaging Data from MAX IV (QIM)[1].

[1] www.qim.dk

Preface

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Acknowledgements

This template is based on the CACHET technical report template and modified for QIM group members by bepi@dtu.dk, last update on 20200501.

Contents

List of Figures

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 - – —

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

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3.0 (1) Mak a cake

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3.0 (2) Do it now

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3.1 Torquent Arcu

Curabitur condimentum suscipit arcu, sit amet convallis urna pellentesque ac. Quisque fringilla tincidunt risus nec accumsan. Curabitur vel sagittis ante. Integer eget placerat leo. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per

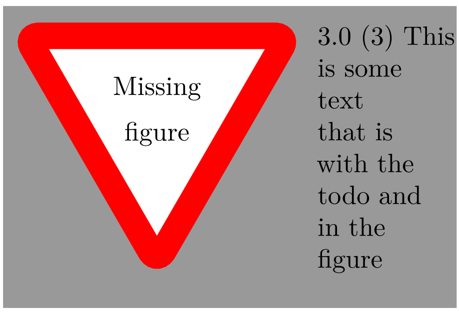

Figure 3.1: This is my special figure. Aliquam ultricies, arcu quis tempor rhoncus, tellus nisl tempus justo, condimentum tempor erat odio ac purus. Integer quis ipsum felis. Aliquam volutpat, leo ac consequat egestas, lectus lacus adipiscing quam, id iaculis dolor quam in erat. Phasellus tempor interdum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

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e	e	e

Table 3.1: This is a caption to the table.

inceptos himenaeos. Vestibulum quis risus in nulla fermentum pellentesque dictum et erat. Nulla vel pretium nunc. Integer tortor lorem, suscipit sit amet ultricies non, porta at metus. Sed pharetra, ante facilisis interdum porta, mi dolor fringilla quam, ac porttitor urna dolor quis massa. Proin viverra semper tincidunt. Vivamus pulvinar pharetra condimentum. Pellentesque rutrum mollis tellus ac scelerisque.

3.1.1 Vestibulum

Mauris luctus sollicitudin vestibulum. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos Figure 3.2(b). Duis eu nisl nec turpis porttitor bibendum eget sed orci. Aliquam consequat lorem a dui viverra porta facilisis augue rutrum. Cras luctus tellus in lectus egestas eu consequat magna cursus. Aenean aliquam neque a nibh elementum ornare. Integer eleifend imperdiet commodo. Morbi auctor, dui vel laoreet congue, purus est accumsan augue, sit amet feugiat neque nisl vel lorem. Curabitur ante sem, lacinia id adipiscing quis, viverra tristique nulla. Pellentesque ullamcorper pellentesque metus varius facilisis. Cras ac dui id odio tempor scelerisque. Curabitur a egestas risus. Pellentesque quis velit in sapien accumsan auctor. Phasellus aliquam, sapien eget lobortis volutpat, libero metus porttitor nisl, sed hendrerit urna dolor nec mi. See Listing 3.1.

```python
# 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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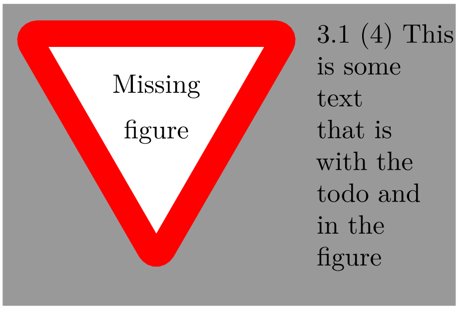
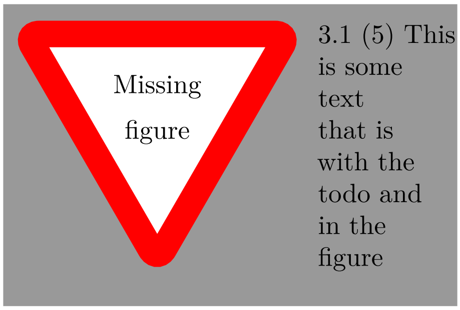


(a) 1 pass



(b) 5 passes

Figure 3.2: loop performance comparison.

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Algorithm 1 Modified mini-batch K-means

Given: K, mini-batch size B, iterations T, dataset X, correlation matrix P.
Initialize $C = \{\mathbf{c}^{(1)}, \mathbf{c}^{(2)}, \ldots, \mathbf{c}^{(K)}\}$ with random $\mathbf{x}$'es picked from X.
$A \leftarrow B \cdot T$ sorted random indexes to X, denoted $a_1, a_2, \ldots, a_{B \cdot T}$.
$X' \leftarrow \{\mathbf{x}^{(a_1)}, \mathbf{x}^{(a_2)}, \ldots, \mathbf{x}^{(a_{B \cdot T})}\}$ ▷ Cache all points
size $\leftarrow 0$
for $i = 1$ to T **do**
    $M \leftarrow B$ examples picked randomly from X'
    for $\mathbf{x} \in M$ **do** ▷ *Assignment step*
        $\mathbf{d}[\mathbf{x}] \leftarrow f(C, \mathbf{x}, \mathrm{P})$ ▷ Cache closest center
    end for
    for $\mathbf{x} \in M$ **do** ▷ *Update step*
        $\mathbf{c} \leftarrow \mathbf{d}[\mathbf{x}]$ ▷ Get cached center for current $\mathbf{x}$
        $\textbf{size}[\mathbf{c}] \leftarrow \textbf{size}[\mathbf{c}] + 1$ ▷ Update cluster size
        $\eta \leftarrow \frac{1}{\textbf{size}[\mathbf{c}]}$ ▷ Get learning rate
        $\mathbf{c} \leftarrow (1 - \eta)\mathbf{c} + \eta\mathbf{x}$ ▷ Take gradient step
    end for
end for
return C, **size**

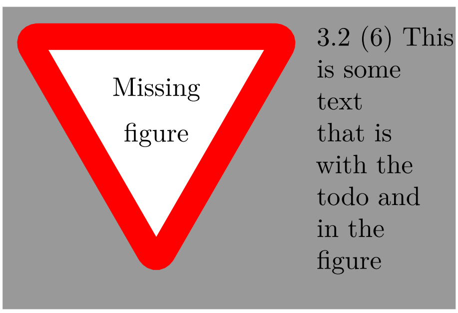

Figure 3.3: This is the caption I wrote.

3.3 Sollicitudin vestibulum

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```python
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        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 3.2: 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%**

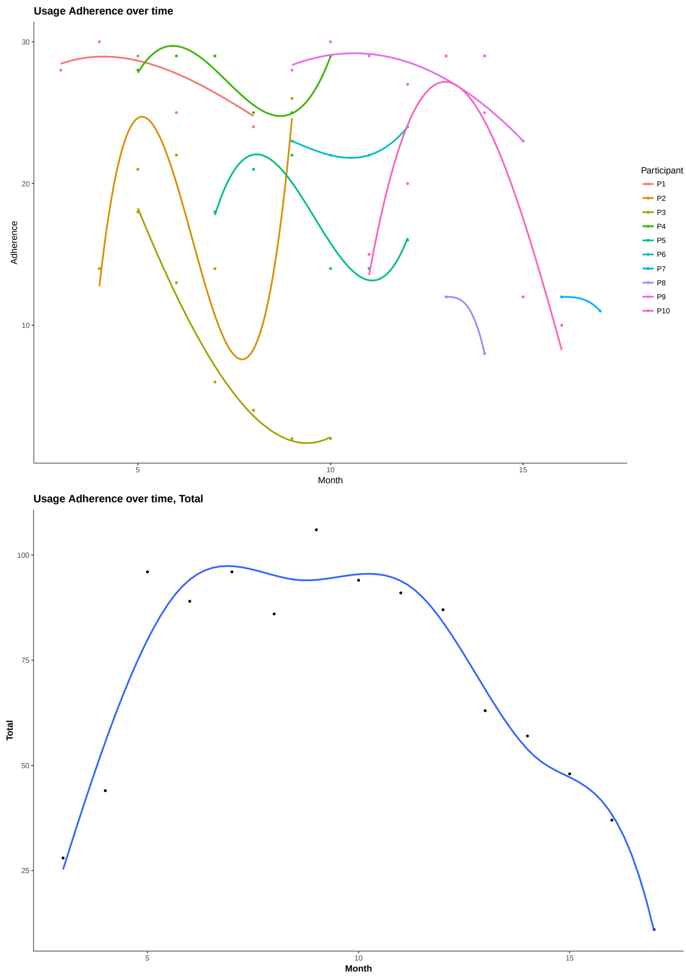

Figure 4.1: Usage of a system over time. Top: Usage patterns for each of the ten participants. Bottom: Total usage pattern.

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.

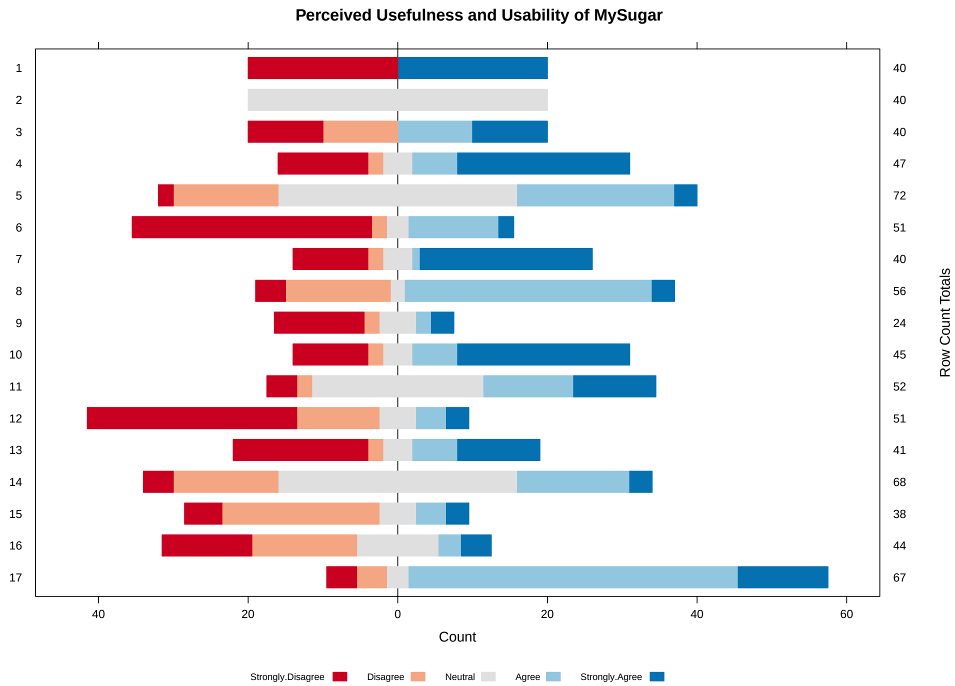

Figure 4.2: Diverging stacked bar chart of the data in Table 4.2.

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.

APPENDIX A
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.

APPENDIX B

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.

```
# A simple example of plotting fitted curves for usage adherence pr.
    participant and in total
# Jakob E. Bardram, 2017

library(ggplot2)
library(xts)
library(zoo)

#loading adherence data
```

```
adherence <- read.csv("~/Dropbox/WRITINGS/2017.CACHET.User.Study.Methodology/method/adherence.csv", sep=";")
adh_data <- adherence

# stacking the data into three columns [Month, Adherence, Participant] which is to be used by ggplot next
# note that the first and last columns of the adherence data are not included (Month and Total)
col_count <- ncol(adh_data) - 1
adh_frame <- data.frame(adh_data["Month"],stack(data.frame(coredata(adh_data[c(2:col_count)]))))
names(adh_frame) <- c("Month", "Adherence", "Participant")

# creating a theme for the graphs
t <-   theme(panel.background=element_rect(fill = "white"),
             panel.grid.minor = element_blank(),
             panel.grid.major = element_blank(),
             axis.line = element_line(colour = "black", size = 0.3),
             legend.background=element_rect(fill = "white"),
             legend.key=element_rect(fill = "white"),
             title = element_text(lineheight=.8, face="bold")
)

# plotting the data for all participants - showing both points and a smooth 'spline' trend line
plot <- ggplot(adh_frame, aes(x=Month, y=Adherence, color=Participant))
plot <- plot + geom_point(aes(x=Month, y=Adherence, color=Participant), size = 1)
plot <- plot + geom_smooth(method = "lm", formula = y ~ splines::bs(x, 4), se = FALSE)
plot <- plot + ggtitle("Usage Adherence over time")
plot <- plot + t
plot

#stacking the Total column
adh_total <- data.frame(adh_data["Month"],data.frame(adh_data["Total"]))

#plotting the Total adherence over time, smooth
plot2 <- ggplot(adh_total, aes(x=Month, y=Total))
plot2 <- plot2 + geom_point(aes(x=Month, y=Total), size = 1)
plot2 <- plot2 + geom_smooth(method = "lm", formula = y ~ splines::bs(x, 7), se = FALSE)
plot2 <- plot2 + ggtitle("Usage Adherence over time, Total")
plot2 <- plot2 + t
plot2

# a plot of the data as a stacked area chart -- not smoothing, so not so nice...
plot3 <- ggplot(adh_frame, aes(x=Month, y=Adherence, color=Participant))
plot3 <- plot3 +
  geom_area(aes(colour = Participant, fill= Participant), position = 'stack')
plot3 <- plot3 +
  theme(panel.background=element_rect(fill = "white"),
        panel.grid.minor = element_blank(),
```

```
        panel.grid.major = element_blank(),
        axis.line = element_line(colour = "black", size = 0.3),
        legend.background=element_rect(fill = "white"),
        legend.key=element_rect(fill = "white"),
        plot.title = element_text(lineheight=.8, face="bold")
  )

plot3
```

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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].

```
# A simple example of a 'Diverging Stacked Bar Chart' for Likert Scale data
    on perceived usefulness and usability
# Based on example from https://www.r-bloggers.com/plotting-likert-scales/
# Jakob E. Bardram, 2017

require(grid)
require(lattice)
require(latticeExtra)
require(HH)

#loading survey data
sgbar.likert<- survey
title<-"Perceived Usefulness and Usability of MySugar"

# A very simple plot -- out of the box
plot.likert(sgbar.likert, main=title)

# Changing the color palette
pal<-brewer.pal((numlevels-1),"RdBu")
pal[ceiling(numlevels/2)]<-"#DFDFDF"
# A slightly more tailored plot
plot.likert(sgbar.likert,
            main=title,
            col=pal,
            reference.line.col=c('black'),
            strip.left=FALSE,
            rightAxis=TRUE,
            sub="5-point Likert Scale"
```

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

```
)
```

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APPENDIX C

Acronyms

CACHET Copenhagen Center for Health Technology

QIM Center for Quantification of Imaging Data from MAX IV

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

Qim