Me^2: Co-Designing Deepfake Encounters With One's Child Self in XR

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Abstract

Mental-health interventions often rely on imaginary self-dialogues. However, sustaining mental imagery can be a barrier for some people. XR approaches to overcome this often involve complex technical efforts to personalize content, which might hinder clinical adoption. Here, we present Me², a deepfake-enabled XR system that requires only a single childhood photograph to support encounters with one's younger self: enabling users to verbally and tactilely comfort a hyperrealistic, emotionally expressive child replica, and subsequently switch perspectives to receive that comfort themselves. We report on a co-design process with psychotherapists, a multidisciplinary team, and naive participants, describing emerging technology and study protocols highlighting trade-offs between clinical efficacy and adoption feasibility. The final design incorporates minimal haptic feedback solution and control over emotional expressions, resulting in feelings of embodiment, emotional engagement and increased self-compassion in naïve participants.

CCS Concepts

• **Human-centered computing** → **Mixed / augmented reality**; • **Applied computing** → *Health informatics*; • **Computing methodologies** → Computer vision.

Keywords

Self-dialogue, self-compassion, embodiment, extended reality, counseling, psychotherapy, deepfakes

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1 Introduction

Many of us may have experienced giving counsel to others in distress, while we may be unable to act accordingly when undergoing a similar situation ourselves. This has been linked to being confined to our own perspective [21]. In fact, externalizing oneself has been shown to be beneficial when navigating adversities [21] and is a popular psychotherapeutic technique relying on mental imagery alone [34], or combined with attributes in physical space such as chairs to represent oneself [3, 20, 48]. In these approaches three mechanisms have been highlighted to underlie change: embodiment and enactment, self-externalization, and emotional engagement [3]. As shown by research in HCI and cognitive neuroscience, multisensory and immersive technologies such as XR are particularly suited to enhance both active embodiment of alternative perspectives [4, 15, 27] and self-externalization [11, 29, 41] while strengthening emotional engagement [18].

Building on this and research on mental health–oriented interaction design [6, 30], we present the co-design process leading to our novel deepfake- and XR-based approach. This design enables a hyperrealistic encounter with a personalized and expressive child replica of oneself based on a single childhood picture. Users may verbally and tactilely comfort the replica and later swap perspectives to experience being comforted by their current self. This aims to foster self-compassion, a well-established predictor of psychological resilience and well-being [23, 31, 53]. Despite self-compassion's importance, existing counseling practices rely mostly on mental imagery [34, 37] or symbolic props [3, 20, 48], which can be difficult to sustain for people with poor mental imagery skills [9, 32]. Our design aims to improve existing interventions by bringing them to a more experiential, immersive, adaptable, and personalized level, while supporting clinical adoption by reducing technical complexity for users.

Our interest in deepfakes emerged from informal co-design sessions with psychotherapists and a patient (see, 3). We evaluated an early XR prototype involving a child mannequin to represent users and a 360 camera aimed at an easy-to-use-system to enable self-externalization in psychotherapy. In these sessions we realized the potential of personalizing the child self-representation via deepfakes to improve personalization and plausibility.

Building on this, we developed a novel pipeline for 360-video deepfakes that allows for additional text inputs to manipulate the emotional expressions, background, and other features. 6 psychotherapists evaluated an extended three-step version of the system. Their feedback informed an interdisciplinary design workshop and the development of the current two-step iteration. This latest version was evaluated by a psychotherapist and tested with 8 naïve participants, showing increased self-compassion and positive affect after the intervention. Our findings illustrate how co-design informed by qualitative and quantitative insights can guide the ethical integration of embodied AI and XR technologies into adaptive approaches aimed to improve well-being.

2 Background and Design Rationale

2.1 Embodiment and self-externalization

Research has shown that multisensory synchrony on a body seen from from a first-person perspective results in feeling that body as one's own [5, 27, 42]. These perceptual changes in turn affect cognitive, affective, and social aspects of oneself [10]. Beyond embodiment, self-externalization can arise when seeing oneself touched in extrapersonal space while simultaneously feeling that touch [29]. Building on such knowledge, efforts in HCI have created settings in which others' perspectives are embodied while one's body is externalized [2, 4, 11, 49]. These findings informed our flexible multisensory XR design aimed at eliciting self-externalization and embodiment to support self-compassion. Prior work shows that affective touch enhances illusory embodiment [8] and that XR embodiment intensifies emotional responses [18], supporting our affective focus and use of touch.

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2.2 Self-compassion

Self-compassion is the capacity to respond to one's own suffering with kindness and a sense of common humanity rather than self-criticism [19, 36, 37]. It has been robustly linked to psychological well-being, resilience, and reduced psychopathology [23, 31, 53]. Despite its therapeutic relevance, many related interventions rely on mental imagery-based self-dialogues [34, 37, 54], which can be challenging for individuals with limited imagery abilities [9, 32] or aversive mechanisms that may constrain emotional engagement [33]. Research suggests that self-dialogues through virtual embodiment and perspective-taking can strengthen self-compassion in clinical and healthy populations [13, 14]. We build on this foundation, attempting to provide an easy-to-use, flexible, and personalizable alternative.

2.3 Similar approaches

Prior XR research had participants offer compassion to a distressed child to later embody the child's perspective and feel the compassion directed at them [13, 14]. This resulted in increased self-compassion and reduced self-criticism and depressive symptoms. Other approaches also build on XR's multisensory potential for self-externalization. E.g., allowing users to switch perspectives between a self-avatar and one of Sigmund Freud [39], or with unfamiliar peers to face oneself [7, 11]. While this has been applied to self-dialogues [2, 49], these approaches often require full-body tracking [13, 14], or the creation of personalized avatars through complex and time-consuming development processes, including full-body scans and expert intervention [55]. Such demands might hinder scalability and adoption, as psychotherapists often perceive current systems as immature and insufficiently realistic for routine practice [16]. Our approach aims to lower this barrier by requiring only a single photograph to generate a hyperrealistic and emotionally expressive personalized replica. In contrast to other works, it also involves tactile cues, which are important for embodiment [5, 8, 42] and may have additional therapeutic benefits [1, 51]. By involving mental health practitioners in the design process, we focus on its adoptability for real-world mental health scenarios.

3 Methodology

This work is situated at the intersection of HCI, interaction design (IxD), psychology, and cognitive neuroscience. From an HCI and IxD perspective, our primary aim is to design a technology-supported therapeutic intervention and to iteratively refine it through close collaboration with clinical practitioners. From psychology and cognitive neuroscience, we bring an explicit concern for experimental rigor and statistical evaluation. Accordingly, our methodology addresses both the development of the interaction design and the research protocol to assess psychological responses [44].

This research builds on early informal co-design sessions with clinicians and a patient at the University Hospital of Psychiatry Zurich to explore how an XR system enabling encounters with one's younger self could be adopted clinically. This involved a first prototype [43] inspired by XR self-dialogue approaches (e.g., [13, 14]), while deliberately reducing the technical complexity that can limit accessibility for psychotherapists (see [16]). Such a prototype employed a gender-neutral child mannequin as a design probe and a 360° camera to enable switching between the participants' and the child mannequin's viewpoints. Feedback from these engagements motivated the integration of deepfake-based personalization to strengthen identification and potentially therapeutic relevance. Here, we report a brief overview of the tested iterations of the design process leading to a novel deepfake- and XR-based design.

We conducted a three-stage iterative co-design mixed-methods study involving semi-structured interviews and observations [45], and combining first-person and embodied experience methods [25, 26, 35]. Quantitative psychological questionnaires (e.g., [12, 52]) complemented the qualitative approaches [44]. In line with established co-design traditions in HCI [47, 50], therapists were not positioned solely as evaluators, but as active collaborators in the design process. They engaged with successive prototype versions, reflected on their experiential qualities, and contributed to shaping both features of interaction and clinical use scenarios. In this process they contributed both to the design and the refinement of questions for its evaluation, treating the co-design sessions as formative encounters rather than summative assessments. The evolving XR system functioned as a technological probe [24] and design material, eliciting situated reflection on therapeutic mechanisms, ethics, and feasibility while shaping the experimental protocol. This approach synthesizes HCI/IxD methods with goals from psychology and cognitive neuroscience [44].

Below, we detail the different stages in our co-design process. First, we conducted individual sessions with 6 female psychotherapists (ages: 29 to 46 years; mean = 39.83; SD = 8.04) to inform the system's therapeutic potential, ethical considerations, and clinical adoptability. An internal interdisciplinary workshop followed (3 female, 2 male; N = 5; 24 to 44 years; mean = 33.25; SD = 8.3) aimed at implementing the psychotherapists' feedback. The final design was first evaluated by a psychotherapist for final adjustments before being tested in a third stage with 8 naïve participants (4 female, 4 male; 22–31 years; mean = 25.9; SD = 3). Participants in the last study received 25 Swiss Francs for their participation. Ethical approval was obtained from the Medical Faculty of the University of Zurich (MeF-Ethik-2024-10).

3.1 System overview

The system supports a perspective-switching encounter with one's younger self through a sequence of interactions in XR. Fig. 1 shows an overview of the design iterations tested at each of the three co-design and evaluation stages. The technical setup consisted of a VR-ready laptop, a Meta Quest 3 headset, and a Kodak SP 360 camera. A custom-made silicon coated 3D printed arm that also serves as a camera tripod was designed for the final test (Fig. 2).

360 videos (approx. 3 min) were recorded with two child actors (aged 8 and 11) in gender neutral clothing against a greenscreen, allowing reuse across different genders and backgrounds. These videos served as source material for our novel deepfake pipeline. Instead of classical approaches requiring substantially similar source and target faces to remain recognizable [38], our method integrates latent diffusion models [46] to generate a new head shape based on a single photograph of participants, independent of the source's physiognomy or hairstyle. Using Image Prompt Adapter [56], ControlNet [57], and AnimateDiff [22], we enable controlled, temporally

coherent animations and emotion modulation over time, producing realistic depictions. The result is a personalized video which was played in Unity 3D.

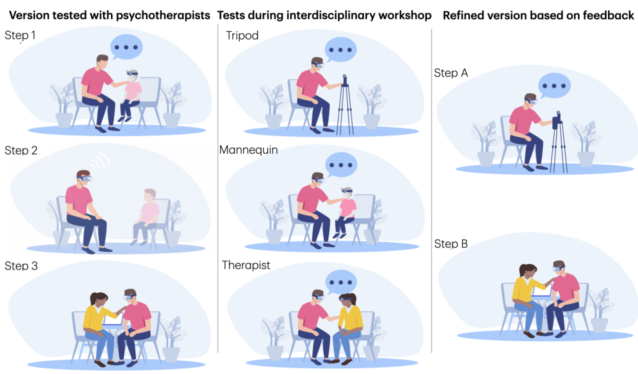

Figure 1: Left panel: Version used with clinicians. Step 1: participants comfort a child mannequin through speech and touch while being recorded. Step 2: they view a deepfake of their younger self in XR while hearing the recorded statements. Step 3: they adopt the child's perspective in XR and face a recording of themselves offering comfort with synchronized haptic feedback. Middle panel: Three alternatives tested in an internal workshop using different camera supports while participants viewed their replica in XR: a tripod, a mannequin, or the facilitator. Right panel: Refined version tested on a naive sample. Step A: participants comfort their deepfake in XR while touching a 3D-printed arm. Step B: they adopt the child's perspective and receive the recorded comfort and touch.

4 Empirical work: iterative co-design sessions

4.1 Sessions with clinical practitioners

Individual sessions with 6 experienced female psychotherapists aimed to refine our initial prototype. They evaluated its clinical utility and adoptability, as well as the practical and ethical challenges it brought forth.

Participants first completed a newly developed questionnaire on attitudes towards technologies and AI, and one on self-compassion [12]. Subsequently, they chose their preferred out of two AI-generated child videos (a conventional deepfake approach and one involving our new pipeline). All opted for our novel deepfake approach to engage with during the three-step protocol described in Fig. 1 (left panel). Participants acted as users of the prototype. In Step 1 they were guided to offer comfort to a child (mannequin) while imagining that it was their younger self feeling sad or distressed; in the following steps they observed the content on XR.

Statistical comparisons showed a significant increase in self-compassion from pre- to post-intervention (one-sided Wilcoxon signed-rank test: $W = 0.00$, $z = -2.02$, $p = .03$). Semi-structured interviews were performed after the intervention, revealing a generally strong perceived therapeutic value alongside some key limitations. In particular, 5 participants experienced talking to the mannequin as uncomfortable and unnatural, and all would have preferred talking to the replica directly. While 5 of them also felt comforted when being touched, they also expressed concerns about physical touch in clinical practice. The same number of participants expressed the need to connect more with the child, which prompted us to improve the emotional expressions of the replica.

These findings motivated 1) testing alternative solutions to remove the interaction with the mannequin, 2) implementing AI-based control over emotional expressions into the deepfake pipeline.

4.2 Integration of feedback in internal workshop

In a one-day workshop, five interdisciplinary researchers (psychology, neuroscience, computer science, and interaction design) evaluated three two-step interaction variants intended to replace the mannequin-based setup as suggested by in the previous stage. This involved first-person explorations, a questionnaire, and a structured conversation. The variants are presented in Fig. 1 (center panel). In all variants, participants comforted an AI-generated representation of their younger self in VR while touching either the empty space below the camera, the mannequin's arm, or that of the therapist. They then adopted the child's perspective to receive the recorded comfort, with camera placement and haptic feedback systematically varied.

Removing the mannequin improved immersion according to participants; however, the need for haptic reference points to maintain spatial alignment (important for embodiment) was emphasized. The tripod condition lacked clear visuotactile correspondence, while the therapist condition introduced size and perspective mismatches. The mannequin condition provided better alignment but felt unnatural when touching the replica due to its material.

These insights informed the development of a refined prototype combining a height-adjustable 3D-printed arm (see Fig. 1, right panel, Step A), thus removing the potentially bulky mannequin while maintaining spatial alignment between the physical and the seen touch. This resulted in a minimalist but efficient solution for haptic feedback.

Participants noted some additional interactional limitations reported in section 6; yet, the updated version was deemed a significant improvement. Based on the psychotherapists' feedback a timeline of dynamic facial expressions by the child (ranging from negative to positive emotions) was integrated. The new design was evaluated by a psychotherapist who gave very positive feedback, considered it ready for clinical adoption, and suggested a psychotherapeutic script to use when testing the new iteration.

4.3 Sessions with a naive sample

The refined two-step design (Fig. 1, right panel; Fig. 2) involving the newly developed 3D-printed arm and emotionally expressive replica was tested on 8 healthy participants. The design was integrated into a psychotherapy script adapted from [54] to focus on understanding one's past self and offering comfort.

Participants completed pre- and post-intervention questionnaires followed by a semi-structured interview, all agreed to involve touch during the experiment. Quantitative results showed a significant increase from pre- to post-intervention in self-compassion (Wilcoxon

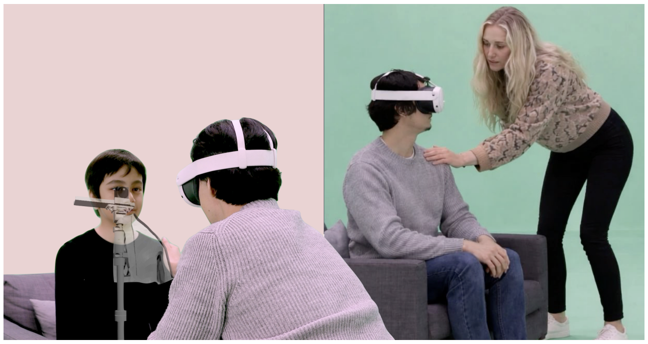

Figure 2: Final iteration tested with naïve participants. Left panel: Step A, a participant faces and tactilely comforts his child self in XR while touching a 3D printed arm that serves as a camera mount. Right panel: Step B, the participant takes the child's perspective in XR where he faces his current self and receives the touch from the facilitator.

signed-rank test: W = 0.00, z = −2.20, p = .036) and positive affect (T-test: t(7) = −4.93, p = .002), while negative affect, body boundary perception, and general connectedness did not change significantly.

Qualitative findings indicated strong emotional engagement, plausibility, self-recognition, and a pronounced sense of connection to the younger self, with touch perceived as particularly meaningful despite some limitations in haptic realism. Participants emphasized that seeing themselves as a child enabled a shift that made it easier to offer comfort.

Overall, the findings indicate that the refined VR self-dialogue protocol is feasible, emotionally impactful, and shows preliminary promise for enhancing self-compassion.

5 Discussion

This work demonstrates the potential of deepfakes for self-dialogues in counseling and psychotherapy, opening new avenues for HCI designs involving this technology for good. By representing users themselves rather than third parties, the approach mitigates common ethical concerns around consent [28]. Rather than framing deepfakes as deceptive or autonomous agents, we enable embodied and affective encounters with different aspects of the self, guided by a facilitator. This contrasts current chatbot-based approaches that position users as passive recipients of psychological advice [17], instead supporting reflection, agency, and potentially greater self-efficacy.

Involving psychotherapists was central to ensuring feasibility, ethical clarity, and clinical adaptability, highlighting the need for simple haptic and emotionally engaging solutions. We leverage deepfakes and XR to support self-externalization and embodied perspective taking in a protocol targeting self-compassion: externalizing oneself as a child may facilitate offering care, while embodying the child may facilitate receiving it. This design may particularly benefit individuals who struggle with mental imagery or are resistant to conventional strategies, while also lowering barriers to mental health care for technology-oriented populations.

Our findings with naïve users support the relevance of touch, further highlighted by research on its therapeutic impact [1, 51], and its contribution to embodiment [5, 8, 27]. However, clinicians, despite finding it comforting, raised concerns regarding safety and professional boundaries. This underscores the need for context-sensitive and consent-driven use of touch in counseling settings.

For HCI, these findings connect AI and XR technologies with real-world mental healthcare practice, highlighting the importance of simple, ethically grounded, clinically aligned designs for immersive mental health systems.

6 Limitations, privacy, and future work

This work is limited by small samples, no control conditions, and the absence of clinical populations, preventing conclusions about efficacy; future controlled clinical studies are necessary to address this. Additional limitations observed during the internal workshop included the absence of visible hands while touching the replica and the distraction of seeing the adult self wearing a VR headset in recorded footage. A follow-up variant with rendered virtual hands improved embodiment but was ultimately discarded due to spatial misalignment that caused discomfort.

In this work, images were used solely for each participant and deleted afterwards with explicit informed consent. Although local rendering supports privacy, cloud-based processing may improve efficiency but introduce data governance concerns that must align with institutional policies particularly crucial in clinical settings.

Alternative self-representations could target other psychological constructs; e.g., visualizing an elderly self may support self-continuity and planning [40]. moreover, to further reduce practical and technical demands of XR that may hinder clinical deployment[16], a video-call–style iteration could preserve core interactions while lowering access barriers.

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