THE INTENTION FOR ADOPTION AND ACCEPTANCE OF MHEALTH APPS

A study into the UI and UX factors that contribute to mhealth app use intention

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Date:	October 2019

Abstract

Due to the rapid development of technology, the number of the available mobile health applications on the internet is enormous. People who want to use health applications are facing a great number of options, from which they have to choose the most suitable for them. Many researchers have focused on the continuance of health apps during long-time use, but not on the predictors of health apps use intention after the first user experience. The purpose of this study is to investigate the role of UX and UI simplicity on health applications, and its importance for the acceptance of such applications after the first use. To research that, 30 individuals were chosen to be part of a usability test of a mobile health application which they had never used before; they had to think aloud while carrying out an assigned task on the examined health application. This interaction process, which was being video recorded, was followed by interviews with the participants.

The results of the study indicate which factors can contribute to the use intention of mobile health applications after the first user experience. It is argued that the user's acceptance is strongly dependent on the simplicity of the navigation. A good and logical order of the navigation steps is the first thing that users notice and appreciate. Similarly, the perceived ease of use, the amount of nutrition information and use instructions on the interface can determine if a health app is going to be accepted. The study shows that the visual aesthetics, the completeness of the app in terms of nutrition information and functions, and its perceived usefulness can also predict its use intention. Based on the determinants of mhealth apps use intention, several design optimizations are suggested in order to make the examined health app more user-friendly, but also in order to show how similar mhealth applications could be designed to be more easily accepted by the potential users.

Keywords: mhealth app, use intention, simplicity, user experience, user interface, mhealth app acceptance

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1. Introduction

The last years, a great demand for mobile health applications has been observed by the research community. Especially with the use of smartphones, the accessibility of health information is easier compared to the past. More and more people are using their phones in order to access health information through various health applications (Plachkinova, Andrés, & Chatterjee, 2015). However, these health applications are not yet supported by sufficient and conclusive research evidence for their effectiveness. Conducted studies on the field show that many health apps are of poor quality and very few of them have significant benefits for their users (Becker et al., 2014). Thus, despite all the potential benefits of mobile health apps due to the accessibility that they provide, there are growing concerns regarding the use intention of such technologies. A question that has still not been answered by the research community is not only how to improve the user experience of mobile health apps, but also how to increase the acceptance of such applications, and therefore their adoption rates (Akter, Ray, & D'Ambra, 2013).

The number of the existing health applications is great. With the availability of so many health apps, the critical point is to find out which characteristics differentiate the ones that are adopted by the users from the ones that are used only once. The understanding of the adoption factors of the health apps relies on the recognition of their usability issues, and therefore identification of the difficulties regarding the user-system interaction is required (Brown, Yen, Rojas, & Schnall, 2013). Previous studies have shown that the effectiveness, efficiency and satisfaction are important factors that influence the users' interaction with a mobile application; however, it has also been found that the design of an application has an influence on the perceived quality of use (Thuring & Mahlke, 2007). In fact, the simplicity of the design of a mobile technology, and consequently its level of accessibility (Ngo, Teo, & Byrne, 2003), is a strong predictor for the perceived visual aesthetics of its users (Choi & Lee, 2012).

The present study examines the user experience and the user interface of a mobile health application. User experience refers to the overall experience of a user from the interaction with a technology product, while user interface is defined as the point of human-computer interaction and communication in a device. The focus of the research is on the simplicity of the navigation and the user interface. The aim of the study is not only to discover the extent to which the simplicity of a health app can predict its use intention, but also to explore which other factors could relate to the acceptance of such applications. To answer that, a mobile health app which is called MyHabeats is tested, by the means of a usability laboratory test. In more detail, MyHabeats is a health application which was initially designed for post obesity surgery patients, but it can also be used as a food diary. It is basically a digital tool to help users build healthy eating habits and make lifestyle changes. It was designed and developed by a group of highly motivated scientists with different backgrounds, in Greece.

The gathered data from the usability test is a source of useful information based on which MyHabeats is redesigned for the purposes of this study, in order to be more accessible and user-friendly. However, the results of this study are not only useful for the examined application, but also for similar ones, since MyHabeats is representative of a larger group

of health applications, in terms of design and functions. The value of this study relies on its recommendations, which could be very useful for UX and UI designers, in terms of making the health apps more user-friendly for the potential users. Considering the big number of health apps which are still under development, but also those which are released but are failing to be used for a long period of time, the detection of the usability issues is of great importance. Based on what is said above, this study aims at answering the following research question: ***"How does the simplicity of a mobile health app's user interface, constructed by its perceived ease of use, its visual aesthetics, and its information design, relate to the perceived enjoyment from the interaction with the app and the intention to use the app again in the future?"***

2. Theoretical Framework

The purpose of this chapter is to discuss the theoretical insights related to mhealth applications acceptance and adoption. It also discusses the role of usability and user experience for the continuance of use of health applications and explains the importance of the simplicity in their navigation and interface. Lastly, the sub-questions and the research model of the study are presented.

2.1. The dominance of smartphones and mobile applications

The high portability of smartphones provides their users with communication on multiple levels; it is real-time, on-demand, and their touch-displays operate with high speed in order to deliver the users' data (Kamel Boulos, Brewer, Karimkhani, Buller, & Dellavalle, 2014). The modern design of their touch screens influences the way that people live, work and learn by making the information easily accessible (Hamka, Bouwman, de Reuver, & Kroesen, 2014). Smartphones make a change in peoples' everyday lives due to their fast processors, their memory, and the small batteries in combination with highly efficient operating systems (Ozdalga, Ozdalga, & Ahuja, 2012). Applications run on smartphones or tablet computers and are distributed via services like the iTunes store (for iPhone and iPad apps) or Google Play (for Android apps) (van Velsen, Beaujean, & van Gemert-Pijnen, 2013). The type of applications that the present study focuses on are the health applications that run on mobiles.

2.2. Mhealth applications

Mhealth (mobile health) is defined by the Global Observatory as medical and public health practice supported by mobile devices such as phones, patient-monitoring devices, personal digital assistants and other wireless devices (Bert, Giacometti, Gualano, & Siliquini, 2014). In developed countries, there are three major potential markets related to health information technology; the information seekers, the motivated healthy and the chronically monitored (García-Gómez et al., 2014). An example of information seekers is a couple who want to have a baby and therefore they seek relevant information. The motivated healthy group includes people who suffer from obesity or people who are willing to lose kilos with the help of health applications, while diabetes patients are a typical example of chronically monitored category. The examined application in this study is an example of app for motivated healthy users, because it approaches obese people and people who want to change their diet. The potential for mobile communication to make a change in the healthcare community is underlined by many researchers. They believe that mobile health applications can facilitate peoples' access to healthcare information (Boulos, Wheeler, Tavares, & Jones, 2011).

Mhealth applications require the use of mobile devices for the clinical data to be collected, the information to be delivered and direct care to be provided. Results of research (García-Gómez et al., 2014) show that mobile phones are useful tools in health communication, self-management of disease, and health promotion, and thus they can have a positive impact on health. One of the factors contributing to the importance of the mhealth apps is their offer of healthcare to unserved populations, by reducing the cost of the healthcare delivery. Most of the health apps focus on fitness and self-monitoring; they represent a tool to assist healthcare professionals in measuring health parameters by setting goals for patients (Higgins, 2016).

In general, health and fitness apps cover a range that includes fitness activities, weight goals, nutrition, sleep, relaxation, general healthcare information, pregnancy, and alternative medicine. Most of them offer a free trial period so the users can check the basic features of the app. Once it is downloaded, the users must give their personal information such as gender, age, weight, and height. With the use of the device's features, such as the camera, microphone, diary, etc., the required data are gathered for making the app more personalized for the user. Although most of the available apps are mostly similar, there are some key differences regarding the way in which the nutrition information is presented and the way that the feedback is delivered to the user (Hingle & Patrick, 2016). It is still not determined which are the factors that contribute to the acceptance of their use.

2.3. Adoption and acceptance of mhealth applications

Despite the rapid growth of mhealth apps, many of them have not been tested regarding their usability (Brown et al., 2013). Moreover, compared to the adoption rates of other apps of gaming (60%) or social networking apps (47%), the adoption rate of mhealth apps is very low (19%) (Yuan, 2015). The adoption rate refers to the pace at which a technology is acquired and used by the public. Results of a previous study (El-Wajeeh, 2014) show that most people use the apps only for a short period of time. It seems that users do not return to applications that do not engage them and thus, they erode their potential effectiveness (Gill, Kamath, & Gill, 2012; McCurdie et al., 2012). Therefore, the acceptance and adoption of the mhealth apps is still in doubt.

There is lack of knowledge regarding the services and benefits of the apps, as well as concerns about their ease of use. The development of the apps relies on the improvement of the user's acceptance process, and therefore more research on the factors that influence the user's intention for adoption is needed. One of the factors contributing to the lack of knowledge on the mhealth apps is that both academics and practitioners develop apps without taking into consideration the human-computer interaction field (Hingle & Patrick, 2016). This results in the development of apps with methodologies that are not accordant to the human factors principles. Consequently, most of the users work with health apps for a brief period, which is viewed by the community of mhealth as a failure (Hingle & Patrick, 2016).

2.4. Usability and user experience

In literature, the terms usability and user experience are often confused due to their close relation. Usability refers to the pragmatic side of the user-product relationship (Hassenzahl & Tractinsky, 2006a). It can be defined as the effectiveness, efficiency, and satisfaction with which the users can achieve specific goals with a product in a particular environment. In more detail, effectiveness is the extent to which a task goal is successfully achieved, while efficiency is the amount of resources that a user expends to reach a task goal. Satisfaction is a subjective measure, defined as the attitude towards the product (Sonderegger & Sauer, 2010). Usability can otherwise be described as an attribute of a good and usable interface which is composed of elements such as user friendliness, ease of navigation, learnability, proper integration of functions, consistency and simplicity of design (Baharuddin, Singh, & Razali, 2013).

On the other hand, user experience has often been criticized for being a vague concept (Hassenzahl & Tractinsky, 2006b) and despite its similarities with usability, there are some key differences between these two terms. User experience refers to the overall experience that individuals get when they interact with a product under specific conditions; thus, user experience is more focused on the hedonic quality of a system, rather than on the pragmatic side of it (Arhippainen & Tähti, 2003). For the purposes of this study, user experience is defined as the overall experience of a user from the interaction with the app, which is affected by the simplicity of an easy-to-use interface and affects the users' intention to use the app again. This definition is similar to how usability and user experience is defined by Baharuddin and Arhippainen (2003). It combines both the pragmatic qualities of a system, which are the ease of use and the simplicity of the user's interface, and the hedonic quality of a system, which is the overall experience that the user gets during the interaction.

2.5. Influencing factors of use and acceptance of mhealth apps

Perceived ease of use

The use and acceptance of a technology has been a topic of great research interest for many years. There are several influencing factors related to the use and acceptance of a technology; perceived ease of use is a major factor that motivates people to accept and use a technology (El-Wajeeh, 2014). It is defined as *"the degree to which a person believes that using a particular system would be free of effort"* (Venkatesh & Davis, 1996). The roots of the perceived ease of use can be found in the Technology Acceptance Model (TAM), which is the most widely applied model of user acceptance (Venkatesh, 2018). The TAM was first developed in 1989 and since then it has been applied on several fields, healthcare being one of them (Holden & Karsh, 2010). A diagram of the TAM model can be found in Figure 1.

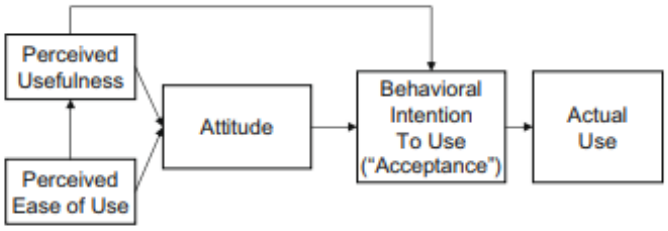


Figure 1. The Technology Acceptance Model of Davis *(Davis, 1989)*.

According to the TAM, the perceived ease of use of a technology and its perceived usefulness have an influence on the actual use of the technology. In more detail, the easier users think a technology is to use, the more useful they think it is. Both perceived ease of use and perceived usefulness affect the attitude of the users towards the technology, which affects their behavioral intention to use the technology, its acceptance and finally its actual use (Davis, 1989). Thus, the information system users are not very likely to adopt a system if they consider it difficult. However, they can change their perceptions of ease of use over time, because a computer system seems more difficult to use at first interaction. The techniques are built up during the use and the attitude towards the ease of use becomes more favorable over time (Hackbarth, Grover, & Yi, 2003). The influencing factor of technology use that will be used for the purposes of the present study is the perceived ease of use, because the emphasis will be on the user interface and the navigation of the examined application, instead of the its perceived usefulness for the participants.

2.6. Evaluating usability and user experience: perceived enjoyment and intention for adoption

2.6.1. Hedonic motivation: Perceived enjoyment

As explained before, the Technology Acceptance Model (TAM) (Davis, 1989) suggests that perceived usefulness and perceived ease of use are two factors that influence the users' attitude and their intention toward a broad range of IT usage. However, these two factors are insufficient in explaining the overall users' behavior toward accepting and using an information technology. Another theoretical model which explains the factors that influence the usage behavior of a technology is the Extended Unified Theory of Acceptance and Use of Technology 2 (UTAUT 2) (Venkatesh, 2003), which is built up on its precursor, the Unified Theory of Acceptance and Use of Technology (UTAUT). The importance of UTAUT 2 relies on the fact that it includes essential elements of eight other models related to behavioral intention or technology acceptance (i.e. Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA), Motivation Model (MM), Theory of Planned Behavior (TPB), Innovation Diffusion Theory (IDT), Social Cognitive Theory (SCT),

Model of PC Utilization (MPCU), Combined TAM and TPB (C-TAM-TPB) (Venkatesh, Thong, & Xu, 2012).

According to UTAUT 2, the behavioral intention of a user and the actual use behavior are predicted by several factors; the performance expectancy, which is the degree to which individuals believe that using the technology will help them to attain gains in a job, the effort expectancy, meaning the degree of expected ease, the social influence, which is the degree to which users perceive that others (family, friends, peers) believe that the use of this technology is important, some facilitating conditions, which refer to the degree to which individuals believe that organizational and technical infrastructure exist to support the use of the system, the hedonic motivation, which is the fun or pleasure derived from the use of the technology, the price value of the system, and the habit, as the extent to which people tend to perform behaviors automatically due to learning (Chang, 2012). A description of the UTAUT 2 model can be found in Figure 2.

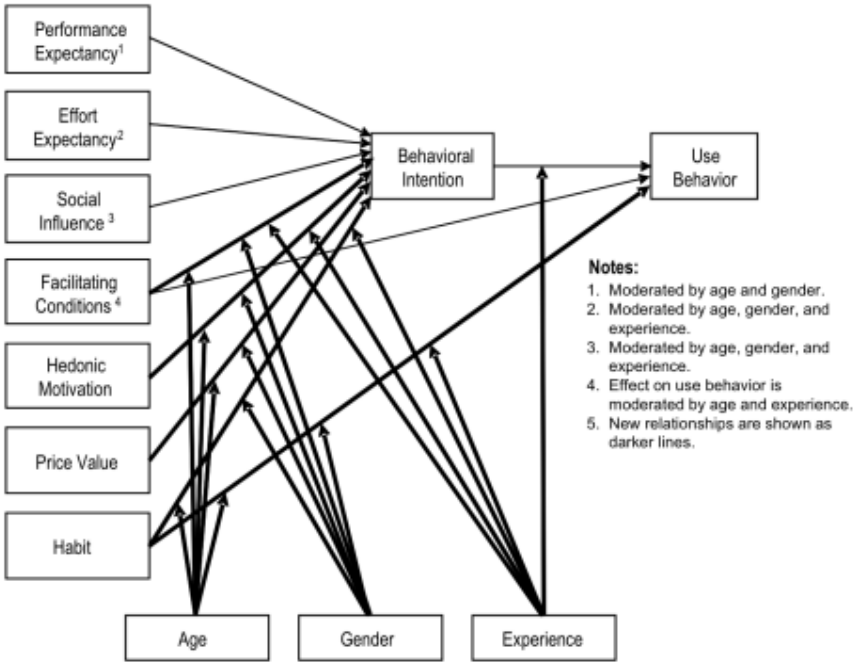


Figure 2. The UTAUT 2 model *(Venkatesh, Thong, & Xu, 2012).*

The UTAUT 2 has been applied, among others, on the healthcare field (Reza Ariaeinejad, 2014). For the purposes of this research, the hedonic motivation variable will be used to explain the behavioral intention of the users to use a mobile health app. The hedonic motivation, as mentioned earlier, describes the perceived pleasure/enjoyment that derives from the interaction of a user with a technology. More specifically, user acceptance can be determined by two types of motivation; extrinsic and intrinsic (Heijden, 2004). Users who are driven by an extrinsic motivation expect a reward or benefit which is external to the

system-user interaction. On the other hand, intrinsically motivated users are driven by benefits that are derived from the interaction with the system itself. Perceived pleasure/enjoyment refers to the intrinsic type of motivation because it measures the extent to which fun can be derived from the system as described. Although health apps are not purely designed for hedonic motivations, many of them include entertaining features in order to engage the users. The examined health app uses gamification elements (game-like features) and thus, it can be pleasant for the users. It can be therefore suggested that in the context of hedonic systems, such as the examined health application, intrinsic motivation is a strong predictor of intentions for the use of the system (Heijden, 2004).

2.6.2. Intention for adoption

As mentioned earlier, perceived ease of use of a technology is a predictor of intention to use (accept) the technology, as suggested by the TAM. Results of research confirm that the required effort to use an app and the ease of its use, is a factor that influences the duration of the use (Dennison, Morrison, Conway, & Yardley, 2013). The intention to use and adopt a technology is also predicted by the hedonic motivation of the user, otherwise described as perceived enjoyment or pleasure during the interaction (Dennison et al., 2013), as explained in the UTAUT 2 (Viswanath Venkatesh, 2018). Simplicity of the user interface can also be a predictor of use intention and adoption of a mobile health technology. The simplicity and its relationship with the use intention of health applications will be explained below.

2.7. Simplicity of the user interface

Although user interface simplicity is not a new concept in the usability and user experience literature, it has mostly been defined in a computer context (Choi & Lee, 2012) and thus, its importance for mobile health applications is still unspecified. There are several reasons that make simplicity of the mobile user interface necessary; the screen space is the most important of all. The screen space of mobile phones is limited, which means that the available space should be used wisely. Thus, the overlapping of multiple windows in the same screen mode should be avoided and displaying a full set of items should be prevented in order to avoid having a screen which is full of information (Choi & Lee, 2012). Results of research suggest that the simplicity of the user interface adds value to the product and persuades users to purchase a product (Lee, Moon, Kim, & Yi, 2015). Simplicity, and more specifically visual simplicity, is not an easily defined concept. In literature, simplicity refers to the number of elements, their variety and their internal structure; it has attributes like ease of use, functionality, and aesthetics (Eytam, Tractinsky, & Lowengart, 2017). It can be achieved by optimizing the number of elements and minimizing the alignment points which are displayed on a screen (Ngo et al., 2003).

Additionally, the simplicity of the user interface has a relationship with the perception of the visual aesthetics of the interface. Visual aesthetics refers to the beauty or the pleasing

appearance of the product (Eytam et al., 2017). This relationship has its roots in the processing fluency theory (Choi & Lee, 2012). According to this theory, the aesthetic pleasure is a function of the user's stimulus processing dynamics, which means that the more fluently the users process the stimuli of the interface, the more positive their aesthetic evaluation of the interface will be. The elements that affect the processing fluency are the amount of information, the symmetry, the clarity, the contrast, and the familiarity of the visual objects. Therefore, a high fluency of users can lead to a positive judgement of their interaction with the system because the recognition and the process of the stimuli is more successful, made with fewer errors and less uncertainty (Choi & Lee, 2012).

In literature, simplicity is classified into three dimensions; the visual aesthetics, the information design, and the task complexity (Maeda, 2006). In the present research project, only the dimensions of visual aesthetics and information design are studied because they are more relevant to the examination of the user interface, compared to the task complexity. The task complexity it is not related to the interface, but rather to the steps of the navigation.

2.7.1. Simplicity of the visual aesthetics

In the new wave of computer interface research, it has been demonstrated that the visual aesthetics determine the enjoyment that derives from the user experience during the interaction (Miniukovich & Angeli, 2014). Also, many times people draw immediate conclusions from the graphical user interfaces, such as considering them fun or boring, and this first impression determines their upcoming evaluative judgments of the system. Considering the amount of information systems and the competition between them, it can be understood why the first impressions matter to interaction design. Users in general like simple interfaces that they can understand quickly; elements of simple user interfaces are clarity, orderliness, homogeneity, grouping, balance, and symmetry (Miniukovich & Angeli, 2014).

The visual design of an interface can be expressed through colors, shapes, font type, music or animation. Results of research conclude that the visual design aesthetics significantly impact perceived usefulness, ease of use, and enjoyment, all of which predict users' loyalty intentions towards a mobile service (Cyr, Head, & Ivanov, 2006). Furthermore, findings of research show a positive relationship between the visual aesthetics of a user's interface and the perception of usability, the evaluations of the content quality, and the emotional satisfaction. Beautiful designs are perceived as more usable and interfaces customized with good visual aesthetics can improve task performance (Choi & Lee, 2012).

In the context of the present study, the visual aesthetics refer to the color, the shapes, the font and the graphics of the app's interface. The purpose is to discover how these user interface qualities have a relationship with the perceived enjoyment from the interaction with the application. The presentation of these elements in a simple way can result in a clear, ordered, homogeneous, grouped, balanced and symmetrical outcome. On the other hand, the presentation of these elements in a complex way can result in an unclear, non-ordered, non-homogeneous, non-grouped, non-balanced, and non-symmetrical outcome.

In this study, it is suggested that the simplicity of the visual aesthetics has a positive relationship with the perceived enjoyment from the interaction.

2.7.2. Simplicity of the information design

Simplicity of a mobile user interface is applicable not only to the aesthetic perception of the visual layout, but also to the information design of the interface. Information design is a concept which refers to the organization, structure, flow, and frame of interface items (Choi & Lee, 2012). Otherwise described as information architecture, the design of the information is a key term of the HCI field because the data classification, formation, organization, and presentation must create a meaningful and effective interaction for the user. Simplicity of the information design can be obtained through the optimal structuring of interface items by lowering the complexity of the visual information that is presented in textual and graphic forms (Choi & Lee, 2012). In the present study, the information design refers to the classification, organization, and presentation of the data on the user interface.

In literature, there are four subconstructs of information design simplicity (Maeda, 2006). Firstly, reduction refers to the aspect of simplicity in which an application is reduced to its essentials. It can be applied to all the aspects of the design, including functionality (goals), structural and navigational complexity, and interface complexity (D. Lee, Moon, & Kim, 2007). The main point of reduction is to design the task performance with fewer steps. In fact, it is quite often observed that users have to make several steps in order to complete the tasks; therefore, a challenge for the user interface designers is to reduce the required steps for the completion of the user tasks. A low depth of a menu structure can improve simplicity (Choi & Lee, 2012).

Secondly, organization of the information is a core component of simplicity and refers to the extent to which an application's structure, functionality, and navigation are organized (Lee, Moon, Ki, 2007). Organization aims at minimizing the cognitive load of a user for efficient processing of information. When the information is organized, it is easier for the users to find what they need and process it (Choi & Lee, 2012). A third component of information design simplicity is integration; the fragmented components of an application should be put into a coherent framework. Abstract integration using trees or net structures does not always conform to human mental habits and it is often an inefficient way of organizing tasks (Lee, Moon, Kim, 2007). The coherence of the interface items across the different applications is of great importance. The tasks can leave users lost, but a consistent framework can help them have an easier access on the information (Choi & Lee, 2012). Lastly, prioritizing is the fourth component and it implies that the user interface of the applications should be focused on the essential and important tasks instead of trying to serve a multitude of diverse goals. This can be achieved by highlighting important or hiding not important information so that users can recognize the information of their interest more easily (Lee, Moon, Kim, 2007).

The aim of the present study is to discover how important the role of user interface simplicity for mobile health applications is. The main assumption of the study is that the

simplicity of the user interface has an influence on the perceived enjoyment of the users when they interact with the app and on their intention to use the app again. For the purposes of the study, the simplicity construct is evaluated in three different ways, as can be seen in Figure 3; the perceived ease of use, the visual aesthetics, and the information design. A perception of ease of use could affect the perception of enjoyment during the interaction and consequently relate to the future use of the technology. The visual aesthetics refer to the visual elements of the user interface which are the colors, the shapes, the font, and the graphics. These elements are placed mostly for customization purposes, but the way in which they are presented, their combination and their amount, can either result in a simple user interface or in a complex one. Finally, the information design refers to the information of the user interface (text) as well as to the way that it is classified, organized, and presented. A simple structure of information can result in a well-organized user-interface, but a complex structure of information can have the opposite results and confuse the users.

The sub-questions of the research are formulated below:

1. *To what extent is the simplicity of the user interface constructed by the perceived ease of use of the health app?*
2. *To what extent is the simplicity of the user interface constructed by the visual aesthetics of the health app?*
3. *To what extent is the simplicity of the user interface constructed by the information design of the health app?*
4. *What is the relationship between the perceived ease of use of the health app and the perceived enjoyment from the interaction with the app?*
5. *What is the relationship between the visual aesthetics of the health app and the perceived enjoyment from the interaction with the app?*
6. *What is the relationship between the information design of the health app and the intention to use the app in the future?*
7. *What is the relationship between the perceived enjoyment from the interaction with the health app and the intention to use the app in the future?*

Based on the literature, a new theoretical model is needed in order to define the exact role of simplicity for the use intention of mobile health apps after their first use. Also, it is of great importance to discover which dimensions of interface and navigation simplicity have a role in the acceptance of mobile health applications. The proposed research model can be found in Figure 3.

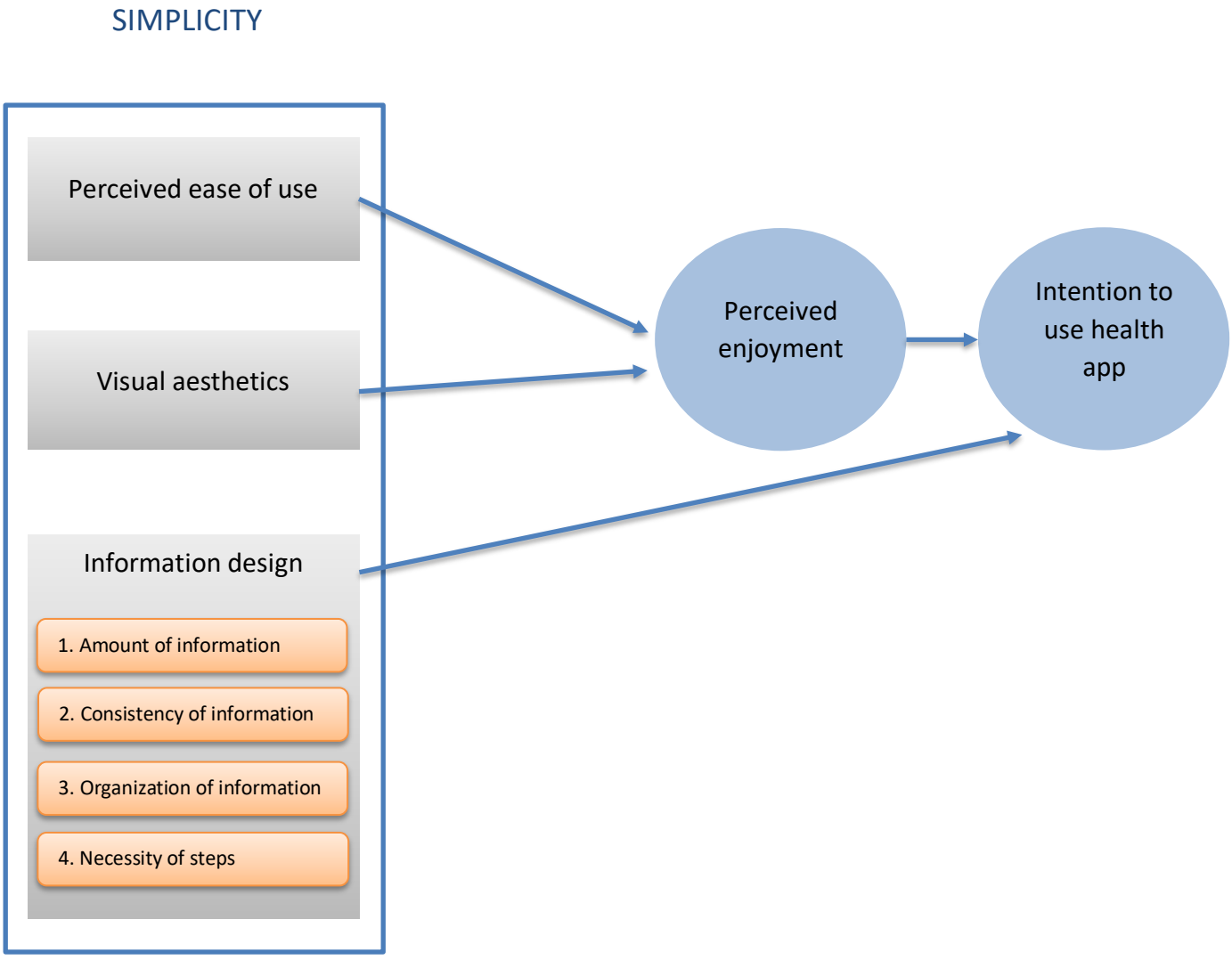


Figure 3. The proposed research model.

3. Methods

3.1. Usability testing: A qualitative study

The purpose of the present study is to discover the predictors of use intention for mobile health applications after the first user experience. More specifically, the focus of the research is on the role of simplicity in the navigation and the user interface for the use intention of the health apps. Therefore, the best way to examine that was by doing a usability test on a health application, which is representative of many others. The usability test aimed at revealing information which could be useful for the understanding of the usage intention factors. Based on the results of the test, useful recommendations have been formulated not only for the examined application but also for other applications with the same purpose. Thus, this study was based on the implementation of a usability test and followed the research design of a qualitative study. The participants of this research project had the opportunity to interact with the application and during their interaction they had to express their thoughts out loud about the navigation and the user interface of the application. Additionally, at the end of the interaction they were interviewed to get more in-depth information about their thoughts on the application's design. The data that was gathered provided rich and detailed information because it was based on focused descriptions (Boeije, 2010).

3.2. The research design: Think Aloud method and interviews

Think Aloud method

The method that was used in the present qualitative study in order to collect the data was the think aloud method, combined with interview questions at the end of the interaction. The think aloud method is a widely used method for usability testing of software, interfaces, websites, and instructional documents (van den Haak, De Jong, & Schellens, 2003) and thus, it is suitable for the usability testing of a mobile application. This method has previously been applied in psychological and educational research on cognitive processes as well as in the context of computer systems (Jaspers, Steen, Bos, & Geenen, 2004). The think aloud method is based on the completion of a task or a set of tasks of an artefact by subjects. During, or after this process, the users must verbalize their thoughts. This method is characterized by high validity because the data obtained reflects the actual use of an artifact, and not the participants' judgements regarding its usability (van den Haak et al., 2003).

There are two main types of think-aloud method; the retrospective and the concurrent. The difference between them lies with the time in which the participants verbalize their thoughts (van den Haak et al., 2003). On the retrospective think-aloud process, the participants first carry out the assigned task in silence and afterwards they verbalize their

thoughts. On the other hand, on the concurrent think-aloud process the participants verbalize their thoughts at the same time that they carry out the assigned task (van den Haak et al., 2003). This method is more consistent and complete compared to the retrospective one, due to the direct verbalization of the participants' thoughts (Fonteyn et al., 1993). The concurrent think aloud method has been accused of lower successful completion rate and less verbalization.

However, for the purposes of this study, the type of think aloud method that was used was the concurrent. The concurrent type was chosen instead of the retrospective because of its consistency, which was required in the context of this usability testing. Since the main goal of the study is to examine the usability and user experience of a mobile application, the best way to gather the required information was to listen to the participants at the same time they were performing the task. In that way, it was more difficult to miss important information because the participants had the application in front of them and they could express any thought that came to their minds. At the end of the interaction they were interviewed with questions. The questions were focused on parts of the theoretical model that were not mentioned during the interaction, but also on changes that the participants would like to see on the app.

Interviews

The interviews were the second part of the data collection process. They were conducted by the author and they were implemented after each participant's interaction with the app. The average time of each interview was 15 minutes. The interview questions were semi-structured and open. The semi-structured and open questions were more suitable for the purposes of this research due to the exploratory type of the study. The participants were encouraged to give long and meaningful answers that could provide insights to the usability problems of the app, instead of one-word answers that are difficult to be interpreted. The interview questions are based on a scheme which is explained later.

3.3. The examined material: MyHabeats mobile application

The material that was examined in this usability test is a mobile application which is called "MyHabeats". MyHabeats was created by a Greek start-up company, whose founder Katy Milioni had the idea of developing an application which would help post-obesity patients to maintain weight loss after doing bariatric surgery. It addresses the problem of patient adherence to post-surgery guidelines for successful weight loss maintenance. The app is separated in two different stages with different goals for the users. The purpose of the first stage is to track the behavior of the users by a daily recording of their meals, while the second one focuses on lifestyle changes for the users and aims at the improvement of their quality of life. Users can have access to the second stage only after earning 180 points in the first stage, by adding 180 meals in total (one meal is equal to one point). This usability test examined only the first stage of the application, because it was not possible for every user to have access to the second stage with only one use, but also because the study focuses

on the way that the nutrition information is presented rather than on the lifestyle changing methods.

Description of MyHabeats mobile application

A description of the first stage's interface can be found below; firstly, the users saw the main menu, which is a list that includes the six meals that the users could have in a single day (Breakfast, Snack, Lunch, Snack, Dinner, Before bed). The participants were asked to add the meals they had during a typical day. The main menu can be found in Figure 4.

Figure 4. *The main menu*

The participants chose a meal (for example Breakfast) and then another screen appeared. The next user interface showed four food categories; proteins, starch, veggies, and fruits, each of them indicated with a different icon, as can be seen in Figure 5.

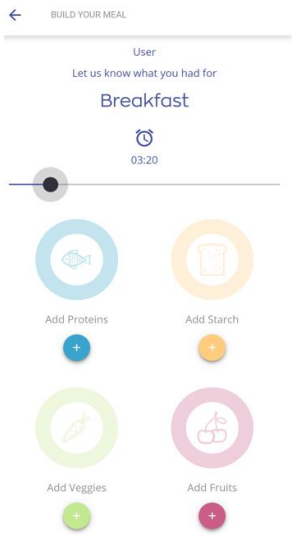


Figure 5. *The food categories*

Then, the users had to choose to which food category their meal belongs. Once they had chosen the food category, a list of foods that belong to the chosen food category appeared. The next step was the measurement of the portion size of the meal. Figure 6 indicates what the portion size interface looks like. As can be seen, the foods are measured based on the number of the tablespoons.

Figure 6. *The portion size of the meals*

After the measurement of the portion size, the participants had to rate their feeling after eating their meal. The feeling system was indicated with emojis that describe the feeling

that a person can have after eating food. The emotions range from starving to sick. An example of the feeling system interface can be found in Figure 7.

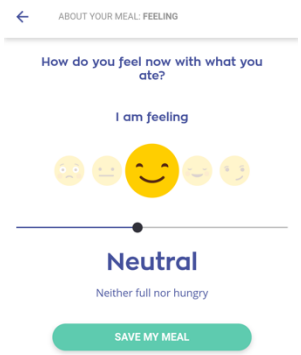


Figure 7. *The feeling system*

The last part of the navigation was the points system. In this part of the journey, the participants earned one point for every meal they had, as a reward. Figure 8 shows the points system interface.

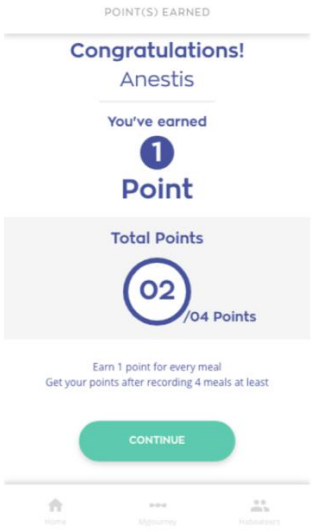


Figure 8. *The points system*

Why MyHabeats?

For the purposes of this study, a health app which is representative of many others had to be chosen. Before choosing the application that would be the study material, research was implemented for a better understanding of the various health applications. MyHabeats has all the characteristics that most health applications, and more specifically nutrition applications, have; list of foods, option of logging food, and food measurement. Therefore, it was suitable for this research. It has both simple and confusing parts in its navigation and its interface, so it is an average application which has some basic functions but still needs a lot of improvement. The purpose of this study is to find which parts of the navigation and the interface contribute to a positive user experience, and which ones are confusing the users and make them less likely to use the app again in the future. The improved design of the app which is suggested at the end of the study has a coherent navigation and an interface that offers the users a pleasant experience.

3.4. The participants and the research procedure

The study took place in one of the labs of the University of Twente. The participants were a sample of 30 adults, both Dutch and international, aged between 18 and 30 years old, currently living in the Netherlands. The average age of the participants was 23 years old and most of them were MSc students with a technical background at the University of Twente. The females were 11 and the males 19. The only two criteria required to be able to conduct the usability test, was basic knowledge of mobile applications use and familiarity with technology. These criteria were necessary because the participants should focus on completing the assigned task while paying attention to the app's navigation and interface, instead of losing time trying to understand the functionality of a mobile application. However, no experience with health or nutrition apps was needed.

The assigned task required interaction of the participants with the app; they had to add the meals they ate in a typical day, choose the food categories, measure the portion sizes, and rate how they felt after eating every meal. The completion of the task for each participant lasted on average 15 minutes and each interview took approximately 15 minutes. The think aloud data was recorded with camera and the interviews were audio recorded with a phone. Later, the recordings were all transcribed by the researcher. The role of the researcher at the usability testing procedure was dual; during the participants' interaction with the app she reminded them to keep talking when they remained silent and also, she was the one conducting the interviews with the participants at the end of their interaction. The author was the only person in the lab with the participants during the procedure.

Instructions for the participants at the beginning of the test

After being welcomed in the lab, the participants were informed about the privacy of their personal information. As soon as they agreed to participate in the test, they were given some oral instructions about the task. The instructions were the following:

Imagine you want to keep a balance on your diet. You decide not to do that by yourself, but with the help of a mobile health application. You download a health app on your smartphone that you have never used before. You have just downloaded it and you want to give it a try. Your task is to use the app and to understand how it works. At the same time, you have to think aloud. That means that you should express out loud all the thoughts that come to your mind, either when you like or dislike something. Take your time, since you don't have a limitation on time.

After listening to the instructions, they started interacting with the application. Some of the participants were very open and were talking a lot, while some others struggled with the fact that they were being recorded. In that case, they were encouraged to talk more and express their thoughts out loud. At the end of the interaction with the application, the participants were interviewed. The interview questions were in total 14. All of them were asked to every participant at the same order. In some cases, the answers of the participants were too short and therefore, the interviewer had to ask the question again in a different way. The interview questions were the following:

1. In general, did you find the app's navigation simple or complicated? In your opinion, which parts were simple and which ones were complicated? Why?
2. Would you consider using this app again? Why?
3. How easy was it for you to use the app? Was it working well? Were you able to find what you were looking for? Did you easily understand how it works? Which parts did you find difficult? How long did it take you to accomplish your task and was that longer than expected?
4. What do you think about the visual appearance of the app? Is there something on the app's interface that you didn't like, or you didn't understand?
5. What do you think about the way that the information was presented? Do you think it was too much or too little information?
6. Did you find any unnecessary steps or functions?
7. Do you think that all the information was well organized?
8. Do you think that the information was consistent in all the navigation?
9. Were you able to execute the frequently used functions without many steps?
10. What do you think about the interaction with the app? Did you find it enjoying or unpleasant? Do you think it is fun to interact with the app or boring?
11. Which do you think is the best and the worst thing about this app?
12. What would you like to see changed at a next version of the app?
13. Are there any functions you wish this app had? Any functions that need to be changed or replaced?
14. How would you rate this app from 0 to 10 and why?

3.5. Data analysis: qualitative data coding

The gathered data was analyzed with the use of the coding method. Coding is one of the most used methods for qualitative data analysis in research (Saldaña, 2016). More specifically, qualitative coding is the process by which some sections of data are identified as relating to a theme (Boeije, 2010). A code symbolizes a group of data and it can be a word or a short phrase. In the present study, the type of qualitative data that is collected and analyzed is a combination of think-aloud and interview video and audio recordings. With regards to the coding procedure, before the conduction of the usability test, a first codebook was made which was used as a draft. This first codebook includes some codes with their descriptions, which were expected to be collected at the usability test. Succeeding the usability test, the video and the audio recordings were transcribed by the author. With the use of the ATLAS.ti program, which is a qualitative data analysis tool, the collected data was coded. After being coded, the first codebook was revised, and some changes were made based on the data (Boeije, 2010). The revised codebook was kept as the final codebook of the study and based on this codebook an inter-rater reliability test has been implemented by a second coder, which is explained below.

First codebook

Before the completion of the usability test, a first codebook was created by the author, which includes codes based on the answers that were expected by the participants. The first codebook consists of 20 codes, which belong to 6 different code categories. The first codebook can be found in Table1.

Code	Code group	Code description
simple	simplicity	the user thinks that the app is simple
complicated/confusing	simplicity	the user thinks that the app is complicated/confusing
easy	perceived ease of use	the user perceives the app to be easy
difficult	perceived ease of use	the user perceives the app to be difficult
understandable	perceived ease of use	the user understands the app
not understandable	perceived ease of use	the user does not understand the app
visually appealing	visual aesthetics	the user thinks that the app's interface looks nice
visually not applealing	visual aesthetics	the user thinks that the app's interface does not look nice
well organised	information design	the user thinks that the information of the app is organised
not well organised	information design	the user thinks that the information of the app is not organised
too much information	information design	the user thinks that there is too much infromation on the app
too little information	information design	the user thinks that there is too little information on the app
enjoyful	perceived enjoyment	the user enjoys interacting with the app
not enjoyful	perceived enjoyment	the user does not enjoy interacting with the app
interactive	perceived enjoyment	the user thinks that the app is interactive
not interactive	perceived enjoyment	the user thinks that the app is not interactive
usage intention	usage intention	the user would use the app again
no usage intention	usage intention	the user would not use the app again

Table 1. *First codebook*

Revised codebook

After carrying out the usability test, the initially made codes were reviewed based on the participants' responses. As a result of this, the first codebook was revised. The revised codebook consists of 22 codes which belong to 8 different code categories. The amount of times that each code was used is also included. This revised codebook can be found in Table 2.

Code	Code group	Code description	Amount of times used
simple	simplicity	the user thinks that the app is simple	30
complicated/confusing	simplicity	the user thinks that the app is complicated/confusing	223
easy	perceived ease of use	the user perceives the app to be easy	39
difficult	perceived ease of use	the user perceives the app to be difficult	44
visually appealing	visual aesthetics	the user thinks that the app's interface looks nice	86
not visually appealing	visual aesthetics	the user thinks that the app's interface does not look nice	52
well organised	information design	the user thinks that the information of the app is organised	25
not well organised	information design	the user thinks that the information of the app is not organised	5
too much information	information design	the user thinks that there is too much infromation on the app	9
too little information	information design	the user thinks that there is too little information on the app	28
enough steps	information design	the user thinks that the navigation of the app has enough steps	14
unnecessary steps	information design	the user thinks that the navigation of the app has unnecessary steps	13
consistent	information design	the user thinks that the information of the app is consistent during the navigation	24
incosistent	information design	the user thinks that the information of the app is inconsistent during the navigation	2
enjoyable	perceived enjoyment	the user enjoys interacting with the app	19
not enjoyable	perceived enjoyment	the user does not enjoy interacting with the app	18
usage intention	usage intention	the user would use the app again	11
no usage intention	usage intention	the user would not use the app again	14
useful	perceived usefulness	the user finds the app useful	5
not useful	perceived usefulness	the user does not find the app useful	26
complete	completeness	the user finds the app complete	8
incomplete	completeness	the user does not find the app complete	40

Table 2. *Revised codebook*

3.6. Inter-rater reliability: Cohen's Kappa

To verify the reliability of the analysis, a second coder was used to analyze part of the data. The revised codebook and the dataset of three random participants was handed to the second coder. The part of the dataset that was coded by the first coder was highlighted, so that the second coder would know which part of the text he had to code. The codes that the second coder assigned to the dataset of the three participants were compared to the codes that the first coder assigned to the dataset of the same participants. The reliability of the analysis was tested with the Cohen's K coefficient, using the SPSS program; this coefficient is a measure for inter-rater agreement between categorical items, such as codes. The SPSS analysis showed that the value of Cohen's K is .72. This number indicates that the level of agreement between the two coders is acceptable. Therefore, the reliability of the data analysis is acceptable.

4. Results

The purpose of this chapter is to describe the findings of the study. First, an overview of the general attitude of the participants towards the examined health app is presented. Later, a more in-depth analysis of the data follows.

The attitude towards the app

The results of the data analysis vary and for that reason they are a source of interesting and useful information, both from a UX and UI point of view. In general, the tested application, MyHabeats, was considered to be a visually appealing application by the participants, because of its well-designed graphics and its nice colors. More specifically, the interface was characterized as clean, nice, and professional. The choice of the colors and the graphics were suitable for its purpose as a health application; health apps usually avoid vivid colors in order to transmit a sense of calmness to the users. However, the visual appearance was found to be the only advantage of the application.

In terms of usability, the navigation of MyHabeats was found to be confusing and complex for most of the participants. The times that the app was characterized as complicated or confusing were 223, while the times that it was characterized as simple were only 30. The confusion was regarding the navigation steps; many participants stated that they would like a simpler and more straightforward navigation. The process of building a meal was found to be confusing because the users had to choose the food category first, and then find the food that belongs to this category, instead of just adding the food. Also, the information and the instructions on the interface was found to be too little. That was something that confused the users even more; the lack of nutrition information made them wonder about the usefulness and the purpose of the app and the lack of instructions made them consider the app difficult to use. As a result of this, most of them said that they are unwilling to use the app again in the future. Participant 7, who is 25 years old, said:

[1] *"I think the purpose of the app is not clear and I won't use an app like this"*

Further, it was very often observed that MyHabeats was incomplete in terms of functions. The lack of nutrition information, instructions, feedback, calendar, and different options of measuring the food made the application look like it is still under development. It was mentioned that the addition of these elements would add value to the application, and it would make it look more complete. Lastly, by observing the behavior and the body language of the participants towards the app, it was noticed that many times they were staring at the screen, taking some time to think how to use the app. That reaction was when they were trying to understand how the complex parts of the navigation work. Also, many times they got frustrated with user interface elements, such as the time scrolling bar, because it was hard to manage and adjust the time of the meal.

4.1. The construction of simplicity: perceived ease of use, visual aesthetics, and information design

The present study suggests that the simplicity of the user interface of a health application can explain the perceived enjoyment from the interaction and predict the usage intention of the application. For the purposes of this research project, the simplicity of the user interface is expressed with three dimensions; the perceived ease of use, the visual aesthetics, and the information design. Several sub questions have been formulated in order to give in-depth answers to the main research question of the study. These sub questions will be answered extensively below.

To what extent is the simplicity of the user interface constructed by the perceived ease of use of the app?

In general, it was observed that most participants found it relatively difficult to use the application and to complete the assigned task without mistakes. That was most of the times due to the complexity of the app. The complexity was regarding the navigation and the interface elements, but mostly regarding the navigation. It was observed that the more complex the participants found the navigation to be, the more difficulties they had using the app. A typical example of confusion was the food addition process. More specifically, in MyHabeats the users first must find the food category of their food, and then add the food from a list of the chosen category. This process was long for many participants either because they didn't know in which food category their food belongs to, or because they didn't understand the food categories from the beginning. Participant 12, who studies Systems and Control, said:

[2] "I want to go back to add another thing from another food group, but I don't know if I can do it. This is not very intuitive."

This confusion affected their perception of use, and consequently they thought that the app is difficult to use. In fact, difficulty of use was mentioned more times than ease of use. This indicates that difficulty of use, as a result of the navigation complexity, is one of the usability issues of MyHabeats. It was also noticed during the usability test that the difficulty of use was related to the complexity of the navigation; consequently, the easiness of use is related to the simplicity of the navigation. It can be therefore be suggested, that the simplicity of the navigation and the interface is constructed by the perceived ease of use of the app, or in other words that the perceived ease of use is an expression of user interface simplicity.

To what extent is the simplicity of the user interface constructed by the visual aesthetics of the app?

The visual aesthetics of the app are elements of the user interface. In the present study, the visual aesthetics refer to the colors, the font, and the graphics of the application. During the usability test, it was observed that most participants liked the visual aesthetics of the app. They referred to the interface of MyHabeats as clean, nice, and professional. It was many times mentioned that the visual appearance of the app is minimalistic and simple. Participant 1, who studies Applied Mathematics, said:

[3] “Generally, the app had a nice layout, it was fresh, simple, things didn’t come out of the screen, so it was nice to use.”

The choice of colors was suitable for this type of application and the graphics made the application more user-friendly. It was mentioned that the addition of more interface elements would result in a complex interface. The application was characterized as visually appealing 86 times in total. The fact that the visual aesthetics of the app didn’t confuse the users, but rather facilitated the navigation, implies that they are related to user interface simplicity. Thus, the simplicity of the user interface can be expressed not only with the perceived ease of use, but also with the visual aesthetics of the interface.

To what extent is the simplicity of the user interface constructed by the information design of the app?

In the present study, the information design refers to four different aspects of the app’s information; the amount of the information, its consistency, its organization, and the necessity of the navigation steps. The collected data suggests that the simplicity of the user interface is related to the information design, but not to all its four components. More specifically, the usability test showed that the information of MyHabeats was well-organized and consistent and its navigation steps were all necessary. However, the amount of nutrition information was considered to be too little. The amount of information was a crucial factor for the perception of the interface simplicity. In more detail, the participants didn’t find enough nutrition information on the application and because of that, their perception of the app was affected; they thought that the app is complicated due to the lack of information.

It was also found that the app lacked instructions, and that affected the perception of ease of use; the absence of instructions made the participants think that the app is difficult to use. They struggled to understand how the app works, and, they didn’t get any kind of feedback about their diet. Most participants thought that the information and the instruction were too little. This indicates that the app was many times considered to be not informative enough. Participant 1, again, said:

[4] “I think it has too little information, I think there should be more options available, for example a button that you press and see how you can use this app.”

Additionally, the lack of nutrition information affected the perceived usefulness of the app as well. Some participants did not find the app useful because of the lack of nutrition information; they stated that they didn’t gain any knowledge from the app, and thus, they didn’t find it useful. The results indicate that the lack of nutrition information on the interface can not only result in a perception of a complex user interface, but also affect the perceived usefulness of the application, while the lack of instructions affects the perception of ease of use. Considering all the above, it can be concluded that the simplicity of the interface is constructed by the consistency and the organization of the information, as well as by the number of the navigation steps, but not by the amount of nutrition information and the instructions; too little information and too little or no instructions does not imply simplicity, but rather complexity.

4.2. Perceived ease of use and perceived enjoyment

What is the relationship between the perceived ease of use of the app and the perceived enjoyment from the interaction with the app?

The collected data indicate that the perceived ease of use of the application has a relationship with the perceived enjoyment from the interaction with the app, but not strong enough. More specifically, half of the participants enjoyed the interaction with MyHabeats and half of them did not. As mentioned earlier, the times that the application was considered to be difficult to use was higher (44), compared to the times that it was found to be easy to use (39). It was observed during the usability test that when participants thought that the app is difficult to use, either due to its complex navigation or its complex interface, they got frustrated, and thus they did not enjoy the interaction. For example, some participants got frustrated after logging their food because they were not sure whether it was saved or not, since there was no clear indication for that. Instead, they had to check every time if the food was saved, something which was annoying for them. Participant 6, who is 26 years old, said:

[5] "I keep looking at these options and I don't like it because I think that if I save and continue it will take me to the food categories."

On the other hand, when the participants considered the application to be easy, they enjoyed the interaction with the app. However, it was observed that not all the times that the participants found the app to be easy to use, did they enjoy the interaction as well. Sometimes, even if MyHabeats was easy for them to use, they did not enjoy the interaction with it. Therefore, it can be said that perceived ease of use facilitates the perceived enjoyment, but perceived ease of use itself does not explain enjoyment during the interaction. As described below, the visual aesthetics are more related to the perceived enjoyment during the interaction, compared to the perceived ease of use.

4.3. Visual aesthetics and perceived enjoyment

What is the relationship between the visual aesthetics of the app and the perceived enjoyment from the interaction with the app?

In the present study, the visual aesthetics refer to the colors, the font, and the graphics of the user interface. As mentioned above, the visual aesthetics of the app's interface can explain the perceived enjoyment of the users during the interaction. In more detail, the application was many times characterized as nice, clean, and professional. The visual appearance was the best aspect of MyHabeats, according to most participants. One example of a nice and interactive visual element of the app is the scrolling bar with the emojis. This interface element represents the feelings that users can have after eating a meal. It ranges from "starving" to "completely full" and was considered to be an enjoyable element of the

interface. The participants of the study stated that this graphic representation is funny and nice. Participant 4, who studies Nanotechnology, said:

[6] "For me it was really pleasant."

In general, it was observed that the visual aesthetics were the most important factor in explaining perceived enjoyment. Compared to the perceived ease of use, the visual aesthetics played a more important role for the enjoyment during the interaction. Therefore, it can be said that the visual aesthetics of the app can predict the perceived enjoyment of the users. The times that interface elements was mentioned as visually appealing were more than the times that interface elements were mentioned as not visually appealing.

4.4. Information design and usage intention

What is the relationship between the information design of the app and the intention to use the app in the future?

As explained earlier, for the purposes of this study the information design refers to the app instructions and the amount of information, its organization, its consistency, and to the necessity of the navigation steps. First, regarding the consistency of the information, most of the participants stated that the information was consistent during all the navigation. The frequency of the times that the information was characterized as consistent is 24. Only a couple of times did the participants mention inconsistency. For example, participant 21, who studies Industrial Engineering, stated:

[7] "There were many types of milk, meat, and cheese, but then at the vegetables there was not even garlic or onion. If you have lots of types of chicken, you also need to have the same for vegetables. Onion and garlic are very often used, and they should be there."

Secondly, regarding the number of steps for implementing an action, it was found that the frequency of times that the steps were considered to be enough for completing a task was almost equal (14) to the frequency of times that the steps were considered to be too many (13). The unnecessary steps were mostly regarding the process of adding the meals to the application. It was often mentioned that instead of adding the food ingredients one by one from different food categories, it would be better if this could be done all in once. Participant 8 said:

[8] "When you select the meal, you have to select the food categories and then you have to go back to add food from another food category; maybe this could be done all in once."

Thirdly, the information was perceived to be very organized. That was mentioned most of the times. The participants did not struggle finding the information they were looking for because it was in the categories that they expected it to be. They mentioned that the main menu was very well organized and in a chronological order (breakfast, snack, lunch, dinner). Participant 25, who is 24 years old, stated:

[9] "The best thing is the main menu; I like the food groups colors and its organization."

The information was perceived to be unorganized only in a few cases. Some participants suggested that there could be more food categories, in order to avoid confusion. For instance, participant 30, who is 20 years old, said:

[10] "Many of the options that I see here are high in proteins, but foods like cashews or cheese are high in fat as well. You cannot categorize them in proteins, when they are mostly high in fat. So maybe there should be a different system because there could be a misconception."

Also, it is worth mentioning that a participant suggested the option of a calendar, which he could use to navigate through the days. He mentioned that being able to go only to the previous or the next day can be chaotic for the user.

Lastly, the amount of information is a concept which was mentioned a lot of times. In the current version of the app, the participants could only see to which category a food belongs. They mentioned that they would like to know more about nutrition information, advantages and disadvantages of their food options and even suggestions of a healthier diet. The times that the information was found to be too little were more compared to the times that it was found to be too much.

Not only it was observed that the amount of nutrition information was found to be too little, but it was also found that the lack of instructions on the app was a drawback of the application, which made the participants unwilling to use the app again in the future. More specifically, the absence of instructions and feedback for the user was a very important factor of unwillingness to use the app again. Most of the participants were unwilling to continue using an application which does not provide them with use instructions.

The other three dimensions of information design, and more specifically the consistency, the organization, and the amount of steps, were not found to have a significant relationship with the usage intention of the app. In more detail, none of the participants stated willing to use the app again because of its organized and consistent information, and its amount of navigation steps. Instead, many of them stated unwilling to use the app again due to the lack of information and instructions. This indicates that the only significant dimension of information design for the use intention of the app is the amount of nutrition information and instructions; too little information and instructions can result in unwillingness of the user to continue using the app. Participant 13, who studies Mechanical engineering, stated:

[11] "I would not use it because I'm used to looking at my proteins, my fat, and my carbs."

Therefore, it can be concluded that the only dimension of the information design that has an importance for the usage intention is the amount of nutrition information and instructions; they should be sufficient in order for the health app to be accepted and used more than once.

4.5. Perceived enjoyment and usage intention

What is the relationship between the perceived enjoyment from the interaction with the app and the intention to use the app in the future?

During the usability test, it was observed that some participants found the interaction to be enjoyable due to the visual aesthetics and the ease of use of the app, while some others got frustrated due to the incompleteness of the app. The participants were interviewed about their intention to use the app again in the future. The times that unwillingness to use the app was mentioned were more than the times that willingness to use the app was stated. In general, it was found that even when the participants enjoyed the interaction with MyHabeats, they stated unintended to keep using the app in the future. This indicates that perceived enjoyment from the interaction with the app itself is not a strong predictor of health app use intention. However, the study traced two more factors which can explain the usage intention of a health application. The data suggests that the completeness of the app, as well as its perceived usefulness, are two factors which are related to the use intention of use of such an application.

4.6. Additional factors that influence usage intention: perceived usefulness (TAM) and completeness of the app

4.6.1. Perceived usefulness and usage intention

As mentioned above, the study traced two more factors which predict use intention of the tested application. In more detail, perceived usefulness is one of them. Some participants said that such an app can be useful for someone who wants to keep track of their diet. Participant 10, who studies Biomedical Engineering, stated:

[12] "I would use the app again. I regularly take care of what I eat, so apps like this are quite useful."

However, most participants thought that the app was not useful. Most of them could not find a motivation or a reason for using an app like that. For example, Participant 1, again, stated:

[13] "I would rate the app with 6/10, because despite the fact that it's nice and it's a good idea, the developers need to keep working on it and add more function to make it more useful."

Another example is Participant 6, again, who said:

[14] "Well, so far, I don't know which the purpose of the app is. From what I saw, it's a recording of what you eat, how do you feel after you eat, so it's like a food recorder. If that's the point then it's great, but honestly, I don't know what the purpose of the app is."

Perceived usefulness is not a new concept in the technology theory. TAM (Davis, 1989) suggests that perceived usefulness, as well as perceived ease of use, are two important factors that influence the usage intention of a technology. The participants who thought that the app is useful were more willing to use it again, compared to those who didn't find it useful. What is worth mentioning is the reason for which the participants didn't find the app useful. The most commonly reported reason was the lack of nutrition information of the app. As stated before, MyHabeats lacked important nutrition information, something which made the participants more confused about the use of the application. Thus, they started questioning its usefulness. The more confused the participants got, the less they understood the application and therefore, the less useful they found it. This indicates that perceived uselessness of the app can result in unwillingness to use it. On the other hand, perceived usefulness can explain usage intention. The more useful an app is perceived to be, the more possible it is that it will be used again. The relationship between perceived usefulness and usage intention is traced in the results of this research and thus, the concept of perceived usefulness will be added to the new theoretical model.

4.6.2. Completeness and usage intention

As mentioned earlier, the study traced two factors which were not included in the suggested theoretical model, which explain usage intention of a mobile health application. The first one is perceived usefulness (TAM) and the second one is the completeness of the application. More specifically, the results indicate that MyHabeats was incomplete in terms of functions and nutrition information. The times that the app was considered to be incomplete were more than the times it was found to be complete. Further, when participants were asked if they would use the application again, most of those who stated unwilling to continue using it, stated that their unwillingness is due to the incompleteness of the app. In more detail, many participants could not find some of the foods they were looking for and the app lacked useful information, such as the calories of the food. Participant 21, again, stated:

[15] "I don't think that I would use it because I just add my meal, but it doesn't inform me about the calories and how I can reduce them. Its incomplete."

The incompleteness of the app affected the perceived usefulness of the app as well. The more incomplete the users found the app to be, the less useful they thought it was. The results indicate that incompleteness of the app not only affects the perception of its usefulness, but also results in unwillingness to use the app again. On the other hand, a complete application in terms of functions and nutrition information is more likely to be used again in the future. Therefore, completeness is a factor which can result in usage intention. As a factor of usage intention, it will be added to the new model of the research.

5. Discussion

5.1. Main findings

The present study addresses the predictors of mobile health apps use intention. The results demonstrated that the simplicity of navigation, the perceived ease of use, and the visual aesthetics of the interface are important factors of health app use intention. In more detail, a simple navigation is characterized by logical and good order of navigation steps in the process of implementing a task. A health app with simple navigation is perceived to be easier to use compared to one with complex navigation, and therefore it is more likely to be used again after the first user experience. The simplicity is not restricted only on the navigation, but it can also be expressed with visual aesthetics. More specifically, the visual aesthetics of the health app can contribute to a positive user experience, because the interaction of the user with the visual elements makes the experience more fun and engaging. In that way, the perceived enjoyment from the interaction with the health app is enhanced and it is more possible that the user will be willing to use the app again.

Furthermore, the amount of nutrition information on the interface, as a dimension of information design, is a significant determinant of health app use intention. The information design consists of four dimensions, which are the amount of the information, the organization of the information, the number of steps to complete a goal, and the consistency of the information. The dimension of information design which was found to have the only value for use intention of a health app is the amount of nutrition information. Even though it was expected that the less information the screen had, the better it would be for the users, it was found that too little nutrition information on a screen had the opposite results. Participants who didn't find enough nutrition information on the app were unwilling to use it again. In other words, the simplicity does not apply on the amount of nutrition information of health applications. Further, as part of the information design, the lack of use instructions played an important role for the perceived ease of use of the app. The absence of instructions made the health app more difficult to use and therefore affected its perception of ease of use.

Also, the results showed that the perceived usefulness of a health app can determine its use intention. The less useful the health app was perceived to be, the less willing were the participants to use it again. The perceived usefulness of the health app was affected by the amount of nutrition information on the interface. The less nutrition information there was on the screen, the less useful the participants considered the app to be. Consequently, they were not willing to use again an application with insufficient nutrition information, because it was not useful for them. Lastly, the completeness of the health app was found to be related to the use intention of the app. The less complete the app was, the less willing the participants were to use it. The incompleteness of the app was due to the lack of functions and the lack of nutrition information. All these findings resulted in a new, updated research model which can be found in Figure 9. As can be seen in the model, only the amount of (nutrition) information has a relationship with the use intention of the app, while it relates

also to the perceived usefulness of the app and its completeness. The use instructions relate to the perceived ease of use of the app. The rest of the relationships are as suggested in the initial research model.

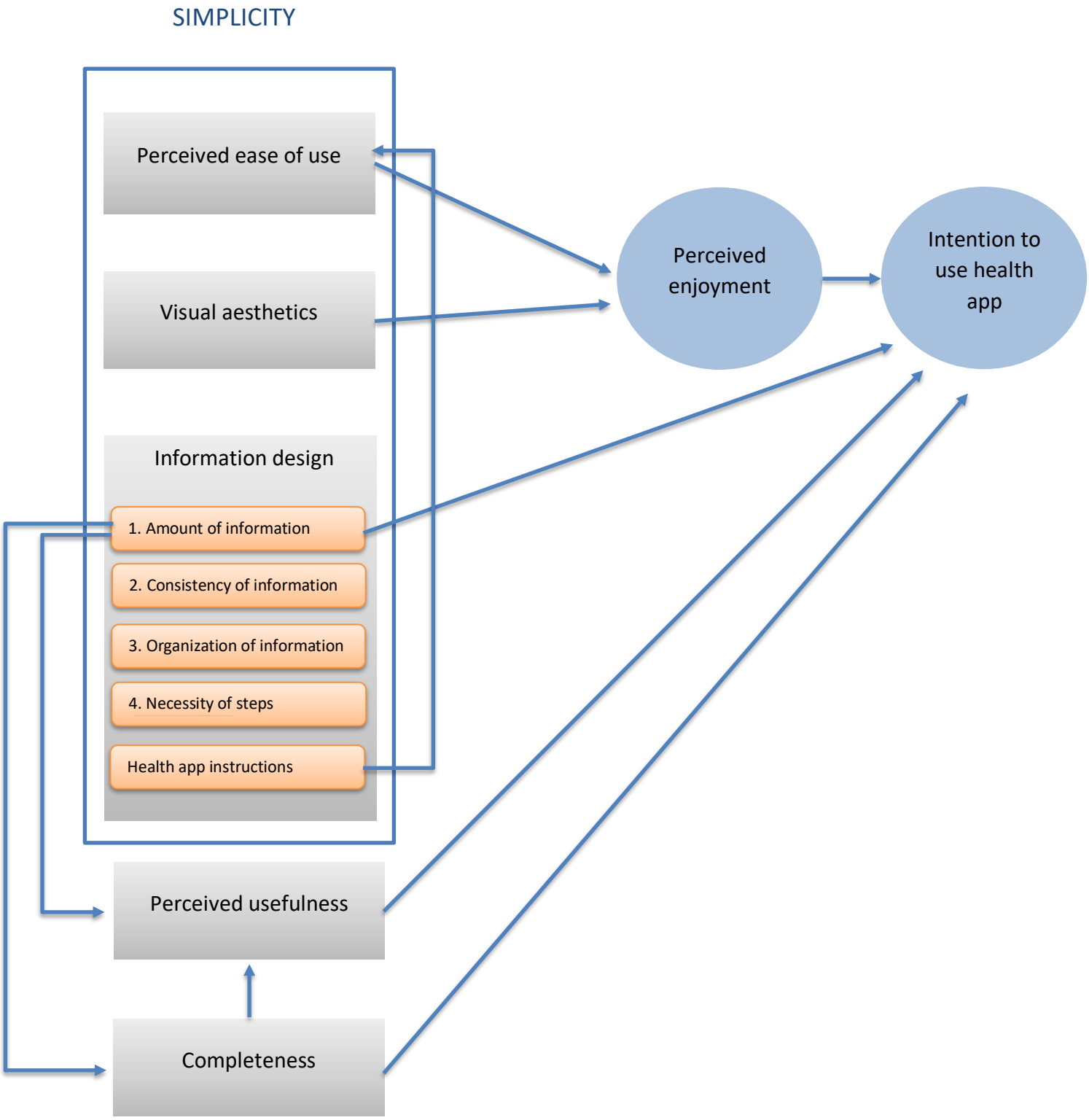


Figure 9. *The research model after the results.*

5.2. Theoretical implications

The present study confirmed the findings about perceived ease of use and perceived usefulness. As TAM (Davis, 1989) suggests, perceived ease of use and perceived usefulness are two concepts which predict use intention of a technology. More specifically, the easier and the more useful the users perceive a technology to be, the more likely it is that they will accept it and use it again. Also, it was noticed that perceived usefulness has a relationship not only with the use intention, but also with the completeness of the app and its amount of nutrition information. It was observed that when participants didn't find enough nutrition information on the health app, they didn't think of the app as useful and complete and they did not intend to use it again. This indicates that a health application with sufficient nutrition information and functions is perceived to be more useful and therefore, it is more likely to be accepted.

Lastly, this study found that the perceived enjoyment, or the hedonic motivation derived from the interaction experience (UTAUT2) (Venkatesh, Thong, & Xu, 2012), is a concept which is related to the visual aesthetics of a health application, and to the use intention of the application. In more detail, the perceived enjoyment was mostly derived from the visual aesthetics of the application, such as the graphics and other visual elements. However, it was found that perceived enjoyment itself cannot explain usage intention. As mentioned before, not all the participants who enjoyed the interaction with the tested app necessarily wanted to use it again. Therefore, perceived enjoyment (or hedonic motivation) is an important factor in the context of technology acceptance, but itself cannot predict usage intention. Combined with other factors, such as perceived ease of use, visual aesthetics, perceived usefulness, and completeness, it can facilitate the user experience and predict the use intention of a health app.

5.3. Practical implications

The examined application is representative of the bigger category of nutrition applications, and therefore the practical implications of the study are not only concerning MyHabeats, but also many other nutrition applications. More specifically, the study focuses on the simplicity of the navigation and the interface expressed with the perceived ease of use, the visual aesthetics, the information design, and on the perceived usefulness and the completeness of the health app. With regards to simplicity, it was found that a health app with simple navigation and design is more likely to be accepted by its users, compared to one with complex navigation. In more detail, the most complex part of MyHabeats was the process of adding a meal. It was found that adding a meal was more complex than necessary; that was something that made the participants unwilling to use the app again in the future. The complexity of the navigation is a factor which relates to the difficulty of use of an application, while on the other hand the navigation simplicity relates to perception

of easiness of use. This suggests that the UX designers, before the development of a health application, should first understand the needs of the users and then build a navigation, in which every step adds value to the process.

Moreover, it was found that the lack of instructions on MyHabeats was one of the factors that affected the perception of difficulty of use. An application which is perceived to be difficult to use is very unlikely to be accepted and adopted by the users. Therefore, the instructions of a health app should be considered as a factor that will affect the perception of ease of use of a health app. Moreover, the visual aesthetics of a health app add value to the interaction with the app and contribute to a good user experience. The elements of the interface of a health app should be therefore, designed very carefully; every visual element should be representative of its category, so that the users recognize its purpose at first sight; for instance, an icon that represents a food category should be indicative of this food category. Likewise, the chosen colors should match with the type of the application. The preferred colors for health apps are blue and green, which are soft colors, instead of red for example, which us an intense color. Further, it was found that the option of dark mode, as part of the visual aesthetics of a health app, is necessary and for that reason it is highly recommended. It offers a better experience in the night hours and many users prefer it.

To continue, the information design (amount of information, number of navigation steps, consistency of information, and organization of information) should be carefully considered in the design process of the app. The research showed that the amount of nutrition information on a health app plays a crucial role; when users could not find the nutrition information that they expected, they were unwilling to use the app again. The amount of nutrition information that is displayed on the screen is important not only for the acceptance and use intention of the app, but also for its perceived usefulness and its completeness. The lack of important nutrition information can prevent the use intention of a health app and make it look incomplete and useless.

5.4. Recommendations

This study tested the usability and user experience of a mobile health application called MyHabeats and some issues regarding its design and navigation were traced. For that reason, I suggest an improved design of the tested health app based on the results of this study; the improved design of MyHabeats can be found in the Appendices. An example of the old and the suggested design can be seen in Figure 10.

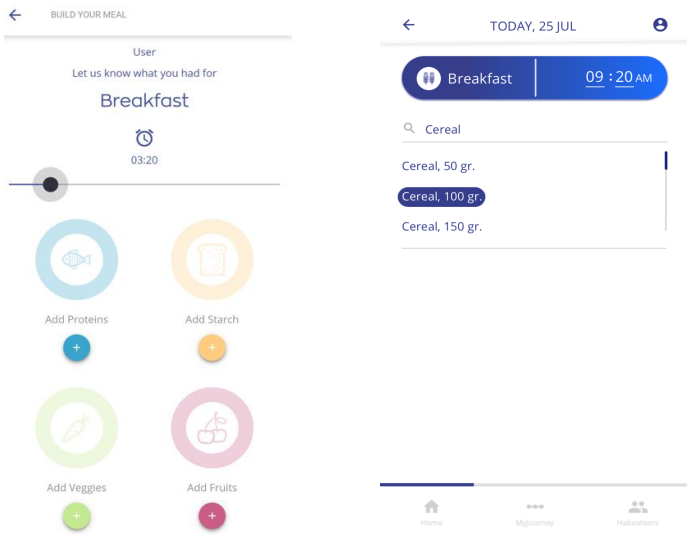


Figure 10. *The original (left) and the suggested (right) screen of logging food.*

Firstly, the way of logging the meals has been simplified. Instead of first choosing the food category and then adding the food, the improved design suggests that users first log the food and then the app automatically shows in which food category the selected food belongs to. In that way, the confusion over the food and its categories is avoided. Also, the way of food measurement has been changed due to its difficulty in calculating. People in Europe are more familiar with grams instead of tablespoons, because it is the most common way of food measurement. Likewise, nutrition information has been added to the design in order to provide users with information about the food they log.

Furthermore, in the previous version of the app the users could only go back and forth to the previous and next day. For making the navigation through the days more convenient, a calendar has been added. In that way, the users can navigate through the days and see what their diet looks like in case they don't remember. Also, the scrolling bar with which the users added the hour that they had the meal is replaced with a clock with AM/PM switch. The usability test traced accuracy difficulties in the use of the scrolling bar; it was very difficult for the users to set the accurate time on such a small scrolling bar with their fingers. Additionally, some changes have been made on the text formulation in order to make it more understandable. Lastly, additional options for deleting, saving, and viewing the meals have been added. The new design has a simpler navigation that facilitates the user experience and it is easier to use. It also has more nutrition information, something which is necessary for the perceived usefulness of the app. It includes more functions in order to be more complete and the visual elements have been simplified in order to avoid confusion.

5.5. Limitations and future research

The findings of this study must be seen in light of some limitations. The first limitation concerns the physical environment of the usability test. This study was a laboratory study, which means that the subjects were aware that their answers were being recorded. Although they agreed to participate in the study, the laboratory environment was stressful for some of them, while in normal conditions they might have been more relaxed and therefore perform better. Future research should consider more carefully the environment in which a usability test takes place; the physical environment should be the least stressful for the participants. Furthermore, it was observed that during the think aloud method, some participants felt uncomfortable talking and sharing their thoughts. Interacting with an application and at the same time talking can be uncomfortable for some people who are not that expressive or relaxed. When this was the case, the interviewer was trying to make them feel comfortable by reminding them that they are not being judged based on their answers and that all the data that is collected from the study would remain confidential. This was found to be helpful, because it made them more comfortable to talk aloud. Therefore, researchers should, from the beginning of the usability test, make very clear to the participants that they are not being judged and there is no reason for them to feel uncomfortable.

Furthermore, one more limitation of the research is that not all parts of the app were examined. The participants could only interact with the first stage of the application because in order to unlock the second stage they would have to collect 180 points. That was impossible, since for every meal they added they got 1 point, and each of them could add maximum 6 meals. The interaction with both stages of the app could result in different conclusions for the research. Moreover, future research should consider examining two or three applications instead of only one. The examination of only one health application in this research was due to limited resources and time, considering that the laboratory room and the camera were booked for a specific amount of time. However, the examination of more health applications would provide rich data and more information about the use intention and acceptance of such apps. Lastly, research of health apps in the future could use elements of more theories instead of only TAM (Davis, 1989) and UTAUT2 (Venkatesh et al., 2012). The combination of more theories would contribute in the creation of a research model with more information, something that would provide more insights in the acceptance factors of health applications.

6. Conclusion

In summary, this study aimed to identify the predictors of mobile health applications acceptance and use intention after the first user experience. It focused on the simplicity of the design, but after the conduction of the usability test more factors of health app use intention were revealed. More specifically, the results of the research indicated that an easy to use health application, which consists of simple and logical navigation steps and use instructions, as well as visual elements that facilitate the user experience, is very likely to be used again. On the other hand, the lack of nutrition information can prevent the use intention of a health app and make it look incomplete. The lack of nutrition information has also an effect on the perceived usefulness and the completeness of the application, because the less nutrition information the application has, the less useful and the less complete it is perceived to be. Consequently, the perceived usefulness and the completeness of the health app are important factors of its use intention after the first user experience. The perceived enjoyment when using a health app comes from the interaction with the visual aesthetics of the interface and combined with other factors it can predict use intention; itself cannot predict future app use. Based on these conclusions, practitioners of health applications should consider simple and easy to use designs, which consist of sufficient nutrition information and instructions and visually appealing elements. Further research is required to examine more in-depth the determinants of health apps use intention.

Acknowledgements

I would like to thank my supervisors, Ruud Jacobs and Joyce Karreman, for their feedback and support. Special thanks go to my family and close friends, who were next to me during this trip of effort and knowledge. I also want to thank the second and third coder for their help and the participants of this study. Lastly, I would like to thank El Nino Digital Development for giving me the opportunity to do my thesis in their company and MyHabeats team for giving me all the necessary information for the examined application. The names of the people who helped me are Katy Milioni, Olga Tsoumani, Maria Manolaki, Anestis Goudas, and Katerina Dounavi. This research would not have been possible without all these people.

References

Adeyinka, T. (2014). Predicting users' continuance intention toward e-payment system: An extension of the Technology Acceptance Model. *International Journal of Information Systems and Social Change, 5*, 47-67.

Akter, S., Ray, P., & D'Ambra, J. (2013). Continuance of mHealth services at the bottom of the pyramid: the roles of service quality and trust. *Electronic Markets, 23*(1), 29-47. doi:10.1007/s12525-012-0091-5

Arhippainen, L., & Tähti, M. (2003). Empirical evaluation of user experience in two adaptive mobile application prototypes, *Proceedings of the 2nd International Conference on Mobile and Ubiquitous Multimedia*.

Baharuddin, R., Singh, D., & Razali, R. (2013). Usability dimensions for mobile applications-a review. *Research Journal of Applied Sciences, Engineering and Technology, 5*(6), 2225-2231.

Becker, S., Miron-Shatz, T., Schumacher, N., Krocza, J., Diamantidis, C., & Albrecht, U.V. (2014). mHealth 2.0: Experiences, possibilities, and perspectives. *JMIR mHealth uHealth, 2*(2), e24. doi:10.2196/mhealth.3328

Bert, F., Giacometti, M., Gualano, M., & Siliquini, R. (2014). Smartphones and health promotion*: A Review of the Evidence* (38), doi: https://doi.org/10.1007/s10916-013-9995-7

Boeije, H. (2010). Analysis in qualitative research: Sage Publications Ltd. doi: https://doi.org/10.5785/26-2-24

Boulos, M. N. K., Wheeler, S., Tavares, C., & Jones, R. (2011). How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from eCAALYX. *BioMedical Engineering OnLine, 10*(1), 24. doi:10.1186/1475-925x-10-24

Brown, W., Yen, P.Y., Rojas, M., & Schnall, R. (2013). Assessment of the health IT usability evaluation model (Health-ITUEM) for evaluating mobile health (mHealth) technology. *Journal of Biomedical Informatics, 46*(6), 1080-1087. doi:https://doi.org/10.1016/j.jbi.2013.08.001

Chang, A. (2012). UTAUT and UTAUT 2: *A review and agenda for future research* (13). Doi: 10.21512/tw.v13i2.656

Choi, J. H., & Lee, H.-J. (2012). Facets of simplicity for the smartphone interface: A structural model. *International Journal of Human-Computer Studies, 70*(2), 129-142. doi:https://doi.org/10.1016/j.ijhcs.2011.09.002

Cyr, D., Head, M., & Ivanov, A. (2006). Design aesthetics leading to m-loyalty in mobile commerce. *Information & Management, 43*(8), 950-963. doi:https://doi.org/10.1016/j.im.2006.08.009

Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology, 13*(3)*, 319-340, MIS Quarterly.

Dennison, L., Morrison, L., Conway, G., & Yardley, L. (2013). Opportunities and challenges for smartphone applications in supporting health behavior change: qualitative study. *Journal of medical Internet research*, *15*(4), e86-e86. doi:10.2196/jmir.2583

El-Wajeeh, M., Galal-Edeen, G.H., & Mokhtar, H. (2014). Technology acceptance model for mobile health systems, *IOSR Journal of Mobile Computing & Application, 1*(1), 21-33.

Eytam, E., Tractinsky, N., & Lowengart, O. (2017). The paradox of simplicity: Effects of role on the preference and choice of product visual simplicity level. *International Journal of Human-Computer Studies*, *105*, 43-55. doi:https://doi.org/10.1016/j.ijhcs.2017.04.001

Fonteyn, M. E., Kuipers, B., & Grobe, S. J. (1993). A description of think aloud method and protocol analysis. *Qualitative Health Research, 3*(4), 430-441. doi:10.1177/104973239300300403

García-Gómez, J. M., de la Torre-Díez, I., Vicente, J., Robles, M., López-Coronado, M., & Rodrigues, J. J. (2014). Analysis of mobile health applications for a broad spectrum of consumers: A user experience approach. *Health Informatics Journal, 20*(1), 74-84. doi:10.1177/1460458213479598

Gill, P. S., Kamath, A., & Gill, T. S. (2012). Distraction: an assessment of smartphone usage in health care work settings. *Risk management and healthcare policy, 5*, 105-114. doi:10.2147/RMHP.S34813

Hackbarth, G., Grover, V., & Yi, M. Y. (2003). Computer playfulness and anxiety: positive and negative mediators of the system experience effect on perceived ease of use. *Information & Management, 40*(3), 221-232. doi:https://doi.org/10.1016/S0378-7206(02)00006-X

Hamka, F., Bouwman, H., de Reuver, M., & Kroesen, M. (2014). Mobile customer segmentation based on smartphone measurement. *Telematics and Informatics, 31*(2), 220-227. doi:https://doi.org/10.1016/j.tele.2013.08.006

Hassenzahl, M., & Tractinsky, N. (2006a). User experience - A research agenda. *Behaviour & Information Technology,* 25 (2). doi: https://doi.org/10.1080/01449290500330331

Hassenzahl, M., & Tractinsky, N. (2006b). User experience - a research agenda. *Behaviour & Information Technology, 25*(2), 91-97. doi:10.1080/01449290500330331

Heijden, H. v. d. (2004). User acceptance of hedonic information systems *MIS Quarterly, 28*(4), 695-704. doi:10.2307/25148660

Higgins, J. P. (2016). Smartphone applications for patients' health and fitness. *The American Journal of Medicine, 129*(1), 11-19. doi:https://doi.org/10.1016/j.amjmed.2015.05.038

Hingle, M., & Patrick, H. (2016). There are thousands of apps for that: navigating mobile technology for nutrition education and behavior. *Journal of Nutrition Education and Behavior, 48*(3), 213-218.e211. doi:https://doi.org/10.1016/j.jneb.2015.12.009

Holden, R. J., & Karsh, B.-T. (2010). The Technology Acceptance Model: Its past and its future in health care. *Journal of Biomedical Informatics, 43*(1), 159-172. doi:https://doi.org/10.1016/j.jbi.2009.07.002

Jaspers, M. W. M., Steen, T., Bos, C. v. d., & Geenen, M. (2004). The think aloud method: a guide to user interface design. *International Journal of Medical Informatics, 73*(11), 781-795. doi:https://doi.org/10.1016/j.ijmedinf.2004.08.003

Kamel Boulos, M. N., Brewer, A. C., Karimkhani, C., Buller, D. B., & Dellavalle, R. P. (2014). Mobile medical and health apps: state of the art, concerns, regulatory control and certification. *2014, 5*(3). doi:10.5210/ojphi.v5i3.4814

Lee, D., Moon, J., & Kim, Y. J. (2007). *The Effect of Simplicity and Perceived Control on Perceived Ease of Use,* AMCIS 2007 Proceedings, *71*.

Lee, D., Moon, J., Kim, Y. J., & Yi, M. Y. (2015). Antecedents and consequences of mobile phone usability: Linking simplicity and interactivity to satisfaction, trust, and brand loyalty. *Information & Management, 52*(3), 295-304. doi:https://doi.org/10.1016/j.im.2014.12.001

Lee, D., Moon,J., Kim, J. (2007). The effect of simplicity and perceived control on perceived ease of use, *AMCIS 2007 Proceedings, 71*.

Liu, C., Zhu, Q., Holroyd, K. A., & Seng, E. K. (2011). Status and trends of mobile-health applications for iOS devices: A developer's perspective. *Journal of Systems and Software, 84*(11), 2022-2033. doi:https://doi.org/10.1016/j.jss.2011.06.049

Maeda, J. (2006). The laws of simplicity. In: The MIT Press, ISBN:0262134721 9780262134729

Maguire, M. (2001). Methods to support human-centred design. *International Journal of Human-Computer Studies, 55*(4), 587-634. doi:https://doi.org/10.1006/ijhc.2001.0503

McCurdie, T., Taneva, S., Casselman, M., Yeung, M., McDaniel, C., Ho, W., & Cafazzo, J. (2012). mHealth consumer apps: The case for user-centered design. *Biomedical Instrumentation & Technology, 46*(s2), 49-56. doi:10.2345/0899-8205-46.s2.49

Miniukovich, A., & Angeli, A. D. (2014). *Visual impressions of mobile app interfaces*. Paper presented at the Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational, Helsinki, Finland.

Ngo, D. C. L., Teo, L. S., & Byrne, J. G. (2003). Modelling interface aesthetics. *Information Sciences, 152*, 25-46. doi:https://doi.org/10.1016/S0020-0255(02)00404-8

Ozdalga, E., Ozdalga, A., & Ahuja, N. (2012). The smartphone in medicine: A Review of current and potential use among physicians and students. *J Med Internet Res, 14*(5), e128. doi:10.2196/jmir.1994

Plachkinova, M., Andrés, S., & Chatterjee, S. (2015, 5-8 Jan. 2015). *A Taxonomy of mHealth Apps -- Security and Privacy Concerns.* Paper presented at the 2015 48th Hawaii International Conference on System Sciences.

Reza Ariaeinejad, N. A. (2014). Importance of mobile technology in successful adoption and sustainability of a chronic disease support system. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 8*, 902-908.

Ricciardi, L., Mostashari, F., Murphy, J., Daniel, J. G., & Siminerio, E. P. (2013). A national action plan to support consumer engagement via E-Health. *Health Affairs, 32*(2), 376-384. doi:10.1377/hlthaff.2012.1216

Saldaña, J. (2016). *The coding manual for qualitative researchers*, SAGE. Retrieved fromhttps://pdfs.semanticscholar.org/583c/3a3460bd5c98068cfc46236414b1bb89ef5e.pdf

Someren, M. W. v., Barnard, Y. F., & Sandberg, J. (1994). *The think aloud method: a practical guide to modelling cognitive processes*. London; San Diego: Academic Press.

Sonderegger, A., & Sauer, J. (2010). The influence of design aesthetics in usability testing: Effects on user performance and perceived usability. *Applied Ergonomics, 41*(3), 403-410. doi:https://doi.org/10.1016/j.apergo.2009.09.002

Thuring, M., & Mahlke, S. (2007). *Usability, aesthetics and emotions in human–technology interaction* (42).

van den Haak, M., De Jong, M., & Jan Schellens, P. (2003). Retrospective vs. concurrent think-aloud protocols: Testing the usability of an online library catalogue. *Behaviour & Information Technology*, *22*(5), 339-351. doi:10.1080/0044929031000

van Velsen, L., Beaujean, D. J., & van Gemert-Pijnen, J. E. (2013). Why mobile health app overload drives us crazy, and how to restore the sanity. *BMC Medical Informatics and Decision Making*, *13*(1), 23. doi:10.1186/1472-6947-13-23

Venkatesh, V. (2018). Determinants of perceived ease of use: Integrating Control, intrinsic motivation, and emotion into the Technology Acceptance Model. *Information Systems Research, 11*(4), 342-365. doi:10.1287/isre.11.4.342.11872

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, *27*(3), 451-481. doi:10.1111/j.1540-5915.1996.tb00860.x

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425-478.

Venkatesh, V., Thong, J.Y.L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly*, *36*(1), 157-178.

Yuan, C., Ma, W., Kanthawala, S., Peng, W. (2015). Keep using my health apps: Discover users' perception of health and fitness apps with the UTAUT2 model. (21), 735-741, Telemedicine and e-Health.

Appendices

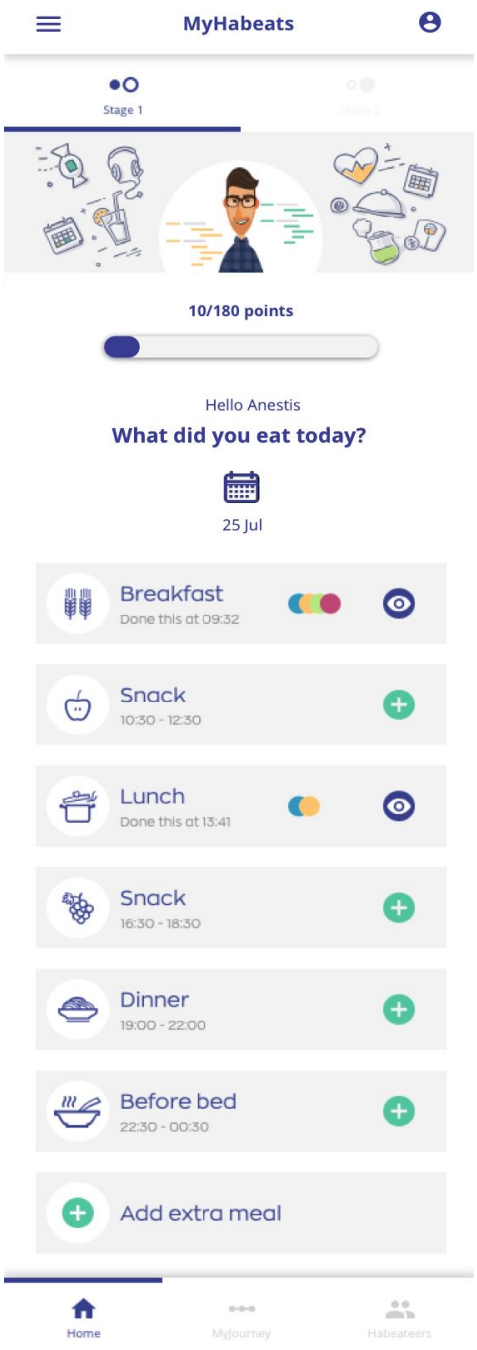
Appendix A: First codebook

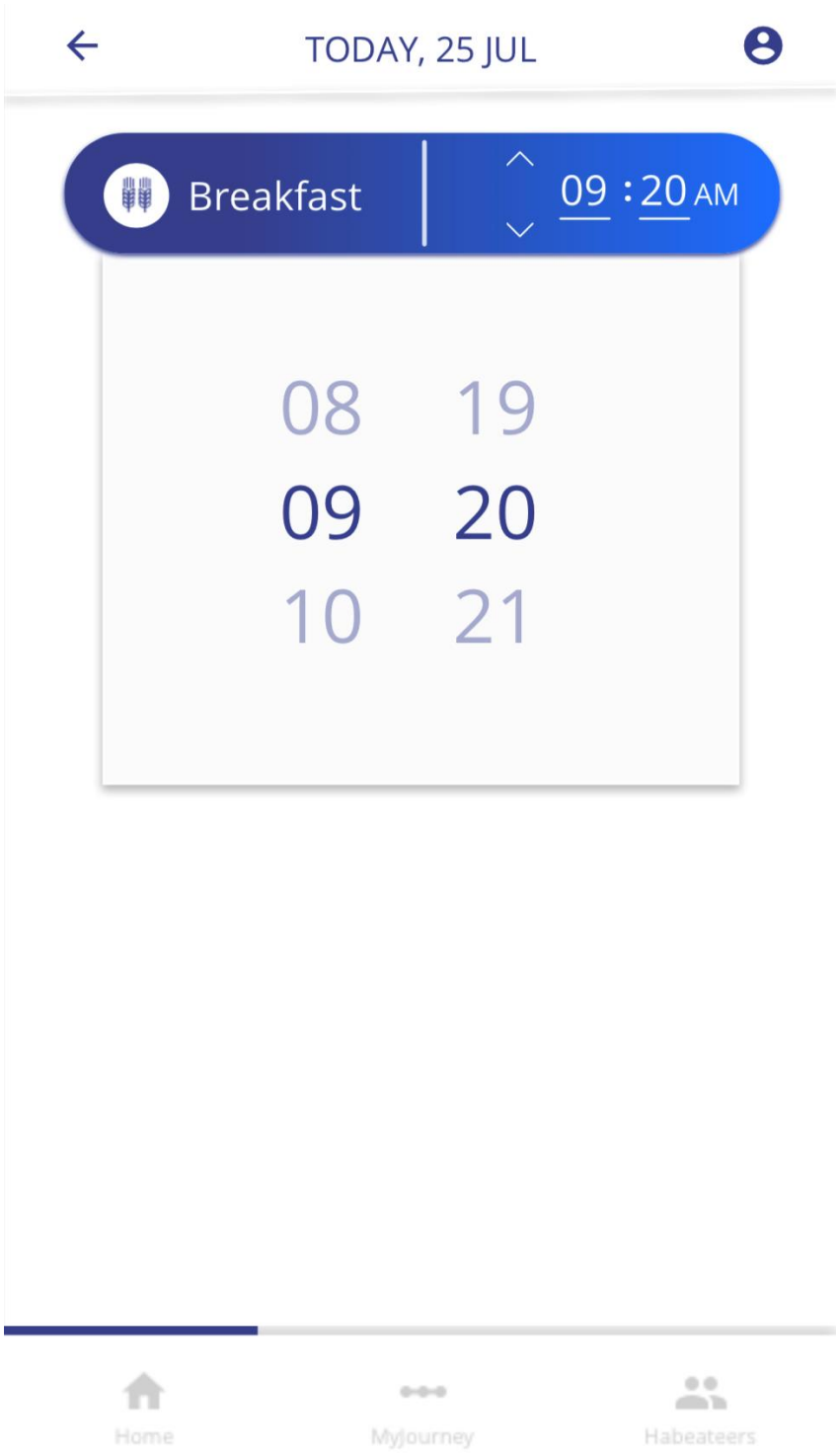
Code	Code group	Code description
simple	simplicity	the user thinks that the app is simple
complicated/confusing	simplicity	the user thinks that the app is complicated/confusing
easy	perceived ease of use	the user perceives the app to be easy
difficult	perceived ease of use	the user perceives the app to be difficult
understandable	perceived ease of use	the user understands the app
not understandable	perceived ease of use	the user does not understand the app
visually appealing	visual aesthetics	the user thinks that the app's interface looks nice
visually not applealing	visual aesthetics	the user thinks that the app's interface does not look nice
well organised	information design	the user thinks that the information of the app is organised
not well organised	information design	the user thinks that the information of the app is not organised
too much information	information design	the user thinks that there is too much infromation on the app
too little information	information design	the user thinks that there is too little information on the app
enjoyful	perceived enjoyment	the user enjoys interacting with the app
not enjoyful	perceived enjoyment	the user does not enjoy interacting with the app
interactive	perceived enjoyment	the user thinks that the app is interactive
not interactive	perceived enjoyment	the user thinks that the app is not interactive
usage intention	usage intention	the user would use the app again
no usage intention	usage intention	the user would not use the app again

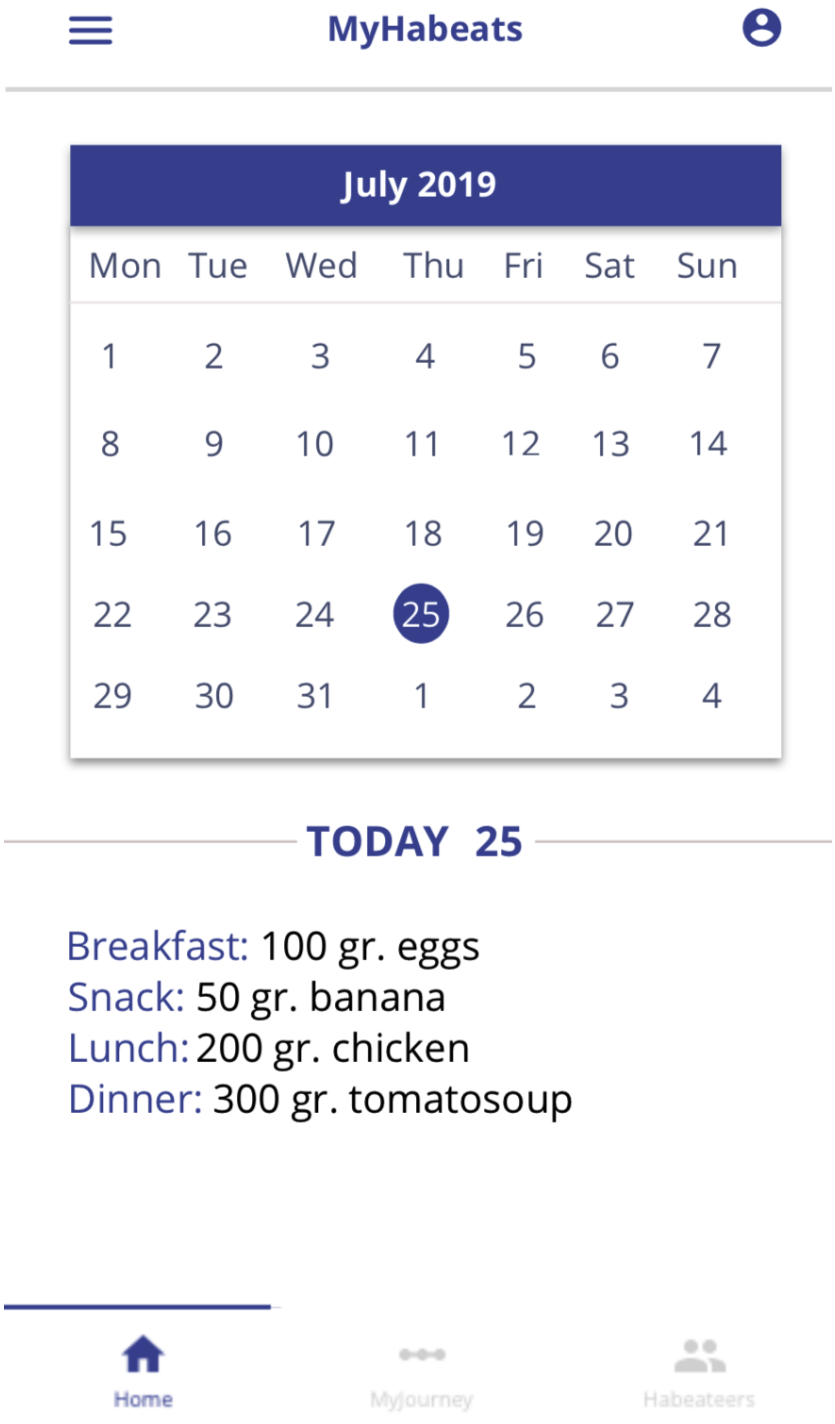
Appendix B: Revised codebook

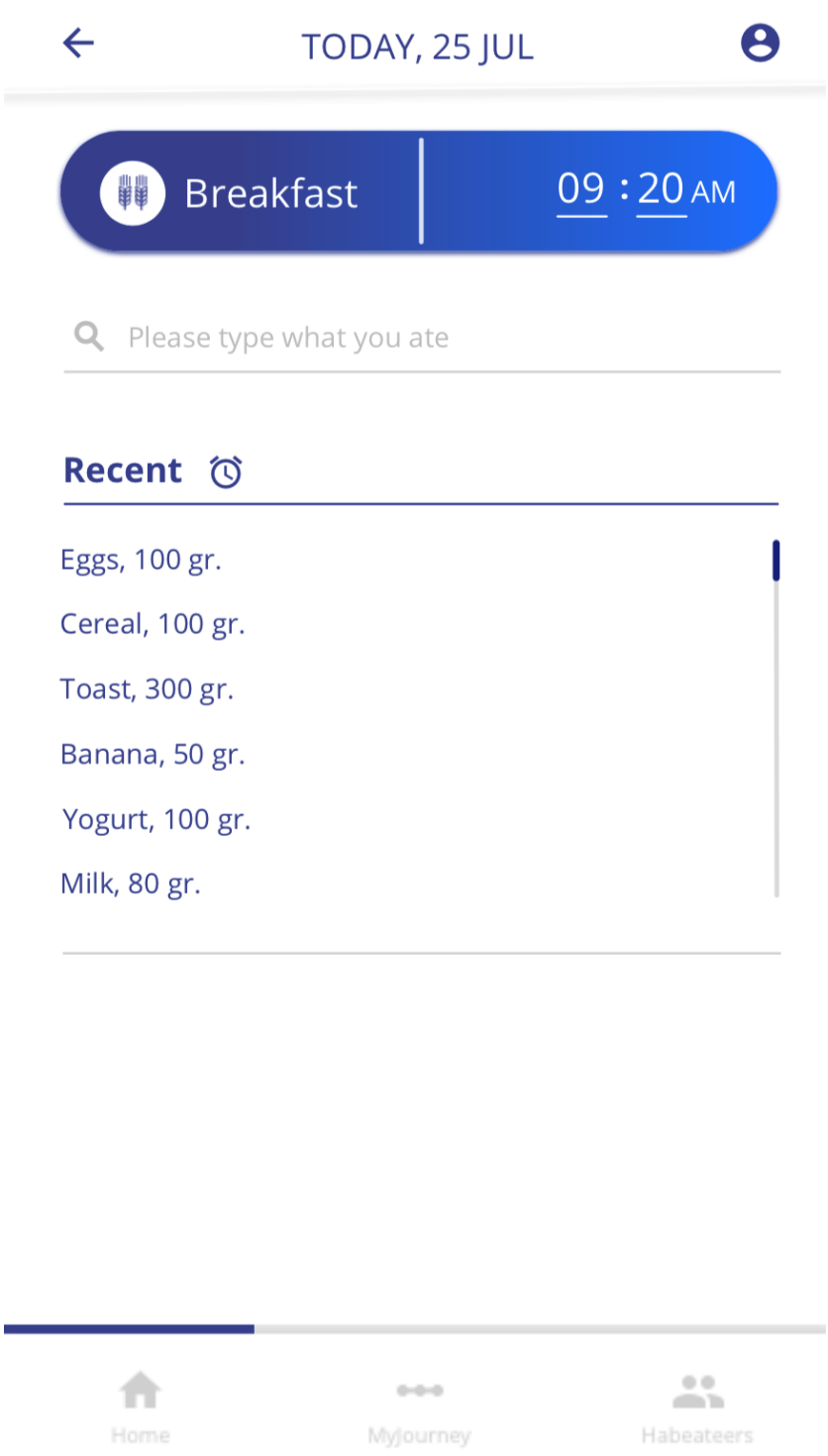
Code	Code group	Code description	Amount of times used
simple	simplicity	the user thinks that the app is simple	30
complicated/confusing	simplicity	the user thinks that the app is complicated/confusing	223
easy	perceived ease of use	the user perceives the app to be easy	39
difficult	perceived ease of use	the user perceives the app to be difficult	44
visually appealing	visual aesthetics	the user thinks that the app's interface looks nice	86
not visually appealing	visual aesthetics	the user thinks that the app's interface does not look nice	52
well organised	information design	the user thinks that the information of the app is organised	25
not well organised	information design	the user thinks that the information of the app is not organised	5
too much information	information design	the user thinks that there is too much infromation on the app	9
too little information	information design	the user thinks that there is too little information on the app	28
enough steps	information design	the user thinks that the navigation of the app has enough steps	14
unnecessary steps	information design	the user thinks that the navigation of the app has unnecessary steps	13
consistent	information design	the user thinks that the information of the app is consistent during the navigation	24
incosistent	information design	the user thinks that the information of the app is inconsistent during the navigation	2
enjoyable	perceived enjoyment	the user enjoys interacting with the app	19
not enjoyable	perceived enjoyment	the user does not enjoy interacting with the app	18
usage intention	usage intention	the user would use the app again	11
no usage intention	usage intention	the user would not use the app again	14
useful	perceived usefulness	the user finds the app useful	5
not useful	perceived usefulness	the user does not find the app useful	26
complete	completeness	the user finds the app complete	8
incomplete	completeness	the user does not find the app complete	40

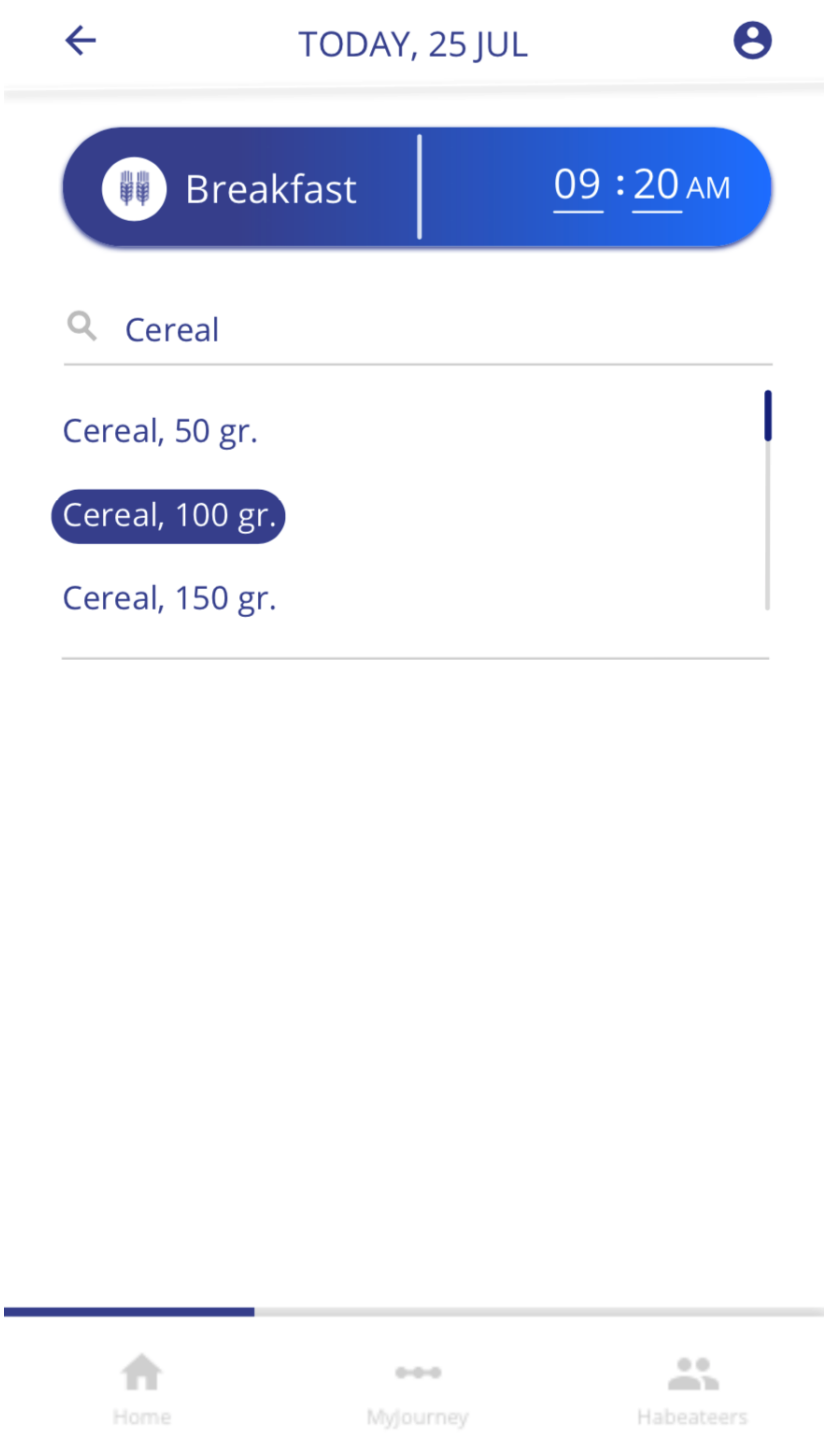
Appendix C: Redesign of the app

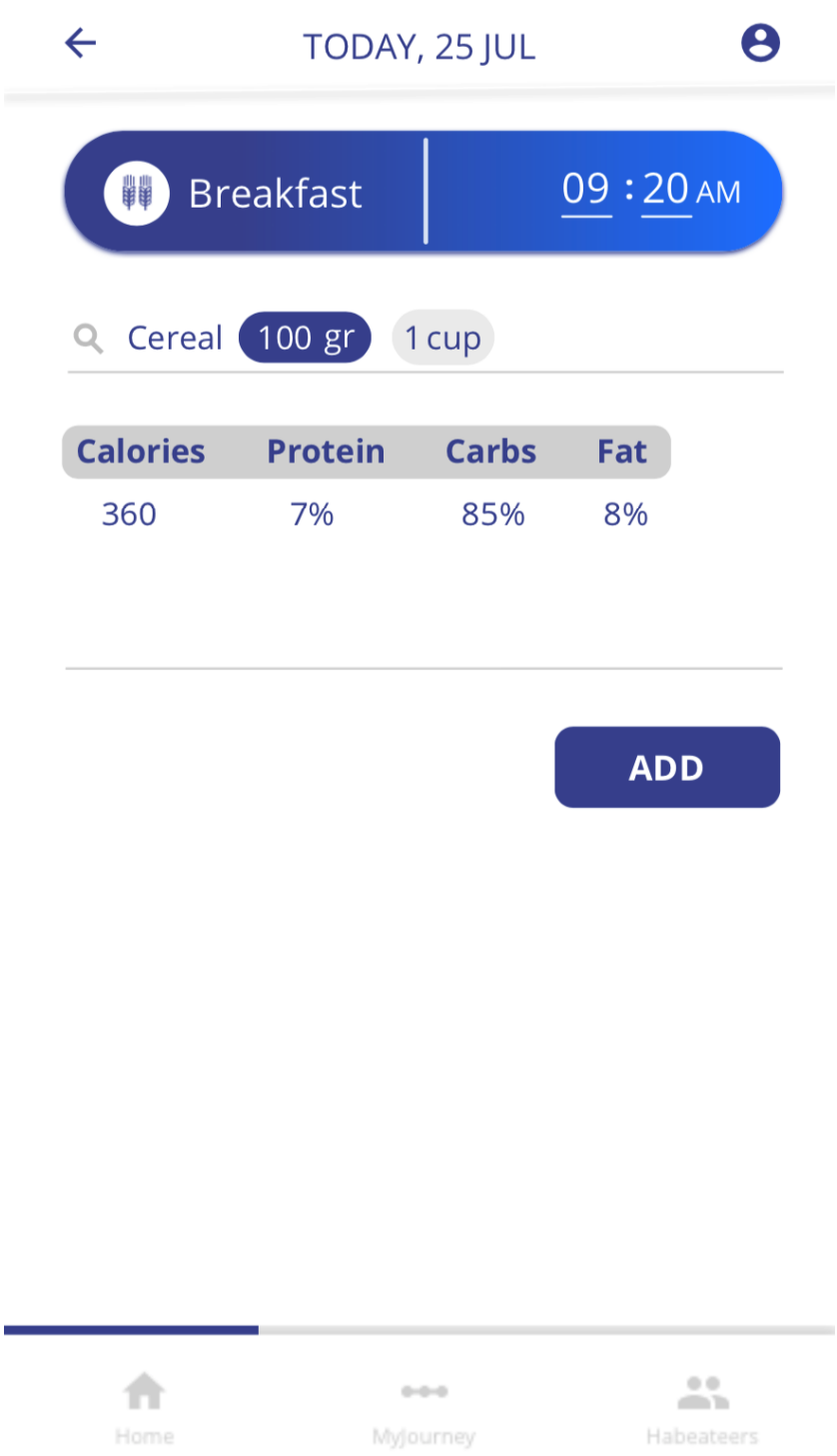

MyHabeats
Stage 1
10/180 points
Hello Anestis
What did you eat today?
25 Jul
Breakfast
Done this at 09:32
Snack
10:30 - 12:30
Lunch
Done this at 13:41
Snack
16:30 - 18:30
Dinner
19:00 - 22:00
Before bed
22:30 - 00:30
Add extra meal
Home
MyJourney
Habeateers

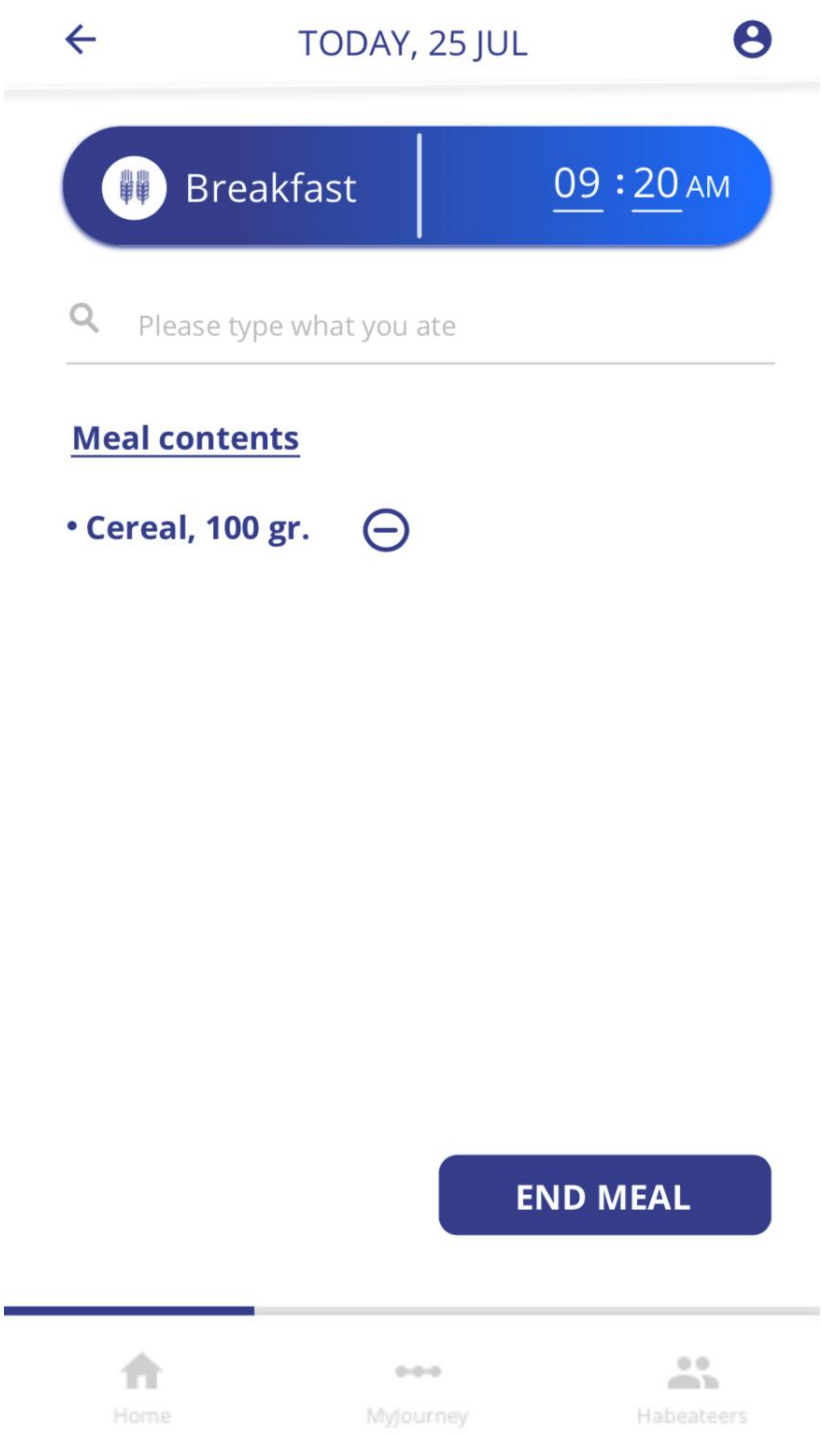

TODAY, 25 JUL
Breakfast
09 :20 AM
08 19
09 20
10 21
Home
MyJourney
Habeateers

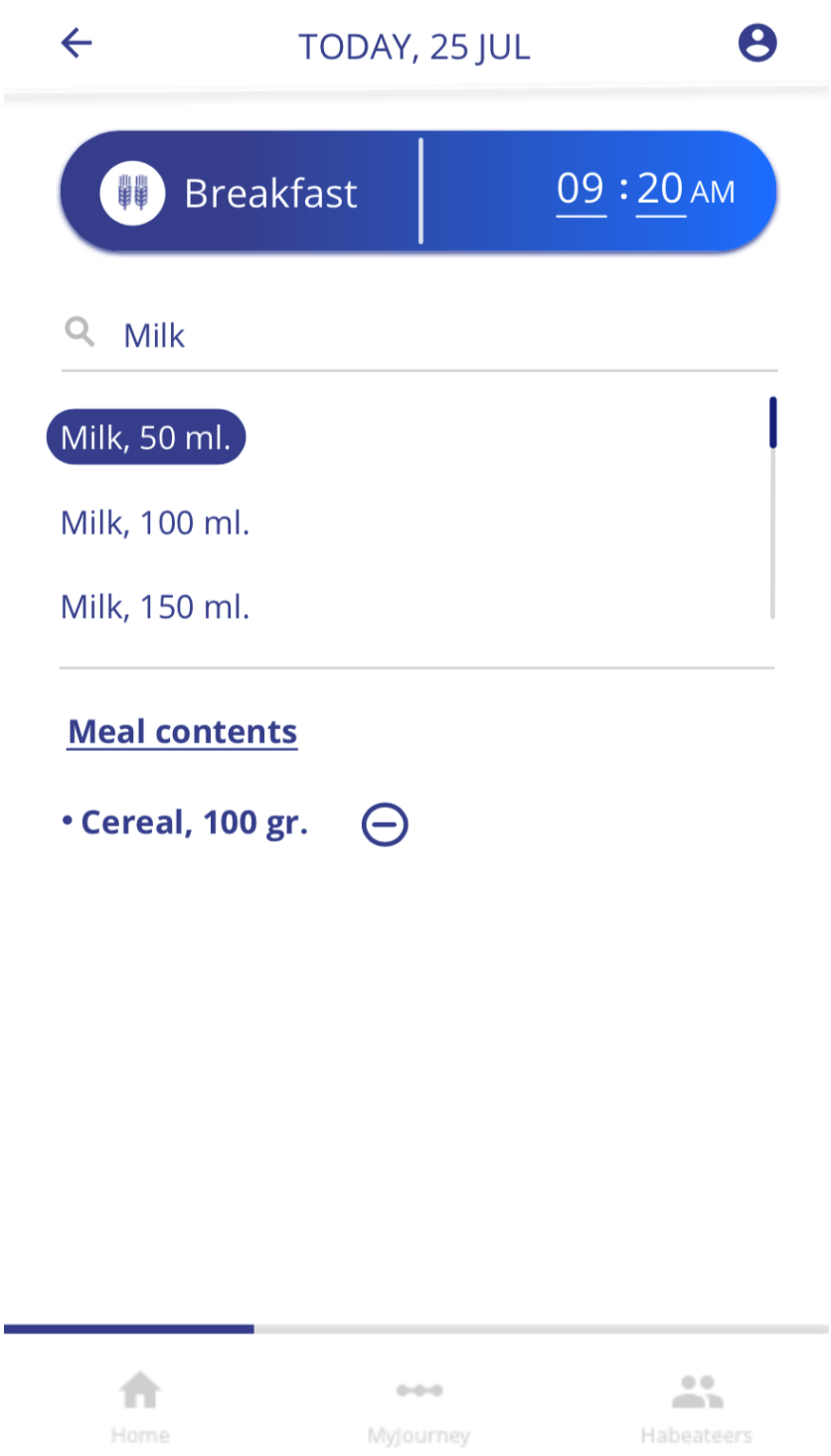

MyHabeats
July 2019
Mon Tue Wed Thu Fri Sat Sun
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31 1 2 3 4
TODAY 25
Breakfast: 100 gr. eggs
Snack: 50 gr. banana
Lunch: 200 gr. chicken
Dinner: 300 gr. tomatosoup
Home
Myjourney
Habeateers

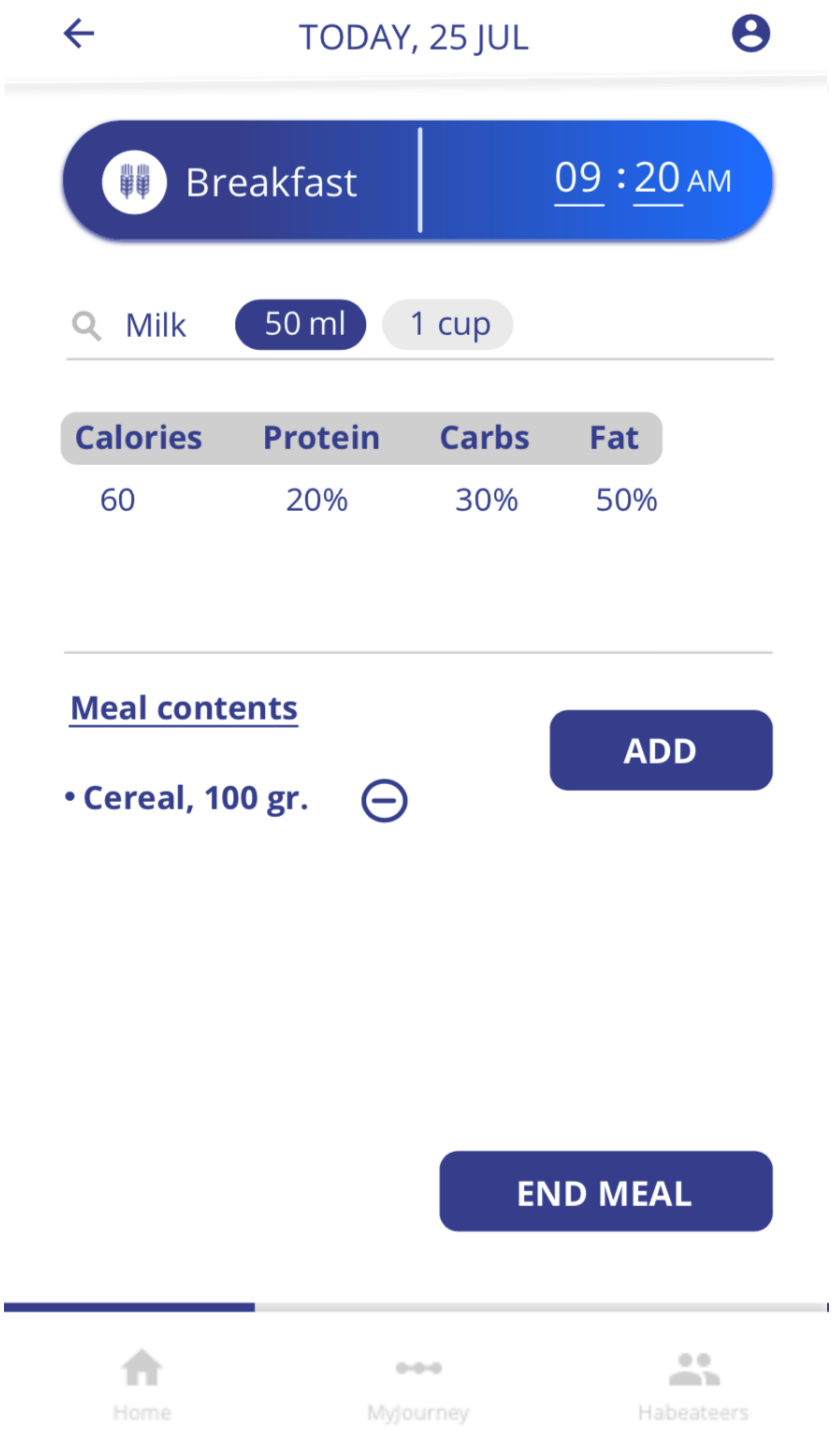

TODAY, 25 JUL
Breakfast
09 : 20 AM
Please type what you ate
Recent
Eggs, 100 gr.
Cereal, 100 gr.
Toast, 300 gr.
Banana, 50 gr.
Yogurt, 100 gr.
Milk, 80 gr.
Home
Myjourney
Habeateers

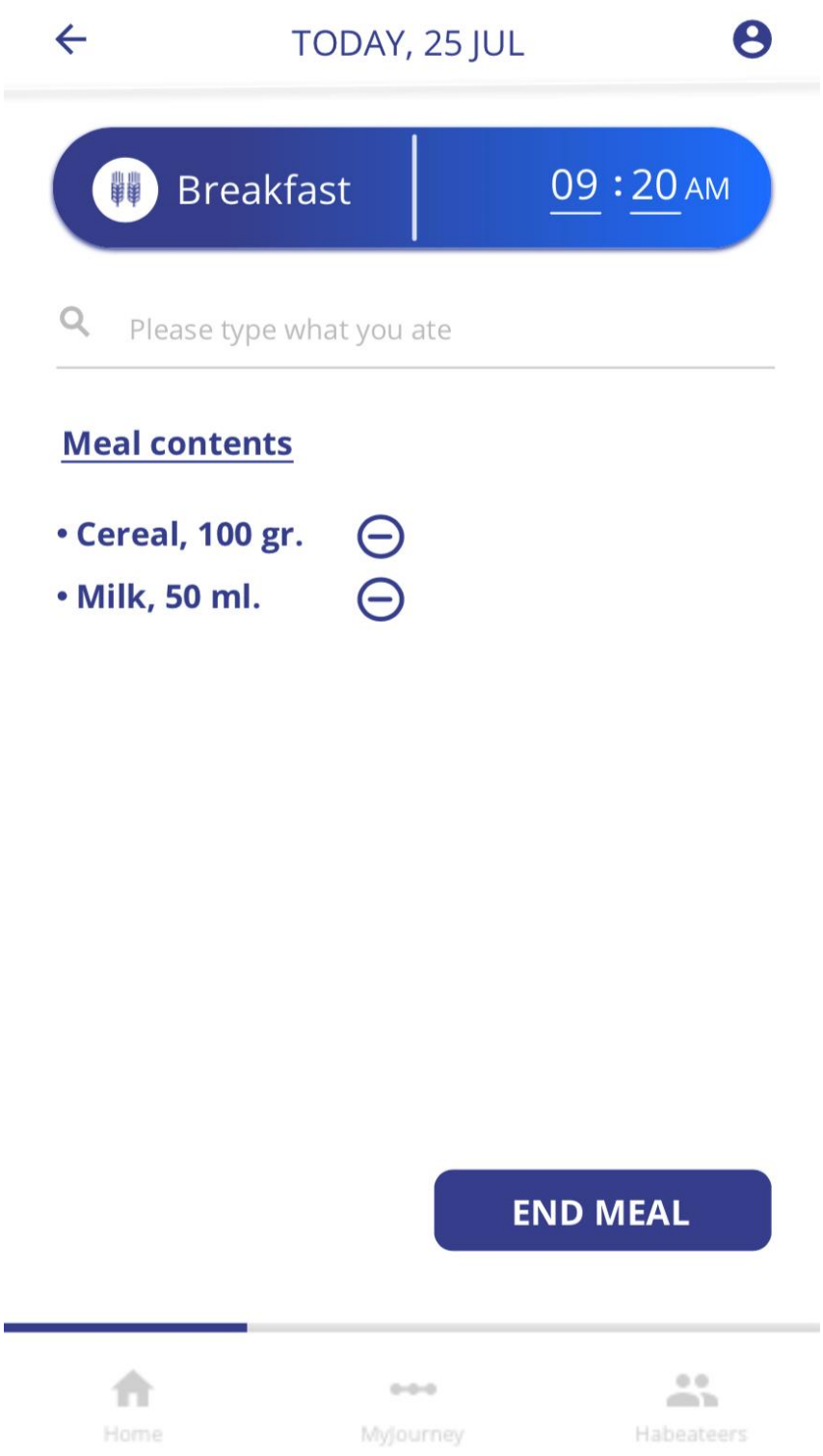

TODAY, 25 JUL
Breakfast
09 : 20 AM
Cereal
Cereal, 50 gr.
Cereal, 100 gr.
Cereal, 150 gr.
Home
MyJourney
Habeateers

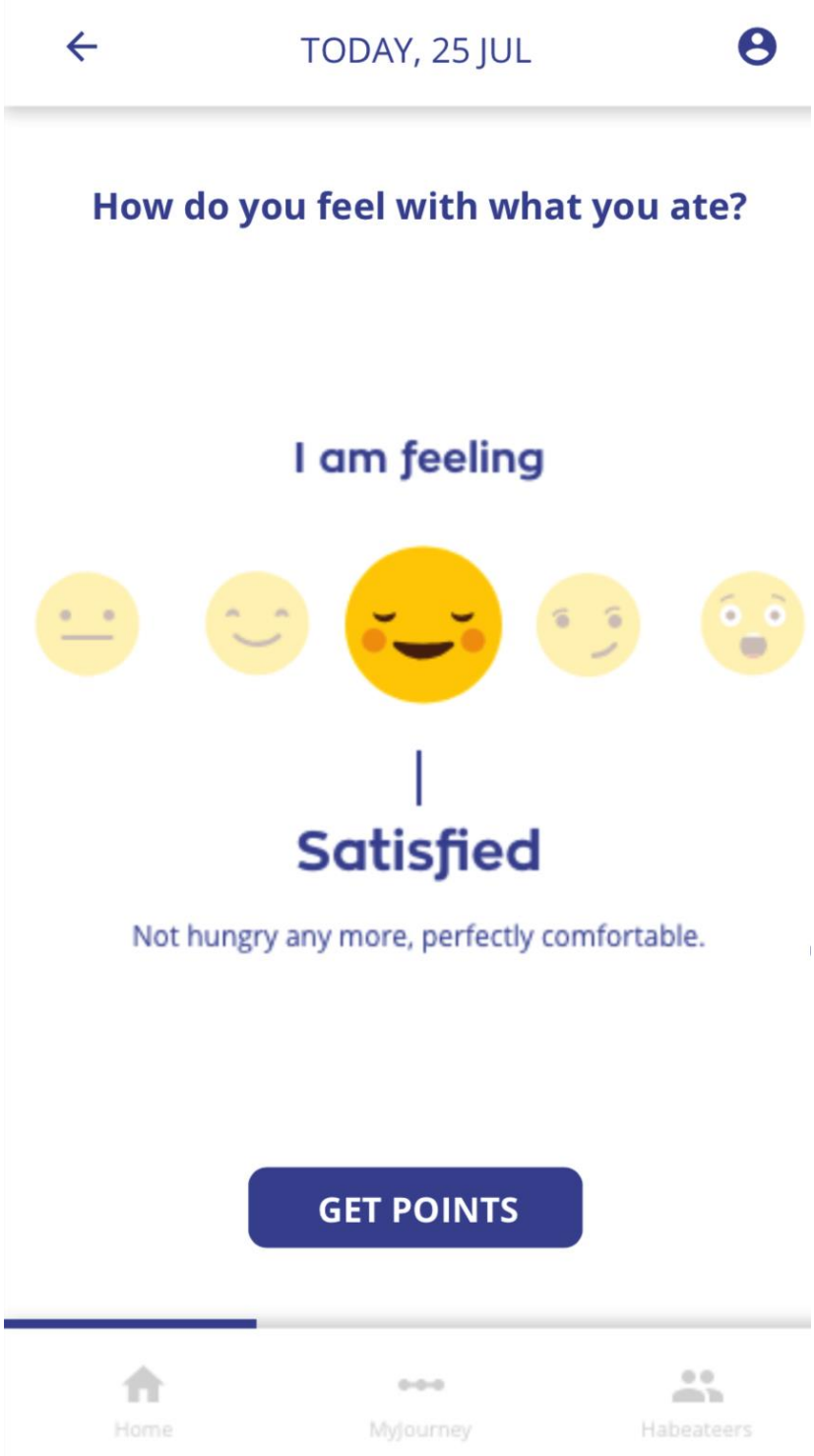

TODAY, 25 JUL
Breakfast
09 : 20 AM
Cereal
100 gr
1 cup
Calories
Protein
Carbs
Fat
360
7%
85%
8%
ADD
Home
Myjourney
Habeateers

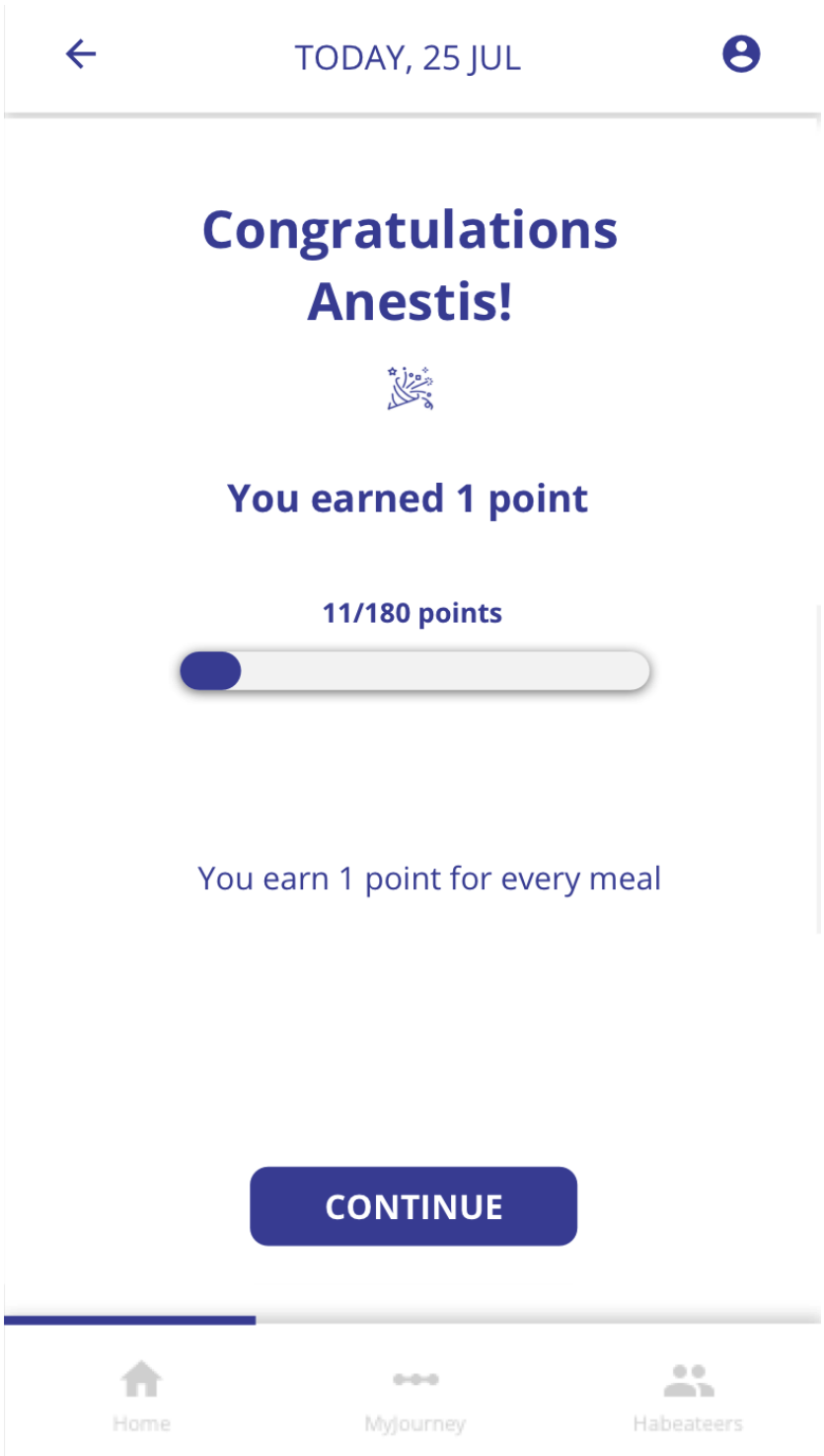

TODAY, 25 JUL
Breakfast
09 : 20 AM
Please type what you ate
Meal contents
• Cereal, 100 gr.
END MEAL
Home
Myjourney
Habeateers


TODAY, 25 JUL
Breakfast
09 : 20 AM
Milk
Milk, 50 ml.
Milk, 100 ml.
Milk, 150 ml.
Meal contents
• Cereal, 100 gr.
Home
Myjourney
Habeateers


TODAY, 25 JUL
Breakfast
09 : 20 AM
Milk
50 ml
1 cup
Calories
Protein
Carbs
Fat
60
20%
30%
50%
Meal contents
ADD
• Cereal, 100 gr.
END MEAL
Home
Myjourney
Habeateers


TODAY, 25 JUL
Breakfast
09 : 20 AM
Please type what you ate
Meal contents
• Cereal, 100 gr.
• Milk, 50 ml.
END MEAL
Home
MyJourney
Habeateers


TODAY, 25 JUL
How do you feel with what you ate?
I am feeling
Satisfied
Not hungry any more, perfectly comfortable.
GET POINTS
Home
Myjourney
Habeateers


TODAY, 25 JUL
Congratulations Anestis!
You earned 1 point
11/180 points
You earn 1 point for every meal
CONTINUE
Home
Myjourney
Habeateers