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Case report

Integrating personalized experience sampling in psychotherapy: A case illustration of the Therap-i module



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ABSTRACT

Background: The experience sampling methodology (ESM) is increasingly being suggested as a clinical tool in mental health care, as it offers ecologically valid, microlevel information on psychopathological processes. Patients and clinicians have recommended that applications of ESM should be personalized and integrated into the existing clinical process, but there is still much uncertainty about how implementation may look like.

Objective: To provide an example of personalized ESM assessment and feedback being integrated into psychotherapy for depression, specifically looking at the collaborative use of ESM in case conceptualization.

Methods: George, a 27-year-old man diagnosed with depression, and his therapist participated in the Therap-i randomized controlled trial, which investigates the efficacy of a personalized ESM module added to psychotherapy. Together, they created a personalized ESM questionnaire, aiming to capture their hypotheses and questions regarding George's case conceptualization. George then filled out his ESM questionnaire five times per day, for 8 weeks. During this period, ESM data were discussed and interpreted by George, his therapist, and a researcher, in three feedback sessions. In these sessions, data were visualized in a flexible feedback interface that allowed for collaborative exploration of George's data. Both patient and therapist evaluated the module through questionnaires and George also participated in a semi-structured evaluation interview.

Results: George's ESM questionnaire included personalized items on the topics of self-esteem and open versus withdrawn behavior. He completed 241 (89.3%) assessments. Discussions during the feedback sessions focused on two core themes: First, George's low energy level, which was further explored with regard to his sleep, medication, and activity patterns. Second, his low sense of self-esteem, which led to an in-depth exploration of his thinking patterns and social interactions. The ESM module was seen as useful and insightful by both George and therapist.

Conclusions: This case shows how ESM and ESM-based feedback can stimulate the collaborative exploration of the patient's complaints, and how it can provide useful insights for treatment. We discuss how our personalized ESM module relates to current clinical principles and practices, and make suggestions for further implementation.

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1. Introduction

Researchers and scientist-practitioners in mental health care are increasingly recognizing that there is innovative potential in applying the experience sampling methodology (ESM) in clinical practice [1–3]. In ESM, patients fill out short questionnaires multiple times per day, typically via their smartphone. The basic premise behind its potential for clinical practice has been that ESM provides new, and in some ways better, information [4]. More specifically, ESM captures dynamic fluctuations of affect, cognitions, behavior, and (social) context, of which traditional questionnaires can only provide retrospective, episodic “snapshots”. ESM is more ecologically valid than traditional self-report questionnaires and minimizes recall bias [5]. ESM has diverse potential applications in a psychiatric clinical setting that are starting to be researched, such as monitoring treatment effects [6] and side effects [7], relapse prevention [8], supporting psychotherapy (especially case conceptualization) [9], and as a stand-alone intervention [10,11].

To fulfill the potential of ESM, patients and clinicians call for ESM to be personalized and flexibly integrated into their care [12]. Technically this is already possible on a large scale, since some digital tools are available such as PETRA [13], PsyMate™ [14], and m-Path [15], that offer (some) flexible options for personalization of ESM questionnaire content and schedules. However, we are only at the start of using ESM as a clinical tool, and there is still much uncertainty about its application in clinical practice. This specifically concerns the personalization and flexibility that both patients and clinicians see as very important. In this case study, we explore the use of ESM in a clinical context, specifically in the process of case conceptualization in psychotherapy.

Case conceptualization is most commonly applied in psychotherapy for complex cases. It describes the process by which patients and therapists form a personalized working theory of the patient’s complaints, which is then used to guide treatment choices. Ideally, this process follows the principle of collaborative empiricism, where patient and therapist collaboratively integrate their perspectives and expertise to form a working theory, which is then subjected to an empirical cycle of testing and adaption [16]. Case conceptualization seeks to obtain more insight into the individual patient, it involves personalization, and it explicitly calls for an empirical component. This makes it highly suitable for using personalized ESM and for exploring its clinical role. Other forms of assessment, like questionnaires and self-monitoring records, are already commonly used in case conceptualization [17], suggesting that ESM may also be able to contribute.

In the current case study, we describe how a personalized ESM module was integrated into the care-as-usual of a patient suffering from depressive symptomatology for which he was treated with both antidepressant medication and psychotherapy.

2. Materials and methods

A 27-year-old man, we will refer to as George, participated in the Therap-i randomized controlled trial (RCT; Netherlands Trial Register ID: NL7190) [9], which investigates the efficacy of a personalized ESM module (the Therap-i module) integrated into psychotherapy for depression versus regular psychotherapy. George provided informed consent and participated in the experimental condition.

2.1. Participant

George¹ has been suffering from depressive complaints since adolescence. At intake, George reported depressed mood, anhedonia, anxiety, internal restlessness, low energy, and a negative outlook on the future. He worried about not finding a job. With regard to his personality, he struggled with a low sense of self-esteem and had trouble standing up for himself. He found it difficult to deal with criticism and opinions of others, had a great sense of responsibility, a need for control, and a perfectionistic streak. When in a depressed mood, he tended to avoid or procrastinate activities and worry about upcoming stressful situations such as an upcoming wedding of a friend.

The loss of a loved one significantly impacted George and his upbringing. George’s parents became very protective of him and his younger brother. In addition, George was verbally bullied at school for multiple years, making him feel like an outsider. He did not tell his parents about the bullying because he did not want to burden them while they were still dealing with losing their daughter. In elementary school, George noticed that he had homosexual feelings. He was upset by this and hoped they would disappear over time. He never told anyone about these feelings until he was 24 years old. When he found the courage to tell others, he received mixed reactions, but, in the end, his family and friends accepted it and George became more open about his homosexuality. However, he was still reluctant to date and wrestled with reconciling his homosexuality with his faith.

At the start of therapy, George’s faith was still a source of comfort and strength for him. He was involved in several religious groups, which organized meetings. He had found a job, in which he took pride in helping others.

Three previous attempts at seeking therapeutic help in the last 8 years had no persistent beneficial effect on his depression. George was starting outpatient cognitive-behavioral therapy when they enrolled in the Therap-i study. Concurrently, George started using antidepressants. At the start of his participation in the study, George scored 42 on the Inventory of Depressive Symptomatology – Self Rated [18], which falls into the category of “severe” depression [19].

¹ To guard the privacy of George, certain potentially identifying details in this case descriptions were changed.

2.2. Personalized ESM module (Therap-i module)

The Therap-i module is integrated into regular psychotherapy sessions and is based on the collaboration between the patient, therapist, and researcher. The module involves four steps. For George, the involved researcher was MNS, except for the second feedback session (see step 3), which LvK conducted. Note that the ESM module serves the goal of maximizing clinical utility for individual patients and choices in this section reflect this goal by weighing both methodological and clinical concerns.

2.2.1. Step 1: preparation and resilience interview

The researcher interviews participants about their personal strengths and resilience factors for about 45 minutes. In this semi-structured, in-house developed, resilience interview, questions originated from solution-focused therapy [20]; such as “How would you describe yourself as a person before you got sick?”, “Can you describe uplifts in the last month?”. These aspects are often relatively underrepresented in clinical practice but are to monitor on the path to recovery. In preparation for the resilience interview and the development of the ESM diary, the researcher gets acquainted with the case by reading intake reports, referral letters, and biographies. By doing this, the researcher gains an overview of the case, develops questions for the resilience interview, and develops ideas for personalized items for the ESM diary.

2.2.2. Step 2: development and initialization of the personalized ESM diary

Next, the researcher joins a treatment session with the patient and therapist to develop a personalized ESM diary. Based on step 1, the researcher has prepared a list of suggestions for potential aspects to cover in the ESM diary. The goal of the ESM development session is to develop a personalized ESM diary covering aspects that capture the patient’s and therapist’s working hypotheses, ideas, and questions about the patient’s case concept (i.e., factors maintaining or attenuating the patient’s depression). First, the researcher explains the goal of the session and the ESM diary development process to the patient and therapist. The ESM diary includes 22 fixed items (see Table A1 in Appendix A), to which up to about ten personalized items can be added. Items are assessed either five times per day or once per day (morning/evening). They are structured into five domains, which cover basic areas of case conceptualization: affect, behavior, cognition, body, and context [21].

The researcher asks the patient and therapist whether they have ideas about which aspects should be covered in the ESM diary. The researcher helps to translate identified aspects into personalized ESM items. Items can be newly formulated or chosen from an existing item repository [13]. When formulating new items, the researcher aims to use the wording of the patient as much as possible, while also following criteria for high-quality ESM items [9]. The content of the ESM diary items is left mainly up to the patient and therapist, but items based on the resilience interview and electronic patient dossier can be suggested by the researcher. The diary development session is immediately followed by a 30-min instruction session with the patient and researcher, including a practice run. It is possible to add items to the ESM diary after a feedback session if relevant aspects arise at a later point.

2.2.3. Step 3: ESM monitoring

Patients fill out their personalized ESM diary five times a day for 8 weeks, with fixed three-hour intervals between assessments. A fixed beep schedule offers the advantages of measurement points that are equidistant in time, allowing for lag-based analyses (e.g., network models, see next section) [22]. Additionally, preliminary evidence suggests that fixed schedules lead to better compliance compared to other schedules (e.g., semi-random) [23]. However, the fixed schedule allows participants to anticipate beeps and adapt their activities (e.g., social engagements) accordingly, potentially compromising representative sampling of participants’ daily lives [22]. The timing of assessments is personalized to fit the patient’s natural sleep-wake rhythm; the first daily assessment occurs 2–3 hours after waking-up in the morning. George received his first beep of the day at 9 a.m. and his last at 9 p.m. The ESM diary is initiated in a web-based interface on our online questionnaire tool Routine Outcome and Quality Assessment (RoQua) [24]. The system is programmed to send text messages (beeps) with links to the online questionnaires to the patient’s smartphone and stores data on a secured server system. This yields a maximum of 280 data points for the personalized feedback. Patients are instructed to complete the ESM diaries as soon as possible after receiving the beep, preferably within 10 min, and that they have limited time to respond. When no response is received, patients will be reminded via text message after 10 min, and the link will be closed after 30 min.

2.2.4. Step 4: feedback sessions

Patients receive personalized feedback during a regular consultation (usually 45–60 min) with their therapist and the researcher after 2, 4, and 8 weeks of ESM monitoring.² Feedback is based on reports that include dynamic visualizations of the ESM data, which can be quickly navigated to allow for use in the sessions with patients and therapists (Appendix B shows a narrated screen captured video). Reports were programmed in R and make prominent use of the packages RMarkdown, Shiny, and ggplot2 [25–27]. Core elements include line plots of raw data over time, including contextual information, plots of activity and company counts, plots of average within-day trends, and graphs of network models (only included at 4 and 8 weeks). Network graphs visualize a contemporaneous network model, showing associations between items within timepoints, and a temporal network model, showing associations between items at consecutive timepoints.³ Network models were estimated using the R package graphicalVAR [28]; more details are included in Appendix C [28–31]. In the session, notes on the conversation can be written in text fields under the plot that is discussed.

² For George, feedback sessions occurred 3, 5, and 8 weeks after starting the assessment, due to scheduling difficulties.

³ Note, that temporal networks were not presented to George and most other participants, see Appendix C for more details.

Subsequently, graphs and notes can be downloaded together and are placed into a static report. This report serves as a summary of the session and is shared with the patient and therapist after.

The goal of the feedback sessions is to collaboratively discuss the feedback to learn about relevant occurrences and patterns in the patient's daily life and how they are related to their depression. The approach is to share observations from the data that provide a different perspective on the patient's complaints and to stimulate a conversation about them. When preparing the feedback session, the researcher examines the dynamic feedback report and notes distinct patterns in the data that might be interesting to discuss with the patient and therapist. Examples include prominent peaks or dips in the course of ESM items (e.g., moments when the patient experienced strong emotions), trends over time, themes in the contextual information, or prominent associations observed in the person-specific network. During the feedback session, the patient is first asked about their experience with filling in the ESM diary and any insights they may already have gained from this. Subsequently, the researcher assesses whether the patient and therapist have specific questions or interests with regard to the ESM data. Their questions and interests are used as a starting point to go over the dynamic feedback report and remain central throughout the feedback sessions. When looking at plots together, the researcher explains what is presented and what one might pay attention to (e.g., to average level, variability, trends, and extreme values in a line plot of an ESM item over time). The researcher might also offer summaries of what can be seen (e.g., "At most moments, you reported low or no irritation. But there are a number of peaks, when you seem to have been quite irritated."). Sometimes the researcher might ask clarifying questions about how the patient filled in a specific question to facilitate a joint perspective on the data (e.g., "When you filled in 70/100 physical activity, what kind of activities were you reporting on; a walk with your dog or a workout?", "How does this item compare to ...?"). In our experience, such explanations and clarifications are important when starting to work with the Therap-i module, but become less frequent over the course of the sessions as the patient and therapist familiarize themselves with the feedback module. Once the patient and therapist are thus empowered to engage with the data visualized in the feedback, it is up to them to judge how interesting they find an observation, what questions this raises for them, or what can be concluded about the patient. For example, a therapist might be surprised by a low level of irritation reported by a patient who is confronted with various conflicts and might inquire about the patient's views on these conflicts. Situations with such conflicts might be identified in the feedback report and provide concrete examples for the discussion. The researchers explicitly encourages such explorations and interpretations, and may stimulate these with questions such as, "Did you expect this?", "How would you explain this?", "How does this align with our observation ...?" In the session, the researchers might point out observations made in the preparation of the feedback, if they are relevant to the current discussion or if there is time left in the session. At the end of the feedback session, the researcher asks what the patient and therapist have learned from the feedback about the patient's depression.

2.3. Evaluation

As part of the measurements conducted in the Therap-i RCT, George filled in two in-house developed evaluation questionnaires about the ESM diary and the broader ESM module [9]. He was further interviewed about his experience with the module. George's therapist also filled in an in-house developed evaluation questionnaire.

3. Results

3.1. Personalized diary

Table A1 (Appendix A) shows George's ESM diary items. The added personalized items included items on various aspects of self-esteem (feeling insecure about his capabilities, feeling judged by others, feeling a sense of belonging) and acting open versus withdrawn (being open about his feelings, speaking his mind, avoiding activities). Other personalized items regarded a feeling of losing control, his engagement with his faith, feeling connected to others, and playing video games. Over the eight weeks of assessment, George completed 241 out of 270 (89.3%) measurements.⁴ On average, George opened the link 3 min and 12 sec after the beep and took 3 min and 43 sec to fill in the ESM questionnaire.

3.2. Feedback sessions

While the majority of available information was presented and discussed in the feedback sessions at least briefly, here we will focus on two core themes.

3.2.1. Depression, energy and sleep

In accordance with his depression diagnosis, George reported feeling down rather consistently throughout the monitoring period with some variation but few values at either end of the scale (Fig. 1A). George reported consistently low energy levels (Fig. 1B), which he said was his main complaint at that time. Feeling energetic was also associated with better momentary affect (Fig. 2A and B [31]). Taken together, this led George and his therapist to hypothesize that energy level may play a central role in George's depression. Subsequently, we looked at sleep in this context. George rated the quality of his sleep as bad with only few exceptions (Fig. 1C). During

⁴ We only report on 270 beeps here as George's third feedback session took place two days before the end of the full 8-week measurement period.

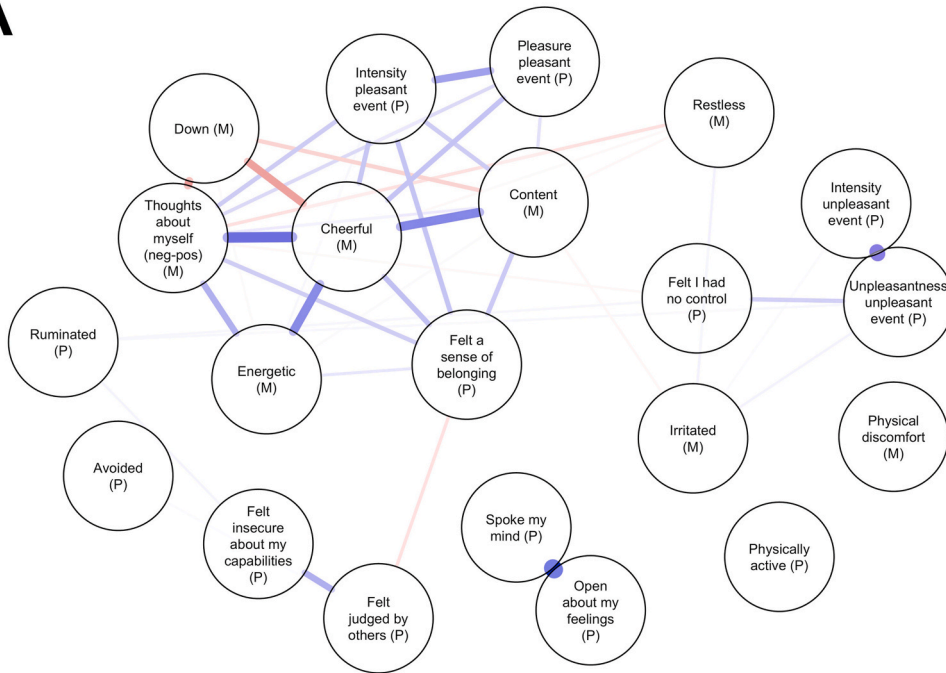


Fig. 1. Course over time of ESM questions in the first topic area “depression, energy, and sleep”.

the sessions, he elaborated that he struggled with falling asleep and with sleeping through the night; a problem he had had for most of his life. Further discussion with George indicated that his sleeping problems did not appear to be linked to sleep hygiene or rumination. While he ruminated a lot during the day (Fig. 3F), he did not at night. He reported that he felt calm in bed and did not pressure himself to fall asleep.

The lack of a proximate behavioral explanation for George’s sleeping problems affirmed him and his therapist in their current course of action, namely using medication to improve his sleep and affect. Yet, over the course of the 8 weeks of monitoring, George’s affect and sleep did not noticeably improve (Fig. 1). At the same time, he suffered from waves of physical discomfort (Fig. 1D), which, as George elaborated, included stomach aches, nausea, sweating, and back pain. Discussions revealed that these waves coincided with dosage increases of George’s medication. In this context, George also expressed his skeptical view towards taking medication. Taken

A



B

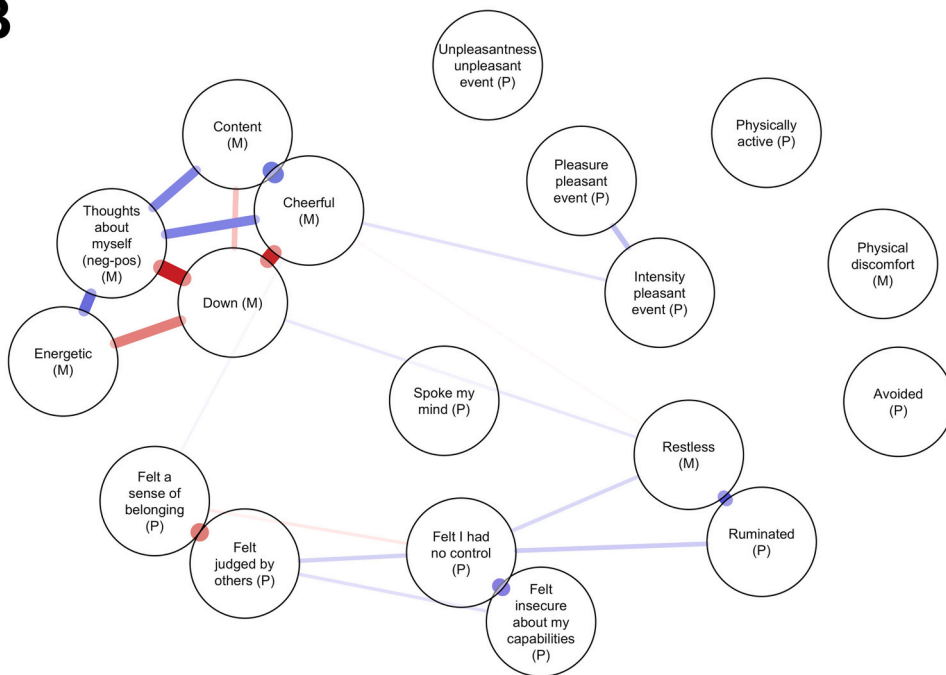


Fig. 2. Contemporaneous networks from the second feedback session (panel A) and third feedback session (panel B). Circles represent variables, and lines between circles represent partial associations between the two variables measured at the same time point. The color of lines indicates whether an association is positive (blue) or negative (red), and their thickness and transparency indicate their relative strength. Note that there is a risk of overinterpreting person-specific network models and training for health care professionals using this method is recommended. See Ref. [31] for a discussion on the use of network graphs in psychotherapy. Questions about the current moment are marked with (M), those about the prior period with (P). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

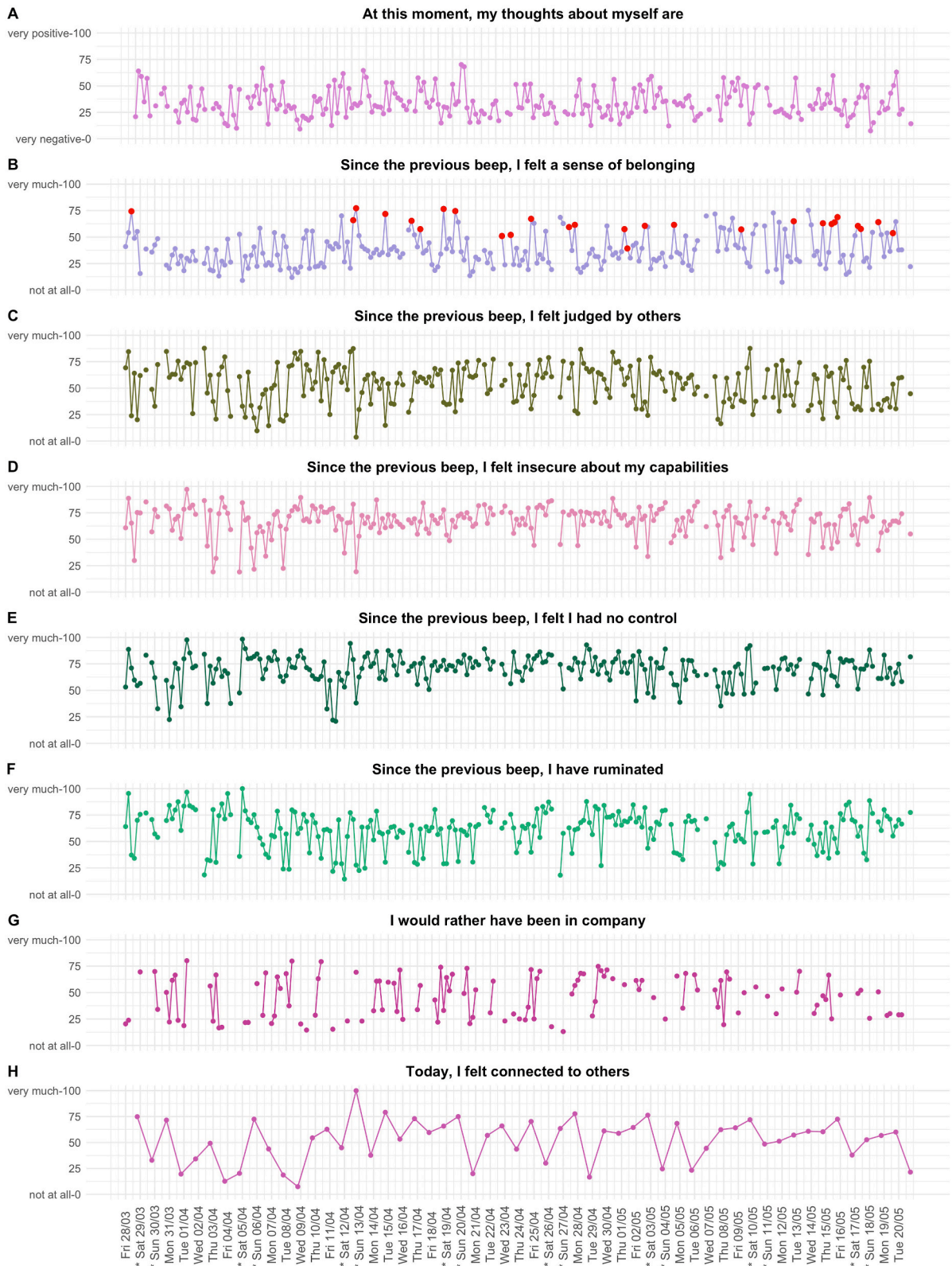


Fig. 3. Course over time of ESM questions in the second topic area “self-esteem and social environment”. Red dots in panel B mark moments when George entered text descriptions of pleasant events in which he was in direct contact (including video calls) with people other than his parents. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

together, this led to a critical evaluation of George's medication with his psychiatrist, in which he was reassured that the side effects would likely stop once the target dosage was reached and that more time was needed to evaluate the effect of the medication.

When further exploring factors possibly impacting George's energy and mood, his therapist expressed an interest in his activities, with behavioral activation on his mind.⁵ Starting with his physical activity (Fig. 1E), the data suggested that George regularly engaged in physical activities of relatively high intensity. However, George explained that most high ratings were given after taking a walk outdoors. After complimenting George for his discipline in this, his therapist enquired about George's experience with more intense physical exercise. George disclosed that he used to go for runs and reflected that this had been good for him. His therapist explained that exercise can reduce depressive complaints. They agreed that exercise could be a potential avenue in George's treatment in the future. With regard to other activities (Fig A1), George had reduced some activities due to his depression and the COVID-19 pandemic. The latter was quite impactful for him, as he was extremely worried about infecting others at work. However, George was aware that it was good for him to keep engaging in pleasurable and meaningful activities with others. He was trying his best to do so and reflected that planning helped him in this quest. The ESM data underscored this point by showing that pleasurable events or activities were associated with better affect (Fig. 2A), which included, among others, watching his favorite television programs with his family and social interactions with friends. The latter was extensively discussed and provides a link to the second core topic.

3.2.2. Self-esteem and social environment

The second core topic in the sessions was George's low sense of self-esteem. His struggle with this issue was expressed in several ESM items pertaining to self-esteem. George's thoughts about himself were negative at the vast majority of beeps (Fig. 3A) and he often reported low values on "I felt a sense of belonging" (Fig. 3B). As George had reported at the start of his treatment, his low sense of self-esteem also played into social and other insecurities. He often felt judged by others, felt insecure about his capabilities, and even regularly experienced a sense of having no control (Fig. 3C–E). Often such thoughts co-occurred (Fig. 2). Further, George ruminated a lot (Fig. 3F), which was discussed in the sessions as a potential coping strategy to gain a sense of security. In the discussions, George reported that this rumination concerned various topics (e.g., COVID, work), but he especially emphasized his preoccupation with past or future social interactions.

George was alone at about half of the beeps and when he had company, it consisted almost exclusively of his parents and other family members (Fig. A2). In the whole 8-week monitoring period, he reported being with friends three times and being with strangers five times (note that the diary question asked about current company, so social interactions between beeps were not captured). This pattern was at least partly owed to social distancing rules and norms during the COVID-19 pandemic, as well as George's own efforts to carefully avoid infection. Given the importance of social interactions for George, we also thoroughly looked at text descriptions he provided about social events (i.e., answers to item S17). This revealed that the majority of George's social interactions took place in an organized (online) group context (e.g., a religious group), which were formal and functional to some extent. Few of these social interactions were purely informal. At a number of these latter social occasions, George's data showed peaks in affect (e.g., cheerful) and positive thinking, specifically the item "I felt a sense of belonging" (Fig. 3B). Discussing with George what these specific occasions gave him, he reflected that he could be himself and express his feelings, and that he felt accepted and listened to by the people around him. The importance of these moments spoke to an unmet need for social connection that was also expressed elsewhere in the data. George desired more contact with others, as he often reported wishing for company when he was alone (Fig. 3G) and the personalized item "Today, I felt connected to others" fluctuated a lot (Fig. 3H), including many days he did not feel connected.

From his reported activity data, we could see that George also sought social contact via social media, which he engaged in a lot (Fig A1). This sparked particular interest in light of George's social insecurities. When discussing his social media use in the second feedback session, he was unsure whether his experiences with it were positive or increased his insecurity by stimulating comparisons to others. He used the beeps in the remaining assessment period to pay extra attention to reflect on this question. In the third feedback session, he reported back that he viewed his experiences with social media as mostly positive. However, he somewhat reduced his social media use because he wished to spend less time on it.

3.3. Evaluation

In the evaluation questionnaires and interview, George shared his view on various aspects of the Therap-i module. Here, we provide a qualitative summary of the key points. George reported that he gained insight about himself through the module. He especially mentioned the lesson that activities and pleasant social interactions improved his mood and that planning these activities helped him to pursue them. He reflected that topics that came up were not completely new to him, but that the ESM feedback results were in line with and helpfully confirmed his thoughts about himself and his depression ("functioned like a mirror"). This helped him to communicate his thoughts and feelings to his therapist, something he had struggled with before. Overall, George became more aware of the complaints he was struggling with. Yet, George felt like the insights he gained could have been translated better into actionable strategies to improve his depression. He attributed this shortcoming to the fact that treatment sessions in between the Therap-i feedback sessions had been sparse and mostly via telephone due to the COVID-19 pandemic. He wished for more time to process the ESM feedback results, specifically information in the person-specific network. Filling in the diary turned out to be less confronting and more doable than he had anticipated, specifically in combination with his work, but sometimes he planned around the moments he

⁵ Behavioral activation is a primary treatment option for depression, which is based on the theory that reduced activities play a role in causing and maintaining the depression. The treatment involves guiding patients to increase their activities.

had to fill in the diaries. The fact that the diary was personalized enhanced his motivation to fill it out. He felt that the resilience interview was stimulating but also somewhat confronting, because he was not used to thinking about himself from a positive perspective regarding personal strengths. However he did find this helpful. Altogether, George found the Therap-i module a useful tool, which he would recommend to others and would like to use again in the future.

George's therapist evaluated the Therap-i module as having a modest direct impact on George's complaints and functioning. He also reported that it contributed to George's insight, the case conceptualization, their working alliance, and choice of interventions. He was interested in using the module in his daily clinical practice, though with a shorter assessment period (<8 weeks), and would recommend it to colleagues.

3.4. Further treatment course

After George had completed the Therap-i module, his therapist discussed options for further treatment planning with his colleagues in the interdisciplinary meeting, as is standard practice in the Netherlands. Besides continued cognitive behavioral therapy, they decided to suggest participation in a running therapy group to George. Acceptance commitment therapy was discussed as an option for the future. Further, his psychiatrist was planning to discuss adding melatonin to George's medication to improve his sleep. These plans were not executed, as George's medication began to improve his mood, energy level, and sleep in the weeks after finishing the module. George found this improvement to be sufficient to continue without further psychotherapy.

4. Discussion

Researchers have professed that ESM may be useful in clinical practice [1–3], but it is still work-in-progress how this research method should be fitted into clinical practice. In this case study, we provide an example of the integration of personalized ESM and ESM-based feedback in the process of case conceptualization during psychological treatment for depression.

The overarching approach of the presented personalized ESM module is the integration of the therapist's professional expertise, the patient's introspective expertise, and the researcher's methodological expertise through a process of collaboration and shared decision making. This approach was the basis for the personalization of ESM assessments, as well as for the interpretation of the gathered ESM data during feedback sessions. First, we showed how a personalized ESM diary, which captured aspects relevant to George's case concept, was created. Second, we showcased a dynamic feedback interface and how that allowed the flexible use of ESM data visualizations during psychological sessions, enabling a collaborative approach to ESM-based feedback. Third, we illustrated a collaborative approach to ESM-based feedback, in which patient and therapist used personalized information gathered in real-life to engage in a discussion about factors triggering and maintaining the patient's complaints, to compare the observations from the data to their own perspectives, to create and adjust their working hypotheses about the patient's complaints, and to think about further treatment for these complaints. This feedback provided relevant information to George and his therapist, as was evident in the in-depth discussions we described and as they reported themselves.

We would like to point out six specific functions of ESM-based feedback that were illustrated by George's case, namely, i) providing an overview over his daily life (e.g., conversation about activity and company counts), ii) highlighting significant moments and linking them to the context they occurred in (e.g., moments that George felt accepted by others), iii) representing George's perspective on the relative severity of different complaints (e.g., his reports of low energy level), iv) evaluating change of complaints over time (e.g., the lack of change in affect, energy, and sleep in the context of medication), v) showing associations between items within the same assessment moment (e.g., association between energy and affect items), and vi) stimulating reflection in daily life (e.g., George's reflections about his use of social media or the amount and topics of rumination).

We would argue that a personalized ESM module that is firmly based in collaboration between patient and therapist fits well within existing clinical practices and theories. Perhaps the closest equivalent to ESM in current psychotherapeutic practice are self-monitoring records, which are commonly used in Cognitive Behavioral Therapy (CBT) [32]. Self-monitoring records correspond to ESM in that patients typically record information about situations, cognitions, affect, and behavior in their daily lives. However, in contrast to ESM, most self-monitoring records are targeted at a limited number of topics and/or specific moments of the day (e.g., moments of high anxiety). Also, they are mostly answered qualitatively by writing text on paper forms. ESM might therefore be viewed as a more frequent, scheduled, standardized, quantitative, digital, and (if assessment is broad as in our module) holistic form of self-monitoring records. The function of self-monitoring records is twofold according to CBT textbooks: Collecting information on patients' daily lives and stimulating them to engage with topics of their therapy in their daily lives [33]. These functions contribute to a larger principle in CBT, namely collaborative empiricism. Collaborative empiricism prescribes that patients and therapists collaborate to integrate their perspectives into a joint working theory of the patient's complaints and that this working theory is then subjected to an empirical cycle of testing and adaptation. Analogous to self-monitoring records, a collaborative and personalized ESM module aligns with this principle, although in a more structured and systematic way. Patient and therapist collaborate to integrate their ideas and questions in an ESM questionnaire, whose data is used to collaboratively explore and further develop or adapt working theories. When the ESM assessment is as broad as in our module, the data might even amount to a third holistic perspective on the patient's complaints, which helps in triangulating important patterns. Future research might learn much about the utility of ESM by more extensively documenting how patients and therapists interact with, interpret, and discuss the data.

It is important to consider the following limitations of this case study. First, the presented ESM module involved contributions of a researcher. A large-scale implementation of ESM and ESM feedback in clinical settings would have to compensate for the researcher's expertise by training therapists and developing ESM tools that are automatized. The presented feedback interface contributed to such

an ESM tool, as it formed the basis for the feedback module in the later developed PETRA application [13], which aims to make personalized ESM accessible in regular psychiatric care. Second, patient, therapist, and researcher invested considerable time and effort into the ESM module, illustrating that ESM will likely involve a cost-benefit analysis in clinical practice. Third, while we showed that ESM feedback can lead to insights, we do not know the counterfactual—would George and his therapist also have come to these insights without the module? Forth, as George discontinued his psychotherapy due to response to his medication, our case study is not able to show an effect on the shape or success of his psychotherapy. We can only discuss what occurred during his participation in the ESM module.

In conclusion, the case of George illustrates how a personalized and collaborative approach to using ESM can be employed to support psychotherapy. It showed that personalized ESM can practically and theoretically fit into the process of psychotherapy, specifically case conceptualization, and that it holds potential to enhance this process when further automatization is realized.

Author contributions

The presented ESM module was developed in collaboration between all authors. Implementation was realized by LvK and MS, under supervision of HR and DvdV. LvK programmed the feedback interface. MS and LvK conducted the ESM intervention with the participant. LvK drafted the manuscript under supervision of HR and MS. HR, MS, DvdV, and RS provided feedback on earlier versions of the manuscript. All authors read and approved the final manuscript.

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Data availability statement

For a case report the sharing of data has to be weighed against the right of the individual patient to stay anonymous. The manuscript reports much of the raw data in figures. The authors are open to consider further data sharing upon request.

Declaration of interest's statement

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2023.e14507>.

Abbreviations

CBT	Cognitive Behavioral Therapy
ESM	experience sampling methodology
RCT	randomized controlled trial

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