



# Exploring Technology-Mediated Parental Socialisation of Emotion: Leveraging an Embodied, In-situ Intervention for Child Emotion Regulation

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## ABSTRACT

Emotion-related parent-child interactions during early childhood play a crucial role in the development of emotion regulation, a fundamental life skill central to well-being. However, limited work in HCI has explored how technology could support parents in adopting supportive emotion socialisation practices. In this paper, we explore how an embodied, in-situ intervention in the form of a smart toy can impact emotion-related parent-child interactions in the home. We draw on (1) interviews with 29 parents of young children who had the smart toy for at least 1 month; (2) co-design workshops with 12 parents and 8 parenting course facilitators. We discuss how the smart toy impacted parent-child interactions around emotions for a subset of families, and draw on workshop data to explore how this could be designed for directly. Finally, we propose a set of design directions for technology-enabled systems aiming to elicit and scaffold specific parent-child interactions over time.

## CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; Haptic devices; • **Applied computing** → *Health informatics*.

## KEYWORDS

parent-child interaction, emotion socialisation, emotion regulation, user-centred design, tangible interaction

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## 1 INTRODUCTION

Emotion regulation is a fundamental life skill with long-term impact on well-being, mental health, positive adjustment, and academic performance [1, 15, 59, 78]. Emotion regulation skills are in part

shaped within the course of parent-child interactions, with considerable evidence showing the parents' central role in helping children not only to regulate their emotions, but also to identify and express them in appropriate ways, through a process known as parental emotion socialisation [25, 61, 72, 77]. Much of the existing work on parental socialisation of emotion has focused on how emotion-related parenting practices, such as parents' reactions to children's emotions, emotion discussion, and parental expression of emotion, influence the way children respond to emotionally evocative situations. For example, studies consistently show that parents' supportive responses to children's emotions—i.e., reactions that are emotion-focused, problem-focused, or encouraging of emotional expression—are associated with better emotion regulatory skills in children, whilst parents' dismissing, critical, or punitive reactions have been associated with weaker skills (see [22, 46, 94] for reviews).

Despite the important contribution of parental emotion socialisation practices to the development of children's life-long well-being, we have yet to explore how this crucial process could be supported through technology. In fact, even in Psychology, little intervention work has focused on parenting as a vehicle for improvements in this area and only few interventions specifically target parents' emotion socialisation practices [30]. These programmes—delivered as part of preventive interventions in community settings (e.g., parenting courses) or targeted treatments in clinical contexts—are time- and resource- intensive and lack scalable delivery approaches that would support transfer of learnings to the home environment. While technology has the potential to address these challenges, only limited work in HCI has looked into how this could be achieved (cf., [79]).

From the HCI perspective, thinking about technology-enabled interventions that would impact socialisation of emotion presents an interesting socio-technical design problem, where the technical features of any designed solution and the social features of the work need to be viewed as fundamentally interrelated [67, 83]. In fact, such interdependence is particularly salient in this context, as the goal of the design is not 'just' to augment an existing social practice, but to, ultimately, shift the intra- and inter-personal practices through which parents impact the way the child understands, expresses, and reacts to emotions.

In this paper, we start unpacking this space by exploring the impact of an exemplar, in-situ emotion regulation intervention on parental socialisation practices over time. We report on a series of two studies with parents of young children and parenting course

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facilitators who had received ‘Purrble’: a child-focused emotion regulation intervention in the form of a smart toy, which has emerged from prior HCI research (cf., [83, 92]) and has been hypothesised to affect parent-child interactions around emotions. In the first study, we interviewed 29 parents of young children who had the smart toy for at least 1 month, to understand long-term appropriation and perceived impact on parent-child interactions associated with emotion socialisation. The findings show how the smart toy naturally facilitated parent-child interactions around emotions and led to a shift in emotion-related parenting practices *for a subset* of families during one-month deployments; while the children in the remaining families still appeared to use the toy for in-the-moment down-regulation, but with no additional shifts in parent-child interactions. The second study then builds on these observations by engaging 12 parents and 8 expert parenting course facilitators in co-design workshops to understand the potential of designing additional support layers to facilitate supportive emotion socialisation practices.

Overall, this paper provides a first indication that situated, interactive interventions *aimed at the child* could also elicit a *shift in parent-child interactions* associated with socialisation of emotion, in ways that the parents themselves perceive as positive. However, more work is needed to understand how such emergent changes in parent-child interactions can be directly supported through socio-technical design.

## 2 RELATED WORK

### 2.1 Parental emotion socialisation and emotion coaching

Parents’ role in the socialisation of emotion emerged in the Developmental Psychology literature in the 1990s [25, 26, 28] as an important parenting dimension with links to a range of child outcomes, such as emotion regulation, behaviour, social functioning, and academic performance [16, 37, 46, 58, 74]. Parents help children to understand, regulate, and appropriately express emotions through the way they express emotions, how they react to their children’s emotions, and how they discuss (or not discuss) emotions [25]. Parental emotion socialisation behaviours have generally been categorised as either supportive (e.g., discussion of the causes and meaning of emotions, reactions that are emotion-focused, problem-focused, or encouraging of emotional expression) or non-supportive (e.g., avoidance of emotional discussion, minimising or punitive reactions) [25]. The term “emotion coaching” has been used to describe a set of supportive emotion socialisation practices which are directly associated with all key aspects of child emotional competence: emotional awareness, expression, and regulation [27, 35, 93]. Parents who adopt an emotion coaching approach notice low-intensity emotions, view the child’s negative emotions as an opportunity to connect and teach, validate the child’s emotions, help the child verbally label their emotions, and coach them in problem-solving situations that elicit negative emotions [35, 36].

**2.1.1 Impact of parental emotion socialisation style.** An emotion coaching response style has been associated with better social, emotional, and behavioural outcomes in children. A number of studies have found that children who receive emotion coaching are more

likely to have better cognitive abilities and stronger social skills than children who do not experience this style of parenting [53, 66, 77]. Higher levels of emotion coaching has also been found to promote positive relationships with peers and buffer children from internalising problems and problems with emotion regulation and aggression during middle childhood and adolescence [9, 20, 48, 49, 87]. Maternal emotion coaching has also been associated with reduced behaviour problems in children with conduct behavioural difficulties [39, 50], and improved emotion regulation and decreased disruptive behaviour for young children with Oppositional Defiant Disorder or from at-risk family environments [23, 24, 29]. Research also suggests that emotion coaching may have indirect effects on child outcomes such as aggression, academic achievement, internalising and externalising behaviours, and social skills through its direct effect on emotion regulation [19, 35, 66].

In contrast, an emotion dismissing response style is one in which parents feel uncomfortable with the expression of emotion and tend to disapprove of or dismiss emotional expression. Parents who are disapproving or dismissive of children’s emotions tend to ignore, criticise or reprimand emotional displays, particularly of intense emotions which may often manifest as challenging behaviour, and may view stress-induced emotional expression as a form of manipulation, weakness or something that should be avoided or minimised [35, 36]. An emotion dismissing parenting style has been found to have a negative impact on children’s emotion regulation and behavioural outcomes [57]. Parenting characterised by punitive and critical responses to children’s emotions has been found to be associated with avoidance and heightened physiological arousal in children in response to negative emotions [27], as well as internalising and externalising behaviour problems [49, 66].

**2.1.2 Emotion socialisation interventions in existing parenting programmes.** Despite increasing evidence of the benefits of emotion coaching in the context of emotion socialisation and, subsequently, in children’s emotional development, practical applications of these ideas in targeted interventions have been slow to emerge. Instead, for the last 50 years, the evidence-based literature has been dominated by behavioural management parenting programmes, such as Triple P [71] and the Oregon model of Parent Management Training [34], which typically have little to no focus on parental responses to children’s emotions and instead place the emphasis on responding to behaviour.

The few interventions which explicitly target parental socialisation practices are usually adaptations of existing group parenting programmes with additional components specifically training parents in emotion coaching skills. For example, Emotion Enhanced Triple P is an enhanced version of Group Triple P tailored to improve children’s emotional competence [32, 70], and Parent-Child Interaction Therapy-Emotion Development is an emotion-enhanced expansion of Parent-Child Interaction Therapy, a manualised psychotherapy for treating difficulties with emotional competence in young children [54, 56]. An exception is Tuning in to Kids [40], which was developed specifically to teach parents of young children emotion coaching skills and improve awareness and regulation of their own emotions. These programmes typically deliver the intervention content over several sessions—typically between

6-12 sessions of 2-hour duration on average—through instructional materials, exercises, role-plays, and psycho-education.

## 2.2 Technology-supported parent-child interaction

Despite a growing body of work on technology-supported parent-child interactions and communication in particular, to best of our knowledge, no work so far has specifically targeted parental emotion socialisation beyond the ‘smart toy’ project ([83, 92] discussed in the introduction and outlined in detail in the next section).

In particular, most of the research on supporting *parent-child interaction in the home* has focused on remote parent-child communication. For example, a number of projects have explored how technology-enabled systems can support parent-child activities when the parent and child are at remote locations, such as facilitating remote play [33, 43], or provide a virtual space where parents and children can interact [47, 88, 98]. With regards to research aiming at supporting parent-child interactions in co-located contexts, recent work has explored parental roles and perspectives in supporting children’s informal learning with educational technologies at home [100]; multi-touch tabletop applications to drive engagement and parent-child interaction (see [97] for a review); surface haptic technologies to support parent-child collaborative science learning [7]; interactive tablet-based ebooks to support dialogic reading [52]; technology-enhanced storytelling activities [12–14, 41, 91, 96]; and sensor-based co-operative exergames [69].

Other HCI work has focused on *supporting parents’ reflection of their role* during everyday interactions with their children. For example, the Awareness Object is a tangible device designed to increase the parent’s awareness of the different roles they can fulfill during a collaborative activity with their child by serving as a physical representation of the parent’s possible roles, on a continuum ranging from ‘peer’ to ‘mentor’ [68]. Finally, other early-stage work has suggested providing parents with a second-person live-view from their child’s perspective during their everyday face-to-face interactions [51] or specifically during moments of conflict [99], as a means of facilitating awareness of how their child sees them in the moment and adopting a more empathic stance.

HCI research is increasingly interested in exploring the opportunities for *technology-enabled interventions in the home*. For example, in-situ mobile intervention services TalkBetter [44] and TalkLIME [84] have been specifically targeted at supporting interactions between parents and children with delayed language development by providing real-time feedback to parents during conversations with their child. TOBY Playpad [60] is a tablet-based intervention tool for children with Autism Spectrum Disorder and their parents, targeting important areas of early language learning as well as skills in sensory awareness, imitation, and social interaction, without the need of direct input from clinicians. Similarly, SpecialTime provides parents engaged in Parent-Child Interaction Therapy with automatic, real-time feedback on the spoken dialogue acts they use when interacting with their children at home, as a means of giving them feedback during their at-home practice of the skills taught in therapy sessions. [42]. Pina et al. have designed a mobile application to support parents of children with Attention-Deficit/Hyperactivity Disorder (ADHD) by detecting parental stress and offering in-situ

cues that remind parents of behavioural strategies to practice in those moments [65]. MOBERO is a smartphone-based system designed to assist families of children with ADHD in establishing effective morning and bedtime routines [85]. Finally, smartphone-based system WAKKEY [11] helps parents use better communication strategies to encourage their children to carry out their morning routines and reduce parent-child conflict.

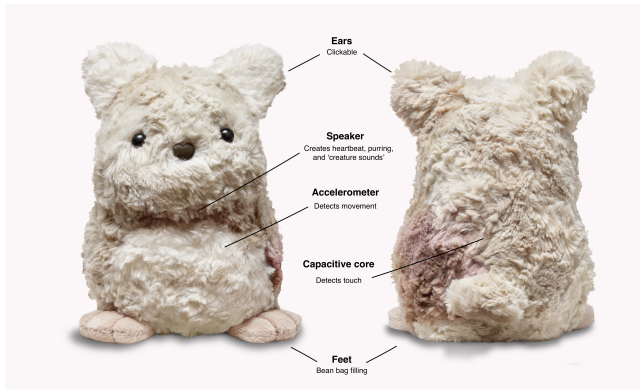
Only a few recent projects have explored the potential of digital technology to *directly support the development of typically developing children’s emotional competence at home* [79, 81]. For example, the SEL Transition Wheel is an interactive artifact designed to support young children in identifying their emotions [86], while ZooU is an intelligent social tutoring system designed to assess and build prosocial skills for children aged 7-12 years [17]. However, to best of our knowledge, only a handful of relevant projects have looked at also involving parents within the interaction. Slovak et al.’s technology probe explored mechanisms to engage parents with social-emotional learning content at home through an interactive, game-like activity [82]. Liew et al. designed CUPA, a three-component child companion prototype which combines heartbeat detection and simulation with deep breathing prompts and an emotion check-in feature for the child with an ‘emotion review’ feature to give parents’ insight into their child’s emotions over the day [55]. Finally, Wallbaum et al. designed an interactive storytelling prototype that enables the recreation of different narratives through a multi-modal interface to help children and parents explore emotional situations [96].

Overall, despite growing research on technology-supported parent-child interactions, more research is needed to understand if/how families might engage with and leverage such technologies within their daily lives in ways that allow for the emergence of positive emotion-related practices. HCI does not provide a good understanding of how to design to facilitate this and guidance to support interaction designers moving into this space is lacking. In the following section, we describe the smart toy intervention that we have selected as a starting point to explore these questions in the present study.

## 2.3 The smart toy

The system—smart toy—used in this work has emerged from a 2-year-long co-design process with children aged 6-10 years with the aim to support child emotion regulation practice in everyday settings [83]. The research prototypes have been since taken to production by the largest non-profit developer of social-emotional learning programmes in the US, Committee for Children. The commercial name of the system is ‘Purrble’.

The smart toy takes the form of a small, interactive plush animal (see Figure 1). What is unique about its underpinning theory of change in contrast to existing interventions is the focus on ‘situated support’ and ‘child-led’ intervention: the intervention aims to deliver in-the-moment support (*situated*) that empowers the child to learn how to regulate their emotions without the need for any formal training for the child or their adults (*child-led*). Practically, the smart toy is presented to children as a ‘vulnerable creature’, which is often anxious (indicated by a fast heartbeat-like vibration), but can calm down when stroked by humans. The only material



**Figure 1: The smart toy**

for parents currently accompanying the toy is a card which states its purpose (i.e., helping children calm down and strengthen their emotion regulation skills) and includes very simple suggestions on how parents could help their child explore the toy (e.g., ‘Help your child explore how Purrble is feeling’, ‘Make Purrble part of your child’s bedtime routine’).

The interaction was designed with the aim to impact two separate stages of the emotion regulatory process: the attentional deployment stage [2, 31, 75, 76], by shifting children’s attention from the emotion-eliciting situation towards interacting with the toy, and the response modulation stage, by facilitating down-regulation through pleasant tactile interaction, analogously to the mechanisms assumed to underpin emotion regulatory effects of human-animal interaction [6, 8, 18, 62, 64]. The full description of the design process and the intervention theory of change is available elsewhere [45, 83, 92].

The smart toy’s internal state is rendered through vibration patterns that mimic a heartbeat, with faster rates corresponding to higher stress levels. The fundamental game loop is the following: whenever the smart toy wakes up from sleep, it is startled and has a rapid heartbeat. Shakes, sudden movements, or pressing its ears also wake and startle the toy, while calm stroking movements and hugs gradually slow the heartbeat, which eventually changes to a purring vibration, indicating a calm, happy state. The toy also makes varying gentle sounds (i.e., sighs, coos, giggles, and grunts) which correspond to its internal state and complement the vibration-based feedback. In terms of the internal components, the toy’s internal state directly corresponds to a simple counter, which goes up or down depending on the interactions registered by the various sensors: capacitive sensors internal to the device detect hugs and stroking, while an accelerometer detects motion so that the smart toy knows if it is picked up, held upside down, and handled roughly versus gently. The vibration patterns and sounds are generated by an internal speaker.

The theory of change underpinning the intervention suggests that by ‘soothing’ the smart toy, children down-regulate themselves; that children will start seeking the smart toy when they themselves are distressed; and that repeated engagements will constructively shift emotion regulation processes in the family, by facilitating the

emergence of alternative family approaches and narratives for emotion regulation [83, 92]. So far, the intervention has been piloted through two qualitative deployment studies (total  $n=25$  families) investigating engagement and acceptability of the prototype in young children’s homes (aged 6-10), as well as subjective indicators of effects on emotion regulatory practices, as reported by parents and children. Findings from these studies have been highly positive: all 25 children engaged with the prototype throughout the deployments, all wanted to keep it for longer, and described how they naturally incorporated it into their everyday routines and gravitated towards it when they needed to down-regulate their emotions, including anger, anxiety, or just needing to relax [83, 92]. However, despite promising results with regards to offering in-the-moment support to children, prior research on the smart toy has not specifically looked at if and how it can facilitate additional parent-child interactions around emotions.

### 3 PHASE 1: EXPLORING APPROPRIATION AND IMPACT ON EMOTION-RELATED PRACTICES

The aim of this first phase was to understand the smart toy’s long-term appropriation and impact on parent-child interactions associated with emotion socialisation. Specifically, we were interested in exploring if the smart toy would be appropriated in additional ways to those reported in previous work over a longer deployment; if it would naturally facilitate any parent-child interactions around emotions; and, if so, how these interactions would be elicited and what impact they would have on families.

#### 3.1 Methods

**3.1.1 Procedures.** We interviewed 30 parents who had received the smart toy as part of a larger Randomised Controlled Trial (RCT) investigating the efficacy of the intervention in delivering measurable change in children’s emotion regulatory practices over time [80]. While the RCT is largely separate from the studies reported in this paper, we provide a brief overview of its methodology for context. 134 parent-child dyads were recruited for the RCT through a mailing list of US-based parents or guardians, whose children were receiving Committee for Children programmes in school. Children were aged 8-10 years and had emotion regulatory difficulties, but at a non-clinical level. The selected families (i.e., parent-child dyads) were randomly assigned to receive either the smart toy or a non-interactive plush toy. Over a period of 4 weeks after receiving the toy, parents had to complete the following: a daily survey on the child’s emotion regulation ability throughout the day, their general mood, and their daily engagement with the toy; and a weekly survey on children’s emotional and behavioural difficulties, general emotion regulation capacity, and behavioural, cognitive, and affective engagement with the intervention. Participating children also had to complete two weekly surveys over the same 4-week period: a shortened and adapted for use with children version of the brief Difficulties with Emotion Regulation Scale (DERS) [73, 95]<sup>1</sup>; and an adapted version of the Implicit Theories of Emotion Scale [89] to assess the extent to which children believed their emotions to

<sup>1</sup>Sample items: ‘I pay attention to how I feel’, ‘When I’m upset, it is hard to control my actions’.

be controllable<sup>2</sup>. The full RCT protocol is described in [80]. This paper does not report on the experiences of RCT participants who received a non-interactive plush toy as they are not pertinent to the specific research questions we aimed to address in this paper.

The relevant ethics approvals were obtained and all participants signed consent forms prior to any data collection. The interview protocol was developed by the first author and the interview questions centred around parents' initial thoughts of and expectations about the smart toy, children's engagement with and appropriation of the toy, parent-child interactions around the toy, use trajectory over time, changes in child or family behaviour patterns that parents noticed –or lack thereof–, and future expectations of use. The remote semi-structured interviews lasted 1 hour on average and took place between 4 and 6 weeks post-deployment. Our participants included 27 mothers and 3 fathers. Interviews were conducted by the first author over Zoom. One participant encountered technical difficulties shortly after the start the interview, so their interview was incomplete and was not included in the analysis.

**3.1.2 Data analysis.** All interview recordings were transcribed in otter.ai. The automatically generated transcripts were then checked for accuracy by the first author and two research assistants. The interview transcripts were then analysed using an inductive approach. Each interview was coded by the first author in the qualitative analysis software NVivo. This process produced more than 333 codes that were subsequently clustered into themes. The themes were reviewed and discussed with the second author before they were defined and named. This paper only presents those themes identified that are most relevant to the specific research questions of this study.

## 3.2 Findings

In this section we discuss the key themes that emerged from our analysis. To protect anonymity, participants are referred to by using 'P' for parent, followed by a participant number. Paraphrasing is indicated by words surrounded by brackets.

**3.2.1 General engagement patterns and impact on in-the-moment down-regulation.** The majority of children who took part in the study (24/29) interacted with the smart toy, as reported by their parents. Two parents reported that their child interacted with the toy, but then lost interest, while in three other cases the child did not interact much with it. All parents whose children interacted with the toy found that it had some kind of impact on their child's emotion regulation in general. This impact could take multiple forms, starting from helping the child calm down or relax in the moment, to a more extensive change in the family (as described in the section below). While how the toy facilitated the down-regulation of emotion for children is beyond the scope of this paper, the majority of parents thought this 'effect' was directly related to the toy's interactivity and its response to the child's actions.

Five parents reported no impact of Purrble. Of those, four reported their child did not interact much with Purrble and one that they interacted but lost interest.

**3.2.2 How parents directed children's in-the-moment use.** Many of the parents (23/29) encouraged their child to use the smart toy. In most cases, parents would either ask their child to go and get the toy or they would give it to them themselves in moments of upset, especially in the first days families had the smart toy. For example, a mum described how she brought the smart toy to her child during a particularly upsetting time, when they had to put down his pet rooster:

*"I think I just said "Hey, sweetheart, I know you're really upset. I thought this might help", you know, when I brought the Purrble to him. [...] And then said, "Look, he needs help calming down. Do you think maybe you could, you know, rub on him a little bit and comfort him because he's pretty upset also?". And so, [child's name] immediately grabbed him, you know, like a little baby and started doing this (motion like holding a baby and stroking it). And so I kind of sat with him and encouraged him, and then, you know, I guess told him "Good job" when the Purrble started to calm down and started to purr. We kind of sat there together and held him and stroked him and then he was really calm. And he probably stayed on the couch with the Purrble, you know, 20-30 minutes or so." [P20]*

Some parents would also remind their child to use the toy when they sent them to their room to calm down, as something that might help them feel better. Parents reported that their child would typically respond positively to those suggestions, seemingly due to its perceived usefulness in such moments.

*"He's very eager to take the coaching, you know, of using Purrble, and I think appreciates being reminded that he's there as a tool." [P12]*

In a few other cases, the smart toy was incorporated in already established family routines, such as around bedtime or in a family's 'decompression' evening routine.

**3.2.3 Eliciting meaningful parent-child interactions.** For some of the families (10/29) the smart toy appeared to naturally elicit parent-child interactions around emotions, beyond the in-the-moment soothing interactions. In what follows, we provide a detailed overview of the emergent parent-child interactions in this subset of families. We start with a quote by P26 (i.e., the 'Vanilla case'), as a way to illustrate what the smart toy could potentially generate within families and inspire design thinking about the opportunity to facilitate similar interactions in other families where it might not appear without further support.

*"Prior to the toy, I feel like it would end in me giving her a positive response to a negative action, meaning I would cuddle her or hug her because she would be crying and I would try to soothe her that way. Or she would stomp off into her room, slam the door—which has been taken off its hinges several times—and she would, you know, stomp up her bed and then she would be very angry or she literally would throw every stuffed animal off her bed. [...] It became very volatile. I think as far as soothing before, it got to a point where we had to let her cry it out or sometimes we would have*

<sup>2</sup>The adapted measure asks children to pick 1 out of 4 statements for each item in order to reduce the required cognitive load (e.g., 'I cannot control my feelings at all; I can control my feelings a little; I can control my feelings a lot; I can control my feelings all the time').

*to bear hug her to at least get her to stop, like flailing or calm down. I think that's why this has been such an amazing experience for me, because [...] when she would get in these moments, it was (always) such a struggle. My husband has stage four metastatic cancer. So his tolerance for a lot of that physical kind of, I don't want to say restraint, but that physical activity wore on him physically, emotionally, mentally, as well. And he's fighting the fight of his life. So it wore him down. And I feel that again, we have this teeny, tiny physical object that now we could literally just be like, "Where's Vanilla (i.e., Purrble)? Well, how come Vanilla's not out here? Maybe we should go ask Vanilla", just something simple like that. And it has eliminated not all, but most of that fighting, most of that struggle. And that's where I look at it, I'm like, this is a freaking godsend. Because now at least her and my husband talk now. [...] And we don't want the time he has with her to be volatile and stressful. And this little being has taken that [...] I would say about 80% out of the way." [P26]*

Parents talked about how having the smart toy had facilitated discussions about emotions in various ways. As described in the previous subsection, parents would often direct their child to the toy when they felt that they needed to calm down. In many cases, doing so was seen by parents as the first step in getting their child to a calmer state so they could then discuss the reasons behind their behaviour while the emotionally charged situation was still relatively 'hot'. The following quote illustrates this:

*"I will ask him like if he's out of control, like sobbing or whatever, "Do you need to go get Purrble?", and he nods and he goes and gets him. And usually the act of walking to his bedroom to get him and coming back and turning him on has like refocused him and calmed him back down enough so we can talk about what is happening in his head. [...] And then we can talk about, you know, he's a little more together to talk about what what he was upset about, or what he didn't understand about his homework, or, you know, why he got in trouble for doing X, Y, and Z." [P22]*

Some parents found that the toy naturally brought up the topic of emotion regulation and served as a prompt to initiate related discussions in a casual and non-intimidating way. The toy's embodiment of the emotion regulation process appeared to be important in this regard, as it provided a tangible way for parents to explain to children how emotions might feel in their bodies and what they could do to manage them. Moreover, it appears that by being perceived and talked about as being anxious and needing help to calm down, the smart toy helped normalise these experiences for children.

*"Well, I think it brought up the whole topic of emotional regulation. So being able to have the discussion around the toy, like, "What does this toy do? Oh, it's very upset when you pick it up. But then it calms down and its heart slows, and then it purrs and it's happy" and so forth. Just being able to introduce that as a concept, that when we get upset and our heart beats fast, then we can try to find ways to calm down. [...] So, just the whole*

*notion that things have feelings, people have feelings, and sometimes we need help to calm down. It's okay to need help to calm down. I just thought those were very helpful things to be reminded about and to actually say out loud." [P01]*

P18 reflected on how realising that negative emotions are normal and can be managed made her daughter more willing to express how she felt to her, instead of thinking that 'there was something wrong with her'.

*"The biggest thing to me that I have noticed is just her willingness to express herself and actually have conversations about her feelings more. So I think that it's kind of brought down some of the scariness of the overwhelming emotions. So because she is able to practice finding that centre and finding that "I'm going to be okay even though these feelings suck", then she's able to feel more safe about talking about her feelings and knowing that they're just feelings and it's okay, you know, rather than just feeling like, "There's something wrong with me", or "I have to hide this" [...]. She's much more open to my gentle prods to get her to talk about her feelings and what's going on." [P18]*

In addition to the smart toy naturally bringing up the topic of emotion regulation, some parents were able to skillfully take advantage of naturally occurring 'teachable moments' to start related discussions with their child. In some cases, this extended to other family members as well, beyond the child participating in the study. For example, P12 described how the toy eventually became a point of reference for the whole family:

*"I think it's also helped, like, teachable moments, even between my husband and older son. Like, just family conversations. Like I said, Purrble's part of our family, you know, and it's really helped to have conversations, you know, "How do you calm Fuzz (i.e., Purrble) down"? And it's just normalised the conversations. Like "Fuzz is mad, you know, he needs to calm down. "Oh, [child's name]'s mad, he needs to calm down. Oh, grandpa's mad, how can grandpa calm down? You know, Grandpa, you need to take a couple deep breaths, you know". And again, that's language that he's had prior to Fuzz but it still has helped surface that and bring it up in different contexts." [P12]*

What seems to be at the heart of all these ways in which parents appropriated the toy seems to be its ability to serve as an intermediary that the child can relate to. Rather than asking the child directly how they were feeling, the smart toy served as another point of focus for both parents and children. Parents found this helped reduce the intensity of conversations that could otherwise be intimidating. Unsurprisingly, most of the parents who reported this added impact were those whose children had been interacting with the toy throughout the study. However, a parent whose child did not interact much with the toy also reported that it opened up discussions in the family by bringing the concept of emotions to life.



*"I mean, Purrble— if anything, that's the biggest thing that it did to our household and to my daughter, that we talk a lot about our feelings and why it's important. [...] [B]ecause it is a thing, something tangible, [...] it helps explain like the emotional part, the feelings part. It helps like break it down more."* [P04]

**3.2.4 Impact on family dynamics/relationships.** As the 'Vanilla case' quote showcases (Section 3.2.3), almost a third of our participants (n=9) reported that the smart toy also impacted the relationships within their family. In some cases, this appeared to be in part due to the child's increased capacity to regulate their emotions when needed—either with the direct support of the smart toy or without it—which led to fewer outbursts and, thus, less disruption for the family. For example, P22 described how having the smart toy made her son's outbursts less frustrating for her as a parent as it allowed him to calm down more quickly than before and then communicate his frustrations:

*"I think it's much better. It's definitely a quicker process. So then my frustration is not building and I can get to the issues quicker, you know, what's going on in his head. So it's not as frustrating for me [...] trying to figure out exactly what is happening to a person who struggles with expressing his emotions."* [P22]

The smart toy appeared to have decreased the conflict between parents and their children in some cases, especially in moments where the child would be asked to calm down. For example, P13 described how she felt that there was less of a 'power struggle' between her and her son when she would ask him to go his room to calm down compared to before having the toy.

*"I'm just having an avenue to get him to calm down a little bit on his own, we've had much less of a power struggle. We were getting to the point where I would say "I need you to go to your room and calm down". And he would go and slam that door, and then he wouldn't be ready to calm down. And then when we would call him back down, it would be this just battle of the wills of saying, "Okay, if you're not ready to talk or if you're not ready to make any progress, then go back up". And he would. He would rather sit there alone and ignore you for days, than ever actually confront the problem. So now it's like he's definitely much more willing to calm down and talk about it."* [P13]

Children's increased willingness to go their room to calm down when asked might have been due to the interaction with the smart toy transforming this parental request from something punitive that could potentially increase the child's upset or make them less willing to comply, into a suggestion of something constructive they could do to calm down. As P01 described:

*"I don't know, but for [child's name] [...], because it's so responsive in that way, it helps make the need to calm down something more ordinary to do and something pleasant to do. You're not being punished by being told to go calm down. You're like, "Oh! I could really use some self-time, petting the thing and feeling better. I want somebody to purr to me and mum's not available*

*for a hug". (laughs) I don't think just any toy would have the same, would carry the same weight, I guess."* [P01]

The same parent noted that there were also fewer fights between siblings since receiving the smart toy, which they attributed to the smart toy serving as a prompt and a reminder for the whole family of the 'need to understand our emotions, feel our emotions, but then also know what to do with them' (P01). Finally, another parent reflected on how the smart toy had improved the quality of her relationship to her child, again through opening the communication lines between them:

*"Just the communication, having more communication and helping her to feel more heard about her feelings. It's just strengthened our connection, our mother-daughter bond, so you can't really ask for anything more than that."* [P18]

**3.2.5 Impact of the surveys.** An interesting finding was that the surveys parents and children had to complete as part of the RCT also led to a shift in their emotion-related practices in some cases, even for families where the smart toy itself did not generate any discussions on emotions. Some parents described how knowing that they would have to complete a survey on their child's emotions every day increased their attention to their child's feelings and reactions to emotionally evocative situations, or served as a reminder and an opportunity to connect with them about how they were feeling and how things were for them. Many parents reflected on how before the study, having those discussions might not have been at the top of their priority list due to competing demands on their time or due to the child's emotions not causing disruptions for the family.

*"I think that my eldest often gets kind of brushed to the side because she seems to be handling it better because it doesn't disrupt the whole family unit whenever she has these big feelings. But that's not necessarily the best or healthiest way. So, for me, I guess, having that focused time where I was like, specifically looking at her and taking that time [...] was really a great time of connecting with her. And just taking note each day of thinking like, "How is she doing emotionally and what did I notice today?". And, you know, helping me to be more conscious and aware of that and not let that fall further in the priority list, you know. So it became more front and centre, so I was able to give more time to it, spend more energy focused on it."* [P18]

One parent talked about how they drew inspiration from the questions included in the surveys to ask their child about how they are feeling, rather than asking generic questions that would normally not generate much of a response.

*"[C]ertain things I wouldn't even have thought about even asking. I guess just already assuming that those things were already taking place. That was I would say that's probably the main key to it with filling out those surveys, was learning how to dig deeper when you actually care. How's their day? You know, is there anything bothering them? Versus generic questions. So I would*

*say that's probably the main thing for our household."*  
[P10]

The child surveys appear to also have had an impact on some of the families. Four parents talked about how completing a survey on their emotions weekly gave children an opportunity to self-reflect and made them more aware of their feelings.

*"I think it's helped him be more mindful of what he was experiencing. Especially like having to fill out the survey and think of how things were affecting him. And maybe be more mindful of it throughout the day."* [P27]

Two other parents felt that the surveys increased their child's ability and confidence to express their feelings to them. For example, P13 talked about how the surveys 'opened the door' for her son to talk to her and his father about thoughts and feelings that he would previously guard:

*"He's kind of the one that would shut you down if you try to be serious. [...] [A]s soon as you try to talk about something that is serious, he kind of shuts down and he's very guarded. Even with me, I'm the closest person in his world [...], but there's certain things that I think he just guards his heart, you know? So we've been trying to talk about emotions a lot. And this kind of opened the door for him. I don't know if it's just the questions that you guys asked gave him talking points, but it gave him [...] some things that he would come every time and talk to us about."* [P13]

**3.2.6 Identified challenges in relation to parental engagement and involvement.** While the smart toy appeared to have initiated an interesting shift in emotion-related practices for over a third of participating families, for most families this was not the case. Although the smart toy has been designed to be a child-led intervention with children expected to naturally drive the interaction, the interview data indicate that this could potentially hinder parental engagement with the intervention, as the smart toy can be perceived by parents as something that is meant to only be used by the child. As children tended to mainly interact with the smart toy when in their room, parents were often unaware of what their child did with it and would tend to forget they even had it. We often heard how it was the daily surveys that reminded parents of the toy and served as a prompt for them to check in with their child about if and how they had been using it.

Moreover, most parents perceived the smart toy as something that was meant to be used by the child as a tool to help them calm down or relax when needed and had not thought it could have additional uses. In fact, in a few cases, it was being asked if the smart toy had initiated any discussions with their child during the interview that made parents realise it could be used in this way.

*"I guess I kind of just forgot that we had it and forgot to remind her that she had it to use. So I think that's really one of the bigger issues, that I wasn't really instigating it."* [P24]

Another factor that could have played into the lack of parental involvement with the smart toy in some families might have had to do with a lack of awareness of the benefits of actively fostering children's emotional competencies. As P18 noted: *"There are definitely*

*parents out there that are much more clueless about how beneficial caring about emotions and healthy feeling processing and all that is for their kids and how much it benefits everybody in the house".* Even when parents were aware of the benefits on some level, there were too many other things demanding their attention on a daily basis to *"sit and talk about [...] emotions"* [P25].

Finally, based on parents' responses when asked what additional resources they would have liked to receive around Purrrble, it can be presumed that many parents lacked the knowledge or confidence needed to scaffold children's learning around emotional experiences effectively without further support. The quote below illustrates this:

*"I think that's missing in many families, you know. When it comes to parenting, there's no playbook, right? Kind of go with the flow, and we make sure they get good enough grades, they get their homework done. But you know, we all experienced this as a first-time parent, and like, no one tells me when, no one teaches us how to go about kind of educating, nurturing their emotions."*  
[P19]

## 4 PHASE 2: EXPLORING ADDITIONAL SUPPORT LAYERS TO FACILITATE SUPPORTIVE EMOTION SOCIALISATION PRACTICES

The interview data indicated a clear disparity between the families for which the smart toy generated additional impact beyond providing in-the-moment emotion regulation support to children, and those for which it did not. In this phase, we were concerned with exploring how additional support layers could reduce this disparity between families which receive the smart toy.

### 4.1 Methods

Building on the interview data, we set out to explore how the smart toy could be expanded and linked with positive emotion-related parenting practices, and what additional design work would be needed to facilitate the emergence of such practices. To that end, we ran co-design workshops with parents who had had the smart toy for at least 8 weeks, as well as parenting course facilitators with experience in running an evidence-based parenting course with a focus on facilitating positive parent-child interactions around emotions.

**4.1.1 Co-design workshops with parents.** We reached out to 54 parents who had received a smart toy as part of a previous study and had consented to being recontacted. The study invitation included a link to a Qualtrics form where participants could read the study information sheet and complete the study consent form if they were interested in taking part.

We conducted 4 co-design workshops with 12 parents in total; 11 mothers, and 1 father. Of those, 9 were based in the US and had taken part in the RCT study (see 3.1.1), while 3 were based in the UK and had received a smart toy as part of a UK study. Eight of the US-based participants had also been interviewed as part of the first study. The co-design activities were aimed at understanding the following: how parents thought the smart toy could be useful for families beyond helping the child calm down in the moment;



how the smart toy could facilitate parent-child interactions around emotions; and what resources would be necessary to have around the smart toy to support such interactions. Each workshop session lasted 2 hours and was conducted over video chat and Miro, an online collaborative whiteboard platform.

**4.1.2 Co-design workshops with Parenting Group Leaders.** To complement the parent data, we also conducted co-design workshops with parents experienced in delivering an evidence-based parenting intervention, 'Empowering Parents, Empowering Communities' (EPEC). EPEC is a well-established method of prevention and early intervention for children and families that combines the latest developmental science and theory with well-evidenced parenting strategies and methods, including a focus on fostering positive emotion-related practices [21]. EPEC parenting courses are led by local parent facilitators (i.e., Parenting Group Leaders; PGLs) who have completed accredited training and receive ongoing training, supervision and support from parenting specialists based in their local EPEC Hub. EPEC parenting courses are adapted for developmental stages. In this study we focused on the 'Being a Parent' course for parents with children aged 2-11 years, as the smart toy has been designed for children falling within this age range [83, 92].

The study invitation was forwarded to group leaders in UK EPEC sites by the UK Hub Lead for the EPEC programme. In order to be eligible to take part, PGLs were required to have run at least three 'Being a Parent' EPEC courses. Participants received a smart toy each and an accompanying document outlining what we would be exploring during the workshop sessions to serve as points for reflection for them over the period before the workshop sessions. The sessions were held 3-4 weeks after participants had received their smart toy units, so that PGLs could understand the potential impact on their own families before the workshops. The workshop activities were similar to those included in the parent workshops, with the only differences being the addition of an activity aimed at understanding which parts of the 'Being a Parent' course the smart toy could be linked with, and a different framing for the activity exploring what additional supports would be necessary around the smart toy to focus it specifically on a potential future deployment of the smart toys as part of the 'Being a Parent' course.

We ran 2 co-design sessions with 8 PGLs in total. The PGLs who took part in the workshops were all female and had run 7 'Being a Parent' courses on average. Each session lasted 2 hours and was conducted over video chat and Miro. One of the participants could not join the session she was assigned to but was still very eager to participate, so they completed the co-design activities on their own on Miro and then discussed their responses over a video call with the first author. For this participant, each activity on the Miro board was set up so that they would first respond on their own and they could then click to see the other PGLs' responses during the workshop session and leave comments. We decided on this process to enable the participant to note down their own ideas without being influenced by other PGLs' responses, but then still give them the opportunity to comment on what others had shared.

**4.1.3 Data analysis.** The co-design workshop audio recordings were transcribed in Microsoft Word for the Web and then checked for accuracy by the first author. Since the workshop activities were conducted in Miro, most of participants' responses were already on

'sticky notes'. The first author read the workshop transcripts and added sticky notes with any responses that had not already been captured during the workshops. Those notes were then grouped together in an iterative process to search for themes across workshop sessions and participants. The data pertaining specifically to how the smart toy could be deployed as part of the 'Being a Parent' course are beyond the scope of this paper and are not reported here.

## 4.2 Findings

In this section we discuss the key themes that emerged from the analysis of the workshop data. To protect anonymity, participants are referred to by using 'P' for parent or 'PGL' for Parenting Group Leader, followed by a participant and workshop number ('PW' for parent workshops and 'PGLW' for workshops with Parenting Group Leaders). Paraphrasing is indicated by words surrounded by brackets.

**4.2.1 Engaging parents.** It is evident that engaging parents with the intervention—while ensuring it remains child-led—is paramount if any additional parent-child interactions are to emerge. Similarly to what we heard in the interviews, workshop participants would often remark that they had not thought of a particular use for the toy until another parent had brought it up or they saw it as a 'quote by a parent' in one of the workshop activities. Thus, more parent-facing information on the smart toy was often recommended as necessary by workshop participants.

*"It's other people's ideas that that then made me think of other ideas [for Purrrle]. So having some sort of suggestions for use in the instructions would be useful."*  
[P3-PW2]

The information parents wanted ranged from practical, such as a simple explanation of how the smart toy operates or which actions make it more 'upset' and which make it 'calmer', to information on the research underpinning it and how it is supposed to improve the child's emotion regulation skills. Similarly, participants thought most parents would benefit from specific pointers to situations and contexts where the smart toy could be useful. Parents suggested different formats, such as a physical, short guide with ideas for parental use that would come with the toy, video demonstrations of when and how it could be used, and quotes or examples from other parents showing how it has worked for them.

**4.2.2 Scaffolding parent-child interactions.** According to our participants, another tier of information needed would be on specific use cases. In terms of the different uses suggested for the smart toy—beyond supporting children in the moments they needed to calm down—the workshop discussions tended to focus on the ways in which it could facilitate emotion-related discussions within families. Similarly to what we heard in the interviews, the smart toy was often talked about as the first step in creating a discussion environment. Parents discussed different ways in which the smart toy could be used as a 'door-opener', to encourage the child to talk about their feelings once they have calmed down. Many parents agreed that the smart toy could act as a 'mediator' to open conversations around the child's emotional experiences and give parents an insight into the child's feelings, since they expected that children

would respond by projecting their own feelings onto the toy. Moreover, some parents thought the toy could also be valuable in those situations by acting as a comfort and another point of focus for the child in the moment (for example, if the child would hold it during an uncomfortable conversation). Several participants talked about how asking how Purrble is ‘feeling’—instead of directly asking the child how they are feeling—could give the child the opportunity to talk about potentially uncomfortable feelings through the smart toy in a safe and non-intimidating way.

*“Sometimes he’ll say ‘- Purrble is upset, -Why is Purrble upset?’, -Well, because this happened or that happened”. And I see it as sometimes a reflection of things that might have happened at school or with friends and he’s not willing to say it about himself quite yet, but he’ll be like “Oh well, you know, Jo told Purrble that he was weird”, or something like that. So it’s kind of a a third party object to use [...], kind of separating it. If he wasn’t comfortable saying, you know, “My friend told me I was weird”, then let’s talk about it that way.” [P5-PW4]*

Beyond the toy’s value during or right after a heated situation, many parents also felt it could be useful as a means for them to introduce and bring up the topic of emotion regulation in a casual and non-intimidating way in calmer moments as well. Parents talked about how the smart toy could help nurture children’s emotion literacy by serving as a concrete example through which they could help their children name different feelings and explain to them how feelings link to bodily sensations. While the smart toy’s potential to open up conversations on emotions dominated the discussions in workshop sessions, several parents thought that it could also be a good medium to nurture children’s empathy and help them practice taking others’ perspectives and identifying their feelings.

Data from the PGL workshops validated and enriched those of the parent workshops. PGLs largely had similar ideas about how the smart toy could be useful for families, while also drawing links with other positive parenting practices and skills parents are taught in the ‘Being a Parent’ course. Most commonly, PGLs stressed the toy’s potential to support parents in helping children identifying and naming their feelings, a key focus of one of the course sessions, as well as making the process of emotion regulation easier for both parents and children to grasp.

*“I think that’s kind of the way of demonstrating that and I think that would help with older children maybe, if you are trying to discuss with them those feelings of overwhelming emotion. Is to kind of say to them like “Look. This is what Purrble feels like when he gets (stressed)”. That links into one of my other things, like helping to articulate emotions and kind of what the different emotions do to their body. I think that would be quite a good way of sort of relating that to older children, particularly, and with kind of how those different emotions feel and what it does to their body.” [PGL5-PGLW2]*

Similarly to how some parents described in their interviews that directing their child to the toy when they needed to calm down was perceived by the child as a suggestion of something helpful to do rather than as a punitive reaction, PGLs thought that the smart

toy would make the time-out strategy taught in the course easier for parents and children alike to implement.

*“(With time out) some parents will worry about the child feeling abandoned. “I couldn’t possibly leave my child on their own and walk away. I’d feel awful abandoning them or something.”. So Purrble could kind of bridge that gap a little bit and say “Look, we’re not leaving them on their own. [...] We’re just, you know, a few steps away. But I think for the child to have that to cuddle whilst they’re calming down on time out, it helps.”” [PGL8-PGLW2]*

Our participants stressed that most parents would need specific support to allow them to scaffold the child’s interactions and experiences with the toy in a way that would reinforce their emotion regulation skills. For example, support on how to first introduce the toy to the child, including the specific language parents should use, came up often during the workshop sessions, as did providing parents with specific prompts they could use to open up discussions through the smart toy. Some parents suggested that an accompanying child-facing resource could potentially be a good way of introducing Purrble’s associated narrative in the form of a back-story, as well as helping to scaffold emotion-related conversations through Purrble-related stories.

**4.2.3 Facilitating sustained and consistent engagement.** An interesting finding emerging from the workshops was the emphasis most participants placed on the importance of establishing routines around the smart toy and, once again, how any parent-facing resources should provide specific suggestions and support on how to do so. Some participants felt that having consistent routines around the smart toy, such as a ‘Purrble check-in’ with their child at bedtime, would enable them to routinely have more discussions around emotions until it became a habit. Almost all participants across workshops agreed that if there was no structure around the smart toy in the form of routines to facilitate some consistency in use, it would be very unlikely for the toy to generate any meaningful impact.

*“I think having even in the most unstable environments, whether it be an unstable home or an unstable emotional child or whatever the case, may be, there always needs to be a constant. Kids need structure and even in the most unstable situations there has to be a constant. So I think the attachment and putting a routine in place go hand in hand. [...] The Purrble is small, its portable, it’s easy for [my daughter] to have a constant. And I think if you don’t have the accessibility, the routine, and the attachment, I think the rest of it doesn’t work.” [P07-PW1]*

In a similar vein, many parents brought up the need for regular reminders and prompts to use the smart toy. These were deemed important both to remind parents that the toy “even exists” [P4-PW3] and prompt them to use it, but also to facilitate repeated engagement on the child’s side.

Participant consensus was that the smart toy should come with a basic set of resources, as well as periodic delivery of additional emotion-related content. Again, this points to a need to keep the

smart toy and the importance of having emotion discussions in parents' minds in order to facilitate sustained engagement. For example, one parent suggested parents could receive a notification with a specific focus for the week or month and suggestions of how the smart toy could facilitate related discussions with the child. Parents had varying preferences in terms of the frequency and format of such content. Some wanted to receive ideas in an email newsletter or in an app, while others wanted to have more choice in terms of when and how they would get the content and suggested a Purrble website or Instagram profile. The common ground appeared to be that any emotion-related content should be delivered in each parent's preferred format, in manageable chunks, and not too often so as not to overwhelm parents. Finally, the idea of a platform where parents could share ideas and experiences with other parents who would also have the smart toy came up during all workshop sessions and appeared to be universally liked as a way of getting inspiration from a community of people with similar experiences.

## 5 DISCUSSION

The studies reported in this paper explored if and how an embodied, in-situ intervention—designed to promote child-led emotion regulation—can also support changes in parental emotion socialisation practices. The interview data indicate that for some families (10/29) having the toy seemed to have facilitated changes in how parents react to and talk about the child's emotions. However, many of the remaining families did not report such changes, with the toy predominantly being used by the child for in-the-moment soothing only.

In what follows, we unpack these observations in three steps: First, we contrast the findings here to the untested logic model of the smart toy, as outlined in prior work [83, 92], to understand if/how the empirical findings match the original authors' expectations of the smart toy's long-term appropriation. Second, we return to the theoretical grounding of *emotion socialisation* from Psychology, and examine how the specific changes in parent-child interactions we observed fit or do not fit the parental practices associated with successful emotion socialisation. Third, we aim to synthesise what we learned about design approaches for technology-enabled systems aiming to elicit and scaffold specific parent-child interactions over time.

### 5.1 How well do our data fit with the smart toy's logic model?

The smart toy's logic model assumes that, building on the in-the-moment emotion regulation support it provides the child, the ongoing use of the toy could naturally facilitate the emergence of alternative approaches and narratives for emotion regulation, thus affecting a wider shift in families' emotion-related practices [83]. While the prior work showed promising results with regards to its impact on children's emotion regulation in short term studies (cf., [83, 92], prior studies did not specifically examine whether and how the toy could facilitate additional parent-child interactions around emotions.

So how have our findings added to this literature? While such wider family shifts were reported by some parents (10/29), the smart

toy alone was not enough to elicit parent-child interactions around emotions for a large percentage of participating families (19/29). In these contexts, the impact seemed to mostly remain centred around the in-the-moment soothing impacts for the child (14/29); or the toy was not used much (5/29). Although the interview and workshop data did not fully enable us to examine the reasons for such strong differences among the families, the interviews suggest a number of potential reasons. For instance, some parents perceived the smart toy as something that was meant to be used only by the child; others seemed to not realise it could have additional uses beyond helping the child down-regulate when needed. Similarly, some of the parents might not have been aware—or appreciate—the benefits of actively fostering children's emotional competencies. Finally, lack of time for having emotion discussions as well as the lack of knowledge or confidence needed to scaffold children's learning around emotional experiences without further support were other likely aspects (cf. Section 3.2.6).

Our findings thus suggest that while the family-wide shifts envisioned in the smart toy's theory of change are possible, many families would require further support in order to extend its impact beyond the in-the-moment soothing support it provides the child. Before we look at how this shift could be enabled through additional design, we will examine whether in the families where wider family changes did happen, these seemed to support emotion socialisation.

### 5.2 Impact on emotion socialisation practices

Literature and interventions on emotion socialisation generally target three key aspects: (1) parental reactions to child's emotion; (2) how parents discuss—or not discuss—emotions; and (3) how parents themselves express emotions. Interestingly, for the 10 families which reported wider family shifts, at least the first two of these aspects seemed to be affected, as outlined below.

**5.2.1 Parental reactions to child's emotion.** Parents' reports showed a range of reactions to children's emotions which are considered supportive and most beneficial for children's emotional development [16, 46, 49, 90]. As illustrated in the findings, these included reactions that were emotion-focused (e.g., directing the child to the toy to help them feel better), problem-focused (e.g., supporting the child in solving the problem that caused the emotions), or encouraging of emotional expression (e.g., encouraging the child to express their feelings and their causes once they had calmed down enough to talk). In particular, the smart toy appeared to help parents in approaching children's expressions of emotion as opportunities to 'connect and teach'. This is important as the literature is clear that child's expression of emotion—particularly of negative emotion—provides an important opportunity for parents to shape the child's competence at understanding, expressing, and regulating emotions [61]. In fact, viewing such expressions as opportunities for learning (rather than a 'nuisance' to be stopped) is a central characteristic of an 'emotion coaching' approach [35, 36] and has to be explicitly taught in related parenting programmes [30, 40].

While we cannot claim that parents' reactions can be fully attributed to the smart toy, interview data appear to indicate that these were often facilitated by the toy, either directly or indirectly. For example, having the toy available as a tool parents could direct

their children to in emotional moments, turned what could have been perceived by children as a punitive reaction (*“Go to your room to calm down”*)—and, thus, potentially upset them more or decrease their willingness to comply—to a suggestion of something helpful they could do to calm down (*“Do you need to go get Purrble?”*). This, in turn, appeared to decrease conflict between parents and children, helping parents stay calmer and preventing an escalation of the situation (e.g., the *“It’s not as frustrating for me trying to figure out exactly what is happening to a person who struggles with expressing his emotions”* comments in Findings).

**5.2.2 Parental discussion of emotion.** The interview data also indicate that the toy facilitated emotion discussions in various ways. For example, by helping the child reach a calmer state in moments of heightened emotion, it allowed parents to then initiate discussions about the feelings and reasons behind their behaviour. It also served as an intermediary through which parents could indirectly ask children about their feelings; or as a prompt to bring up the topic of emotion regulation—and the associated discussion of emotion—into daily interactions. Finally, it provided a tangible way for parents to explain how emotions link to physical sensations and how to manage them; and normalised negative emotional experiences and the need to regulate emotions.

Overall, the toy appeared to help parents communicate to children that their emotions are acceptable and worthy of expression and discussion, which is the fundamental message children receive from ‘emotion-coaching’ parents [36]. The workshop data then point to the toy’s potential to also facilitate more ‘active’ aspects of an emotion coaching approach, such as helping the child verbally label their emotions and coaching them in problem-solving situations that elicit negative emotions.

### 5.3 Design approaches for systems aiming to elicit and scaffold specific parent-child interactions

So what have our data across interviews and workshops taught us about the additional layers of design that could help facilitate positive emotion-related interactions and practices—as described in the previous section—for those families where this might not emerge naturally? In what follows, we aim to synthesise what we learned about design approaches for technology-enabled systems aiming to elicit and scaffold specific parent-child interactions over time.

Specifically, we suggest that the design of such interventions could involve three interrelated levels: (1) designing for the child; (2) designing to engage parents with the intervention; and (3) designing to guide emergent parent-child interactions.

**5.3.1 Designing for the child.** The first level pertains to designing the child experience, which in the case of the smart toy consists of a physical toy that embodies the emotion regulation process and affords a set of situated actions the child can do to calm down or relax. Our data validate the emphasis placed on such interventions being ‘child-led’ and ‘situated’—the main design goals guiding the development of the smart toy [83, 92]. Children’s interest in and engagement with the object, as well as its fit with their lives, appear to be a prerequisite for it to generate any meaningful parent-child

interactions and, by extension, any impact in the wider family context (i.e., if children do not find the object appealing and their interaction with it enjoyable and/or helpful, parents will not have much to work with).

Why does it matter that the object be interactive though? For example, why couldn’t a regular plush toy be used in a similar way to generate parent-child interactions as the smart toy did for a subset of our families? While we cannot offer a definitive answer on this, our data indicate that the toy’s interactivity played an important role in facilitating parent-child interactions around emotions in two ways. Firstly, the interactivity and feedback appeared to directly support the child in calming down enough so that the parent could then initiate discussions about the reasons behind the child’s behaviour or feelings. Secondly, the toy’s embodiment of the emotion regulation process—which is directly connected to its interactivity—was conducive to it becoming associated with emotional connotations and serving as a point of reference for families in a way that a regular plush toy likely could not. Work in HCI, especially in the areas of tangible user interfaces and embodied interaction, has repeatedly shown the potential benefits of tangible interaction models based on embodied metaphors to support learning [3–5], in part due to their capability to bridge the abstract and the concrete, rendering abstract processes and concepts tangible and, thus, easier to grasp and work with (e.g., previous research on playful learning with tangible technologies to help children learn abstract concepts [5, 101]).

We explore how the tangible nature of an object can also have value for engaging the parents with the intervention and guiding any emergent parent-child interactions in the following two sections.

**5.3.2 Designing to engage parents with the intervention.** The second level then builds on the child’s experiences with the intervention, to start engaging the parent. While our data are not very clear with regards to the reasons behind some parents’ lack of engagement with the intervention, they clearly show that parental engagement is paramount if the toy is to facilitate supportive emotion socialisation practices. We argue that for parents to engage, the system has to provide value to them—beyond any value it might have for the child—and that needs to be clearly communicated. Therefore, the design should help parents realise what the intervention could do for them, as well as what engagement is required on their part. We further hypothesise that the more parents are able to appropriate the object for their own ‘agenda’, the more they will engage with it. An open question is then how to empower parents to figure out additional ways the object could work for them, while still ensuring the intervention addresses its target outcome.

Data from both interviews and workshops indicate that some parents would tend to forget about the smart toy when it was not in sight. Since it is important that the object is designed to fit with the child’s practices and environment—which might mean it mostly stays in their space—an important open question then is how to design so that parents are reminded of it even when it is not visible to them. One way of doing so could be having an accompanying physical token for the parent which would link to digital intervention content. Work on tangible and ambient systems has shown how physical objects can serve as ongoing ambient

reminders just by being embedded into the user's environment (e.g., [63]), and showcased their potential to be used as portals to the digital space (e.g., see [82] for an application in the context of social and emotional learning in the home).

Participants' reports on the unintended effects having to complete the RCT surveys had for some families (cf. Section 3.2.5) point to another potential design extension to engage parents with the intervention. For example, some parents mentioned that knowing they would have to complete daily surveys made them more attentive to their child's emotions and reactions to emotionally evocative situations. For others, the survey questions served as inspiration for prompts they could use to initiate emotion discussions. This suggests that one potential direction would be developing a similar activity structure around the object to serve as a reminder for parents and aid with engagement. As repeatedly suggested by our workshop participants, this could take the form of consistent reminders and/or prompts to use or refer to the object in their interactions with their child, for example, through a smartphone-based app. In the case of the smart toy, the system could also potentially be extended to detect the child's stress and/or track when and for how long it was used. A visualisation of that data could then be delivered to the parent (e.g., through the app) with accompanying prompts to support them in initiating a dialog about the reasons behind the child's use of the toy, in a similar way to how other systems have employed in-situ cues to support parents during a range of interactions with their children (e.g., [11, 44, 65, 84]). We expect that negotiating the balance between parental engagement while ensuring the intervention remains child-led will likely require more exploration in future work.

**5.3.3 Designing to guide emergent parent-child interactions.** The third level concerns the design of the dyadic, parent-child experience around the object/intervention. While it is necessary to design suitable experiences at the individual level, we argue that technologies aiming to impact or elicit interactions between parents and children should also take into consideration and specifically design for the dyadic experience they aim to generate.

For example, this would involve designing to generate and guide an experience parents and children can have together. Building on the rich body of work within HCI exploring the design and use of storytelling systems for parent-child interactions (cf. [38] for a review), we envision that combining a physical object with a storytelling element could be a feasible way of scaffolding emergent parent-child interactions towards a particular intervention aim. For example, future work around the smart toy could involve designing stories the Purrble character goes through, linked to emotional experiences children might typically encounter at a particular age. The stories could include prompts to encourage parents and children to have a dialog with each other, drawing on emotion coaching techniques, such as validating the child's emotional experiences, labelling emotions, and helping the child problem-solve. Such activities could then be embedded into routines to help with ongoing engagement and reinforcement of skills—an aspect seen as crucial by our workshop participants.

An interesting design challenge—and what we argue should be the ultimate aim of any interventions aiming to shift practices within the family context—would be extending the impact of the

intervention to situations where the object is not available. In the case of the smart toy, future design work could, for example, focus on helping parents and children draw connections between what is happening within the 'Purrble stories' to real situations in the child's life. This could provide a playful and casual way of discussing constructive responses to such situations that the child could then implement in real life. We imagine that the closer the situations are to what is happening for the family, the more engaging the interactions will be. The open question then is how such content might be designed and delivered so that it is customisable enough to fit with the families' needs at any given time, while still being targeted enough to bring about the desired outcome. Drawing inspiration from tangible storytelling systems [10, 96], we suggest that a potential approach could be to combine guided and open-ended storytelling, using a structure similar to that of 'Choose Your Own Adventure' gamebooks—where the reader can make choices that determine the main character's actions—while also allowing for customisation of characters and contexts to enable families to modify the narratives to fit their needs. Importantly, any such work should also take into account the child's developmental stage and how that might impact the interaction with the system, as well as the type and extent of parental scaffolding needed.

## 6 LIMITATIONS

The series of studies reported in this paper serve as a first important step into this intriguing design space. However, several open questions remain that invite follow-up work.

While the interview and workshop data have been promising in terms of showcasing the potential of the smart toy to lead to a wider shift in families' emotion-related practices, the studies reported here did not aim to provide definitive data on the smart toy's impact on parental emotion socialisation practices and other important outcomes, such as children's emotion regulation skills and well-being. More rigorous studies are thus necessary to assess any such effects and their magnitude, as well as to understand the mechanisms through which such effects might arise. For example, as reported in the Findings, it appears that the surveys participants had to complete as part of the RCT also had an unintended impact on emotion-related parent-child interactions for some of the families, and, as such, it is not clear if the smart toy would have generated such impact for these families without the surveys. While this provided an interesting design insight, future deployments would likely need to require less involvement from participants to provide ecologically valid data about the smart toy's appropriation and impact in families.

Furthermore, the data did not fully enable us to examine the reasons for the clear disparity observed among participating families with regards to the smart toy facilitating a wider shift in families' emotion-related practices. While the interview data suggest a number of potential reasons for this disparity, future work should investigate what other factors might contribute to the differences among families, such as parents' existing emotion socialisation practices, underlying beliefs, and motivations, and parents' own emotion-related skills and behaviours. Moreover, while families in the first study had had the smart toy for a longer period compared to previous deployments ([83, 92]), novelty effects might still have

been present, influencing the frequency and nature of families' interactions with and around the toy. As such, future deployment studies should explore how these might change over a longer period and influence any effects observed.

Finally, the lack of data from children, both with regards to the appropriation and impact of the smart toy (Phase 1), as well as in the co-design work exploring additional support layers to generate and scaffold positive emotion-related parent-child interactions (Phase 2) is another limitation of this work that will need to be addressed in future studies. While focusing on parents' and parenting course facilitators' perspectives generated interesting design insights and formed a first step into this design space, future work will need to complement this approach by also involving children both in further iterative co-design development, as well as in evaluating the intervention impact.

## 7 CONCLUSIONS

Parental socialisation of emotion is known to be crucial for child long-term well-being. However, the field so far lacks effective and/or widely available approaches to support parents in adopting supportive emotion socialisation practices. In this paper, we drew on an interview study with parents of young children who had received an embodied, in-situ, intervention for child emotion regulation to explore how it can impact emotion-related parent-child interactions; and on co-design workshops with parents and parenting course facilitators to explore how this could be designed for directly. Our findings showcase the potential of technology to support and scaffold parent-child interactions that can lead to successful parental socialisation of emotion, but also highlight a range of design questions that will to be addressed to make such interventions widely applicable.

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