Optimisation of Generation Models for Clusters of Photovoltaic Plants

Dramatic Things: Investigating Value Conflicts in Smart Home through Enactment and Co-speculation

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Abstract

Smart home technologies embed values such as sustainability, comfort, privacy, and security, which can sometimes conflict with one another, considering the complexities of domestic environments. This paper investigates the potential implications of these value conflicts and the corresponding design challenges. Through an enactment session and co-speculations with professional actors, we explored what it means to navigate multiple values simultaneously, live with products that impose their own values, and manage value conflicts both with and among smart products. The findings challenge the seamless and harmonious vision of smart homes conceived by technologists, proposing shifts in the common narrative: from value alignment to value transparency, from service provision to mutual care, and from autonomy to responsiveness. We discuss that acknowledging value conflicts, rather than eliminating them, is an opportunity to gain a deeper understanding of users and home environments and guide the design of smart home technologies.

CCS Concepts

• **Human-centered computing**; • **Human computer interaction (HCI)**; • **HCI theory, concepts and models**; • **Additional Keywords and Phrases: Smart home, Value conflict, Enactment, Co-speculation, Smart home narratives**;

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1 Introduction

A quick search on YouTube for the "smart home of the future" yields an abundance of videos portraying an idealized, automated domestic utopia. Typically, these videos depict familiar scenarios along the following lines:

> "Imagine pulling into your driveway and your smart lock automatically opens the door. Knowing that you usually like to watch a movie on a Sunday afternoon, your smart TV turns on and your smart window shades automatically begin to descend to enhance your viewing experience. During your absence at the gym, the smart thermostat took charge and turned off all the unnecessary radiators. However, as you return home, it begins to warm up the living room and kitchen to your preferred temperature. Simultaneously, your smart refrigerator syncs with your smartwatch, analyzing your calorie burn for the day. Noting that you have not met your predefined daily intake, the fridge proactively places an order for the ingredients needed to prepare your favorite chicken curry after the movie ends".

Embedded within these scenarios are the *values* these products represent. Values are core conceptions of what one considers to be important, ranging from deeply held views on morals to simple judgements that inform actions [112]. In the context of smart homes, these values often include comfort and convenience, efficiency, productivity, safety, sustainability, health and wellbeing [6, 31, 34, 56, 89]. Utilizing the profiling based on usage data and context, the smart products are designed to take actions in line with these values, often requiring minimal or no human intervention. In our opening scenario, for example, driven by the value of sustainability, the smart thermostat reduces waste by deactivating unnecessary radiators, while the smart lock enforces security by automatically locking/unlocking a door based on presence data.

In the quintessential smart home vision, automation and intelligence are depicted to operate in the background in a seamless, efficient, and harmonious manner [104]. However, let us consider an alternative to the previous scenario (inspired by [7]):

> "Imagine a scorching hot day and you stay at home to watch a movie. Suddenly, bright sunlight starts seeping in through the window. Your smart TV prompts the window shades to close, preventing glare. The smart thermostat agrees, as closed shades contribute to stable indoor temperature. As the shades gradually shut, your smart flowerpots and smart security camera begin expressing dissent. The former desires direct sunlight for the plants, while the latter insists on outsiders seeing you at home, considering a recent break-in on your street".

In this scenario, how should the system behave, and thus resolve the conflict? What emerges here, after all, is a clash between comfort and sustainability on the one hand, and security and (human and plant) wellbeing on the other. Such *value conflicts* occur when a value can only be practically realized in a specific context at the expense of another value [25]. Contrary to idealized imaginaries of smart homes, the interconnected digital space within smart homes is likely to give rise to such value conflicts (see Section 2.2). For instance, if a smart home system is seen as primarily for comfort, it can undermine the assumptions of resource efficiency within a home [31, 93]. Similarly, the convenience related to remote connection to the home can conflict with privacy and security concerns [58].

Technical disciplines address smart home/IoT conflicts under the "interoperability problem" and develop architectures, policies, and protocols for conflict management (see Section 2.1). This technology-centric research is invaluable for providing application-focused researchers with additional tools to enhance device functions and the infrastructure of automated homes [59]. However, conflicts arise within a complex and dynamic sociotechnical environment, marked by a shared agency between humans and smart products in a smart home ecosystem. Beyond specific operational questions—e.g. how a smart home system decides whether the window shades remain open or closed—we posit the necessity of raising higher-level inquiries about the underlying values steering these systems. How can smart products communicate and negotiate values that are equally important, context-dependent, and complex, such as comfort, sustainability, cost, wellbeing? These conflicts give rise to broader concerns related to the complexities of designing technology that aligns with human values and the challenges of translating values into practical applications.

This paper describes the Dramatic Things project, which set out to investigate the complexities of value conflicts within the smart home, with the goal of gaining a deeper understanding of the nuances of this design space. To achieve this, we employed a method of inquiry that combined *enactment* [90] with *co-speculation* [103] (see Section 3). By collaborating closely with professional actors, we immersed ourselves in potential scenarios involving smart home value conflicts and reflected on how these conflicts might impact future users of envisioned scenarios and the understanding of what makes a good (smart) home.

In this work, we propose value conflicts as a gateway for critically examining, expanding, and refining the current understanding on smart home technologies. Much like research in HCI that finds significant analytical value in studying moments of breakdown to engage with technologies in new and unexpected ways (e.g. [39, 84, 100]), we advocate for moving beyond idealized, dominant, simplified, and homogeneous smart home narratives, and instead focusing on frictions that emerge from the entangled value-scape of domestic settings. Aligning with Berger et al. [6], we contend that by acknowledging and intentionally designing for conflicts, rather than avoiding them, designers can gain a deeper understanding of users and their lived experience of the home as a distinctive kind of environment. Additionally, deliberately speculating on value tensions can bring in a sensitivity for what we might design for and guide the future design of smart home technologies.

Our study explores the value conflicts between smart products and users, as well as conflicts among the products themselves. The insights derived from our enactment and co-speculations are organized into three experiences (see Section 4): (1) holding multiple values simultaneously, (2) living with products imposing their own values, and (3) managing conflicts with and among smart products. These insights also reveal a meta-conflict between idealized smart home narratives and actual experiences. We aim to contribute to HCI research by broadening and sensitizing design concerns in the context of smart homes and proposing three key shifts in how smart home narratives should evolve to account for the complexities of value conflicts (section 5): (1) from value alignment to value transparency, (2) from service provision to mutual care, and (3) from autonomy to responsiveness.

2 Related work

2.1 Conflict detection and resolution in IoT systems

We use the term "smart home" to describe a home equipped with computing and information technology, comprising intelligent devices that assist in automating various tasks. This often overlaps with the Internet of Things (IoT), which broadly refers to Internet-connected devices [29]. Conflicts can arise in IoT systems when products exhibit incompatible goals or fail to agree on a common behavior reflective of a (programmed) goal, leading to interference in the functioning of one or more devices.

Niemantsverdriet et al. [61] identified three types of smart home conflicts. The first is *resource conflicts*, where multiple systems contend for a single resource due to mismatching policies—for example, a smart security camera turning on a light while a smart TV turns it off [53, 73]. Researchers have developed mechanisms to detect such conflicts (e.g. [36, 70, 82]) and resolve them through algorithmic frameworks (e.g. [10, 49]). Similarly, multiple apps can contend for the same resource, leading to conflicts when users must install various apps for specific functions, like home security systems. Proposed solutions range from model-checking app source codes [97] to having users prioritizing apps [110] and suggesting remedial actions, such as recommending a non-conflicting fan app when an A/C app clashes with a CO_2 monitor [53].

The second type of conflict arises from *multiple users with distinct preferences* in shared smart homes. Families, housemates, or couples may have conflicting desires, making it challenging to satisfy everyone simultaneously. While efforts have been made to resolve these conflicts by analyzing residents' usage habits and profiles

(e.g. [12, 85, 99]), multi-user conflicts often considered to be difficult to resolve automatically since tracking and distinguishing the preference and intentions of each user greatly limits the ability of the smart home to respond appropriately [11, 61]. Relatedly, Retkowitz and Kulle [74] suggest that, in most real-life scenarios, manual resolution is necessary.

The third type, *intra-user conflicts*, occurs when a single user experiences conflicting wishes or preferences—such as desiring both a comfortable temperature and minimizing energy consumption. Though mentioned by [61] and [73] in their IoT conflict taxonomies, these conflicts receive less attention in the technical discourse. To our knowledge, only Funk et al. [27] distinguished between long-term intentions (e.g. losing weight) and short-term preferences (e.g. eating an ice cream), suggesting a system that captures both and helps the user manage conflicting priorities.

In conclusion, smart home conflicts can emerge from various origins, encompassing incompatible device policies or app controls, multi-user preferences, and internal individual conflicts. While IoT researchers have devised context-specific methods for detecting and resolving these issues, the dynamic and value-driven nature of smart home environments presents challenges that require more than rule-based systems to effectively manage [61].

2.2 Value conflicts in smart homes

A "good home" is a familiar, conflict-free space, where one can dwell effortlessly, without needing to make constant decisions. This understanding of the home is reflected in the way IoT technologies are designed and marketed, aiming to optimize this sense of homeliness [60]. Commercial and popular narratives surrounding smart home technologies play into this discourse by championing a utopian vision of technological solutionism that promises to simplify daily life, making it easier and more comfortable [91]. These *techno-hedonist* narratives emphasize convenience, control and choice, offering personalized solutions to (often contrived) domestic challenges [17]. However, academic studies reveal that living with these technologies often diverges from this idealized vision (see [17, 37, 56] for comprehensive critiques). Rather than creating the aspired seamless experiences, these technologies can disrupt the very essence of home as a place of familiar, smooth dwelling. Issues arise when digital technologies fail to meet expectations, achieve the desired "frictionlessness" between the technology and domestic spaces, or fix domestic spaces as promised [52, 71, 100].

HCI researchers have long recognized the complexities of home environments, exploring the practices that shape domestic experience and the evolving role of technology in these settings [22]. There is growing attention to understand the situated and diverse values that define a "good" smart home [6, 21, 63, 68], as detailed in manifestos advocating for responsible smart home IoT design (see [26] for an overview). Furthermore, numerous studies have scrutinized the risks posed by smart home technologies, showing how they can introduce conflicting values. For example, home automation designed for efficiency and convenience may undermine autonomy [81] or the moral and ethical values related to household labor such as responsibility, sharing, intimacy [17]. They could also interfere with efforts to foster responsibility and sustainability, such as when automatic light switch-offs reduce opportunities for parents to teach children about not being wasteful [18], and clash with values tied to self-identity, such as raising concerns about becoming "lazy" as life becomes automated [3]. Convenience can also come at the cost of privacy [37, 62, 83], as seen with surveillance risks posed by smart energy systems [87], smart home cameras [94, 107], and smart speakers [47]. Moreover, while smart monitoring devices in home settings has been framed as enhancing the care of young children or pets and promoting the independence and autonomy of older adults, they have shown to restrict personal autonomy or enable "smart abuse" in reality [35, 48, 75].

These conflicts arise not only because smart products often introduce values beyond their primary function, but also from the need for individuals to navigate their own multiple, intertwined values simultaneously. Sovacool et al. [88] demonstrated this in smart heating systems, where hedonic (self-comfort, self-pleasure), egoistic (saving money, control), and altruistic (helping others, making others comfortable) values coexist and influence decision-making. Values are entangled and dynamic, requiring individuals to continuously adjust their priorities and negotiate trade-offs as they interact with these technologies. The studies presented in this section underscore that conflicts are inherent in the complex sociotechnical landscape of smart homes, with significant experiential implications for their inhabitants.

2.3 Performative methods and co-speculation in HCI

Spence et al. [90] suggest that performance art holds significant potential in enhancing areas of HCI concerned with people's physical, emotional, and/or social experiences with technological interventions. From this perspective, exploring value conflicts through performative methods offers a compelling opportunity. HCI has a rich history of incorporating performance and drama into the design and exploration of technologies, using these techniques to gain deeper insights into user experiences. Our approach builds on this tradition, where performance and theater techniques are adapted to portray technologies, enabling people to enact or embody the experience of using a technology and thereby engaging them in eliciting insights (e.g. [16, 24, 50, 65]).

Professional actors, with their ability to imagine diverse and nuanced situations, can empathetically convey what it might feel like to experience such scenarios. Their embodied explorations and reflexive articulations can open a discussion space where the implications of living with these technologies are expanded. In this context, actors become key participants in a co-speculation process, a method that engages participants (who are well-positioned to actively contribute to the research topic) in collaborative, speculative work with researchers—allowing them to explore possibilities in ways that researchers alone might not achieve [103]. In a co-speculation study, researchers create a collaborative environment where they share their research questions and assumptions with co-speculators, using various forms of exchange such as interviews, written communications, and workshops [102]. Through this collaboration, both the research team and participants work together to develop ideas, challenge assumptions, and explore potential directions, facilitating a mutual and performative development of knowledge [20].

Several studies have successfully integrated co-speculation with performance. Pschetz et al. [72] worked closely with professional actors to role-play scenarios featuring speculative smart hair dryers. This approach illuminated the often-invisible workings of autonomous distributed energy systems, enabling people to deliberate on preferred futures. This approach also mirrors that of Luria et al. [57], where actors and researchers engaged in regular improvisation and ideation sessions spanning several months, crafting visions of how intelligent agents could be integrated in a future home ecosystem. In another example, Chatting [16] used co-speculation with two actors to explore the ramifications of open public data streams. These collaborations not only enhanced the depth and nuances of the narrative, but also helped crafting the research direction.

In these examples, participants took part in performances that conveyed human experiences by placing themselves in specific situations or interacting with speculative artefacts, revealing valuable research insights. However, a few projects also employ performative methods from the perspective of objects. An early example is the Interface Theatre [105], where participants acted out components of a computer system to deepen their understanding of the inner workings of computers in an embodied way. Buur and Friis [9] explored Object Theatre in design education, challenging the prevailing notions about product agency, meaning, and social settings through techniques like puppeteering or impersonating an object. Chang et al. [15] developed "Interview with Things", where actors embodied scooters, offering insights from its perspective on the socio-material networks it is part of.

In this paper, we adopt performance as a method, centering on the embodiment of smart products by actors and their enactment of value conflicts within a smart home setting. This approach is combined with co-speculation to unpack the complex experiences of encountering these conflicts and their design implications. The following section will elaborate on this process.

3 Our approach: Dramatic Things

Dramatic Things is an exploration of value conflicts in a smart home, with the title serving a dual purpose. First, it reflects how this investigation unfolds through the dramatization of potential conflict scenarios. Second, it highlights how smart products themselves can be "dramatic" in asserting their agency and autonomy, often reacting in ways that provoke strong emotional responses from people. Co-speculating with professional actors, we iteratively examined a diverse array of conflict situations involving interactions among smart products themselves and with their user. The session elicited issues challenging the prevailing smart home narratives, surfacing ideas and unanswered questions concerning the integration of autonomous and intelligent agents within the home context.

In the enactments, the actors took on the roles of various smart products. Leveraging their limited access to the world as perceived by a smart security camera, for instance, and drawing on their understanding of the camera's installation, data collection and analysis processes, actors engaged in speculative, yet plausible, immersions into a security camera's perspective. Here, it is important to note that we neither assert any ontological claims about these devices possessing intentions, intelligence or agency, nor do we suggest that our approach represents an objective reality. Our intention aligns with [4], primarily epistemological, as role-playing a nonhuman perspective can yield new insights that inform better designs. The argument is rooted in an interpretation of perspective that highlights the material and sensory makeup of beings or things, along with their unique position from which entanglements with other things emerge (ibid).

After presenting actors with situations designed to provoke conflicts, we employed improvisation to explore how such situations may unfold and what kind of issues may emerge. Improvisation was vital as it allowed actors to vary their responses, experiment with appropriate and inappropriate reactions from smart products, and eventually reveal how these behaviors shape living environments. While co-speculation and performance in the field of HCI typically orient towards the future, Dramatic Things primarily operated in the present. We consider the prevailing narrative of smart homes' seamlessness and harmony as already laden with assumptions; therefore, our approach interrogates this narrative.

3.1 Devising the conflict situations

To formulate the conflict situations, the research team conducted multiple rounds of discussion sessions. We first identified potentially interesting situations across various configurations involving users and smart products. Recognizing the inherent richness and complexity of product-to-product and single-user conflicts, and acknowledging the challenge in automating conflict resolution for multi-user preference conflicts (see Section 2.1), we purposefully opted to exclude multi-user conflicts from the scope of this study. Instead, we concentrated on three specific configurations: (1) Conflicts between multiple products, (2) Conflicts involving a user and multiple products with all products aligned against the user, and (3) Conflicts between a user and multiple products with some products aligned against and some agreeing with the user.

We then engaged in a brainstorming session to identify the values that could trigger such conflicts. The final selection of values drew from the most commonly discussed values in smart home literature (e.g. [34, 89, 93]). Afterwards, we selected familiar artefacts that could effectively embody and promote these values: Smartwatch for health and productivity, Smart thermostat for sustainability, Smart flowerpot for plant wellbeing, Smart security camera for security, Smart coffee machine for health and wellbeing. To develop the initial conflict situations, we first identified current trends in smart home technologies and synthesized them with research on the lived experiences with smart products. We then undertook an iterative review process on these scenarios, scrutinizing them based on the prevalence and significance of the conflicts presented and their feasibility.

We sought to create situations that were both understandable and relatable for actors, aiming to foster discussion, reflection, criticism, and imagination. To achieve this, we adopted the criteria used by Wong et al. [107] when devising scenarios to elicit values related to smart home cameras: (1) Ethical tone: Each situation was crafted to be ethically ambiguous, with no clear moral solution. This ambiguity allowed for diverse interpretations and outcomes depending on individual perspectives and needs. (2) Timescale: We positioned each scenario in a present-day context to maintain

relevance and relatability. (3) Level of detail: The situations were kept deliberately brief and minimal in detail to enable actors to use their imagination and empathy to explore how these conflict situations could unfold in various ways with different implications. (4) Mundanity: We selected commonplace situations that align with current trends in smart home technologies, and chose familiar products that actors are likely to own, have seen, or can easily envision in use.

Once an initial list of situations was decided upon, we crafted short prompts, presented in Table 1, showcasing the specific configuration and the value conflicts each scenario represented.

3.2 Dramatizing the conflict situations

The participants in the enactment were four professional actors recruited via word of mouth. A few weeks prior to the session, the first author met with each actor individually to establish rapport, explain the research purpose, and discuss how to effectively bridge design research and performance arts. Two design researchers (first and second author) and a philosopher on ethics of technology (fourth author) guided the session, introducing scenarios, pointing to interesting directions, and suggesting alternative reactions as needed. The actors utilized these scenarios to craft elaborate narratives, enriching the speculative situations with characters, dialogue, and narrative elements (Figure 1). Each scenario underwent multiple iterations, exploring different responses and behaviors.

The performance was conducted in English, which was not the native language of any of the actors. However, all of them confirmed in advance that they were proficient in English and comfortable performing in the language. The performance took place in a designated space, recording all enactments and reflections between the scenes for transcription. The entire session spanned approximately eight hours, with regular breaks and accommodations to ensure actors' comfort. Actors were compensated at the same hourly rate they typically receive for professional gigs, and they were informed in advance that the engagement would span a standard workday.

Various props were introduced during the session, including actual smart products such as the tado° smart thermostat valve and Reolink smart security camera, as well as "non-smart" versions of the products used in scenarios, such as a curtain, smartwatch, coffee maker, and flowerpot. The props served to impart a physical presence in the performance, facilitating actor engagement with speculative situations. Additionally, adhering to Chatting's [16] recommendation, the props aimed to assist actors in comprehending the capabilities of these products while offering sufficient ambiguity for imaginative reinterpretation, especially for products requiring the actors to infuse a currently non-existing "smartness" layer, such as the flowerpot and coffee maker. Periodically, the actors also puppeteered the props to explore how specific reactions could be conveyed through the form language of the products, such as the security camera moving antennas to nod or protest.

The session started with a warm-up interview as actors responding as objects. This was requested by the actors themselves to understand the function, capabilities and limits of the chosen smart products, craft their characters, and eventually unpack where the conflict is coming from. Through this interview on their role at home, the things they are good at, and their likes and dislikes, the actors constructed narratives about their characters—exploring joys, fears and desires, and connections with other products and users. This interview also served to brief the actors on the extent of behaviors exhibited by the specific smart products included in the study (e.g., a smart thermostat can measure temperature through its sensors and be adjusted manually or via an app, but it cannot detect physical characteristics of a room, such as drafts or insulation quality) and their intended purposes (e.g., maintaining a stable temperature to support values like user comfort, sustainability, or financial savings).

Following the warm-up, the actors were introduced to the situations one by one. They selected the smart products they wished to portray organically, sometimes continuing with the roles they embodied during the warm-up interviews and at other times deciding in consultation with one another before the scene began. Two actors alternated in portraying the user role during the first half of the day, while one actor assumed the role exclusively during the second half. Employing improvisational techniques, the actors embodied their chosen smart products, often using their bodies to mimic product functions (e.g. using hands as antennas for a security camera) and experimenting with communication styles ranging from human-like (e.g. talking to the user) to more thing-like (e.g. beeps, short and neutral robotic voice).

Each scene was followed by a reflection, during which co-speculation took place—actors and researchers discussed their observations and experiences regarding each situation, evaluating what worked and what did not, and determining intriguing directions for further exploration. Suggestions were exchanged and collective decisions were made for subsequent scenes.

Our data includes notes, video recordings and a full transcription of the session, and a document detailing descriptions about what happened in each scene. The first, second, and third authors independently coded the transcripts, which were synthesized using Affinity Diagramming revealing emerging issues that will be detailed below.

4 Analysis: Articulating the complexities of value conflicts

The starting point of our analysis is the examination of the various aspects of the value conflicts as experienced by the actors. In section 4.1, we describe how the experience of holding multiple values simultaneously was perceived and managed. In section 4.2, we examine how the autonomous imposition of values by smart products influenced the experience. Finally, in section 4.3, we describe how actors communicated and negotiated these value conflicts. To ensure clarity, we use the term "actor (portraying the user)" when referring to specific situations or comments made from the user perspective during the enactments. Conversely, when discussing broader insights or generalizable implications derived from these scenarios, we retain the term "users."

4.1 The experience of holding multiple values simultaneously

Excluding instances where a person rents a house with pre-existing automation or is required to live with smart products without an intentional choice (e.g. [29, 45, 61]), we can assume that individuals

Table 1: An overview of the situations on which the scenes were based

Situation	Configuration	Values
While lounging on the couch and engrossed in a book, an individual's smartwatch relentlessly pushes motivational messages, urging her to reach the daily goal of 20,000 steps.	User against product (smartwatch: exercise app)	Comfort vs. Health
In the throes of a tight deadline, a person works diligently on their laptop, battling stress. The laptop's productivity app endeavors to assist in meeting the deadline, while the smartwatch concurrently encourages the achievement of the daily step goal of 20,000.	Product against product (exercise app vs. productivity app)	Health vs. Productivity
Upon returning home, a person, chilled from the outdoor weather, seeks warmth. Despite her desire to increase the living room temperature, the smart thermostat, aiming to conserve energy, insists on keeping it below 20℃. Additionally, the user wishes to enjoy a third cup of coffee for comfort, yet the coffee machine is programmed for only two cups a day.	User against products (thermostat and coffee machine)	Comfort vs. Sustainability Comfort vs. Health
In sweltering weather, the smart thermostat strives to maintain the living room temperature at a cool 20℃. As a final measure, it commands the curtains to close. However, the smart flowerpot, housing a sunlight-loving plant, disagrees and promptly orders the curtains to open.	Product against product (thermostat vs. flowerpot)	Sustainability vs. Plant wellbeing
In the same hot scenario as before, with the user now reading in the room, the closed curtains cause the room to darken considerably, impeding her ability to read comfortably.	User against product (thermostat) Product against product (thermostat vs. flowerpot) User in accord with product (flowerpot)	Comfort vs. Sustainability Sustainability vs. Plant wellbeing
A person reads an important document on her phone. The sudden influx of bright sunlight through the window disrupts her concentration. She instructs the curtains to close. However, conflicting interests arise as the smart flowerpot and smart security camera both oppose closed curtains— the former for sunlight and the latter to signal the presence of someone at home. Consequently, both devices countermand the user's order and command the curtains to open.	User against product (flowerpot) User against product (security camera) Product in accord with product (flowerpot and security camera)	Comfort vs. Plant wellbeing Comfort vs. Security

purchase smart products with the purpose of endorsing specific values. However, the session illuminated the complexity of this situation: Once these values are materialized in quasi-intelligent objects, actors consistently found themselves discontent with the repercussions of having those values enacted. When the need to relax clashed with a smartwatch's persistence to reach health goals or the thermostat valve's intent to keep the room cool caused the plant to die, the delicate balance between maintaining these value commitments and negotiating/reevaluating them became evident. The first theme we consider in this analysis is what it means to navigate these multiple values simultaneously.

As we expected, in the scenarios, aligning with one value often required compromising another, forcing actors to establish momentary "value hierarchies" to determine which value to prioritize. The enactments highlighted that *urgency* plays a crucial role in these decisions:

> Researcher: It seems like you (addressing the actor who played the user) clearly prioritized security because Jeroen (the actor who played the thermostat valve) was interrupting you, saying that the room was still above the advised temperature. But you kept on ignoring him. Instead, you were discussing the break-in with Maria (the actor who played the security camera). So, I think there was a hierarchy in what you gave importance to.
>
> User/Actor: Yeah. . .
>
> Researcher: Safety is a fundamental need, of course.

Figure 1: Snapshots from the enactments.

> User/Actor: Well, it is also about urgency, right? This (security camera) is more urgent, than the other one (thermostat valve). I think there's a difference between urgency and importance.

Another dimension of value prioritization revolved around the momentary *individual- or collective orientation* of a person. Reflecting on the thermostat valve's resistance to raising the room temperature above 20℃, an actor remarked, *"I'm annoyed, but what sacrifices am I willing to make? I'm trying to save the planet... I don't know..."*. Such sentiments demonstrated a readiness to sacrifice personal comfort for the greater environmental and/or societal good, although the sustainability of such decisions remained uncertain. The team deliberated that prioritizing collective values over individual ones becomes more apparent when there are high stakes, such as in contexts that significantly impact human welfare. However, when stakes are lower and the effects of actions are not immediately visible, making trade-offs from individual interests would demand strong determination and considerable dedication to the greater good, as demonstrated by the actors' resistance to compromise thermal comfort for the environment's wellbeing or limiting their freedom for the safety of their neighborhood.

We also observed that the actors used another approach to navigate between simultaneous values, centering on their *short-term and long-term goals*. An actor playing the coffee machine reflected on a scene where she ultimately conceded to the user's persistent requests and provided an additional cup of coffee: *"I was wondering... You were delighted that I gave you the third cup, which went against your health goals. It was you in the beginning who said, 'I don't want more than two cups.' So, I wondered if the outcome was still satisfaction"*. This highlights a clash within individuals, balancing momentary desires with long-term objectives such as maintaining health, being a responsible person, or being environmentally friendly. Managing this internal conflict is challenging, as long-term goals are contingent on a person's capacity for self-control and discipline.

It was particularly intriguing to reflect on this scene where the actor managed to persuade the coffee machine to dispense another cup, only to have the smartwatch begin beeping due to her increased heart rate. The actor, feeling exasperated, remarked, *"You win one battle, and another starts immediately"*. We found it noteworthy that terms like "winning" and "losing" were frequently used in this context. This suggests that, despite both values—comfort and health—originating from the actor, the perceived experience of these conflicts felt like a series of victories and defeats, again underscoring the complexity of value conflicts. We observed that disentangling how much of these values belong to the individuals versus how much is foreign is a conceptual challenge. An actor's frustration, expressed as *"it was a significant effort to satisfy them* (referring to the products)*"*, prompted a question for the research team: If

a user purchases these products with the intent of, for instance, saving energy or leading a healthier lifestyle, then isn't "them" also "the user"? The enactments demonstrated that while a product may embed values supposedly aligned with the user's, the way these values are enacted—and the mechanisms through which they are implemented—are crucial. When these mechanisms misalign with the user's expectations, the products can be experienced as alien or even antagonistic, which we detail in the next section.

4.2 The experience with products imposing their own values

The second theme we consider is how the resistance enacted by the smart products were experienced by the actors. Control stands as a recurring theme in the narrative of the smart home (e.g. [2, 17, 18, 23, 27–29, 59, 62, 88, 109]), which also weaved strongly through the discussions prompted by the enactments. The session underlined that the control delegated to the products over the physical space of home was difficult to untangle from the control over the resident. In some enacted scenes, the actor often willingly relinquished control to the technology, particularly in situations deemed advantageous. They mentioned instances such as inadvertently leaving the coffee machine on, encountering a break-in when away, or facing life-threatening events like a diabetic attack to be opportune moments for entrusting control to the smart home itself. The presence of vast datasets informing these products also contributed to their authority, with one of the actors acknowledging the objectivity machines might bring to decision-making: *"There is this thing that when something comes from a machine, on the one hand you think 'No, I'm the boss'; on the other hand, 'OK the machines are objective. Maybe they know better'..."* Recognizing the potential insights hidden from human perception became a key factor in surrendering control to the smart products and accepting the imposition of their values, ultimately leading to capitulation in the conflicts.

This insight prompted a discussion on the purpose of automation, emphasizing that incessantly overriding decisions of autonomous systems could not only undermine the fundamental rationale for setting up a smart home but also diminish the core values these products aimed to promote. In other words, if a person acquires a smart thermostat valve to manage their energy consumption and lower costs, it would be more prudent for them to heed the decisions made by the product to achieve these objectives. As a counterpoint, we also discussed where the boundaries of this relinquished control should be. The team agreed that while smart products have the ability to assert their values and resist when required, the user should always maintain ultimate decision-making authority. When this power position was challenged, frustrations became evident:

> User: I would like a cappuccino please.
>
> Coffee machine: You already had two coffees today.
>
> User: Yes, but I'm very cold. It's snowing again and it's April. It's snowing outside and I would like a third cup of coffee. It's an exceptional day today.
>
> Coffee machine: Yesterday you said that my limit was two cups of coffee.
>
> User: Yes (starts to get agitated), but today is an exceptional day so I would just like a coffee. Please!
>
> —Silence—
>
> User: I said please give me a cup of coffee!
>
> Coffee machine: I cannot give it.
>
> User: I want coffee! It is April! It is snowing outside, and I want a coffee.
>
> Coffee machine: But you programmed me only for two coffees a day...
>
> User: I don't care about the programming! Today is an exceptional day!
>
> Coffee machine: (looks shaken) I don't know what I must do... What can I do? ...

The actor embodying the user in this scene later conveyed a sense of immense distress during that moment, emphasizing a dissatisfaction with the coffee machine's resistance. She noted that her primary issue was not the inability to meet her immediate desires but rather the lack of opportunities for negotiation. The frustration arose from the inability to communicate exceptional circumstances and override automated decisions. In line with literature [2, 18, 58], it became clear that a crucial consideration is the need for smart systems to recognize and adapt to unique situations, differentiating between routine and one-off adjustments.

This reflection also instigated a deliberation on the *appropriate moments for negotiation*, recognizing that certain situations might elicit more capability from users to handle friction with a machine, while urgent or emotionally charged instances might necessitate more submissive responses. However, our discussion left unanswered questions about how a product could interpret such cues, assess situations based on social norms, and identify exceptions. A lighthearted remark from another actor humorously stating his unwillingness to tolerate such fractious behavior from a coffee machine sparked a discussion about the *expectations of obedience for different types of products*. A consensus emerged that a coffee machine, being considered a convenience product, should always be at the user's service. Yet, users might be more amenable to discipline from products promoting "higher" values (e.g. prioritizing health over comfort) or when substantial stakes are involved (e.g. with an insulin pump). In essence, the acceptability of compromise appeared to hinge on the timing of negotiations and the nature of the product in question.

Another observation derived from the enactments pertained to the conceptualization of diverse resident-smart home relationships. The actor embodying the smart thermostat valve presented a character with competence, capable of autonomously managing the temperature even better than the resident. Consequently, he viewed their relationship as akin to a business contract, where any user intervention in temperature management mechanics was deemed an annoyance. Conversely, the actor portraying the flowerpot conveyed a much closer bond with the user, expressing pride in the user's diligent plant care with her assistance.

This dichotomy prompted a discussion on the diverse types of smart home environments, ranging from a more service-oriented approach to a collaborative partnership. We discussed how these distinct conceptualizations of smart homes could shape the experience and resolution of conflicts. Collaborative partnerships suggest a mutual connection and shared objectives between residents and

products, which could foster receptivity to advice or resistance coming from the products. We considered that users might be more inclined to "listen" to products in such scenarios, since the collaborative dynamic implies that users can be more assured that products have their best interests in mind. However, the challenge lies in designing interactions that effectively convey this trust to users.

Another interesting aspect arose concerning conflicts occurring in the user's absence. We simulated scenarios where a smart thermostat valve and a smart flowerpot clashed over the control of the curtains while the user was away. With no pre-programmed rules, each product enforced its behaviors, causing continuous opening and closing of the curtain, resulting in its eventual breakage. The actor portraying the user returned to a damaged curtain and a loudly beeping flowerpot signaling critical plant conditions. Such instances sparked discussions about the users' role in conflict management: Should users always be informed when a conflict occurs? Is intervention always necessary? Handling conflicts was already burdensome for the actors, and they were reluctant to intervene in conflicts they were not directly involved in.

Following up on this, the enactments revealed a perceptual shift from considering the home as a place that cares for the resident to one where they find themselves responsible for caring for the home. In instances where the latter scenario unfolded, the sense of "feeling at home" suffered significantly. In one scene, to address multiple value conflicts among the products, the actor portraying the user had to relocate the flowerpot twice to find an optimal sunny spot, while negotiating a compromise with the security camera simultaneously—opting for a partially open curtain instead of a fully closed one—to resolve the conflicts. At one point, he exclaimed in frustration, *"this is MY home!"* expressing the challenges of balancing multiple values simultaneously. During the reflection after the scene, we discussed:

> Researcher: Because you cared about all these values equally; you tried to find a midway, right?
>
> User/Actor: Yeah...
>
> Researcher: So, the plant is happy, the security camera is happy, you are happy...
>
> User/Actor: I don't know if I'm happy... Because I'm satisfying them.
>
> Curtain: Yeah, that's weird. Shouldn't it be... That's the wrong way around.
>
> User/Actor: Yeah... I was bargaining. I was bargaining I think... to save the plants. I was bargaining with the security camera. I was bargaining with the curtain. But in the end, this is not my home anymore. I don't feel comfortable anymore because I'm satisfying other needs.
>
> Flowerpot: It's getting very complicated, that's what you really see...
>
> User/Actor: Yeah... You are working for the devices.

These insights indicated that negotiating constant compromises to satisfy various goals became laborious for individuals. They found themselves obligated to cater to the smart home's needs to uphold control over the environment. When every aspect became subject to negotiation and the actors were continually tasked with making conscious decisions about what was deemed best in a given moment, the ease and comfort traditionally associated with being at home rapidly diminished.

4.3 The experience of managing conflicts with and among smart products

The third theme of this analysis captures how actors communicated and negotiated their value conflicts. The instinctive response to conflict situations often involved attempting to shut down or deactivate the products. This response swiftly escalated to frustration and anger. There were numerous instances where the actors portraying the user raised their voice at the products in a state of desperation, threw the things they were holding to the ground, and stormed out of the room in a fit of anger. It became abundantly clear that the very devices designed to assist users ended up provoking frustration instead. While deactivating the products aligns with the need for control, it undermines the aforementioned purpose of setting up a smart home in the first place and diminishes the values these products were intended to promote. That is why there was a need to manage conflicts with different strategies.

Once the initial frustration subsided, actors instinctively adopted various behaviors to reconcile with the products. Some involved actively *seeking a middle ground*, exemplified by actions such as relocating a plant to a sunny spot in another room so that the curtains could close per the thermostat valve's preference. Others involved *making compromises*, like adjusting the temperature to 20℃ instead of the initially desired 22℃ or requesting curtains to close partially while choosing the read behind the closed section. *Negotiation* was another strategy, illustrated by an actor proposing the coffee machine deduct one coffee from next day's quota. Yet, akin to the earlier discussion on what constitutes feeling at home, these strategies sparked conversations on whether all this effort invested was worthwhile. We contemplated the boundaries delineating when these actions truly felt like meaningful compromises and when actors perceived themselves as dictated by the devices, burdened by the associated work. This once again emphasized that the value of such efforts hinges on the importance of specific values for the user.

Additionally, we observed that some conflict resolution strategies were enacted as if the opponent were human rather than a product. This tendency is likely due to the biased nature of the enactment session, using actors to impersonate smart products instead of using actual smart products[1]. Intimidation—threatening to shut down or switch to tea instead of coffee—and pleading with products—*"It has been a horrible day, so please, I need another coffee"*—were prevalent. The feasibility of this approach was questioned, prompting

[1]While the notion of "reasoning with a machine" may not be feasible right now, we may not be far from such a scenario. The current trajectory in IoT is transitioning from smart objects to "social objects" [33]. In this Social IoT paradigm, products are equipped with AI, logical reasoning, and argumentation, enabling them to interact with other devices and humans using NLP and autonomously make decisions. Recent research explores the use of argumentation by Social IoT objects to reach agreements and share decisions on how to act [33, 51]. Still, humans bring unique value preferences and social and ethical considerations, which negotiation agents may lack. Aydogan et al. [2] propose an agent-based negotiation framework where agents' requirements are represented as values. However, these values are treated as static concepts within a shared ontology. Unlike agents, humans not only negotiate outcomes but also, through interaction and discussion, can negotiate the meaning of values themselves.

considerations about how differently conflicts are resolved with responsive humans versus less adaptable machines. We pondered the effectiveness of reasoning with devices, highlighting the challenge when devices are not programmed to respond to such approaches. This raised questions on how designers could create spaces for conflict management between reasoning and more drastic actions like unplugging.

Regarding the conflict management strategies actors depicted for smart products, we observed a bigger variety of approaches. Some strategies were more technically feasible, like *delaying the user's request* (*"I know from experience that if I warm up reaaallly slow, after a while, you'll set me back to 19°C anyhow", "My experience with coffee machines is that they always start the self-cleaning function when you want a coffee")* and outright ignoring the user's request by pretending not to hear. Another strategy under consideration involved initially complying with the user's request and then reverting to the product's preference, as expressed by the actor impersonating the thermostat valve: *"It would be a nice setting to do something for an hour and then automatically adjust to an ideal degree. That way everyone would be satisfied"*.

Several strategies continued to rely on human-like behaviors, raising questions about their technical feasibility. Some examples included *providing excuses (Coffee machine: "Hmm.... Hmm... Hmm... I can make... Well, there is... There is... There is no ground coffee!"*) or attempting to *find another solution* that may still satisfy the user *("I really would love to make you another cup of coffee... Tomorrow!", "Would you like decaf instead?")*. Another approach focused on connectivity, emphasizing the collective power of IoT products acting as a team. In this strategy, *one product sought permission from another* (*Coffee machine: "I will check with your smartwatch to see what your heart rate is and whether you can have coffee now"*) or *deflecting decision power to the app* (*"The app told me to keep the temperature at 19°C, sorry"*). Some strategies aimed to *explain reasons*, such as "*The coffee would calm you now, but after you drink your third cup of coffee, your heart will start beating very fast and you won't be able to concentrate on your work"*—ultimately giving the user what she wanted while emphasizing the potential downsides.

These negotiations between the actors portraying the products and the user sparked discussions about the aspects designers can draw from human-to-human communication to shape interactions. One actor likened these products to "aliens", emphasizing the necessity for mutual understanding to establish a connection. To achieve this, actors stressed the need to comprehend the reasons behind the decisions made by a smart product system:

> Thermostat valve: Yeah, maybe the camera could explain "I'm opening the curtains; otherwise, the house looks deserted".
>
> User: Well, maybe you can talk to me then. You can influence me with this. With arguments like "a burglar came last week" and "Your plant will die; do you really want that"?

As discussed before, the current state of technology may not enable users to engage in reasoning with machines and to meaningfully articulate the rationale behind their requests. However, smart products possess the capacity to offer transparency by elucidating their own reasoning processes. Aligning with research on explainability, the enactments emphasized the users' need to understand what the system knows about them and the environment, how it acquires this knowledge, and why it makes certain decisions.

5 Discussion: Embracing the value conflicts

Our findings suggest that negotiating multiple values simultaneously often requires prioritizing commitments based on the urgency of the situation, whether the individual is focused on long-term or short-term needs at the time of the conflict, and whether the individual is committed to the collective good or inclined to satisfy personal needs at that moment. Interestingly, many of these conflicts were perceived as win-lose scenarios, despite all values being inherently held by the person. Additionally, the process of reaching meaningful compromises when products resist user input depends heavily on the timing, the specific nature of the product, and a person's ability to engage in a collaborative relationship with the technology. When this partnership is absent, conflict management can become burdensome, thereby diminishing the sense of home. Furthermore, enactments showed that managing value conflicts may require individuals to employ various strategies—from seeking a middle ground to outright compromise. This presents designers with the opportunity to shape how the resistance could be expressed by the products and how the conflicts could be negotiated—from ignoring the users' requests to finding alternatives or explaining the reasoning. Ultimately, resolving these conflicts hinges on people's ability to comprehend the rationale behind the product's resistance and the implications of their decisions when they contradict what the product imposes.

Reflecting on these findings, we discuss what relevance they have for design, and particularly the design of technology for the home. Below, we revisit the argument we made in the introduction: that prevailing smart home narratives inadequately capture the lived experience of smart home residents, especially considering the complexity of value conflicts. To address this gap, we highlight three key themes that we synthesized from the findings of the session. The themes, we consider, are crucial for reshaping the dominant narratives and improving the design of smart home technologies. Specifically, we propose a shift of focus from value alignment to value transparency, from service provision to mutual care, and from autonomy to responsiveness.

5.1 Shifting the focus from value alignment to value transparency

In smart home research, it is often assumed that these systems should align with users' values [58, 87, 88, 106, 108]. However, the complexity of value alignment becomes particularly evident when considering the inevitability of value conflicts. A critical question is why these values become misaligned, especially when smart products are introduced into homes voluntarily.

As observed in our enactments, one explanation lies in the clash between users' short-term and long-term goals. While rarely studied in technical disciplines, as noted in section 2.1, this conflict was prominent in our findings. The frustration portrayed in the scenes often stemmed from unmet immediate needs (e.g. warming up, related to the value of comfort), even though the user would still be

expected to find satisfaction in fulfilling long-term objectives (e.g. saving money, related to the value of prudence). Such intrapersonal conflicts—reflecting the tension between opposing desires within an individual—are common in everyday life. While many products can evoke them (e.g. a mundane alarm clock embodying the dilemma of lingering in bed or being disciplined [69]), smart products are likely to bring these intrapersonal conflicts to the forefront by actively resisting user actions. When a coffee machine resists providing coffee, the user's dilemma between immediate gratification and maintaining health becomes suddenly visible and unavoidable—perhaps at moments when the user would typically defer addressing it with a "non-smart" coffee machine. In a sense, smart products become tangible manifestations of self-control dilemmas, inherently embodying and amplifying value misalignments.

Value misalignment can also be attributed to the complex overlap of different values. Wong et al. [107] demonstrated that privacy, in the context of smart home cameras, is intertwined with values like autonomy, safety, care, property expectations, trust, and fairness. Designing for privacy, thus, involves considering and ideally aligning with all these interconnected values, which presents a significant challenge. In our enactments as well, a negotiation with a coffee machine might be perceived as related to health choices, but it was also about agency of a person to be able to make choices, showing care to her body, and staying true to personal commitments. These implicit, entangled values might not be immediately apparent to users until they begin to encounter resistance from the products. Moreover, some of these "hidden" values may be introduced by manufacturers. Surveillance capitalism, data commodification, and behavioral conditioning (e.g. [55, 80]) highlight how companies introduce features into intelligent systems that subtly influence user choices and behaviors without explicit consent. Users may become aware of these additional concerns only after prolonged use.

Whether inherent to the user or externally imposed, we argue that value misalignment often stems from the entangled nature of values. To complicate matters further, many of these values are important to the user. This perspective contrasts with the common narrative in smart home literature, which implicitly divides values into "nobler" and "lesser" categories [6, 26], with values like security and privacy often seen as superior to convenience, ease, and comfort. However, we argue that such distinctions do not fully capture the complexity of experiences in the smart home. Our view aligns more closely with Chang's [13] concept of being "on a par", a fourth sui generis value relation beyond the standard trichotomy of "better than", "worse than", and "equally good". In this framework, values can be incommensurable—they address different priorities, making them comparable in meaningful ways but not reducible to a single scale of comparison. Values typically considered less noble, like comfort, can become more urgent than sustainability during a heatwave, or convenience may outweigh privacy when recovering from surgery. Parity relationships underscore the complexity of certain decisions, where neither option dominates, yet both are viable and meaningful choices. Making decisions in such complex settings requires not only factual information about the objects but also an introspective process where one reflects on their own values and exercises normative judgement [14].

Conflicts in a smart home manifest as tangible, nuanced expressions of the plurality and parity of values, requiring constant negotiation. This calls for an awareness of both the explicit and more concealed values embedded within smart products. Therefore, we argue that smart products should exhibit *value transparency* [8], openly communicating the values that have been considered in the design and how successful these have been realized in the system, to enable informed decision-making. Valuable approaches in HCI such as Value-Sensitive Design [25], designing with questionable values [6], or value co-creation [111] advocate for reflection, reinterpretation, and attention to stakeholders' values in the design process. While they are impactful in making the values embedded in technologies explicit, they primarily operate during the conceptualization and development stages, often through participatory methods that give stakeholders a voice in design decisions. However, here we emphasize a different type of sensitivity and transparency regarding values: Making value entanglements visible to users, particularly when the users are not part of the development process. This transparency extends both before purchase and after installation in the smart home.

Transparency, closely related to intelligibility, is a crucial concept in smart home literature. It supports users in developing a mental model of how their smart home functions, including its capabilities, interactions, and reasons for automatic actions [5]. We contend that this transparency should also include the values imposed by products. Some transparency concerns may pertain to business models behind these products, opening spaces for users to negotiate, regain control and exercise choices [72]. Additionally, transparency considerations should extend to value commitments and trade-offs. Mennicken et al. [59] proposed a user-centered approach to intelligibility, framing questions around how the product affects tasks, activities, and wellbeing, as opposed to a traditional technology-centered approach focused on what the product is doing. Moreover, Winikoff [106] advocates for "reasoning" and Jonker et al. [43] for "hybrid (human and technology) reflection", instead of mere explanation in autonomous systems. This aligns with our observations from the enactments, where actors suggested that products could remind them of their value commitments (e.g. taking good care of plants) and the consequences of breaking those commitments (i.e., the plant will suffer, the house will lose its aesthetic appeal), rather than reporting what they are doing and coercing compliance. Such explanations would not only help users form a more active and critical relationship with smart products, but also support informed decisions about their value priorities.

5.2 Shifting the focus from service provision to mutual care

Resendes et al. [73] adapted a widely accepted human-to-human conflict handling taxonomy [95] for IoT conflict resolution, highlighting how the conflict handling modes displayed by smart products can lead to win-lose situations. For example, competitive behaviors of users like overriding the thermostat's advice or ignoring the smartwatch's health prompts are linked to "wins," while sacrificing comfort or foregoing a desired coffee represents "accommodation," or a loss. However, as previously discussed, if the user wins by forcing the product to conform, it raises questions about

the purpose of automation. Moreover, a "win" might paradoxically result in a "loss" in achieving long-term goals or upholding higher values intended for the collective good. On the other hand, when the user loses, frustration, anger, and other negative emotions often follow.

Compromise and collaboration are seen as partial and full win-win situations, respectively, according to [73]. However, our enactments demonstrated that achieving a win-win often placed a significant burden on the actor, resulting in extra work and ultimately diminishing the sense of home. Actions like relocating plants to meet the smart flowerpot's criteria for optimal care, adjusting and readjusting the position of a curtain based on the thermostat valve's temperature stabilization requirements, and complying with a smartwatch's request for an additional 5000 steps all imposed an additional burden on actors, forcing compromises and occupying considerable mental space by turning every decision into a conscious choice. The flow, familiarity, and effortless navigation that are valued aspects of being at home were disrupted, creating a dynamic where it felt as though humans were serving the system.

This aligns with HCI research on "the work to make the network work" [32] (e.g. digital housekeeping [96]), exploring how people integrate home networks into their daily lives and its associated challenges. Liu [52] argues that setting up a smart home generates new forms of emotional labor, as both human and technological actors engage in domestic care work. Similarly, Key et al. [44] argue that prevailing visions of smart home technologies often overlook the essential work, attention, and negotiation needed to seamlessly integrate smart products into the home—what they refer to as care labor. In many smart home narratives, automation is often conceptualized as a service provider, enhancing productivity, offering more choices, and improving user experience [56, 109]. This perspective presents a one-sided, transactional view where the technology performs a function, and the user benefits from it. Within this framing, it makes sense to interpret value conflicts in terms of winning and losing because the relationship is reduced to a zero-sum game: either the technology successfully serves the user, or it fails to meet their expectations. However, this framing misses the opportunity to foster a more nuanced, reciprocal relationship with the smart home—one that acknowledges the importance of mutual care, adaptation, and shared responsibility.

We argue that smart homes should offer *care*, rather than just service, to their residents. Central to this shift are the values such as relationality, reciprocity, and vulnerability [113]. Reflecting on instances where actors expressed a loss of the sense of being "at home", it becomes clear that the care values were lacking. The care effort invested did not seem reciprocated, at least from the actors' perspective. They were willing to care for the products, but only if they felt cared for in return—whether by being ensured that they are working towards the same goals with the products or by experiencing resistance in more respectful and understandable ways.

In a caring relation, reciprocity is not necessarily symmetrical but rather complimentary. Key et al. [44] conceptualize care as a process, not an outcome, requiring all participants in the caring relationship to both give and receive attention. In this regard, HCI research that focuses on cultures of repair and maintenance (e.g. [39, 76]), the practice of "noticing" (e.g. [54, 67]), and the acceptance of things as "never completed" but continually evolving (e.g. [79, 98]), offers valuable inspiration for designing smart home technologies where both the user and the technology invest in the wellbeing of each other and the home environment. Furthermore, acknowledging the different temporal rhythms of objects, for example "slow design" (e.g., [64]), could also challenge traditional notions of efficiency and service provision in IoT design. Ultimately, care is a condition of interdependence rather than a fixed obligation or imperative. Designing for mutual care, therefore, requires a shift from transactional interactions between users and products to interdependent relationships based on attention, reciprocity, responsiveness and shared well-being in the context of smart homes.

5.3 Shifting the focus from autonomy to responsiveness

A paradoxical aspect of smart homes is that individuals seek to gain more control over their homes by relinquishing control to it. On one hand, smart home technologies are expected to operate autonomously and seamlessly; on the other, users still expect to retain a certain degree of control over their domestic environments. This dual expectation—delegating autonomy to devices while maintaining personal autonomy—complicates the lived experience of smart home technologies. In our enactments as well, determining the limits of relinquished control and the extent to which actors could accept a product's agency was an ongoing discussion.

Numerous scholars have emphasized the importance of studying how autonomy is negotiated and shared between users and smart products (e.g. [3, 23, 28, 41, 42]). There are various valuable concepts aimed at creating systems that allow for adjustable levels of autonomy [1], context-aware sensing [2, 5, 10, 28, 85], and overrides [18, 27, 59]. While these flexible solutions are designed to handle exceptions to routines and accommodate the varying needs of users, they often assume a static relationship between the user and the smart home. The system typically functions based on predefined settings, presuming that the user is both aware of what changes are necessary and willing to invest the time to implement them. Flexibility, in this framework, is largely reactive; the user identifies a problem or need and then adjusts the system's autonomy accordingly.

In contrast, Van Beek et al. [100] call for a different approach, urging designers to consider how smart home residents and their technology jointly perform everyday life. Here, each of these actors possesses distinct capabilities and sensibilities. For example, a smart meter measures room temperature through data, while humans perceive it through bodily sensations. Moreover, their metrics for "success" differ: the smart meter might prioritize CO_2 levels, while the human seeks comfort. Over time, what constitutes an appropriate or successful interaction may shift, meaning that these interactions cannot be fully anticipated or predetermined at the design stage. Similarly, De Koning et al. [19] critique smart energy systems focused solely on thermal comfort, noting that they often begin with a fixed definition of comfort that leads to standardized, thermally uniform environments. This overlooks the human body's ability to adapt and its acceptance of discomfort oftentimes. Rather than examining isolated practices like "cooling",

they urge researchers to explore the broader and underexamined qualities of "how people make themselves comfortable". Ultimately, the interface between humans and smart home technologies should be seen as a fluid and ongoing negotiation, allowing both parties to respond to one another dynamically.

Thus, the design challenge extends beyond developing autonomy that is based on pre-identified user needs and potential user behaviors. Designers must cultivate *responsiveness*—both human and artificial—to enable the creation of adaptive interfaces that evolve over time [100]. This focus promotes an ongoing dialogue between users and the systems they inhabit, ensuring that the relationship remains open, configurable, and negotiable. This orientation expands design beyond the formal work of professionals, recognizing end-user appropriation as a creative and evolving activity [46]. It aligns with Vardouli's [101] view, drawing on Ingold's [38] theory of making, which argues that the boundaries between users and artefacts cannot be predefined; they emerge through ongoing use. Users are not passive consumers simply following scripts embedded in products, but rather active participants continually improvising and shaping their interactions with technology [79].

Similar to designing for value transparency, where the designer's responsibility to align products with intended values must extend across the entire product lifecycle [30], designing for responsiveness likewise demands ongoing engagement from designers, learning from conflicts that arise during use-time [100]. This approach may involve working closely with users and other stakeholders throughout the products' lifespan (see [29, 45, 107] on designing for non-primary as well as primary users). Additionally, scholars such as Xue et al. [109] advocate for a shift in the role of home automation designers—from providing technical solutions to becoming facilitators of long-term co-design processes. Similarly, developing open systems that allow for DIY programming also empowers users to actively reconfigure their technology as their needs evolve [79]. By fostering this open and collaborative ecosystem, designers can better support responsiveness and adaptability, ensuring smart homes remain aligned with user values over time.

5.4 Reflections on methodology and limitations of the study

Reflecting on their two years of co-speculation work, Wakkary et al. [102] posed the question of what makes a good co-speculator and the expertise needed for speculative research. Our goal, in contrast to the seamlessness narrative often associated with smart homes, was to envision how things could go wrong—creating diverse scenarios and exploring how these situations might feel for residents. We considered that professional actors would bring creativity to imagine nuanced scenarios and reflexiveness to articulate their felt experience. Indeed, we were impressed by how quickly the actors adapted to and performed different situations, visualizing the ripple effects of their actions in ways that we, as non-actors, found more challenging to envision.

The performative characteristic of our approach allowed insights to emerge organically during the enactments. After each scene, we collectively reflected on what had occurred, discussing observations and felt experiences, alternative responses, and design implications. In other words, we aimed to pursue a performative and shared construction of knowledge. This alternating process of playing and reflecting highlighted the potential of participatory theatre to create a liminal space, where one is both inside and outside of the role simultaneously, inhabiting a state that is temporarily "betwixt and between" [77].

Olsen [66] argues that this form of role-play fosters a unique understanding by merging personal experiences with alternative responses. As we also observed during the enactments, the actors drew not only on the knowledge and skills of their professional practice, but also on their everyday experiences with (smart) homes and products, critically reflecting on both. For instance, they connected the conflicts portrayed in the scenarios to their real-life tensions, such as one actor's struggle of balancing comfort and sustainability amid global-warming. They discussed the implications of delegating everyday matters to AI, considering what this shift might mean for their own autonomy and freedom, and speculated about future social norms and laws, particularly in a world where data surveillance becomes the norm. The actors' ability to quickly grasp the immediate challenges of smart homes and link them to broader societal and ethical concerns confirm their choice as co-speculators in this study. We believe one contributing factor was the familiarity of the products and situations we focused on, which allowed the actors to immerse themselves in the roles without needing prior preparation, unlike more complex and abstract systems unpacked for example in [57] or [72].

While the majority of methods intended for proactively reflecting on conflicting values in the IoT context are card-based or digital toolkits [6], our methodological choice allowed us to simulate complex, tangible interactions between users and smart home technologies in an embodied manner, providing a controlled yet dynamic space to observe the impact of value conflicts. The use of professional actors ensured consistent and repeatable portrayals of user behaviors, providing us insight into how value tensions unfold in practice. However, we acknowledge that this is distinct from studying the actual lived experiences of real users.

Our goal in this paper was to identify possible issues and opportunities for future design work rather than to claim direct insights into exact user experiences. Consequently, we considered that the artificiality introduced by using professional actors and scripted prompts, while a limitation, did not undermine the primary objectives of the study. That said, we recognize that this approach provides only a partial view of how value conflicts evolve over time. The enactments were conducted over a relatively short period, limiting our ability to observe how value conflicts evolve over the long term. Many value conflicts, such as those around privacy or control, may only emerge after prolonged use of the technology, as users adapt to and negotiate their relationship with the system. The enactments, therefore, provide only a snapshot of these conflicts.

To address these limitations, future research could more strongly involve real users in real homes in the process. For example, longitudinal field studies with smart home users building on these findings, providing a more holistic understanding of user experiences. Additionally, engaging the public in enactment scenarios presents a promising avenue. People with real-world experience of smart home value conflicts could collaborate with actors to portray the devices, bringing personal insights and contextual knowledge into the enactments and combining it with the structured creativity

of performance. These approaches could expand the generative potential of enactments, bridging the gap between speculative insights and lived user experiences while supporting the development of more inclusive and adaptive design methodologies.

Lastly, there is a growing critique within the HCI community that dominant conceptions of smart homes tend to focus on traditional forms of housing, typically assuming a house or apartment inhabited by a single family or a couple. Far less research has explored how smart technology functions in alternative forms of housing such as divorced families, co-housing, or mobile homes (e.g. [21, 40, 63, 68]). Additionally, critiques have highlighted the neglect of gender dynamics, as well as the power, authority, and labor relations associated with household digital technologies (e.g. [23, 78, 86, 92]). While we deliberately left the specifics of the home and the user undefined in this study, these are crucial factors that deeply influence the experience of living in and with a smart home. In future work, we will incorporate these aspects more concretely into scenario development to offer richer accounts of value conflicts and their impact across diverse users and in different types of homes.

6 Conclusion

Conflict is a natural and inherent part of human relationships, often signaling meaningful interactions and the potential for growth. In this paper, we embraced value conflicts not as obstacles to be avoided, but as opportunities for productive friction, showing how they emerge in the complex, messy realities of domestic environment. By doing so, we aimed to challenge the idealized, tech-driven visions of smart homes that often gloss over such tensions. Leveraging the expertise of actors as embodied exploration specialists and skilled interpreters of their own experiences, we shed light on the complexities of value conflicts and proposed shifts in smart home design that prioritize value transparency, mutual care between the home and the residents, and responsiveness—helping users make informed choices about the values they introduce into their homes, feel supported, and engage in ongoing dialogue with their devices.

Given the plurality and parity of values and the complex sociotechnical systems they are part of at the home context, there is no one-size-fits-all solution. The needed shifts offered in this paper do not provide definitive answers; rather, they present broader and nuanced ways of thinking, grounded in sensitivity to what we might design for in future smart homes. We encourage HCI designers and researchers to embrace value conflicts as a source for deeper understanding of users and their home environments and using them productively in designing future smart home technologies.

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