Caring for the Furry Friends in the Smart Home

An Initial Exploration of a Child-Centered Approach to Designing for Pets

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Abstract

Smart home technologies are often designed to meet the needs of adults, yet children and pets also live with these systems without being meaningfully considered in their design. Child-Computer Interaction (CCI) researchers have shown the value of studying children's experiences and ideation of technologies used in the domestic space. In this pictorial, we explore experiences at the intersection of children, pets, and smart home technologies by analyzing data from an in-home study with 6-to-11-year-olds. Our analysis identifies five themes in how children perceive smart home technologies in the context of pet care: convenience, presence, physical comfort, emotional wellbeing, and responsibility. Grounded in children's everyday routines of playing with and looking after their pets, this work offers design directions for domestic technologies that account for non-human household members.

Author Keywords

smart home; pet care; children's participation in home; multispecies design; automation; labor

CSS Concepts

CCS → Human-centered computing → Human computer interaction (HCI) → Empirical studies in HCI

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Introduction

Automated systems now handle many domestic tasks, with a growing market targeting pet owners [1, 3, 23]. While industry marketing frames these devices as tools for adult convenience [28], they fundamentally alter the daily lives of children and pets who share the home. Children often engage with these technologies through play and affection [19, 29], but current home technologies primarily address adult concerns like control and efficiency [4], with little room for how children actually think about or use them [28, 49]. As such, smart home designs treat the household as a system to be optimized, reinforcing adults as managers and relegating children and pets to peripheral roles [43, 49].

Prior research demonstrates children's situated expertise in relating to non-speaking creatures [12, 13, 24], which suggests children have distinctive insights to contribute to the design of technologies that affect animals. Yet much of the discussion around child-centered design has framed children's contributions in terms of ethical values [18, 26]. Meanwhile, smart home design discourse remains shaped by human-centered frameworks that foreground adult human needs, leaving little room for the multispecies dynamics that characterize many actual households. Our study investigates children's reasoning about smart home technologies within human-animal-technology triads. We ask:

RQ1: How do children perceive their pets' encounters with smart home technologies?
RQ2: What can children's experiences teach us about designing pet-aware home technologies?

The data presented in this pictorial come from a more comprehensive study on how children and families live with smart home technologies [7]. In that study, we recruited nine families with children ages 6 to 11, an age range when children begin noticing how smart home devices work and start taking on caregiving tasks for pets [40, 41]. Over 2-3 months, families participated in four activities: a parent interview, a child-led home tour, a self-paced design workbook, and a closing interview. Using a pictorial approach, we present five ways children perceived their pets' encounters with smart home technologies: confronting the reality of breakdown, maintaining connection across distance, supporting physical comfort, navigating the push-and-pull of emotional wellbeing, and prompting reflection on responsibility. From there, we analyze how those depicted interactions reflect children's sense of closeness with their pets, and examine how children selectively offload some tasks while preserving others as meaningful acts of tending. Children consistently present themselves as active mediators between technologies and pets, and extend their reasoning to the scale of the household ecosystem. These findings point to the importance of designing for multispecies households and suggest that smart home futures should move beyond human-only assumptions to account for non-human household members. This work contributes to the growing conversation on child-centered design and brings a multispecies lens to CCI.

Related Work

Reconfiguring Pet Care in the Smart Home

Human experience is meaningfully co-constructed through relations with other species [6]. Haraway [5] develops this view through the concept of companion species as living creatures that make meanings together with humans through labor, communication, and shared histories. Bringing animals from wild habitats into the domestic sphere shifts these dynamics, and the rise of new technologies further exposes underlying tensions [23]. The field of Animal-Computer Interaction (ACI) emerges to address these complexities [30, 31], with its core philosophy distinguishing *technology informed by the animal's perspective* from *animal technology*, the latter often being human-deterministic and essentialist [16].

In practice, animals express their experience of technology through behavioral responses [22], and humans fill in the active labor of observation and interpretation for the absence of verbal expression by reading behavioral regularities within the situated practices that humans and animals share [31, 51]. Integrating technology into the home prompts an ongoing debate over whether such interventions foster or hinder relational care. Kahn et al. [52] identify the problem as "replacing actual nature (i.e., humans' (especially children's) innate pull toward physically interacting with the living beings around them) with technological nature" (p. 37). Research with dog owners reveals hesitation toward technologies that replace direct contact, alongside appreciation for tools that strengthen mutual awareness [25]. To bridge this gap, Mankoff et al. [10] design a system that uses multimedia to simulate an owner's presence for the pet and provides the owner with ambient activity data. Subsequent studies test how pets respond to systems of this kind, and they note that authentically conveying emotion and responsiveness across species at a distance remains a significant challenge [3, 10, 51].

In the smart home setting, Strengers et al. [39] show that companion animals increasingly shape everyday energy-demanding practices in ways dominant smart home technologies fail to capture. One direction forward is to link pet behaviors to domains traditionally framed as human-only, like reading a cat's temperature-seeking movements as input for home energy management [55]. In a similar spirit, other work calls for treating non-human actors as participants whose roles emerge relationally through specific situations and settings [38]. While this body of research establishes that non-human participants and shared domestic environments matter, it leaves underexplored *how* these environments actively shape human–pet relationships.

Conceptualizing Youth's Technology-Mediated Pet Care

Animals act as developmental partners, and incorporating human-pet interaction into developmental theory expands our understanding of relationships and empathy across the lifespan [12, 13, 24, 27]. In these interactions, children reveal their thinking about animals' emotional and cognitive capacities. When asked to design for animals, children at first default to human-centered interpretations, projecting human needs and preferences onto animals [17], but these perceptions can evolve with deeper engagement. Parekh et al. [15] use Augmented Reality to help teenagers inquire into their pets' sensory worlds, fostering perspective-taking from the animal's point of view. They find that teenagers revise their assumptions through iterative cycles of observing, testing, and reflecting with their pets [15]. Such processes not only cultivate more-than-human thinking but also show that perspective-taking can be intertwined with scientific inquiry and design practice [14].

Children bring a distinct expertise to domestic life, and their tendency to view animals as responsive beings allows them to develop relational sensitivities that adults may overlook [20, 24]. Their design ideas about technology reflect not only their relationships with pets but also their emerging identities as technology users and creators [21]. Although child-centered design frameworks emphasize the importance of involving young people as design partners [18, 21, 26], smart home research lags behind in this regard, particularly in households where smart home technologies shape the lives of children and pets without meaningfully incorporating children's perspectives. As a result, children's distinctive ways of reasoning and creative design contributions remain underrecognized, despite their relevance to everyday domestic interactions with technology [34].

Child-Centered Ways to Elicit Children's Smart Home Experiences

Central to child-centered research is letting children lead, allowing their interests and creative expression to guide the process [36, 37]. The Mosaic approach, in particular, combines multiple methods into a holistic, multistage toolkit that pieces together a "living picture of [children's] lives" (p. 13), including children's narrative accounts, their photographs of objects that matter to them, child-recorded home tours, and interviews with the close adults in their lives, such as parents [36]. Being present in the home can surface embodied memories and experiences that rarely emerge in stand-alone interviews [9], making this approach well-suited to studying how children experience smart home technology, where cognition is shaped by its physical and social context [11]. Through techniques such as child-led tours, traditional researcher–participant power dynamics are inverted, and children can better communicate their understanding of their living spaces on their own terms [2]. These methods sit within a broader art-based, participatory tradition that helps children express ideas beyond words [53]. By centering creative and embodied forms of expression, we aim to honor children's participatory rights and make sure their perspectives shape the design of technologies responsive to the nuances of multispecies family life.

Methodology

Following the Mosaic approach [36], our original study [7] built a multifaceted understanding of the home through four interconnected steps.

Parent interview

After we explained the study procedures during recruitment, parents provided consent. We interviewed each parent to learn about their child's ownership, access, use, and preferences regarding smart home technologies. These interviews gave us a baseline understanding of the family's smart home setup and helped us follow the child more closely during the home visit.

Child-led home visit

Before letting the child take the lead, we obtained their assent by explaining the purpose of the visit and acknowledging their expertise in the home environment. They guided us through the space, describing the uses, preferences, and memorable moments tied to selected smart home technologies. Aside from our occasional clarifying questions, the walkthrough was largely child-directed. Pets frequently appeared along the way, and the child recalled memories involving them.

Design workbook[1]

To support parent-child collabrative reflection and ideation, families completed a design workbook we created for the study [50], using their home as a reference, guided by narrative prompts featuring fictional families and common smart home devices.

Exit interview

Following workbook completion, families took part in an interview to share their responses.

Study Participants

With the approval from the University of Michigan's Institutional Review Board, we recruited nine families with children ages 6-11 via social media, flyers, and mailing lists in Seattle, USA. Each household had multiple smart home devices. Families received $20 for each stage of participation, plus a $40 bonus for completing all stages. Although the broader project did not focus on pets, we encouraged families to consider the needs of all household members, and children in five of the nine families spontaneously shared how their pets interacted with the technology.

Name	Age	Gender	Pets	Pet-related tech
Zella	9	F	A dog, Taco	Tracker, smart camera
Lori	8	F	Two cats, Bae & Coco	Litter box, robot vacuum, smart speaker, smart display
Georgie	9	F	Three dogs, Jon & Archie & Gwen	Robot vacuum
Mia	10	F	A dog, Manny	Robot vacuum, thermostat
Sylvia	11	F	Two cats, Fio & Spark	Smart doorbell, thermostat, feeder

[1] https://osf.io/z9k5p/overview?view_only=3351a53418e64083af05821630b6da19

Data Analysis

Although the larger study [7] was not designed to elicit children's observations of pets, children naturally discussed their pets' experiences during the home visits and exit interviews, which served as the main data source for this pictorial. While the child was the central participant, parents were also present during the exit interviews and often contributed through naturally unfolding conversation. We included parent's responses to their child's ideas to compare their perspectives or provide a fuller picture of how children's ideas evolved.

All sessions were recorded and transcribed, with children's and pets' names changed into pseudonyms. The first author reviewed all the transcripts from the original study [7] and conducted an inductive thematic analysis [32], identifying pet-related excerpts and developing analytical memos. Through iterative discussions with the research team and ongoing consolidation, these memos coalesced into five themes centered on children's perspectives on how pets encounter smart home technologies.

Along the way, the first author created visual memos to give form to children's vivid but often fluid and elusive descriptions. This step was vital for two reasons: 1) illustrations incorporated the researcher's situated observations and helped clarify design moments that were difficult to capture through verbal accounts alone, and 2) the visual format compensated for the lack of direct pet depictions in children's original artifacts.

By translating children's words and workbook ideation into refined illustrations, we were able to present children's descriptions and imaginations into a cohesive visual narrative. These illustrations did not merely accompany our findings; they were integral to how we made sense of the data by holding together fragments of children's talk, ideation, and exchanges with parents that would otherwise have remained dispersed.

Findings

Drawing on children's varied perspectives on smart home technology, we identified five ways they understood these devices in relation to pets:

1) Experiencing convenience punctuated by inconvenience.
2) Staying present in pets' lives.
3) Supporting pets' physical comfort.
4) Navigating the push-and-pull of pets' emotional wellbeing.
5) Forming early ideas about responsibility, often guided by parents.

1 Experiencing Convenience Punctuated by Inconvenience

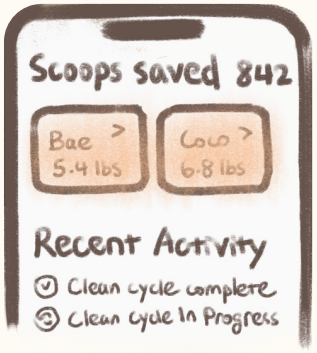
Families in our study often adopted certain smart home technologies with the promise of streamlining routine pet care and reducing manual labor. While these tools offered improvements, their effectiveness varied depending on the household's specific needs and pet behaviors.

For Lori, the smart litter box represented a significant upgrade from manual cleaning. She commented on how its automated features kept the surrounding area cleaner and valued the data-driven insights that helped her stay aware of the pets' health and supported a less hectic lifestyle she had grown accustomed to.

Lori: "It [the smart litter box] just gets a few speckles on the mat. It kind of moves through and takes away. There's never really that much stuff that's building up in the litter box."

Lori: "It waits a bit and then it can do its cycle and put the poopy in the bag."

Lori's mom: "They have been healthier, and you also use much less litter. It seems like a good thing, especially if you have multiple cats. [Showed researcher the app] Say we want to do Bae, it will say health issues. There's no issues, so we can't look at it, but it would identify health issues if she started using the litter box a lot more often."



However, not all technologies delivered on their promise of convenience. Georgie's family cycled through a number of robot vacuums in search of one that could better handle their cleaning demand associated with having three dogs, but failed to do so. Those vacuums were all named after their perceived function, as Georgie recalled: *"we have actually had four, I'm pretty sure. We called it the Poop Avoider,"* while the current model, described as *"one of the newer pieces of software,"* was named the *"Cleaning Elizabeth."*

This naming tradition reflected the family's attempts to domesticate a technology that had repeatedly failed around their pets. Even with newer models, the underlying tension persisted.

Georgie: "The new one was more advanced, and that one broke down because it didn't know how to avoid dog poop. It all got stuck in it."

While managing pet waste frequently exposed gaps between technological promise and the reality of breakdowns, these routine interactions served as a baseline for children's perceptions of what technology is and does in the home.

2 Staying Present in Pets' Lives

Children spoke highly of smart home technologies for the way they enabled them to be present for their pets, whether right beside them or from away.

After a distressing incident where Zella's dog ran away, their family decided to purchase a tracker. The parents understood how much it had impacted Zella and wanted to provide reassurance. Buying the tracker was the family's way of showing her that the dog would be safe from now on, and that there would always be protection in place.

Zella: "Taco escaped, twice! Once he ran out of the way to the little park."

Zella's dad: "It was before we got the AirTag; it was what prompted us to get that."

Although Zella's mom was not personally interested in the technology, she noticed Zella was engaged with the tracking collar and its companion app. Zella appreciated the family's decision to get the tracking collar and showed her grasp of how it works.

Zella's mom: "[Next time] when she [Zella] is worried like, 'oh, what if Taco runs away, or what if he gets lost?'...

... We can say, 'you know what, don't worry, if it does happen, we can track his location, and we have multiple ways to find him. It will be okay.'"

Zella: "We look through the camera and then, 'oh no, where's my dog, and [we] can catch 'em.'"

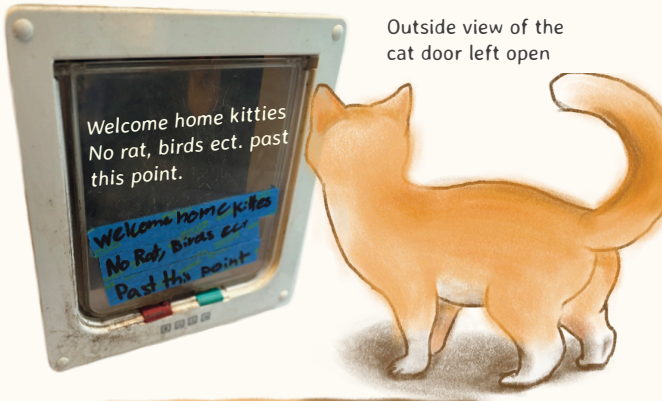
Keeping pets safe was not limited to devices made for tracking. Lori's family discovered an unexpected side use for their smart litter box, which ended up helping them locate their cat after it went missing while the family was gone for a trip. Lori's mom shared a story of how smart home devices can provide reassurance through data originally collected for other purposes. She asked Lori if she remembered it was the smart litter box that confirmed the cat had simply gone to visit her bedroom and was safe and sound.

Lori's mom: "Cat sitter had come over and she [Bae the cat] hid. She [the sitter] was freaking out and calling me when we were in Portland...

... The time they use the litter box, it weighs them. It tells you how often they visit."

Lori's mom: "Do you remember how we figured it out?"
Lori: "It [the smart litter box] weighed them [and logged data such as the time of use and the cat's weight]."
Lori's mom: "I said to the cats sitter, 'don't worry, she [Bae] was probably hiding on Lori's bed [after using the litter box]. She does that a lot.'"

In addition to the smart litter box, a smart doorbell allowed families to observe their pets closely from afar. With this added layer of oversight, the family felt comfortable leaving a small door open for the cats to venture outside and return. Sylvia described how the smart doorbell facilitated communication when her family was on vacation:



Outside view of the cat door left open

"We look at the cats and sometimes talk to them through the doorbell if they're on the front porch."

Inside view

2 Staying Present in Pets' Lives

These check-ins served not only to monitor the pet as intended, but also to reinforce family bonds. Zella's family relied on a smart camera to observe their dog while away.

Zella's mom: "So we placed one of the cameras inside in our living room, where he [Taco the dog] hangs out when we're gone and [we] checked in on him."

Families found amusement reviewing footage of their dog's antics. The playful language they developed around the practice turned co-watching into a lighthearted family activity. Zella's mom recalled a moment at a restaurant:

"We were 'spying on the dog,' and that one time, we saw on camera that he went up to our back door, and lifted his leg and peed, and then just went back to sleep on the couch. That's informative to us, but also it's really funny."

Zella's mom: "We got such a kick out of that. It was really fun, and it's silly."

With these devices, and the pet as a central figure whose behavior fostered family connection, the distance that traditionally caused anxiety for owners became an opportunity for closeness. Having grown up around connected smart home devices, our child participants came to see these devices as tools that let family members stay attentive to one another and to their pets, despite physical separation.

3 Supporting Pets' Physical Comfort

Smart homes supported pets' physical comfort by regulating environmental comfort. Thermostats, in particular, created shared spaces of warmth for children and pets. For example, in Sylvia's morning routine that her mom described:

"15 minutes before she [Sylvia] gets going...

... [Sylvia] adjusts the thermostat to turn on the heater...

... [Sylvia] just flops in front of the air vent with the cat, pets the cat and gets the warm air, and has that little snuggle wake up time."

Sylvia identified her favorite spot in the house where heat comes out and expressed her enjoyment chilling with the cats.

"Right here. I like to lay down there when it's really cold outside. My head and my cat should be right there. Oftentimes he's always around. He'll lay down and see me."

Children also considered their pets' thermal preferences when adjusting home settings. Mia reflected on finding the right balance being *"not too hot, not too cold or something."* However, she noticed that other family members and their dog Manny might feel temperature differently. In explaining her workbook answers, Mia shared her own perspective alongside an imagined account of Manny's:

"I like it warm and cozy...

... [Imagine] Manny said '[she prefers temperature that is] cool enough so I don't have to pant'... she [Manny] has fur so she gets overheated probably pretty easily...

... I figured out her preferred temperature-ish."

Recognizing her own flexibility to adapt to different temperatures (e.g., taking off or putting on more clothes), in contrast to Manny's more limited ability to do the same, Mia demonstrated heightened attentiveness to Manny's comfort. As her dad observed, *"Mia thinks a lot about Manny's comfort."* Mia calibrated what she called a *"preferred temperature-ish,"* a negotiated balance between her own comfort and Manny's. In doing so, she practiced a tacit form of co-habitation, adjusting as she observed and empathized. She understood temperature as a shifting condition that needed to be actively tuned, not set once and forgotten.

Across these cases, both Mia and Sylvia demonstrated that care was not static or one-directional. When using the same device, their understandings of comfort were not universal but influenced by each pet's specific situation and their own evolving sensitivities.

4 Navigating the Push-and-Pull of Pets' Emotional Wellbeing

Smart homes influenced how children relate emotionally to their pets. These technologies surfaced vulnerabilities in pets and sparked children's feelings of empathy or frustration, making the emotional stakes personal and immediate. Georgie's frustration began with the robot vacuum's inaccuracy in sensing of its surroundings. She noted a gap between the device's promised capabilities and its actual behavior, a situation she described as *"directly disruptive."*

Georgie: "The camera is programmed to avoid things, but it bumps things when it can't exactly judge how wide it is."

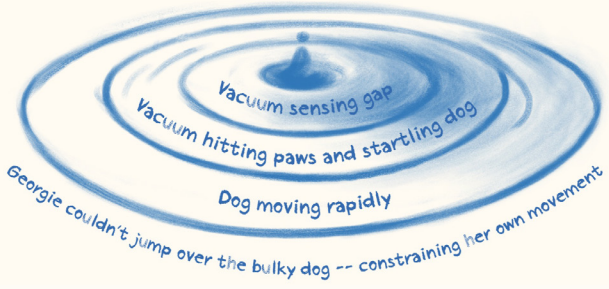
Georgie devised her own workarounds, experimenting playfully and adjusting her movements. However, when the dogs encountered the device directly, her individual coping strategies broke down. She distinguished these as *"indirectly disruptive"* situations.

Georgie: "I actually got bolder towards it and put my shoe on top of it and had it go for a ride...

... I jump over as it's going towards me."

"The dogs don't like it because it runs over their paws. It was once disruptive in my opinion, but what makes it even more disruptive is that the dogs are way faster and way more bulky than it...

... When it runs over the dogs' paws, they quickly get up to find a new space. And when they start walking around everywhere, that feels really disruptive because I can't jump over a dog yet."



Here, disruption cascaded: the vacuum startled the dogs, whose reactions then constrained Georgie's own movement through shared space. When all three parties — child, dogs, and vacuum — were in motion, the scene became chaotic.

Mia faced a similar situation and noticed a clear asymmetry in how the robot vacuum responded to a humans versus an animal.

Mia: "Sometimes when I'm standing right in front of it, it turns. It knows I'm there. But for Manny, I don't think it does, and she gets scared of it."

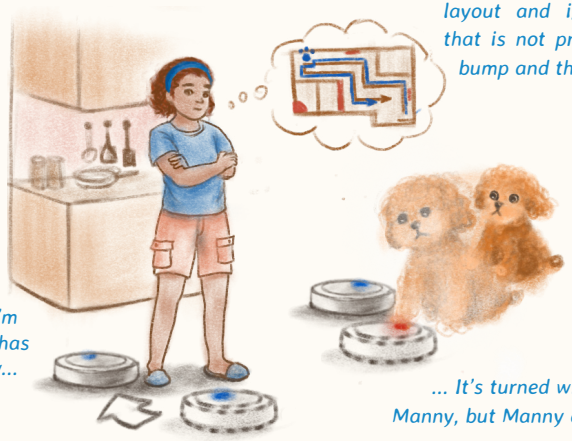
Even without knowing exactly how to fix this issue, Mia felt an instinctive urge to step in and protect Manny.

"I go over there and shield Manny from it. I'm like, 'get away!'"

With the vacuum routinely malfunctioning around Manny, Mia reasoned through the vacuum's logic. She speculated that the device needed to bump into the dog before recognizing it as a living being rather than a static obstacle on its map. While a human was detected before collision, an animal was not picked up until after contact.

Mia: "I think it [the vacuum] has to bump into it [the dog] before it sees that. It has a map layout and if it's something that is not predicting it'll still bump and then go around it...

... It thinks I'm a wall, so it has to turn away...



... It's turned when it bumps into Manny, but Manny doesn't like that."

Mia's explanation suggests she was building a mental model of the vacuum's sensor behavior and navigation strategy. When asked what she would change about the vacuum, Mia imagined adding a camera and live feed so she could better understand what the vacuum was perceiving:

"I could have a camera so I can see what's going on. Maybe it could have a controller. It could be attached to the vacuum in front of it so I could see where it's going."

4 Navigating the Push-and-Pull of Pets' Emotional Wellbeing

Lori revisited the smart litter box, what she called the *"kitty little robot,"* which she had earlier described as a way to detect weight differences and monitor each cat's health. This idea gave Lori the chance to spell out a system she had been mentally sketching that linked each cat's unique preferences to design elements tailored to their needs. Without being prompted, she moved fluidly from her daily observations of each cat to her own system design.

Lori: "Bae always seems to go like

whenever it's a hot day and there's hot tiles, and cuddles up."

from which she inferred that

"Bae likes heated butt or body, so it would heat up the thing for her, so she became more cozy and comfortable."

She also noted Bae's subtle emotional cues, such as low enthusiasm and energy.

"I feel like sometimes she can be 'a little bit' and she's too 'Bleh' [a word Lori used to describe the disinterested Bae]."

For Coco, she associated him with kinetic energy, informed by her astonishment at his big jumps.

"[I have seen] him jumping like six feet."

Lori's idea of a family-friendly robot vacuum featured modular, layered elements that together formed a multi-species system. The design accommodated both a fictional human baby and her two cats, based on speculations about the conditions under which humans and pets can thrive together.

Bae's traits and likes
- Warmth-seeking: warm surfaces
- Comfort-oriented: resting and grooming
- Emotional soothing: a space that feels safe, calm, predictable

Human baby's likes
- Soothing motion, calming music, gentle rocking

Coco's traits and likes
- Exploratory: play space
- Active: stimulating objects and interactive features that motivate movement

Lori depicted how she wanted the robot vacuum to serve Coco and Bae:

"Maybe it [the vacuum] could grow a big long poles and then spread out at the bottom and make it a basketball court thing. Then Coco could bat out the little thing on the post — he could be playing a jumpy basketball.

It would have a block that comes up and Bae could rest her head on it. It would give her something to rest her chin on. If her paws started pulling off, it would groom for her paw too. She could be like laying down in her warm place with her head rest."

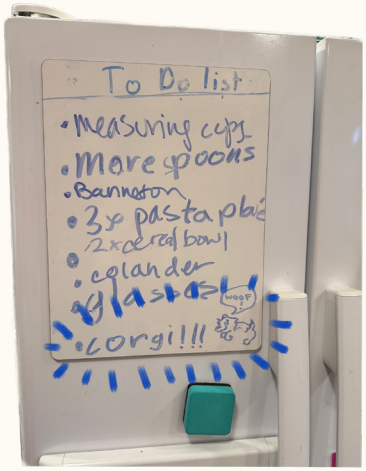
She further extended the design to include a baby, making the robot vacuum for the whole household:

"The baby could be like listening to music and being rocked. They would go around the house because it's a vacuum."

5 Forming Early Ideas about Responsibility

Smart home technologies played a role not only in supporting daily pet care but also in learning what pet ownership involves. As there was a clear contrast between Lori's identity as a dog lover and her mom's as a cat person, Lori immersed herself in everything she could learn about dogs to show her mom how serious and enthusiastic she was about adopting a new dog.

Lori's mom: "She's [Lori's] trying to sell me on getting a corgi and I'm not a dog person. I appreciate other people's dogs, but I love cats. Anyway, I was like, 'we have to learn more about a corgi, and it's not as easy as you think. So let's learn more.'"



Lori: "What's the breed of the day?"

Lori showed her commitment to caring for a corgi through ongoing use of the smart speaker as a convenient source of knowledge. Her mom recalled how Lori would turned to Ziggy [the nickname of the smart display], her close companion for quick tips, to ask what was needed to raise a corgi:

"She'll [Lori will] say 'Ziggy, what does it take to raise a dog?'...

... It'll [the smart speaker will] give her information that's either incomplete or confirms what she is trying to convince me of, and she'll use what it said as extra evidence to help convince me of her position."

... She'll be like, 'well, mama, I can use my allowance.'...

Applying what she learned from the smart display about caring for a corgi, Lori started a dog-walking business to practice responsibilities. This gave her mom insight into Lori's follow-through and enabled a more informed decision about whether the family would be prepared to adopt a corgi in the near future.

Lori's mom: "We're doing a little corgi-walking business that's going to have a hundred percent discount for corgis so that she can get some experience walking dogs. I'll be with her, and she can feel what it's really like."

"And honestly if a year from now, she is still on this and is fully informed, and I'm fully informed, maybe it's something I would consider."

"There's a lot of toddling between devices to research different aspects of corgis, now that I've told her after we get some updates done to the house, maybe we can consider another pet."

In thinking through the current functionalities of the refrigerator, Lori imagined ways it could become a more proactive and personalized helper. She described a system that could automatically recognize actions like giving treats and keeping logs. This vision reflected transferring her real experiences of feeding cats to the corgi caregiving as well as imaginative thinking about building the idea of responsibility into design.

Lori: "Instead of you forgetting marking Coco's treats, it would be the little emoji. If you had it turned on while you were doing Coco's treats, it would mark it for you. So basically the emoji would be able to look and see you doing that from the fridge...

... It would have a cat mode. So the cat mode or the corgi mode [is] right here on the fridge. There would be a little thing that goes up and down here."

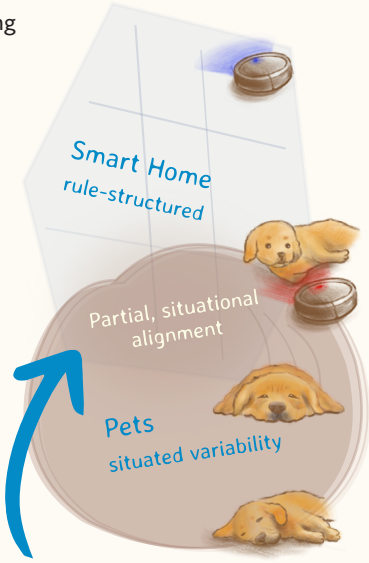
Discussion

Children as Intermediaries in Pets' Encounters with Smart Homes

> *"As we are raising young humans and thinking about their interaction with the world, I still sometimes get hung up on like, 'are we doing a disservice by having this machine feed the cats, versus actually having to [have our kids] learn to think about what time it is [to feed the cats], think about this other living being [regarding how to take care of them], when do they need to get fed interacting with them?'" — Sylvia's mom*

Having described the five ways children perceived how their pets encounter various smart home technologies, we situated our findings along a spectrum that reflects each child's level of technological involvement in pet care. At one end is task-oriented mediation, where technology assists with discrete caregiving activities. At the other end is relational mediation, where technology alters how children understand their relationship with their pets. Across this spectrum, children positioned themselves within the push-and-pull between technology and pet, and actively assessed whether devices have fulfilled their caregiving role. This engagement played out through moments of both functioning and breakdown. When technologies worked as intended, children experienced a heightened sense of fulfillment and developed a tacit awareness of the behind-the-scenes automations that not only kept things running, but also carried broader implications for the child-pet relationship. For instance, a camera feed became more than a surveillance tool, and a smart litter box more than a cleaning reminder. Children gave positive accounts of these automation-augmented connections, describing how the technologies sustained companionship and closeness with their pets at a distance. These accounts support the premise behind many remote interaction systems [3, 10].

At the same time, children's awareness of automation echoes concerns that such systems get in the way of the very bonding moments they aim to support [25, 51], which is most visible during moments of breakdown. In van der Linden et al.'s survey of adult pet owners [25], participants weigh whether technology only compensates for their absence from their pets or enriches the time they spend together. Children in our study reasoned along similar lines, but rarely surfaced this tension explicitly until technological failures, the moments when their underlying assumptions became visible. They perceived breakdowns not as mere functional disruptions but as disturbances to their relationship with their pets. In these moments, the smart home revealed itself as a rule-based actor enforcing programmed logic, while pets were contingent, living beings whose actions frequently unsettled that logic [31, 46].



Children make sense of rules that are (not) realized in reality

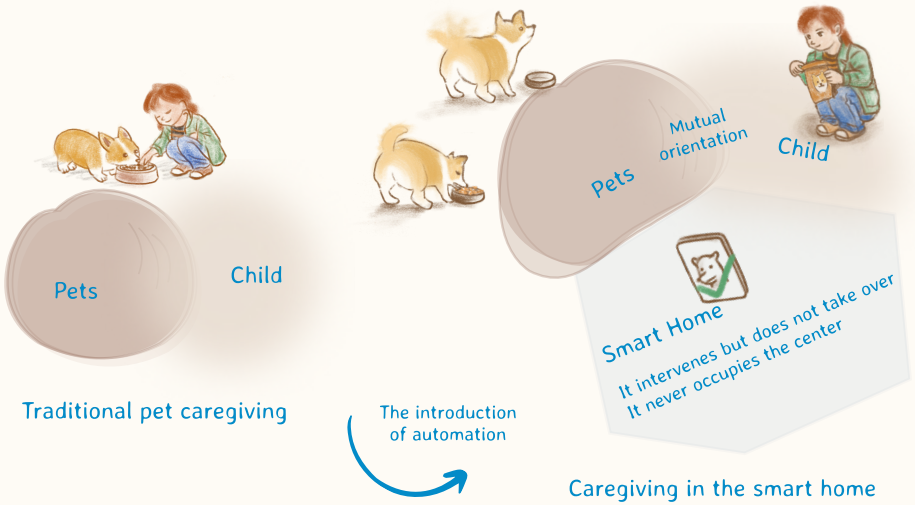
This friction activated children's sense-making. They noticed the variations, tried to account for pets, and persisted in working out what went wrong. As Hatano and Inagaki describe [44], incongruity between what is expected and what actually happens elicits committed comprehension activity, which commonly arises in situations involving pets. This is the kind of engagement we observed when children encountered mismatches between how a device was supposed to behave and how their pet actually responded to it. Within this gap, children acted as intermediaries, striving to resolve the friction between pet and device. The robot vacuum emerged frequently in children's narratives as a focal point for this dynamic. Children were keenly aware of their pets' fear or confusion in response to the vacuum's erratic movement. As Mia speculated, this unpredictability ran both ways. Just as her pets could not anticipate the vacuum, the vacuum treated pets as unpredictable obstacles to be probed and mapped before it could plot a path. This mutual illegibility cast Mia as a translator between two fundamentally different logics, and as the one who absorbed the friction.

Children's interpretation does not end with mediation. As tasks become automated, children confront a deeper tension around how care is valued when machines perform the work. We argue that caregiving holds meaning in itself. Expending effort looking after another being produces togetherness as a byproduct of the effort itself, without needing separate bonding rituals. This effort constitutes the relationship and matters especially in middle childhood, when children are developing independence while wanting to care for and be needed by others [8, 33]. Taking responsibility for

another teaches children social competence and their own values, and pets are well-suited to this role [12, 35]. Yet smart home technologies may intervene in these care routines. The core issue is neither that automation removes care entirely, nor that children trade effort for leisure time with their pets; it is that automation may displace the forms of care that cultivate a relational connection between child and pet and give children a sense of accomplishment [42].

Automation, however, is more than a simple trade-off. Adults' efforts to better understand their pets through technology have, in some cases, left owners more confused about what their pets actually need [51], whereas our findings show that children develop what we call a *technological conscience*. Rather than relinquishing sense-making or fully deferring responsibility to machines, they made careful choices about what to automate. For example, Lori preferred to automate tracking tasks like logging food, but she still wanted to handle feeding herself, making a clear distinction between tasks that she could hand off and those that felt meaningful to do herself. This kind of selective engagement complicates how prior smart home research positions children. Earlier smart home work categorizes family members into drivers and passive users [43], especially in the context of parental control of children's technology use [28]. In our child-pet case, children did not fall into the passive camp, but instead saw themselves as in charge of a full range of caretaking activities, supervising, questioning, and stepping in when they thought technology might hurt their pets. These actions allow children to express their values and reinforce their bond with their pets in ways that diverge from conventional caregiving labor [47]. In this vein, smart home technologies can support children in caring on their own terms.

At the relational level, this dynamic gives rise to compensatory caregiving practices without replacing the core child–pet bond. Pets continue to orient toward the child, and children remain aware of themselves as the ones who respond to their pets' needs. When children feel that automated actions lack the emotional weight of hands-on interaction, they adjust by creating or imagining alternative practices to stay connected. These workarounds include changing routines or actively intervening when technologies upset pets. Over time, they stabilize into new routines [24]. Rather than diminishing care, automation redistributes it into forms that are more focused on relationships and emotional connection.



Lessons from Children for Pet-Aware Smart Home Design

> *"It [robot vacuum] could be something that could help you clean your house, but it would also be fun, so then your pet would not be scared of it. They would be something that your pet want to be closer to and pop on... something that a cat would love other than just you." — Lori*

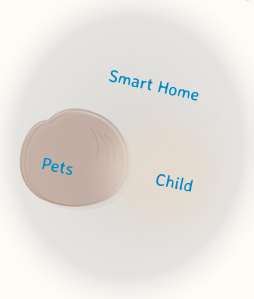
Although children and pets care for each other, both groups are often treated as end-users of household technology [28, 43]. We identify four opportunities to reframe children and pets' participation in the smart home.

Expanding the design scope beyond *pet* technologies. Children across our study naturally considered how everyday devices, even those not designed for pets, affected their pets' lives. This challenges common pet-market assumptions that technologies fit neatly into "pet" or "non-pet" categories [23]. In households with pets, the effects of these technologies ripple outward in ways designers may not anticipate [46], suggesting that smart home technologies occupy a broader design space than their primary functions imply. In this sense, children's views align with Mancini's argument that the *C* in Animal-*Computer* Interaction should include any technology that affects animals, whether or not it was designed for them [30].

Grounding multispecies design reasoning in children's care for pets. When looking closely at all kinds of technologies, our child participants paid particular attention to those not designed with pets in mind, especially when the devices made their pets uncomfortable. This awareness led to a consistent pattern in how they thought about and responded to technology. They saw pets as agentic beings who willingly approach technologies and take pleasure in these encounters [20, 24]. Pets simultaneously occupy multiple relational roles that matter deeply to children as playmates, siblings, sources of comfort [12], and sometimes even as a figure they care for like a "little human" (p. 214) [54]. Research shows that children often use more nurturing language when talking about pets than when talking about people [40, 54]. This caring orientation helps explain why children in our study sometimes thought about what their pets might feel and carried this perspective into how they reasoned about technology. When discussing thermostats, they focused on their pets' comfort and actively searched for compromises between humans and pets. In her designs for robot vacuums and refrigerators, Lori drew on everyday observations to imagine configura-

tions that could accommodate both human and pet needs. In doing so, children naturally enacted the "designing for others" agenda that extended consideration to other people, animals, and things in the home (p. 29) [55].

Treating the household as a networked system. Our child participants described technology as embedded in a larger system that weaves together human routines, pet behaviors, and the physical environment, with each acting upon the others [25, 56]. Lori and Georgie's practice of naming their devices and associating them with particular experiences and expectations expressed this understanding. Forlizzi and DiSalvo [57] similarly find that the robot vacuum pulls every family member into a new set of relations with the device, eventually reshaping how housekeeping itself is carried out. Naming, like other ways children form connections with their devices, turns the device into a carrier of household practice [48, 58]. Beyond this social dimension, children describe pets, specific devices, and the everyday occurrences as forming a unit, and it is through this unit that emotional reactions and social attributions toward smart home technologies take shape [58]. They also noticed that pets' movements, emotions, and subtle cues often fall outside what devices can detect [31], and they actively worked to make sense of how pets might fit or fail to fit into the regularities the smart home assumes. Through this back-and-forth calibration between what technologies capture and what pets actually do, children become aware of where automation reaches its limits and where their own intervention matters. Out of this, they construct a holistic understanding of the household as a shared environment, rather than a collection of isolated actors [56].



Designing for shared presence and continuous negotiation. As we showed earlier, children in our study directed attention to human and pet household members on roughly equal footing, which resonates with calls to assign humans and non-humans comparable roles in design [48]. This means moving away from treating pets as secondary to human decision-making and instead recognizing them as co-inhabitants of the home. A multispecies design paradigm should attend not only to inclusion but to the ongoing interaction and adjustment that shared living requires; this entails a shift toward adaptive systems that respond to pets' bodily presence and behavioral patterns. Current smart home systems are largely reactive and respond to discrete triggers without adapting to the constant movement and variability of animal life [46]. The devices our child participants imagined, by contrast, supported shared presence and continuous negotiation among household members with overlapping and sometimes competing needs. Centering children's accounts surfaces a view of the household that prevailing design conventions tend to leave implicit, and points toward a different relationship between technology, people, and pets.

Limitations and Future Work

This study is exploratory in nature. It draws on data from a broader investigation that was not originally focused on pets' interactions with smart home technologies. A limitation of our multi-step design, which depends on close engagement with participants, is that only a small number of families took part. Future research should balance in-depth engagement with a larger and more diverse group of participants, including a wider range of household types, pet species, and other contextual factors.

In this formative study, we found that children had a great deal to share about their pets, and demonstrated a depth of attention and reflection. This suggests that technologies for pets may serve as a child-appropriate proxy for understanding how children make sense of other beings in their surroundings. Rather than asking children directly about abstract concepts like agency, empathy, or interdependence, researchers can approach children's understanding of these themes obliquely through the concrete, emotionally charged terrain of pet care. Future work could build on the observational and imaginative capacities children demonstrated in this study to elicit both retrospective accounts of lived experience and prospective design thinking. More design work conducted directly by children is needed, not only to validate the interpretations here, but also to deepen children's own appreciation of the non-human lives sharing their homes. Such work would also give children a meaningful voice in shaping the technologies that increasingly mediate those relationships.

Conclusion

This study set out to understand how children experienced their pets' encounters with smart home technologies and what those experiences could teach us about designing for multispecies households. Drawing on parent interviews, child-led home tours, design workbooks, and closing interviews from five of nine families with children ages 6–11, we found that children actively interpreted, negotiated, and intervened in encounters between pets and smart home technologies. Our findings show that children occupy a distinctive intermediary position between smart home technologies and pets. We demonstrate that automation does not eliminate care but redistributes it, prompting children to engage in compensatory practices that reassert relational presence when they delegate routine caregiving tasks to machines.

These findings have implications for designs that endure across the changing dynamics of multispecies households. They highlight that technologies not explicitly designed with pets in mind can nonetheless shape pets' experiences and wellbeing. This calls for an expanded design space. Children understand households as shared ecosystems rather than collections of independent users. Their reasoning calls into question the narrow functional logic embedded in many consumer smart home products. Designing for multispecies homes, therefore, requires supporting the co-presence of all who dwell in the home and ongoing negotiation between them.

Selection and Participation of Children

Because participation required families to own multiple smart home devices, have children actively using them, and commit to a multi-stage in-person study involving planning and logistics, recruitment took months. We advertised widely through social media, mailing lists, flyers, local schools, children's hospitals, library and institution events.

We used an initial participant interest survey to collect parents' email. Then we followed up with interested parents to schedule a quick call to explain the study details, share consent forms, and answer their questions. We asked parents to discuss this research study with their children before joining the study.

After each family signed the IRB-approved parental consent form and joined the study, we interacted with the child participant from each family twice: the first time was during the home visit for the child-led tour; the second time was a home visit to conduct the parent-child exit interview. For both home visits, we obtained child assent right after we arrived at their home. We informed both children and parents that they could take breaks during the study or stop at any time.

All researchers completed ethics and safety training for children at our institutions, and ensured that children felt comfortable to participate in the study. We anonymized all children's data for the analysis.

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