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Echo: guided self awareness

Using personal data to support client self awareness through therapy.

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Preface

This Master thesis was prepared at the department of Applied Mathematics and Computer Science at the Technical University of Denmark in fulfillment of the requirements for acquiring a MSc degree in Digital Media Engineering/Computer Science and Engineering.

Kongens Lyngby, August 3, 2018

The image shows two handwritten signatures in black ink. The signature on the left is 'LYSEA' with a stylized flourish underneath. The signature on the right is 'Alina' with a similar flourish.

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Summary

One in four people are during their lifetime affected by poor mental health and mental health disorders. This imperative societal concern has been developing over the last years, becoming one of the leading cause of illness worldwide. Development in ubiquitous sensor technologies made it possible to easily collect an unprecedented amount of health data on individuals. There has been an increasing research interest in mobile health (mHealth) applications, addressing physical health, wellness and mental health. Prior work in mental health has mainly addressed specific disorders. Since this is not the only way of characterizing poor mental health, a solutions addressing mental health independently of a disorder is needed. This is what this thesis strives to accomplish.

Echo, a solution for clients to use personal informatics in psychotherapy is proposed. This thesis documents the design of Echo, an iPhone mental health mHealth application prototype. The application offers a great variety of automatic and self-assessment tracking options, that can be adapted to the specific therapy and client-therapist relationship. Echo offers a different level of insight into the individual's life and what affects mental health. Insights and reflection are supported by therapists, providing guided self-awareness for clients. The solution was designed through an iterative, user centred, lean design process. Clients and therapists were closely involved in shaping Echo's concept and interface, ensuring their needs were met. User-involvement relied on a thorough, qualitative approach, exploring every facet of the concept. Echo's concept and its interactive prototype were highly appreciated by therapists and clients alike. A functional solution was requested by participants throughout the design process, proving there is a high need for a solution like Echo in practice.

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Acronyms

CBT Cognitive Behavioural Therapy. 8, 9

HCD Human Centred Design. 25, 28, 30, 35, 43, 57, 69

HCI Human Computer Interaction. 9–13

MVP Minimal Viable Product. 26

PD Participatory Design. 2, 10

PI Personal Informatics. 2, 3, 7, 16, 17, 21–23, 25, 81, 101

QDA Qualitative Data Analysis. 44, 47, 48, 103

QS Quantified Self. 2, 38, 97, 98

UCD User Centred Design. 2, 3, 6, 10, 25–28, 31, 33, 40, 55, 57, 101

UI User Interface. 6, 26, 30, 57–59, 63, 64

UML Unified Modelling Language. 33

USM User Story Map. 21, 26, 28–30, 36, 37, 40, 41, 43, 52, 54, 57, 58, 60–64, 83, 84

UX User Experience. 25

CHAPTER 1

Introduction

"To know thyself is the beginning of wisdom" - Socrates

Poor mental health is an important societal concern that has been constantly increasing over the last years. According to Sundhedstyrelsen (The Danish Health Authority), 13.2% of the population in Denmark reported poor mental health in 2017, an increase of 3.2% since 2013 [28]. Poor mental health and associated mental disorders are some of the largest and most rapidly increasing categories of diseases[23] worldwide, affecting health systems and becoming a bigger societal burden than cancer or cardiovascular disease[23].

1.1 Context and motivation

Mental health is defined by not only the lack of mental illness but by the psychological resources and abilities required to develop oneself mentally and handle challenges and stress in family and work life [28]:

Mental health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community. [62]

Recent studies in mental health have also pushed for a shift of paradigm in intervention, from a symptom repressing focus to fostering the individual's well being [55]. Building on Ryff's cognitive model for psychological well being [56], well being therapy has a focus on the individual's self awareness through self-observation, structured diary and the interaction between patient (client) and therapist. The active role of the patient (client) in achieving recovery is emphasized [55], especially in the context of preventing relapses. Self awareness in particular was previously discussed as a measure of therapy effectiveness [50].

Advances in ubiquitous sensor technologies, the rise of pervasive computing and big data have created new opportunities for mental health [58],[45] in this regard. The large volume of data continuously and seamlessly generated, the so called personal digital trace, can provide a deeper understanding to a person's behaviour and emotions.

There is a huge interest in Personal Informatics (PI) from the mental health research area and a large number of studies have investigated different applications[45]. The Quantified Self (QS) movement is pioneering the field of PI, pursuing "*self knowledge through numbers*"¹. There is a large spectrum of mobile health (mHealth) applications commonly falling in to three main categories: wellness, management of physical illness and mental health and illness [5]. However, the overlapping area between wellness and mental illness that psychotherapy is concerned with, was not previously investigated. In the scope of this thesis psychotherapy is defined as therapy conducted by psychologists or psychotherapists, independent of a disorder or diagnose, within mental health. Clients are defined as individuals actively attending psychotherapy², regardless of their quandary.

The motivation of the thesis is rooted in the lack of a personal informatics tool to be used in psychotherapy independent of a clinical diagnose.

The thesis describes the design development of Echo, a PI solution for clients, to be used in therapy. The thesis has a holistic view on the design, by getting a well founded understanding of the domain through an extensive User Centred Design (UCD) process, and a detailed conceptual and interface design. While focusing on the design and not the implementation, it strives to evaluate all the facets of the concept and interface design. Echo is utilizing elements within PI: physical, behavioural and social parameters to help understand the psychological states of the client, further referred to as personal data in the thesis.

1.2 Prior work

Being at the convergence between PI and mental health mHealth, Echo's design was inspired by previous design research in these two areas. The thesis reviews related literature on design methods for mental health solutions and PI applications in mental health. Moreover, it discusses existing solutions used to inspire Echo's design. The complete review can be found in Chapter 2 Background and Literature Review.

User involvement in mental health application development is rapidly increasing due to the emphasis on keeping clients engaged between therapy sessions [43]. The design methodologies used within mental health are mainly User Centred Design including Participatory Design (PD) and focuses on how to involve client and therapist despite it being a very sensitive area[15][43]. The main methods are role-play[43] and including the therapists throughout the design process[15]. Another important point is what design aspects to consider before and during the design [3].

There is an extensive research on mental health applications of PI, mostly focused over a specific diagnose. A recent review of mental health studies involving self tracking reveals previous use of 71 different information sources for mobile sensing ranging over

¹<http://quantifiedself.com/>

²This will be referred to as therapy from here on out

a wide spectrum of categories: social, psychical, location, device, subject, environment and bio. An example closely related to Echo is Monarca, a personal mental health mHealth application for bipolar disorder. Monarca combines system driven tracking and self-assessment to provide a better insight into the disease for both patient and clinician, supporting the patient's self-awareness and optimizing the treatment.

1.3 Research question/ problem statement

The overall problem area of the thesis is How to use personal data in psychotherapy? Since the thesis focuses on the design and concept phase it addresses the following research question:

How should personal data be presented and used in psychotherapy sessions?

This includes the following underlying questions to research:

- What personal data is relevant for clients in psychotherapy?
- What features are relevant for an mental health mHealth application used in psychotherapy?
- How should the mHealth application be presented and used in psychotherapy, and how often?

The thesis consists of four iterations, each addressing facets of the main problem by utilizing existing User Centred Design (UCD) methods for defining, creating and evaluating the concept and design of Echo.

1.4 Research goals and methods

The research question was answered by conducting surveys, a focus group, a design workshop, a role-play workshop and think aloud sessions. These methods were all supported by desktop research, conducted within the mental health domain, UCD and design methodologies.

1.4.1 Background and Literature review

The thesis presents the background within psychotherapy and summarizes existing literature on the following area:

- Design methodology within mental health
- Personal Informatics (PI) within mental health

1.4.2 Empirical considerations

Since the scope of the thesis was the concept and application design, it includes participant inputs, therefore most of the empirical data was qualitative. The data was analyzed using thematic analysis.

1.4.3 Participants

To reach the desired outcome of Echo, two types of participants were recruited: clients and therapists.

Clients consisted of people who had been or were currently in psychotherapy.

Therapists were either psychologists or psychotherapists who had prior experience with clients.

The participants were recruited through several psychologist forums and volunteer organizations, through the authors' network and through the psychologist expert used throughout.

1.4.4 Collaboration

Throughout the thesis a psychologist was used as an expert for domain knowledge, sparing and validation.

1.5 Result and contribution

The main contribution of the thesis is the concept and design of Echo, a system that helps clients and their therapists during and between therapy by utilizing the clients personal data.

Echo is an mental health mHealth iPhone application that the therapist will introduce to the client in the beginning of the therapy process. It gives the possibility to track both automatically, using phone based sensors and wearables, and manually.

The automatic tracking options, possible to turn on and off are: sleep, physical activity, social activity, app usage and pulse.

The manual tracking is divided into two categories, self rating and custom. Self rating is anything that the client rates from 1-5, custom is any task the client is asked to do, i.e call their brother or reflect on a given issue.

All the tracking in Echo is homework from the therapist, and the clients can add notes to all the elements they are tracking.

Echo also offers the possibility to see visualizations and key metrics on the automatic and self rating tracking. Furthermore the clients can easily get an overview of all notes made

The use of Echo is adaptable for the given therapist, client and the concrete problem the client is seeing a therapist for.

Echo offers the client the possibility to track their own behaviour and patterns and discuss it with their therapist. It is not a stand alone application, but can also be used after a therapy process has finished, to give the client a tool to aid further work on their problem.

Echo is an application that lies between the clinical treatment applications and the self help wellness applications already out there. It supports guided self-awareness.

Echo is designed for clients as the primary user, which means that the therapists will only have access to the data with the clients consent and thereby privacy is ensured.

The design consists of a hi-fi prototype of Echo, developed using Marvel ³ and Adobe Illustrator CC ⁴. The final prototype can be found here:

<https://marvelapp.com/32g615f>

The design has been developed through iterations including both therapists and clients, which entails discoveries of how to work with the clients in terms of design involvement. The area is quite sensitive and a lot of previous research has been done in the domain. Echo differs from the articles in Chapter 2 Background and Literature Review review by having the clients participate throughout the process.

³<https://marvelapp.com>

⁴<https://goo.gl/5EWDUa>

1.6 Thesis overview

The remaining of the thesis is structured as follows:

Chapter 2 Background and Literature Review first introduces the background for using Echo and discusses aspects of psychotherapy. It then reviews relevant prior work in design methodologies for mental health and personal informatics in mental health.

Chapter 3 Methodology presents the overall methodology followed in this thesis - a User Centred Design design process, discussing the choice of UCD methods used. Methods used in the empirical work are also described here.

Chapter 4 to Chapter 7 present the actual design process throughout the four iterations. Each iteration describes the design goals, the methods, participants and apparatus used. The results of the user inputs analysis are presented and discussed.

Chapter 8 Echo: final prototype describes the outcome of the design process, Echo's final prototype. Both the concept and the User Interface (UI) are presented in detail, and a complete micro interaction diagram of Echo's prototype is given.

The research question and the results of the thesis are discussed in **Chapter 9 Discussion**. The chapter also discusses some relevant reflection points for the results, on the impact self tracking can have in on psychotherapy and clients.

Chapter 10 Conclusion, rounds up with a summary of the whole thesis and its result and discusses future work for introducing Echo in the psychotherapy practice.

CHAPTER 2

Background and Literature Review

This chapter introduces the knowledge foundation of Echo's design. It first discusses the overall context for Echo, which includes important aspects of the psychotherapy domain. Two particular approaches that Echo is intended supporting: cognitive behavioural therapy and psycho-dynamic therapy are touched upon. Related literature and prior work is reviewed after. The literature was selected in relation the mental health and personal data domain of the thesis. It consists of design methodologies and Personal Informatics in mental health and related systems. Key papers are discussed more in detail, emphasizing how Echo differs or is inspired by prior work.

2.1 Background

Practical psychology spans over a wide range of application areas: clinical psychology, counseling psychology, neuropsychology, etc. Psychotherapy is however not defined based on the branch of psychology, the educational background of the psychologist, nor the presence of a diagnose of the client. It is defined based on the practice of the psychologist. One important factor in practicing psychotherapy is authorization. The psychologist needs to obtain an authorization which implies practical work with clients, under the supervision of another authorized psychologist. Furthermore, authorized psychologists can further specialize on adult, child or organizational psychology. Besides psychologists, another group of therapy providers are psychotherapists. These are very similar to psychologists, as they help clients through therapy for improving mental health, but differentiate, according to the Danish Psychotherapist association ¹ in the problems they tackle, as psychotherapist do not deal with diagnoses or severe mental problems - but provide counseling instead. Echo is targeted at psychotherapy, with either psychologists or psychotherapists, further commonly referred to by 'therapists'.

In terms of methods, a common approach is to use a combination of theories and tools, to accommodate to the clients needs, understand their problems and finding

¹<https://psykoterapeutforeningen.dk/>

solutions² ³. This was consistent to how the therapists surveyed and interviewed described their approach (further described in Iteration 1: Initial validation and research and Iteration 2: Echo concept development). There are several categorization of psychotherapy approaches. Psykologbogen⁴, a danish psychologist knowledge platform and organization, identifies three main approaches: Psychoanalysis/psychodynamic therapies, Cognitive Behavioural therapies and Humanistic therapies. The Danish psychology lexicon (Psykologileksikon)[7] additionally includes Body therapy and Systemic therapy. The American Psychological Association (APA)⁵ includes Integrative or holistic therapy, which is reflecting the blending of the above approaches, in line with the clients needs. The approaches Echo is designed in mind with are further described.

2.1.1 Cognitive behavioral therapy

Cognitive Behavioural Therapy (CBT) is most commonly the targeted approach when designing applications for psychotherapy and mental health. Bakker et al. [2] have, based on an extensive review of mental health applications, formulated a set of recommendations for design; their first recommendation, "Cognitive Behavioral Therapy Based" refers, as the name says, to the use of CBT principles. Bakker et al. build on prior work attempting to incorporate technological solutions and CBT, that were proved both cost-effective but also therapy efficient and valid.

CBT works generally with symptoms and symptom reduction, better functioning, and preventing the remission of the specific problem the therapy deals with [24]. It can be viewed as a collection of interventions that combine a variety of cognitive, behavioral, and emotion-focused techniques [24]. Focus is put on identifying so called "triggers" and learning how they influence cognitive processes and behaviours. Triggers can be anything from emotional, physical, the presence of others, physical setting, social pressure, activities or thoughts. CBT is different from other psychotherapy approaches, because it focuses on a current problems rather than issues from the past. It is a more practical approach such as changing habits or behavioural patterns and ensure awareness of these, which self tracking, quantified self or personal informatics can support well. CBT is an extensively used approach in psychotherapy for a wide range of problems [2], [24]. CBT based mental health applications have also proven efficient in different interventions : depression , anxiety, social anxiety. chronic pain, smoking cessation, etc [2]. An important aspect of CBT is that it is not only applicable in a diagnose or condition, but it is "fundamentally a prevention technique" [2, p. 4], used in both prevention and treatment, to avoid worsening.

²<http://www.apa.org/topics/therapy/psychotherapy-approaches.aspx>

³<https://www.health.harvard.edu/mind-and-mood/types-of-psychotherapy>

⁴<http://www.psykologbogen.dk/>

⁵<http://www.apa.org/>

2.1.2 Psycho-dynamic therapy

Psycho-dynamic therapy is rooted in the psychoanalytic therapy, founded by Sigmund Freud and has a focus on the unconscious. It argues that it is the unconscious that is driving the behaviours and decisions, and by exploring it one can find the roots of the experienced problems. Unconscious behaviours are behaviors dictated by inner problems that one has not acknowledged. The therapist role is to support the client in uncovering the unconscious patterns, by observing their behavior, their reactions, by always asking what they mean in the conversation. Psycho-dynamic therapy works a lot with symbols, dreams, images and tries to decipher the unconscious motivation for handling things the way clients do. have the potential to support the collection of these different aspects for psycho-dynamic therapy.

The use of personal informatics has been proven to have benefits both in clinical mental health [5] and well being solutions. The idea to incorporate personal informatics within psychotherapy was also strongly supported by the expert's inputs. It is to be used within psychotherapy by clients working with therapists (psychologists and psychotherapists), regardless of the client's problem or therapist background. Therapy-wise, Echo is intended at both psycho-dynamic and CBT based therapy. CBT is naturally easy to integrate, as it is looking into symptoms and client parameters. Even if psycho-dynamic based therapy is not obviously fitted to integrate this type of sensor data, expert input suggested that all this data can be a reflection of a inner cause or problem that is not easily discoverable. This idea was also expressed in the interviews by therapists having a psychodynamic approach. As mentioned above, PI have the opportunity to facilitate the collection of parameters that psycho-dynamic works with, to uncover inner problems. Bringing these parameters in the therapy could shed light on the client's needs and help the therapist better target his efforts.

2.2 Design methodologies within mental health

This section focuses on previous research on methodologies and frameworks used within personal data and mental health application development.

Prior work argues that when working with mental health technologies or interventions it is paramount to acknowledge the possible constraints due to the sensitivity of the area [49] [43] [15]. Additionally there are ethical concerns.

Using IT in mental health care is more relevant than ever due to the accessibility of the technology, with almost everyone having a smart phone [49] and the importance of activating clients between sessions [43]

As in Human Computer Interaction (HCI), there has been a shift in how much clients or patients should be involved in their treatment or engaged in their therapy. This is due to achieving better results when collaborating with users [20] and that clients

engagement in their therapy is crucial for achieving positive results[43]. Additionally, it is crucial to involve the clients and patients in the design and ensure user empowerment [20] [49].

This is best achieved with Participatory Design (PD) according to Orlowski et al. and can be done by either using PD to design the system which will then ensure more user involvement in the daily processes or by designing the process and the system simultaneously using PD[20]. For Echo the latter is hard to do since it does not aim at changing the practices within therapy but merely to support it.

2.2.1 Design and evaluation guidelines for mental health technologies

In their article, Doherty et al.[15] focuses on what parameters to keep in mind when designing a system for mental health. HCI methodologies such as User Centred Design (UCD) and PD are harder to apply in the field of mental health, considering the limited access to clients and sometimes also mental health personnel. UCD and PD are still valid approaches, the most important aspect is how to use some elements from these frameworks in a manner that respects the sensitivity of the area.

In the design process, the need to clarify the outcome the application is designed for is accentuated. Besides usability and the user experience, a mental health application is designed for some impact on the therapy. Therefore it is relevant to consider the following parameters:

- Is it a stand alone tool or is designed to be used in combination with face-to-face therapy?
- What type of clients or patients it is developed for?
- Is it developed for a specific disorder and it's intervention methods? or is it aiming at improving the client-therapist relationship and communication? or is the goal client self-awareness? etc.

Doherty et al. highlights designing in collaboration with mental health care professionals. A determinant aspect is adapting the UCD process to the given setting and gathering background information on the area and the target group. Here included are suggestion to use experts, future workshops and role-play. The role-play aspect is stressed, since therapists, according to Doherty et al. have encountered it during their training/education and that it is a good alternative to observation or other more intrusive methods, to understand the practice of therapy. It is also suggested to include the design of a protocol for usage.

In terms of collaboration with therapists the article stresses the potential difficulties

as a result of the interdisciplinary collaboration. It also emphasizes on the knowledge sharing between HCI professionals and therapist to ensure a cooperation. It states that when possible, removing the technical aspect of e.g. a prototype, ensures less focus on unknown territory for the therapists.

The design recommendations covers three areas, designing for clients, designing for therapists and general design recommendations.

The clients aspect includes engagement, social and cultural backgrounds, using familiar technologies etc. In terms of engagement the article is looking at how to motivate and keep the clients motivated to use the application, including building upon the interest and motivation of the clients. They also emphasize that in mental health it is important that the engagement should be with the treatment rather than the technology. Of course it is optimal that the engagement with the system would enhance engagement with the therapy. [15]

In relation to the client and their social and cultural backgrounds, they argue that the ontology of the client including all aspects from profile (e.g. age, gender, socio/cultural, etc.) to life history (e.g. early life, significant event, etc.) should be incorporated in decisions and considerations [15]. This is not as relevant for the design of Echo, since the previous history and potential diagnosis of the user is irrelevant for the app usages. A user of Echo can be anything from a stressed student to a person suffering from anxiety.

When designing with the therapist in mind, existing skills, experience and values of the therapist as well as the constraints a possible application can put on their time and their therapy methods are the most relevant aspects to consider. It is important that it supports the existing methods and routines [15].

This is quite relevant for Echo and for answering the research question. Therefore, therapists were used throughout the iterations. Moreover, a psychology expert was used to ensure the value was present for therapist, since they would introduce Echo to clients.

Another significant aspect is the client-therapist relationship, this can vary depending on the therapy approaches used, but it is key to be aware of the importance of the relationship:

"Although modern research suggests that an empowering relationship is not in and of itself sufficient for achieving positive change, the central importance of effective client-therapist relationships is now recognized in most intervention theories." [15, p. 247]

Additionally, elements such as adaptability, usability, sustainability, tangibility, privacy, personalization and customization are also briefly mentioned by Doherty et al.

The paper discusses the different evaluation stages from lo-fi prototyping in design to clinical studies. The main contribution is to evaluate in all stages, keep ethics in check and how to evaluate in the sensitive area of mental health. This includes keeping in mind who the system is designed for and using peer users or the therapist as a proxy if there is no access to clients.

Fortunately the access to clients was not a problem when designing Echo, since it was of great importance for the design to have the engagement and acceptance of the client.

Doherty et al. has very valid considerations for designing within mental health, and a lot of the elements highlighted was in-cooperated in the thesis, here including the methodologies to use. Despite Doherty et al. stating that therapist are more accessible, recruiting therapists for the design process was initially challenging, probably due to them having to participate voluntarily.

2.2.2 Taking part: role-play in the design of therapeutic systems

Matthew et al. discusses role-play in HCI and in mental health. [42] It is argued that role-play is quite useful in mental health because of the normal difficulties to understand the area, limited access to end users, and the stigma associated with mental health issues. Furthermore the therapy setting should be a very safe space and therefore outside intrusion is not allowed. By using role-play, the designers can still get the user's perspective.

Matthew et al. claim that role-play can be used to understand therapy, get feedback on design before clinical use and train therapist in using tech, making them less reluctant towards it. Role-play is especially fitted for the domain, since therapists have used it through their training and use it in their therapy. Role-play is used for evaluating prototypes in HCI, an example is 'mock therapy' where the system or design is tested in a close-to-real therapy session.

The article uses the role-play aspects from psychotherapy to enhance the role-play in HCI and give a relation to why it is useful. In therapy role-play is used to gain insight about a clients thoughts, behaviour and feelings. Three case studies are used to illustrate how the role-play can be used in mental health care system development: (i) developing a system for clients to track symptoms by recording thoughts, behaviour and feelings, (ii) prototyping and evaluating a design and (iii) create the protocol for introducing a system to the therapists and get their input.

In the first case the goal was to understand how it is to be a client and understand how a therapy session work. This was done by role-play in-situ of the therapist office, with the researcher acting as a real client within the session and doing homework as

well.

The next case had the goal of getting criticism and do design debugging. This was done by having six therapist pair up and play a scenario where the therapist explains and introduces the system to a client. Here the therapist acting as clients were given a role card. This helped the feedback because as Matthew et al. states:

One of the uses of role-play is to provide frank and non-subjective criticism of a person or a behaviour in a safe environment[42, p. 649]

It is also a safe way to test a system and get pre-clinical evaluation, because it is close to the real clinical setting.

In the third use case seven therapist were used. While some were role-playing, the rest was asked to observe and comment. This was effective especially since therapists rarely use technology in their sessions. It introduced how to use the technology and more important understand how it could be used in their sessions.

These three case studies shows how role-play in HCI can help gain an understanding of the setting in therapy and the process. It also helps improve design and get therapists to see the value of the system. Role-play can help give insight where it is otherwise limited.

Matthews et al. concludes with some guidelines and considerations when using role-play in design.

- Use improvised role-play for exploration, use scripted role-play for debugging, validating, making protocol, and getting therapists open to it.
- The longer the role-play, the closer to reality and the more engaged the participants become.
- Let the therapist play themselves. They can also play the client - they are not unaccustomed with it.
- Add unfamiliar elements (the technology) to familiar settings (therapist office) to see how it works.

The idea of using role-play to evaluate a system, get a concrete idea of the setting and introduce a new application is quite relevant for the development of Echo. Two imperative elements gained from this article are that asking therapist to do role-play is not an obstacle, due to them being accustomed to it and that it is hard to get therapists to accept new technology into their practices.

Both Doherty et al. and Matthews et al. are concentrating on the therapist as the primary involved user. This is not the approach that this thesis have decided to take, because of the access to clients and limited access to therapists. Furthermore the end users, the clients, should be in focus.

2.2.3 The Personal Health Technology Design Space

While the two previous papers concentrate on the overall methodology the article by Bardram and Frost [3] has a more practical and concrete approach to designing a system within personal health.

Bardram and Frost, 2016 [3] are defining and categorizing the aspects and elements to keep in mind when designing within the personal health area. They use two different applications Monarca (intervention for people with bipolar) and BeWell (a wellness app for personal use) to explain the different elements to consider, since these two are almost direct opposites in their choices of the design space described in the article. They are defining a Personal Health Technology design space which is divided into four areas, as shown in Figure 2.1

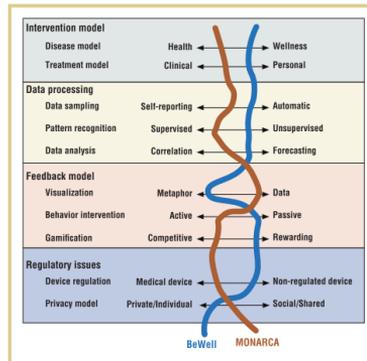


Figure 2.1: The personal health technology (PHT) design space from Bardram and Frost [3, p. 72]

The intervention model aims at defining the following questions: Is it designed for a specific illness or for general mental wellness? Is it part of clinical setup or is it a personal tool? If the application is aimed at having an impact on a disease or is designed for clinical setup it is important to base it on evidence of effect on the method that the application supports.

Data processing includes data sampling, pattern recognition and data analysis. The first consideration is what type of data is collected and by whom. This should be defined based on what type of data the application uses.

System-driven data collection makes sense if it is possible to collect it without user involvement, but downsides or considerations are how precise it is and in what quality. In terms of user-driven data collection, the question is if it is valid enough due to human interpretation and lack of objectivity.

What type of data analysis of the collected data is equally necessary. Is the application displaying correlation or forecasting to the users? Forecasting and prediction is quite sensitive, especially within mental health, due to the possible affect on users and the risk of inaccuracy [3]. This is also one of the reasons Echo did not have these elements.

In the feedback model Bardram and Frost encourage the developers of a personal health application to consider the following aspects: visualization, behaviour intervention and gamification. The visualization aspect is simply the decision of either showing the concrete data to the user or using a metaphor, i.e. the age of a fish in Fish'n Step to illustrate the amount of steps taken.

For behaviour intervention there is the choice of a passive or active intervention type. The passive feedback is letting the user seek out the information whereas the active is pushing the information to the user, i.e. notifications and reminders. The gamification element is also divided in two, either a rewarding or a competitive approach. This means that the user can either be motivated by rewards when doing good or by comparing and competing against others or themselves.

The last design feature category is regulatory issues. This is regarding privacy model and device regulations. It will not be discussed further since it is outside the scope of the thesis.

The design space is meant as guidelines to be used when developing, but it does not require the design to contain all of the four categories. Furthermore Bardram and Frost emphasizes that it does not have to be an either-or choice in regards to the design space, for instance the system could have both user-driven and system-driven data sampling. They round up giving examples of a clinical treatment technologies.

"..Such systems are typically used for the collection of self-reported data but might include automatically sensed data as well. More advanced data processing and analysis are rarely applied, because data is interpreted and used by clinicians. In these systems, the feedback model is often based on showing the data combined with active behavior intervention from clinicians or simple rules."

They also give an example of personal wellness technologies.

"Personal wellness systems are not prescribed as part of a medical treatment and should thus include intrinsic motivation for people to use them. Therefore, they typically have a more aesthetically appealing look and feel, including the use of graphical metaphors, dynamic and interactive feedback, and gamification elements. "

The article describes the different aspects to keep in mind and questions to ask when designing a system within mental health. For Echo the data is both user-driven and system-driven and there are no correlations, forecast or prediction due to the risk of clients being prompted with negative predictive data that will only worsen their problem.

The definition of a clinical and a wellness technologies and what they typically contain does not quite fit the design of Echo. This is to some extent due to the nature of the system being somewhat in between these two definitions, this thesis tries to question and push the existing, somewhat rigid divided applications, often defined by diagnosis.

Even though Bardram et al. are stating that it is a very flexible design space and that both or none of the models can be integrated, there is still some categorization about what should go in what type of mHealth application that does not fit Echo. Echo is for instance not sending or sharing data with the therapist and at the same time it is not using gamification or metaphors for motivational purposes.

2.3 Personal informatics in mental health

The section draws a landscape of prior work in Personal Informatics, focusing over results in mental health applications. Prior results in the area were used in the design as a theoretical foundation of what is possible. Echo's design process did not have a focus on the system architecture, data collection and analysis, but used the results discussed in this section as fundamental assumptions for the concept and interface design.

Personal Informatics (PI) (also referred to as quantified self, self tracking, personal analytics [36] or personal sensing [45], [27]) take a holistic, quantitative approach to health and mental health, utilizing the digital trace produced by ubiquitous sensing [45]. PI systems incorporate different parameters, from body measurements like heart rate to behavioural and social aspects like location and activities [27].

Previous work in PI have studied the correlation of various measured parameters and mental health, by means of wearable devices or smartphone based sensors. A recent comprehensive review of 34 studies [54] shows that several parameters have been found to have a consistent correlation with mental state and mood assessments. The review identifies 7 categories of behavioral features used in previous studies: social, psychical, location, device, subject, environment and bio.

These consists of no less then 71 different information points that can be extracted from mobile devices. The social category consists of Call Duration, Call Frequency, Calls missed, Maximum call duration, etc. They are based overall on 16 unique

sources in the smartphone or wearable device (for example SMS log, Call log, Accelerometer, GPS, Screen, Microphone, LED sensor) [54].

In general previous systems focus on a specific diagnose e.g depression, anxiety, bipolar disorder, etc. There are also many systems with a focus on the therapist and improving the therapy, based on different parameters measured. This is how Echo differentiates, being a client-focused application, that can be used in therapy regardless of a specific diagnose.

Several studies have focused on investigating the relation between pi captured parameters and depression. One example is the StudentLife study, at the University of Dartmouth [9]. The application used in studying the 48 college students mental health and behavioral trends made use of sensor based tracking and self assessment through the PHQ-9 [31] form. The study found conversation frequency and duration and co-location with other students to be significantly related to depression.

Kelley et al. [29] describes the use of PI in stress detection and management through typing analysis, mouse pressure or wearable sensors measuring physiological signals like breathing and heart rate.

Another study [35] focused over Post Traumatic Stress Disorder (PTSD), discusses the use of a minimalist PI setup in psychotherapy. Larsen et. al, 2017 [35] describe a quite novel and unique approach for self tracking, yet incredibly simple: a one-button wearable device. Tracking took place between psychotherapy sessions and targeted occurrences of subjective experiences, identified and defined by the user together with his therapist as precursor to the hyperarousal state the therapy was concerned with. The motivation for self tracking as part of psychotherapy was routed in the bias introduced by memory recall, which according to Larsen et al.:

influences the accuracy of answers to [the therapist's] questions, the ability to make accurate assessments, or even the ability to recall particular events at all [35, p. 1].

This is also part of Echo's value proposition, as of now, the accuracy of the data used in therapy relies on the client's recollection and reporting ability. Echo offers support to recall of events and aspects through the automatic and manual tracking, which can be annotated with context by the client. Larsen et al. also argues that active self tracking should be used in combination with passive sensing for a more holistic understanding of the mental state. This is supported through self-rating and custom tracking in Echo, as presented in Chapter 8. Not only the ability of reporting is supported; Echo creates a mean for the client to become more self-aware. Quite remarkable for this study is the user adoption of the system and self tracking routine. This might indicate that the effort a user must take as part of tracking and also the simplicity of the system are crucial for the user experience and the value perceived by the user.

Three particularly related solutions in the literature are reviewed next. The purpose of the review was to derive learning points applicable for the content, interaction and interface design of Echo, based on the practical experience of these case studies.

2.3.1 Monarca

The Monarca system[4], a pioneer in smartphone-based behavior monitoring technologies for mental health [45] is targeted at clinical use, for patients suffering from bipolar disorder. It consists of a mobile application for clients and a web portal for clinicians, designed, as Echo through a ucd process. The mobile application is used to collect objective (sensor based) and self-reported patient health data, which is then available for clinicians to review on the web portal. Automatics sampled data covers physical activity, mobility, social activity, phone usage and voice features. Self-assessment includes mandatory items like mood, sleep, medicine intake and subjective activity and optional ones like warning signs, alcohol, stress. The data is presented through concrete graphs visualizations, as in Echo. Echo interface was also inspired by Monarca's in self-assessment module.

The application differs from Echo in the clinical aspect, for instance the medicine intake module. While also supporting patient self-awareness, the scope of the Monarca application also differs from Echo in its self-care, self-treatment focus, in reducing the need for clinical supervision and treatment. Another differential aspect is mood predictions made based on collected data. The mobile application is shown Figure 2.2.

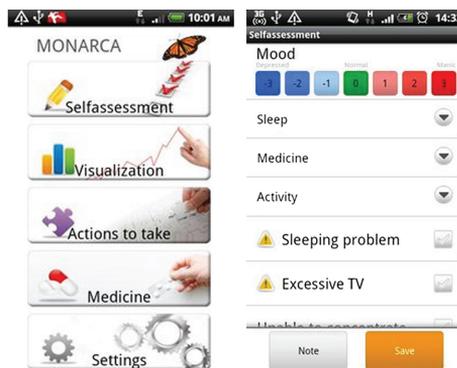


Figure 2.2: The Monarca system, mobile application preview of main page and self-assessment.

2.3.2 Emotion sense

Emotion sense is an application developed by the Computer laboratory at the University of Cambridge, in collaboration with social psychologists [58]. Very similar to

the scope of this thesis, Emotion sense is a smart phone application tracking passive data through a wide range of sensors and user's own reported moods. This is analyzed to identify "what might be triggering peaks in their mood". Mood assessment is done through a interface different then previous surveying techniques, on a two dimensional matrix called the "emotion grid", see Figure 2.3. The point assessment is further clarified through a short traditional survey.

Emotion sense was used in a very large scale study of the relation between automatic tracking data (smartphone sensor based) and the "user's demographics, personality, well-being perception, and other psychological factors" [58, p. 2]. The study also investigated whether sensor based data can be used to assess user's mood and happiness. Compared to Monarca and Echo, Emotion sense has a very broad scope. The study was conducted with general public, that installed and used the application after advertised through a media campaign. This was done independent of a mental health diagnose or therapy involvement. The study reports a strong correlation between sensor based tracking and well-being perception, as well as the possibility to predict mood based on automatic tracking with an accuracy of 70%. This results could be used to provide guidelines for data interpretation for therapists in Echo's case.



Figure 2.3: Emotion sense application

2.3.3 MyRoR

MyRoR, described by Pavell et al. [51] is an application designed to support self-awareness and self-understanding. While not having defined a specific application, it is very relevant for Echo, due to its focus on self-awareness. Pavell et al. [51] discusses mental health as a potential application for MyRoR. The emphasis is put on interface design to support self-awareness. They describe a story based design paradigm for visualizing personal data, stressing the challenge of capturing, coding and visualizing complex information about one's life. To address this challenge they define models for

context based data collection and visualization that is accessible for the inexperienced user.



Figure 2.4: MyRor, an example of a story

Stories are sequences of meaningful daily events, displaying the available processed data via images and narratives. Stories are designed based on the Story Model [51], defining five story dimensions : the setting, theme, characters, storyline and point of view. Information is categorized and processed around eight types of contexts: activity, availability, emotional, environmental, mental, social, spacial and temporal, analogous to tracking options in Echo. An aspect emphasized is context. Not surprisingly, usefulness of the information cannot be detached from the context it was recorded in. Without its context, information about one's parameters loses value. Deriving the different contexts to create stories using automatic tracking is not trivial though. In MyRor this is done by means of user annotations to automatically recorded information and stories. This has inspired the annotating feature of graphs and homework, as described in Chapter 8 Echo: final prototype. The user evaluation concluded that the story-based interface was very effective in providing self-awareness - users reported perceiving the system as a snapshot of oneself. This is also what Echo is intended at, by providing a multitude of different tracking options and the possibility to add custom ones. While image capturing seems to be a good provider for context, it was not considered for Echo, but discussed as possible future work.

2.4 Design for Personal Informatics

Having reviewed design processes and frameworks for mental health and pi and related systems, it is important to also review design challenges and recommendations in terms of interface and design for PI, to round up the knowledge basis needed for Echo's design.

When it comes to design of personal informatics, a lot of previous work has personal informatics design, a framework was needed to further refine the user needs and goals from the USM in relation to the data tracked and deriving meaning from it. Li et. al's stage based model [36] is the referenced model in the Personal Informatics research area. The model describes five stages : the preparation, collection, integration, reflection and action Figure 2.5. The stages can be either user or system driven, or a combination of both. Furthermore PI systems can have either several data tracking sources (multifaceted) or one (uni-faceted).

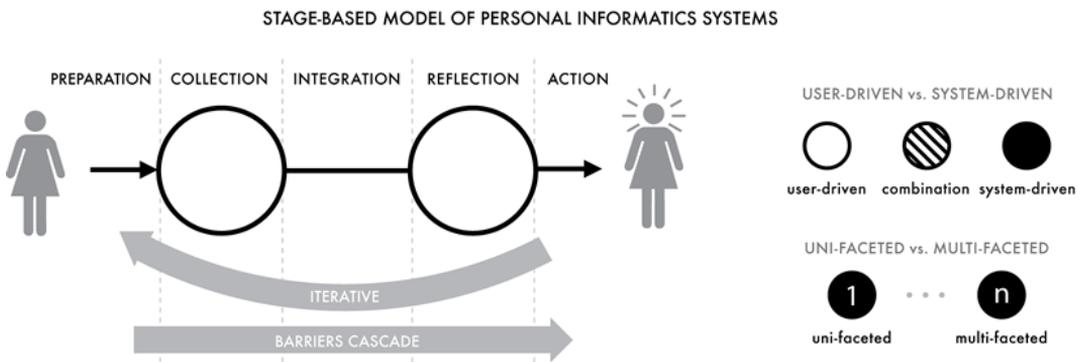


Figure 2.5: The stage based model framework for personal informatics, [36]

The stages are defined as sequential and overall iterative. In preparation tracking parameters and tools are decided, collection is represented by the actual tracking, integration means preparing, combining, transforming the data in order to reflect upon in the reflection stage. Finally action is where decisions are taken to take action, or change goals and reiterate through the model.

The model was adapted to Echo (see Figure 2.5 in Chapter 8 Echo: final prototype), as, compared to other Personal Informatics system, Echo has two different user roles (clients and therapists). The model helped shaping the concept and investigate in a more detailed level the roles of the clients and therapists in the different aspects of tracking.

One critic to the stage based model is that it is too focused on the action as an outcome, while reflection is limited to a single stage. In many cases there might not be a specific action goal, but reflection should be an integrate part of all stages. This is also true for Echo, since the application is intended at improving therapy outcome and overall, mental health. The desired outcome is tough a supporting better understanding of the client for the therapist and increasing self-awareness for the client. This can be facilitated through continuous reflection.

This shift of paradigm in personal informatics from a research dominated area to a personal one [26] brings more challenges to design, to support the reflection stage. Fan, 2013 [16] weighs data visualization as "one of the main ways by which users of

personal informatics tools *make sense of their data*" [16, p. 1]. This reflection stage is fundamental to PI systems to leverage both the understanding of the different patterns personal data may describe but also to make this knowledge actionable for behavioral change [13]. Reflection in is characterized by Li et al, 2013. through six dimensions or question asked from the user's perspective: **Status** (or what is my situation now?), **history** (or what was my situation in the past?), **goals** (or what is the desired future status), **discrepancies** (or what is the distance between my status and my goals?), **context** (what affects my status?), **factors** (or how are the different parameters related?) [37]. However these considerations of PI systems need to be carefully adapted when applied to mental health. One aspect is users might have limited experience, knowledge and time for interpretation and data analysis. At the same time mental health is a very sensitive area. Goals as defined in the above questions are for instance not straightforward applicable within mental health. This is also the motivation for not including goals in Echo, suggested by the clients in one of the user involvement activities. This is further discussed in Chapter 9.

Different techniques have been used priorly, including traditional statistical charts, avatars or story based visualizations. Existing systems typically employ several data streams, across multiple domains. Fan [16] argues that simply visualizing the different data streams separately, does not suffice for the user to derive meaning. Echo offers means of comparison in personal patters by combining data streams. Specific data mining must as well be implemented to support insights. There is a fine line between visualizing the raw data, providing insights and providing the ability to zoom into the details, in a way that engages users [16]. Qualitative and quantitative information must be carefully integrated. In Echo qualitative data is collected though custom trackers and notes. There was an attempt to integrate these with automatic tracked data, to provide means for understanding, for instance how mood is influenced by different objective parameters.

Regular charts have been traditionally used for visualization purposes. They can also have shortcomings, as similar visual models can describe very different data sets [34], [41]. One also needs to have the ability to comprehend specific statistical visualizations. Therefore inexperienced user needs a simple way of interacting with his / her data. In Echo, this is was done by having simple line charts to represent trends over time and summarizing statistics for the different key metrics.

Cuttone et al. [13] also focuses over the challenge of turning observations and insights from PI into actions. The authors suggest that state-of-the art systems fail to offer the flexibility and personalization needed for the key element in PI: self-reflection. To address this challenge, Cuttone et al. builds on top of PI models and state of the art systems design to define four heuristics to make the design *"facilitate effective exploration of personal data and make such data actionable for behavior change"* [13, p. 4]:

- Make data interpretable at a glance Data visualizations must be optimized for interpretation at a glance, for users to obtain feedback and answers with

minimal effort and time. As [16], the authors argue against dividing insights into different visualizations, with every one conveying a specific property or parameter of the data. In Echo this is covered by having a single module for visualizing graphs - the Charts. Here different automatic and self rating trackers can be combined to provide an easy overview of patterns.

- Enable exploration of patterns in time series data
When analyzing patterns one is concerned with two different perspectives: global trends and periodic patterns. Global trends measure how a variable changes over time (increase, decrease) and periodic patterns measure how the variable changes with a repeating pattern (week, month). Echo provides different filtering options for daily, weekly and monthly overview of results, both graphical and key metrics.
- Enable discovery of trends in multiple data streams
By tracking different parameters, users are generally interested in seeing the relations between different parameters, for example how sleep is influencing productivity. Data visualizations need to provide means for investigating this relations, either by means of comparing or correlating. In Echo's case, comparison is the mean to enable discovery of trends. Correlations visualizations were disregarded due to realistic limitations in accuracy and the application area, where is dangerous to make explicit inferences. Another aspect is the dichotomy of causality and correlation, discussed by Jensen: *are we drinking coffee because we are tired, or are we lacking sleep because of the caffeine in the coffee we are drinking* [27, p. 15].
- Turn Key Metrics into Affordances for Action
Cuttone et al. [13] make an analogy to the work flow of an analysts, to illustrate the importance of interaction in generating insights about personal data. An analyst typically generates a data view, explores the result then adjust the parameters or generates a new data view to get insights. Likewise, am this iterative process in PI systems can help identify key metrics and use them to derive possible actions for behavior change. Visualization should allow interactions like slicing, filtering, scrolling, zooming in various ways, by time or category, by thresholds or geographical area, etc. The interaction pattern recommended is "*Overview first, zoom and filter, then details-on-demand*" [13, p. 10]. Echo has considered some of the interaction elements discussed, like filtering and scrolling. However there were limited possibilities for implementing interactions through prior to implementation, therefore this is a main consideration of future work.

2.4.1 Overall considerations

To sum up, personal informatics can provide key information and insight into mental health. A lot of previous studies have focused over determining the relation between self-tracking data and mental health parameters and showed evidence of the

power of personal informatics in understanding and supporting mental health. Prior work has also shown the importance of the interface and visualization design in self-awareness focused solutions, like Echo is. While not focused over a specific diagnose within mental health, Echo borrows from existing systems in terms of automatic and self-assessment tracking, context annotation and visualization design to support exploration of personal patterns and support self-awareness.

CHAPTER 3

Methodology

This chapter describes the overall methodology of Echo's design process. The research objectives are discussed at first, followed by a description of the methods used in different iterations. The chapter is rounded off with a critical discussion of the possible implications of the chosen approach.

The motivation for the overall methodology is routed in the research objectives of this thesis and backed by the reviewed literature on personal informatics and design for mental health methods in Chapter 2 Background and Literature Review. Echo is a mental health mHealth solution for integrating PI in psychotherapy.

The approach most commonly used in design research area are Human and User Centred Design methods [1], [40], [59], (see Chapter 2). HCD and UCD advocate for continuous user involvement along the design process. While HCD has a broad perspective, putting the general human psychology and the human needs and limitations at the center of the designed solution, UCD is more focused on the target audience for the specific solution. Both make use of the same methods and are widely used interchangeable in literature [40]. In the remaining of the thesis the term UCD and HCD will be used interchangeably. Typically a UCD process involves iterations, where user feedback is used to update requirements specifications and prototypes. Principal methods used in User Centred Design include: background interviews and questionnaires, focus groups, ethnography, cultural and technology probes, personas, user scenarios and various forms of prototyping and user testing.

An User Centred Design approach was followed in designing Echo, due to its benefits documented by considerable design research [40]. However, traditional UCD processes were previously critiqued as lengthy and heavy, focusing over creating specification documents rather than focusing on meeting user needs [59]. The need for a more rapid and flexible process in the design of Echo in the thesis, given the limited time frame, has brought the attention to a related approach, Lean UX.

Recently, the demand for faster processes in designing new products have lead to an industry born approach to UCD, the Lean UX. [38]. The Lean UX paradigm is shifting focus from design deliverables, i.e design specifications, to satisfying user needs in the design process. It does so through an iterative feedback loop **build-measure-learn** [19], [6] 3.1 which, seeks to imagine or derive user needs, design prototypes and

validate needs with prototypes. This was the process each iteration followed. An example of the loop as applied in Echo's design is shown in Figure 3.1.

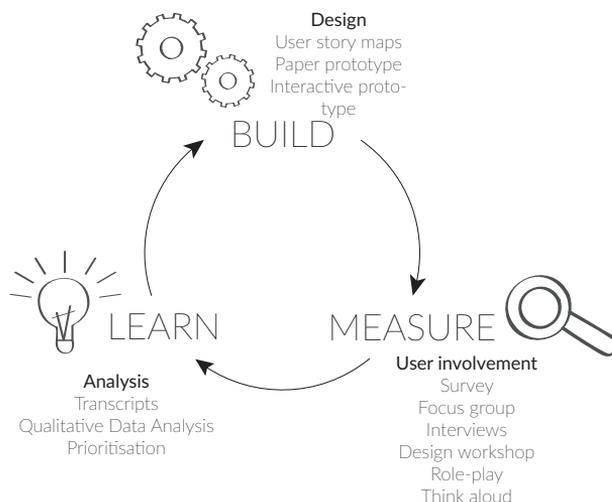


Figure 3.1: The build - measure - learn Lean UX feedback loop in Echo's design process. Compiled by the authors (adapted from Gothelf [19])

A core concept is the Minimal Viable Product (MVP). The MVP is developed through prototyping. Different options exist, depending on the scope of the prototype build, from pen and paper to fully coded. Prototyping in lean is focused on implementing only the must-have, crucial user tasks. Less prioritized tasks are pushed to further implementation (design) sprints or disregarded. This is achieved through a simple approach, followed in each of the iterations in Echo's design. First, functionality is described through user stories, prioritized into a hierarchical model of goals, activities and tasks, the **User Story Map (USM)** [52]. The cards prioritized for current release are refined into a **prototype** of the . This helps speed the design process, as it changes focus from extensive requirements specification to designing only needed functionality.

In designing Echo, User Story Maps were extremely valuable for structuring and prioritizing user feedback data into a clear concept. It also served as a rapid and flexible "design contract" to ensure agreement and common understanding between the authors. Prototypes of the MVP defined through User Story Maps were built in incremental detail levels, as the project progressed.

The overall methodology can therefore be described as a lean, User Centred Design approach. Echo was designed in an iterative way from concept to UI, with the involvement of clients, the primary users, and therapists, secondary users. The design was

iterative in that the prototype of each iteration was improved upon in the following one. Using an iterative method meant more time was used on the overall application design rather than perfecting specific elements through design specifications. It also meant user feedback was collected based on three versions of Echo prototypes rather than design specifications. However, iterations with users brought challenges in terms of planning and managing users for the different methods of involvement along the iterations.

As discussed in Chapter 2 Background and Literature Review, UCD methods must be however carefully selected and adapted when designing for mental health. The specific methods used are discussed in the next section.

3.1 Methods in iterations

An overview of the four iterations is given in figure 3.2

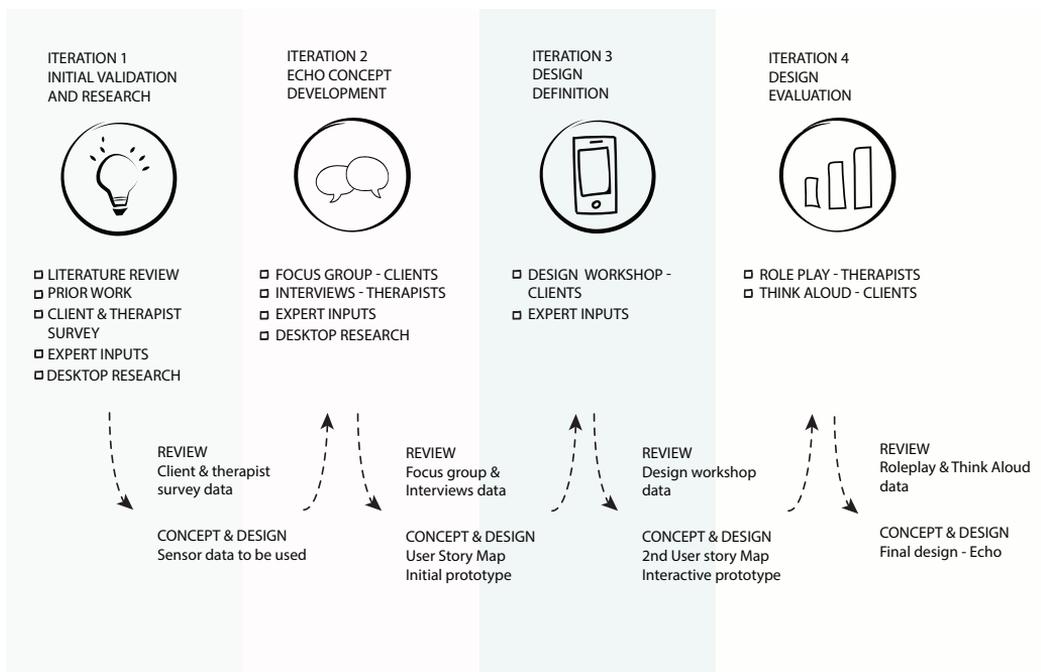


Figure 3.2: Design process overview, compiled by the authors

Prior to the design process a great deal of the related literature and prior work was reviewed in order to lay the needed academic basis and domain understanding. This was however recurrent throughout the process of the design

Echo was designed in four iterations where users (clients and therapists) were involved, with different goals. Each iteration used different aspects of User Centred Design (UCD) methods. The methods selected were predominantly qualitative methods, to gain a good understanding of both user types, clients and therapists and their needs for the solution.

The methods used in the iterations follow the Human Centred Design (HCD) process as described in Maguire[40]: Planning, Context of use, Requirements, Design and Evaluation

The reason for following this structure is due to the high focus on usability, which according to Maguire [40] enables a lot of benefits, including: increased productivity, reduced errors and improved acceptance. Phase 1, Planning is not included, as this was completed prior to the iterations.

Phase 2 Context of Use: identifying stakeholders, identifying the context, ask existing users, observe the field and tasks analysis. Maguire [40] emphasizes it is important to ensure a broad knowledge of the domain and the context the application will be used within. Task analysis was done through USM throughout the four iterations.

Phase 3 Requirements: thorough stakeholder analysis, user requirements, interviews, focus groups, scenarios, personas and existing solution analysis among other things.

Phase 4 Design: parallel design, design guidelines, card sorting, prototype etc.

Phase 5 Evaluation: Involving different methods such as user testing, participatory evaluation and Assessing cognitive workload.

Table Table 3.1 gives an overview of the iterations coverage of the research goals of Echo.

Research question	Addressed in
What personal data is relevant for clients in psychotherapy?	Iteration 1,2
What features are relevant for an mHealth application used in psychotherapy?	Iteration 3,4
How should the application be presented and used in psychotherapy, and how often?	Iteration 1,2,3,4

Table 3.1: Research goals as they were covered by the thesis design process

The choice of methods in each iteration is discussed next.

3.1.1 Iteration 1

As mentioned by Maguire [40] it is important to ensure a broad knowledge of the domain and the context the application will be used within. Therefore a lot of desktop research has been conducted to get a broad idea of the context. Furthermore the psychologist expert has been consulted through interviews and discussions on phone and Skype. In this iteration this has been mostly to get an introduction to her practice as well as to understand to what extent how the application could be used. Some of the parameters discussed were: what types of problem does the client come with, what type of data could be used, when should that data be used in therapy and in what context. Furthermore inputs were given on the different types of therapy and the concept of homework in therapy. The expert has been used for each iteration to give feedback on the method and formulations. Due to the sensitivity of the area there has been no field studies or observations. Task analysis was done using the User Story Map technique, which offered a definition of functionality within Echo.

The survey was created using the recommendations from Mackenzie[39, ch. 5] and Nielsen for online surveys [47]. They are pinpointing the following elements: quick and painless, ask few questions, ask different questions of different visitors, ensure that the questions are easy to understand. Furthermore the survey used mostly closed-ended questions for a statistical result, but a few open-ended were used to collect participants' own opinions.

3.1.2 Iteration 2

Iteration 2 consisted of a focusgroup, interviews and the initial design as a result of these.

Personas were not used in the first iterations due to a close collaboration with actual users. The focus was mainly on requirements, gathered from interviews and focus group using scenario of use. The focus group method was chosen due to the benefits mentioned by Tynan, 1988[11] and Kitzinger, 1994[30] (i)time-saving compared to individual interviews, (ii) give the possibility to discover new unexpected outputs and (iii) they offer interaction between participants:

Crucially, focus groups are distinguished from the broader category of group interviews by 'the explicit use of the group interaction' [30, p. 1].

The focus group was created based on the principles from Tynan[11] and Kitzinger[30]. This includes creating an open space for the participants and using participatory tools such as card sorting and rating exercises. The number of participants was kept low, due to the sensitiveness of the topic, as argued by Tynan et al.[61]. According to Kitzinger it is also important that there is a common ground between the participants i.e. they all had or were seeing a therapist.

Therapists interviews were conducted as semi-structured qualitative interviews[33]

The initial prototype design was created by the authors of the thesis based on the review of prior work and user inputs from the the first iteration and interview and focus group. This was done in line with Cooper's recommendations, that states users may lack the necessary knowledge and skills to be involved in the actual design [12]. The initial design made use of three methods discussed by Maguire in [40]: brainstorming, parallel design and design guidelines. Brainstorming was used used for idea generation, having the starting point in the user inputs organized in a User Story Map. The result of the brainstorming were a set of ideas on the application's components that were then further refined through parallel design. Here the authors worked separately on the generated ideas to design different UI. This helped achieve more diversity in the User Interface, *"before settling on a single solution (possibly drawing from several solutions)"* [40, p. 608]. The outputs of the parallel design session were discussed thoroughly and combined into a single prototype. Apple design guidelines for IOS were used in order to *"embody good practice in interface design, [...] increase the consistency between screens and reduce the development time"* [40, p. 608].

3.1.3 Iteration 3

Iteration 3 was focused on the forth phase of Human Centred Design described by Maguire [40], design. In the thesis this phase consisted of two parts: a the design workshop held with client participants and a redesign of the prototype.

Having the initial application UI designed, next step was to challenge it by involving users. Given that through the first two iterations Echo was narrowed down to have a focus on the client, only client participants were involved. This was done through a design workshop that consisted of three design methods of HCD: card sorting, scenarios of use using a low-fidelity paper prototype. First the concept design was on focus. Card sorting was chosen as a method in order to validate the structure of the application and the user journey defined in the initial design session. Besides validating application structure through the use of different user groups for the sorting activity, this method can help uncovering difficulties in understanding and design inconsistencies. For the interface design, scenarios were chosen to be played out using a paper prototype. This is motivated by the need to investigate examples of how the application would be used by the users in therapy to satisfy their needs [40]. Maguire argues that at a low fidelity prototype should at least be used in order to ensure the functional needs of the users are met.

The prototype was redesigned using the inputs from the design workshop as described above, using brainstorming, parallel design and the Apple IOS design guidelines.

3.1.4 Iteration 4

This iteration focused on the Evaluation of the Echo design and concept and a final redesign of Echo. Two types of user involvement were chosen. They consist of the

elements mention by Maguire [40]: user testing, participatory evaluation and assessing cognitive workload. Think aloud was used for client participants, as it covers all of the three elements. It is an easy and effective way to test an application in terms of usability. This is measured by the possibility of the users to navigate through the application. Learnability [21] could also to some extent be seen by how the tasks got incrementally easier for the users.

The method offers access to what the users were thinking while using the application. It is however hard to do for the user, since you think faster than you speak, as stated by Nielsen et al. [48]. This constraint of the cognitive load can be used to determine how difficult a given task is for the user by noting how much the user is verbalizing[48]

”demanding tasks creating a “high cognitive load” interfere with verbalization, because other processes crowd verbal information out of working memory.”[10, p. 72].

According to Nielsen[48] (stated in Nielsen et al.) five users are enough to find the main usability issues, therefore five participants were used for Think aloud user tests in Iteration 4: Design evaluation. Nielsen argues the tasks the users are asked to do should also be kept simple, to minimize the cognitive load and the prototype tested should be functional enough for the users to understand [48].

The role-play method was selected based on the amount of literature explaining the benefits of this method within mental health. Both Doherty et al.[15] and Matthews et al.[42] argues for the benefit when the area is so sensitive and access to the clients might be limited as well as the therapists being familiar with the role-play method from their field.

The prototype was redesigned using the inputs from the design workshop as described above, using brainstorming, parallel design and the Apple IOS design guidelines, The result is shown in Chapter 8 Echo: final prototype.

3.2 User involvement and data analysis

Having a UCD focus, a great deal of user input was collected and analyzed throughout the thesis. This section describes the research approach to the UCD process: the data collection and analysis done in the four iterations, ethical considerations, expert and participant selection and recruitment and the roles of the authors in the different user involvement activities.

3.2.1 Participants

The thesis involved two types of users, clients and therapists. In all four iterations of the design, both client and therapist participants were continuously recruited through

the authors' networks, through meetings and emails with therapists and psychologists organizations, word of mouth, the expert's network and social media. Each of the workshops involved a number of 4 - 5 client participants, in accordance to recommendations by Nielsen [48]. Three therapists participated in the role-play workshop.

Client users are defined as individuals who have prior been or are currently involved in psychotherapy. This was a requirement for recruitment for all iterations. Their therapy experience ensured they were able to contribute in terms idea generation and identifying functional elements for the application. Another aspect was to be able to be critical through their own experiences in therapy.

After the first client focus group, where only female participants attended, male participants were recruited in order to balance the dynamic of the discussions and make the input representative of a higher user base.

Therapist users were involved based on the guidelines defined by Doherty et al. on design for mental health [15]. Even if the application was defined to be focused on the client, the therapist plays a crucial role as the facilitator in the tracking preparation and also the reflection process (see Echo's stage based model Figure 2.5).

3.2.2 Expert

The expert's role was to give a basic ideas of a therapist view of the concept and application, and ensure a continuous feedback on iterations and concept ideas. The expert is a MA in psychology and has a body therapy education. She has a her own clinic. Her approach is holistic, including conversational therapy with psychodynamic aspects as well as cognitive behaviour therapy.

3.2.3 Moderators role

All user involvement were moderated by the authors of the thesis. In sessions with two parallel user groups both authors were moderating. In sessions with one main activity, the roles were equally distributed and alternated between moderating and taking notes.

3.2.4 Data collection and ethics

Given the sensitive domain area of the thesis - mental health - and the extensive data collection, measures were taken to ensure participants understand and are assured on how their inputs are used in the thesis. The participants were asked to sign a consent form prior to starting the test. For the therapist interviews a verbal consent was received from the participants. A complete description of ethics considerations, along with a copy of the consent form are available in Appendix K Data handling and ethics. Additionally all pictures and transcripts were anonymized in regards to clients participants.

3.2.5 Qualitative data analysis

All the user involvement were transcribed or summarized and analyzed using thematic analysis. Transcriptions were made for all the sessions. For activities where users were engaged in a task with paper cards or a prototype, transcripts were combined with summaries of selected parts, compiled using the recordings and notes.

Thematic analysis is a qualitative data analysis inspired by grounded theory principles, and the *"most widely used framework for analyzing qualitative data"* [60, p.567]. One particular principle used was coding. Coding involves reiterating through transcripts or summaries and annotating text with labels that are important for the specific research goal.

The codes used were based on what was relevant in relation to each iteration and the overall development of Echo, here included, validation, design elements and concept. In addition, codes related to the method (participant dialog, moderator input, workshop activity and reflections about the workshop) were used to evaluate the workshop.

3.3 Discussion

All research methods come with trade offs and limitations. The thesis follows a lean UCD process. While the design process itself is indeed very focused on the user needs, rapid prototyping and gathering continuous user feedback, the overall project has been heavily documented, given the requirements for a master thesis. Seeing it from this perspective, Echo's design process resembles more a traditional User Centred Design than a lean one. All user interactions were in detail transcribed, analyzed and discussed in the different iteration chapters - much like design deliverables or requirement specifications. However, having a traditional approach would have resulted in a extensive design documentation and UML based specification and less iterations of the prototype.

Another option for methodology given the novelty of Echo's application area, would be a Design Thinking approach. However, Orłowski et al. recommend using participatory design within mental health rather than design thinking, due to including the user throughout the design process [49].

Another important aspect of the approach, as explained above, is that the UCD process involved mostly qualitative methods. Having a more quantitative approach would have limited the depth of the design insights. The motivation for doing so, is rooted, again, in the focus of the thesis - design. The evaluation process has generated a lot of usable feedback that was implemented. Validating using standard schemas like SUS [8] or the perceived usability [14] are considered for future work.

CHAPTER 4

Iteration 1: Initial validation and research

The first iteration focused, as illustrated in Figure 3.2, on a initial validation of the concept of Echo and getting clients and therapists initial thoughts. The domain of Echo was investigated to clearly understand the context, which concluded in narrowing down the scope of Echo. Here included defining whom Echo is defined for, for what use and what aim [15]. This consist of four sub goals as shown in table Table 4.1

Goal	(i)Defining the target group	(ii)Selecting initial trackers for Echo	(iii)Clarifying if clients would show data to the therapists	(iv)Clarifying how therapist would use Echo in therapy.
Methods	Desktop Research	Expert and Client & Therapist survey	Client survey	Therapist survey
Participants	None	Clients & Therapists	Clients	Therapists

Table 4.1: Iteration 1 Overview

4.1 Method

The methods used in the first iteration have to some extend followed the structure of understanding and specifying the context of use in Human Centred Design explained by Maguire [40] (see Chapter 3 Methodology). The methods used consist of a survey, desktop research and expert inputs.

4.1.1 Participants

Two surveys were collected, one for clients and one for therapists.

Clients

The nine participants were all female and were selected by the criteria discussed in Methodology. They were recruited through the authors' network and the expert used. The age span was between 25-43. None of the participants had used any apps in therapy before and they had different therapists.

Therapists

Twenty therapists or psychology students participated in the therapist survey and were recruited through postings on Dansk Psykolog Forening (DPF)¹, Psychologists Facebook groups, Headspace², Psykologisk Kortids Rådgivning³, Psykologisk Samtalecenter⁴, Studenterrådgivningen⁵ and Sind⁶ as well as from a psychodrama group of the psychologist expert. Most of the places mentioned are based on volunteers, students as well as therapists. The distribution of students and non students were around 50%.

4.1.2 Apparatus

Google forms⁷ was used to create the two surveys. It was shared with all the above mentioned organizations and the clients via email and Facebook. The surveys can be found in Appendix C

The User Story Map was created using post-its on the wall and the storieOnBoard tool⁸, a simple tool for collaboratively designing USM.

4.1.3 Procedure and design

The procedures and design of the different methods will be described in this section, for a theoretical background of the methods see Chapter 3 Methodology.

4.1.3.1 Identifying Target group

Echo's users were defined in this iteration based on desktop research, consisting of statistics review within the domain of the concept and goal of Echo. Furthermore a definition of primary and secondary users were concluded based on the User Story

¹<http://www.dp.dk/>

²<https://www.headspace.dk/kobenhavn>

³<http://pknrnorrebro.dk/kontakt/>

⁴<https://psykologisksamtalecenter.dk/>

⁵<http://www.srg.dk/>

⁶<http://sind-kbh.dk/>

⁷<https://www.google.com/forms/about/>

⁸www.app.storiesonboard.com

4.2 Results of iteration

The results of this iteration defined the target group and validated the initial concept of Echo.

4.2.1 Target group

Echo can be used by all clients who see a therapist. To ensure that the design fits the user, the target group was narrowed down, mainly on age. This is somewhat conflicting with Doherty et al. [15] that states that the client ontology is relevant, however Echo is designed independently of some of these parameters.

According to KORA (the Danish Institute for Local and Regional Government Research) [44] people referred to a psychologist in 2013 were most often between 15-54 years old. Likewise, Sundhedsstyrelsen states that Danes between 16-54 are most affected by poor mental health [28]. Secondly, in 2013 the people with most health apps on their phone were in the age span of 18-49 [17].

Finally a study regarding usage of QS [53] shows that most QS users and most interested non-users are between 25-44. Based on these statistics the target group has been defined as the following:

- Age 18+, but to narrow the scope: 18-64.
- Gender: all
- Socio/social background: any, but the user should be seeing a therapist.
- Technical skill: all levels
- Demographic: DK
- Platform: iPhone users, since most Danes are using IOS rather than Android ⁹

4.2.2 Survey

The results from the client survey shows that the preferred trackers are smart-phone screen time, pulse and location. It is the same both for self tracking and for what they would show and talk with a therapist about, See Table H.1.

⁹<http://danskemedier.dk/wp-content/uploads/pressemeddelelse-mobile-life-final.pdf>

Choice of trackers in percentage		
<i>Trackers</i>	<i>Self tracking</i>	<i>Track and show therapist</i>
Smart-phone screen time	67%	67%
Pulse	56%	67%
Location	33%	44%

Table 4.2: Percentage of answers of top three trackers.

The key findings of the client survey are:

- 30% of the clients did already use some kind of self tracking tool (for respectively steps, sleep, weight, activity and calories. They were doing it to be aware of their patterns and to loose weight.)
- 20 % were seeing a therapist at the moment for one to three months, at the time of the survey.
- 80% have seen a therapist in the past.
- 11% did not want to show or talk about any of their personal sensor based (tracked) data with their therapist

The most important of these result is the last item, meaning that when asked **What smartphone sensor based personal data would you show or talk about with your psychologist, if it would improve your therapy? (select one or more)**, 89% of the respondents would show and talk about their data with their therapist. This accommodates goal (iii): clarifying if clients would show data to the therapists and validates part of the concept for clients.

4.2.2.1 Therapists

The result of the therapist survey show that the most important tracked data seen from the the therapist perspective are location, pulse, phone calls and smartphone screen time.

To answer the goal(iv) of the iteration the following question was asked

In what scenarios could you see yourself using sensor data in a therapy sessions?

The top three answers were: As a tool for tracking improvements(30%), as a homework tool(20%) and as a supplement to diary keeping or questionnaires(20%).

An interesting result was that 60% would use these types of data in their therapy The rest argued that the chosen data was either not relevant in therapy in their opinion or too simple to make use of in therapy as seen in the two quotes from respondents.

Choice of trackers by therapist	
<i>Trackers</i>	<i>Pct. of respondents</i>
Location	50
Pulse	30
Phone calls	25
Smartphone screen time	25
None	25
Text messages	20
Activity	15
Sleep	10
Food	10

Table 4.3: Percentage of answers for each tracker data in therapist survey Appendix C

As people come to therapy with very different problems and complaints, I find it hard to believe, that any such single factor will be a significant help in dealing with the clients.

The data would be “too simple” to use in a meaningful manner. I prefer to rely on the clients account, that I find more meaningful.

Overall the survey meets the second(ii) goal of the iteration having smart-phone screen time, pulse, location and phone calls,food, sleep, activities and blood pressure.

4.2.3 User Story Map

The User Story Map were used to get a clear and concurring initial idea of Echo and to ensure a discussion of the domain and help decide on primary user of the system and where the system fits in the context. It also helped define what to investigate further. It is therefore more of a brainstorming result than an actual USM to be iterated over.

The User Story Map have been divided into two separate sections. One for clients and one for therapists. This also helped decide on the primary user, based on the extensiveness of the client version compared to the therapist.

The expert approved the goals, activities and tasks of initial User Story Map after being introduced to the concept.

4.2.4 Discussion of results

The way of doing the User Centred Design in this iteration have proven to be very valid and gave a lot of inputs, that would possibly not have been taken into consideration have the users and expert not been involved. The use of User Story Map proved

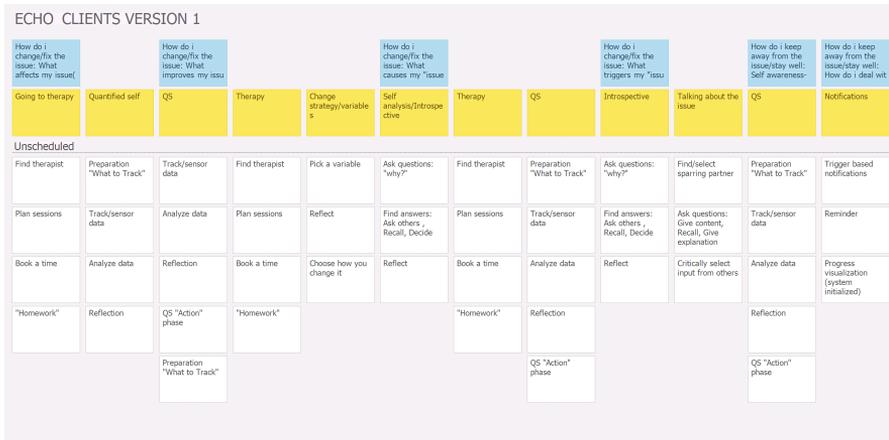


Figure 4.3: User Story Map Clients. Compiled by the authors

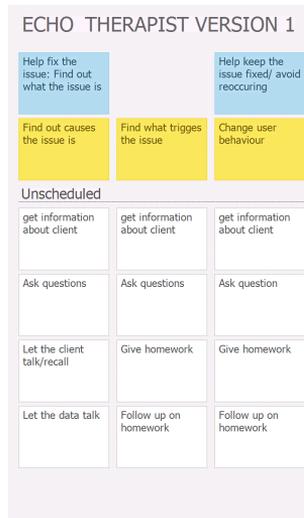


Figure 4.4: User Story Map Therapists. Compiled by the authors

to be a valuable way of collecting requirements and a good tool for both discussion and united understanding of the concept. The survey helped answer some questions in relation to both goal (iii) and goal (iv) and helped define the goals for the next iteration, even if the sample size might be too small in the traditional sense of quantitative data. Furthermore it defined some of the tracking options, though they are be further investigated qualitatively in Iteration 2: Echo concept development.

The results of the therapist survey did not show a staggering rate of therapists eager

to use these data, this might be caused by how technical the question was phrased. As discussed in several articles[15][43] in the section 2.2, one of the most challenging aspects of when designing for the mental health domain, is that therapists have a reluctance to use technology in a field with so many years of traditional human focus. This aspect was also mentioned when talking with Dansk psykolog Forening. The GDPR ¹⁰ issues also makes therapist very aware of data and how to use it correctly.

¹⁰<https://www.eugdpr.org/>

CHAPTER 5

Iteration 2: Echo concept development

The overall goal of this iteration was to get input from users to generate requirements using the User Story Map for the initial concept and design of Echo. This includes a more thorough analysis of some of the elements discussed in Iteration 1: Initial validation and research and answering the sub question. The sub goals of this iteration can be found in Table 5.1

Goals	(i)Defining trackers to be included in Echo	(ii)Define when and by whom Echo should be used in therapy	(iii)Define how Echo should be introduced and used in therapy.	(iiii)Define if Echo should be used during and/or between sessions
Methods	Focus group & Interviews & Desktop research	Interviews & focus group	Interviews & focus group	Focus group & Interviews
Participants	Clients & therapists	Clients & therapists	Clients & therapists	Clients & therapists

Table 5.1: Iteration 2 Overview

5.1 Method

According to Maguire[40], the next step in Human Centred Design is requirements. The methods used in to support this step consist of interviews, focus group and desk-

top research to further define what tracking option to include in Echo, see Methodology for further discussion of the methods.

5.1.1 Participants

The participants were recruited from the authors' network, the expert and through the survey from Iteration 1: Initial validation and research

5.1.1.1 Focus group

The focus group participants were all clients and consisted of four females within the age span of 29-36. All the participants had participated in the survey in Iteration 1: Initial validation and research.

5.1.1.2 Interviews

The two main requirements for the interview participants were: (i) being a therapist or psychology student and (ii) have previous experience working with clients. Participant A. was 65 years old and an authorized clinical psychologist using mainly psychodynamic therapy, Participant B. was 24 years old and a master student of organization psychology in the last year.

5.1.2 Apparatus

The interviews were conducted via Skype, since the participants were located in Århus and Sweden. It was conducted with audio only.

The focus group used scenario cards in the first session, consisting of small cards created by the moderators, see Figure 5.1. The tracking options were chosen based on answers from the survey in Iteration 1: Initial validation and research. Each participant was given a rating sheet. The rating was done on a 5-point Likert scale from very relevant (1) to very irrelevant (5), see Appendix D. Furthermore a whiteboard and small sticky notes were used for the last part of session 1, for the clients to add on a time-line on the whiteboard. Both focus group and interviews were audio recorded using a recorder on Android phones and the interviews were recorded on the mac computer they were held on. Google voice typing was used for transcription and QDA miner Lite ¹ was used for Qualitative Data Analysis for more detail see section 3.2.

5.1.3 Procedure and design

The procedures and design of the different methods are described here.

¹<https://provalisresearch.com/products/qualitative-data-analysis-software/freeware/>

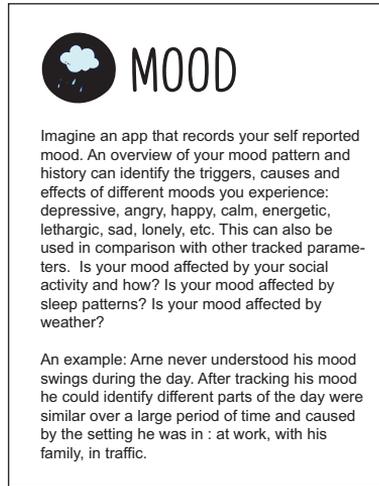


Figure 5.1: Mood scenario card used in focus groups. It contains a description of the tracking option (here mood) and a small case where the tracking option would be relevant. Compiled by the authors

5.1.3.1 Focus group

The focus group, consisting of four participants, a moderator and a notetaker. It was held at Aalborg Univeristy in Sydhavn on the 24th of April from 17-18.30 in a classroom. The focus group consisted of two sessions.

In the first session the participants were asked to read, rate and discuss 10 different scenarios cards, corresponding to the 10 possible trackers based on surveys from iteration 1 and desktop research. The trackers with scenarios were: Physical activity, sleep, mood, SMS, calls, app usage, pulse, location, blood pressure and food consumption. The rating was done individually on a rating sheet and then the rating was discussed by all participants.

The participants were then asked to agree on top three of the scenarios and add them to a time-line on a whiteboard, indicating when they thought an app with the data would be useful, i.e between or during therapy sessions. Finally they were asked where in a therapy time frame they saw the use of Echo, i.e. initially, first session, after some sessions, etc.

In the second session the participants were asked to discuss how they saw the app being used in therapy.

The focus group was constructed and carried out with focus on creating an open space for the participants[11] and using participatory tools such as card sorting and rating exercises [30]. The moderator guide can be found in Appendix D.

5.1.3.2 Interviews

The interview was conducted, due to the lack of therapists participating in the focus group, to include inputs from therapist and not only clients. The interviews were conducted as semi-structured qualitative interviews[33]. The Interview guide is available in Appendix E. The main goal of the interview was defined and then divided into sub goals, which were rephrased as questions.

Both interviews and focus group were roughly transcribed and analyzed using a qualitative data analysis tool, see section 3.2 User involvement and data analysis for details.

5.1.3.3 Trackers

Based on the results from the first iteration, the focus group, the interviews and desktop research, a comparison of trackers was performed. The tracker chosen for Echo was then based on the most often mentioned tracker within the scope and relevance of Echo. The desktop research consisted of articles reviewing or summarizing other studies within the same domain.

5.1.3.4 User analysis

A thorough investigation of previous solutions and literature review were carried out as well as a brainstorming session to clearly define the roles of both the primary users(clients) and secondary users(therapists). This also affected decisions on the interface and whether or not both user types should have their own interface.

5.2 Results

The results of this iteration defined what trackers Echo should contain, the primary user of Echo, how Echo should be introduced and used and when.

5.2.1 Focus group

The scenarios from session 1 with the highest scores are activity, sleep, mood and pulse.

The rating was also intended to make the participants talk and discuss. Using the QDA, made it clear to see that mood was the most discussed and relatable, see Figure 5.3 below.

There was some skepticism towards if the trackers could actually calculate and show what the scenarios examples showed. One participant complained about wrong predictions when using Clue². The participants discussed the benefits and drawbacks of

² An application to track female health www.clue.com

<i>Scenarios</i>	Rating				<i>Median</i>	<i>Mode</i>
	<i>Partic. 1</i>	<i>Partic. 2</i>	<i>Partic. 3</i>	<i>Partic. 4</i>		
Pulse	4	4	4	2	4	4
Calls	1	1	3	1	1	1
Location	2	4	1	1	1.5	1
SMS	2	1	1	1	1	1
Blood pressure	4	4	1	2	3	4
Mood	5	5	5	5	5	5
Food	4	1	1	2	1.5	1
Phone usage	3	3	5	3	3	3
Sleep	4	4	5	4	4	4
Activity	4	4	4	4	4	4

Table 5.2: The results of the 5-level Likert scale rating from each participant of each tracking options scenario and the mode and median for each tracker, see section 5.1.3.1



Figure 5.2: Cardsorting and rating in focusgroup, session 1

tracking, it can help you become self-aware, but it can also turn out to be a stress factor, both in terms of having to do manual tracking and seeing the data. However they all agreed that if you have found out what stresses you or makes you sad, you are in general more aware of it. The main design elements retrieved from the Qualitative Data Analysis of the focus group are:

- Add correlation of different trackers
- Maybe remove goals that the client could feel bad about not achieving.
- Physiological measurements are more interesting because they are hard to obtain otherwise.
- Be able to make notes, annotate why the data looks at it does, so when you go back and look at it, you can see why and don't need to remember.
- Make the data representation and visualization simple if client uses it alone.

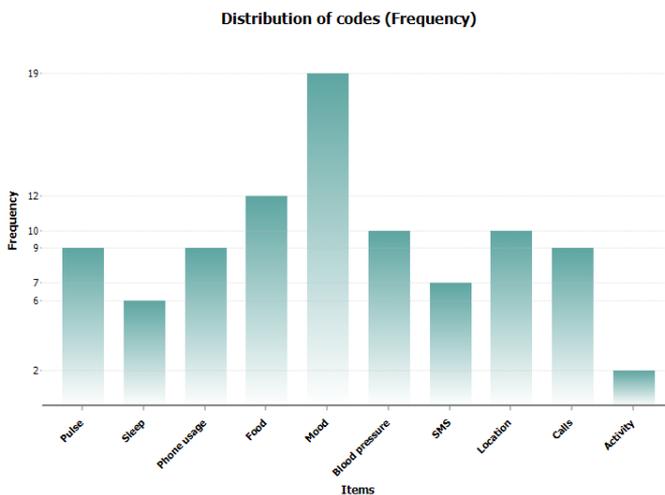


Figure 5.3: Scenarios coded frequency. Compiled by the authors

- The clients has to believe that it can actually correctly indicate what it is suppose to too
- It should offer the possibility to select and display only the relevant data not all.
- It should be personalized and customizable
- Echo should be able to fit all types of clients and their type of problem

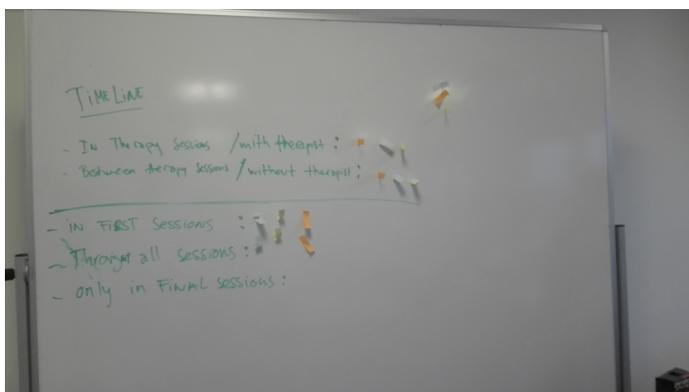


Figure 5.4: When should Echo be used, focus group, session 2.

In regards to when and how Echo should be used, there was a clear consent that it should be introduced by the therapist and it should be in the beginning of a therapy time frame, maybe session 1-3. Hereafter it would depend on the client and the problem, how often it should be discussed in therapy. They would like to use the application both between sessions by themselves and during sessions with the therapist. There were some discussions as to whether or not Echo should allow clients to send the data to the therapist prior to a meeting. When discussing how often Echo should be used one participant summed up the consensus of the group *"dynamically in the session and regularly on my own."*

An important aspect of the focus group is that the participants are talking and discussing the trackers from their point of view, meaning that since they all have been going to a therapist their self-awareness might be higher than others. Therefore some of the trackers might not seem relevant to them, but might be to other potential users of Echo.

This also indicates that the users should be able to select the trackers, since it might be someone new in therapy or someone who has been going to therapy before. Based on the analysis the clients did not see the point of SMS, calls and food because they only focused on how these elements could affect their mood and problem and not how for instance the amount of calls can be used to indicate a depressed mindset. They did however still see the idea and concept of Echo having value:

...an initial thing when you start out like a helpful tool when you don't really have a clue you can really see the coherence between your patterns and moods and it's very good to use this. you can see what's going on and in what time frames and talk with your psychologist about it. Appendix B, Focus group recording, 40:49

The complete transcribed focus group can be found in Appendix B

5.2.2 Interview

Both the participants were very aware of the appearance of their clients, facial expression, the way they talk (words, pace). It is important to see the client, look for the unconscious expressions, the words that are not said, bodily expression or even silences.

The data that they found quite valuable would be data that can tell them how their client are doing in different social situations, i.e. work, meeting friends. Another important element for both was sleep.

They also saw a benefit in having a small note or diary function, to help the client remember what happened or what affected them.

One saw Echo being used as a tool for preparation before the client arrives and they both saw the value of using it in therapy. Mostly to help keep focus on the most relevant elements and to start a discussion.

In terms of clients looking at the data themselves one of the therapist concluded:

They [The clients] report back to me in the conversation, they are coders of the information themselves or they can report it back and I can read it before that. But sometimes I think it's better if the patients themselves actually looks at the pattern, or look at the answers, together with me and we can talk about it Appendix B, Interview therapist 1 recording, 20:49

They would not use it every session though, but use it in different sessions depending on the client and their problem. They both stressed that the therapist should introduce Echo and explain it thoroughly both in terms of why it makes sense in therapy and how the given client should use it.

I would introduce it because it would be important for the patient to know that I think this is a helpful tool. Appendix B, Interview therapist 1 recording, 28:54

It is very important that it is not a one fits all solution. It is not only for the client that it should be customizable and personalized but also for different therapists.

Both therapist saw Echo as a valid product that could actually aid them in therapy sessions.

I think your task [project] is really really good to help people report back about sleep, about feeling better or feeling worse, about different things. Even I as a psychodynamic [therapist] I could use that information but I couldn't use it as the only means of therapy, I would still have to meet my patients Appendix B, Interview therapist 1 recording, 10:37

I think this is a good area, but you need to, as always, be very sensitive of how to use it and when to use it and so on. But it could be very helpful to have it designed. Appendix B, Interview therapist 1 recording, 35:30

The complete transcriptions of the interviews can be found in Appendix B

5.2.3 Target group analysis

The therapists still have to be considered as secondary users, since they would use the application in cooperation with the clients. They would be introducing the application and initialize the talk in relation to Echo in a therapy session. However

they would not have their own user interface, even though it was suggested in the focus group and the interview, because the therapist does not need access to the data.

The arguments for creating a web portal for therapists were that it would give the therapist a possibility to look at the data prior to having a therapy session with a client. This would reduce the time in the therapy session used for analyzing and reviewing data. It could be an opt in, opt out option.

However both privacy concerns and some clients in the focus group felt like they were perceived as a set of data instead of a person, because they were not given the possibility to argue for the data made it clear that it should only be there if highly useful.

In other solutions that contain a web portal such as Moodbuster[46] and Monarca[3], it makes sense due to a more clinical approach such as adjusting medicine intake and a possibility to monitor patients, but that is not the scenario with Echo.

It is quite important to distinguish between sharing and showing. Clients would not mind showing their data, but some would be more reluctant to share data with their therapist than with their doctors, due to the precedence within the medical field.

Furthermore it opposes the concept of the therapist being a facilitator as both clients and therapists emphasize in both interviews and the focus group. A web portal is not seamlessly adaptable in the existing approach of psychotherapy.

5.2.4 Trackers

As mention in the method section, the different trackers used in Echo was determined by comparison of other reviews and the empirical data. The table below shows the distribution of trackers.

<i>Source</i>	Trackers								
	<i>Activity</i>	<i>Pulse</i>	<i>Sleep</i>	<i>Location</i>	<i>Light</i>	<i>SMS</i>	<i>calls</i>	<i>App use</i>	<i>Mood</i>
Survey C.		x		x		x	x	x	
Survey T.		x		x			x	x	
Focus group	x	x	x						x
Interview		x	x	x					x
Rohani et al.[54]	x	x	x	x	x	x	x	x	
Mohr et al.[45]	x		x	x	x	x	x	x	
Harari et al.[22]	x							x	x

Table 5.3: Echo trackers selection

There are many more sensors and useful tracking options than mentioned in the above table, this is however the key elements. Some of the papers used for comparison in the table do also include battery life time and Bluetooth, this is however not included in Echo. Microphone and camera has also been discussed, but was considered to be too intrusive.

Based on the above, the trackers selected for Echo are: Pulse, app usage, Location, Activity and Light. Furthermore it will include manual trackers that can be created and added as wanted, this could be used for mood. SMS (text messages) and phone calls are included under communication in app usage. It is however not possible to see exactly how many calls and texts, how long the call was or to whom. This restriction was based on a concern of it being too intrusive which might cause some clients to obtain from using Echo.

5.2.5 User stories

To update the User Story Map, user stories had to be made based on the results from this and the previous iteration. They were created using the template from Economy and Patton "As a [type of user] I want to [do something] So that I can [get some benefit]" [52, ch. 7]. To keep the structure from the previous USM, the user stories was divided into client and therapist. Some of the user stories are shown below

1. As a client I want to ...

- ...track myself, so that i can learn about myself
- ...revise my data, so that I can move forward in my therapy
- ...show my data with my therapist, so that I can get a more informed advice /therapy
- ...see changes in my patterns over time, so that I can understand the root cause of my problem
- ...discuss with my therapist what I can be aware of, so that I can change my behavior/work through my problem.

2. As a therapist I want to...

- ... understand the parameters that affects my client, so that I can understand and help my client better
- ...help my clients be more self aware, so that my clients can change their behaviour
- ...give my clients homework so that I can understand my clients better
- ...discuss my clients objective data, so that I understand their problem

- ...support my client in between sessions / keep him/her engaged so he/she can work on solving the problem

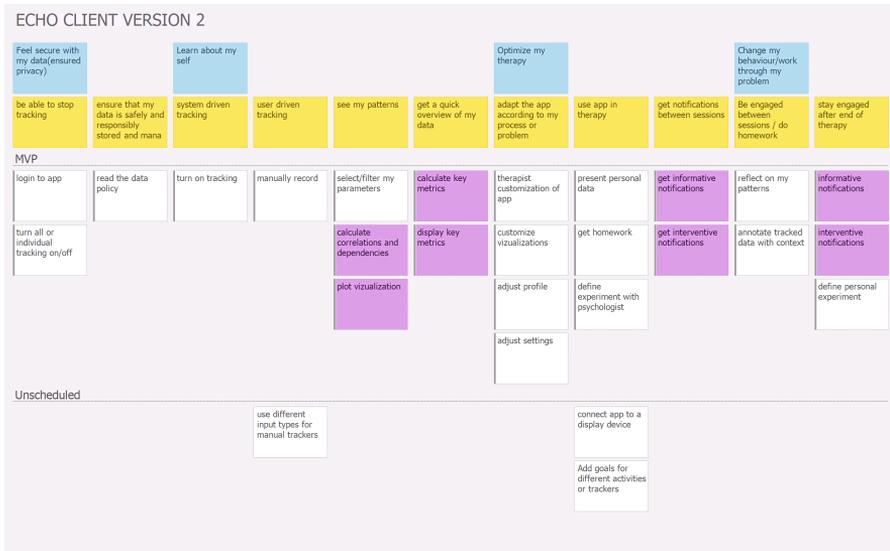


Figure 5.5: User Story Map - version 2, Clients. Compiled by the authors

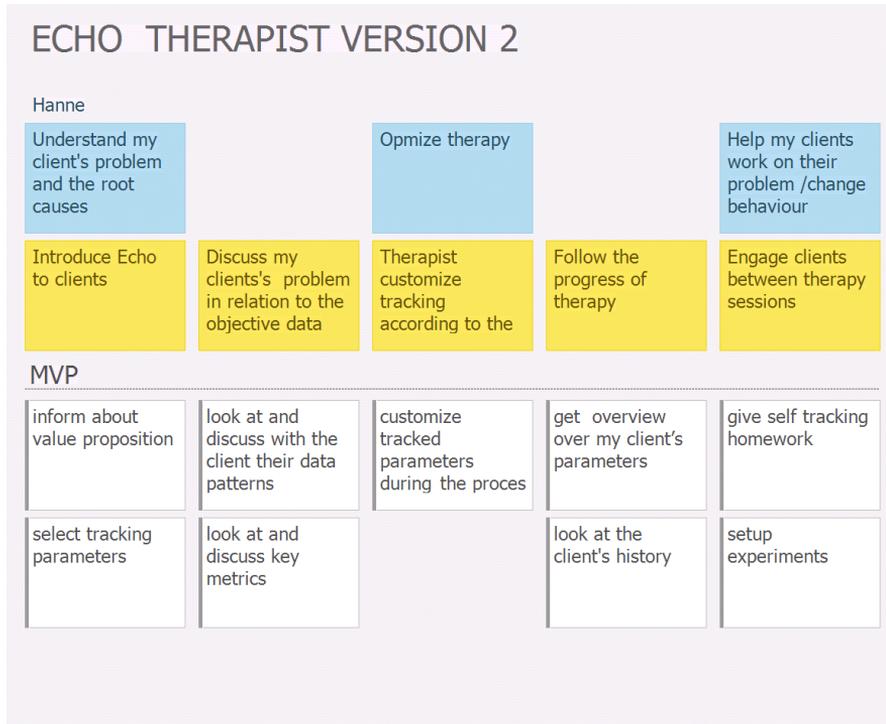


Figure 5.6: User Story Map - version 2, Therapists. Compiled by the authors

5.2.5.1 Initial design

Based on the USM the following initial design of Echo was created using Marvel prototyping tool³ Below are some of the screens created, the full initial design can be found at Appendix F.

Each tracker has its own graphs that can be viewed in the Appendix F. The graphs in the initial design are however just mock graphs as examples of how they could be designed, since the purpose of the initial design was to have a base for a design and a discussion in the design workshop.

The idea for the therapy module was based on the concept that the clients should be able to easily show the data to their therapist, without the therapist having to have a portal of their own.

³www.marvelapp.com

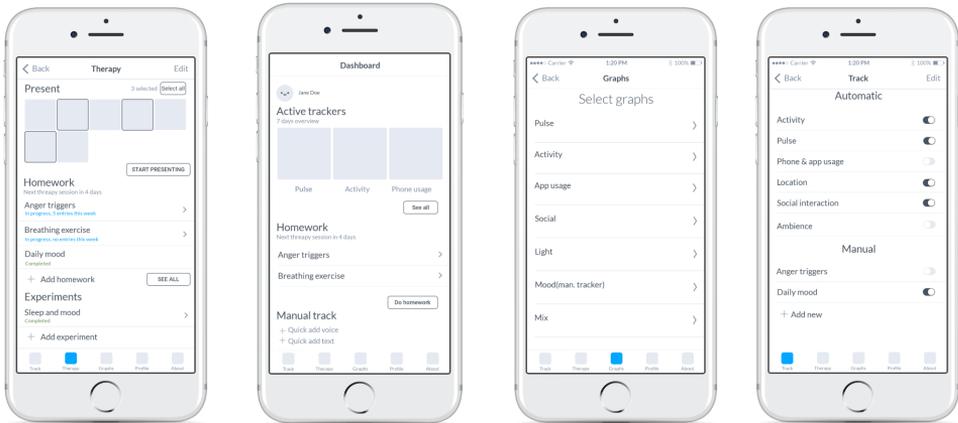


Figure 5.7: Initial design, therapy, dashboard, graphs and track. Compiled by the authors

5.2.6 Discussion of results

The four main goals of the iteration: getting requirements, defining what trackers Echo should use, how and when the application should be used and defining the concept has all been fulfilled through the different UCD methods used.

Initially the focus group was planned as the only user involvement, but due to the challenge of getting therapist involved, it had to be divided into two separate methods. One thing worth considering is that even though the users have very relevant inputs, not all feedback makes sense for Echo.

The fact that they had already worked with themselves and had become more self-aware through prior therapy makes them indifferent to some of the trackers that other client or new client could still benefit from. Another element is that all participants had to imagine how it would work without any design or IT background[12, ch. 9], which might make them doubt how it could be done.

CHAPTER 6

Iteration 3: Design definition

The third iteration in Echo's development was focused on the application's User Interface (UI) design. The overall goal was to **evaluate the content (through the USM defined in the previous iteration) and the initial UI design of Echo**. More specific, user feedback was sought to evaluate four different goals, as presented in Table 6.1

Goals	(i) Evaluate if USM tasks support user needs	(ii) Evaluate flow and screen interaction	(iii) Prioritize screen content	(iv) Identify missing elements
Methods	Card sorting of user tasks	Card sorting of user tasks	Card sorting of user tasks & Scenario role-play	Scenario role-play
Participants	Clients	Clients	Clients	Clients

Table 6.1: Iteration 3 Overview

6.1 Methods

According to Maguire[40], the next step in Human Centred Design is producing and evaluating design solutions. The methods used in this step consist of a Design workshop [40] that consisted of a serie of other UCD methods: paper prototyping, card sorting, user stories and scenarios. Please see section 3.1.3 in Methodology for a detailed discussion of the methods.

6.1.1 Participants

All participants used in the workshop are or were previously clients, three females between 28 to 36, who also participated in the first focus group and a 28 years old male participant. One participants was an iPhone user and the rest were Android users.

6.1.2 Apparatus

User stories (USM tasks) paper cards were used for the first session of the design workshop. In the second session, paper cut-outs of the application's screens were used for a card game and scenario role-play. The workshop was audio recorded with Android phones, transcribed with Google Voice Typing¹ and analysed with QDA Miner Lite². Storiesonboard.com³ was used to implemented the user feedback in USM and the UI prototype was developed in Marvel⁴.

6.1.3 Procedure and design

A design workshop [15] was held in a closed classroom at Aalborg University, in Sydhavn, on the 24th of May, between 17.30 - 19.30. This provided a high internal validity but a lower external validity, due to not being done in the actual context [39, ch. 5]. It consisted of two sessions: one focused on the requirements and the user journey and one focused on the UI design. The Moderator guide for both sessions can be found in Appendix G.

In the first session, after being introduced to the topic of the thesis and the general rules of the workshop, the participants were divided into two groups and each group was seated at a different table together with a moderator. The participants were given paper cards with user tasks created based on the previous iterations User Story Map (see Figure 5.5). They were asked to discuss the cards together, sort them into categories and label the defined categories. The participants were also allowed to add their own tasks, if they considered so. This was to verify that the application met the needs of the users, and supports all the different tasks a user would perform through the app. Figure 6.1 and Figure 6.2 show the USM created by the two participants groups.

After the categorization the participants were asked to create a user journey for using the application in therapy. When both tasks were completed, each group presented their user journey to the other group (see Figure 6.3).

In the second session, targeted at evaluating the UI, participants interacted with the initial design through a paper prototype of screen cut-outs. Paper prototyping was

¹<https://support.google.com/docs/answer/4492226?hl=en>

²<https://provalisresearch.com/products/qualitative-data-analysis-software/freeware/>

³<http://storiesonboard.com/>

⁴<https://marvelapp.com/>

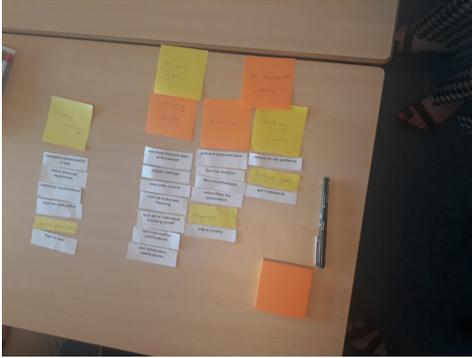


Figure 6.1: User story map created by the first group



Figure 6.2: User story map created by the second group

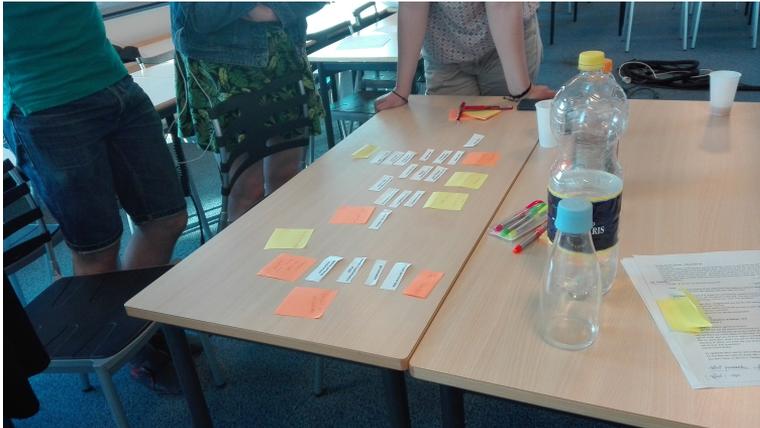


Figure 6.3: Participants presenting and discussing around one of the user story maps

chosen as it is *well suited to understanding very high level interface requirements* [63, p. 20]. The initial UI was not in detailed defined, but contained the high level functionality (Track, Therapy, Graphs, Profile and About modules, and the graphs used were simply examples, as described in section 5.2.5.1). This session consisted of two activities: a card game and a role-play of different therapy scenarios using the paper prototype.

In the card game each participant received a mixed pile of 25 paper cards corresponding to screens of the app. 25 paper cards with titles of the screens were displayed on the floor in the room where the workshop was held. The participants had to start at one of the title cards on the floor and look in her/his card deck for that specific screen. If he/she had it, they could move forward to the next title card. If they lacked the

specific screen, they would need to ask the other participants about it. They would continue until they would form a whole 25 deck with all the screens. The game was planned to actively involve the participants in getting familiar with the different screens of the application for the role-play session - see Figure 6.4. However, towards the end of the game the participants started to do a trading game and instead of walking around the floor cards, they would look at each others decks and exchange different screens - see Figure 6.5.



Figure 6.4: Participants playing the screen card game



Figure 6.5: Participants trading in the card game

After playing the card game the participants were divided into two groups, each with one moderator for role-playing of five scenarios. The topic of the scenarios was chosen based on the client's user journey in Echo as defined in the initial design: (i) being introduced to the app, (ii) showing the data in therapy, (iii) following up on homework, (iv) self-preparation for the therapy, and (v) being self aware of own patterns. The scenarios can be found in Appendix G. The participants were asked to take turns reading a scenario and playing out using the 25 paper screens that were displayed on the table - see Figure 6.6. After each scenario, the participants discussed whether they agree or have a different view on the scenario than the one playing it. In one of the groups, the participants had quite different opinions, generating a lot of relevant discussions for Echo's design.

6.2 Results

The user inputs from the workshop are summarized in the following sections, in regards to the goals of the iteration, defined above in Table 6.1

6.2.1 Goal (i): evaluate if USM tasks support user needs

This goal was addressed in the card sorting session. Overall, both participant groups discussed the iterative nature of the USM tasks. More specific, goals were introduced, to define the objective of tracking and to structure the tasks in regards to it; The

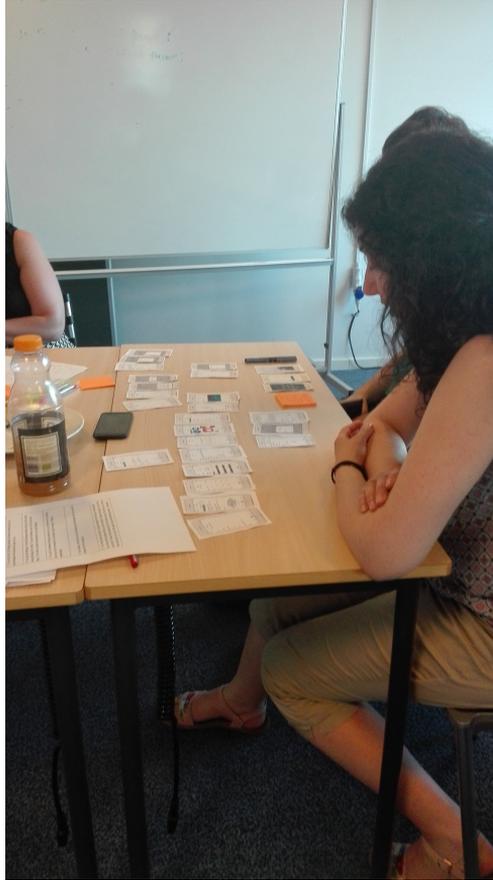


Figure 6.6: Participants role-playing and discussing different scenarios using the paper prototype

participants suggested an iterative process in relation to goals: setting a goal, self tracking, doing homework, measuring progress, setting new goals, *"then you start collecting data again and it's a iterative process"* (see Appendix B Data sources, Iteration 3, 02.45 in Design workshop part 3.m4a). Another important aspect discussed was the therapist and client's roles. Consensus was that the therapist initiates the process, by introducing the app, explaining the expected benefits and demonstrating the tasks the client would be recommended by him/her to do in the app i.e manual tracking, notes, homework.

In order to update the User Story Map, the feedback was categorized more specific to the user goals defined in the map, in Table 6.2.

Feel secure with my data(ensured privacy)	<p>Even if the application is dealing with a great deal of personal and sensitive data, the clients did not show concerns regarding the "read the privacy policy" task. However, defining personal data like gender, age etc. was not seen adding value for the client</p>
Learn about my self	<p>The participants had different opinions on the tasks related to this goal. One participant was particularly disagreeing with the graphs being accessible to the client, as clients don't have the necessary background to interpret the data in relation to the goal of the therapy. All participants agreed that it is important to be aware of what the graphs indicate to the client, i.e negative progress. Another idea discussed was the selection of tracking parameters; consensus was that it should be defined together with the therapist. Automatic tracking was preferred over manual; it is still important to be able to track custom parameters, but it should require little effort from the client. Visualization elements from applications like Moves⁵ and Clue⁶ were referenced as positive to the tracking experience. Furthermore, some terms difficult to grasp were discussed : key metrics, visualization, annotate, personal data, mix [graphs]. In terms of UI, all participants agreed the application should be kept simple, visual, icon-based.</p>
Optimize my therapy	<p>One of the tasks introduced by the participants was the definition of therapy goals but also session to session goals for tracking progress. It was suggested that the introduction to the application contain a video demonstration of the application and clear to understand examples of the most common client tasks i.e how to add tracking entries, how to annotate. The participants also described annotating as very important for the tracking process, in order to give context to data but also for the client's self-reflection and preparation for therapy (annotations were not implemented in the paper prototype). In terms of visualizations (graphs), participants discussed again the role of the client and therapist in deriving meaning from data. One participant suggested that it should be the therapist's task to identify potential correlations. Another participant thought that the reflecting over the personal data during the therapy session would be to timely, and suggested this as a task for the client to perform in preparation for the session. Opinions were also divided in terms of adding homework - if it should be during the therapy session or after. Interventive notifications were re-defined as reminders in relation to tracking and homework rather than the client's (mental) state.</p>
Change my behaviour/work through my problem	<p>While a large focus was put over the previous therapy goal, the participants saw the benefit of the application for the client's individual work to improve mental state. The possibility to add context to tracked data was reviewed as very important. The participants discussed annotating as adding comments both in text and voice. Another aspect touched upon was the possibility to see one's history of graphs, data, homework and notes. This was discussed in the idea of clients re-practicing exercises or homework after the therapy process, on their own. Notes were also touched upon as a tool for tracking ideas or for questions for the therapist.</p>

Table 6.2: Design inputs in relation to the User Story Map goals

6.2.2 Goal (ii) evaluate flow and screen interaction

The two user story maps and the user journey presented by the two participant groups in the card sorting session (see Figure 6.1 and Figure 6.2) shared a common organization of tasks, similar to the USM defined in the previous iteration (see Figure 5.5 in Iteration 2: Echo concept development). According to Maguire, clear organizations of cards from several users means the application has a well defined scope [40]. The distinction between "in-therapy" usage and "on-my-own" usage of the app was very clear in both groups and consistent with the distinction between the goals: **optimize my therapy** and **learn about my self / work through my problem**. Overall, the described flow was similar. The difference consisted in the selection and definition of tracking parameters - individual or with the therapist (the preparation stage described in Li's stage based model [36]).

The user journey was validated by the card sorting technique. However, flow and screen interaction was difficult to measure. This is due to the participants limited interaction with the paper prototype, when playing scenarios in the second session. This might be due to using all the application screens from the first prototype, which made it difficult for the participants to have an overview of the application and distinguish between different functionality. The interaction was therefore re-evaluated with an interactive version of the prototype, in the subsequent iteration (see Chapter 7).

6.2.3 Goal (iii) prioritize screen content

This goal was concerned with the design of the main screen of the application, the dashboard. The participants came with different opinions on what is the preferred way of selecting content to be displayed for easy access in the dashboard (third screen shown in Figure 6.9). They have discussed whether the approach to the dashboard should be personalization. Some participants argued that Echo should be aware of the active tracking, the current status of the client and display meaningful information relevant for the status. On the other hand another participant talked about the surprise effect - even if some particular information might not be characterized as important, it could reveal surprising facts, and support self-awareness.

6.2.4 Goal (iv) identify missing elements

Both sessions have contributed with relevant suggestions in terms of new or missing tasks. Most notable, as previously touched upon, were the annotation and browsing of history data tasks. UI elements like check-marks for homework, icons for different screens were also brought in the discussion by the participants. Another new aspect discussed by participants during the card sorting activity was goals defined by the client together with the therapist, through the application. This was however disregarded from the design, as the psychotherapy application area is quite different compared to other areas where self tracking is used. While it is obvious that the psy-

chotherapy goal is to help the client in regards to his/her mental health and mental well being, it is very difficult to define very specific goals for the psychotherapy. This decision was also supported by discussions with the therapist expert and it is further touched upon in Chapter 9 Discussion.

6.2.5 Inputs for concept and UI design

Based on these inputs the Client User Story Map was slightly adjusted. The therapist USM was not further used, as Echo was defined to be focused on the client. The homework task was turned into a activity, to support the different needed tasks in relation to homework: add new type of homework, define new homework in therapy (with therapist), define experiment with therapist, mark homework as done in notification screen / pop-up, mark homework as done in homework screen (in app), write notes on homework, audio record notes on homework. Other new tasks introduced were: see quick image tutorial (tour of app), view historical data in calendar, personalize stats shown on dashboard (system task). Another result of the was concerned with the language used in both describing the requirements, but also in the application, for different labels. Using the users language in the UI makes it intuitive for them to recognize and find the functionality they look for. Therefore both the User Story Map and UI labels were updated with user suggested terms. The updated USM is displayed in Figure 6.7.

After defining the User Story Map, the application prototype was updated. Paper prototyping was used for creating new screens for the missing elements identified and as well adapt the existing ones, in accordance with the previous discussed points. Screens were added for annotating, recording voice notes, homework tasks and viewing history of homework as well. All the screens of Echo version 2 can be found in Appendix B, Designs, Echov2.

In general a whole redesign of all the different graphs was made. Ambience was removed from the trackers and sleep was added based on discussions by the clients in the workshop and expert inputs.

The design was also enriched with more visualizations and icon based UI elements, as shown in Figure 6.9.

A color scheme was chosen to add detail to the different elements and to be used in the graphical design of the different graphs and achieve a higher fidelity in the prototype version. The color scheme is showed in Figure 6.10. The primary color is pastel green. This was chosen as it is a positive color, symbolizing hope and health [25], concepts that are at the core of Echo.

Micro-interactions were used to re-define the interaction flow through triggers, rules, feedback and loops. Figure 6.11 shows the paper version of the micro-interactions definition.

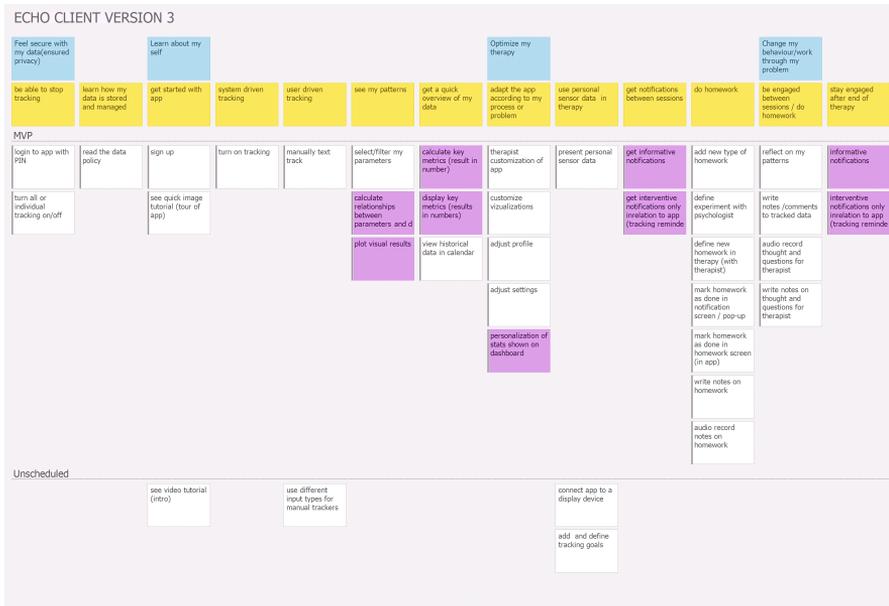


Figure 6.7: User Story Map - Second design, Clients. Blue cards represent user goals, yellow cards - activities, white cards - user tasks and purple cards - system tasks. Compiled by the authors

Based on the micro-interactions definition, an interactive prototype was implemented using Marvel⁷ and is available here: <https://marvelapp.com/92c8g1e>

⁷<https://marvelapp.com>

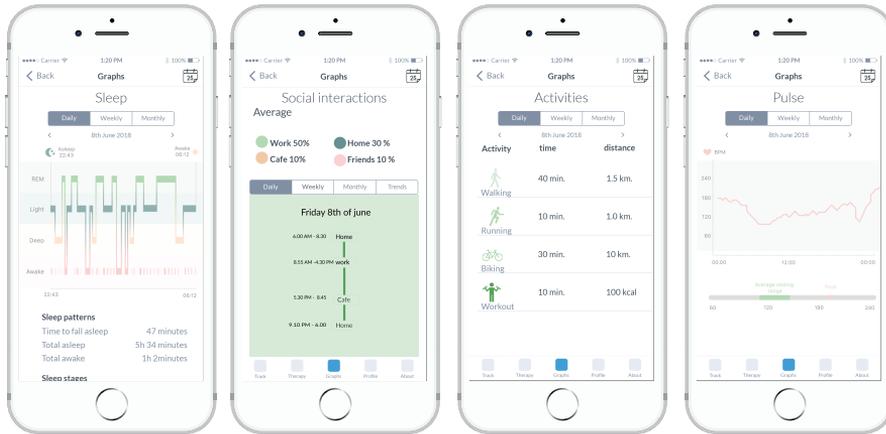


Figure 6.8: Echo prototype version 2, examples of redesigned Graphs: Sleep, Social Interaction, Activities and Pulse, daily views. Compiled by the authors

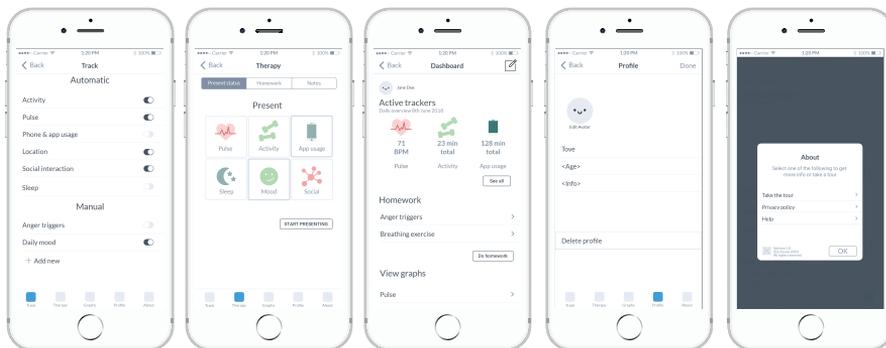


Figure 6.9: Echo prototype version 2, main modules: Track, Therapy, Graphs, Profile, About. Compiled by the authors

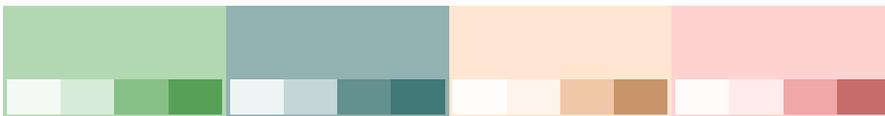


Figure 6.10: Color scheme used in Echo. Compiled by the authors

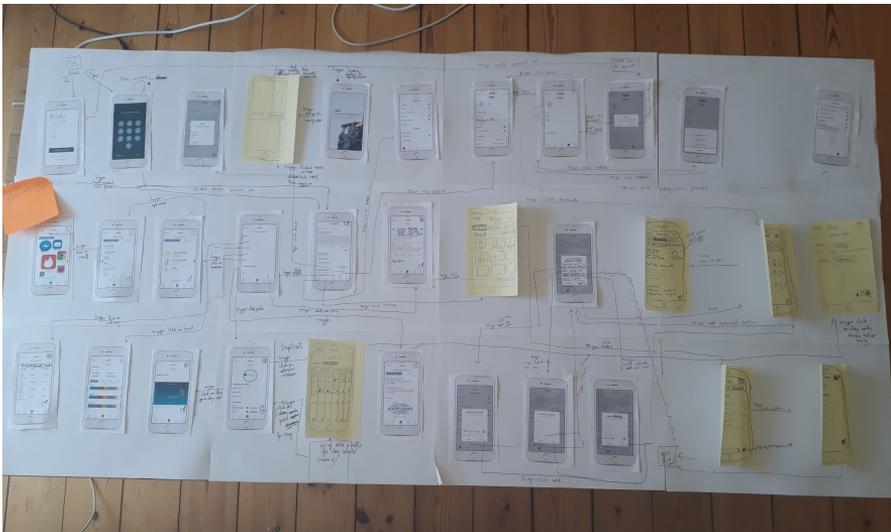


Figure 6.11: Second version of Echo's prototype design, paper prototype with annotated micro-interactions

CHAPTER 7

Iteration 4: Design evaluation

This iteration sought out to get insight from both clients and therapist in regards to design improvements. This was done through different types of evaluation, depending on the user type. This was the final iteration with users. The three sub goals of this iteration is shown in Table 7.1

Goals	(i)Final user evaluation of the concept of Echo	(ii)Final user evaluation of the UI & UX design	(iii)Final design inputs
Methods	Think Aloud & role-play	Think Aloud & role-play	Think Aloud & role-play
Participants	Clients & Therapists	Clients & Therapists	Clients & Therapists

Table 7.1: Iteration 4 Overview

7.1 Method

This iteration follows the last part of HCD called Evaluation[40] as presented in Chapter 3 Methodology. The approach consisted of two methods: role-play [42] with therapists and Think Aloud [10] with clients. These methods were chosen due to their relevance within the mental health domain and their ability to test usability including learnability and systems functionalities.

7.1.1 Participants

The participants were recruited from the authors' network and through the expert and previous user involvements regarding Echo.

7.1.1.1 Role-play

The role-play participants consisted of three therapists, all female and all above 50. One participant was a psychologist, one a psychotherapist and the last one a family therapist. Two were iPhone users and one an Android user. They all had different level of experience with role-playing.

7.1.1.2 Think Aloud

The think aloud consisted of three female and two male participants. The age of the participants were between 25 and 36. Some of the participants had participated prior in the Echo user involvement and some participated for the first time. Three of the participants were Android users, one was an iPhone user and the last was both Android and iPhone user.

7.1.2 Apparatus

The role-play was video and audio recorded on an iPad and the Echo prototype was used on an iPhone 8 and a Samsung Galaxy A3 phone. The Echo version 2 prototype as described in Iteration 3: Design definition was used Appendix B, designs, Echov2. A role card description was created for the role of the client which was used in all mock therapy sessions. Furthermore a comment sheet for all the module was used, see Appendix H

The think aloud was carried out using the Echo prototype Figure 6.9 on an iPhone 8, and an introductory think aloud video¹ was shown on a Lenovo laptop in the introduction.

7.1.3 Procedure and design

This section describes the procedures for the role-play and the think aloud, the methods and the reason for using them was described in Chapter 3 Methodology.

7.1.3.1 Role-play

The role-play workshop consisted of 2 sessions. It was carried out in-situ at one of the participants clinic, which increased the external validity. It was scripted role-play due to the aim of evaluating Echo [42]. The total role-play workshop lasted approximately 2 hours. The first session consisted of 4 mock therapy sessions of around 15 min. each, where each of the participants got a role to play and a short intro of setting the stage and the participant playing the client got the client role card. The participants playing the therapist were instructed to play themselves. Through

¹ <https://s3.amazonaws.com/media.nngroup.com/media/editor/2014/08/18/thinking-aloud-demo.mp4>

all four mock therapy sessions the role card of the client was the same. After each mock session a wrap up discussion was done to get the inputs from all the participants.

The first mock session imitated the first time at a therapist. Before the next mock session the participant playing the therapist and the observer was given a walk through of Echo. The second mock session imitated the third therapy session with a client, including introducing Echo to the client. The third mock session imitated a fourth therapy session, where the client had been using Echo for a week. In this mock session the participants was told not to use Echo directly, the phone was not allowed in the session, but they could talk about the app if it made sense. The last mock session had the same setup as the third except that they were allowed to use the app directly if they saw it fit.

In the second session each participant were given a phone with Echo on it and was asked to look around in Echo and add comments on each module on the comment sheet. Afterwards, a small wrap up discussion about when and where to use Echo was held. The moderator guide for the role-play can be found in Appendix H.



Figure 7.1: Role-play, session 2 participants are evaluating the module of Echo

7.1.3.2 Think Aloud

The think aloud was a within-subjects [39], user involvement conducted at both DTU and AAU adapting to where the participants could attend. Four was held at DTU and one at AAU. It was held in a closed room, to ensure no disturbance and unnecessary random variables. This provided a high internal validity but a lower external validity in regards to not being used in the actual context [39, ch. 5]. It consisted of an

introduction, including an intro video², eight tasks and a wrap up interview. Only the participant, the moderator and the note taker was present. The participants was informed of the screen and audio recordings. The concept of the application was described to the participants who did not know it already, for the others this was skipped.

The key features that were tested through the tasks were: the tracking setup, present mode, homework and notes in the therapy tab, combined graphs and the specific graphs for app usage and sleep in the graph, the dashboard and the calendar. The moderator guided the process and gave the task, but refrained from talking, except for encouraging the participant to keep talking aloud. The note taker focused on elements that were not retrievable in the audio and screen recordings such as facial expressions and body language. The goal of the Think Aloud was to evaluate Echo and test usability, here included learnability[21]. The moderator guide, including the tasks can be found in Appendix I

7.2 Results

The results below consists of the analyzed discussion and feedback from the clients in the think aloud, and discussions, observations and participant notes from the role-play workshop.

7.2.1 Role-play

The role-play workshop was conducted to get an evaluation of the concept and design of Echo from therapists, goals (i) and (ii).

Session 1

To easily discuss the four mock therapy session, the participant playing the client in the given scenario will be addressed as client, and the participant playing the therapist, will be addressed as therapist. When quoting, the therapist is T and the client is C. The English was somewhat of an obstacle for the participants, translation was sometimes needed and some of the participants felt uneasy doing it in English.

Since the first mock session imitated the first time at a therapist it consisted mainly of clarifying why the client was there. The client followed the role card very closely and was troubled when having to answer questions not in the role-card. The main comment on the first mock session was that it was very short and a bit unnatural. However they still managed to play out most of a normal session, as the observer mentioned:

²<https://s3.amazonaws.com/media.nngroup.com/media/editor/2014/08/18/thinking-aloud-demo.mp4>

it was very quickly, but E.[the therapist role] still managed to get a picture of the client and give homework, but the whole middle part was missing.
(Appendix B, Session 1 part 2, Time:9.51)

Before the second mock session, the therapist was given a walk-through of Echo by the moderators. The therapist was then instructed to present Echo to the client. Since the therapist was an Android user it was a bit hard for her to move around in the prototype, made for iPhone, and she needed help to find things and use the phone.

The therapists introduction was very focused on manual trackers and not really mentioning any of the automatic ones. This could be due to the participant having a better understanding of them and maybe also preferring these.

The client was a bit troubled about the having to show what she had been tracking and worried that it might feel like extra homework. she asked the therapist if she thought it would actually help her. The therapist assured that the client only had to show what she wanted and emphasized that it was not a control of the client, solely a tool to help her. It could even help the client do things she wanted to and not what she had to.

In the wrap up discussion, the observer and client noted that the therapist included the introduction to Echo very smoothly and naturally. It was clear that the therapist should know the application better. The observer was appreciative of the way the therapist managed to naturally move from the client's problem in the role-play to introducing the app "*I think it was very elegant*".

She also stressed that the therapist needs to know the app well, otherwise the client won't understand the benefits nor be willing to put the effort to use it. The therapist needs to be able to answer the clients questions regarding Echo and transition smoothly between the discussion about the app and the rest of the therapy. The therapist said that she felt the app introduction like an interruption in the contact with the client in therapy, because she was trying to find a specific functionality. Being used to and knowing the app very well could remove that problem.

In the third scenario it was assumed the client had been tracking her self for a week, the main instruction here was to not explicitly use the app and the phone in the session.

They however talked a lot about the Echo in this session, the client initializing it. The client emphasized on the pulse tracking and talked about it giving her a clear idea of how stressed she was at work. After the moderator tells the participants to wrap up they conclude:

T: so as a conclusion about the app, we can say, maybe it is a little bit helpful?

C: Yeah, yeah.. Appendix B, Iteration 4, session 1, part 4: 7:29

In the wrap up discussion they were talking about how the participants playing the client adapted to the role as it transforms and how the client and therapist adapts to the app.

The fourth session setup was the same as the previous except that they were allowed to use the app if they saw it fit. The participant talked quite a lot about the app in this scenario but did not use the phone. The client gave a lot of good feedback on the app.

T: and have you used the app?

C: yes

T: and what..

C: and then i recognize that I was actually not smoking so much as I thought I was and that makes me feel good because then my old mum doesn't have to say to me don't smoke, don't smoke all the time and my children don't have to say don't smoke because I recognize that was not..

T: ..an issue

C: no, and I recognize that I was moving quite a lot

T:yes, moving physically or..

C: moving physical yes and then that makes me feel good because I know that's important for me, not because the doctors says or something, but because I know it's something that will make me feel good in the time before with the stuff with Jens and the work and that... so the app helped me to recognize it

T: yes, and what about sleeping?

C: I.. if I understand it right... I'm not so familiar with it.. but if I read it the right way then I can see that I actually sleep. The last time I was here I told you that I didn't know if I slept but because I can see that I actually sleep then I.. I'm not so tired anymore not all the time.

T: No

C: Not all the time

T: ..and maybe you go to bed in another way because you know you can sleep

C: Yes that's for sure I don't have to lie down and think [puuhhh] maybe I can sleep maybe I can't. What am I going to do if I can't sleep am I going to read or am I going to get out of bed and make some light house work or something stupid Appendix B, Iteration 4, session 1 part 4, 17:38

All the participants were quite intrigued by Echo and saw a lot of potential using it. When asked specifically into the homework tab and the present status of the app, they all replied that it was useful and saw no problem asking the client about it, they compared it to asking about homework.

E: yes I could , I could imagine

H: yes I would do it with the family or something I always give them homework. writing it down and sending them a picture on the phone so that would be obvious

M: What type of homework?

H: that depends of what is in the App, that I don't know.

E: it also depends on the issue , Because I think that if I had a client with, who's very upset and so, I would use that app, With a pulse that function in the app more but if it is a client who is going around and around and around I would use the function with the notes more and I would like to see, ..[towards H.] you talked about it, that you didn't know that you was sleeping but when you looked at the app you could see, oh I was sleeping, I think that's a very good function in the app and also with activity how often I call like I do not use my phone because I'm so depressed and then there is 10 calls, its useful, because all human beings are lying in that way
Appendix B, Iteration 4, session 1 part 4, 25:13

The 4 scenarios really helped for evaluating the application. Seeing the therapist introduce Echo in the second mock session, made it clear that it is crucial that the therapist knows Echo well before introducing it to a client.

Furthermore using Echo affects the relation between client and therapist in a positive way, they have more of a common ground, which is quite important in therapy [15].

The fact that they talked quite a lot about the app might be an indicator of how much time it would take up, however looking at the dialogues in each scenario it is very easily intertwined with the rest of the therapy.

Finally seeing that the participants did not always follow the directions given, but adapted the use of Echo to the therapy, shows that Echo is very adjustable for each therapist and client and what issue that is at hand.

Session 2

The participants were asked to write comments on the three main modules of the app (see Appendix H), the key comments were:

- I would like to have more functions that reveal my behavior sleeping, eating, why nothing about sex
- it's so smart! that you can add whatever you want to keep attention on ex. alcohol, cigarettes I tried calling you
- when i have people in therapy I typical write /draw on a whiteboard, their homework would typically be there as well, therefore it would be practical if you could take a picture and import to homework so it was in the app and not in photos

- its smart to combine and pay attention to my changes and to help my memory
- optional for the client to add what is relevant, i.e. what did I do today
- generally it is important that it is as simple as possible and that all is repeated no matter where you are entering the app and what it adds - i cant really tell from the prototype

A round up discussion was held were the two main questions were: **“Would you look at a clients data prior to a therapy session if you had the option?”** One participant would, to prepare for the therapy sessions. It was discussed that it depends on the given client.

When asked how they would get the clients data, they all imagined that the client would send the data on email or through the app. None of them wanted access to the clients Echo or their own portal, but potentially a small interface in the app where they could see messages from the clients.

This led to a discussion regarding who should take the initiative to talk about data from Echo in a therapy session. They all had an idea of the therapist most likely initiating it, however they also saw the idea of the client initiating it, that way the client would take responsibility for their own process.

The second question was **”Is there any data that you would not like the client to look at by themselves?”**.

All participants agreed that there would not be anything they did not want their clients to see, they here emphasized that Echo should not by itself conclude on the data and then tell the client the conclusion. For instance if the client has a high pulse which could be due to a panic attack, Echo should not say ” you are having a panic attack”. That would not be helpful for the client to see. This was already discussed in the design process and Echo does not notify the user of these things.

In conclusion it is very important that the application is adjustable to different client, therapists and problems.

7.2.2 Think aloud user tests

The main conclusion of the think Aloud was to simplify Echo. The participants had a lot of valid input throughout the eight tasks. This has here been sorted by the different modules. To follow the specific comments the prototype from Iteration 3: Design definition is shown in small here, for more details see Iteration 3: Design definition. Furthermore the interactive prototype can be found at <https://goo.gl/FPgDBC>.

7.2.2.1 Graphs

Most participants liked all the individual graphs(see section 6.2.5), but the combined graph was a little to complex for them to grasp, especially the mood part of it. This was due to the confusion based on mood being tracked as words, they were expecting a rating. Furthermore since the mood did not have a legend, the color coding was more confusing than helpful. Especially since some of the same colors from app usage and activity was used. Some of the participants noted that they would imagine negative words to be red and positive words to be green. Suggestions were :

- Rate mood with numbers instead of text
- call graphs results
- more detailed weekly and combined graphs
- add a feature to enable clicking in a combined graph and go directly to the specific graph for the clicked element
- make it easier to jump between differnt graphs in either weekly and daily view. only one graph screen where you can see single or combined graphs
- clear and easy to identify what data is from today in both calendar and graphs.
- Less color/categories in App usage Add axis on the graphs.
- Change order of categories in sleep, i.e. not awake and deep sleep next to each other
- add information about sleep phases in sleep
- sleep quality in percentages as there is in many other sleep tracking apps.
- info icon for how to do stuff, i.e. read the combined graph.

Most participants found the combined graph through the present mode. It is somewhat confusing for them that it is accessible under both graph and therapy. Some of the participants preferred to see each graph separately rather than using the combined one when doing tasks. This is partly because of the lack of detail in the combined graphs.

Mood

The mood graph itself had some of the same comments as mood in the combined graphs. If it was rating instead of words a visual representation would be possible, which most users would prefer. The word cloud in the mood graph was not easily understood by all participants.

Activity

The participants were somewhat confused about whether activity was location, aka social activity or physical activities. One participant also mentioned that 'workout' in the daily graph was measured in calories despite the header in the table saying distance. There were also some confusion as to if it would be tracked manually or automatic.



Figure 7.2: Combined graphs- accessible from therapy and graphs

App usage

The app usage graph was easy to understand for most, but some struggled to find how much time they spent playing games, which was part of task 6. This was mostly due to the legend being in the bottom of the screen and a lack of implemented possibility to enter the different categories in the prototype. Task 6 was only completed by participants who had stumbled upon games in a prior task or seeing games in the combined graphs, either through graphs or present mode.

Sleep

This screen was easily understood, some commented on the graph not being easy to use and they all looked at the key metrics to answer task 7, **How did you sleep last night?** Furthermore they would like more information on the different sleep phases and maybe get an indication of their sleep quality as there is in many other sleep tracking apps.

7.2.2.2 Therapy

The therapy module consist of present mode, homework and notes. The present mode was not easily understood by all participants, some wanted to go to graphs by clicking on the icon instead of having to select them and then press "start presenting". One participant misunderstood it as current status. The label stating next therapy session was seen as some as a deadline for homework. In summation it did not give the easy overview as intended, due to complexity and not all participants understanding all the elements. However there was also positive feedback: *"This is amazing, it looks really good. It's a very nice overview of everything."* Appendix B, Iteration 4, Think aloud T, 10:53

The homework part was easy to comprehend for most participants, and they saw the benefit of the feature, however the experiment homework was more confusing than helpful. 'Type' in the pop-up was discussed, and they all had different ideas of what it would include. Homework was used in alternative ways than designed for by some participants, i.e. as a way to check their status or progress.

The note part of therapy was quite easy understood by all, but with different objectives as how to use it. They all liked the notification set-up options.

7.2.2.3 Track



Figure 7.3: Therapy main screen, present tab selected

This was quite easy for all participant, they used words as intuitive, easy and simple. Due to the phrasing of task number oneAppendix I, most participants understood that they had to register mood and not just set up the tracker. The only comments were that they would have a informative text next to the + button and that maybe renaming it to set-up instead of track.

7.2.2.4 Profile

Very few comments, they all understood it and it made sense to all. The only confusing part was that the placeholder name "Tove" was confusing to all non Danes. They all liked the fact that the wearables was listed and easily added to the app.

In general there were suggestions to add info icons to guide the user throughout the app, maybe some renaming of labels and modules. The note possibilities in graphs was not easy to find for the users. The menu should be more clear and in general more icons in the app. Some would like an intro to the app before signing in. The color code should be more clear throughout the app and more coherent. Echo is somewhat simple but has a steep learning curve. Even if there were a lot of optimization comments only one participant would not use Echo and they all saw a lot of potential. Below are some of the comments from the participants:

My overall thoughts is that there is a lot of information in the app, it seems not complicated. I think it's very easy to use when you're first learn to use it. Appendix B, Iteration 4, Think aloud D, 34:25

I think that the idea is great. Specially the automatic tracking. I think that actually shows a lot with the pulse and the sleep patterns and phone use. Those three are really interesting and the way that they are there shown is actually ok. Appendix B, Iteration 4, Think aloud B, 27:56

7.2.3 Discussion of results

The main objective of this iteration, evaluating Echo and thereby getting feedback for improvements and validation were all met.

7.2.3.1 Role-play

There were a potential bias since one of the participants were already quite familiar with the concept of Echo, due to her being involved as the expert throughout the thesis. However since they all had similar comments in regards to Echo, this bias was

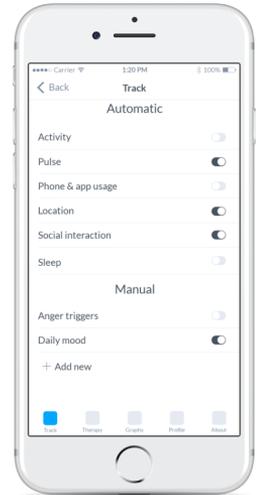


Figure 7.4:
Track screen

not considered relevant. The role-play workshop did not provide a lot of new design inputs, but that was not the goal. The aim was to get hands on ideas of how Echo could be used in real life and get therapist concrete thoughts on the app and concept. This is also why role-play was selected, since it offers a better understanding of the context, is a safe way to get some in-context validation [42] and offers access to an otherwise closed space [15]. The role-play also offers a safe space for criticism [43], however one of the participants were not as accustomed to role-play and was therefore initially not so comfortable. Furthermore it was an obstacle that the participants were not comfortable speaking English.

7.2.3.2 Think Aloud

The participants all saw the value of Echo even if there were a lot of optimization suggestions, this gives an opportunity to fine tune the app. Almost all participants could see themselves using it in a therapy setting. The biggest challenge was to select what suggestions and features should be added to the design of Echo and which ones should be discarded. Even if 85% of usability issues are found using only 5 participants³, there are most likely more thing to improve after redesigning the app. It was quite interesting to see that the learning curve of Echo might be a bit steep. This clearly proved that a tutorial from the therapist would aid the use of Echo a lot. This iteration was a reminder of simplicity over complexity.

³<https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/>

CHAPTER 8

Echo: final prototype

This chapter presents the output of the thesis, Echo's final design. This chapter consists of a detailed description of the interface and interaction design. The design has changed substantially since Iteration 3: Design definition, due to the amount of feedback. This led to changing the structure and modules of Echo.

8.1 Echo. Guided self-awareness

To clearly define the concept of Echo, the problem, solution and value proposition from lean [38] was defined as shown in Figure 8.1. Having a clear concept makes the design process much more focused since elements, modules and screens have already been defined.

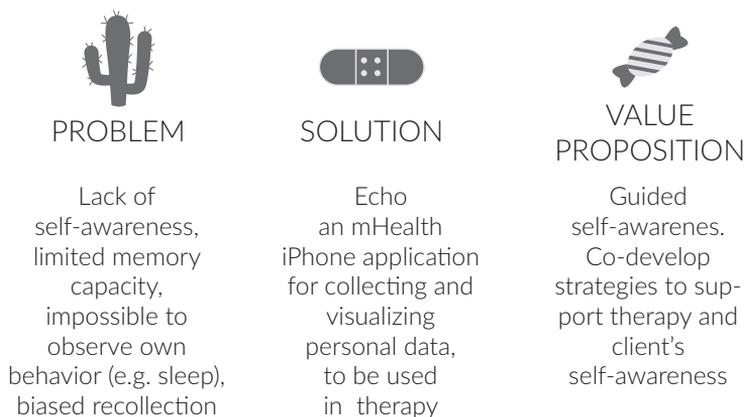


Figure 8.1: Echo's concept, from a Lean UX perspective. Compiled by the authors

In Echo the client is the primary user, the therapist is only using Echo with the client on the clients phone. Echo is supporting the therapy, but it is not a self-contained application, it should only be used in relation to a therapy process. This also means that even if it is inspired by other Personal Informatics systems, it does not contain

the same amount of data detail, interventive notifications and goals, because these elements does not make sense in a therapy setting.

To clearly define Echo and what it entails, a persona (see Figure 8.2) was created with her own motivation, data and problem, this is used to illustrate how Echo could be used in a therapy process. The client role card from Iteration 4: Design evaluation was used to give the persona details. Moreover a small data set of Tina’s data from 14th of may to 12th of june was generated for developing the hi-fi prototype of Echo. An excerpt of the personas data can be seen in Table 8.1. It is worth mentioning that the data is not completely representative of a common Echo user, since Tina has tracked manually every day, in reality there would be some gaps in the data. Having a persona also means that not all the elements will be displayed in the prototype, since it does not make sense for a given user to use all the functionalities and trackers in Echo.

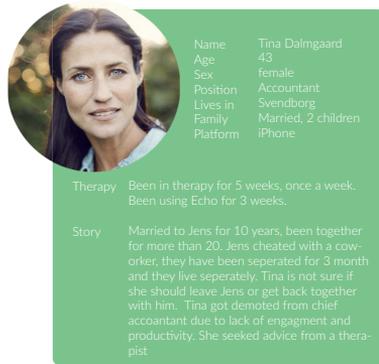


Figure 8.2: Persona card. Compiled by the authors

Date	Activity(h:min)			Social(h:min)				Rating		
	Biking	Walking	Sleep	Work	Friends	Home	Out	Mood	Smoke	Alcohol
2018/05/22	00:43	00:12	40	07:54	01:00	13:00	0	2	1	1
2018/05/23	00:23	00:41	81	07:00	02:00	14:00	0	1	3	2
2018/05/24	00:54	00:22	64	07:54	0	11:00	03:00	2	2	1

Table 8.1: Excerpt of the persona’s (Tina Dalmgaard) dataset. The full data set can be found at Appendix J

A stage based model [36] diagram was created for Echo, to elucidate the different



Figure 8.3: Echo's self tracking model, Compiled by the authors, based on Li's stage based model [36]

stages and what elements were user or system driven. For Echo the distribution of client and therapist involvement was also added. Echo's stage based model is shown in Figure 8.3. In Echo the preparation state is deciding what elements to track, what homework to do. This is decided through a discussion between the therapist and client, with the therapist as the main actor. The Collection state is where the client tracks. In the reflection state, the client and therapist are reflecting and discussing the results from Echo and determine how to use the knowledge to move forward in therapy and with the initial problem of the client. Finally the action stage is where the client can take actions, do something, based on the reflection done with the therapist. All the stages are iterative and multifaceted since therapy covers several aspects of a client's life. As mentioned by Li[36] most often the multifaceted systems do not offer combined visualizations of the different facets, however Echo offers to show different aspects in one combined graph.

8.1.1 User Story Map

Based on the user feedback described in Iteration 4: Design evaluation from both clients and therapists the User Story Map was adjusted to the new changes in the concept of Echo. This was the base for the final design. The USM is also aligned with the stage based model described above.

8.1.2 Modules

The concept of Echo consists of four modules that are the key functionalities of Echo: charts, homework, notes and setup. Echo also contains a calendar to visualize when data has been added. Before defining what each module consists of, the concept of trackers in Echo will be explained.

8.1.2.1 Trackers

There are three types of trackers in Echo, the automatic which is everything system based, a self rating tracker where the user can rate a given element from 1-5 and a

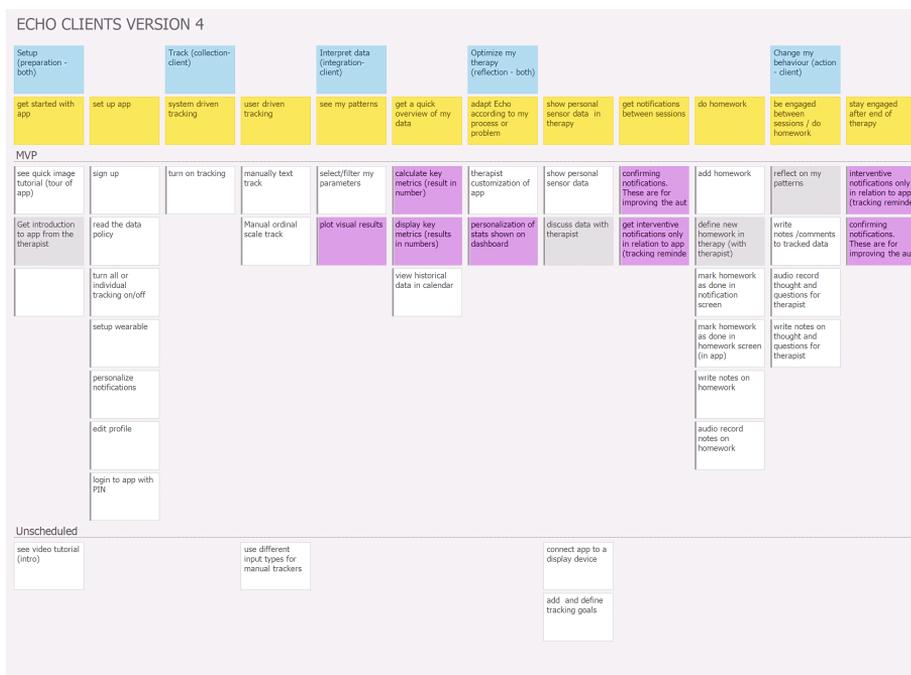


Figure 8.4: Echo User Story Map. Compiled by the authors

custom where a task or a reflection can be added.

A custom tracker is often something that needs to be done, i.e. call your brother, reflect over your relationship. The self rating can be anything from mood to alcohol consumption or sex.

Echo comes with 5 possible automatic trackers: pulse, app usage, sleep, exercise and social. The pulse is measured through a wearable or possibly through the phones lens if no device available, which would then make it a custom tracking.

The app usage is tracked from the phone usage and contains four categories: music, social media, communication (SMS, messenger, calls etc.) and games.

Sleep measures quality and the 3 main stages of sleep: REM, deep, light and time awake.¹. If no wearable is connected this is tracked as a self rating tracker.

Exercise is all types of physical activities such as walking, running, biking, workout, etc.

¹<https://www.tuck.com/stages/>

The last category within automatic trackers is social, this is all the social activities based on GPS and wifi, possibly using the Foursquare Places API² to determine cafes etc. The social category has 4 sub categories: home, work, friends and family and cafe and restaurants.

8.1.2.2 Charts

This is where the user can see their data from automatic tracking and from self rating tracking, either represented as key metrics or visualized graphically. They can see the daily, weekly and monthly data and have the possibility to have up to three trackers shown simultaneously in one graph. This is where the client can see their tracked history within Echo. This is a combination of the previous therapy and graph modules.

8.1.2.3 Homework

This is anything the therapists asks the client to do by themselves between therapy sessions. It could be reflecting on something or a task to accomplish, tracking automatically, tracking self rating or custom. All of these can contain notes. The homework is given in the therapy session by the therapist.

8.1.2.4 Notes

There are three main types of notes: therapy, homework and charts. A therapy note is a note the client makes in Echo, related to something they want to discuss with the therapist next time, this could be questions, considerations or thoughts.

The homework notes are notes added to self rating or custom homework. These notes are optional to add.

The last category is chart notes, which are notes made in the chart module, to either clarify or remember what triggered a certain peak or outlier in the data or simply for adding context.

8.1.2.5 Setup

This module consist of the profile, account settings such as device and notification setup and an about module including help, data policy and a tutorial.

The profile includes name, email, password a pin for securing privacy, and the possibility to delete the profile. The notifications settings gives the user the possibility to opt in or out of reminders. There are two types of notifications, homework- which

²<https://developer.foursquare.com/places-api>

reminds the user to do their homework and a confirmation reminder which gives the user the possibility to optimize Echo by aiding the system, e.g. "Echo have detected this location as your friends home, is that correct? "

8.1.2.6 Calendar

Echo has a calendar to easily get an overview of trackers and notes. The calendar is accessible from all modules main screen and all charts. A specific day can be chosen in the calendar and it will show the user what type of data Echo has registered in the given day.

8.2 App design and UI

This section will go into details about the visual identity of Echo as well as the design elements in the main screens of Echo.

The final design of Echo is a product of all the four previous iterations and their feedback from users as well as inspiration from existing applications both within (see Chapter 2) and outside the domain of mental health applications.

To get an idea of the structure of Echo a flowchart has been created, see Figure 8.5

8.2.1 Visual identity

Echo is using the same color scheme as in the previous design Figure 6.10, more colors has been added to better assist the differentiation for the user as oppose to using shades and tints. The colors have been more coherently and carefully used to support the definitions from section 8.1. Echo's main color for logo, general icons etc. is green. This was chosen, as mentioned in Iteration 3: Design definition because it symbolizes hope and health [25]. Echo's logo can be seen in Figure 8.6.

The icons used in Echo are inspired by IOS icons from the Apples guidelines³ and are adjusted to fit the context of Echo. Each tracker, both automatic and manual have a color assigned to them and each sub elements of that category is assigned the same color, e.g. exercise and walking.

The menu of Echo is a tab bar in the bottom of the screen to allow the user to easily navigate between the four modules, see Figure 8.7. It is present in all main modules that are represented on the menu.

8.2.2 Screens

This section will go briefly through the main elements in the main screens of Echo. For a thorough understanding see the micro interactions of Echo in section 8.3

³<https://developer.apple.com/design/human-interface-guidelines/ios>

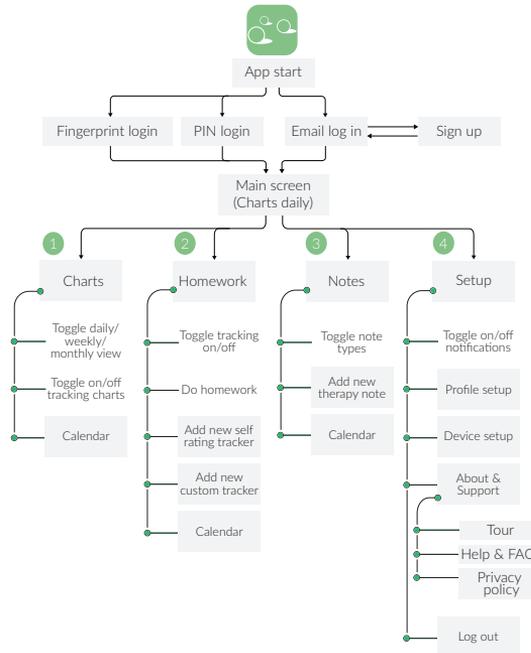


Figure 8.5: Flowchart of Echo. Screens are represented by grey rectangles, the given screen functionality is added in text. Compiled by the authors



Figure 8.6: Echo's logo. Compiled by the authors



Figure 8.7: Bottom menu with Echo's four modules: charts, homework, notes and setup (homework menu item active). Compiled by the authors

Micro-interactions. The interactive prototype is also available at marvel: <https://marvelapp.com/32g615f>. Please note that not all the possible interactions are in-cooperated in the Marvel prototype, but there is proof of concept of all possible interactions types.

8.2.2.1 Charts

Charts is somewhat similar to the previous graph module in Chapter 6 except that it has been simplified, so there is only one view for all graphs and the user can then select the given tracker they want to visualize, either a single one or up to three.

The user can only choose to view a category e.g. social and exercise and not a sub category, e.g. work and biking. This possibility could be implemented in the next version. All the graphs and key metrics in Echo was generated and calculated through Excel based on the personas data set and then added to the screens. For the full data set see Appendix J

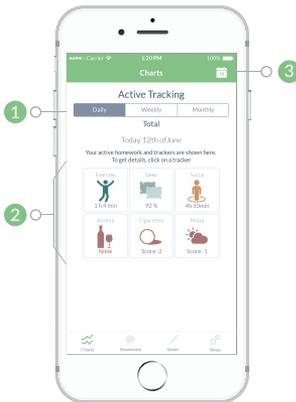


Figure 8.8: Dashboard of charts, the main page of Echo

The main page of the charts is a dashboard where a quick overview of either totals for daily or average for weekly and monthly is shown. This also works as a access point to each of the separate graphs. The dashboard is only displaying active trackers, so it does not necessarily display all existing trackers.

1. This is the Segmented Controls^athat allows the user to select a daily, weekly or monthly view of the graph and key metrics.

2.The buttons display the total or average for each tracker/homework and when clicked the user is sent to the visualizations of the clicked tracker, i.e. exercise

3. This is the calendar icon which will send the user to the calendar page when clicked.

^a<https://developer.apple.com/design/human-interface-guidelines/ios/controls/segmented-controls/>



Figure 8.9: Chart for exercise, sleep and social part 1

This is the graphical interface of a users data. In Figure 8.9 exercise, sleep and social is selected and a visualization for these three parameters is shown. The view can be scrolled to see more data, see next section.

1. This is the back button which will send the user to the previous page. It is always present except for on the main page of a module

2. When clicking on one of the buttons, the given tracker is selected. A max of 3 can be selected at the same time to avoid clustered graphs on a small screen.

3. This is the chart area and a previous day, week or month can be seen by swiping here (implemented in Exercise weekly).



Figure 8.10: Chart exercise, sleep and social part 2

This displays the key metrics of the selected trackers.

4. Overview of the social key metrics: home, work, friends & family and cafe & restaurant

5. Overview of the sleep key metrics: REM, deep, light and awake

6. Overview of the key metrics for exercise, since Tina only walks and bikes and sometimes runs to catch the bus, these are the only ones displayed.

8.2.2.2 Homework

The homework screen consist of creating homework, doing homework and seeing history of homework. The homework is easily created either by turning on the automatic tracker, using a preexisting self rating or custom tracker or creating a new custom or self rating tracker. When a user wants to do their homework, i.e. rate a given parameter or do a task, they can easily access that in the homework screen and rate or accomplish it. When selecting what type of homework the user wants to see the history for, they will automatically be sent to the calendar screen where they can select for what time span they want to see the history. See calendar in Figure 8.15.

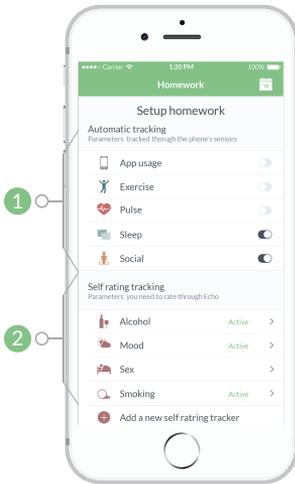


Figure 8.11: Homework screen part 1

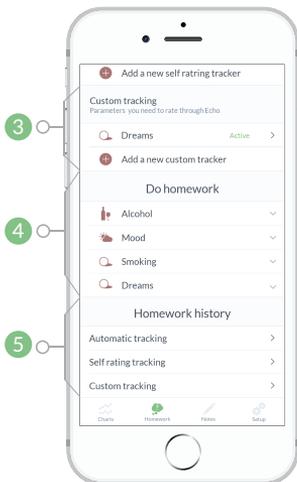


Figure 8.12: Homework screen part 2

This is the setup section of homework, i.e. trackers. 1. The user can turn on and off automatic trackers. It hereby gives the user an overview of what automatic trackers are on.

2. The user can see which self rating trackers are active, edit them by clicking the list item and they can also add a new self rating tracker.

The self rating has three default types: alcohol, mood and sex. The user can add anything he likes and the Echo logo will be displayed as the icon.

3. The setup of homework has one more option, the custom trackers. This can also be edited and any possible custom tracker can be added.

4. Here the user will rate their self tracking and do their custom tracking. Notes can be added to both. The manual tracking is done by expanding the items in the list.

5. This is the history of the homework, when the user clicks one of these list items they will be directed to the calendar default view and can see the history of homework, i.e. trackers and notes.

8.2.2.3 Notes

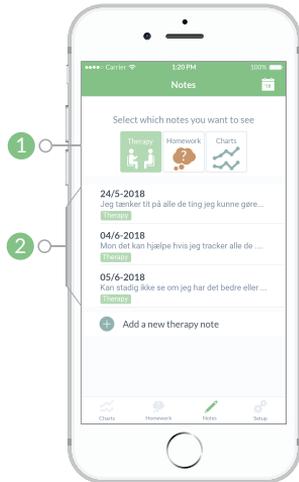


Figure 8.13: Notes, therapy filter on

This is where the user can get a quick overview of the notes added to Echo.

1. Clicking the buttons will select or deselect the type of notes that will be displayed, all three can be selected at the same time. In Figure 8.13 only therapy notes are displayed. If several types are displayed, it will be sorted by category and then by ascending dates
2. This is the list of the notes shown based on the selected type. It shows when the note was created, a description of what it contains and a tag. When clicking the list item, the user will be sent to the note and can read it, edit it or delete it.

8.2.2.4 Setup

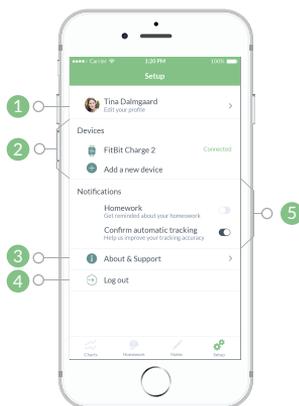


Figure 8.14: Setup screen in Echo

1. This is the profile, here the user can see their main info and their picture, they also have the possibility to edit or delete it by clicking the profile item.
2. This is where the users devices are shown including their status. The user can also set up a new device here by clicking the "add new device"
3. When the user clicks the "about and support" item they get three option, take the tour, get help and read privacy policies.
4. Here the user can log out of their profile
5. This is the notification setting, the user can select to have either homework or confirm notification on or off.

8.2.2.5 Calendar

The calendar view is accessed from all the main screens of each module and from all screens in charts. It is a quick overview of the users history.



Figure 8.15: Calendar view

The calendar uses the same types of buttons as the other screens, here the automatic, self rating and custom tracking can be selected as well as all three types of notes.

1. This is where the user is informed of what month they are viewing and they will be able to change that by clicking either arrow next to the text. left for previous month and right for next month

2. This is the calendar view. It displays the days of the month chosen and indicates which days are from previous month with the gradient of text color. Furthermore today's date is indicated by a border around it.

3. The colored circle on a given day indicated what information has been added to Echo on that day. The color matches the color of the button selected.

8.3 Micro-interactions

The micro-interactions for the final prototype of Echo can be found in Figure 8.16. In consideration to the size of the micro-interactions diagram, only selected screens have been annotated. For modules with interactive elements within the screen i.e filtering in notes and charts, the date tabs, sliding toggles on and off or expanding items, not all the different screen setups are display, but representative ones have been chosen to illustrate the concept. The complete set of 110 screens can be seen in Appendix B, Designs, Echov3.

Triggers, feedback, rules and loops were described in accordance to Saffer's book, *Microinteractions: Designing with Details* [57]. Triggers are interactions that initiate a change of state i.e the press of a button, or a timer for notifications. They can be either user or system initiated. Rules define what the change is i.e what happens when a save button is clicked and the feedback is the (most commonly visual) representation of the rule, that informs the user the rule has been activated. Loops determine when rules are executed, based on some time or history of actions i.e. access is denied after the PIN is mistaken three times.

All the different interactions were annotated with triggers and feedback. Repetitive elements like back buttons or menu items are only annotated once for readability purposes. As well, not all interactions have rules and loops.

Figure 8.16: Echo Microinteractions diagram

8.4 Discussion

Even though the final prototype has been designed meticulously and keeping the relevant user input in mind, there is still possible improvements for the next version. The possibilities was discovered and discussed throughout the final prototype design. Some of them might need further research to ensure they are relevant for users.

- Compatibility with other wearables than Fitbit
- Offer users to choose their own icons to represent their self rating or custom tracking.
- Offer the possibility to view the visualizations in full screen mode when double tapping on the graph.
- Offer the possibility to view visualizations for sub categories, e.g. biking in Exercise or social media in App usage
- Offer to sort across categories in notes.
- Create a messaging module, to send and receive messages and notes between the client and the therapist

Before any of these extra features would be in cooperated, the design should be validated, implemented and tested in a pilot study to ensure Echo meets its goal: Offering guided self-awareness in psychotherapy.

CHAPTER 9

Discussion

In this chapter the research question, its sub questions and aspects of self tracking in mental health are discussed. This include a look at the results from the thesis and how that corresponds to the literature within the domain of mHealth application within mental health.

9.1 Echo - did it answer the research questions?

What personal data is relevant for clients in psychotherapy?

As mentioned in the introduction, personal data was, in the thesis, defined as physical, behavioural and social data. Moreover this was further defined in Echo as automatic trackers containing all three types of data, [27] [3], self rating and custom trackers, consisting of the behavioural data.

Defining exactly what type of personal data was relevant for clients in psychotherapy requires an understanding of what data a client in psychotherapy would benefit from. The client might have an indication of what their problem is or what causes it, but not necessarily know what parameters of their life is affecting or causing the problem or would help it. The therapist on the other hand, have a more professional understanding of what social, physical or behavioural data would be important for the given client.

This is an important aspect discussed throughout the thesis, the importance of ensuring flexibility and the possibility to select relevant trackers. Echo supports this by offering the possibility to easily turn on or off any of the trackers and create new ones. Having all the trackers in Echo on would however affect the battery lifetime, which the users should be warn about if choosing to do so.

What features are relevant for an mHealth application used in psychotherapy?

The features selected for Echo had to make sense for the clients and more specifically had to emphasize the benefit of using it within psychotherapy with their therapist. Furthermore, the development of Echo should keep the experiences, skills, tools and processes of the therapist in mind to get their accept of the application [15].

Based on these considerations, homework and notes were selected as key modules. Homework is a very common practice in psychotherapy and clients see a benefit of the system if they can annotate the tracked data, to remember the context.

The chart feature needed to support the need for clients to understand their data both while talking to a therapist and by themselves. A crucial element here was that the clients should not be exposed to harmful system driven conclusions, i.e. you are having a panic attack

The participant had other suggestions to features for Echo, that did not necessarily fit the overall concept and goal of the app. And even if the process of designing Echo relied heavily on users' inputs, they do not necessarily have the knowledge or understanding required to know what they want.[32] [12, ch. 9].

An important example is clients wanting to have goals in Echo (see Iteration 3: Design definition). This did not fit within the scope of Echo, and could potentially have a very negative affect within the framework of psychotherapy. Besides it is very hard to have a measurable goal within psychotherapy.

It is not the users job to design the solution, but the designers needs to be able to decipher and interpret what the users actually want.

How should the application be presented and used in psychotherapy, and how often?

This question was mainly answered through user input and was more concept oriented. Therefore having the domain knowledge and the inputs from both therapist and clients was paramount due to the specificity of the domain.

Even if the therapist might be the most obvious resource for answering this question, it was still relevant to include the clients inputs since they needed to be engaged within the concept to actually use it[15] The answer to the question is in fact very simple. It should be decided by the given therapist and client using the application, therefore the most important role of Echo is to give enough possibilities for the users to customize it.

How should personal data be presented and used in psychotherapy sessions?

With all the sub questions answered, all the building bricks to answer the main research question was defined. The result of the thesis is Echo, which answers the research question. Echo offers to accommodate self-awareness by presenting tracked data to the user, which he/she then can share with the therapist. Echo offers the personalization needed to embrace all clients and therapists, the 'how' in the research questions will therefore be defined by the Echos users.

9.2 Self tracking in mental health

This section discusses an important trait of the research contribution of the thesis: self tracking in mental health and the possible impact of self tracking.

How much self-awareness is too much self-awareness

One of the important discussion points in the design workshop (see Iteration 3: Design definition) focused over the roles of the client and therapist in deriving meaning from the data. While some participants saw the value of becoming more self-aware of own patterns, one participant believed that the sense making process belongs completely to the therapist's role:

I'm not sure if it's relevant for me to see all these graphs alone, on my device, because I don't know how to interpret it. That's why I'm going to a therapist in the first place, to interpret my behaviour. If I see this [it means] I can diagnose myself.

This challenge of designing visualizations that provide meaningful and actionable feedback but does not however negatively impact the users was previously discussed in related literature and in the QS community.

Frost et al. present a similar argument, in regards to the Monarca application for bipolar patients, however here it is focused on mood prediction. Both the designers and clinicians involved with the design of the Monarca solution saw the benefit of informing patients about their forecast mood state. It would provide insights for both patients and clinicians and allow them to prevent unwanted mood changes. [18]. However the idea of presenting mood swings for the patient was rejected due to ethical concerns, as predicting mood could end up as *"a self-fulfilling prophecy"* [18, p. 5]. Kelley et al. [29] report similar findings: *"displaying someone's stress data does make them more aware of their stress levels, but can also exacerbate their stress"* [29, p. 630].

Echo was designed with this in mind. While not making any negative predictions, as it only shows historical data it will also not make inferences about the data - for instance in the case of a panic attack, the user would see a high pulse from the pulse chart, but it would not be labeled it as a panic attack. In the role-play session held in iteration 4 (see Iteration 4: Design evaluation) the therapists have all agreed on this matter.

Tracking drawbacks and possible impact on psychotherapy

Another important aspect to discuss is the risk of shifting focus in psychotherapy from the problem of the client to tracking. Drawbacks of self tracking have been previously discussed in literature and the Quantified Self community. Fan mentions that tracking too many things can overwhelm the person tracking, and this might

lead to loss of motivation and inconsistent tracking data [16]. In Echo's case, tracking parameters will be agreed upon by the client and the therapist and can easily be adjusted if such tracking fatigue might arise. Many QS - ers report self tracking as becoming an obsessive goal in itself ¹ ².

Client participants also expressed concerns in regards to self tracking. When discussing tracking scenarios in Iteration 2, the client participants mentioned the benefits and drawbacks of tracking: it can help you become self-aware, but it can also turn out to be a stress factor, both in terms of having to do the manual tracking and dealing with the data. However they agreed that if you have found out what stresses you or makes you sad you are in general more aware of it and you are able to use it for your benefit. Echo's design has strived to followed Doherty et al.'s guidelines : designing with focus over the therapy rather than the technology [15].

The misleading idea of self-awareness

Self-awareness and self knowledge are not one-time exercises. Acknowledged since ancient times as *"the beginning of wisdom"*, self-awareness through self reflection and self tracking is not a new concept. Self tracking has for centuries been done through diaries and alike methods [27]. However, this exercise takes a lot of discipline and sustained effort. Some clients might not see the benefit of using Echo, if they already feel like they are very self-aware. That would not be a common case. There is always something to learn about one's self. Even so, it takes a lot of discipline and sustained effort to self track and reflect on personal informatics, and Echo provides a support framework to do so.

9.3 Limitations

This sections briefly touches upon the limitations of the research work and how this could have an impact on the results obtained.

One limitation was access to participants. Unlike in funded research, participants in this thesis were involved on a voluntarily basis. Few clients were recruited from the social groups of the authors, on the basis discussed in Methodology. Recruiting therapists was a challenge, especially for the first two iterations.

As mentioned in the Methodology chapter, an expert psychologist was used to guide the psychotherapy domain related decisions. A limitation was that the expert used is closely related to one of the authors. As well role-play therapist participants were collaborators of the expert used. This could have impacted the feedback received.

Another limitation was the fact that the prototype developed and evaluated through the four iterations was a hi-fi, nonfunctional prototype. Screen interactions were mimicked to a high degree of detail using Marvel³, however it is not possible to exten-

¹<https://www.theodysseyonline.com/be-patient>

²<https://www.washingtonpost.com/news/to-your-health/wp/2015/05/11/a-fitbit-fanatics-cry-for-help/>

³<https://marvelapp.com/>

sively cover all possibilities with such a solution. Especially in terms of interaction with charts, future work should implement more meaningful interactive possibilities.

CHAPTER 10

Conclusion

The Thesis has explored many aspects to be able to properly answer the main question: *How should personal data be presented and used in psychotherapy sessions?* This includes a thorough selection of what methods were relevant for each sub question, discussions, analysis and interpretation of the empirical data and a meticulous design process. The thesis also investigated the areas of mental health mHealth applications, Personal Informatics and User Centred Design. This included the possibility to investigate, the rather under explored, area between wellness and clinical mental health mhealth applications.

In addition, the thesis offered the opportunity to work closely with therapists and clients, and thereby understanding what parameters are crucial for supporting a therapy process. New knowledge was gained in terms of how to empower the clients and still ensure the importance of the therapist.

A clear goal of the thesis was to have the possibility to dive deep into the sub elements of what such an application should contain and how it should be used.

The idea, concept and design of Echo were welcomed with positive feedback from both therapists and clients. All the therapists asked into when it would be available for them to use in practice. This is a clear indication that even if this thesis does not conclude with an implemented prototype it has thoroughly investigated all the aspects prior to implementation and managed to solve a relevant problem, for aiding clients and therapists in psychotherapy.

10.1 Future work

The main future work for Echo would be to evaluate the final prototype, preferable with new users, then develop and implement the application. To ensure that Echo actually aids the psychotherapy, an in-context pilot study would be conducted with the implemented prototype.

Another important next step would be to clearly define the protocol for usage[15] and define how Echo should be introduced to therapists. This could be done in

several ways, but further research would be needed to decide on the optimal way.

Based on the research done so far, the therapist needs to have a thorough understanding of Echo and would benefit from using the application before introducing it to a client. This requires an introduction of the possibilities in Echo as well as the benefits it offers to psychotherapy.

APPENDIX **A**

Distribution of Contributions

The distribution of contribution of the writing was as follows

Alina : Chapter Summary, Chapter 3 Methodology, Chapter 6 Iteration 3: Design definition, section 8.3 and microinteractions diagram

Lys: Chapter 4 Iteration 1: Initial validation and research, Chapter 5 Iteration 2: Echo concept development, Chapter 7 Iteration 4: Design evaluation, Chapter 8 Echo: final prototype, Chapter 10 Conclusion and section 3.1.1, section 3.1.2 and section 3.1.4

Both: Chapter 1 Introduction, Chapter 2 Background and Literature Review and Chapter 9 Discussion

For further details see Table A.1. An X indicates who is key responsible for the chapter or section, a **X** is used for chapters.

The empirical work for each iteration consists of performing the UCD methods, transcribing, doing Qualitative Data Analysis and discussing what elements are relevant for the next design.

Each of the design versions included paper mockups and marvel and illustrator screens.

Table A.1: Distribution of work, X: indicates the writer and key responsible

Chapter	Alina	Lys
Report writing		
Summary	X	
Ch. 1 Introduction	X	X
Ch. 2 Background & Literature Review	X	X
Sec. 2.1 & 2.3 -2.4	x	
Sec. 2.2		x
Ch. 3 Methodology	X	
sec. 3.1.1, 3.1.2, 3.1.4		X
Ch. 4 Iteration 1		X
Ch. 5 Iteration 2		X
Ch. 6 Iteration 3	X	
Ch. 7 Iteration 4		X
Ch. 8 Echo: final Prototype		X
Sec 8.1 - 8.2		x
Sec. 8.3	x	
All Graphics and Diagrams	x	
Micro interactions Diagram	x	
Ch. 9 Discussion	X	X
Sec. 9.1		x
Sec. 9.2 - 9.3	x	
Ch. 10 Conclusion		X
Appendices	X	X
Empirical elements		
Iteration 1	X	X
Iteration 2	X	X
Iteration 3	X	X
Iteration 4	X	X
Design version 1	X	X
Design version 2	X	X
Design version 3	X	X
Defining Micro interactions all iterations	X	X
User Story Map all iterations	X	X

APPENDIX B

Data sources

The complete set of audio recordings, video recordings and transcripts from all the user involvement activities and the the full designs for Echo version 2 and Echo version 3 are available for download from Google Drive ¹ at <https://goo.gl/EMwffs>

The Google Drive folder is structured in five sub-folders, corresponding to the four iterations and designs:

B.1 Iteration 1

- Client survey (Google form)
- Therapist survey (Google form)
- Client survey results
- Therapist survey results

B.2 Iteration 2

Focus group

- Focus group recording.m4a
- Focus group transcript

Interviews

- Interview therapist 1 transcript
- Interview therapist 1 recording
- Interview therapist 2 transcript
- Interview therapist 2 recording

B.3 Iteration 3

- Design workshop summary
- Audio recording

¹<https://drive.google.com/>

B.4 Iteration 4

- Think aloud screen and audio recordings
- Role-play video recording
- Think aloud transcripts
- Materials used in the roleplay
- Roleplay transcript

B.5 Designs

- Echov2
- Echov3

APPENDIX C

Surveys

C.1 Client survey

Survey Clients

We are working on our master thesis at DTU Compute, which tries to answer how smartphone sensor based personal data can be used in therapy.

The thesis will include the design of a mobile application that can help clients and their psychologist during and between therapy by utilizing the clients' personal sensor data.

We would like to see what data people who have been or are currently going to a psychologist would show to/talk about with their psychologist.

The questions consist of some basic information about you, to help us determine if there is any difference in the answers based on people's age etc.

Furthermore we are interested in whether or not you do self tracking, i.e. do you monitor your sleep, your weight, your pulse, etc. to find out how that relates to what data you would want to show to / talk about with a psychologist.

By answering this short survey you will help us tremendously in regards to validating the concept.

Important to note:

The thesis is only looking at the design and is not developing the application. However if the system was developed the possible data collection would fall under the following rules: the data will belong to the client and can only be accessed by the psychologist with the clients consent. The smartphone sensor based personal data data will be securely stored and encrypted to ensure security and privacy of the clients.

*Required

1. What is your age *

Mark only one oval.

- 18-23
- 24-29
- 30-34
- 35-40
- 40+
- Other: _____

2. Do you track yourself in any way today? (fitness, sleep, pulse, steps, weight etc?) *

Mark only one oval.

- Yes Skip to question 3.
- No Skip to question 5.

Self-tracking

3. What are you tracking?

4. Why are you tracking?

Psychologist experience**5. Your experience with psychologists ***

Mark only one oval.

- Currently seeing a psychologist *Skip to question 6.*
- Have been in therapy in the past *Skip to question 7.*
- Other: _____ *Skip to question 7.*

To determine if the time period they have been seeing a psychologist makes any difference in peoples opinion about sharing their data

6. How long have you been going to a psychologist? *

Mark only one oval.

- 1-3 mnd
- 3-6 mnd
- 6-9 mnd
- 9-12 mnd
- More than a year

Smartphone sensor based personal data

This section is looking at the data that we have found potentially interesting after talking to psychologists, and are therefore the ones we want to get your input on. If you have other data that you either self track or you would find interesting to discuss or share with your psychologist, please note it in "other"

The personal (sensor) data would be owned by the client, if the application was developed.

7. Which of your own data would you find interesting to track for your own knowledge? (select one or more) *

Tick all that apply.

- Location: number of locations a day / activity / travel times
- Smartphone screen time(how long time are they using their phone)
- Pulse (Heart rate / heart rate variability)
- Number and duration of outgoing and incoming calls
- Number of outgoing and incoming sms
- None
- Other: _____

8. What smartphone sensor based personal data would you show or talk about with your psychologist if it would improve your therapy? (select one or more) *

Tick all that apply.

- Location: number of locations a day / activity / travel times
- Smartphone screen time(how long time are they using their phone)
- Pulse (Heart rate / heart rate variability)
- Number and duration of outgoing and incoming calls
- Number of outgoing and incoming sms
- None
- Other: _____

Further help

We would love to get as much input from potential future users as possible to improve the concept, ideas and design.
If you would help us further by participating in a focus group, role playing or interviews please add you email below

9. If you want to help us, please write your email below.

C.2 Therapist survey

Survey psychologists

We are working on our master thesis at DTU Compute, which tries to answer the question of how personal smartphone sensor based data (PSSBD) can be used in therapy.

The thesis will include the design of a mobile application that can help clients and their psychologist during and between therapy by utilizing the clients' personal smartphone sensor based data. The focus is on therapy done by clinical psychologists. However we still find answers from psychology students and other types of psychologists relevant.

We would like to get an evaluation/validation from a broad spectra of psychologists and psychology students of the concept.

Therefore we are asking you to answer a few questions about you as a psychologist or psychologist student and whether or not your find smart phone sensor based data relevant.

By answering this short survey you will help us tremendously in regards to validating the concept.

Important to note:

The thesis is only looking at the design and is not developing the application. However if the system was developed the possible personal data collection would fall under the following rules:

The personal data will belong to the client and can only be accessed by the psychologist with the clients consent. The personal data will be securely stored and encrypted to ensure security and privacy of the clients and comply with current legislations.

*Required

1. What describes you? I am.. *

Mark only one oval.

- a psychology student
- a master graduate in psychology
- an authorized psychologist
- a specialist(children psychology, adult psychology or organization psychologist)
- Other

2. How did you hear about this survey *

Mark only one oval.

- Facebook group (Dansk Psykolog Forening)
- Headspace
- Psykologisk Korttidsådgivning
- Sind
- Studenterrådgivningen
- Psykologisk SamtaleCenter
- Facebook group (Dansk psykologi Forening - Students)
- Psychodrama group
- Other: _____

personal smartphone sensor based data

This section is looking at the clients personal smartphone sensor based data that we have found potentially interesting after research on both the psychological aspect as well as what data are available to record digitally and with device constraints in mind. Therefore these are the data that we

want to get your input on. If you have other data that you would find interesting or useful in therapy , please note it in "other"

3. Which of the following personal smartphone sensor based data do you find useful or relevant in therapy? (Client's data) *

Tick all that apply.

- Location: (number of locations a day / activity / travel times)
- Smartphone screen time(how long time are they using their phone)
- Pulse (Heart rate / heart rate variability)
- Number and duration of outgoing and incoming calls
- Number of outgoing and incoming sms
- Other: _____

4. Would you use this sensor data in your therapy session? (i.e. pulse, location, sleep, food, activity etc.) *

Mark only one oval.

- yes *Skip to question 6.*
- no *Skip to question 5.*

Personal smartphone sensor based data

To get more information about why you would not find personal data relevant in therapy, please answer below.

5. Why would you not use sensor data in therapy sessions?

Skip to question 7.

Personal smartphone sensor based data

6. In what scenarios could you see yourself using sensor data in therapy sessions?

Tick all that apply.

- As a tool for homework
- As a supplement/alternative to diary/questionnaires etc.
- As a tool just for the clients
- As a tool for tracking the improvement of the clients
- Other: _____

Skip to question 7.

Further help

We would love to get as much input from psychologists and psychology students as possible to improve the concept, ideas and design. If you would help us further by participating in a focus group, role playing or interviews please add you email below.

4/30/2018

Survey psychologists

7. If you want to help, please add your email

Powered by
 Google Forms

APPENDIX D

Focus group moderator guide

Date: 30th April, 17.00 - 18.30

Participants: K, A, T and H

Location, Frederikskaj 12, room 3.66

Goal:

- when and how to use the system in therapy
- what scenarios are relevant and useful?

The scenarios do not contain technical / application specific information (about types of sensor data or UI/UX representation of it). For the purpose of the focus group it should be assumed that the data can be recorded and displayed optimally and that is what the decisions should be based on.

- when should the system be used for the defined scenarios?
- how should it be used in therapy?

Plan

Introduction (5 min)

Thank you for joining today. We are doing our master thesis, that looks into how personal smartphone, sensor data can be used to support psychotherapy; What do we mean by support: help clients and their psychologist understand their patterns to be able to achieve their goals. Today we'll have two sessions and a small break in between. We'll start in a minute explaining about the first one.

But before we begin there are some small guidelines:

No right or wrong answers, only different points of view

We're audio recording - one person speaking at a time preferably

Please turn off your phones. If you cannot and if you must respond to a call, please do so as quietly as possible and rejoin us as quickly as you can.

Our role as moderators will be to guide the discussion, but not as such participate

D.1 Session 1

Introduction

So the first session here will take around 40 min and then we will have a break. First of all we will divide you into two groups: Lets say A and T, K and H. In each group you will together read ten scenarios and then individually rate them on your own paper, which we will distribute. After you have rated it you have to discuss it with your group member. You will have 2 min to do both the rating and the discussion for each scenario. We will let you know when you have to move to the next scenario.

Rating

What scenarios makes sense to have in therapy? Read scenarios and decide on a individual rating for each scenario from 1-5 (very relevant(1), somewhat relevant (2), neutral(3) , somewhat irrelevant(4), very irrelevant(5))

Discuss your rating

Next decide on a top 3 of scenarios in each group, you will get 2 min. for that. You will briefly present it to the other group afterwards. (groupwise)

When done with the 10 scenarios, pick top 3 = 2 min i total Now let's move together. Each group will now have 2 min to present it to the other group, who wants to start? (all together)

Meet up and present each groups decisions of top 3 scenarios. = 2 min in total Now as the last thing before the break, we want you to put the scenarios up on the board here. So the first part is determining when you would see it being useful, i.e. between or during, the next part is when in terms of when in the therapy time frame to use it. You will get 10 min from now on. (all together) Pile Sorting/the card game to start discussions: help each other decide when the top scenarios should be used - give them a time slot indicator. = 10 min

Break 5 min - snacks and drinks

D.2 Session 2

Introduction to the task

We will continue with session 2, it will take approximately 15 min. In this session we will just ask you to discuss this question. (The question and sub questions are written on board). To start you off, let's have a round the table of what each of you think on who should take the initiative to talk about the data in the app in a therapy session?

An overall discussion based on the question: *how should the app be used in therapy, to make it comfortable and meaningful for the clients?*

If the discussion doesn't flow, the moderator will have 3 sub questions to get the discussion going:

- Should it be initiated by the client
- Should it be initiated by the psychologists
- Should it be a regular thing or only when it seems meaningful in terms of the therapy progress/issue

Round up & thank you for today

D.3 Scenarios rating

Add a X where you think each scenario goes (a X for each scenario).

Scenario	Very relevant (5)	Somewhat relevant (4)	Neutral (3)	Somewhat irrelevant (2)	Very irrelevant (1)
Pulse					
Calling					
Location					
Messaging					
Blood pressure					
Mood					
Food					
Phone usage					
Sleep					
Activity					

Figure D.1: Rating table using a 5 point Likert Scale, used by participants in the focus group to rate every scenario

D.4 Scenarios



LOCATION

Imagine an application that can accurately tell you how much time you have spent at home, at work and at other places, i.e. cafes, fitness center, friends places etc. The data will be displayed in an easy understandable way so you easily can get an overview of how often you stay at home or went out in for instance weekends and evenings. The data can be used if you want to reduce your stress (too many places in one day), increase or decrease your amount of social interaction (how many times were you at home or at a friends place), or keep focus and productivity (how many hours have you been in school, at work, studying at home or at the library etc.)

A small example: John is feeling a little sad and moody and has problems getting things done. He is normally a very outgoing person and extrovert to some extend. The app helps John see that he the last months has been at home on almost every day both weekends and weekdays. He checks his calendar and sees that he didn't have any visitors either, he is simply lacking social interaction.



PULSE

Imagine an app that accurately tracks and shows your heart rate throughout the day and over different periods of time. This can be used to identify your stress patterns, i.e. what is it that makes you stressed? It can pinpoint what affects you and what helps: having a lot of meetings in a day, self study at home, handing in assignments or exams, spending time with friends, being up until late, waking up early, taking a lot of phone calls (or a specific one), etc. It could also help you see your behaviour when you are stressed, i.e. do you tend to sleep, eat, change moods due to being stress?

An example: Louise is writing her master thesis and often complains about stress affecting her efficiency with writing. By tracking her stress pattern she realizes her pulse is increasing with the number of calls and notifications per day.



MESSAGING

An app that shows an overview of your messaging patterns, i.e. sms and other messaging applications. The data is shown in an easy and quickly understandable way. It could for instance tell you how often and how long (timewise) you spend texting, when you texted, etc. This can give information about your social interaction or time spent chatting

For example, Anne always complains about Peter not being present when spending time with the kids, while he thinks he is very much present. His messaging patterns thought him he was always texting a lot with his friends in the afternoon, when he was actually watching the kids.



CALLING

Imagine an application that can accurately tell you how much and how long you are talking on the phone, either when calling or receiving calls. The data will be displayed in an easy understandable way so you easily can get an overview of how often you talk on the phone and for how long and what types of call you are making. This data can be used to indicate your depression level, understanding your social habits and possibly your stress indicators, as well as being able to see your own habits.

An example: Hanne is feeling like her friends don't really like her anymore, she never hears from them and they rarely call. She feels neglected and sad, when she looks at her app she sees that it is not actually true, her friends calls her the same amount of times as she calls them.



SLEEP

An app that shows your detailed sleep pattern for every night and gives you the possibility to see your sleep for periods of time. This can also be used in relation to other parameter tracked (like pulse, activity level, etc). This data can help you with stress level, anxiety, tiredness, irascibility / anger / high temperament, procrastination, perfectionism etc

An example: Sean has in the recent months experienced his family complaining about him always being angry. He could not understand why they thought so, and blamed it on the stress caused by switching jobs. When this persisted for a long time he started with his psychologist to trace the causes of his anger. Sean tracked different aspects of his daily life and his wife rated his anger daily. There was a huge relation between the amount of sleep he got and the anger reported: it was not the fact of getting a new job in itself, but having to commute way further and waking up 2 hours earlier in some of the days.



PHONE USAGE

Imagine an application that can accurately tell you how much time you spent on your phone in total and on each type of applications, i.e. social media, e-mail, games etc. in an easy and understandable way. The data could be used if you wanted to improve your productivity, addiction to your phone, low self esteem, social anxiety, social phobia and other possible issues or improvement areas.

A small example: Marie is having problems getting her tasks done, and is getting stressed and ends up not doing any of the tasks. She feels like she does nothing but work all day, but when looking at phone usage in the app she realizing that she uses facebook for 4 hours a day.



MOOD

An app that records your self reported mood. An overview of your mood pattern and history can identify the triggers, causes and effects of different moods you experience: depressive, angry, happy, calm, energetic, lethargic, sad, lonely, etc. This can also be used in comparison with other tracked parameters. Is your mood affected by your social activity and how? Is your mood affected by sleep patterns? Is your mood affected by weather?

Arne never understood his mood swings during the day. After tracking his mood he could identify different parts of the day were similar over a large period of time and caused by the setting he was in : at work, with his family, in traffic.



FOOD

Imagine an application that can accurately tell you how much food and what food you have consumed, based on your inputs. The data will be displayed in an easy understandable way so you easily can get an overview of how often and what you eat. The data can be used if you want to reduce your food intake or get an overview of your eating habits, i.e are you eating more or less when you are sad or happy. An example: Torben is constantly hungry even if he just ate, it makes him irritable and annoyed, when looking at the application he can see that it is especially on wednesdays he eats a lot, that is when he is having his mum over for tea, he does not have a good relation with his mum.



BLOOD PRESURE

Imagine an application that can accurately tell you how high your blood pressure is displayed in an easy understandable way so you quickly and easily can get an overview of how your blood pressure is and when it is higher or lower. This data can be used to for instance help you give an indication of your mental stress level, how often you are getting angry or being hot-tempered.

An example: Lena is having problems understanding why she is always forgetting things, being tired and annoyed, but by looking at her app she sees that her blood pressure has been very high for the last month and she needs to do something different.



ACTIVITY

An app that shows you an overview of your activity: whether you bike, run, walk, exercise, do sport, clean around the house, etc . It will display it in an easy understandable way, for instance by day, over a period of time or by comparison between selected periods. This data can help understand your stress level, your mood, etc. Besides it can be used in relation with for example reported mood - to see how physical activity influences mood, stress, relationship dynamics.

Take an example: Morten started seeing a psychologist for coping with stress. His app showed him that he was stressed on all working days, this did not make sense to him, because he really loved his work. However some days stress was low and when identifying how those days were different, he discovered something interesting. He was not stressed in the days when he was training the day before.

APPENDIX E

Interview guide

Participants:

Lil Mollen: authorized psychologists, Sweden

Kristoffer Geer: psychologist student, Århus

Briefing

Set the stage: purpose and context

As you know, we are doing our thesis at DTU that is designing a system that uses personal smartphone based sensor data in therapy. More specifically it is a system where the clients can track themselves in different regards, for instance how social they are, mood, pulse for stress and anxiety etc. The idea is that this can be used by the client to become more self aware and by the psychologist and the client in therapy sessions to pinpoint possible daily / physical elements that can affect the psychological aspects. It could be used in different ways by the client and by the psychologists. This is what we want to get your thoughts on as a psychologist, today. We are recording the interview, for the purpose of the thesis, we hope that is ok..

Any questions before we begin?

To understand your points of view we will start by getting an idea of your approach in therapy

- What (data) scenarios are relevant and useful?
For Kristoffer: First of all, do you have clients today or have you had? If not, phrase questions as “imagine that” - future perspective.
- Can you describe to us what kind of information from the client you use today in your therapy sessions, besides the conversation? (i.e. What the clients say, facial expressions, breathing, calls, social life etc)
- Can you give us an example of that?
- Do you use any digital tools today in your sessions? App, web, questionnaires? Why? Or why not?
- Is there some data that you would like to use that you don't have access to today? (For instance location, pulse and calls)
- When should the system be used for the defined scenarios?
- How do you see such data being used in therapy?
- If you imagine your clients having this app we are designing, how would you see it being used? (Lill: in the survey you answered that you would use this app as

homework and as an assessment tool, can you elaborate on that? Kristoffer: in the survey you answered that you would use this app as a tool for homework, as a supplement/alternative to diary/questionnaires etc., as a tool just for the clients, as a tool for tracking the improvement of the clients, can you elaborate on that?)

- How often would you use it?
- How should it be used in the specific therapy sessions?
- Can you explain how you would introduce this application to a client?
- Let's assume that you are in a therapy session with a client who is using the app. How would you use the app in the specific session? (should it be initiated by you or the client - if it's you: would you look at the data with the client / ask the client to talk about their experience/awareness)

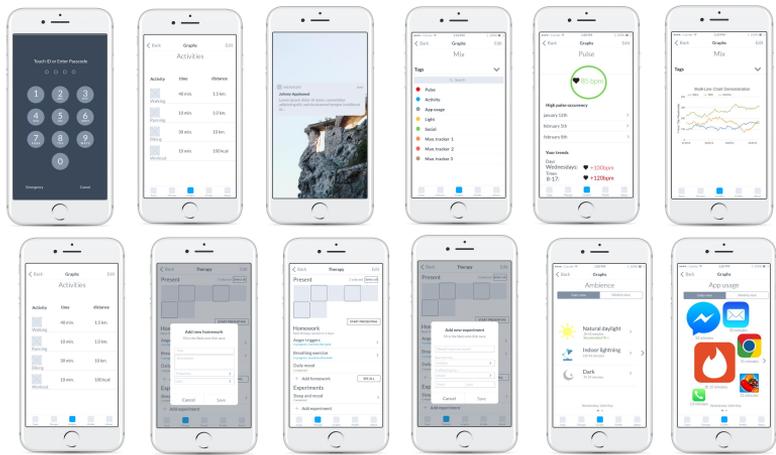
Debriefing

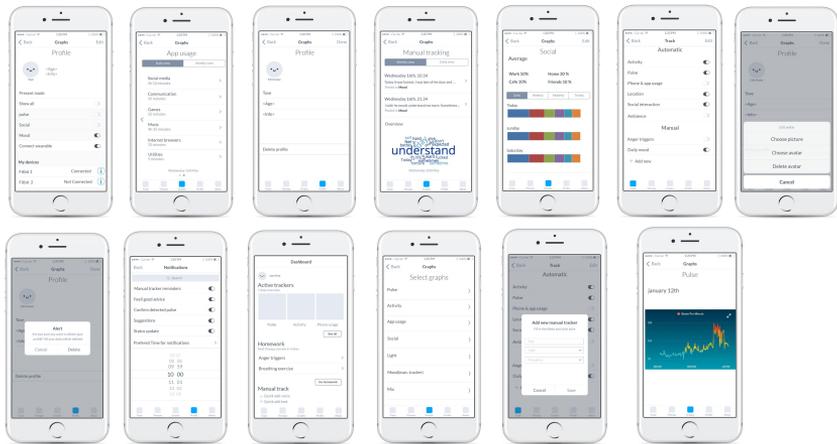
Do you have anything else you would like to add?

Thank you a lot for participating and for your input (would you like helping us again?)

APPENDIX **F**

Echo v1 - Initial prototype





Design workshop Moderator Guide

Iteration 3

Date: 24th May, 17.30 - 19.30

Participants: K, A, T, H, S

Location, Frederikskaj 12, room 3.66

Goal

- Get feedback on initial design
- Get suggestions for missing elements
- Evaluate the initial user tasks (USM)

Questions

- does the user story map : content, user journey (workflow) covers the user needs, is the flow as expected? what is missing?
- prioritizing : what to have on dashboard? What are the most important or useful features to get at first?

Plan

Introduction (5 min)

Thank you for joining today. We are doing our master thesis, that looks into how personal smartphone, sensor data can be used to support psychotherapy; What do we mean by support: help clients and their psychologist understand their patterns, to be able to achieve their goals. Today we'll have two sessions and a small break with food in between. We'll start in a minute explaining about the first one.

But before we begin there are some small guidelines:

- No right or wrong answers, only different points of view
- We're audio recording - one person speaking at a time preferably
- Please turn off your phones. If you cannot and if you must respond to a call, please do so as quietly as possible and rejoin us as quickly as you can
- Our role as moderators will be to guide the discussion, but not as such participate

G.1 Session 1

17.40 Evaluation of user tasks (USM)

Introduction to Session 1

So in this first session we will ask you to have a look at some tasks that we have created to make sure the app has the right content. We would like you to sort them and make a user journey, we will explain more about that in a bit. First we will divide you into two groups and then when you are done with the two tasks you will present it to the other group.

[divide into two groups]

The tasks have been made as cards and we would like you to in each group you sort the cards based on a category that you will give them. Afterwards we will ask you to make a user story - imagine that you are the user of the app and what steps you will have to go through when using the app in therapy. Therefore the categories have to be made in a way that you can create a story with them. We have around 10 tasks, if there are some task missing, add them yourself, there are pens over here and blank cards here. Do you have any questions? You will get 15 min for this first sorting task.

[participants work on the task]

Now the second task is to create the user journey, imagine that you are a client that goes to a therapist and then you are introduced to this app. The story starts here and ends with you being done with the therapy and on your own. Any questions? (15 min)

Now we will gather and briefly present the journey to each other, you have 2 min. each for the presentation.

Short recap of the two groups presentation

18.15 Break - food

G.2 Session 2

18.30 Evaluation of UI design

Introduction to screens game (10-15 min): So to get started, we will start by introducing you to the screens of the app so far. To do it in a more fun way and get you up on your feet after food, we will make a small game. As you can see there are small papers on the floor. First you select one to stand at. Then you each get 25 cards, and you have to make a complete set of the app. The way it is done is kind of like the game fish, where you ask for the card you are missing based on the paper you are standing at. When you have the one where you are standing, you move to another label and ask for that. Any questions? (Showing how it works)

[participants play the game]

Introduction to scenarios (45 min):

Now, that you hopefully have an idea of the screens we will do a small role play game in two groups. To shake it up a bit, we have divided you differently than before. So in each group you will have 5 scenarios that you will act out using the screens. One will read the scenario and the other will try and show what they would do in that scenario in the app using the screens. We have 30 min to do this, and you will switch roles after each scenario. Any questions?

[divide into two groups.]

Here are the scenarios and feel free to stand or sit or whatever makes the most sense for you when you are using the app. Think of what you would do in real life.

Scenarios

1. You are at the 3rd therapy session for exam anxiety and your psychologist introduces the app to you
2. You are at therapy, it's the 5th therapy session and you have been using the app for a while. You are in therapy due to too many sad days. You want to share the data with your psychologist
3. You are in between therapy sessions, you go there every monday and you have homework to do before next monday. Today is wednesday
4. Its sunday, tomorrow you are seeing your therapist, and you want to prepare for the session.
5. You have been going to a psychologist for the last 5 months and you have both agreed that you are ready to keep working on your own and don't need more sessions for the time being. But then you have a bad day and you go to the app to get help feeling better.

19.30 Thank you for today

G.3 User tasks cards used in first session

login to app	turn all or individual tracking on/off
read the data policy	turn on automatic tracking
Get informative notifications	Get interventive notifications
define personal experiment	annotate tracked data with context
reflect on my patterns	get homework
present personal data	customize visualizations
adjust profile	adjust settings
manually record	See key metrics
select/filter my parameters	therapist customization of app
See visualizations	

APPENDIX H

Role-play Moderator Guide

Iteration 4

Date: 12th of June, 18.30 - 20.30

Participants: E, H, C

Location: Paradisets Psykologiske Rådgivning, Bjernemark Byvej 2, Svendborg, Fyn.

Goal

- What effect does using Echo in therapy have?
- Get feedback on the concept that only clients have access
- Is it problematic for the client to use the app by themselves
- How should it be used in therapy?

Notes Make very clear scenario, with roles and clear motivation for characters.

Plan

Introduction (5 min)

Hi and thank you for joining today. As you all know we are doing our master thesis, where we are designing an app, that looks into how personal smartphone, sensor data can be used to support psychotherapy; What do we mean by support: help clients and their psychologist understand their patterns to be able to achieve their goals.

Today we'll have two sessions, one with role-play which takes around an hour and one small session for around 30 min. where we will discuss and ask you to give your thoughts on the app. We will have a small break in between the two sessions and afterwards we will have dinner.

But before we begin there are some small guidelines:

- We are testing our concept and the app, and not you.
- No right or wrong answers, only different points of view
- We're video recording - one person speaking at a time preferably
- Please turn off your phones. If you cannot and if you must respond to a call, please do so as quietly as possible and rejoin us as quickly as you can
- Our role as moderators will be to guide the role-play and discussions, but not as such participate

H.1 Session 1

<i>Scenario</i>	<i>Therapist</i>	Distribution of roles	
		<i>Client</i>	<i>Observer</i>
Scenario 1	E	C	H
Scenario 2	C	H	E
Scenario 3	E	C	H
Scenario 4	E	H	C

Table H.1: Distribution of roles for the four mock session

18.40 Scenario 1

Introduction to Session 1

In the first session we will have a few, short role-play sessions. You will be switching roles : one of you will play the therapist, one the client, and one will observe the role-play - we already defined who plays who in the different scenarios. After each role-play session a small discussion will be done, where the observer can contribute.

[The participants places them self according to their role]

To warm up we will ask you to do a simple role-play so we can get an idea of how a therapy session works. For this we'll have E as the therapist and C as a client. H - you going to be the observer - you are welcome to comment at the end of the roleplay. The scenario is that it's the first therapy session of the client and therapist. C here is what you need the scenario of your character - please take 2 min to read it and then we can start. We'll have 10 min to play in this first session, I'll let you know when you have to wrap up Ok, let's start! .

Scenario 1

A typical scenario of a therapy session - field study when not possible, more an overall idea for us in general - control data for the scenario 3 and 4 Method: 15 min Give the client their scenario - 2 min Set the scene - 2 min And ask them to play it out for 10 min. Any comments - 2 min

[participants do the role-play]

[The moderator facilitates a round up discussion of scenario 1]

Scenario 2

Ok, let's move to the second roleplay. The roles now are: C, you are the therapist, H , you are the client - so you will be playing the same client, Tine. and E, you will observe the two. In this session we will assume that is the 3rd time for Tine in therapy and her therapist - that would be you C, wants to introduce Echo to her - an app that the therapist thinks can help their progress. To begin with , we'll take a few minutes to introduce the app to C (Lys) and E (Alina). H - you will read about your character. We will begin after.

[participants do the role-play]

[The moderator facilitates a round up discussion of scenario 2]

Scenario 3

So now you have done a small role-play for a classic therapy session and now we would like you to do two more mock therapy sessions. You all have an idea of the app now and the client. It's the 4th therapy session. In this scenario the client has been using the app since last therapy session. You are however not allowed to use/play with/look at the app in the therapy session. You get around 5 min to play the scene, I will let you know when you have to wrap up. E you are the therapist, C you are the client and H you are the observer. C you are welcome to take the scenario for the client with you. Please take your places. Action.

[participants do the role-play]

[The moderator facilitates a round up discussion of scenario 3]

Scenario 4

Explanation: So this is the final roleplay. It is very similar to the previous: . It's the 4th therapy session, the client has been using the app since last therapy session. The difference is that we in this scenario would ask you to use/play with/look at the app in the therapy session. You get around 5 min to play the scene, I will let you know when you have to wrap up.

E you are the therapist, H you are the client and C you are the observer. H you are welcome to take the scenario for the client with you. Please take your places. Action.

[participants do the role-play]

[The moderator facilitates a round up discussion of scenario 4]

19.50 Break

H.2 Session 2

20.30 Evaluation of UI design

Introduction to evaluation (10-15 min):

In this session, we will look more at the app itself Each of you will get a phone with the app so you can try and play with it for a few minutes, and this [handing out the comment sheets] piece of paper where you can write a few notes about the app's three main modules: trackers (parameters, data you can track), Graphs - representations of the data - also the calendar and the Therapy module, where the client can present, add and do homework and add notes in relation to data tracked, the homework or just notes for the next therapy session.

[They each get a phone and a piece of paper with four fields, one for each module in the app. They get 2 min for each module.]

[participants evaluate the app]

Round up discussion (10 min):

So this is the last part before dinner. We would like you to discuss two questions.

You will get around 5 min for each question:

- Would you look at a clients data prior to a therapy session if you had the option?
- Is there any data that you would not like the client to look at by themselves?

If the discussing doesn't start, the moderator has some sub questions to ask:

- What tracked data should the client see by themselves
- Thoughts on client and therapist division of the app
- Thoughts on how the data should be presented?

20.40 Thank you for today

MODULE	YOUR NOTES
Track	
Therapy Present Homework Notes	
Graphs Tracked data: pulse, activity, social, app usage, ambience, manual tracking Calendar	

Figure H.1: Comment Sheet for participants - role-play session 2

Think Aloud Moderator Guide

Iteration 4

Date: 30th April, 17.00 - 18.30

Participants: K, A, T, D and B

Location, Frederikskaj 12, room 3.01 and Elektrovej 324, room 261

Goal:

- Evaluate the app (UI and UX) - focus on visualizations - evaluate learnability
- Evaluate which visualizations facilitate the understanding of own tracked data and patterns (self awareness)
- Focus on Therapy and Graphs modules - ignore profile and about

Plan

Introduction (5 min)

Thank you for joining us for this think aloud test, it will take about 30-40 minutes. Think aloud means that we will give you the app, ask you to do some tasks and try to say aloud all the thoughts you have. To get you an idea of what think aloud is and what we expect from you, we have a small think aloud demo [showing the video ¹]

We will give you a list of tasks you have to do using the application. The most important thing is to verbalize all your thoughts while you do the tasks. Please take your time, so that you do not jump into another task too fast. We will guide you through the entire test, but you will do all the talking. No right or wrong answers, we are interested in all thoughts you might have. We will give you one task at a time. I'm the moderator and xx will take notes on me and the app. So before we begin, are you an android or iphone user?

[if android: The design is for an iphone, so to give you a quick idea of how it works i'll show you. So it doesn't have the buttons in the bottom like android, going back and so forth is in the top of the app.]

It is a prototype, so all things are not yet done and clickable, if you see something

¹<https://s3.amazonaws.com/media.nngroup.com/media/editor/2014/08/18/thinking-aloud-demo.mp4>

you cant click just tell us what you would do and what you expect to happen if you click.

But before we begin there are some small guidelines:

No right or wrong answers, only different points of view

We're audio recording - one person speaking at a time preferably

Please turn off your phones. If you cannot and if you must respond to a call, please do so as quietly as possible and rejoin us as quickly as you can.

Our role as moderators will be to guide the discussion, but not as such participate

Any questions before we begin?

1.1 Tasks

1. Trackers: You are using the app for the first time and you have agreed with your therapist that you for the next week record your sleep and mood. You want to track that using the app.
2. Therapy/Homework: You are at a therapy session and your therapist gives you a homework to do. You add it in the app.
 - The homework is to call your brother, because you don't talk
 - The homework is to follow how your mood is for the next week
 - The homework is to see if training affects your mood
3. Therapy/Present Mode: You are going to your therapist in 2 days and you want to prepare what visualizations to show him/her in your next session. You select mood and activity and app usage.
4. Therapy/Notes/manual tracker: You have been introduced to the app by your therapist in your last session and discussed using it to follow your dreams before next session. You just woke up and remember a few bits and pieces of your dream, so you grab the phone and want to add it to Echo.
5. Graphs/Combined graphs: You have been tracking yourself for a week and you want to see if you mood changes depending on your activity and/or your app usage.
 - can you see any dependencies?
6. Graphs/App usage: You're seeing your therapist and you're asked if you made progress with playing less games on your phone for the last week. You look for it in the app.
 - Have you made progress?
7. Graphs/Sleep: Its the 9th of june, your therapist asks you how you slept last night, you look for it in your app.
 - How did you sleep?
8. Dashboard/calendar: This is three tasks in one. You are in the train to see your therapist, you open the app to see how you have been doing for the last week and for today and see when you added notes in the last month. (should

be simplified)

- How many notes did you add?

[The participant goes through all 8 tasks]

Exit interview

- What are your overall thoughts on the app?
- Can you see yourself using it in therapy?
 - What if the therapist suggests it?
- Are there some things you are missing or a feature you would like to have in the app?

Round up & thank you for today

APPENDIX J

Personas Data

The data created as a representation of a possible Echo user, Tina Dalmgaard, is shown here. The data was used to generate the graphs and calculate the key metrics seen in the final prototype of Echo.

APPENDIX **K**

Data handling and ethics

Given the sensitiveness of the thesis area, there was a need for investigating ethics and good practice for data collection and processing, in accordance with current legislation. The legal department at the Technical University of Denmark (DTU) was consulted in this regard. While there are several rules and an ethics application is required for this area of research, DTU's policy for students project is more open, closely following the danish legislation. According to the Danish Data Protection Agency ¹ or Datatilsynet in Danish, student's collecting of (sensitive) personal data as part of students projects and as such, master thesis projects, are exempted from notifying and ethics approval from the Agency, under two conditions :

- that the students are active students enrolled in a higher education
- that participants and owners of the collected data give their express consent

Even if the collection of personal sensor data and respective study falls out of the scope of the master thesis, having a user centred, participatory design approach implied having clients give inputs based on their experience in psychotherapy. Given the possibility of participants sharing sensitive data through the focus groups and design workshops that were recorded for analysis and documentation, consents were signed prior to the specific activities by all participants K.1. For Skype and call interviews, participants were informed of the recording and gave their (verbal) consent.

¹<https://www.datatilsynet.dk/english/the-danish-data-protection-agency/introduction-to-the-danish-data-protection-agency/>

Focus group - participant consent

I agree to participate in the focus group conducted part of the master thesis at DTU Compute titled "*Putting personal data to work: support psychologists in applying more informed therapy strategies and how that can aid clients in improving their mental health*".

I understand that participation in this focus group is voluntary and that I am free to leave the focus group at any time.

I also consent to be audio recorded during the discussion. None of my experiences or thoughts will be shared with anyone besides of the thesis authors, less all identifying information is removed first.

Please sign below to indicate that you have read and you understand the information on this form and that any questions you might have about the session have been answered.

Date: _____

Name _____

Signature: _____

Thank you!

We really appreciate your participation.

Figure K.1: Participant consent form

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