Reflecting on Emotions within VR Mood Worlds

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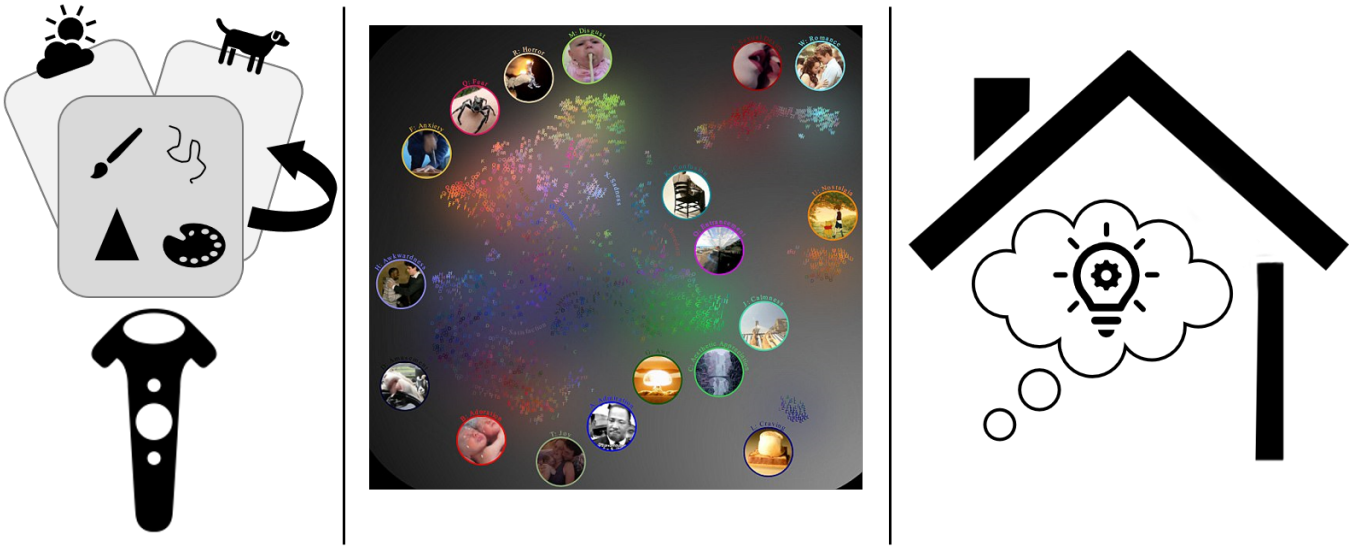

Figure 1: Three identified research gaps. Left: Fostering autonomy through creating one's own virtual environment. Middle: Identifying 27 complex emotions, image taken from Cowen et. al [10]. Right: Self-reflection on emotions at home.

ABSTRACT

Virtual reality applications can be an effective tool for emotion regulation and therefore support emotional well-being and mental health. However, many VR applications focus on inducing (positive) emotions and there is little research on how users can express their emotions autonomously at home. Thus, there is a need to inquire how emotions can be expressed independently in virtual environments. To that end, this position paper presents VR Mood Worlds, a VR application for ER intervention, that allows users to visualise their emotions and thus supports emotion regulation and emotional well-being.

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CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; *HCI theory, concepts and models*; Visualization systems and tools.

KEYWORDS

emotion regulation; virtual reality (VR); mood; feelings; reflection

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1 INTRODUCTION

Virtual reality (VR) offers a variety of benefits to foster well-being and to support therapeutic interventions such as emotion regulation (ER) techniques [26]. For instance, the complexity of real-life experiences can be reproduced while variables such as sound, light, object sizes etc. can be kept under control [30]. Furthermore, VR allows for real-time measurement of cognitive, physiological, behavioural and emotional responses [7, 37]. On the other hand, VR offers possibilities to create spaces for artistic expression [8] and

individually designed therapeutic environments [19] that enhance the experience beyond what is actually possible in reality.

Related work shows that digital technologies such as VR to support autonomous mental health management are on the rise [9] and offer more rapid access to mental health care, especially for isolated, hard-to-reach patients [15]. They appear to be beneficial in terms of intensity and duration of treatment, costs, and continuity-of-care [35, 36] and can increase emotional, psychological and social well-being [38].

However, when analysing recent VR applications for ER [26], most use VR to induce emotions in its users, mostly for anxiety therapy [25] or for relaxation purposes [21, 34, 42]. This position paper argues that VR interventions to support ER should provide means for users to express their own complex emotions and thus support reflection and a deeper engagement with those emotions (fig. 1). Hence, we contribute VR Mood Worlds, a VR application that shows ways how to (1) provide autonomous and personalised well-being support, (2) visualise complex emotions and (3) assist reflection at home.

2 RELATED WORK

In therapeutic contexts, VR as a visual medium promises to support users in engaging with their emotions [20]. Although it is mostly known for anxiety or exposure therapy [25], it has also been used in a variety of other mental health related areas, e.g. mindfulness [27], stress reduction [40, 45], visual lifelogging [12], or to recreate memories [39, 41]. Additionally, it is also becoming more prominent for ER interventions [26]. However, a variety of aspects of VR ER support have not yet been sufficiently explored. In this section, we discuss the potential of autonomous and personalised creation of VEs, visualising complex emotions and self-reflection on emotions at home.

2.1 Autonomy and Personalisation in VR

Research about VR applications offering autonomous and personalised mental health support lack in focus so far. In previous work on emotions in VR specific emotions were often induced by the experimenter in the HCI community. For example, Banos et al. [4] only allowed participants to choose between present VEs, while other studies randomly assigned participants to specific emotion-inducing VEs (e.g. [24, 42]). Wagener et al. [43] found a similar lack of user autonomy when investigating commercially available VR applications. However, it has been shown that mental health care is becoming more personalised and that individually designed therapeutic environments in VR appear beneficial [19]. Further, the process of self-designing an environment in the context of ER seems therapeutic [43], which is why properties of VR stimuli with emotional content can (and should) be adjusted in real-time [31].

2.2 Emotion Regulation of Complex Emotions

Emotions are often high in intensity and triggered by a specific event or activity [13]. They differ from *moods*, which are usually lower in intensity, last longer [29] and are often influenced by a variety of factors [13]. Although the VR application that is presented in this paper only has 'mood' in its name, the system can be actually utilised for both, visualising short-term, intense emotions and long-term moods. Learning how to regulate emotions is called emotion regulation (ER). ER therapy denotes a set of mental processes by which people modify their emotions and teaches strategies to regulate which emotions they have, when they have them and how they express them [2, 32]. One of the core aims of ER is to modify situation-based emotional responses [28]. As such, ER strategies need to be adaptive for the individual across situations [16, 17]. With special regard to that, VR appears promising as it allows to try out complex ER strategies in different environments similar to the real world [26].

Looking at VR applications that support ER, the range of emotional states induced in VR seems to be rather small. A literature review by Montana et al. [26] shows that most VEs are designed to evoke relaxation, joy, sadness or anxiety and that studies compare a maximum of two emotionally charged VEs with each other. Many of them base their research on the well-established six basic emotions (anger, disgust, fear, happiness, sadness and surprise), first introduced by Paul Ekman [14]. However, newer research by Cowen et al. [10] identified 27 more complex emotions (see middle image in fig. 1).

Other than the limited range of emotional states, the review by Montana et al. [26] also highlights that many studies done in HCI seem to evaluate VR as positive technology to elicit positive change in its users. This includes inducing happiness, relaxation or a mindful state of mind [21, 34]. Another review by Wagener et al. [43] suggests similar results regarding commercially available VR applications. However, ER is also about accepting and up-regulating negative emotions [17], which is not often the focus of VR applications so far.

2.3 Self-reflection at Home

One of the contextually adaptive ER strategies [16, 17] is called *cognitive reappraisal* [26]. Cognitive reappraisal is the personal (re-)interpretation of a situation, and it includes reflecting on and rethinking an emotion [5]. Thus, it is linked with self-reflection. Reflection is defined as a process to structure certain information with the aim of providing utility for the individual [46]. For the field of ER, cognitive reappraisal or self-reflection, amongst other aims, means identifying and naming emotions, understanding the causes and to consciously accept the own emotional states [23]. It is important to note that cognitive reappraisal and acceptance are two different ER strategies. More precisely, cognitive reappraisal or self-reflection might lead to acceptance while for acceptance as a strategy, cognitive reappraisal is not necessarily needed. In sum, being emotionally aware can improves one's well-being [3].

However, this is difficult to achieve for many people in their daily lives [23, 33]. Consequently, ER became one of the key elements of many psychotherapeutic approaches [18], such as cognitive or dialectical behavioural therapy (e.g. [5]). However, therapy in reality, also called treatment as usual (TAU), has its challenges. The amount of available services is limited and often there is social stigma attached to seeing a psychotherapist [11, 22]. Digital technologies might be a solution, not to replace TAU but to support and complement its services, especially by offering support to hard-to-reach patients that would otherwise not undergo treatment [15] or that could benefit from tools that help to train emotional control [31].

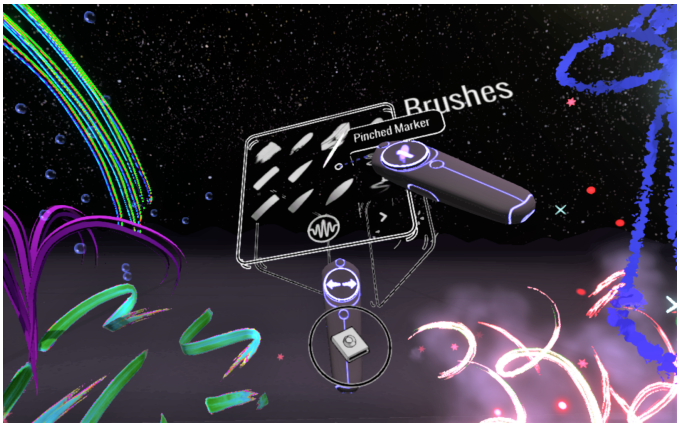

Figure 2: Rotatable menu in OpenBrush attached to one controller showing the brush selection menu. For VR Mood Worlds, other panels would be added, e.g. for selecting pre-set objects and manually adjusting light and weather.

Visual methodologies such as VR can support users to effectively engage with their emotions [20]. Also, research has shown that VR is effective for ER interventions [26]. Thus, it appears that VR could be a useful tool to support users in autonomously reflecting on their emotions within the privacy of their homes.

To summarise, related work has shown that technologies such as VR are effective in providing therapeutic ER interventions and can increase well-being. However, several research gaps have been identified that are not yet sufficiently addressed. Hence, (1) autonomous and personalised mental well-being support (2) for visualising complex emotions (3) to self-reflect at home is not yet provided.

3 VR MOOD WORLDS

To address the identified research gap, we introduce an ER intervention system called *VR Mood Worlds*. It (1) will allow its users flexibility and individuality by letting them create their own VEs while being in VR, (2) will be used to visualise complex emotions in so called *mood worlds*, and (3) will offer several means to support self-reflection at home. The section is structured in line with the identified research challenges.

3.1 Providing Autonomy and Personalisation

Related work has shown that visualising emotions can have a therapeutic effect [43]. We hypothesise that this also applies to self-designing a VE. However, in previous work VEs were mostly changed by the experimenter to induce certain emotions. VR Mood Worlds will provide several means and tools for users that support autonomy to create individual and personalised VEs while being in VR.

To understand the process and the user experience of expressing emotions, we conducted a pre-study with twelve participants (5 male, 6 female, 1 non-binary). They were given a box with different materials, including, amongst others, coloured crayons, clay and 30 photos that have been shown to represent emotions. Participants could further use any other material or personal items they had at home. Their task was to visualise a certain emotion with help of this material. Preliminary results, gathered in a post-test semi-structured interview, indicate participants were divided in which material to use: Nearly half of the participants solely used crayons and clay and stated they wanted to be as free as possible to express their imagination, while the other half relied on photos as pre-set objects and were of the opinion that without those they had not been able to fulfil the task.

Thus, VR Mood Worlds will offer, first, the possibility for artistic expression [8] by using the application Open Brush (see fig. 2). Users will be able to freely draw abstract shapes, select colours of the sky and objects, and to construct simple 3D objects by themselves, similar to using crayons or clay in reality. Second, users will be able to recreate the complexity of more realistic real-life experiences [7, 30, 37] by providing pre-set high quality 3D objects. Those will appear as fully rendered 3D objects when chosen from a menu. To reduce the amount of time needed to create a fully immersive environment, users will also be able to choose between pre-set scenes. Those scenes will be quite plain, for example only showing sand dunes in a desert or some trees and grass flooring in a forest, and those can be then equipped further.

As can be seen on the left image in figure 1, all panels will be combined and attached to one controller. In contrast to world-based menus, this guarantees that nothing of the VE will be concealed by the menu, thus enhancing the user experience and therapeutic function of this application. The combination of both menu types in one application also allows a mixing of individual drawing and pre-set objects to further enhance personalisation.

3.2 Expressing Complex Emotions

Although recent studies identified 27 emotions [10], emotions induced by VEs are mostly limited to the basic six emotions [26]. It has further been shown that the field of positive technologies for positive change is rather well-researched.

As an exploratory application, VR Mood Worlds could expand this research and set the focus on ER interventions that allow a representation of complex emotions, positive and negative ones. The imagined use cases are manifold: Users could represent their emotions in an abstract way that has only meaning to them, they could recreate a specific situation that caused them to feel this emotion, or they could design an environment that induces their felt emotions in others. As an example, therapists in a study by Wagener et al. [43] imagined that users could design a thunderstorm for anger worlds. Further, Pinilla et al, [31] already gathered an overview of how colour, movement, sound and shape of objects could change to represent different arousal or intensity and valence of emotions. For example, angular-shaped and fast-moving objects generally symbolise higher arousal. It will be interesting to see if those results still apply in a complex scenery that as a whole represents emotions. Although such an approach might not support learning to name the six basic emotions, it might be as valuable to visually express multilayered emotions and moods.

3.3 Possibilities to Enhance Self-Reflection of Emotions

Research suggests that the process of self-designing VR Mood Worlds that represent complex emotions and moods might already have a therapeutic effect [43]. However, we hypothesise that an additional value of VR Mood Worlds lies in its potential to support reflection on those emotions. Upon finishing, users will be able to emotionally take a step back to reflect on their work, looking more at the canvas they created instead of being immersed in it.

To further enhance the reflection process, VR Mood Worlds could include a questionnaire to prompt thinking about one's emotions. Slightly modified measuring scales such as the reflection inventory scale [6] could prove beneficial in this regard. Based on research about the advantages of integrating questionnaires in VR [1, 44], this questionnaire will be conducted while the users are still in their self-created VE to further increase reflection.

Additionally, the application will offer in-game psycho-educational information, as Wagener et al. [43] proposed, that might facilitate self-reflection. Thus, when some pre-set object is chosen, for example a shark, additional information could be shown about the symbolism and its relation to a specific emotion. This could prompt the user in consciously re-assessing why they chose this object.

Moreover, VR Mood Worlds will provide a sharing possibility to invite family, friends or a therapist to experience the VE. Wagener et al. [43] showed that such a sharing option is a valuable asset, and that therapists would generally approve of such as an introduction to more in-depth talking. Offering a sharing option could, first, facilitate the self-reflection, for example by talking to others about the reasons behind choosing this specific colour or object. In the future, one could even think about using artificial intelligence to establish such a conversation. Second, this could also benefit interpersonal understanding. For example, showing how one feels to a partner or family member after an argument could facilitate the reflection process of both persons and pave the way to a dispute settlement.

4 CONCLUSION & FUTURE WORK

This position paper identifies three research gaps that by addressing them could create more effective VR applications that support ER. More (1) autonomous and individually created VEs that are used to (2) visualise complex emotions in order to (3) self-reflect on emotions at home are needed. To address these research challenges, we introduced the concept of a VR application, named VR Mood Worlds, that discusses means how to create a meaningful VR intervention system supporting ER at home. Future work could implement those theoretical ideas and study their effectiveness regarding ER and user experience. Further, instead of using self-reports to assess emotion representation and self-reflection, continuous tracking of physiological information, for example gathered via smartwatches, could provide valuable objective data about the emotional experience in VR. In addition, future work should critically reflect on the limitations of this approach. The affordances of the technology shape in what way users can express themselves in the virtual environment (VE). This challenge inevitably leads to the question of suitability. More precisely, for which user groups it is suitable and beneficial to express themselves in this way. We believe the HCI community can play an important role to address these research gaps and explore how to create effective systems that support emotional well-being.

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