EARLY CLIENT INVOLVEMENT IN THE DESIGN OF A BLENDED SMARTPHONE APPLICATION AND DASHBOARD FOR DEPRESSION (TOTEM)

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Abstract

Technological developments can optimize therapy for depression. However, early client or user involvement is crucial. The smartphone application and dashboard 'plaTfOrm using evidence-based inTervEntions for (Mental) health' (TOTEM), based on cognitive behavioral therapy and behavioral activation, is being developed together with clients from the start. Objective monitoring (e.g., activity/travel-related behavior) and human-in-the-loop AI machine learning allow tailored blended care, combining face-to-face therapy with online modules and Just-in-Time Adaptive Interventions. As a first co-creation step, clients with (prior) depression or depressive complaints and psychologists evaluated the usefulness of an existing Health for Travel Behaviour (HTB) application and feedback report developed for cardio patients, which monitors and improves travel-related physical activity. Online semi-structured interviews followed an HTB demonstration. In total, 16 interviews (14 clients and 2 psychologists) were transcribed and analyzed. Participants perceived the application as user-friendly, relevant, useful, attractive, and a supplement to standard care. It encourages people to engage in activities. The feedback report was also perceived as transparent, useful, and relevant. Emotional aspects are underemphasized (e.g., assessment of feelings and mental health-related psycho-education). When tailored to depression (with attention for different recovery phases), monitoring and improving travel-related physical activity was considered helpful in supplementing standard care for depression.

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Depression is a leading cause of avoidable suffering worldwide. Nevertheless, the impact of depression on societal and economic development is not receiving sufficient attention, nor are adequate efforts being undertaken to avert and mitigate the negative consequences of depression (Herrman et al., 2022). Investments in mental health care have been reported to be scarce worldwide (Chisholm et al., 2016). When people suffering from a mental health condition such as depression want to seek help, they face important barriers, such as the stigma related to seeking help, shortage of well-trained clinicians, and issues with accessibility (Chisholm et al., 2016; Teepe et al., 2021). Pharmacotherapy is an important treatment for handling depression (Shinohara, 2019), which is considerably cheap (Richards et al., 2016; Shinohara et al., 2019). However, pharmacotherapy (e.g., anti-depressants) often comes with adverse side effects. For instance, relapse risk, emotional numbing, feelings of detachment, drowsiness, or even suicidality (Read & Williams, 2018; Richards et al., 2016). Moreover, a substantial part of the depressive population is unresponsive to anti-depressants, with estimations as high as 20-30% for major depressive disorder (MDD) (Gillain et al., 2022). The choice for drug treatment should not be taken lightly, only after applying well-established evidence-based therapies, and people not responding sufficiently (e.g., Cognitive Behavioral Therapy (CBT)). Unfortunately, waiting lists for such treatments can be long (Pedrelli et al., 2019), leading to too many untreated cases of depression and other mental health problems. The lack of appropriate support has detrimental consequences for the individual and their loved ones. Considering depression in young adults and adults, employers, insurers, health insurance and the government are affected as well (e.g., reduced productivity or job employment, increased expenses) (Chisholm et al., 2016). Therefore, existing therapy must be optimized to reach more people more effectively, with fewer resources.

How Technology Can Help To Optimize Therapy For Depression

Recent technological developments can optimize existing therapy by increasing access to care and reducing stigma since there is no need for physical attendance, with lower costs than face-to-face therapy (Baumel et al., 2020; Messner et al., 2019). However, technology for mental healthcare without a human component is challenged by issues with engagement, uptake, and adherence (Bevan Jones, 2020). Therefore, technology should not be used to replace but to supplement

standard care in the form of blended care, i.e., combining face-to-face therapy with online tools. Blended care allows therapists to reduce the number of face-to-face sessions, while clients can self-manage faster and more, increasing cost-effectiveness (Chandrashekar, 2018; Messner et al., 2019; Van der Vaart et al., 2014). As clients use the mental health applications between sessions, they need to be motivated to engage in using the application in an adequate/sufficient manner, especially at times without direct contact with the therapist. The strength and quality of the motivation for technology adoption can be stimulated by using real-time prompts, notifications, or gamification (Chandrashekar, 2018). Moreover, technology-enabled care allows digital phenotyping, i.e., an ecological form of information collection based, for instance, on app usage, screen time, sensors (e.g., GPS, accelerometer, wristband) and/or a digitized experience sampling method (ESM). This type of data collection allows inclusion of the daily life context of the client under treatment and his/her thoughts/feelings in that particular context (Daniëls et al., 2019; Insel, 2018; Mulvenna et al., 2021). As a result, detailed information about the client's complaints and possibilities and opportunities are available for analysis. Use of such information in between therapy sessions increases the effectiveness of an application, since treatment can be personalized and embedded in the daily life context, for instance in the form of micro-interventions that increase engagement with little burden on the client. Micro interventions are also referred to as just-in-time-adaptive-interventions in case they are based on decision rules that specify which intervention should be provided at which time, based on time-, user-, and/or environment-based information. These JITAI provide the needed type of support in real-time at the moment when it is most needed by monitoring vulnerability (i.e., the right time) and receptivity (i.e., availability) (Baumel et al., 2020; Hardeman et al., 2019; Nahum-Shani et al., 2018; Teepe et al., 2021). Importantly, JITAI should be evidence- and theory-based (Nahum-Shani et al., 2018). A recent review showed that the use of JITAI in applications for depression is still largely overlooked, therefore not allowing these applications to reach their full potential (Teepe et al., 2021).

Finally, to foster user involvement, or facilitate better user experience, co-creation throughout the design process is essential (Jones et al., 2020; Mansson et al., 2020; Van der Vaart et al., 2014). Co-creation or co-design refers to a process of partnership between users and stakeholders, allowing the technology development to match the needs and preferences of the target population. This process should apply to all technology-related aspects (e.g., content, accessibility, privacy, implementation), and in different phases, from a scoping or discovery phase to prototype evaluation, with opportunities for iteration (Jones et al., 2020).

'Platform Using Evidence-based Interventions For (Mental) Health' (TOTEM)

The online 'plaTfOrm using evidence-based inTervEntions for (Mental) health' (TOTEM) is developed to tackle a number of the above-described barriers to seeking and accepting care: accessibility (availability, affordability, acceptable time investment), low degree of self-management, and fear of stigmatization (Mojtabai et al. 2011). TOTEM combines a smartphone application and dashboard for people suffering from depression[†]. TOTEM is based on CBT principles, a collaborative, individualized, psychological therapy with long-term effects, that is empirically well-supported for a range of psychological issues, including depression (Hofmann et al., 2012; Richards et al., 2016). According to CBT, maladaptive cognitions contribute to maintaining emotional distress and behavioral problems. To address these maladaptive cognitions, CBT combines a variety of cognitive, behavioral, and emotion-focused techniques (e.g., cognitive restructuring) (Hofmann et al., 2012). One fundamental principle of CBT is behavioral activation (BA). BA aims to increase positive experiences by activity scheduling, including responsibility-related and recreational activities. These activities can produce both primary (e.g., enjoyment) and secondary benefits (e.g., extension of social support system). BA was effectively applied in depression, with indications that BA can be as effective as full CBT, even though it is easier to provide and with lower costs (Hopko et al., 2004; Jacobsen et al., 1996; Ly, Carlbring, & Andersson, 2012; Richards et al., 2016). Both CBT and BA have already been successfully offered via the internet or smartphone (Ly et al., 2012; Thase et al., 2020). The Intervention Mapping (IM) approach, a well-established framework for the planning of theory- and evidence-based interventions (Eldredge et al., 2016; Van Agteren et al., 2021), serves as a guide for: 1) the development of target variables that need to be monitored and changed to reach the health-promoting goals (e.g., think flexibly), 2) the selection of methods and techniques that need to be implemented to reach these targets and how they can be applied in the platform, and 3) the implementation and evaluation of the platform. As can be seen in Figure 1, the primary health outcome (i.e., depression severity) is believed to depend upon a set of health promoting goals (i.e., how flexible people act, feel and think) which require the performance of specific actions (e.g., travelling in a physically active manner, expressing emotions, observing thoughts). These so-called performance objectives (i.e., PO: what you need to do to attain the desired outcome) in turn,

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[†] TOTEM is not designed for patients with severe depression who struggle with suicidal thoughts, as they require more intense face-to-face follow-up.

can only be achieved if the appropriate underlying determinants (e.g., attitude, skills, knowledge) are changed in the desired direction, which is what the term 'change objectives' refers to (i.e., CO: what needs to be accomplished to reach the PO). The Theoretical Domains Framework (TDF) was used as a guide to determine the more precise change objectives (Cane et al., 2012) while the Behaviour Change Techniques Taxonomy v1 (Michie et al., 2013) served as an evidence-based system for the selection of suitable behavioral change techniques.
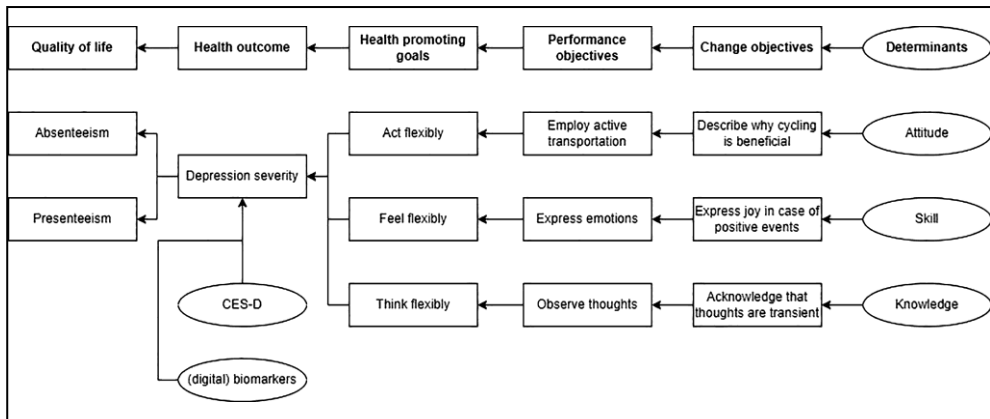

Figure 1. An Illustration of a Model of Change According to the IM Protocol

See Figure 2 for an illustration of the TOTEM platform. Inside TOTEM, the 'Profiler Unit': 1) collects (to-be-determined) (digital) biomarkers (i.e., quantifiable behaviors) that are derived from a set of features registered by the smartphone and sensors (e.g., how often the smartphone screen was on/off, GPS, accelerometer wristband). 2) monitors the current 'state' of the user (e.g., increased sedentary behavior or acute stress), and 3) predicts depression severity (Abdullah et al., 2016; Van Ballegooijen et al., 2014) by means of Ensemble learning, i.e., classification technique resulting in better predictive performance and higher accuracy than single algorithms (Aleem et al., 2022; Peng et al., 2017). Profiler Unit output serves as input for the therapist, e.g., to supplement his/her observation and judgment with contextualized information obtained via the smartphone (i.e., behavior/activities), sensors (e.g., indications of stress), and ESM (i.e., assessing thoughts and feelings). Additionally, output from the Profiler Unit serves as input for the 'Intervention Planner Unit'.
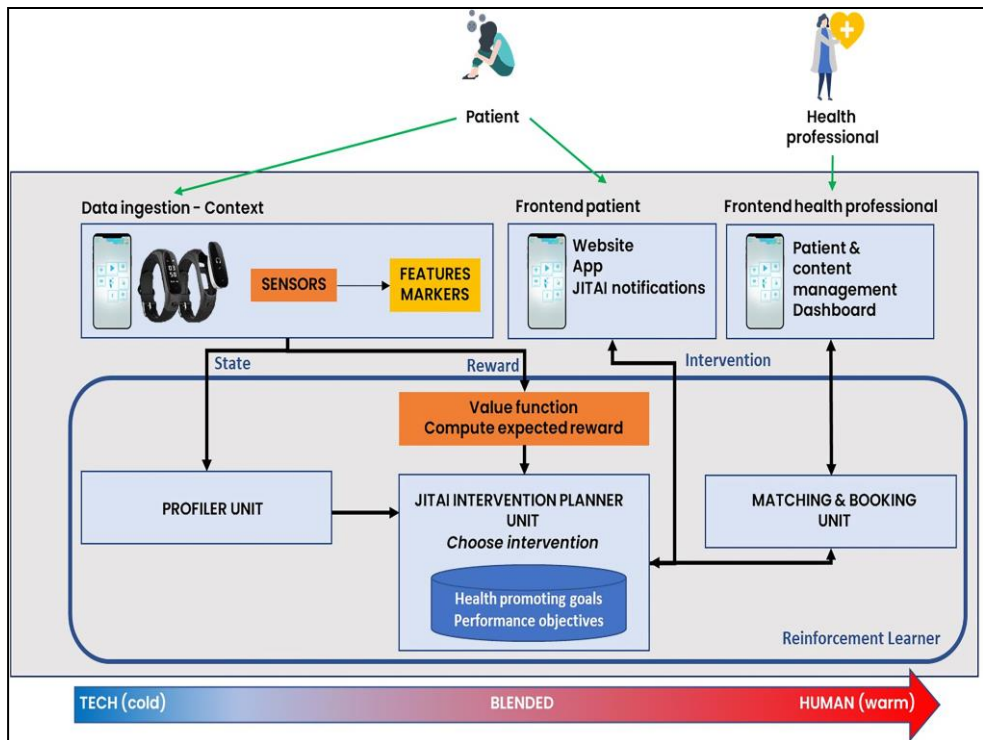
Figure 2. TOTEM Platform

The Intervention Planner Unit intelligently manages an 'Intervention Repository' which contains different types of intervention formats, ranging from more classic psycho-education modules or homework assignments, to so-called JITAI (i.e., compact prompts triggered by and tailored to momentary needs detected by the Profiler Unit). Selection of the most appropriate intervention format starts from a set of specific decision points and -rules (Nahum-Shani et al., 2018) that are initially based on expert opinion. Through reinforcement learning an algorithm discovers which combination of interventions works best, per user and context, by finding which activity output is the most rewarding over time (Akanksha et al., 2021). In terms of intervention selection and execution, a blended constellation uses both the Profiler Unit output and the therapist's judgment. As such, the therapist, or 'the human-in-the-loop', can follow up on the interventions and overrule propositions made by the algorithm that are considered inappropriate. In other words, the Intervention Planner Unit operates on input from both the Profiler Unit and the therapist in order to set up a knowledge base, serving future users and therapists as well. Finally, the TOTEM platform comes with a 'Matching and Booking Unit' that assists the therapist in planning of face-to-face sessions and online modules.

The combination of these sources of information allows the therapist to map the evolution of the depression severity and provide highly tailored blended care. For instance, based on the (detected narrowing of the) activity pattern, it can be determined that the client would benefit from following a module on behavioral activation. However, the information can also be used for face-to-face sessions. For example, the therapist can comment that high-stress levels are experienced during a particular activity, as indicated by smartphone and sensor data. Suppose the ESM data also suggests that the client reports negative thoughts during this activity. In that case, it is necessary to pay attention to this (after all, biological stress can also be positive). Perhaps it is possible to fill this activity differently, more positively. Or the platform could send tips or an encouraging message to the client before the activity. These JITAI can also encourage clients to complete their homework.

Aims

This study describes the first step of a co-creation development process in which end-users (i.e., clients with depression/depressive complaints) and experts (e.g., psychologists) evaluated the usefulness of an existing smartphone Health for Travel Behaviour (HTB) application and feedback report. The HTB app was initially developed for cardiac patients and allows monitoring and improvement of travel-related physical activity, which aligns with the principles of behavioral activation via transport-related behavior from the TOTEM platform (Batool et al., 2018, 2022). The clients with depression/depressive complaints and psychologists assessed the usefulness of active transportation to increase activity levels in depression. Special attention was given to topics such as usability, gamification as a behavioral change technique, and different phases of recovery in depression (i.e., onset, improvement, and recovery).

Methods

Interviews and Procedure

After signing a consent form, participants filled a demographics questionnaire and a standard questionnaire for depression diagnosis (i.e., Center for Epidemiologic Studies Depression Scale (CES-D), score ≥16; ICC≥.70) (Devins et al., 1988; Vilagut et al., 2016). Due to the COVID-19 pandemic, it was not possible to have the application actively tested by participants. Therefore, online presentations demonstrating the HTB application and feedback report were held instead. The presentation included the following sections: (1) an introduction (e.g., background information and goals), (2) the HTB application (e.g., example screens, information about the functionalities, required actions, etc.), and (3) the feedback report (e.g., discussion per section, complete overview, etc.). After the presentations,

semi-structured interviews were conducted. A prospective perspective was used because participants did not formulate their opinions based on actual user experience.

Sample

Two participant groups were recruited through criterion and convenience sampling to obtain a purposive sample. The first group (n = 14) consisted of clients who had previously received treatment, or were currently under active treatment, for depression or depressive symptoms by a psychologist from an ambulant private clinical practice. The following inclusion criteria were set: 1) Must have or have had depressive symptoms in the past six months, 2) Over 18 years of age, 3) Ongoing or completed treatment with a psychologist, 4) No serious suicidal risk, and 5) No bipolar diagnosis.

The second target group that was included consisted of psychologists, experts, and/or therapists (n = 2); only one inclusion criterion was used: currently working with depressive clients as a psychologist/therapist.

The primary focus of the study was on the client population. No exact number of participants that needed to be included was prespecified. Interviews were conducted until no new themes or topics emerged (i.e., data saturation). Therapists were recruited to provide additional opinions on the app and feedback report because of their relevant expertise.

**Table 1.** Overview of the Depression Group's Demographics

	Depression group (n = 14)	**Males (n = 4)**	**Females (n = 10)**
Age group, n (%)			
18 – 30 years old	3 (21.4%)	-	3 (30%)
31 – 45 years old	3 (21.4%)	2 (50%)	1 (10%)
46 – 60 years old	8 (57.2%)	2 (52%)	6 (60%)
Living situation, n (%)			
Alone	3 (21.4%)	-	3 (30%)
With partner, no children	4 (28.6%)	-	4 (40%)
With partner and children	2 (14.3%)	1 (25%)	1 (10%)
With parents	4 (28.6%)	2 (50%)	2 (20%)
Other	1 (7.1%)	1 (25%)	-
Work situation, n (%)			
Student	2 (14.3%)	-	2 (20%)
Part-time	1 (7.1%)	1 (25%)	-
Full-time	6 (42.9%)	3 (75%)	3 (30%)
Temporary sick leave	2 (14.3%)	-	2 (20%)
Permanent sick leave	2 (14.3%)	-	2 (20%)
Other	1 (7.1%)	-	1 (10%)
CES-D score			
Range	3 – 45	11 – 33	3 – 45
Mean score (X ± SD)	23.5 (11.148)	21.25 (9.032)	24.4 (12.123)

Table 2. Overview of Signs and Symptoms Experienced by Participants
during Depressive Episodes

	Group	Males	Females
Drowsiness	13 (92.9%)	3 (75%)	10 (100%)
Loss of interest	9 (64.3%)	3 (75%)	6 (60%)
Feeling worthless and hopeless	12 (85.7%)	3 (75%)	9 (90%)
Sleep issues	11 (78.6%)	3 (75%)	8 (80%)
Weight change	4 (28.6%)	1 (25%)	3 (30%)
Panic and anxiety	11 (78.6%)	3 (75%)	8 (80%)
Easily irritable	9 (64.3%)	2 (50%)	7 (70%)
Restlessness or tardiness	12 (85.7%)	2 (50%)	10 (100%)
Indecisiveness	10 (71.4%)	2 (50%)	8 (80%)
Feeling guilty	9 (64.3%)	2 (50%)	7 (70%)
Memory and/or concentration issues	8 (57.1%)	2 (50%)	6 (60%)
Neglect of social contacts	9 (64.3%)	1 (25%)	8 (80%)
Suicidal thoughts	6 (42.9%)	1 (25%)	5 (50%)
Emotional outbursts	7 (50%)	1 (25%)	6 (60%)
Fatigue and low energy	11 (78.6%)	4 (100%)	7 (70%)

Health for Travel Behaviour (HTB) Application and Feedback Report

The HTB application (Figure 3) monitors travel behavior by collecting: 1) GPS-based location data of the trips and activities performed throughout the day, 2) Duration, start- and end-time of the activities and trips that are executed throughout the day, 3) Detection of the used transport mode: motorized transport, cycling, and walking (but unable to correctly distinguish between different types of motorized transport modes, such as car, bus, or motorcycle), and 4) Covered distance during the trips. Moreover, three additional parameters are manually provided by the patient: 1) activity type (e.g., home, work, shopping), travel partner (e.g., spouse, friends), and motorized transport mode (e.g., car driver, car passenger) (Batool et al., 2022).
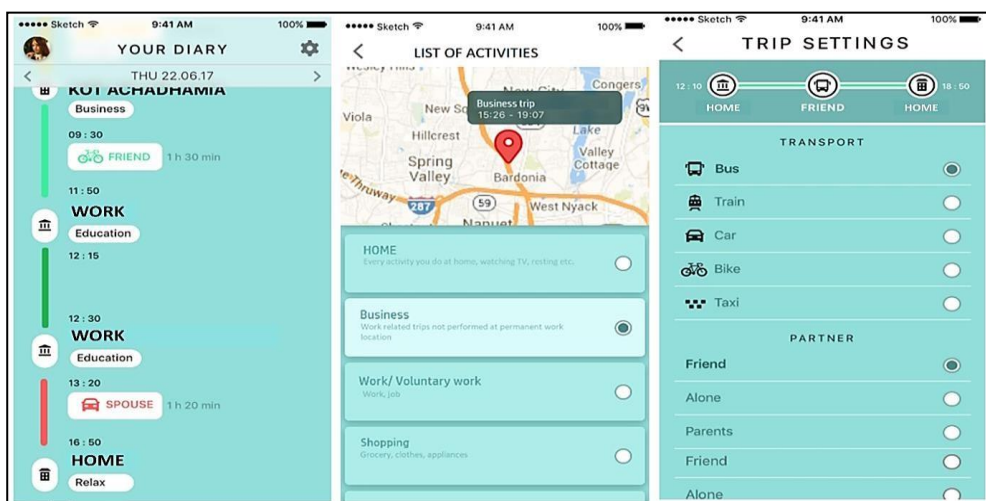
Figure 3. HTB Interface

A feedback report is generated based on monitoring data of each individual for three weeks, summarizing the duration, distance, and weekly frequency of active transportation mode trips (i.e., walking and cycling). The Active Travel Score (ATS) is reported as well, defined as the physical activity gained by using active transportation modes. Physical activity is defined as the energy cost or amount of oxygen consumed during rest (i.e., Metabolic Equivalent (MET)). The ATS is based on the standard recommendation of 150 min/week of moderate-intensity physical activity spread over 5 days. Calculated for a week, the ATS ranges from 7.5 to 15 Kcal/w*kg. The algorithm allocated each patient to one of the following categories: 1) inactive, 2) low active, 3) sufficiently active, 4) active, and 5) highly active. The report also compares the category allocation with that of peers, allowing the user to check if they perform below or above average. Furthermore, the report included the simple home-based trips (i.e., home-activity-home) executed as driver or passenger, taxi or motorcycle, that could be replaced by active transport, together with the impact on the ATS (Batool et al., 2018, 2022). For more detailed information on the calculation of the ATS score and the definition of simple home-based trips, we refer to (Batool et al., 2022).

The content of the feedback report was based on the transtheoretical model of change (TTM), containing Stages of Change (SOC) and Processes of Change (POC). The included SOC referred to: Pre-contemplation (i.e., when people are still unaware and thus do not acknowledge any problem), Contemplation (i.e., people realize what the benefits of behavior change can be, but the costs of change are considered as being too high), Preparation (i.e., the decision for future change is made, together with small steps towards the set goal), Action (i.e., people are now actively changing their behavior or acquiring desired behavior) and Maintenance (i.e., the required behavior change is not only established but also maintained over time) (Prochaska & DiClemente, 1983). The POC refer to strategies used for changing behavior while progressing through the SOC. Experiential processes are typically considered successful in the earlier SOC and refer to perceptions, thoughts, or feelings concerning the behavior (e.g., thinking about consequences). Meanwhile, behavioral processes are considered successful in the later SOC and refer to observable situational and social strategies (e.g., controlling environmental cues). In the current version of the HTB feedback report, the POC are included without considering the respective SOC. This approach was followed to check whether people in certain SOC indeed prefer the POC as suggested by literature. However, it is also possible to measure their respective SOC and only include POC based on the respective stage. Besides containing information that should support the SOC (e.g., facts concerning the benefits of active transportation and support for setting goals), the HTB feedback report included some fixed parts that include psycho-education concerning the health benefits of travel-related physical activity. The remaining sections related to user's individual performance: physical activity level from active transport, encouraging comments linked to their ATS score, and the impact of trips that could potentially be replaced with active transport (Batool et al., 2018, 2022).

Analyses

A topic list was drafted containing all themes considered relevant for the further development of the application and the feedback report in relation to depression disorders. Based on this topic list, a semi-structured interview guideline (Appendix 1) was prepared to ensure that all predetermined topics were covered during the interview.

The interviews were analyzed using the deductive thematic analysis method. The thematic analysis method allows for identification, analysis, and reporting of themes in one's data (Braun & Clarke, 2008). Themes can be analyzed in two ways, deductively (e.g., Merriman et al., 2021) and inductively (e.g., Herrick et al., 2020). The deductive thematic analysis is a top-down coding approach that starts from a predetermined set of codes because one expects to find information about them in the data (Saldana, 2013). Accordingly, the topics predetermined at the start of the study were used as an initial set of codes during the analyses. Even though the original codebook changed during the coding (i.e., some codes were restructured, some codes were removed, and new codes were added), the codebook still reflected the data structure, which is considered very important (Si & Hubbard, 2021).

After the interviews, data processing was based on the thematic analysis method of Braun & Clarke (2008): 1) Data familiarization: transcribing and reading the data, writing down non-verbal clues, 2) Generating initial codes: code larger sections with a broad code name and write down notes, 3) Searching for themes: merge different codes into one potential theme, 4) Reviewing themes: check if the themes still relate to the initial coding and study purpose, 5) Final themes: decide on the final themes and matching names, and 6) Producing the report: preparing a report disclosing the findings, related to the research questions.

After conducting the qualitative analyses, some descriptive statistics were calculated (e.g., age, gender, living situation, etc.). These statistics are included in the results section to allow readers to assess the generalizability of the findings (Gibbs et al., 2007).

Results

This section first presents the results for the client group, followed by those for the therapists. For both groups, the following themes will be discussed: (1) application-related topics, (2) depression-related topics linked to the application, (3) modifications to the application in function of depression-related characteristics, (4) feedback report-related topics, (5) depression-related topics linked to the feedback report and (6) modifications to the feedback report in function of the depression-related characteristics. Each theme is then further divided into subthemes like user-friendliness, perceived usefulness, etc.
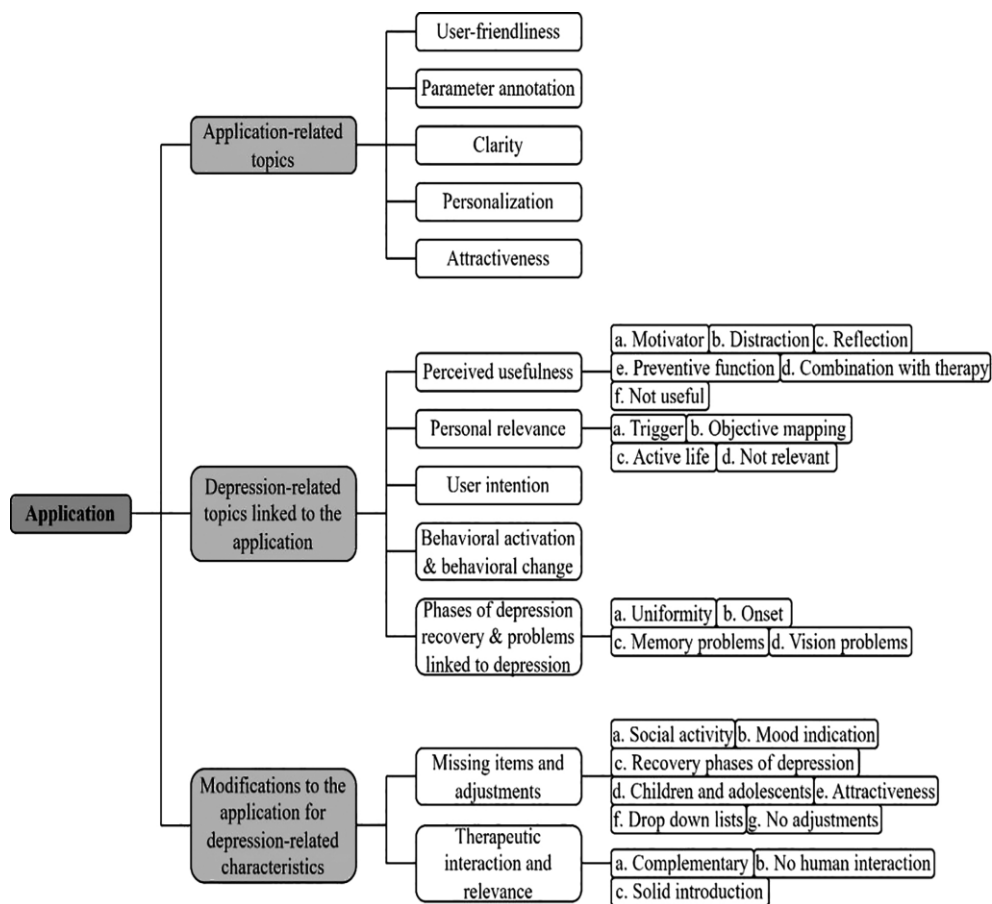
Client

  Application

Figure 4. Schematic Overview of Application Themes – Clients

At the beginning of each interview, participants were asked to score the application between 0 and 10. All scores ranged from 6 to 10, averaging 7.75/10. Participants stated that the app gave a professional impression but is currently focusing heavily on the physical aspect. Some participants also noted that in the beginning, it would not be easy for them to use the app because of their limited technological knowledge.
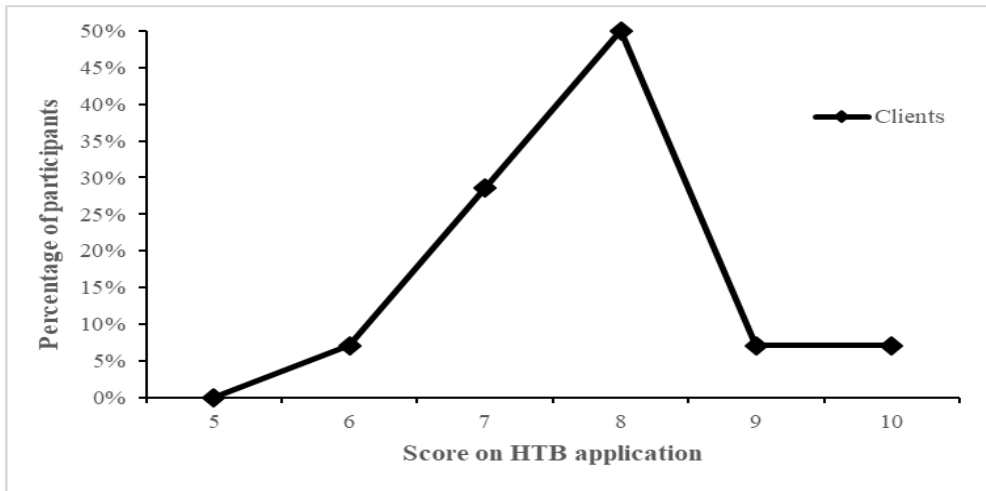
Figure 5. Overall Score on the HTB Application

Note. This graph demonstrates the percentage of client participants for each given score out of ten on the HTB application (n = 14).

Application-related topics

User-friendliness. All participants stated that the app looks user friendly. The two most prominent reasons to support this were: (1) the daily trip- timeline is already created automatically, and (2) there is not much to enter yourself. Furthermore, the app also appears to be quite learnable. A few older participants commented that it might take them some more time to use the application properly.

Parameter annotation. When the daily trip-timeline needs to be completed, participants can select most of the information from drop-down lists which limits the average completion time to a few minutes per day, which was appreciated. Some also indicated that it would make them more likely to fill in the timeline, even in the beginning or onset phase.

Some participants were somewhat concerned that the timeline could only be completed the day after since memory problems are a common depression symptom. On the one hand, people might forget completing the timeline, on the other hand, correctly reconstructing trip history from the day before can be challenging. Participants would prefer more flexibility in terms of when to fill out the trip timeline.

Clarity. All participants perceived the application as clear and well-organized. It immediately provides a clear representation of the timeline, and there is no need to search for relevant items which makes the application accessible to all persons (i.e., those with much or little knowledge of technology). Suppose the application is to be modified to suit Participants recommend that, for people with

depression as the targeted users, not too many elements should be added to maintain the current level of clarity.

Personalization. None of the participants considered personalization a decisive factor for using the application in the future. About half of the participants did not think it was necessary at all while the other half would appreciate an option to adjust color, icons, and/or font to personal preference. A few commented they would not be interested in personalizing the app in the early phases of recovery since it would cost too much energy.

Attractiveness. Opinions in terms of appeal were divided with half of them stating they found the application sufficiently attractive, the majority of these being participants saying personalization was not necessary. Others indicated the application could be a bit more colorful and with additional visual elements to avoid it looks a bit monotonous.

Depression-related topics linked to the application
Perceived usefulness.

Motivator. The application may have a motivating function in an individual's recovery process because it can objectively show a person's progress. Moreover, one might want to travel more actively because the app records it. However, some indicated that there is a high possibility that the application would lack of a sufficient motivating effect in the initial phase of recovery.

Distraction. Having to fill out the application can distract from somber thoughts as it requires thinking about what one did yesterday or the previous days. It also helps one to come up with ideas on how to travel more actively.

Reflection. It can be helpful for individuals to see what they have been doing recently. On the one hand, this can be confrontational and will encourage changes in behavior. On the other hand, the app can show improvement and correct biased opinions in the case happening.

Combination with therapy. Some participants indicated that the app would only be helpful if used in treatment, especially in the onset. The data should be further discussed with the therapist, and the treatment adjusted accordingly.

Preventive function. The application can be helpful in recovery. When a person is already in the recovery phase, the application can detect relapses more quickly, meaning it can also have a preventive function.

Not useful. two participants indicated that they did not see the application's usefulness.

Personal relevance.

Trigger. Many participants indicated that the application could motivate them to go outside on difficult days and also remind them that it is vital to keep doing things, yet, to a lesser extent in the early phases of depression recovery according to some of the respondents.

Objective mapping. Some participants would use the app to objectively map themselves because they tend to view everything more negatively. The app could support them to drift less likely into negative thoughts.

Active life. Some participants are already highly active, exercising, counting their steps, etc., all activities they would also like to track in the app. Others indicated that walking was an outlet during their depression and that the app fits well with that too.

Not relevant. The two participants who did not consider the application useful also indicated that the application would not be relevant to them. However, they were open to revising their opinions in the event of future modifications.

User intention. The majority of the participants would want to use the application, should it be currently available for download. Even in the recovery phase, some would still be inclined to use it as it can be a certain form of control. Others, in turn, were not convinced to use the application for various reasons, such as not using applications much, being too lazy, or not seeing the use of it.

Behavioral activation and behavioral change. According to most participants, the application can be behavior-activating because it may motivate and trigger clients to travel more actively. Furthermore, it clearly maps out where there is still room for improvement. However, participants indicated that there are also some prerequisites for using the app and to achieve behavioral activation such as a sufficient amount of notifications and reminders, therapist involvement in the follow-up, and avoidance of people overdosing themselves with too much and/or too heavy challenges.

Phases of depression recovery & problems linked to depression.

Uniformity. Most participants felt the app should not be tailored in function of the recovery phase. A uniform app creates a familiar environment, and participants felt that was more important. Many indicated that it is important not to start with the application independently, especially in the beginning, but to always do so in consultation with a therapist. When entering recovery, guidance can be adjusted accordingly.

Onset. some participants indicated it would be best to keep the application as simple as possible, certainly in the beginning to prevent people would drop out due to worries in terms of time and effort needed to complete the travel diary correctly and regularly.

Memory problems. Memory difficulties are an often-reported problem among people with depression. The majority of the participants believed it crucial that notifications remind them to complete their timeline.

Vision problems. Persons with depression may also experience temporary problems with their vision. The ability to adjust text size could for instance be helpful in this regard.

Modifications to the application for depression-related characteristics
Missing items and adjustments.

Social activity. An exclusive focus on active traveling may not be sufficiently recovery-enhancing for persons with depression problems, social contacts are also important. The application should allow collection of information about what activity one did and with whom, and this data should also be incorporated into the feedback report.

Mood indication. Individual mood should be questioned one or several times a day, for instance requesting individuals to give a score on a scale (e.g., 7-point Likert scale) in terms of how they feel. The option of adding additional information would be helpful, but not be made mandatory.

Recovery phases of depression. For some participants, it should be possible to adjust how much information should be entered into the app, depending on the phase. If the application cannot be adapted, it is recommended to start by partly filling out the application and to systematically build this up (e.g., first week: one displacement, second week: two, etc.).

Children and adolescents. Two participants commented that it might be interesting to create two versions of the app, one for adults and one for children and adolescents. Most of them are technology-minded, so that the app could be a valuable addition to their treatment.

*Attractiveness. S*ome participants would appreciate opportunities to customize certain aspects of the app, such as color, layout, font, etc. Also, more graphical elements could be added to increase its attractiveness.

Drop-down lists. Some participants commented that not all modes of transportation are currently included in the drop-down lists. However, this may be relevant for the monitoring of social activities are (e.g., airplane, scooter, etc.). Thus, the application should provide an option where users can add options to the drop-down lists.

No adjustments. Two participants considered the app useful in its current form and did not need additional modifications.

Therapeutic interaction and relevance.

Complementary. Most participants indicated that the application should always be combined with therapy. Several reasons are given for this: (1) the app is not going to be used enough without a therapist, (2) human interaction is essential for recovery from depression, and (3) the application can be a good starting point for conversation.

No human interaction. Some participants are more in favor of separating face-to-face therapy from the application because not everyone needs therapeutic interaction to the same extent. Since the app may also have a preventive function, there is a possibility that people may not be in therapy when using the app. However,

if wanted or needed, a user can still decide to provide the report to the therapist after some time and start working with it.

Solid introduction. Some participants felt it is the therapist's job to explain the application clearly and help them get started, if not, some people might quickly stop using it.
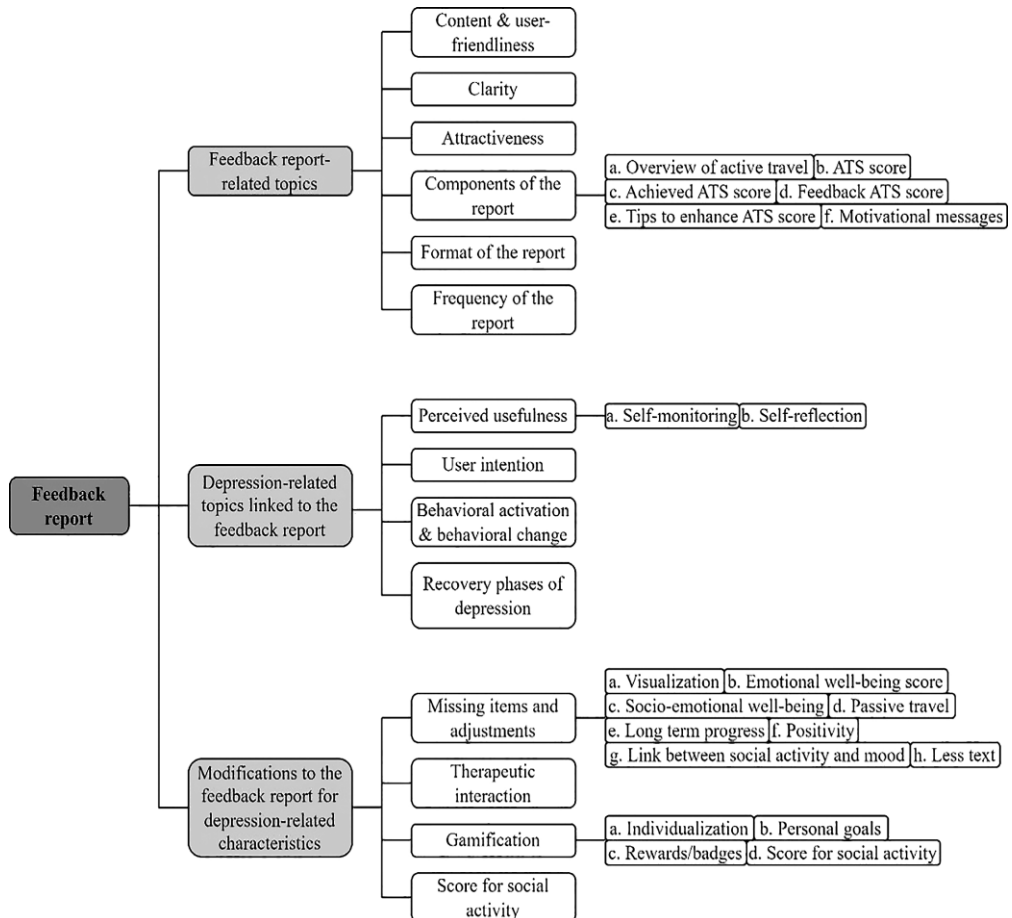
Feedback Report

Figure 6. Schematic Overview of Feedback Report Themes – Clients

Participants gave the feedback report an average score of 7.3 out of 10. The primary focus of the report was on the physical implications of increased activity levels with little emphasis on social activities or emotional aspects of depression. This will probably have affected the evaluation of the feedback report.
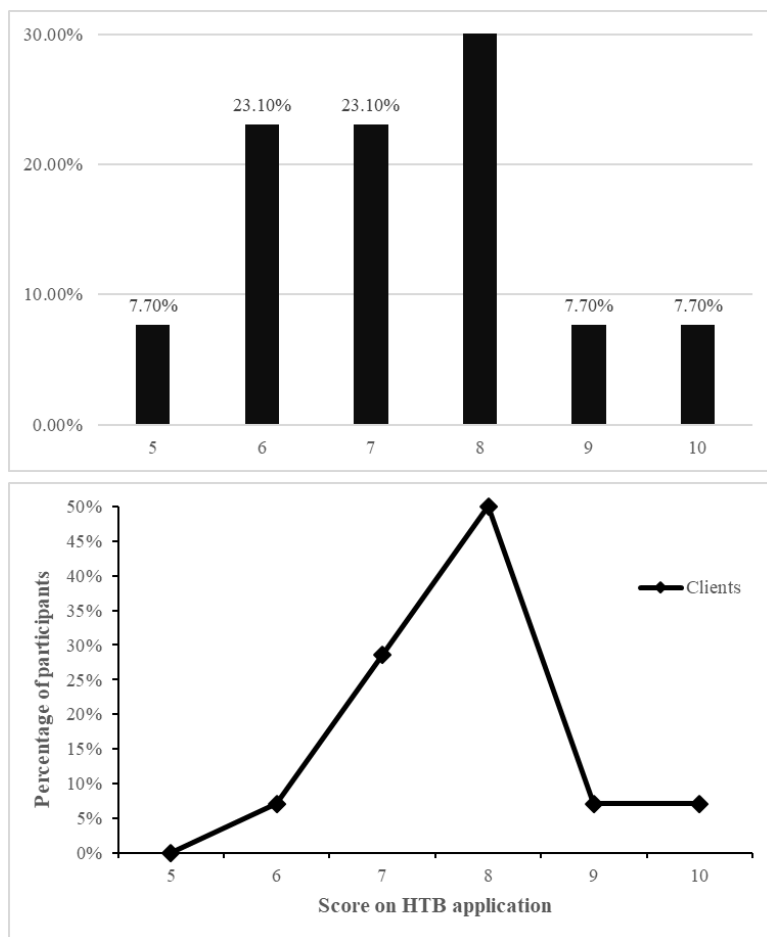
Figure 7. Overall Score on the Feedback Report

Note. This graph demonstrates the percentage of client participants for each given score out of ten on the feedback report (n = 14).

Feedback report-related topics

Content & user-friendliness. The overall impression was that the report currently focuses too much on the physical aspect of recovery, without attention for the mental, emotional and social aspects. Nevertheless, the report is clear according to most participants and contains suggestions that can be implemented immediately.

Clarity. Most participants felt that the report is clear and well-organized. It clearly shows what is important and uses well-known icons. Furthermore, subdivision into different sections was positively evaluated since it improves searchability of information. Also in terms of accessibility, the reported scored well,

albeit some participants indicated that it contained too much text sometimes which generated a loss of interest.

Attractiveness. All but two participants indicated that the visuals included in the report could be further improved for instance, through the addition of color and graphics in combination with less textual information. These comments explain why some participants felt that the report was not that appealing.

Report structure.

Overview of active travel. Opinions were strongly divided. Some found it pleasing that only the active trips were included in the overview, while others found that the passive trips should also be included. After all, these can also contribute to recovery; for example, a passive trip can serve a social function.

ATS score. Has a clear structure and is also nicely presented from a visual point of view. Moreover, it may motivate people to travel in a physically more active way. However, the score range was considered too narrow. As a result, improving the score may sometimes be difficult, resulting in the score being demotivating rather than motivating. Furthermore, the current score is only about active travel, which might be a too narrow approach in the context of depression treatment.

Achieved ATS score. Participants unanimously agreed that the group score should not be included in the report as it can be confrontational and stressful for clients. It felt too much like a competition.

Feedback ATS score. Formulation of feedback on the ATS score is described as too negative. In the early phases of depression recovery, it can be tough to do anything that will prevent a person from achieving a high ATS score. Nonetheless, positive reinforcement is highly important during that time.

Tips to enhance the ATS score. Participants were enthusiastic about this part of the report, especially about the usefulness of tips on how to get started. Furthermore, this section was attractive because it contains more visual elements and concisely conveys the message.

Motivational messages. Currently, the motivational messages focus too much on the physical aspect and not enough on the mental and social aspects of depression. Participants did agree that the motivational messages should continue to have a prominent place in the report, although increased levels of personal tailoring would be appreciated.

Format of the report. Participants are satisfied with the report being sent by email because it allows them to choose with whom they want to share the report, and they can do so easily. An important condition, however, is the dosing of those messages, i.e., how regularly these mails are sent.

Frequency of the report. The vast majority of participants felt that users should be able to decide for themselves how often they want to receive a report. The volume should be determined based on personal preference and depression severity. Moreover, there should be a minimum number of days between each report so that sufficient progress can be made.

Depression-related topics linked to the feedback report
Perceived usefulness.
Self-monitoring. The report may motivate persons with depression to keep doing things or to begin doing things again. It clearly demonstrates where improvement is needed and possible and may help people regain control. Using the scores and statistics, the report also allows individuals to see progress over time which can be an additional motivating factor.

Self-reflection. The report may help people see why engaging in physical activity is important and make them reflect on their actions.

User intention. Most participants would like to make active use of the feedback report. Some indicated that they would read the report in its entirety each time, while others would only read the entire report the first time and, from then on, only those parts they consider relevant. Three people indicated they had no intention of using the feedback report in its current version. However, they would use it when tailored more towards depression.

Behavioral activation and behavioral change. According to most participants, the feedback report can be behaviorally activating as it may motivate and trigger clients to travel more actively and achieve better scores. However, it is important to add more explicit links with the emotional and social aspects of depression. As a result, a person's self-awareness can be increased, which may increase intervention effectiveness. Finally, some participants mentioned that the feedback report could stimulate behavioral activation and change but to a more limited extent in the onset phase where even small progress requires big effort.

Recovery phases of depression. Half of the participants believed the report should not be tailored in function of recovery phases. Similarity creates uniformity and support. Depending on the current situation, people could choose to ignore some report sections. The other participants felt the report should be adapted in the beginning because it can be overwhelming, with too many distracting factors. According to them, it is better to progressively add report sections report instead of providing all the information at once.

Modifications to the feedback report for depression-related characteristics
Missing items and adjustments.
Visualization. The report contains too much text and not enough visuals and color. By adding these elements, people may find the report more appealing and work with it more.

Emotional well-being score. Collection of mood-related data and calculation of an emotion-related score included in the feedback report would be an essential addition..

Socio-emotional well-being. The report should also account for users' socio-emotional well-being and elaborate on this, for example, in the tips and motivational messages. Participants mentioned they would be willing to work on this particular aspect, if it would be possible to follow up on it via the feedback report.

Passive travel. Passive traveling for social purposes should be included in the feedback report as it may help to promote recovery.

Long-term progress. Currently, the report only shows the ATS score of the past period. To remain motivated, it is recommended to show progression over a more extended period (e.g., three months, a year, etc.). Most participants indicated that this progress is best shown as a graph so it can be understood at a glance.

Positivity. The tone of voice of the report is currently rather negative. Messages should be rephrased in a friendlier and more encouraging manner. Less or slower progress should also be positively endorsed. Areas for improvement should be communicated as well, but always in a positively reinforcing frame.

Link between social activity and mood. Inclusion of the correlation between activities and mood states would give clients more insight into their functioning and feelings, which may stimulate behavioral change.

Less text. The report currently contains too much textual information. Less text and more graphics would increase willingness to engage with the feedback report.

Therapeutic interaction. Most participants agreed that discussing the report with their therapist would be best. This allows the client to gain more insight into his/her own functioning by putting things in the proper perspective. Furthermore, the therapist can help determine which parts of the report may be relevant at that moment, and personal goals can be linked to the report. Finally, all participants agreed that the report should only be sent to the client and that the client should be able to choose whether or not to share it with the therapist.

Gamification.

Individualization. Opinions were strongly divided for gamification features. Autonomy on the side of users in terms of which features to use and which not was important.

Personal goals. According to participants, personal goals should not be mandatorily imposed and be discussed with the therapist so that they are adequately tailored to the individual. Poorly aligned goals may lead to increased stress and pressure, which may negatively affect the recovery process.

Rewards/badges. Opinions on receiving rewards or being able to collect badges are divided. Some participants did not see the added value while others thought it could be symbolically motivating. Badge collection should not be stressful, but encouraging.

Ranking and group goals. Most participants agreed that adding rankings and group goals is not suited in the context of a depression recovery process. It may demotivate people if they perform worse than other group members and create pressure to perform.

Online forum. An online forum can make clients feel less alone, enable them to get in touch with peers, and exchange tips and tricks. Essential for this to be successful is that such a forum must be strictly monitored so that no unwanted or

false messages can be posted and that users do not begin to take on a therapeutic role.

Score for social activity.

For the majority, it was unsure what this should look like. Additionally, most thought it would not be easy to score social activity since the need for it differs between persons. Some participants suggested that instead of assigning a score, it would be better to focus on the relationship between social activity and mood. Therapeutic conversations could then be based on these relationships, and the treatment plan could be adjusted accordingly.
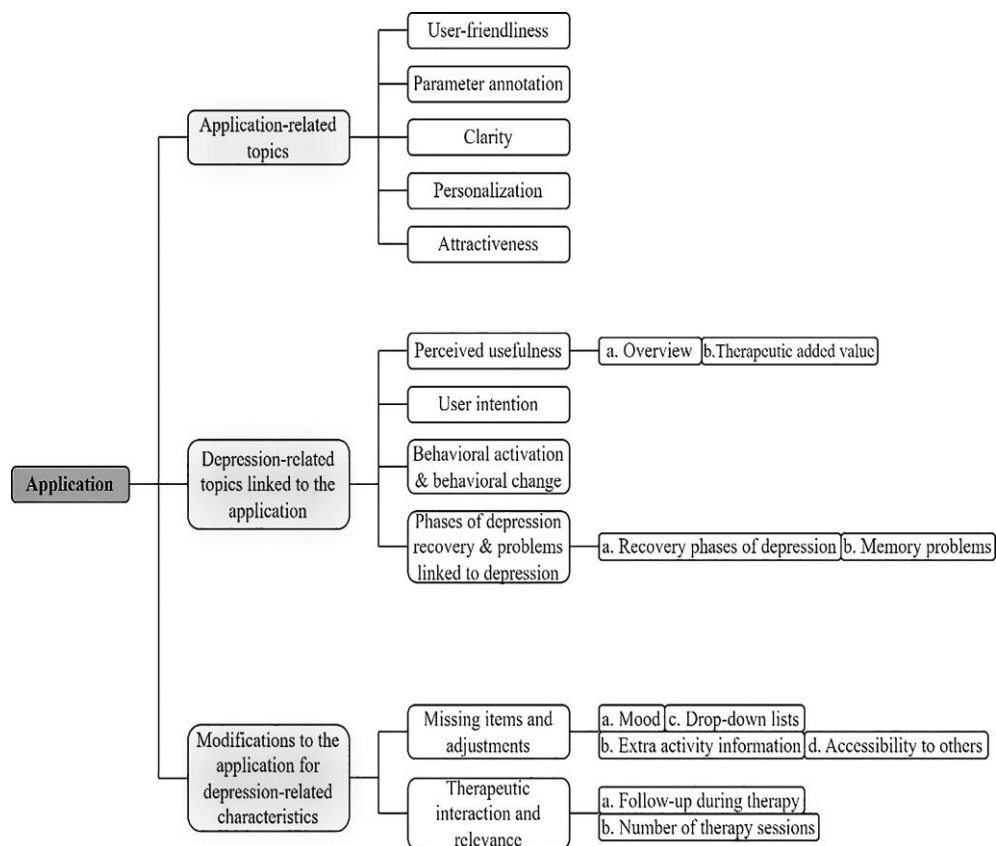
Therapists
Application

Figure 8. Schematic Overview of Application Themes – Therapists

Immediately after the presentation, participants were asked to score the application in its current form from 0 to 10. The therapists gave an average score of

7.5 out of 10 as the application may be useful, but only targets a partial portion of depression.

Application-related topics
User-friendliness. The app is very user-friendly. It contains a lot of information and is very easy to use as you do not need to add much information next to the drop-down menus.

Parameter annotation. Clients need to spend a few minutes per day to update their timelines. The primary use of drop-down menus was positive because it significantly facilitates the process. However, it might be problematic for clients with memory problems that the timeline can only be completed one day later.

Clarity. Both therapists reported that the application was very clear. Only the color coding was not entirely clear to one therapist, and should be explained better.

Personalization. At the moment, the application is not customizable. According to the therapists, it would be nice to configure some aspects to the client's preferences, such as color and font. However, it was certainly not a necessity.

Attractiveness. According to both therapists, the application contains a good balance between simplicity and attractiveness. Since color and shapes are used, it is sufficiently appealing. If changes are made to the application in the future, it is critical to carefully monitor the balance between simplicity and attractiveness to avoid overstimulating clients.

Depression-related topics linked to the application
Perceived usefulness.
Overview. The application clearly displays all active movements at a glance. This may be helpful to clients as it allows to maintain better overview, achieving greater self-awareness.

Therapeutic added value. Nowadays, clients are often asked to monitor their entire day with pen and paper. However, the application is much more efficient and discrete. Afterward, the information from the application could be a starting point during therapy to ask specific questions and tailor therapeutic interventions to a person's activities.

User intention. Both therapists were open to using the application in therapy. If the application were available, they would recommend it to their clients.

Behavioral activation and behavioral change. The app itself will not result in behavioral activation and/or behavioral change, but will instead have a supportive function. Nevertheless, in case the therapist asks questions about the data in the application, it may result in increased self-awareness on behalf of the client, which in turn may positively affect behavioral activation. The application requires a certain level of commitment. As a result, the clients are more involved in the recovery process and can regain control over their situation.

Recovery phases of depression & problems linked to depression.

Recovery phases of depression. To preserve uniformity, the therapists believed that it is unnecessary to adapt the app to the phases. However, the use of the application should differ depending on the phase. For example, initially, only complete one activity per day. Put differently, the counseling that accompanies the application should be adapted to the phases.

Memory problems. Memory problems are common in persons with depression. Therefore, they need optional reminders and notifications, reminding them to complete the required information. Otherwise, many could forget to complete their timeline.

Modifications to the application for depression-related characteristics
Missing items and adjustments.

Mood. Once or several times a day, the application should assess how a person feels or has felt throughout the day. With this information, therapists can tailor their questions. Over time, it may be possible to see connections between activities and state of mind. The therapists disagreed on whether adding additional, optional information to this assessment should be possible. On the one hand, it may provide further clues during therapy; on the other hand, it may lead to internal speculation in the client, which can hinder the recovery process.

Extra activity information. The app should permit adding more details to the completed activities. Currently, it monitors where a person travels to and with whom. It also monitors the type of activity (e.g., working, social activity, etc.). However, it does not specify what activity specifically was undertaken (e.g., shopping, eating out, etc.), not with whom. Not only physical activity but also social activity is vital for recovering from depression, and linking these two together would, therefore, make the app much better suited for the target group.

Drop-down lists. Participants should be able to add locations, etc., in addition to the drop-down lists. This increases the ease of use of the application.

Accessibility to others. The application may contain sensitive information about a person, which can lead to suspicion from the users. In addition, it is possible that clients do not want their partner, family, etc., to be able to see what is being entered in the application. It should be made possible to make certain data, or the application itself, inaccessible to others.

Therapeutic interaction and relevance.

Follow-up during therapy. The application and the therapy are complementary but cannot replace each other. The data from the application can be used to guide the therapy. At the start, clear agreements about the follow-up need to be set, to avoid unrealistic expectations (e.g., the therapist cannot monitor every client daily outside the therapy sessions).

Number of therapy sessions. Although the app cannot replace therapy, individuals may need fewer therapy sessions at a later recovery phase, due to self-monitoring via the app.
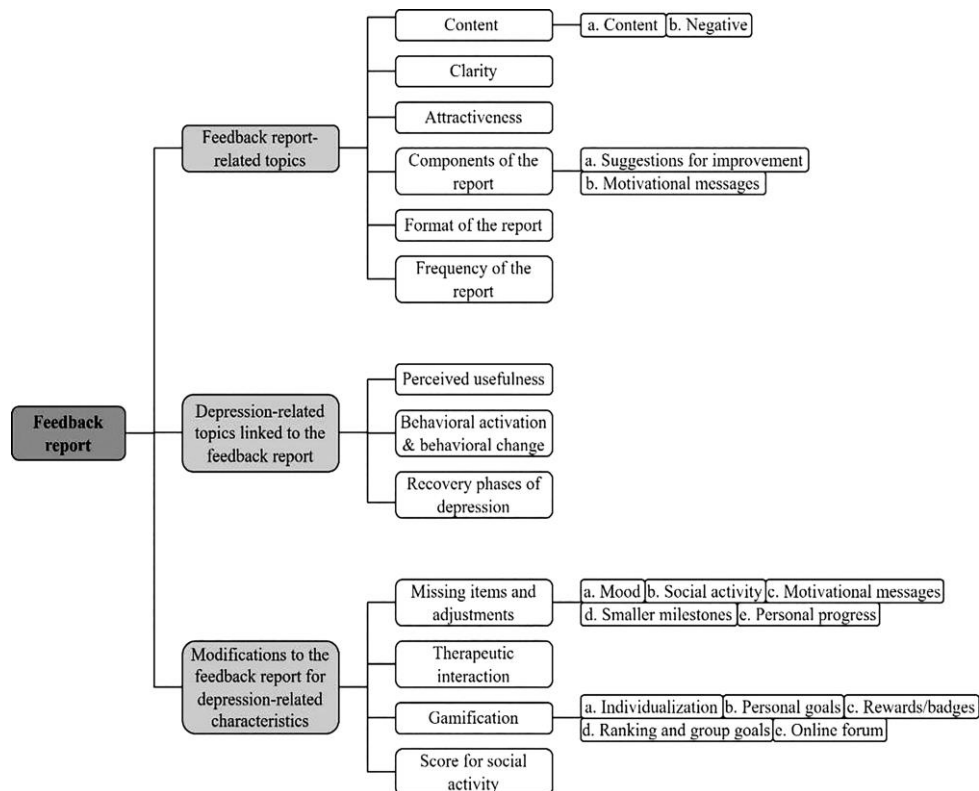
Feedback Report

Figure 9. Schematic Overview of Feedback Report Themes – Therapists

As with the overall score for the application, therapists also give an average score of 7.5/10 on the feedback report. Adjustments are needed as physical activity is only a part of depression.

Feedback report-related topics
Content.
Content. The therapists found that the report insufficiently focused on depression-related characteristics, as physical activity is only a part of depression.

Negative. The messages in the report are being conveyed too negatively. In the recovery process from depression, positive reinforcement is essential, which is not sufficiently included in the report.

Clarity. The report in its current form is straightforward, both visually and content-wise. It presents everything quickly and clearly without much distraction.

Attractiveness.

The report is supported by pictograms and different colors, making it visually appealing. Yet again, caution must be taken with report modification, so that clients are not overstimulated.

Components of the report.

Suggestions for improvement. This section is very useful according to the therapists; clients can immediately get started with this, which lowers the barrier to getting started.

Motivational messages. Currently, these do not adequately address emotional and psychological aspects of depression. Changing these messages is necessary.

Format of the report. It was good that the report is sent to the client via email. In fact, if the report is only available in the application, it could be overlooked. Furthermore, a PDF document is larger and easier to read. Lastly, the report is easy to forward via email, making it more convenient for the client to provide it to the therapist.

Frequency of the report. The therapists disagreed with each other on the frequency of the feedback report. One liked to receive the report on a weekly basis. In contrast, the other thought that it should be adapted to the current recovery phase a person is in. Someone in the later recovery phase needs less intensive follow-up, and thus less frequent reports.

Depression-related topics linked to the feedback report

Perceived usefulness. The feedback report currently lacks some essential sections to make it sufficiently useful for persons with depression issues. Meaningful and social activities, combines with state of mood also need to be addressed.

Behavioral activation and behavioral change. In its current form, the report will not lead to behavioral activation and/or change. However, it has a supportive role. Clients themselves need to put less effort into keeping track of everything and will also be stimulated by the report to think about their own recovery. Combined with therapy, this may lead to behavioral activation and/or change. Again, it should be noted that the report would be much more effective when more attention is being paid to a person's mood and activities.

Recovery phases of depression. As with the application, the therapists preferred a uniform report that is not adapted to the phase a person is in. Again, the therapist can discuss with the client how and to what extent the report will be used, adjusting therapy accordingly.

Modifications to the feedback report for depression-related characteristics
Missing items and adjustments.

Mood. The report should also include some sort of mood score based on the – yet to be included – assessments in the app (i.e., an average score of all the measures, not a score calculated based on the person's activities). In the slightly longer term, the report could then also include correlations between mood and activity (e.g., if someone performs this activity, it is notable that their score for mood on those days is significantly lower than on other days).

Social activity. Not only physical activities are important, social activities can be recovery-enhancing. When clients have to add what and with whom they performed activities in the app, the report can give an overview of this. This overview should include the activities linked to active travel and those related to inactive travel (e.g., driving to a friend's house to go shopping, in which shopping is a social activity).

Motivational messages. Motivational messages should focus more on the psychological, emotional, and social aspects of depression. Furthermore, messages may be conveyed more positively to enhance recovery.

Smaller milestones. The report currently works with big milestones. For example, the range of the ATS score is relatively narrow, so one already has to put in quite a lot of effort to improve their score. By taking a smaller-step approach, people will have more successful experiences, making them more likely to be motivated to keep using the report.

Personal progress. Graphs should be used to visualize long-term evolution. This can be both confrontational and motivational for clients. Based on this, personal goals can be established together with the therapist.

Therapeutic interaction. Therapeutic involvement is essential when interpreting the feedback report. Through conversation, the results can be discussed in more depth and detail, next treatment steps can be determined, and clients can reach increased self-awareness.

Gamification.

Individualization. Overall, care should be taken when adding gamification principles, as this could have positive and negative effects. It could motivate clients to perform better. However, it could be an additional stress factor that hinders recovery. Therefore, it is essential to evaluate for each client whether or not it is good to work with gamification elements.

Personal goals. It should be possible to define personal goals in the application, which are then addressed in the feedback report. However, these goals should always be set in consultation with the therapist so that they can be sufficiently individualized.

Rewards/badges. It is unnecessary to include rewards or badges. It may even hinder the therapeutic process since recovering from depression is not as easy as achieving a badge. Getting a compliment or motivational words upon achieving a goal are worthy alternatives.

Ranking and group goals. Both are more prone to have a negative effect because clients may start comparing themselves to each other, which can potentially be demotivating. Furthermore, this causes intrinsic motivation to diminish, making relapse more likely.

Online forum. This could be interesting, but the therapists were wondering to what extent it will be feasible. After all, such a forum must be heavily monitored and moderated to prevent the spreading of negative and/or false information.

Score for social activity. Both therapists agreed that a score for social activity is a delicate matter. On the one hand, it may lead to stress because one wants to get as high a score as possible, which can negatively influence recovery. On the other hand, just because someone has had many social contacts does not mean that they were enjoyable or meaningful. Therefore, currently, it seems better to refrain from such a score in the report.

Discussion

The current study served as a first step in the co-creation development process of TOTEM, in which clients with depression and psychologists evaluated the usefulness of the HTB application and feedback report aimed at increasing travel-related physical activity for depression. Participants were enthusiastic about the application and perceived the app as user-friendly, relevant, clear, useful, and attractive. Among others, it was indicated that the application should supplement standard care (e.g., weekly consultations). It would encourage people to engage in more activities, and most individuals would be interested in using the app as an external motivator. However, emotional aspects were currently underemphasized in the app (e.g., assessment of feelings). Increased tailoring and appropriately dosed push notifications would be useful as well. Most participants were also quite enthusiastic about the feedback report. Participants did indicate that the report should be better tailored to depression. For example, the psycho-education currently offered too much physical aspects instead of mental health and social activities. Nevertheless, participants perceived the feedback report as clear, useful, and relevant. About half of the participants thought that the feedback report could take phases of depression recovery into account, e.g., too much information for the early phases. Similarly, experts also stressed that in case the application and feedback report would be used in therapy, the counseling should be tailored towards different phases of depression recovery.

The results mainly hinged toward the usefulness of TOTEM as an external motivator. That being said, functionalities offered in the platform are aimed at developing intrinsic motivation over time (e.g., goal-setting, scaffolding, choice options, therapeutic alliance, opportunities for social activities), targeting the needs forwarded by the self-determination theory (SDT). This theory posits a continuum

of motivation, ranging from extrinsically controlled types of motivation to self-directed or 'intrinsic' motivation. Intrinsic motivation is driven by self-awareness and elicits inherent satisfaction, resulting in more sustained behavior change. In contrast, extrinsic motivation is more driven by an instrumental orientation, resulting in less stable behavior change (Kushnir et al., 2016), for detailed categories and a test of the continuum structure, see Howard et al. 2017 (Howard et al., 2017). In addition to motivational profiles, SDT posits three basic intrinsic needs that operate as motivational resources: 1) Need for competence: feelings of success and efficiency, 2) Need for autonomy: psychological (or decision) freedom and volition, acting without pressure or enforcement from an external source (or task meaningfulness), and 3) Need for social relatedness: belonging, attachment, and care with respect to significant others or a group (Sailer et al., 2017). Indeed, TOTEM is an elaborate extension of HTB. For instance, by allowing clients to add planned social activities and the person(s) that accompanied them during that activity. Moreover, it will proactively encourage clients to perform social activities, e.g., in the form of JITAI. Actual user experience with the HTB application and feedback report, as a component of TOTEM, could have offered the opportunity for candidate users to experience the potential for increasing developing and/or increasing levels of intrinsic motivation as well, besides external motivation.

By demonstrating the potential of increasing travel-related physical activity as an addition to standard care for depression, the current study showed promise for the use of TOTEM, which builds further on this by incorporating principles of CBT and behavioral activation, digital phenotyping, and JITAI into a blended care format. In its current form, TOTEM is especially applicable for (young) adults with an affinity for technology. Although this group is highly relevant due to its presence in the labor market, other target populations may benefit less from the platform in its current format. For instance, with coming age, elderly are prone to (mental) health issues and require enhanced support that may go beyond the care that health care professionals can provide (Lara et al., 2020; Messner et al., 2019). Therefore, once established in its current format, TOTEM should also target the older adults, for instance, by using different designs or incorporating technology training. Another relevant group that could be targeted is people with low health literacy, who are more likely to delay or forsake appropriate care (Levy & Janke, 2016).

TOTEM is currently aimed at secondary care, with psychologists, among others, using the application to supplement their current practice. A challenge for wider implementation of TOTEM in secondary care consists of sufficient adoption by the practitioners. Therefore, future research on the effectiveness of TOTEM is essential. The same goes for general practitioners, who would now serve as gatekeepers that guide patients with depressive symptoms to respective caretakers that implement the platform, instead of relying on psycho-pharmacology as the first line of defense. However, TOTEM could be used for primary care as well, when it would be widely distributed as a standalone application for mild depressive symptoms that goes beyond standard psycho-education. General practitioners would

then recommend the platform directly, without intervention by a therapist. Nevertheless, care should be taken in case that those requiring additional support (i.e., with indications of moderate to severe symptoms) would still be referred to a clinician for help. Although not entirely ruled-out for the future, plans for use in tertiary care are not being made so far.

Limitations

The current study consists of a first step in the development process of TOTEM, which is subjected to co-creation and extensive future testing. Current ideas, efforts, and results are preliminary, and more theorizing, development, and research should be implemented before the contribution of TOTEM to standard care receives the required empirical support. Due to Covid-19, we made use of online interviews. Although a recommended method during lockdowns (Moises & Torrentina, 2020), which was already becoming mainstream before that time (O'Connor & Madge, 2017), there are some downsides to it (e.g., technical issues, more distance between interviewee and researcher) (O'Connor & Madge, 2017). Moreover, we used a semi-structured interview guide covering predefined topics, which could have hindered participants from spontaneously providing new topics (Dirix et al., 2022).

Conclusions

Both end-users and experts considered an application with a feedback report to monitor and improve travel-related physical activity as a valuable addition to standard care for depression. Clearly, the application needs to be tailored towards people with depression (e.g., more focus on other activities than physical activities) and cannot be used as a standalone application. Ecological momentary assessment could increase attention for feelings and emotions. The current insights will be applied to the TOTEM platform that additionally incorporates principles of CBT and BA, together with digital phenotyping and JIAI, after which it will be subjected to further co-creation before implementation.

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Attachment 1. Semi-structured Interview Guide

Topic List
1) General: first impression after the demonstration
2) HTB-app
3) Feedback report
4) Closing questions

General Questions
Before we start the interview about the app and the feedback report, I'm going to give you some information and ask some general questions.

- Remember that you have signed an informed consent. You have the right to stop the interview at any time. Can you verbally confirm if you agree to the use and processing of your data, anonymously of course.
- The interview will be about the app and the feedback report of which you just got a presentation. Was everything clear in the presentation? If you have any questions, you can ask them now or during the interview. There are no right or wrong answers to the questions. If you want to give a negative answer about the app in the feedback report, this can be done. We learn the most from honest answers. This will not affect anything such as the therapy, availability of the app in the long term, etc.
- Can you briefly introduce yourself? Do you use the smartphone a lot, do you know anything about apps, what do you use the smartphone for, etc.
- What is your reason/motivation for participating?
- What do you hope the app could have done for you during your depression? (if difficult question, it will be asked again later on in the interview).

Questions related to the Health & Travel Behavior (HTB) application and feedback report
Questions related to the application. This part of the interview is mainly focused on the HTB app, so try to answer the questions from this perspective as well. The feedback report will be discussed in a subsequent section. If during the interview you suddenly come up with something about the feedback report, this can of course be mentioned and you do not have to wait until the next part. (show slide 9)

- Overall, what is your first impression about the app?
  - Score between 0 and 10?
  - What is the reason for giving this particular score?
- If the app is available, would you like to use the app yourself? Why/why not?
- What would be the main reason(s) for you to start using the app?
- When do you have expectations for a human interaction? When do you think this is desirable? Or do you prefer to keep this anonymous and independent.
- You just saw some sample screens of the app in the presentation. Did you find this attractive enough? Did they speak to you?
- While seeing the images, did the app seem clear to you? What was clear/what was unclear?
- Is the app clear?
- After an initial introduction, how user-friendly does the app seem to you?

- Do you think it's okay that you still have to fill in things yourself and that this can only be done a day later?
- Is it necessary to adapt the layout to people with depression? Because of cognitive complaints. Do you have tips?
  - May also depend on the phase of recovery from depression: onset, improvement, recovery
- Does it seem realistic to you to fill in all the requested information? Depending on the phase you are in: start, improvement, recovery.
- Do you think that the app can be useful for people with depression? Why/why not?
- Behavioral activation is difficult with depression, how could the app help?
  - Would a buddy system be useful for that activation (therapist, fellow patient, …)? If so, who should that buddy be?
- This app was originally developed for cardio patients and is therefore also designed from this perspective. When we now look at depression from the point of view, are there things that you think are missing or that need to be adjusted?
- The recovery from depression follows a certain course: onset, improvement, recovery. Do you have the feeling that you need different things from the app in the different phases? For example: in an initial phase where there are still many complaints or in a subsequent phase where you already know some recovery but still need guidance.
- Which useful therapist interventions do you think could be digitized?
- Did you find the app sufficiently customizable to personal preferences? Why/why not?
- Do you have any comments to improve the app?

Questions related to the feedback report. This part of the interview focuses mainly on the feedback report, so try to answer the questions from this perspective as well. If during the interview you suddenly come up with something about the HTB app, this can of course be mentioned, so it does not matter that we are already went over this part.

- Overall, what is your first impression about the feedback report?
  - Score between 0 and 10?
  - What is the reason for giving this particular score?
- What do you think of the content of the feedback report?
- Would the feedback report motivate you enough to increase the number of physical activities that you perform?
- Behavioral activation is difficult with depression, how could the feedback report help?
  - Would a buddy system be useful for that activation (therapist, fellow patient, …)? If so, who should that buddy be?
- If you used the app, would you actively use the feedback report? For example: follow the recommendations, read quotes, etc. Do you have suggestions that could motivate?
- You saw some examples from the feedback report in the presentation. Did you find this attractive enough? Did they speak to you?
- When you saw the images, did the report seem clear to you? What was clear/unclear?

- Do you think that the use of the feedback report can be useful for people with depression problems? Why/why not?
- If not useful, what should be changed to make the report useful for people with depression?
- As already mentioned, everything was originally developed for people with heart problems and is therefore also based on this approach. Looking now from the standpoint of depression issues, are there things that you think are missing or need to be changed from the feedback report?
- The recovery from depression has a certain course: beginning, improvement, recovery. Do you feel that you need different things from the feedback report in the different phases? For example: in an initial phase where there are still many complaints or in a post-phase where you already know some recovery but guidance is still needed.
- Nowadays, a lot of attention goes to the concept of 'gamification'. Gamification is the application of game principles and techniques in a non-gaming context. I am now going to give some examples that could possibly be used in the future, you can then indicate what you think of each example:
  - o Possibility of rewards (financial, material, badge, points, …)
  - o Challenges
  - o Leaderboard (anonymous)
  - o Personal progress: graph with evolution over time
  - o Working around group goals
  - o Tips and advice that can be exchanged through a forum.
- The ATS score concerns movement. To tackle depression, the focus should not only lay on being physically active but also about being socially active. This currently receives little attention in the app. The 'pointer for exercise', what would this look like for social activity?
- Currently, the feedback report is being sent by e-mail. Are you satisfied with this or would you like to see an adjustment?
- How often would you like to receive a feedback report?
- Do you have any comments to improve the feedback report?

Closing section

We have arrived to the end of the interview. Are there any topics or things we haven't discussed about the app or the feedback report? Or are there other things you would like to mention?

'Briefly summarize the interview, thank the participant and ask for feedback on the interview.'