

TeenWorlds: Supporting Emotional Expression for Teenagers with their Parents and Peers through a Collaborative VR Experience

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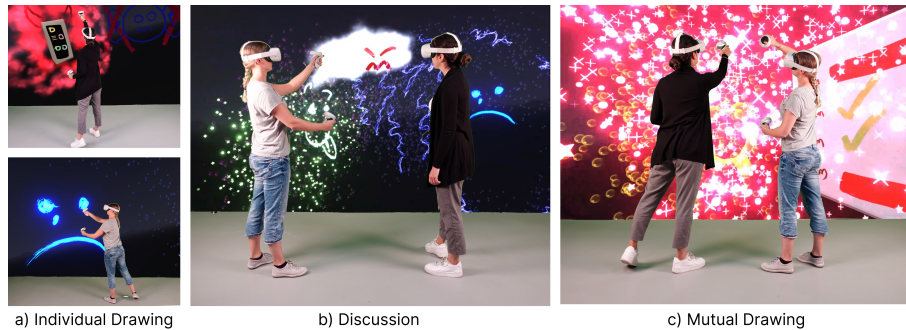


Figure 1: Participants engaging in a) an individual drawing regarding a shared conflict, b) a discussion phase where they visit each other's individual drawings, and c) a mutual drawing regarding their feelings after the conflict was resolved.

ABSTRACT

Adolescence is a period of growth and exploration, marked by influential relationships with peers and parents. These relationships are essential for teenagers' well-being, highlighting the need to support their interpersonal interactions. Emotional expression is key in resolving conflicts that can frequently arise. This paper investigates the potential of TeenWorlds, a Virtual Reality (VR) application, to facilitate emotional expression and shared understanding among teenagers and their peers and parents. In our study, teenagers, accompanied by either a peer or a parent (total $n=42$), used TeenWorlds to visually represent their emotions during a shared conflict, discuss them, and collaborate on a joint VR drawing. Our findings indicate that TeenWorlds can foster communication, reflection, and strengthen interpersonal relationships. However, notable differences were observed in interactions with peers versus parents. We

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contribute insights into designing VR systems that support reflective experiences and meaningful family interactions, ultimately enhancing the well-being of adolescents, parents, and families.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **Virtual reality**; **Empirical studies in HCI**.

KEYWORDS

Virtual Reality, adolescent, teenager, youth, CCI, reflection, emotional expression, parents, family, collaboration

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1 INTRODUCTION

Adolescence is a unique phase of life characterised by significant growth and exploration [97, 98, 106, 107]. While these changes can be challenging, and can lead to emotional turbulence and interpersonal conflicts [21, 79], they also present opportunities for

teenagers to form their identities [25, 57, 126] and establish their autonomy [67, 108]. During this time, relationships with peers and parents become increasingly complex and influential [8, 15]. Peer interactions are crucial as they help shape teenagers' social skills, self-esteem, and behavioural patterns [8]. Simultaneously, the parent-teen relationship undergoes significant transformations as teenagers seek greater independence [23, 42, 95]. Despite these changes, the role of parents remains critical [112, 113], as they can provide not only emotional support and security [15, 42] but also guidance as adolescents navigate the challenges of growing autonomy [49, 51]. Communication and shared understanding can lead to enhanced well-being and academic success [17, 29].

Emotional expression, defined as the communication of inner emotional states towards the outside [41], is a key component of these relationships. It can foster teenagers' emotional intelligence [102] to convey their feelings and thoughts clearly, promoting deeper understanding and connection with others, and thus strengthening empathy [48, 73] and interpersonal relationships [37]. Meaningfully engaging with one's emotions can overall help in navigating emotional complexities [91, 92]. However, emotional expression is not always straightforward, and can benefit from external support, particularly for teenagers who can experience heightened sensitivity to social and emotional situations [33]. Therefore, this paper explores the opportunity of designing virtual environments that enable teenagers to express themselves emotionally with peers and parents as a way to support them in that direction.

Nowadays, teenagers increasingly utilise technological tools as a means of communication and expression, e.g. through textual messages and emojis [87], as well as voice messages and video chats [9]. This shift is exemplified by their extensive use of textual messages, including the use of emojis [87], as well as verbal communication such as voice messages and video chats with friends [9]. Concurrently, teenagers interested in well-being and mental health may prefer digital tools over face-to-face interactions [34, 35]. Thus, there is an opportunity to design such environments that support teenager's well-being, for example through the development of technologies that provide new and extended spaces for emotional expression through behavioural, nonverbal and/or verbal means [41]. In Human-Computer Interaction (HCI) research, there is already a growing interest in designing technologies that aim to address teenagers' well-being, such as e-learning computer games to foster emotional intelligence [74], using interactive technologies for stress management [3], or supporting parent-teenage relationships and communication using meme-creating platforms [117]. Previous research has also shown that technologies that allow emotional expression could foster reflection and empathy among children of various ages, their families, and peers [110, 111]. Despite this interest, and the clear benefits of engaging teenagers in emotional expression together with their peers and parents detailed above, exploring how technologies could support *emotional expression* specifically for the user group of *teenagers*, and thereby strengthen their interpersonal relationships, remains under-explored.

One promising technology to support the emotional expression of teenagers is Virtual Reality (VR). VR applications allow highly controlled yet immersive environments [66] that can separate from real-world distractions and provide the space to express oneself in a

“safe” and playful environment, in a way that is not feasible in physical reality. Moreover, prior work has demonstrated the potential of VR to successfully support both individual [122] and joint [101] emotional expression for adult users. Recently, exploratory co-design work was conducted within HCI on how teenagers could be supported by VR environments in developing strategies for regulating emotions, which can include emotional expression [55]. Additionally, research has already demonstrated the suitability of VR for art therapy with this demographic, enabling participation even by teenagers who find it difficult to create content in traditional art therapy [104]. The present work addresses the opportunity to employ VR in order to engage teenagers in emotional expression, both visually and verbally, together with two key stakeholders in their everyday experiences: their peers and parents. We also explore how teenagers' experience in VR is affected based on whether they engage in this activity alongside their parent or another teenager (i.e. a peer). Literature details how teenagers spend a decreasing amount of time with their parents and an increasing amount of time with their peers [24, 62]. Moreover, previous research has shown that teenagers might communicate more openly with peers than with parents, disclosing more intimate information [80]. Thus, in this paper, we seek to address the following research questions (RQs):

RQ1: How does a VR application for **visually and verbally externalising visual and verbal externalisation of** emotions affect teenagers' interactions and mutual understanding with their peers and parents?

RQ2: How does that differ depending on whether teenagers engage in this activity alongside a parent or a peer?

To address these questions, we conducted a study in which teenagers used *TeenWorlds*, our adaptation of the VR application OpenBrush¹, which previous research has used in similar ways [55, 121–123]. In a multi-user setup, teenagers engaged with *TeenWorlds*, together with their parents or their peers, to represent their emotions concerning a conflict that both participants had experienced with each other. First, ten teenager-parent pairs and eleven teenager-teenager pairs individually represented their emotions through drawing in VR, then engaged in perspective-taking [31, 32] by visiting and discussing each other's drawings in VR, and finally created a joint VR drawing. Based on quantitative and qualitative analysis, we found that *TeenWorlds* is an engaging experience that can help mediate communication, foster reflection, and increase the appreciation of the participants' relationship towards each other. However, our comparative analysis indicates that the current system setup is more effective for engaging with parents than with peers, suggesting the need for additional support to enhance emotional expression and reflection between peers. Based on our findings, we derive design implications, emphasising the need for scaffolding to reflect, and we discuss how technologies like *TeenWorlds* could facilitate meaningful family interactions.

Therefore, this paper contributes: (i) empirical findings on supporting emotional expression for teenagers, their peers, and parents through creative VR drawing, (ii) an exploratory user study evaluating the impact of *TeenWorlds* on reflection, communication,

¹<https://openbrush.app/>. Tilt Brush, now called Open Brush, was made open source by Google in 2021 on GitHub.

and relationships, (iii) comparative results showing how teenagers' experience differed when engaging with peers versus parents, and (iv) design implications for future (VR) technologies aiming to facilitate reflection of teenagers with both their parents and peers and fostering well-being in teenagers and families.

2 BACKGROUND & RELATED WORK

This section reviews key concepts ~~such as:~~ emotional expression, empathy, and well-being. ~~We then,~~ and examines HCI literature on ~~designing for~~ teenagers and families, and previous VR approaches for emotional expression.

2.1 Emotional Expression, Empathy, and Well-being

Emotional expression refers to communicating inner emotional states towards the outside [41], encompassing both verbal and verbal expressions among others, as well as complex behaviour such as visualising emotions by writing or drawing [41]. It forms the core of numerous therapeutic approaches, notably art therapy [44, 68], emphasising the role of visualisation and reconstruction of emotions for increasing positive affect and reflection, the process of introspection where individuals review and analyse their thoughts, emotions, and behaviours [38]. This process of expressing emotions has a number of important benefits. First of all, emotional expression can support both hedonic well-being (i.e. as an activity causing happiness) and eudaimonic well-being (i.e. to learn skills, reach one's potential, finding meaning) [19]. For example, expressing negative emotions can help with emotional regulation [41, 52]. This can result in cognitive change, which in turn can increase subjective well-being [84] (one's cognitive and affective evaluations of life satisfaction [20]). Moreover, sharing how we feel can build new relationships and strengthen existing ones [37]. However, it is important that the listener exhibits empathetic behaviour to the sharer when disclosing emotions [84]. Empathy, defined as the ability to understand and share another person's feelings, thoughts, and perspectives [2, 16, 36, 83], is integral to effective emotional expression. Similarly, the term emotional intelligence is tightly linked with empathy and emotional expression. Emotional intelligence refers to the capacity to identify, assess, and manage our emotions, as well as the emotions of others [102]. Emotionally intelligent individuals can better moderate conflicts and have an increased understanding of themselves and their relationship with others [102]. The relationship between emotional intelligence, emotional expression, and empathy is crucial, particularly for teenagers. Namely, high emotional intelligence supports social relationship development, stress reduction, and mutual understanding [30].

In the context of this work, we focus on emotional expression by externalising emotions in three different steps: visualising emotions through drawing, discussing them verbally, and combining these methods in collaborative settings. Our study delves into how VR-mediated emotional expression, both visual and verbal, affects interpersonal relationships and fosters mutual understanding between teenagers and their peers and parents. Given our focus on VR technology use, the following two sections discuss technologies for teenagers and their families in a general setting, and then specifically looking into employing VR for emotional expression.

2.2 Teenagers, Parents, Families, and their Interactions with Technologies

HCI researchers have been increasingly investigating the interactions of teenagers (typically users between 13-19 years) [26] with technologies. Among other topics, they have examined teenagers' technology-supported communication [1, 39, 40] and their perspectives on social VR [69]. More recently, the topic of supporting teenagers' well-being through technology has attracted more focus, e.g. investigating the potential of conversational agents in addressing teenagers' emotional needs [54], or how mental health apps can foster engagement and sustained use [10]. A large body of literature has also investigated family relationships (including teenagers or children, and their parents) with technologies [59, 75, 86, 129]. An emphasis has also been placed on the influence of the interactions between teenagers and their parents on their technology usage [130], and how parent involvement and open communication can lead to better outcomes, including improved parent-child relationships [11, 64, 65]. Thus, a recurring topic is that of technology mediation and coordination of use within families [5, 12, 47], as technology use can be a source of conflict between teenagers and their families [90, 128, 132, 135]. Notably, Blackwell et al. [5] explored the underlying reasons for technology-related conflicts between teenagers and their families. They concluded that while parents think they openly communicate with their children about technology usage, children feel their parents only tell them what *not* to do. Additionally, echoed by the findings of Hiniker et al. [47], they highlight the desire of all family members to agree when to pay attention to one another and not to a device [5]. These studies show the importance of mutual activities and joint time together for both parents and their children. Transferring this from real-life to digital settings, numerous research works have explored how to support child-parent joint media engagement, including remote communication and play [14, 28, 109, 125, 134, 136] and co-located joint play and gaming [46, 96, 114, 137]. Most importantly for our study, Bindman et al. [4] explored joint media engagement with tablets using artistic creation, showing the different roles that parents may assume, i.e. that of a collaborator or guide. Further, Vacca [117] examined how joint media usage, i.e. digital media creation platforms, can improve teen-parent relationships, for instance by establishing a starting point for teenagers to reflect and more openly communicate with their caregivers.

Building on previous research that aims to support the interactions between teenagers and their parents through technology, and extending it to support peer interactions as well, this research engages them in a specific activity that has the potential to support their well-being [84]: emotional expression. Limited research so far has leveraged VR for supporting joint media engagement with these groups, particularly in an emotional expression setting. Therefore, the next section discusses literature on supporting emotional expression using VR, to further contextualise our work.

2.3 Employing VR for Emotional Expression

VR can be a powerful tool for emotional expression due to its unique features: it evokes visceral emotional responses through a sense of "being there", called presence [94], creates controllable,

immersive and distraction-free spaces [66], enables the use of dynamic elements and spatial distancing to convey significance [123], and allows users to physically explore and approach environments from various angles and perspectives [123]. These affordances ~~are often~~ can be leveraged to induce emotions [85, 118], for example in ~~the fields of~~ exposure therapy [76], positive change [56], mindfulness [89, 120], relaxation [88, 93], and stress management [103]. Thus, VR has been employed in ~~clinical and therapeutic settings~~ therapy with adults for emotion regulation [78] and creative expression in art therapy [43, 44, 68]. Given the above, an increasing body of HCI work has been exploring the design of VR applications for expressing and reflecting on emotions. Focusing on adults, prior research has found that individual creative expression in VR can increase positive affect [122], support emotion regulation [124], and allow users to reflect and engage in perspective taking when combined with voice-based guidance [123]. Beyond ~~VR use in~~ individual settings, HCI researchers have also designed ~~multi-user collaborative~~ VR experiences, e.g. to improve collaborative learning [63] by displaying users' facial expressions on avatars. Specifically ~~on the topic of~~ emotional expression, Semsioğlu et al. [101] explored collaborative emotional experiences enabling adult pairs to visit each other's expressive drawings in VR with the goal of reflection and communication, but without engaging them in joint drawing.

There is a growing interest in exploring the impact of VR on teenagers' emotional intelligence. Previous work has investigated how VR can foster empathy with immigrant classmates [81], or support emotion regulation for the prevention of risk behaviours [45]. Additionally, psychology researchers who employed VR for art therapy with two teenagers demonstrated how this was an effective technique to engage this demographic in externalising their emotions, even for those who find it difficult to create something in traditionally art therapy settings [104]. Drawing in virtual reality can serve as a "container" for typical adolescent emotions like anger, guilt, and confusion, allowing teenagers to express common defence mechanisms, such as disengagement and dissociation, more freely [99, 104]. Shamri [104] additionally referred to the VR environment as an "intermediate space" that can facilitate therapeutic engagement with teenagers' complex or hard-to-reach emotional issues, enhancing their communication and expression by allowing non-verbal modes of expression. Building on this, Kitson et al. [55] conducted co-design sessions to investigate how teenagers could be supported in regulating their emotions through the use of VR. They found that teenagers desire sharing an emotional space with friends and families in VR in order to connect with them. Coupled with the findings of Shamri [104] regarding the effectiveness of VR for teenagers' emotional expression, these findings highlight the opportunities for designing VR applications that allow teenagers to both individually and collaboratively express their emotions.

Therefore, building on prior work that uses VR ~~as a medium~~ for externalising emotions, we leverage VR affordances to foster ~~positive affect~~, reflection and communication, specifically focusing on teenagers as a user group, and engaging them with peers and parents to emotionally express themselves, both individually and ~~in a joint VR drawing~~ collaboratively.

3 EVALUATION

We conducted a user study with $n = 42$ participants. Ten teenagers participated together with their parents (which we will refer to as teenager-parent pairs), while eleven teenagers participated alongside a peer (teenager-teenager pairs). The overall aim was to explore how teenagers express and discuss their emotions and empathise with their interlocutor by drawing in VR, and to investigate how this might differ depending on whether they engage in this activity alongside a parent or peer. The study received prior ethics approval from our University's Ethics Board. Most study sessions took place in a 6×11 m room in a school. Each pair of participants received a ~~laptop for questionnaire completion and two wireless Oculus Quest 1 headsets, which were chosen for their ease of use for participants and simple set up for the researchers, as they did not require any additional hardware to be brought to and set up at the school.~~ Two teenager-parent pairs participated in the school as well; the other teenager-parent pairs participated from their respective homes.

3.1 Participants

We recruited an overall number of $n = 42$ participants, including 32 teenagers and 10 adults. The teenager-teenager pairs were friends, except for T31-T32, who were sisters, and T17-T18, who described themselves as classmates. The participants were recruited through contacting a local school and from extended contacts of the authors. For the teenager-parent pairs, teenagers were aged 14-17 ($M = 15.8$, $SD = 1.2$) and parents 33-68 ($M = 48.5$, $SD = 10.1$), also refer to Table 2. The age of teenager-teenager pairs ranged from 14 to 17 ($M = 15.4$, $SD = 0.9$), also see Table 3. All participants gave their written consent prior to participating in the study, and parents or legal guardians additionally provided written consent for their child's participation. Participants self-assessed that they felt mentally stable and healthy at the moment of participation. P6 and T6 reported that they were neurodiverse at the time of the study. Participants were remunerated with a restaurant voucher worth approximately 15€ and free snacks and beverages during their participation. Teenagers also received a certificate of participation and an exemption for classes during their participation.

3.2 Data Collection

Interactions in the VR environment were screen-recorded and pictures of the experiment were taken with participant consent. Quantitative data was collected from five questionnaires. Further, we collected qualitative data through a combined approach of exit interviews and post-study notes.

Measures. The following questionnaires were administered to all participants: (i) Basic Empathy Scale (**BES**), measuring empathy specifically for teenagers [50] - subscales: Cognitive Empathy (CO), Affective Empathy (AF); (ii) Single Item Trait Empathy Scale (**SITES**) [58], measuring empathy with a single item; (iii) Saarbrücken personality questionnaire SPf (**IRI**), measuring empathy [18, 82] - subscales: Empathic Concern (EC), Perspective Taking (PT), Fantasy (FS), Personal Distress (PD); (iv) Self-Reflection and Insight Scale (**SRIS**), measuring levels of reflection [38] - subscales: Self-Reflection (SR), Insight (IN); (v) Positive and Negative Affect

Scale (PANAS), measuring felt emotions [127] - subscales: Positive affect (PA), Negative Affect (NA);

BES, SITES, and SRIS were translated into the local language by two independent reviewers fluent in both English and the local language, one an HCI researcher and the other a psychologist and HCI researcher. They then agreed on the best translation for each item. We used BES and SITES to include both adults and teenagers and to facilitate a comparative analysis for RQ2. By using SPF-IRI to assess perspective-taking and empathetic concern and SRIS to evaluate reflection and insight, we gained insights into how Teen Worlds focusing on conflict impacted mutual understanding. Finally, PANAS was used to assess if Teen Worlds increased positive affect and decreased negative affect, which could support interpersonal interactions and mutual understanding, addressing RQ1.

Interview Protocol. We conducted brief exit interviews that lasted between 4.68 and 13.63 minutes ($M = 9.83$, $SD = 2.95$) for teenager-parent pairs and between 3.18 and 8.58 minutes ($M = 5.38$, $SD = 1.63$) for teenager-teenager pairs. In the interview, we asked participants to discuss their experiences with Teen Worlds, including their conflict, emotions during VR drawing, thoughts and emotions when visiting each other's drawings, and important aspects of their individual and mutual drawings. The full interview protocol can be found in the supplementary material.

Post-study notes. Two researchers attended each study session, collecting study notes such as comments and observations on participants' interactions during the study and interviews.

3.3 Procedure

Pre-study, participants gave consent, provided demographic data and completed the BES, SITES, IRI and SRIS questionnaires. They were then shown a video introducing the VR equipment and the VR application. Participants were given approximately ten minutes to familiarise themselves with the drawing functionalities by trying out Teen Worlds. They then decided on a shared conflict to use in the study and engaged in an Autobiographical Emotional Memory Task (AEMT) [77], a validated and widely used method in HCI to induce emotions and moods by remembering that situation in detail. After that, they filled out the PANAS questionnaire. The main part of the study contained the following phases (see Figure 1):

- **1. Individual Conflict Drawing:** The participants entered the virtual space, divided by a virtual wall, while in the same physical room. They were tasked with expressing their emotions during the conflict by creating their own virtual environment without speaking to each other.
- **2. Discussion:** Then, the virtual wall was removed, allowing participants to visit each other's drawings. Participants explained their VR drawings and how they felt during the conflict to each other.
- **3. Mutual Drawing:** Lastly, participants visualised their emotions upon resolution of the conflict together in one shared drawing.

After the study, participants filled out PANAS, BES, SITES, IRI and SRIS and took part in an exit interview.

3.4 Data Analysis

For our quantitative analysis, results of the Shapiro-Wilk statistic and visual inspection suggest normally distributed data, thus using parametric tests. A one-way ANCOVA was conducted with *Post* measurements as dependent variables, *Group* as the factor, and *Pre* measurements as covariate [22]. This aimed to compare the relationships between *Pre* and *Post* measurements across groups. A Two-way ANOVA was unsuitable due to meaningless pairwise comparisons (such as *Pre teenager-parent* vs *Post teenager-teenager*), which should be avoided as suggested by Dugard and Todman[22]. Instead, they recommend ANCOVA for pre/post designs for increased validity over repeated-measures ANOVA. Thus, a Bonferroni correction of $\alpha = .025$ was applied to account for multiple tests of pre/post scores, and all reported *p*-values are Bonferroni-adjusted. Further details can be found in the supplementary material.

For our qualitative analysis, all 21 interviews were transcribed verbatim. Two researchers analysed the interviews as well as the post-study notes through iterative open coding using the MaxQDA software, resolving any disagreements by discussion. After an initial round of open coding, two authors applied thematic analysis by using affinity diagramming in line with Blandford et al. [6]. Thus constructed codes and themes were iteratively discussed and translated into English. Our method follows an interpretative approach to understand data within its context [13]. We also analysed participants' VR drawings using screen recordings, for instance to code the use of symbols, colours, brushes, and depicted emotions. The full list of codes is available in the supplementary material.

4 FINDINGS

This section presents quantitative results from the questionnaires as well as qualitative insights from the interviews. The sessions lasted on average $M = 72.62$ minutes (min: 61.37, max: 79.92, $SD = 6.04$) for the teenager-parent pairs, and $M = 70.26$ minutes for teenager-teenager pairs (min: 61.47, max: 74.97, $SD = 4.21$).

4.1 Quantitative Results

For quantitative results, we refer to teenager-parent pairs as the *Parental* and to teenager-teenager pairs as *Peer*. For the one-way ANCOVAs found to be significant, post-hoc *Tukey HSD* were conducted comparing *Pre* and *Post* measurements (see Figure 2). The ANCOVA for negative affect PANAS (NA) showed a significant effect of *GROUP* on *POST* with *PRE* as a covariate $F(1, 40)=15.306$ (see Table 1 and Figure 2). Thus, there was a significant difference in the negative affect delta from *PRE* to *POST* between the *Parental* and *Peer* group, with *Parental* decreasing more than *Peer* (see Figure 2). The ANCOVA was also found to be significant for perspective-taking (IRI PT) $F(1, 40)=4.483$. Thus, there was a significant difference in the perspective-taking delta from *PRE* to *POST* between the *Parental* and *Peer* group, with *Parental* increasing more than *Peer* (see Figure 2). The ANCOVAs were also found to be significant for self-reflection and insight (SRIS) overall $F(1, 40)=5.518$ and for the reflective insight sub-scale (SRIS-IN) $F(1, 40)=4.912$. Thus, there was a significant difference in the self-reflection and insight deltas from *PRE* to *POST* between the *Parental* and *Peer* group, with *Parental* increasing and *Peer* decreasing (see Figure 2). Distributions of the *Pre-Post* deltas are presented in Figure 3. There were no statistically significant

Table 1: Mean values and standard deviations for *Pre* and *Post* measurements for all scales. ANCOVA statistics for *Post* measurements as dependent variable with factor *Group* with *Pre* measurements as covariates. Effect sizes η^2 provided for statistically significant results (see bold p-values). The first row shows the abbreviated name of the questionnaires and the second row their subscales as well as their overall or "total" score (abbreviated as "TOT").

	PANAS		BES			SITES	IRI					SRIS		
	PA	NA	TOT	CO	AF		TOT	EC	PT	FS	PD	TOT	SR	IN
M_{Pre}	30.238	20.643	73.048	35.833	37.214	3.690	50.548	13.952	13.738	11.810	11.048	68.786	42.714	26.071
SD_{Pre}	7.053	6.544	9.530	5.383	7.179	0.897	8.849	3.131	3.100	3.710	3.844	10.072	7.649	5.106
M_{Post}	34.833	17.595	73.071	35.595	37.476	3.714	51.214	14.381	14.071	12.000	10.762	68.381	42.190	26.190
SD_{Post}	6.629	6.045	9.681	5.653	6.645	0.970	9.257	3.283	2.975	3.832	3.999	9.200	6.729	5.718
$F_{1,40}$	0.015	15.306	1.152	0.299	1.197	1.414	1.608	2.461	4.483	0.025	0.083	5.518	1.581	4.912
p	.903	<.001	.290	.587	.280	.241	.212	.125	.040	.873	.775	.024	.216	.032
η^2		0.277							0.101			0.121		0.109

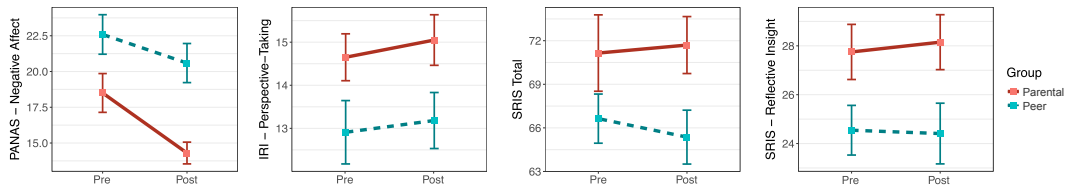


Figure 2: Line plots showing Pre and Post measurements for the sub-scales with significant ANCOVA results: PANAS Negative Affect, IRI - Perspective-Taking, SRIS Total, SRIS - Reflective Insight. Peer groups generally gave worse ratings. There seem to be some interaction effects: PANAS-NA and IRI Perspective-taking improved from *Pre* to *Post*, the SRIS scales point to different directions between *Pre* and *Post*.

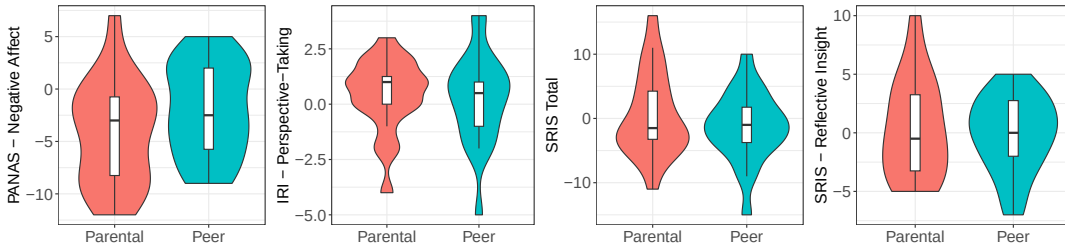


Figure 3: Violin plots showing the distributions of Pre and Post measurement deltas for the sub-scales with significant ANCOVA results: PANAS Negative Affect, IRI - Perspective-Taking, SRIS Total, SRIS - Reflective Insight. The plots' shapes look adequately distributed.

differences for PANAS PA, BES, SITES, IRI (TOT, EC, FS, PD), and SRIS SR (see Table 1).

4.2 Qualitative Findings

Based on our qualitative inquiry, three themes were constructed: *Mediating Communication*, *Experiencing Reflection*, and *Fostering Understanding & Appreciation*. Before discussing these themes in detail, we provide an overview of the general impressions gathered during the study. Most participants enjoyed TeenWorlds, rating it with $M = 8.96$ out of ten on average. They found it fun and "helpful, it's very therapeutic" (T25) for resolving conflicts and expressing their emotions, especially appreciating the collaborative drawing aspect. Nevertheless, some had difficulties identifying and representing their emotions and navigating the VR environment.

From analysing the participant drawings (see Supplementary Material), we found that most conflicts between teenagers and parents involved screen time, technology usage or household tasks. Conflicts between teenagers and peers were more varied, with recurring themes of physical conflict (T13-T14, T17-T18) and arguments over similar clothing (T19-T20, T27-T28). Both groups used stick figures

and emojis to represent emotions and prominently featured the colour red for anger and tears for sadness. Mutual drawings often included animated brushes, such as stars or bubbles, and heart symbols. Teenagers-parent pairs often drew figures holding hands (T7-P7, T8-P8, T10-P10), and wrote words of affirmations (e.g. "I love You" (P5)), while peer drawings were more diverse. Figure 4 shows some of the participants' drawings. Below, we describe our qualitative findings, illustrating them with interview excerpts.

4.2.1 Mediating Communication. The first theme highlights how TeenWorlds helped participants develop new communication skills. Participants noted an increase in communication through TeenWorlds. For example, P1 was annoyed about T1 coming home late, but T1 acknowledged that they had not discussed this conflict deeply before: "I am much happier now that we could work it out using TeenWorlds without our usual silence and lack of communication" (T1). P7 mentioned that TeenWorlds provided a foundation for communication. Regarding a conflict about doing homework, P7 shared: "We could talk openly about our feelings and portray them together" (P7). TeenWorlds not only increased communication but

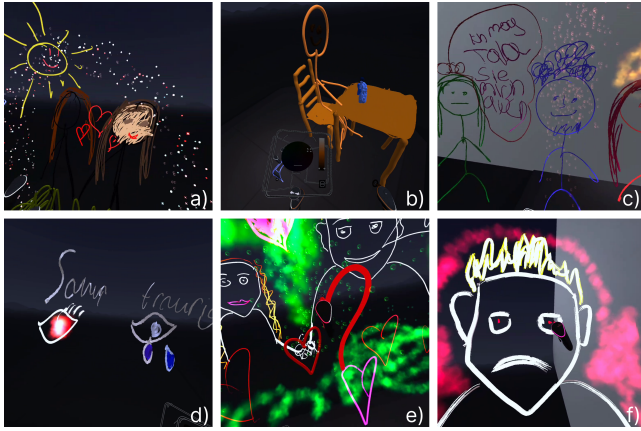


Figure 4: Examples of participants' drawings, showcasing some similarities: use of stick figures (all), symbols such as hearts (a, e) and tears (d, f), and holding hands (e).

also helped participants appreciate its importance for future conflict management. They realised the value of active listening, sharing needs and thoughts, which encouraged them to apply these skills to prevent or better manage future conflicts. One participant, a teenager preferring playing on the console than doing homework, explains this aspect as follows: *"I can understand the other side better now and hope that we can continue to find a good solution together and talk about it better in the future and that together we don't let the feeling of anger or sadness or bewilderment or helplessness arise in anyone, but that we can simply talk about it better and find a solution together so that both of us feel better."* (T7)

4.2.2 Experiencing Reflection. TeenWorlds fostered self-reflection in participants across three dimensions: *How did I feel/behave?, Who am I?, How do I want to behave?* For the first dimension, participants reported that TeenWorlds encouraged reflection on their emotions and behaviours during that specific conflict. Drawing their individual "world" in VR with brushes and colours made them aware of the range of emotions they felt. For example, one participant realised their emotions were more complex after using red and blue in their drawing: *"I just noticed that the conflict also made me sad and I was not aware of it. Only when I thought about it and put it into colour did I become aware of it."* (P4) Additionally, participants started to question their reactions and behaviour during the conflict. T7 said: *"I also thought about whether my reaction was right or wrong."* (T7). Especially visiting the other person's drawing facilitated perspective-taking and encouraged self-reflection. T22 reflected: *"to not only hear but also see this from their perspective helped me understand how I acted in the conflict."* (T22) Interestingly, the experimenters observed direct effects of this self-reflection, such as participants apologising to each other after the study.

Moreover, TeenWorlds supported participants in acquiring more self-knowledge about who they are as a person. Participants found that TeenWorlds helped them gain insights into their personality, character, and general behaviour. For instance, P7 realised through the individual drawing, *"I became very aware of this [losing control when angry] through the drawing (P7)"*, and T14 noted that *"the discussion has really helped me [to understand] that I also had a*

very big ego back then. I have also seen that I have moved in a more positive direction" (T14). Through this self-reflection, participants recognised the benefits of regulating emotions and changing their behaviour to prevent the escalation of future conflicts. For instance, T14 reflected: *"If this conflict were to arise again, I would try not to get angry directly, not to let my emotions control the steering wheel directly"* (T14).

4.2.3 Fostering Understanding & Appreciation. The third theme explores how TeenWorlds enhanced participants' *understanding and appreciation* of each other. First, participants reported that TeenWorlds facilitated a deeper understanding and increased empathy, enabling them *"to feel [the other's] feelings"* (T24). They also gained insights into the underlying causes of conflicts. For example, T21, who wanted to copy from a friend during an exam, commented: *"[TeenWorlds] helped me to realise that I would have put her in an unfavourable situation if she had helped me."* (T21). Furthermore, some participants expressed heightened care and appreciation for each other, celebrating their relationships. Drawing in TeenWorlds helped them to focus more on the strength of their friendship than on the source of conflict. For example, two friends who liked the same boy, noted: *"We were thinking of ourselves when we drew it and not of the boy (T24) - Exactly! About our friendship and that nothing can come between us"* (T23). When teenagers experienced TeenWorlds with their parents, they valued the mutual drawing as a bonding experience and shared quality time, helping them *"find something in common (P7)"*. Both parents and teenagers commented that TeenWorlds could mitigate existing conflicts, e.g. about media usage, with P7 saying *"I no longer have this aggression towards his console(P7)"*, and T7 appreciating the collaborative goal it offered.

5 DISCUSSION

This paper examined how VR, through TeenWorlds, could support teenagers' emotional expression and shared understanding in a multi-user context involving their parents and peers. Overall, interacting with TeenWorlds was a positive and enjoyable experience for participants, mediating communication and highlighting the importance of effective communication and conflict management for future interactions (RQ1). Moreover, our findings showed that TeenWorlds can encourage participants to reflect on their past and future behaviours, actions and themselves, enhancing both mutual and self-understanding (RQ1). Our comparative analysis showed differences between teenager-parent versus teenager-teenager pairs (RQ2) in regard to perspective-taking (IRI-PT) and self-reflection (SRIS), with parental pairs showing more positive changes. Parental pairs also experienced a greater decrease in negative emotions compared to peer pairs (RQ2). This suggests that challenging forms of self-expression and reflection, such as those facilitated by TeenWorlds, may benefit from the scaffolding, guidance, and emotional support that parents can provide, aligning with previous work [15, 42, 49, 51, 105]. In our study, parents seemed to offer more effective support than peers. Below, we first discuss how different forms of scaffolding could be integrated to improve reflection. Then, we reflect on how VR experiences such as TeenWorlds, combining individual and collaborative emotional expression, can promote well-being for teenagers, parents, and, more broadly, the family.

5.1 Encouraging Reflective Experiences through Scaffolding

Participants ~~in our study~~ experienced both individual and collaborative reflection [100] through TeenWorlds. While Marcu et al. [71, 72] employed “collaborative reflection” to describe care teams’ documentation and communication to interpret behaviour based on collected data, we extend this concept to include both teenagers and their parents. ~~While not applicable to every participant~~, TeenWorlds was able to evoke various levels of reflection, following the framework of reflection by Fleck and Fitzpatrick’s [27] as a spectrum of five consecutive levels (R0-R4). Some participants did not report to have reflected (thus only engaging in R0: Description), but even for some of those it ~~seemed to be~~ was an engaging and fun experience that fostered interpersonal relationships, according to our qualitative findings. Others reached R1: Reflective Description, reflecting but reinforcing their existing perspectives. Others progressed to R2: Dialogic Reflection, ~~and discovered~~ novel constructive approaches [27] for conflict management and communication, including emotion regulation and enhanced self-awareness [70]. For instance, they realised the importance of active listening and emotional sharing. They also increasingly appreciated their relationships [7], reflected in differences in their drawings and conversations across the study. For instance, P5 wrote the words “sad” in her individual drawing, compared to “I love you” in the joint one, while T23-T24, whose conflict was about texting the same boy, expressed their realisation that nothing can come between their friendship. As such, we even encountered a few participants apologising to each other during or after the study, highlighting the deep level of reflection, perspective-taking, and empathetic concern that TeenWorlds helped some participants to achieve. Even though some participants declared their intentions to change their behaviour in conflict situations in the future, which could suggest reaching R3: Transformative Reflection, this cannot be verified without further studies, to evaluate whether TeenWorlds can have such an effect long term.

However, the quantitative findings show that TeenWorlds seems to be more “effective” for parental pairs than teenage pairs. Specifically, while there was a general tendency of a decrease of negative affect, the reduction was less pronounced for *Teenage Pairs*. This suggests that it was more challenging for teenagers alongside teenage peers to regulate their emotions or keep an “emotional distance” while engaging in the activity. We also found significant differences in the change from Pre to Post between both *Parental Pairs* and *Teenage Pairs* for perspective-taking (IRI-PT), which increased for both but more for *Parental Pairs*. This suggests that teenagers among themselves did not manage to increase their perspective-taking through the TeenWorlds experience to the same extent as when together with adults. Finally, there was a significant difference in SRIS which increased for *Parental Pairs* but decreased for *Peer Pairs*. This was the case for the overall SRIS score and for the SRIS-IN subscale, suggesting that in particular the insights were more “difficult” for teenagers to achieve with a peer compared to with an adult. These findings suggest that the presence of an adult can provide encouragement for reflection, while the absence of this kind of support can lead to less successful interactions with TeenWorlds and lower levels of achieved reflection. This is in line

with prior work, emphasising that reflection can be a challenging activity and needs to be encouraged [105] and that adults, especially caregivers such as a guardian, therapist, or parent, can assume the role of a “skilled partner” providing necessary guidance and encouragement for children [119].

Based on the above, we derive design recommendations for future systems aiming to deliver reflective experiences for teenagers and their peers and parents. Regarding the first, **we recommend that future VR applications should focus on incorporating different forms of scaffolding, as this might be needed for teenagers to be able to effectively reflect together with their peers.** To that end, the system could be enhanced in order to provide this scaffolding, for instance through voice-based prompts [123] specifically designed for teenagers. Wagener et al. [123] demonstrated that voice-based guidance through voice prompts can successfully scaffold reflection for adult users who draw their emotions about a challenging situation in VR. However, as a first step, these prompts would need to be evaluated with teenagers and adjusted accordingly to cater to their unique needs. **They would also need to be designed with cultural differences in mind, considering both general conflict resolution practices and specific dynamics, such as parent-child relationships within a given culture.** Moreover, we envision that a physical representation of an avatar in VR could scaffold reflection in a more playful way than the pure voice prompts employed by Wagener et al. [123]. Incorporating avatars would also be in line with previous work that explored how they influence teenagers’ learning of emotion regulation strategies [133]. Apart from enhancing the system, we imagine that involving other older members of teenagers’ care ecosystems, as a third party to the experience, could support them to reflect. Such an example could be a school counsellor, or other qualified professionals, especially in cases where such systems would be used in therapeutic settings. For instance, previous work in art therapy engaged teenagers in VR drawing where the therapist had an observational role, accompanying them in the virtual space and talking to them [104]. Translating this to our work, future research could incorporate the therapist in a similar role in TeenWorlds, and explore how this supports teenagers reflecting with their peers.

We recommend that future work should explore the integration of more family members in the reflection process of teenagers, and investigate the dynamics of e.g. including both parents in the interaction with TeenWorlds, or also other care ecosystem members. This would have the potential to assimilate real-life situations, where interactions within a family can take place with multiple stakeholders expressing their experiences and emotions [110]. Moreover, designing such collaborative experiences is in line with recent work that has underscored the importance of designing interactions among children and multiple care ecosystem stakeholders, particularly in the domain of technologies for emotional expression and reflection [110, 111].

5.2 Facilitating Teenager, Parent, and Family Well-being through VR Experiences

Here, we discuss how engaging in experiences such as the one provided by TeenWorlds can support well-being, both individually for teenagers and parents, as well as in the context of their joint family

interactions. Regarding the first, i.e. **learning skills for emotional expression and conflict management**, our findings point to the potential of experiences such as TeenWorlds to develop emotional expression skills, as part of emotional well-being [52, 53], for both teenagers and their parents. Both the analysis of the qualitative data, the VR drawings (see Figure 4 and supplementary material) and the quantitative findings indicate that TeenWorlds helped participants express their emotions. This shows how TeenWorlds can be linked to approaches used in art therapy [68, 131], using colours and drawing to find emotional relief. Further, participants enjoyed being immersed in dynamic elements and the “sealed-off” environment of VR, providing necessary temporal and emotional detachment from real-life conflicts so that engaging with TeenWorlds was seen as “*very therapeutic*”. This opens up the potential of VR as a valuable asset for art therapy in collaborative settings, e.g. engaging teenagers together with their parents in therapy settings, which future work could explore. This is important given the difficulties that are linked to emotional identification, expression, and management, especially for teenagers [92, 102], and previous work that demonstrated the benefits of using VR in art therapy for teenagers in individual settings [104]. Concurrently, our findings demonstrate that TeenWorlds can facilitate developing and practising skills for effective communication and conflict management, linking to psychological well-being [53]. **Further, our qualitative findings highlight how VR’s unique characteristics are particularly conducive to conflict resolution.** While VR is already known for its immersive and interactive environments that foster a strong sense of presence [66, 94] and can support well-being by fostering self-reflection and expression [123], our findings reveal additional benefits specific to resolving shared conflicts: (i) immersive representations help individuals externalise and understand their perspectives and roles in the conflict; (ii) the ability to share and explore each other’s representations, while “walking through” them, fosters engagement with differing viewpoints; and (iii) co-located collaborative actions, such as drawing connections between viewpoints within a shared space, promote mutual expression and understanding. TeenWorlds leverages these characteristics through its three phases, which scaffold expression, reflection, and perspective-taking, thereby offering a tailored approach to support conflict resolution. Notably, teenagers in our study were encouraged to select *previously resolved* shared conflicts for ethical considerations. Nonetheless, our study demonstrated the potential of using TeenWorlds for active conflict resolution as well. However, in this scenario, participants may experience strong negative emotions, leading to rumination – repetitive negative thought cycles that counteract the benefits of reflection [115]. This could hinder open communication and mutual understanding. Thus, an interesting point for future research is exploring the integration of a third person, be it a therapist or another family member, assuming the role of guide or even mediator, to mitigate any risks. **Therefore, we propose that VR experiences such as TeenWorlds can be leveraged in individual and family settings for learning skills for emotional expression and conflict management.** By using a toolset for autonomous self-expression, allowing both individual and collaborative interactions, facilitating perspective-taking, and utilising VR’s immersiveness, such systems could help develop these skills.

The second aspect regards **supporting joint family interactions**. In particular, we found that TeenWorlds can facilitate quality time between teenagers and parents, addressing their social and emotional well-being [53]. Parent participants elaborated on how much they enjoyed spending time together with their child while using TeenWorlds, especially during the mutual drawing. This was interesting, as screen time and technology usage was a recurring conflict in our study (5 pairs), in line with previous literature on parent-child/teenager conflict around technology usage [5, 47]. Unlike smartphones, which are frequently criticised for monopolising the attention of family members and typically carry negative connotations in family settings [116], engaging with TeenWorlds was perceived more positively, perhaps due to the ability to engage in a shared activity using VR, contrary to the individual type of interactions that smartphones and other screens might promote. Moreover, as VR insulates users from outside distractions, it can provide the (head)space for a constructive joint activity that connects both parties, supported by previous research that investigated how joint use of technology can mitigate disagreements and be enjoyed by both parents and children [110]. Thus, we see the potential of VR systems that allow both individual and collaborative emotional expression, perspective taking, and communication in VR, to counteract the tendency that family members spend less time together [61, 138], and to address their mutual desire for more experiences of “we-ness” [60] by shaping common activities that both teenagers and parents enjoy. **Therefore, we propose that VR experiences such as TeenWorlds can be leveraged as a technology to allow for joint family quality time, connecting teenagers and parents through playful, engaging, purposeful experiences as a basis for shared family time.** Thus, our work extends previous findings by showing how VR technologies, especially those allowing not only individual but also joint artistic emotional expression, could be a suitable medium in that regard.

5.3 Limitations & Future Work

In this section, we discuss the limitations of our work and explore opportunities for future HCI research when developing VR applications aiming to support teenagers in emotional expression. TeenWorlds is a VR experience combining visual and verbal emotional expression. While this was a specific design choice to leverage the benefits of emotional expression (e.g. [52]) and multi-user collaboration (e.g. [101]), we cannot isolate which specific aspect of interacting with TeenWorlds contributed to the observed effects. **Future work could explore the impact of varying these aspects, such as different VR interactions or using TeenWorlds remotely rather than in-person.** Furthermore, other methods and technologies may replicate some elements of TeenWorlds that contribute to conflict resolution, such as shared visual expressions through pen and paper or tablets (e.g. Bindman et al. [4]). However, it is unlikely that the overall experience – especially the integration of the three phases that leverage VR-specific affordances, such as visiting and walking through each other’s drawings – could be fully replicated by other methods to achieve similar outcomes. Notably, participants were allowed to select their own conflict scenarios, which introduced variability among pairs. However, this choice provided flexibility

and a more realistic experience in TeenWorlds, as opposed to recalling conflicts within predefined themes. Future research could focus on recruiting participants with similar conflict experiences to further evaluate TeenWorlds, alongside the current study. Additionally, we observed that a few teenagers showed limited enthusiasm, expressing the view that there was nothing more to gain since the conflict had already been resolved, which might be a reason for the rather short interviews for some pairs. We further hypothesise that this might be due to the fact that participation allowed them to stay away from class as the study was conducted during a normal school day. Despite limited enthusiasm for some pairs, the vast majority of participants enjoyed TeenWorlds. However, this further emphasises the need to carefully recruit teenagers and scaffold their technology-mediated experience when the goal is to achieve reflection.

6 CONCLUSION

This paper explored how VR, through *TeenWorlds*, supports teenagers' emotional expression and shared understanding with peers and parents. We conducted a user study (n=42) to investigate how TeenWorlds aids emotional expression, communication, and reflection with peers or parents. Our findings show that TeenWorlds mediates communication between teenagers and their parents and peers, highlighting the importance of communication in avoiding or mitigating conflicts and fostering reflection and appreciation for relationships. The results suggest that TeenWorlds is more effective with parents than peers. This indicates that teenagers may need specific scaffolding, provided by parents but often lacking with peers. Future work could integrate prompts to enhance scaffolding and explore how systems like TeenWorlds can facilitate well-being by navigating conflicts and fostering enjoyable joint activities with parents. We hope our work informs future research supporting teenagers' emotional expression, particularly within their care ecosystem.

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A PARTICIPANT TABLES

Table 2: Demographics of teenager-parent pairs (N=20).

ID	Age	Gender	Nationality	VR Experience
P1	45	Female	Lebanese / German	None
T1	17	Male	Lebanese / German	1-2 times
P2	50	Male	Turkish	None
T2	14	Male	German	None
P3	55	Female	German	1-2 times
T3	16	Male	German	1-2 times
P4	54	Male	German	None
T4	15	Female	Turkish	None
P5	52	Female	German	None
T5	15	Female	German	1-2 times
P6	48	Diverse	German	1-2 times
T6	16	Diverse	German	1-2 times
P7	45	Female	German	None
T7	17	Male	German	Regular user
P8	35	Male	Turkish	1-2 times
T8	17	Female	German	None
P9	33	Female	German	1-2 times
T9	14	Female	German	1-2 times
P10	68	Male	German	1-2 times
T10	17	Female	German	None

Table 3: Demographics of teenager-teenager pairs (N=22).

ID	Age	Gender	Nationality	VR Experience
T11	16	Male	German / Turkish	None
T12	16	Male	Kurdish / Turkish	None
T13	15	Male	Bosnian	None
T14	15	Male	Albanian	None
T15	15	Male	Moroccan	None
T16	15	Male	Ghanaian	More than 5 times
T17	16	Male	German	3-5 times
T18	15	Gender Fluid	German	None
T19	15	Male	German / Bulgarian	1-2 times
T20	15	Male	Turkish	None
T21	17	Female	Turkish	None
T22	17	Female	German	None
T23	17	Female	Turkish	None
T24	17	Female	German	1-2 times
T25	15	Male	German	None
T26	14	Male	German	None
T27	15	Male	German	3-5 times
T28	15	Female	German / South African	None
T29	14	Male	German	None
T30	15	Male	German	1-2 times
T31	16	Female	Syrian	1-2 times
T32	15	Female	Syrian	None