# Online surveys for exploring the usability and user experience of 'CARIMO', an ICT-supported fitness program for care-dependent people


**Authors:** Birgit Trukeschitz, Marlene Blüher

**Organization:** Vienna University of Economics and Business (WU), Research Institute for Economics of Aging



**Document Number:** Discussion Paper No. 1/2018 of the AAL-project CareInMovement (CiM) and Discussion Paper No. 1/2018 of the Research Institute for Economics of Aging, Vienna University of Economics and Business (WU)

**Version/Date:** 20 September 2018

**Document Type:** Discussion paper

**Dissemination Level:** public

Funded by the European Commission and Partner States within the Active and Assisted Living Programme

# Table of Contents

# List of Figures



# List of Tables

# Acknowledgements

The project CareInMovement (CiM) – AAL-JP grant number AAL 2014-1-021 – has received funding from AAL JP, cofounded by the European Commission, National Funding Authorities of Austria, Italy and Switzerland and the individual project partners. Collaborating partners in the CiM project were Salzburg Research Forschungsgesellschaft m.b.H. (lead partner), Vienna University of Economics and Business (WU), Paris Lodron University of Salzburg, ilogs mobile software GmbH, bit media e-solutions GmbH, ALDIA Cooperativa Sociale, Hilfswerk Salzburg and Eichenberger-Szenografie. The CiM project ran from October 2015 until September 2018.

This publication would not have been possible without co-funding from WU and FSW (Fonds Soziales Wien/Vienna Social Fund).

### To cite this paper:

Trukeschitz, Birgit; Blüher, Marlene (2018): Online surveys for exploring the usability and user experience of 'CARIMO', an ICT-supported fitness program for care-dependent people, Discussion Paper No. 1/2018 of the AAL-project CareInMovement (CiM) and Discussion Paper No. 1/2018 of the Research Institute for Economics of Aging, Vienna University of Economics and Business (WU), Vienna.

# 1 Introduction

Exploring usability and user experience of Active and Assistive Living (AAL) technologies requires survey techniques for collecting quantitative data that are suitable for the target group of older people. Older people are more likely to have experiences with paper and pencil questionnaires than with online questionnaires. However, online questionnaires provide a couple of advantages compared to paper questionnaires, such as a reduced potential for human error during survey delivery, completion, and data entry (Greenlaw and Brown-Welty 2009). They also offer a greater variety of options to illustrate and accentuate issues within the questionnaire. Tablet computers in particular have been discussed as a suitable medium for the delivery of digital questionnaires to older people, because they require no additional tools for entering information (such as a physical keyboard or a mouse) and their touchscreens provide the opportunity to compensate for potential age-related motor difficulties (Fanning and McAuley 2014).

The consortium of the European AAL JP project [1] "Care in Movement – empowering communities to care by combining smart technology and personal help to maintain mobility" developed a tablet-based fitness and entertainment app, "CARIMO", for older people receiving home care services. CARIMO comprised two devices: a tablet and a wearable fitness bracelet, and was tested for 8 months by 84 home care recipients in Austria and in Italy. We collected data on usability and user experience at two points in time using an online survey that was tailored to the characteristics of CARIMO and the access requirements of the user group. The survey was produced using a common survey tool, LimeSurvey[2], and then integrated into the CARIMO app. The study design of the CARIMO trial was approved by the ethics committee of the University of Salzburg (EK-GZ 30/2016).

The purpose of this working paper is to describe and analyze the usability and user experience data collection using online surveys for older, care-dependent people. In particular, this paper seeks to answer two research questions:

- How was the online survey designed for older people?
- How did the online survey work with older people?

This discussion paper goes as follows: in Chapter 2, we will describe our approach toward collecting data from older people using online surveys. Then, we will address the advantages of digital surveys, the challenges to be anticipated when delivering online surveys to older people, and, lastly, the design of our online survey for the older target group. Chapter 3 provides an overview of the concepts and measures used to evaluate the usability and user experience of CARIMO. In Chapter 4, we will provide an assessment of the online surveys delivered to older users addressing response rates, the duration of data collection, the time to complete the online survey, and potential help received in completing the online survey.

[1] AAL – The Active and Assisted Living (AAL) programme aims to promote active and healthy aging by funding projects in the field of information and communication technology (ICT) (http://www.aal-europe.eu/).
[2] www.limesurvey.org

Chapter 5 will be the conclusion to this working paper, discussing the strengths and limitations of our CARIMO online surveys, and presenting useful online survey features for older people.

# 2 Data collection using online surveys for older people

In this chapter, we elaborate on our decision and approach to conducting the usability and user experience evaluation of CARIMO via an online survey. First, we address the advantages of digital surveys, and in particular, of tablet computers for delivering digital surveys (2.1), and discuss any implications and potential challenges for older adults as respondents of online surveys (2.2). Based on these insights, as well as a review of the existing literature in the area of questionnaire design, we conceptualized the design of the survey in terms of layout and format, which we describe in 2.3.

## 2.1 Advantages of digital surveys and tablet computers

Today, online surveys are widely used in different settings of market and academic research. They have started to supplement or even replace the traditional paper questionnaire for several reasons. While paper questionnaires are often a good and simple solution for small sample sizes, survey administration becomes more expensive and time- and labor-intensive with increasing sample sizes. Moreover, with paper questionnaires, the data is exposed to human error at various points during data collection and data entry, and questions can be left (un-)answered in an unsatisfactory manner. A follow-up on these unanswered items may not be a viable option, either because of time pressure or because a follow-up would be uncomfortable and perceived as coercive by respondents (Greenlaw and Brown-Welty 2009, 466f, Fanning and McAuley 2014, 2). Digital surveys, however, allow for greater control during the delivery of the questionnaires, and apart from fixed investments, costs increase only marginally with rising sample sizes. In addition, digital questionnaires offer the opportunity to validate data in real time, by allowing only ‘valid’ responses (Fanning and McAuley 2014).

Increasingly, mobile devices such as smartphones or, especially recently, tablet computers have been used to complete online surveys (Brosnan, Grün, and Dolnicar 2017). Aside from the possibility to access, complete, and submit a questionnaire from any place (with internet access and a sufficiently charged device), tablets offer a particular set of advantages for the delivery of digital questionnaires, especially for older people with physical restrictions. Tablets rely solely on the touchscreen as a mode of interaction, and do not require additional input equipment, such as a physical keyboard or a mouse. Furthermore, tablet surfaces are typically less visually cluttered with complicated menus and task bars (Fanning and McAuley 2014)

In their studies comparing questionnaires delivered via pen-and-paper method and via tablet computers, Fanning and McAuley (2014), Newell et al. (2015) and Shah et al. (2016) found that both methods of delivery produced similar response rates and data quality. Furthermore, they noted that respondents preferred the tablet version, and even reported enjoying answering the survey more via tablet. Even for people with severe physical restrictions, such as patients in amputee rehabilitation, tablet computers have been found to be a suitable and comfortable mode of data collection (Payne et al. 2017).

In a study of smartphone and tablet use among people with visual impairments, Crossland, Silva, and Macedo (2014) found that people with reduced ability to see also owned tablet

computers, using them mainly for internet access, different apps and e-books. The text-to-speech function, large print, large screens, and the ability to change the font and the contrast were cited as useful features by the respondents.

Particularly in combination with tests of computer-based or mobile apps, system-integrated digital questionnaires may pose an unobtrusive way of collecting data from test users. However, these advantages do not count for much if the actual target group of the digital survey receives it negatively or is not able to handle the online survey.

## 2.2 Challenges of online surveys for older people

Some of the challenges to be considered when developing an online survey for older people are directly related to **older adults' (lack of) experience and familiarity with ICT usage**. To complete a digitally administered questionnaire, a certain level of digital competence is assumed. The respondents have to be able to access the survey, navigate it, and most importantly, answer it (i.e., understand and work with different response formats, select the correct answer, or type a response to an open question). The share of older people adopting ICT in their daily lives has increased over the last few years, with the percentage of internet users among the age group between 65 and 74 rising from 3.3% in 2002 to 51.5% in 2017.[3] However, compared to younger generations, older adults are still less likely to use ICT; among the group between 65 and 74, 41% had never used the internet in 2017, compared to almost 0% among those between 25 and 34 years and 1.5% among those between 35 and 44.[4] There is also a notable difference between men and women among older internet users, with considerably more women (51.8%) having no experience using the internet than men.[5]

Several known factors contribute to this 'digital divide'. However, there is **no consensus in the literature about the main barriers regarding older adults' use of ICT**. While some refer to age-related **decline in physical and cognitive abilities** (Charness and Holley 2004, Czaja and Lee 2007), others argue that the primary barriers are not in fact a skill-deficit, but rather **negative attitudes towards ICT use related to fear, anxiety, lack of motivation and interest** (Selwyn et al. 2003, Neves, Amaro, and Fonseca 2013). In this context, there is some evidence suggesting that older adults are often **less confident** than younger cohorts and tend to **underestimate their knowledge and abilities**, resulting in less frequent use of ICT (Vroman, Arthanat, and Lysack 2015, 157).

When developing an online survey for older people, particularly for people with long-term care needs, possible **physical as well as cognitive limitations** have to be **taken into consideration**. Typical physical, age-related limitations include visual impairments or deficits in motor skills. The digital questionnaire must be readable for older adults; most notably, this means an adequate font, font size, and color contrast.

Because of their apparently intuitive and de-cluttered surface (discussed in Chapter 2.1), tablet computers are sometimes presented as a way to introduce the internet and modern technology to older adults and to close the digital divide between age cohorts (Tsai et al. 2015). For the

[3] https://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/informationsgesellschaft/ikt-einsatz_in_haushalten/053946.html (last accessed 2018-08-22)
[4] https://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/informationsgesellschaft/ikt-einsatz_in_haushalten/073636.html (last accessed 2018-08-22)
[5] https://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/informationsgesellschaft/ikt-einsatz_in_haushalten/073636.html (last accessed 2018-08-22)

same reasons, tablets are also increasingly promoted as suitable formats for delivering online questionnaires for older adults (Fanning and McAuley 2014).

However, regardless of the assumed advantages of tablet computers, it is also important to keep in mind that older adults using **tablets** for the first time might encounter various **usability-related problems** with these devices. Such issues may be due to physical or cognitive conditions, such as the fingers not meeting the requirements of the sensitivity of the touchscreen (e.g. because of arthritic deformation), or not understanding some concepts and symbols crucial to navigating the tablet (e.g. moving back) (Barnard et al. 2013). Furthermore, older adults, who are already accustomed to the use of a stationary personal computer, might face some initial challenges when using a tablet computer with a smaller screen and different mode of interaction (Jayroe and Wolfram 2012). Therefore, adequate support when learning to use the technology, qualified training, and the availability of training materials (e.g. manuals) are crucial components for older adults to successfully adopt tablet usage (Barnard et al. 2013).

Apart from the digital skills and confidence of older adults, which need to be addressed during survey construction and implementation, there are also **challenges related to the design of the survey** itself. These challenges may also be compounded when confronted with a vulnerable target group, such as older, care-dependent people (Rolstad, Adler, and Rydén 2011). The survey design can influence response rates as well as the quality of the data (Ganassali 2008).

One of the most commonly cited challenges of surveys is **'response burden'**. Rolstad, Adler, and Rydén (2011) summarize response burden as "the effort required by the [respondent] to answer a questionnaire", which may be influenced by "questionnaire length, density of sampling, cognitive load required completing the survey, and layout and interface of the reporting format". We identified two aspects of 'response burden' that are especially relevant in the design of a questionnaire for older adults.

First, one of the most prominently discussed aspects of response burden is **survey length**. There is conflicting evidence about the impact of the length of a questionnaire on response rates (Rolstad, Adler, and Rydén 2011). However, some research suggests that closer to the end, items in longer questionnaires tended to have higher non-response, shorter answers in open fields, and a lower variability on ordinal scales (Revilla and Ochoa 2017). It is typically recommended that an online questionnaire should not take longer than 15-30 minutes (Ganassali 2008), others even suggest the limit rather at a duration of 10 to 20 minutes (Revilla and Ochoa 2017).

The second factor, which contributes to survey length, but also plays its own distinct role in response burden, is the **number of response categories**, especially in questions concerning personal attitudes and opinions. Especially in questionnaires covering multiple aspects of a topic or multiple topics, and with several item batteries, respondents might become fatigued or irritated, opting to either quit the survey, or stop answering earnestly. There is no consensus, in the social sciences and in market research, about the 'ideal' length of a response scale. Some propose simple binary formats claiming that more variety is often just random, while others claim that nuance and effect can only be found in ordered scales of 5, 8, or 11 categories (Dolnicar and Grün 2013). In their study comparing binary, ordinal and metric response options related to behavioral intentions, Dolnicar and Grün (2007) found that all three scales produced the same reliability. They concluded that the answer format had an impact on the speed with

which the respondents complete the questionnaire, but all three formats are perceived as "equally simple, pleasant, and useful to express feelings" (Dolnicar and Grün 2007, 108). Assessing forced binary scales in comparison with multi-category formats in the context of opinions on certain brands, (Dolnicar, Grün, and Leisch 2011, 247) found that "forced binary questions were answered more quickly, perceived as less difficult, were equally reliably and led to the same managerial implications." In both cases, they propose that when speed of completion and reducing the potential response fatigue is essential, binary answer formats are suitable and valid options.

## 2.3 The design of the online survey for older people

The CARIMO usability survey was designed and formatted considering the potential challenges of online surveys for older people discussed above. Basically, our decisions about the design and implementation of the survey were based on the assumption that there was no prior experience or familiarity of the respondents with the format of an online survey, or even internet usage in general. Potential visual restrictions, as well difficulties with motor activity, were also taken into account.

### 2.3.1 Survey length and duration of response

The goal was to design a survey that was diverting and varied for the respondents. However, it was most important that filling out the questionnaire would not become a tedious effort for the CARIMO service users. Frustration among the respondents should be avoided, on the one hand, to reduce the risk of incomplete questionnaires. On the other hand, due to the integration of the survey in the CARIMO app, any frustration with the survey might also have had negative implications for the respondents' attitudes and future usage of CARIMO. Thus, we aimed to keep the questionnaire short in accordance with common recommendations in the literature (see Chapter 2.2):

- ☑ **Survey completion should not exceed 15 minutes.** As a general rule of thumb, Hopper[6] suggests that for a 15-minute survey, one should aim for 30 to 45 questions with mixed response types (as simpler and more complex questions are expected to even each other out). We aimed to implement this guideline by reducing the number of questions to 37 in the first survey and 33 in the second survey. We also made use of the survey tool's opportunity to "filter" some questions or make them conditional, where an associated question is only displayed depending on the answer of the previous question. Both surveys contained the same three filtered questions (for more detail, see Trukeschitz and Blüher (2018)). Furthermore, we also kept questions and answer possibilities as simple as possible (see 2.3.2).

### 2.3.2 Survey layout and question-answer format

The layout of the survey, including the question-answer format, is crucial to the length of the questionnaire. It is also relevant to the experience of the respondents when answering the questionnaire. We implemented the following guidelines to ensure a positive turnout:

[6] https://verstaresearch.com/blog/how-many-questions-in-a-10-minute-survey/ (last accessed 2018-08-24)

**Survey layout**

- ☑ **One question per page.** When answering questionnaires on mobile devices, scrolling and complex data input have a negative effect on the completion rate, i.e. with such questionnaires, respondents tend to quit the survey without completing it. Thus, fewer questions per page are recommended for surveys designed for mobile devices.[7] We assumed that our target group might be overwhelmed easily with scrolling and keeping count of multiple questions per page. Therefore, to avoid the need for scrolling altogether, we opted for one question per page and designed the layout of our questions to fit exactly within the screen of the tablet, concluding with the "next" button at the bottom of the screen.

- ☑ **Portrait format.** The CARIMO app was displayed on the tablet in landscape format. However, the portrait format was found to be more suitable for the questionnaire. It enabled us to present the information in the question more comprehensively than the landscape format, and allowed us to keep one question, including illustration, on one page without the need for scrolling, and while keeping a larger font size. Thus, we set up the survey layout for a portrait format, and instructed the respondents in the questionnaire introduction to turn the tablet upright for optimal display.

- ☑ **Images to illustrate the topic of the questions.** Images related to the specific topic of the question were used for two reasons. On the one hand, they were meant to help respondents make the correct associations about the CARIMO aspects addressed in the questions. On the other hand, they could make the questionnaire more colorful and diverting for the respondents.

- ☑ **No skipping questions.** To avoid respondents unintentionally skipping questions in the survey and forgetting about them (a "back" option was provided to change previous responses), we set the survey to prohibit skipping questions. Normally, respondents answered a question and then clicked on the "next" button. However, if the respondents left a question unanswered and tried to move on, a short text popped up instructing them to answer the question. As this incorporates the risk that respondents may feel too forced to answer questions they are truly not able to answer, we allowed for a 'don't know' option to indicate their ambivalence (see also below).

**Question-answer-format**

- ☑ **Single and multiple-choice questions in check-box (radio-button) format.** Simple, one-click response formats are recommended specifically for the design of web surveys to be completed on mobile devices.[8] Furthermore, we assumed that the respondents were not familiar with less traditional survey methods in online surveys, such as drop-down or drag-and-drop ranking response types. Except for one open-field type question at the end of the usability survey, we aimed to conduct the survey using only simple and typically known question types.

- ☑ **Reduced number of response options.** We aimed to minimize the burden and duration of responses by reducing the number of response options. As explained in detail in 5.3, Dolnicar and Grün (2013) found that collapsing response options can be

[7] https://www.surveymonkey.com/curiosity/optimize-mobile-surveys/ (last accessed 2018-08-23)
[8] https://www.surveymonkey.com/curiosity/optimize-mobile-surveys/ (last accessed 2018-08-23)

a valid option without critically compromising the quality and validity of the results. Instead of using a ranking scale, we scaled down most of our response options to a binary format, using simple Yes/No questions. Similarly, we collapsed the original 7-response scale for two opposite ends of a semantic differential ranging from -3 (boring) to +3 (entertaining) to a binary response option allowing users to indicate the general trend of user experience, e.g. whether the respondent assessed CARIMO as 'rather boring' or 'rather entertaining'). Furthermore, reducing response options also enabled us to keep with the previous guideline of one question per page, while ensuring the question and answer options were still large enough to read for people with visible impairments.

☑ **Familiar images for ranking scales relating to enjoyment.** For the rating of the individual CARIMO features, we kept ranking scales, but used images the respondents were familiar with from the CARIMO app (see Figure 1).

**Figure 1: CARIMO smiley faces**

Source: CiM Project

In the survey tool we used, LimeSurvey, the images had the additional advantage: to select an answer, the respondents simply had to tap on the image. The goal was to enable respondents to complete the survey even when experiencing limitations in vision or fine motor skills.

☑ **Including "don't know" options.** There is frequent consensus that by offering a "don't know" answer option, survey results may lose information. Researchers may be concerned that respondents may rather choose the 'don't know' option to quickly complete even more difficult parts of the survey instead of giving them another thought (along with "satisficing" or "response-style behavior", see Dolnicar and Grün (2014)).[9] Apart from "don't know" in the sense of "I cannot recall or retrieve this information at all", a respondent choosing "don't know" can have other reasons for picking this option. This choice may imply a respondent does not feel his/her answer qualifies in terms of detail or accuracy, or does not want to answer (Beatty et al. 1998). Depending on the placement of the "don't know" answer option in opinion questions, it can also be interpreted and selected as an ambiguous (neither/nor) answer (Dolnicar and Grün 2014), however there is no certainty regarding how the respondent understood, and consequently selected, a "don't know" answer.

Nonetheless, if justified accordingly, there are legitimate reasons to include "don't know" as an answer option, for example, if "not knowing" may be likely for a considerable amount of respondents (Dolnicar and Grün 2014). Especially after the first months of the CiM project, we expected some CARIMO test users to not be familiar enough with the app or certain features of CARIMO to feel capable of giving a qualified response. Therefore, to avoid false results by forcing respondents to choose a positive or negative answer, "don't know" was included as a response option for some questions

[9] https://verstaresearch.com/blog/dont-know-is-not-an-option/ (last accessed 2018-08-24)

concerning attitudes towards CARIMO. As we wanted to learn more about the share of respondents unable to assess CARIMO, the 'don't know' option was placed separately and not between response options to reduce the number of respondents choosing it as an ambiguous answer. Furthermore, we argue that for the usability evaluation of CARIMO, and in the context of usability surveys for older adults in general, there is something to learn from the prevalence of "don't know" answers. We chose not only to include don't know answer options in some of our questions, but to analyze them as well, which has led to relevant insights about the usability of CARIMO (see Trukeschitz and Blüher 2018).

### 2.3.3 Survey delivery

The mode of survey delivery may also affect the ease or difficulty faced by respondents when accessing the survey. To facilitate the users' access to the CARIMO usability survey, the survey was **integrated into the CARIMO app**. By implementing the following features, we aimed to make sure that users were aware of the survey, and had a convenient way to access and complete it.

- ☑ **Pop up window to inform about the survey.** The CARIMO test users were informed about the survey via a pop up dialogue window that appeared once a day when they activated CARIMO, providing them with two options: to do the survey now or later. After clicking on the button "Yes, I want to do the survey now", the survey opened automatically in the default web browser. In this manner, the pop up window was set up as a **daily reminder** until the survey was completed or the data collection ended.

- ☑ **Offer users the option to postpone the start of the survey.** It was possible that the survey pop up came at a time that was not convenient for the users to participate in the survey. Therefore, in addition to starting the survey right away, the pop up window provided the option to do the survey "later", with no further pop-ups that day. On the following day, another pop-up reminding to fill in the questionnaire appeared which was repeated until the CARIMO test users answered the survey or the data collection ended.

- ☑ **Permanent button to access the survey via the CARIMO home screen.** This feature was made available for the second survey, after feedback from CiM-Assistants, who supported CARIMO test users with filling out the survey. The first usability survey was only accessible via the daily pop up window, but once the survey was postponed for "later", people had to wait for the next day to start the survey. Thus, in addition to the daily reminder pop up, a shortcut was installed on the CARIMO home screen that made the survey accessible at any time. Users who wanted to fill out the survey later in the day could do so for the second survey, adding to a more convenient answering experience.

- ☑ **Offer users a break.** This feature was implemented after feedback from the care organization, who pretested the survey and reported that they perceived the questionnaire to still be quite long. While it was theoretically possible to interrupt the survey at any given point, after approximately half of the questions, the respondents were provided with a screen explicitly asking if they wanted to pause the survey until the next day, or if they wanted to continue right then. By offering this break option,

respondents who might already have been tired from answering the survey, had a "legitimate" option to stop the survey (and continue later).

- ☑ **Automatic return to CARIMO.** We aimed for a coherent integration of the survey into CARIMO. Thus, we set up the survey so that upon completion of the questionnaire, respondents would be returned to the CARIMO app automatically. This step was also important considering our assumption that among the CARIMO test users there would be people who were not familiar with operating web browsers on the tablet, and who might have difficulty returning to CARIMO on their own. Implementing the automatic return could ensure that after respondents completed the survey they would get back to the main app.

# 3 Usability and user experience of CARIMO

In this chapter, we briefly describe the concepts shaping our evaluation design. Usability and user experience are central terms in evaluating user perception of technological products and apps. However, to gather meaningful insights about the usability and user experience of CARIMO, the concepts have to be defined and geared towards the intended target group and the purpose of the product. After a review of existing measures of usability and user experience, we found that they were not entirely suitable for application in the evaluation of CARIMO: they are too generic, often assume digital skills and familiarity with ICT terminology, and do not explicitly focus on the user's personal experience (for more detail, see Trukeschitz and Blüher (2018)).

Subsequently, we focus on the core definitions of the terms usability and user experience (see section 3.1), and then explain how we applied them to the evaluation of CARIMO (see section 3.2).

## 3.1 Usability and user experience

The concept of **usability** deals with the design and characteristics of technological devices and apps in regards to their usage. Theories and standards of usability, most notably ISO 9241-210, which describes a human-centered approach to the design of interactive systems, are used as guidelines for the development of new technological products as well as for the evaluation of existing products and software.

According to ISO 9241-210, usability is defined as the "*extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use*". Following ISO 9241-110, the guiding principles of usability for the design of a computer interface are its suitability for the task, self-descriptiveness, conformity with user expectations, suitability for learning, controllability, error tolerance, suitability for individualization.

The term **user experience (UX)** emerged as a counter-movement to the dominant concept of usability, which is very much work-related and process-oriented, to move beyond the instrumental aspects of using a product. User-experience focuses on the "human perspective", recognizing the significance of emotions, affect and experiences in person-computer interaction. It is concerned with the subjective, affective reasons and consequences of usage:

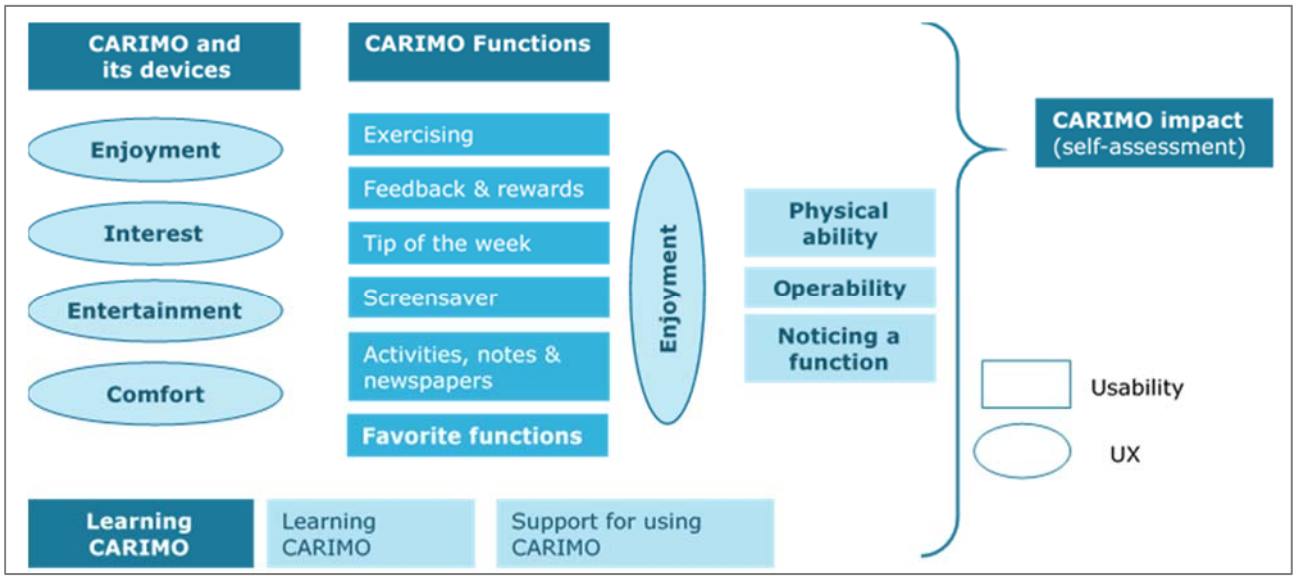
"*UX is a **consequence** of a **user's internal state** (predispositions, expectations, needs, motivation, mood, etc.), the **characteristics of the designed system** (e.g. complexity, purpose, usability, functionality, etc.) and the **context** (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.).*" (Hassenzahl and Tractinsky 2006, 95).

## 3.2 Selecting usability and user experience aspects to evaluate CARIMO

CARIMO offered too many features to be included in one questionnaire. Thus, the online survey to evaluate **the usability and user experience of CARIMO** had to be limited to features of the app that seemed most important for further development of CARIMO and for understanding the actual usage behavior. To select these (design) features, we developed a first draft of the usability questionnaire and collected feedback and further topics of interest in the CiM consortium, particularly from the developers of CARIMO (technical and content partners), the user interface designer and the two care organizations. The final decisions were made by the research team at the WU, the Vienna University of Economics and Business, who was responsible for the evaluation of usability and user experience.

The final questionnaire focused on four aspects of usability and user experience of the CARIMO program for home care service users: the devices (tablet and fitness bracelet), learning CARIMO, CARIMO functions and the self-assessed impact of CARIMO on the test users' attitudes (see Figure 2).

**Figure 2: Selected usability and user experience aspects of CARIMO**



# 4 Assessment of the online-survey to explore usability and user experience of CARIMO

In this section, we evaluate the feasibility of the online survey that we carefully tailored to the abilities of care dependent older people (see Sections 2 and 3). We assessed response rates (4.1), duration of data collection (4.2), the average time to complete the surveys (4.3), and whether people had to rely on help from others for the periods of data collection for both surveys (4.4).

## 4.1 Response rates

In total, 114 home care recipients participated as test users for the CiM project, 69 in Austria and 45 in Italy. Originally, the aim was to recruit 120 participants for the trial phase, 60 in each country. However, this number could not be reached by the home care organizations in charge of recruitment. Due to various reasons (e.g. declining health status), several participants dropped out of the project after it started. Ultimately, 84 people (53 in Austria and 31 in Italy) tested CARIMO for the entire testing period of 8 months[10].

The usability survey was administered to the test users twice during the trial phase: once after the 6-week initial training period where CARIMO was introduced to the service users, and once in the last month of the eight-month CARIMO trial period.

Altogether, 90 CARIMO test users participated in one or both surveys. Of those 90 users, 77 participated in both surveys, 10 only in the first, and 3 only in the second survey. Thus, there were 87 CARIMO test users who filled out the first usability survey, and 80 users who participated in the second survey. Furthermore, some users quit the surveys before finishing them, resulting in partial questionnaires in both surveys (5 partial questionnaires in $t_1$ and 3 in $t_2$; 5 partial questionnaires in those who participated in $t_1$ and $t_2$). Altogether, 72 respondents completed both questionnaires. Considering the number of participants towards the end of the CARIMO trial period, the response rates for participants, who started and completed both questionnaires respectively, translated to 91% and 86%.

***First wave* ($t_1$)**

The first usability survey for CARIMO service users was active between August 2nd and September 15th 2017 in Austria, and between August 10th and October 25th 2017 in Italy. Overall, 87 CARIMO test users, or 94% of all active[11] trial participants, responded to the first usability survey. In Austria, 55 (95%) participants started and completed the online survey. In Italy, 32 (91%) participants started the survey, and 27 (77%) finished it. Altogether, 82 CARIMO test users (88%) completed the first survey and answered all questions.

63.2% (55) of the respondents were home care service users from Austria, 36.8% (32) from Italy. The majority of participants (74.4%) were women (71.9% in Italy, and 76.4% in Austria). The respondents were between 49 and 91 years old. The average age was 74.6 (75.9 in Italy

[10] For more information on the trial phase and the test users, see Trukeschitz et al. (2018).
[11] During the 8-month trial phase, i.e. before, during and after the two usability surveys were available, some participants withdrew from the project for different reasons. “Active” refers to the trial participants that were active during the availability of the online survey or at the end of the survey in the respective countries.

and 73.9 in Austria); half of all participants were 75 years and older (median of 75.5 in Italy, 75 in Austria).

### *Second wave ($t_2$)*

The second usability survey for CARIMO service users was available from February 19th and finished on March 26th in Austria, and March 20th 2017 in Italy. In total, 80 CARIMO test users, or 95% of all active trial participants, participated in the second wave of the usability survey. In Austria, 53 service users (100%) started the survey, and 52 (98%) completed it, in Italy, 27 (87%) participants started the survey and 25 (81%) completed it. Excluding the three partial responses, 77 respondents, or 92% completed the second usability survey.

In the second survey, 66.25% (53) of the respondents were from Austria, and 33.75 (27) were from Italy. In total, almost exactly three quarters of the respondents were women, 74.1% in Italy, and 75.5% in Austria. The respondents were between 49 and 91 years old, with a mean age of 74.4 years, 76.1 in Italy, and 73.5 in Austria. The median age for both countries was 75 years.

**Table 1: Overview of response rates in $t_1$ and $t_2$**

| | | |
|---|---|---|
| **1st survey**: (88% response rate excl. 5 partial) | | |
| Austria: | August 2nd – September 15th 2017 | 55 complete questionnaires (**95%**) |
| Italy: | August 10th – October 25th 2017 | 27 complete questionnaires (**77%**) excl. 5 partial |
| **2nd survey** (92% response rate excl. 3 partial) | | |
| Austria | February 19th – March 26th 2018 | 52 complete questionnaires (**98%**) excl. 1 partial |
| Italy | February 19th – March 20th 2018 | 25 complete questionnaires (**81%**) excl. 2 partial |
| ***72** participants completed **both questionnaires** (excl. 5 partial)* | | |

Source: WU, CiM usability surveys, (SU) 2017/2018, n=90, own calculations

### *Partial questionnaires ($t_1$ + $t_2$)*

Eight CARIMO test users (8.8%) submitted partial questionnaires. Five respondents in the first survey and three respondents in the second survey quit the usability questionnaire before finishing it.

In $t_1$ (37 questions), all of those who quit the questionnaire were Italian CARIMO test users (two men, three women). One user quit after question 5, one after question 18, and one user quit after question 24. Two users practically finished the questionnaire, but quit after question 35 and were included in the non-completion rate. Three of the respondents who delivered partial questionnaires in the first survey later completed the second survey without quitting it. The other two dropped completely dropped out of the CiM project several weeks after the first usability survey.

In $t_2$ (33 questions), one respondent was from Austria, and two were from Italy (one man, two women). One user broke off the survey after the first question, one only opened the survey but did not continue, and one user quit after question 21. The CARIMO test user who only opened

the second questionnaire without answering any questions had not participated in the first survey at all. The other two had completed the first survey.

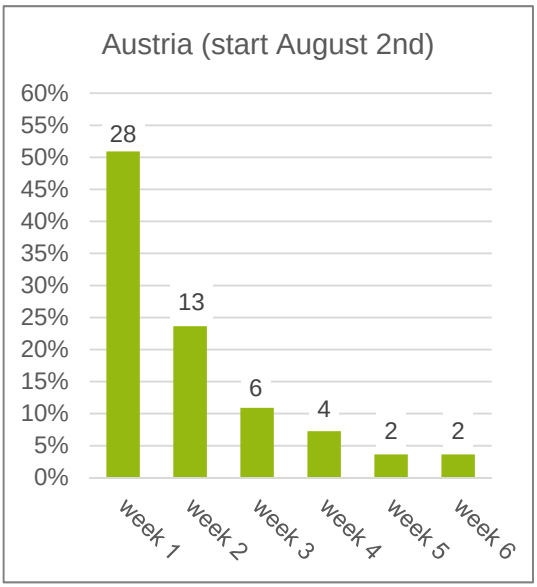
***"One-time respondents" ($t_1$ + $t_2$)***

We were interested in some basic demographic characteristics of the users who participated in only one of the two usability surveys. Of the 13 CARIMO test users, who participated in only one of the usability surveys, 69.2% were women (compared to 75.3% women among two-time respondents). The people who answered only one survey were between 62 and 88 years old, with an average age of 77.2 and a median age of 79 years. The "one-time respondents" were thus slightly older than those who participated in both surveys.

## 4.2 Duration of data collection

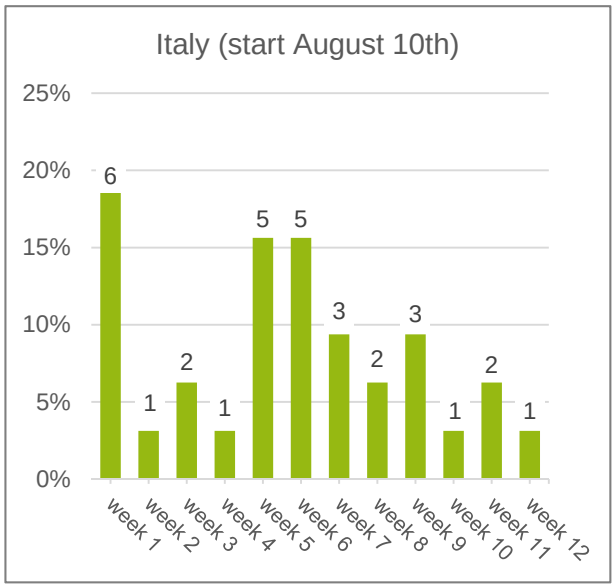
Data collection for the first survey lasted about 6 weeks in Austria and about 12 weeks in Italy. In Austria, slightly more than half of the surveys were completed during the first week, then the response rate slowed down with fewer people responding each week (see Figure 3). In Italy, the response was slower and more evenly distributed over 12 weeks (see Figure 4).

**Figure 3: Duration of data collection ($t_1$, Austria)**




Source: WU, CiM usability survey, (SU) 2017, n=55, own calculations; week: Mon-Sun

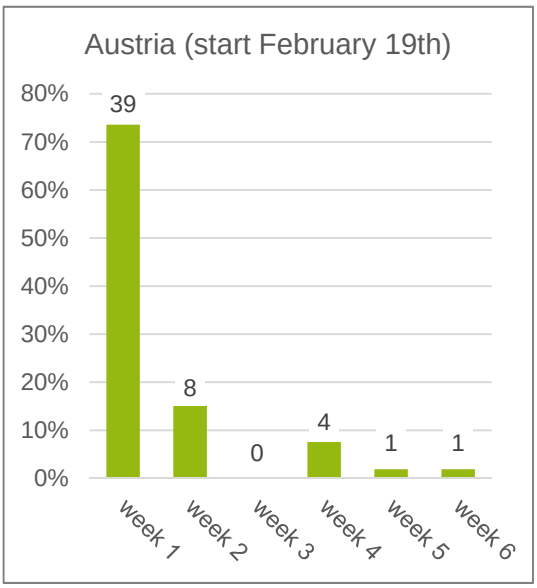
**Figure 4: Duration of data collection ($t_1$, Italy)**




Source: WU, CiM usability survey, (SU) 2017, n=32, own calculations; week: Mon-Sun

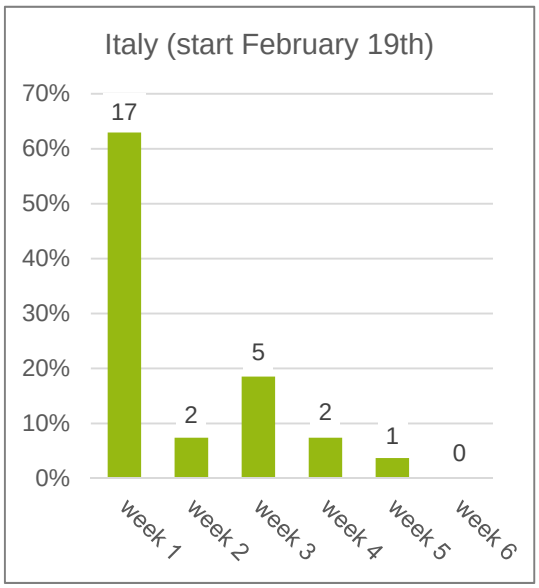
The period of data collection for the second survey was shorter in comparison, lasting 6 weeks in Austria (see Figure 5) and 5 weeks in Italy (see Figure 6). Also in contrast to the first wave, the majority of respondents in both countries (over 70% in Austria and over 60% in Italy) completed the survey within the first week.

**Figure 5: Duration of data collection ($t_2$, Austria)**




Source: WU, CiM usability survey, (SU) 2018, n=53, own calculations; week: Mon-Sun

**Figure 6: Duration of data collection ($t_2$, Italy)**




Source: WU, CiM usability survey, (SU) 2018, n=27, own calculations; week: Mon-Sun

The initial availability of the surveys over CARIMO (i.e. the daily pop-up reminders to complete the survey) was extended for both waves to achieve the highest possible number of responses. Additionally, the CiM-Assistants were tasked with reminding the users to complete the surveys or help them in doing so (for further information about the help received for completing the surveys, see 4.4). The longer the duration of return, especially with the first survey, could also be related to the fact that it took place during the summer, when many of the CiM-Assistants were on their annual leave and could not follow up on their CARIMO service users in a timely manner.

## 4.3 Time to complete the online survey

One important requirement of the survey design was that the surveys should not take the users much longer to complete than approximately 15 minutes (see Chapter 2.3). This was also the approximate duration that was given to the respondents in the introduction to the survey.

Due to the conditional questions in the surveys (see Section 2.3.1), some respondents were shown more questions than others (between 1 and 3 additional questions). This resulted in response times that were longer overall. In addition, the second survey was slightly shorter than the first survey. Thus, the time used to reply to the individual questions was used for comparison between the countries and survey waves.

For the first survey, which comprised 37 questions in total, respondents took between 3 minutes and 52 seconds and 43 minutes and 52 seconds to answer. The overall mean response time was slightly more than 15 minutes. In Austria, respondents were on average 2 minutes 30 seconds faster than in Italy. Half of the respondents took longer than 13 minutes to answer the first survey, in Austria 12 minutes 37 seconds, and in Italy, almost 14 minutes (see Table 2). The differences between the response times in Austria and Italy, in terms of the total questionnaire response time as well as the mean response time per question, were not significant.

**Table 2: Response times ($t_1$)**

| First wave | Total (n=81 +,++) | Austria (n=54 +) | Italy (n=27 ++) |
|---|---|---|---|
| **Number of questions** | **37** | | |
| **Shortest response time** | 3.86 min (3min 52sec) | 3.86 min (3min 52sec) | 5.72 min (5min 43sec) |
| **Longest response time** | 43.86 min (43min 52sec) | 39.96 min (39min 58sec) | 43.86 min (43min 52sec) |
| **Mean response time overall** | 15.20 min (15min 12sec) | 14.35 min (14min 21sec) | 16.89 min (16min 53sec) |
| **Median response time overall** | 13.04 min (13min 2sec) | 12.61 min (12min 37sec) | 13.97 min (13min 58sec) |
| **Mean response time per question (sec)** | 26.33 sec | 24.92 sec | 29.12 sec |
| **Median response time per question (sec)** | 16.76 sec | 16.15 sec | 18.47 sec |
| + an extreme outlier (1566.90 min to complete the survey) in Austria was excluded from the calculation<br>++ 5 partial responses in Italy were excluded from the calculation | | | |

Source: WU, CiM usability survey, (SU) 2017, n=81, own calculations

As expected, the second survey, which was shorter by four questions, also took respondents less time to answer. The users' response times ranged between 4 minutes 28 seconds and 50 minutes 44 seconds, with an average duration of almost 12 minutes, and similar durations in Austria and in Italy. Half of the respondents took less than about 9 and a half minutes to complete the second survey, in Austria and in Italy (see Table 3). As in the first survey, the differences between the response times in Austria and in Italy were also not significant, concerning both the overall response time per questionnaire, as well as the mean response time per question.

**Table 3: Response times ($t_2$)**

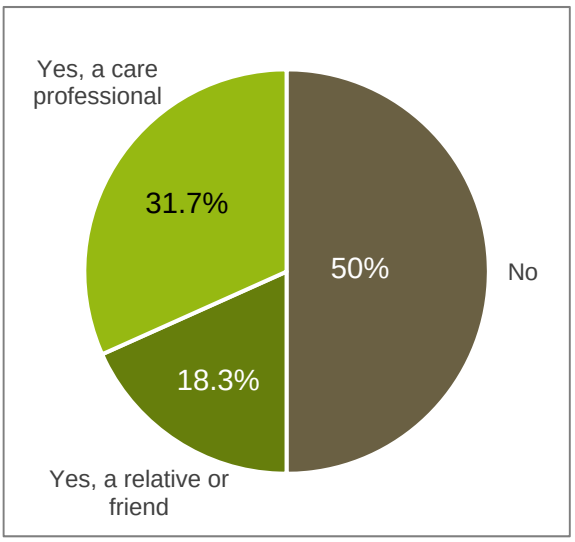
| Second wave | Total (n=77 +,++) | Austria (n=52 +) | Italy (n=25 ++) |
|---|---|---|---|
| **Number of questions** | **33** | | |
| **Shortest response time** | 4.47 min (4min 28 sec) | 4.76 min (4min 46sec) | 4.47 min (4min 28sec) |
| **Longest response time** | 50.74 min (50min 44sec) | 50.74 min (50min 44sec) | 29.91 min (29min 55sec) |
| **Mean response time overall** | 11.97 min (11min 58sec) | 11.86 min (11min 52sec) | 12.19 min (12min 11sec) |
| **Median response time overall** | 9.60 min (9min 36sec) | 9.53 min (9min 32sec) | 9.76 min (9min 46sec) |
| **Mean response time per question (sec)** | 23.71 sec | 23.71 sec | 23.69 sec |
| **Median response time per question (sec)** | 14.76 sec | 14.57 sec | 14.76 sec |
| + 1 partial response in Austria was excluded from the calculation<br>++ 2 partial responses in Italy were excluded from the calculation | | | |

Source: WU, CiM-usability survey, (SU) 2018, n=77, own calculations

## 4.4 Help received for completing the online survey

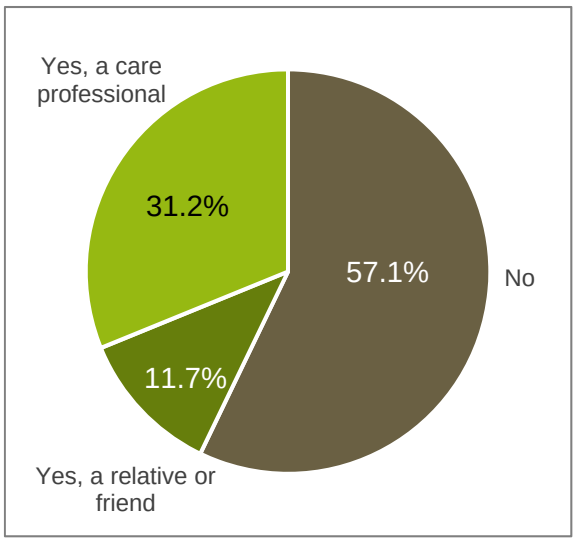
Half (50%) of those who completed the first survey stated that they did not receive any help in filling out the questionnaire, whereas 18.3% had had help from a relative and 31.7% had received help from a care professional (see Figure 7). In the second survey, more respondents reported that they had no help with answering the questionnaire. While the share of people who had help from a care worker remained approximately the same at around 31-32%, fewer people had help from friends or relatives (see Figure 8). Overall, the reduction in needing help was not significant.

**Figure 7: Help with answering the survey, $t_1$**




Source: WU, CiM usability survey, (SU) 2017, n=82, own calculations

**Figure 8: Help with answering the survey, $t_2$**




Source: WU, CiM usability survey, (SU) 2018, n=77, own calculations

In general, our CARIMO online survey seemed to have been accepted by the home care recipients, although support from care workers and others was important even after the six-week initial training of CARIMO and already having been supported once with the second survey.

# 5 Conclusions

In this working paper, we described the design and implementation of a digital survey for older adults with care needs to evaluate the usability and user experience of the app CARIMO. In addition, we assessed the strengths and limitations of the digital survey approach for older people and identified some useful features for online surveys targeted at older people. CARIMO is a tablet-based fitness, entertainment, and communication app for older users of home care services and consists of a tablet and a fitness bracelet. The survey was conducted twice in nearly identical form to assess changes in the perceptions of the CARIMO test users over time (the results are available in Trukeschitz and Blüher (2018)).

## 5.1 Strengths and limitations of the CARIMO online surveys

So far, there are not many publications discussing the implementation of a tablet-based online survey for an older, vulnerable target group. Fanning and McAuley (2014) provide preliminary evidence suggesting that using tablets to administer questionnaires to older adults is an

acceptable method of data collection. They report that older adults preferred the tablet version to a paper-and-pen format, appreciated speed of use, dynamic features and easy data entry, but found the tablet questionnaires more difficult to navigate in comparison. Beyond this, there is not much evidence about characteristics and features required to successfully enable older adults to complete online surveys. Our insights from conducting a tablet-based online survey for older adults confirm the findings of Fanning and McAuley (2014). In addition, we emphasize the **importance of careful design** and **implementation of the digital survey** that considers the abilities and interests of the target group.

The online survey tool recorded information about individual questionnaire response, such as the completion date, and the response time for individual questions and the whole survey. This allowed us to **assess the implementation** of the CARIMO usability and user experience evaluation without putting additional questions in front of the respondents. However, beyond the actual response and completion rates, we did not assess how the respondents actually perceived the surveys.

For the successful implementation of our online survey concerning the usability and user experience of CARIMO, we considered a number of **potential challenges older, vulnerable people may face**. A lack of experience with online surveys in particular, a lack of familiarity with ICT in general, and a combination of cognitive and physical limitations are common barriers in terms of ICT usage of older adults (see e.g. Vroman, Arthanat, and Lysack (2015)). Importantly, we aimed to get the CARIMO participants to access the survey, and then stay interested and able to complete the questionnaire.

Thus, we sought to keep their **response burden to a minimum**. We conducted a review of the literature concerning older people's challenges and needs in terms of ICT-usage and online questionnaires (e.g. Vroman, Arthanat, and Lysack 2015, Fanning and McAuley 2014), as well as research on the design and completion rates of online surveys in general (e.g. Brosnan, Grün, and Dolnicar 2017). Based on the evidence from previous studies, we then set a framework for the design and layout of the surveys. All aspects of the design focused on simplification of the survey, starting with the integration of the survey in CARIMO (for easy accessibility), the questionnaire length, and the choice of wording and formats of questions and response options.

The simplification approach was satisfactory, in terms of high response rates and completion rates. However, some interventions and adaptations to our approach during data collection (activating CiM-Assistants, introducing a permanent link to the questionnaire in $t_2$) were necessary to achieve these results. The data collection period was relatively long for both surveys, 6 and 12 weeks in Austria and Italy respectively for the first survey, and 6 weeks in both countries for the second survey. In addition to the daily CARIMO reminders and calls from CiM-Assistants, both times, around 30% of service users were reminded and supported by CiM-Assistants to complete the surveys.

Compared to the first survey, (non significantly) a smaller number of respondents in the sample needed **help** and more filled out the second survey on their own (57% in $t_2$ compared to 50% in $t_1$). Furthermore, two thirds of the respondents had submitted the second survey within the first 3 days, whereas it took 21 days in the first survey to reach the same response rate. Carefully interpreted, users seemed to have become familiar with the process and potentially more confident in opening the second survey on their own. Another reason could be that CARIMO test users had the opportunity to access the second survey at any time that was

convenient for them via the new permanent button on the CARIMO home screen. It is also possible that the CiM-Assistants were more actively pointing the CARIMO users to answer the survey. Hence, it seems useful to not only have tools but also to have people to remind the participants to complete the online questionnaires.

Although CARIMO users indicated that they *had* help to complete the survey, this does not necessarily mean that they *needed* help. For some, it may have been the case that the CiM-Assistant was present or reminded the CARIMO user to fill out the survey, in a "let's do this together!" attitude to speed up the process of data collection. Either way, the presence of the CiM-Assistants (or others) may have had implications for the responses, which needs to be considered in the analysis of the survey results.

By keeping the surveys short, with fewer questions, reduced response options and only selectively applying items from existing measures, we managed to keep the **duration for completing a questionnaire** in the recommended time frame below 20, and around 15 minutes (on average). The median response time was 13 minutes in the first survey, and less than 10 minutes (9 minutes, 36 seconds) in the shorter, second survey. In the second survey, respondents were two seconds faster per question, indicating that they were already familiar with the format and content and thus able to reply a bit faster. However, as can be expected, the short and simple survey came at the expense of some additional meaningful information (if we had been able to ask more questions) and at the expense of more detailed, more varied responses (if we had used more nuanced response formats).

We also considered the decision to selectively include **"don't know" as a response category** as beneficial for the overall soundness of the usability and user experience evaluation of CARIMO. The results, discussed in detail in Trukeschitz and Blüher (2018), showed that "don't know" was chosen by respondents in what we deemed an "acceptable" amount (typically below 5 or 10%). Moreover, a significant share of "don't know" in some questions actually reflected issues with project implementation in the first few months. In hindsight, the "don't know" response option could have also been included in questions asking respondents to recall something (e.g. whether they had seen a certain feature in CARIMO). This way, cases where respondents essentially "contradicted" themselves and distorted the analysis could have been avoided more effectively.

Finally, we tailored the **survey to fit exactly on the display of the CARIMO tablet**, showing one question at a time on the screen. Furthermore, the integration of the survey into the CARIMO app was based on a token system that allowed us to connect responses to individual users and link the two surveys for our analysis of changes over time. Thus, the surveys were optimally displayed only on tablets, and available to service users only via their own CARIMO tablet. This could be considered a strength as well as a limitation – if there were users who would have preferred answering the survey on a smart phone or a PC, this would not have been possible.

## 5.2 Useful online survey features for older people

Based on our assessment of the responses in general, we identified useful online survey features that facilitate participation of older people. In the case of the CARIMO usability and user experience surveys, some of these features were implemented in the online survey tool (which may also set some restrictions to specific design ideas), whereas others had to be programmed into the CARIMO app or the interface between the app and the survey.

First, when designing an online survey, it is important to consider how the **survey is delivered** and how the target group can **access the survey easily**:

- ☑ Because it is easy to forget about a survey, or forget how to access it exactly, we opted for **daily reminders to complete the questionnaire**. However, we also tried to avoid giving the users the impression of being forced to participate. Therefore, we included the **option to postpone answering the survey**. The option to continue or start the survey at any time during the second survey (via the **permanent survey access shortcut** on the CARIMO home screen) appeared to be a useful addition to the second survey, shown by the quicker response times for the second survey.

- ☑ Something might come up when answering the questionnaire or a respondent might become tired. Thus, we included an opportunity to stop the survey and continue participation another time (by **offering an optional break**). Via the daily reminder, and in the second survey, the permanent questionnaire shortcut, users had the possibility to return to the survey the next day or another time and resume answering the questionnaire.

The survey tool allowed us to **customize the CARIMO usability survey** according to the identified needs and challenges of older adults:

- ☑ We used a **bigger font size** and made sure the **color contrast** of the graphic layout was compatible with people with visual impairments.

- ☑ To avoid the need for scrolling, we divided up questions so **each question would be shown on a single page**. We took care that the **"next" button was always visible**. We used the same tablet for the formation of the survey as for the test users to check that the layout of the survey displayed well on the intended response medium. This may take some time, but we argue it was worth the effort to promote a positive experience for the respondents.

- ☑ We also included **images** for two reasons: first, to point people to the topic of the questions, and second, images as response options facilitated choosing a response on the screen by simply tapping on the image (as opposed to hitting the radio button or a line of text). This way, we were able to account for potential motor disabilities among the older users, and give visually impaired respondents a break from having to read lengthy response options.

There were some additional features we planned to implement, but were unable to, due to time constraints during the construction of the questionnaire in LimeSurvey or due to limited setting options. For future surveys involving this target group, we recommend looking into making bigger check boxes (radio buttons) to facilitate proper response selection. Furthermore, we also suggest implementing an easy text-to-speech feature, which reads text out loud to people who have difficulties reading the questions and response options.

# 6 References


Barnard, Yvonne, Mike D. Bradley, Frances Hodgson, and Ashley D. Lloyd. 2013. "Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability." *Computers in Human Behavior* 29 (4):1715-1724. doi: https://doi.org/10.1016/j.chb.2013.02.006.

Beatty, Paul, Douglas Herrmann, Cathy Puskar, and Jeffrey Kerwin. 1998. "'Don't Know' Responses in Surveys: Is What I Know What You Want to Know and Do I Want You to Know It?" *Memory* 6 (4):407-426. doi: 10.1080/741942605.

Brosnan, Kylie, Bettina Grün, and Sara Dolnicar. 2017. "PC, Phone or Tablet?: Use, Preference and Completion Rates for Web Surveys." *International Journal of Market Research* 59 (1):35-55. doi: 10.2501/ijmr-2016-049.

Charness, Neil, and Patricia Holley. 2004. "The New Media and Older Adults:Usable and Useful?" *American Behavioral Scientist* 48 (4):416-433. doi: 10.1177/0002764204270279.

Crossland, Michael D., Rui S. Silva, and Antonio F. Macedo. 2014. "Smartphone, tablet computer and e-reader use by people with vision impairment." *Ophthalmic and Physiological Optics* 34 (5):552-557. doi: 10.1111/opo.12136.

Czaja, Sara J., and Chin Chin Lee. 2007. "The impact of aging on access to technology." *Universal Access in the Information Society* 5 (4):341. doi: 10.1007/s10209-006-0060-x.

Dolnicar, Sara, and Bettina Grün. 2007. "How constrained a response: A comparison of binary, ordinal and metric answer formats." *Journal of Retailing and Consumer Services* 14 (2):108-122. doi: https://doi.org/10.1016/j.jretconser.2006.09.006.

Dolnicar, Sara, and Bettina Grün. 2013. ""Translating" between survey answer formats." *Journal of Business Research* 66 (9):1298-1306. doi: https://doi.org/10.1016/j.jbusres.2012.02.029.

Dolnicar, Sara, and Bettina Grün. 2014. "Including Don't know answer options in brand image surveys improves data quality." *International Journal of Market Research* 56 (1):33-50. doi: 10.2501/ijmr-2013-043.

Dolnicar, Sara, Bettina Grün, and Friedrich Leisch. 2011. "Quick, Simple and Reliable: Forced Binary Survey Questions." *International Journal of Market Research* 53 (2):231-252. doi: 10.2501/ijmr-53-2-231-252.

Fanning, Jason, and Edward McAuley. 2014. "A Comparison of Tablet Computer and Paper-Based Questionnaires in Healthy Aging Research." *JMIR Res Protoc* 3 (3):e38. doi: 10.2196/resprot.3291.

Ganassali, Stéphane. 2008. "The Influence of the Design of Web Survey Questionnaires on the Quality of Responses." *Survey Research Methods* 2 (1):21-32. doi: 10.18148/srm/2008.v2i1.598.

Greenlaw, Corey, and Sharon Brown-Welty. 2009. "A Comparison of Web-Based and Paper-Based Survey Methods:Testing Assumptions of Survey Mode and Response Cost." *Evaluation Review* 33 (5):464-480. doi: 10.1177/0193841x09340214.

Hassenzahl, Marc, and Noam Tractinsky. 2006. "User experience - a research agenda." *Behaviour & Information Technology* 25 (2):91-97. doi: 10.1080/01449290500330331.

Jayroe, Tina J., and Dietmar Wolfram. 2012. "Internet searching, tablet technology and older adults." *Proceedings of the American Society for Information Science and Technology* 49 (1):1-3. doi: 10.1002/meet.14504901236.

Neves, Barbara Barbosa, Fausto Amaro, and Jaime R. S. Fonseca. 2013. "Coming of (Old) Age in the Digital Age: ICT Usage and Non-Usage among Older Adults." *Sociological Research Online* 18 (2):1-14. doi: 10.5153/sro.2998.

Newell, Steve M., Henrietta L. Logan, Yi Guo, John G. Marks, and James A. Shepperd. 2015. "Evaluating Tablet Computers as a Survey Tool in Rural Communities." *The Journal of Rural Health* 31 (1):108-117. doi: doi:10.1111/jrh.12095.

Payne, Michael, Shannon Janzen, Eric Earl, Barry Deathe, and Ricardo Viana. 2017. "Feasibility testing of smart tablet questionnaires compared to paper questionnaires in an amputee rehabilitation clinic." *Prosthetics and Orthotics International* 41 (4):420-425. doi: 10.1177/0309364616661257.

Revilla, Melanie, and Carlos Ochoa. 2017. "Ideal and Maximum Length for a Web Survey." *International Journal of Market Research* 59 (5):557-565. doi: 10.2501/ijmr-2017-039.

Rolstad, Sindre, John Adler, and Anna Rydén. 2011. "Response Burden and Questionnaire Length: Is Shorter Better? A Review and Meta-analysis." *Value in Health* 14 (8):1101-1108. doi: https://doi.org/10.1016/j.jval.2011.06.003.

Selwyn, Neil, Stephen Gorard, John Furlong, and Louise Madden. 2003. "Older adults' use of information and communications technology in everyday life." *Ageing and Society* 23 (5):561-582. doi: 10.1017/S0144686X03001302.

Shah, Kalpit N., Martin R. Hofmann, Ran Schwarzkopf, Deeba Pourmand, Nitin N. Bhatia, Gregory Rafijah, and Samuel S. Bederman. 2016. "Patient-Reported Outcome Measures: How Do Digital Tablets Stack Up to Paper Forms? A Randomized, Controlled Study." *American Journal of Orthopedics* 45 (7):E451-E457.

Trukeschitz, Birgit, and Marlene Blüher. 2018. Usability of 'CARIMO' after initial training and over time. The home care service users' perspective in Austria and Italy. In *Discussion Paper of the AAL-project CareInMovement (CiM) No. 3/2018 and and Discussion Paper No. 6/2018 of the Research Institute for Economics of Aging, Vienna University of Economics and Business (WU), Vienna*.

Trukeschitz, Birgit, Siegfried Eisenberg, Marlene Blüher, Ulrike Schneider, Harald Rieser, Susanne Ring-Dimitriou, and Cornelia Schneider. 2018. The effects of 'CARIMO', an ICT-supported fitness and entertainment program for home care service users: Evidence from a quasi-experiment in Austria and Italy. In *Unpublished Discussion Paper of the AAL-project CareInMovement (CiM) No. 5/2018 and Unpublished Discussion Paper No. 8a/2018 of the WU Vienna University of Economics and Business, Vienna*.

Tsai, Hsin-yi Sandy, Ruth Shillair, Shelia R. Cotten, Vicki Winstead, and Elizabeth Yost. 2015. "Getting Grandma Online: Are Tablets the Answer for Increasing Digital Inclusion for Older Adults in the U.S.?" *Educational Gerontology* 41 (10):695-709. doi: 10.1080/03601277.2015.1048165.

Vroman, Kerryellen G., Sajay Arthanat, and Catherine Lysack. 2015. ""Who over 65 is online?" Older adults' dispositions toward information communication technology." *Computers in Human Behavior* 43:156-166. doi: https://doi.org/10.1016/j.chb.2014.10.018.