NearBy

The design and development of an application for self-registering meals during online treatment for eating disorders.

Link to Git Repository

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ABSTRACT

As a result of long waiting queues for patients seeking treatment for eating disorders, several clinics have invested in digital treatments (Riksät, n.d). One such online treatment is NÄRA, an initiative by Stockholm Center for Eating Disorders, where a central part of the treatment is for patients to daily register and reflect upon all their meals and other behaviors connected to the eating. However, the current platform for this registration is inadequate as a successful self-tracking tool, since none of four patients that participated in a survey (see Section 5.1 Result of pre-study survey) responded that they register their meals in connection to their meal-time. This project addresses how self-tracking of meals during online treatment for eating disorders can be improved to increase the user experience and motivation, while ensuring the quality of the treatment. Based on literature on personal informatics and human behavior, a native application was designed and developed as a minimal viable product (MVP), where patients can register meals and compensations and reflect upon them, set up- and edit a meal plan, and see visualized personal data for further reflection and behavior analysis. The design and MVP were evaluated using qualitative evaluation methods, where patients found it easy to use the application and believed that it would increase their self-tracking rate, and the clinicians found the MVP promising. Further work includes implementation of non-developed design ideas, and more both qualitative and quantitative evaluations.

1. INTRODUCTION

1.1 Motivation

The number of people getting admitted for eating disorders is constantly increasing, which has amplified the pressure on treatment centres (Elfström, 2018). According to the national quality register for eating disorders, the number of new registrations of patients with an eating disorder increased by 809% from 2003 to 2018 in Sweden, i.e.. from 314 patients in 2003 to

2540 patients in 2018 (Riksät, 2020). In order to meet that demand, many institutions have begun to give digital treatments where the patient gets guidance and exercises online instead of having to be physically present at a treatment centre (Riksät, n.d). Stockholm Centre for Eating Disorders, (SCÄ), is an initiative under Stockholm County Council and The Karolinska Institute that currently is one of the world's largest specialist clinics that strives to develop and improve eating disorder care. SCÄ conducts development projects and research close to the clinical activities and in collaboration with other research groups in order to increase knowledge about eating disorders and to improve care for patients. In addition to their treatment centre where they meet patients physically, they provide online treatment, NÄRA, aimed at adult patients with bulimia and binge eating problems. NÄRA is available for patients with other types of eating disorders as well. The treatment is based on the evidence-based treatment method Enhanced Cognitive Therapy (CBT-E) and is specially developed as a result of many years of research and evaluation (Stockholm Centrum för Ätstörningar, n.d).

Regardless of if a patient undergoes treatment for an eating disorder at a centre or online, an

important step in the treatment is that the patient needs to self-track their meals. Information that is required from the patient in the self-tracking is details about the meal they ate, the context of where and with whom they ate, together with a reflection on how they felt during the meal. NÄRA's current self-tracking solution provides the patient with relevant questions and forms to fill in so that the patient can self-track their meals and emotions. The researchers behind NÄRA argue that it is crucial that the registration takes place in connection to the meal for the reflection to be as meaningful as possible. However, according to a survey with 8 patients that previously had been gone through, or is going through treatment for an eating disorder, none of the 4 patients that had used self-tracking in their treatments responded that they register their meals in connection to their meal-time (See appendix 1).

According to the clinicians and designers behind the development of NÄRA, the current solution that NÄRA provides to their patients is inadequate as a successful self-tracking tool. The main issue with such a self-tracking tool is to balance the user experience of the self-tracking flow with the quality of the treatment. From the patient's point of view, the threshold for self-tracking has to be decreased and the tracking itself needs to be seamless and not take too much effort. On the other hand, from the clinicians' point of view, the self-tracking needs to be elaborative and include reflections as well as context of when the registered meals occurred. For the clinician to provide a good treatment for the patient, the self-tracking needs to find the right balance between these two perspectives.

1.2 Research Question

How can the self-tracking of meals during an online treatment for eating disorders be improved for increased user experience and motivation?

2. RELATED WORK

Below follows a literature review of work related to this project.

2.1 Personal Informatics

Along with the propagation of wearable technologies and gamified applications, personal informatics (PI) has become a well-known technology that enables people to self-monitor, and self-track themselves (Suh & Cheung, 2017). By using software and hardware systems, personal informatics technologies facilitate individuals to collect personal information for the purpose of increasing self-control, foster insights and promoting positive behavioral changes (ibid). By tracking and analyzing data on well-being, finances, weight, and physical activity, personal informatics can help people experience self-improvement by enabling them to explore and reflect upon the information (Lupton, 2014). However, there is an ambiguity in the research regarding PI tools. Moreover, there is research that indicates the benefits of using PI tools for behavioral change, as well as research that signals the contrary, that PI tools often are ineffective at enabling a change of behavior. (ibid)

In a study with 68 participants conducted in 2010, researchers were investigating the problems that users experience during collecting and reflecting upon personal information (Li. et al, 2010). Based on the research, a stage-based model of personal informatics was developed. The model is composed of a series of five stages: *Preparation*, *Collection*, *Integration*, *Reflection*, and *Action*. Every stage has its barriers that must be considered in order to design a personal informatics system that enables people to successfully collect their personal data.

Preparation: The preparation stage is the phase that occurs before people start to collect their data and refers to the process where the person determines which tools to use for their specific purpose. The determination process can be seen as a barrier if the choices are too many, and the user switches tools during the process, thus valuable data may be lost.

Collection: This stage is where people collect and observe their personal information, such as their interactions with people, their inner thoughts, and their behavior. Several barriers could be identified during this stage, both user-related and data-related. The user-related barriers can occur due to lack of time, lack of motivation, or out of obliviousness. Data-related barriers are connected to difficulties collecting accurate information, such as the estimations are too subjective or there are no standards to compare with, making the gathering of data inadequate.

Integration: In the integration stage, the collected information is prepared, combined, and

transformed for the user to later examine and reflect on in the reflection stage. In this stage, users can experience barriers if the gathered information is too hard to transform into visualized data, e. g. the user needs to transcribe their handwritten notes into their phones.

Reflection: In this stage, the user gets to reflect on their gathered information. If the information is presented so it is difficult to understand it can prevent users from exploring and reflecting on their data, thus becoming a barrier. Furthermore, another barrier in this stage is the lack of time.

Action: The last stage is where people decide how to proceed with their newfound understandings of themselves. To avoid barriers or failing in this stage, goals or system-generated actions is beneficial. (ibid)

2.2 Human Behavior

According to Fogg's Behavior Model (FBM), a behavioral change requires three elements that converge at the same time: *motivation, ability*, and *trigger* (Fogg, 2009). A person needs to be sufficiently motivated to change their behavior, they must acquire the ability to make the change and lastly, they need a trigger that sets the change in motion. According to the behavior model, initially, the motivation must occur to establish a change (ibid). Motivation, in general, is the internal process that encourages people to make a change or take on a new challenge (Sansone & Harackiewicz, 2000). Furthermore, people need to have the ability to make a change. Hence, designers of persuasive experiences must, to increase their user's ability, enable the behavior to happen (Fogg, 2009). Moreover, potential barriers must be reduced for users to perform a target behavior. According to Fogg, the elements of motivation and ability are related to one another as trade-offs. Hence, when motivation is low, behavioral change can still occur if the ability is high, and vice versa. Besides motivation and ability, a change of behavior needs a trigger that sets the behavior in motion. A successful trigger has three characteristics. Firstly, the trigger is noticeable for the user, secondly, it is associated with the target behavior, and lastly, the trigger alarms the users when they are motivated and can perform the target behavior (ibid). Many self-tracking applications provide triggers in the form of notifications since they nudge their recipients to perform a particular behavior (Bentley & Tollmar, 2013). Most notifications include the user to set the time, duration, and eventual reminders of the notice. Thus, it is the user's task to estimate when they believe that their target behavior should occur. According to the study by Bentley and Tollmar (2013), adding notifications increased the frequency of logging food intake from 12% to 63%, a greater than 5x improvement. Participants in the study stated that the reminders were appreciated since they recognized how easy it was to forget to perform the logging without the reminders (ibid).

3. METHOD

The method consisted of two main phases, the Design phase (see Section 3.1 Design phase) and the Development phase (see Section 3.2 Development phase)

3.1 Design phase

The design phase consisted of a literature review, a pre-study survey, stakeholder interviews, sketching and prototyping, and user testing.

3.1.1 Literature review

A literature review was conducted to find a solid ground for the problems and barriers that occur during the collection of personal information. Further, the literature review was carried out to find a standpoint for the design choices that were to be implemented in the minimum viable product (MVP). This resulted in insights regarding how to use motivational features and aspects of seamless interaction.

3.1.2 Pre-study survey

A pre-study in form of a survey was conducted with the aim to gain insights into how patients with an eating disorder experienced self-tracking of meals. The target group was all people that are going or have gone through treatment for eating disorders. Eight patients participated in the survey, however, only four of the participants self-track their meals during their treatments. The survey let participants elaborate on how they perceived the self-tracking of their meals, and how they usually executed their meal registrations (see appendix 1). The answers were valuable for the development of the MVP as they underlined what was important from the users' perspective.

3.1.3 Stakeholder interview

Multiple interviews with experts from the Karolinska Institution were carried out throughout the entire project. Initially to understand the scope of the problem from stakeholders' and experts' points of view, and to comprehend what their needs and concerns were regarding the self-tracking of meals for their patients. During the design- and development process, the stakeholders and experts continuously validated the ideas and possible solutions for the MVP and figured as a sounding board when questions arose. This resulted in valuable insights, especially since much information regarding eating disorders is considered as delicate, together with propositions for future work.

3.1.4 Sketching/prototyping

When the gathered information and data were collected and analyzed, a brainstorming session was conducted. This to define the requirements that could be determined from the findings in the pre-study. The requirements were divided into 4 categories: Food registration, Reflection, Flow/ Layout/ Structure, and Extra features. Moreover, the categories facilitated the design process and ensured that no valuable functionalities were forgotten. An initial design in form of a clickable prototype was created in Figma to work as a blueprint for the MVP that was later created during the development phase (see Appendix 2).

3.1.5 User testing

A qualitative user testing was conducted with the aim to gain insight into how users perceive and move through the prototype. The user testing was in the form of a think-aloud usability test of the clickable prototype together with a semi-structured interview. The testing was initially planned to be executed through physical meetings, however, due to the current situation regarding COVID-19, physical meetings were restrained so the testing were performed through digital tools. 5 user tests were conducted with users that had no previous experience with online treatments for eating disorders, hence the user experience was the parameter that was tested. The users were instructed to perform tasks throughout the prototype, thus examining the user flow, what was apparent, and what could be improved. (see Appendix 3)

3.2 Development phase

The development phase consisted of a review of what tools to use, the development of a minimal viable product (MVP), and lastly a patient evaluation.

3.2.1 Tools

A backlog with to-dos was conducted in Trello and GitHub was used for collaboration.

The working application was developed using React Native (React Native, Oct 29), a framework for building native apps using React. As for state management, React Hooks was used since it made it possible to reuse logic and behavior without having to change the hierarchical structure of the components. User data was shared globally using the context hook, and stored in Firebase using authentication and Cloud Firestore.

3.2.2 Development

The development of the application was based on the design choices resulting from the design phase, where an MVP was developed to cover the most crucial requirements established in the design phase.

3.3.3 Patient evaluation

Once the MVP was developed, a qualitative evaluation was conducted with a patient currently under online treatment for eating disorders. This evaluation focused less on usability since that already had been evaluated in the design phase. Thus, the purpose of this evaluation was to evaluate how the application was perceived to help the self-registration of meals and other activities by a patient. The evaluation took place online and in the format of a semi-structured interview. The MVP was shown to the patient using an IOS simulator (go to simulator), and questions were asked, such as:

- What do you think about this way to register meals and reflection?
- What would you have expected when clicking on X?
- How do you experience the overview?
- Why?

4. RESULT

Below the results from the pre-study survey, the stakeholder- user-, and patient evaluations, and the final delivery are presented.

4.1 Result of pre-study survey

The survey showed that 3 participants (75%) that self-tracked their meals during treatment for eating disorders usually registered through their smartphone. Further, 4 of the participants (100%) answered that they would have preferred to register through their smartphones. 3 of the participants wrote that they found their current meal-registration applications very complicated and time-consuming. Moreover, one of the participants elaborated and specified that they usually forgot to register since it was so problematic to log in to the application. On the question regarding how detailed the participants were in their meal-registrations, 3 participants (75%) answered that they registered their meals with minimum details, e.g., only with brief information about time and meal. One participant elaborated on the question regarding possible obstacles for meal-registrations and concluded that the manual input of data was an obstacle that prevented them from successfully self-track their meals. Furthermore, another participant answered that it was too complicated overall to register and that it was problematic to add comments on something that did not apply to their personal experiences. 3 participants (75%) answered that the most common reason for not registering their meals was because they did not have the strength to do it. (See Appendix 1)

4.2 Result of user testing

The results from the user testing confirmed that the registration and reflection forms were found to be simple, and seamless for the users. Moreover, the favourite feature in the registration form and the simple reflection form with pre-set questions were the two predominant features that contributed to the seamless interaction. However, multiple opportunities for improvements were found. The key take-aways from the user testings were the following:

- It was unclear where the previously registered meals could be found
- It was unclear where the added compensations end up
- The icons were misleading in the tab bar and in the meal plan
- The copy was not motivational, and too inhuman
- It was unclear what "1 raspberry" was. Hence, if it meant one raspberry or one portion of raspberries?

(see Appendix 3)

4.3 Stakeholder evaluations

The stakeholder interviews gave insights about what aspects needed to be considered during the design of the application, where the below aspects were found as very important:

- The possibility to reflect over the meals
- The possibility to elaborate on the context in which the meal was eaten or not eaten
- The patient should be able to find patterns in their eating
- The patient needs to register continuously

The final stakeholder evaluation of the design gave insights from the clinicians' perspective on how the application would work as a tool to be used during the online treatment. The clinicians found the user interface to be very user friendly, that it was good with the overview section of registered and eaten meals and that the patient can edit their meal plan and turn on notifications. They also proposed that the number of answer options in the reflection part could be increased, for the clinicians to get an even better understanding of the context in which the patient ate or didn't eat their meal. Additionally, they suggested that to enhance the possibility for the patient to analyze their behavior, a feature of seeing how long it has been between two meals in the overview section would be a good improvement.

4.4. Patient evaluation

The patient evaluation of the MVP confirmed that the application could make the registration easier for the patient. The patient stated that he thought it would be easier to register at the time of the meal with a mobile application and that it was smooth that he could save foods as favourites for different kinds of meals: "Smooth to have saved items as favourites, I always eat the same thing for breakfast so that feature is nice!". Additionally, he liked the overview and understood what the overview showed and said that it could work as a tool for analyzing both his registration and for his eating habits. As for the actual reflection part, he thought that he "[...] really like

the reflection form, I don't have the time or energy to comment with free text with every meal so it was nice that it was pre-set questions", and that this probably would make him register his meal more often.

4.1.3 Final delivery

Link to git repository

The final delivery consists of three major functionalities: the possibility to register meals and compensations, edit a meal plan, and an overview page with statistics and previous registrations (see Images X, Y & Z). First, the user needs to log in to the application, and if they don't have an account, they can create one (see Image 1 & 2).

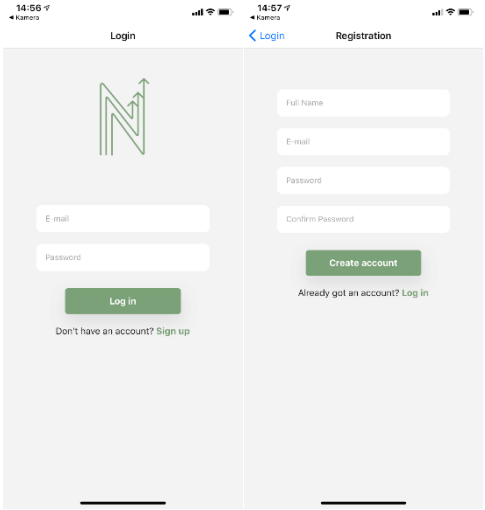

Image 1 - *Login page*

Image 2 - *Sign up page*

When entering the application, the home screen shows all planned meals for the day (see Image 3 & 4). The meals presented here are all part of the user's personal meal plan, which can be found under the meal plan tab in the tab bar. If the user clicks on a card, a three-step meal form will appear as a modal. First, the user answers if they ate the meal or not. If the meal was eaten, the user can add what they ate, either through adding it manually or by picking food from their own saved favourites list (see Image 5). The favourite list is personal and different depending on which type of meal it is: breakfast, lunch, dinner, or snack. The next step in the meal registration is the reflection form, where the user needs to fill in when they ate the meal, how they felt, who they ate with, and where (see image 6). All but the feeling inputs are selectable, pre-set option answers, and the feeling input is a slider. In the last step in the meal registration before submitting, the user can elaborate in the free text about their meal, and how they felt in the context of the meal (see Image 7). During the meal registration, the user can follow the steps in the progress bar. When a meal is added, the card in the home screen becomes green, and if a meal was not eaten, the bar has a lighter green color (see Image 4).

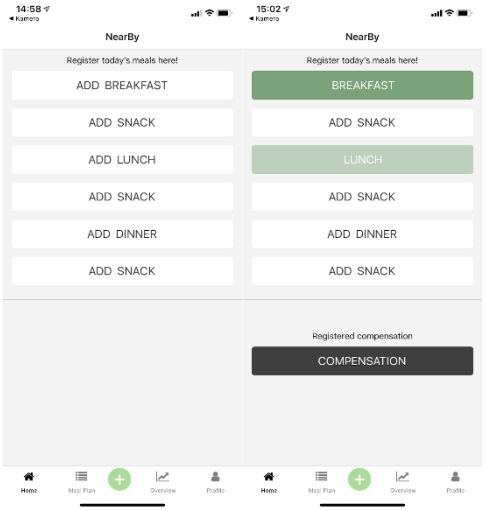

Image 3 - *Home page with no registered meals*

Image 4 - *Home page with some registered meals and one compensation*

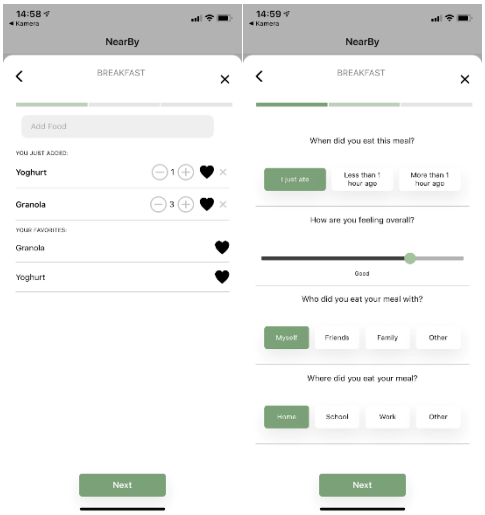

Image 5 - Adding food by searching or pick from favourites

Image 6 - The reflection form

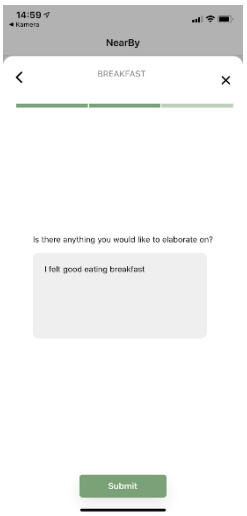

Image 7 – *The elaborate step*

The user can also choose to add a compensation or an extra snack using the plus button in the tab bar. A similar step-by-step form similar to the meal registration form will then appear, and the extra snack and/or compensation will also appear in the start page (see Image 4).

Secondly, the user can edit their meal plan in the meal plan tab in the tab bar (see Image 8). Here the user can add and remove meals from the meal plan, set the time for the meals and turn on notifications to register the meals - either all of them at once or one by one. Additionally, the time of the notifications can be set to a certain time after the meal should be eaten (see Image 9).

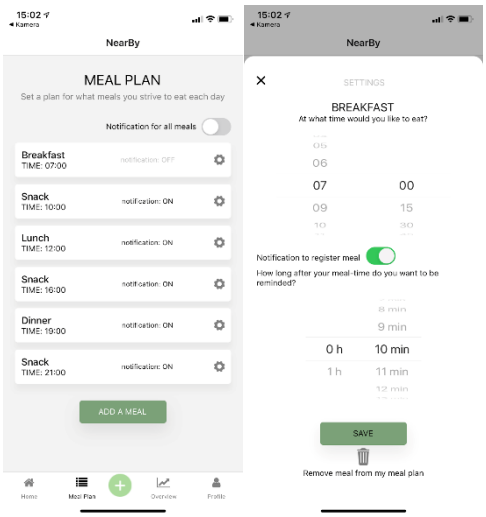

Image 8 - *Meal plan overview*

Image 9 - *The user can change the settings of a meal in the meal plan*

Lastly, the user can reach an overview page (see Image 10) from the overview tab in the tab bar. Here, data about how many days in a row the user has registered meals, the longest streak of registering meals and average meals registered per day is presented, together with data about how many meals per day the user has registered the last seven days. Additionally, the user can navigate to see more detailed statistics. Here, the user can see the division of registered meals per meal type (see Image 11), as well as eaten meals per meal type (see Image 12). From the overview tab, the user can also choose to see their previous registrations (see Image 13), and get more detailed information about the registration by pressing a meal card (see Image 14).

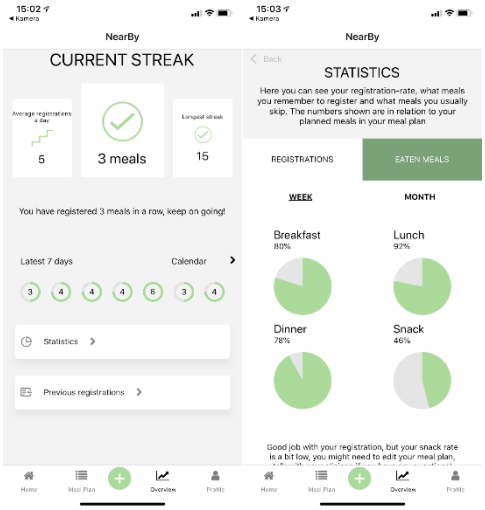

Image 10 - *The overview page*

Image 11 - *Statistic over registers meals*

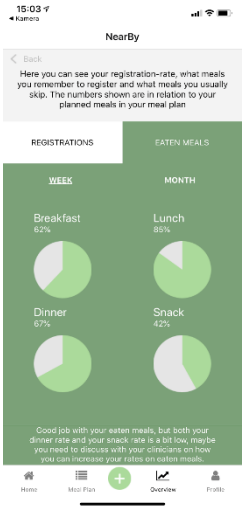

Image 12 - *Statistics over eaten meals*

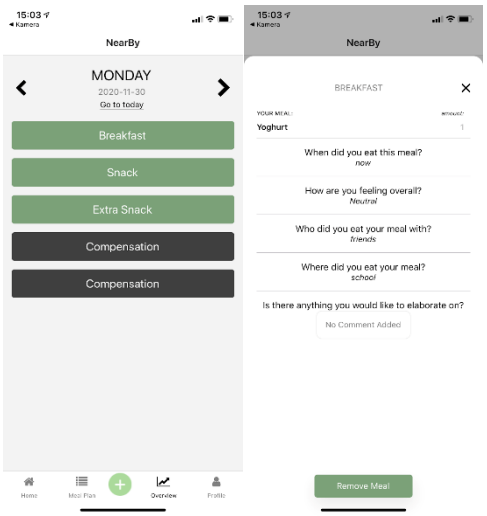

Image 13 - *Previously registered meals*

Image 14 - *Information of what was registered for one specific meal*

5. DISCUSSION

Below follows a discussion on the design of the MVP in relation to related work, restrictions and limitations and future work.

5.1 MVP in relation to related work

The choice of designing and developing a mobile application for self-registering meals and compensations for patients under online treatment for eating disorders was based on that users can experience barriers if the gathered information is too hard to transform into visualized data (Li. et al, 2010). Letting users register their daily meals in a mobile context removes that barrier, since users don't have to note their meals in a separate document before registering the meal into the system. Additionally, following Fogg's Behavior Model (FBM) (Fogg, 2009) users need to have the ability to perform a task, to perform the task and potential barriers must be reduced for users to perform a target behavior (ibid.) which in this case is registering meals and reflecting upon them. Thus, to make users register their meals, the users must have easy access to the registration which the mobile application allows. Additionally, the step-by-step registration with pre-set parameters and answering options allows fast registration which can increase the ability to perform the actual registration and reflection of the meals. Additionally, pre-set parameters also allow for better data gathering and possibility to visualize user data.

Since user-related barriers can occur due to lack of time (Li. et al., 2010), the application was designed for users to be able to register their meals anywhere they are, as fast as possible, to decrease that possible barrier. Also, Li et al. (2010) mentions that lack of motivation can become a barrier for users. This aspect is regarded in the MVP where the overview page with visualized user data allows users to follow their progression and what their registration rate looks like. Additionally, it allows for reflection on gathered information, so that it is easy for users to understand, explore and reflect on their data - for example, the registration rate and what meals they usually eat or skip. This might reduce the barrier of reflection, and users can be encouraged to continue registering their meals. Barriers can also occur out of obliviousness (Li. et al., 2010), and a change of behavior needs a trigger that sets the behavior in motion (Fogg, 2009). This is targeted by enabling notifications to remind users to register their meals, where the user is notified that they need to perform the targeted behavior - register a meal - when they have decided by themselves that they want to perform the behavior. Since most notification settings include the user to set the time, duration, and eventual reminders of the notice (Bentley & Tollmar, 2013), this is also implemented in the application.

5.2 Balance treatment requirements and user experience

One challenge when designing the MVP was to consider both the user perspective and the quality of the treatment. From the stakeholder interviews (see Section 4.3 - Stakeholder evaluations) it was clear that the online treatment had some requirements that needed to be considered, such as elaborative reflection, what the patient is supposed to register and how the data is used and analyzed during the treatment. However, the focus of the project was to increase the motivation and ability to register from a patient-perspective, since the current web-based solution suffers from several usability problems. When designing the MVP, it was therefore crucial to gain knowledge about both perspectives, and this was realized by on one hand involving the stakeholders at the clinic several times during the design process, and on the other hand conducting a pre-study and evaluation with patients. The treatment requirements that had to be compromised in this project was the possibility to elaborate on details regarding the context of a meal in the reflection form, as well as the possibility to choose more emotions than the pre-set feelings. Generally, the clinicians wanted to have more details about

every meal and compensation, which in this project would compromise the easy and fast registration that is crucial for the ability and motivation for users to register.

5.3 Restrictions and limitations

Since the target group of the project are patients that undergo online treatment for eating disorders, it was difficult to find patients to test the design and MVP on. All possibilities to get in touch with patients were restricted by patient security regulations, therefore, the only option of getting in touch with patients was through our own social networks. It would have been desirable to include more patients in the design process and in the evaluation of the MVP, so that the results would have been even more based on the users' perspective. Another limitation of the project was that the time was not enough for developing all design ideas and scaling up the testing.

5.4 Future work

There are several possible future developments for the application. First, the suggested functionalities from the clinicians during the last design evaluation could be implemented and tested. The functionalities that aren't fully developed in the MVP should also be finalized, such as adding a meal to the meal plan, enabling notifications for all meals at once and overview based on real user data. Additionally, the application should be tested with more patients - both through quantitative testing to understand how the application works usability wise and through qualitative testing in order to go in depth with the perception of the application. The testing could also be designed as a study of user behavior during a longer period, measuring if users' registration rate increases with the use of the application and if the reflection form gives all essential information needed to provide insights through the overview. In such a study, participants would be divided into two groups: one group would use the application to register their meals and the other group would use the existing web-based system. After the study, the results from the different user groups would be analyzed and compared, and thus bring insights into how the application works and how it could be further developed to be easy for users to use but at the same time ensure the quality of the online treatment.

6. CONCLUSION

The report describes the work of designing and developing an MVP for self-tracking during online treatment for eating disorders. In the design phase, a clickable prototype was created and evaluated with non-patients. The usability issues that arose were iterated on and implemented into the MVP that was developed using react native and firestore cloud. Patients found it easy to use the application and believed that it would increase their self-tracking rate. The clinicians found many of the solutions promising and wished for further development. However, the application could not be validated correctly due to time constraints and the difficulties of reaching real patients to test with.

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Attachment - Individual Contributions

Stated below are the persons responsible for each part. However, all group members contributed equally regarding time and workload for each part.

Report:
Abstract: [EF]
Introduction: [EO]
Related work: [EO]
Method: [LF]
Result: [EF] [EO]
Discussion: [EF] [LF]
Conclusion: [LF]

Technical development: [EF] [LF]
Design: [EO]
User testing: [EO]