Unfulfilled Promises of Child Safety and Privacy: Portrayals and Use of Children in Smart Home Marketing

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Smart home technologies are making their way into families. Parents' and children's shared use of smart home technologies has received growing attention in CSCW and related research communities. Families and children are also frequently featured as target audiences in smart home product marketing. However, there is limited knowledge of how exactly children and family interactions are portrayed in smart home product marketing, and to what extent those portrayals align with the actual consideration of children and families in product features and resources for child safety and privacy. We conducted a content analysis of product websites and online resources of 102 smart home products, as these materials constitute a main marketing channel and information source about products for consumers. We found that despite featuring children in smart home marketing, most analyzed product websites did not mention child safety features and lacked sufficient information on how children's data is collected and used. Specifically, our findings highlight misalignments in three aspects: (1) children are depicted as users of smart home products but there are insufficient child-friendly product features; (2) harmonious child-product co-presence is portrayed but potential child safety issues are neglected; and (3) children are shown as the subject of monitoring and datafication but there is limited information on child data collection and use. We discuss how parent-child relationships and parenting may be negatively impacted by such marketing depictions, and we provide design and policy recommendations for better incorporating child safety and privacy considerations into smart home products.

CCS Concepts: • **Social and professional topics → Children**; • **Human-centered computing → Empirical studies in ubiquitous and mobile computing**; *Empirical studies in HCI*; • **Security and privacy** → *Social aspects of security and privacy*.

Additional Key Words and Phrases: Smart home technologies; smart home marketing; child safety; child privacy; parent-child relationships

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1 INTRODUCTION

There has been growing research in CSCW and related fields on families' use of smart home products and the associated benefits and challenges [10, 11, 35, 37, 38, 53, 61, 107, 111, 121]. As families adopt smart home products for purposes of comfort, convenience, security, and entertainment [2, 17, 93, 107], children inevitably become users and data subjects of these technologies [67, 106]. Smart home products such as smart speakers, smart locks, and smart lights can provide great utility and entertainment in children's day-to-day lives [11, 38, 107, 111]. However, products that are primarily intended for adult users (e.g., robot vacuums and monitoring cameras) can also pose physical safety and privacy risks to children, especially when such products are not designed with children's needs and capabilities in mind [111, 121, 126] and when children are viewed as smart home bystanders or incidental users [45, 61, 121]. Indeed, prior work has found safety [111], privacy [68, 124], and usability [11] issues in children's interactions with smart home technologies. There are also pressing calls from recent regulatory efforts about centering children's needs in technology design, such as the UK's Age Appropriate Design Code ("digital products and services, likely to be accessed by children, are appropriate for use by and meet the development needs of children") [84] and California's Age Appropriate Design Code Act ("privacy and safety by design for any digital product or service to account for children's possible access") [80].

In contrast to the smart home issues children encounter, families and children are frequently featured in smart home marketing materials across the web, print, and social media to signal that such products are for household use, including for children. Smart home websites function as a main marketing channel and an official source for families to learn about product functions, quality standards (e.g., UL certification), service policies, and purchase options [63]. Our motivation was to examine how vendors depict children's roles and experiences in the smart home when placing children in their marketing. Doing this allows us to understand whether vendors' narratives of children's and families' smart home experiences—and the norms and expectations these marketing messages set for end-users—(mis)align with research evidence on family smart home interactions. Furthermore, despite the above-mentioned issues child users encounter [22, 68, 111], it is unclear whether smart home vendors actually have product features and resources to address child safety and privacy. As such, we took a qualitative content analysis approach by analyzing products websites of 102 smart home products containing children's images or videos to answer these research questions:

- **RQ1:** How do smart home vendors portray children in their marketing materials?
- **RQ2:** Do the depictions of children in smart home marketing align with vendors' actual communications of product support (e.g., features and resources) for child safety and privacy?

We found that smart home vendors used staged compositions of versatile home spaces, daily activities, and thoughtful storytelling to situate their product use cases around children in family life. Children of different age groups were depicted as active users or passive beneficiaries in various types of smart home experiences. For instance, infants and toddlers were shown as passive beneficiaries of a safe and comfortable smart home environment guarded by thermostats or smoke alarms; they were also used as symbols of family happiness and connection, as well as props to highlight how the product brings convenience to parents. By contrast, young children and teens were frequently featured as active users in entertainment and productivity-related smart home experiences. Children of all ages were consistently depicted as the subjects of monitoring to emphasize how smart home products enhance parental control, protection, and the care of children. Among these depictions, we also found that marketing appeals (e.g., happiness, fear, and control) were frequently used to highlight how smart home products add value to families.

Contrary to websites' depiction of children's harmonious smart home experiences, we found that vendors' communications of product support and data practices regarding child safety and privacy were limited. Parental controls mainly focused on content filtering and screen time without addressing smart home-specific access management—a major tension point parents experience for guiding their children's interaction with smart home technologies [111]. Information related to child safety and privacy was hard to find on product websites and was ambiguously communicated. We identify misalignments in three aspects: (1) children are depicted as active users in smart homes, but there is a lack of child-centered product features, parental controls, and resources; (2) harmonious child-product co-presence is depicted, but potential child safety issues are neglected; and (3) children are depicted as the subject of monitoring and datafication, but there is limited information on how children's data is collected and used.

Our findings contribute to existing research in the fields of CSCW and HCI on family and smart home technologies [10, 35, 53, 61, 111, 121] by demonstrating and characterizing the discrepancy between how children and families are centered in smart home product marketing and the lack of child- and family-centered design and support among these products. We discuss how smart home vendors' marketing portrayals of children may harm parent-child dynamics by perpetuating stereotypical and idealized parenting narratives. We discuss how our findings can inform the design of safe and privacy-protective domestic technologies for families by highlighting concrete design and policy implications: vendors should invest in child-inclusive product designs to address misalignments with their marketing depictions, and regulators should require vendors to provide upfront product information on child safety and privacy.

2 BACKGROUND AND RELATED WORK

2.1 Family and Children in Marketing

Marketing is the process of exploring, creating, and delivering value to meet the needs of a target market [4]. Every message from a company, whether on printed materials, websites, or social media, could be considered part of their marketing [14]. Marketing communications are not just about describing the utilitarian features and values of the products and services; they construct meanings, desired feelings, and emotions such as safety, connection, and peace of mind [42]. Product websites are marketing channels to present a brand's image while demonstrating product features and functions. Regulatory agencies such as the US Federal Trade Commission require marketing information to be "truthful, not misleading, and when appropriate, backed by scientific evidence" [33]. However, product websites are known to use persuasive techniques (e.g., emotional appeals) to create favorable brand attitudes [86, 105].

In particular, "family" is often used in marketing to situate products in everyday contexts [21] and provoke positive meanings based on the viewers' psychological attachments to family relationships [47, 83]. To further signal the feeling of "family" in marketing communications, children are often placed in scenes such as gatherings, meals, and bedtimes [94]. Children are also an important consumer segment and are considered as "three markets in one" [73]: they have pocket money for direct spending, they constitute future markets for many products, and they influence family purchases and buying patterns [60]. Therefore, children appear in product marketing in which they are both the targeted audience (e.g., toys and food) [13, 30] and to symbolize a "precious and enjoyable way of living" (e.g., cars and houses) [3]. However, marketing often depicts "ritualized displays of idealized social relationships" [43] rather than genuine reflections of real life. The marketing portrayal of people can be stereotypical and simplified [3, 43, 90], or even run the risk of being manipulative and exploitative [72].

While prior work studied marketing's impact on children's choice for food [55], clothing [18], and toys [56]; fewer studies have examined the depiction of children in technology-related marketing contexts, even though today's children tend to grow up surrounded by technologies while becoming "prey" for tech companies competing to attract and cultivate brand loyalty [70]. The younger generation influenced by marketing and consumer culture include iPads, smart toys, and Echo Dot kid on their wishlists [50, 81]. Given the influence of product marketing, technologies, and the consumer culture on family and children's lives, it is important to understand how tech companies depict children in their marketing. Our study focuses on smart home products, as the notion of "smart home" inherently relates to families and children, and many smart home products are branded under major tech companies (e.g., Amazon, Google). Our goal is to learn about the narratives that businesses create to market smart home products to families and whether those narratives are supported by considerations for children and families in product design.

2.2 Children and Smart Home Technologies

Smart home technologies encompass sensors, monitors, interfaces, appliances, and devices that provide digital connection, enhanced monitoring and control, and services to the home environment and its occupants [17, 102, 108, 119]. As families adopt various types of smart home technologies for security, convenience, productivity, pleasure, and learning [62, 102, 107], children are inevitably becoming active [11] or passive users of these technologies [39, 121].

A growing body of research in CSCW and related fields has studied families' smart home experiences [53, 61, 107]—how smart home technologies mediate family communications [10, 11], interactions [36, 111, 121], and relationship [35, 37, 38, 100]. For instance, Garg studied families' practices and choices of using smart speakers and found that parents use them as aids for parenting tasks and regulating child behaviors [35]. Geeng et al. found that parents adopted smart door locks for children's easy entry access and for monitoring such entryway activities [39]. Parents in Sun et al.'s study described their children using smart speakers to control lights in bedrooms, motion sensors to aid night-time bathroom needs, and smart doorbells to check who is at the door [111]. Families in Strengers et al.'s study used connected entertainment systems, voice assistants, and smart lighting for entertaining family experiences such as dance parties and "staycations" [107]. Smart home technologies can also enhance learning opportunities, facilitating users' knowledge acquisition, information exchange, and skill development [23, 65, 102].

Despite these benefits, there are safety [111], privacy [22, 68], and usability [11] issues regarding children's interactions with smart home technologies. For instance, parents have reported physical safety incidents (e.g., a robot vacuum running over the child's toes), unsafe situations caused by children's improper device use (e.g., children being able to increase the home's water heater temperature via voice assistant), and children being exposed to unsuitable digital content (e.g., a voice assistant misunderstands child's query and returns inappropriate results) [111]. Smart home technologies pose privacy risks when they capture families' intertwined voice, image, movement, location, and health data [52, 70]. Communication breakdowns often occur between young children and voice assistants due to the children's developing speech and limited understanding of the voice assistant's capabilities [99].

To build upon this prior work on how family experiences are mediated by smart home technologies and how these technologies are situated in family life, our work investigates two key concepts: (1) We analyze how vendors depict and construct smart home experiences of children and families in marketing; doing this allows us to understand whether vendors' depicted narratives (mis)align with existing research on family smart home interactions. (2) We examine how smart home vendors communicate child safety and privacy related information on product websites, especially considering the above-mentioned issues child users encounter [22, 68, 111]. This approach allows us to

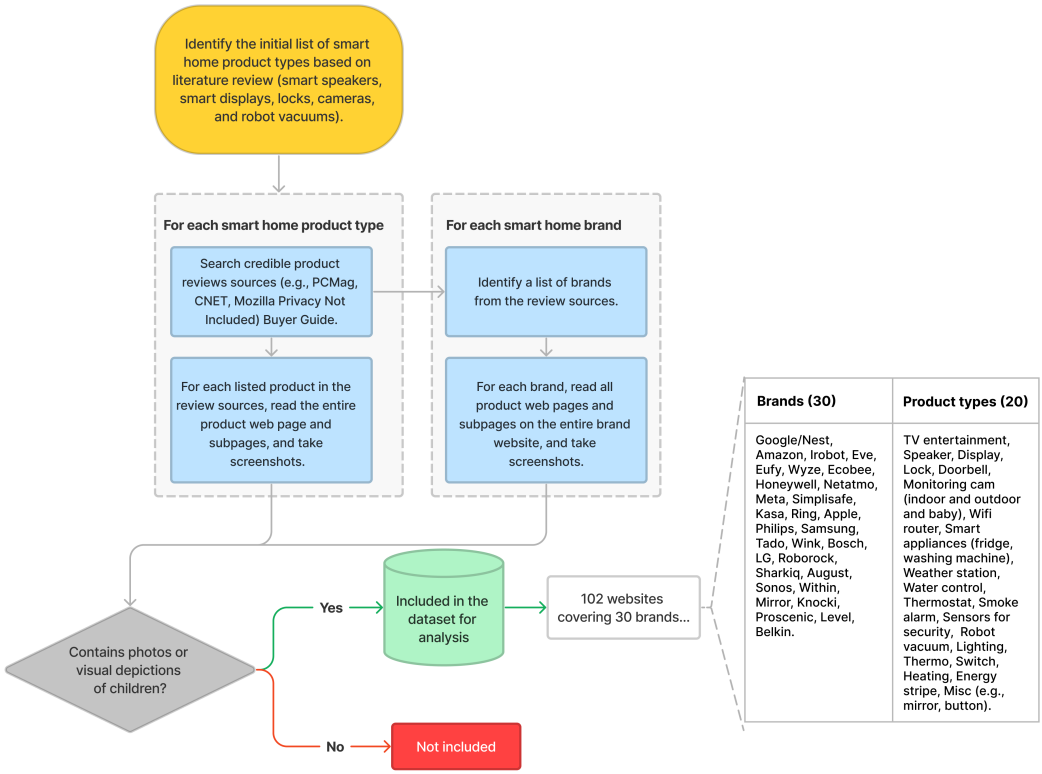


Fig. 1. Our data collection approach and inclusion criteria: First, we identified the initial list of smart home product types based on a literature review (smart speakers, smart displays, locks, cameras, and robot vacuums). Second, for each smart home product type identified, we searched review sources to locate product brands. Third, we reviewed the smart home brands and product webpages. Then, we included product pages that contain visual depictions of children in our data set.

assess to what extent the portrayals of children in smart home marketing match vendors' actual considerations of child and family interactions in product design, or whether vendors are merely appropriating idealized depictions of children's interactions with smart home products—potentially misleading families about their products' suitability for children.

3 METHOD

We conducted a content analysis of product websites of 102 smart home products containing images or videos of children. Content analysis is a common observational method to evaluate how different kinds of content are communicated [57]. The method has been widely used in HCI research in a variety of contexts, such as e-commerce website features that encourage impulse buying [79], misleading claims in VPN ads [1], and consumer-facing data breach notifications [128]. From September 2021 to April 2022, we used several complementary approaches to collect and sample a variety of smart home product websites, as shown in Figure 1.

3.1 Data Collection and Sampling

We started our searches with identifying the types of smart home products used by families with children based on prior research [45, 107, 111]; examples include smart speakers, displays, locks, cameras, and robot vacuums. We excluded "smart" toys or other internet-connected devices that are used by children individually but are not integrated into rooms or spaces in the home. For each product type, we then looked through credible tech product review sources (e.g., NYTimes, CNET, and PCMag) for ratings and rankings to identify specific brands and products. We used these rankings to create a list of a broad set of relevant products that are sufficiently popular or prominent to be included, as professional product reviews are known to influence consumers' purchase behaviors [44, 66, 92]. We also referred to Mozilla's "Privacy Not Included buyer's guide"[1] as another credible source, which contains reviews of 52 smart home products focusing on safety and privacy aspects.

We also performed complementary searches along the line of product brands. For each brand mentioned in product reviews, we browsed through all the smart home products from that same brand to identify if any of the brand's other products also had child-related marketing content. For instance, when looking at a ranking of smart displays, we identified displays from Amazon, Google, and Meta all had child-related marketing content on their product websites; we then looked at the websites of all other smart home products from those brands to expand our search.

For each product website identified in the initial searches, we only included it in our dataset if it had any images or videos depicting children. This is because our analysis focused on *how* children and their smart home experiences are depicted in smart home marketing and *whether* those portrayals are indicative of children being considered in product design and support, rather than on attempting to quantify how often children appear in smart home marketing.

Sample. Throughout our data collection, we looked at the websites of over 700 smart home products, and identified 102 product websites that included depictions of children from 30 vendors across 20 product categories. Among the 102 websites, 87 had children-related images, 35 had videos containing children, and 27 websites had both images and video of children. A full list of our dataset is available online.[2]

3.2 Data Analysis

We used both inductive and deductive coding approaches [87, 97] to create analytical memos while annotating product websites in our dataset. As themes emerged from our initial memoing, the first author drafted a codebook and refined it by going through the entire dataset, while iteratively revising the themes/codes and discussing them with the research team. The first two authors then conducted rounds of independent coding to refine the codebook further. The first author then coded the entire dataset. We did not calculate inter-rater reliability as the whole research team had been closely involved in developing and refining the codebook [71].

Our final codebook (see Appendix A) contains codes in three high-level categories, with the premise that child-related marketing images, videos, or texts are included in the website: (1) the presentation and functions of the smart home product in relation to children, (2) children's depicted smart home interactions and experiences, and (3) communication of child safety and privacy related features and information.

The first category captures the product features, control functions, and placement in the home environment based on the website's depiction. For instance, we adapted insights from Strengers et al. [107] into codes to capture three types of smart home experiences: (1) *protection*, i.e., "care and

[1] https://foundation.mozilla.org/en/privacynotincluded/
[2] https://osf.io/nyjrx/?view_only=7912cabc2ef7477a9daba65309f026de

surveillance" of the home property and residents for safety, security, and health; (2) *productivity*, i.e., how smart home technologies help families save time and reduce the mental or physical effort in daily tasks; and (3) *pleasure*, i.e., fun and entertaining activities. In this way, we identified if and how children are depicted relating to certain types of smart home experiences, use cases, and products.

The second category's codes were created using a bottom-up approach through analytical memoing. The codes cover how smart home marketing materials depict children's characteristics (e.g., age, expression, and developmental difference), smart home use cases and scenarios (e.g., direct interactions vs. no interactions), and the presence of other people (e.g., independent use vs. co-use). We aimed to understand how children of different age groups might be portrayed as having different levels of interactions with the product.

The third category aims to reveal whether there are (mis)alignments between the depictions of children in smart home marketing and respective child, safety, and privacy features offered by products. We adapted findings from Sun et al. [111] into codes regarding the communication of child-specific smart home features (e.g., child-specific content and child locks), parental controls, safety instructions, and information addressing child privacy and data collection.

We thoroughly reviewed the vendor's website for each smart home product in our sample, including main product pages, product support subpages, linked resources, and privacy policies. We searched for keywords like "parental control," "child safety," and "child privacy" on every page to find relevant content. We then analyzed (mis)alignments between child depictions and child safety & privacy information, considering factors such as the inclusion of child safety and privacy features on product websites, the ease of locating this information, and the level of details provided. We further triangulated our findings with prior research on child safety and privacy in smart homes to identify misalignments.

3.3 Limitations

First, the marketing depiction of children is likely to exist in other smart home products and brands not represented in our sample. While we did not aim to provide an exhaustive catalog of all smart home marketing experiences, we assessed the depictions of children in a diverse range of smart home products selected through multiple complementary approaches (see Figure 1). Therefore, we are confident that our sample provides reasonable insights into how children are portrayed in smart home marketing of popular products. Relatedly, our sample focused on English-language (US) product websites. Future work could investigate cross-cultural differences in smart home marketing, taking other languages and regions into account.

Second, product websites were chosen as the focus of our analysis as they are relevant official sources for consumers to gather product-related information and service policies; they also serve as the online presence of brands to facilitate purchases [31]. Other channels such as third-party sellers (e.g., Best Buy and Target), TV commercials, and social media platforms may also contain content depicting children's smart home experiences. However, consumers may still visit the official websites even if they initially learned about the products through other channels.

Third, information regarding child safety and privacy might be found in places like terms of use or privacy policies, although studies have shown that consumers skip such policies [77, 82, 114]. Given our aim to identify and characterize general themes in the depiction of children and families in smart home marketing, we did not conduct technical analyses of products or companion apps—such analyses would have been impractical for the size of our diverse sample of products. While it is possible that smart home product websites do not communicate all product information and features related to child safety and privacy, some vendors in our sample did list such information on

their websites. Future research could complement our findings with technical analysis of individual smart home products.

Fourth, while we used marketing materials as our main data source, our analysis may not fully capture marketers' business goals, target markets, and consumer segments. Relatedly, we cannot determine how families would perceive or respond to smart home marketing materials. Our findings can guide future user studies to examine the effect of depicting children in smart home marketing on families' perceptions and product adoption.

4 RQ1 FINDINGS: DEPICTION OF CHILDREN'S SMART HOME INTERACTIONS AND EXPERIENCES

In this section, we first describe composition elements in child-related marketing depictions—such as common home settings, activities, and use cases—to characterize the depicted smart home contexts (see Section 4.1). We then present how children of different age groups were portrayed interacting with various smart home products differently (see Section 4.2). We also identified relevant marketing and emotional appeals used in text and images to convey product values (see Section 4.3).

4.1 Composition and Storytelling

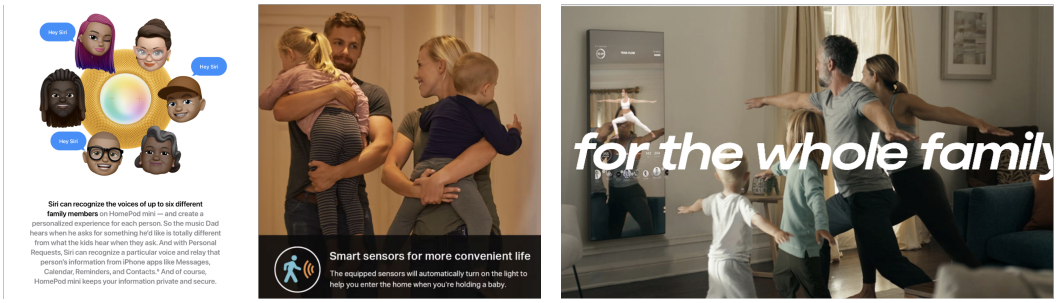
Composition is the art of arranging objects relatively in a frame [85]. Storytelling aims to create emotional connections between the brand or product and consumers, generating consumer engagement and positive behaviors [49, 91]. To contextualize our findings, we identified composing elements in product marketing materials that contained children. We found that physical home spaces typically served as settings for smart home products; the products were subtly placed in family routines and activities rather than being prominently featured. The accompanying textual descriptions for the images mentioned child-related words to situate the product use cases around children's daily lives.

4.1.1 Home spaces as the setting. Since smart homes are inherently connected with the concept of home, we found that the physical "home" is typically used to stage smart home products. Different rooms and spaces at home enable specific actions and behaviors for children and families, and they provide the context for smart home-related interactions, events, and experiences. We identified private versus shared home spaces based on whether and how children were depicted sharing the spaces with other family members.

- *Private spaces for kids: bedrooms and playrooms.* From an infant nursery with a crib to a playroom decorated with toys, these spaces tended to be filled with elements of playfulness and fun to support kids' alone time.
- *Indoor shared spaces: kitchens and living rooms.* Children were depicted spending time with families in these spaces for meal preparation, social activities, conversations, and entertainment.
- *Transient shared spaces: front doors and entryways.* Children entering or leaving home pass through such spaces.
- *Outdoor spaces: yards around the house.* Children played and interacted with friends or families in such spaces.

4.1.2 Common depicted activities. We observed four types of depicted family routines and activities in which children's direct interaction or ambient co-presence with the products were featured.

- *Play.* A common activity in which children were depicted, including physical play (e.g., running around, playing sports, and using play sets), solitary play (e.g., playing with toys,



(a) (b) (c)

Fig. 2. Examples of children and family-related concepts: (a) Apple HomePod Mini recognizes different voices so that "the music Dad hears when he asks is totally different from what the kids would hear when they ask;" (b) Kasa smart light switch will "automatically turn on the light to help you when you are holding a baby;" (c) Mirror smart gym display is "for the whole family."

coloring, and reading), social play (involving interactions with other people), and indoor or outdoor play. Different types of play are often combined, for instance, playing soccer in the backyard combines physical and social play.

- *Families spending time together.* Unlike the play theme that emphasized children having fun, this theme tended to highlight the "togetherness" among family members (e.g., eating, watching TV, and casually hanging out together). Children might still be shown playing with toys near their parents, but the main message from the depiction is more about family time and less about children's own play.
- *Bedtime activities.* Examples include parents telling bedtime stories, parents dimming or turning off the lights, and children falling or being asleep. Alongside the children's actions, the objects and environment (e.g., pajamas, teddy bears, and soft lighting) created a bedtime atmosphere.
- *Hallway activities.* Examples include putting on or taking off shoes, opening or closing the door, ringing the doorbell, and hopping on the front door steps. Supporting objects such as backpacks, take-out food, and toys were used to indicate the transient moment.

4.1.3 Children and family-related concepts. Besides children-related imagery, we also found three types of textual descriptions that expressed child-related concepts: (1) explicitly highlighting children's direct use (see Figure 2a); (2) signaling product benefits to parents (see Figure 2b); and (3) indicating the inclusion of children by using "everyone" or "whole family" (see Figure 2c). These examples show how text complemented the images by conveying child-related smart home use cases to highlight the product's relevance to children.

4.2 Children's Age-Oriented Levels of Interactions with Smart Home Technologies

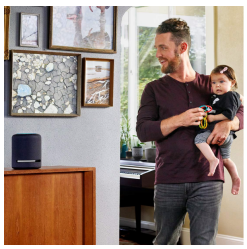
We found that children of different age groups were shown interacting with different types of smart home products at various levels. We identified three age groups: infants and toddlers, young children, and preteens and teens. We further identified three levels of interactions: direct interaction, co-presence without interaction, and children as subjects of the products. Next, we discuss the age-oriented levels of interactions supported by other aspects, as shown in Table 1, where relevant.

4.2.1 Infants and toddlers: co-presence with products. Babies are often placed in commercials to elicit viewers' positive reactions [89]. In our sample, 31% of the 102 websites contained visuals of

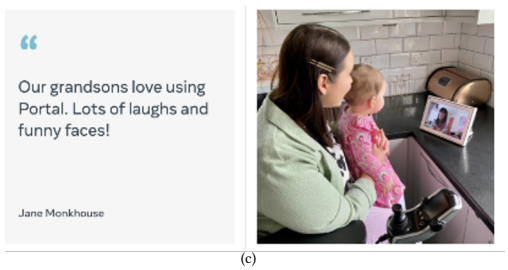
Table 1. Key findings of children's age-oriented interactions. Each age group is represented by colored-sections respectively: green (infants), blue (young), yellow (teen), and red (all). For each age group we distinguish between direct interaction/use (left column) and co-presence with the technology without interaction (right column).

Age groups	Infants		Young		Teen		All age groups
Level of interactions	Direct interaction/use	Co-presence without interaction	Direct interaction/use	Co-presence without interaction	Direct interaction/use	Co-presence without interaction	Being used on (by cameras)
Relating smart home experiences	Communication, entertainment	Protection, comfort, productivity	Communication, entertainment, convenience	Protection, comfort, productivity	Communication, entertainment, convenience, protection	Protection, comfort	Protection
Roles children play in the depiction	Device users	1. Beneficiaries of the product 2. Symbolize family connection and happiness 3. Occupy parents as props	Device users	1. Beneficiaries of the product 2. Symbolize family connection and happiness	Device users	1. Beneficiaries of the product	Subject of monitoring and control
Adult presence	Always adult presence	Sometimes adult presence	Sometimes adult presence		Sometimes adult presence		Mostly no adult presence
Home spaces	Shared	Private and shared	Private and shared		Shared		1. Infants being monitored in private spaces. 2. Teens being monitored in shared spaces.
Primary beneficiary of the product	Children and parents	Everyone in the family	Children	Everyone in the family	Children	Everyone in the family	Parents

(a)



(b)



(c)

Fig. 3. Examples of infants and toddlers next to smart home products: (a) A baby playing with their caregiver in a comfortable environment, the temperature controlled by Amazon smart thermostat; (b) A parent occupied with a baby while interacting with an Amazon Echo smart speaker; (c) A toddler involved in family conversations via a Meta Portal display.

babies. As the youngest group with developing mobility and motor skills, they were rarely depicted to have active or direct interactions with smart home products. Instead, they tended to play three key roles while mostly being portrayed as co-present with smart home products.

First, as shown in Figure 3a, they were portrayed as beneficiaries of products that featured protection and health-related concepts (e.g., thermostats, smoke alarms, and weather stations): children's safety and well-being were depicted to be enhanced with these products. Second, infants and toddlers were included to symbolize family happiness and togetherness while they enjoy smart home benefits (e.g., easy controls as shown in Figure 5f). Third, as shown in Figure 3b, infants and toddlers were featured to highlight how smart home products enhance convenience when

Fig. 4. Examples of young children directly interacting with smart home products: (a) A child consuming fun content on an Amazon Echo display; (b) A group of children enjoying a family movie night using Google Chromecast; (c) A child talking to parents via a Netatmo monitoring camera; (d) Two children about to use the Level smart lock; (e) A child giving commands to an Apple Homepod Mini speaker; (f) Two children misusing an Eve smart water meter to play pranks on their mom by "stealing" mom's phone to turn on the water spray.

adults were occupied with child-rearing responsibilities. In very few cases, e.g., Figure 3c, infant and toddlers could be considered as users of products that support communications.

4.2.2 Young children: level of interaction varied by product. Young children were depicted in 78% of the websites in our sample. Contrasting to infants and toddlers who were barely depicted interacting with smart home products, young children were shown using the product (e.g., smart speakers, displays, and TV entertainment systems) in 24% of the analyzed websites; the purpose was for pleasure (see Figure 4a-b), convenience (see Figure 4c), and learning. In addition, devices such as smart doorbells and locks were shown as helping children access the entryway (see Figure 4d). Such findings align with prior work on young children being users of smart home technologies for living, learning, and playing [10, 111, 125]. While young children's direct interactions with products were often under adult supervision in shared home spaces, an exception is Apple demonstrating a smart speaker placed in the kid's room for potential unsupervised use in a private space (see Figure 4e). Another case (see Figure 4f) showed children playing pranks using the product, indicating how children might misuse smart home products in real life. In contrast, young children were rarely depicted interacting with devices featuring protection and health-related experiences. In 16% of all websites, young children shared presence with these products as the beneficiaries while playing without parents—in the safe and comfortable environment enabled by thermostats, smoke alarms, and lighting (see Figure 5a-c).

While most child-device co-presence scenes occurred in shared spaces at home or with adult supervision, an interesting outlier is robot vacuums. Since robot vacuums can move around the house, they appeared next to a sleeping child (see Figure 5d), a playing child (see Figure 5e), or a child spending time with parents (see Figure 5f). These depictions indicate that children could directly benefit from a clean home environment or indirectly benefit from spending time with parents who are relieved of such cleaning chores. In reality, robot vacuums are hardly a product for children, and prior research has found that parents have safety concerns about children being around robot vacuums [111]. However, the marketing depictions in our sample indicate the risk-free operation of robot vacuums around young children.

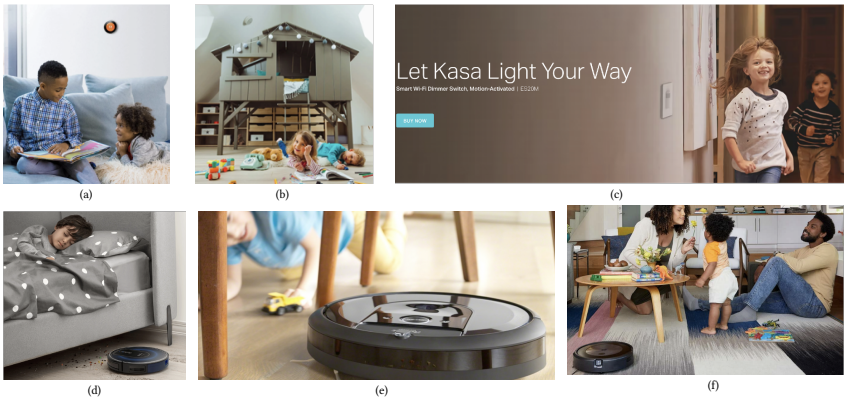


Fig. 5. Examples of young children co-present with smart home products: (a) Children reading in a comfortable environment supported by a Nest smart thermostat; (b) Children playing while being protected by a Netatmo smart smoke alarm; (c) Children running in the hallway, activating Kasa smart lights; (d) A child sleeping next to a RoboVac vacuum; (e) A child playing next to an iRobot vacuum; (f) A child standing next to a Roomba vacuum.

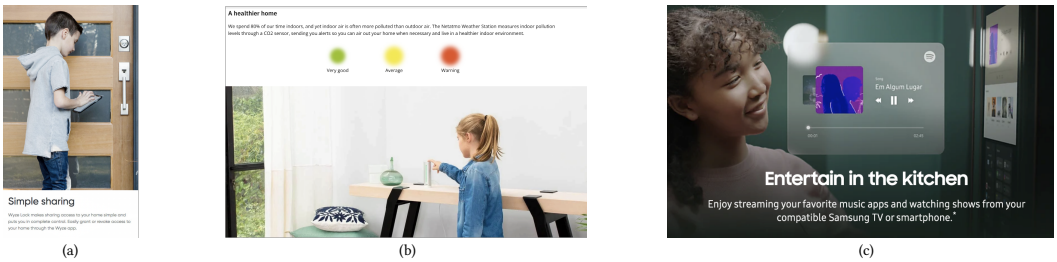
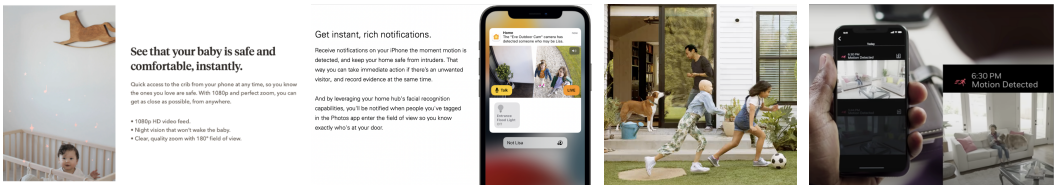


Fig. 6. Examples of preteens and teenagers interacting with smart home products: (a) A preteen unlocking a Wyze smart lock via a phone; (b) A teen checking air quality via a Netatmo weather station; (c) A teen selecting a song on a Samsung smart fridge's display.

4.2.3 Preteens and teenagers: more direct use. Pre-teens and teenagers appeared in 22% of the websites and were portrayed using more types of smart home products more independently than the younger groups. The examples in Figure 6a-c showed how they access and use smart home devices. Such depictions align with what teenagers might be capable of in reality as they go through adolescence and develop autonomy [127]. The depiction of teenagers' autonomy is also consistent with prior work on teenagers' need for more decision-making agency and device controls in smart homes, such as being able to change room temperature as needed [29].

4.2.4 Children of all ages as subjects of monitoring. 25% of the 102 websites depicted children being monitored in various contexts via camera products. Adults, rather than children, were the primary beneficiaries of such monitoring. Such depiction aligns with prior work that found parents tend to use cameras to keep an eye on children [45]. In 6% of the websites, infants and toddlers were depicted being monitored via cameras while they were alone sleeping, playing, or crying in the nursery (see Figure 7a). In contrast, 20% of the websites showed young children being monitored when playing in the bedroom (see Figure 7b), eating in the kitchen, hanging out in the living room, or coming home from outside.



(a) (b) (c) (d)

Fig. 7. Children of all ages as subjects of monitoring: (a) A toddler in a nursery (Ecobee); (b) Young children being monitored at the door (Eve); (c) Teens being monitored while playing soccer (Nest); (d) A live feed on an adult's phone monitoring a teen at home (Honeywell).

In comparison, preteens and teenagers were not shown as the subject of monitoring in their private spaces at home. Instead, 4% of the websites captured them hanging out in living rooms or coming through the entryway (see Figure 7c-d). Such depictions of teenagers being monitored are inconsistent with prior work that shows how teenagers struggle to maintain privacy at home when parents' goals conflict with teenagers' needs [113].

4.3 Marketing and Emotional Appeals

Marketing appeals are communication and persuasive strategies that grab attention, speak to individuals' desires, and provoke emotional responses [15]. We found three types of appeals in child-related depictions. First, happiness appeals encouraged families to long for the product and imagine use cases. Second, fear appeals sought to present problems that parents could relate to. Both are emotional appeals that could trigger consumers' emotions [96] to affect their information processing [7], attitudes toward the marketing content [9], and purchase decisions [34]. Finally, control appeals were used to sell the core benefits of smart home products. Altogether, these appeals strive to make consumers identify with the products and recognize their value. We discuss the implications of these appeals in more detail.

4.3.1 Happiness appeals. Happiness refers to "a state of well-being and contentment; a pleasurable or satisfying experience" [104]. In a high arousal state, happiness could mean excitement or enthusiasm; in a low arousal state, happiness could mean peacefulness or calm [8, 78]. We found both states of happiness in children's direct interactions and co-presence with products. The excitement and fun side of happiness tended to be depicted through children's activities that involved using the product (see Figure 8a). By contrast, the peaceful and calm side of happiness was demonstrated by highlighting the "togetherness" of families who are being cared for and protected by smart home products (see Figure 8b). The happiness appeal showed the sense of harmonious family life with value added by the smart home products.

4.3.2 Fear appeals. Marketers often invoke consumers' fear and anxiety by communicating potential negative consequences that might arise without the product [103, 118]. Scenarios that tap into parents' concerns center on children's safety and well-being [32]. We found that some websites either directly depicted children in distress or described hypothetical situations that appealed to parents' fears to introduce the product as the solution. These depictions tended to feature infants and young children when they were shown co-present with the products (see Figure 8c-e).

4.3.3 Control appeals. Control is a prominent benefit of smart homes as it promises the convenience of managing multiple devices [20, 102] and enhanced productivity for living, multi-tasking, and daily tasks [107]. Building on such definitions of control, we found that control was communicated

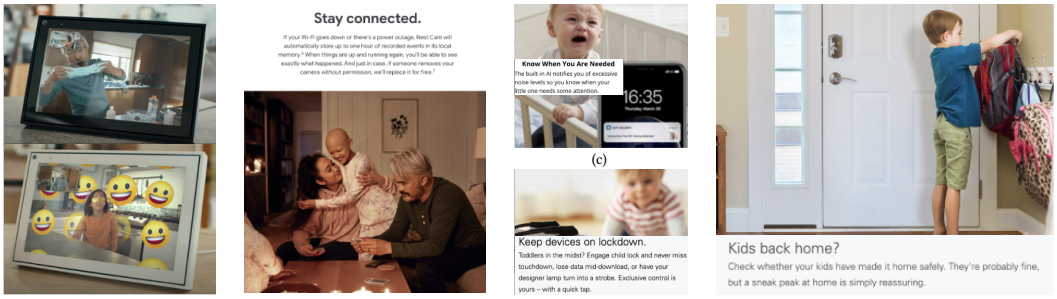


Fig. 8. Examples of happiness and fear appeals: (a) A fun child-grandparent moment for shared-cooking with AR filters (Meta display); (b) A harmonious family time (Google Nest Camera); (c) A crying toddler (Eufy camera), with nearby texts explaining that the camera's AI feature could detect "when your little one needs your attention;" (d) A baby approaching a power strip (Eve energy strip), with the text "Toddler in the midst" to introduce the power strip's lockdown feature; (e) A child hanging a backpack near the front door (Eve camera), with the text "Kids back home? Check whether your kids have made it home safely."

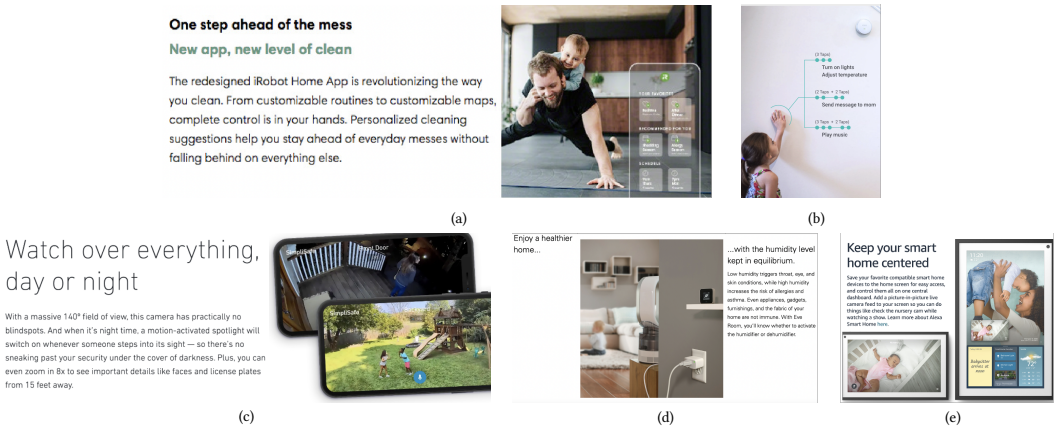


Fig. 9. Examples of control appeals: (a) A man carrying a baby (iRobot), with text "from customized routines to customizable maps, complete control is in your hand." (b) A child using a smart controller (Knocki), with text "transfer walls into powerful control interfaces so that your favorite tasks are always within reach." (c) A live view of children playing in the yard (Simplisafe camera), with text "watch over everything, day or night." (d) An air quality monitor (Eve) near a baby; (e) An Amazon Echo Show highlighted "keep you smart home centered" so that the user could "check the nursery cam while watching a show."

as an appeal (1) to support functional controls of devices, the home environment, and tasks, enabling convenience and ease; and (2) to achieve a sense of "control your life"—which is built on functional controls and accomplished by staying informed of what is happening at home and to your children, a manifestation of "protection and care" of the family. The two aspects of the control appeal jointly facilitate a sense of assurance and peace of mind.

When the control appeal primarily conveyed the functional management of smart home devices, children were rarely shown as the ones exercising control. Instead, children were depicted to symbolize a busy family life—they were placed as props next to smart home devices, phone app interfaces, or voice commands to demonstrate how adults could multi-task with the product (see

Figure 9a). Only in a few cases were children shown as the main user controlling the devices, e.g., operating doors (see Figure 6a) and accomplishing tasks via a smart controller (see Figure 9b). Such examples appealed to both children's drive for some control and parents' interests in involving children in the smart home.

In contrast, the global sense of "control your life" was conveyed as parents staying informed of children's activities and about the physical environment at home. Such global control over the sometimes unpredictable experience of childrearing was demonstrated by monitoring children's activities via active check-ins or passive notifications (see Figure 7). The active and pervasive monitoring of children implies the appeal to have instant access across time or space (see Figure 9c), whereas passive notifications demonstrate how the device provides timely information and keeps parents in control while otherwise enabling them to disengage and relax (see Figure 8c). Moreover, a few websites emphasized control at both levels while promising parent relaxation and entertainment (see Figure 9e). These depictions of constant monitoring and notification-driven parental responsiveness appeal to the dominant Western ideology of intensive parenting [98].

In summary, the marketing and emotional appeals tied back to the depictions of children discussed in Sections 4.1 and 4.2. Smart home marketers used staged and versatile home spaces and daily activities to situate the products around children in family life. Young children and teenagers played more active user roles in pleasure and productivity-related smart home experiences. In contrast, infants and toddlers were dominantly depicted as beneficiaries of protection-related products, symbolizing happy families and serving as props to occupy parents. Children of all three age groups were consistently depicted as the subjects of monitoring to symbolize parental control, protection, and the care of children. Such depictions, along with the marketing and emotional appeals, are likely meant to make consumers identify the product with values important to them and their families such as happiness, protection, and peace of mind.

5 RQ2 FINDINGS: VENDORS' COMMUNICATION OF PRODUCT SUPPORT FOR CHILD SAFETY AND PRIVACY

Our findings in Section 4 showed that children are depicted in smart home marketing as directly interacting with or being physically around smart home products, and are portrayed as the "everyone" in the family. To understand whether the constructed depictions of children's harmonious smart home experiences are actually reflected in product design and support for children, we analyzed each vendor's websites (including product main page, sub and support pages, linked resources, and privacy policies as described in Section 3.2) to understand how they address child safety and privacy along three aspects: (1) descriptions of product features that support child safety and privacy (see Section 5.1), (2) descriptions of parental controls (see Section 5.2), and (3) information on child safety and privacy (see Section 5.3).

5.1 Scant Child Safety and Privacy Product Features

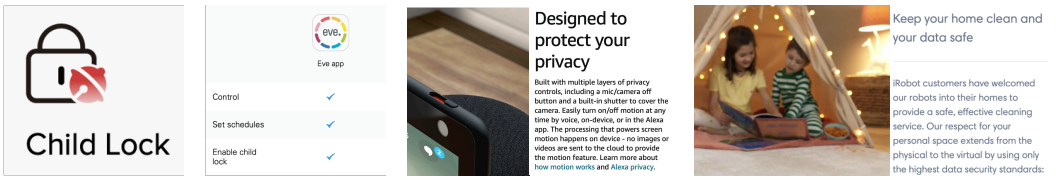
Since all product websites in our sample depicted children using or being around smart home products, we expected some consideration and acknowledgment of children in product features. Surprisingly, only a few product websites explicitly highlighted safety or privacy-protective features such as *child safety locks*, *privacy shutter switches*, and *guest/household mode*; 93% of the websites in our sample did not describe *any* built-in product design features addressing child safety or privacy.

More specifically, only two products in our sample offered a child safety lock feature, though the communication was minimal: one appeared as an icon (see Figure 10a); the other is on an app interface (see Figure 10b). In both cases, there was no further information on whether the child lock is a physical or digital feature and how it works. The two privacy-protective features we found were also not child-specific. One is the privacy shutter switch that only exists on some smart

speakers and displays (Meta Portal, Google Nest Hub 2nd Gen, Amazon Echo Show 5 and 10, and Amazon Glow) as a physical switch to turn off the camera or microphone (Figure 10c). The other is "guest mode" (on a few Google smart speakers and displays) or "household mode" (on Meta Portal display) which facilitates device sharing while considering personal data privacy. In particular, Meta recommended turning on the "household mode" for children's safe use of their product [76], although this mode is not exclusively designed for children.

5.2 Limited Parental Controls

Parental controls are technical solutions to help parents manage children's online activities and protect children from risks and harms [123]. We found that only a few smart home products (mostly smart displays and speakers) from three vendors (Apple, Google, and Amazon) provided parental control features for restricting children's media content access and screen time. Importantly, no provided parental control appeared to specifically target the smart home context, e.g., supporting parents in managing how children could access or control home automation experiences, even though this has been a major concern for parents [111]. For instance, Apple's marketing of the Homepod Mini showed the device being placed and used in a kid's bedroom (see Figure 4e), yet the product pages did not provide instructions on how parents could manage or limit children's Homepod use to control other smart home automation (e.g., limit control over smart lights to the kid's bedroom but not parents' or siblings' rooms). Although Apple has parental controls for iOS and macOS, these controls are not available for Apple's smart home products such as Homepod Mini.



(a) (b) (c) (d)

Fig. 10. Examples of child safety and privacy information on smart home product websites: (a) Roborock S7 robot vacuum showed a child safety lock symbol; (b) Eve listed the child lock control option for the Eve app for two different products: the smart water controller and the smart power strip; (c) Amazon Echo Show 5 provided a physical switch to turn off the camera and microphone; (d) iRobot showed two children playing happily in a tent, while the text said "keep your home clean and your data safe."

5.3 Insufficient and Ambiguous Child Safety and Privacy Information

We also assessed whether and how vendors conveyed child safety and privacy information on the websites to examine if the advertised child smart home involvement is accompanied with relevant safety and privacy instructions.

5.3.1 Information about child physical safety. Our findings revealed that 65% of the 102 product websites did not provide any product safety information. Among the 35% of websites that mentioned safety, the most relevant child-specific safety information was regarding physical safety, i.e., any unreasonable risk of injuries or harms if appropriate safety controls and monitoring are not in place [16, 27]. Only five products from two brands included product safety disclaimers specifically addressing safety risks to children. However, such information was placed in less noticeable locations. For instance, the Meta portal display webpage portrayed several children use cases while

disclaimers about electrical safety, children's use, and choking hazards was located in separate tabs under "Portal Health and Safety Info" at the footer [75].

5.3.2 Information about children's data safety and privacy. Prior work has found that tech companies often conflate data safety with privacy [115]. Among the 30 brands in our sample, we found six communicated safety in the context of data and information safety, a synonym for privacy; 12 brands mentioned privacy as a product value proposition, but they rarely specified practices around children's data. Figure 10d shows an example by iRobot that mentioned data safety—"keep your home clean and your data safe." Similarly, the Eufy doorbell webpage showed children on camera with the text "local storage ensures you are safe from hackers and data leaks." Although such data safety statements were not directly referring to children, they are relevant to children considering that their data might be captured inevitably.

As for data privacy, existing work has found that smart home products' privacy policies can be hard to find and lack contextual privacy implications of the data collected by the specific smart home devices [69]. Very few websites in our sample included a product-specific privacy policy, and almost no vendor presented information about children's data safety and privacy on its product pages. Instead, 50% of the 30 smart home vendors in our sample briefly mentioned children in their general privacy policies, but only to claim that their product is not meant to be used by children. For example, one vendor claimed, *"[vendor/product names] are not directed to children under the age of 13 (or 16). We do not knowingly collect personal information from individuals under the age of 13"*—despite the use of children in the marketing materials for their products. Six vendors clarified that if children's data were ever collected, they would delete the data once informed. This indicates a concerning disconnect between these products being presented as family products deployed in home contexts likely used by children versus a deflection of responsibility for children's data privacy in legally required privacy disclosures. Only three vendors (Amazon, Apple, and Google) provided dedicated resources addressing child data collection, but even these resources were not all specific to smart home products despite their respective services offering the creation of child accounts.

Overall, we found that (1) very few websites showed product features addressing child safety and privacy; (2) parental controls were limited and mainly focused on content filtering and screen time without addressing smart home-specific access management; and (3) there was scant and ambiguous information about child safety and data privacy specific to smart homes, as well as a deflection of responsibility for children's data despite the use of children in product marketing.

6 DISCUSSION

Our findings show that vendors' depictions of harmonious child experiences in smart homes are to a large extent unfulfilled promises, given the lack of product features and information supporting children's smart home safety and privacy. Next, we summarize the main misalignments that emerge from a cross-section analysis of our findings presented in Sections 4 and 5, and in relation to prior work. We then discuss the marketing portrayal's potential impact on parent-child relationships and implications for smart home product design and public policy.

6.1 Misalignments Between Marketing Depictions and Product Realities

Building on prior work on children's safety [111], privacy [68, 113, 124], and usability [11] needs in the smart home, our findings revealed three major mislangiments: (1) children are depicted as users in marketing but products have inadequate child-centered product features and parental controls; (2) marketing materials depict harmonious child-product co-presence despite unaddressed potential child safety issues with products; and (3) children are depicted as the subject of monitoring and

datafication by products in marketing but there is limited information on child data collection and use practices.

6.1.1 Children depicted as users vs. inadequate product support. Sections 4.2.2 and 4.2.3 showed that young children and teens were depicted as direct users, sometimes without adult supervision, for smart home products such as smart displays (for communication and entertainment), smart locks and doorbells (for convenience), weather stations (for health and environment monitoring), and smart water meters (play pranks). Such depictions of children's smart home experiences align with findings in prior research: even young children want control over smart home experiences related to them, such as using voice assistants to control bedroom lights or checking who is at the door via smart doorbells [26, 95, 111]. In comparison, our findings in Section 5 indicate a lack of supporting product features and information for children's use, even for products that are highly relevant to children's smart home experiences (e.g., smart speakers and lights in the kid's room). While parental controls can be a general product feature designed for children's online safety, we observed a general lack of *smart home-specific* parental controls that help parents configure and guide children's smart home experiences. This contrasts with parents' desires for granular parental controls that support child smart home experiences identified in prior work (e.g., kids should only be able to control lights in their own bedroom and adjust the temperature within a safe range) [111]. Vendors appropriate children and family life in their marketing materials but appear to neither adequately consider children in their product design nor provide sufficient information on how parents can manage children's use.

6.1.2 Depicted harmonious child-product co-presence vs. potential child safety issues. Our findings in Section 4.2.1 showed that infants and young children were often shown co-present with smart home products as beneficiaries, or as a way to symbolize "family." However, such depictions conflict with prior research that identified usability, privacy, and safety issues in children's smart home experiences [11, 52, 111]. For instance, the depiction of a robot vacuum cleaning around a sleeping or playing child (see Figure 5d-f) suggests that such product use around young children is safe, whereas prior work has found that children have been injured or scared by robot vacuums [28, 111]. The emphasis on harmonious child-product co-presence in marketing—in conjunction with the finding that smart home products generally lack child safety considerations—misrepresents the safety risks children might face around these devices at home. Furthermore, with the limited information on child safety, parents are inadequately supported to understand potential risks and how to deploy smart home products safely in an environment shared with children.

Notably, our analysis indicates that some vendors were aware of potential safety issues when children encounter their products and would sometimes highlight respective safety measures in their product marketing and information. For example, Eve depicted a toddler approaching the power strip to showcase their "child lock" product feature (see Figure 8d). In another example also by Eve, children were shown using a parent's phone to control a smart water meter and play pranks (see Figure 4f)—a potential safety hazard. However, in most cases, vendors' likely awareness of potential child safety issues did not appear to translate into actual product support. Our findings in Section 5 show that very few products have child safety features or sufficient safety-related information.

6.1.3 Children as subjects of datafication vs. nontransparent communication about data practices. As smart home devices become embedded in family lives—and thus children's lives—children inevitably become the subjects of constant monitoring and data collection by smart home technologies [46]. This point is supported by many of our analyzed products, for example, families sharing a smart

lock; scheduled off-time for smart lights in children's bedrooms; and Alexa built into many non-Amazon products (e.g., Samsung smart fridge) that collect children's voice data. Prior work has shown that parents worry about smart home devices' excessive data collection and vendors' lack of transparency [68, 111]. Our findings in Section 5 revealed that most smart home vendors fail to provide clear and adequate information about the collection and usage of child-related data. Despite the use of children in their product marketing, many vendors, instead of acknowledging and addressing that children are likely to interact with or be recorded by their products, evade the issue and deflect responsibility for children's data by stating in their privacy policies that their products are not meant for children below a certain age or that they do not intentionally collect children's data. Even when vendors do provide information about their practices regarding children's data, respective disclosures often do not specifically pertain to the smart home product in question. This lack of transparency regarding child-related data practices can hinder parents' ability to protect their children's privacy, especially as previous studies have shown that even adult users struggle to fully understand the data collection and profiling practices in smart homes, as well as relevant privacy and data protection laws [68, 111, 126].

6.2 Potential Effects on Child-Parent Relationships and Parenting

Research in CSCW and adjacent fields has investigated how technologies affect family communication [120, 122], value formation [5, 12], and parenting [10, 51]. A key takeaway from such work shows that domestic technology design impacts parent-child relationships; therefore, the design of respective products needs to consider factors such as real-life family contexts and children's development [100]. In contrast, our findings show that smart home marketing constructs an idealized narrative of parent-child relationships—that parents have the power and obligation to control and monitor children from infancy to adolescence, in both private and shared home spaces, and throughout their daily routines.

This continuous parental monitoring or notification-prompted responsiveness reinforces the ideology of intensive parenting culture, which is prevalent in cultures emphasizing individualism and competition, such as the United States [98]. The use of fear appeals in some product websites, aiming to heighten parents' anxieties to keep children safe, positioned the advertised products as providing parents with complete control over every aspect of children's lives to reduce risks. However, research indicates that intensive, intrusive, or authoritarian parenting does not necessarily result in better child outcomes [98, 112] but is instead associated with parental guilt [116]. There has been criticism of technologies that promote or reinforce unhelpful parenting expectations, such as parental control apps and similar screen time monitoring approaches, as they also reduce child autonomy to explore the home environment without parent oversight [64].

Moreover, the use of infants and toddlers in marketing materials for smart cameras and baby monitors suggests a deliberate targeting of prospective or new parents—a group navigating drastic life changes, newly experiencing parenthood, and in need of parenting tools and resources [41], while also forming brand loyalty as their parenthood perceptions and expectations can be heavily influenced by media and advertising [48, 58, 101]. As such, the marketing appeals of safety (see Figure 7a), convenience (see Figure 3b), and peace of mind (see Figure 9d) might make a strong impression on parents for product adoption. However, these appeals also suggest stereotypical norms and expectations regarding datafication and control of child behavior. Smart home vendors need to critically assess and improve their depictions of the stereotyped parent-child relationships, specifically addressing potentially unhealthy power dynamics that fail to recognize children's evolving needs and capabilities across different ages and developmental phases.

6.3 Design Implications: Considering Children in Smart Home Product Design and Development

The three key misalignments we discussed above highlight how children were portrayed using or co-present with smart home products in product marketing, but vendors rarely provided child-friendly features or mechanisms supporting children's access and control needs. Prior work has highlighted how young children and teenagers differ substantially in their smart home needs [40, 110, 113]: young children need more parental management and scaffolding, whereas teenagers need more autonomy and privacy. Our findings validate the need for smart home vendors to actively consider children's varying age and levels of interaction in designing smart home products. For instance, imagine if smart lock vendors would consider how children of different ages might use their product—a young child might rely on parents to manage door access while learning about safe use (e.g., when to open the door and for whom), whereas a preteen might use the phone app to unlock the door (Figure 6a). Such smart home products should be designed with parental controls or child-specific profiles that allow parents to customize children' access levels to smart home functions. A good example are the parental control features introduced in Apple iOS 16, which allow parents to set age-appropriate restrictions on what media content children can access [6]. Something similar, an age-appropriate access control mechanism considering children's needs could exist in the smart home context. For instance, such a mechanism could allow children to control lights in selected rooms (rather than the entire home), adjust temperature within a safe range, and prevent children from accessing certain devices (e.g., smart water heaters and security alarms) for safety reasons.

Meanwhile, while prior work has identified that technologies can facilitate family communications and a sense of belonging by offering topics of conversation [54, 74], children are often not considered as active participants in such family communications [100]. For smart home products that children will likely use, product design could include conversation triggers for parents to discuss and scaffold information about child safety and appropriate use. For instance, when setting up a smart lock that children might be able to control via apps, the product onboarding process could invite parents and children to discuss and practice scenarios: what to do when getting a notification of the lock, who should manage entry and exit, and how to handle the entryway records. Such child-inclusive design could also support children's autonomy in the smart home [117].

For some smart home products (e.g., robot vacuums) that are not designed for children but are likely to encounter them (especially young children) in family home environments, hardware and software safety features, such as child locks, need to be considered. A good example in our sample is the child lock option provided by Eve for both the smart power strip and the water controller. This feature provides parents with another layer of protection in case (young) children get their hands on the buttons.

Lastly, we observed children across different age groups being portrayed as subjects of constant monitoring in camera-related products. These products need to be equipped with privacy-protective features that recognize children's contextual and evolving privacy needs with respect to parents' monitoring, as well as families' privacy needs against corporate surveillance. While teenagers were depicted being monitored playing in the yard (see Figure 7c) or coming home from school (see Figure 7d), prior work has pointed out the tensions between teenagers' privacy needs and parents' monitoring [113]. Although a few vendors have incorporated a privacy shutter switch to promote the value of privacy, the idea of privacy-by-design needs to be incorporated into more smart home product features beyond smart speakers and displays. Furthermore, respective solutions need to consider the potentially conflicting needs and power asymmetry between (older) children and parents when it comes to who has control over devices and privacy features.

6.4 Policy Implications: Mandate Transparent and Useful Information About Child Safety and Privacy

Consistent with prior work showing smart home product privacy policies being hard to find [69], our findings show that smart home vendors did not provide sufficient information about products' potential child safety and privacy risks. Information about what data a specific product might collect about children and for what purposes was rarely mentioned upfront; instead, it was either missing or buried in vendors' general privacy policies. Such opaque communications about data practices around children are problematic as they do not address parents' information needs: prior work has highlighted how parents consider safety features [111] and privacy information [24, 25, 88] when purchasing smart home products, and how parents care about children's privacy when the product collects family data [39, 121].

Policymakers and regulators should mandate clearer and more useful presentation of child safety information on smart home product websites and packaging. Doing this will help consumers make informed purchase decisions by understanding potential risks, not just the benefits, highlighted in marketing materials. Existing work on IoT privacy and security labels has found that presenting information about the product's data practices, access control options, and who the products are intended for affect consumers' purchase decisions [24, 25]. Building on such findings, product pages featuring children should specify if the products could be used by children and provide direct links to instructions for child users and information about child data collection and protection. Relating back to the discrepancies we identified (see Section 6.1), smart home vendors should be held more accountable for their marketing depictions of children. These depictions should accurately reflect the actual interactions between children and the products, and vendors should also be required to highlight potential safety risks. Eve's example (see Figure 8d) demonstrates that addressing potential child safety risks in product design and marketing can be beneficial to both companies (child safety as a differentiating feature) and consumers (products safe for use with and around children).

Relatedly, the current "notice and choice" approach in privacy regulations has limitations [19, 115]. Even with transparent communication about safety issues and data practices, parents might feel coerced into accepting risks and undesired data practices in order to enjoy the benefits of the product. Therefore, in addition to mandating transparent communication of child safety and privacy practices in marketing, regulations should encourage vendors to present privacy- and safety-related information in engaging and understandable ways [59, 109] that align with parents and other consumers specific needs.

7 CONCLUSION

Through a content analysis of the product websites of 102 smart home products that feature child depictions, we contribute insights into how vendors depict children's experiences and interactions with different types of smart home products. We found that vendors used staged compositions, purposeful storytelling, and accompanying textual descriptions to highlight how children of different age groups can be active users or passive beneficiaries in the smart home, while making happiness, fear, and control appeals to parents. Yet, we further identified that many of these marketing promises remain largely unfulfilled because of a lack of consideration for children in products' features, as well as insufficient child-related safety and privacy information. Very few smart home vendors presented product features for child safety and privacy on product websites; parental controls were limited and mainly focused on content filtering and screen time without addressing smart home-specific access management; and child privacy-related information was generally lacking or difficult to find. We identified three key misalignments between smart home vendors' marketing depictions

of children and respective product features and data practices: the child-friendly use cases and scenarios depicted in smart home marketing were not adequately supported by the actual product design; they also did not represent or obscured potential child safety and privacy issues; and the provided information was insufficient regarding child data collection and use practices—including deflecting responsibility for children's data—despite children being shown with the products in marketing materials. We discussed our findings' implications for parent-child relationships, smart home design, and public policy, emphasizing the need to align the promises of smart home products with designs that are safe, privacy-protective, and appropriate for children.

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A APPENDIX

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Table 2. Codebook: Analysis of he image/product composition elements

Analysis of the image/product composition elements			
Code/subcode			**Explanation**
Featured smart home concepts and experiences	Protection		The purpose is to provide protection for the home and its residents. This relates to products that are used to enhance security, safety, and provide care. Examples of such devices include smart cameras, door locks, doorbells, and smoke alarms.
	Productivity		The purpose is to enhance productivity in the management of a household, which involves managing energy, offering convenient control, reducing effort, saving time, and supporting routines. Examples of such products include smart speakers/displays and robot vacuum cleaners.
	Pleasure		The purpose is to provide enjoyable and pleasurable activities, particularly entertainment. Examples of such products include entertainment devices, such as smart speakers/displays, smart TVs, and lighting systems.
	Health		The purpose is to promote health in the smart home. Examples of such products include smart thermostats and workout stations.
	Learning		The purpose is to serve learning and education. Examples of such products include smart speakers that highlight the learning features.
	Other/unsure		When unsure or not included in above categories.
Composition of the image	Smart home product and children in the same image or video	yes	The smart home product and children are captured in the same image or video.
		no	Only children are in the images or video, no (physical) smart home product is shown in the image or video.
	Image connected to other images on the web		Other images on the website demonstrate the same child in this image.
	Type of images	Photograph	The illustration is a photo taken by camera.
		Part of the screen	The illustration is a screenshot of e.g., children appearing on a smart display or on a phone app.
		Moving (animated) image	The illustration is a moving (animated) image, e.g., gif.
		Taken from web videos	The illustration is a screenshot from a video or a video preview.
		Other illustrations	The illustration is an emoji/cartoon, etc.
Context shown in the device image with children	Room and device placement	Children room (bedroom and playroom)	The illustration shows a children room, evident from the room decoration, including children's bed, books, toys, fun wall decorations, etc.
		Living room	The illustration shows a living/family room, evident from the TV or couch/sofa, family gatherings, in the room
		Kitchen	The illustration shows a kitchen, evident from kitchen countertops, appliances, stove, etc.
		Adult bedroom (no child)	The illustration shows an adult's bedroom, evident from beds and decoration.
		Bathroom	The illustration shows a bathroom, evident from its decoration, shower, sink, towels, etc.
		Office	The illustration shows an office, evident from the computers, bookshelves, work stations, andpeople's activities.
		Entrance	The illustration shows an entrance, evident from the door area, both from the inside and outside and people's activities, e.g., changing shoes or grabbing keys.
		Porch/backyard	The illustration shows a porch, evident from the outdoor part of the home that is distinct from the front door/entrance
		Other/unsure	When unsure or not included in above categories.
	Demonstrated control function	On the device	The illustration shows control functions on the device, evident from the product interface where it shows settings or controls. Examples include smart speakers, thermostats, etc.
		On the phone or apps	The illustration shows control functions on the phone or apps, evident from people using phone to control the smart home device
		Via voice control	The illustration shows voice control, evident from people using voice command to control the smart home device. Note that sometimes it shows text around the image, e.g., Alexa, turn on light.
		Other/unsure	When unsure or not included in above categories.
Key concepts in the webpage (including text and audio) for child related images	Keywords/concepts shown related to children/family		The illustration shows keywords and concepts, such as family, children, baby, parents, grandparents, everyone, loved ones, and related keywords.
	Other keywords/concepts in the webpage	Privacy	The illustration shows privacy-related keywords (not necessarily has additional resources/links).
		Safety	The illustration shows safety-related keywords and concepts (not necessarily has additional resources/links).
		Protection/care	The illustration shows protection/care-related keywords and concepts (not necessarily has additional resources/links).
		Peace of mind/assurance	The illustration shows peace of mind/assurance-related keywords (not necessarily has additional resources/links).
		Control	The illustration shows control-related keywords (not necessarily has additional resources/links). The concepts include: 1. function control/command including parental control, 2. active check in/monitor to stay informed, and 3. passive notification of what is happening at home and to children. Note that surveillance can be also included in here, e.g., when a camera-related product shows description like "you could see what's going on anytime anywhere you want."
		Convenience	The illustration shows convenience/easy-related keywords.
		Connection	The illustration shows connection-related keywords.
		Trust/reliability/dependability	The illustration shows trust/reliability/dependability-related keywords.
		Learning	The illustration shows learning/grow-related keywords.
		Pleasure/fun	The illustration shows pleasure/fun/entertainment/pleasure-related keywords.
		Functionality	The illustration shows keywords related to features that could be useful/beneficial/performance-improving.
		Conservation	The illustration shows conservation/energy-saving-related keywords.
		Other/unsure	When unsure or not included in above categories.

Table 3. Codebook: Analysis of children in the images

Analysis of children in the images		
Code/subcode		**Explanation**
Appeared age range of children	Infant/baby/toddler	It is evident from children's physical characteristics, the types of activities, adult presence, etc.
	Young children	
	Preteen/teenager	
	Unsure	Age unsure.
Facial expression	Positive	It is evident from children laughing, smiling, excited, etc.
	Negative	It is evident from children crying, being angry/nervous, showing impatience/boredom, etc.
	Neutral	It is evident from children showing no expression, being chilled (e.g., when reading), sleeping, etc.
	No face seen	The illustration does not show children's faces.
	Other/unsure	When unsure or not included in above categories.
Interactive context: children interacting with the device	Watch something on the device	It is evident from children watching media content.
	Listen to something on the device	It is evident from children listening to music.
	Communicate with or through the device	It is evident from children talking to the device and communicating with other people via the device.
	Read/write/sketch/draw on the device	It is evident from children performing these activities on or with the device.
	Sing along the device	It is evident from children singing along the device and music coming out from the device.
	Dance along the device	It is evident from children dancing/exercising along the device and music coming out from the device/
	Lock/unlock the door	It is evident from children locking/unlocking the door or attempting to do it.
	Control lightings	It is evident from children using smart speaker/display to control lights or directly controling lights.
	Use the door(bell) camera (from outside)	It is evident from a camera view of children waiting at the door.
	Other/unsure	When unsure or not included in above categories.
Passive context: children's activities when co-presenting with the device	Sleep	The child benefits from the smart home device by experiencing a cared-for and protected environment, even when engaging in activities not directly triggered by the device. In this context, the child is not necessarily using the smart home device directly but serves as a beneficiary or prop within the smart home environment.
	Walk/run/jump/ climb/crawl	
	Play	
	Eat/drink	
	Children being watched through camera	
	Getting ready to go outside	
	Other/unsure	When unsure or not included in above categories.
Other people	Child and device alone	It is evident from scenarios that only children are physically around (sleeping/playing/doing something while the device is functioning) with the device functioning.
	Other children around	It is evident from two or more children presenting in the image, who can be interacting with the device together or passively enjoying the protected environment by the smart home device.
	Child mainly using the device with adults presence	It is evident from other adults physically around but not participating in children's interactions with the device.
	Child co-use the device with other adults	It is evident from adults using the device with children together.
	Adults using the device, not children	It is evident from adults primarily using the device, while children are not using or interacting with the device
	Neither children nor adults using the device	It is evident from children and adults being around the device but not actively using them. They may benefit from the ambient environment cared by the smart home device.
	Other/unsure	When unsure or not included in above categories.

Table 4. Codebook: Analysis of child safety and privacy-related features and information

Analysis of child safety and privacy-related features and information		
Code/subcode		**Explanation**
If safety is mentioned (in text)	Webpage providing additional safety resources	The webpage provides extra links and resources for safety.
	Webpage not providing additional safety resources	The webpage provides no extra links or resources for safety, and it just mentions words about safety.
If privacy is mentioned (in text)	Webpage providing additional privacy resources	The webpage provides extra links and resources for privacy, and it just mentions words about privacy.
	Webpage not providing additional privacy resources	The webpage provides no extra links or resources for privacy, and it just mentions words about privacy.
Presence of product features addressing privacy or safety		The webpage shows features, such as child safety lock or privacy shutter buttons.
Presence of parental control-related information		The webpage shows how they offer parental control for the products, e.g., child-specific access control.
Presence of information for parents		The webpage shows information on what parents could do or not do with the children and the device, e.g., parents should supervise children when using the device.
Presence of child-specific content, features, functions, and profile		The webpage shows products offering child mode, content, and child profiles.
Presence of information/disclaimer of potential risks		The webpage shows potential safety risks or misuse, or explains what parents need to be aware of regarding the potential privacy or safety risks.
Presence of information on child data collection and use		The webpage shows how the company handles child-related data. Examples include data collection and use, sharing, and selling.
Indication of child existence (when child image is not presented)		The webpage shows no children, but the image shows child-related signals, including children's bedroom or toys/stuff around the smart home device or in the room.
Presence of smart home guide, e.g., teaching children about device use		The webpage shows instructions or materials directly addressing children, teaching children about device use.