Book Chapter

Innovations to enhance engagement and efficacy in a mHealth psychological intervention targeting grief: Lessons learned and future directions

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1. Introduction

Mental health issues are a significant challenge worldwide, with an estimate of 1 in every 8 people, or 970 million people around the world, experiencing a mental disorder during their lifetime [1]. The digital revolution has opened new avenues for delivering psychological interventions to improve mental health issues via the Internet. Internet-based psychological interventions (IBIs) are a type of mHealth interventions and are defined as " treatments that are mainly delivered via the Internet with at least some therapeutic tasks delegated to the computer"[2]. Cognitive-behavioral therapy is the most employed and researched type of IBI (ICBT) [3–5].

The use of IBIs has several advantages over conventional face-to-face interventions, such as cost-effectiveness, accessibility, flexibility in time and place of delivery [6–9] and even anonymity [10]. Indeed, mHealth psychological interventions can be accessed from any location with an Internet connection and can be delivered at a lower cost, making them more accessible to those with limited financial resources or underserved populations, particularly in rural areas [11]. Moreover, they allow both patients and clinicians to work at their own pace and reduce the stigma of having a mental disorder or going to a psychologist or therapist [6,12].

IBIs can be classified into three categories based on their format and delivery mode: self-guided, therapist-guided and blended interventions [13]. Self-guided interventions are fully automated and designed to be self-administered without therapist support. Therapist-guided interventions involve a trained mental health professional who provides different levels of support and feedback through email, brief phone calls or short messages [14] on top of the online program. Finally, blended interventions combine face-to-face sessions with Internet-based sessions into one integrated treatment [15,16].

A large amount of randomized controlled trials (RCTs) [17,18] and meta-analyses suggest that IBIs are effective for treating a wide range of mental health conditions [19–21]. However, most studies in this field show that therapist-guided interventions report a higher efficacy compared to self-guided ones and achieve equivalent effects to face-to-face therapy psychotherapies [22–25].

However, despite the evidence supporting the effectiveness of IBIs, their implementation can be challenging. A significant problem that arises in IBIs is high dropout rates, particularly in self-guided interventions [26,27]. Indeed, engagement tends to be highly variable and inconsistent, leading to problems in retention, data quality and clinical impact [28]. Evidence suggests that attrition rates for IBIs are quite high with an average dropout rate around 40% [26,29]. Research on non-usage attrition has demonstrated an initial rapid decline in program use over the first few weeks, with most attrition occurring within the first month of the intervention [30]. Eysenbach [31] proposed the term "law of attrition" to describe the phenomenon of participants dropping out of IBIs at a higher rate. Self-administered IBIs suffer from higher attrition than guided IBIs [22]. The reasons are complex and multifaceted [22,32].

Several factors to improve adherence to IBIs have been identified, such as reminders to visit or return to the website, or to complete research data [31,33–35]. Adherence operates on two levels: within the IBI itself and within the research project [31,36]. Adherence to the IBI refers to the extent to which participants comply with and follow the guidelines and recommendations of the Internet-based treatment or program [32]. This includes their willingness to engage with the intervention, their level of completion of the recommended activities, and their

overall commitment to the program. Adherence to the research project refers to the extent to which participants adhere to established procedures during a study, including their commitment to completing questionnaires and providing feedback at different stages of the study. Adherence is essential for ensuring that research findings are reliable, valid, and can inform clinical practice and policy [28]. Moreover, adherence to the program is crucial for maximizing the effect of the intervention, the primary objective of which is to improve mental health [37,38].

Given the importance of adherence for the success of IBIs, it is crucial to design interventions that are user-friendly, engaging, and that address the challenges faced by individuals seeking mental health care. By doing so, we can improve adherence rates and therefore maximize the potential impact of such interventions. However, despite the increasing use of IBIs, guidelines for successful implementation are lacking [39].

1.1 Our project

Hereafter, we present our experience with LIVIA 2.0, a cognitive-behavioral online program for prolonged grief symptoms after bereavement or romantic dissolution. LIVIA 2.0 was developed with the aim to include several innovation to LIVIA, the original program for grief-related symptoms after bereavement or separation, which demonstrated its efficacy in German and in therapist-guided format via an RCT for both bereaved and separated individuals [40]. LIVIA consisted of ten text-based sessions, and covered topics such as emotional reactions in the context of interpersonal loss, obstacles to successful adaptation and possibilities for overcoming them. For more information on the program's content, please refer to Brodbeck et al. [40].

Given that no empirically-assessed IBI for grief existed in French [41], we translated the original LIVIA program from German into French and adapted it into a self-guided program (LIVIA-FR) [42]. Results from a pilot study showed that out of 148 interested individuals, 41 participants completed the pre-test and 29 completed the post-test questionnaire. With 12 people dropping out of the study between pre-test and post-test, the attrition rate was 29.2% for our self-guided program LIVIA-FR compared to the original German program which offered guidance by a therapist, and which had an attrition rate of 13.6%. In terms of psychopathological symptoms, the results showed a significant reduction in grief symptoms (d = .66), and in avoidance strategies (d = .69). Satisfaction with the program was good, with more than two-thirds of participants giving a positive or neutral assessment. The results of our pilot study highlighted a promising tool but also showed weaknesses, which led us to develop an upgraded version called LIVIA 2.0.

LIVIA 2.0 was therefore developed based on theoretical and empirical findings on grief processes and IBIs to improve users' adherence and program efficacy compared to its original version, LIVIA-FR. Regarding the content, LIVIA 2.0 consists of ten sessions. These include an introductory session, a closing session, and 8 sessions in between belonging to 4 modules. Theoretically anchored in the Dual Process Model of Coping (DPM) [43,44], one of the most influential models of coping with loss, each module features a session focused on loss and another on restoration. Indeed, according to the DPM, coping with loss involves two separate and interacting processes: a loss-oriented and restoration-oriented process. The loss-oriented process involves facing the reality of the loss and the restoration-oriented process involves adjusting to an environment without the lost person. The DPM postulates that to efficiently cope with the loss, people oscillate between the two processes. Therefore, LIVIA 2.0 imitates the oscillation process in the DPM by alternating between loss- and restoration-focused sessions. The modules have the

following main themes: cognitions, emotions, behaviors, and identity. The sessions involving these modules are composed of psychoeducational information and exercises. In each session, participants can choose between 3 variations of an exercise (some exercises vary in content, others in duration). They are expected to complete one exercise per session but can complete all 3 available exercises if they wish to. LIVIA 2.0 also contains texts, audio and video files, and interactive quizzes. Participants were able to contact a health professional upon request through a contact button on the program's homepage. For more details about the content of each session, please refer to the study protocol [45]. The recruitment for our RCT, which sought to compare the efficacy and adherence rate of LIVIA-FR and LIVIA 2.0 [45] has just been completed. A total of 62 individuals participated in the trial, with 29 participants assigned to LIVIA 2.0 and 33 participants assigned to LIVIA 1. The results showed that 37.9% of the participants in LIVIA 2.0 failed to complete the post-test and dropped out of the program, while 42.4% of the participants in LIVIA 1 dropped out.

This chapter will provide an overview of the five innovations implemented in LIVIA 2.0 and examine their success and relevance for the future of mHealth psychological interventions. It will also present descriptive results regarding their implementation to shed light on the potential benefits they may bring to the field.

2. Innovations implemented in LIVIA 2.0

2.1 Guidance on demand

Recent research has shown that adding guidance to an IBI improves effectiveness and retention rates [38]. However, additional research has nuanced this finding. Indeed, in their meta-analytic review, Moshe et al. [25] showed that guidance has less benefits when implemented in more interactive IBI. Moreover, as shown hereafter, several studies indicate that optional guidance might be a reasonable alternative to weekly guidance. In a large, naturalistic trial testing the effectiveness of five self-help cognitive behavior e-therapy programs for different anxiety disorders, Klein et al. [46] showed that, out of 2660 people who subscribed for an anxiety-oriented online intervention, only 75 (2.8%) chose to have a weekly e-mail guidance, whereas the rest chose a fully automated program. Additionally, a few studies have implemented guidance on demand and compared it to weekly per default guidance. In a RCT assessing the effectiveness of an IBI for social phobia, Berger et al. [17] compared a self-guided intervention group to a weekly therapist-guided intervention group and to a therapist-guided on demand group. The intervention was equally efficient for all groups. In a RCT of an iCBT program for anxiety and depression symptoms, Hadjistavropoulos et al. [47] showed that participants send half as many messages with optional guidance compared to weekly guidance. Moreover, even if optional guidance was associated with more dropouts, the effectiveness was similar to that of the weekly guidance group. Finally, in an uncontrolled trial with a similar program, Hadjistavropoulos et al. [48] showed that, even if only 22% of participants chose optional (vs. weekly) support, both groups achieved similar symptom reduction. This encouraged us to propose a guidance on demand (and not a default weekly guidance) to the participants in our study.

2.1.1 Method

In both our control (LIVIA-FR) and experimental interventions (LIVIA 2.0), participants had continuous access to a contact form when they were logged into their account. We had informed them during the introduction session that they could contact our team of psychologists whenever they felt the need. In LIVIA 2.0, they were additionally reminded on several occasions within the program that they could contact us. We committed to providing an answer within three working days. To analyze the requests for the present paper, we counted as one conversation a request by a participant, the answer from our team and the potential answer of the participant. Two members of our team independently coded the requests according to a predefined coding scheme with the following categories: 1 "technical problem", 2 "understanding problem", 3 "need for support", 4 "announcing the withdrawal from the program". For e-mails from category 3, we applied the Motive-Oriented Therapeutic Relationship (MOTR), an approach which relies on the underlying motives of the patient to guide the therapeutic interventions [49] and has been argued to have the potential to boost the efficiency of the guidance within IBIs [50]. Hence, before responding to the participant, we conducted a Plan Analysis [51], a case formulation method that allows to identify the potential underlying motives of the participant at play, based not only on the content of the e-mail, but also on the responses to the pre-test questionnaires and to the program exercises (when available).

2.1.2 Results

We received an e-mail from 15 of the 29 participants (52%) for a total of 29 conversations. When coding the content of the e-mails, we achieved an interrater reliability of κ = .94. Most requests (12 requests, 57%) concerned technical issues. No participant contacted us for an understanding problem and four (19%) announced their withdrawal from the program. Five requests (24%) concerned specifically a guidance request, stemming from a single participant.

For this participant, we first conducted a Plan Analysis within our team, which revealed two main themes: "*Avoid putting your activities on pause*", which satisfied the plan "*Avoid feeling loneliness and your husband's absence*", and "*Do your best*", which fulfilled the plan "*Avoid showing your vulnerability*". We tailored our response to their initial email to consider these plans. The participant's response was enthusiastic, they followed our recommendations while also sharing more intimate feelings. Afterwards, they contacted us several times during the program, either to ask other questions related to the completion of the program or to share intimate thoughts that the program and our exchange had stimulated.

2.1.3 Conclusion

These results indicate that, when completing LIVIA 2.0, only very few participants asked for support. Only a small percentage of participants contacted us for guidance, and most of the requests were related to technical issues rather than emotional difficulties or program completion problems. While the percentage of participants requiring guidance corresponds to previous studies that reported 48-60% of the participants requiring guidance [17,47], the content of the requests differs with the majority of participants contacting our team for technical support. One possible explanation for this low rate of proper guidance requests might be that we did not remind participants often enough that they could request guidance, contrary to Berger et al. [17]Cliquez ou appuyez ici pour entrer du texte.. Upon detailed consideration, the results of previous studies indicate that participants who are least in need of support are the ones benefiting from a guidance on

demand format. Indeed, Berger et al. [17] showed that those requesting guidance were the ones most involved in the use of the program. Moreover, Hadjistavropoulos et al. [48] found that only people who had lower levels of symptoms chose a guidance on demand over a weekly guidance. It might be that our sample was in higher need of support, be it because of the nature of the symptoms (grief symptoms are associated with more isolation) [52–54], because of the symptom load of the sample, or because of the timing of the research, which occurred after the COVID-19 crisis [41]. Indeed, COVID-19-related isolation was shown to predict poorer cognitive and mental health outcome, as well as less healthy behaviors [55]. Nevertheless, our experience with applying MOTR to our IBI, even though limited, was satisfactory and showed potential to increase alliance and engagement within the program. In sum, relying on the present evidence, we recommend using a default weekly guidance and applying MOTR in IBIs targeting grief symptoms.

2.2 Automated reminders

Several studies have highlighted the positive aspects of using reminders in the context of IBIs. Ritterbrand et al. [56] found that email reminders increased by 45% program logins, while Hutchesson et al. [57] found that enhanced program features, including reminders and tailored feedback, facilitated greater adherence to their Web-based program. Additionally, when given the choice, people prefer to receive reminders to use programs and applications [34,35,58]. Other researchers have found no significant difference between phone and postcard reminders in terms of login frequency, making email reminders a particularly appealing option as they require fewer resources as they are cheap and easy to disseminate [33,59]. Christensen et al. [60] conducted a RCT to evaluate the effectiveness of different types of reminders for an Internet-based mental health intervention. Their study included 5 groups in total: 3 treatment groups and 2 control groups. The treatment groups received either email reminders, telephone reminders, or combined email and telephone reminders, while one control group received a placebo Website without any reminders and the other control group received the placebo Website with telephone calls. Participants in the website condition with email reminders group had the highest login frequency of 6.8 times per week, followed by the combined email and telephone reminder group with 4.8 times per week, the telephone reminder groups with 4.4 times per week, the control group with the placebo Website without reminders with 3.6 times per week, and the control group with calls reminders had the lowest login frequency with 3.3 times per week. In sum, the researchers of the study found that email reminders were the most effective and efficient way to promote adherence to the IBI. Additionally, the website with email reminders was the most preferred program among all conditions. These results highlighted the importance of considering participants' preferences and the use of cost-effective methods in the design of IBIs to enhance adherence [60].

Regarding the frequency of reminder delivery, Fry and Neff's [61] systematic review uncovered that reminders sent at a periodic interval minimized the use of assistance from a health professional resource. Schneider et al. [30,62] also highlighted the importance of temporality by showing that reminders sent at the beginning of the intervention are the most relevant. Indeed, they noted that participants who received an email two weeks after their first visit logged in to the program significantly more often compared to participants receiving the email after six weeks.

2.2.1 Methods

For LIVIA 2.0, in an effort to enhance participant retention, automated emails were sent a) when a new session becomes available and b) if the participant has not logged into LIVIA 2.0 for seven consecutive days. Regarding adherence to the research project, a total of six reminders could be sent per participant during the study, including three reminder emails at each stage (pre-test and post-test) before they were deemed to have dropped out. For the present paper, we counted the number of reminder emails that each participant received directly from LIVIA 2.0. The emails function was to notify either: (a) the opening of a new session, or (b) the observation of a non-connection to the program. For the automated research emails, we also counted the number of emails sent per participant at each stage of the research project.

2.2.2 Results

Regarding emails sent to increase program adherence, the LIVIA 2.0 program automatically sent 231 emails in total to 27 participants to notify them that the new session was available. More precisely, out of 8 people who completed the entire study, an average of 17.75 (min = 17 and max= 19) emails were sent. For the remaining 19 participants, an average of 4.68 (min = 1 and max= 16) emails were sent for an average of 2.26 (min = 0 and max = 5) modules completed. In addition, 107 emails in total were sent to 27 participants to notify them that they had not logged in in 7 consecutive days. More precisely, out of 8 people who completed the entire study, an average of 6.88 (min = 2 and max= 14) emails were sent. For the remaining 19 participants, an average of 2.89 (min = 1 and max= 8) emails were sent.

Regarding adherence to the research project, at the pre-test stage, we sent 5 reminders to 5 different participants. 22 participants needed no reminders to fulfill the pre-test questionnaire. In summary, 27 participants completed the pretest after receiving at the most one reminder. For the most committed participants in the project and program, 8 participants, who completed the entire program (all modules), needed no reminders to complete the pre-test questionnaires. At the post-test stage, we sent 36 automated reminders to 27 participants. 11 participants needed no reminders to complete the post-test questionnaires, 5 participants needed one reminder, two participants needed two reminders, and 9 participants received three reminder emails and did not complete the post-test questionnaires. In summary, 18 participants completed the post-test after receiving at the most two reminders. Out of 8 participants who completed both the post-test questionnaires and all the modules of LIVIA 2.0, 5 of them did not need any reminders, 2 participants needed 1 reminder and 1 participant needed 2 reminders. Importantly, one participant decided to stop participating in the project, mentioning that they felt pressured because of the multiple emails they were receiving.

2.2.3 Conclusion

The analyses have led us to make several conclusions regarding the use of automated reminders to increase adherence to IBIs. Firstly, the results indicate that a substantial number of reminders were sent to participants, with varying effects on adherence. While some participants completed the program successfully without any reminders, others required multiple reminders. It is therefore important to strike a balance in the frequency of reminders to avoid overwhelming participants and potential negative effects. Our study acknowledges that it is difficult to determine the exact impact of reminders on completion rates within the

LIVIA 2.0 program. Limited information is provided on the individual responses and experiences of participants, except for one participant who mentioned feeling pressured due to multiple emails. Further research is needed to gain a better understanding of the specific impact of reminders on adherence and participant experiences. Despite the potential negative effects experienced by a minority of participants, the cost/effectiveness ratio of implementing automated reminder emails remains attractive. The majority of participants appeared to benefit from reminders. Researchers are encouraged to consider the overall positive impact of reminders while being mindful of potential negative effects and participant experiences. Finally, it is strongly recommended to monitor the frequency of emails received by participants from different sources. Tracking the number of reminders and the sources they originate from can help researchers ensure that participants are not overwhelmed with excessive reminders. Monitoring the frequency will also help identify patterns and optimize the reminder strategy for better participant engagement.

2.3 Tailored recommendations and exercise selection

Tailoring is the process of designing customized communications by collecting and evaluating personal data to determine the most appropriate information or strategies to meet an individual's specific needs, preferences, and characteristics [63]. It has been found that tailoring individualized messages for each participant can be more effective than presenting generic information in terms of program engagement, self-efficacy and health behavior improvement [64]. Tailored information is more likely to be processed more intensively, remembered and perceived as personally meaningful than generic information [65]. It could be argued that some degree of tailoring may be needed for people suffering from the loss of a loved one, as each significant relationship and path with the grieving process is unique.

2.3.1 Methods

To enhance program adherence and to address the observation that participants tend to open most of the modules at the beginning of the program to see what it offers before selecting which module they want to start with[1], we developed personalized recommendations about the order in which to complete the modules in LIVIA 2.0. Automatic and personalized recommendations (e.g., start with the "Emotion" module, followed by the "Behavior" module, etc.) were made based on a questionnaire in which each participant had reported their program goals and priorities in the introduction module (see Table 1). The program recommended the modules in order of their importance for each participant. Regardless of their answers to the questionnaire, participants were able to choose the completion order freely. This implies that all participants did not experience the same navigation journey to complete LIVIA 2.0. The aim of this innovation was to evaluate the tailored recommendations based on participant goals and priorities, hypothesizing it would enhance program adherence.

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[1] We made this observation in our pilot study with the LIVIA-FR program [42].

Moreover, another level of tailoring was applied within the navigation of each module, where three choices of exercises were offered so that participants could select the exercise they felt suited their needs the most. For instance, in the loss-focused session in the Emotion module, participants had the choice between three audio exercises: (1) a 5-minute self-compassion break, (2) a 12-minute acceptance exercise, and (3) a 20-minute emotion awareness exercise. The answers generated by the program were different according to the exercise chosen and the participants' answers.

2.3.2 Results

Results showed that of the 29 LIVIA 2.0 participants, 8 (27.6%) completely finished the program and 21 (72.4%) did not; 6 (20.7%) followed the module recommendation order, 8 (27.6%) did not, and the data for 15 (51.7%) were not available as the participants did not pursue the program far enough to extract this information. Regarding drop-outs, these happened for 11 participants during the Introduction session, for 4 during the Emotion module (all occurred during the session dealing with loss), for 3 during the Behavior module (1 occurred during the session dealing with loss, 2 during the restoration session), for 2 during the Cognition module (1 occurred at the very beginning of the module, 1 occurred during the session dealing with restoration), and for 1 during the Identity session dealing with loss.

The module recommendation order was very diversified among the 17 participants for whom the recommendation order was provided, with 10 different orders established. The most common orders were "Cognition-Emotion-Identity-Behavior" and "Cognition-Identity-Emotion-Behaviour", both of which were the recommendation order for 3 participants. The Cognition module was suggested most frequently as the first choice for 9 participants, followed by the Emotion (5), Behavior (2) and Identity (1) modules. The Behavior module was most frequently recommended as the last module to be completed for 10 participants, followed by the Cognition (3), Emotion (2) and Identity (2) modules.

Regarding the selection of the exercises within a session, 67% of the participants completed one exercise, 16% completed two, and 16% completed all three. Generally, the first exercise proposed was the most often selected in every session.

2.3.3 Conclusion

The recommendation order was very diversified among participants, even with a sample size as small as ours. Therefore, no specific participant profiles or individual differences may be extracted. Nevertheless, this indicates that participants have a great diversity in their priorities when completing an IBI. However, some tendencies can be outlined. For more than half of the sample, the Cognition and Behavior modules were recommended as the modules to start and finish with, respectively. Approximately half of the participants (42,8%) followed the recommended order. Future research could help better understand how participants experience this specific kind of tailoring. For example, why did some participants not follow the recommended order? Is the endorsement of the recommendation associated with the outcome?

Finally, regarding the selection of the choice of exercises within a session, the experience of the present study indicate that most participants selected only one exercise and chose the first one available. Thus, if program developers have limited means to develop the content, we would recommend proposing a single exercise per session.

2.4 Assessment and promotion of personal resources

Clinical psychology and psychotherapy have long offered methods based on the principle of resource activation in patient assessment, treatment planning and psychological interventions [66,67]. Problem-solving technique and solution-focused approaches are two classic examples of effective psychotherapeutic intervention that build on this paradigm in individual and family psychotherapy [68−70]. Picked up in particular by the positive psychology approach, identifying and especially mobilizing people's resources are seen as important vectors for change and well-being [71]. These principles are also echoed in internet therapies and chatbots [72].

There are few psychometric instruments, especially in French, that provide a broad profile of a person's individual resources (psychological and social) which do not focus on specific positive skills or dispositions (coping, optimism, creativity, gratitude, forgiveness, etc.) or which does not rely on very long inventories to assess a full range of resources, such as Seligman's Values In Action assessing character strengths [73,74].

AERES addresses these gaps. It is a resource self-assessment instrument based on card sorts and a semi-structured interview, initially developed and validated with a population of patients with chronic psychiatric disorders [75]. It allows the identification of three types of resources: the individual's personal qualities, their leisure activities and passions, and their external resources (social and environmental). The sorting is done for each type of resource in two steps: first, the person selects all the resources they believe they have, and then they take each resource and evaluates its effectiveness for their personal recovery. For each selected resource, the person indicates the extent to which it contributes to their well-being, and whether it is useful, especially when they are not feeling well. This evaluation allows to distinguish the present/absent resources and, among the present resources, the ones that can be mobilized and the ones that are effectively mobilized for the recovery or restoration of well-being.

We integrated a computerized version of AERES in LIVIA 2.0, whereby participants completed it during the introductory session. The self-assessment of resources process was simplified to reduce its duration and thus limit the length of the first program session. Nevertheless, it pursues the usual goals of this type of task: firstly, to complement an otherwise problem- and symptom-focused clinical assessment with a more positive view of oneself; secondly, to encourage the use of personal resources to cope constructively with negative events or challenges; and thirdly to stimulate the use of resources in case of difficulties encountered during an intervention (e.g a tedious, painful or stressful exercise in the program). For this reason, participants were able to access their personal resource profile at any time by clicking on a dedicated button.

2.4.1 Methods

A computerized version of AERES was developed within the LIVIA 2.0 program and was proposed in the introductory session. Compared to the original tool, only the sorting of cards illustrating the resources was retained. As the computer tool obviously does not allow to carry out a semi-structured clinical interview, this part of the AERES was removed. The instruction on the usefulness of each resource was adapted to focus attention on grief management (and not recovery in the more general sense of the term). The sorting of the cards was expected to take 3-5 minutes. It resulted in a personal profile that was presented in three independent sections (leisures and passions, social and environmental resources, personal qualities). In each section, the participant could see all the

cards that they considered as personal resources and then their classification according to their usefulness in the management of grief. No comments or graphics accompanied this pictorial and synthetic presentation.

2.4.2 Results

Of the 29 participants, 17 people completed the AERES in the introductory session (the 12 who did not also did not go further in the program). Eleven people reported having a total of more than 20 resources, four people between 18 and 20, and three between 14 and 16. Except for one person who indicated having only 3 personal qualities, there were at least 4 resources listed in each of the three areas. On average, the participants checked off 6.7 leisure/passions resources (*SD* = 1.7, min. 4, max. 9), 6.2 socio-environmental resources (*SD* = 1.2; min. 4, max. 8) and 8.9 personal qualities (*SD*=2.8; min. = 3, max. = 12).

As shown in Table 2, the most cited personal qualities are humor (16x); courage, curiosity, and perseverance (15x); reflection, gratitude, and hope (14x). The least cited resources are optimism (7x) and self-confidence (9x). Regarding socio-environmental resources, family and nature (16x) along with acquaintances and friends (15x) are the most selected ones; health professionals are the least cited (3x) with romantic relationships (7x anyway) and pets (6x). Playing sports (16x), travelling (15x), watching TV / listening to the radio / surfing the internet (15x) are the most frequently mentioned leisure activities. Creative activities (plastic arts, 7x), playing games and singing / playing music (8x) are the least frequently reported of this category. Compared to the data collected from 213 psychiatric patients [76], the profiles observed here show that our participants have more resources overall. In terms of personal qualities, our participants mentioned more often than the psychiatric patients having humor, courage, curiosity, perseverance, reflection, or spirituality; they reported as much self-confidence, wonder, listening to one's body or hope, but less optimism and gratitude. We also observed significant differences in the socio-environmental resources, where our sample ticked off more of these resources than the psychiatric patients, except for health professionals (who were naturally less present because the people receiving therapy could not take part in the study), romantic relationships or pets. In terms of hobbies/passions, the differences are mainly in favor of our sample, except for cooking and games, which seem to be less practiced.

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Once the AERES was completed, 7 of the 17 people clicked at least once on their resource profile during the program: 3 returned once, 1 twice and 4 three times. Unfortunately, it is not possible to know at what times and for what reasons these participants revisited their resource profile, knowing that this could have been part of one or another LIVIA 2.0 exercise or a tip given by the program in case of difficulty in completing an exercise.

2.4.3 Conclusion

Once the AERES was completed at the beginning of the program, it must be noted that the personal resource profile was consulted rather rarely by the participants. Even though the principle of providing a reminder of one's own resources at any given time could have been considered relevant, particularly in the case of difficulty in accomplishing certain tasks, its implementation remained unsatisfactory in view of the low number of times that participants explicitly and

purposefully called upon their personal resources. Should we conclude that the self-assessment of personal resources is not relevant in this context and may not be included in an IBI?

In clinical practice the original AERES is supplemented by a semi-structured interview that is particularly important because it stimulates recovery by focusing attention on new perspectives that are not necessarily focused on difficulties or problems. A points not retained in the computerized form is the selection of resources that the person wishes to develop or discover, which opens up a whole field of positive recovery-oriented interventions. The standardized nature of LIVIA 2.0 obviously did not allow this option to be explored. Apart from the few exercises that mobilize the results of the AERES, the availability of this inventory therefore remains largely unused and does not resolve the paradox associated with all resource-based interventions: if people are able to identify and mobilize their resources to solve their difficulties, they do not need the help of a therapist. It is doubtful that a relatively standardized program that simply brings out a list of resources is sufficient to bring about significant change. In this sense, it would probably have been more relevant to have the profile carried out at the same time as the exercises significantly require the use of personal resources, in order to optimize the profiles obtained from the outset. The exercise could also be split up to better focus attention on each of the resource areas. By being briefer, and more focused on a particular aspect of one's own resources, the person may have more opportunity to reflect on the presence and mobilization of their strengths to better deal with both the painful aspects of the loss and the new perspectives that it opens up in their life.

2.5 A Module Focused on Identity and Autobiographical Memory

Autobiographical memory, which refers to memories from the past personal experiences, plays a crucial role in social interactions [77], helps us plan the future [78], and shapes our emotional experiences [79]. Our personal memories are also intertwined with our sense of self and help us understand who we are [80,81]. Autobiographical memory disturbances can manifest in different ways according to the psychological disorder [82]. For people experiencing prolonged grief disorder, the image of the lost person remains central to the person's sense of self; they have what they called a merged identity. In these people, the image of the lost person continues to fuel personal goals, motivations, and future plans, as if detachment could not be achieved. This has implications for autobiographical memory retrieval and goal development [83]. Indeed, individuals with prolonged grief disorder are more likely to recall past memories related to the lost person and have difficulties recalling specific and positive past events or envisioning future events without the lost person [84,85].

Therapies that employ cognitive–behavioral techniques are efficacious in ameliorating the symptoms of prolonged grief [86], such as exposure to memories of the death, behavioral activation, and restructuring of maladaptive appraisals. However, up to 50% of individuals do not respond to treatment and it is possible that these people are those characterized by a merged self-identity, for which the mere idea of doing better might imply a threatening de-merging from the lost person [83]. By addressing identity and autobiographical memory disturbances, patients with prolonged grief symptoms may benefit further from existing CBT programs. To our knowledge, no intervention for grief related symptoms has specifically focused on these elements. To address this gap, we developed an innovative online module focused specifically on identity and autobiographical memory.

2.5.1 Method

The identity module, like the other three modules in LIVIA 2.0, consists of two sessions. In this module, the loss-oriented session aimed to help individuals process and integrate their experience of loss into their autobiographical memory. The participants could choose up to three exercises designed to help individuals revisit memories with and without the lost person, in order to explore the relationship between these memories and their sense of self. This session aims to support the development of a more congruent sense of self. In the restoration-oriented session, the focus lay on specific adaptive autobiographical memories and on specific adaptive future projections, for example about pleasant activities or personal qualities. The session offered three exercises for individuals to choose from, aiming to help them identify and envision future goals that are meaningful and rewarding, and in harmony with their values and interests. By helping individuals develop positive and adaptive future goals, this session aims to support the maintenance of a positive and coherent sense of self over time. After finishing each exercise in LIVIA 2.0, participants were asked to complete an online evaluation containing an assessment of the utility of the exercise on a scale of 0 (not at all) to 5 (extremely). Participants who answered 0 or 1 were required to explain why they found the exercise unhelpful, while those who answered between 2 and 5 were asked to elaborate on how the exercise proved useful. Based on this assessment, we collected quantitative and qualitative data from 14 participants about the usefulness of the different exercises proposed in the Identity module. We used a Thematic Content Analysis method [87], which involved coding and categorizing the data to identify key themes related to the usefulness of the different exercises proposed.

2.5.2 Results

First results indicated high levels of utility, M = 3.13 on a scale ranging from 0 (not at all) to 5 (extremely) for the six exercises included in the module. The thematic content analysis of participants' responses highlighted six main themes:

1) Self-reflection and identity: participants found value in exploring their own values, positive qualities, and independent activities.

It made me realize that I have given up activities that I used to enjoy and that I need to focus more on group activities. (ID 9)

2) Future orientation: participants appreciated thinking about the future and setting goals, which helped them find direction and envision a life beyond the loss.

It is useful to project into the future because I am stuck in my present sadness and regrets of having lost Harry. (ID 1)

3) Memory exploration: participants found it useful to recall different memories that they may not be used to remember, such as positive memories of the deceased or memories unrelated to the lost person.

Reading this part of the module, I realize that I think all the time of my life with Harry, as described for the selective autobiographical memory. By doing this exercise, it's the first time that I look for memories elsewhere and it makes me think a lot. (ID1)

4) Positive mindset and personal growth: participants enjoyed focusing on the positive aspects of life and adopting a more optimistic perspective.

I can see the positive side of my life. (ID4)

5) Progress monitoring: participants found beneficial that the exercises helped them monitor their progress in coping with grief and identify areas for improvement.

It is useful to see that I have made good progress in my grief. I can consider a holiday abroad. (ID 4)

6) Difficulties and uncertainties: a few participants (4) faced challenges in completing exercises or understanding the objectives.

I am not sure I am in the requested target. (ID 2)

2.5.3 Conclusion

Identity and autobiographical memory disturbances are common in psychological disorders, particularly in prolonged grief [83], and can hinder recovery [82]. The online module described above offers an innovative approach to address these disruptions. The findings indicate that the identity-focused module was generally beneficial for participants coping with the loss of a closed one. However, addressing the difficulties and uncertainties some participants experienced is crucial to enhance the overall effectiveness and accessibility of the module. Future research should continue to explore the effectiveness of this type of intervention focusing on autobiographical memory and mental projection into the future in treating psychological disorders.

3. Conclusions

IBIs have a tremendous potential to improving mental health access and outcomes. However, the challenge of high dropout rates remains a significant obstacle [88,89]. To address this issue, researchers and practitioners must work to develop effective strategies for enhancing engagement and reducing attrition. The mHealth psychological intervention LIVIA 2.0 incorporated five key innovations aimed at improving engagement and outcomes compared to its predecessor, LIVIA-FR. These innovations included guidance on demand, automated reminders, tailored recommendations and exercise selection, the assessment of personal resources and a module focused on identity and autobiographical memory.

The guidance on demand feature showed limited success as only few participants requested help to move forward in the program. Future research could

explore the reasons people did not contact us. However, the limited evidence we gathered regarding the application of a MOTR approach show promises, as the response of the participant was clearly positive and it helped them pursue the program with motivation. In light of the current evidence, we would recommend using a weekly guidance and applying MOTR in IBIs targeting grief symptoms.

Automated reminders have gained attention as a promising strategy to enhance participant adherence to IBIs [56–58]. However, to ensure their effectiveness and minimize potential drawbacks, it is crucial to strike a balance in reminder frequency. We recommend considering the individual needs and preferences of participants when determining the timing and frequency of reminders. Finding the right balance is crucial to encourage adherence without becoming burdensome. Moreover, to gain a deeper understanding of the impact of reminders on participant adherence and experiences, further research is needed. Studies with different formats, timing, and wording to identify the most impactful design elements. Quantitative data on completion rates should be complemented with qualitative data to explore the effects of reminders beyond mere completion. Investigating participant perspectives, motivations, and barriers will inform the development of more effective reminder strategies. Last but not least, clearly communicate the purpose and benefits of reminders, emphasizing how they support participants' engagement and treatment outcomes. Provide participants with options to manage or modify their reminder preferences, empowering them to have control over their experience. Finally, to assess the impact of reminders, it is important to include comprehensive measures in research protocols. Beyond completion rates, gather data on participant experiences, satisfaction, and perceived helpfulness of reminders. A systematic evaluation will provide insights into the overall effects of reminders on adherence and engagement, enabling researchers to refine their strategies accordingly.

The innovation of providing tailored recommendations and exercise selection showed limited success, as only half of the participants followed the recommended order to complete the modules in LIVIA 2.0, while the remaining participants chose their own path. This indicates that giving the choice to participants to select the order of completion that best suits them appears as a good solution. Additionally, the participants tended to select only the first exercise proposed out of the three options presented in each session. When designing mHealth psychological interventions, it is crucial to consider the diversity of participant needs and incorporate tailored content accordingly. However, our results suggest also that offering multiple exercise options may not be necessary, as it is time consuming to implement compared to the limited use that our participants made of it.

The integration of the AERES tool [75] into a mHealth psychological intervention is a promising innovation, aiming to provide a positive, resource-focused approach to therapy. However, participant engagement with this tool in LIVIA 2.0 was quite low, indicating a need for further refinement. Future research should focus on ways to improve user interaction with this tool, potentially through more personalized and interactive methods. This could involve reintegrating components included in the semi-structured interview from the original AERES, such as the selection of resources that the person wishes to develop or discover or breaking down the resource identification process into more manageable, focused sections in link with the currently proposed content of the intervention. While this innovation signifies a step towards a more resource-oriented therapeutic approach, its effective implementation within mHealth psychological intervention remains a challenge to be addressed.

The module focusing on identity and autobiographical memory disturbances has shown some promise in addressing key issues in prolonged grief, as evidenced by positive participants' feedback on its usefulness. Identity and autobiographical

memory disruptions are common features across various psychological disorders and can significantly hinder the recovery process [82]. Therefore, the positive reception of an identity-focused module in LIVIA 2.0 from the participants suggests that it could be a valuable addition to mHealth psychological interventions. The novelty of such an approach underscores the necessity for further rigorous investigation to demonstrate its effectiveness across a broader population. Moreover, it is important to continue improving the content and delivery of this type of interventions, with special attention to overcoming potential difficulties and uncertainties of the participants. This endeavor is integral to the advancement of treatment methods in the field of grief therapy and beyond.

By learning from the successes and limitations of innovations such as those in LIVIA 2.0, researchers can further refine and develop effective mHealth psychological interventions to address a wide range of mental health issues. MHealth psychological interventions can transcend traditional barriers of time place or stigma, making mental health support more accessible and personalized. However, the road to fully realizing this potential is challenging. As we navigate this path, continuous collaboration between researchers, mental health professionals, and the people for whom these tools are designed (for example by using co-designs) [90] will remain a vital ingredient.

Acknowledgments

Conflict of Interest

The authors declare no conflict of interest.

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Table 1. Questions asked to establish order of modules recommendations for sessions 2-9

It is important for me...	Not at all 1	2	3	4	5	6	7	8	9	Very 10	Related module
... to be able to do the things (activities) that give me satisfaction											Behavior
... to better understand who I am today (my identity)											Identity
... to be able to confront situations that remind me of the person lost											Behavior
... to feel and accept my negative emotions (e.g., anger, sadness, guilt)											Emotions
... not to let my negative thoughts overwhelm me											Thoughts
... project myself into a future that makes sense to me											Identity
... allow myself to experience positive emotions (e.g., pleasure, joy, peacefulness)											Emotions
... develop more positive ways of thinking											Thoughts

Table 2. Cumulative frequencies of resources considered present by the participants

	Resources	N (max=17)	Percent	Psychiatric Sample (%)*
Personal qualities	Humor	16	94.1	82.2
	Self-esteem	9	52.9	51.6
	Courage	15	88.2	76.5
	Curiosity / love of exploration	15	88.2	80.3
	Perseverance	15	88.2	73.2
	Wonder / savoring	11	64.7	66.7
	Body consciousness	11	64.7	62.0
	Reflectiveness	14	82.4	75.1
	Optimism	7	41.2	62.4
	Gratitude	14	82.4	92.0
	Spirituality	11	64.7	78.4
	Hope	14	82.4	56.3
Leisure activities and passions	Acquaintances	15	88.2	70.0
	Work	11	64.7	45.1
	Family	16	94.1	77.9
	Friends	15	88.2	76.5
	Romantic relationships	7	41.2	38.5
	Professional healthcare	3	17.6	85.9
	Living place	15	88.2	81.7
	Pet	6	35.3	39.0
	Nature	16	94.1	79.3
External resources	Cooking	9	52.9	63.8
	Sports	16	94.1	52.6
	Singing / playing an instrument	8	47.1	36.6
	Plastic arts	7	41.2	45.5
	Gardening / home repairing	10	58.8	37.1
	Reading / writing	13	76.5	70.0
	Going to a show	13	76.5	57.3
	Music / radio / TV / internet	15	88.2	93.0
	Travelling / visiting / excursions	15	88.2	58.7
	Playing games	8	47.1	56.8

* Percentage of the selected resources by a psychiatric sample of N=218 [76]

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Table 3. Summary of each innovation implemented in LIVIA 2.0, along with their respective results and recommendations.

Innovation	Result	Recommendation
Guidance on demand	This type of contact was not as successful as anticipated. Only a very low proportion of participants contacted us, and mainly for technical reasons.	We recommend using a default weekly guidance.
Automated reminders	Aside from one participant who explicitly shared their experience with email, we do not know what impact the reminders had on other participants.	We recommend the use of reminders since there were no detrimental consequences for not having them.
Tailored recommendations and exercise selection	Half of the participants followed the recommended order to complete the modules in LIVIA 2.0, while the remaining participants chose their own path.	We recommend limiting users to one exercise per session instead of giving them the freedom to choose multiple exercises.
Assessment and promotion of personal resources	e-AERES implementation remained unsatisfactory in view of the low number of times that participants explicitly and purposefully called upon their personal resources.	We recommend splitting up e-AERES to better focus attention on a particular aspect of resources. This way a person will have more opportunity to reflect on the presence and mobilization of their strengths.
A Module Focused on Identity and Autobiographical Memory	The identity-focused module was generally appreciated and beneficial for participants coping with the loss of a close one.	We recommend using an identity-focused module for IBIs targeting grief because of its successful implementation and positive participant reception.