

From Instruction to Embodiment: Socially Augmented VR for Parenting Skills Rehearsal

Sofia Seinfeld^{1,*†}, Pierre Bourdin-Kreitz^{2,†}, Adrian Montesano^{1,†} and Ferran Marsà Sambola^{1,†}

¹Universitat Oberta de Catalunya, Department of Psychology and Educational Sciences, Rambla del Poblenou, 154-156, 08018 Barcelona

²Universitat Oberta de Catalunya, Department of Computer Science, Multimedia and Telecommunications, and XR-Lab, Interdisciplinary Research and Innovation Hub, Rambla del Poblenou, 154-156, 08018 Barcelona

Abstract

Parenting interventions are effective in reducing harsh parenting practices and improving family well-being. However, they involve substantial economic costs, are inaccessible to all families, and remain difficult to scale. Moreover, both face-to-face and digital formats offer limited opportunities for immersive rehearsal of emotionally challenging parent-child interactions. This paper introduces VR4Parenting, an ongoing project exploring socially augmented extended reality (XR) as a complementary tool for parenting skills training. We propose a spectrum model of Social XR, ranging from low-embodiment augmentations to high-embodiment experiences involving virtual body ownership and first-person perspective switching. The initial prototype developed within VR4Parenting uses 360° video to enable parents to experience simulated interactions either as a parent or from the embodied perspective of a child. By leveraging embodiment and perspective-taking, the system aims to foster empathy, emotional regulation, and reflective practice. We describe the participatory design process, prototype features, and a mixed-methods evaluation plan assessing usability, embodiment, and preliminary parenting-related outcomes.

Keywords

parenting interventions, virtual reality, empathy, virtual body ownership, social XR

1. Introduction

Violence against children remains a pervasive global public health concern, with parents and caregivers most frequently identified as perpetrators of physical and emotional abuse against toddlers [1]. Evidence-based parenting interventions, such as Parent-Child Interaction Therapy (PCIT) and the Positive Parenting Program (Triple P), have demonstrated efficacy in reducing harsh disciplinary practices and improving child outcomes [2, 3]. Although these interventions incorporate experiential learning components, such as role-plays and live coaching, they may not fully bridge the gap between skill acquisition and in-the-moment implementation, as emotionally charged parent-child interactions unfold within the unstructured and high-stress conditions of daily family life. Moreover, in real-life settings, it is impossible to provide parents with the perspective of a child experiencing different parenting styles. Although this perspective-taking can be facilitated through imaginal exposure, such exercises may lack realism and can be challenging for parents who have difficulty engaging in vivid imagination [4]. This paper introduces VR4Parenting, an ongoing research project that leverages Extended Reality (XR) to augment existing parenting interventions. Rather than merely simulating child behavior, we propose a socially augmented VR system designed to enhance emotional self-regulation, perspective-taking, and non-verbal communication skills. This extended abstract outlines a design framework for embedding

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*Corresponding author.

†These authors contributed equally.

✉ sseinfeld@uoc.edu (S. Seinfeld); pbourdin@uoc.edu (P. Bourdin-Kreitz); amontesano@uoc.edu (A. Montesano); fmarsa@uoc.edu (F. M. Sambola)

ORCID 0000-0001-9649-0785 (S. Seinfeld); 0000-0002-8745-3787 (P. Bourdin-Kreitz); 0000-0001-9201-8694 (A. Montesano); 0000-0002-1710-8953 (F. M. Sambola)



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social augmentation into therapeutic parenting simulations and presents the design of the first pilot studies to be conducted as part of the VR4Parenting project, which aims to enhance positive parenting skills through the use of XR technologies.

2. Background: The Translational Gap in Parenting Interventions

Contemporary digital health interventions for parenting are predominantly screen-based, typically delivered via web platforms or mobile applications, and primarily focus on video content or text-based psychoeducation. While accessible and familiar to the general public, these formats lack the situatedness and interpersonal contingency required to rehearse emotionally difficult interactions, such as those that frequently occur in parenting interactions. Moreover, recent meta-analyses suggest that even though these digital interventions can have some immediate benefits, their long-term effects remain limited [5]. Face-to-face therapy provides real-time support and skills training and has demonstrated clinical effectiveness. However, it presents three significant barriers to widespread adoption and sustained impact. First, this type of therapy involves substantial economic costs, as training therapists requires significant financial and time investments, as well as specialized physical infrastructure (e.g., one-way mirrors and dedicated observation rooms) [6]. Moreover, in-person therapy is not easily accessible to broad populations, as it is often costly and therefore financially prohibitive for many families, particularly those living in vulnerable circumstances or in areas characterized as “medical desert” [7, 8]. Second, face-to-face interventions are difficult to scale due to a critical global shortage of mental health professionals capable of delivering evidence-based parenting support. This workforce gap leaves many families without access to timely intervention [9]. Third, the combination of high patient demand and heavy caseloads, particularly within under-resourced public healthcare systems, significantly elevates therapists’ risk of mental health deterioration and burnout [10]. Finally, although face-to-face support to improve parenting skills is an effective and promising approach, further empirical work is needed to better understand how to extend its impact. At the same time, the rapid growth of telehealth models and the development of automated feedback systems that transpose clinical practice to the home context demonstrate a clear need to find ways to maintain experiential learning and active practice of skills in remote therapeutic contexts. By immersing parents in controlled yet emotionally evocative environments, mixed-reality methods, including virtual reality (VR), present a compelling alternative. Indeed, VR can simulate the intensity of child and parent distress across everyday challenging parenting situations while maintaining psychological safety and offering repeatable practice opportunities even within home settings.

3. Toward Socially Augmented XR

In this paper, we use the term socially augmented extended reality systems (XR) to describe a class of technologies spanning virtual, augmented, and mixed reality in which social and communicative behaviors are intentionally modified, enhanced, or synthesized through computational mediation, thereby enabling forms of interaction that extend beyond the constraints of unmediated face-to-face communication. We propose that this capacity for augmentation can operate across a spectrum of virtual environments with different levels of embodiment, from fully embodied first-person virtual avatars to third-person observers [11], or even augmented reality overlays that do not involve body ownership at all [12]. The relationship between virtual body ownership (VBO) and social augmentation is therefore not a strict prerequisite but rather amplificatory. The foundational work of Slater and colleagues established that under conditions of multisensory correlation, synchronous visuotactile stimulation or congruent motor-visual feedback (or a combination of both), users can experience a powerful illusion that a virtual body part or entire virtual body “feels like” their own [13]. This illusion persists even when users know that the body is not their own, and evidence suggests that when a user’s virtual body is approached or virtually “harmed,” they exhibit physiological responses similar to those observed in real-life situations [14]. Critically, VBO has been shown to produce measurable

behavioral and attitudinal consequences. Banakou and colleagues demonstrated that adults embodied in a virtual child's body not only overestimated the sizes of objects (consistent with a child-scale perspective) but also exhibited implicit attitude changes, associating themselves more with child-like attributes [15]. Hamilton-Giachritsis and colleagues extended this finding to the parenting domain, showing that virtual embodiment as a child in a distressing parenting interaction increased maternal perspective-taking and empathy, and resulted in increased fear of violence [16]. However, this study focused on a sample of mothers, not fathers, and was limited to the simulation of a single parent-child interaction seen from the child's point of view (i.e., asking the toddler to pick up his toys). Overall, these studies suggest that VBO might serve as a powerful vehicle for empathy induction and perspective shift in simulated parenting interactions. Importantly, from our perspective, VBO is not the only pathway to socially augmented experiences in XR. Social augmentation can also emerge, for instance, through the overlay of social cues in augmented reality, such as gaze direction indicators, emotional state annotations, or conversational turn-taking signals, which hold clear potential for parenting training contexts where sensitivity to interpersonal dynamics is essential. Likewise, some VR interventions adopt a third-person perspective, positioning users as observers of challenging interactions rather than directly embodying a participant in a given role [17]. Although these approaches involve lower levels of embodiment, they still qualify as Social XR because they intentionally modify how social information is delivered and experienced. We therefore propose a spectrum model of socially augmented XR, ranging from low-embodiment augmentations (e.g., AR gaze cues superimposed on a real social interaction or third-person VR observation) to high-embodiment augmentations (e.g., first-person VR with full-body ownership, where social cues are experienced as self-relevant). This spectrum is further shaped by Place Illusion (PI) and Plausibility Illusion (Psi), as defined by Slater [18], referring to the sense of "being there" and the feeling that virtual events are actually occurring. For the VR4Parenting project, this spectrum model has direct design implications. Full VBO, embodying either a virtual parent or child and interacting with a contingently responsive virtual character simulating different roles, represents the high-embodiment, high-plausibility end of the spectrum. This is where we hypothesize the greatest gains in empathy, self-regulation, and skill transfer. However, we also recognize that some parents may find full embodiment overwhelming and that AR-based augmentations delivered during real interactions with their own children represent a future scalability pathway. Our current prototype therefore targets the high-embodiment region while remaining conceptually situated within the broader Social XR design space.

4. The VR4Parenting Approach

4.1. Participatory Co-Design

In the first phase, we are administering an online questionnaire to parenting experts (e.g., psychologists, educators, and policymakers) as well as to parents. The purpose of this survey is to inform the development of VR4Parenting simulations by identifying parenting situations that are particularly challenging for parents of toddlers and therefore most suitable for immersive simulation. This analysis will also guide decisions regarding the most appropriate perspective from which each scenario should be experienced (i.e., parent, child, or bystander), with the aim of maximizing the effectiveness of the training for specific parenting skills. In the second phase, we will conduct focus groups with selected experts and parents to further refine the content and interactive elements of the VR scenes. During these sessions, participants will review storyboards, draft VR scripts and provide feedback on the realism, believability, and emotional appropriateness of the scenarios. This iterative process will ensure that the final simulations are both evidence-informed and closely aligned with stakeholders' lived experiences and professional expertise.

4.2. Prototype Description

Our first VR prototype will be developed using 360° video technology, in which parents will experience different simulated scenes from a first-person perspective. In future iterations, however, we aim to incorporate computer-generated content, such as fully simulated scenes created through computer graphics, as well as mixed-reality features that superimpose learning elements onto real-life interactions. The initial prototypes will be delivered through a Meta Quest 3 headset. Although the specific scenarios have not yet been defined and will depend on the participatory design process described below, we intend to integrate several social augmentation strategies into the experience. In the first iteration, the main focus will be on implementing a VBO illusion to enable perspective swapping. A key feature of the VR scenes will be the opportunity for parents to engage in a challenging parenting situation either from the perspective of the parent (i.e., mother or father) or from the perspective of the child experiencing different parenting styles (e.g., positive, neutral, or negative). See Figure 1 for an example. These visual perspective shifts will allow parents to practice positive parenting skills in an experiential manner. At the same time, they will foster reflection by helping parents understand how children may feel in response to different parental behaviors and how these behaviors shape children's reactions (e.g., becoming calmer or more dysregulated).

In future iterations, several additional elements could be explored to further enhance the immersive and educational potential of the system, including:

- **Emotion-Sensitive Avatar Feedback Mechanisms:** In future iterations of VR4Parenting it would be valuable to explore the incorporation of adaptive nonverbal behaviors in the child avatar to further enhance emotional realism and training impact. For instance, gaze direction and duration could be parameterized according to the child's emotional state, with gaze avoidance and rapid eye movements signalling dysregulation, and sustained mutual gaze indicating repair and openness to reconnection, as in the work of [19, 20]. Additionally, expressive blendshapes based on facial action units could be implemented to convey subtle and realistic variations of distress rather than exaggerated expressions. Investigating these features would help determine whether they increase ecological validity and enhance parents' sensitivity to nuanced emotional cues during challenging interactions.
- **Augmented reality feedback during real parental interactions:** In future research, it would be particularly valuable to investigate how mixed reality could be leveraged to provide real-time

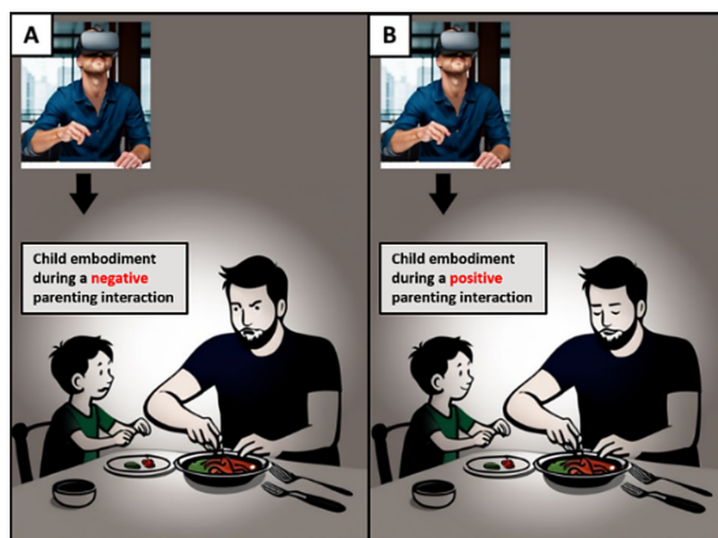


Figure 1: Conceptual illustration of a VR simulation in which a parent experiences a parenting interaction from a child's perspective (positive or negative) and practices parenting skills from the parent's perspective. The specific scenarios to be simulated will be determined through the participatory design process.

feedback to parents during interactions with their children, with the aim of enhancing parenting skills. For instance, during naturalistic parent–child interactions, augmented overlays could superimpose context-sensitive information indicating the child’s likely emotional state as inferred from nonverbal cues (e.g., facial expressions, gaze patterns, posture), as well as suggesting more adaptive parental responses. Similarly, in simulated training scenarios designed to practice specific parenting skills, real-time feedback could be delivered based on parents’ verbal and nonverbal behaviors. Such augmented feedback mechanisms could support self-monitoring and skill acquisition by helping parents understand how they are performing and how their responses might be adjusted to promote more positive interaction outcomes. Investigating the effectiveness, acceptability, and ethical implications of this form of real-time mixed reality feedback would represent an important direction for the future development of VR4Parenting.

4.3. Evaluation Design

To evaluate the impact of the VR prototype, a series of validation studies will be conducted using a mixed-methods approach. An initial pilot study with parents ($n=20$) will assess user experience and preliminary intervention effects. Quantitative data will be collected through standardized self-report measures administered before and after the VR experience to evaluate constructs such as embodiment, presence, usability, affective responses, empathy, and parenting-related outcomes. Instruments under consideration include measures of empathy (Reading the Mind in the Eyes Test), parenting self-efficacy (Parenting Sense of Competence Scale), affective response (Self-Assessment Manikin), and child behavior (Eyberg Child Behavior Inventory). Behavioral responses during VR exposure will also be systematically observed. Audio and/or video recordings will be collected only with explicit informed consent to enable analysis of in-session behavioral reactions and thematic analysis of post-experience interviews. In addition, practitioners will participate in a complementary validation study to assess the system’s usability, acceptability, and perceived applicability in professional settings. Standardized instruments such as the System Usability Scale (SUS) and the USE Questionnaire will be administered to measure satisfaction, perceived usability, and relevance. This assessment will be followed by semi-structured interviews exploring feasibility, integration into existing parenting programs, and opportunities for refinement. Interviews will be audio-recorded with informed consent and analyzed using qualitative methods. All data will be fully anonymized before analysis. Participation will be voluntary, and participants will have the right to withdraw at any time without providing a reason.

5. Conclusion: Embodiment, Empathy, and the Future of Parenting Support

VR4Parenting explores how socially augmented XR can extend experiential learning in parenting interventions. While established programs are effective, they remain resource-intensive and cannot easily provide parents with experiential learning opportunities in realistic simulated parenting experiences, lived from a parent or child perspective. By leveraging VBO and perspective switching, the proposed system aims to support empathy, emotional regulation, and reflective practice within immersive simulations of challenging parent–child interactions.

Rather than positioning XR as a replacement for face-to-face interventions, VR4Parenting is conceived as a complementary and potentially scalable tool that enables repeated, safe rehearsal of emotionally charged situations. The proposed spectrum model of social augmentation—from high-embodiment VR to future mixed reality feedback during real interactions—offers a flexible framework for designing and evaluating such systems.

Ongoing validation studies will examine usability, acceptability, and preliminary indicators of impact. Together, this work contributes to emerging discussions at the intersection of Social XR and clinical intervention, offering both a design framework and an empirical foundation for future research. We hope that immersive technologies may help bridge the gap between knowing what to do

as a parent and being able to do it in the moment.

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Declaration on Generative AI

Parts of this paper were edited for clarity and formatting using a generative AI tool. The authors reviewed and take full responsibility for the final content.

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