Usability and user experience of ‘CARIMO’ after initial training and over time

The home care service users’ perspective in Austria and Italy

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1 Introduction

Technological solutions, most importantly mobile applications for smart devices, are a popular way to provide guidance and motivation for people to exercise and stay physically active (Middelweerd et al. 2014). However, design, features and functions of fitness applications and smart devices on the market are mostly aimed at a younger generation and people who are familiar with and skilled in the use of new technologies. Recent evidence showed that the use of information and communication technology (ICT) declines with increasing age and frailty (Keränen et al. 2017). Thus, older and frail people can be seen as less experienced in the use of new technologies.

Older adults, particularly those who already deal with certain physical limitations, might also benefit from fitness apps (e.g. Fong et al. 2016). However, conditions of use and functionality of those apps and devices may not be appropriate. Studies evaluating the acceptance and usability of health-related apps for older users have pointed out that such apps are often not sufficiently sensitive to the needs and limitations of older adults (Preusse et al. 2017, Wildenbos, Peute, and Jaspers 2015). Thus, they might discourage older adults from taking advantage of new technologies. Barriers of use, specifically for older adults, are related to characteristics of new technologies that do not appropriately respond to the progressive degradation of sensory, physical and cognitive abilities associated with the process of aging (Wildenbos, Peute, and Jaspers 2018). The perceived usefulness as well as a user-friendly design adapted to the needs of an older, vulnerable population are thus crucial to the successful usage of new technologies in this group (Or et al. 2011, 57).

Scientific studies assessing the usability of fitness applications and fitness trackers for older people can be assigned to two groups. The first group considers older adults' perception and acceptance of fitness apps and activity trackers and evaluated products *already available* on the market, such as MyFitnessPal, Fitbit, Mi-Band, or Windows Band (e.g. Mercer et al. 2016, Preusse et al. 2017, Puri et al. 2017, Willner et al. 2017). The most popular fitness and activity monitoring apps, however, are typically designed with a younger target group in mind (Tedesco, Barton, and O'Flynn 2017). Studies of usability of such fitness apps and activity trackers for older adults often had to rely on small sample sizes and thus applied mostly qualitative and mixed methods. The samples of such studies involved between 6 (Schlomann et al. 2016) and 40 (Lyons et al. 2017) older adults. Trial phases were not long, exposing users to the technology only for a short period of time, ranging between 3 days (Mercer et al. 2016) and 12 weeks (Lyons et al. 2017).

The second – much smaller – group of studies have evaluated health and fitness apps for older or chronically ill adults, *developed* in the context of research projects, such as McMahon et al. (2014), or Hong et al. (2014). While these studies assessed apps that were modified to specifically address an older, more vulnerable target group, they were also limited by small sample sizes and short testing periods. In their two-part usability study of an app promoting wellness motivation, McMahon et al. (2014) included 9 test users in the first part and 14 test users in the second part of their evaluation, with the trial periods lasting 4-7 days. Also in a two-part usability evaluation, Hong et al. (2014) studied a web-based app promoting physical activity in older adults with chronic conditions with a trial group of 10 older adults participating in a 1-day usability assessment of the app and 23 older adults testing the app over a period of 2-3 weeks.,

Short-time usability evaluations are common and broadly accepted, however, there are also studies that have evaluated usability once or more during the trial phase. Fausset et al. (2013), for example, recommend repeated assessment of usability. They suggested that older adults who explore a new physical activity-enhancing technology might initially have a positive attitude towards the usage and potential benefits. However, users may become more skeptical over time or discontinue usage as they encounter significant barriers of use. Therefore, users of these apps may see their initial enthusiasm fade away over a longer period of use.

In the European AAL project[1] 'Care in Movement – Empowering communities to care by combining smart technology and personal help to maintain mobility', a tablet-based fitness and entertainment app, 'CARIMO', was developed for users of home care services. CARIMO consists of a tablet with a fitness app and a wearable fitness bracelet for tracking steps and activities, such as walking, working out, or cycling. The design and functionality of the fitness app aimed to take into account the restrictions the target group faced and considered their lack of familiarity with new technologies. CARIMO had been tested for 8 months by 84 home care recipients in Austria and in Italy. We collected usability and user experience data at two points in time using online surveys tailored to the characteristics of CARIMO and the access requirements of the user group.

The aim of this discussion paper is to analyze and compare the usability and user experience of CARIMO from the perspective of older adults who receive home care – after the initial training phase and after eight months of use at the end of the trial phase. We aim to evaluate whether user impressions of CARIMO have changed over time and whether CARIMO was received differently by users in Austria and in Italy. In particular, this paper seeks to answer five research questions:

- How did older adults evaluate the general attractiveness of CARIMO?
- How did they perceive the effort to learn how to use CARIMO and (where) did they need help?
- Which CARIMO features were especially popular?
- How did the older users perceive the fitness function with regard to its functionality, selection of appropriate exercises, exercise incentives and experienced impact on their physical activity behavior?
- How did older users perceive the additional CARIMO functions, namely newspapers, activities, and notes?

This discussion paper is divided as follows: Chapter 2 provides a short introduction to CARIMO. In Chapter 3, we will describe our conceptual and methodological approach, addressing our conceptual understanding of the concepts of usability and user experience, and describing the process of data collection, the sample, and data analysis. Chapters 4 to 6 comprise our findings: Chapter 4 deals with the general impression of CARIMO, including the suitability of the devices for the users. Chapter 5 concerns the users' perception in regard to learning to use CARIMO, as well as help needed when dealing with CARIMO. Chapter 6 addresses CARIMO's most popular features, and Chapter 7, provides our findings related to the core aspect of CARIMO, the exercise and fitness-related features. In this chapter, we will address issues of design, operability and suitability of the exercise videos, incentives CARIMO

[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/).

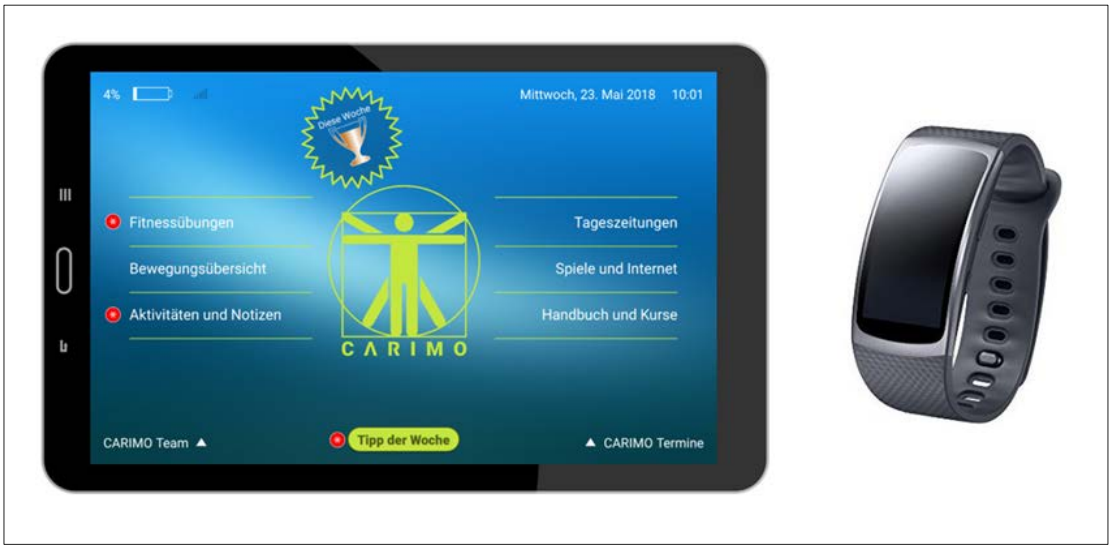
offers to increase physical activity, and the experienced impact of CARIMO on the users. Chapter 8 addresses the newspaper and activities and notes functions. In Chapter 9, we will provide a systematized summary of individual users' comments regarding their experiences with and suggestions for CARIMO. Chapter 10 deals with a summarized overall perception of CARIMO and its potential as a commercial product. In Chapter 11, we will discuss our results and address implications for future research and development of AAL products for older adults.

2 About CARIMO

CARIMO consisted of a tablet and a fitness bracelet and was developed for older home care service users (see Figure 1). Older people using home care services require personal help with some activities of daily living, such as housekeeping or personal care. A care worker visits them once a week or more to support living at home.

CARIMO aimed to increase physical activities in a group of people who already experienced limitations in coping with daily life and dependency on personal help. Thus, the development of CARIMO as well as the formative and summative evaluation of CARIMO had to be responsive to the abilities of one of the most vulnerable groups in society. CARIMO thus focused on a restricted number of functions that addressed 'body and mind' – i.e. fitness and entertainment/communication.

Figure 1: CARIMO home screen and fitness bracelet



Source: CiM-Project (https://www.careinmovement.eu/carimo/)

The content of the core function of CARIMO, the **fitness function**, was developed with input from sport scientists of the CiM-Consortium and aimed to meet the mobility requirements and fitness levels of the target group. The fitness function consisted of six sub-functions: (i) *daily changing sets of exercise videos* for exercising at home (including descriptions of each exercise in written and audio form) and (ii) an *activity overview* to show users how many of their daily or weekly activity and exercise goals they have already completed. The users could (iii) *track some of their activities and steps* automatically, or intentionally with manually activated GPS tracking. In addition, they could enter activities manually. Based on the amount of completed exercises, time spent doing other physical activities and counted steps, CARIMO

gave (iv) *feedback and awards* (bronze, silver, and gold 'trophies') to encourage and motivate users. Additionally, (v) *a weekly tip* was provided, prompting users to go for walks and offering ideas for simple forms of exercises and activities. A screensaver that appeared after a few minutes of inactivity on the CARIMO-tablet when it was charged gave (vi) *physical activity recommendations* and informed users of the benefits of regular exercise.

In addition to the fitness function, CARIMO offered some more **general entertainment functions**, such as a selection of daily national and regional newspapers, games, and internet. Older adults also had the opportunity to communicate with other members of their care network via a function called **'activities and notes'**, enabling them to leave notes for and receive notes from members of their care network. A **system tutorial** provided users with step-by-step instructions on using the CARIMO app. To keep CARIMO as simple as possible, CARIMO was installed with a launcher, replacing the home screen of the tablet with the CARIMO app (see Figure 1).

3 Concepts, measures and data

This chapter describes our approach to evaluating how the CARIMO users perceived CARIMO and whether there were any changes in user perception over time or between the participants in Austria and Italy. To this end, we first developed a concept of usability and user experience tailored to CARIMO and the requirements of the target group, and then collected data using online surveys. In the following sections, we will lay out how we conceptualized usability and user experience (Section 3.1), give an overview of the data collected (Section **Fehler! Verweisquelle konnte nicht gefunden werden.**) and the timing of data collection (Section 3.2). We then describe the sample (Section 3.3) and the methods for data analysis (Section 3.4).

For both CARIMO usability surveys, we used the digital questionnaire format LimeSurvey[2], which was integrated into the CARIMO app. Thus, the survey was directly accessible via the CARIMO-tablet, making it as easy as possible for the users to start the survey. For more information on the challenges and solutions for implementing an online survey for older adults, see Trukeschitz and Blüher (2018c).

3.1 Conceptualizing and measuring usability and user experience

Usability and user experience are core concepts for the evaluation of user perspectives of new technologies and mobile apps. However, to contribute to meaningful results, they need to be defined properly and take into account the intended target groups and the purpose of the products to be evaluated. In the following sections, we present our understandings of usability and user experience, and how these concepts relate to the fitness app CARIMO (Section 3.1.1). We then discuss the measures we used in our questionnaires (Section 3.1.2) and, finally, address how we adapted existing measures and designed our survey to evaluate the usability and user experience of CARIMO for older adults (Section 3.1.3).

3.1.1 Concepts of usability and user experience

'Usability' and 'user experience' are concepts dealing with the design and functionality of consumer products. Both concepts relate to characteristics and the experiences from the

[2] www.limesurvey.org

usage of the products by the intended target group. Most commonly, usability and user experience are associated with technological products and devices, media, software, and apps. The concepts are used for evaluation purposes as well as for guiding the development and design of new technological products (McNamara and Kirakowski 2006, Petrie and Bevan 2009, Nielsen 2001).

Although the terms usability and user experience are sometimes used interchangeably, they carry slightly different connotations. 'Usability' implies a pragmatic, work-oriented perspective focusing on the effectiveness, efficiency, and satisfaction with which a product can help a user achieve a specific goal (ISO 9142). 'User experience (UX)', in contrast, is conceptualized by a more holistic approach, addressing the design and characteristics of computer software from a 'human perspective'. Going beyond the instrumental, user experience also captures the emotional and experiential aspects of usage for the user (Hassenzahl and Tractinsky 2006).

CARIMO comprises two different devices with distinct user interfaces and several thematically diverse features (such as physical activity and exercise, daily chores, entertainment and information). As part of our evaluation design, we selected the aspects that were most relevant to the usability and user experience of CARIMO.

Thus, the usability aspects we used for assessing CARIMO referred to:

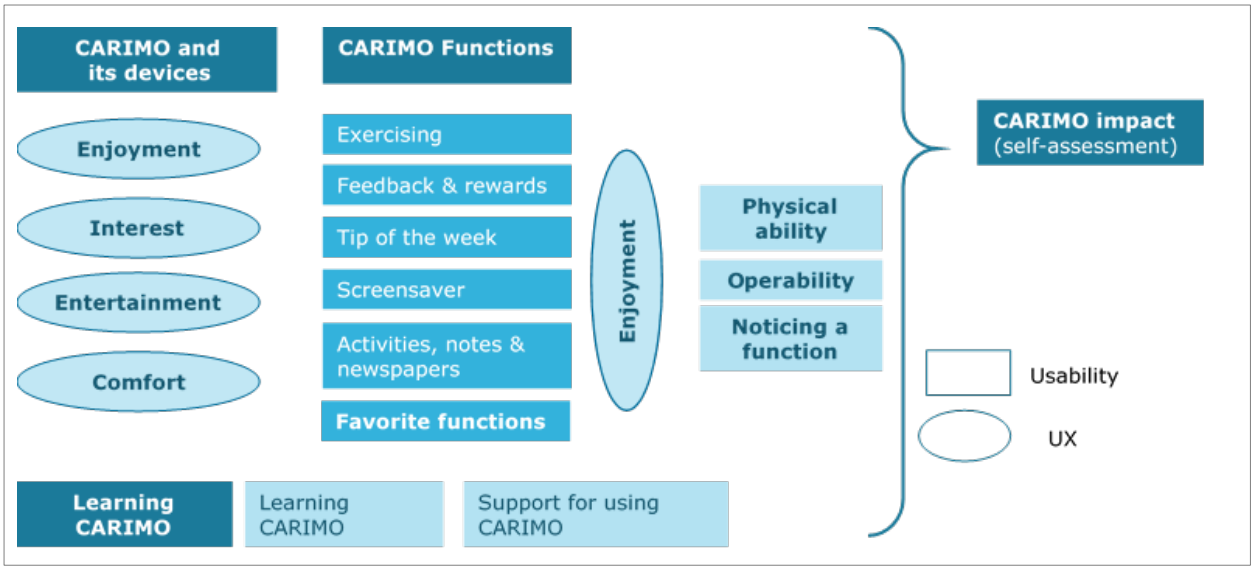
- → Accessibility, i.e. usability of the app and devices especially for users with limited technical experience and potential physical limitations (ISO 9241-171:2008))
- → Learnability ("the time and effort required to reach a specified level of use performance with the system (also known as *ease of learning*)", Petrie and Bevan (2009)),
- → Ease of use – with regard to CARIMO as a whole, as well as the CARIMO fitness function, and
- → CARIMO's ability to help users achieve the goal of increased physical activity and well-being (for more detail, see Trukeschitz and Blüher (2018c))

With regard to the user experience of CARIMO, we focused on:

- → Users' general impressions and perceptions of CARIMO's attractiveness, and
- → Whether and how much home care service users enjoyed and appreciated individual CARIMO features (for more detail, see Trukeschitz and Blüher (2018c)).

We focused on four aspects of CARIMO (see Figure 2): (i) the devices (tablet and fitness bracelet), (ii) learning to use CARIMO, (iii) CARIMO functions, and (iv) the self-assessed impact of CARIMO on the test users' attitudes towards physical activity and exercise. *Usability evaluation* covered specific characteristics of the chosen devices, selected aspects of the CARIMO fitness functions (mainly physical ability, operability and awareness of such functions), learning CARIMO, and the self-assessed impact of CARIMO. *User experience* was evaluated for the devices and the app in general as well as the specific functions of CARIMO (for details see Figure 2).

Figure 2: Selected usability and user experience aspects of CARIMO



Source: Trukeschitz and Blüher (2018c)

In general, we aimed to collect data on usability and user experience for two points in time, after the initial training phase and at the end of the trial.

3.1.2 Measures from existing usability and user experience questionnaires

There are several validated questionnaires seeking to measure usability and user experience (Figl 2010). These instruments capture different dimensions of usability and user experience concepts, depending on their intended target group, scope, and underlying theories of usability or user experience. In the German-speaking community, the most widely established software usability questionnaires are based on the principles of dialogue design in ISO 9241, an often cited example being the questionnaire by Prümper and Anft (1993) (Figl 2010). Alternative measures also focus on aspects of usability and individual user experience apart from functionality (e.g. Hassenzahl, Burmester, and Koller 2003) or address apps for a specific purpose, such as mobile apps directed at health-related aims and purposes (e.g. Stoyanov et al. 2015).

Those existing measures were used as guidelines and input during the conceptualization of the CARIMO survey. However, due to the following reasons they could not be implemented in their original form and composition:

- **Too generic:** As they aim for broad applicability and coverage of many different apps and software, many existing usability questionnaires seemed to be too generic and do not sufficiently capture the functionality and aims of a specific application, such as CARIMO.
- **Digital skills and familiarity with ICT-terminology required:** They often implicitly require a certain level of digital skills and previous experience with the usage of technology, computers and apps (e.g. to make comparisons with other apps) to be able to actually answer the questions. Respondents need to possess knowledge of the current app terminology to give meaningful answers. Some questionnaires for the evaluation of usability of apps are meant for people who are already familiar with the

technology and are able to evaluate the app in the context of their previous technological experience. The questions are also worded accordingly, which challenge people not that experienced with or interested in technology.

- **Shortcomings in expressing own experiences:** Many usability questionnaires ask for an impersonal assessment of usability, as opposed to whether they, as an individual, were actually able to navigate the software.

After a careful review of existing measures, we adopted questions directly from two questionnaires. To add these items into our survey, we made adaptations to fit them to the requirements of the target group and our concept of usability and user experience of CARIMO.

ISO 9241-based usability assessment questionnaire by Prümper and Anft (1993)

This questionnaire measures user perceptions regarding software's characteristics in terms of functionality and efficiency. In seven usability categories based on the guiding principles of dialogue design from ISO 9241, the respondents position their assessment on one of seven ordinal response options between two semantic opposites. The questionnaire focuses explicitly on the usability of professional software and functionality, as evidenced, for instance, by its emphasis on the software's tolerance of handling or entry errors. However, it also offers measures for a product's "suitability for learning", from which we derived our own questions for "learning CARIMO"

Table 1: Example of the ISO-9241-based usability questionnaire

The software…	---	--	-	-/+	+	++	+++	The software…
requires a lot of time to learn	☐	☐	☐	☐	☐	☐	☐	requires little time to learn
requires the memorization of many details	☐	☐	☐	☐	☐	☐	☐	does not require the memorization of many details

Source: Prümper and Anft (1993), own translation into English

In the semantic differential format, the respondents are asked to indicate their position on software characteristics, e.g. how much time is needed to learn the software. The response options, however, convey two meanings. First, the respondent can indicate his/her position by choosing one of the response option between the two opposing statements. Second, the minus/plus symbols also indicate the desirability of this software characteristic of the software. Both interpretations may not match in all cases, e.g. a software may take long to learn but the respondent has time or does not bother spending time on learning. Thus, the coding of the response options does not necessarily indicate whether something is the case or not, but may also be related to implicitly indicating whether a response option is appreciated or not. Response options which only indicate if something is the case and leave desirability assessment to a separate question can be answered more easily.

AttrakDiff by Hassenzahl, Burmester, and Koller (2003)

This tool captures a user's perception regarding four different types of an app or a software's quality: pragmatic quality related to function, hedonic quality related to identity (promotion of self-expression) and stimulation (personal development and goals), and general attributes of attractiveness. Respondents are asked to indicate their impressions on a spectrum of seven increments between semantically opposite one-word descriptors (e.g. "clear – confusing").

This questionnaire was utilized in part to gauge the users' first and general impressions of CARIMO itself and the usage of CARIMO. The following items were adapted and simplified for the CARIMO usability survey:

Table 2: Selected items from the AttrakDiff questionnaire

	-3	-2	-1	0	1	2	3	
lahm → boring	☐	☐	☐	☐	☐	☐	☐	*fesselnd* → entertaining
kompliziert → complicated	☐	☐	☐	☐	☐	☐	☐	*einfach* → easy

Source: Hassenzahl, Burmester, and Koller (2003), own translation into English

Although the coding of the response options follows the same line of reasoning as above, the meaning is easier to capture as the questionnaire simply uses catchwords.

3.1.3 Adaptations of measures for the CARIMO usability and user experience survey

We expected our test users to face the challenge of filling in the online survey, if we managed to appropriately select and phrase questions and response options. Therefore, a number of changes were made to the existing usability and user experience instruments: we selected questions that were expected to be most relevant to the CARIMO users and to the CiM Consortium and thus did not apply the instruments entirely. We narrowed down the wording to make it as specific as possible to facilitate participation. For example, we refrained from asking what other users think by addressing the specific user and asking for her/his personal view.

In addition to the phrasing of the questions, we also adapted the response options. We either reduced response options or simplified them by using images of five smiley faces with decreasing "happiness" as a rating scale (see Figure 3). The smiley faces were the same as the faces used in the CARIMO app when asking the users to indicate how they felt before and after completing the CARIMO exercise program. By choosing response options that the users were presumably already familiar with, we hoped to facilitate their participation and capture their emotive perspective as opposed to an abstract scale based on numbers.

Figure 3: CARIMO smiley faces

Source: CiM Project

All changes were made to enable users who were not familiar with online surveys on ICT-solutions to answer the questions easily. For details on our formal guidelines in *designing* the questionnaires for this specific target group, see Trukeschitz and Blüher (2018c).

3.2 Data collection and data sets

We collected data on the usability and user experience of CARIMO twice during the CARIMO trial period. The first survey was delivered after the initial phasing-in and training phase of six weeks in test month 2, and the second survey at the end of the trial phase in test month 8 (see

Figure 4). For information on collecting data via online surveys for older adults see Trukeschitz and Blüher (2018c)

Data collection lasted approximately 12 weeks for the first survey (6 weeks in Austria, 12 weeks in Italy due to the holiday season in August) and 6 weeks for the second survey.

The study design of the CARIMO trial was approved by the ethics committee of the University of Salzburg (EK-GZ 30/2016)

Figure 4: Timings of the usability and user experience surveys

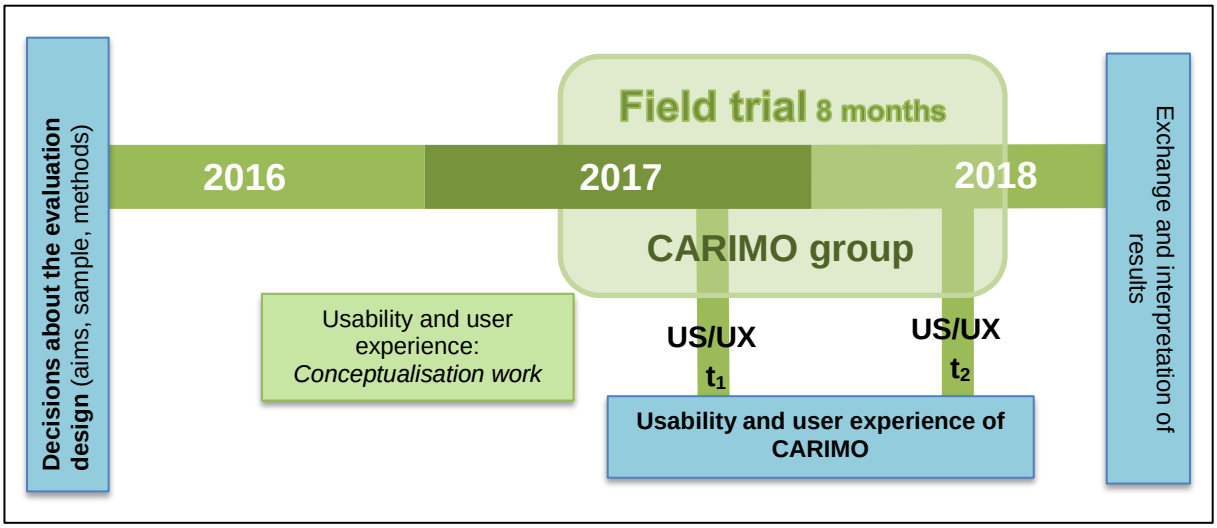


Table 3 displays the aspects of usability and user experience of CARIMO that were evaluated in our usability and user experience surveys. Topics were collected from the CiM project partners. The WU team developed the questionnaire that was commented by the CiM project partners.

Ultimately, the first survey comprised 37 individual questions (including 1 to 3 conditional questions) and the second survey contained 33 questions (including the same conditional questions). The surveys contained exactly the same questions except for four questions in the first survey, which were not repeated in the second.

The difference in the total lengths of the questionnaires resulted from the decision to ask some questions only in the first survey. They concerned user perceptions and attitudes that we did not expect to change significantly over time and thus seemed to allow to further shorten the survey. More specifically, these questions addressed the suitability of the font size on the CARIMO tablet, the legibility of the time and the step count on the fitness bracelet, and a preference for music with the CARIMO exercises.

Conditional questions were implemented to avoid unnecessary response fatigue for respondents, who would not be able to answer specific questions (e.g. if they were not aware of a certain feature, they were also not able to assess its user experience). Once their ability to answer a question was determined via a filter question, depending on their response, the conditional questions appeared or did not appear. Two filter questions were associated with three conditional questions in the CARIMO surveys. The first filter question related to the users' awareness of the CARIMO manual, the second filter question related to help received from others with CARIMO.

Table 3: Topics of the usability and user experience survey (service users); waves (t_1, t_2)

Topics of the usability and user experience survey (service users)	
Devices and overall assessment	**Assessment of the functions of CARIMO**
Enjoyment, comfort of devices (t_1, t_2)	Enjoyment, physical abilities, operability of the exercise function (t_1, t_2)
Overall assessment of CARIMO (t_1, t_2)	Evaluation of feedback and rewards function, tip of the week and screensaver (t_1, t_2)
CARIMO shown to other people (t_1, t_2)	Evaluation of activities and notes and newspapers (t_1, t_2)
	Evaluation of favorite functions (t_1, t_2)
Learning CARIMO and support	**Self-assessed impact of CARIMO**
Learning CARIMO (t_1, t_2)	Motivation (t_1, t_2)
Support received from other people (t_1, t_2)	Wellbeing (t_1, t_2)
Evaluation of the system tutorial (t_1, t_2)	
	Assessment of the survey
	Help with questionnaire (t_1, t_2)

The data set of the first wave was labelled 'WU, CiM-usability survey, (SU) 2017', of the second wave 'WU, CiM-usability survey, (SU) 2018'. Data containing both waves of collecting data on the usability and user experience of CARIMO were labelled 'WU, CiM-usability surveys, (SU) 2017/18'

3.3 The CARIMO sample

114 home care recipients in Austria (69 persons) and in Italy (45 persons) participated in the CiM project as test users. Due to various reasons (e.g. declining health status), several participants dropped out of the project. Ultimately, 84 persons (53 in Austria and 31 in Italy) tested CARIMO for the entire testing period of 8 months.[3] The usability survey was administered to the test users twice during the trial phase, resulting in two comparable datasets.

Response rates

Response rates were calculated according to the number of active CARIMO test users on the last day of the respective survey.

The first survey, issued in August 2017, yielded a total response rate of 94% (87 responses). However, some participants stopped the survey at various points midway, resulting in an

[3] For more information on the trial phase and the test users see Trukeschitz and Blüher (2018a)

overall response rate of 88% of test users who completed the first survey (82 responses) (see Table 4).

Table 4: Response rates of survey 1 (t_1)

	Completed surveys	Response rate	Started surveys	Response rate
Austria	55	95%	55	95%
Italy	27	77%	32	91%
Total	**82**	**88%**	**87**	**94%**

Source: WU, CiM-usability survey, (SU) 2017, own calculations

The second survey, implemented in February 2018, yielded a response rate of 95% (80 responses), with 92% of test users who completed the second survey (77 responses) (see Table 5). Both times, response rates were slightly higher in Austria than in Italy.

Table 5: Response rates of survey 2 (t_2)

	Completed surveys	Response rate	Started surveys	Response rate
Austria	52	98%	53	100%
Italy	25	81%	27	87%
Total	**77**	**92%**	**80**	**95%**

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

In total, 77 participants responded to both surveys, resulting in 72 completed questionnaires (see Table 6).

Table 6: Number of service users who responded in t_1 and t_2

	Completed surveys	Response rate	Started Surveys	Response rate
Austria	51	96%	52	98%
Italy	21	68%	25	81%
Total	**72**	**86%**	**77**	**91%**

Source: WU, CiM-usability surveys, (SU) 2017/2018, own calculations – response rate based on number of active participants at the end of the second survey

It has to be noted that CARIMO was aimed to be tested with 120 service users, 60 in each country. The targeted sample size could be reached in Austria at the start of the trial, but not in Italy. Thus, the field trial had to start with a lower number of participants (for details on the study design see Trukeschitz and Blüher 2018b).

Sample characteristics

Sample characteristics were calculated based on the number of CARIMO test users who responded to both surveys (but did not necessarily complete them) (see Table 7). The data was drawn from the CiM-effectiveness questionnaire (t_0) (see Trukeschitz and Blüher (2018a) and merged with the dataset from the usability surveys (for the descriptive statistics, see Table 7).

Respondents, who took part in both surveys, after the initial training phase and at the end of the project, were between 49 and 91 years old, with an average age of 74.3 years and a median of 75 years. With an average age of 76.1 years and a median of 75 years, the Italian respondents were slightly older than the Austrian respondents who were on average 73.4 years old (median 74.5 years). Statistically, this age difference between the two regions was not significant.

About three quarters (75.3%) of these respondents were women, with similar proportions of men and women in both countries.

Most respondents had finished only compulsory education (36%), with similar shares in Austria and in Italy. More than half had either completed an apprenticeship (only in Austria, where they made up the biggest group with 41.2%) or visited vocational school (21.6% in Austria and 37.5% in Italy). Around 10% had attained higher education, a high school diploma or tertiary education.

Data about the care dependency of home care service users were only available for Austria, The long-term-care allowance levels[4] indicate the level of need. More than half of the Austrian respondents did not receive a long-term care allowance (level 0) and could be considered as relatively independent. The others required support for more than 65 hours (level 1), 95 hours (level 2), and more than 120 hours (level 3) per month.

Usage of technology at the beginning of the CARIMO trial period (June 2017) was similar in Italy and in Austria. Around 90% participants had used cell phones (smartphones (29.2%) as well as feature phones (69.4%)). Almost 30% of all respondents had used computers or laptops at least sometimes, although computer usage had been more common for Austrian respondents (31.3%) than for Italians (20.8%). 12% of the respondents had used a tablet before their participation in the CareInMovement project. Roughly, one third of the respondents in both countries reported to have used the internet at least sometimes before the trial phase of CARIMO.

[4] In Austria, people in need of long-term care are granted a cash benefit to improve their purchasing power of services. This long-term care allowance has seven levels, depending on the level of need for personal help (Trukeschitz, Schneider, and Czypionka 2013). For the CiM project only people with low to moderate need of care (level 0 to 3) were included (see Trukeschitz and Blüher (2018a)).

Table 7: Summary of sample characteristics for all participants who answered both surveys (including partially completed questionnaires)

	Survey 1 + 2	Total (n=77)	Austria (n=52)	Italy (n=25)	Difference
Age 2017	min – max	49-91 years	49-86 years	64-91 years	n.s.
	mean	74.3 years	73.4 years	76.1 years	
	median	75 years	74.5 years	75 years	
Sex	Women	58 (75.3%)	39 (75.0%)	19 (76.0%)	n.s.
	Men	19 (24.7%)	13 (25.0%)	6 (24.0%)	
Education	Compulsory	27 (36%)	18 (35.3%)	9 (37.5%)	sig.
	Apprenticeship	21 (28%)	21 (41.2%)	0 (0.0%)	
	Vocational school	20 (26.7%)	11 (21.6%)	9 (37.5%)	
	High school diploma or tertiary education	7 (9.3%)	1 (2.0%)	6 (25.0%)	
Long-term-care level	0	n.a.	29 (55.8)	n.a.	n.a.
	1		11 (21.2%)		
	2		7 (13.5%)		
	3		5 (9.6%)		
Usage of technology**	Cell phone	65 (90.3%)	44 (91.7%)	21 (87.5%)	n.s.
	PC/Laptop	20 (27.8%)	15 (31.3%)	5 (20.8%)	n.s.
	Tablet	9 (12.7%)	4 (8.5%)	5 (20.8%)	n.s.
	Internet	25 (34.7%)	17 (35.4%)	8 (33.3%)	n.s.

Notes: n.a….not available; n.s…not significant; sig….significant at 5%-level

Source: WU, CiM-effectiveness questionnaire 2017, baseline and CiM-Usability survey, (SU) 2017/2018, n=77 (**excluding incomplete data for long-term-care level, education, and usage of technology (responses recoded to show yes/no for use of technology)), own calculations

3.4 Data analysis

After completion of the online surveys, datasets were exported into the statistical software package STATA version 15 and prepared for analysis. Starting with an overview of user perceptions and ratings of usability of CARIMO, we first conducted descriptive analyses, looking at frequencies of responses. We used a combination of pie charts and bar graphs to illustrate these results.

In a second step, we focused on whether the users' assessment of CARIMO changed over time. For this, we restricted the analysis to respondents who contributed to the usability survey in both waves. We conducted bivariate analyses for paired samples using Stuart-Maxwell-test, McNemar's-test and Wilcoxon-signed-rank test (two-tailed) to detect any changes over time.

We also tested for differences in user perceptions between Austria and Italy. Here, we used the entirety of responses for each survey respectively, comparing Austrian and Italian responses separately for t_1 and for t_2, to get an accurate understanding of any differences

between opinions at the respective times. This resulted in a slightly bigger sample size than for the time comparisons. For the country comparisons, we applied chi-square tests (Fisher's exact for small cell counts < 5) for nominal data and Mann-Whitney-U (two-tailed) test for ordinal data. To determine whether a specific change over time could be attributed to the responses in one of the countries, we applied a Wilcoxon-signed-rank test (two-tailed) for all respondents who answered both surveys.

We corrected the results for multiple testing using the Benjamini-Hochberg method with the statistics-software R (Benjamini and Hochberg 1995).

The statements from the open text box for comments about CARIMO at the end of the survey were translated, and entered into an Excel file for analysis. The statements were paraphrased, summarized and coded. They were then arranged into themes reflecting different types of user feedback about CARIMO.

4 General attractiveness and legibility of CARIMO - tablet and fitness bracelet

Previous studies showed that clip-on as well as wrist-worn activity trackers are useful tools for health monitoring for older adults. Wrist-worn devices were considered as personal items with an aesthetic component by older adults, who were found to put a big emphasis on comfort, usability and price (Puri et al. 2017). However, initial excitement was not always able to carry over into longer-term use. For older adults to use wearable devices on a regular basis, new technologies have to be tailored to the activities they are most likely to do. In addition, the benefit of the new devices has to be communicated clearly (Fausset et al. 2013, Preusse et al. 2017).

There are some potential advantages of using tablets as devices for older adults. Tablets can easily be operated without a mouse or keyboard by simply touching the screen and they are also light and mobile, but have a larger surface than smartphones. Previous research suggests that tablet-based training programs for older adults can influence training adherence positively compared to traditional methods, such as brochures (van het Reve et al. 2014). However, considering the evidence in Vroman, Arthanat, and Lysack (2015) dealing with how older adults react to technology in general, and Seifert et al. (2017) finding that increasing age correlates with decreasing use of health and fitness monitoring technology, the developers of CARIMO expected the test group to be unfamiliar and possibly anxious about the use of smart devices.

In the following chapters, we describe how the users generally assessed CARIMO in terms of attractiveness and responsiveness to age-related visual restrictions for the tablet (Chapter 4.1) and the fitness bracelet (Chapter 4.2), and report on test users general impression of CARIMO was after using it for more than 6 weeks (Chapter 4.3).

4.1 The CARIMO tablet – general attractiveness and legibility

Tablets usually come with a variety of pre-installed apps, optional settings and many functions. The default set up of smart devices can appear difficult to navigate, overwhelming and eventually frustrating for first time users. However, in order for users to get acquainted with and using CARIMO, the app was pre-installed and fixed as a launcher. This means that the 'typical' tablet home screen background (usually with a selection of apps and widgets) was replaced by the CARIMO surface. Pressing the 'home' button on the tablet directed the user back to the CARIMO home screen (see Figure 5). As such, CARIMO was the only app on the tablet available to the users.

The functions of CARIMO were limited to a set of six core functions, three at each side of the CARIMO logo (fitness-related functions to the left: 'physical exercises', 'overview of physical activities' and 'activities and notes', and entertainment-related functions to the right: 'newspapers', 'games and internet' and the 'system tutorial').

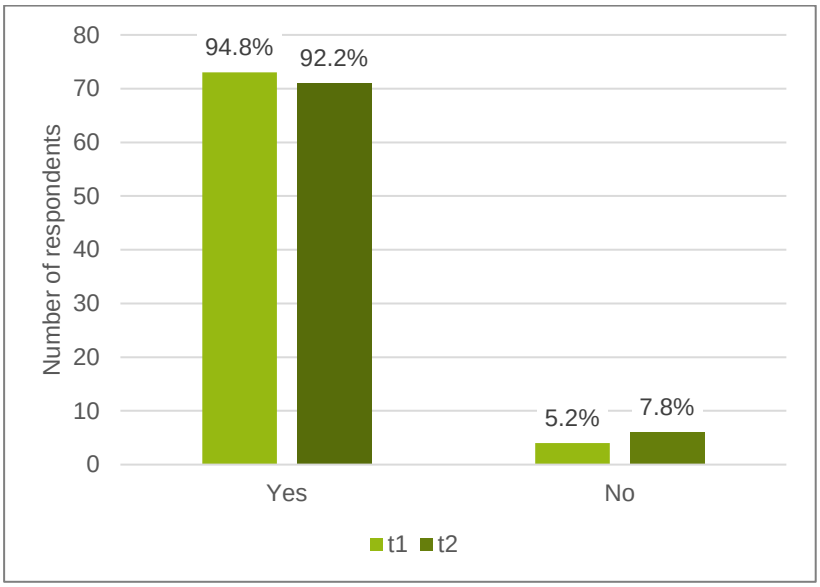
In addition, battery status as well as date and time were displayed at all times on the CARIMO home screen. On the main screen, users also saw a symbol indicating their weekly amount of physical activities (i.e. the trophy filled up and changed colors with more activity recorded). On the CARIMO tablet, users also had access to the 'tip of the week' and to their 'CARIMO calendar' for dates with CiM-assistants (i.e. care workers involved in the CiM-project), volunteers, and relatives belonging to the 'CARIMO-Team'. A log-on button allowed a member of the CARIMO care network to log into the system.

Figure 5: CARIMO home screen, Austrian version

Source: CiM Project

Overall, the **CARIMO tablet** was **very well received** (see Figure 6). A great majority of the respondents in the first survey, 94.8%, stated that they enjoyed using the CARIMO tablet. This number did not change much towards the end of the CARIMO trial period, with 92.2% still reporting that they enjoyed using the CARIMO tablet. There was no difference between Italy and Austria.

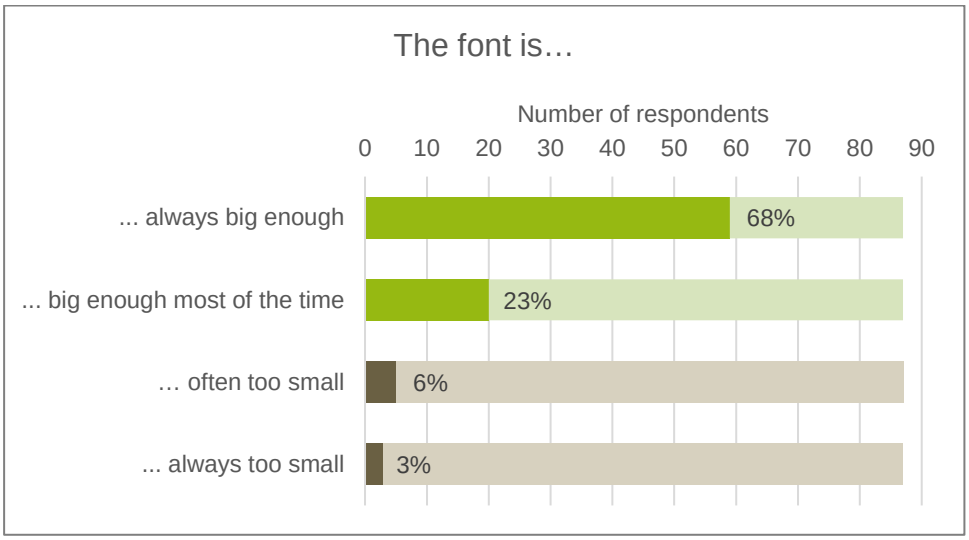
Figure 6: Whether participants enjoyed using the tablets



Source: WU, CiM-usability surveys, (SU) 2017/2018, n=75, own calculations

Usability of smart devices for older adults crucially depends on whether people can see and read the contents on the screen easily (Barnard et al. 2013). After the initial training phase (in the first survey), we asked respondents if they were **able to read the font size on the tablet comfortably**. For more than two thirds of the respondents, the font size on the CARIMO tablet was always big enough for comfortable reading, and almost a quarter reported that the font size was big enough most of the time. However, in total, almost 1 in 10 users stated that the CARIMO font size was often (6%) or always (3%) too small (see Figure 7). There were no differences between the Austrian and Italian users.

Figure 7: Readability of the font size on the CARIMO tablet, t_1



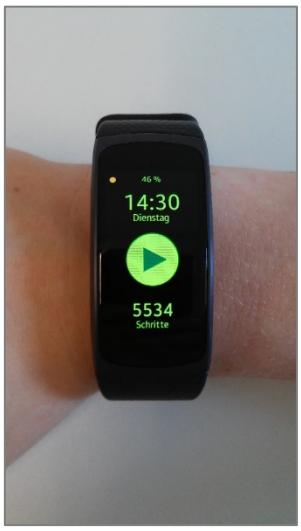
Source: WU, CiM-usability survey (SU) 2017, n=87, own calculations

4.2 The CARIMO fitness bracelet – comfort and legibility of key information

For the CARIMO fitness bracelet, developers in the CiM project used a commercially available activity tracker (Samsung Gear 2) with a customized surface to facilitate the GPS tracking (see Figure 8). The customized surface also provided a display of the time, daily step counts and a shortcut for the activation of GPS tracking of activities such as walking, cycling, or hiking. When in relative proximity to the CARIMO tablet, the fitness bracelet synchronized automatically with the tablet via Bluetooth and updated the CARIMO activity and exercise overview.

The wristband of the fitness bracelet was made from rubber silicone and was closed using a clasp that clips into place (see Figure 9). The test users were informed that the CARIMO fitness bracelet was waterproof for daily activities, such as washing dishes or showering, and could be worn all the time.

Figure 8: CARIMO interface on the CARIMO fitness bracelet



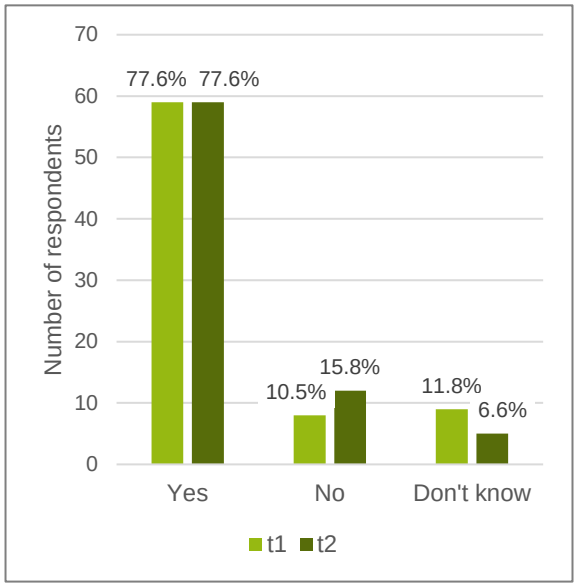
Source: WU

Figure 9: CARIMO fitness bracelet with clip-on strap

Source: SRFG

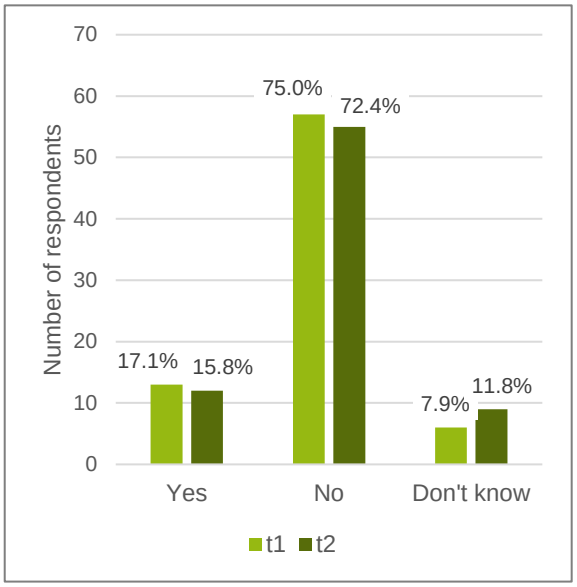
Overall, more than **three quarters of the respondents** answered that they found the **fitness bracelet comfortable to wear** (see Figure 10), and **did not feel restricted in their activities** when wearing the bracelet (see Figure 11). However, there was also some evidence of discomfort and inconvenience in the second survey, 15.8% (compared to 10.5% in t_1) reported that they did not feel comfortable wearing the bracelet and 15.8% (compared to 17.1% in t_1) felt restricted in some activities. There were, however, no significant changes over time in both assessments of the comfort of the fitness bracelet, and the feelings of restriction. Whether the respondents found the CARIMO fitness bracelet comfortable to wear also did not differ between Austria and Italy. Likewise, users in Italy and Austria responded similarly as to whether they felt restricted by the fitness bracelet.

Figure 10: Comfort of the CARIMO fitness bracelet



Source: WU, CiM-usability surveys, (SU) 2017/2018, n=76, own calculations

Figure 11: Feeling restricted when wearing the CARIMO fitness bracelet



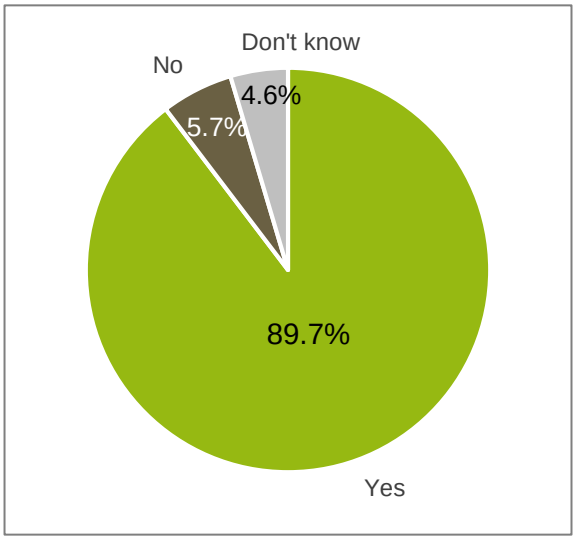
Source: WU, CiM-usability surveys, (SU) 2017/2018, n=76, own calculations

The display of the fitness bracelet is relatively small compared to surfaces on other devices, such as tablets. This was expected to reduce legibility of information, especially for an age group that typically has a higher level of visual restrictions than a younger population. Thus, it was important to determine whether the font size on the CARIMO surface was sufficiently large.

More than **three quarters of the respondents** reported that they were **generally able to read the font on the fitness bracelet**. However, there the legibility differed between the display of the time (see Figure 12) and the display of the step count (see Figure 13). While **89.7% had no problems reading the time**, 77.9% stated that they were able to read the step count well. Only 5.7% reported not being able to read the time well on the fitness bracelet. **14% reported not being able to read the step count**. There were no differences between Austria and Italy.

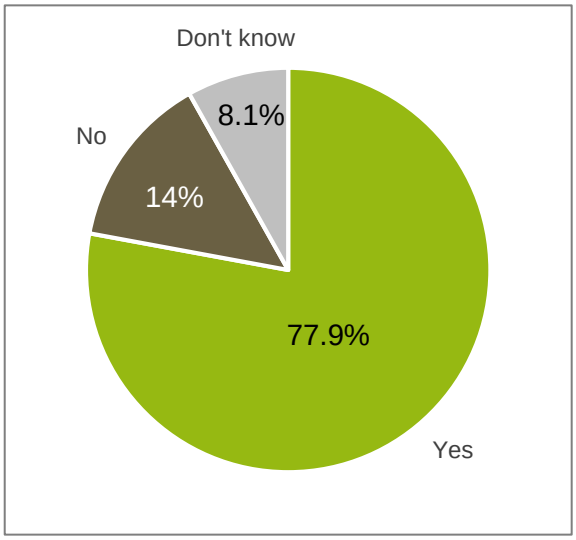
These results correspond with the actual design of these two elements on the bracelet, with the font of the time being slightly larger than the step count. Additionally, once a high step count was reached (e.g., more than 12,000 steps a day), the display was not large enough resulting in the last number of the step count being partially cut off, potentially affecting legibility.

Figure 12: Legibility of the time display on the fitness bracelet, t_1



Source: WU, CiM-usability survey, (SU) 2017, n=87, own calculations

Figure 13: Legibility of the step count on the fitness bracelet, t_1

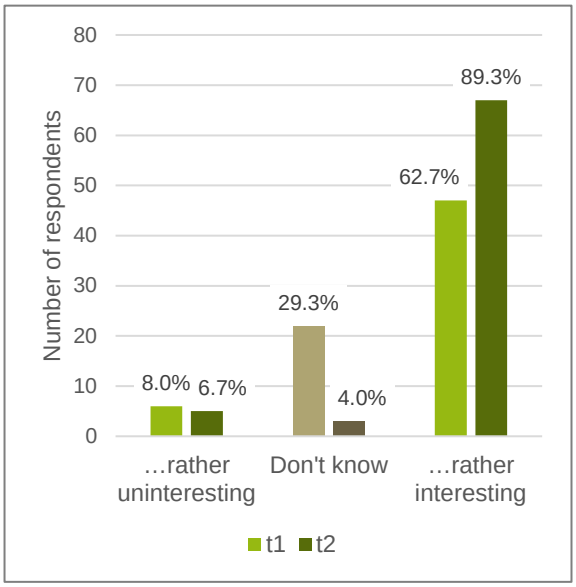


Source: WU, CiM-usability survey, (SU) 2017, n=86, own calculations

4.3 General impressions and appeal of CARIMO

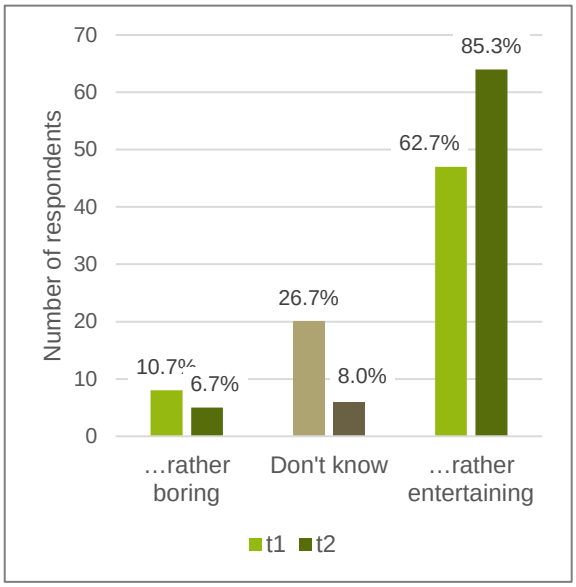
The test users were asked to indicate their general impressions of CARIMO and how they rated CARIMO in terms of attractiveness. Two items addressed two related aspects of attractiveness (interesting vs uninteresting and entertaining vs boring) (see Figure 14 and Figure 15).

Figure 14: Interest – CARIMO is…



Source: WU, CiM-usability surveys, (SU) 2017/2018, n=75, own calculations

Figure 15: Entertainment – CARIMO is…



Source: WU, CiM-usability surveys, (SU) 2017/2018, n=75, own calculations

In the first survey, almost two thirds of the respondents rated CARIMO rather interesting and rather entertaining, whereas approximately 10% reported negative impressions in both cases, assessing the app as rather uninteresting and rather boring. However, the fairly high share of

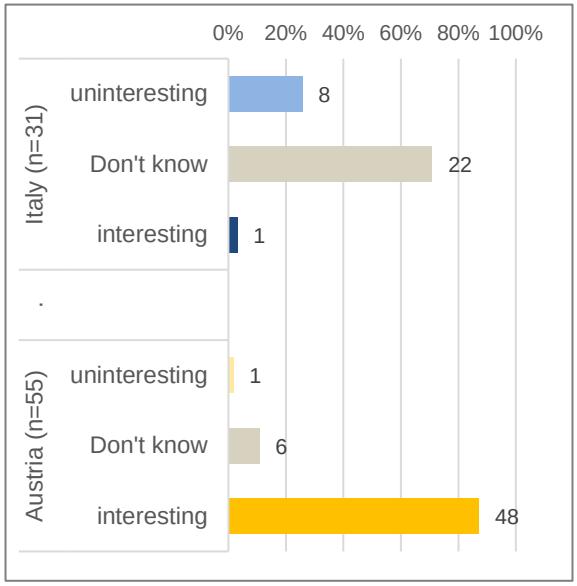
undecided users (“Don’t know” 29.3% and 26.7%) at the time of the first survey indicated that some were not able or not willing to decide after the 6-week initial training phase.

Asked a second time shortly before the end of the trial period, after almost eight months of access to CARIMO, more respondents were able to express their impression about CARIMO. **Many responses changed from ‘don’t know’ in the first survey to a positive assessment of CARIMO in the second survey**, with 89.3% rating it as rather interesting and 85.3% as rather entertaining.

To determine whether the changes between the first and the second assessment were significant, we treated the variables as ordinal, ranging from the negative impression (“rather uninteresting” and “rather boring”) across the ambiguous, undecided “don’t know” to a positive impression (“rather interesting” and “rather entertaining”). The Wilcoxon-signed-rank test revealed that in both cases, the changes were highly significant (interesting/uninteresting – $p<0.001$ and boring/entertaining $p<0.001$). This result can be attributed to respondents who answered ‘don’t know’ in the first, but formed a positive impression by the second survey.

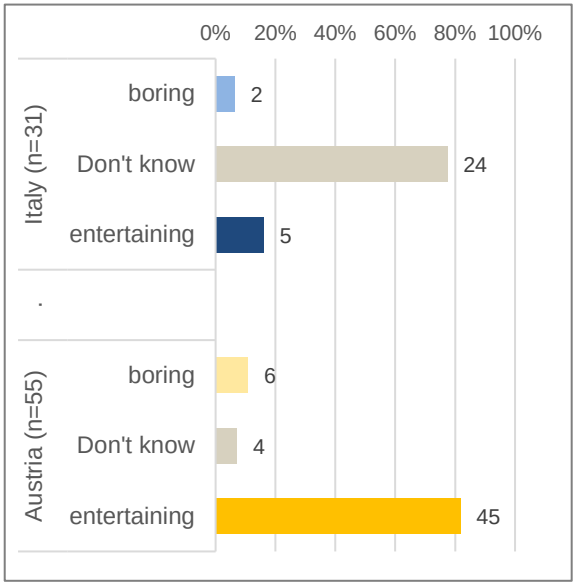
Interestingly, there were **substantial differences between Austria and Italy**. Comparing the responses in the two countries revealed that the majority of the Italian users were not able to evaluate CARIMO after the initial training phase. After the first weeks of using CARIMO, more than 70% of the respondents in Italy did not know whether to rate CARIMO as interesting or not or entertaining or not. Opposed to that, only around 10% of the Austrian respondents were not able to assess CARIMO (see Figure 16 and Figure 17).

Figure 16: Interest in CARIMO, t_1, by country



Source: WU, CiM-usability survey (SU) 2017, n=86, own calculations

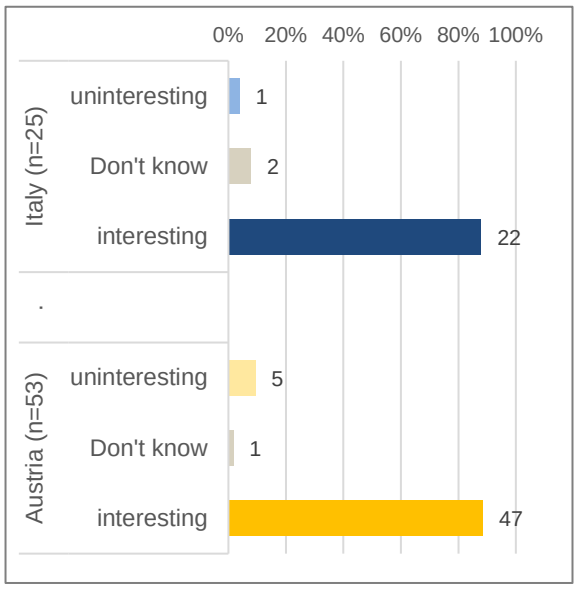
Figure 17: Entertainment in CARIMO, t_1, by country



Source: WU, CiM-usability survey (SU) 2017, n=86, own calculations

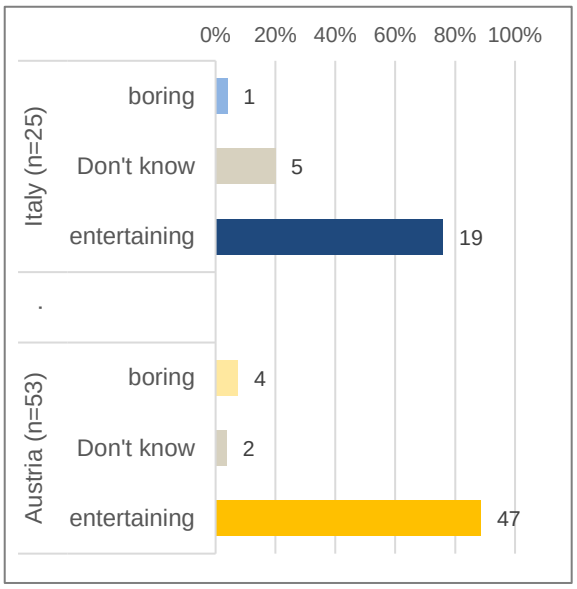
Thus, the initial difference between the user groups in Austria and Italy was highly significant (Mann-Whitney-U <0.001 for interest and entertainment in t_1). Towards the end of the CARIMO trial period, the opinions in Italy had improved significantly (Wilcoxon-signed-rank $p<0.001$ for interest and entertainment). As a result, at the end of the trial, ratings were distributed similarly in both countries. Ultimately, 88% of Italian respondents found CARIMO rather interesting; 76% found it rather entertaining (compared to 88.7% for both items of user experience in Austria) (see Figure 18 and Figure 19).

Figure 18: Interest in CARIMO, t_2, by country



Source: WU, CiM-usability survey (SU) 2018, n=75, own calculations

Figure 19: Entertainment in CARIMO, t_2, by country

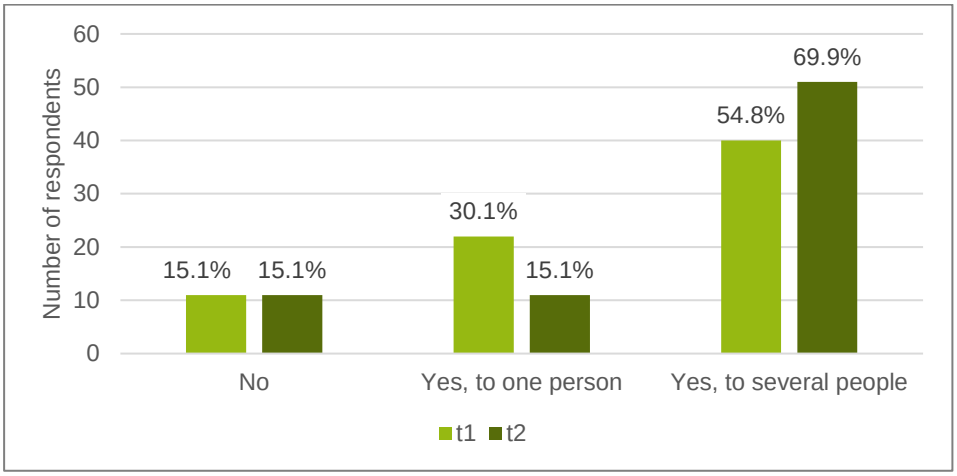


Source: WU, CiM-usability survey (SU) 2018, n=75, own calculations

CARIMO was conceptualized as a tool that can be used to engage with others – ideally by exercising or doing other physical activities together, i.e. going for a walk to collect steps or try out one of the weekly tips. We also assumed that the test users would show their new devices to others to talk about the tools to get other people's assessment.

In fact, the **large majority of the test users had shown CARIMO to other people** at the time of the first survey, and even more at the time of the second survey (see Figure 20). First, more than 85% of the respondents reported having shown CARIMO to one or several relatives or friends. More than half (54.8%) had even shown CARIMO to more than one person. While the total percentage of people, who had shown CARIMO to other people, remained the same over time, more people had shown CARIMO to several others at the end of the trial phase (69.9%). Looking at all response options, the Wilcoxon-signed-rank test revealed that these perceivable changes were not statistically significant (p=0.08). There were no differences between Italy and Austria.

Figure 20: CARIMO shown to relatives or friends



Source: WU, CiM usability surveys, (SU) 2017/2018, n=73, own calculations

5 Learning to use CARIMO & help received

CARIMO was designed based on the assumption that the test users had little to no previous knowledge or experience with smart technologies. Evidence from usability studies of apps and wearable devices and older adults suggests that this target group needs additional support with using the technology, either in the form of practical training or physical or digital manuals/tutorials (McMahon et al. 2014, Steinert, Haesner, and Steinhagen-Thiessen 2018). Consequently, in addition to designing CARIMO for intuitive and easy use for older adults, it was also important to provide adequate training and effective support where needed.

Thus, a phasing-in period was implemented in the trial (Schneider and Rieser 2018). For six weeks after the start of the field trial, the test users received weekly visits from care workers ('CiM-Assistants') to train them to use CARIMO in their home. The Austrian CiM-Assistants received guidelines and a checklist from the CiM-Consortium to follow a step-by-step process in training the CARIMO users. Furthermore, they were asked to report on the results of their visits. The task of the CiM-Assistants was to encourage the users to get familiar with different functions of CARIMO. Their visit offered the test users the chance to ask any questions that may have arisen from using it so far. (for details on the phasing-in see Schneider and Rieser 2018)

In addition to the weekly visits, three further options for help and assistance were provided. First, a system tutorial was available directly in the CARIMO app. Second, support was available via a hotline provided by the social care organizations. Third, some CARIMO test users participated in the CiM project together with their informal carers, who were also potential sources of support with CARIMO. For further information about the perspectives of CiM-Assistants, informal carers and volunteers with regards to the provision of support with CARIMO, see Blüher and Trukeschitz (2018).

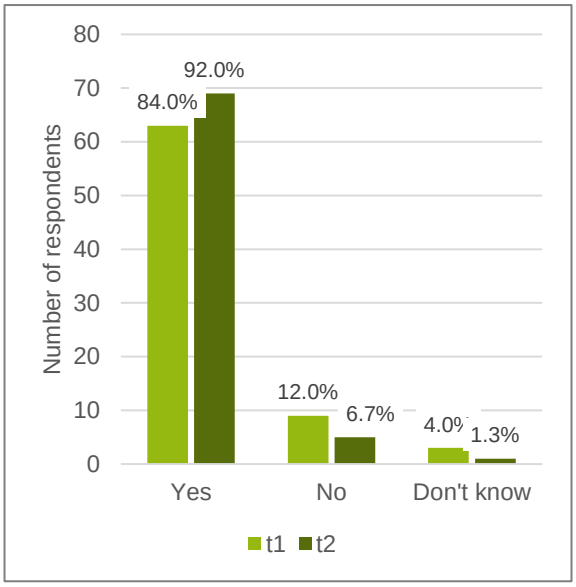
Considering the target-group-oriented design as well as the availability of the different modes of support, we aimed to determine how the test users rated CARIMO in terms of its learnability, i.e. their assessment of the effort it took when learning how to use CARIMO.

A first indicator of learnability, 'trying out CARIMO', aimed to capture a more 'playful' exploration of the system with little perceived effort (see Figure 21). Overall, a **large majority of respondents reported that they enjoyed trying out CARIMO in both surveys**, slightly increasing from the first (84.0%) to the second time (92.0%). Conversely, the number of those who reported they did not enjoy using CARIMO in the first survey (12.0%) also decreased in the second survey (6.7%), similar to those who answered 'don't know' (4.0% in t_1 and 1.3% in t_2). Overall, the fact that the majority of respondents enjoyed trying out CARIMO did not change over time. There were no differences between ratings of users in Austria and Italy.

A positive, but slightly more balanced assessment resulted from asking the test users whether they found CARIMO easy to learn. This implies the effort it takes to achieve the goal of learning to use something (see Figure 22). In the first survey, slightly **more than two thirds of the respondents (68%) reported finding CARIMO easy to learn**, as opposed to 21.3% who answered that they did not find CARIMO easy to learn and 10.7% who were undecided. More people found CARIMO easy to learn the second time around (77.3%), and correspondingly, the percentage of those who did not find CARIMO easy to learn decreased (13.3%), while the share of those who were undecided remained roughly the same (9.3%). There were no

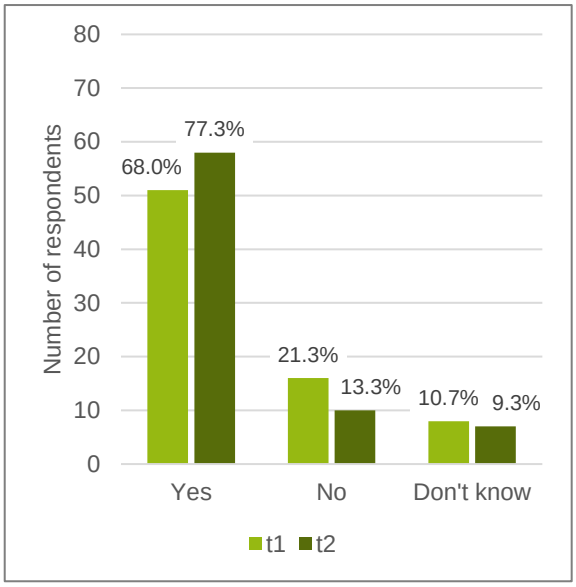
significant changes in ratings between the initial training period and the end of the trial phase. There were also no differences between Austria and Italy.

Figure 21: Enjoy trying out CARIMO



Source: WU, CiM usability surveys, (SU) 2017/2018, n=73, own calculations

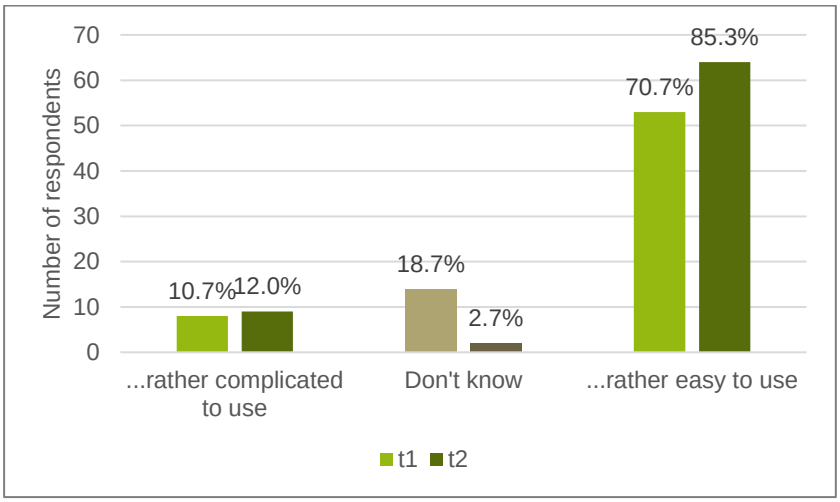
Figure 22: CARIMO is easy to learn



Source: WU, CiM usability surveys, (SU) 2017/2018, n=75, own calculations

Additionally, we also tried to capture the test users' general assessment of CARIMO's ease of use. We asked them whether they found CARIMO in general "rather complicated to use" or "rather easy to use" while also allowing for an ambivalent position via the option "don't know" (see Figure 23). Shortly after the initial training period, **more than two thirds of the respondents (70.7%) stated that they found CARIMO rather easy to use**, compared to 10.7% who perceived CARIMO to be rather difficult to use, and 18.7% who could not or did not want to decide between the two response options ('don't know'). Towards the end of the CARIMO trial period, most of the respondents, **who had not formed an opinion in the first survey, came to a decision at the end of the trial**, as only 2.7% answered 'don't know' the second time around. The **percentage of respondents, who found CARIMO rather easy to use, increased** from 70.7% to 85.3%, and the share of those who found CARIMO rather difficult to use increased slightly from 10.7% to 12.0%. Despite the visible changes between the first and the second survey, especially the apparent shift from "Don't know" to "rather easy to use", Wilcoxon-signed-rank test revealed that it was not a significant improvement (p=0.189). There were again no differences in how the respondents in Italy and in Austria perceived CARIMO's ease of use.

Figure 23: Perceived ease of use of CARIMO



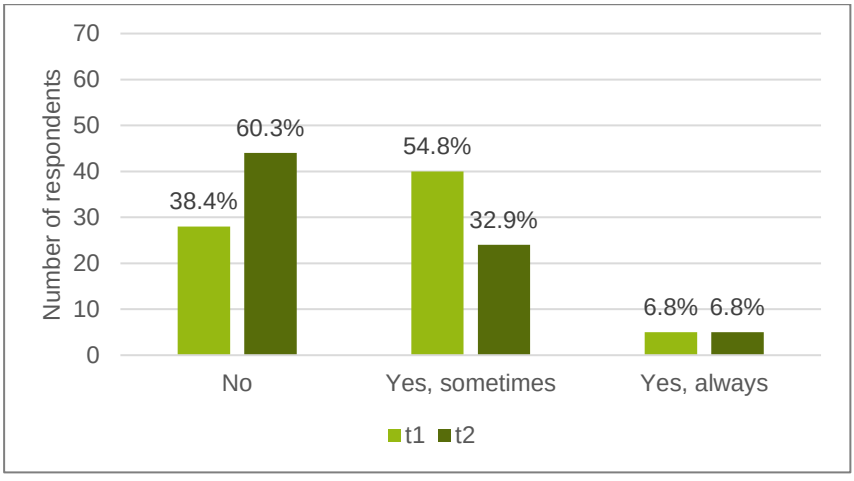
Source: WU, CiM usability surveys, (SU) 2017/2018, n=75, own calculations

5.1 Using CARIMO: help needed and received

Although the majority of the respondents found CARIMO easy to learn (see above), a large part of them also still had to rely on help from others when using the app and the devices (see Figure 24). **Almost two thirds of the respondents reported needing help when using CARIMO after the six-week training period**. Only 6.8% always needed help with CARIMO, compared to 38.4% who stated needing no help.

Towards the end of the trial period, the need for assistance when using CARIMO had significantly decreased (Wilcoxon-signed-rank $p<0.023$). Furthermore, this development was observed for respondents in Austria as well as in Italy, with no differences between the countries. While the number of people who always needed help with CARIMO had stayed the same, the number of those who reportedly needed help sometimes had decreased from 54.8% to 32.9% and the share of those who stated that they did not need help at all had increased from 38.4% to 60.3%.

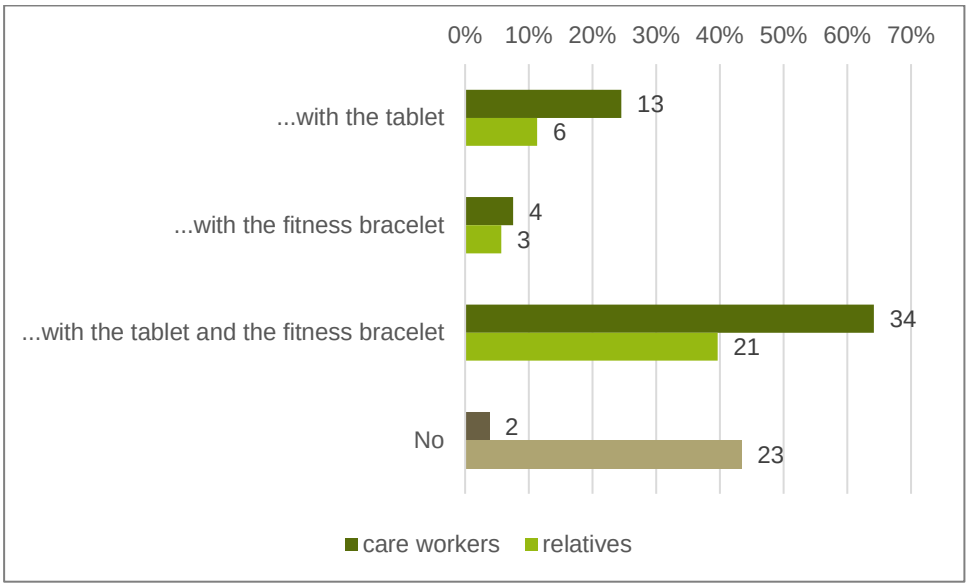
Figure 24: Help needed when using CARIMO



Source: WU, CiM usability surveys, (SU) 2017/2018, n=73, own calculations

As it was a core task of the CiM-Assistants to support test users during the initial training phase, almost all of those test users, who needed **help, received** it **from care workers** (96.2%). In addition, **more than a half** (56.6%) **also received help from family and friends** (see Figure 25).

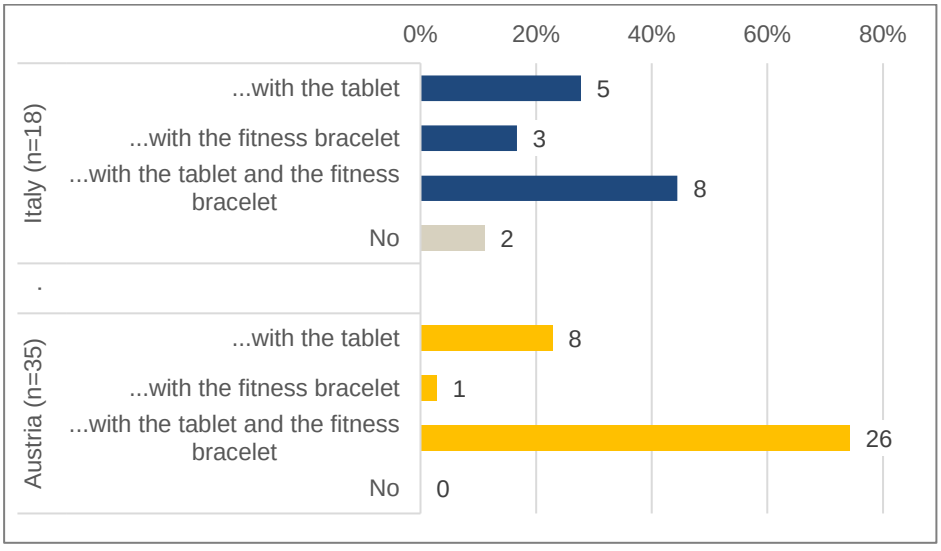
Figure 25: Help from others with CARIMO, t_1



Source: WU, CiM usability survey, (SU) 2017, n=53, own calculations

At the time of the first survey, there were some notable differences between Italian and Austrian users in where they received support from care workers (see Figure 26). First, some respondents in Italy reported that they did not receive any help from care professionals (11.1%), as opposed to respondents in Austria, where everyone had some help with CARIMO from their CiM-Assistants. Almost three quarters of the Austrian respondents received help from care professionals with both the tablet and the fitness bracelet, compared to 44.4% in Italy. The respondents in both countries received help in a similar fashion from relatives.

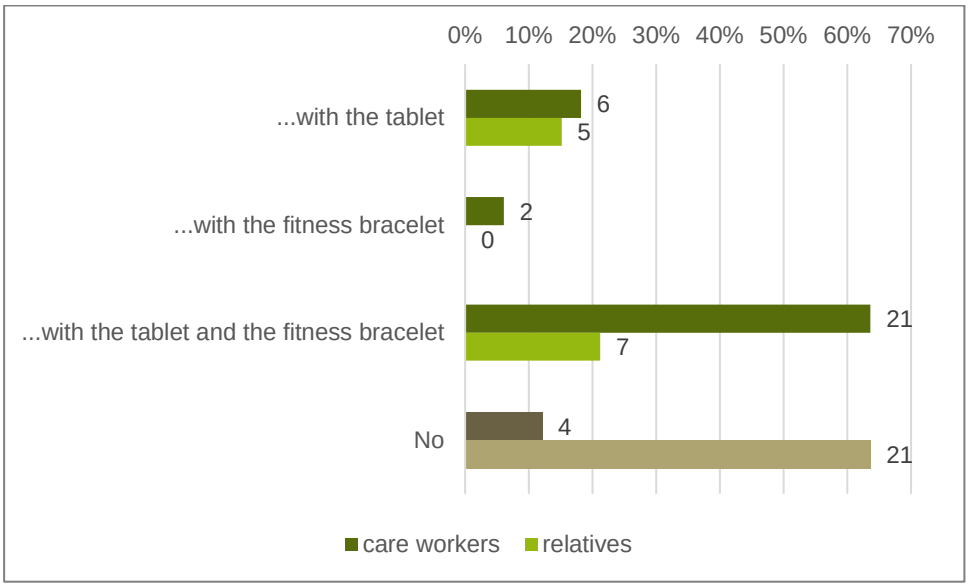
Figure 26: Help from care workers with CARIMO, t_1, by country



Source: WU, CiM usability survey, (SU) 2017, n=53, own calculations

Towards the end of the CARIMO trial period, 87.9% of those who still needed help from others with CARIMO received their support from care workers, whereas 46.4% also had help from relatives (see Figure 27). There were no differences between respondents in Italy and in Austria in the kind of support they received from either care workers or relatives.

Figure 27: Help from others with CARIMO, t_2



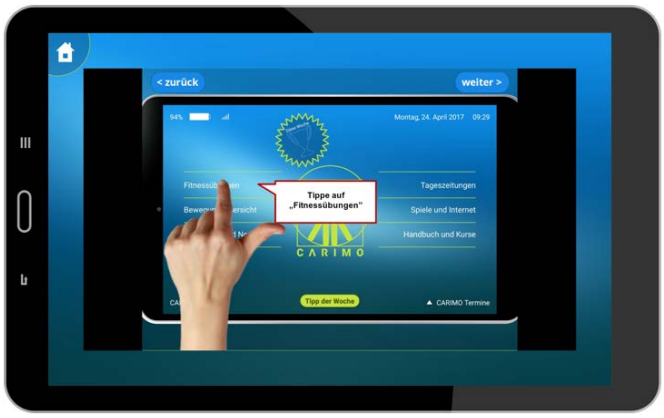
Source: WU, CiM usability survey, (SU) 2018, n=33, own calculations

Irrespective whether a care worker or a family member/friend supported, **most of the respondents received help with solving problems with both the tablet *and* the fitness bracelet.**

5.2 The CARIMO system tutorial

The CARIMO system tutorial was an integrated, interactive CARIMO function. Using screenshots from the CARIMO app in combination with descriptions of different buttons, images and icons, and prompts that asked the user to select specific buttons to proceed, it guided the user through the entire CARIMO app (see Figure 28).

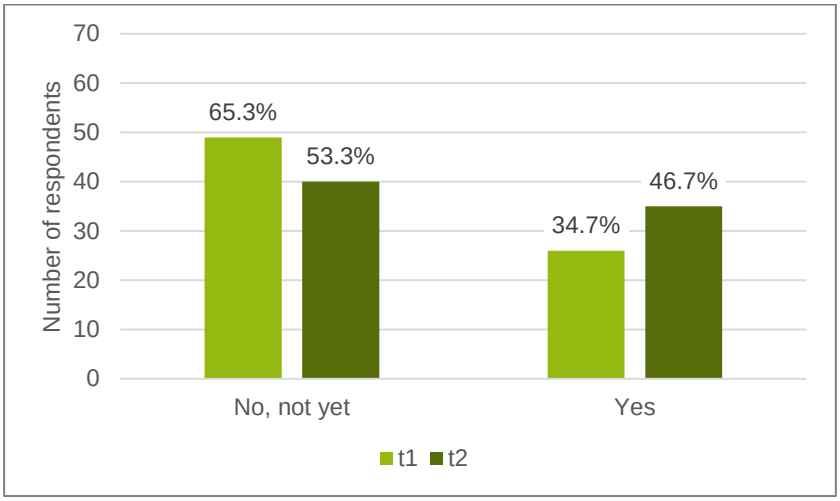
Figure 28: CARIMO system tutorial



Source: CiM Project

Although more than half of the test users reported needing help with CARIMO after the initial training period, **only 34.7% had looked at the CARIMO system tutorial** (see Figure 29). The evaluation question was carefully phrased, so that people, who only had a quick look at the tutorial but did not complete reading the tutorial, could agree. The comparatively low number of people who looked at the tutorial may be due to the personal help they got from CiM-Assistants and family/friends. Towards the end of the official trial period slightly more respondents (46.7%) were aware of the CARIMO system tutorial, although overall, the number of users knowing about the tutorial did not change significantly. This pattern was not notably different between Austria and Italy.

Figure 29: Are CARIMO users aware of the CARIMO system tutorial?



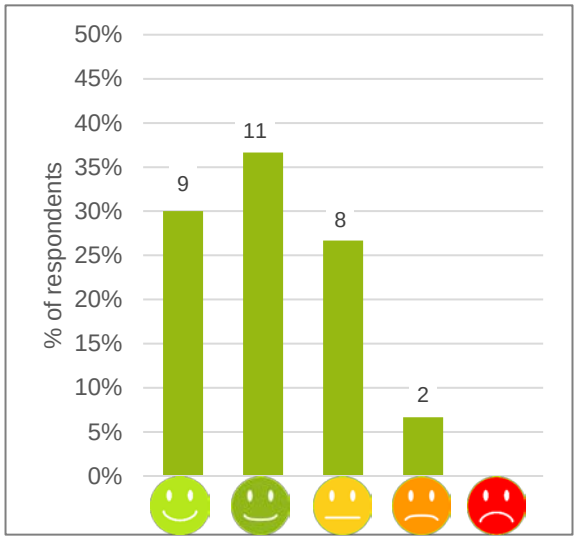
Source: WU, CiM usability surveys, (SU) 2017/2018, n=75, own calculations

A closer look at the distributions between both surveys revealed that eight respondents who first reported having already had a look at the tutorial, reported in the second survey that they had not seen the tutorial. The CARIMO system tutorial was intended mainly as a source of support and explanation of CARIMO and its different features and options, but not as a function to be used regularly. Thus, it is possible that by the time they had become familiar with CARIMO on their own, the users had forgotten about the existence of the tutorial.

After determining whether clients were aware of the CARIMO system tutorial, those who replied ‘yes’ were asked to indicate how useful they found the feature. Because of this the number of respondents to this question was reduced in the first survey (n=30) and only slightly increased in the second survey (n=35).

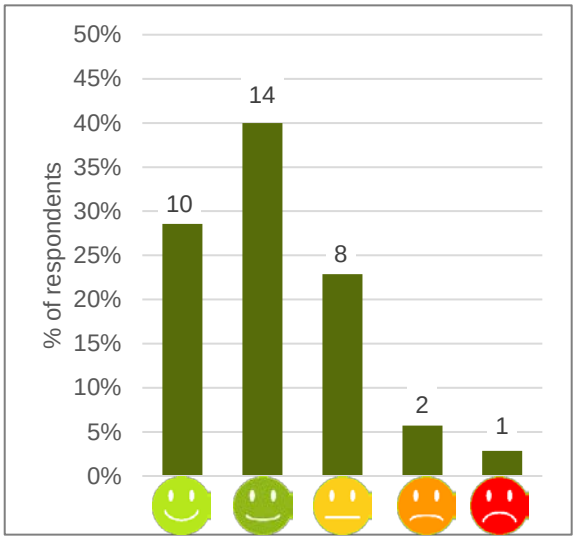
Figure 30 and Figure 31 illustrate how those who had looked at the system tutorial rated its usefulness in the first survey and in the second survey. More people were able to rate the tutorial’s usefulness in the second survey, but the overall assessment did not change significantly when comparing the responses available for both surveys. About **a third of all test users, who looked at the system tutorial, did not find the tutorial very useful**. There were no differences between the two countries. The comparatively low rating of the usefulness of the system tutorial did not come as a surprise. At the time of the survey, the system tutorial still used screenshots that were no longer up to date. In addition, the tutorial did not cover all functions and options offered by CARIMO.

Figure 30: CARIMO users' rating of the CARIMO system tutorial, t_1



Source: WU, CiM usability survey, (SU) 2017, n=30, own calculations

Figure 31: CARIMO users' rating of the CARIMO system tutorial, t_2



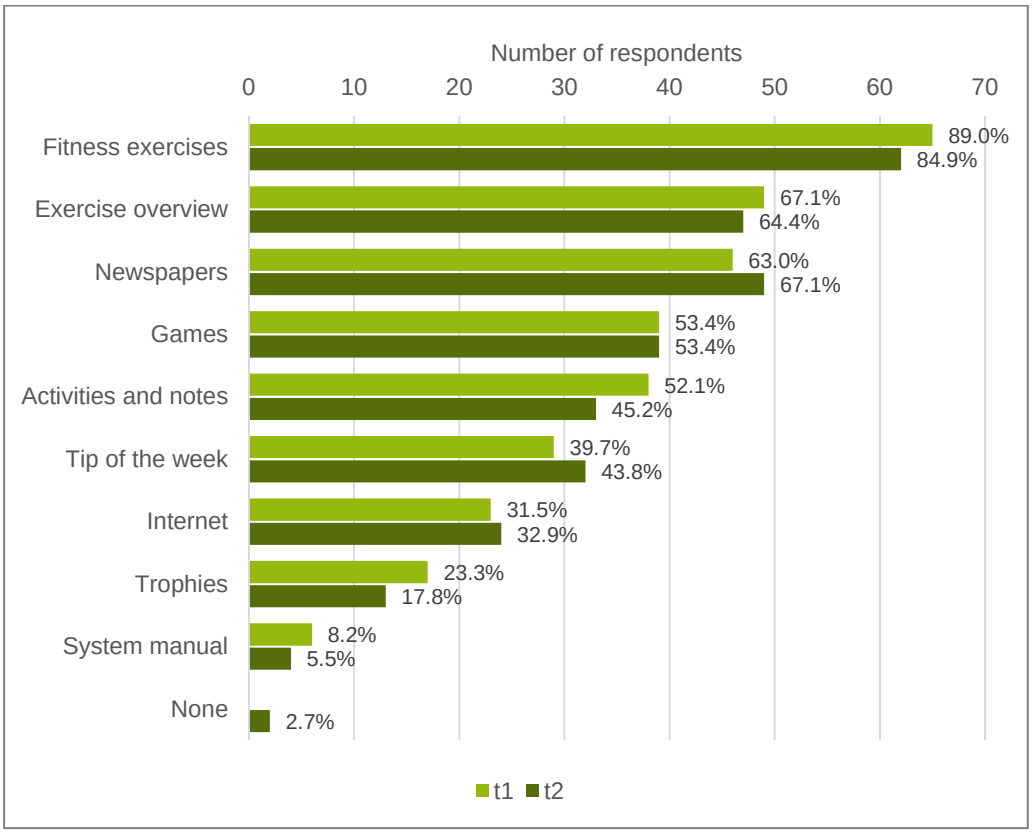
Source: WU, CiM usability survey, (SU) 2018, n=35, own calculations

6 Favorite CARIMO features

CARIMO included multiple features to promote exercise and physical activity, in addition to several other features offering opportunities for entertainment and interaction with others in the care network. Providing the respondents with a list of CARIMO features, we asked them to choose the features that they especially enjoyed. We did not restrict the number of possible options. In the first survey, respondents picked between one and nine (all) features, the most frequent number of favorite features in Austria was four (selected by 32.7%), and two in Italy (selected by 30.4%). In the second survey, respondents picked between 1 and 8 features, with most Austrians selecting three or four features (20% each), and most Italians selecting 4 features (29.1%). **On average, respondents chose four different favorite features in both countries**. The number of favorite features did not change over time. Although the respondents in Austria tended to choose more favorite features than the respondents in Italy, they were not different overall.

Figure 32 shows a ranking of CARIMO features according to the frequency with which the respondents selected them. The **CARIMO fitness exercises** were **clearly the most popular function**, both after the initial training period, as well as towards the end of the CARIMO trial phase. **Roughly two thirds of the respondents** also **enjoyed the exercise overview** and the **newspapers** after a longer period of using CARIMO. Approximately half of the respondents also selected 'games', and 'activities and notes', followed by the 'tip of the week', internet access, the trophies, and the system tutorial. A very small number of respondents stated in the second survey that they enjoyed none of the mentioned major CARIMO features.

Figure 32: Favorite CARIMO features



Source: WU, CiM usability surveys, (SU) 2017/2018, n=73, own calculations

Although the number of favorite features was roughly similar, there were some differences between Austrian and Italian users when it came to which features they preferred (see Figure 33, Figure 34 and Figure 35). After the initial training period, the **CARIMO exercises** were selected as a favorite feature by almost every **Austrian** respondent (94.5%), whereas noticeably fewer respondents in Italy (79.3%) chose the exercises as one of their favorite features. By the end of the trial period, however, the shares of those who valued the fitness exercises were similar in both countries, with 84% in Italy and 86.5% in Austria.

Fewer than half of the Italian respondents selected the **CARIMO activity overview** as a favorite feature, whereas the majority of the users in **Austria** valued this feature. The chi^2-test ($p=0.008$) confirmed that this difference between the groups was highly significant, and remained so throughout the trial phase, as the opinions did not change much towards the end of the trial period (chi^2 $p=0.008$).

Lastly, there was a significant difference in whether Italian and Austrian respondents selected the CARIMO **internet** as a favorite feature in the first survey (chi^2 $p=0.01$). Access to the internet was a feature that more than half of the respondents in **Italy** valued, whereas only a bit more than 20% of the Austrian users selected it as a favorite feature in the first survey. Towards the end of the trial phase, the groups were slightly more similar (40% selected internet in Italy, 26.9% in Austria) and thus no longer significantly different (chi^2 $p=0.246$).

Figure 33: CARIMO fitness exercises as a favorite feature, t_1 and t_2, by country

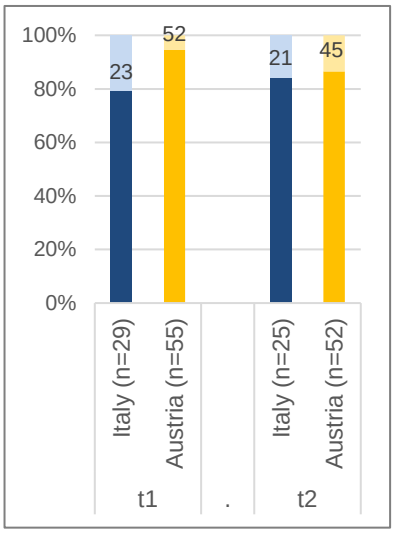


Figure 34: CARIMO activity overview as a favorite feature, t_1 and t_2, by country

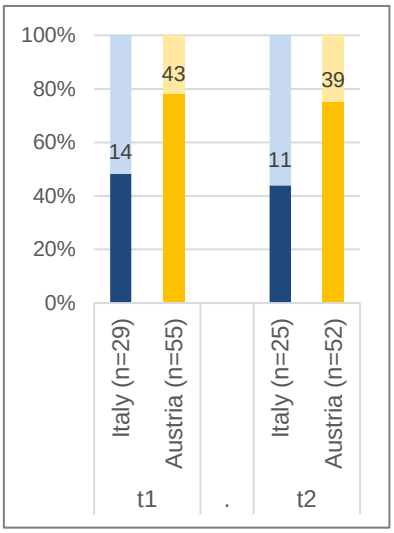
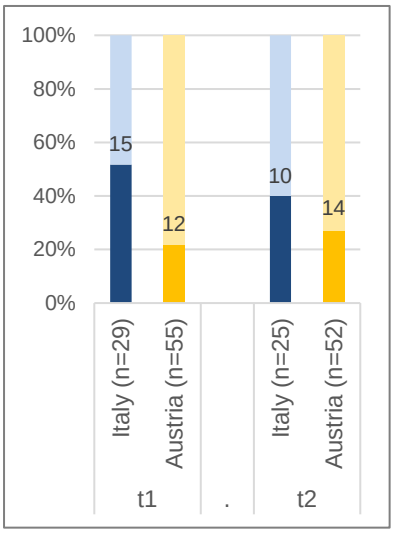


Figure 35: CARIMO internet as a favorite feature, t_1 and t_2, by country



Note: lighter area: total number of respondents in a country
Source (Figure 32 33 34): WU, CiM usability surveys, (SU) 2017/2018, t_1 – n=84 and t_2 – n=77, own calculations

7 Exercising with CARIMO

The CARIMO app aimed to enhance physical activity and exercise among older adults by

- providing users with appropriate exercises and information about the exercises and by
- including features that may motivate them to exercise and stay active.

In addition to the 10 minutes exercise program, to increase motivation, the app also offered a daily and weekly activity overview, feedback on completed exercises, rewards, such as bronze, silver and gold trophies, and weekly tips on how to stay fit and incorporate activity into daily life. When charging the tablet, a screensaver gave different health and quality of life-related reasons for regular physical activity and exercise.

In this chapter, we present our findings regarding the users' perception of the CARIMO fitness function in terms of design (Chapter 7.1), the CARIMO exercise function in use (Chapter 7.2), selection of exercises (Chapter 7.3), incentives (Chapter 7.4), and how they perceive the impact of CARIMO on their physical activity behavior (Chapter 7.5).

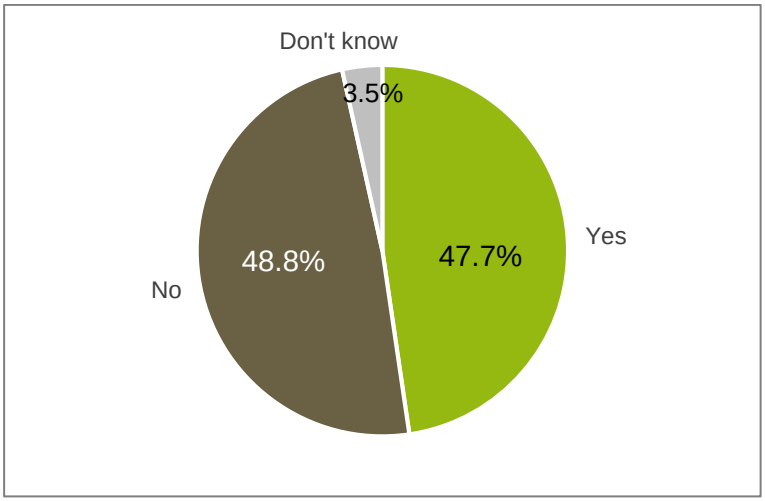
7.1 Design: music with exercises?

There was consent in the CiM consortium that the exercise program had to have instructions and videos to show the exercises. However, the opinion about having music with the exercises was mixed. Thus, a question on background music was integrated in the first usability questionnaire.

Altogether, the respondents were also split in their opinion on whether the CARIMO exercises should be accompanied by music or not (see Figure 36). A slight majority of 48.8% were against any sort of music accompanying the fitness exercises, whereas 47.7%

were actually in favor of some background music. Country-wise, 51.6% of the Italian respondents and 45.5% of the Austrian respondents were in favor of some background music during the CARIMO exercises. Thus, there were no notable differences between the preferences of the users in Austria and Italy. This implies that background music should be an optional function. However, it has to be considered that taste in music varies. Thus, incorporation of music needs options for users to customize the background music to their taste.

Figure 36: Preferences for and against background music with exercises



Source: WU, CiM usability survey, (SU) 2017, n=86, own calculations

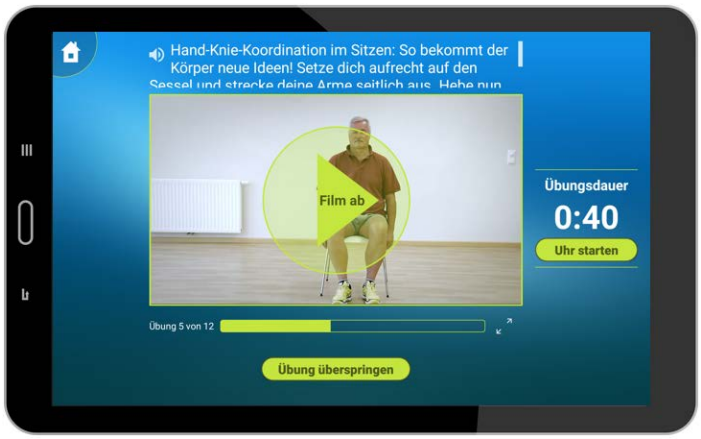
7.2 The CARIMO exercise function in use

To complete their daily CARIMO fitness exercise program, the users had to correctly operate the fitness function of CARIMO (see Figure 37). This involved several steps and aspects:

- knowing what to do (by either reading the description of the exercise, listening to an audio-description and/or watching the video);
- starting a countdown (if the exercise is timed, as opposed to a set number of repetitions they have to count themselves);
- doing the exercise as correctly as possible;
- proceeding to the next exercise; and
- saving the status of completed exercises at the end of the program.

Additionally, users could enlarge the video, skip an exercise they could not or did not want to do, or stop the training entirely by returning to the home screen (including the option to continue the training later on). A progress bar charted the progress in the exercise program.

Figure 37: CARIMO exercise function

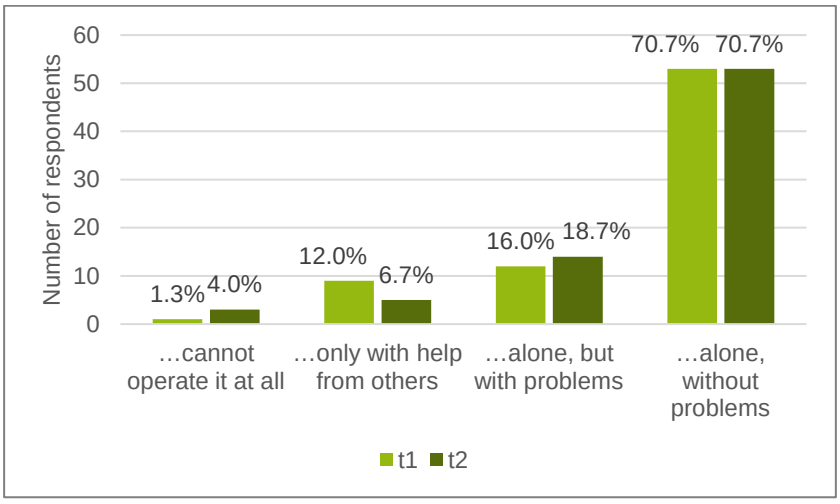


Source: CiM-Project

Figure 38 illustrates how respondents assessed their ability to operate the CARIMO exercise function over time. Already after the initial training phase, **the majority (two thirds) of the respondents reported that they could operate the CARIMO exercise function well on their own.** Approximately 20% experienced some problems but could go along. A bit more than 10% reported that they needed help. Only one user reported that (s)/he could not operate the fitness program at all.

The ability to operate the CARIMO exercise function **did not change over time**. The share of respondents who could manage well on their own remained exactly the same, with a slight increase for those who could manage alone but with problems, as well as for those who stated they could not operate the CARIMO exercise function at all.

Figure 38: Ability to operate the CARIMO exercise function

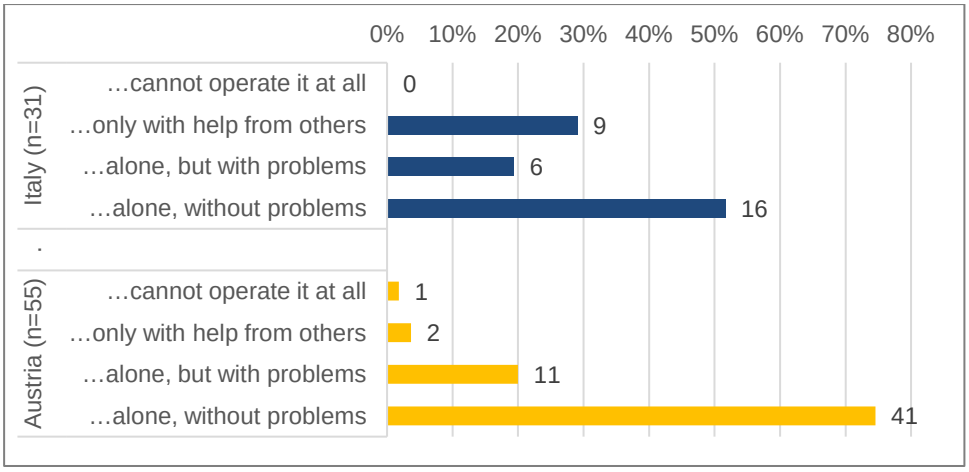


Source: WU, CiM usability surveys, (SU) 2017/2018, n=75, own calculations

The country comparison revealed that the **CARIMO users in Italy** had significantly more **difficulty operating the CARIMO exercise program** than the Austrian users after the initial training phase and at the end of the trial (Mann-Whitney-U test $p<0.05$ in t_1 and t_2). After the initial trial period, almost 30% of the Italians were only able to operate the exercise function with help from others, 19% had some problems, and a bit more than half could operate it alone without problems. In contrast, more than 90% of the Austrians were able to operate the

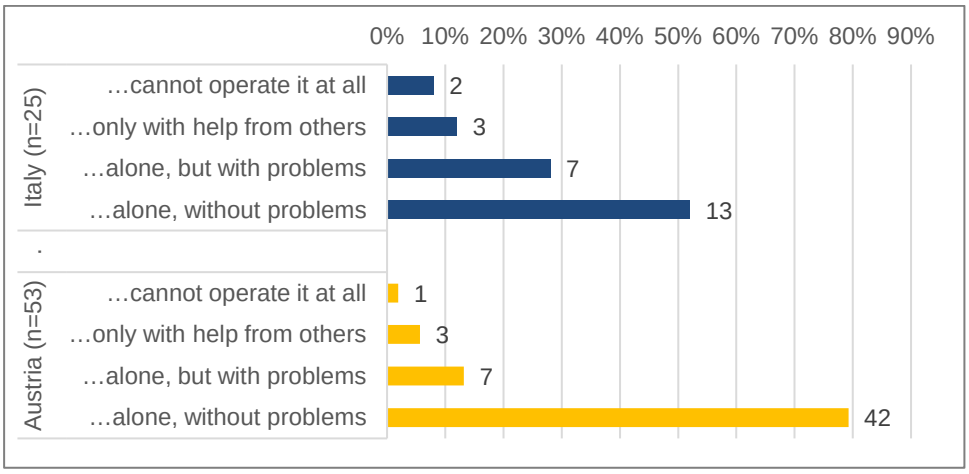
CARIMO exercise program on their own and only about 5% of the Austrian users required help from others or were unable to operate it at all (see Figure 39). Towards the end of the trial period, fewer Italian respondents required help from others to operate the exercise program. Overall, the difference between the groups remained significant at the end of the trial. Contrary to Italy, the share of users, who were able to manage well on their own, had slightly increased in Austria (see Figure 40).

Figure 39: Ability to operate the CARIMO exercise function, t_1, by country



Source: WU, CiM usability survey, (SU) 2017, n=86, own calculations

Figure 40: Ability to operate the CARIMO exercise function, t_2, by country



Source: WU, CiM usability survey, (SU) 2018, n=78, own calculations

7.3 Selection of exercises

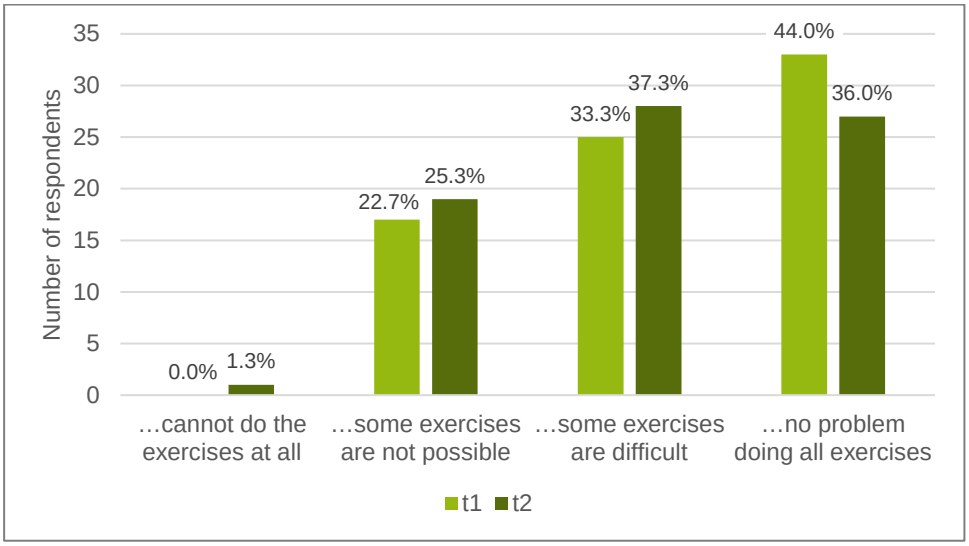
The exercise videos for CARIMO were planned and filmed by sports scientists who asked older adults to perform the exercises. The sports scientists selected exercises that were deemed appropriate for older adults with possible existing mobility restrictions (Jungreitmayr and Ring-Dimitriou 2016). The exercises required no more extra equipment than a regular chair. Before the start of the field trial, participants completed a fitness assessment and were assigned to one of two difficulty levels that determined the type of exercises they received.

The daily changing exercise programs were set to take around 10 minutes in total and consisted of six different exercises that were repeated once throughout each daily program. The exercise programs always contained a combination of exercises that focused on enhancing or maintaining physical agility, balance, and muscle strength (for further details see Jungreitmayr and Ring-Dimitriou 2016).

After the initial training period, **three quarters of the respondents were physically able to do all CARIMO exercises**, with 44% of the users reporting that they had no problem doing the exercises at all, and 33%, who reported having some difficulty, while still being able to do all exercises. For a bit more than **20% of the respondents, some exercises were not possible,** but no one replied being unable to do any of the exercises. Towards the end of the trial period, the share of users who were able to do all exercises had remained about the same, although it was more evenly distributed with fewer people reporting no problems and slightly more respondents reporting some difficulty when doing the exercises. One quarter stated that some exercises were not possible, and one person answered that s/he was not able to do the exercises at all (see Figure 41). Overall, the respondents' ability to do all CARIMO exercises did not change over time. Participants in Austria and in Italy reported similar experiences of difficulty with the exercises.

According to the sports scientists in the CiM-Consortium, some difficulty with exercises is useful to help people to develop strength and skills. However, it is important to explicitly communicate the need for a certain level of intensity while exercising and maintain a balance between levels of difficulty to prevent frustration and discouragement among the users.

Figure 41: Physical limitations to CARIMO exercises



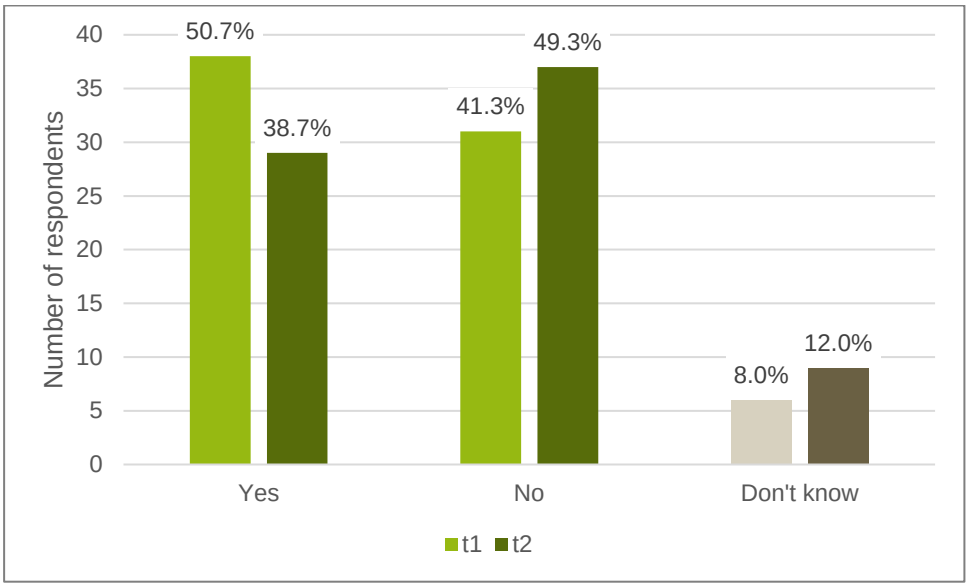
Source: WU, CiM usability surveys, (SU) 2017/2018, n=75, own calculations

The CARIMO exercise program was set up with two repetitions of each exercise per day. This implies that users had 'only' six different exercises per day. So, we were interested in whether people would have liked more variety of exercises in their daily program.

At the time of the first survey, about half of the respondents said they would support the idea of more variation of exercises per day. For over 40%, the existing variety of the program was sufficient, whereas less than 10% did not have an opinion (see Figure 42). Towards the end of the trial phase, the positions on these questions had only slightly changed. More

respondents now reported no need for more variety, and fewer stated that they still would like more variety in the exercises. The share of people who did not know whether they really wanted more variety also slightly increased over time from 8% to 12%. This implies that also in a group of people in need of support, **more variation in exercises would be appreciated**.

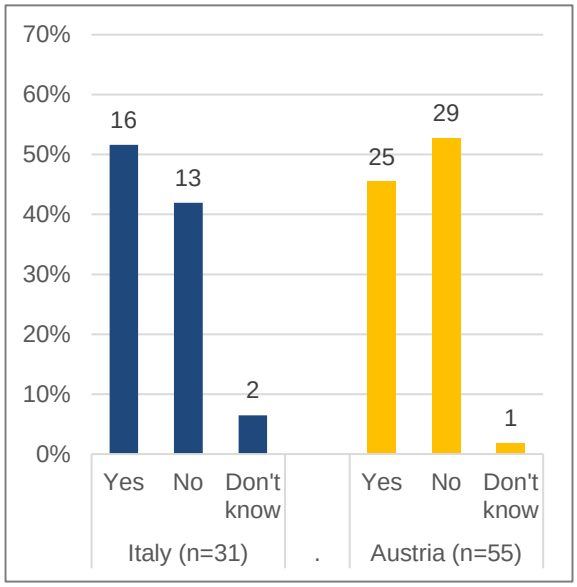
Figure 42: Preferences for or against more variety in the CARIMO exercises



Source: WU, CiM usability surveys, (SU) 2017/2018, n=75, own calculations

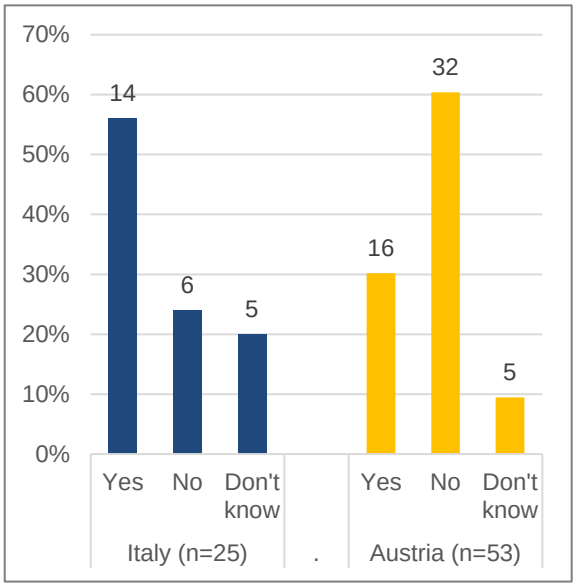
The country comparison revealed that after using CARIMO for a longer time, the users' preferences regarding the **variety of CARIMO exercises** differed between Austria and Italy. In **Italy**, more than 50% and thus the majority of respondents were **in favor of greater variety**, whereas a little more than 40% did not need more variety. In Austria, those who did not need more variety were in the majority (see Figure 43). Despite this tendency, these preferences were not different overall. However, towards the end of the trial phase, these country-specific preferences were stronger, and more different, resulting in a chi^2-test result ($p< 0.05$).

Figure 43: Preferences for or against more variety in the CARIMO exercises, t_1, by country



Source: WU, CiM usability survey, (SU) 2017, n=86, own calculations

Figure 44 Preferences for or against more variety in the CARIMO exercises, t_2, by country



Source: WU, CiM usability survey, (SU) 2018, n=78, own calculations

7.4 Incentivizing physical activity with CARIMO

To achieve an understanding of how well the CARIMO features to promote physical activity were received by the CARIMO test users, we asked them to indicate how pleased they were with these features. We asked the respondents to rate the daily alternating exercises, the activity overview, the availability of trophies as rewards, whether they had actually tried out any of the tips of the week, and how they rated the tips, using smiley faces (see Chapter 3.1). We also aimed to find out whether they were actually aware of the CARIMO screensaver.

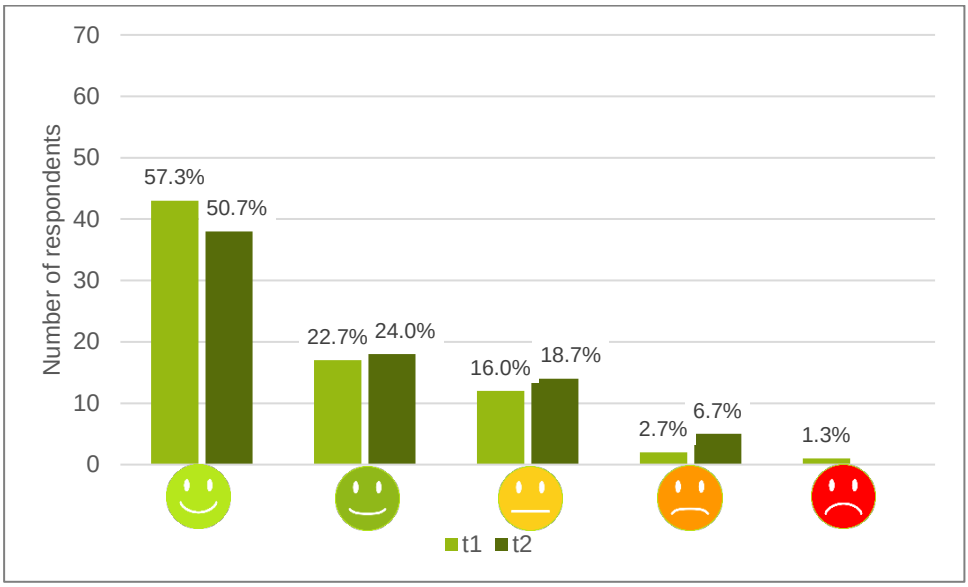
7.4.1 Daily alternating exercises

The CARIMO exercise program changed on a daily basis. The individual exercises were drawn from a pool of more than 100 exercise videos and compiled into daily exercise routines by the sport scientists of the CiM-Consortium (for details see Jungreitmayr and Ring-Dimitriou 2016).

After the last exercise video in a daily program, CARIMO recapped the number of exercises completed (i.e. not skipped) and gave motivational feedback to the user, e.g. congratulating them on completing all exercises or, if not all exercises were completed, encouraging them to try again.

Figure 45 illustrates how the CARIMO users' perception of the daily changing exercise program developed over time. After the initial training period, **80% of the respondents gave an overall positive rating to the availability of daily alternating CARIMO exercises**, which decreased slightly to about 75% towards the end of the CARIMO trial period. Overall, there was only slight decrease in general satisfaction with the CARIMO exercises.

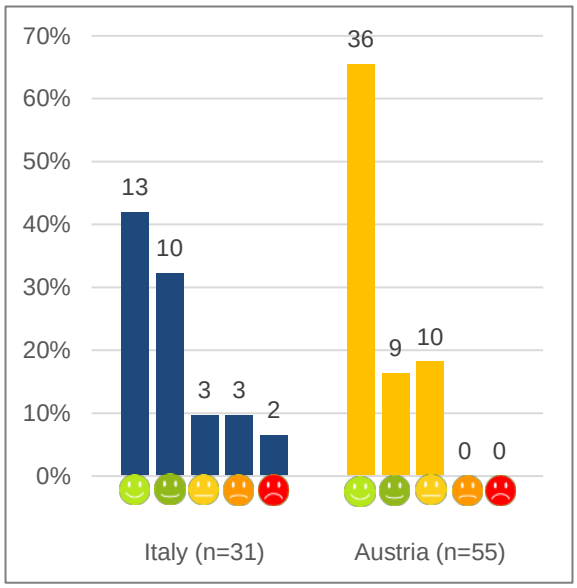
Figure 45: CARIMO users' rating of daily alternating CARIMO exercises



Source: WU, CiM usability surveys, (SU) 2017/2018, n=75, own calculations

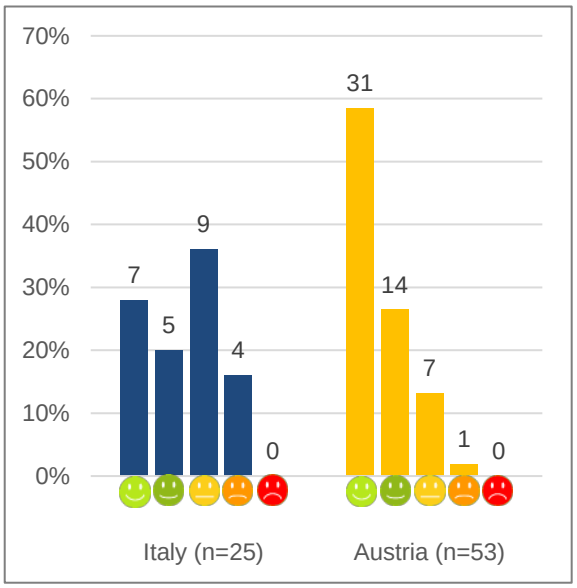
There was a significant **difference** in how the users in **Austria and Italy assessed the daily alternating CARIMO exercises**. Whereas the Austrian respondents gave highly positive ratings (more than 60% chose the best possible answer, and no negative assessments), the **Italian users** were a bit **less convinced**, though still positive (see Figure 46). This difference remained significant and became **even more pronounced towards the end of the trial phase**, when the Italian users were still much less enthusiastic about the feature than the Austrians (Mann-Whitney-U test $p<0.05$ in t_1 and $p<0.01$ in t_2) (see Figure 47).

Figure 46: Rating of CARIMO exercises t_1, by country



Source: WU, CiM usability survey, (SU) 2017, n=86, own calculations

Figure 47: Rating of CARIMO exercises t_2, by country

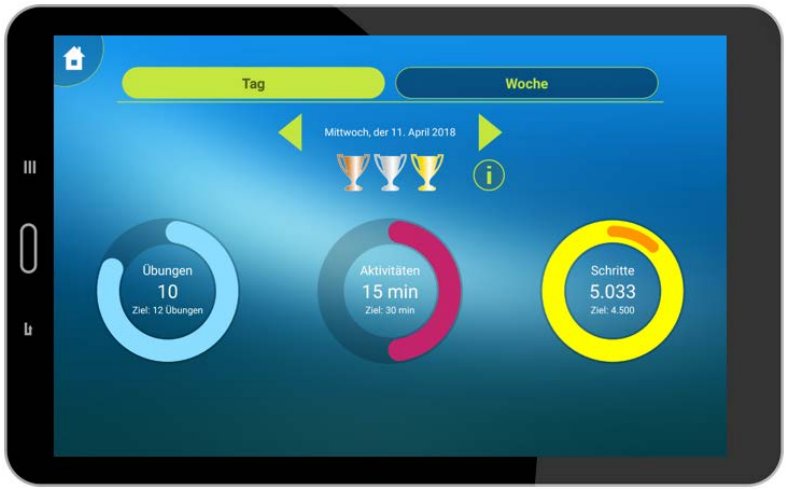


Source: WU, CiM usability survey, (SU) 2018, n=78, own calculations

7.4.2 Activity overview

The CARIMO activity overview enabled the users to keep track of their daily or weekly exercises and physical activities (see Figure 48). One screen showed how much of their daily exercise, activity and step goals the users had reached. It also gave a visual impression of how much activity was still needed to reach a daily goal. A weekly overview was also available, as well as the possibility to look at the overview of past days and weeks by clicking on the arrow symbols next to the date. Additionally, the users had the option to select one of the three 'activity donuts' to receive a more detailed overview of their daily or weekly activity. The detailed overview showed the time when they completed the exercises and indicated the number or duration of the activities, or, in the case of the counted steps, showed a histogram of the steps walked over the day.

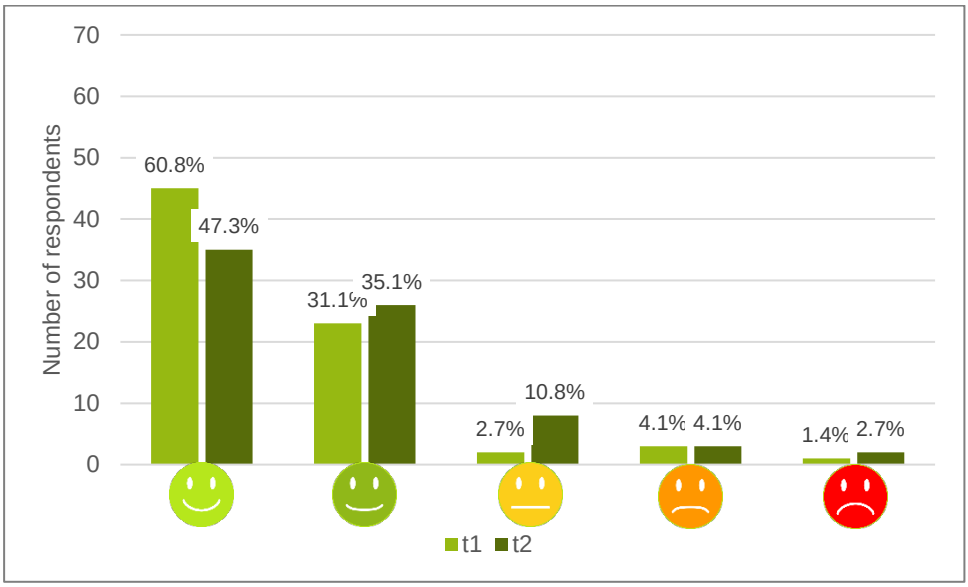
Figure 48: CARIMO activity overview (main screen)



Source: CiM-Project

More than **90% of the respondents gave the activity overview a positive rating** when they were asked to indicate how they felt about being able to track their physical activities with the CARIMO activity overview the first time after the initial training period. **Over 60% gave the highest rating**, and less than 10% gave a moderate or negative rating. However, **at the end of the CARIMO trial period, the ratings of the CARIMO activity overview were perceivably lower**. Although they were still positive, the most positive response was selected less frequently (47.3%), while the lower ratings slightly increased.

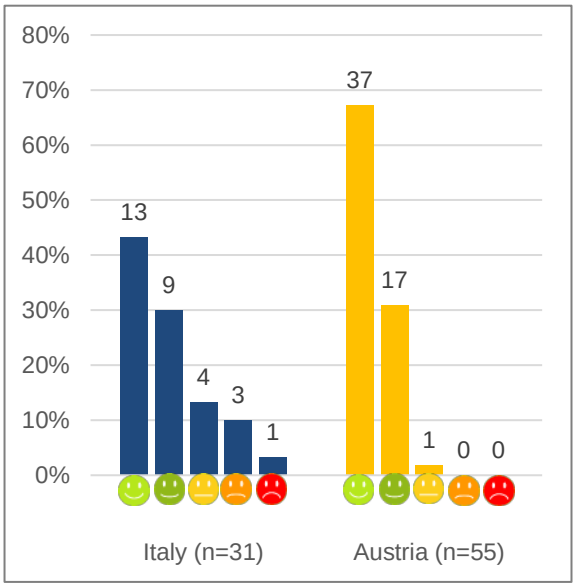
Figure 49: CARIMO users' rating of the CARIMO activity overview



Source: WU, CiM usability surveys, (SU) 2017/2018, n=74, own calculations

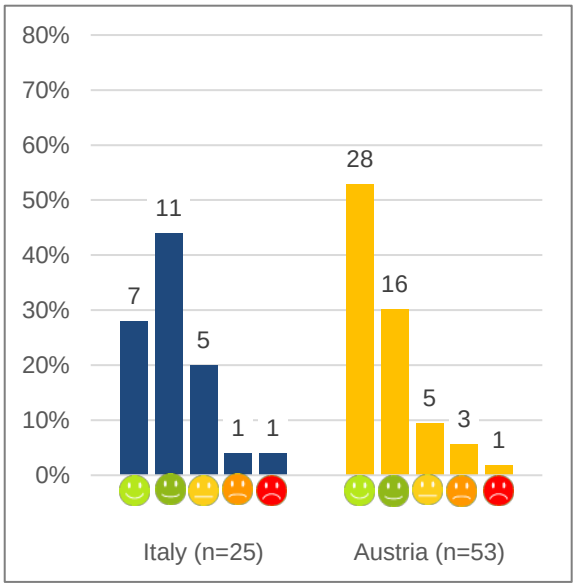
A side-by-side comparison of the responses in Austria and Italy revealed that there was a significant difference in how users rated the activity overview in the two countries in the first survey (Mann-Whitney-U $p<0.05$). **After the initial training period**, respondents in **Austria viewed the activity overview more positively** than respondents in Italy (see Figure 50). However, at the end of the trial phase, the ratings were overall more moderate and did not differ between respondents in Austria and Italy (see Figure 51).

Figure 50: Rating of the CARIMO activity overview, t_1, by country



Source: WU, CiM usability survey, (SU) 2017, n=85, own calculations

Figure 51: Rating of the CARIMO activity overview, t_2, by country



Source: WU, CiM usability survey, (SU) 2018, n=78, own calculations

The decrease in the overall ratings of the CARIMO activity overview over time can be mainly attributed to the users **in Austria** (Wilcoxon-signed-rank $p<0.05$), as it did not change much for the respondents in Italy. There are several potential explanations for why the activity

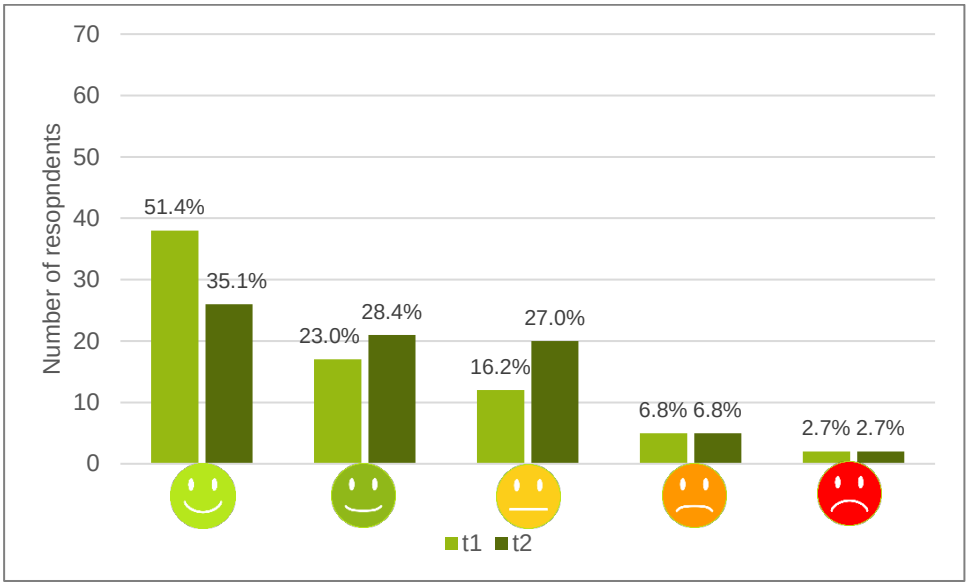
overview somehow lost its appeal to some of the CARIMO users. It is possible that the novelty of the activity overview had simply worn off; the users did not collect enough exercises, activities and steps to enjoy or benefit from using the activity overview. Additionally, there were issues with properly registering the exercises and the accuracy and transfer of the step count from the fitness bracelet, as indicated in the comments of the users at the end of the questionnaire.

7.4.3 Awards

A commonly used motivational incentive in different commercially available fitness apps is the opportunity for users to collect some sort of reward through program adherence (Lister et al. 2014). CARIMO users could record their activities to receive daily or weekly rewards. Activities comprised physical exercises, number of steps while wearing the fitness bracelet, and/or outdoor activities recorded by the fitness tracker manually or automatically. The awards were animated trophies displayed in the CARIMO activity overview and on the CARIMO home screen. The trophies filled up with increasing exercises completed, steps and activities recorded, and changed colors from bronze, to silver, to gold. The users were also able to see how many exercises or steps they still needed to complete or collect to reach a better trophy, and how many steps and exercises were necessary in total to reach the next trophy. The cut-off levels were provided by the CiM-partners University of Salzburg and Salzburg Research.

After using CARIMO for 2-3 months, around three quarters of all respondents indicated that they appreciated the availability of trophies for completed exercises and reaching physical activity goals. About 16% were ambivalent, whereas a little less than 10% were not happy with the trophies. Towards the end of the CARIMO trial phase, the positive impression of the trophies had decreased; with fewer people choosing the best rating and an increase in those who gave the trophies a ‘second best’ or moderate rating (see Figure 52). Although a certain decrease in enthusiasm is visible in the graph, it is not a notable trend. Furthermore, Austrian and Italian users did not differ in their rating of the CARIMO awards.

Figure 52: CARIMO users' rating of availability of "awards" for completed exercises

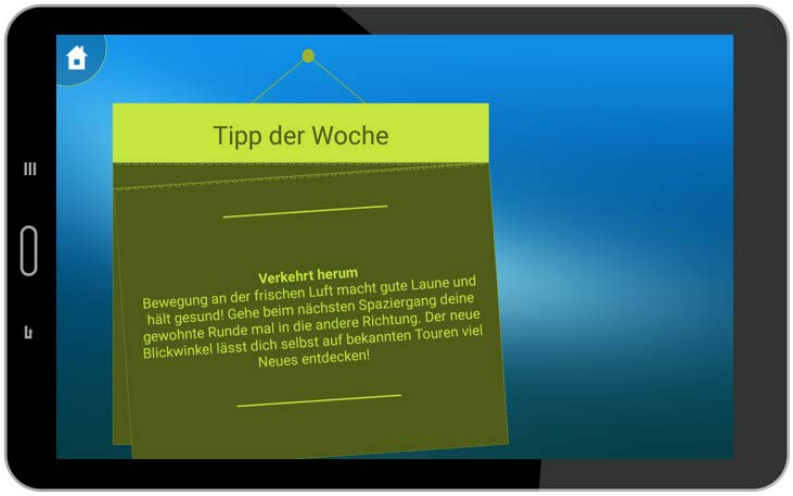


Source: WU, CiM usability surveys, (SU) 2017/2018, n=74, own calculations

7.4.4 Tip of the week

At the start of each week, CARIMO users received a new, short 'tip of the week' (see Figure 53). When a new tip was available at the beginning of the week, CARIMO informed the users via a small red notification symbol attached to the tip of the week button. The notification symbol disappeared when the tip was opened once. The purpose of the tip of the week was to prompt and encourage the test users to be physically active. The different tips of the week provided tips about healthy movement in general, ideas on how to include little bouts of exercise when doing daily chores and activities, and suggestions for how to change up outside walks and make them diverting and fun.

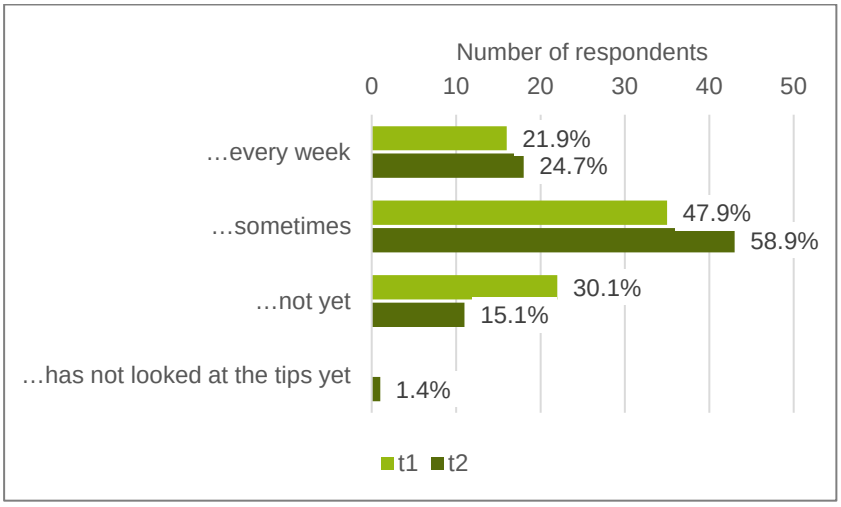
Figure 53: CARIMO tip of the week (example)



Source: CiM-Project

At the time of the first survey, the majority of respondents (69.8%) reported having already followed one of the exercise tips at least sometimes (see Figure 54). Thereof, around half of the respondents had sometimes tried one of the weekly tips, whereas **21.9% stated that they had actually followed them every week**. The responses also indicate that all of the respondents had at least looked at the exercise tips, but there were still around 30% who had not tried any of the tips. The responses were similarly distributed in Austria and in Italy.

Figure 54: Trying out the CARIMO tip of the week

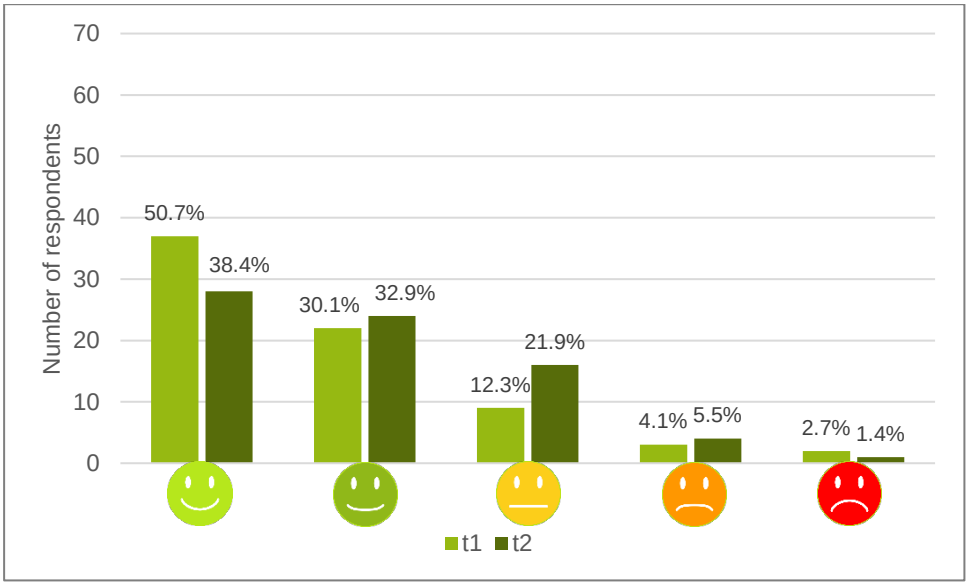


Source: WU, CiM usability surveys, (SU) 2017/2018, n=73, own calculations

Towards the end of the CARIMO trial period, the share of users who tried the tips regularly had not really changed. The share of test users who had not yet tried out the CARIMO tips of the week had halved (15.1%), and correspondingly, the numbers of those who reported that they had tried the tips at least sometimes or even every week, increased. One respondent, who had at least seen the tips at first, reported in the second survey that she or he had not looked at the tips yet. Possibly, this person did not remember looking at the tips before.

Overall, the weekly tips received mostly positive ratings (see Figure 55). More than 50% of the respondents rated the tips with the highest satisfaction, and **over 80% gave the tips an overall positive rating**, whereas 12.3% were moderately satisfied with the availability of weekly tips and 6.8% gave an overall negative assessment. Looking at the graph in detail, a notable decrease in the ratings over time is not detectable. The initial ambition or enthusiasm about the weekly tips was curbed in the highest rating option (from 50.7% to 38.4), and most likely shifted to the moderate camp (which increased from 12.3% to 21.9%), as the negative ratings remained mostly the same.

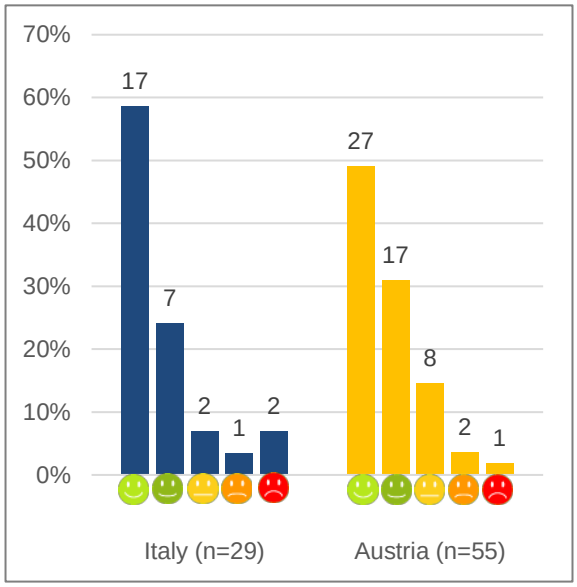
Figure 55: CARIMO users' rating of weekly tips for exercise and activity



Source: WU, CiM usability surveys, (SU) 2017/2018, n=73, own calculations

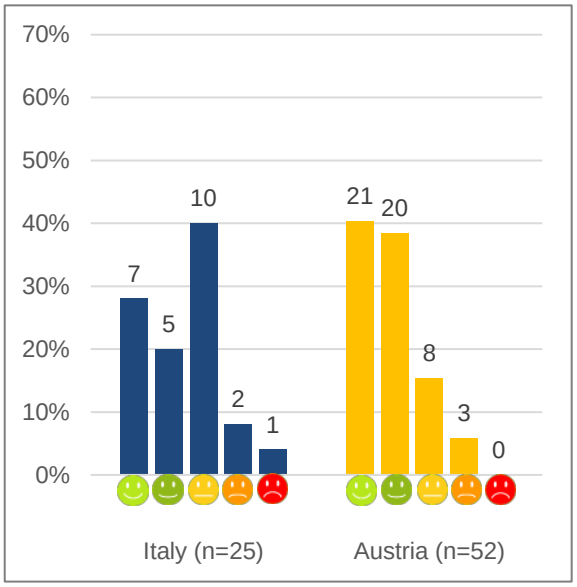
Over the course of the CARIMO trial, the **weekly tips** were rated differently in Italy and in Austria. In the first survey, the ratings were positive and similarly distributed in both countries (see Figure 56). However, towards the **end of the trial period**, **Austrian users** gave **more positive ratings** for the weekly tips than the users in Italy – this difference is not significant (see Figure 57).

Figure 56: Rating of weekly tips for exercise and activity, t_1, by country



Source: WU, CiM-usability survey, (SU) 2017, n=84, own calculations

Figure 57: Rating of weekly tips for exercise and activity, t_2, by country

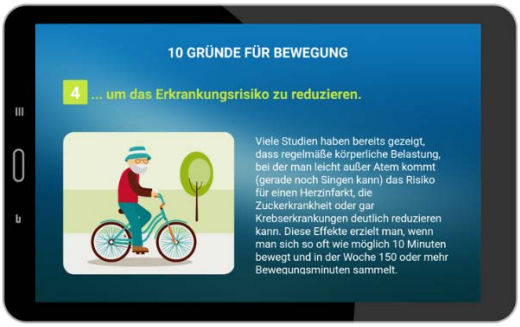


Source: WU, CiM-usability surveys, (SU) 2018, n=77, own calculations

7.4.5 CARIMO screensaver

While charging the CARIMO tablet, a customized screensaver appeared after a few minutes of inactivity on the tablet. The CARIMO screensaver was a slideshow of 10 different reasons for regular physical activity and exercise, with short explanations and matching illustrations (see Figure 58).

Figure 58: CARIMO screensaver (10 reasons for physical activity: shown reason Nº 4: '… to reduce risk of illness')



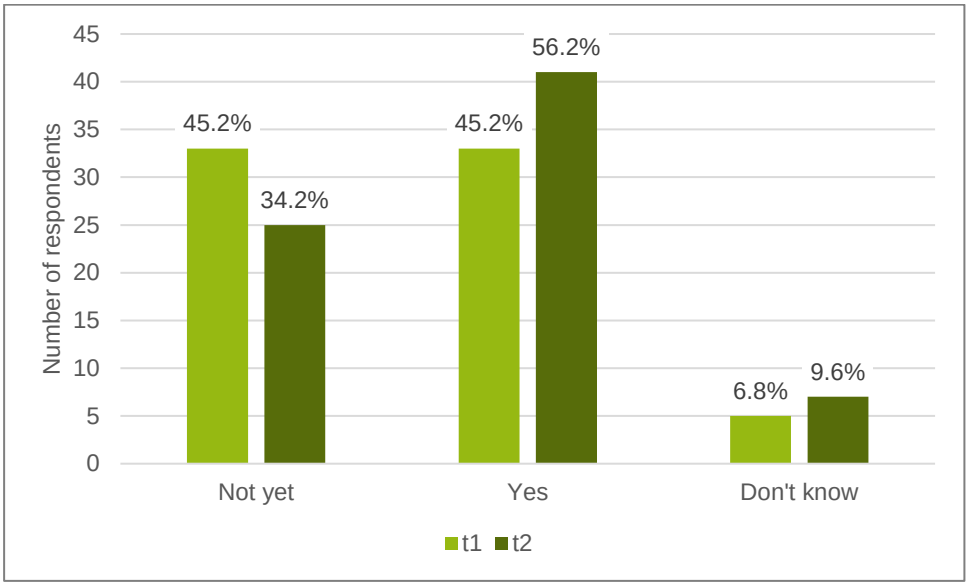
Source: CiM-Project

Because the CARIMO screensaver was a very subtle feature of CARIMO (only appeared when the tablet was charging and not actually in use, and disappeared at the moment of any kind of interaction with the touchscreen or buttons), we wanted to find out whether the respondents were actually aware of the screensaver.

Overall, **only around half of the respondents were aware of the CARIMO screensaver** (see Figure 59). At the time of the first survey, the proportion of respondents who were aware of the screensaver and those who had not seen it yet was exactly the same, close to half (45.2%). The rest, 6.8%, stated that they did not know. At the time of the second survey, the number of people who had not seen the screensaver had decreased (34.2%), while the number

of those aware of the screensaver had increased (56.2%). However, there were also more people, who responded 'don't know' (9.6%) than the first time. Overall, **the changes in the respondents' awareness of the CARIMO screensaver were not significant over time.**

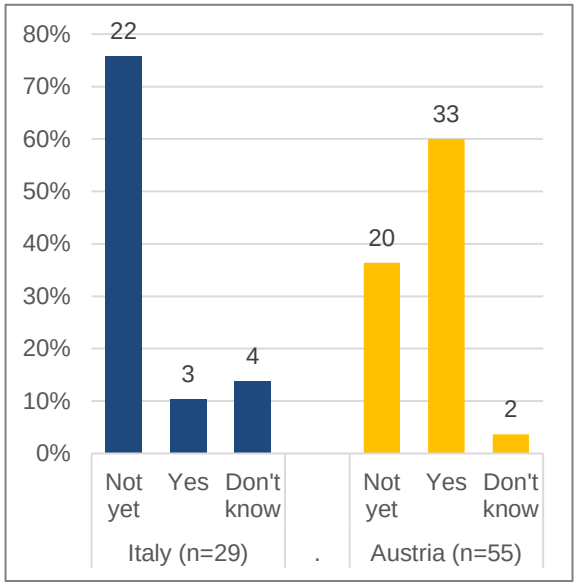
Figure 59: Whether respondents were already aware of the CARIMO screensaver at the time of the survey



Source: WU, CiM usability surveys, (SU) 2017/2018, n=73, own calculations

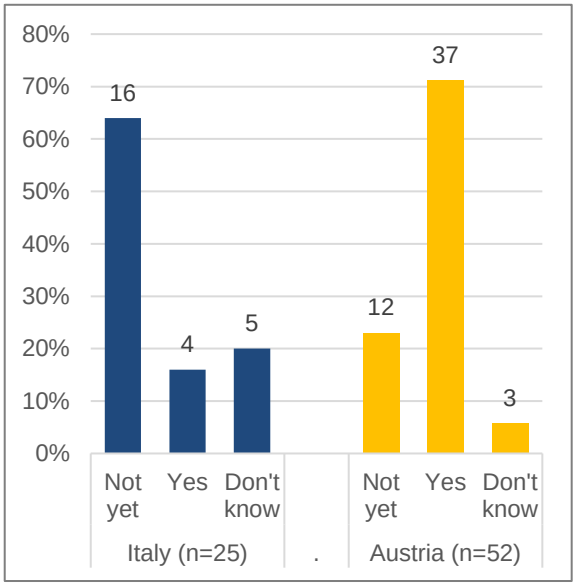
A look at the responses in the individual countries reveals that a **significantly higher share of the users in Austria** was **aware of the CARIMO screensaver** than in Italy (chi^2 $p<0.01$ for t_1 and t_2). Initially, only 10% of Italian respondents, but 60% of users in Austria had reported having seen the CARIMO screensaver (see Figure 60). By the end of the CARIMO trial period, the majority of Italian users, more than 60%, and only over 20% of users in Austria had still not seen the CARIMO screensaver (see Figure 61).

Figure 60: Awareness of the CARIMO screensaver, t_1, by country



Source: WU, CiM usability survey, (SU) 2017, n=84, own calculations

Figure 61: Awareness of the CARIMO screensaver, t_2, by country



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

7.5 Experienced impact of CARIMO exercises

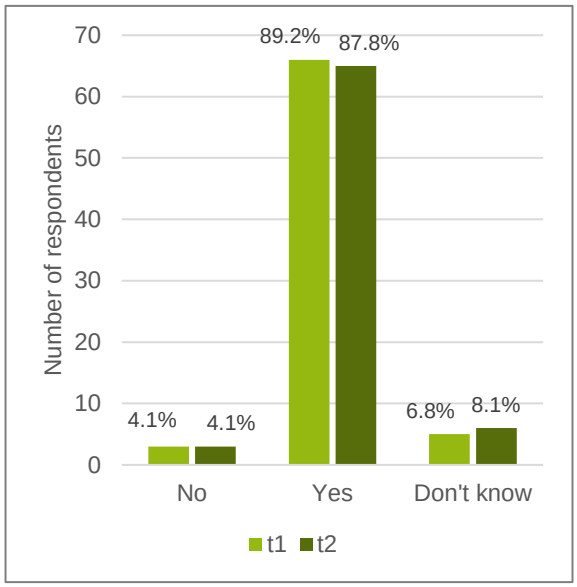
CARIMO aimed to provide the tools and some incentives to support the CARIMO users to engage in healthy movement. However, it was possible that those measures and the design of CARIMO did not reach the test users in the intended way.

Overall, the large majority of CARIMO test users reported that they felt motivated by CARIMO to do fitness exercises, and to increase their movement in general. After the initial training period, **almost 90% of the test users said that CARIMO motivated them to do fitness exercises**, opposed to 6.8% who were not sure and only 4.1%, who reported CARIMO did not motivate them to do fitness exercises. Several months later, towards the end of the CARIMO trial period, this assessment had not changed substantially (see Figure 62). There was also no relevant difference between how respondents in Italy and in Austria assessed CARIMO's ability to motivate them to do fitness exercises.

CARIMO's capacity to motivate users to increase their activities in general, e.g. to go outside or go for a walk, was rated slightly weaker in comparison to its capacity to promote exercising, however, it was still reportedly high overall. After the training period, more than **80% of the test users felt motivated by CARIMO to increase their physical activities**, whereas around 15% dismissed this, and 4.1% reported that they did not know.

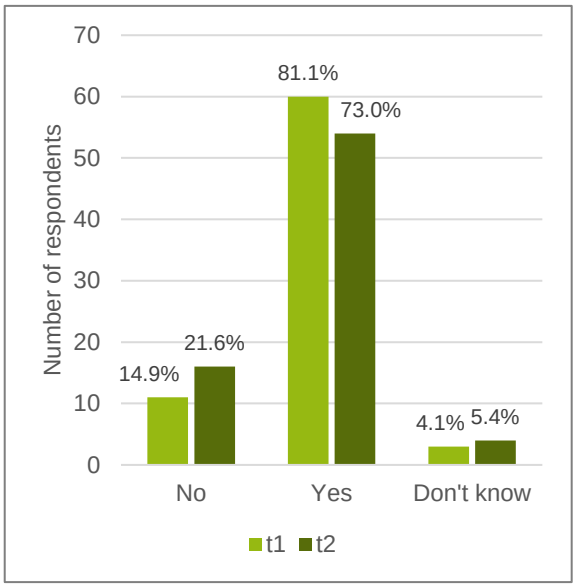
Towards the end of the CARIMO trial period, the motivational impact of CARIMO had not notably changed (see Figure 63). The responses of the users in Italy did not differ from those in Austria.

Figure 62: Motivation from CARIMO to do fitness exercises



Source: WU, CiM usability surveys, (SU) 2017/2018, n=74, own calculations

Figure 63: Motivation from CARIMO to increase movement (e.g. go for a walk)

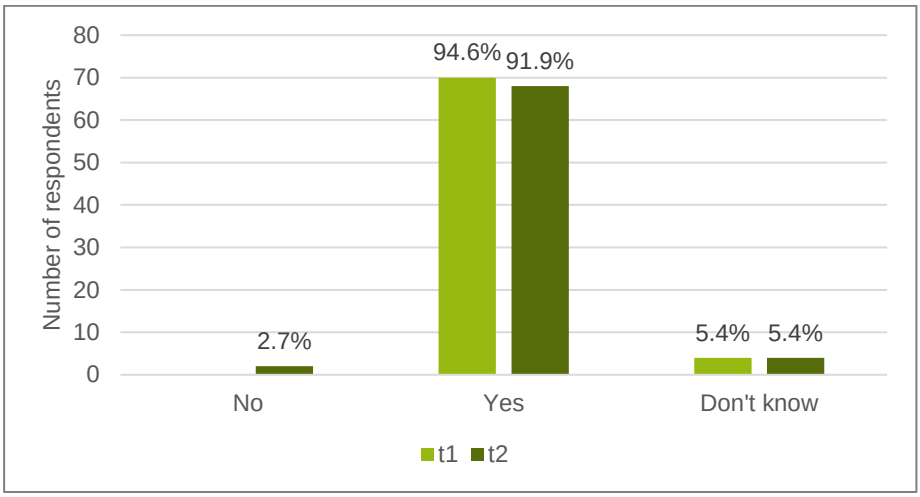


Source: WU, CiM usability surveys, (SU) 2017/2018, n=74, own calculations

Most of the respondents, 94.6% in the first survey, and 91.9% in the second survey, agreed that exercising with CARIMO personally benefitted them. Around 5% reported that they were not sure both times, whereas only 2.7% saw no personal benefit from exercising with CARIMO towards the end of the trial period (see Figure 64). Over time, the share of those who perceived a personal benefit from exercising with CARIMO remained about the same. A comparison of

the responses in Italy and in Austria revealed that in the first survey, Italian users were slightly less convinced of CARIMO's benefit than their Austrian peers (83.3% in Italy versus 96.4% in Austria). Towards the end of the CARIMO trial period, the responses were more similar (92.5% in Austria and 88% in Italy).

Figure 64: Self-assessment of personal benefit of exercising with CARIMO



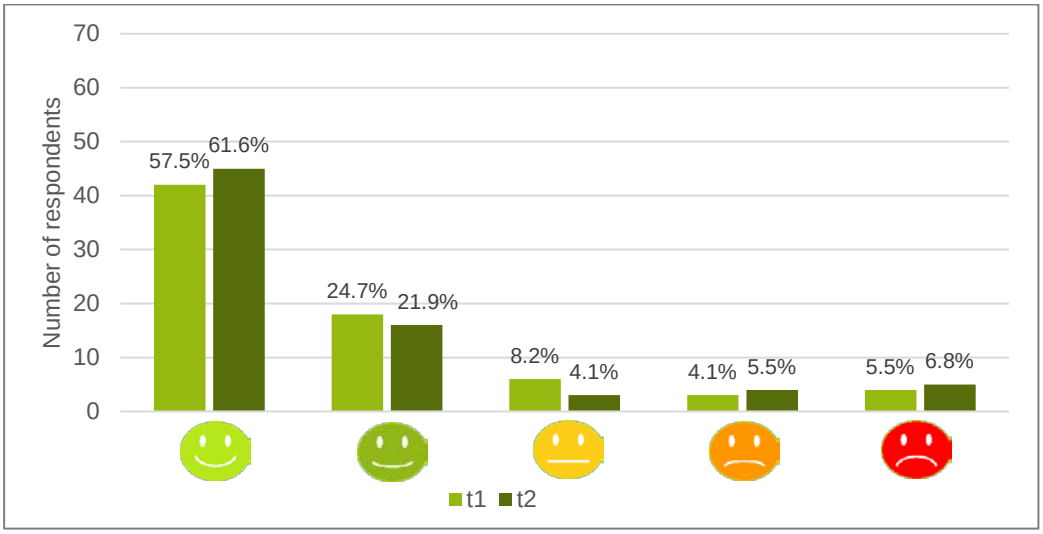
Source: WU, CiM usability surveys, (SU) 2017/2018, n=74, own calculations

8 CARIMO Newspapers

The CARIMO newspaper feature provided a selection of known regional and national newspapers via RSS-feed. The users had the choice between six different papers which provided a list of current articles. One advantage of the CARIMO newspaper feature over the paper versions was the bigger font size of the articles. However, RSS-feed changes by the media providing the RSS-feed affected the CARIMO test users' access to the newspaper.

Overall, the newspaper feature was received well by the CARIMO users, with more than 80% indicating that they liked the feature (see Figure 65). There was no change over time.

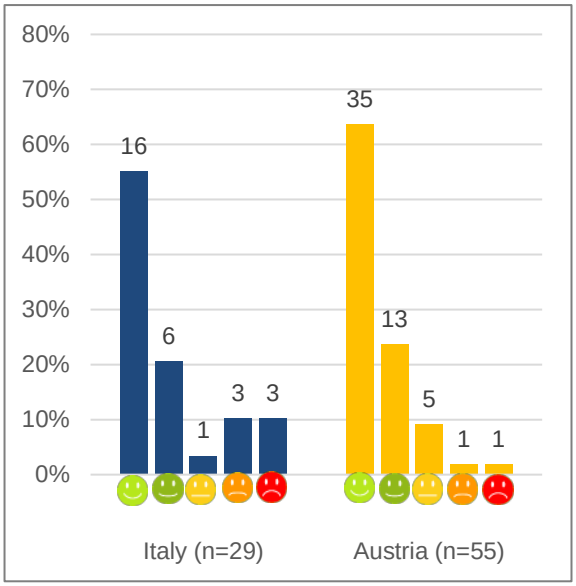
Figure 65: CARIMO users' rating of the CARIMO newspaper feature



Source: WU, CiM-usability surveys, (SU) 2017/2018, n=73, own calculations

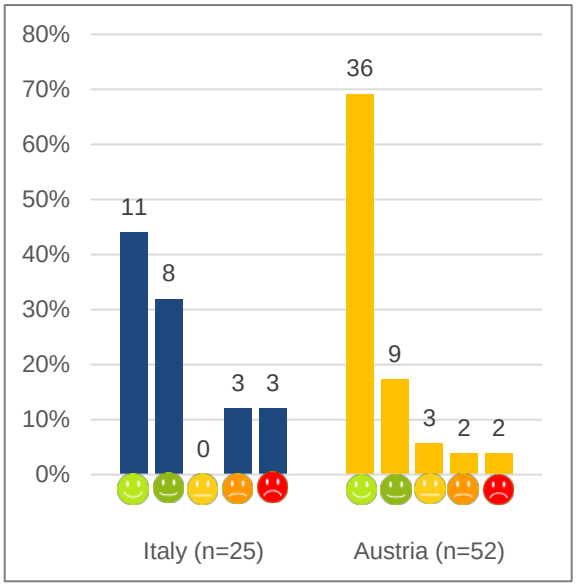
The country-comparison shows that in the first survey, the ratings of the respondents in Italy and Austria were comparably favorable (see Figure 66). However, towards the end of the trial period, the opinions about the **CARIMO newspaper feature** were slightly more different in Austria and in Italy: whereas they were still **favorable and highly positive in Austria**, they were a bit more negative in Italy (see Figure 67).

Figure 66: Rating of the newspaper feature, t_1, by country



Source: WU, CiM-usability survey, (SU) 2017, n=84, own calculations

Figure 67: Rating of the newspaper feature, t_2, by country



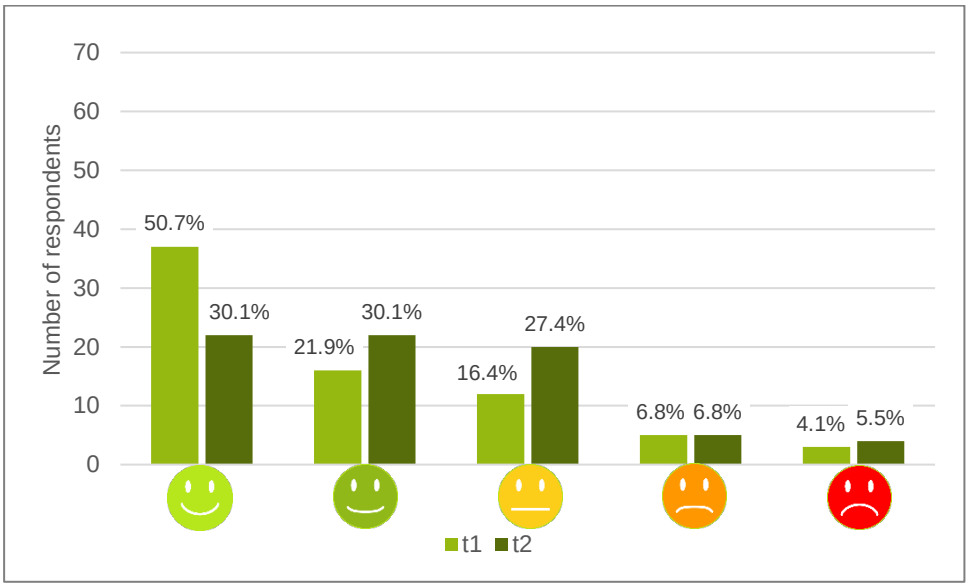
Source: WU, CiM-usability survey, (SU) 2018, n=77, own calculations

9 CARIMO 'Activities and notes' feature

The 'activities and notes' feature was initially planned only for the communication between formal and informal carers of the service users. It intended to facilitate their exchange by providing them with an option to leave notes and document typical support activities, both on the CARIMO tablet of the service users, as well as through their own access to the CARIMO web-platform, which could be used on any computer. However, it was extended to actively include the CARIMO test users by enabling them to also read and write notes for their carers or possibly as a kind of diary, and enter activities that were considered relevant in terms of physical activities and exercise (that were registered in the activity overview).

After the initial training period, the **'activities and notes' feature** was **rated fairly positively overall,** with more than 70% indicating a positive impression. However, the higher rating had **decreased significantly towards the end of the CARIMO trial period** (Wilcoxon-signed-rank $p<0.05$), and those who were very positive at the beginning had shifted their opinion to a slightly less positive or moderate attitude towards the 'activities and notes' feature (see Figure 68).

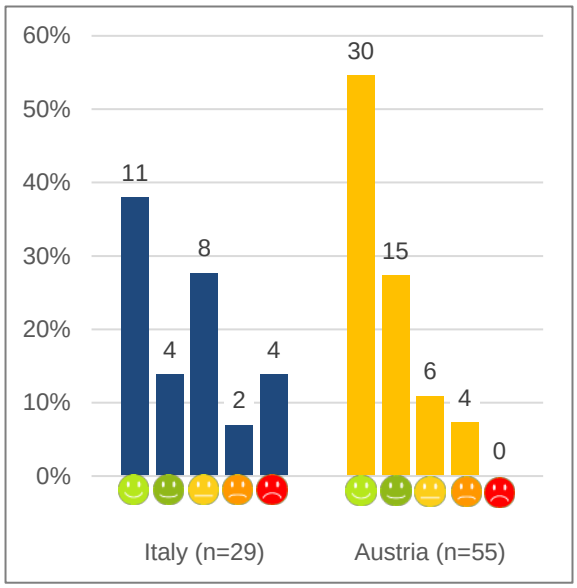
Figure 68: CARIMO users' rating of the CARIMO 'activities and notes' feature



Source: WU, CiM-usability surveys, (SU) 2017/2018, n=73, own calculations

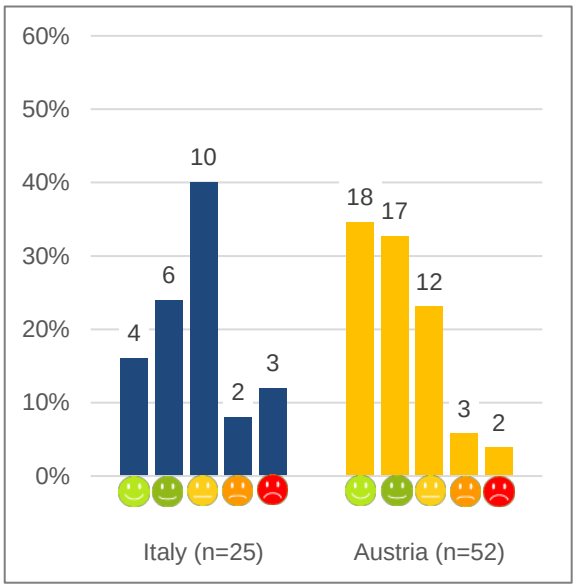
The country comparison shows that apart from overall decreasing ratings, the **CARIMO 'activities and notes'** were also received differently in Austria and in Italy. In both surveys, after the initial trial period as well as towards the end of the CARIMO trial period, the **users in Italy** gave the feature **less positive ratings** than the users in Austria (Mann-Whitney-U $p<0.05$ in t_1 and in t_2) (see Figure 69 and Figure 70). The Wilcoxon-signed-rank test, performed on those users who responded twice (n=73) shows that the significant decrease is attributed to the shifting ratings in Austria ($p<0.05$).

Figure 69: Rating of the CARIMO 'activities and notes' feature, t_1, by country



Source: WU, CiM-usability survey, (SU) 2017, n=84, own calculations

Figure 70: Rating of the CARIMO 'activities and notes' feature, t_2, by country



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

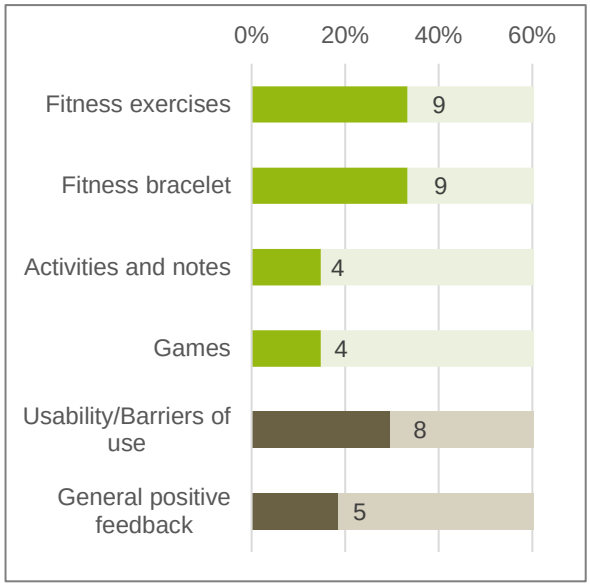
10 What the CARIMO users wanted to add…

At the end of both surveys, the respondents were asked whether there was anything that could be done or changed to improve CARIMO. There were 28 respondents (34%) who took this opportunity in the first survey, and 24 respondents (31%) in the second survey. 14 respondents answered both times. The responses were not strictly concrete suggestions focused on how to improve CARIMO, but rather a collection of general feedback and criticism concerning the app as a whole, the tablet, the fitness bracelet, and individual functions.

We extracted the comments from the survey files and translated the Italian responses. We then paraphrased the remaining responses, sorted the paraphrased text extracts according to their common CARIMO aspect (either a CARIMO function, usability related, or general feedback) and grouped them in smaller, meaningful subthemes. This process was conducted individually for each survey. In a second step, we synthesized the results for a comprehensive overview. Figure 71 and Figure 72 illustrate the prevalence of the CARIMO features and types of feedback in each survey.

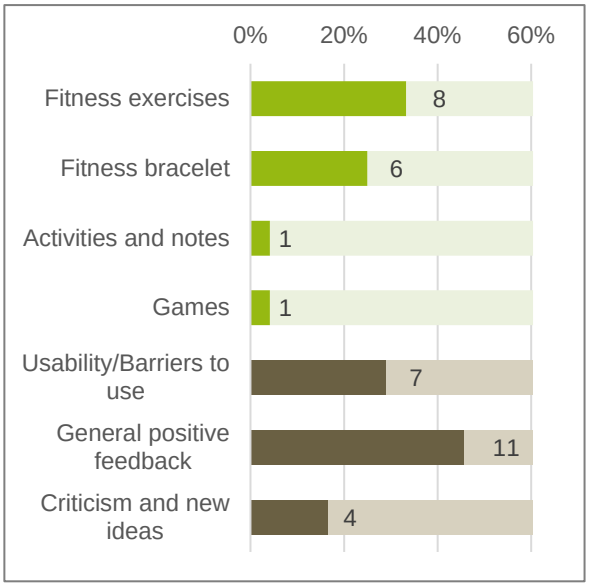
Upfront, a few users apparently had **problems with the touchscreen keyboards and text entry**; some responses turned out to be distorted by different text symbols and, presumably, the tablet's autocorrect. Nonetheless, we were able to identify the intended text and include it in our analysis. In two more cases, the users' comments were cut short and apparently submitted before the comments were completed, resulting in one comment which could not be included in the analysis.

Figure 71: Topics of user feedback, t_1



Source: WU, CiM-usability survey (SU) 2017, n=27, own calculations (green: users who commented about specific CARIMO features; brown: feedback regarding usability and general positive feedback)

Figure 72: Topics of user feedback, t_2



Source: WU, CiM-usability survey (SU) 2018, n=24, own calculations (green: users who commented about specific CARIMO features; brown: feedback regarding usability and general positive feedback)

10.1 Feedback on CARIMO features

The CARIMO features that were addressed in the final comments in both surveys were mostly the fitness exercises, followed by the fitness bracelet, and some remarks about the activities and notes function as well as the games. **Comments about the CARIMO features decreased somewhat in favor of more general feedback in the second survey**. The general feedback included comments about the usability/barriers of use of the app and the devices, as well as positive statements about CARIMO, and some criticism and new ideas in the second survey.

10.1.1 Feedback on the fitness exercises

Problems with usability and settings

In both surveys, the respondents brought up problems with usability and settings of the CARIMO exercise function, namely that they had issues with the registration of their completed exercises, indicating that **CARIMO did not always register the exercises accurately** (2 respondents), and that they had troubles with navigating the exercise function, resulting in unregistered exercises (1 respondent). One respondent in Italy noted that the exercise **descriptions were shown in the wrong language**.

Some suggestions for improvement

The respondents had some suggestions for improving the exercise function that were partly related to questions asked in the usability survey, and partly their own ideas. Both times, there were respondents who **suggested more variety with the exercises**, some who wanted **music to accompany the exercises** ("to help body and mind"), and some who would have liked **feedback on whether they did the exercises correctly**. One person suggested including the **visit from a physical therapist who could answer questions regarding the exercises**. Another respondent noted that the **actors in the exercise videos seemed younger and fitter than the target population**, and that the exercises should match the disabilities of the users. S/he also added that the **background in the exercise videos**, an empty room (gym) **did not reflect the smaller living rooms**, where the users typically did the exercises.

Doing the CARIMO exercises

In the first survey, some users **commented on their ability to do the exercises**. Two respondents were not able to do the exercises for a while, one because the CARIMO tablet had to be repaired, and one because of an accident, but stated that they were looking forward to taking it up again. Another user reported that s/he **enjoyed doing the exercises together with the CiM-Assistant**.

10.1.2 Feedback on the fitness bracelet

Issues with counting and transferring steps

Many comments regarding the fitness bracelet (5 in the first survey, 4 in the second survey) referred to i**ssues the bracelet had with correctly counting and transferring steps to the CARIMO app**. One of those respondents remarked that when the **battery of the fitness bracelet** died during an outdoors activity, the steps were lost. However, one person noted that counting steps worked well.

Problems with usability and settings

Some users reported problems with the usability and settings of the fitness bracelet. In the first survey, some of the respondents (n = 8) went into more detail, noting that: they found the **automatic registration of activities did not work properly**; it was **easy to change settings unintentionally**; they found the **watch too small and too complicated**; the **GPS-tracking** was sometimes difficult and **did not always work**; they **would have liked an instruction tutorial**; the **battery life was too short** for some activities (hiking); and the **time does not stay visible**. In the second survey, respondents criticized the fitness bracelet for sometimes being difficult to use, not working most of the time, and because the settings were difficult to change or figure out.

10.1.3 Feedback on 'activities and notes'

The activities and notes function was mentioned in four comments in the first survey, and once in the second survey. Only one respondent referred to the 'notes' part of the function, stating that their relative could only save notes on the CARIMO tablet. The other comments concerned the registration of activities. One respondent who was not sure how and if to categorize a certain activity ("Is cooking and washing the dishes a household task [in the physical activity relevant way]"?) and another person was unsatisfied with the availability of timeframes for certain activities ("The times to enter an activity are too short, e.g. hiking 30 minutes. I hike for 3 hours"). One person noted in both surveys that a certain activity in the list of physical activities was not adequate for the target group (climbing).

10.1.4 Feedback on games

Games were also mentioned four times in the first survey, and once in the second survey. The users criticized that several **aspects of different games were not working** or settings that they were not satisfied with. One person noted that s/he would have liked the ability to **download more games in the CARIMO app**.

10.2 Barriers to use CARIMO / Usability

The respondents brought up several aspects of CARIMO and the devices that they perceived as barriers to use the app. The issues they had were difficulty with using CARIMO on their own, the user interface design, as well as their ability to interact with the tablet.

10.2.1 Perceived difficulties when using CARIMO alone

Some respondents commented that they found CARIMO difficult when using it alone (three in the first survey, three in the second survey). They **referred to their own lack of technological skill and experience**, which could (and does) keep them, and other older adults with no technological experience, from using CARIMO on their own. One person reported that s/he found CARIMO ok to use, and another reported that s/he **was glad that there was always someone to ask about CARIMO** (referring to the CiM-Assistant).

While some respondents had difficulty, when using CARIMO alone, there was also one user who implied that s/he brought CARIMO along on a longer trip away from home (for treatment at a health facility).

10.2.2 User interface design

In both surveys, there was one person respectively who reported that the font size used in CARIMO was too small, with one respondent **suggesting to make the font size larger** everywhere (implying that they meant both the CARIMO tablet as well as the fitness bracelet). One person commented that using CARIMO was incompatible with her disability, referring to her eyes.

10.2.3 Interaction with the CARIMO-tablet

Some users commented that they had difficulty when trying to fulfill certain tasks on the tablet. Two respondents were dissatisfied with the touchscreen ('horrible'), reporting that it did not always work. Another user reported difficulty when writing/entering information using the touchscreen, and added that s/he **bought a pen to use**.

10.3 General positive feedback

Many users gave **general positive feedback**, without going into detail about what would needed to be done to improve CARIMO. The users highlighted different positive aspects about CARIMO, stating that they were excited and 'everything is ok' and 'super'. Two users noted the **benefits for their body, health, fitness**, and one of them, in the second survey, credited his/her **participation in the project for taking away his/her fear of new technology**. The second survey at the end of the CARIMO trial phase also revealed how much some users enjoyed CARIMO, with one person stating that s/he could not imagine not having CARIMO, and two respondents **stating their wish to keep the tablet**. Overall, they found CARIMO "good" and "interesting".

However, in the end, there were also people, who **generally enjoyed CARIMO although they did have some issues**, such as not having the time to use it, finding it difficult to use sometimes, the CARIMO app needing some repair, or needing help with using CARIMO.

Criticism and some new ideas

Respondents at the end of the second survey brought up some criticism as well as new ideas. One respondent criticized the lack of involvement from the CiM-Assistant. One person would have liked to have **more company to go on walks** together, one suggested adding a feature to use CARIMO also as **a more comprehensive calendar**, and one person stated the wish for more **easy entertainment** in the form of jokes or 'something funny'.

11 Overall perception of CARIMO

To give an indication of how CARIMO might perform on the market from a business perspective, we determined CARIMO's 'Net Promoter Score (NPS)' (Reichheld 2003). The net promoter score is used as an indicator for business growth and financial performance across different industries. The concept behind the net promoter score is based on customer loyalty and the importance of positive word-of-mouth for growth (Grisaffe 2007, Reichheld 2003).

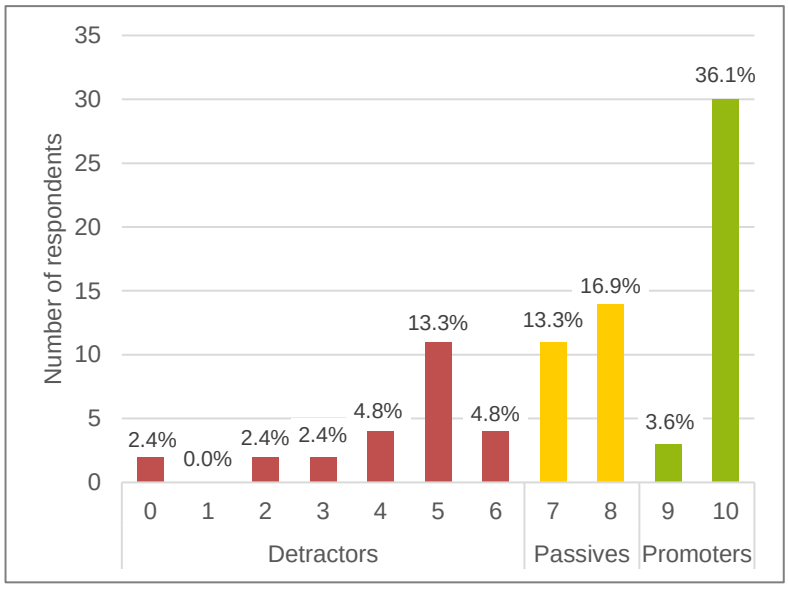
Therefore, as the last question of the effectiveness analysis survey (Trukeschitz et al. 2018), we asked participants to indicate on a scale from 0 (least) to 10 (most) how likely it was that they would recommend CARIMO to other older adults. Depending on their answer, respondents were categorized as 'promoters', i.e. loyal enthusiasts who are likely to tell their

friends about CARIMO, ‘passives’, who are generally satisfied but unenthusiastic, and ‘detractors’, who are unhappy users and who might discourage others from buying or using CARIMO.

Figure 73 shows the distribution of respondents on the net promoter scale, and Figure 74 gives an overview of the distribution of respondents in the three groups. The largest group was indeed the CARIMO users who were classified as promoters (39.8%), whereas the shares passives and detractors were smaller and had the same size between them (30.1% respectively). In Austria, both the share of the promoters as well as the detractors was higher than in Italy: 42.3% were promoters, and 32.7% were detractors in Austria, compared to 35.5% promoters and 25.8% detractors in Italy. Despite this difference in numbers, the varying distributions in both countries cannot be assumed to be statistically different.

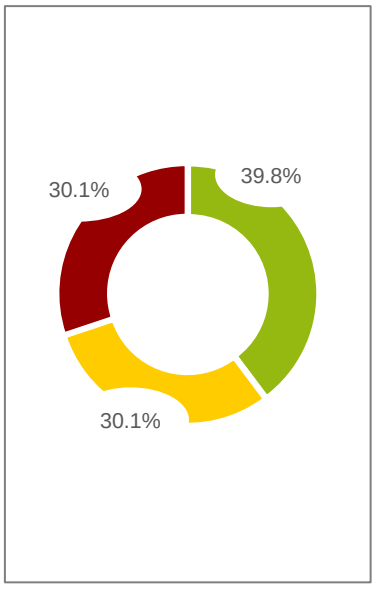
The net promoter score is calculated by subtracting the percentage of detractors from the percentage of promoters. It can range between -100% (only detractors) and +100% (only promoters). For CARIMO, the net promoter score is 9.7% (in Austria 9.7%, and in Italy 9.6%). To our knowledge, no other fitness app for older adults has been evaluated using the NPS, which makes comparison difficult. For reference, the 400 companies surveyed by Reichheld (2003) had an average NPS of 16%, while the companies with the most enthusiastic consumers reached NPS between 75% and more than 80%. However, these scores relate to products already available on the market and not to a prototype tested in a field trial for the first time.

Figure 73: Distribution of respondents on the range of the NPS



Source: WU, CiM-effectiveness questionnaire 2017 and CiM-Usability surveys, (SU) 2017/2018, n=83, own calculations

Figure 74: Summarized distribution of Promoters, Passives and Detractors



Source: WU, CiM-effectiveness questionnaire 2017 and CiM-Usability surveys, (SU) 2017/2018, n=83, own calculations

12 Conclusions

This paper set out to analyze the perception that frail older adults have of usability and user experience of CARIMO, an ICT-supported fitness and entertainment program, consisting of a tablet and fitness bracelet, developed in the AAL project CareInMovement (CiM). It particularly investigated the change in usability and user experience over time.

12.1 CARIMO – overall well perceived

In general, the **prototype CARIMO was very well received**. The idea to offer frail people a fitness and entertainment program was perceived as **interesting and useful** by the users to maintain and improve physical activities despite problems coping with activities of daily living. The design and functions of CARIMO were rated as attractive. We could show that frail older people were able to use CARIMO and maintained their interest in CARIMO and their intention to use it over time. The **restriction to a set of functions addressing 'body and mind'** revealed to be useful as well as installing **CARIMO with a launcher**, defining the app as the home screen of the CARIMO tablet.

Overall, the majority of respondents tended to give favorable usability and user experience ratings of the CARIMO features and gave a positive assessment of the design and usability of the app in general. More than **a third of all test users** were **very enthusiastic about CARIMO and would very likely recommend CARIMO to other older people**. Ultimately, around 39% of the respondents could be identified as promoters of CARIMO, i.e. people who were so confident in the prototype that there was a very high likelihood that they would recommend it to their peers. We thus got the impression that CARIMO conveyed an interesting idea for a group of vulnerable people who would not find a comparable product on the market.

Given the enthusiastic, mostly favorable results in the first usability survey after the initial training phase, and the evidence in Fausset et al. (2013), we expected a decline in enthusiasm towards the end of the 8-month trial period. However, with the exception of two CARIMO features (ratings of the 'activity overview' in Austria and 'activities and notes' in both countries decreased over time), the **user perception of CARIMO remained relatively stable and positive over the eight month trial**. In fact, where a considerable amount of users was initially undecided, they then changed their opinion of CARIMO to a more positive stance. After trying out CARIMO for almost 8 months, more people reported that they found CARIMO interesting and entertaining than after some weeks of training.

However, the prototype **CARIMO did not convince all users,** which may be due to a series of bugs or misspecifications in the system during the trial (e.g. missing translations into Italian, failed synchronization of tablet and fitness bracelet). Consequently, a third each was ambivalent or even cautious to recommend CARIMO. The users in Italy were often a bit less enthusiastic than the Austrian respondents, which may also be explained **by overlooked aspects of the implementation of CARIMO** in the Italian test region.

To increase the ability for more frail people to use CARIMO, a next version of the app should **incorporate adjustable font sizes**. In contrast to the app on the tablet, adjusting font sizes for fitness bracelets seems very limited, given the hardware currently available on the market. There are also a couple of **suggestions for improving the functionality** of CARIMO, derived from user comments (see Chapter 10), such as the addition of a physical instructions tutorial, feedback on completed exercises, and further adaptation of CARIMO and its features to the

daily life of its users (selection of appropriate activities, background and actors for exercise videos).

12.2 CARIMO – context factors matter

12.2.1 The role of context factors

In order to replicate these positive results, a set of **context factors need to be considered**, such as a well-designed training phase, a working app, timely and friendly support and features that are relevant and engaging for the target group. There is evidence for the importance of these factors in our data. The introduction of CARIMO did not work as well in Italy as in Austria, as was indicated by a share of 70 % of users in Italy who were unable to decide whether they like CARIMO or not after 6 weeks of access to the system. Thus, in addition to a working app these **context factors matter** and have to be **taken into account in any business model** for ICT-innovations for vulnerable people.

12.2.2 CARIMO user support needed

Common evidence from usability studies with apps for older adults shows the **need for support of a vulnerable target group**, either in the form of practical training or physical or digital manuals/tutorials (McMahon et al. 2014). Although the majority of CARIMO users rated CARIMO as easy to learn, personal help was at least sometimes needed. Help needed to use CARIMO, however, declined over time.

It was **personal help rather than the incorporated system tutorial** that helped people to understand the fitness and entertainment app CARIMO. Although, there was a number of users needing help, only a few of them had seen the CARIMO tutorial. Perhaps the tutorial was not labeled or introduced adequately enough to be recognized as a tool of support. The rating of users who had seen the tutorial was modest. At the time of the trial, the system tutorial, however, did not display the most recent version and lacked some functions. In the comments, it was pointed out that people wanted a (physical) manual/instruction rather than a manual/tutorial incorporated into the app.

Business models have to take into account that **personal support** would be **needed to involve frail older people** in using a fitness and entertaining app, such as CARIMO. This support to learn CARIMO and to get confidence in using CARIMO could be provided by relatives, care workers, family and friends or volunteers. However, some training of these people, particularly if they are not that familiar with new technologies, would be needed.

12.3 CARIMO – fitness exercises were particularly popular

Overall, CARIMO was dedicated to enhancing the users' physical activity behavior and fitness. To ensure this, and also to avoid the users 'getting lost' on the tablet, CARIMO was deliberately set up as the main and most visible function of both the tablet and the fitness bracelet, furthermore promoting a strong association between the app and the devices.

The results from this usability and user experience analysis suggest that CARIMO's aim to create an interesting **fitness app** that can be used by **older adults with limited capabilities** was **successful**: overall, the fitness features, especially the fitness exercises and the activity overview, were the CARIMO features that were popular with most respondents. In addition, each of these features also received high ratings compared to the other features. This indicates that the users indeed appreciated CARIMO especially for its fitness elements and what it

offered for their fitness and health. CARIMO was also rated as motivating and beneficial for their well-being by most users. However, it is important to note that while the CARIMO fitness exercises were also the feature that was popular among most Italian users, there was less enthusiasm about the additional fitness features such as the activity overview. Besides the fitness exercises, the newspapers were the next most popular CARIMO feature among Italian users.

Also, **some setbacks from the initial enthusiasm** could be observed with the additional incentives to increase physical exercises. The activity overview, for example, was rated less positively towards the end of the trial phase, which may be related to decreasing exercise levels overall, or a lack of accuracy of reporting the users' achievements, which was implied in the comments regarding the faulty step count and the difficulty with registering completed exercises. Similarly, the trophies, an element in fashion with typical interpretations of 'rewards' in fitness apps, were not received well, which may be because they did not actually 'reward' more exercise and physical activity. This could be due to issues with the devices or as a result of user error.

In terms of usability of the fitness function, CARIMO was able to address the target group's requirements for the most part. However, it might make sense to provide a greater capacity for individualization of CARIMO. Potential for individualization, and thus a higher usability for the home care service users with different capabilities, was detected with the operability of the exercise function (including the automatic counting of completed exercises, as pointed out in the comments), the selection of exercises, and the option for background music.

12.4 CARIMO – entertainment features are a useful addition

The idea of CARIMO was to address topics related to **'body and mind'**. CARIMO's entertainment features, such as a **selection of newspapers** and **games**, represented the mind-related aspects and were also **well received** by the users. E-newspapers were a favorite function for almost two thirds of the respondents, and games for about a half. Games in particular were an important feature to several users at least in the beginning, as indicated by the different comments referring to improving/criticizing the settings of individual games or a desire for more options. Using our data, we cannot generalize the results and conclude that these entertainment features would be perceived similarly well without the activity-stimulating counterpart.

The **'activities and notes' feature** allowed users to manually enter a selection of activities and write notes or read notes that others from the CARIMO-team left for them. Such a messenger system can be used to facilitate communication between different groups of the care network, either by complimenting or in some cases by substituting traditional modes of communication. This CARIMO feature, however, was **not received well** as indicated by the significantly decreased ratings in the second survey. The CARIMO test users were either not convinced of the utility of the 'activities and notes' function, or were not satisfied with how it worked.

If a long-term care organization, however, wants to catch up with other industries, **an ICT-supported tool to facilitate communication can be useful**. If such new modes of communication between care workers and service users/their informal carers are intended, solutions need to be easy to use, attractive, and consider the current ways of communication

between the groups. In any case, benefits for all user groups need to be clearly stressed and easy to experience **to create a sustainable new mode of exchange**.

12.5 Strengths and limitations of the data

12.5.1 Online survey for frail older people worked well

We collected data using online surveys **tailored to the functions and features of the CARIMO** prototype and the **requirements of the users** unfamiliar with handling online questionnaires. Out of a range of functions, features and possible issues for usability and user experience, we selected possible issues by consulting the CiM-Consortium, particularly the content and business partners.

Data collection worked well, as we managed to meet the abilities of frail older people. We set up a **survey with restricted complexity**. This implied phrasing the questions as clear as possible by using simple language and screenshots of CARIMO to illustrate the meaning. On the other hand, the common 7-point scales as used for the assessment of technology acceptance (e.g. TUI by Kothgassner et al. 2012) seemed too complex to be rated by our target group. Thus, we restricted response options or illustrated their meanings with smiley faces.

To reach a high response rate in a group of frail older people having first experiences with new technologies, the **design of the online usability survey was responsive to the restrictions of the target group** (i.e. physical restrictions, visual impairment, lacking familiarity with the survey format as well as with the technology in general). While the results are assumed to be accurate in showing the general direction of how users perceived CARIMO, the **reduced number of response options resulted in a lack of detail**.

A decision that definitely paid off was to **include a 'don't know' option**. We could show that offering this option provided information as people were not forced to make a decision they were not able to make at the moment. For two features of CARIMO, we could show that sometimes more time was required to be able to evaluate a feature. Although reduced complexity of the questionnaire comes with cutbacks in accuracy and comprehensiveness, it allows a vulnerable target group, not familiar with such questionnaires, to participate and to express their opinions (For a detailed assessment see Trukeschitz and Blüher (2018c)).

CiM-Assistants and relatives or friends **supported the users** in completing the online questionnaires and thus facilitated the field trial and the **participation of users in the evaluation surveys** of CARIMO. 30.6% received help from a CiM-Assistant in t_1, opposed to 27.8% in t_2. However, it can be shown that the second online survey was completed by more users on their own than the first survey (51.4% received no help from others in t_1, and 59.7% in t_2). Altogether, the second survey was completed in a much shorter time frame (6 weeks) than the first survey (13 weeks) (for details on the online survey design see Trukeschitz and Blüher 2018c). Over time, participants may have gotten used to dealing with the online questionnaire, developing more self-reliance, confidence and competences.

12.5.2 Sample size and duration of field trial

Compared to other usability studies, both of commercially available and experimental fitness apps for older adults (such as e.g. Mercer et al. 2016, McMahon et al. 2014), our study was able to capture the perspectives of a **comparatively large sample** over a **long time period**. However, for more detailed assessments more users would have been needed to improve the

power of the analysis. We originally intended to include 60 home care service users in each country. For various reasons, this number could not be reached in Italy (see (Trukeschitz and Blüher 2018a)).

Using a quantitative approach with a larger sample, and an (almost) identical follow-up questionnaire were useful in providing evidence of how a comprehensive fitness app for older adults is actually perceived by the target group. We restricted the analysis of change over time to users who participated in both surveys. This allowed us to monitor changes in their perception. On the other hand, this potentially neglects the view of people not happy with CARIMO who dropped out of the field trial after the first usability survey. However, just five participants did not complete the second survey. Thus, we did not expect much biases due to case missings. A loss of interest and feeling overwhelmed with CARIMO, in combination with declining health, were the main reasons participants decided to drop out of the project (see Trukeschitz and Blüher 2018a).

12.5.3 Future work

The study also relied on the subjective reporting of the respondents and could not consider whether the reported enthusiasm, motivation, and intention to use CARIMO reflected their actual usage of CARIMO. **Future work** could thus **bring together objective and subjective information** by e.g. combining usage data, socio-economic data and usability as well as user experience ratings to investigate the characteristics of enthusiastic and less enthusiastic users.

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