The Self-Care Technology Process Model (SCTpm): A Framework for Designing VR-Based Self-Care Technology

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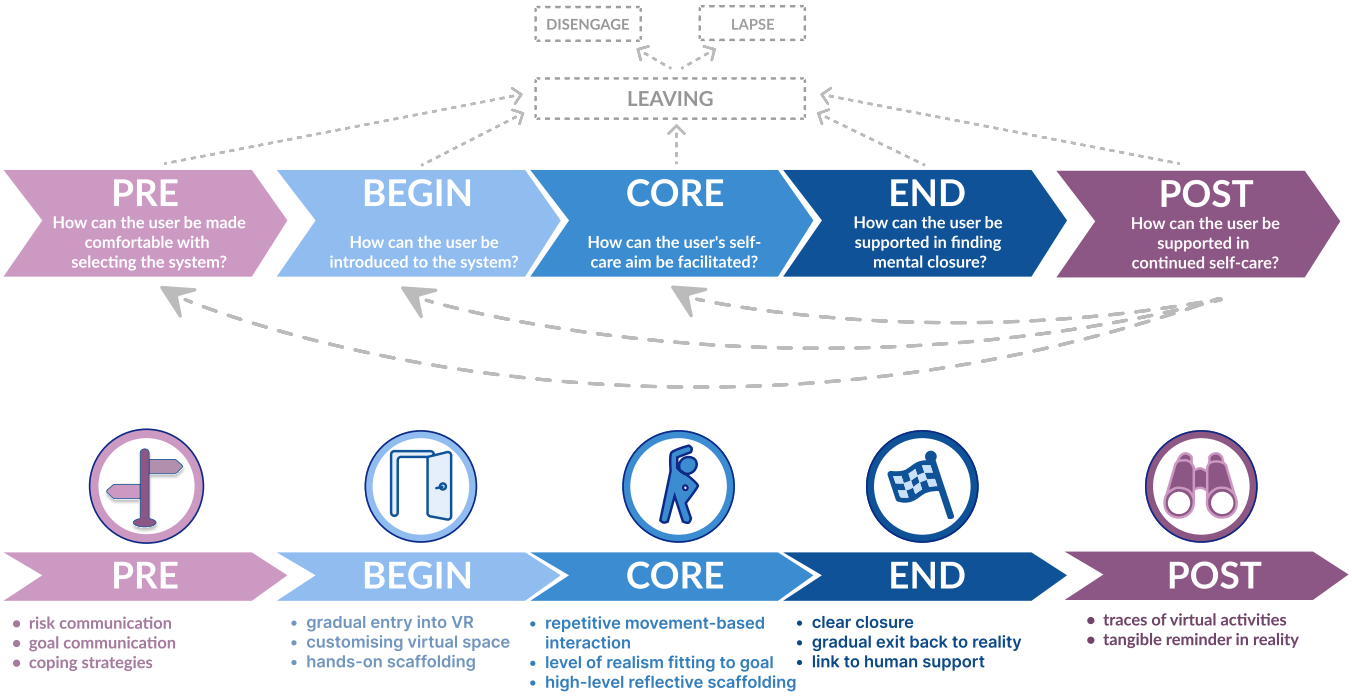

Figure 1: The VR-Based Self-Care Technology Process Model (SCTpm). The user journey consists of five phases, each addressing specific user needs. Failing to meet these needs may result in users disengaging from the VR application. To ensure continued engagement, designers should address key questions for each phase, supported by phase-specific design recommendations. Upon completing the VR experience, users typically restart at the *Pre*, *Begin*, or *Core* phase.

Abstract

Designing for ongoing engagement in Virtual Reality (VR) self-care and well-being interventions presents several challenges. Current frameworks supporting designers in this task primarily focus on specific well-being objectives, such as goal-setting or self-reflection, but often lack implementable design recommendations to enhance engagement and prevent lapsing. To address this gap, we propose the Self-Care Technology Process Model (SCTpm), which builds on six prior studies on VR self-care applications. The SCTpm is a framework for an intervention-centred self-care journey, providing targeted design recommendations tailored to evolving user needs and supporting sustained interaction. Evaluated by n=10 experts, the SCTpm demonstrates its potential to enhance the iterative design and evaluation cycles of VR-based self-care technologies, sensitising designers to create effective and more engaging systems. Findings further indicate that the SCTpm can provide valuable guidance for designers and researchers at different levels of expertise in developing innovative VR applications for self-care.

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CCS Concepts

• **Human-centered computing → Human computer interaction (HCI)**; **HCI theory, concepts and models**; **Virtual reality**.

Keywords

Virtual Reality, model, framework, engagement, self-reflection, reflection, design recommendations, user needs, mental health, well-being, self-care

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1 Introduction

Currently, 3.6 billion people – half of the global population – lack access to essential health services. The World Health Organisation (WHO) thus recommends self-care interventions as a critical path to reaching universal health coverage and promoting health [102, 103]. To support these efforts, so-called "self-care technologies" (SCTs) are being designed for diverse use cases, such as fostering mental shifts for a positive change (e.g. [43]), or practising strategies for stress relief (e.g. [5]). One promising SCT is Virtual Reality (VR), offering unique affordances such as immersiveness, customisability, and the ability to block out real-world distractions [66]. These features have led to widespread adoption of VR in HCI research for self-care (e.g. [5, 54, 64]). However, the challenge lies in understanding specific factors that make the design of SCTs effective, ethically sound, and engaging to create SCTs that deliver meaningful and impactful interventions. To support the development of effective and ethically sound self-care technologies (SCTs), HCI research has proposed general design recommendations (e.g., [13, 18, 21]). Other work outlines broad principles – such as encouraging reflection[8, 61], supporting goal-setting [1], and promoting engagement [25] – but often lacks actionable guidance for implementation. As a result, designers may struggle to translate these abstract insights into effective, human-centred solutions. Moreover, these recommendations do not necessarily apply to the unique affordances and challenges of VR.

Existing frameworks specifically targeting the design of VR-based self-care activities primarily focus on specific aspects, such as realism [3], stress therapy [105], or user experience [89]. Alternatively, they provide high-level guidance with only little implementation advice without considering phase-specific user needs [37]. Therefore, this presents an opportunity for research to develop specific design recommendations, helping designers tailor their VR application to self-care-specific user needs.

The importance of a holistic framework for VR-based SCT design is emphasised by three key considerations, highlighting that this is an area demanding special attention and requiring thoughtful design. First, self-care is deeply personal, as it involves self-reflection and personal exposure, such as acknowledging personal limitations, which can leave individuals feeling vulnerable [16, 81]. Second, technologies have the power to shape users' perceptions and behaviours [91]. When users are in a vulnerable state, inadequately designed technologies may reinforce harmful perceptions or encourage unintended behaviours [81]. Third, VR as an immersive medium introduces additional layers of responsibility to SCT design, as it can create lasting emotional impact beyond the immediate experience [92], which may both positively support self-care and intensify potential negative consequences.

Given these considerations and to address the gaps in the framework space, we propose the *Self-Care Technology Process Model (SCTpm)* – a holistic framework designed to help designers navigate the key steps required to create immersive, effective, safe, and engaging VR self-care applications. By integrating empirical findings from VR research with theoretical accounts of self-care, the SCTpm is designed to leverage the full potential of VR to meet the unique needs of users throughout their self-care journey and to help designers navigate each step of the process. With our work, we contribute (i) a conceptual understanding of phase-specific user needs in a VR-based self-care journey and guiding questions to meet those, (ii) a structured and holistic framework characterising how designers of VR-based SCT use this knowledge to design for engagement and effective self-care activities, and (iii) phase-specific design recommendations informing the design and evaluation of future VR systems tailored to support users' self-care and well-being.

2 Related Work

This section aims to offer a broad overview of key concepts related to self-care, examining how their theoretical foundations shape HCI frameworks and design principles. We first define self-care and present different types of self-care activities. Then, we explore the ethical and moral implications of designing SCTs, particularly VR-based SCTs. We discuss existing conceptual frameworks and guidelines for designing technology, deriving a clear research gap, and highlighting the need for a framework like our SCTpm.

2.1 Frameworks and Aspects of Self-Care and Well-being

The WHO defines self-care as "the ability of individuals, families and communities to promote health, prevent disease, maintain health, and cope with illness and disability with or without the support of a health worker" [102]. Thus, the WHO recognises individuals as active agents in managing their own health care and well-being, in areas including health maintenance, disease prevention, health promotion, and rehabilitation [102]. The WHO stresses further, that self-care can be carried out by individuals without prior psychological training and on their own behalf [101]. Effectively, self-care revolves around meeting one's unique physical, emotional, and mental needs. This is why the SCTpm seeks to improve the design of VR-based self-care applications that empower individuals – regardless of their psychological expertise – to take charge of managing their own mental health and well-being.

The practice of self-care involves regularly incorporating behaviours or strategies that promote mental well-being into daily routines [16]; in other words, self-care encompasses a combination of lifestyle choices and activities that are consistently applied in everyday life [106]. To conceptualise, El-Osta et al. [24] developed the *Self-Care Matrix*, organising self-care into four key dimensions

(Activities, Behaviours, Context, and Environment) and illustrating how elements of self-care interconnect across micro, meso, and macro levels. The SCTpm mainly focuses on a person-centred micro and meso perspective on self-care, presenting a framework to help designers create VR applications for *self-care activities* (first dimension), which in turn can positively influence *self-care behaviours* (second dimension).

These self-care activities are defined as intentional actions and practices aimed at achieving, maintaining, or promoting optimal health and well-being [52]. A central aim of many such self-care activities is to gain a deeper understanding of oneself, which is essential for tailoring self-care behaviours to fit one's lifestyle, daily routine, and personal needs. Thus, it often requires in-depth self-reflection, acknowledging one's vulnerabilities and needs, the willingness to admit personal challenges, limitations, and boundaries, and the courage to confront stigmas and deal with societal pressure [52]. Although self-care activities can differ widely in form and focus, many share a common goal: to support *introspection* – the process of becoming more aware of one's internal states [88], develop an in-the-moment awareness of own needs [23], and engaging in ongoing self-evaluation [23]. For example, mindfulness, self-reflection, self-expression, and emotion regulation are distinct practices, yet all promote introspection in different ways. Because self-care encompasses such a diverse range of self-care activities with overlapping aims, the SCTpm proposed in this paper is not tied to a single practice. Instead, it seeks to provide a broader, more inclusive framework that accounts for various forms of self-care and the shared introspective processes they involve. As such, the corpus of empirical work underlying the SCTpm includes different self-care activities, namely mindfulness, self-reflection, self-expression, and emotion regulation. To understand similarities and differences between these self-care activities, how they are currently supported through VR applications, and why these particular practices were chosen as the foundation for the SCTpm, the following sections provide a more detailed overview.

2.1.1 Mindfulness. Mindfulness is a well-studied self-care practice in HCI [93]. It involves present-moment awareness with acceptance [38, 39, 82], cultivated through practices like guided or walking meditation [17, 38] and short-term training [46]. VR supports mindfulness by reducing distractions and enhancing focus [5, 56, 57], which was found to be helpful particularly for beginners [31, 48]. Custom environments, gamification (e.g., Re-Mind VR[1]), and biofeedback tools [4, 67] can boost engagement. VR also enables embodied techniques like body swapping [22] to support mindfulness.

Given this high interest within the HCI community in developing VR-based systems for mindfulness, a study from this field is included in the development of the SCTpm.

2.1.2 (Self-)Reflection. Self-reflection supports well-being by fostering self-awareness and personal growth [7, 14, 29, 30, 49, 79, 83, 87]. It is often distinguished between reflection-in-action [74] – the spontaneous ability to 'think on our feet' and reflection-on-action, conducted in retrospect. Most VR studies combine reflection with concepts like empathy [84], learning [45], or storytelling [6]. Despite VR's potential for actionable insights through its immersive environments [9, 26, 60, 63, 104], explicit prompting of reflection, for instance through conversational agents, remains rare [55]. Generally, HCI literature notes a lack of focus on developing introspective self-care practices, in particular with VR [70, 84].

These research gaps inspired us to add several VR-based studies that explicitly facilitate self-reflection when constructing the SCTpm.

2.1.3 Emotional (Self-)Expression. Emotional self-expression -— through verbal and non-verbal methods like writing or drawing – supports emotional processing and perspective-taking [14, 32, 33, 49, 79]. Central to practices like art therapy [20, 51], visual expression can enhance reflection and generate positive affect [19, 40, 75]. However, few studies have explored VR for emotional self-expression [43], even though VR art-making offers similar benefits to traditional methods – such as stress reduction and mood improvement – while enabling novel 3D interactions [35, 71]. To reflect this emerging area, we included relevant studies about VR-based emotional expression in the development of the SCTpm.

2.1.4 Emotion Regulation. Emotion regulation (ER) involves managing emotional responses to enhance well-being [11, 32, 34, 53], modifying thoughts, emotions, and goals to facilitate behaviour change [27]. VR has shown promise for promoting ER and cognitive change, such as reshaping bodily self-consciousness [72]. Yet, VR-based ER support remains underexplored in HCI [80], with most systems lacking psychological grounding and focusing on information rather than skill-building [78]. A 2022 review found that over half of VR ER studies focused on exposure therapy, with only two addressing psycho-education for cognitive change [50]. Thus, there is an ongoing need to develop VR-based ER systems that focus on these gaps, which is why ER-related studies were included in the corpus of the SCTpm.

2.2 Ethical Considerations when Designing VR-Based SCT

When designing self-care applications for VR, they should be designed with ethical and moral considerations to ensure they support self-care without causing harm. This is especially true due to three key considerations, showing that the design of VR-based SCT is an area that demands special attention and requires particularly thoughtful design.

First, self-care is deeply personal and can leave individuals feeling vulnerable [81]. Self-care revolves around meeting one's unique physical, emotional, and mental needs, which often requires in-depth self-reflection and a willingness to acknowledge personal challenges, limitations, and boundaries [16]. Additionally, people often have to navigate societal pressure and confront stigmas surrounding self-care [52]. This combination of self-exposure and external factors makes self-care deeply personal and can leave individuals feeling vulnerable [81]. Considering the inherent vulnerability of individuals practising self-care, SCTs should be designed in a manner that is not only effective but also empathetic, supportive, and respectful of users' vulnerabilities [81, 90].

[1]Re-Mind VR:
$https://store.steampowered.com/app/862220/ReMind_VR_Daily_Meditation/$

Second, technologies hold the power to influence users' perceptions of the world (hermeneutic scaffolding), shape their experiences, and guide their actions and behaviours (pragmatic scaffolding) [90, 91]. Thereby, technologies often mirror the designers' beliefs and values and reinforce them in its users [81, 91]. This is why it is already well-known that technologies should prioritise user needs, support intuitive interactions, convey a clear meaning, and provide immediate feedback to ensure that users understand the outcomes of their actions [62]. Moreover, they should empower users and remain engaging while adhering to ethical and safety standards [58]. However, these embedded values can have larger repercussions when users are in a vulnerable state, potentially leading to unintended stronger negative consequences [81]. Given the significant influence of technology on people, designers bear the responsibility to create ethical and morally sound technology [90], whose guidelines and standards should go beyond the boundaries of general technology design.

Third, VR adds further challenges to SCT design. For instance, additional extensive knowledge in tracking technologies, multimodal interaction, and computer graphics is required when designing VR applications [42]. Further, the immersive nature of VR provides significant "emotional experiences" that have been found to create lasting impressions for users beyond the actual experience [92]. While this allows for great opportunities for self-care, potentially positively influencing self-care routines in real life, this characteristic could also intensify the consequences of (unintended) harmful and 'poor' design. Thus, technology design, constrained by its own ethical and moral boundaries, is intertwined with complex and deeply personal topics such as mental health and self-care [73], with VR as an immersive medium introducing additional layers of sensitivity and responsibility to SCT design.

While safe and ethical design principles must always be adapted to the specific self-care aim and context, some general principles hold true across VR-based SCTs. These applications should avoid oversimplifying mental health challenges or making exaggerated claims about their efficacy—issues that have long affected the credibility and safety of SCTs [65, 81]. Furthermore, the highly individual nature of self-care means that a one-size-fits-all approach is neither practical nor effective [13], reinforcing the need for tailored and user-sensitive experiences.

These ethical, personal, and technological complexities form the foundation for the SCTpm introduced in this paper. The SCTpm is designed to guide the development of VR-based self-care technologies in a way that respects user vulnerability, acknowledges the mediating role of technology, and leverages the affordances of VR without overlooking the risks. By offering a structured yet flexible process model, the SCTpm aims to support the creation of self-care applications that are not only effective and engaging but also ethically grounded and inclusive of diverse user needs.

2.3 Conceptual Frameworks to Design Self-Care Technologies (SCTs)

In HCI, there have already been several conceptual frameworks developed to understand how to design technologies for reflection, well-being, and improved living. This section positions the SCTpm within this broader HCI research landscape. The aim of this section is not to present a comprehensive review of available related frameworks, instead it reflects on how the SCTpm builds and diverges from influential examples, highlighting the need for the SCTpm.

2.3.1 Frameworks for Designing SCTs. One of the most well-known concepts of designing technologies is the human-centred design (HCD) process [15], involving iterative design, testing and evaluation cycles and prioritising user needs to ensure that systems are relevant, usable, and meaningful. The SCTpm encourages HCD principles, integrating into step three and four - designing solutions and testing against requirements - while also helping to discern *in which phase* users deviate, *which specific user need* was probably not met, and to *find design solutions* to better meet these needs and to counteract further deviation – aspects that are not part of the HCD process.

In terms of reflection as a self-care activity, one of the most well-known is the *Reflective Practice Theory* by Schön et al. [74] that postulates the critical role of continuous reflection for practitioners and designers in fostering learning and improvement. They introduced two key concepts: reflection-in-action, which happens during the intervention or design process, and reflection-on-action, which occurs after the activity is completed. This fundamental idea is included into the SCTpm, which on top of that incorporates specific design recommendations how to design for both types of reflection, both for users and for designers.

Further, some design recommendations, albeit not frameworks, are intended to support designers in creating effective and ethically safe SCTs (e.g. [13, 18, 21]. For example, these include researching, designing, and evaluating SCTs from multiple perspectives and methodologies [13], considering the social and cultural background of users, and designing for user engagement [21]. However, these guidelines generically address SCTs and do not specifically cater to the unique capabilities and affordances of VR.

Other models that inspired the SCTpm have focused on the principles of user self-care journeys and self-reflection when using wearable technologies. For example, Epstein et al.'s *Lived Informatics Model* [25] describes the cyclic user engagement with wearables and how reflecting on the personal data that is collected by them can be integrated into users' daily lives. Epstein et al.'s research considers how the user chooses an application, collects data, reflects on it, and then gains insights into their health and behaviours. They also discuss how users decide whether to continue using the app or refrain from using it if it no longer supports their self-improvement goals. Similarly, the *Technology-Mediated Reflection Model* [8] suggests that users engage in ongoing reflection, evaluating how their health data aligns with their needs in a cyclical process. Similarly, the *Tracker Goal Evolution Model* [61] highlights trust and reflection as key contextual factors that drive the transition from internal user needs to qualitative goals. It also suggests how these can be measured with respect to quantitative goals. The *Longitudinal Goal Setting Model* [1] adopts a broader perspective, focusing on well-being. It outlines a cyclical process of setting and adjusting goals through iterative reflection, aimed at supporting self-improvement for both therapists and clients. While these approaches have informed the SCTpm – such as the understanding that users' goals might shift over time, that they continuously reflect, and that unmet needs can lead to disengagement – none of the aforementioned

studies offer design recommendations tailored specifically to VR and catering to more than one self-care activity.

2.3.2 Frameworks for Designing VR-Based SCT. HCI research has also developed frameworks specifically for VR that are loosely linked with self-care and wellbeing, such as designing for presence (e.g. [77]), realism (e.g. [3]), user experience (e.g. [89]), and influencing human behaviour (e.g. [59]). However, they do not present a specific link to self-care and mental well-being, albeit, as previously established, these use cases require a thought-through design due to its impact and the vulnerability of users.

Only few works specifically target self-care and mental well-being for VR. One example is by Zaharuddin et al. [105], providing guidelines for stress therapy in VR. While they provide a list of recommendations, such as the importance of interaction possibilities and of nature-based environments, they do not include phase- and user-specific needs, the overall procedure of a user journey, and only focus on stress therapy as use case, which does not necessarily translate to other self-care endeavours.

Another example is the conceptual model called *RIOR* [37], (Readiness for reflection, Immersive estrangement, Observation and re-examination, Repatterning of knowledge), which attempts to provide solutions for mitigating the tension between immersion and reflection in VR. It promotes the importance of creating mental headspace for reflection, using techniques such as viewpoint manipulation or cinematic storytelling for immersive estrangement, becoming self-aware, and including familiar elements for personalisation. While its proposed design ideas of this model informed the specific design recommendations of the SCTpm – such as the importance of entering VR in users' own time or using personalised artefacts – this model focuses on a single self-care activity and does not integrate changing user needs and the overall user journey. It also does not provide a visual that could be especially helpful in teaching or for early-career researchers. Instead, the SCTpm provides a broader overview for designers of VR-based SCT while still managing to integrate specific design recommendations in a visual way.

In summary, while the concepts and frameworks discussed above provide a diversity of design guidance, they are either too general with respect to technology design, do not focus on VR, only focus on one self-care activity, or do not provide specific enough design recommendations. The aim of our research is to address this by developing a more extensive framework intended to help designers develop VR experiences that can facilitate and support self-care practices. In particular, the aim is to develop a design process model that combines empirical findings of VR research with theoretical accounts of self-care. To this end, we propose the *Self-Care Technology Process Model*, which we now describe.

3 The VR-Based Self-Care Technology Process Model (SCTpm)

The SCTpm (see Figure 1) depicts a user self-care journey combined with phase-specific design recommendations to support designers of VR-based self-care and well-being systems in creating effective and engaging experiences. It is grounded in prior literature and empirical research. The following sections present the foundational work on which the SCTpm is based, explain how it should be used, by whom, and in which contexts, and describe each step of the framework in detail.

3.1 Constructing the SCTpm

The SCTpm aims to provide explicit phase-specific guiding questions and design recommendations supporting designers in creating effective, safe, ethical, and empathetic VR-based self-care technology. In order to construct the SCTpm, we built on insights from literature reviews and analysis of frameworks, and a series of empirical studies that designed and evaluated VR-based self-care applications for various well-being contexts.

The main corpus informing the SCTpm included the following:

(1) A systematic app review, abbreviated as *Role of Tech* [96], which identifies gaps between psychotherapists' recommendations for the design of VR-based self-care applications and the available applications. It highlights the need for customisation, clearer communication of objectives and limitations, and more holistic approaches that integrate cognitive, affective, and physical well-being;
(2) A study exploring the impact of haptic and auditory cues in VR on introspection, mindfulness, and presence, abbreviated as *Passive Haptics* study [94], which demonstrates that passive haptic feedback enhances introspection, body awareness, and supports mindfulness practice;
(3) A study called *VeatherReflect* [95] comparing quantitative and qualitative visualisations of stress data in VR (via 2D graphs and weather scenarios), which shows that the immersive weather-based scenarios enhanced the depth of introspection, engagement with the data, and increase motivation to reflect on personal stress metrics;
(4) A study called *MoodWorlds* [98] in which users customise their virtual environments using pre-sets like 3D objects or lighting, and drawing tools such as (animated) brushes and colours in order to express positive emotions, finds that autonomous emotional self-expression enhances emotional engagement, positive affect, and well-being;
(5) A study called *SelVReflect* [99] that extends the aforementioned tool palette for autonomous self-expression by carefully designed voice-based VR guidance to help users reflect on personal everyday challenges such as work anxiety, and emphasises how this combined approach supports perspective-taking and in-depth self-discovery;
(6) A study called *MoodShaper* [97] that designs and evaluates three interventions in VR providing technology-mediated emotion regulation support based on established therapeutic emotion regulation methods, and demonstrates how each significantly improves positive affect, enhances the ability to regulate negative emotions, and reduces negative affect.

The main corpus informing the SCTpm was carefully selected to provide a well-rounded foundation by addressing distinct yet complementary aspects of VR-based self-care design. Each study represents distinct yet interconnected facets of self-care, contributing unique insights that, together, form a cohesive understanding of how to design effective and empathetic applications. These studies were chosen because they address critical and distinct aspects of VR-based self-care design, including current design gaps between

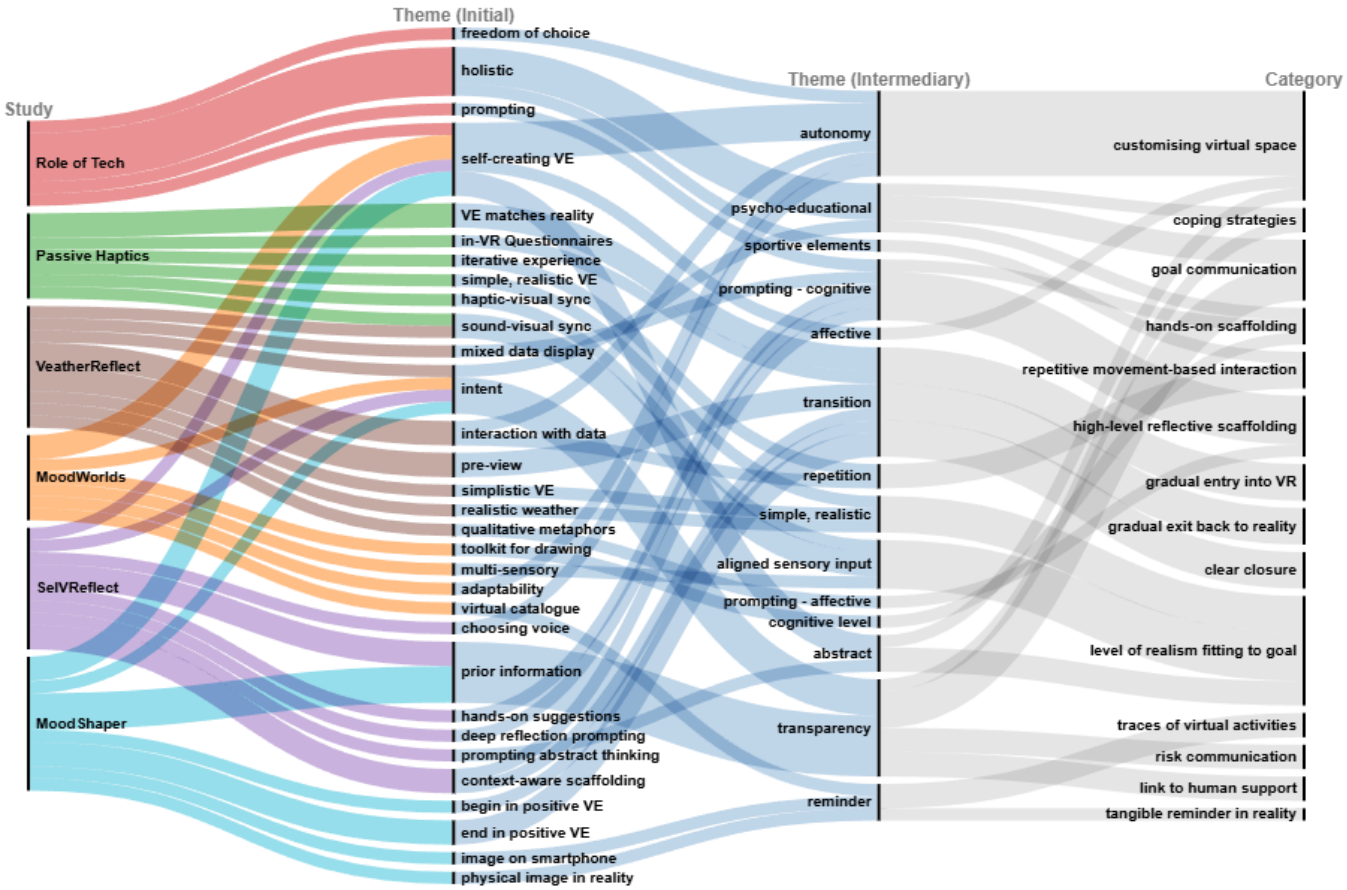

Figure 2: Diagram showing the information flow from the main corpus to the identified themes, which are clustered into the Design Recommendations of the SCTpm. The studies in the corpus are abbreviated as follows: Role of Tech [96], Passive Haptics [94], VeatherReflect [95], MoodWorlds [98], SelVReflect [99], and MoodShaper [97]. 'Virtual environment' is abbreviated as 'VE'.

existing applications and user needs [96], the impact of sensory feedback [94], the role of immersive visualisations for introspection [95], ideas for the personalisation of a virtual environment [98], the integration of guidance for introspection [99], and an example of how VR can help move forward after successful introspection by facilitating cognitive and emotional change [97].

The selected corpus reflects a broad range of self-care activities, each chosen to address a specific research gap in current HCI research on well-being applications. We anticipate that future work will focus on these areas, making the SCTpm particularly valuable for designing innovative VR self-care applications. Thus, we focused on mindfulness (as it remains one of the most extensively studied self-care activities in HCI [93]), self-reflection (which has received limited attention with respect to its explicit facilitation [84]), emotional self-expression (with few studies exploring its potential in VR [43]), and emotion regulation (where current VR research largely emphasises exposure therapy [50] and information delivery [78] over skill development and cognitive change [70, 78]). Together, these works form an interconnected body of research that the SCTpm builds on to generate actionable guidance, ensuring the SCTpm framework is both holistic and adaptable.

This corpus was read in detail by two authors of the paper and analysed through a structured process. To support triangulation from the six studies, each study was systematically coded with regard to its aims and self-care activity, study procedure, key findings, and design recommendations. Through iterative discussions and affinity diagramming [47], we identified recurring concepts and emerging categories, which are consolidated in Figure 2. This figure captures both shared and study-specific insights, mapping codes (initial themes) to higher-level intermediary themes and finally to the key design recommendations of the SCTpm. A detailed table of this analysis can be found in the supplementary material.

3.2 Using the SCTpm

The SCTpm is intended to assist designers and developers in creating self-care applications for laypeople by providing inspirational ideas, supporting design refinement, and guiding outcome evaluation. As such, the SCTpm supports the iterative design process

in alignment with the principles of the Human-Centred Design Process (HCDP) [2, 15], aiding designers by integrating design recommendations with a comprehensive understanding of user needs throughout the self-care journey. It upholds essential HCD values, such as understanding the user context and defining user requirements. In particular, it aligns with the third and fourth steps of the HCD process: generating solutions and evaluating them against established requirements. If designers find that their VR self-care prototype does not meet these requirements, the SCTpm can guide subsequent iterations by pinpointing in *which phase users exit the system*, identifying *specific unmet needs*, and offering insights to *develop design solutions* that address them. Using the SCTpm may help improve the effectiveness, safety and use engagement of VR self-care applications. Consequently, we envision the SCTpm being used both in iterative design cycles and in the evaluation of existing VR prototypes. This section provides a detailed overview of the target group and the intended use context for the SCTpm.

3.2.1 Target Group. The SCTpm is intended to assist designers and developers in creating VR self-care applications by integrating design recommendations with a comprehensive understanding of specific user needs throughout the self-care journey. Importantly, in this context, the term *users* specifically refers to end-users, meaning laypeople who are not psychologically trained but are interested in self-care. To avoid any confusion, we use the term *designers* to refer to individuals who use the framework. This group includes anyone involved in the design, development, implementation, or evaluation of VR-based systems for self-care and well-being. This encompasses students prototyping and learning about design and system development, educators supporting that learning and assessing student work, as well as researchers and practitioners working in the field of Human-Computer Interaction. The target group of the SCTpm is further expanded to include individuals from industry who are involved in the development and publication of VR self-care and well-being applications, for example on platforms such as Steam. The SCTpm is intended to support people with varying levels of experience, from those new to the field to those with substantial design or research expertise.

3.2.2 Use Context. We envision two distinct use contexts for the SCTpm. First, the SCTpm is intended to support the *design and development of novel VR applications for self-care and well-being*. It can be used in brainstorming sessions, either individually or in teams, to guide the design process beyond the *Core* phase. In doing so, it facilitates thoughtful reflection on how to create effective, ethical, and safe self-care applications. In this context, the SCTpm can serve as both a checklist and a prompt for designers to consider all stages of the user self-care journey. It should encourage designers to reflect more deeply on their design, discern phase-specific and other relevant requirements, and refine their ideas inspired by the design recommendations provided in the SCTpm.

Second, the SCTpm can also be utilised to assess and *evaluate existing VR applications for self-care and well-being*. For instance, it can assist in grading student projects, in providing feedback on projects to design-teams, for example for those in mentoring or supervisory roles, and offer valuable insights for industry professionals seeking support or validation for their products. The strength of the SCTpm lies in its clear visualisation of the user self-care journey, combined with specific design recommendations. This helps establish a shared language among different stakeholders, enabling more effective communication of the strengths and weaknesses of the VR application being assessed. In this way, the SCTpm contributes to a more transparent and tangible approach to communicating ideas and delivering constructive feedback.

3.3 Explaining the SCTpm

The SCTpm (see Figure 1) divides a VR-based self-care experience into five distinct phases. Throughout each of these phases, users experience evolving needs, which they reflect on to determine whether the system meets their individual requirements. If their needs are satisfied, they are likely to progress to the next phase. However, if their needs are not met, they may choose to discontinue use of the system. Leaving the system can occur for constructive reasons, such as achieving their self-care goals, acquiring the necessary skills, feeling healthier and better equipped to manage real-world challenges, or choosing to explore non-technological self-care methods. This type of disengagement is referred to as positive *disengagement*. In contrast, users may also avoid or abandon a VR application due to negative factors such as usability issues, an unsatisfactory user experience, hardware or software limitations, or significant design shortcomings. Furthermore, there are various neutral reasons for suspending the use of a VR application. These include, but are not limited to unforeseen or situational life circumstances such as the birth of a child, being on holiday, family-related matters, individual psychological or physiological factors such as nausea that could pose risks to the user's well-being, or forgetting to use the system. Some of these reasons may lie beyond the designers' capacity to anticipate or address through design. To distinguish these scenarios from positive disengagement, this step is referred to as *lapsing*.

To meet the diverse and evolving needs of users, designers can develop and refine their systems through iterative testing, facilitating either continued use or positive disengagement. To that end, designers are supported by guiding questions for each phase, outlined in the SCTpm, for example, ' *'How can the user be made comfortable with selecting the system?"* in the PRE phase. These guiding questions articulate the primary aims and design objectives to focus on during each specific phase. Furthermore, the SCTpm offers a collection of phase-specific design recommendations (see Figure 1) intended to inspire designers and facilitate the creation of effective and ethical designs for VR-based self-care and well-being systems. They can also serve as a checklist to assist in the iterative testing and evaluation of systems within this context.

The subsequent sections will explore the specific user challenges and design recommendations relevant to each phase in more detail. To illustrate how the SCTpm could be used for each phase, we draw on an imaginative use case of a VR-based self-care application for emotion regulation (ER). Please note that while our illustrative example centres on an ER application, we envision that the proposed approach is applicable to a broader range of use contexts. We envision that the SCTpm was used in brainstorming sessions with interaction designers and in iterative evaluation cycles to develop that imagined use case. We discuss a comprehensive design journey based on this fictitious example, synthesising elements from

each study of the corpus that informed the framework to showcase specific design recommendations. Elements linking to the specific design recommendations are presented in phase-specific lists after the description of each phase.

3.3.1 Pre Phase. After having decided to conduct a VR-based self-care activity, users need to select a fitting application. However, they are presented with an overwhelming number of applications available in an often unordered manner available on the consumer market [10, 85]. Users may feel anxious, especially if they are preparing to address an emotionally challenging task. Thus, in the *Pre* phase, the designers' primary objective should be to reassure users and facilitate their selection process.

Helpful strategies and design recommendations for this phase include:

- *Transparently communicate risks*, i.e., you will re-experience strong negative emotions,
- *Clearly communicate goals and objectives*, i.e., to encourage self-reflection,
- *Offer practical guidance for coping strategies*, i.e., suggesting a walk in nature or consulting a mental health professional if needed.

Transparency in privacy policies and data confidentiality can also build trust and influence users' choices [21, 81].

For the illustrative use case, designers could create a comic-style storyboard to convey the objectives and risks of their VR emotion regulation self-care applications, leveraging visuals for better recall than text. This comic-style storyboard could be uploaded as 2D or 3D to consumer platforms like Steam or printed to inform participants in user studies. The storyboard might depict a person recalling an event that triggered strong negative emotions, transparently explaining that users may relive such events and feel similar emotions when using the application. It would illustrate that the application can be exited at any time, but that the reliving moment typically occurs after approximately 15 minutes in VR. Additionally, the storyboard would advise that when feeling overwhelmed by the effects of experiencing the application users could seek support from friends, family, or therapists, and provide contact details for public services offering immediate help. These steps could address users' needs for comfort and detailed information. In summary, the storyboard could show how a person experiences strong emotions to communicate risks and objectives, it could depict a time-specific structure of the application to communicate clear objectives of the application, and it could visualise a person talking to friends to encourage the usage of real-life coping strategies.

3.3.2 Begin Phase. As users engage with the application in the *Begin* phase, they often experience a 'blank-page syndrome' and feel overwhelmed, particularly if they are untrained in conducting self-care activities such as self-expression or self-reflection. To help users become familiar with the system, they can be assisted with both technical operations (i.e. usability aspects of the system) and system-specific strategies, such as meaningful self-expression (i.e. how to conduct the self-care activity) [41]. To that end, systems could adhere to the following design recommendations:

- *Offer a gradual entry into VR*, i.e., visually facilitating the transition between reality and VR, for instance through matching the virtual space to the real one. We recommend referring to work by Kitson et al. [44] for more detailed guidance on easing users into VR.
- *Offer options to customise the virtual space.*
- *Provide hands-on scaffolding*, i.e., positive affirmations, encouragement and detailed guidance about the usability of the system.

Following these design recommendations can enhance user enjoyment and create a sense of meaning during this phase. The duration of this phase can vary widely based on individual technical literacy, mindset, and pre-existing knowledge.

Considering the illustrative use case, the *Begin* phase marks when users start with the VR ER application. To ease the transition from reality to VR, the experience could begin in a virtual space resembling the user's real environment, such as a comfortable living room. A virtual entity, like a friendly cat, might guide users in interacting with the space — for example, by encouraging them to draw on an empty picture frame or throw trash into a bin. Engaging in virtual cleaning, a metaphor shown to promote relaxation [68], could further be used to personalise the environment, helping users feel more at ease. The controls that are thus learned, i.e. drawing and throwing objects, will be important mechanics in the following *Core* phase. This stage can be skipped if users already know the application from multiple usages. In a nutshell, these decisions in designing the *Begin* phase correspond to the proposed design recommendations by including a closed space similar to the real environment as an option for gradual entry into VR, the possibility to draw and re-arrange 3D objects in the interactive space to customise the environment, and the integration of a friendly avatar, such as a cat, that provides hands-on scaffolding to help users learn about usability aspects of the system (i.e. drawing and throwing objects).

3.3.3 Core Phase. Once users are familiar with the system, they move into the *Core* phase, where they conduct the primary self-care activities, such as mindfulness exercises or emotion regulation tasks. A key challenges in this phase is balancing the level of stimulation, as both overstimulation and understimulation can result in fatigue or boredom. Users require time to enter the right mental state and develop skills that can be integrated into their daily lives. Most self-care activities of the corpus informing the SCTpm took between 10 and 30 minutes, but the ideal duration for effective self-care remains an open question. To promote reflection on the self-care activity objectives, designers could integrate the following design recommendations:

- *Provide a repetitive movement-based interaction with the virtual space that stimulates both mind and body*, as gestures and body postures can enhance cognitive restructuring [69, 100]. For instance, users could be required to interact with 3D objects involving movement of one's body for five times or a couple of minutes. This can promote self-awareness and skill development [76]. Yet, physical exertion should be balanced with self-care goals to avoid unnecessary fatigue, which can detract from engagement and presence. A standing-room-scale virtual environment can encourage movement and perspective-taking without causing strain.

- *Provide a level of realism that fits to the self-care activity's goal.* Virtual environments can be realistic, abstract, or minimalistic depending on what is deemed the most useful for that specific self-care activity. For example, based on our corpus, if the goal is to relax, a realistic naturalistic environment seems beneficial, whereas when the objective is to express and reflect on emotions, a more abstract visualisation seems more effective.
- *Provide high-level reflective scaffolding*, prompting deeper reflection with the self-care activity and oneself. In contrast to the *Begin* phase, this could involve questions about the underlying meaning of certain aspects, or the use of metaphorical visuals that prompt users to reflect on their significance, elicit reframing, and make them envision how to apply it in their everyday life.

In the illustrative use case, users transition at their own pace from their customised virtual living room to the main part of the self-care activity, for instance by opening the door to enter a vast, minimalist space. The virtual cat accompanies users, encouraging them to recall a sad or angry moment and to express their emotions through drawing, reassuring them that there is no right or wrong way to do so. If users demonstrate hesitation or difficulty engaging with the task, the cat proactively offers suggestions or can be approached for guidance on how to visualise emotions, ensuring that users do not feel overwhelmed. Once the drawing is complete, the cat offers a ball of yarn for the user to throw at the drawing. After each throw, the drawing is gradually erased and the ball of yarn reappears by the user's side. This process encourages repeated, physical interaction with the virtual environment, which allows for necessary time to process the idea of releasing negative emotions that way [97]. The cat would occasionally ask high-level reflective questions, nudging users to think more deeply about what is happening around them. In summary, these design choices for the *Core* phase align with the recommendations as follows: Throwing the ball of yarn repeatedly at the drawing is a repetitive movement-based interaction with the environment, a low level of realism was chosen as the self-care goal is to express own emotions, which opens up the mental capacity for abstract visualisations, and the cat asking questions about the drawing makes people reflect more on the meaning behind the ER activity.

3.3.4 End Phase. In the *End* phase, it is essential to ensure that users achieve psychological or mental closure, as the absence of such closure can lead to rumination and dissatisfaction [28]. They should feel a sense of accomplishment, strengthening the awareness that the self-care activity has been successfully concluded and its objective has been achieved at this moment. This can be facilitated by integrating the following design recommendations:

- *Provide clear mental and visual closure*, i.e., through visual means. For example, the virtual setting could switch again, or there could appear celebratory visuals or affirming quotes. These types of visuals can reinforce a sense of accomplishment and discourage rumination.
- *Provide a gradual exit back to reality*, i.e., integrating a transition phase back to a familiar virtual space where users feel secure or that looks similar to their real environment before removing the VR headset.
- *Provide notice that links to existing human support systems.* Integrating this can compensate for potential shortcomings of the system.

In the illustrative use case, this could be reflected by the cat guiding users back to the previously customised virtual living room. This change of scenery back to a known scene would be a gradual exit out of VR. The ball of yarn could rest on the couch, symbolising the completion of the ER task. A recording could play on the TV, showing the user throwing the ball of yarn at the drawing and gradually erasing it. Both of these aspects can help users to find mental closure and understand that the self-care activity has been successfully finished. The cat could then gently remind the user of the available human support system in reality, should they wish to talk to someone.

3.3.5 Post Phase. The *Post* phase refers to the design of self-care experiences beyond VR, that is, after users have completed the VR self-care activity. In this phase, users reflect on their experiences and the application's effectiveness, thinking back to what it was like when using the system and if their overall self-care needs were met. They then decide whether to re-engage with the same system (leading them back to the *Begin* phase) or if they want to skip the *Begin* phase in case they are already used to the system and thus jump directly to the *Core* phase. They can also explore alternative applications (transitioning to the *Pre* phase), or disengage or lapse completely from using the system. The duration of this phase can vary drastically, lasting from minutes or hours to weeks and months. Still, several design recommendations can be leveraged to shape the users' experience during this phase; they can encourage continued engagement or positive disengagement. For instance, designers could pay attention to the following:

- *Provide traces of the virtual self-care activities on other digital systems*, i.e., screenshots or scores from finishing the self-care activity could be provided in the digital space as reminders. This can refer to VR, such as appearing when next putting on the headset, but could also extend to other digital spaces such as receiving notifications on a smartphone or connecting wearables to insights or scores gained in VR.
- *Provide tangible physical reminders in reality*, i.e., displaying self-care outcomes like drawings made in VR as pictures in the real home, for example through printing or displaying on a smart screen.

Seeing those traces of the VR-based self-care activity in the digital or physical space in everyday life can facilitate reflection and motivate ongoing use. This consideration is especially important for VR-based SCTs, as they are not as seamlessly integrated into daily routines as mobile applications on smartphones, and people might need gentle reminders to re-engage with the experience. Being reminded could consolidate the outcomes of the self-care journey, such as personal growth, practising strategies, and strengthening learnings from reflective activities.

Translated to the imaginative use case, the users would have taken off the VR glasses and be back in reality in the *Post* phase. The cat from the VR experience could occasionally appear on their smartphone, playing with the ball of yarn and sharing encouraging quotes. It would remind users that they can continue using the

app if needed. Additionally, the recording of how the user erased the VR drawing could be provided as a moving gif. Users could also print their VR drawing or personalised living room as wall art, and optionally, receive a customised ball of yarn as a keepsake. Therefore, the cat appearing on the smartphone and the recording as a gif represent traces of the virtual activities found in other digital spaces of users' everyday life, and the print-out and the real ball of yarn are tangible reminders of the self-growth journey.

4 Validating the SCTpm

To validate the SCTpm, we conducted semi-structured expert interviews with $n = 10$ participants. The overall aim was to evaluate if the SCTpm was intuitively understandable, how it could be used in practice, and to discuss any potential refinements. This section first introduces our expert sample. We then present the procedure of the interviews and discuss how we collected and analysed the data.

4.1 Participant Sample

We recruited experts from our extended professional and social network, resulting in a diverse group representing seven different nationalities. In the selection process, we ensured diversity to better evaluate the generalisability of the SCTpm across different well-being contexts, SCTs, and user groups. Thus, our sample included both early-career researchers (less than two years of experience) and senior researchers (with over 25 years of experience) in HCI and well-being. The average age of participants was 35.8$years$ (min: 26$years$, max: 55$years$, sd: 8.27$years$), with an average of 10.15 years of experience (min: 1.5$years$, max: 25$years$, sd: 7.09$years$.). We also aimed for a broad representation across sub-disciplines, including experts in personal informatics, (serious) game design, physical and mental health, digital health, and well-being. For further details, see Table 1.

4.2 Procedure

The participants were sent an initial version of the SCTpm with a short description via email to read before the interview. This material can be found in the supplementary material. After giving informed consent and providing demographic data, the researcher briefly presented the framework again while screen sharing to remind experts about the structure. Then, the participants were asked about their first impression, aspects they would like to adjust or refine, how they envision the framework to be used and by whom, and how if at all, they would apply this framework in their own research. The full interview guide can be found in the supplementary material as well.

4.3 Data Collection & Analysis

We gathered qualitative feedback from the participants to understand their thoughts about the SCTpm, how it could be used and by whom, and to gather ideas for refinement. The semi-structured interviews were conducted via Zoom and lasted on average 32 : 28$minutes$ (min: 23 : 42$minutes$, max: 44 : 20$minutes$, SD: 6 : 29$minutes$). Interviews were audio-recorded, transcribed verbatim, and imported into Atlas.ti software. Initially, two authors coded two interviews using open coding and established a coding tree through iterative discussion. The remaining transcripts were then individually coded by one author using the established coding tree. Themes were identified through thematic analysis [12] in a final discussion session between two authors.

4.4 Findings of the Expert Validation

Overall, all the participants emphasised the need for a framework such as SCTpm, and highlighted the benefits for HCI research, their own research fields and applicability to multiple contexts and flexibility in design. Some core findings will be discussed in this section. One participant summarised the need for the SCTpm as follows:

> "Reflecting on the studies that we do and also derive recommendations based on what worked and what did not work is very important to make progress in human-computer interaction. Meaning that we definitely need this type of work in order to identify best practice guidance." (E5)

Based on our qualitative inquiry, four themes were derived from the data: *Creating Shared Language and Facilitating Exchange*, *Enhancing Inspiration and Facilitating Evaluation*, *Addressing Disengagement as a Positive Choice*, and *Balancing Specificity with Generalisability*.

4.4.1 Creating Shared Language and Facilitating Exchange. One of the key insights from the feedback was the emphasis on shared language as a strength of the framework. Participants appreciated how the framework helped simplify discussions about challenges related to self-care by providing a common vocabulary. This shared language was seen as especially helpful for facilitating communication between different target user groups, such as designers in industry, healthcare professionals, early-career and established HCI researchers, and students, allowing them to better express and address specific needs and challenges when designing and evaluating VR applications for self-care systems. Experts reflected that such a shared language can enhance collaboration both in the design and implementation phases and facilitate teamwork in the idea generation phase. It can ensure that users of the framework, regardless of their level or area of expertise, can quickly grasp the model's components and apply them in real-world contexts. By supporting dialogue, the framework can facilitate that the system's goals and objectives are more clearly understood and achieved. One expert clarified:

> "So in HCI, it's like, we all have different terms for things. So yeah, having that shared language would be helpful. [...] As a visual, it gives students and people from the industry something more tangible rather than just like 'hey, you should have reflective scaffolding'. It's like: Where should you have that in which stage? And then have some examples of what that could look like for XR, this just gives people the language to talk about the same thing." (E2)

4.4.2 Enhancing Inspiration and Facilitating Evaluation. This theme highlights the SCTpm's dual function: inspiring the design of new systems while also facilitating the assessment of existing ones. Experts noted that the SCTpm could serve as a checklist or guideline when developing new systems within the well-being and self-care

Table 1: Participant Demographics

P-ID	Age	Gender	Region of Residence	Profession	Main Expertise	Research Interests	Years of Experience	Model Expertise
E1	36	Male	Europe	Lecturer in Digital Health	digital health, health, supporting people in expressing health needs	Design & Development of systems, well-being, health, self-reflection, human-centred health technologies, generative AI	7	Yes
E2	34	Female	North America	Postdoctoral Researcher	Mental health and well-being technologies	Design and development of systems, evaluation of systems, XR, wearable technologies	10	Yes
E3	42	Female	Oceania	Senior Lecturer	VR, serious games, supporting people with depression, exergames	Persuasive technologies, well-being, health, mental health, design and development of systems, personal informatics	15	Yes
E4	29	Female	Europe	PhD Student	Technologies for mental health, e.g. disorders	Well-being, understanding user needs, design and development of systems, personal informatics	3	Yes
E5	42	Male	Oceania	Associate Professor	UX, games, supporting people to physically and mentally improve	Well-being, mental health, physical health, design and development of systems, VR	16	Yes
E6	36	Male	Europe	Professor for HCI	Technologies for well-being and physical therapy	well-being, physical health, mental health, design and development of systems, VR, self-reflection, personal informatics	15	Yes
E7	29	Male	Europe	PhD Student	interactive immersive media, XR, education	well-being, design and development of systems, XR, self-reflection, learning, self-improvement	5	No
E8	29	Female	Europe	PhD Student	feedback systems to support people improving themselves	physical health, personal informatics, well-being, design and development of systems	4	No
E9	55	Female	North America	Professor for HCI	playful technology, supporting people socially and emotionally	well-being, design and development of systems, VR, self-reflection, games and play	25+	Yes
E10	26	Female	Europe	PhD Student	digital health, AI	digital health, well-being, design and development of systems, behaviour change	1.5	Yes

context. They explained that both they themselves and the students they supervise often have innovative ideas for new systems but frequently overlook designing for phases beyond the core experience. In such cases, referring to the SCTpm can initiate a reflective design process, ensuring that all phases – not just the core – are addressed. Furthermore, the framework's specific design recommendations help refine ideas, leading to the creation of more effective and safe self-care activities. By providing this framework, the SCTpm can also foster creativity by encouraging ideation and anticipating challenges in regard to engagement and user needs. One participant explained:

> "The model would be really helpful in teaching, providing students who want to create something that helps people some guidance. They need a framework to help them. [...] And in design brainstorming sessions with myself or with a team, to map out what the user experience is." (E2)

The SCTpm was also viewed as highly valuable for evaluating existing prototypes. Experts frequently receive requests from industry professionals and students to evaluate their systems. In alignment with the theme of *Creating Shared Language*, the SCTpm can serve as a common framework for identifying and communicating system shortcomings. It can also act as a self-assessment tool for designers, providing a structured approach to evaluating their own systems. Experts emphasised the benefit that the SCTpm provides a structured approach for assessment, which is easily understandable. They stressed that inspiration and evaluation are closely intertwined in iterative design cycles, particularly within

the framework of Human-Centred Design (HCD) and participatory design, both being underlying constructs of the SCTpm. Given this context, they see the potential for the SCTpm to be used in both generative and evaluative ways, guiding the creation of new ideas while also providing a robust framework for assessing and refining them.

> "Sometimes systems cover all of these phases even in one session, like in a user study. So I think when I have a VR system that I want to evaluate, then I can probably try to consider all these phases in my design process already. This can be a reminder to not forget to, like, provide participants with like the outcome or meaning of the system in the *End* and *Post* phase" (E8)

4.4.3 Addressing Disengagement as a Positive Choice. A critical observation made by nearly all experts was the need to view disengagement from SCTs as a potentially positive or necessary choice. They mentioned that disengagement could result from valid reasons, such as the user's life context (e.g. illness, stress, vacation). Additionally, many well-being interventions are intentionally designed to become redundant over time. This occurs when users have sufficiently learned and practised the necessary skills within the safe environment provided by VR, enabling them to apply these strategies in real-life situations. Self-care support supported by technology is also often only needed in specific life circumstances, such as feeling sad because of a specific event. Thus, the continued use of the interventions might not necessarily be required as part of users' self-care. To that end, experts highlighted the distinction between positive disengagement from SCTs and lapsing. While positive disengagement was seen as a natural and beneficial outcome when users no longer require the intervention, lapsing carries negative connotations and is often attributed to usability problems or design flaws within the system. The feedback suggested that lapsing and deviation phases should be presented in a way that accounts for these differences in terminology. This was summarised as follows by E1:

> "Within HCI research, there's a lot of work that has highlighted that disengagement is actually not a bad thing, that they have very good reasons for it, and that disengagement is actually a very important phenomenon to look at. So there are also increasingly more studies that investigate why people abandon digital technology. If it is a technology-related issue, maybe usability of user experience issue, then it obviously needs to be fixed." (E6)

4.4.4 Balancing Specificity with Generalisability. Another finding from the interviews was the importance of balancing concrete, specific examples and ensuring the framework remains general enough to be applicable across a wide range of contexts.

On the one hand, experts noted that examples and case studies help clarify the application of the SCTpm, especially for novice users. They identified one of the framework's key strengths in its specific design recommendations, with some experts expressing great enthusiasm to implement these ideas in their upcoming prototypes. They also stressed that, despite these tailored suggestions, the framework remains sufficiently generalisable, ensuring it can be widely applied across different contexts. To that end, experts further explained that as researchers become more experienced, they require more specific connections to their respective subfields. Being less targeted to specific design contexts is, thus, a shortcoming. Thus, when using it in their own research, they suggested combining the SCTpm with field-specific frameworks tailored to the particular well-being context, such as mindfulness activities, to create the most effective self-care activities.

On the other hand, there is a risk that overly prescriptive examples could narrow the framework's scope, limiting its applicability. Experts emphasised the importance of ensuring the framework remains versatile enough to address various use cases, as experts were excited about the possibility to be able to use this framework when designing completely different SCTs. Yet, the framework should avoid an overly abstract, high-level approach that could diminish its practical usability. This dichotomy is expressed illustratively as follows:

> "The powerful element of this model is actually the sensitising nature of it. Rather than treating it like a recipe, this model is more useful as it makes you aware of perspectives and techniques that you have not considered yet. [...] People could try it with other technologies, and see how it combines with other more explicit models [from respective fields]" (E1)

4.5 Findings from Expert Validation Informing the Visual Appearance of the SCTpm

Participants further provided specific refinement ideas on how the appearance of the SCTpm could be changed to increase intuitive understanding and increase usability across expertise levels of the target group (see subsubsection 3.2.1). A figure depicting the changes from the initial version to the final version of the SCTpm is included in the Appendix Figure 3 and a detailed explanation of each change can be found in the supplementary material. In summary, the findings from the expert validation inform the SCTpm as follows:

- Radial Format Into Linear Orientation: The model's shape was changed from radial to linear to better reflect the sequence of user interaction phases and to visually separate real-world phases (Pre and Post) from VR-based interaction.
- Deviating, Lapsing and Guidance: The terminology and arrows indicating users leaving the system were revised to more neutrally and accurately reflect diverse user journeys, now emphasising positive disengagement, and to clarify this for both experienced and new designers.
- Deviating, Lapsing and Guidance: The terminology and arrows indicating users leaving the system were revised to more neutrally and accurately reflect diverse user journeys, now emphasising positive disengagement, and to clarify this for both experienced and new designers.
- User Self-Care Journey: The visualisation of the user journey was refined with dashed arrows showing multiple return paths, acknowledging that users may re-enter the system at different phases or discontinue use altogether.

- Guiding Questions and Design Recommendations: To improve clarity and flexibility, the guiding questions for SCT designers were integrated directly into the SCTpm while design recommendations were moved to a separate part of the figure to give them more prominence, thus visually balancing meta-level guidance with VR-specific design recommendations.
- Wording of Design Recommendations: Based on expert feedback, some design recommendations were reworded for greater clarity and intuitive understanding.
- Icon Changes: Icons were updated to more clearly convey the core design goals of each phase and enhance alignment between visual elements, guiding questions, and design intentions.

5 Discussion

In this work, we constructed the VR-based Self-Care Technology Process Model (SCTpm), a framework combining a user self-care journey with phase-specific design recommendations supporting designers in creating VR-based self-care and well-being systems. In this section, we discuss the generalisability of the framework, which was based on findings related to VR, to other SCTs. Further, we reflect on its adaptability to specific well-being use contexts, and present limitations and future work.

5.1 Generalisability to other SCTs

The SCTpm was constructed based on six VR related studies for self-care and well-being, making it particularly suited to designing VR-based self-care and well-being applications. However, we found an interesting tension between the need for the framework to be generalisable to other SCTs and being specific and tailored to VR. As experts highlighted the perceived broad applicability of the SCTpm to both other technologies and different well-being contexts (i.e. mindfulness, cognitive restructuring, reflecting on health), it seems well suitable to be used for other self-care technologies (SCTs), including augmented reality (AR), mobile applications, personal informatics, and artificial intelligence (AI). While the user-centred requirements are similar across various SCTs, reinforcing the SCTpm's versatility, an open question remains how phases of the framework might change in other non-VR SCT contexts. For instance, when translating the SCTpm to a mobile application for self-care, will there be discernable *Begin* phase or will users start more immediately with the *Core* phase? Future work should validate the framework for different SCTs, confirming its effectiveness beyond VR-based well-being and self-care support.

At the same time, the SCTpm was praised for providing specific and tangible phase-specific guiding questions and design recommendations, which were considered applicable or can be made applicable to other SCT contexts in line with intermediate level knowledge [36]. To that end, the SCTpm is considered an adaptable tool for specific design endeavours. To elaborate, when designers have already experienced a design resource or strategy in their respective fields that show promise, they can use the SCTpm to classify and structure it accordingly. For instance, when designing for vulnerable and marginalised user groups, designers would need to adapt the design recommendations accordingly. Effectively, the SCTpm has the potential to be customisable to explicit research endeavours.

5.2 Applicability to Social Experiences

The SCTpm was constructed based on studies that focused on individual VR-based self-care and well-being applications in mind. Together with the experts, we reflected on the applicability of the framework to multi-user and group experiences; key take-away messages are highlighted in bold. A key challenge is **supporting asynchronous progression**, as participants in the *Begin* and *Core* phases may move at different speeds. Some users may take longer to acclimatise to the VR environment or engage with tasks, requiring flexibility in pacing and tools to maintain group cohesion. In the *End* phase, achieving collective closure is vital, as users may be ready to finish at different times. Features like shared virtual memory books could foster a sense of group accomplishment while allowing for personalised closure at the same time.

Further, social dynamics also play a significant role. Some experiences are structured and hosted, such as family therapy led by a therapist, while others are open-ended, like volunteer-based self-care support groups. Hosted sessions are more coordinated, whereas self-organised groups require flexible frameworks to accommodate fluctuating participation and leadership. **Thus, the framework would need to be extended to address the needs of the group as a whole.**

We hypothesise that the SCTpm remains a valuable tool supporting designers navigating these challenges with social group dynamics. The individual phase-specific needs still apply, however the importance to integrate some of the specific design recommendations may differ. For example, there is a multi-user VR application for emotional expression supporting teenagers paired with teenagers or teenagers paired with their parents to collaboratively express and reflect on their emotions in regard to a shared conflict [86]. In this context, designing flexible transition phases to prevent user boredom is crucial for creating an engaging and effective application. Therefore, **the SCTpm would need to be expanded to include these guiding questions as a core element in the design and iterative testing of such applications.** Further, the research about collaborative experiences found that parental guiding can successfully scaffold the reflection process for teenagers. This might diminish the need for high-reflective scaffolding provided by the system in the *Core* phase of the application, which would **need to be adjusted to account for human guidance in social VR settings**. This posits an interesting research endeavour for future work.

5.3 Limitations

The diverse participant sample in this study introduces several limitations. The wide range of experience levels, from early-career PhD students to senior academics, may have influenced the depth of contributions. In tendency, PhD students had less experience with model development and possibilities to compare to other models, providing more theoretical than practical insights. Yet, their input was valuable in regard to an intuitive understanding of the SCTpm, especially considering that students and novice researchers were considered part of the direct target group of using the model.

Additionally, we incorporated a wide range of well-being and self-care-related research interests, ranging from digital health over serious games to personal informatics. This broad range of focus areas may have fragmented the discussion, with certain aspects of the framework receiving more attention than others, depending on individual priorities. Future research may benefit from a more focused participant group to ensure a broader applicability of the framework.

Furthermore, while the SCTpm is based on a carefully selected corpus that spans a wide range of self-care activities – from mindfulness and introspection to emotional self-expression and regulation – it stems from studies by a single research group. This offers the advantage of coherence and depth across key aspects of VR-based self-care but also may introduce a potential bias, as the framework could reflect the group's specific perspectives and design approaches. Future work should explore its applicability and robustness by incorporating diverse contributions from different institutions and research traditions.

Moreover, we assessed the conceptual validity of the SCTpm through interviews with HCI experts. As a valuable next step, a series of concrete case studies could apply the SCTpm in real-world research contexts such as ideation, evaluation, and teaching. Furthermore, a between-subject design – comparing research projects in which the framework is used with those in which it is not – could be employed to evaluate the practical benefits of the SCTpm in everyday research practice, examining whether the envisioned use cases and anticipated effects hold true in practice.

6 Conclusion

In this work, we have presented the Self-Care Technology Process Model (SCTpm), which supports designers of Virtual Reality (VR) applications in designing effective, safe, and engaging self-care and well-being applications. It integrates the diverse yet specific needs of users in their self-care journey with explicit guiding questions and design recommendations. Based on six VR-based self-care studies, we identified five phases in the self-care journey of users that can be actively designed for. We validated the framework with $n = 10$ experts, showing how using it can create shared language between a multitude of stakeholders. The SCTpm can be used both to inspire the creation of new systems and to evaluate existing ones. It was found to strike a balance between being generalisable across various well-being contexts and offering specific, practical guidance for designers of VR-based self-care technologies. Thus, the SCTpm addressed the need in HCI research of an integrated and holistic framework, empowering designers to navigate the key steps required to create effective, safe, and engaging VR-based self-care applications by providing specific yet adaptable guidance to tailor solutions to specific use cases, enabling users to feel that their individual needs are met.

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References

[1] Elena Agapie, Patricia A. Areán, Gary Hsieh, and Sean A. Munson. 2022. A Longitudinal Goal Setting Model for Addressing Complex Personal Problems in Mental Health. *Proc. ACM Hum.-Comput. Interact.* 6, CSCW2, Article 270 (nov 2022), 28 pages. doi:10.1145/3555160

[2] Mithun Ahamed and Wael Yafooz. 2018. Extended User Centered Design (UCD) Process in the Aspect of Human Computer Interaction. *International Conference on Smart Computing and Electronic Enterprise (ICSCEE2018)* (07 2018), 1–6. doi:10.1109/ICSCEE.2018.8538388

[3] Hamza Al-Jundi and Emad Tanbour. 2022. A framework for fidelity evaluation of immersive virtual reality systems. *Virtual Reality* 26 (01 2022), 1–20. doi:10.1007/s10055-021-00618-y

[4] Judith Amores, Xavier Benavides, and Pattie Maes. 2016. PsychicVR: Increasing mindfulness by using Virtual Reality and Brain Computer Interfaces. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI EA '16)*. Association for Computing Machinery, New York, NY, USA, 2. doi:10.1145/2851581.2889442

[5] Pasquale Arpaia, Giovanni D'Errico, Lucio Tommaso De Paolis, Nicola Moccaldi, and Fabiana Nuccetelli. 2021. A Narrative Review of Mindfulness-Based Interventions Using Virtual Reality. *Mindfulness* (2021), 1–16. doi:10.1007/s12671-021-01783-6

[6] Sojung Bahng, Ryan M. Kelly, and Jon McCormack. 2020. Reflexive VR Storytelling Design Beyond Immersion: Facilitating Self-Reflection on Death and Loneliness. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. doi:10.1145/3313831.3376582

[7] Eric P.S. Baumer, Vera Khovanskaya, Mark Matthews, Lindsay Reynolds, Victoria Schwanda Sosik, and Geri Gay. 2014. Reviewing Reflection: On the Use of Reflection in Interactive System Design. In *Proceedings of the 2014 Conference on Designing Interactive Systems* (Vancouver, BC, Canada) *(DIS '14)*. Association for Computing Machinery, New York, NY, USA, 93–102. doi:10.1145/2598510.2598598

[8] Marit Bentvelzen, Jasmin Niess, and Paweł W. Woźniak. 2021. The Technology-Mediated Reflection Model: Barriers and Assistance in Data-Driven Reflection. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (Yokohama, Japan) *(CHI '21)*. Association for Computing Machinery, New York, NY, USA, Article 246, 12 pages. doi:10.1145/3411764.3445505

[9] Marit Bentvelzen, Paweł W. Woźniak, Pia S.F. Herbes, Evropi Stefanidi, and Jasmin Niess. 2022. Revisiting Reflection in HCI: Four Design Resources for Technologies That Support Reflection. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 6, 1, Article 2 (mar 2022), 27 pages. doi:10.1145/3517233

[10] Paul Best, Matilde Meireles, Franziska Schroeder, Lorna Montgomery, Alan Maddock, Gavin Davidson, Karen Galway, David Trainor, Anne Campbell, and Tom Van Daele. 2022. Freely Available Virtual Reality Experiences as Tools to Support Mental Health Therapy: a Systematic Scoping Review and Consensus Based Interdisciplinary Analysis. *Journal of Technology in Behavioral Science* 7 (03 2022). doi:10.1007/s41347-021-00214-6

[11] Tibor Bosse, Charlotte Gerritsen, Jeroen de Man, and Jan Treur. 2013. Learning Emotion Regulation Strategies: A Cognitive Agent Model. In *2013 IEEE/WIC/ACM International Joint Conferences on Web Intelligence (WI) and Intelligent Agent Technologies (IAT)*, Vol. 2. 245–252. doi:10.1109/WI-IAT.2013.116

[12] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77–101. doi:10.1191/1478088706qp063oa

[13] Paula Braveman and Laura Gottlieb. 2014. The Social Determinants of Health: It's Time to Consider the Causes of the Causes. *Public Health Reports (1974-)* 129 (2014), 19–31. http://www.jstor.org/stable/23646782

[14] Fred B. Bryant, Colette M. Smart, and Scott P. King. 2005. Using the past to enhance the present: Boosting happiness through positive reminiscence. *Journal of Happiness Studies* 6, 3 (2005), 227–260. doi:10.1007/s10902-005-3889-4

[15] Catherine Burns. 2018. *Human-centred design.* Routledge, 207–227. doi:10.4324/9781315385907-10

[16] Lisa D Butler, Kelly A Mercer, Katie McClain-Meeder, Dana M Horne, and Melissa Dudley. 2019. Six domains of self-care: Attending to the whole person. *Journal of Human Behavior in the Social Environment* 29, 1 (2019), 107–124.

[17] Karen Cochrane, Lian Loke, Matthew Leete, Andrew Campbell, and Naseem Ahmadpour. 2021. Understanding the First Person Experience of Walking Mindfulness Meditation Facilitated by EEG Modulated Interactive Soundscape. In *Proceedings of the Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction* (Salzburg, Austria) *(TEI '21)*. Association for Computing Machinery, New York, NY, USA, Article 18, 17 pages. doi:10.1145/3430524.3440637

[18] Victor P. Cornet, Carly Daley, Luiz H. Cavalcanti, Amit Parulekar, and Richard J. Holden. 2020. Chapter 14 - Design for self-care. In *Design for Health*, Arathi Sethumadhavan and Farzan Sasangohar (Eds.). Academic Press, 277–302. doi:10.1016/B978-0-12-816427-3.00014-2

[19] Journey Coward. 2022. Doodling as Self-Expression: Building Self-Efficacy in Normally Functioning Adults. https://api.semanticscholar.org/CorpusID:

245716053
[20] Jane E. Dalton and Catherine E. Hoyser. 2021. *Healthy Relationships in Higher Education*. Routledge, Chapter Creative and collaborative expression as contemplative self-care.
[21] Gavin Doherty, David Coyle, and Mark Matthews. 2010. Design and evaluation guidelines for mental health technologies. *Interacting with Computers* 22 (07 2010), 243–252. doi:10.1016/j.intcom.2010.02.006
[22] Nina Döllinger, David Mal, Sebastian Keppler, Erik Wolf, Mario Botsch, Johann Habakuk Israel, Marc Erich Latoschik, and Carolin Wienrich. 2024. Virtual Body Swapping: A VR-Based Approach to Embodied Third-Person Self-Processing in Mind-Body Therapy. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '24)*. Association for Computing Machinery, New York, NY, USA, Article 110, 18 pages. doi:10.1145/3613904.3642328
[23] Margie Eckroth-Bucher. 2010. Self-Awareness: A Review and Analysis of a Basic Nursing Concept. *ANS. Advances in nursing science* 33 (10 2010), 297–309. doi:10.1097/ANS.0b013e3181fb2e4c
[24] Austen El-Osta. 2019. The Self-Care Matrix: a unifying framework for self-care. *International Journal of Self Help and Self Care* 10 (06 2019), 38–56. doi:10.6084/m9.figshare.12578741
[25] Daniel A Epstein, Clara Caldeira, Mayara Costa Figueiredo, Xi Lu, Lucas M Silva, Lucretia Williams, Jong Ho Lee, Qingyang Li, Simran Ahuja, Qiuer Chen, Payam Dowlatyari, Craig Hilby, Sazeda Sultana, Elizabeth V Eikey, and Yunan Chen. 2020. Mapping and Taking Stock of the Personal Informatics Literature. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 4, 4 (12 2020). doi:10.1145/3432231
[26] Jean-Daniel Fekete, Jarke van Wijk, John Stasko, and Chris North. 2008. *The Value of Information Visualization*. Vol. 4950. Springer, 1–18. doi:10.1007/978-3-540-70956-5_1
[27] Chris Fife-Schaw and Charles Abraham. 2009. How much behavior change should we expect from health promotion campaigns targeting cognitions? An approach to pre-intervention assessment. *Psychology & health* 24 (09 2009), 763–76. doi:10.1080/08870440801956184
[28] William Gerin, Matthew Zawadzki, Jos Brosschot, Julian Thayer, Nicholas Christenfeld, Tavis Campbell, and Joshua Smyth. 2012. Rumination as a Mediator of Chronic Stress Effects on Hypertension: A Causal Model. *International journal of hypertension* 2012 (02 2012), 453465. doi:10.1155/2012/453465
[29] Nima Ghorbani, PJ Watson, and Michael B Hargis. 2008. Integrative Self-Knowledge Scale: Correlations and incremental validity of a cross-cultural measure developed in Iran and the United States. *The Journal of Psychology* 142, 4 (2008), 395–412.
[30] Anthony Grant, John Franklin, and P Langford. 2002. The self-reflection and insight scale: A new measure of private self-consciousness. *Social Behavior and …* 39 (01 2002), 172–173. doi:10.1177/0306422010390622
[31] Diane Gromala, Xin Tong, Amber Choo, Mehdi Karamnejad, and Chris D. Shaw. 2015. The Virtual Meditative Walk: Virtual Reality Therapy for Chronic Pain Management. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 521–524. doi:10.1145/2702123.2702344
[32] James J. Gross. 1998. The Emerging Field of Emotion Regulation: An Integrative Review. *Review of General Psychology* 2, 3 (1998), 271–299. doi:10.1037/1089-2680.2.3.271 arXiv:https://doi.org/10.1037/1089-2680.2.3.271
[33] James J Gross. 2015. Emotion regulation: Current status and future prospects. *Psychological inquiry* 26, 1 (2015), 1–26.
[34] James J. Gross. 2015. Emotion Regulation: Current Status and Future Prospects. *Psychological Inquiry* 26, 1 (2015), 1–26. doi:10.1080/1047840X.2014.940781 arXiv:https://doi.org/10.1080/1047840X.2014.940781
[35] Irit Hacmun, Dafna Regev, and Roy Salomon. 2018. The principles of art therapy in virtual reality. *Frontiers in Psychology* 9 (2018), 2082.
[36] Kristina Höök and Jonas Löwgren. 2012. Strong concepts: Intermediate-level knowledge in interaction design research. *ACM Trans. Comput.-Hum. Interact.* 19, 3, Article 23 (oct 2012), 18 pages. doi:10.1145/2362364.2362371
[37] Jade Jiang and Naseem Ahmadpour. 2021. Beyond Immersion: Designing for Reflection in Virtual Reality. In *33rd Australian Conf. on Human-Computer Interaction* (Melbourne, VIC, Australia) *(OzCHI '21)*. Association for Computing Machinery, NY, USA, 208–220. doi:10.1145/3520495.3520501
[38] Jon Kabat-Zinn. 2003. Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice* 10, 2 (2003), 144–156. doi:10.1093/clipsy.bpg016
[39] Jon Kabat-Zinn. 2009. *Wherever you go, there you are: Mindfulness meditation in everyday life*. Hachette Books.
[40] Sandra L. Kagin and Vija B. Lusebrink. 1978. The expressive therapies continuum. *Art Psychotherapy* (1978).
[41] Girija Kaimal, Katrina Carroll-Haskins, Marygrace Berberian, Abby Dougherty, Natalie Carlton, and Arun Ramakrishnan. 2020. Virtual Reality in Art Therapy: A Pilot Qualitative Study of the Novel Medium and Implications for Practice. *Art Therapy* 37, 1 (2020), 16–24. doi:10.1080/07421656.2019.1659662
[42] Gerard Kim. 2005. *Designing Virtual Reality Systems: The Structured Approach*. Springer London, –233. doi:10.1007/978-1-84628-230-0
[43] Alexandra Kitson, Mirjana Prpa, and Bernhard E. Riecke. 2018. Immersive Interactive Technologies for Positive Change: A Scoping Review and Design Considerations. *Frontiers in Psychology* 9 (2018), 1354. doi:10.3389/fpsyg.2018.01354
[44] Alexandra Kitson, Ekaterina R. Stepanova, Ivan A. Aguilar, Natasha Wainwright, and Bernhard E. Riecke. 2020. Designing Mind(Set) and Setting for Profound Emotional Experiences in Virtual Reality. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference* (Eindhoven, Netherlands) *(DIS '20)*. Association for Computing Machinery, New York, NY, USA, 655–668. doi:10.1145/3357236.3395560
[45] Chongsan Kwon. 2019. Verification of the possibility and effectiveness of experiential learning using HMD-based immersive VR technologies. *Virtual Reality* 23, 1 (2019), 101–118.
[46] Emily K. Lindsay and J. David Creswell. 2017. Mechanisms of mindfulness training: Monitor and Acceptance Theory (MAT). *Clinical Psychology Review* 51 (2017), 48–59. doi:10.1016/j.cpr.2016.10.011
[47] Andrés Lucero. 2015. Using Affinity Diagrams to Evaluate Interactive Prototypes, Vol. 9297. 231–248. doi:10.1007/978-3-319-22668-2_19
[48] Kai Lukoff, Ulrik Lyngs, Stefania Gueorguieva, Erika S. Dillman, Alexis Hiniker, and Sean A. Munson. 2020. From Ancient Contemplative Practice to the App Store: Designing a Digital Container for Mindfulness. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference* (Eindhoven, Netherlands) *(DIS '20)*. Association for Computing Machinery, New York, NY, USA, 1551–1564. doi:10.1145/3357236.3395444
[49] Sonja Lyubomirsky, Kennon M Sheldon, and David Schkade. 2005. Pursuing happiness: The architecture of sustainable change. *Review of general psychology* 9, 2 (2005), 111–131.
[50] Anna-Leena Macey, Joseph Macey, and Juho Hamari. 2022. Virtual reality in emotion regulation: A scoping review. In *International GamiFIN Conference*.
[51] Cathy A. Malchiodi. 2012. *Handbook of Art Therapy, 2nd ed.* The Guilford Press, New York, NY, US. Pages: xv, 496.
[52] Nicole Martínez, Cynthia Connelly, Alexa Perez, and Patricia Calero. 2021. Self-care: A concept analysis. *International Journal of Nursing Sciences* 8 (09 2021). doi:10.1016/j.ijnss.2021.08.007
[53] Kateri Mcrae and James Gross. 2020. Emotion regulation. *Emotion (Washington, D.C.)* 20 (02 2020), 1–9. doi:10.1037/emo0000703
[54] Jessica Isbely Montana, Marta Matamala-Gomez, Marta Maisto, Petar Aleksandrov Mavrodiev, Cesare Massimo Cavalera, Barbara Diana, Fabrizia Mantovani, and Olivia Realdon. 2020. The Benefits of Emotion Regulation Interventions in Virtual Reality for the Improvement of Wellbeing in Adults and Older Adults: A Systematic Review. *Journal of Clinical Medicine* 9, 2 (2020). doi:10.3390/jcm9020500
[55] Nathan Moore, Naseem Ahmadpour, Martin Brown, Philip Poronnik, and Jennifer Davids. 2022. Designing Virtual Reality–Based Conversational Agents to Train Clinicians in Verbal De-escalation Skills: Exploratory Usability Study. *JMIR Serious Games* 10, 3 (6 Jul 2022), e38669. doi:10.2196/38669
[56] Marivi Navarro Haro, Marta Modrego-Alarcón, Hunter Hoffman, Alba López-Montoyo, Mayte Navarro-Gil, Jesus Montero-Marin, Azucena Garcia-Palacios, Luis Borao-Zabala, and Javier Garcia-Campayo. 2019. Evaluation of a Mindfulness-Based Intervention With and Without Virtual Reality Dialectical Behavior Therapy® Mindfulness Skills Training for the Treatment of Generalized Anxiety Disorder in Primary Care: A Pilot Study. *Frontiers in Psychology* 10 (01 2019), 55. doi:10.3389/fpsyg.2019.00055
[57] María V. Navarro-Haro, Yolanda López-del Hoyo, Daniel Campos, Marsha M. Linehan, Hunter G. Hoffman, Azucena García-Palacios, Marta Modrego-Alarcón, Luis Borao, and Javier García-Campayo. 2017. Meditation experts try Virtual Reality Mindfulness: A pilot study evaluation of the feasibility and acceptability of Virtual Reality to facilitate mindfulness practice in people attending a Mindfulness conference. *PLOS ONE* 12, 11 (11 2017), 1–14. doi:10.1371/journal.pone.0187777
[58] Harold Nelson and Erik Stolterman. 2012. *The Design Way: Intentional Change in an Unpredictable World*. MIT press. doi:10.7551/mitpress/9188.001.0001
[59] Jun Rong Jeffrey Neo, Andrea Won, and Mardelle Shepley. 2021. Designing Immersive Virtual Environments for Human Behavior Research. *Frontiers in Virtual Reality* 2 (03 2021). doi:10.3389/frvir.2021.603750
[60] Jasmin Niess, Kristina Knaving, Alina Kolb, and Paweł W. Woźniak. 2020. Exploring Fitness Tracker Visualisations to Avoid Rumination. In *22nd Intern. Conf. on Human-Computer Interaction with Mobile Devices and Services* (Oldenburg, Germany) *(MobileHCI '20)*. Association for Computing Machinery, NY, USA, Article 6, 11 pages. doi:10.1145/3379503.3405662
[61] Jasmin Niess and Paweł W. Woźniak. 2018. Supporting Meaningful Personal Fitness: The Tracker Goal Evolution Model. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–12. doi:10.1145/3173574.3173745

[62] Donald A. Norman. 2002. *The Design of Everyday Things.* Basic Books, Inc., USA.

[63] Francisco Nunes, Nervo Verdezoto, Geraldine Fitzpatrick, Morten Kyng, Erik Grönvall, and Cristiano Storni. 2015. Self-Care Technologies in HCI: Trends, Tensions, and Opportunities. *ACM Trans. Comput.-Hum. Interact.* 22, 6, Article 33 (dec 2015), 45 pages. doi:10.1145/2803173

[64] Olatunji Omisore, Ifeanyi Odenigbo, Joseph Orji, Amelia Hernandez, Rita Orji, Nilufar Baghaei, and Meier Sandra. 2024. Extended Reality for Mental Health Evaluation —A Scoping Review (Preprint). *JMIR Serious Games* (03 2024). doi:10.2196/38413

[65] Lisa Parker, Lisa Bero, Donna Gillies, Melissa Raven, Barbara Mintzes, Jon Jureidini, and Quinn Grundy. 2018. Mental Health Messages in Prominent Mental Health Apps. *The Annals of Family Medicine* 16 (07 2018), 338–342. doi:10.1370/afm.2260

[66] Anitha Pillai and Prabha Mathew. 2019. *Impact of Virtual Reality in Healthcare: A Review.* IGI Global, 17–31. doi:10.4018/978-1-5225-7168-1.ch002

[67] Mirjana Prpa, Kıvanç Tatar, Jules Françoise, Bernhard Riecke, Thecla Schiphorst, and Philippe Pasquier. 2018. Attending to Breath: Exploring How the Cues in a Virtual Environment Guide the Attention to Breath and Shape the Quality of Experience to Support Mindfulness. In *Proceedings of the 2018 Designing Interactive Systems Conference* (Hong Kong, China) *(DIS '18)*. Association for Computing Machinery, New York, NY, USA, 71–84. doi:10.1145/3196709.3196765

[68] Julian Rasch, Michelle Johanna Zender, Sophia Sakel, and Nadine Wagener. 2024. Mind Mansion: Exploring Metaphorical Interactions to Engage with Negative Thoughts in Virtual Reality. In *Proceedings of the 2024 ACM Designing Interactive Systems Conference* (Copenhagen, Denmark) *(DIS '24)*. Association for Computing Machinery, New York, NY, USA, 2305–2318. doi:10.1145/3643834.3661557

[69] Martin Reimann, Wilko Feye, Alan Malter, Joshua Ackerman, Raquel Castaño, Nitika Garg, Robert Kreuzbauer, Aparna Labroo, Angela Lee, Maureen Morrin, Gergana Nenkov, Jesper Nielsen, María Perez, Gratiana Pol, Carolyn Yoon, Chen-Bo Zhong, and José Rosa. 2012. Embodiment in Judgment and Choice. *ORG: Rationality, Cognition, & Decision Making (Topic)* 5 (02 2012). doi:10.1037/a0026855

[70] Simon Riches, Lisa Azevedo, Leanne Bird, Sara Pisani, and Lucia Valmaggia. 2021. Virtual reality relaxation for the general population: a systematic review. *Social psychiatry and psychiatric epidemiology* 56 (2021), 1707–1727.

[71] Matthew Richesin, Deborah Baldwin, and Lahai Wicks. 2021. Art making and virtual reality: A comparison study of physiological and psychological outcomes. *The Arts in Psychotherapy* 75 (09 2021), 101823. Issue 4. doi:10.1016/j.aip.2021.101823

[72] Giuseppe Riva, Rosa Baños, Cristina Botella, Fabrizia Mantovani, and Andrea Gaggioli. 2016. Transforming Experience: The Potential of Augmented Reality and Virtual Reality for Enhancing Personal and Clinical Change. *Frontiers in Psychiatry* 7 (10 2016). doi:10.3389/fpsyt.2016.00164

[73] Pedro Sanches, Axel Janson, Pavel Karpashevich, Camille Nadal, Chengcheng Qu, Claudia Daudén Roquet, Muhammad Umair, Charles Windlin, Gavin Doherty, Kristina Höök, and Corina Sas. 2019. *HCI and Affective Health: Taking Stock of a Decade of Studies and Charting Future Research Directions.* Association for Computing Machinery, NY, USA, 1–17. doi:10.1145/3290605.3300475

[74] Donald A. Schön. 1992. *The Reflective Practicioner: How Professionals Think in Action.* Routledge. 384 pages. https://doi.org/10.4324/9781315237473

[75] Martin E. P. Seligman and Mihaly Csikszentmihalyi. 2014. Positive Psychology: An Introduction. In *Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi*, Mihaly Csikszentmihalyi (Ed.). Springer Netherlands, 279–298. doi:10.1007/978-94-017-9088-8_18

[76] Ilene Serlin. 2011. The History and Future of Humanistic Psychology. *Journal of Humanistic Psychology - J HUM PSYCHOL* 51 (09 2011), 428–431. doi:10.1177/0022167811412600

[77] Mel Slater and Sylvia Wilbur. 1997. A Framework for Immersive Virtual Environments (FIVE): Speculations on the Role of Presence in Virtual Environments. *Presence: Teleoperators and Virtual Environments* 6, 6 (12 1997), 603–616. doi:10.1162/pres.1997.6.6.603

[78] Petr Slovak, Alissa Antle, Nikki Theofanopoulou, Claudia Daudén Roquet, James Gross, and Katherine Isbister. 2023. Designing for Emotion Regulation Interventions: An Agenda for HCI Theory and Research. *ACM Trans. Comput.-Hum. Interact.* 30, 1, Article 13 (mar 2023), 51 pages. doi:10.1145/3569898

[79] Petr Slovák, Christopher Frauenberger, and Geraldine Fitzpatrick. 2017. Reflective Practicum: A Framework of Sensitising Concepts to Design for Transformative Reflection. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (Denver, Colorado, USA) *(CHI '17)*. Association for Computing Machinery, NY, USA, 2696–2707. doi:10.1145/3025453.3025516

[80] Petr Slovák, Ran Gilad-Bachrach, and Geraldine Fitzpatrick. 2015. Designing Social and Emotional Skills Training: The Challenges and Opportunities for Technology Support. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul, Republic of Korea) *(CHI '15)*. Association for Computing Machinery, New York, NY, USA, 2797–2800. doi:10.1145/2702123.2702385

[81] Velvet Spors, Martin Flintham, Pat Brundell, and David Murphy. 2023. Care-full data, care-less systems: making sense of self-care technologies for mental health with humanistic practitioners in the United Kingdom. *Frontiers in Computer Science* 5 (2023). doi:10.3389/fcomp.2023.1230284

[82] B. Stahl, E. Goldstein, J. Kabat-Zinn, and S. Santorelli. 2010. *A godfreys Reduction Workbook.* New Harbinger Publications.

[83] Ursula M. Staudinger. 2001. Life Reflection: A Social-Cognitive Analysis. *Review of General Psychology* 5, 2 (2001), 148–160. doi:10.1037/1089-2680.5.2.148

[84] Kalliopi-Evangelia Stavroulia and Andreas Lanitis. 2019. Enhancing Reflection and Empathy Skills via Using a Virtual Reality Based Learning Framework. *International Journal of Emerging Technologies in Learning (iJET)* 14 (04 2019), 18. doi:10.3991/ijet.v14i07.9946

[85] Kinga Stecuła. 2022. Virtual Reality Applications Market Analysis—On the Example of Steam Digital Platform. *Informatics* 9, 4 (2022). doi:10.3390/informatics9040100

[86] Evropi Stefanidi, Nadine Wagener, Dustin Augsten, Andy Augsten, Leon Reicherts, Paweł W. Woźniak, Johannes Schöning, Yvonne Rogers, and Jasmin Niess. 2024. TeenWorlds: Supporting Emotional Expression for Teenagers with their Parents and Peers through a Collaborative VR Experience. In *The 30th ACM Symposium on Virtual Reality Software and Technology* (Trier, Germany) *(VRST'24)*. Association for Computing Machinery, NY, USA. doi:10.1145/3520495.3520501

[87] Daniel Stein and Anthony Grant. 2014. Disentangling the Relationships Among Self-Reflection, Insight, and Subjective Well-Being: The Role of Dysfunctional Attitudes and Core Self-Evaluations. *The Journal of psychology* 148 (09 2014), 505–22. doi:10.1080/00223980.2013.810128

[88] Selina Jeanne Sutton. 2020. Gender Ambiguous, Not Genderless: Designing Gender in Voice User Interfaces (VUIs) with Sensitivity. In *Proceedings of the 2nd Conference on Conversational User Interfaces* (Bilbao, Spain) *(CUI '20)*. Association for Computing Machinery, New York, NY, USA, Article 11, 8 pages. doi:10.1145/3405755.3406123

[89] Katy Tcha-Tokey, Olivier Christmann, Emilie Loup-Escande, and Simon Richir. 2016. Proposition and Validation of a Questionnaire to Measure the User Experience in Immersive Virtual Environments. *The International Journal of Virtual Reality* 16 (10 2016), 33–48. doi:10.20870/IJVR.2016.16.1.2880

[90] Peter-Paul Verbeek. 2005. *What Things Do: Philosophical Reflections on Technology, Agency, and Design.* Pennsylvania State University Press.

[91] Peter-Paul Verbeek. 2006. Materializing Morality Design Ethics and Technological Mediation. *Science Technology & Human Values* 31 (05 2006), 361–380. doi:10.1177/0162243905285847

[92] Rafael Villena-Taranilla, Sergio Tirado-Olivares, Ramón Cózar, and José Antonio González-Calero. 2022. Effects of virtual reality on learning outcomes in K-6 education: A meta-analysis. *Educational Research Review* 35 (01 2022), 100434. doi:10.1016/j.edurev.2022.100434

[93] Shelley Viskovich and Linda De George-Walker. 2019. An investigation of self-care related constructs in undergraduate psychology students: Self-compassion, mindfulness, self-awareness, and integrated self-knowledge. *International Journal of Educational Research* 95 (02 2019). doi:10.1016/j.ijer.2019.02.005

[94] Nadine Wagener, Alex Ackermann, Gian-Luca Savino, Bastian Dänekas, Jasmin Niess, and Johannes Schöning. 2022. Influence of Passive Haptic and Auditory Feedback on Presence and Mindfulness in Virtual Reality Environments, In Proceedings of the 2022 International Conference on Multimodal Interaction. *International Conference on Multimodal Interaction (ICMI '22)*. doi:10.1145/3536221.3556622

[95] Nadine Wagener, Marit Bentvelzen, Bastian Dänekas, Paweł W. Woźniak, and Jasmin Niess. 2023. VeatherReflect: Employing Weather as Qualitative Representation of Stress Data in Virtual Reality. In *Proceedings of the 2023 ACM Designing Interactive Systems Conference* (<conf-loc>, <city>Pittsburgh</city>, <state>PA</state>, <country>USA</country>, </conf-loc>) *(DIS '23)*. Association for Computing Machinery, New York, NY, USA, 446–458. doi:10.1145/3563657.3596125

[96] Nadine Wagener, Tu Dinh Duong, Johannes Schöning, Yvonne Rogers, and Jasmin Niess. 2021. The Role of Mobile and Virtual Reality Applications to Support Well-Being: An Expert View and Systematic App Review. In *Human-Computer Interaction – INTERACT 2021: 18th IFIP TC 13 International Conference, Bari, Italy, August 30 – September 3, 2021, Proceedings, Part IV* (Bari, Italy). Springer-Verlag, Berlin, Heidelberg, 262–283. doi:10.1007/978-3-030-85610-6_16

[97] Nadine Wagener, Arne Kiesewetter, Leon Reicherts, Paweł W. Woźniak, Johannes Schöning, Yvonne Rogers, and Jasmin Niess. 2024. MoodShaper: A Virtual Reality Experience to Support Managing Negative Emotions. In *Proceedings of the 2024 ACM Designing Interactive Systems Conference* (Copenhagen, Denmark) *(DIS '24)*. Association for Computing Machinery, New York, NY, USA, 2286–2304. doi:10.1145/3643834.3661570

[98] Nadine Wagener, Jasmin Niess, Yvonne Rogers, and Johannes Schöning. 2022. Mood Worlds: A Virtual Environment for Autonomous Emotional Expression. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (<conf-loc>, <city>New Orleans</city>, <state>LA</state>, <country>USA</country>, </conf-loc>) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 22, 16 pages. doi:10.1145/3491102.3501861

[99] Nadine Wagener, Leon Reicherts, Nima Zargham, Natalia Bartłomiejczyk, Ava Elizabeth Scott, Katherine Wang, Marit Bentvelzen, Evropi Stefanidi, Thomas Mildner, Yvonne Rogers, and Jasmin Niess. 2023. SelVReflect: A Guided VR Experience Fostering Reflection on Personal Challenges. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (<conf-loc>, <city>Hamburg</city>, <country>Germany</country>, </conf-loc>) *(CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 323, 17 pages. doi:10.1145/3544548.3580763

[100] Nadine Wagener, Johannes Schoning, Yvonne Rogers, and Jasmin Niess. 2023. Letting It Go: Four Design Concepts to Support Emotion Regulation in Virtual Reality. In *2023 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*. 763–764. doi:10.1109/VRW58643.2023.00224

[101] World Health Organization. 1983. Health Education in Self-Care: Possibilities and Limitations. Online pages. https://iris.who.int/bitstream/handle/10665/70092/HED?sequence=1

[102] World Health Organization. 2021. Guideline on Self-Care Interventions for Health and Well-Being. Online pages.

[103] World Health Organization. 2023. Mental health. (2023).

[104] Soojeong Yoo, Phillip Gough, and Judy Kay. 2018. VRFit: An Interactive Dashboard for Visualising of Virtual Reality Exercise and Daily Step Data. In *Proceedings of the 30th Australian Conference on Computer-Human Interaction (OzCHI '18)*. Association for Computing Machinery, New York, NY, USA, 229–233. doi:10.1145/3292147.3292193

[105] Farhah Zaharuddin, Nazrita Ibrahim, and Azmi Yusof. 2022. A Conceptual Framework for Designing Virtual Environments for Stress Therapy. *Applied Sciences* 12 (10 2022), 9973. doi:10.3390/app12199973

[106] Christopher Ziguras. 2004. *Self-Care: Embodiment, Personal Autonomy and the Shaping of Health Consciousness*. Routledge. doi:10.4324/9780203633977

Appendix

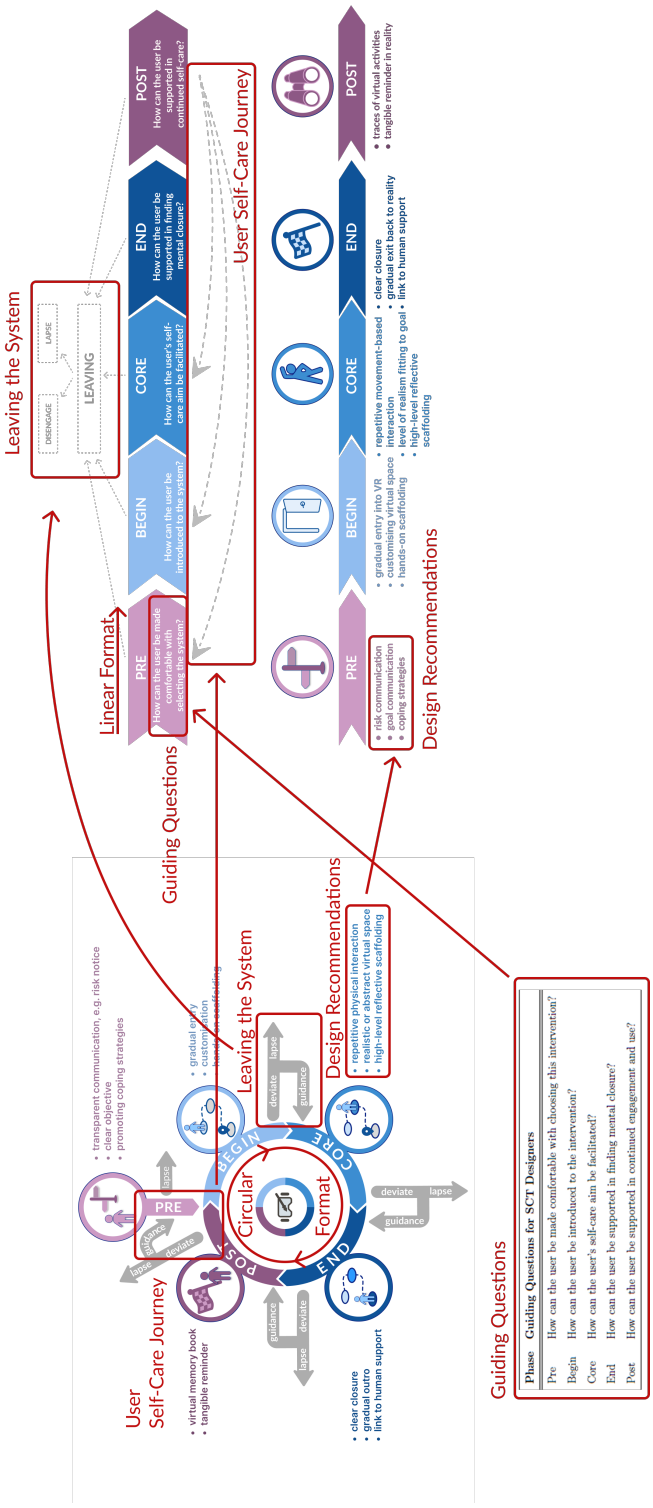

Figure 3: Changes from the initial version of the SCTpm to the final version of the SCTpm, based on expert feedback. A more detailed description and motivation for each change can be found in the supplementary material.