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# The Role of Mobile and Virtual Reality Applications to Support Well-being: An Expert View and Systematic App Review

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**Abstract.** Interactive technologies for autonomous mental health management are on the rise due to limited therapy access and stigma. However, most commercial mental health apps are neither theory-based nor clinically tested, and psychological theories are not easily accessible to app designers. Thus, it remains unclear if current mobile and VR mental health apps meet therapists' expectations. To address this gap, we conducted interviews ( $N = 11$ ) to build an understanding about current therapeutic practices with a focus on emotion regulation and their applicability to mobile apps. We then conducted a systematic app review of 60 mental-health-related mobile and VR apps applying the themes identified in our interviews as an understanding lens. We draw upon the identified discrepancies to pinpoint design implications for better embedding lived therapeutic practice into mental health apps. We contribute by providing a common grounding between therapists and developers on the features and properties of well-being mobile and VR apps.

**Keywords:** Well-being · Mental Health · Mobile Apps · Virtual Reality · Emotions · Feelings · Mood · Therapy.

## 1 Introduction & Motivation

Digital technologies such as mobile and virtual reality (VR) applications (apps) supporting autonomous mental health management have now established themselves on the consumer market [13]. Such technologies promise the users opportunities to improve their mental health and foster well-being [59]. While digital therapies might not be able to fully substitute psychotherapeutic treatment [13], they can be a viable alternative in cases in which starting such a treatment is difficult (e.g. because of stigmatisation [14, 40, 56, 58] or limited availability of services [14]). Thus, many people are instead turning to technological solutions that have the potential to reduce such challenges and support them in their mental health management [40, 58, 56]. Hence, there is a need to build an understanding of the current mental health technologies available on the consumer market.

Searching for *mental health* or *well-being* apps in the major app stores produces thousands of results for mobile and virtual reality (VR) apps. However, only few of these apps are evaluated through clinical trials [65] and it remains unclear if commercially available apps for mental well-being meet the expectations of mental health experts. Previous work has attempted to understand experts' perspectives on mobile health apps [33, 50] and well-being app's content [31, 53] separately. Our approach is different as we combine both, using therapists' expectations and attitudes as basis for analysing existing commercial apps. Further, we apply this experts' view on both mobile and VR apps. In contrast to similar studies of the HCI community with a focus on specific topics, e.g. learning [50] and mindfulness [34], we inquire the therapeutic intervention of engaging with feelings (i.e. emotion regulation (ER)). ER is employed in many different therapies (sec. 2.2). Specifically, our research is guided by the following research questions (RQ):

- RQ<sub>1</sub>: How should mobile apps and VR apps support and extend the therapeutic process based on current therapeutic practice?
- RQ<sub>2</sub>: How are mobile apps and VR apps currently supporting mental health and well-being?

To answer these questions, we interviewed 11 therapists about their therapeutic practice. Grounded in the interview findings, we developed themes to systematically analyse 45 mobile and 15 VR commercially available mental health and well-being apps. Since both, mobile and VR apps, are available on the consumer market (e.g. in leading app stores), users interested in improving their well-being could potentially use them separately or together. Thus, it is valuable to analyse the opportunities and limitations of both types of apps together and explore how they can complement each other to support autonomous mental health management.

The contributions of this paper are threefold: (1) By analysing the expectations of therapists, we provide developers and scholars with a clear picture of what is needed to support users' mental self-care. (2) Through analysing different types of apps, we draw a detailed picture of the state-of-the-art features in well-being apps. This can potentially motivate therapists to augment and extend their current therapeutic methods to cater to the needs of patients outside of a therapy room. (3) By interweaving insights from both interviews with therapists and a review of commercial apps, we provide common grounding and shared language between therapists and app developers on the features and properties for well-being apps, which facilitates a productive dialogue among different stakeholders [10].

## 2 Related Work

To provide theoretical context, we first define key terms and discuss the role of feelings for well-being and therapy. We then review existing research of how mobile and VR apps are already used in therapeutic practice.

## 2.1 The Role of Feelings for Well-being and Therapy

According to the WHO, *mental health* is an integral part of health and forms the foundation for well-being and an effective functioning in society [66]. Yet, *well-being* is an abstract construct that is, for the scope of this paper, best described as *a dynamic optimal state of psychosocial functioning* [11], which is build upon five core pillars, namely positive emotion, engagement, relationships, meaning, and accomplishments [49]. *Emotions* can be classified as a circumplex of two dimensions: valence (negative to positive) and activation (low to high) [45]. Emotions can be triggered by an event or activity [20] and differ from *moods*, which are lower in intensity than emotions, last longer [43] and are often influenced by a range of factors [20]. Emotions and moods are often collectively described as *feelings* [27]. In this paper we primarily focus on apps that are working with emotion regulation (ER). ER is defined as the process by which people modify and regulate their emotions, and how they experience and express them [3, 44]. In ER therapy, one key strategy is to become emotionally aware, or using the umbrella term *engaging with feelings* [44]. In our research, we define *engaging with feelings* in regard to digital mental health management as internally *identifying (ID)*, and verbally or visually *expressing (XP)* feelings.

## 2.2 Methods of Emotion Regulation Therapy

ER is a common 'intervention' used in different forms of therapies [24], the most common being cognitive-behavioural therapy (CBT), dialectic-behavioural therapy (DBT), depth psychology or schema therapy. A shared aim of many of these psychotherapies is to provide the support and skills to overcome the difficulty of engaging with feelings. As part of such an ER intervention, generally speaking, patients learn to *identify* their feelings, *understand* the causes, and to consciously *accept* their emotional states [30].

In ER interventions, many different treatment modalities, such as artistic expressions (e.g. art therapy, role-play [48]) and psycho-education are proven to be useful to learn to engage with feelings. *Psycho-education* comprises systemic and didactic psychotherapeutic interventions with the goal to provide information, education and teach therapeutic strategies to improve well-being [52]. We believe that new technologies might offer possibilities to create spaces for therapeutic, artistic expression [9] and individually designed therapeutic environments [25]. Consequently, we strive to explore the potential and challenges of commercially available mobile and VR apps which support autonomous mental health management.

## 2.3 The Potential of Mobile and VR Technologies for Mental Health and Well-being

Smartphones have become popular for capturing well-being data (e.g. [18]). Past research works on this topic mainly focused on mental health [5], mindfulness [34, 35] and mood [12]. However, the efficacy of well-being interventions is unclear [33,

63]. Further, intervention-driven work has been subject to critique related to its appropriateness, privacy considerations and engagement [42, 60].

Similarly, HCI research has started to explore the use of VR for well-being support, given that it has proven to be an affective medium whose immersive virtual environments (IVEs) can evoke emotional states and responses similar to reality [26, 32, 39, 57, 62]. Although in the mental health domain VR is mostly used as a method for exposure therapy [40], it has also been explored for other mental health related areas such as mindfulness [41], stress reduction [57, 65], role-play [26], journaling [4], , and to recreate memories [58].

The interest in commercial mobile and VR well-being systems is steadily increasing. Concurrently, research established guidelines for designing visual content of VR apps used to elicit positive change [29, 46] and outlined the design space of VR well-being apps with the means of a systematic literature review [28]. We extend these approaches by analysing commercial well-being mobile and VR apps based on insights derived from expert interviews with a specific focus on ER. In line with Gaggioli et al. [22], we define *commercial well-being apps* as "positive technologies" targeting broad masses through common app stores such as the iOS App Store or Steam.

### 3 Interviews with Therapists

We conducted semi-structured interviews that addressed the therapists' conceptualisation of well-being, which methods for engaging with feelings they use, and how they define the aim of therapy. By conducting interviews with therapists, we gain an in-depth understanding of which therapeutic methods supporting well-being are currently applied in therapeutic practice. Further, we determine what therapists expect from mobile and VR well-being apps (**RQ<sub>1</sub>**). The themes deduced from the interviews form the basis for our app analysis (**RQ<sub>2</sub>**).

#### 3.1 Method

Due to the current COVID-19 pandemic, the whole study was conducted virtually. All participants were contacted via email and interviews were conducted via videoconferencing software.

**Participants** We conducted interviews with  $N = 11$  licensed psychotherapists from Germany ( $M = 44.3$  years,  $min : 26$ ,  $max : 62$ , 11 female). Participants were personally contacted via email obtained from publicly accessible websites. Though education and current occupation vary across the sample (table 1), all participants are licensed by the state of Germany to practice psychotherapy and have further worked with patients in psychotherapy for at least two years ( $M = 8.8$  years). Six participants majored in psychology (diploma or master degree) and five are educated as alternative practitioners for psychotherapy. Five participants are currently designated as psychological psychotherapists, which

means that they continued training for five additional years, three as alternative practitioners for psychotherapy, three specialised in art therapy, two in depth psychology, one in osteopathy, and one works in healthcare. Three participants have a secondary, non-psychological education (P6 and P8 have majored in graphical design, P10 has majored in pedagogy). Our sample encompasses therapists with different educational backgrounds and varying specialisations. Thus, it represents a typical sample of psychotherapists in Germany that use ER in their daily psychotherapeutic work. Regardless of the specialisation, we refer to all participants collectively as "therapists", though some name themselves practitioners or clinicians. In line with most of our interviewees, we refer to people psychotherapists work with as "patients". When we discuss people utilising a mobile or VR app, regardless of their state of well-being, we refer to them as "users".

**Table 1.** All participants are state-approved psychotherapists in Germany and have been working in psychotherapy for at least two years. Psychological/therapeutic education and current occupation within this field differ.

	Education	Occupation
P1	alternative practitioner for psychotherapy	alternative practitioner for psychotherapy
P2	alternative practitioner for psychotherapy	alternative practitioner for psychotherapy
P3	major in psychology	psychological psychotherapist (focus on depth psychology)
P4	major in psychology	psychological psychotherapist, working in healthcare
P5	major in psychology	psychological psychotherapist
P6	alternative practitioner for psychotherapy	art therapist
P7	alternative practitioner for psychotherapy	osteopath
P8	alternative practitioner for psychotherapy	art therapist
P9	major in psychology	psychological psychotherapist (focus on depth psychology)
P10	alternative practitioner for psychotherapy	alternative practitioner for psychotherapy (focus on art therapy)
P11	major in psychology	psychological psychotherapist

**Interview Protocol** We conducted semi-structured interviews that addressed the therapists' conceptualisation of well-being, which methods for engaging with feelings they use, and how they define the aim of therapy. They further evaluated the benefits of technological aids for (private) therapeutic usage and specified features and properties they think important for both mobile and VR well-being

apps. We provided the participants with a short explanation of the well-known use cases of mood tracking mobile apps and anxiety therapy VR apps. The complete interview protocol can be found in the supplementary material.

**Data Analysis** Interviews were held via videoconferencing software and lasted an average of 42.3 minutes (*min* : 25, *max* : 56). Each participant was compensated with 25€. The interviews were audio-recorded, transcribed, and translated into English. For the analysis, we used a six-step process of reflexive thematic analysis with daily feedback cycles between two co-authors [8]. The results are reported using an interpretivist semi-structured approach [6].

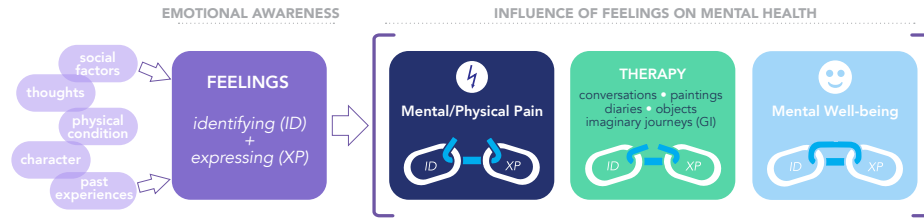
### 3.2 Results

Based on our qualitative inquiry, three themes were derived from the data: *From Psychological Theory to Lived Practice*, *Mental Health as Holistic Concept* and *Offering a Safe Place*. Our findings are described below and illustrated with excerpts from the interviews. Specific topics and features of each theme that will be used for the app review ( 2) are marked in bold font.

**From Psychological Theory to Lived Practice** The first theme derived from our data focused on how psychotherapists approach the concepts of emotions, feelings and mood in theory versus in practice. Based on psychological theory there is a clear difference between these concepts. One participant explained in more detail: "*[...] in principle we are not aware of the emotions [...]. When they become conscious, then we speak of feelings, that is the 5% that are above the water surface, considering the iceberg model*" (P9). Other participants elaborated on their conceptualisation of mood. For instance, they described mood as a baseline that shapes every emotion to a certain extent or as a "*conglomerate of different emotions*" (P4). Seven participants agreed mood is a longterm concept compared to emotions or feelings. This is further emphasised by the following statement: "*[Mood is] like a weather situation that runs through it, over several hours, over several days, or even through an entire season*" (P3). With these assessments, they agree with widely accepted theories of emotion and mood from related work (sec. 2.1). However, when specifically asked about the wording they use in practice, 82% state that they do not differentiate between emotions and mood in practice. The majority of participants agreed that it is more meaningful to focus on one illustrative term in their psychotherapeutic work to not confuse their patients. One therapist commented: "*[...] when you work with people it doesn't make sense to differentiate*" (P6). Thus, we follow the terminology of the therapists in this paper and use *feelings* as a generic term for emotions and mood.

In line with the approach of focusing on one easily understandable concept (e.g. feelings) to support patients in their psychotherapeutic process, participants further emphasised the importance of responding to individual patients' needs in a flexible manner. Nine therapists elaborated that the specific method





**Fig. 1.** Schematic conceptualisation of the second theme *Mental Health as Holistic Concept* based on the interviews. By using therapeutic methods patients learn to identify (ID) and express (XP) their feelings, which re-establishes their mental well-being.

that best supports a patient needs to be chosen on an individual basis and may vary as much as using conversations, drawings, diaries, objects, imaginary journeys/guided imagery and many more.

All therapists stressed the importance of **recording** feelings. Even though the majority of therapists mentioned the value of flexibility in interactive technologies when **recording** feelings, seven also imagined utilising **predefined** recording options, using properties like emojis, scales, colours, or labelling words to choose from. However, two therapists stressed not to use intensity scales or graphs, as this could distort the bigger picture of the own well-being and one participant explicitly emphasised not to use smileys: *"They are too vague, an emotion has many layers and is constantly changing"* (P8).

The caution towards **predefined** recording methods is further illustrated by four participants who pictured an **unrestricted** implementation method, like journaling or being able to create own labels for feelings. Further, five therapists suggested **prompts**, meaning that an app urges the user to answer deeper questions, or that an AI suggests how one could feel given a specific situation.

**Mental Health as Holistic Concept.** During our interviews, many participants explained that mental health is a holistic concept. It includes mental, physical and social well-being and is not merely the absence of mental illness. Using the words of one of our participants: *"True healing is about body, mind, and soul"* (P7). Furthermore, therapists explained that thoughts as well as physical conditions influence feelings: *"When I think in a certain way, it affects how I feel. And if I think differently, it may be that my feeling is no longer quite as dramatic"* (P5).

For all therapists, mind, body, and the process of engaging with feelings are directly linked to well-being. Figure 1, composed of the therapists' descriptions, shows the schematic conceptualisation of the role of ER therapy and the influence of feelings on well-being. One therapist highlighted the value and the challenge of being able to connect with and regulate one's emotions: *"Mental health is when emotions are agile and can be contained. When my feelings are frozen, such as with depression, or if my emotions are overflowing and too much and cannot be*

tamed, [as for example] with borderline patients or self-harming [patients], then that is because the feelings cannot be regulated" (P1).

Consistent with a holistic approach towards mental health, therapists emphasised that apps should address feelings, thoughts and physical aspects. For seven therapists, the ideal app should **support** the user by offering **teaching & tips**. One therapist stated: *"It's good to know that I feel this way or that way, but it's also good to know how I can feel better, to help people to help themselves"* (P6). To achieve this, five therapists suggested that apps could tutor and guide through exercises. Five others imagined apps offering emotional support, e.g. through affirmative quotes. Therapists also expressed the importance to include some psycho-educational elements to educate and to provide background information about chosen symbols or objects in apps. As an example, P1 imagined that a patient chose a wolf in a VE: *"[...] and then you could read two or three sentences about it, and then they [the patients] think about it, 'ah, so I took the wolf, then maybe I feel like this and that'. To have the mirroring aspect again"* (P1). For three participants, another important aspect seemed to be a notification option that support the user to not forget thinking about their own well-being during the day.

Many therapists also thought about the supportive feature of **sharing** data with others. Although three therapists discussed the benefits of sharing thoughts and feelings with other patients via some form of social network, opinions deviated between the productive and destructive nature of social networks. However, four participants approved of sharing content with the therapist. In regard to VR, three participants considered recording and documenting sessions meaningful to revisit later, and to share those with therapists to offer them a better glimpse of their imagination. It was stressed, though, that one of the benefits of VR is to use it in the privacy of your own home: *"[...] where nobody sees this but me"* (P3).

**Offering a Safe Place** Many therapists emphasised that the task of therapy is to support the emotional awareness of the patients by helping to internally *identifying* and externally *expressing* one's feelings, which is in line with related work (sec. 2.1). This is best highlighted by the following statement: *"Independent of whether it is behavioural therapy, depth psychology, or systemic analysis, it is always about emotions being activated in therapy and this leads to success"* (P9).

By activating emotions and engaging with them, therapy supports patients in processing the past, understanding the present, and developing strategies for the future *"to act appropriately"* (P4). However, therapists stressed that they mostly need to start small. Nearly all, 10 out of 11 participants, elaborated that patients have trouble naming feelings and that therapists spend a lot of time teaching that *"'good', 'bad', and 'I can't get up'"* (P3) are not descriptions of feelings. In figure 1, this is expressed by becoming emotionally aware of one's feelings.

Consequently, apps should support the user in identifying and reflecting on one's feelings. For instance, many therapists had some form of psycho-educational

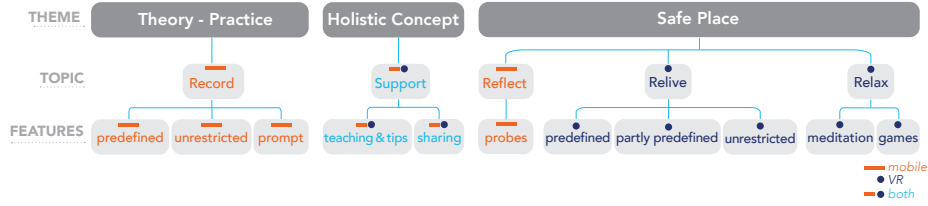
training to **reflect** in mind, e.g. to explore the causes of experienced feelings. Seven therapists suggested that apps should prompt the user in linking a feeling with a specific situation to increase the awareness of the causes. That being said, identifying and reflecting on one's feelings can only happen in a space where people feel safe. Therapy is, inter alia, about the possibility to live emotions in a way often inappropriate or suppressed in everyday life. 10 therapists emphasise that it is important in therapy to offer a space *"to just exist with the feelings"* (P1). A quote by one therapist captures this notion: *"It is also very important for the person himself to meet his feelings in a visualised way, to hear or see his loneliness. I provide the framework for him to be angry at times (...). That also has something relieving, because it is just allowed in this specific setting"* (P10). Thus, apps should offer a safe environment to express the own feelings. Therapists assessed VR as an opportunity to offer patients such a safe space.

To illustrate, most therapists saw the benefits of VR apps to **relive** a certain experience or environment that is either similar to own memories or to a desired situation. More precisely, seven participants imagined using **predefined** virtual environments (VEs), e.g. exploring different landscapes or having a walk in a park. Thus, they transferred the therapy method of guided imagery to VR. One participant summarised the positive effect of VR for guided imagery: *"When you take body trips [in real therapy], they have an effect on the body as if you were really there, otherwise you wouldn't do that with the patients. I imagine it to be similar when patients use VR for that, that they really experience this imaginary place as if they were there"* (P6).

Furthermore, eight therapists could also fathom a **partly predefined** implementation. Users would be presented with a simple pre-set VE but were able to create their own *happy place* by enriching it through (pre-set) objects, e.g. choosing animals, the weather, other objects, and colours. One contemplated: *"It [pre-set objects] also takes away a bit of individuality, because I preset something. But for patients who find it difficult to visualise things themselves, this could be really helpful because you give them impetus"* (P4).

Apart from that, five participants thought VR should be *"the freer the better"* (P8), which we call an **unrestricted** implementation. They imagined using abstract forms, colours, or creating avatars representing a specific feeling. Two participants could also envision constructing a VE from scratch. They stated that this would help practice visualisation techniques that are also useful in stressful situations in real life: *"I could also imagine that they [patients] would like it, if they were really angry, that they could simulate a really violent thunderstorm so that the weather and the whole environment would adjust to their mood. For some of them, it would be a great help to accept it [their anger], if they could transform the whole room around them into their feeling"* (P3).

However, six participants were of the opinion, that VR should be rather used to experience positive emotions as they were unsure of the risk of getting re-traumatised. Thus, besides supporting reflection and reliving safe environments, to **relax** is a third important aim of such VEs. Nine participants focused on releasing stress and further three mentioned that having fun in the process of



**Fig. 2.** Themes derived from the interviews, including topics and features that form the basis for mobile (orange), VR (dark blue) and both (light blue) app reviews. Specific properties of each feature, e.g. emojis or graphs, are not listed in this figure.

experiencing a predefined VE or by creating one themselves could already improve one’s mood.

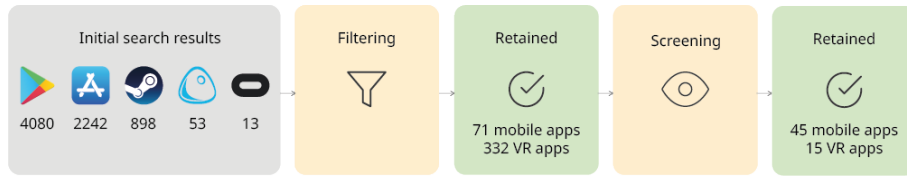
## 4 Mobile and VR App Review

To further explore how autonomous mental health management technologies are currently supporting mental health and well-being (**RQ<sub>2</sub>**) and to identify possible mismatches between the therapists’ recommendations and commercially available apps, we systematically analysed 45 mobile and 15 VR apps that focus on engaging with feelings. We included both mobile and VR apps in our review as users interested in improving their well-being could potentially use them separately or together, since both are available on the consumer market (e.g. in leading app stores). Thus, it is valuable to explore opportunities and limitations of both and how they can complement each other to support autonomous mental health management. Mobile and VR apps were coded using three topics each, which are further divided in several features and properties derived from the interviews (fig. 2).

### 4.1 Method

Our analysis includes 45 mobile and 15 VR commercial mental health and well-being apps. We inductively coded the features and properties derived from the interview results. Our systematic search process is depicted in figure 3.

**Selection criteria** Two authors defined several selection criteria in iterative discussion sessions. We selected mobile apps from the iOS App Store and the Google Play Store and VR apps from three major gaming platforms (Steam, Oculus and Viveport). The final search terms encompassed apps that contained *mood*, *emotion*, *feeling*, *wellbeing*, *well-being*, and *mental health* in either their title or description. We chose these search terms because therapists and patients often use these terms interchangeably (sec. 3.2), and to take different notation possibilities into account. In addition, we limited the search to the categories of *Health & Fitness*, *Medical* or *Lifestyle*, which are the same for all app stores.



**Fig. 3.** Systematic 3-step process of searching, filtering and screening of mobile and VR apps, resulting in 45 mobile and 15 VR apps.

We focused on apps that seem to have relevance for users. As a proxy for this, we used the rating count (i.e. the amount of people that wrote reviews) with a threshold of 100 reviews. Unlike the number of downloads, the rating count is available on iOS App and Google Play Store and is thus comparable. As VR apps tend to have fewer reviews overall, the criterion of a minimum rating was not included. We then screened for duplicates.

The systematic review followed a 3-step process for both mobile and VR (fig. 3). The initial search rendered 6322 mobile and 964 VR apps. They were then filtered based upon exclusion terms, e.g. *fitness fun* (for a full list see supplementary material), resulting in 71 mobile and 332 VR apps (Viveport does not support exclusion). Finally, the apps were screened manually to ensure their relevance, e.g. horror related VR games were excluded. The final body included 45 mobile and 15 VR apps (collected in September 2020).

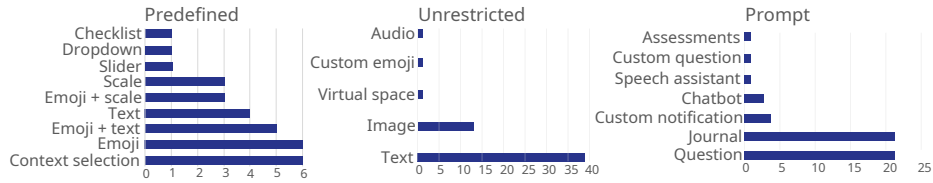
**Coding Process** Based on the interview results, we coded mobile and VR mental health and well-being apps separately (fig. 2). Two authors initially coded the apps independently. Then, in an iterative process, they discussed the results and coding of features and properties. Any ambiguous case was discussed with the other co-authors. Our final codebook is presented in figure 2.

The mobile apps were analysed in-depth by using them at least three times over the course of a week. The VR apps were played at least once<sup>4</sup>. For both, descriptions available on the respective app stores were analysed on the premise of getting insights into important app features that might have been missed while using.

## 4.2 Mobile Apps

**Results Mobile Apps** Based on the interviews, we analysed 45 mobile apps focusing on the three topics **record**, **support** and **reflect**, and corresponding features (fig. 2). For a more fine-grained analysis, we also explored the usage of specific properties such as emojis. For a detailed description, please consult the supplementary material.

<sup>4</sup> Apart from the App *Prana* [55], which is to date not yet released. Here, we watched demonstration videos and playthroughs on YouTube.



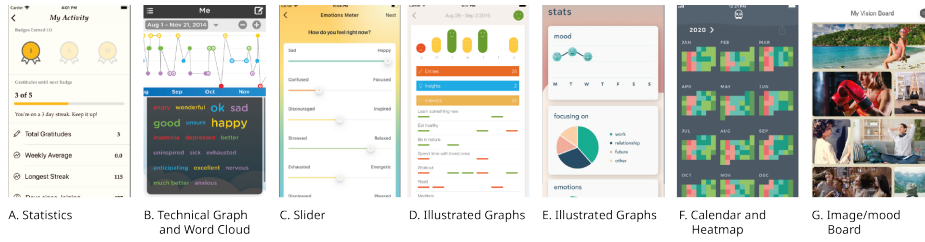
**Fig. 4.** For the topic of *record* the features were categorized by the type of interaction which ranged from *predefined*, *unrestricted* to *prompt*.

In the topic **record**, we investigated the flexibility of recording one’s feelings. The results are depicted in figure 4. For the feature *predefined*, emojis and emojis combined with other properties such as text were used most often. For the feature *unrestricted*, a text recording feature was found in 39 apps, surpassing all other properties. We further examined the usage of *prompts*. Using questions as triggers and journals were the most popular form of prompts, found in 23 apps each. Artificially intelligent chatbots that are able to reply dynamically, thus acting more as a therapist than a static journal, were found in three apps.

Mobile apps also offer **support** by providing *teaching & tips* and *sharing* options. To teach, 21 apps used exercises or tasks, 17 apps a form of tip, advice or guide, and eight apps quotes or affirmations. Regarding *sharing* options, 10 apps utilised community based sharing, e.g. with other app users, and four offered private sharing with friends.

The topic **reflect** deals with methods of how apps enable the revisiting of the recorded data to support self-reflection. Some examples for *probes* are shown in figure 5. Five apps used statistics, mainly in the form of listed numbers associated to an activity (fig. 5A). The most common probe used were graphs. Technical graphs (fig. 5B) were found in 12, and illustrated graphs, using some form of embellishments such as emojis to further support the presentation of data (fig. 5D,E), were found in eight apps. Two apps used word clouds, virtual spaces and scores (fig. 5B). Calendars to prompt reflection, not merely as a form to navigate, were found in nine apps (fig. 5F). The more visual means such as image collection or mood boards were found in two apps (fig. 5G). As a meta analysis, apps were further rated according to their assistance to reflect upon reasons and causes of feelings, which is called situation analysis. To determine its use, apps were rated as providing low (raw data is presented without guidance), medium (data is presented in context of other data but without direct suggestions about its meaning), or high (direct suggestions and correlations between feelings and causes are presented) levels of situation analysis support. Forty-three apps were rated low, two apps medium and none high.

**Discussion Mobile Apps** We will now discuss the findings in relation to the insights from the interviews. In line with the requirements of therapists in regard to sec. 3.2, mobile apps offer a wide range of **recording** possibilities, of which emojis are dominating as predefined properties. We want to emphasise that eight



**Fig. 5.** Examples of *probes* used by apps to **reflect**, ordered with increasing complexity and vividness. Image sources: A [47], B [64], C [54], D [7], E [38], F [37] G [61] .

apps combine them with further elements like text or scales, probably to support the learning process of identifying feelings, thus teaching ER skills. A similar reason might also relate to the high usage of text. As a predefined property, it provides labels for feelings, which expedite the recording of data so that it can be captured more regularly, and as an unrestricted property as prompts, it offers individuality, as wished by nine therapists. However, only three apps offer artificially intelligent chatbots, although five therapists mentioned such prompts specifically because of their benefits to teach ER strategies.

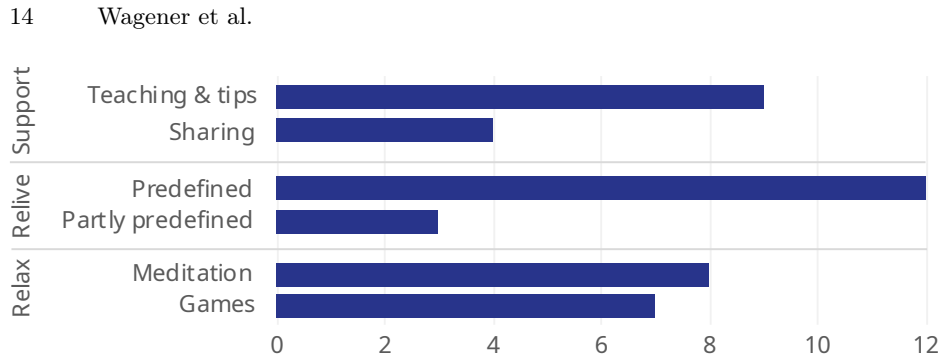
Besides offering tips and guides, ten apps provide **support** via *sharing* data with others, although restricted to other users and friends. Based on the therapists' opinions, we emphasise the potential for using apps as a way to also connect with professionals for remote support, which may increase the development of ER strategies.

Whilst recording will already provide some opportunities for reflection, many apps provide further features to explicitly **reflect**. We identified graphs as the most popular probe. This contrasts the findings from our interviews, where two therapists specifically mentioned not to use graphs. We further identified that only two apps support a medium and none a high level of situation analyses, which was addressed by seven therapists. Although some attempt to support a deeper reflection process (e.g. six apps use a labelled photo of a recent activity for context selection), it appears that most apps present raw data without further guidance on how to reflect upon it.

### 4.3 VR Apps

**Results VR Apps** We analysed 15 VR well-being apps focusing on the three topics **support**, **relive**, and **relax** (fig. 2). For a detailed description, please consult the supplementary material. The results are shown in figure 6.

Fourteen apps provided some form of **support**. Of those, seven offered *teaching & tips* via tutorials and instructions, such as guided meditation sessions (fig. 7A,B), and two via in-game information, such as psycho-educational elements and affirmative quotes (fig. 7C). Four apps also offered *sharing* possibilities, either by presenting information about one's game statistics or opportunities



**Fig. 6.** Graph shows the amount of VR well-being apps fitting to the topics *support*, *relive* and *relax*, and its corresponding features.

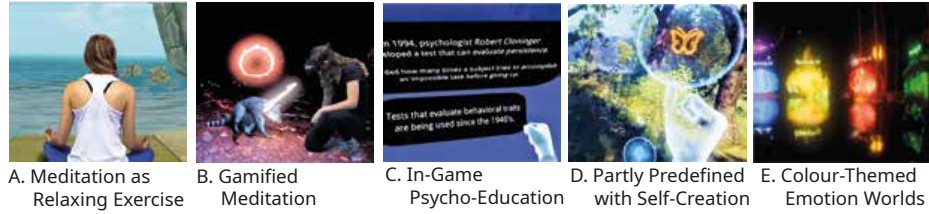
for recording and screenshots. One app has what can be interpreted as a link to professionals, flashing a warning notice and advising professional support if needed [1].

Within the topic **relive**, 12 apps were *predefined*, in which the users are presented with pre-set environments. Users can only choose between different environments or music before they enter an otherwise non-interactable VE. Three apps use a *partly predefined* method, of which two provide some interaction with the VE [16, 21] and one offering possibilities to create new (though preset) objects like trees or command the weather (fig. 7D). None offered an *unrestricted* environment.

Regarding the topic **relax**, eight apps focus solely on meditation exercises. To distinct further, six focus on meditation through preset VEs (e.g. fig. 7A), while two [17, 55] added gamification elements to meditation, e.g by reviving animals through relaxing one’s respiration (fig. 7B). Further, seven apps offer relaxation through games for enjoyment such as stone skipping or popping balloons.

**Discussion VR Apps** We will now discuss the findings in relation to the insights from the interviews. To **relax** was the most prominent aim for VR well-being apps, mentioned by nine therapists. Eleven VR apps meet this criterion, consolidating both the participants’ opinion and findings from research [51, 57, 65]. However, the main focus of the apps is on meditation (six apps of our sample, e.g. fig. 7 A,B). This was surprising as meditation was not once mentioned by therapists. As an explanation, commercial meditating VR apps seem to target mostly non-professionals and are rated as especially helpful and engaging for beginners [19]. This might reflect (and re-influence) the pre-dominant opinion in society, that an average user automatically equates relaxation with meditation, as previously addressed, e.g. by Lukoff et. al. [34]. This finding highlights the need to better educate users by including psycho-educational elements, as four therapists emphasised. However, only one app included such psycho-educational in-game information (fig. 7C).





**Fig. 7.** Examples of VR well-being apps. Image sources: A [15], B [55], C [1], D [23], E [21].

Additionally, therapists emphasised the importance of flexible interactive technologies and the possibility to autonomously *create* a VE. Only one [23] included some form of self-creation (fig. 7D) by allowing the user to grow trees, have butterflies flying around, and changing the weather in an otherwise pre-set VE. This was unanticipated as creating an own VE is already used quite a lot in non-commercial therapeutic apps [4, 58]. Thus, we propose that commercial VR well-being apps should enhance the interaction possibilities with the VE to allow users an unrestricted interactable VE to build their own imaginary world, as elaborated in sec. 3.2.

Additionally, 10 therapists stressed that therapy should offer a space for unbiased emotional exploration and expression. This aspect was only mentioned once in regard to VR, which was surprising because VR is considered an efficient medium for artistic expression [9, 29]. Although also switching between virtual settings, e.g. beach and forest, might elicit different feelings, only one app [21] publicly communicates the aim of emotional exploration. It offers coloured emotion worlds to "*discover new emotions*" and to "*explore different kinds of mental states and find your emotional balance*" [21] (fig. 7E).

Finally, all therapists were sceptical regarding the risks of VR and agreed that digital well-being apps should only be considered as additional tools. Only one app [1] addresses this aspect by adding a note about possible risks. Previous work has shown that meditation, which we found to be the focus in our VR sample, has many potential benefits (e.g. inducing positive emotion [19]). Nevertheless, users should be informed about possibilities and limits of mental health support technology. Thus, based on the recommendations of the therapists we interviewed, we propose that all commercial VR well-being apps should add such a notice.

## 5 Discussion

In this research, we explored current lived therapeutic practice and how commercially available technologies support mental health management. We conducted qualitative interviews with psychotherapists and a systematic mobile and VR app review. We identified several recommendations for digital mental

health management (**RQ1**), including, amongst others, the need for supporting the user in a holistic way and to offer a safe place in which patients can reflect, relive emotions and relax (fig. 2). Our mobile and VR app review finds that the implementation of such elements varies to a great extent within each medium (**RQ2**). We use the themes identified in our qualitative analysis as an outline for our discussion.

### 5.1 From Psychological Theory to Lived Practice

Therapists' opinion about a flexible usage in the wording is met by the apps, as has been demonstrated by the hundreds of results when using the search terms *emotions, feelings, mood, mental health* and *well-being*. However, such labelling is also misleading. To illustrate, based on our initial search, we got presented with a multitude of different mobile apps (e.g. apps to regulate ambient lighting, to monitor cannabis usage or a violent VR app shooter game). It seems as if the interchangeable use of these terms found in psychological therapy gets transferred to the field of digital technologies, thus, making it hard for users to immediately find an appropriate app. Further, therapists expressed a desire for a flexible framework that does not limit an individual's expression of emotions, feelings or moods, given that most people have trouble understanding or defining such concepts. We propose that apps could provide definitions of terms, e.g. 'feelings' vs. 'emotions', thus offering skill acquisition, but should also allow users to choose their own wording. We also found that apps seldom offer customisable user interfaces and methods to record their feelings, that can be changed according to the current mood. Effectively, users would need to switch completely to another app in order to individualise their recording experience. However, taking different mobile and VR apps into account, flexibility is quite high: Apps range from being very precise in conveying statistics but being reduced to numbers and graphs (mobile apps), to immersively experiencing feelings but with less information conveyed (VR).

*Recommendation 1: Mobile and VR apps for mental health and well-being could allow users to choose which terms they want to use in their respective app (e.g. feelings vs. emotions).*

### 5.2 Mental Health as Holistic Concept

Therapists envisioned mental health as a holistic concept, stressing that mental well-being is a conglomerate of thoughts, physical and mental health. Regarding the therapists' wish for psycho-educational information (e.g. how to differentiate feelings from physical reactions), they, inter alia, imagined the usage of worksheets, quizzes and in-game information. Only few apps reflect the holistic view on mental health. We found a clear lack of psycho-educational features in mobile, and only one VR app included them [1]. This holds also true for affirmative quotes, which can strengthen the mindset, which was included in only one VR app [21]. Bakker et al. [5] point out that mobile apps are well positioned to deliver psycho-education by multimedia and audiovisual tools, while [28] highlights the

importance of a mind-body-dialogue in VR. Both complement our findings that apps should put more emphasis on teaching and advising mechanisms.

Regarding the physical aspect, it was surprising that although smartphones can easily provide accessible objective data about physical activities like step count [36], only few included such information. One example is *Life Cycle*, which uses Apple Health to import physical activities and sleep data. The developers of the VR app *D.R.I.L.L* [17] were the only ones in our VR examples that acknowledged the physical aspect as part of engaging with one’s feelings. Examples such as the iOS Health App [2] and the VR well-being platform DynamixVR, of which *D.R.I.L.L* [17] is part of, prove the feasibility of interpreting mental health as a conglomerate of aspects.

*Recommendation 2: Mobile and VR apps for mental health and well-being should approach mental health as a holistic concept, including psycho-educational and sportive elements.*

### 5.3 Offering a Safe Place

In lived practice, therapists offer a safe space for patients to engage with their feelings, to safely reflect upon emotions, to relive (and relieve of) emotions, and to relax. They also stress the importance of digital apps doing the same. Yet, this was one of the most underdeveloped areas of commercial apps. Our study shows that many mobile well-being apps heavily rely on the feature *record*, but the depth and possibilities to *reflect* differs greatly from app to app. An area that is noticeable missing is how apps can scaffold and guide the reflective process, in other words rather than simply displaying data back to a person, apps could explore approaches that provide more guidance on the reflection process. Bakker et al.[5] recommend that apps should report thoughts and feelings by presenting data in regards to the treatment goal. We argue that apps should broaden this aim to provide more guidance on how to interpret the data (reflection).

In both interview and VR app analysis, the VR approach seems to be less focusing on cognitively *identifying* and *reflecting*, than on the topic of *reliving*. Therapists described it as a learning-by-being method, that a) makes users feel automatically calm by visiting predefined VEs, b) can teach them ER strategies, specifically imaginary journeys, that are useful in stressful situations in real life, c) helps in *expressing* emotions by seeing and feeling visualisation techniques, e.g. by adjusting the outer environment to inner feelings (one therapist gave the example of visually expressing anger by a black thunderstorm), and d) can be a gamified process which can relieve users by having fun in the process of creating an own safe place or by adjusting the outer environment according to inner feelings. Research highlights the potential of VR to offer such playful artistic expression [29], which improve one’s well-being [28].

However, VR well-being apps should also offer other methods than the learning-by-being approach, such as learning-by-mirroring, e.g. through an avatar. We further assumed more unrestricted environments based on the high demand for individually fitting safe places. Despite literature suggesting that VR (and mobile apps as well) as new technologies could be used as artistic media to individually

design therapeutic environments [9, 25], we found only one app that at least partly allows for adjusting the environment [23].

*Recommendation 3: Mobile and VR apps should combine cognitive and affective approaches to mental health management (e.g. probes and artistic expression).*

#### 5.4 Limitations and Future Work

The interviews revealed interesting distinctions between the envisioned features for mobile and VR well-being apps. Yet, we recognise that the approach used in this paper is prone to certain limitations. As we did not want to influence the participants in any way, we only mentioned the well-known use cases of mood tracking for mobile apps and of anxiety therapy for VR apps. However, as the therapists had very little experience with both mobile and VR well-being apps, we could have used a multiple-choice questionnaire, shown them videos, or have them try out several apps to increase the level of detail with which the therapists answered questions about specific app properties. Future research could identify specific design considerations for mobile and VR apps to make them more attractive for therapists and users. Moreover, future work could take other stakeholders' opinions into account, identifying user and app developer preferences.

## 6 Conclusion

This paper analysed commercially available mobile and VR apps for mental health using lived therapeutic practice as an understanding lens. To that end, we conducted interviews with therapists, developed a coding scheme and analysed 60 mobile and VR apps. We found that there is a mismatch between what therapists envision digital technology to provide and what commercial mobile and VR well-being apps offer. Currently, most mobile and VR well-being apps focus on a specific well-being aspect, cannot be fully customised, lack opportunities for individual expression and should offer more support to users in identifying and reflecting upon their feelings. We hope that our results provide a starting point for future discourse between therapists, scholars and commercial app developers and provide a common grounding and language between different stakeholders.

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