MORe:
Design and Evaluation of a Digital Menu Plan for a Retirement Home

Bachelorarbeit

vorgelegt von

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an der

Universität Konstanz

Mathematisch-Naturwissenschaftliche Sektion

Fachbereich Informatik und Informationswissenschaft

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Konstanz, 2021

Abstract

Interaction design for older people receives growing interest from researchers and designers alike. While many systems aim at mitigating symptoms of age-related decline, the system that is the focus of this thesis supports retirement home residents in their everyday meal ordering tasks: “MORe - Meal Ordering in a Retirement Home” is the digitized version of the currently employed paper menu plan that residents of the retirement home KWA Parkstift Rosenau in Konstanz use to order lunch to their apartment.

This thesis describes how MORe was designed and evaluated. First, research on the topic of interaction design for older people was conducted. In the course thereof, the apparently problematic relationship between technology and older people was investigated. To elicit requirements, user research in Rosenau was conducted in the form of a contextual inquiry which helped to define the scope of MORe. Design guidelines for older users were used as guidance on how to execute these ideas.
The features of MORe and the design considerations that went into them are described. The evaluation of MORe represents the central part of this thesis: Guided by the question of how retirement home residents react to and use the digital menu plan, a qualitative user study with three participants living in Rosenau was conducted. Its results are discussed in detail, as well as redesign ideas and possible directions for future work. The reactions to MORe were mainly positive: All participants stated they would like to use it. Apparently, the benefit of the functionality of MORe outweighed the smaller usability problems that were encountered. This thesis concludes with a discussion of the process that was undergone and a reflection of what could be learned in the course of the design and evaluation of MORe. Overall, cooperating and conducting research with older people proved useful for their unique viewpoints and input for redesign ideas.

Acknowledgements

An dieser Stelle möchte ich mich gerne bei all den Leuten bedanken, die mich in der Abschlussphase meines Studiums besonders unterstützt haben.
Zunächst einmal bei Harald Reiterer und der AG MCI im allgemeinen, die mir mit einem Platz im Hiwi-Büro ein Zuhause in der Uni geboten hat. Diese Umgebung war das beste, was meinem Studium hätte passieren können.
Außerdem gilt mein Dank Johannes Zagermann, der als mein Betreuer die letzten anderthalb Jahre mit endlosen Ratschlägen und vor allem immer einem offenen Ohr für meine vielen Fragen da war. Danke, dass du mich bei diesem Thema unterstützt hast.
Im Rahmen der Unterstützung auf Uni-Seite möchte ich mich auch bei Stefanie Everke Buchanan und Heike Meyer von der Schreibberatung ganz herzlich bedanken. Durch den regelmäßigen Austausch in den gemeinsamen Schreibzeiten war ich seit Anfang meiner Seminararbeit nie allein mit dem Schreiben.
Auch bei Mitarbeitern der Rosenau, insbesondere Corina Gold, will ich mich bedanken. Ihre Unterstützung meines Vorhabens von Anfang an, insbesondere während der beiden Studien, hat meine Arbeit in dieser Form erst möglich gemacht.
Riesen Dank geht auch an meine beiden Korrekturleserinnen für die vielen wertvollen Hinweise und Vorschläge.
Schließlich geht ein großes Dankeschön an meinen Mann: Vor allem während meiner Bachelorarbeit warst du mir eine unglaubliche Stütze und hast mir soviel abgenommen, damit ich mich voll fokussieren konnte. Danke dafür.

Contents

List of Figures

List of Tables

1 Introduction

People over the age of 65 already constitute more than a fifth of the German population and are said to reach about a third in the next 40 years (Statistisches Bundesamt, 2017). In contrast to common beliefs, a study in Switzerland lately showed that many of those older people own and use devices like computers (owned by 60 % of the interviewed participants), tablets (25%) and smartphones (30%), with numbers rising (Seifert and Schelling, 2015). However, Seifert and Schelling also report that there is a big contrast when compared to the numbers of technology usage (in the example of internet usage) of younger people: According to them, more than 90% of people under 40 stated to use the internet. These numbers decrease monotonoically with rising age. Of the people between 40 and 60, between 80 to 90 % reported to use the internet. The steepest decrease can be seen for people in their sixties (60-70 %) and finally of those 70 years and older, less than 40% stated to use the internet.

Even though these numbers might suggest otherwise, Vines et al. (2015) have argued that chronological age is actually not the reason for low technology acceptance amongst older people. Instead, research locates the source of the problem within the designs and designers of those systems: Designers are typically young (Tonolli, Teli, and D'Andrea, 2015) and tend to design for "people like themselves" (Lindsay et al., 2012). As a consequence, emerging systems can largely be sorted into one of two categories: Category one contains many common devices which exclude older people from their target user group by not paying attention to their stricter usability requirements (Hitchcock et al., 2001). Category two consists of systems that are designed specifically for older people. These devices, for example clumsy 'senior-friendly' phones are largely perceived as stigmatizing by older people (Keates, Clarkson, and Robinson, 2002; Blythe, Monk, and Doughty, 2005). These problems in the areas of usability and user experience are seen as the actual source for low technology acceptance among older people (Light, Leong, and Robertson, 2015).

While there is a lot of research in the HCI community concerning usability guidelines for older people (for example by Darvishy, Hutter, and Seifert, 2017) or about systems that tackle age-related problems (as identified by Otjacques et al., 2010), little research has been done on developing systems that take the more rigid requirements of older people into account while providing support for an everyday task, just like many systems developed for a younger target user group do (Otjacques et al., 2010). A promising use case for the development of such a system could be found during the author's employment at the reception of the retirement home KWA Parkstift Rosenau in Konstanz. Rosenau is a residence for about 240 autonomously living older people who are between 70 and 100 years old (mean age about 86). These residents can cook for themselves, visit the in-house restaurant or order lunch to their apartments. If they want to have their meals delivered, they fill in a paper menu plan three weeks in advance and hand it in at the reception. There, the orders are entered into a computer by reception staff. This process is not only cumbersome for employees, but also prone to error: Especially transferring the orders from paper plan to the computer is a common source for attention errors which lead to wrong or even no meals being delivered to the respective resident. Experiencing this process brought the idea that if the residents' orders were available digitally directly, a lot of work could be saved and transmission errors by reception staff could be avoided.

The design, implementation and evaluation of this system which is called MORe (**M**eal **O**rdering in a **Re**tirement Home) is the subject of this thesis. The content of the following work is structured as follows:

The first chapter gives insights into the theoretical background of this work: A literature review revealed that much (interaction) design that is done specifically for older people stigmatizes them by propelling stereotypes regarding older people (ageism). Thus, the need was identified to find a non-stigmatizing design solution, even though designing MORe specifically for older people.

As a second step, an analysis of related work was performed. Besides several examples for the general topic of interaction design for older people, two systems were identified with high relevance to the development of MORe which are discussed briefly.

Subsequently, requirements were elicited. To counteract stigmatizing tendencies and to gain deeper insights into the context of the users, a contextual inquiry was conducted. In the course thereof, four residents and two receptionists were interviewed. Contextual data about the current meal ordering process as well as about residents' attitude towards technology were collected. This lead towards idea generation in combination with the research and incorporation of usability guidelines for older users. These measures helped to define what the scope of MORe should contain (contextual inquiry) as well as how these functions and design should be implemented (usability guidelines).

In the following chapter, the process behind the interaction design of MORe is described. The goal was to find a design that allows for a functionality as comprehensive as possible so it would be considered as a real alternative to the paper menu plan by participants. In addition to the transferred menu plan features, new features were added to facilitate the meal ordering process. For example, the users can declare recurring choices (like receiving salad for starter instead of the default soup) that are applied automatically for every new menu they order. This digital menu plan was implemented as an app optimized for usage on an iPad.

The next chapter illustrates the preparation and conduction of the qualitative user study that was conducted to evaluate MORe. It involved three Rosenau residents that tested and discussed MORe. The aim was to find out the participants' reactions to and usage of the digital menu plan.

Subsequently, the results of the study are discussed. The gathered qualitative data were analyzed to reveal the distinct characteristics of the three participants. The main results revolve around the participants' reactions to and usage of MORe. Overall, MORe was received very positively. Participants' statements suggest that the participants perceived the potential usage of MORe to outweigh the costs (in terms of effort) of the slightly complicated interface.

In the following discussion, the author's experiences gained in the course of designing and evaluating MORe are illustrated. These include cooperating and conducting studies with older people. Also, comparisons are drawn with literature findings and systems from related work, especially by Otjacques et al. (2010) who also developed a system to support retirement home residents in their meal ordering process.

Finally, a conclusion and outlook is given where possible future directions of this research are discussed.

2 Theoretical Background

This chapter summarizes the literature research that was conducted as part of the Seminar to the Bachelor's Project (Reutlinger, 2020). It revolves around interaction design for older people and therefore begins with a short discussion of a suitable terminology for talking about older people. Subsequently, the current situation of interaction design for older people is investigated and how observed usability problems for older people might be connected to a problematic perspective of researchers and designers towards that demographic. This chapter ends with an overview of physiological and cognitive changes that typically accompany the ageing process.

2.1 Talking about Age

When literature from Human-Computer Interaction (in the following referred to as HCI) uses the terms 'older people', 'seniors' or 'elderly', it generally talks about people that are 65 years old and older. Which term to refer to this demographic by has been subject of debate. For example Johnson and Finn (2017, p. 17) refer to the case of blog author Graham (2012) who has received criticism for the title of her blog 'The New Old Age'. Thus, she asked experts in the field of ageing about their opinions. The answers revealed that the supposedly simple problem of finding a suitable term is, in fact, a multilayered dilemma that reaches into personal preferences as well as societal word assignments: In the answers, the terms "elderly", "seniors" or "senior citizens" (amongst others) were discussed. Interestingly, no consensus was found about either of these terms. One reasoning was "to use the term 'older people' because it's the least problematic. Everyone is older than someone else." This argumentation can also be found in literature (Blythe, Monk, and Doughty, 2005) and therefore "older people" is also used across this thesis to refer to those people aged 65 and above.

2.2 The Vicious Circle of Bad Design for Older People

In contrast to common beliefs, many older people do own and use modern technological devices: A study from 2015 revealed that over 60% of the older people that were interviewed owned a computer or laptop, more than 25% owned a tablet and more than 30% owned a smartphone (Seifert and Schelling, 2015). The same study showed that the numbers of technology usage among older people are rising. However, compared to younger people's use of technology (using the example of internet usage), the numbers describing technology usage of older people are significantly lower: In recent years (2012-2014), more than 90% of younger people (ages 18 to 40) used the internet. For those between 40 and 60, about 80 to 90% were internet users. Providing a strong contrast, the numbers for people in their sixties revolved around 60-70% and of those aged 70 years and older, less than 40% were reported to use the internet (Seifert and Schelling, 2015).

Wilkinson and De Angeli (2014) situate older people's reluctance to use technology in their "Cycle of design oversight influencing the uptake and engagement of technology". The cyclic structure ("Older People reluctant to engage with Modern Products and Services" → "Older People's views not sought" → "Designers fail to recognise Older People's needs" → "Inappropriately Designed Products and Services" → "Older People reluctant to engage

with Modern Products and Services" → …) illustrates that there is not one single reason for the low uptake of technology amongst older people, but rather that it is part of a larger problematic situation. Based on this depiction, the author has come up with a scheme that expresses the connection of the different problem areas of design for older people. It is portrayed in Figure 2.1 and discussed below.

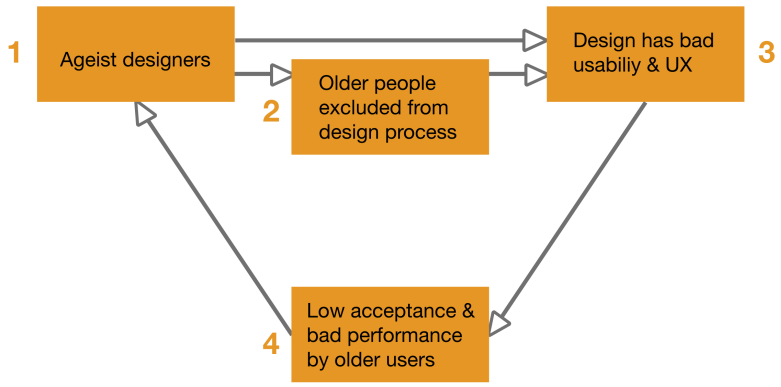

Figure 2.1: The Vicious Circle of Bad Design for Older People as identified in Reutlinger (2020), based on Wilkinson and De Angeli (2014).

In a survey published in 2015, Vines et al. (2015) studied over 600 papers from the SIGCHI community published over the last 30 years to see how the topic of ageing has been discussed in HCI literature. They didn't only find out that the interest in the field has been growing (seeing that 80% of the investigated papers had been published in the last eight years), but also discovered a prevalent perspective: Often motivated by our ageing society, the focus tended to lie on understanding ageing with the goal to develop systems that might mitigate the physical and cognitive decline. This perspective of age as a problem that can be solved by technology has also been labelled to be ageist by Tonolli, Teli, and D'Andrea (2015). Drawing comparison to the argumentation of critical gerontology[1], Vines et al. (2015) raise the question "whether the recent growth in age-related HCI research is similarly problematic in how it reifies negative portrayals of what it means to be old in contemporary society". They argue for shifting the perspective of older people away from a biomedical point of view towards a view that includes a person's individual life-course.

Such an ageist design attitude leads to excluding older people from the design process (Sengpiel, Volkmann, and Jochems, 2019), which in turn induces systems with poor usability (Wandke, Sengpiel, and Sönksen, 2012). An ageist perspective also directly leads to stigmatizing design, as has been shown by Hernández Encuentra, Pousada, and Gómez-Zúñiga (2009).

It is well known that many systems display poor usability (Light, Leong, and Robertson, 2015) and user experience (Wandke, Sengpiel, and Sönksen, 2012) when it comes to older people. Apart from shifting to a "non-ageist" design and research attitude or explicitly including older people in the design process, usability problems for older people are often addressed by composing sets of guidelines specifically for older people (for example those by Darvishy, Hutter, and Seifert, 2017) or emphasizing a more diligent implementation of commonly known guidelines (like the usability heuristics by Nielsen, 1994). A system with poor usability and user experience leads to frustrating experiences that can negatively affect a person's technology acceptance (Hernández Encuentra, Pousada, and Gómez-Zúñiga, 2009) which leads to the common observation of older persons experiencing trouble with technology or rejecting it altogether. This can reinforce an ageist view in the observing person, thereby closing the vicious circle.

[1] Vines et al. (2015) summarize the perspective of critical gerontology as "the empowerment of older people — […] to support them in transcending socially constructed norms of what it means to 'grow old'", especially in comparison to the view of "classical" gerontology which tends to focus on biomedical decline and therefore often draws a picture of age as a pathological condition.

2.2.1 Matching the Vicious Circle to the UCD Lifecycle

These identified problem areas can be associated with the four stages of the user-centered-design lifecycle by Hartson and Pyla (2019) which is depicted in the center of Figure 2.2: Problems one and two (ageist designers and exclusion from the design process, respectively) can be associated with stage one of the lifecycle ("Understand user work and needs")[2]. Notice that excluding older people from the design process also directly influences the creation of design concepts (UCD lifecycle stage two). The problem of poor usability and user experience has to do with the created design concepts (UCD lifecycle stage two) as well as the realized prototypes (stage three). Finally, when evaluating the system (stage four), the problems of low acceptance and bad performance of older users can be observed.

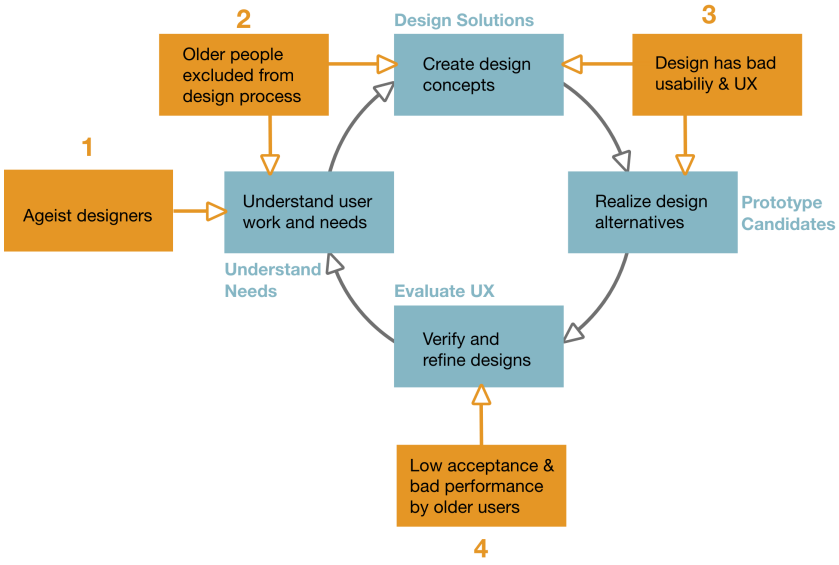

Figure 2.2: UCD Lifecycle annotated with the Vicious Circle of Bad Design for Older People.

Matching the problem areas of the vicious circle to the stages of the user-centered-design process reveals how learnings from the vicious cycle have influenced all design stages of the MORe prototype: In the research phase (including a literature survey and contextual inquiry), the topic of ageism and how to not be ageist as a researcher and designer has been covered (UCD lifecycle stage one: "Understand user work and needs"). Also, some first design ideas were developed (UCD lifecycle stage two: "Create design concepts"). Complemented with research design guidelines for older people, these concepts were implemented (UCD lifecycle stage three: "Realize design alternatives") in the form of the MORe prototype. A formative qualitative user study was conducted to "verify and refine designs" (UCD lifecycle stage three). The observations made there in turn lead to a better understanding for the user group and also to more insights into personal lifecourses of older people, which reduced ageist stereotypes for the author.

[2]It is noted that the lifecycle explicitly shows the design process as inherently iterative, so no clear beginning and end is defined. Even so, because "Understand[ing] user work and needs" is one of the first activities necessary when designing a new system, in this work this step is handled as the first one.

2.3 Characteristics of Ageing

In order to retrace the origin of older-people-specific design guidelines, the perceptional and cognitive changes that accompany ageing have been investigated and can be found in full in Reutlinger (2020). When looking at age-related decline, it is important to be aware that not all people age the same way. The amount and severity of decline, as well as the affected abilities, vary highly from person to person (Hernández Encuentra, Pousada, and Gómez-Zúñiga, 2009).

Perceptional changes can be summarized under the decrease of signal-to-noise ratio (Fisk et al., 2009). This means that for example with hearing, older people don't necessarily perceive sounds as quieter overall, but rather experience trouble distinguishing the relevant noise from the irrelevant one. According to Godde, Voelcker-Rehage, and Olk (2016), changes in vision contain the tendency for presbyopia as well as a reduction of the amount of light that reaches the retina.

Changes in cognition are of special interest to designing an interactive system. Godde, Voelcker-Rehage, and Olk (2016) divide cognition into Fluid Intelligence and Crystalline Intelligence, where Fluid Intelligence includes the areas of attention, working memory, executive functions and speed. Crystalline Intelligence, on the other hand, corresponds to the concept of Long-Term Memory and therefore includes areas of memory like Procedural, Episodic, Semantic and Prospective Memory. According to Godde, Voelcker-Rehage, and Olk (2016), cognitive ageing is characterized by decreases in Fluid Intelligence while the Crystalline Intelligence often stays intact and can even improve up into high age. Decreases in Fluid Intelligence are especially relevant in Working Memory: While its capacity is limited regardless of age, age-related decline shows in the areas of language processing, reasoning and problem solving (Fisk et al., 2009). Also, older people are more likely to find it hard to suppress surrounding information ("inhibition control", Godde, Voelcker-Rehage, and Olk, 2016).

Another area that is affected by age-related changes are motor skills. Especially decreases in fine motor skills that are needed to use common input devices like mouse, keyboard or touchscreen, are reported to have the potential of significantly affecting the daily functioning of older people (Godde, Voelcker-Rehage, and Olk, 2016). Such decreases consist of less strength and less control about how much strength is applied, as well as pathological changes like arthritis that impede perceiving haptic feedback.

These aspects which characterize older people need to be taken into account when designing for older people to facilitate a good usability and user experience.

3 Related Work

This chapter summarizes the state of the art analysis in the area of interaction design for older people in general that was performed as part of Reutlinger (2020). It is supplemented by a more detailed discussion of two systems that show more similarities with the research conducted in this thesis: Otjacques et al. (2009c) conducted a project that brought forth a system called “Sammy” which is described in the next section. However, since the interface of “Sammy” is very minimal and not very up-to-date (having been developed in 2009), a commercial system is looked at in the section afterwards: “CasaGusto” is the only digital meal ordering system that could be found that is targeted at older people specifically.

While in Reutlinger (2020) the state of the art of general interaction design for older people was investigated and the discussed systems involved apps and websites targeted to older users, few of the systems were targeted to retirement home residents and none aimed at supporting the process of meal ordering.
The investigated systems include ’Grandcare’ (grandCare Systems, 2019a) and ’SeeYouLink’ (SeeYouLink, Inc., 2019) which both contain a terminal for the older user and a monitoring back-end for relatives or care staff. Another example is ’Breezie’ (That Device Company Ltd., 2017a) which is an Android tablet system that offers a customized tablet experience. It contains ’senior-friendly’ versions of common apps as well as the possibility to add ’conventional’ apps. It has been introduced for entire retirement homes, leading to the formation of tablet-centered communities amongst the residents.

Figure 3.1: *Left:* Home screen of the Grandcare interface for older users. *Image taken from grandCare Systems (2019b). Right:* The Breezie “Favourite apps” screen. *Image taken from That Device Company Ltd. (2017b).*

Other examples include the app ’Easierphone’ (Pappy GmbH, 2019) that integrates common phone features into one app, aiming to improve usability by utilizing bold colours and very large buttons and text. Also ’Elementique’ (Elementique Senior, 2019) was found which is an Android launcher aiming to optimize the user interface by large buttons and bold colours. In contrast to ’Easierphone’, however, it replaces the original home screen instead of being an additional app. It therefore shows some resemblance to the ’Breezie’ system.

These systems are characterized by having different foci: 'Grandcare' as well as 'SeeYouLink' clearly are targeted towards relatives or caretakers of older people who might be concerned about their wellbeing. These monitoring systems therefore might fall into the trap of stigmatizing products (see Section 2.2). 'Breezie' and 'Elementique' on the other hand aim to facilitate the usability of 'normal' tablet systems and appear to be targeted at the older users more directly. However, all of these explored systems offer a wide range of functionality and cover features like picture and internet browsers, phone functionality, entertainment apps and more. Therefore, they are of little relevance to the development of MORe.

While these examples show that a lot of design work and research is done in the broad area of interaction design for older people, little can be found that matches the characteristics of the research conducted for this thesis more closely: designing a system that supports autonomously living residents of a retirement home in ordering their meals, which was also observed by Otjacques et al. (2010).

3.1 "Sammy": Digital Meal Ordering for Retirement Home Residents

Otjacques et al. (2010) report the design process as well as the evaluation of the system "Sammy", a touch screen device combined with an RFID reader and a ticket printer. They additionally describe their learnings and insights during the whole project including their employed co-design methodology and the 6-month longitudinal field study about the adoption of the system. Since this project shows so many similarities to the approach taken during the process of this thesis, the project of Otjacques et al. is referred to several times throughout this work for comparison of design and evaluation methodology as well as results and learnings.

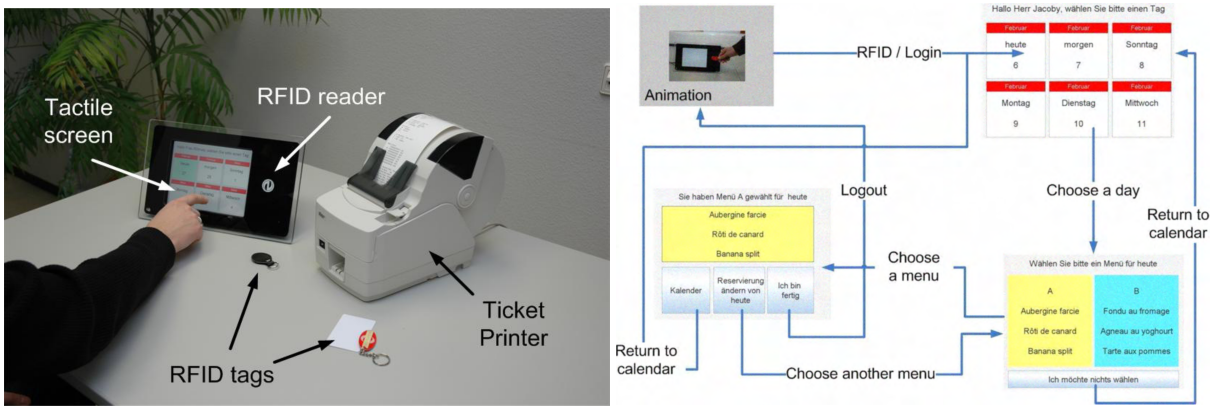

Figure 3.2: "Sammy" system for digital meal ordering for retirement home residents. *Left:* Picture of hardware set up. *Right:* Diagram of menu structure (pictures taken from Otjacques et al., 2009b).

"Sammy" was the result of an interdisciplinary research project involving computer scientists as well as gerontologists. Otjacques et al. (2010) describe the goal of their research "to imagine an ICT application that can support older people ageing without severe impairments in their daily life". They investigated a retirement home in Luxembourg with about 120 residents. Similar to Rosenau, that retirement home provides apartments for autonomously living older people. The residents can order lunch in the in-house restaurant as well as register for events or excursions via the front desk.

The design process of "Sammy" is an example of the implementation of the UCD cycle (as discussed in Hartson and Pyla, 2019): Otjacques et al. analyzed the context of the retirement home, its processes and the target users by conducting interviews with staff as well as residents. Based on these data, the researchers defined the system

scope: They decided on a small touch device that didn't look too much like a computer in order not to scare potential users (because their analysis had revealed that most residents had little to no prior experience with computers). For easy user identification, each resident received a personal RFID tag that they could tap against a specific part of the touch device to log in. In a second iteration, Sammy was expanded with a ticket printer so the users could take away a confirmation of their choices.
Sammy was designed to support its users in managing their social activities that were offered in the retirement home. As the first activity to be implemented, the researchers chose the daily lunch. Residents could either select one of the two menus offered in advance to reserve it or chose when they arrived in the restaurant. In the latter case, it might have happened that the menu they chose was sold out already. This task was implemented in the first prototype because every resident was familiar with it, so learning the task itself wouldn't interfere with learning how to use the interface. In later iterations, Sammy's features were expanded to include registration for excursions as well as in-house activities. The registration process had previously been managed manually by retirement home staff, so Sammy presented a less work-intensive alternative.
As early as the implementation phase, formative evaluations were conducted. Similarly, pre-tests were conducted before the official launch of the first version of Sammy (which can be seen as a summative evaluation of the first version). After Sammy was officially introduced and deployed, it was positioned in the entry hall of the retirement home and released for every resident (and staff member) to use. In the first week after introduction, researchers were present every day to offer support and to promote Sammy. Afterwards, researchers were present one day a week to offer further support and collect observational data and feedback during a 6-month longitudinal study. During this period, Sammy received further updates based on the collected data like more types of activities that could be registered for and the possibility to print a personalized "newspaper" consisting of weather forecast and news based on specified personal interests.
Otjacques et al. (2010) call their methodology a "co-design process because the users were not only involved in identifying flaws but also in suggesting improvements of existing features or proposing new ones".

Overall, the evaluations are characterized by very positive feedback. Many residents appear to have switched to only using Sammy to make their lunch reservations. Also many users who didn't have any technology experience beforehand were reported to be able to successfully use Sammy to make their reservations. According to Otjacques et al. (2010), Sammy is still being used after the 6-month period (at the time of writing of their paper). More detailed evaluation results and learnings reported by Otjacques et al. are discussed later in relation to results from the evaluation of the MORe prototype.

3.2 "CasaGusto": Website for Ordering Meal Delivery for Older People

CasaGusto (*CasaGusto - Zuhause geniessen* 2020) is a Swiss meal delivery service that offers freshly cooked and refrigerated meals delivered as soon as the day after placing the order. Users can order either by phone or online. However, users are encouraged to order online by receiving a discount of CHF 2.50 for every meal they order that way.

CasaGusto offers its service via a website whose design hardly communicates that the provided service is targeted at seniors. Only the pictures of happy customers show older people enjoying their meals and they mention that healthy food is especially relevant in higher age. The clientele is mainly revealed by the website's logo, footer, and "about us" section where the organisation Pro Senectute[1] is communicated to be behind this service.

The design of the CasaGusto website is very clean with few distinct colours, large font and large, clear buttons. Any icons are accompanied with a label. The only noticeable flaw is the colour contrast between some texts

[1] According to their website, Pro Senectute is "the largest specialist and service organisation for senior citizens in Switzerland" (*Pro Senectute – wir sind die Organisation für das Alter* 2021).

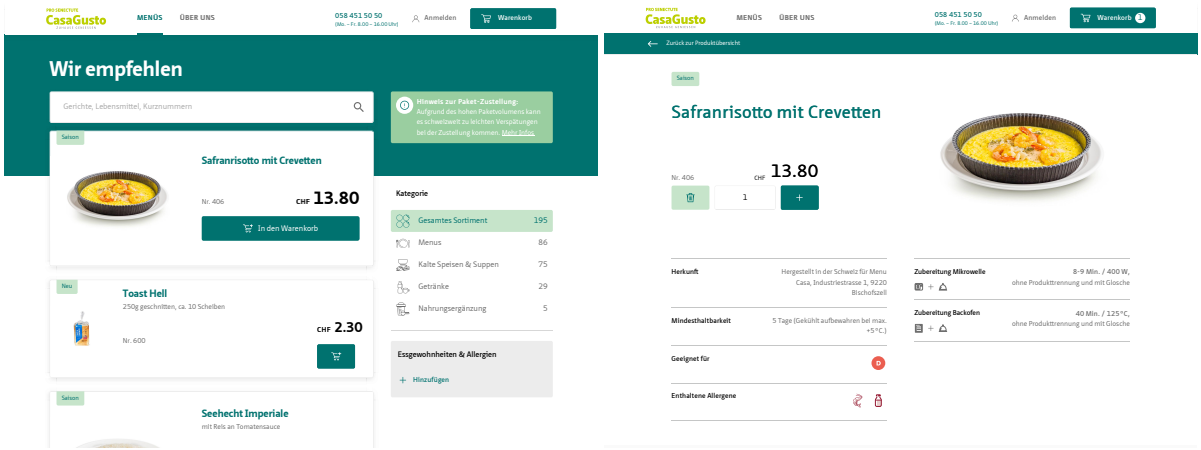

Figure 3.3: Interface of 'CasaGusto' meal delivery service (pictures taken from *CasaGusto - Zuhause geniessen* 2020).

and their background: Any text on light green (`#9acea0`) background, either in white (for example "Hinweis zur Paket-Zustellung" on the right) or in dark green (`#02726f`), like the highlighted "Gesamtes Sortiment" on the right) fails the WCAG contrast requirements (W3C Web Accessibility Initiative (WAI), 2019) for normal-sized text with 1.79 or 3.22, respectively (required for AA contrast is at least a contrast ratio of 4.5).

When a user clicks on the title of a meal (which is only marked as clickable via the cursor changing to a small hand which is a sign of poor affordance), more details thereof are displayed such as place of origin, preparation notes and information about allergies and ingredients. The information are visualized with icons. The labels of these icons appear as tooltips when the user hovers over the icons (or by tapping on them when using a touch screen device).

Overall, the website of CasaGusto appears to be a thoughtful and well-usable tool that supports older people according to individual preferences and needs. It successfully targets older people as user group while avoiding to stigmatize or belittle them. It is not without flaws, the aforementioned examples of poor colour contrast could easily be avoided by rigurous verification of implemented usability and accessibility guidelines.

4 Requirements Analysis

This chapter illustrates how the requirements for MORe were determined. The goal of these requirements was to tackle the third stage of the Vicious Circle, "Design has bad usability and UX". Therefore, the questions to be answered were what to design and how to design it. Both processes are described in more detail in Reutlinger (2020). To answer the first question, a contextual inquiry was performed at Rosenau. The collected data helped to determine the features of MORe, gave insights into the current meal ordering process and shed light on technology experience and attitudes of Rosenau residents. This process is described in the first section. To determine how the identified tasks and problems which MORe aimed to support could be formed into specific features and how these features should look and feel, usability guidelines from HCI literature were explored. The results thereof are discussed in the second section of this chapter.

4.1 Contextual Inquiry

The goal of the contextual inquiry was to inform the question of *what* to design - the scope, functionality and employed mental model of the system. A combination of interviews, observations and collecting artifacts allowed for developing a holistic picture of the current meal ordering process at Rosenau.

The information gathered at the reception mainly informed scope and features of the developed system, as well as ideas for future work. The interviews conducted with the reception staff (two participants) revealed that the current meal ordering process involves most departments of Rosenau and the involved steps span three weeks from the point when residents mark their choices to the day they receive their ordered meals. Also, the reception plays a central part in the process which leads to busyness-related problems like waiting times (for residents) and attention errors (in the transferred meal orders). Observing work at the reception gave insight into some everyday struggles as well as formed an understanding of the constant busyness and interruptions that define the receptionists' work.

With the residents, the interviews (four participants) represented a way to get to know some older people a little closer to help to empathize with this user group that is distinctively different to the author's. Additionally, the interviews were used to find out about the participants' attitudes and experiences about technology. The participants were very diverse in their prior experiences: For example, one participant used to visit computer classes regularly and owned several devices like a computer, tablet and smart phone. Contrasting therewith was another participant who reported not having used any computer or modern mobile device.
Observing the participants filling in a menu plan helped to gain insight into the individual process of making the meal choices. Here, many individual preferences and habits were identified that helped inform feature design. For example, individual preferences were revealed like trying to eat as little meat as possible or trying to eat fish as often as possible.
This information facilitated defining requirements about the functionality of MORe. Additionally, information about the current menu plan could be gathered as well as hints about problems thereof.

As a result of the gathered data, digitizing the menu plan that is filled in by the residents promised to drastically reduce the reception's involvement in the meal ordering process. When the residents' meal choices are recorded digitally right away, the additional step of transferring choices from the paper plan into the system would be rendered unnecessary, thus saving working time. An additional possible improvement by having a digital menu plan for the residents is to allow them to have insight into the current state of their order and directly change or cancel an order. As has been mentioned by receptionists during the interview, spontaneous changes present a substantial source of effort for them.

By observing the usage (filling-in as well as reading) of the paper menu plan by residents as well as receptionists, and supplemented by comments made during the interviews, elements of the paper plan could be identified that are necessary and needed to be adapted by the digital version (for example, being able to combine the components of several menus to customize an order), as well as some problems that might be mitigated by the prototype (like menu component alternatives that are printed at the bottom border of the plan and therefore are often overseen by residents).

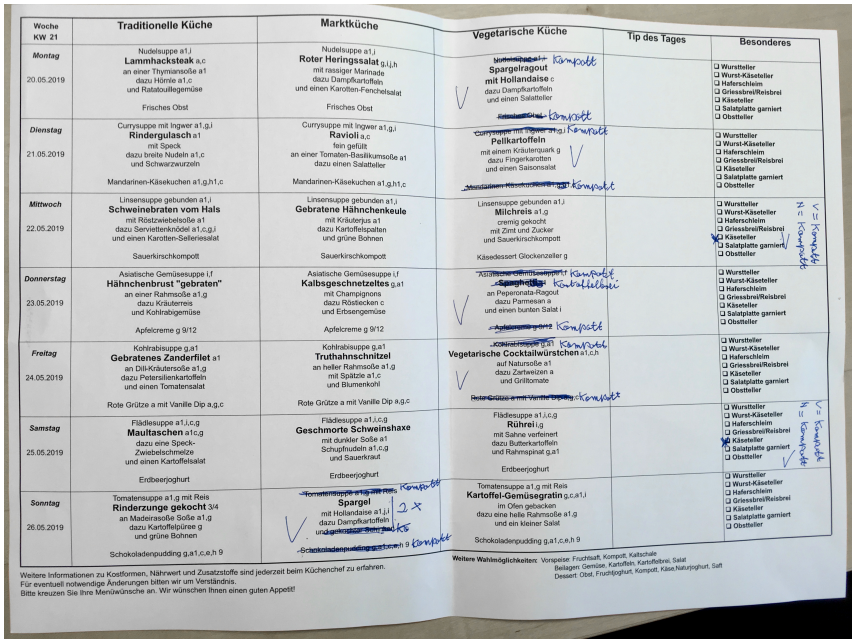

Figure 4.1: The paper menu plan used by Rosenau residents to order lunch to their apartment.

4.2 Design Guidelines

There are a plethora of design guidelines specifically supporting the design of systems for older users (e.g. Farage et al., 2012; Darvishy, Hutter, and Seifert, 2017). However, most of these read rather as an extended or refined version of general design guidelines like Nielsen's ten usability heuristics (Nielsen, 1994). The commonly known principles of minimizing cognitive load, designing for visibility and readability as well as applying affordances hold true regardless of the age of the user group. The only difference lies in what a sufficient implementation of these guidelines looks like. This section provides a short summary of those design guidelines that proved most relevant to the design of the digital meal plan prototype which are guidelines regarding information architecture and visual design.

As a consequence of the decline in working memory, it is especially important for older users to strive for minimal complexity. In the area of information architecture, it is suggested to implement this by designing a flat and broad instead of a narrow and steep menu structure (Fisk et al., 2009). This way, less steps need to be taken to reach a goal and therefore less errors can be made. This additionally helps to decrease the amount of sequential information that the user might need to keep in mind, therefore reducing the load on the user's working memory.

Complying to design guidelines regarding visual design requires diligence when choosing interface colours: To fulfill the AAA standard of the WCAG 2.0 accessibility guidelines (W3C Web Accessibility Initiative (WAI), 2019), the contrast between text and background colours needs to be at least 7.5:1. All colours for buttons and other elements in MORe were chosen accordingly and the text colour was set to black.
Icons are required to be easily readable and rather simple (Hawthorn, 2000) while still not being too abstract for easier understanding (Noichl and Schroeder, 2018).
Adequate sizing of elements and text is one of the most basic ways to improve usability. Darvishy, Hutter, and Seifert (2017) therefore propose tap targets to be at least 12×12 mm in size and fontsize to be at least the operating system's default size, which currently is 17pt for any iOS 14 device (Apple, 2020).

5 MORe: **M**eal **O**rdering in a **Re**tirement Home

This chapter illustrates design and development of MORe. It summarizes the more detailed descriptions that can be found in Reutlinger (2021). First, a brief overview of the used technology is given, followed by an introduction to the general concept of MORe. Afterwards, the three main screens are described: The menu plan overview which functions as a home screen, the weekly menu plan as well as the preferences section.

5.1 Technology Used

For the development of MORe, the cross-platform programming framework React Native (Facebook, 2020) was used. It was coupled with the complementary framework (650 Industries, Inc, 2021) as well as React libraries such as React Redux (Abramov, 2021), Immer (Weststrate, 2020), React Navigation (React Navigation, 2021), React-Native-Snap-Carousel (Delmaire and Bertonnier, 2020), React-Native-Numeric-Input (Himelbrand, 2019) and Reanimated 2 (Mansion, 2020). Thanks to Expo it was possible to have MORe run on a local or remote server and access it on a (10 inch) iPad by installing the Expo client app and connecting to the server from there.

5.2 Concept

MORe is made to resemble a menu plan not only through its functionality but also through design. Therefore the original physical menu plans are used as central visual elements for navigation: The available weeks are represented by depictions of closed menu plans on the home screen (menu plan overview), and when a plan is opened to view or order menus, the menu plan screen has an image of an open plan as background image. The third screen that contains preferences is the only one breaking with the menu plan metaphor and simply contains three sections where the user can define options to be applied automatically.

Figure 5.1: The three screens of MORe: Menu plan overview (left), weekly menu plan (middle) and preferences (right). *Larger versions of these pictures are depicted in the follwing sections.*

This structure was chosen to implement usability guidelines recommending a flat menu structure (Fisk et al., 2009). The idea behind this is that less steps that need to be taken to reach a goal lead to less possible errors. This additionally helps to decrease the amount of sequential information that the user might need to keep in mind, therefore reducing the load on the user's working memory. As a means to support minimal complexity, it is a way to deal with older people's decline in working memory.

5.3 Home Screen: Menu Plan Overview

The home screen shows all available menu plans in chronological order. This way, users can refer to past weeks as well as future weeks as they like. The current week is highlighted by a brighter colour and by the line written on top that reads "current week". Other plans can be explored by swiping horizontally. The menu plan representations contain date and week number, a prominent open button as well as information about how many menus are ordered for that week.

Figure 5.2: The menu plan overview in MORe.

5.4 Weekly Menu Plan

The weekly menu plan contains the central meal ordering functionality of MORe. Its main focus are the menus that can be ordered for each day. Additionally, the option to view and register for events has been integrated here.
Since the menu plan contains a lot of information, a solution needed to be found to make the required details visible on demand while allowing for a good overview and as little complexity as necessary. As mentioned before, the goal was to keep the menu plan in one screen. The intention was to support the user to always keep their context and orientation. Therefore the idea of displaying information in-place instead of switching to deeper nested screens was implemented based on the idea of the pattern "List Inlay" (Tidwell, 2010): When showing a list of things (like the weekdays in the weekly menu plan), a List Inlay can be used to expand a list item and allow for interaction or additional information within itself. This "expansion" concept has been used in a lot of places throughout MORe like in the weekly menu plan and in the preferences where the three sections of the preferences each can be expanded vertically to view them and interact with them.

5.4.1 Menus

When the user opens the menu plan of a week, the days of that week are displayed in a list. If a day lies in the past, it is greyed out and while the menu that was ordered for that day (if any) can still be viewed, it can't be changed anymore. On days that are either today or in the future, menus can be ordered, edited and cancelled. This can be seen in the left picture of 5.3: The first two displayed days lie in the past and the third one is the current day.

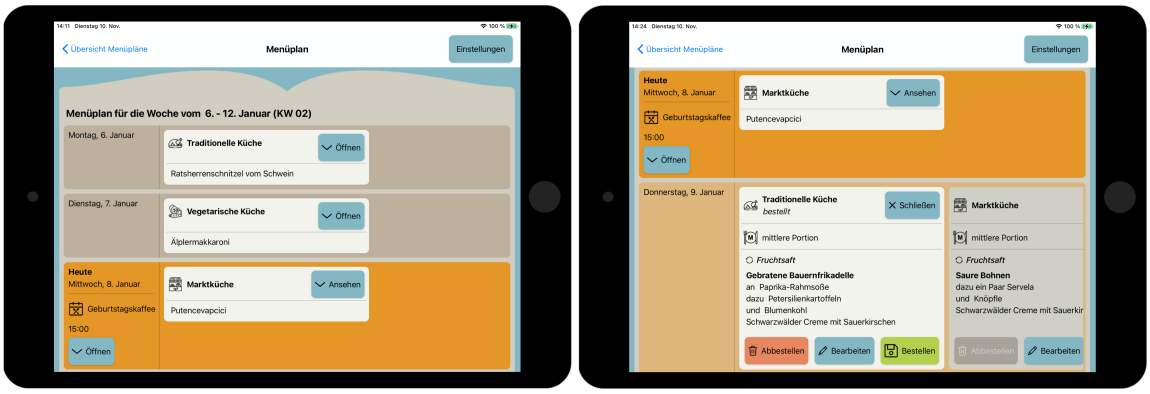

Figure 5.3: The weekly menu plan with collapsed days (left) and a mid-sized day (right).

The main area of each day displays information about ordered or available menus. When a week has been opened, all the days are initially collapsed. In this state, either the infomation that no menu has been chosen is displayed or the name and main component of the ordered menu. A button on the top right of a day allows the user to open it for more information.

When the user has opened a weekday and it is displayed in its middle size, the three available menus are shown. Like the menu plans on the home screen, they can be explored by swiping horizontally. If the day lies in the past, only the menu that was ordered is shown. If one of the menus is ordered, it is highlighted in a brighter colour and under its name appears a subtitle reading "ordered". At the top right corner of each menu there is a close button that allows the user to collapse this day and return to the first view.
At the bottom of each menu there are three buttons for cancel, edit or save. By using the save button, the user can order this menu directly without any customization. If they do want to customize a menu, they can expand it further by tapping on edit (shown in Figure 5.4).

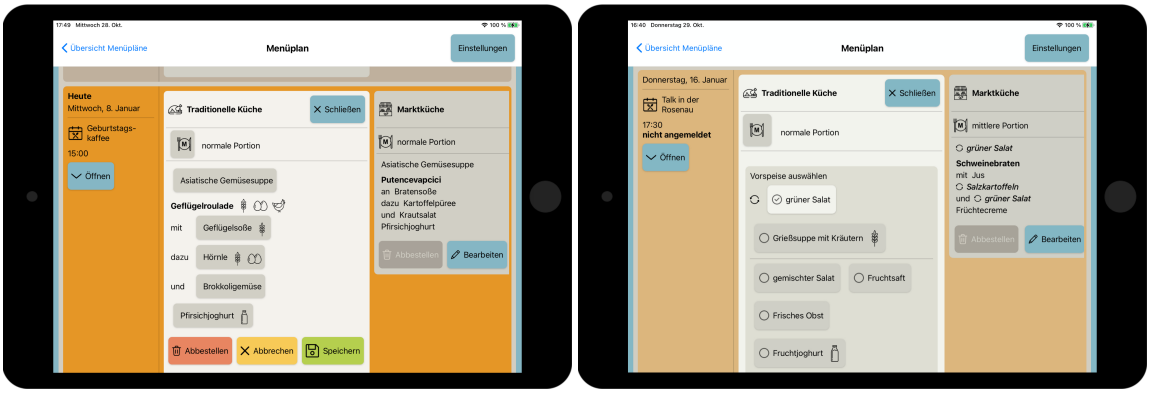

Figure 5.4: The expanded view of a menu (left) and of a component (right).

In the expanded menu view, each changeable menu component has a button-like design that allows the user to open it to reveal a drop-down-like list revealing alternative options. The list items are designed to be button-like elements with a circle to the left and where applicable an ingredient icon on the right. This button-like design offers an increased affordance in contrast to 'normal' list items as often used in drop-down menus. These options contain alternatives from other menus on the same day as well as alternatives that are always available. Additionally, as the last entry, the option to choose "none" is always available.
Many menu components or alternatives are accompanied by icons that illustrate ingredients or allergens. They represent the legally required information about allergens that are coded with numbers and letters in the original paper menu plan.

5.4.2 Events

At the left of each day, the date and any events of Rosenau that take place on that day are displayed. Originally, these events are made public in a seperate event calendar and registration is done personally via the reception. When the user taps the open button, they can expand the event view to find more details and the option to register for the event. They can register several guests at once and also choose between the food options that are offered during the event.

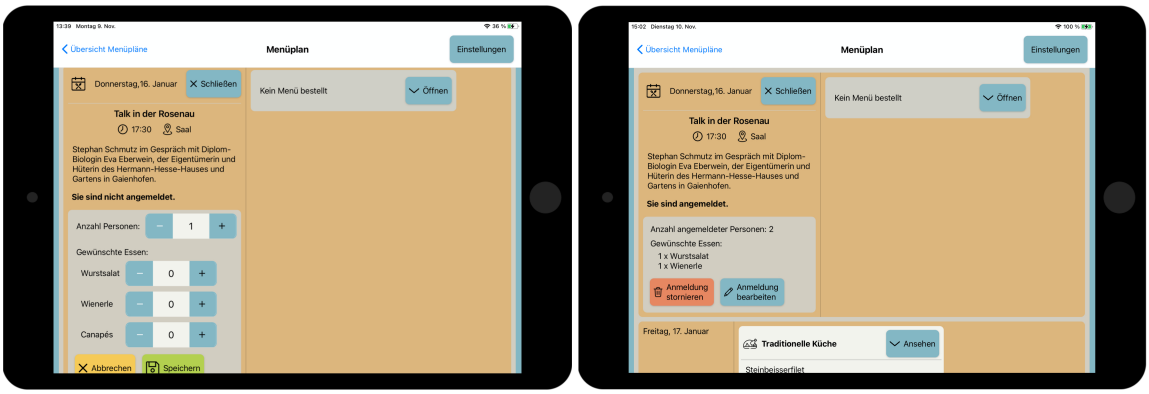

Figure 5.5: The view of event registration during (left) and after (right) the registration process.

5.5 The Preferences Screen

The navigation bar at the top of any MORe screen contains a button that leads the user to the preferences. This way, they can access them from both the menu plan overview or a weekly menu plan. The preferences screen consists of three sections that allow the user to define options that are applied automatically throughout the menu plans.

5.5.1 Likes and Dislikes

The first preferences section offers the functionality to sort the ingredient icons that are also shown in the menu plan in three lists. One list stands for ingredients the user doesn't want to eat, another for those they do like to eat, and the third one in the middle can contain all 'neutral' ingredients.

The concept of this feature was inspired by the interaction pattern “List Builder” (Tidwell, 2010). A big difference to the original, however, is the number of lists: In contrast to the three lists used here, an original list builder consists of only two lists (one as the origin of the list items and another as destination).
Tidwell mentions using drag-and-drop as a possible way for the user to move items between the lists. However, performing a drag-and-drop interaction can be cumbersome for older people because of sensomotoric decline or diseases like arthritis (Hawthorn, 2000). Therefore, the interaction works by tapping on an item to activate it and then tapping inside one of the lists to assign it to that category.
Once an item is assigned to the like or dislike category, its icon changes appropriately: It is backed with a green heart or red warning triangle, respectively. After the user saves their choice, this changed appearance is also applied to the ingredient icons in the menu plan.

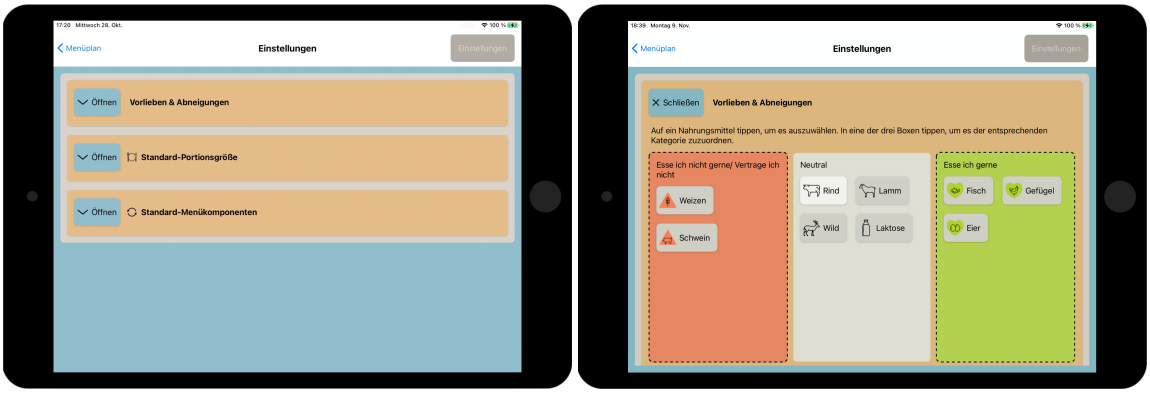

Figure 5.6: Overview of the preferences screen (left) and the likes/ dislikes section (right) of the preferences screen of MORe.

5.5.2 Portion Size

The second section (left picture of Figure 5.7) offers the option to define a new standard portion size. Anything chosen here is applied to the menu plan. Still, if the user wants to change the portion size of an individual menu, they can do so in the menu plan manually.

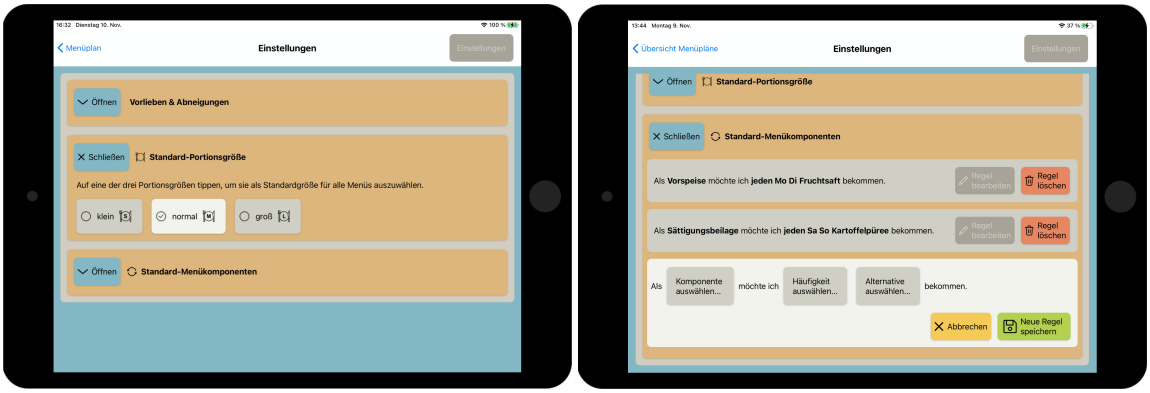

Figure 5.7: The portion size section (left) and the alternative rules section (right) of the preferences screen of MORe.

5.5.3 Rules for Recurring Choices

The idea behind the third section (right picture of Figure 5.7) is to give the user the opportunity to define 'rules' for choices they order on a regular basis. Here they can choose for which menu component (starter, sauce, supplementary side, vegetable side, or dessert) how often (either every day or on certain weekdays) they want to receive which alternative (depending on the menu component for example green salad or fruit juice). Similar to the portion size, these rules alter the initial values of the menu components in the menu plan but can always be overridden manually.

6 Study Preparation and Conduction

The evaluation of MORe was designed as a qualitative user study that took place in a common room at Rosenau. While it represents the final step in the process of developing and evaluating MORe, it is thought of as a formative evaluation to inform a potential redesign iteration for future work. This chapter illustrates how the study was designed and conducted.

6.1 Study Design and Research Question

This study was chosen to have a broad perspective on the reactions and usage of Rosenau residents towards MORe in contrast to a typical usability study. Similarly, Otjacques et al. (2010) argue for matching the evaluation method to the design process. They conducted several qualitative studies during the design and evaluation period of the Sammy system (described in chapter 4). Out of those, the study that was performed as part of a last refinement step before the launch of Sammy (described in Otjacques et al., 2009a) shows similarities to the evaluation of MORe: Otjacques et al.'s study consisted of 5 participants who each tested the system on their own before being interviewed. The goal of that study was to evaluate the participants' acceptance of the system.

The evaluation of MORe was guided by the question **"How do older people use an app for digital meal ordering?"**. This question is deliberately worded very broadly. Since the preliminary research (literature survey, contextual inquiry) investigated the topic of interaction design for older people under several perspectives (views on aging in society and its implications in interaction design and HCI research, the context of a retirement home and its processes, as well as personal encounters with older people), this study aimed to find out how retirement home residents would react to, accept and use a digital version of the current paper menu plan. This approach aims to cover more than just usability. Rather, it aims at giving a deeper insight into several aspects of the user experience of MORe.
As such, the general reactions and attitudes of the participants were investigated: Do they like the idea of a digital menu plan? Does it make them feel more or less in control of their food choices and orders? Are there aspects of MORe that feel stigmatizing to the participants?
Of course, usability aspects also played an important part in the study goals: Do the prior experiences of the participants match the technology skills required by MORe? If the participants need to actively learn how to use MORe, would they do that? Also, do the implemented design guidelines regarding colour, text and element sizes and menu structure succeed?

To answer these questions, a mix of different methods was employed. In a starting interview, demographic characteristics and prior technology experience of the participants were inquired. Subsequently, MORe was introduced and its features were demonstrated. Then the participants were observed while they used MORe themselves. Due to time restrictions, some features were not tested by the participants but instead demonstrated by the study conductor and discussed with the participants. Afterwards, the participants filled in the UEQ questionnaire for some additional quantitative data.

The UEQ questionnaire (Laugwitz, Held, and Schrepp, 2008) was used because it gives insight into the six qualities of *attractiveness*, *perspicuity*, *efficiency*, *dependability*, *stimulation* and *novelty* which match well with the questions that guided the study. The UEQ consists of 26 question items that each are constructed as a seven-point Likert scale, making it fast and easy for participants to fill out.

6.1.1 Study Set Up and Tasks

The study was designed to take one hour per session. Table 6.1 shows the procedure for each of the study sessions.

What	Details	Data collection instruments	Duration
Welcoming	Greeting	-	2 min
	Welcome form	-	2 min
	Informed consent	-	2 min
Interview	Demographic interview	Video recording, note taking	10 min
Observation	For each feature: First demonstration, then testing by participants	Video and screen recording, note taking	20 min
	Demonstration and discussion of remaining features	Video and screen recording, note taking	10 min
	Further discussion	Video recording, note taking	5 min
	UEQ questionnaire	Questionnaire	5 min
Goodbye	Hand over compensation	-	2 min
	Confirm compensation	-	1 min
	Saying goodbye	-	1 min
			60 min

Table 6.1: Overview of a study session.

The participants were given four tasks that covered the most features of MORe. Each task was preceeded by a demonstration of the respective feature by the study conductor.

The first and main task asked the participants to order lunch for the next week. This task couldn't be solved in a correct or wrong way, it was rather an exploratory one. The participants were expected to open the correct menu plan (starting in the menu plan overview). From there, they should open each day, explore the menu options and choose the menus and components to their liking. The goal of this task was to find out the general acceptance of this main feature of MORe as well as to observe interaction patterns like the order in which the meals and meal components are chosen. The idea of this task was also to find out whether the digital menu plan represented a sufficient "translation" of the original paper version that allowed the participants the same functionalities.

The second task addressed the menu plan overview. The participants were asked to find out whether they have filled in the menu plan for one of the coming weeks. This task required them to swipe through the menu plan overview, find the required plan, read its "cover" and detect that the bottom line reads "0 of 7 menus ordered".

The third task covered the event registration functionality. It required the participants to register two people for an event next week. The idea behind this task was to test the visibility of the event plan features in the menu plan. Since this was an additional feature that exceeded the original menu plan functionalities, the reactions and opinions of the participants were of great interest.

The fourth task adressed the "likes and dislikes" feature. The participants were asked to sort given ingredients in the likes/ dislikes lists. This task tested the usability of this feature (especially the "tap and tap" alternative to the "drag and drop" interaction). After they had completed the task, the participants were shown how their choices were reflected in the menu plan and were asked for their opinion about this feature.

The remaining two features, portion size and recurring choices, were initially also planned to be tested by participants. But during the pilot study it emerged that there wasn't enough time for it if the study sessions were to take no more than one hour. Therefore, those two features only were demonstrated to the participants and discussed with them subsequently.

6.1.2 Study Preparation

After the preliminary contextual inquiry, the author had stayed in contact with Rosenau staff members and communicated the development progress of MORe (and the expected time frame of the study) and especially asked for the situation regarding COVID-19. The latter is described in more detail in the next section.

When MORe was ready for evaluation, the primary contact staff member was reached out to to settle the general study conduction. That way, the most suitable room of Rosenau was discussed and an appointment was made to test the technical set up in that room. Also, the staff member helped with participant recruition: Since personal contact (of the author as an external person) with residents was to be avoided as much as possible due to COVID-19, the required characteristics of the participants were discussed and she (the Rosenau staff member) contacted them. Those characteristics were mainly that the participants were owners (and users) of an iPad so that learning how to use an iPad would not interfere with learning how to use MORe. Secondly, an open mindset was needed to be willing to take part in such a study and finally, a balance of the number of male and female participants was strived for. Since 5 to 6 participants were aimed for, two to three male and female residents were aimed to recruit. For the most part, the recruitment process was as follows: The staff member informally asked participant candidates whether they owned an iPad when she met them for example in the lobby area. If they responded positively, they were further asked whether they were interested to participate in a study concerning an app for meal ordering. If they agreed to participate, their names were forwarded to the author who set up an information letter containing further details and announcing a call in the coming days to arrange an appointment for the study session. These letters were printed by the staff member and handed out to the participant candidates.

When the participant candidates were called a few days later, they were prepared and showed large interest in the study and the app. The fact that they had been approached by a staff member had already build trust towards the author/ study conductor and overall encouraged them to participate. Since the participants were required to be owners of an iPad, the possible candidates were very limited. For example, several residents that were contacted by the staff member would have been interested to participate, but used for example an Android tablet or "only" a smartphone and computer. Nevertheless, six candidates were identified and four study appointments for the coming week were agreed upon. As a chance to follow up on the conversation had during the contextual inquiry, the two participants from the first study who owned an iPad were contacted again. While both were willing to participate, one sadly was in quarantine for the time of the planned study sessions. The other one, however, agreed to participate again (P02).

Similar to the conduction of the contextual inquiry, the participant compensation of 10€ was decided to not be paid out as money, but via small gifts. Since it was the week before Christmas, handmade Christmas cookies in the value of 10€ were ordered in a local café. This idea was brought forward by the staff member and was greatly appreciated by all participants.

As a final step before the first study session, a pilot test was conducted to test the recording set up, check for last bugs and also review all study documents for mistakes. Additionally, this test was used to test out the length of one study session. Indeed, having the participants test out all features proved to take too long. Since all features seemed relevant enough to be discussed, it was decided that the last two planned tasks that covered the features portion size and recurring choices would only be demonstrated by the study conductor and discussed with the participants.

6.2 COVID-19 Considerations

The plans to conduct the user study of MORe in December 2020 started to become increasingly problematic when the COVID-19 case numbers in Germany rose. Since older people belong to a high-risk demographic, contact with them was to be reduced to a minimum.

At the time of the conduction of the study (mid-December), the hygienic measures applied at Rosenau were as follows: Only visitors were allowed in who didn't show any symptoms of a respiratory illness, who hadn't had contact with someone infected with COVID-19 and who hadn't visited a high-risk area in recent time. Additionally, wearing a face mask in the corridors and lobby area was mandatory. If a safety distance couldn't be kept, a mask should also to be worn. In contrast to university regulations for studies, no desinfection of surfaces or objects was required. In cooperation with the management staff member, hygiene considerations and measures were arranged. The measures were als follows:

Ventilation. The room was ventilated before and after every study session. Per the request of one participant, the window was left open during the whole study session with her.

Large room. Thanks to the close cooperation with Rosenau, one of the common rooms could be reserved for the conduction of the study. This room was in the lobby area of the retirement home and was usually used for meetings and presentations among up to 30 staff members or residents. Therefore it was quite large and its layout allowed for the study conductor to keep a distance of about two metres from the participant, making it possible for participant and conductor to not wear masks during the study session.

No personal contact. To minimize contact, the participants were greeted and said goodbye to from behind the study conductor's table. Also, the demonstration of MORe features did not happen side-by-side at the iPad, but instead via a TV monitor that the room was equipped with. Additionally, all study documents were numbered and placed on the participants' table in the correct order. These measures allowed the whole study session to be performed without study conductor and participant getting close to each other.

Air purification. Due to Rosenau hygienic measures, the room that was used for the study came equipped with an air purification device which was turned on during the whole time that the study conductor was present.

Desinfection. As an additional precaution, the measure of desinfecting all surfaces and devices before and after every study session was employed. This meant desinfecting especially the iPad, and the pen the participants were given, as well as the table they sat at and the armrest of the provided chair.

FFP2 face mask. Also for increased security, a FFP2-standard face mask was worn in cases when the study conductor came in close range with the participants.

Despite all of these arranged measures, it was possible at any day that the study would be prohibited by Rosenau management. Luckily, this situation did not occur. However, after the first three study sessions that were conducted on the first day of the study, the author decided to cancel the further conduction of the study. This had to do with several reasons:
After the greeting, when study conductor and participant had taken their seats, the conductor explained that due to the distance, both could take off their masks - if the participant was comfortable with it. One of the participants hesitated. While she agreed after a moment (even though being pointed out that she could decide for both to leave the masks on), her hesitation showed that she did perceive her participation in the study as a potential risk. Experiencing this caution caused the first doubts of the study conductor whether continuing the study as planned was wise. The second incident that pointed towards increased caution was a conversation with the cooperating management staff member later that day. She expressed concerns due to rising COVID-19 case numbers and a more tense situation at Rosenau. Due to the tighter lockdown that was imposed the following day (December 16th), the second half of the study sessions were cancelled.

Thankfully, the hygiene measures seem to have been successful as none of the participants, nor the study conductor or the staff member showed signs of a COVID-19 infection.

6.3 Conduction

Figure 6.1 shows the set up of the room where the study sessions took place. The table of the study conductor (on the left) was set vis-à-vis to the table where the participant took place (on the right). Thanks to the size of the room, the tables could have a distance of about two metres, allowing to keep a safe distance between study conductor and participant.

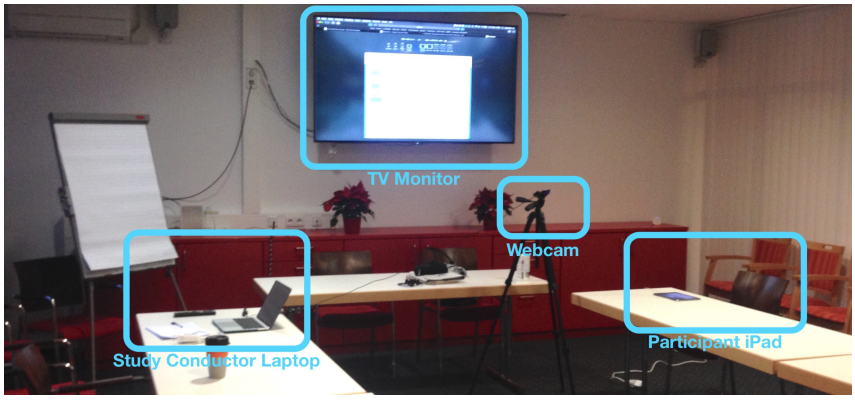

Figure 6.1: The study setup: Study conductor laptop (left), TV monitor (top), webcam (below TV), participant iPad (right).

At the front of the room, a large TV monitor is mounted which was used to demonstrate features of MORe to the participant. Below the TV, the webcam can be seen which was set up to record the face of the participant as well as their upper body and the iPad. This way, their facial expressions, gestures and interaction with the iPad could be recorded. The webcam was also used not only to capture the usage of MORe, but also to record the interview.

In Figure 6.2, the technical set up of the study can be seen. For the demonstration of MORe features, it was running in the browser of the study conductor's laptop. The browser window was displayed on the TV monitor which was connected to the laptop with an HDMI cable.

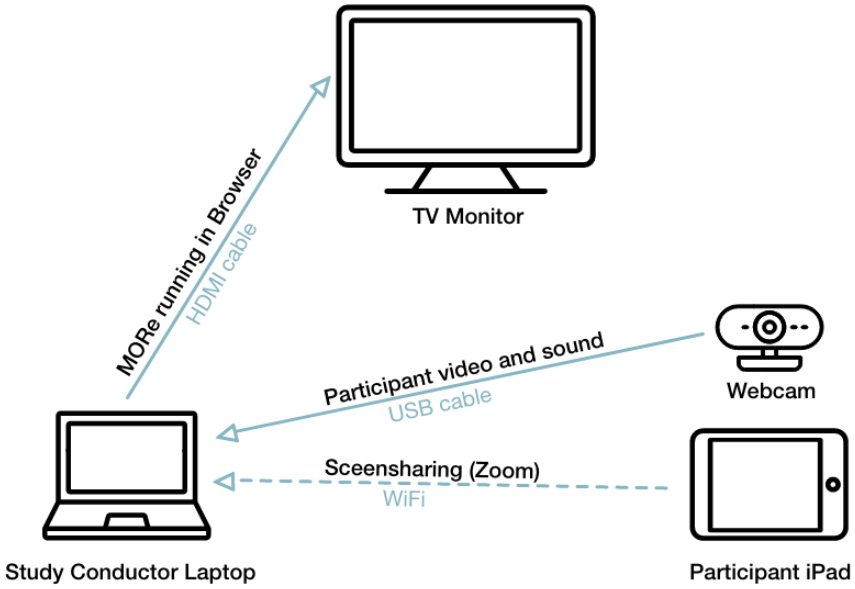

Figure 6.2: Diagram of the study setup: Study conductor laptop (left), TV monitor (top), webcam (below TV), participant iPad (right). *Icons by Freepik, srip and Darius Dan via Flaticon.com*

To record sound and video of the participant and capture the iPad's (Apple iPad Air 2, 9.7 inch) screen simultaneously, Zoom (Zoom Video Communications, Inc., 2021) was used: Before each study session began, the study conductor started a Zoom call between the laptop and the iPad. The webcam that was directed to the participant's position was set up as video and microphone source for the laptop Zoom user. The iPad, on the other hand, shared its screen and its microphone was muted. Since the iPad's sound output can't be muted when in a Zoom call, some in-ear headphones were plugged in and rolled up to avoid acoustic feedback. For recording, the record function of Zoom was used. Figure 6.3 shows a screenshot of the Zoom call during one of the study sessions.

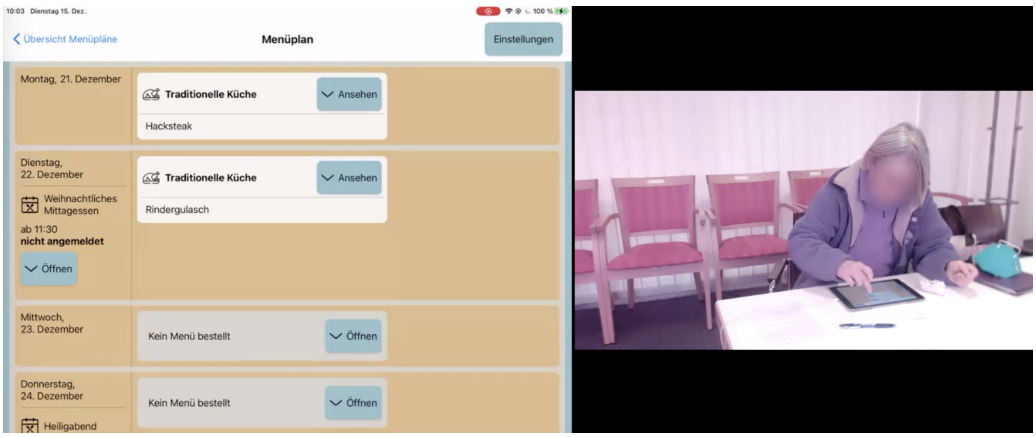

Figure 6.3: A screenshot of the recording setup via Zoom. *Left:* Shared participant iPad screen. *Right:* Webcam recording of participant.

7 Study Results

This chapter describes the process of analyzing and interpreting the collected study data. The collected data, including demographic information about the participants, the collected qualitative data referring to MORe and the results of the employed UEQ questionnaire are reported. This chapter concludes with a description of learnings and redesign ideas.

7.1 Data Consolidation and Analysis

The data analysis process was started by transcribing the study session videos. They included the interviews as well as the part in which the participants tried out MORe. For the second part, an emphasis was laid on identifying critical incidents. By recording the screen capture on the iPad simultaneously to the participant's gestures (see Figure 6.3), it was easy to see clearly what happened on the screen but also identify reactions of the participant. Also, since the screen recording doesn't show the touch points of the participant, the synchronous participant video helped in several cases to identify the exact interaction.

Based on Lazar, Feng, and Hochheiser (2017), the study transcripts were coded. This was done by marking sections of the texts with different colours depending on the topics that were identified during the transcription process. These topics were *technical know how*, *suggestions and feedback*, *problems and reactions*, *personal remarks* and *Rosenau food*. For deeper insights, the interesting statements and observations that were identified during the coding process were extracted and written on cards that were clustered into a diagram, inspired by the idea of a Work Activity Affinity Diagram (Hartson and Pyla, 2019). The process of spatial categorization of the notes allowed for a deeper understanding of the discussed topics. It proved especially helpful to look at statements across the participants. Several times, all three participants had made a statement or could be observed regarding a feature or topic and it turned out that they had diverging opinions and reactions. These statements are discussed in depth in section 7.4.
The additional collected data like the demographic information and the results of the UEQ questionnaire were initially looked at separately. However, during the analysis of the qualitative data from the transcripts, the characteristics of the three participants revealed themselves to be quite distinct from each other. Therefore, some observations and statements were collected to further describe the three participants. The results are reported in section 7.3.

7.2 Demographic Data

Instead of asking the participants to fill out a demographic questionnaire, a "demographic interview" was conducted. This means that questions regarding demographic data were asked. This served as conversation starter and as a chance to get to know the participants a little bit closer by asking follow-up questions. The data collected this way are displayed in Table 7.1.

The participants one, two and three are referred to as P01, P02 and P03, respectively, from here on.

Topic	Question	P01	P02	P03
Demography	Age	76	77	72
	Gender	female	male	female
	Years living in Rosenau	5	3	3
	Former profession	Secretary	Lawyer	Businesswoman
Technical affinity	Technical devices used in profession	Computer (several times a week, for text processing)	-	-
	Technical devices owned	iPad, digital camera, formerly: laptop	iPad, smart phone, computer	iPad, smart phone, computer
	Frequency of iPad usage	3× a day	several times a day	several times a day
	Years since owning iPad	3	5	6
	Self-perceived iPad usage expertise*	3.5	3.5	3.5

Table 7.1: The demographic information of the study participants. * *Ranging from 1 to 5 with 1 being a total beginner and 5 being an expert.*

The participants' age ranged from 72 to 77. Compared to the age distribution of Rosenau residents (see Reutlinger, 2020) which resembles a normal distribution with a peak at ages 84 to 88, the participants belong to the youngest 15% of Rosenau residents. Therefore, their attitudes and reactions can't be seen as generally expressive for the Rosenau population.
Two of the participants were female and one was male, with the years of living in Rosenau ranging from 3 to 5 years. Only P01 who used to be a secretary had used a computer for work. Participants two and three who used to work as a lawyer and businesswoman, respectively, reported not having used modern technological devices in their professional life.
Apart from owning an iPad (which was mandatory for study participation), only participants two and three reported owning a smartphone and a computer. P01, on the other hand, said that she only used her land line phone and a digital camera, but she did not own a mobile phone or computer. P01 did mention, however, that she used to own a computer before she got her iPad.
Regarding usage of their iPad, P01 reported using it approximately three times a day (in the morning, at noon and in the evening) mainly to check for mails and the weather forecast. Participants two and three said that they used their iPads several times a day for various tasks like looking up things online or online banking. P03 mentioned that she often prefers reading on her iPad to reading an actual book because it weighs less and therefore is easier for her to hold.
The participants owned their iPads for 3, 5 and 6 years, respectively. Interestingly, all three of them assessed their iPad usage expertise at 3.5 of 5 on a scale from beginner to expert.

7.3 Participant Characterization

This section aims to aggregate some contextual information about the participants to provide a clearer image of the three people. The idea is to facilitate associating the statements and observations in the following section with one of the three participants.

P01 has been living in Rosenau the longest (for five years) compared to the others. She used to work as a secretary where she used a computer several times a week. She also used to own a computer before her family got her an iPad three years ago for easier communication. Thus, duration-wise, she has the least experience with it, compared to the other participants. She uses her iPad mainly for communication (e.g. e-mail) and to check the weather forecast. She does not own any mobile phone or computer, rendering her iPad the only computer-like device she uses on a daily basis. P01 exhibited the least confidence in interacting with MORe. There were several incidents where she lost her orientation in the interface and was confused by its reaction (or lack thereof). She also scrolled with little control by initiating the scroll movement and then taking the finger off the touch screen. Thereby the scroll position often wasn't ideal for viewing the contents of the interface. Apart from being lactose-intolerant, P01 tries to eat as little meat as possible and overall is very keen on eating "naturally". She therefore doesn't really like the food offered at Rosenau. She never eats the sauces served with the menus, but instead adds her own sauces or dressings (if she eats in the restaurant, she even brings them there). P01 usually prefers having lunch in the restaurant for social contacts. She only eats at her apartment right now because of COVID-19.

P02 was the only participating man. He was also the oldest of the participants with 77 years. He has been living in Rosenau for three years. He used to work as a lawyer and didn't use any technical devices there. He reported to own two smartphones as well as two laptops in addition to his iPad, and uses all these kinds of devices several times a day. He has owned an iPad for five years. He explained that he used to take computer classes for several years and overall is very interested in learning more about using computers. He misses the exchange with others about this interest of his and therefore considers giving computer classes for other Rosenau residents himself. Several times during the study session, P02 detected small layout errors (for example, the last letter of a word being printed in another line). He was amused by these errors and explained that he understood how they can happen: "The columns just aren't wide enough." While this isn't exactly how layouting in React Native works, being able to categorize an error shows a deeper understanding of the concept of layouting. At one moment, he took the study iPad in both hands, commenting that he realized it had become warm and that he wanted to test whether it was too warm. Both of these examples illustrate his good technical understanding. Out of all three participants, he appeared the most skillful at using an iPad. He never experienced confusion when testing MORe and his "style" of interaction was characterized by confident, controlled movements. P02 stated that he loves food. He seemed to take a pride in not being a picky eater and emphasized that he can't understand the number of reclamations the kitchen receives. He rarely mentioned meals that he dislikes and instead gave several comments about his favourite meals.

P03 was the youngest with 72 years. She had been living in Rosenau for three years. In her professional life, she had been working as a businesswoman. Apart from her iPad, she reported owning a smartphone and computer. She proudly commented that she had owned her first computer in 1989. She said that her current iPad can take a SIM card so that she can access the internet from anywhere. Compared with the other participants, she showed rather high skills in interacting with the iPad, however, not quite as much as P02. In contrast to him, she experienced confusion when she encountered some usability problems. Apart from being used to tackle administrative tasks digitally, P03 expressed quite strong expectations towards modern technology. For example, her statement "There are websites that make you have a fit." shows that she has expectations of web sites to fulfil a minimum of usability requirements. She mentioned several times the online store that her children operate and seems to have learned a lot about how technology functions in that context. For example, she said that most problems in software cannot be eliminated with rigorous testing alone but are exposed when the product is used by real users. She also mentioned that a digital menu app like MORe probably wouldn't be too hard to realize

since it's only a matter of attitude and programming. She gave an example of how shipment tracking is broadly available in online commerce to illustrate the state of the art in technology that makes people's lives easier. Additionally, P03 stated that "You could create the app in such a way that it can be used at a laptop as well". This shows that she doesn't view modern technology devices as separated systems but can mentally transfer functionalities from one device to another. P03 is allergic against palm oil and coconuts. Therefore there are a lot of meals in the menu plan of Rosenau that she can't eat. She also has a distinct taste and overall is very deliberate about what she eats.

7.4 Qualitative Results

In the process of clustering the extracted notes, several topics could be identified. In general, these can be split up into comments or observations regarding the MORe app and insights about the participants' personal context (self-image, food preferences, dining at Rosenau).

7.4.1 General Feedback and Usability

Overall Feedback on Usability Especially participants two and three commented positively on the usability of MORe. P02 stated that he could get started with it right away and would be able to order his meals right from the start.
P03 explicitly mentioned that the app is easy to use. She also liked the structure of the app and said that "you can see directly what you can do by clicking", praising the interface's affordance.
In contrast, P01's statements were more reserved and critical. Her statement "When I've done this [meal odering] two or three times, it won't be a problem anymore. Overall, it makes sense." shows how she didn't experience her troubles as problematic enough to criticize the app's usability. She expressed this attitude several times, attributing her troubles with understanding something to her little experience in using the app.
A similar willingness to learn was also expressed by P02 who stated that when something doesn't work as expected (in this situation: Sorting the ingredient icons in the likes/ dislikes list which he expected to work via drag and drop), he would just try around until he'd find out how to use it. This "trial and error" attitude appears to be rare among older people, as literature lists it under the most prominent differences between the interaction styles of older versus younger users (Lee, Chen, and Hewitt, 2011).

Praise 1:	Participants showed willingness to spend time learning how to use MORe.

Readability Since readability received a lot of attention when designing the interface of MORe, it was pleasing to hear from P02 and P03 that they didn't need their reading glasses to use the app (P01 didn't bring reading glasses and didn't mention experiencing problems with readability in general). Interestingly, they used them for reading the study documents, but not when they interacted with MORe. P02, who had noted in the beginning that he often has problems reading small fonts explicitly stated that he can read everything in the app easily.

Praise 2:	Readability of text in MORe is good enough that participants didn't need to use their reading glasses.

Reasons for Using a Digital Menu Plan All three participants stated that they would like to use an app like MORe when ordering meals. Their willingness ranged from a rather factual statement that the app "makes sense" (P01) to the more enthustiastic statements from both P02 and P03 (P02: "I would like to use the app next week!"). Participants one and two showed mild disappointment when they learned that the app was not intended to be actually used in Rosenau, but resembles only a study prototype (P03 didn't think of the app as "real" in the first place).

Praise 3:	All three participants would like to use MORe for meal ordering on a regular basis.

7.4.2 Menu Plan

General Feedback

Generally, the menu plan functionality was received positively. Ordering menus was perceived to be "fast" and "not difficult" (P03). P02 liked the colourful buttons at the bottom of the menus. P02 and P03 especially liked the visibility of the alternatives (which led to P02 feel like there were more options to choose from than in the paper menu plan) and the visibility of the order status like "no menu ordered" or the visually highlighted chosen menu component alternatives.

Navigation

Regarding navigation, two observations could be made: First, P02 discovered the button that lead to the preferences himself and wanted to try it out right after he had finished the task of ordering menus. This shows a curiousity and readiness to test things out which stands in contrast to the often reported attitude of not wanting to break anything amongst older people (Lee, Chen, and Hewitt, 2011). Second, P03 was observed to take an interesting route from an opened menu plan to the preferences screen: She first closed the opened day, then went back to the menu plan overview screen to then click the button in the top right corner, leading her to the preferences. This matches the observations from Fisk et al. (2009, p. 80) that older users tend to return to their starting point before navigating to another screen, even when that screen is reachable right from the beginning.

In two instances, P01 showed some insecurity in using the back button at the top left: Right at the beginning of the first task, she accidentally opened a wrong menu plan and didn't know how to get back. She showed signs of irritation before the study conductor hinted at the back button. This incident shows that even though she uses her own iPad on a daily basis and the back button in MORe matches the standard look of the iOS back button, she either didn't expect or didn't recognize it. In another moment, she had chosen some alternative and wanted to reverse her choice. Her finger went to the back button, as if her idea of "back" (in German: "zurück" as in "rückgängig") collided with the navigation function of the back button. With her finger hovering over the button, she reconsidered her intention and in the end did not press it but corrected her choice by tapping on another alternative.

Visibility and Structure

Weekly View and Weekdays When P01 initially had the current week open for the task of ordering menus (which required the participant to open the following week), she first wasn't aware which week she was in. She

also didn't realize that Monday was already in the past and therefore was confused about how she could change the displayed menu. The situation was solved when the study conductor pointed out that she was in the wrong week, whereupon she managed to return to the menu plan overview and opened the correct menu plan.

Participants one and two skipped a weekday when ordering menus. They didn't realize it when tackling the days one by one nor when they scrolled back up after being done with Sunday and reviewing their ordered menus.

Problem 1: Several participants skipped a weekday when ordering menus and did not realize this when (briefly) reviewing the week's orders.

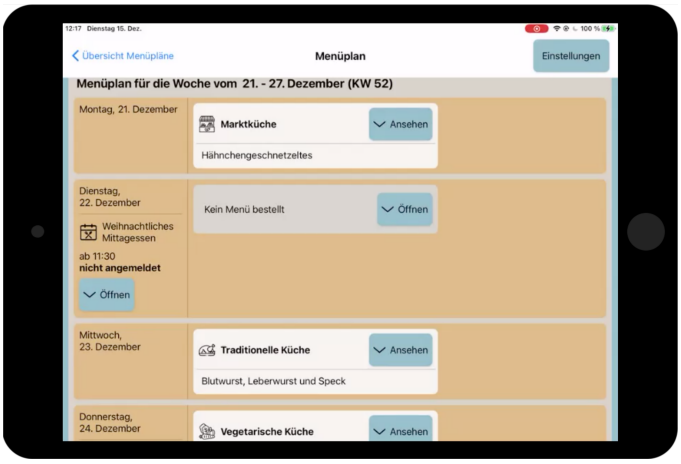

Figure 7.1: Participant screenshot showing the skipped weekday.

After saving a menu, participants one and two mostly took a last look at the mid-size menu view where a summary of their choices was displayed. P03, in contrast, never looked at these summaries.

Observation 1: After saving an ordered meal, several participants used the mid-sized menu view as a confirmatory summary of their order.

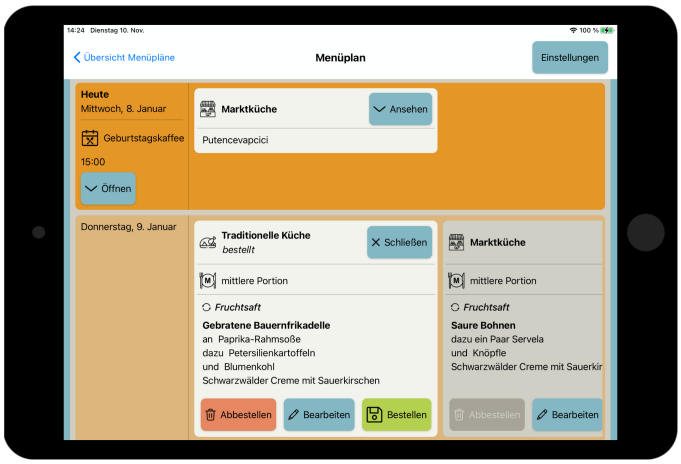

Figure 7.2: Screenshot showing a menu summary.

Daily View and Menus When a weekday was collapsed, P02 was confused on how to reach the edit button.

Problem 2: The collapsed view of a menu lead to a mode error for a participant who didn't know how to reach the edit button which is only displayed in the mid-size view of a menu.

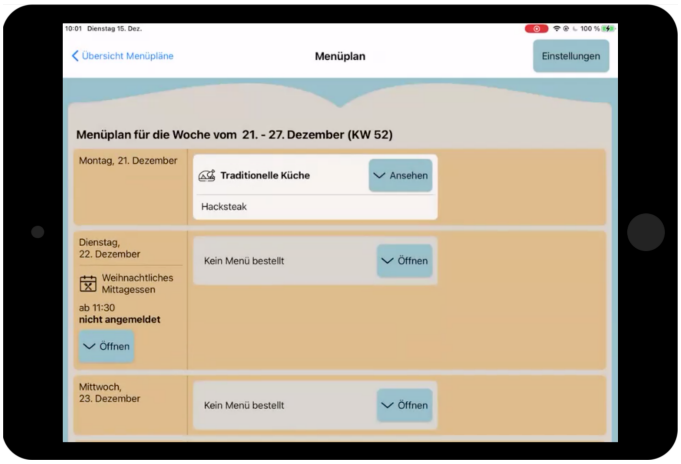

Figure 7.3: Participant screenshot showing the collapsed view of a menu.

The mid-size view of a menu (as seen in Figure 7.2) led to a few misconceptions among the participants: P01 tried several times to open a menu by tapping on its content area (instead of the open button). She continued doing so until the study conductor showed her the open button.
P01 and also P02 at some point tried to tap onto a menu component to open it for editing.

Problem 3: All participants at least once tried to open a (mid-sized) menu by tapping at it instead of using the edit button.

Additionally, P01 most times expanded a menu before starting to read it in full.

Sequence of Meal Ordering All participants went chronologically from Monday to Sunday. Inside each weekday, they mostly chose one menu and went with it - an exception was P02 who once, after he had chosen and edited a menu, went back and read through the other menus, in the end chosing another menu. Another time he stopped editing a menu halfway in, read through another menu and switched to editing this one.
P01 and P02 orderd their menu components chronologically, from starter to dessert. P03, on the other side, happened to change her mind after being halfway through with a menu: After changing a side dish, she went back and changed starter and vegetable side.
These different sequences of meal ordering make use of the rather free structure of the MORe interface: No defined sequence of steps has to be taken to order a menu. Instead, users can go about as they wish - either straight from Monday to Sunday and from starter to dessert or go back and forth and change their mind at any time. This confirms the menu plan metaphor and the goal of allowing users to transfer their mental model of how to use a paper menu plan to MORe. Because the contextual inquiry had revealed that users have different strategies and habits for ordering their meals, a goal was to allow for such personal habits in MORe, too.

Praise 4: Participants made use of the flexibility offered by the MORe interface to change in the middle of editing one menu to abort and/ or start editing another menu.

Wish: Weekly Menu Overview Participants one and two both mentioned that they miss the possibility to compare the three offered menus each day with the menus on other days. By having all menus of every day visible at once, the paper menu plan offers this view. However in MORe, the users can only compare the chosen menu of a day with the chosen ones of other days, or compare the three offered menus inside one day.
P01 stated that she would like such a view so she would be able to order more diverse menus. She brought up the example of ordering noodles: Sometimes, spaghetti are the main course of a menu, and when she considers ordering it, she would like to check whether she has chosen pasta as a side dish in the days before or after. Because of this missing view, she found the MORe menu plan to offer an inferior overview to the paper menu plan.
Similarly, P02 stated that, since he tries to eat more vegetarian meals, in the paper menu plan he first looks at the column containing the vegetarian meals to find out on which days the best vegetarian options are offered. Only after choosing those, he goes on and fills in the other days with one of the non-vegetarian options. This approach for choosing meals is currently not supported well by MORe. While P02 once stressed that he thinks of his habit as an exception and therefore not necessary to be supported by MORe, he later said that he prefers the paper menu plan over MORe because he misses this seven day menu overview.

Suggestion 1:	Two participants requested an overview of all meals offered in a week, similar to the overview offered by the paper menu plan.

Buttons (Order, Edit Order, Save, Abort)

Order versus Edit Buttons When starting with the task to order menus, for the first menu, participants one and two both initially tapped on "order" instead on "edit" menu even though they planned on editing it. They realized their mistake when the menu didn't expand to offer them editing options. While P01 reacted with irritation and impatience, she corrected her mistake herself and tapped on "edit". P02, on the other hand, acknowledged his mistake but went on to the next day. He didn't expect that he was able to change his order afterwards. After being pointed out by the study conductor, he went back to day one and edited the menu as he wanted initially.

Save All three participants expressed familiarity with the concept of saving (and closing) interface elements after editing or choosing something (in this case, their menu choices). Especially P01 and sometimes P02 muttered about saving like "... and save, of course."

Praise 5:	All participants were familiar with the concept of saving a choice before going on with another interaction step.

Close Interestingly, participants one and three showed opposite usage of the menu close buttons: While P01 meticulously closed almost every single menu, P03 used the close button not even once.
With P02, a discussion emerged about saving versus closing: He stated that he would need to learn to hit close every single time. The study conductor answered by pointing out that he can close a menu but he doesn't have to. But he has to save his choice if he changed something, and therefore if he did edit the menu, he can't close until he tapped save. While accepting this explanation in the moment, in a later instance he confused the explanation. Thinking that saving is optional and closing mandatory, he was irritated when the close button was deactivated after he had edited the menu. While the system feedback (greyed out close button, active save button) supported him in understanding his mistake and correcting his understanding of the interface, he criticized that he was given no explanation of why the close button was greyed out. At this point, he emphasized his idea of a large red arrow pointing to the save button.

Praise 6: MORe allowed for individual interaction patterns by offering a close button which is not mandatory to be used.

Problem 4: While deactivating the close button when changes have been made proved helpful in some cases, it also elicited confusion with one participant who required an explanation of why he could not simply close the menu.

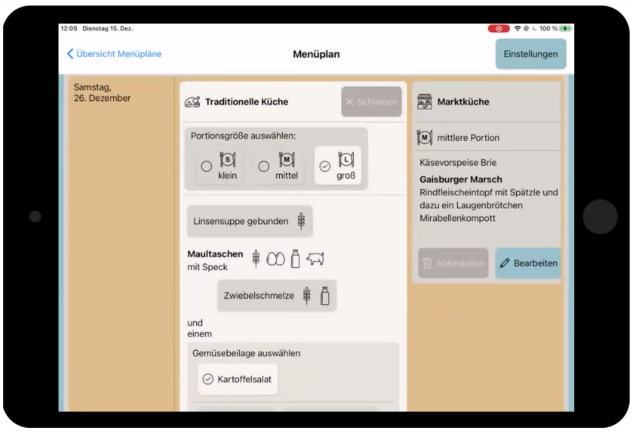

Figure 7.4: Participant screenshot showing a menu view with a deactivated close button.

Regarding the close button, several problematic situations emerged among all three participants:
In once instance, P01 had chosen an alternative starter when she tapped the close button. Since the button was deactivated, nothing happened. Apparently, she didn't notice this and without any irritation or confusion just went on to open another menu component. This case showed that deactivating the close button when changes have been made can save the user from unintentionally aborting the ordering process. Since she clearly didn't intend to close the menu, maybe she wanted to close the drop down containing alternatives for the opened menu component.
Another time, after she had successfully ordered menus for several days and had used the close button multiple times, P01 suddenly appeared to forget where she could find the close button or didn't recognize it anymore. After scrolling right and left and looking at other menus, she found the button again and used it effortlessly.
As another example, P02 was irritated that he could close a day with the button from another menu than the one he had ordered and saved.

Components and Options

Within an expanded menu, P01 showed severe struggles with opening menu components to choose an alternative or cancel the component altogether. Apparently, the button-like design (grey background, rounded corners, shadow) did not lead to a sufficiently clear affordance. Since she had no trouble in recognizing other buttons as such, maybe she would have needed an explicit button that says something like "open alternative list". These struggles appeared several times. After a time, she showed that she had learned the interaction mostly. Still, in one case, she first scrolled up and down before she remembered to tap the menu components' name.

Problem 5: Lacking affordance of menu components repeatedly lead to confusion for one participant.

Apart from a lacking affordance, another factor contributing to this problem might have been that for her, cancelling a menu component was something different than opening a list of alternatives (even though that list contains a "none" option at the end). Maybe that comes from the "process" of how changing a menu component in the paper menu plan works: First, the user crosses out the original component. Then, they often either draw an arrow from the alternative, for example from another menu, to the original component. Alternatively, they often write their new choice next to or above the crossed out original component.
This understanding also showed up when she was ordering the menu for Sunday and realized that this was the first time that she didn't choose "none" as a starter, but actually chose salad as an alternative. She commented that she had meant to do that for every day. This mismatch of concepts (paper menu plan: cross out and then choose alternative versus MORe: choose "none" (potentially) as alternative) might be mitigated by adding a button with a label like "cancel or change component".
In contrast, the other two participants showed no problems in tapping the menu component itself to cancel it or choose an alternative. P03 even stated that "You always see those [elements] with a grey background that you need to click.", showing that she clearly understood the affordance.

Another incident in connection to menu component alternatives emerged when P01 opened a menu component alternatives list and tapped on the original element. Since that one was chosen already, no changes were visible. Confused by receiving no feedback, she simply chose another alternative instead. This way of adapting to the (apparently) available options instead of persisting on reaching one's goal (or at least giving it another try) is similar to the phenomenon described in literature: Older people tend to adapt and rather restrict themselves than persisting on achieving their goal, if that could require effort by somebody else, to not appear needy or be a burden (Minichiello, Browne, and Kendig, 2000).

Wishes In terms of alternatives, the participants expressed several ideas and wishes. For example, P02 wants to be able to cancel parts of the main dish, just the way he can do that by striking through those he doesn't like in the paper menu plan. He would also like to be able to express the wish "no banana" when ordering fresh fruit. Other wishes revolved around options for salad: P01 wanted to order salad without dressing and P02 suggested the option to order salad dressing on the side or order a small salad portion.

Suggestion 2:	Participants required to be able to express more detailed wishes when ordering a menu.

Scrolling

In general, interaction by scrolling emerged to be a bigger topic than expected. Probably due to less familiarity with modern technology and also less day-to-day usage of her iPad (compared to the other participants), P01 scrolled by initiating the scroll movement and then using the animation's inertia to arrive at the desired scroll position. In contrast, P02 and P03 scrolled with more control by letting their finger touch the surface for the entire scrolling movement. This way, P01 achieved noticeable less accurate scroll positions.
Later in the study session, P01 commented that she is impatient and needs everything to work fast: "I don't sit there for hours and scroll up and down and forth and back." This statement suggests that she perceived scrolling to be somewhat cumbersome, even though she didn't say that directly.

Problem 6:	Due to performing scrolling interactions with little control, the high amount of scrolling interaction was perceived as cumbersome by one participant.

Horizontal Scrolling Overall, horizontal scrolling was used with less ease than vertical scrolling: Especially P01 required several hints that she could see the desired interface elements if she scrolled sideways. For example,

only after P01 had ordered her meals for the first half of the week (always the most left menu), she started to scroll horizontally through the menus to view all three of them before choosing one. Overall, P01 appeared to not perceive the cut-off menu(s) on the sides as affordance for available scrolling interaction. This is probably due to horizontal scrolling being far less common than vertical scrolling.

Problem 7: One participant often was not aware of the possibility to scroll horizontally, leading her to miss out on content.

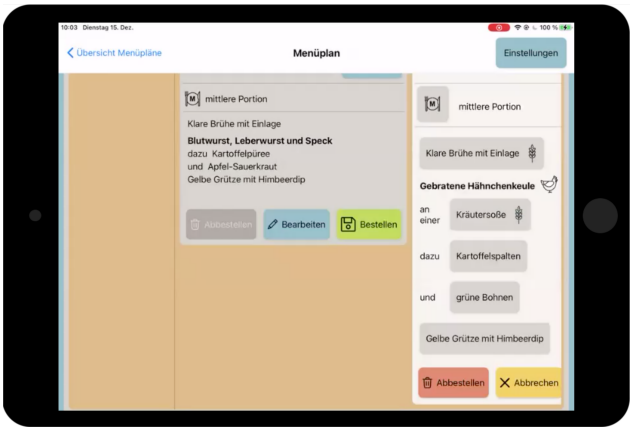

Figure 7.5: Participant screenshot showing interaction with a menu that is cut off horizontally.

Another prominent example for participants taking some time before scrolling sideways is that several times P01 and P03 both opened the menu in the middle and didn't bother to scroll horizontally in order to put it into focus (seen in Figure 7.5). Instead, they made do with what they saw, which sometimes were only parts of the available alternatives. They only scrolled to the right when they had to, for example to acces the save button.
Additionally, in two cases, P01 had trouble with spatial memory: Once she scrolled to the rightmost menu (as she had done several times before) and after interacting with the menu, she tried to scroll even more to the right to see the other two menus. Apparently she had forgotten that she already was at the rightmost scrolling position. Another time, she opened a weekday where the rightmost menu was ordered. In such a case, MORe automatically scrolls to the ordered menu so the user can directly see their order. P01 wasn't aware of this scroll position and tried to scroll to the right to access the other menus. She appeared to always expect the intial scroll position to be at the leftmost menu, no matter what she ordered. Additionally, she might not have realized that she was looking at the vegetarian menu which is always on the right.

Problem 8: In several instances, one participant did not realize that she was at the rightmost scrolling position, leading to her trying in vain to scroll further to the right.

Vertical Scrolling Vertical scrolling was performed with substantially more success by the participants than horizontal scrolling. However, especially P01 often didn't scroll up or down to make a menu or alternative list completely visible. Instead she worked with what she could see.
Several moments of irritation for participants one and three were evoked by an implementation oversight: When the alternative list for one menu component, for example sauce, is currently open and the user opens the alternative list for another component like vegetable side (which automatically closes the first alternative list), the menu's scroll position corresponds to the position of the first list. This often leads to the list that the user was focusing on not being visible. This interface behaviour led to confusion especially for P01, even though she was

able to recover by herself and scroll to the desired alternative list. For P03, this also was irritating once, leading her to briefly stop and needing to reorient herself. However, the next time the menu went out of focus like this, P03 wasn't irritated anymore and simply scrolled to the intended position.

Problem 9: Missing automatic re-focus lead to participants being confused when the desired interface elements were not visible as expected.

Depiction of Preferences

Ingredient Icons Participants one and two both asked for explanations of the ingredient icons during the first task. Later, when the functionality of sorting ingredients into the likes/ dislikes lists was explained and the menu plan was reopened to demonstrate that the icons had changed (green heart/ red warning triangle), P01 reacted with astonishment. She then went on and opened different menus to see more examples thereof. It could be observed that she initially expected the ingredient icons to be also depicted in the non-expanded menu view.

Problem 10: Participants required explanations of ingredient icons in the menu plan.

Portion Size P02 showed a strong reaction to the portion size functionality. He detected the possibility to change the portion size for a given menu in the menu plan, commented positively, and changed the portion size to "large" (he said that this was one of his favourite dishes). In general, he commented that he would like to be able to order a large portion of dessert.

Suggestion 3: A Participant requested the possibility to order a large portion for specific menu components like dessert.

Standard Component Rules P02 commented on the different icons indicating whether an alternative has been chosen manually by a user (pencil icon) or whether it's chosen automatically by a user-defined rule (circle icon). He also mentioned the italic font that is used for a menu component in case that it differs from the original. He said that it gives him the feeling of being in control.

Praise 7: The visual distinction of changed menu components were successful in giving a participant the feeling of being in control.

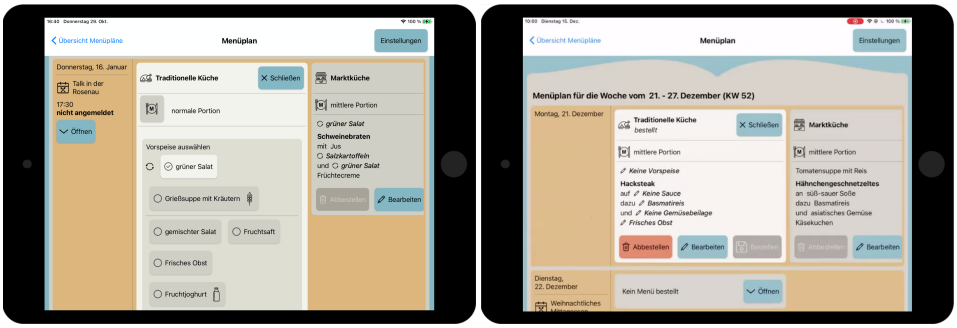

Figure 7.6: Participant screenshot showing distinction between menu component alternatives chosen automatically (left) and manually (right).

7.4.3 Menu Plan Overview

The participants reacted very positively to the menu plan overview. P02 stated that it fulfills his requirement of providing a history of ordered menus. P03 described the overview as clear. The only slightly negative feedback was a wish from P02 that the text line on the menu plans that says "x of 7 menus ordered" could be written in a larger font.

Suggestion 4: The line reading "x of 7 menus ordered" on the menu covers should be written in a larger fontsize.

Regarding the task to find out whether menus have been ordered in a specified week, P01 and P02 had no problems in perceiving the red zero that marked no ordered menus for that week. They saw the information directly and even pointed out that the red zero illustrated "no ordered menus" well. In contrast to this, P03 did not perceive the required information for quite some time. When she did see it eventually, she understood the differences between the red and black font colour quickly.

Praise 8: The red 0 indicating that no menus have been ordered for a week was generally perceived fast and understood easily.

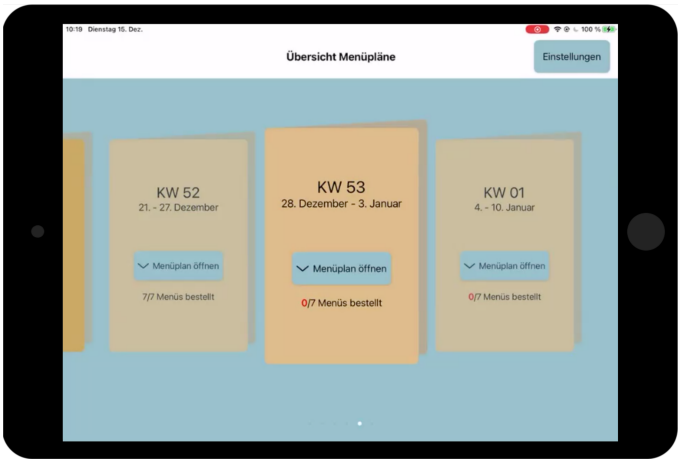

Figure 7.7: Participant screenshot showing red 0 highlighting that no menus have been chosen for that week.

Interestingly, the scrolling interaction in the menu overview caused several noteworthy observations. First, scrolling (or swiping) horizontally through the menu plans was mostly no problem. However, after having scrolled through the menu plans successfully for the first task, P01 seemed to forget that she could scroll to see more plans which lead to her being irritated when she was asked to open another menu plan in a later task. This might have to do with the fact that she is not familiar with horizontal scrolling and only did it without problems in the first task because just moments before, she had watched the study conductor's introduction where this interaction style was demonstrated.

Overall, the carousel-like design of the menu plan overview seemed to work successfully. However, all three participants opened menu plans without focussing them first. Luckily, the carousel implementation did not deactive buttons of carousel elements (= menu plans) which are not in focus, so that this interaction style was a viable

alternative. It would be interesting to further study whether this behaviour had something to do with the participants maybe not clearly perceiving which menu plan was the focused one (due to a lack of distinguishability from the non-focused elements) or if there were other reasons.

Observation 2: All participants mainly opened menu plans whithout them being the element in focus.

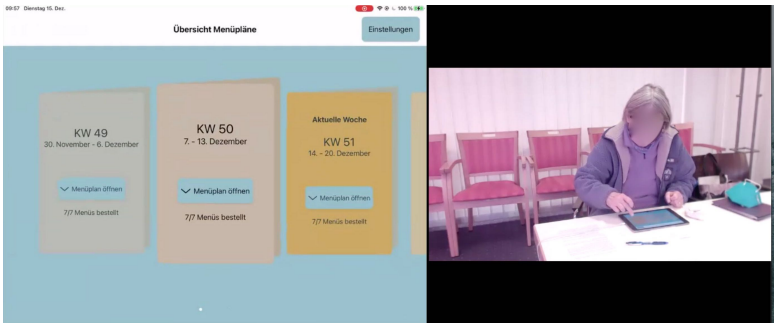

Figure 7.8: Recording screenshot showing P01 opening the menu plan on the right without putting it into focus.

7.4.4 Events

The functionality to register for events and the food offered there was received positively by the participants. When asked whether they would use this function, they didn't only confirm, but they named numeral reasons for why they would like to use it: P01 stated that while she prefers personal contact for tasks like this, "to relieve the reception employees, [I] would rather choose to register digitally from home in peace". She also mentioned that she would use the event registration functionality so that reception employees wouldn't drown in paper anymore.
As another reason for registrating digitally for events, P03 mentioned that this way, she doesn't need to contact the reception for it by calling or going there. This statement shows a wish for being more independent from reception employees.

Praise 9: All participants appreciated the possibility to register digitally for events.

P01 and P02 explicitly praised the possibility to register more than one person fo an event, even though P01 mentioned that she doesn't need that option since she doesn't have any relatives in the region who would accompany her. Nevertheless, she saw the value of the function for other users.

Regarding usability, there were mixed comments and observations. For example, while P01 said that "this is basically very simple", she also said that right now the app is so new for her that she has to look for everything. But once she'd used it for a couple of times, she would expect it to be no problem anymore. When she used the app, P01 had problems finding the specified event that she was asked to register for. After she had found it and successfully registered for it, she showed a feeling of contentment when she closed the event ("And close. Yes, perfect.").
P02 also pointed out both positive and negative aspects: He liked that the information saying whether the user is registered or not is written in bold to enhance visibility. He pointed out that "people easily and often forget whether they have registered for an event, and therefore, such a clear indicator is important". On a negative note, P02 also found an inconsistency in the close button when compared to the close button of menus: For the

latter, if the user has edited a menu, they can't close it without either explicitly aborting or saving their changes. However for an event, the registration process can be aborted implicitly by using the close button even when changes have been made.

Problem 11:	The close button of the event registration feature is not deactivated when the user has changed something that should be either explicitly saved or aborted, in contrast to the deactivated close button when a menu order is changed.

Since the combination of menu plan and event calendar is an extension of classical menu plan features, the participants were asked whether they think this made sense. The participants had different opinions on this. P02 and P03 both really liked the combination. P03 stated that merging the menu plan and event calendar made sense simply "because both have to do with food".
P01, on the other hand, came to the conclusion that she didn't like the combination. She said that "the events are something completely different and have nothing to do with the menus". While she would like to register for events and the food offered there digitally, she would prefer it as a separate function. When the idea behind this function (to reduce the number of cases where residents cancel menu orders because they forgot that there is an event or excursion on that day where food is served) was shared with her, she mentioned that the people going on such an excursion are so few and also are still mentally fit enough that they should be able to think of cancelling their order in advance or don't even order in the first place.

Suggestion 5:	While the combination of event calendar and menu plan was perceived mostly positively, one participant preferred it to be a separate feature.

P02 expressed two wishes for improving the event registration functionality: First, he proposed to not show events that take place in the evening in the same line as the lunch menus, but below. His second remark wasn't actually expressed as a wish, but he praised the existence of a deadline feature (which doesn't exist in the current version of MORe) and would like it to be displayed in the collapsed as well as in the expanded view of an event.

Suggestion 6:	A participant requested events that take place in the evening to not be displayed in the same line as the lunch menus, but below.

7.4.5 Preferences

For the preferences in general, P02 wished for a warning message in case the user hasn't saved any changes yet and is about to leave the preferences section.

Suggestion 7:	A participant requested a warning message when a user is about to leave the preferences screen with unsaved changes.

Likes/ Dislikes

While all participants used the likes/ dislikes feature successfully, they had different opinions on whether they would actually use it for themselves. P01 as well as P02 confirmed that they would like to use it. Advantages that were mentioned contained P01 being lactose intolerant. This made her want to use the feature not only to be supported in choosing lactose-free meals, but she also mentioned that she would like the kitchen to offer more lactose-free alternatives (like a lactose-free version of the herd curd that accompanies dishes like a baked potato), but they argue that it is not worth it because of the small number of residents that are lactose intolerant. She hopes that if all Rosenau residents who can't or don't want to eat meals containing lactose would express that in this feature, the kitchen might become aware of the demand for more lactose-free options.
P02 simply stated that he likes the feature because it only adds information but doesn't alter the menu plan's content or options.

In contrast, P03 stated that she would use this feature only to a limited extent. She found it unnecessary because all ingredient information is already visible in the menu plan anyway.

Praise 10:	By two participants, the likes/ dislikes feature was perceived very positively and as a helpful tool to support them in choosing appropriate meals.

Regarding the range of implemented ingredients, P01 stated that she found them sufficient. On the other hand, P03 suggested subdividing the category poultry more finely (because she personally doesn't like turkey but would eat chicken). She would also like vegetables to be added to be able to express her personal taste.

Suggestion 8:	A participant suggested to expand the categories available as liked/ disliked food to finer subdivisions, e.g. for poultry and to add vegetable varieties to be able to cater to personal preferences better.

Participants two and three expected a drag and drop interaction. When they found out or were told that instead they simply activate an item by tapping it and move it to the desired field by tapping that, they reacted positively surprised. P02 said that he liked that even more because it was simpler.

Praise 11:	While unexpected, the "tap to activate and deactivate" interaction that was used instead of drag an drop was received very positively and commented to be even easier than drag and drop.

P02 additionally stated that he liked the colours red and green as these were "standard colours". According to him, they "increase the incentive even more to use [the app]".

Portion Size

P02 stated the wish that he'd liked to automatically order large portion sizes for his favourite dishes.

Suggestion 9:	A participant suggested a feature that allows him to define favourite dishes that would automatically be ordered in a large size.

When asked whether they would like to use the function to define a smaller or bigger standard portion size, participants one and two confirmed. P01 said she often liked to eat only a small portion size but often forgot to order it. Because of that, she would very much like to define it just once. P02 would like to often eat a larger portion and stated that he would use the function so that he didn't "need to set certain things up every day".
In contrast to this, P03 said she wouldn't use this function because she always ate the standard portion size.

Praise 12:	Most participants would make use of the possibility to automatically order a specific portion size to save work on changing portion sizes manually.

Standard Rules

The standard component functionality posed an addition to the classical menu plan functionality of MORe. While it was supposed to make users' life easier by automizing frequent choices, there were doubts that it might make the users not feel completely in control over their meal choices. Therefore, it was almost surprising to see how positively all three participants responded. P02 was especially enthusiastic, stating: "Yes! The whole feature: great!" He said he really liked the feature even though he didn't need it (because he liked to stick with the original menu that was created by the chef). One reason why he felt like staying in control was the visual differentiation between manually versus automatically chosen menu component alternatives (italic font and circle or pencil icon, respectively).
P01's reason for approving the feature was that she almost always preferred salad over soup.

Praise 13:	All participants were very fond of the possibility to define recurring meal choices and stated that they would use it.

When being asked whether they like that the rules are applied in such a way that the alternative they set in the rule is selected automatically for new menus, their responses diverged. P02 and P03 liked it that way while P01 would prefer the alternatives defined by her only to be indicated, but to have the original menu chosen if she doesn't edit it manually. As reason she gave that she found it cumbersome to change the alternative back to the original one.
P03 commented that she liked the rules being applied automatically because she had practically always salad as a starter and this way less manual menu selecting to do. She also said that she would still feel in control because she knew that it was her who defined any automatic rules.

Suggestion 10:	Most participants welcomed the automatic application of the recurring meal choices. One participant, however, would prefer to have the recurring choices be indicated but not automatically applied.

7.4.6 Other Suggestions

Paper Menu Plan

In addition to every lunch menu, residents receive a small raw food bowl by default. This raw food is not mentioned in the menu plan and can't be altered. Since many residents don't like it very much (for example, P03 called it "weird"), P02 suggested a feature for MORe to alter or cancel it.

> **Suggestion 11:** Participants would like to be able to alter or cancel the raw food bowl they automatically receive with every meal via a feature of MORe.

Restaurant App

P02 and P03 both expressed wishes for a digital tool to support restaurant service employees in taking the residents' orders. Right now, this works by the employees noting the guest's name and menu choice on a piece of paper that is forwarded to the cook who prepares the plates. The participants stated that they find this process complicated.

> **Suggestion 12:** Several participants wished for an easier, digitized meal ordering process in the Rosenau restaurant.

Wishes for a Rosenau Intranet App

Even before she had tested the app, P03 stated that she would like to have a "Rosenau app" that contains the menu plan, events, newsletter, message board, a function to sign off for holidays and more. As reasons she gave that important information often wouldn't reach all residents or that the current process of signing off for holidays is prone to errors (for example when reception employees then have to pause and unpause the menu orderings accordingly).

> **Suggestion 13:** One participant stated her wish for a more comprehensive Rosenau app that includes more administrative features and information.

7.5 UEQ Results

As a small quantitative addition to the mainly qualitative study, the participants filled in the UEQ questionnaire after testing MORe. Due to the very small sample of only three participants, these results however cannot be seen as very expressive and should be taken with a grain of salt.

When the participants' answers were digitized for analysis, it was interesting to see that the answers of participants two and three tended to be extremely positive: For almost all question items, they ticked the most positive Likert scale item. This might be due to the fact that they wanted to be nice to the study conductor. Unfortunately, this lowered the expressiveness of the questionnaire results further.

For exploring the UEQ results, the official UEQ analysis tools (Team UEQ, 2018) were used.[1] For analysis, the seven-item Likert scale is transformed into values between -3 and $+3$: -3 corresponds to the most negative item, 0 to the neutral middle item, and $+3$ to the most positive item. This way, the participants' answers can be transformed into comparable numbers.

The authors of the UEQ offer bechmark data to which to compare the achieved results. In figure 7.9, the black line represents the values achieved by MORe. The coloured bars in the background represent the benchmark data. The colours make a statement about the relative quality to the systems described by the benchmark data: dark green ("excellent") corresponds to "is in the range of the 10% best results", light green ("good") means that "10% of results [are] better, 75% of results worse", and so on.
This visualization shows that for most scales, the results categorize MORe in the top 10% of systems. Especially *novelty* received great ratings (with a mean of 2.8).

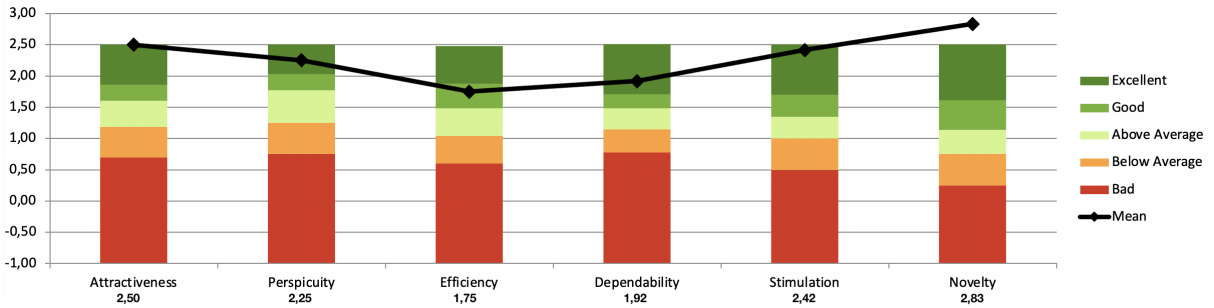

Figure 7.9: Visualization showing comparison of MORe UEQ results to benchmark data. *Visualization created by Team UEQ (2018).*

Two of the scales are now to be discussed in more detail: *Efficiency* is investigated because it received the lowest overall ratings. *Perspicuity* has also been chosen to take a deeper look into because of its high relevance to the research question of how older people react to and use the digital menu plan.

An exception to the mostly "excellent" ratings is *efficiency*, which is rated as "good". When looking at the answers to the question items that correspond to the *efficiency* scale, the item "inefficient/ efficient" received outmost positive answers (mean: 3.0), the item "cluttered/ organized" received two answers at 3 and one at 0 (mean: 2.0). The third item "impractical/ practical" was rated differently by all participants (one at 3, one at 2 and once at 0, resulting in a mean of 1.67). Finally, the worst rated item in this category was "slow/ fast", which received ratings of 3,1 and -3 (mean: 0.33). These numbers give a hint that while MORe was apparently perceived as quite attractive, it did seem a little cumbersome or slow to use.

Taking a closer look at the results of the *perspicuity* scale offers a little more detailed view into how complicated or easy learning MORe was rated. Overall, *perspicuity* received a mean rating of 2.25, which is very good.
The items "difficult/ easy to learn" and "not understandable/ understandable" both received the most positive ratings (3, 3 and 2, mean: 2.67). "Confusing/ clear" was rated similarly (3, 3 and 1, mean: 2,33). The worst rated item associated with *perspicuity* was "complicated/ easy", which received ratings of 3,2 and -1 (mean: 1,33).
This suggests that while MORe was perceived as a little complicated, it was still easy to learn. This finding matches the comments from P01 reported earlier who stated that she needs some time to get the hang of MORe, but that she can imagine she would learn it fast.

Overall, the results of the UEQ questionnaire appear to support the overall positive feedback collected from the participants. MORe appears to be seen as an interesting, yet slightly complicated app that participants enjoyed using.

[1] This Excel workbook offers automatic analysis of answers, computation of results and creation of basic visualizations.

7.6 Redesign Ideas and Future Work

This section illustrates exemplatory how the problems and suggestions identified during the study data analysis could influence an upcoming design iteration of MORe. Some of the problems (for example, missing auto focus for scrolling (Problem 9) or inconsistent behaviour of close-buttons of menus and event features (Problem 11) require programmatory fixes rather than interface redesign considerations and are therefore not discussed in further detail. Focus has been laid on those suggestions and problems that require reconfiguring whole concepts or features of MORe rather than small tweaks like increasing font size of a line of text (as requested in Suggestion 4). For every redesign idea, the referenced problem(s) or suggestion(s) are portrayed.

7.6.1 Menu Plan Improvements

Offer Weekly Overview of All Menus

> **Suggestion 1:** Two participants requested an overview of all meals offered in a week, similar to the overview offered by the paper menu plan.

When asked whether he preferred the paper menu plan or MORe, P02 mentioned that the lack of a weekly overview of all menus including the side dishes in MORe made him prefer the paper version. Therefore, such an overview appears to be a must-have for MORe.

Figure 7.10: Redesign idea of a weekly overview that allows comparison between menu components of different days.

Figure 7.10 resembles a first idea of what such an overview could look like: Static views (without interactive elements) of all menus are presented in a grid view. Arrangement of days and menus has been kept to match the other views. By tapping the open button next to a day's date, the user can expand that day to the expanded view. This view would need rigorous testing to see whether users can distinguish the different views and don't experience a lot of mode errors. Other versions of this view could also contain buttons for each menu that lead the user directly to the "edit" view of that respective menu.

Since the whole menu plan is too large to be viewed at once, at least on the employed 9.7” iPad, some kind of zooming and panning interaction would need to be implemented. This could simply be the gestures used to view pictures on an iPad. However, this also offers opportunities to research how panning and zooming interactions are perceived and used by older people. Also, techniques which enable the user to “fold” the interface could be applied here, since the applied menu plan metaphor gives the menu plan some physicality.

Improve Menu Component Affordance

Problem 5:	Lacking affordance of menu components repeatedly lead to confusion for one participant.

Since one participant repeatedly experienced trouble opening menu components to edit them, a design with explicit affordance for these components could look like Figure 7.11.

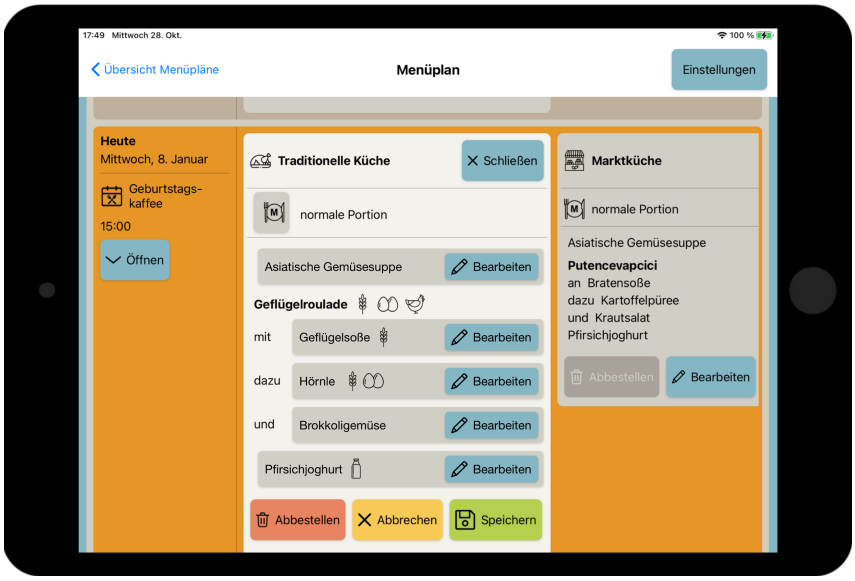

Figure 7.11: Redesign idea of improving menu component affordance by adding explicit buttons.

While this might solve the initial problem, such an amount of buttons leads to a more cluttered interface (which should be avoided when designing for older users (see Hawthorn, 2000). This might lead to higher decision-making times (Hick, 1952).
To mitigate this effect, a solution might be to offer a mode with increased affordances that looks similar to this for users with little experience. A second mode could consist of the “emptier”, original version. This could cater to the fact that the other two participants had no problems in tapping on the menu component names to edit them.

Allow Free-Text Comments

Suggestion 2:	Participants required to be able to express more detailed wishes when ordering a menu.

Participants wanted to be able to express special wishes like a “fresh slice of lemon” on the side of a fish dish or to only receive parts of a main dish when it consists of several pieces. In the current paper menu plan, they can

simply write their wish next to the marked menu.
Such a free text input feature has been planned for a future version of MORe anyways. Figure 7.12 depicts how such a feature could be integrated into MORe.

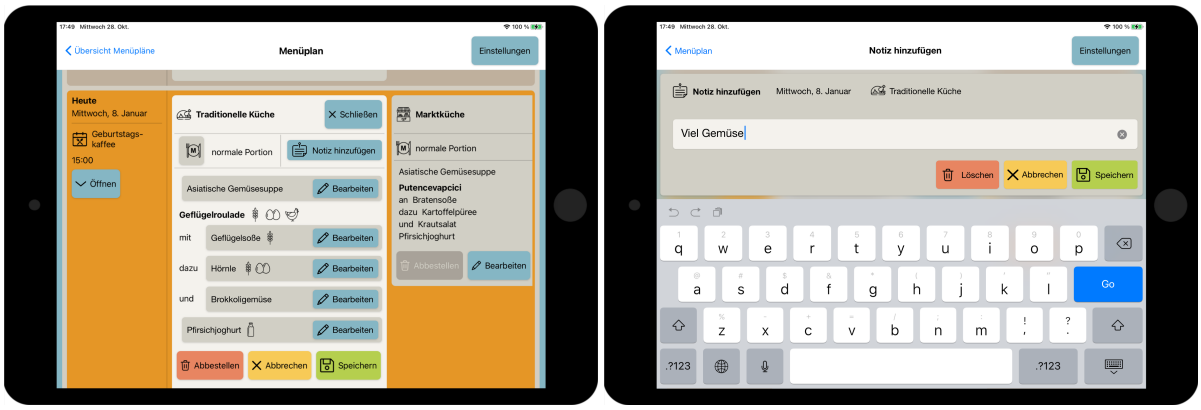

Figure 7.12: Redesign idea of how to add text notes to a menu.

However, this feature would need to be designed with caution since the depicted design with a new screen for text input introduces a break in the interaction: The user loses the context of the menu plan, the day and the menu to which the note is added to.

Add Scroll Bars

Problem 6:	Due to performing scrolling interactions with little control, the high amount of scrolling interaction was perceived as cumbersome by one participant.

Problem 7:	One participant often was not aware of the possibility to scroll horizontally, leading them to miss out on content.

Problem 8:	In several instances, one participant did not realize that she was at the rightmost scrolling position, leading to her trying in vain to scroll further to the right.

The amount of scrolling required to interact with the menu plan turned out to not be ideal for users with little familiarity with scrolling gestures. One way of tackling this problem could be to add always visible scroll bars to the menu plan of MORe as can be seen in Figure 7.13. These scroll bars would also act as additional hint that there is more content available than currently visible and to visualize the user's current scrolling position. If necessary, these scroll bars could also be augmented by arrow buttons to enable the user to interact via button presses (as can be seen in the 'Breezie' system discussed in Section 3).

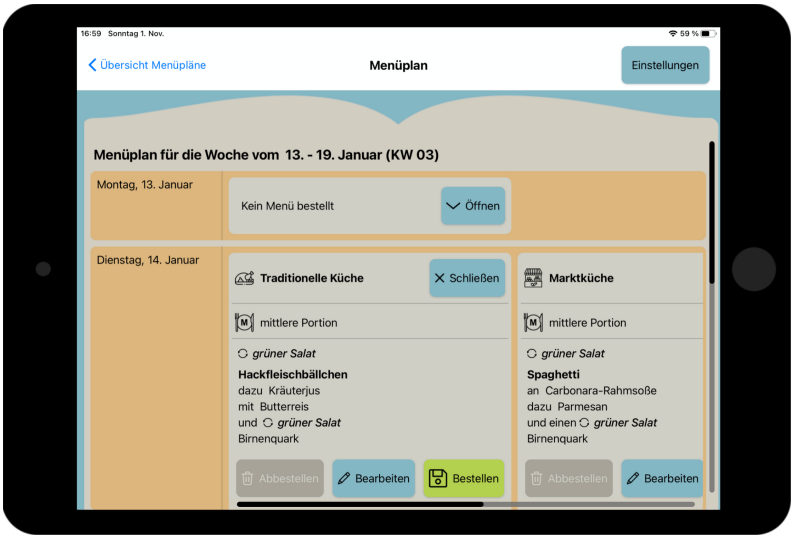

Figure 7.13: Redesign idea of depicting scroll bars to facilitate scrolling and visualize the scrolling position.

7.6.2 Make Automatic Application of Recurring Wishes Optional

> **Suggestion 10:** Most participants welcomed the automatic application of the recurring meal choices. One participant, however, would prefer to have the recurring choices indicated but not automatically applied.

Since the participants' opinions about automatic application of the rules for recurring meal choices differed, this function could be made optional. The left picture of Figure 7.15 shows how this option could be presented on the preferences screen. The right picture shows a first design of what such an indication could look like (when a user has chosen not to apply the rules automatically).

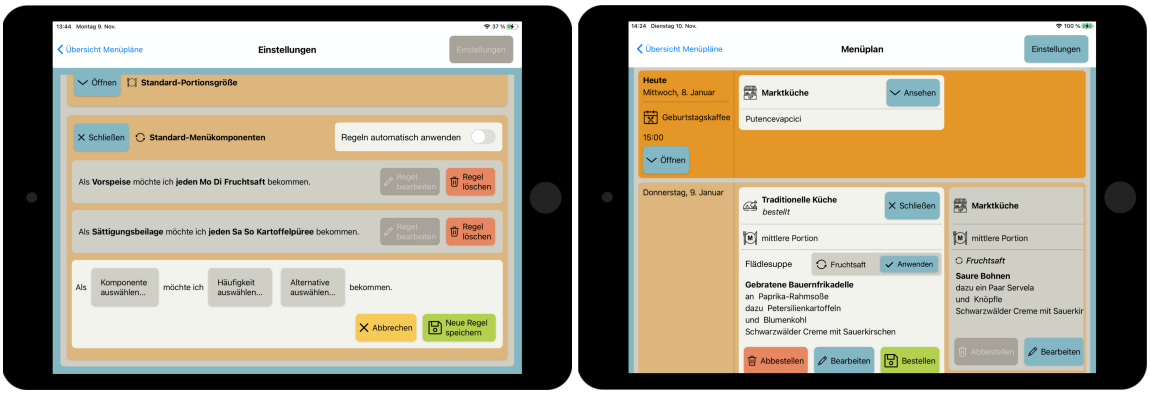

Figure 7.14: Redesign idea of making the automatic application of recurring wishes optional. *Left:* Option in the preferences section. *Right:* The indication that a rule would apply here.

Such an option might not only increase the feeling of control for the user, but also implements the design guideline of offering customization of the system (see Mitzner, Boron, et al., 2010). This way, both users that would like to have their standard choices chosen automatically and thus have less work to do themselves, as well as those who would like to prefer to make all their selections manually, could be accomodated.

7.6.3 Reconfigure Functional Scope of MORe

Suggestion 5: While the combination of event calendar and menu plan was perceived mostly positively, one participant preferred it to be a separate feature.

Suggestion 13: One participant stated her wish for a more comprehensive Rosenau app that includes more administrative features and information.

Several comments of the participants hinted towards an app for Rosenau residents that contains more functions than the menu plan. Indeed, as a result of the contextual inquiry such an app was identified as a promising tool to support several administrative processes in Rosenau. Such an app could contain exhaustive meal ordering features that also allow for ordering breakfast and dinner. It could have features that digitize processes that currently involve manual work by reception staff like reserving guest rooms. It could contain a newsboard with important internal information, a telephone book as well as the ability for reception employees to send notifications (for example if a package has arrived for the resident), rendering a big amount of telephone calls unnecessary.

Overall, such an app would represent an intranet for Rosenau residents and could be extended to connect to staff interfaces and general company processes.

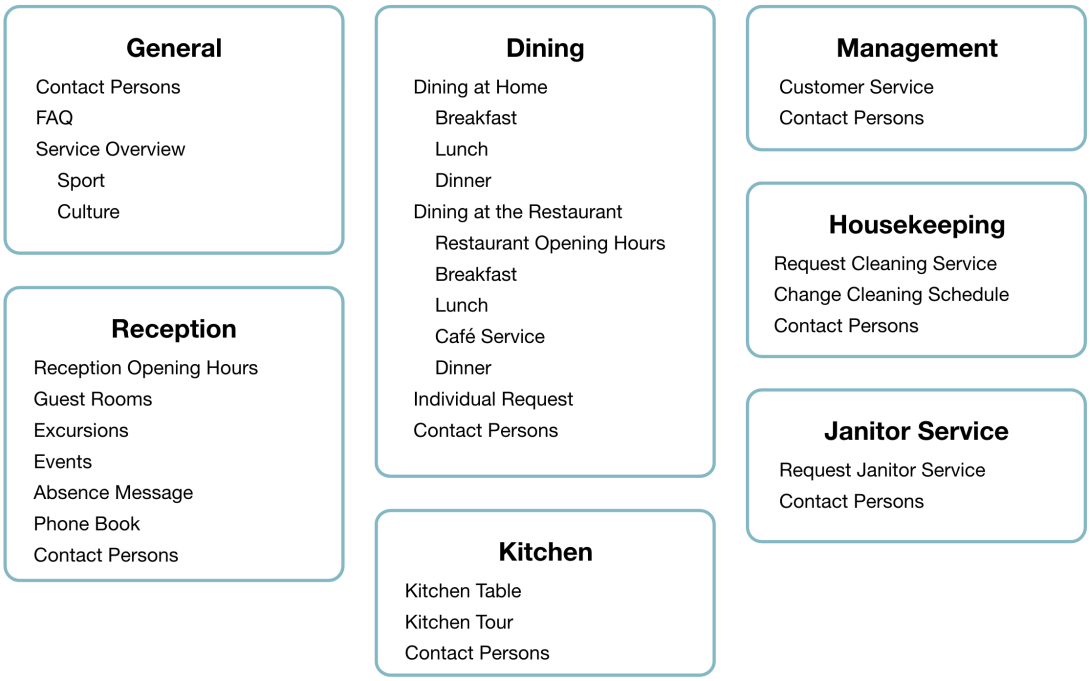

Figure 7.15: Overview of the functions that a Rosenau intranet application for residents could contain.

8 Discussion

The aim of this chapter is to draw a bigger picture of what was learned in the process of designing and evaluating MORe. How do the thoughts described in Reutlinger (2020) hold now after designing MORe and especially after conducting the qualitative user study with older people? Looking back at the goal of Reutlinger (2020) which was defined as "How does one successfully design an interface explicitly usable for older people without branding it being 'for the old' and thus being discriminating?", can MORe be called a success? Additionally, some statements collected during the user study that illustrate attitudes of the participants are discussed.

This chapter not only puts the conducted research into a larger context by referring back to literature that was investigated in Reutlinger (2020), but also by taking up some learnings by Otjacques et al. (2010) that were first mentioned in the related work in Chapter 3.

8.1 Getting to Know the Living Context of Older People

In Reutlinger (2020), it was layed out how important it is to get to know older people personally when designing for them. Apart from "usual" user research, it was argued that this helps to recognize older people as individuals instead of a homogenous group (Y. Rogers et al., 2014). This is seen as one means to reduce ageist tendencies as a researcher. Indeed, observing day-to-day life at Rosenau and especially experiencing the participants in their living context shaped the author's picture of older people. The conversations performed as part of the contextual inquiry in the beginning as well as the qualitative user study in the end gave insights into the interesting, diverse and rich lives of the participants. Also the diverging reactions to MORe in the user study showed that, even in such a small sample with only three residents who even were of similar age and had a (more or less) similar technology experience, we need to be aware that older people are just as diverse as "younger people" regarding background stories, technology experience and especially interests and values.

During the user study, participants mentioned that there had been a Rosenau resident who used to help residents with technology-related questions. P01 stated that he had been the one to set up her iPad for her when she first got it. P02 said that that resident used to give computer classes for Rosenau residents. Both participants stated that the mentioned resident can't offer his technology support anymore due to age-related reasons. P02 mentioned that now he considers giving computer classes for other Rosenau residents himself. Insights like this show that in the ecosystem Rosenau, there are a multitude of interest groups. The existence of a peer-to-peer technology support in itself proves many of the myths described by Wandke, Sengpiel, and Sönksen (2012) wrong and is a great example of empowerment and self-efficacy amongst older people.
The participants expressed regret that the offered computer support doesn't exist anymore, especially since there is plenty of demand for it. This was experienced first-hand when one participant asked the study conductor to help her with a problem with her iPad, stating that staff people sadly don't have time for requests like this. While the study conductor couldn't solve her problem, she appeared to understand the given explanation. Situations like this show that something like weekly or even monthly office hours for IT problems, offered on a volontary basis, could be a valuable offer for Rosenau residents. The author actually considers to further pursue this idea once the risks of meeting with older people are reduced when the current COVID-19 situation is less tense. Such a service could also have big potential for future research collaborations.

8.2 Collaborating with Older People

Conducting research about and with older people turned out to be a rich and positive experience. In the following, some observations and take-aways are described.

8.2.1 Close Cooperation with Staff

Getting oneself acquainted with staff members when conducting research in an institution like a retirement home is reported to be a beneficial measure (Otjacques et al., 2010). This also proved fruitful for the research conducted for MORe: Close cooperation with the deputy of the Rosenau director largely helped pave the way for the study: She (and other staff members) supported the recruition process of participants and helped making sure the hygiene measures taken during the study were appropriate.

Being able to specify the staff member as contact for possible inquiries in the recruition letters to the participants probably was an effective first step in building trust with them: Communicating that the study is conducted in consultation with a known and respected staff member probably contributed to the residents' willingness to participate.
Similar experiences have been reported by Otjacques et al. (2010). They also took effort in communicating that their study received official support by the management of the retirement home and attributed a large part of the user's acceptance for their system to this.

8.2.2 Apologetic Behaviour of Participants

Overall, participants apologized frequently for their remarks and suggestions, especially if they pointed out a problem with MORe.
For example, P02 brought a lot of helpful comments, feedback and ideas. And yet he apologized for criticizing several times. For example, he said "I aplogize, but you wanted [honest feedback]." P02 and also P01 tended to relativize their wishes for improvement due to the effort they may require to implement. Such statements were similar to "But that's probably also very complicated" (P01).

8.2.3 Valuable Ideas and Suggestions from Participants

Otjacques et al. (2010) report that they received plenty of suggestions for extended functionality of their Sammy system. They conclude that "[this] example illustrates that older people can be creative and can imagine features that are not present yet", underlining the value that older people can bring to research. The same was experienced during the evaluation of MORe: The participants suggested plenty of improved or added features, displaying creativity and understanding of the possibilities that technology has to offer.

8.2.4 Usability Concerns for Other Residents

An unexpected observation during the study sessions was that all three participants expressed concerns about the usability of MORe for other residents. They stated that there are many Rosenau residents that don't (yet) use modern technology. P03 stated that she "heard that some people in their mid-80s have an iPad, iPhone or

smartphone". P01 also expressed concerns for residents that are visually impaired or have never used an iPad before. She added "Or those that are in a wheelchair and simply can't [handle things on their own] anymore. But they need assistance anyway."
The same has been observed by Otjacques et al. (2010) who report that "some older people expressed fear concerning the acceptance of the system by other residents."

P02 repeatedly stated that he knew how to use UI elements such as a close button but that he presumes that some in their eighties probably wouldn't. He said "Average age 85. It has to be very simple." His concerns certainly are true - he (as well as the other participants) is in his early seventies and therefore represents the younger residents of Rosenau. However, his statements show hints of the perspective that older people often consider others to be "old" but not themselves (Hitchcock et al., 2001; Minichiello, Browne, and Kendig, 2000): P02 clearly is quite confident about his computer literacy but sees himself as an exception among Rosenau residents.

8.3 Participants' Reactions and Attitudes towards MORe

Technology acceptance of older people has been investigated thoroughly in Reutlinger (2020). One of the findings was that it is connected to the notions of perceived usefulness and perceived ease of use (Mitzner, W. A. Rogers, et al., 2016) which were established by Davis (1989). According to Davis, perceived ease of use is "the degree to which a person believes that using a particular system would be free of effort". He goes on to define perceived usefulness as the characteristic of a system "for which a user believes in the existence of a positive use-performance relationship" which can be seen as part of user experience. According to Mitzner, W. A. Rogers, et al. (2016), "[b]oth variables, perceived ease of use and perceived usefulness have been shown to be independent of demographic characteristics like education, gender or age."

With this definition in mind, the reasons given by the participants to use MORe and the willingness they expressed to learn using it (which are discussed in the following paragraph) point towards a high perceived usefulness which might explain the statements of the participants that they would like to start using MORe as soon as possible.

8.3.1 Reasons for Using a Digital Menu Plan

The participants gave several reasons for wanting to use MORe. Two stated a wish to save on paper. Also two mentioned that they think of the current meal ordering process as cumbersome - less for themselves, but they rather dislike that reception employees have to enter all their choices into the computer. Therefore, reducing employee workload was an often mentioned reason why they would like to use a digital menu plan.
Additional reasons of P03 can be seen as the desire for more independency. Firstly, she mentioned that she disliked depending on receiving a paper menu plan to be able to order lunch. Secondly, she described that in case she wanted to cancel a menu, she had to meet the deadline at 9am. Since the reception's phone is often occupied, this cancellation is stressful for her. Additionally, P03 explained that she is used to take care of administrative tasks (like online banking) digitally and therefore wishes to be able to also order lunch digitally. She also mentioned that she found it easier to express her wishes (like changing the starter from soup to salad) in the app than in the paper menu plan. This might surprise at first, since the interaction with paper and pencil can be seen as one of the most intuitive interactions (because people are used to it since childhood). Maybe she finds it easier in MORe because here she can choose the wanted alternative from a list and doesn't need to recall possible alternatives and then write her choice down manually.

8.3.2 Willingness to Learn to use MORe

P01 stated several times that she would need a little learning time to feel confident using MORe. While this shows that there is room for improvement of the learnability of MORe, it also shows that the participant is willing to learn how to better use it. This reveals that she perceives MORe to be worth the effort to learn using it well. This effect has also been reported by Mitzner, Boron, et al. (2010): They connected their observations of very positive attitudes towards technology to the older adults "perceiv[ing] the benefits of using technology to outweigh the costs".

8.3.3 Complexity of Interface

Since MORe was designed to offer the full functionality of the current paper menu plan as well as some additional features, it cannot be seen as simplistic: It offers many possibilities to express the users' choices. Overall, it lends towards giving the user flexibility in the way they interact with it rather than being restrictive like specifying the order in which certain ordering steps need to be performed. This was done with purpose, as the participants of the contextual inquiry had been observed applying different strategies to fill in their menu plans.

In comparison, the Sammy system (Otjacques et al., 2010) was deliberately designed to be very simple. As a consequence, it was actually rated too simplistic by the users: "The residents progressively proposed increasingly complex features to tackle the whole flexibility of the real process. What is unknown is the relative weight of 'ease-of-use and simplicity' compared to 'proximity to the real processes' in the adoption process of these older users. If a fully flexible application had been proposed since the beginning, it would have been much more complex to learn than Sammy 1.0. In this case, what would have been the residents' attitude? We do not know." (Otjacques et al., 2010).
In another statement, they concluded: "The users requested more flexibility. For instance,they asked to be able to modify their choices whenever they want. The last versions of Sammy were much closer to classic IT applications than the initial one in terms of navigation. They were more powerful but also more difficult to use." (Otjacques et al., 2010)
The decision to make Sammy a very simple system probably was still the right choice since Otjacques et al. report that their target users had no or very little prior technology experience. Probably the situation would have been different if their project had been conducted in more recent times: After all, the first iPad was published in the same year as their study (2010) and can be argued to be the starting point for wide-spread use of tablet computers.

8.3.4 Suitable for all?

Overall, the complexity of MORe seems to match the participants' technology skills quite well. However, one could argue that the participants of the user study do not represent the average Rosenau resident. If MORe was to be designed to be usable by more or even most of Rosenau residents, its features and also visual design would probably need to be changed significantly. Therefore it deliberately was always communicated as an alternative to the current paper menu plan, never as replacement.

Otjacques et al. (2010) have come to a similar conclusion: "[D]espite all technical efforts some insurmountable neurophysiologic and physical limitations have to be acknowledged when designing ICT for the elderly. These age-related changes can make a system like Sammy only appropriate for relatively healthy senior users."

These words sum up the learnings made during the design and evaluation of MORe quite well: Conducting research with older people gave valuable insights and opened new perspectives. It confirmed that older people can profit from technology that aims to support users in everyday tasks, just like younger people do. Paying attention to rigorous implementation of usability guidelines paid off and made MORe usable and desirable for the participants. Still, it is far from being usable or even accessible for the majority of Rosenau residents.

9 Conclusion and Outlook

This thesis illustrated the process of the design and evaluation of the digital menu plan application MORe.

At the beginning, a literature review had revealed the current situation of interaction design for older people to be problematic: Technology acceptance amongst older people is considerable lower than for the rest of the population. Research sees a connection to the fact that many of today's systems don't take into account age-related changes that lead to higher usability requirements by older people. On the other hand, the trap of designing specifically for older people was identified which often leads to designs that stigmatize potential users by evoking negative associations with age like a sense of dependence.
This situation was found to not have one cause, but to be the result of a vicious circle: The prevalent view upon older people in society and amongst researchers or designers is characterized by an ageist perspective. This leads to older people being thought of as being difficult to cooperate with and not being helpful in a design process, therefore excluding them. Thus, many systems are designed *for* older people, but not *with* them. As a consequence, the emerging systems exhibit poor usability and user experience, which in turn leads to little acceptance of these systems by older people. And if they do use them, they often experience many problems, which in turn reifies the stereotypes that older people don't want to or can't use technology.

Sensitized by these findings, a contextual inquiry was conducted to follow the literature recommendations and confront possible ageist stereotypes of the author. Also, it served as user research to investigate the context of Rosenau, the living situation of its residents and the current meal ordering process. Informed by these results, the scope and features of MORe were defined. Additionally, compliance with usability guidelines from literature was given special attention to during the interaction design and implementation.
The resulting system does not only provide basic menu plan functionalities, but is expanded by functions like event registration and preferences that allow for example automatic application of selected recurring choices.

How residents of Rosenau would react to and use these features and a digital menu plan in general was the guiding question of the qualitative user study that was conducted to evaluate MORe. Three participants each tried out MORe and discussed their findings and opinions in a semi-structured interview with the study conductor/ author. Due to the current COVID-19 situation, special attention was given to hygiene measures during the study sessions to keep everybody involved safe. Therefore, a study set up was developed that allowed the study conductor to be in the same room as the participant while keeping their distance. A central TV monitor was used to demonstrate the participant the features of MORe and how to use them. A video call between the iPad used by the participant and the study conductor's laptop where the iPad's screen was shared allowed the study conductor to observe closely what the participant was doing. This study set up represented a mixture between an in-person and a remote study and proved useful for this particular case.

The analysis of the collected qualitative data revealed that MORe was accepted well by the participants. They all expressed that they would like to use it in real life to order their meals. Its functionality seemed to outweigh some usability problems like a high amount of scrolling interaction which was perceived as cumbersome by one participant.
Overall, MORe seems to fulfil the goal of developing a system specifically for older people that takes its users serious in the sense that it supports them in everyday tasks and treats them like capable persons.

Cooperating with the participants, during the initial contextual inquiry as well as in the final qualitative study, proved to be a worthwhile experience: The participants each had valuable suggestions and opinions that would have been missed otherwise. Interacting with the older people additionally was helpful to perceive them as individuals with very distinct life paths resulting in diverse personalities and opinions. This confirmed literature findings and raised the author's awareness that older people are a probably even more diverse demographic than younger people. Therefore, designing for them requires more diligence not only in adhering to usability guidelines, but also in catering for inter- and even intrapersonal differences by allowing for flexibility in the interface and offering optional features. For example, the automatic application of user-defined recurring choices was perceived positively by two participants, but the third would have preferred them to only be indicated. Thus, a redesign idea emerged that would give the user the option to have these rules be applied automatically or not.

Looking at the bigger picture, the experiences with MORe confirmed many literature findings that urge researchers and designers to reflect upon their concept of older people. Curiosity for MORe's features and willingness to learn using it to overcome initial struggles as well as demands for the retirement home's management to introduce digital services characterized the participants statements.

Since the qualitative user study was conducted with only three participants who all possessed at least basic skills for interacting with an iPad, the question emerges in what way the selection of different participants who might have been older and/ or have less technology experience would have influenced the study results.
First of all, from the beginning, MORe was developed for users with at least basic technology experience. Developing for novices is a different research object which requires more focus on learnability. Therefore, the design of the app would have been different, for example, the tradeoff between functionality and complexity would have favoured (minimized) complexity even more, leading to a reduction of features.
Additionally, the demonstration part of the study would have involved a larger focus on training and explaining basic technology principles (like saving and closing).
Finally, since this study focussed on participants' statements, naturally, different participants would have reacted differently. For example, participants two and three who both were very familiar with using modern technology gave many improvement ideas. These probably wouldn't have been proposed by less experienced participants.
Overall, developing a comparable application for older novice users would be a different research focus, but definitely worthwhile for future work.

Another imaginable variation of the conducted study would have been to let the participants use MORe over the course of several days or even weeks. Such a study would give insight into whether MORe is suitable for everday use. It might also give the participants the opportunity to develop more individual interaction patterns and try out whether they would like to use features like the automatic application of recurring wishes. However, the intention behind the conducted formative study was to capture first reactions of participants to inform a possible redesign iteration. Therefore, a more in-depth study about the real-life usage of MORe appears more appropriate for a potential improved version of MORe as part of future work.

A Rosenau staff member that was involved in preparing the final study also expressed her support for MORe and intends to initiate a meeting of the author and Rosenau decision-makers to present the findings of this research, in particular, results of the contextual inquiry which analyzed the current meal ordering process. Also, the participants' support and suggested demand for more digitized services at Rosenau might prove interesting to look into further.
Several participants mentioned that there used to be a resident who offered IT support for peers. They thought it to be a pity that he couldn't offer this service anymore due to age-related limitations. The request of one participant, as well as several support requests that were received during the author's employment at Rosenau, lead to the idea of offering free, regular IT support consulting hours on site where Rosenau residents can come with their questions and personal devices. Such a service of course would only be possible once the contact risks due to the current COVID-19 situation have subsided. Such a service could also offer plenty of opportunities for future research cooperation projects.

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Appendix

Content of Attached USB Stick

This thesis is accompanied by the following digital files:

1. Seminar to the Bachelor's Project (Title: "Interaction Design for Older People - Using the Example of Digitizing the Meal Ordering Process in a Retirement Home")
2. Bachelor Project Report (Title: "MORe: Meal Ordering in a Retirement Home")
3. A digital version of this thesis.
4. A video demonstrating the features of MORe.
5. The study documents of the qualitative user study.
6. A declaration of authorship.

Furthermore, the source code of MORe can be found in the HCI Group's GitLab under `https://gitlab.inf.uni-konstanz.de/ag-hci/student-projects/bsc-reutlinger`.