

Exploring User Experience and Adherence in an Ecological Momentary Intervention: A Qualitative Study

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Abstract

In an era in which digital technologies have become integral to daily life, the intersection of psychology and technology has led to innovative interventions to enhance mental well-being. Ecological momentary interventions (EMIs) and just-in-time adaptive interventions (JITAs) present such innovative solutions. This study aims to fill the still existing gaps in contemporary research by assessing user experience and adherence to an EMI in the context of a pilot study using micro-randomized trials. The main study involved a sample of 72 participants from, mainly but not exclusively, the Netherlands and Germany, who engaged in 16-days of intervention featuring exercises from Cognitive Behavioral Therapy (CBT), Positive Psychology (PP), and Acceptance Commitment Therapy (ACT). With 16 participants partaking in follow-up interviews, this study employed a qualitative design and thematic analysis to assess participants user experience with and adherence to the EMI. Results indicate that participants generally found the exercises of the EMI clear and feasible, although external factors like social settings and stress impacted exercise completion. The desire for a more personalized experiences that would include progress tracking was mentioned by participants as a key factor that could further enhance their adherence. Future research should focus on enhancing feasibility, personalization, and optimal exercise timing. The findings of this study emphasize the need for tailored interventions and advance our understanding of user experience and adherence in EMIs with the goal of building towards effective JITAs.

1. Introduction

In an era marked by the omnipresence of digital technologies, the intersection of psychology and technology has given rise to innovative interventions aimed at enhancing mental well-being. As mental illnesses such as depression and anxiety are highly prevalent and are associated with a high socioeconomic burden, there is a need for scalable and economically viable solutions for treating these mental health conditions (Pourahmadi et al., 2019). However, a significant challenge in implementing digital mental health interventions (DMHIs) such as EMIs or JITAs still lies in facilitating and understanding the predictors of user adherence and a positive user experience.

1.1 Ecological Momentary Interventions (EMIs) and JITAs

Ecological momentary interventions (EMI) have gained prominence in recent years as they can be implemented as intervention tools for a variety of health behaviors, psychological and physical symptoms, and present scalable solutions for integrating therapy into daily life (Heron & Smyth, 2010). Research indicates that EMIs are well-accepted by users and patients and can be effective in treating a wide variety of health behaviors, as well as physical and psychological symptoms (Heron & Smyth, 2010). In addition, recent research has shown that EMIs in combination with smartphones can be utilized to deliver cognitive-behavioral therapy (CBT), relaxation exercises, and mindfulness practices based on the user's current needs, and are able to be integrated into the daily routines of users, thus making EMIs more engaging and potentially more effective than traditional interventions that require scheduled sessions (Loo Gee et al., 2016; Schueller et al., 2017; Balaskas et al., 2021).

However, the delivery of these interventions often lacks personalized elements and is frequently delivered in a generic manner. Just-in-time adaptive interventions (JITAs) address this by offering a type of intervention strategy designed to provide timely and personalized support and assistance based on an individual's specific needs and context. JITAs represent an advanced approach in health technologies that use the principles and foundation of EMIs

but take them further to provide more sophisticated and tailored health interventions. JITAs are promising for the realm of mobile health (mHealth) due to their capacity to adapt to an individual's changing conditions and contexts in real-time. In addition, they have been proven to be effective in the context of reducing stress and improving individuals' mental well-being (Nahum-Shani et al., 2018).

1.2 Adherence and User Experience in DMHIs

1.2.1 Adherence

While digital mental health interventions (DMHIs) such as EMIs and JITAs have shown to be sufficient in terms of cost and accessibility and are a promising tool in addressing common mental health disorders, a problem which still remains in such DMHIs is the lack of sustained adherence, as user engagement varies, in regards to initial uptake and ongoing interactions of users with these interventions (Borghouts, 2021). This poses a problem for the designers as well as the users of the technology platform as the intervention is unlikely to reach its intended effect when not used for and adhered to the recommended period of time (Torous et al., 2018; Melcher et al. 2020). Also, Triberti et al. (2018) are emphasizing the importance of acceptance and adherence in facilitating the adoption of DMHIs and come to the conclusion that such interventions need to be used in the intended way in order for them to be effective.

In the context of assessing the reasons behind adherence and non-adherence, intrinsic motivation has been found to be a predictor in multiple different reviews. Intrinsic motivation can be defined as engaging in an activity for its inherent satisfaction, fun or challenge, rather than for external rewards or pressures. It involves spontaneous behaviors driven by curiosity and positive experiences (Ryan & Deci 2000). In a study using structural equation modeling, perceived self-determination and within that internal locus and internal volition have been found as key determinants in predicting and thus facilitating intrinsic motivation, more so than perceived choice (Reeve et al., 2003). Returning to the link between intrinsic motivation

and adherence, Richard et al. (1997) highlighted the importance of intrinsic motivation as a predictor of sustained exercise adherence. Also, in a study that assesses adherence in an e-health intervention, in the context of examining individual and household predictors of adolescents' adherence to a Web-based lifestyle intervention, Mâsse et al. (2015) found intrinsic motivation as one major factor that directly predicted adherence.

Nevertheless, research on the contextual factors behind adherence and long-term engagement with DMHIs is still in its infancy. This means that while research has been done on the factors that influence motivation and adherence, a comprehensive understanding and systematic approaches to address these factors in personalized digital mental health interventions, such as EMIs and JITAs, are still developing. As Jakob et al. (2022) state in a comprehensive literature review, understanding the factors behind adherence is necessary in order to improve the effectiveness of digital mental health interventions, but it yet remains to be an area that is underexplored in contemporary research. The review by Jakob et al. (2022) highlights the need for more research to identify and understand the predictors of adherence to DMHIs. Also, the study by Shams et al. (2023) underlines that examining adherence to eHealth interventions calls for further investigation into specific factors that influence adherence, indicating that our current understanding is still in its developmental stages. Studying motivation and adherence to DMHIs and the potential reasons for non-adherence is thus the first step in reaching the overarching goal of designing effective interventions, as an optimized adherence helps to realize interventions intended effects (Tremain et al., 2020).

1.2.2 User Experience

A gap in contemporary research does not only exist in understanding the factors and predictors behind adherence but also in the intricacies of user experience in DMHIs, which represents another important predictor for adoption and sustained use (Alquahtani et al., 2020). User experience encompasses various different aspects such as usability, acceptability, feasibility, and satisfaction, and is essential for the effective adoption and sustained

engagement of users in DMHIs (Alruwaili et al., 2023; Borghouts et al., 2023). Thus, addressing these elements of user experience is crucial for enhancing the overall impact and success of DMHIs such as EMIs and JITAs.

By applying a realist evaluation methodology, the study by Postma et al. (2024) find that high accessibility and feasibility of EMIs are essential to a positive user experience as they help to facilitate active participation and integration of the intervention into daily life. In the EMI that Postma et al. (2024) are evaluating they find that overall user satisfaction and acceptance remains high despite occasional technical issues with the intervention platform, while participants mainly value the ability to practice exercises daily and having an increased awareness of their context, feelings, thoughts, and behavior.

In a study aiming to introduce and evaluate a novel Ecological Momentary Assessment (EMA) method to better capture and analyze user experience in DMHIs, the importance of user experience for higher user engagement is emphasized. This increased user engagement is in turn linked to the effectiveness of such interventions and helps to realize its intended outcomes (Lukka et al., 2024). Thus, focusing on improving user experience is central to significantly enhance the success of DMHIs and can be realized through methods like EMA.

In the context of assessing user experience in DMHIs that are aimed at changing behavior, an assessment of whether tasks are feasible and understandable for users play a central role, as they determine user engagement and effectiveness in achieving health related outcomes (Yardley et al., 2015). Also Wong et al. (2021) state that a poor user experience can limit the long-term effectiveness of DMHIs. Thus, user experience, and more specifically the understandability and feasibility of the intervention to users, is an important factor to consider in an overall assessment of the effectiveness of these interventions.

1.3 Micro-randomized Trials

As evaluating the efficiency of EMIs and JITAIs presents specific challenges and traditional randomized controlled trials are often not suitable for these dynamic interventions, there is an increasing demand for new evaluation approaches that can consider the real-time, context-specific nature of these interventions, such as micro-randomized trials (Qian et al., 2022; Dempsey et al., 2015). The research conducted by Battalio et al. (2021) illustrates the efficacy of employing micro randomized trials to create JITAIs. The results provide evidence to advocate for the integration of micro randomized trials into other JITAIs, emphasizing the advantages of real-time adaptability and personalized approaches in enhancing intervention outcomes.

In addition, micro-randomized trials can assist researchers in determining the impact of their interventions, identifying when and for whom they are effective, and recognizing the factors that influence the effectiveness of interventions. By continuously collecting and analyzing data on participant responses to different intervention components, MRTs enable researchers to identify which elements of an intervention are most effective in real-time contexts. This iterative process allows for the fine-tuning and optimization of intervention strategies, ultimately leading to the development of more efficient EMIs and JITAIs (Klasnja et al., 2015).

1.4 Qualitative Approach

With the goal of building towards JITAIs, this study will focus on assessing the user experience and adherence to an ecological momentary intervention in the context of a pilot study using micro-randomized trials. This will be done by conducting qualitative research through conducting follow-up interviews to the main study and applying thematic analysis.

Qualitative interviews allow researchers to get detailed and nuanced insights into individual experiences and perceptions. In addition, such method allows for flexibility in exploring topics and participants perspectives, as sub-questions and interview probes can evolve based on the interviewee's responses (DiCicco-Bloom & Crabtree, 2006). In addition,

while quantitative data provides valuable metrics, it often falls short in capturing the nuanced insights and subjective experiences of participants. Tenny et al., (2022) further emphasize the role of qualitative research in understanding the “how” and “why” of phenomena, by focusing on incorporating open-ended questions. Thus, by applying a qualitative approach this interview study aims to gain an in-depth understanding of the reasons behind a positive user experience and adherence or the lack thereof.

1.5 Research Questions

The first research question that will focus on an assessment of user experience of the EMI will be the following: “How understandable and doable are the exercises of the intervention for participants and what aspects contribute to or hinder participants from having a positive user experience?”. The second research question that will focus on an assessment of participants adherence to the EMI and its exercises will be the following: “How do participants subjectively experience their motivation and engagement with the intervention and its exercises, and what aspects contribute to or hinder their active participation?”.

2. Methods Section

2.1 Participants

The main study comprised a convenience sample of 72 participants, mainly but not exclusively from the Netherlands and Germany, who participated in an EMI lasting for 16-days. These participants volunteered and received incentives in the form of SONA credit points or an Amazon gift card worth up to 50 euros. Following the completion of the main study, which lasted 23 days, a subset of 16 participants was randomly selected for additional follow-up interview. This interview-study focuses on the qualitative insights gathered from the 16 interviews, which were conducted to gain deeper understanding of the participants’ user experience and adherence to the EMI and its exercises. The interview sample included a diverse group of participants with 5 males, 10 females one non-binary person and an age range of 19 to 34 (see Appendix B for detailed demographic information about the 16

interview participants). The names of the participants were pseudonymized to ensure anonymity.

The main study and interview-study were approved by the BMS ethics committee of the University of Twente (approval code: 240007) in accordance with the committee's guidelines. In addition, the study has been pre-registered on the open-source project management tool OSF (<https://osf.io/z645p/>). Participants eligible to take part in the study and willing to participate in follow-up interviews signed a written informed consent form. People that did not meet the inclusion criteria of being over the age of 17 or did not meet the criteria of having at least mild levels of psychological distress as indicated by the Kessler Psychological Distress Scale (K10), were excluded from participating in the study.

2.2 Design and Procedure

This study employed a qualitative design using thematic analysis to explore participants' experiences and perceptions. First of all, potential participants were directed to the study website by QR codes or advertisements they encountered or by seeing and registering for the study through SONA. After showing to be eligible to take part in the study as indicated by the Qualtrics screening questionnaire, participants were briefed about the procedure of the study for approximately 20 minutes by one of the researchers. Next, participants were informed about screening result, and if eligible were invited to a briefing with one of the researchers. In this briefing, participants were introduced to the study, intervention platform m-Path, as well as its exercises by one of the researchers.

2.2.1 Intervention

The pre-intervention period started with one week of short questionnaires being delivered to the participants to get insight into their daily life and well-being. After this week, participants received four types of exercises for each four days in a row. Four assessments were delivered to participants during the first seven days and eight assessments during the following 16 days of intervention.

The first four days of intervention included positive psychology exercises. More specifically participants engaged in an exercise called ‘Gratitude Journal’ (PP) to facilitate the cultivation and appreciation for the aspects of the participants life that they are grateful for. In this exercise participants were asked to list down three things in their current life, that they feel grateful for. In addition, participants were asked to reflect on why they are grateful for these particular things and were also asked to pay attention to the feelings that arise during this process of reflection. The next four days of intervention included an exercise ‘Savouring: Positive Memory’ (PP) which was aimed at helping participants to recall happy memories and their accompanying emotions in much detail to experience positive emotions and decrease negative symptoms. During this exercise participants were asked to think of a memory that made them experience strong positive emotions in the past, and were subsequently asked to reconstruct the memory in as much detail as possible. For the next four days, participants engaged in a ‘Opening up’ (ACT) exercise aimed at aiding participants in coping with and embracing negative emotions and thoughts by letting them pass and neutrally observing them without any attached value or meaning to them. Finally, participants engaged in four days of a ‘Cognitive reappraisal’ exercise (CBT) which focused on the active reframing of participants thoughts to perceive situations more positively in an attempt to modify unhelpful negative thinking.

2.2.2 Interview-study

The follow-up interviews were conducted remotely to accommodate the convenience of the participants. All interviews took place online, allowing participants to engage from the comfort of their homes. Flexibility in scheduling allowed participants to choose a time that suited their availability. In addition, the interviews taking place online allowed the researchers to take steps towards standardized recording and transcription methods.

As to the procedure of these follow-up interviews, the researchers first tested whether audio recording and transcription was working in Microsoft Teams, and then proceeded to ask

participants if they have filled out the informed consent form and whether or not the participant has looked at the information sheet provided to him or her per email prior to the interview. In the informed consent form, participants were asked to tick yes or no boxes relating to having understood and being in accordance with the information provided, which mainly included information about a basic level understanding of the study, risks associated with participation and the use of the information provided by participants in the study. In the information sheet helped participants and served as a reminder before being interviewed about their experience with and adherence to the intervention, ultimately leading to the participants being able to give more nuanced and comprehensive answers. After having given an introduction to the main themes of questions in the interview, the researchers proceeded to start the recording and ask the questions as prepared in the interview scheme.

2.3 Materials; Interview Questions

The follow-up interview included three sections each focusing on different aspects of the participants experience with the intervention. In total 17 questions were asked to assess participant user experience and their motivation and adherence to the intervention and its exercises. The first section focused on the usability and user experience of the intervention and its exercises. The first question being asked was: “Did you find the exercises clear?”, with follow-up questions to explore clarity in depth. The second section aimed at assessing the usability of the intervention and exercises from the participants' perspective. In this section, the first question being asked was: “How doable was it for you to do the exercises?”, with several follow-up questions to identify factors that made the exercises easier or more difficult. The final section was aimed at assessing participants' motivation and adherence to the intervention and its exercises. The first question being asked in this section was: “How motivated were you to do the exercises?”, with follow-up questions to explore motivational factors and changes over time (see Appendix A for a list of all questions and follow-up questions).

The rationale behind the construction of the interview scheme was multifaceted, with the overall aim of obtaining clear and in-depth responses from participants. The questions were crafted to directly address specific aspects of the research objectives by using clear and straightforward language to ensure accessibility and minimize misunderstandings. Predominantly open-ended questions were asked, to get participants to express their thoughts and experiences in their own words to facilitate the capturing of rich and detailed data.

2.4 Data Analysis

The transcriptions of the interviews conducted with participants were uploaded into a Microsoft Teams file. Afterwards the researchers manually looked for and fixed inaccuracies by listening to the recordings of the interviews and correct errors in transcription word for word, in order to prepare them for data analysis. Data analysis was conducted using thematic analysis as a methodological approach for assessing qualitative interview data and identifying as well as interpreting patterns of meaning and recurrent themes in the data (Riger & Sigurvinsdottir, 2016). The software Atlas.ti was used to facilitate the management of interview transcripts and apply the thematic analysis. An initial round of open coding was conducted, wherein segments of the transcripts were systematically examined and assigned descriptive codes to capture key ideas, concepts, and themes. In addition, a comprehensive codebook was developed based on the two research questions and emergent themes from the data. After having established definitions and criteria for each code, the codes were systematically applied to segments of the interview transcript. Finally, themes were identified through a systematic process of reviewing and comparing coded segments across the dataset.

The potential for researcher bias in the coding process was addressed by introducing cross-coder reliability and a discussion between the researchers about the working definitions of codes and themes, as well as their frequencies. Each of the three researchers coded 3 other interview transcripts for each of the other two researchers. Subsequently and if necessary, adjustments were made to the codes and their working definitions by the researchers.

3. Results

A total of 16 participants who completed the 16 days of intervention partook in follow-up interviews. The main themes identified in these interviews were the clarity and feasibility of exercises, participants motivation and adherence to them, changes in their motivation over time, and participants suggestions for improvements (see Table 2 below for a complete list of themes and codes as well as their working definitions and number of occurrences).

Table 2

Codes and Their Working Definitions

Code	Occurrences	Working Definition
Clarity and understandability of the exercises		
<i>Clear</i>	33	Exercises are clear and understandable
Clear layout, structure and formulation of questions	6	Questions of the exercises are well-organized and easy to understand
Systematic and step-by-step progression	4	Logical, sequential order of the exercises
Clear instructions	9	Instructions are easy to follow and understand
Overall satisfaction with clarity and understandability"	19	General satisfaction with how clear and understandable the exercises are
<i>Not clear</i>	3	Instances where exercises were found to be unclear
Feasibility of the exercises		
<i>Doable</i>	29	Exercises and their requirements are feasible and within participants capabilities to accomplish
Notifications as reminders	2	Notifications to remind participants to complete the exercises as enhancing feasibility
Short length of the exercises	5	Exercises are brief and manageable
Systematic and step-by step progression	3	Exercises follow a logical, sequential order
Overall easy to do and convenient	14	Exercises that are simple to complete and fit well into participants' routines

Code	Occurrences	Working Definition
Feasibility of the exercises depended on the type of exercise	3	Feasibility varied depending on the specific exercise
Feasibility of the exercises depended on current stress level	2	Feasibility varied depending on participants' current stress levels
<i>Not doable</i>	27	Exercises that participants' found unfeasible
Being in company with other people	3	Challenges completing exercises when around others
The time at which they receive the exercises	14	Difficulty related to the timing of exercise delivery as impeding feasibility
Circumstantial factors and personal stress	3	External factors and personal stress affecting feasibility negatively
Time limit of exercises	1	The time limit to complete the exercises was too short and would have preferred more time
Motivation and adherence		
<i>Intrinsic motivation</i>	26	Internal motivation to engage with the exercises
Effect of the exercises	16	Perceived impact or benefit of the exercises as a factor within intrinsic motivation
Personal interest in the study	4	Participants' interest in the study itself as an aspect of their intrinsic motivation
Tracking progress and monitoring own emotions	4	Motivation through self-monitoring and tracking progress being mentioned
<i>Extrinsic motivation</i>	7	Motivation from external factors such as rewards or social influences
Change in motivation over time	16	Participants' motivation evolved over the study period
No change in motivation over time	4	Motivation remained constant in participants
Suggestions for improvements		
<i>Suggestions for improvements</i>	52	General suggestions for enhancing the exercises in regards to improving adherence and user experience
Expiration time of exercises	7	Need for clearer deadlines or expiration times for exercises
Increased diversity and variety of exercises	5	Desire for a greater variety of exercises
Availability of self-monitoring	11	Suggestion for options to self-monitor progress over time
More explanations	4	Need for more detailed explanations
More personalization	23	Desire for exercises tailored to individual needs and preferences
More visual features and additions	3	Request for more visual elements and additional features

Code	Occurrences	Working Definition
Timing of exercises	21	Suggestions regarding the optimal timing for exercise delivery

3.1 Clarity and Understandability of the Exercises

A vast majority of participants were satisfied with the overall clarity and understandability of exercises which was based in their clear instructions and step-by-step progression, as well as due to the clear layout, structure and formulation of questions. As Saskia says “Yes, the layout was perfectly clear and the structure of the questions as well. [...] so I didn't have any problems with the app or the layout. “. In addition, Olivia, Finn, Luca, and Allison mention that what made the exercises clear was their systematic and step-by-step progression. Furthermore, Mila says that “the language was quite direct and I really like that you could just answer and it would just automatically move to the next question”. Another reason for the exercises being clear as mentioned by the participants, for example Sophie, Olivia or Johanna, was that there were instructions which aided in their understanding of the exercises and reminded them what to do. In conclusion, while the vast majority of participants found the exercises to be clear and understandable, their answers and the reason as to why differed but were mainly based in their satisfaction with clear instructions, a clear layout and a step-by-step process of the exercises.

3.2 Feasibility of the Exercises

Another recurrent theme within the interviews and captured through the codes “doable” and “not doable”, is that a vast majority of participants find the exercises to be easy to do but mention factors such as being in company with other people, the time at which they receive the exercises or personal stress which ultimately make them more difficult to do.

As Finn indicates “When I was among my colleagues, friends or staff members, finding this moment of silence will be sometimes tricky.” In addition, Sophie says “[...] when

I'm around friends and then this questionnaire pops up [...] it feels odd to just now do a survey. Or if I'm at work [...]". An example for personal factors interfering with the participants ability to do the exercises is the quote of information provided by Noah "I was going to a very negative emotion at that time, so it was difficult to write everything at that time.", and Emily "When I'm very anxious, it's very hard for me to think clearly. So when I'm doing an exercise, I can't focus on doing the exercise because I have so many for racing thoughts and stuff like that [...] ". A recurrent theme that is connected to this is the timing of the exercises as John said "Around the exam week, it's of course a little bit more stressful around those weeks. And then sometimes I would see another exercise pop up and then I would get a bit more annoyed [...]", or Olivia said "I think the timings quite impacted, like when we would get those exercises, that impacted a lot on I how well I could do them." Finn indicates "around the noon and yeah around the date, like 10 to 2 it's not the ideal moment to do the exercise for my experience", or Mila indicates another time preference by saying "Sometimes you had like exercises at 8:30 at 8 something and [...] I didn't do it very often. Too early." And adds "when I was really, really busy, I did not even touch my phone." as another constraint.

In conclusion, while the participants generally found the exercises to be feasible, various contextual and personal factors, such as the timing, social environment, and individual stress levels, had a significant impact on their capacity to complete the exercises. Nevertheless, the structured nature and reminders associated with the exercises facilitated their completion for many participants despite the aforementioned challenges.

3.3 Motivation and Adherence

3.3.1 Intrinsic versus Extrinsic Motivation

A recurrent theme in regards to the type of motivation and adherence in participants, is that the majority of participants partook in the study out of intrinsic motivation rather than extrinsic motivation and were able to sustain adherence. As Saskia said in the interview

“intrinsic motivation here was the biggest part I would say [...] just to see if I can handle myself better at the end of those two weeks.” or as Mila indicated “Because you became aware on how you feel.” when asked about what motivated her to do the exercises over prolonged periods. Within intrinsic motivation, the biggest factor that motivated the 16 participants was the positive effect that specific exercises themselves had on them, as Finn mentioned “the personal experience of the effect after the very first exercises gave me really good motivation to do the exercises in the later days” or Mila that, when talking about the positive effect of the exercises, mentions “This I knew it's good for me, so I will continue. [...] It was not like I will stop.” Also, Julia mentioned “So even though sometimes I got annoyed by it, especially in the evenings or early in the mornings, I still thought that it would be good for me. So then I still kept doing it.”, while Olivia referred to something similar in saying “ [...] it was helpful. The knowledge that it would help me. That's helped me be more motivated to continue.” Not as frequent but still present within the interviews was participants mentioning factors of extrinsic nature as motivating them to engage with the intervention as James said “If I can be honest, the gift card. That's it.” when asked about his motivation behind participating. Also John said “My motivation would be extrinsic. I would say it is not intrinsic. So it's because, well, I promised someone I would do them.”

3.3.2 Fluctuations in Motivation Over Time

While the majority of participants were able to sustain adherence and partook out of intrinsic motivation, fluctuations in motivation and thus adherence appeared in a majority of participants and were also mainly based on the effect that the different exercises themselves had on the participants, as judged by participants themselves, but also factors such as the amount of time an exercise was sent during the day or the repetitive nature of the exercises hampering and consequently leading to fluctuations in motivation and adherence within participants. As Allison said “I was quite motivated, but it also depended on the kind of exercise. So for the positive ones, I was very motivated and I noticed that for the other two

ones, I was a little less motivated.”, or Luca that mentioned “It depends on the purpose of each exercise. The exercise I mentioned before, for some exercise I feel like just a way to make an excuse [...]”. As to the amount of times an exercise was sent and hampering motivation and adherence within participants, Julia mentioned “I think I was more motivated in the beginning than in the end, because sometimes the notifications got a little lot. So I did a lot of exercises throughout the day and that was sometimes a little too much.”

To conclude, the majority of participants in the study adhered to the exercises primarily due to intrinsic motivation, driven by the positive impact of the exercises on their well-being. While extrinsic motivation was less frequently mentioned, factors such as repetitive exercises and the frequency of notifications led to occasional fluctuations in motivation and adherence.

3.4 Suggestions for Improvements; a Personalized Experience

3.4.1 Desire for More Personalization and Self-Monitoring

Regarding the suggestions for improvements of the intervention and its exercises that participants made when asked about what could make them clearer, and more doable, as well as what the exercises would need in order for participants to be motivated to doing them over prolonged periods, they mentioned various factors. Most commonly mentioned by participants was the wish of a more personalized experience, and the wish for self-monitoring to see one’s own progress over time. As Allison mentioned “I would be able to kind of see my own personal results. [...] I think that would be quite interesting because obviously it would show if the exercises had any kind of impact [...] seeing my own progress. I think that would help a lot because sometimes it's like it's hard to really see the progress when you don't really have proof of it. So being able to see to somehow see the progress, I think that would really motivate me to continue it, continue doing it for a longer period [...]”. Also, John mentioned “[...] now it's 23 days I think and it feels very impersonal. [...] it might be nice if you have some like after every week would have some sort of mail or report about how you're doing

right [...] to motivate you. [...] that your progress is being recorded still or that you're on the right track.” Also quotes of James “feedback would be nice. [...] if I have improved”, Luca “[...] you need to monitor the progress so that you can really solve the negative challenges. But if I just come with an idea and I leave it aside [...] it won't last for so long.”, or Victoria “And I feel like it would be nice to see actual progress, your own progress [...]. [...] because that would be more motivating [...]. I feel like for me, if I can directly see a more immediate effect it's always just more motivating.”, point to this recurrent theme.

3.4.2 Timing and Flexibility of Exercises

Additionally, participants mentioned the timing of the exercises in consideration of personal factors that interfere with their feasibility, and asked for an expansion of the time limit of exercises. As Victoria said “[...] if you could just like maybe help with more customizable to the time schedules of the person who's using it so you can like just tell the app OK between these times I'm working it's not possible for me to do this, otherwise you could just keep missing the exercises as well.”, or Luca who said “I think it's only about the timing, so if possible, I can really set up a fixed time period where the notification can pop up. It would be nicer. It can be adjusted to my own schedules.” An example for the wish of an expansion of the time limit of exercises is a quote of Saskia who mentioned “[...]when I was traveling or something, I was a bit annoyed that I can't submit the questionnaire like longer than half an hour later, I would expand the time limit a bit more to let's say an hour. Because, you know, sometimes we don't have my phone. Sometimes, sometimes I'm in the lecture, sometimes I'm in the gym and I don't have it with me all the time [...]. So the time limit was the biggest issue for me anyway.”, as well as Mila who suggested “more flexible time, or to the extent the 30 minutes [...] Reminders for longer intervals.”

3.4.3 Need for More Explanations and More Variety in Exercises

A smaller number of participants also mentioned more explanations and clarifications of terminology used within the exercises, and asked for more diversity and variety in the exercises to address their repetitive nature. As Saskia suggests I think an explanation beforehand of the Likert scale would be better. You know where you state what is 0, what is 1 what is 2 [...]” In regards to the repetitive nature of questions John mentioned “I mean it's so it's quite repetitive. So it's a bit boring in that sense. [...] And I think it might be nice to have it randomly distributed even though if there's an algorithm behind it. [...] it will be nice to even have more diversity in that as well.”, or Jan who suggested “[...] something like more altered questionnaires. [...] So the questionnaires were the same every single day, 23 days. If they maybe changed throughout the day or something like that, it would help to stay motivated. so there would be more change in it.”

To conclude, participants suggested various improvements to the intervention and its exercises, emphasizing the need for a more personalized experience and the ability to self-monitor progress, as these features were seen as key to enhancing motivation and adherence. Additionally, they emphasized the importance of adjusting the timing and expiration of exercises, providing more explanations, and increasing the diversity of exercises to prevent monotony and enhance engagement.

4. Discussion

The primary objective of this study was to investigate the factors contributing to or hindering a positive user experience in the EMI, focusing on the understandability and feasibility of its exercises. Additionally, the study aimed to understand participants' motivation and adherence to the EMI and its exercises, while identifying factors influencing participants motivation to complete the exercises.

The results indicated that the majority of participants found the exercises clear and doable due to the clarity of instructions, layout, simplicity of prompts, and a step-by-step process, leading to an overall positive user experience. However, external factors such as

social settings, time constraints, and personal stress occasionally impeded exercise completion. Timing of exercise prompts, particularly during inconvenient periods, was a common barrier. Intrinsic motivation was the primary driver for sustained adherence, with participants reporting positive effects from the exercises. However, motivation fluctuated based on the perceived value of specific exercises and notification frequency. Participants expressed a desire for a more personalized experience, including self-monitoring features to track progress, which was seen as a major potential motivator for sustained adherence. Suggestions for improvement included adjusting exercise timing to individual schedules, extending completion windows, enhancing clarity with more detailed explanations, and increasing exercise diversity to combat repetitiveness and improve overall user experience.

4.1 Comparison of Results to Existing Research & Other Theories in DMHIs; with Suggestions for Future Research

4.1.1 Clarity and Feasibility; TAM & UTAUT

The findings of this study on feasibility and clarity of the EMIs exercises align with and extend various theoretical frameworks that address user experience in DMHIs. Perceived usefulness and ease of use play a central role in the Technology Acceptance Model (TAM) and present a major predictor for actual usage behavior and adherence (Davis, 1989). This is in accordance with the results of this study as participants found the exercises clear and straightforward, which facilitated ease of use, contributed to a positive user experience and facilitated adherence. In addition, participants mentioned the effect of the exercises as the biggest motivating factor, which translates to the concept of perceived usefulness predicting actual usage behavior in the TAM.

The Unified Theory of Acceptance and Use of Technology (UTAUT) introduces performance expectancy which is akin to perceived usefulness in other technology acceptance models. If users have high performance expectancy, they are more likely to engage with and continue using the intervention (Philippi et al., 2021). This is further highlighted by the results

of this study which show that users want to see and monitor their progress over time to see that the intervention and their exercises are useful to them. Future research should aim to primarily address and focus on further enhancing feasibility of the EMI and its exercises. This is due to the fact that, as judged by participants feedback the biggest potential for further improvements lies in this area, more so than in the clarity and understandability of exercises which already seemed to be sufficient.

4.1.2 Motivation and Adherence

As indicated in the results section, participants mentioned the effect of the exercises themselves as the main factor of their motivation, as well as the main factor for their sustained adherence, thus validating the used framework for this study which points to motivation as the main predictor for adherence (Richard et al., 1997; Mâsse et al., 2015). Stout & Barto (2010) define intrinsic motivation as a system that receives internal rewards for learning progress, which drives the agent to improve its skills and competence within its environment. This is in accordance with the results of this study as the vast majority of participants mentioned to be intrinsically motivated, and also mentioned progress tracking as an essential element that could further enhance their motivation and adherence to doing the exercises. In this context, future research and specifically longitudinal studies, are needed to assess sustained adherence to and long-term effects of the EMI.

4.1.3 Suggestions for Improvements; a Personalized Experience

The desire for a more personalized experience and the ability to track progress was a central aspect in participants suggestions for improvements. This desire presents an overarching narrative throughout the results as participants emphasized that the lack of personalization, particularly the lack of being able to adapt exercises to their personal circumstances, affected feasibility, motivation, and adherence. The results of a study by O'Driscoll et al. (2024) suggest that self-monitoring behavior through Ecological Momentary Assessment (EMA) and a MCII-strategy can aid in goal reprioritization, where goal pursuit

itself drives further goal pursuit. In this sense the sustainment and enhancement of goal pursuit is emphasized as essential, which is in accordance with participants wishes for improvements to this study's EMI and their wish for progress tracking. In this sense, future research should explore customizable intervention features, such as self-monitoring tools which enable a more personalized and motivating experience.

Additionally, other suggestions for improvements made by participants also form the basis for future research to build on and to investigate further. More specifically, future research should also aim to incorporate an expansion and flexibility of time windows for exercises as well as an increased diversity in exercises. Nevertheless, what is still relevant in this context for future research to discuss is balancing engagement and convenience with rigorous research designs in EMIs, as letting people chose when to do the exercises of the EMI would address participants need for more personalization and flexibility but would contradict the study design which employs micro-randomized controlled trials (micro-RCTs). Future research should aim to address this dilemma by attempting to find a middle ground where user preferences are partially accommodated without compromising the basis of the experimental design. Finding this middle ground and being able to address the participants suggestions for improvements could in turn could contribute to more effective, personalized, and engaging EMIs and JITAIs, leading to better user experience, adherence and overall mental-health outcomes.

4.1.3 Divergence from Existing Research

4.2.3.1 Social Connectedness. A divergence of this study's findings from findings of current research and theories can be noted as social connectedness, the ability of users to interact with other people and social support within the DMHI, is often mentioned as an important factor for DMHI engagement, which has not been noted by participants in this study (Schueller et al., 2017; Borghouts et al., 2021). For instance, the Efficiency Model of Support by Schueller

et al. (2017) states that provision of human support in the context of DMHIs is essential as such technological interventions are more efficient in reaching intended outcomes when used in combination with human support that goes along with it. Also in the previously mentioned Unified Theory of Acceptance and Use of Technology (UTAUT), social influence is mentioned as a main predictor for acceptance of DMHIs (Philippi et al., 2021). Also, from the perspective of self-determination theory, which includes relatedness as one key aspect, the role of social connectedness in facilitating the success of and adherence to DMHIs, would be emphasized (Ryan & Deci, 2000). Based on this divergence between this study's findings and existing research, future research could investigate whether the incorporation of tools fostering a social and communal element in EMIs has indeed no effect or if it could further enhance user experience and adherence to EMIs.

4.2.3.2 Challenges Faced by Participants During High-Stress Periods. Participants indicated that they often felt unable to complete exercises during high-stress periods. This shows that optimal timing and personalization of exercises is essential, but also may indicate a contradiction with the contemporary conceptualizations and design of EMIs and JITAs. Often, EMIs and JITAs are constructed in a way that they provide support during exactly such high-stress periods in which participants of this interview-study often felt unable to complete the exercises. Based on this contradiction, future research might reconsider the rule of delivering prompts during high-stress periods and further investigate optimal exercise timing.

Mohr et al. (2017) introduced personal sensing, which involves collecting and analyzing data from daily life sensors to monitor mental health, laying the groundwork for innovative DMHIs. Future research on combining personal sensing with EMIs could help optimize timing and stress detection to address participants' concerns. In addition, reinforcement learning models could improve intervention delivery by considering timing and frequency of intervention exercises (Gönül, 2018; Nofshin et al., 2024). Integrating personal sensing and reinforcement learning models could enhance the effectiveness of interventions

by aligning them more closely with participants needs and stress levels. In this sense, future research could focus on reconsidering and optimizing exercise timing and personalization in EMIs and JITAs.

To conclude, other models in DMHIs such as the TAM and UTAUT confirm the role of feasibility and clarity of exercises to a positive user experience and further emphasize the potential role of progress tracking tools. A divergence from existing research can be found in regards to the importance of social connectedness in contributing to the success of DMHIs, as indicated by theories and models such as self-determination theory or the Efficiency Model of Support. In addition, participants indicating to feel unable to complete prompts during high stress periods might challenge the rules by which EMIs and JITAs are currently being conceptualized and designed. Future research should focus on conducting longitudinal studies and potentially incorporating the suggestions for improvements made by participants in this interview-study.

4.3 Limitations

Several limitations must be acknowledged to contextualize the findings and guide future research. The interview study employed a random subsample of 16 participants primarily from the Netherlands and Germany, which may limit the generalizability of the results, due to geographical and cultural specificity and the relatively small size of the sample. In addition, some participants may have provided inaccurate reports of their psychological levels of distress or adherence to the intervention due to social desirability or memory biases. This limitation could be addressed by incorporating more objective measures and cross-referencing self-reported data with other sources. An additional concern might be the remote data collection, as the lack of face-to-face interaction may lead to missing contextual nuances like non-verbal cues and may thus have led to difficulties in interpreting data accurately during thematic analysis. In this regard, future studies might consider hybrid approaches that combine online and in-person methods.

4.5 Conclusions

The results of this study reveal that while participants generally found the exercises clear and feasible, external factors such as social settings and personal stress occasionally impeded their ability to complete them. Intrinsic motivation emerged as the primary driver for adherence, with participants emphasizing the importance of seeing tangible progress and having a personalized experience. The findings highlight the interconnectedness of feasibility, motivation, and adherence, emphasizing the need for personalized interventions to sustain long-term engagement. The desire for features such as self-monitoring and flexible timing underscores the importance of aligning the intervention with individual schedules and needs. By addressing these factors, future research can improve the effectiveness and user experience of digital mental health interventions, aiming to enhance mental health outcomes and user satisfaction. The results of this study lay the groundwork for developing more personalized, engaging, and effective interventions, by advancing our understanding of user experience and adherence in EMIs.

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Appendix A

Table 1

Interview Questions Used in the Study

Question Number	Interview Questions
1	Did you find the exercises clear?
2	Was it clear for you how to do them?
3	What made them clear?
4	What could have made them clearer?
5	How doable was it for you to do the exercises?
6	What things made it easier to do an exercise?
7	What things made it more difficult to do an exercise?
8	Were there any moments where you did find the exercises particularly helpful, or unhelpful?
9	What would have made it easier for you to do an exercise?
10	How motivated were you to do the exercises?
11	What motivated you?
12	Did your motivation change over time?
13	How could you have been more motivated?

14	What factors influenced your motivation to do the exercises?
15	Can you recall any instances where you felt tempted to stop doing the exercises?
16	What motivated you to continue?
17	What would the intervention and its exercises need in order for you to stay motivated over prolonged periods?

Appendix B

Table 3

Demographic Information of Interview Participants

Name (pseudonym)	Age	Gender	Nationality
Finn	32	Male	Sri Lanka
Olivia	19	Female	France
Julia	22	Female	Germany
Sophie	23	Female	Germany
Noah	34	Male	India
Emily	20	Female	Germany
Elena	23	Female	Latvia
James	24	Male	Indonesia
Allison	23	Female	Germany
Jan	23	Male	Germany
Victoria	23	Female	Netherlands
Luca	23	Non-binary	Vietnam
Mila	21	Female	Luxembourg
Johanna	21	Female	Germany
Saskia	20	Female	Belarus
John	21	Male	Netherlands