Designing with Dynamics: Reflections on Co-design Workshops Between People Living with Dementia and Their Care Partners

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Abstract

Human-Computer Interaction (HCI) researchers focusing on informal care partners and people living with dementia often create personas, incorporating expectations about the pair's relationship dynamics to guide their research and design outcome. Similarly, in our two iterations of co-design workshops aimed at designing a robot to enhance these relationships, we started with expectation that care partners would primarily lead the relationship. This assumption guided the design of the co-design workshops, which included diary studies followed by co-design sessions with eight dyads. However, our results from reflexive thematic analysis challenge the initial view that relationship dynamics follow a single persona or outcome. Instead, the diversity in relationship dynamics led to multiple design outcomes, highlighting the need for HCI researchers to consider care dynamics when designing and conducting research studies for care partnerships. Researchers can structure and create iterative co-design workshops to accommodate these dynamics by incorporating ongoing reflection on the dyad's relationship dynamics and the researchers' influence throughout all co-design stages. This approach enhances researchers' ability to create more thoughtful and effective relationship technology.

CCS Concepts

• **Human-centered computing** → *Empirical studies in HCI*; *Collaborative and social computing*; **Participatory design**.

Keywords

co-design, people living with dementia, PLwD, dementia, caregivers, older adults

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1 Introduction

The rising number of dementia diagnoses [4] has inevitably led to an increase in **care partnerships**, where people living with dementia and informal care partners—unpaid family members or friends—work together to navigate the challenges of irreversible cognitive decline [55]. Following this trend in care partnerships, there is an increasing focus in the Human-Computer Interaction (HCI) community on designing technologies to enhance these partnerships [62]. When designing such technologies, researchers often create personas explicitly or implicitly envisioning user profiles to guide their study [59]. Given the central role of partnership in supporting care and studies of care, the personas would inherently include **relationship dynamics**, a form of power dynamics that concerns how power is distributed within the relationship between informal care partners and people living with dementia.

The relationship dynamics associated with personas of care partners and people living with dementia from the prior HCI studies come in various forms. Some research focuses on care partners, exploring partnership dynamics from the perspective that care partners experience care burdens [23, 75] and need empowerment. This approach has been reflected in studies addressing invisible labor [36, 71], and decision-making during transitions like moving from home to formal care [31] or crises like the COVID-19 pandemic [24]. Other research, building on the observation that people living with dementia may have diminished voices, seeks to empower them. These studies aim to amplify the autonomy and agency of individuals living with dementia through methods promoting personhood [16, 21, 28, 45, 77], daily enjoyment [34, 65], and self-management systems [20]. Other researchers adopt approaches that treat care partners and people living with dementia as equal partners. They propose methods and technologies that attempt to involve both parties collaboratively, highlighting their shared roles in fostering connections and mutual support [32, 33, 46, 64, 75]. In each form of research, researchers develop personas, tailored methods, and designs based on the type of relationship dynamics the study seeks to examine or support.

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However, relationship dynamics are complex and diverse, and only focusing on one type of representation may not be sufficient when considering technology design and adoption. For example, many robots are developed under the image of "partners" due to their human-like features [11] in popular media like Robot & Frank and Big Hero 6 [19, 73]. Designs based on these assumptions may primarily focus on supporting the care needs of people living with dementia. They may miss other types of relationship dynamics, such as those with equal partnerships between care giver and receivers. These dynamics may result in less effective design outcomes, perpetuating stereotypes and failing to capture the real-world diversity of users' needs [52]. As such, relationship dynamics require a reflexive focus similar to power dynamics: a reflexive mindset that promotes awareness, accountability, and objectivity regarding the various stakeholders involved in technology design [5] throughout the research and design processes [6, 80]. Research should critically reflect on the evolving roles of stakeholders [9] and assess researchers' roles with participants [51], particularly when considering relationship dynamics during co-design.

We recognized this complexity of relationships when we conducted two co-design workshop iterations focused on designing robots to enhance care relationships. We began with the assumption that care partners would primarily lead the conversation—and, by extension, the relationship. However, as we analyzed the results from the two co-design workshop iterations and reflected on the interactions between care partners, people living with dementia, and researchers, we realized the nuanced dynamics within these relationships did not always agree with our initial assumptions and required further unpacking. The dynamics within each pair of participants differed significantly, and the need for help was not always one-sided. We also found that these differences greatly impacted the workshop process and design outcomes. As such, with eight dyads of people living with dementia and their care partners, this paper seeks to answer these research questions:

1. *What types of pre-existing relationship dynamics between the care partner and individuals living with dementia are observed in technology co-design workshops?*
2. *How do the relationship dynamics between care partners and individuals living with dementia shape the workshop process and impact the resulting technology design?*
3. *How can co-design workshops for technology be designed to accommodate the existing relationship dynamics between care partners and individuals living with dementia?*

Through qualitative analysis of our workshop, we identified four types of relationships that resulted in their consequent designs: those where care partners experience self-blame, leading to designs aimed at mitigating personal impacts; cases where problems are framed from the care partner's perspective, resulting in care partner-driven designs; situations with disparity in identifying challenges resulting in conflicting design solutions; and finally, relationships where challenges are viewed collaboratively, leading to designs for collaborative relationship. Our findings also contribute to the ongoing discussion within the HCI community on refining methodology when designing technology for relationships. We provide guidelines on how researchers could incorporate the care dynamics when designing and conducting research studies.

2 Related work

In this section, we discuss literature exploring the various factors that influence the interpretation of relationship dynamics, reflecting on their complexity. Following this, we review existing co-design methods and the resulting technologies developed for people living with dementia and their care partners, aiming to provide an understanding of the technological space in HCI.

2.1 Complexity in Relationship Dynamics

Relationship dynamics around care can differ significantly based on the contexts and require careful consideration during the research and design process. For example, relationship dynamics may be affected by communication methods that may range from open and positive interactions, such as using humor and advocating for one another [14, 17], to more negative dynamics, such as avoidance [17] or frustration directed toward the other [48]. The roles within and outside the care relationship can also influence the relationship dynamics. Care partners can be companions, planners, and collaborators within care [36, 54, 63], but they can also hold other familial roles related to care recipients [43]. Similarly, people living with dementia can also hold other familial [68], professional, hobbies, and leisure roles [13] related to care partners. These roles and identities often evolve from moment to moment across various stages of aging [12]. External expectations and stakeholders further add to the complexity of these dynamics. In some cases, other stakeholders, such as "assistants" or "monitors," may influence the caregiving process [25, 54]. Societal expectations, such as the association of caregiving with women and nurturing roles [18, 79], or the belief that children should not make decisions for their parents (e.g., compared to children caregivers, it might be easier for spousal caregivers to make caregiving decisions[43]), also shape these dynamics and the power balance within caregiving relationships.

Just like tension often exists between institutional structures and the researcher's everyday experiences [27], the care partner's perspective of the relationship dynamic could differ from that of people living with dementia, thus affecting their relationship. For example, in care relationships, care partners may feel that people living with dementia are disengaged or uninterested in conversations [66]. However, people living with dementia may be interested but perceived as not engaged because of their communication challenges, difficulty recalling information, understanding social cues, retrieving words, or following conversations [66]. Their perceptions of each other may then affect how they act towards each other. For example, care partners may adapt by reducing communication with the people living with dementia, projecting their perception of disengagement from the person living with dementia to maintain a sense of "normalcy" in their interactions. Given the complexities in relationship dynamics, the type of relationship between care partners and people living with dementia requires careful reflection.

2.2 Co-design and Technology for Care Partners and People Living with Dementia

Despite the complexity of relationships, previous HCI methods often focus on a single type of relationship guided by a specific persona to have a unified design outcome. This results in designs that may align well with the targeted persona but miss the opportunity to consider the diversity of participants' relationships.

Some research centers on care partners, often focusing on relationships where care partners take a primary role and emphasize ways to alleviate their burdens. These studies address how technology can support their evolving care needs [75] to enhance relationships, such as suggesting technologies for multifaceted roles of care partners beyond caregiving [36], the invisible work of emotional labor [71], particularly during times during the pandemic [24]. However, designs that focus on the perspective of care partners as the primary role may not address the needs of other relationships. For instance, previous research suggested information technology to help cope with a care partner's caregiving needs across transitions from home to formal residential care [31] may not be suitable where people living with dementia have strong willpower and have a hard time transitioning. In another example, research has proposed designing for the emotional labor that care partners experience while witnessing the deteriorating health of their loved ones [71] might not be helpful for functional relationships, where care partners provide physical assistance without deep emotional attachment. Focusing on relationships based on the perceptions of care partners dominating the relationship may overlook other relationship dynamics.

Conversely, other research emphasizes the relationship dynamics of people living with dementia during the research process, aiming to position them as the driving force shaping the relationship dynamic. Researchers tried to combat the negative societal attitudes that lead to feelings of powerlessness, neglect, or abuse towards living with dementia [21, 45]. These studies focus on design methods to enhance personhood [28] and designing technology to promote daily enjoyment, calmness, and relief [34] for people living with dementia. Similar studies also tried to address the overshadowing of their voices in caregiving dynamics [16] and understanding how to involve people living with dementia in research [77]. However, technologies designed to position people living with dementia as the driving force in relationships may not adequately address the needs of other relationship dynamics. For example, Smile, a camera system designed to enhance friends or family visitor engagement by capturing and displaying photos on digital frames in the rooms of people living with dementia [35], may not be suitable for relationships where visitors take a more active role. In such cases, people living with dementia might want to learn more about their visitors or events outside their nursing home rather than focusing on photos within their environment. Similarly, Happje, a step-by-step cooking app aimed at fostering autonomy, social engagement, and collaboration for people living with dementia [65] may not address relationships where care partners are the driving forces, lack the time to participate, or may feel additional pressure to avoid mistakes during cooking activities. Overall, emphasizing relationships based on empowering people living with dementia may not be suitable for other relationship dynamics.

Other research views the relationships as harmonious, as equal contributors to the design process, reflecting relationships characterized by equal partnership [46]. The designs from these studies may not fit those relationships in which one side takes a more active role than the other. For example, robots or voice-based conversational agents designed to foster cooperative reflection, such as those aimed at fostering gratitude [37] or providing reflection prompts to address care partners' experiences [64], may not be suitable for one side that is more active and has a strong need for autonomy and empowerment. As such, while care partners may seek cooperative reflection, people living with dementia, in this case, may prioritize having their voices heard and their concerns addressed directly rather than being filtered through a voice agent or interpreted as expressions of gratitude from the care partner. Similarly, tools like the MATCH mobile app, designed to strengthen meaningful connections through training videos on using music for care as needs evolve [75], may not be appropriate for relationships that struggle to spend time together. Other designs, such as researchers designed Tumbler [32] and the Turnaround device [33] to foster conversations and bonding between care partners and people living with dementia using everyday sounds or create music would be suitable for relationships that people want to spend time with each other. However, relationships where care partners already feel the burden of care cannot be enjoyed as they must put in the effort to initiate the activity. Moreover, people within the same relationship may have different views. For example, a robot designed to provide word suggestions during conversations may be appreciated by care partners but perceived as disruptive by people living with dementia, making conversations more challenging instead of easier [46]. These examples highlight how research focused primarily on care partners' perceptions of relationships may fail to address the care recipients' needs fully.

While previous HCI research that focuses on designing for specific expectations of relationships can help achieve a unified design outcome, it may overlook opportunities to address other types of relationships, potentially reducing the effectiveness of the resulting technology. In our research with care partners and people living with dementia dyads, we began with the expectation that care partners often play a more active role in relationships. However, we later discovered that each dyad had unique needs shaped by distinct dynamics, requiring different technological solutions. Observing and understanding these relationship dynamics through deeper reflection is essential, even during the co-design phase.

3 Methods

Our research builds on reflection on a series of co-design workshops aiming to create social robots that enhance the relationships between care partners and people living with dementia. In the sections below, we describe the iterations of the research structure in detail. Furthermore, we describe participant demographics, the data analysis process, and our positionality in conducting this work.

3.1 Iterations on Co-Design Workshops – From Care Partner Focus to Diverse Relationship Dynamics

The co-design workshops include two phases: a diary study during which care partners journaled their daily reflections on their relationships and a co-design session where care partners and care recipients created concepts of a robot that can enhance their care relationship. We chose to use co-design workshops, a process of "creative cooperation [72]," because it allowed us to explore potential concepts for a robot collaboratively with the care partner and recipient living with dementia. We chose to use diary studies as part of the co-design workshop because they provide a deeper understanding of real-world situations and natural information from participants' daily lives [15, 49]. Furthermore, conducting the diary studies before the co-design sessions allowed the dyads to review and contextualize their experience and offered the research team a view into the relationship dynamics. In both workshops, we presented the robot as the ultimate goal or design outcome through videos, and participants did not interact with a physical robot. We iteratively revised the workshop structure based on lessons learned from conducting the initial session. The Indiana University Bloomington's Institution Review Board (IRB) approved all study procedures, including the modification.

3.1.1 *Initial Workshop Design.*

The first version of the co-design workshop comprised a two-week diary study followed by a two-hour co-design session. Care partners first voice recorded their emotions while interacting with care recipients for 14 days. The diaries included different daily prompts, including questions probing their positive and negative emotions with each other during the day.

After completing the diaries, two pairs of care partners and recipients participated in an in-person co-design session. The co-design session featured four technology cards and 21 situation cards to support design activities. The technology cards and situation cards were inspired by previous research on the "crazy eights" method, which has the potential to encourage participants who were not experts in design to generate multiple concepts and move beyond their initial ideas [42]. Each technology card featured one of five possible robots: QTrobot [50], Nao [2], Joy For All [1], Haru [30], and a Mobile Robot [37]. The robots were chosen because of their availability in the researcher's lab. The corresponding situation cards described daily activities such as cycling, hiking, completing chores, playing football, attending a dance class, making doctor's appointments, or communicating with each other. Each co-design session included four activities:

- Diary Reflection: To encourage participants to reflect more on their own experiences, we showed printed transcribed diaries with all entries and asked the dyads of the experiences in writing the diary.
- Brainstorming Activity: To encourage participants to not be constrained with initial thoughts for the robot design, we asked them to create a use-case scenario based on a randomly assigned technology card and situation card in two minutes.
- Storyboard Development: To explore and refine a single design in greater depth, each dyad created a storyboard based on their chosen situation and technology cards.
- Show-and-Tell: To enhance the design conversation and explore potential ideas after viewing each other's presentations, each dyad presented their work addressing a problem they experienced. The show-and-tell ultimately leads to a discussion of the similarities, differences, and further design considerations.

Upon completing the first co-design session with two dyads, we observed both participants living with dementia appeared to have limited comprehension of the co-design activities and engaged only minimally. For example, both participants living with dementia struggled to follow the brainstorming activity due to a lack of understanding of the robots' concept and technical capabilities from the brief explanation provided. The care partners had to intervene and lead the brainstorming activity and storyboarding development.

Reflecting on this experience, the first and second authors then reviewed and coded the video recordings to look for areas for improvement in the workshop. They focused on three key areas of the workshop design: (1) the effort required from people living with dementia to participate in co-design, (2) additional interactions that care partners had to assist with the people living with dementia, and (3) the researcher's interactions with both. This initial coding process resulted in three themes: "*Linking scenarios to everyday life experiences*," "*Encouraging conversation without relying on recall*," and "*Reduce the cognitive load, one step at a time*." These findings led to personalized workshops with more preparation beforehand and redesigned technology and concept cards. We then designed the revised workshops to be online to better support recruitment with diverse types of relationships.

3.1.2 *Revised Workshop Design.*

The revised co-design workshops consisted of a one-week diary for the care partner and a one-hour co-design session. The shorter period of diary study and the simplified prompts (same prompts every day) were designed to minimize cognitive burden and allow care partners to become accustomed to the diary process. Thus, instead of reflecting on and describing their emotions extensively, care partners rated their relationships daily ("*Today, I have a good relationship with the care recipient.*") on a scale of 1-4. They also recorded reflections with their care recipients, responding to prompts about the challenges and successes in their relationships.

Following the diary study, care partners and care recipients attended an online co-design session. Before each co-design session, we transcribed, reviewed, and discussed the recordings of daily reflections. We chose three themes and generated theme illustrations using Dall-E, an AI system that creates images from an input written text [56]. We used DALL-E-generated images because they allowed for more specificity, creating images that closely aligned with the dyads' real-life scenarios. These illustrations allowed participants to visualize and envision these challenging scenarios better. Example prompts include: "*generate an image under this scenario based on a diary from the caregiver who is also old. Don't include any human faces. Include only the hands if necessary. This image will be shown to caregivers and recipients as a workshop scenario: two old people were arguing. One does not understand the other.*" We chose not to include people's faces, as generated faces may not accurately represent the participants, which could lead to a sense of disconnect from the design process.

We then conducted each co-design session with only one dyad instead of two, as we believed such a format would provide more support for people living with dementia. The online co-design session included three activities:

- Diary Reflection: Researchers presented three themes with prompts and illustrations related to the challenge.
- Storyboard Development: A video of QTrobot [50] was shared to the participants. We only presented QTrobot (instead of all four robots in the initial workshop) to reduce participant cognitive load. QTrobot was selected because it has human-like physical figures, which makes it more relatable and socially accessible for older adults [74]. Participants were then asked

to choose one challenge they thought the QTrobot could address. We then prompted the participants to envision what the robot could help and sketched the storyboard.

- Show-and-Tell: Toward the end, we presented the storyboard we had drawn based on our understanding to the participants and asked for their thoughts and feedback.

3.2 Participants

We recruited eight pairs of care partners and people living with dementia. For confidentiality, we assigned pseudonyms for each participant in this paper. We recognized that the relationships between care partners and care recipients are complex and varied, as shown in section 2.2. Indeed, the care partners in our study were all family members of people living with dementia (Table 1). We chose to refer to them as care partners and recipients to focus on the discussion on their care relationships, recognizing that those are deeply intertwined and influenced by other relationships they had with each other. Care recipients in our study include people diagnosed with various types of dementia, including Frontotemporal Dementia, Lewy body, Posterior Cortical Atrophy, Primary Progressive Aphasia, Alzheimer's, and Vascular Dementia.

For the first iteration workshop, we recruited two pairs of care partners and care recipients through a previous study [36]. We recruited six dyads for the revised workshops through word of mouth, social media channels, and a working relationship with a local organization. Before officially enrolling in the study, the care partners completed a screening questionnaire. They participated in an online conversation with us to review the study information sheet and verify their authenticity. Screening questions include the care partner's status (primary or non-primary caregivers), the age of the person being cared for, hours spent providing care per week, the duration of caregiving, the relationship between the caregiver and care recipient (e.g., parent-child or spousal relationships), and the type of dementia involved. This careful screening helped provide the context of the caregiving relationships and prevent fraudulent participation [57]. Although we initially received 86 recorded responses and conducted several online conversations, some were excluded due to poor online quality or mismatches in the provided information. Ultimately, we selected the final six dyads for the online workshop. Table 1 lists the final eight dyads.

3.3 Analysis

We used the reflexive thematic analysis approach [10] to analyze the co-design data. The first and second authors began the analysis by focusing on the revised co-design workshop transcripts, as most participants were from this iteration. They began by familiarizing themselves and open-coded the data to evaluate how the workshop succeeded or failed to empower people living with dementia, building on reflections from the initial co-design workshop. However, after the first few rounds of coding and discussions, they observed a diverse set of nuanced power dynamics that differed from those in the first workshop. In this phase, the research team started recognizing other relationship dynamics: in some pairs, people living with dementia were more active in the relationship, while in others, both individuals demonstrated equal levels of activeness. These dynamics did not align with our initial expectation of the care partner being more active in a caring relationship.

The first author then referred to power dynamics literature, which suggested *commanding* with words indicating "must, should, or have to [40]" or *permission* which requires "granting or denying" [29]. Based on this suggestion, the first and second authors conducted a round of coding focusing on direct expressions of power through interactions involving instances of commanding, granting permission, using exclusive or inclusive languages, disagreements, agreements, completing each other's sentences within the dyad, and asking for opinions. They also coded instances including exclusive language, when participants used terms like "you," "me," or "I," and inclusive language when participants referred to the relationship with terms like "we" or "us." Moreover, they also extended their coding to include aspects of robot design, identifying whether the design was driven by the care partner, the robot's interaction with the people living with dementia, or interactions involving both parties. All authors collaboratively discuss patterns among the codes during their weekly meetings, examining various dynamics and how each dynamic influenced different design outcomes. This analysis led to the formulation of the first main theme, "complexity of relationship dynamics," along with four relationship-type subthemes.

As the authors started to discuss high-level themes and how to present them, they identified additional insights reflecting how researchers might influence the relationship dynamics. The first author then revisited the transcripts from all co-design workshops and conducted additional coding, continuing to refine the themes until the final write-up of the paper.

3.4 Positionality

All authors are researchers with experience studying the intersection between HCI and health/well-being, including working with a wide range of participants and designing various technologies to support them. The first and third authors have extensive experience and long-term working relationships with older adults and people living with dementia. The fourth author has studied how technology can empower older adults and support active aging. These experiences and values shaped our perspectives on the study design. They also influenced how we interpret participant interactions and experiences, framing the data analysis process and directions.

The first two authors also have personal experiences and relationships with people living with dementia and care partners, including close family members and friends. These relationships motivated them to pay attention to the intricacies of care relationships and advocate for elevating the voices of care partners and recipients. Taken together, the research team's ultimate goal is to provide ways to continue learning from, reflecting on, and improving how researchers, people living with dementia, and their care partners work together to support care meaningfully.

	Workshop Iteration	Partner (Age/Gender)	Recipient (Age/Gender)	Yrs of Care	Relationship
1	Initial	Jason (28/M)	Linda (91/F)	2-5	Grandson
2	Initial	Stacy (51/F)	Mia (79/F)	2-5	Daughter
3	Revised	Elaine (63/F)	Reeve (67/M)	> 5	Spouse
4	Revised	Rosanne (61/F)	Ron (68/M)	2-5	Spouse
5	Revised	Sherry (73/F)	Tim (83/M)	> 5	Spouse
6	Revised	Bianca (60/F)	Carter (77/M)	> 5	Spouse
7	Revised	Kat (82/F)	Sean (84/M)	> 5	Spouse
8	Revised	Larry (60/M)	Marian (99/F)	> 5	Son

Table 1: Care Partner and Care Recipient Demographics

4 Results

To design technologies that enhance the relationships between care partners and recipients amid the ongoing changes caused by dementia, we recognize the importance of understanding relationship dynamics during the co-design process. We present our findings through two main themes to emphasize the significance of involving both individuals in the dyad when designing technology for relationship dynamics and understanding the context of their existing relationship. The first theme is the complexity of relationship dynamics, where we identify and describe four distinct dynamics observed between care partners and recipients living with dementia and how each relates to the dyad's design. The second theme focuses on how the researchers' role can influence the natural emergence of these dynamics within a workshop setting.

4.1 Complexity of the Relationship Dynamics: Pre-existing Dynamics in the Design Process Influencing the Robot Design

The workshop interactions reflected the relationship dynamics and significantly impacted the designs created. Below, we describe the four relationship dynamics we observed in the co-design.

4.1.1 Self-Blame and Designing to Mitigate Personal Impact. During the co-design process, when participants were asked to describe scenarios from the care partner's diary to help recall real-life dynamics, a distinct pattern emerged where one party often blamed themselves for not being accommodating enough. This self-blame influenced the design of the technology, leading to solutions aimed at assisting or reminding one side of the dynamic.

For example, when Bianca (CP, 63/F) and Carter (CR, 77/M) described their communication problems, Bianca (CP) was deliberately exclusive in her language, attributing the problem to herself as the care partner: *So last night,... **I'm** at the end of my rope. Don't talk to me. **I** just want to make things simple. So if **you** need anything right now, tell me otherwise, **I'm** going to sit and **I'm** not moving.* Here, Bianca (CP) described how she was sometimes too harsh with Carter (CR). Bianca continued to blame herself for the communication issues and how her impatience could lead to Carter feeling bad about it:

> *"There's **deficiency in my patience** when I am tired... The problem is that when I say I'm at the end and can't do anymore, Carter feels bad about his situation. So that's not a good dynamic, right? Because he feels bad that he is the reason I'm exhausted. That's what I would like to avoid. So, I mean, then he feels bad, not out of his own doing, because he has dementia."*

This self-blame dynamic also surfaced during the robot design process. Bianca (CP) immediately expressed how the robot should listen and intervene to break the mood: *"It would need to listen [to the conversation]... if it's sensitized to certain phrases, or maybe a tone of voice that it could activate. Then it says, 'I love you anyway.'...something silly that will break the mood. "* Here, Bianca (CP) envisioned a robot that could detect her tone and provide gentle reminders when her words might negatively impact the dynamic.

In another example, Sherry (CP, 73/F) and Tim (CR, 83/M) exhibited a similar dynamic, where Tim (CR) exclusively saw it was his problem and he let Sherry wait for him to get up: *"Because of **my immobility, I** prefer to have Sherry bring me some things to help me get ready for the morning. But as she said, **I don't always** get up when she does... That can be a challenge. "*

Tim (CR) further blames himself for not being able to show his perspective on their dynamic:

> *" My primary position in all of that is that Sherry has a lot of stuff to do just because she's a person with a life of her own. Unfortunately, **I'm now in a condition where I can't do all of those things by myself**. So **she** has the additional burden."*

The dynamic of self-blame was reflected in the robot design process. Tim (CR) focused on addressing his feelings of inadequacy and sought to solve problems without relying on his care partner's help through the robot: *"...being able to move around. So the fact that it's stationary, most of the stuff that I would use it for is limited."* After recognizing the robot's limitation in mobility, he proposed a solution that would allow him to address some of his needs independently, even while in bed: *"It would be useful if I could, for example, without even getting out of bed, say, 'Hey, robot, what's going on?"'*

As seen in both cases, when one side blames themselves for a relationship, it influences the design of the robot and what they want the robot to do, reflecting their self-perceived responsibilities and needs.

4.1.2 Finding Problem From Care Partner Perspective and Care Partner-Driven Design. In contrast to self-blame, some dynamics emerged where the care partner exclusively attributed the challenges in the relationship to the care recipient when describing their life scenarios during the workshop aimed at enhancing their relationship. In these cases, the care partner often made decisions on behalf of the care recipient. This dynamic often leads to the care partner driving the design process, attempting to convince the care recipient to accept the design.

Despite initial resistance, the care recipient typically accepts the design proposed by the care partner. For example, in Kat (CP, 82/F) and Sean's (CR, 84/M) discussion about their confusion in the relationship, Kat (CP) detailed what was occurring in their relationship, hence hinting that there was no time to listen to Sean, who has a lot of questions: *"I don't have time to* ***talk you*** *through or listen for an hour or two to go from, you know, confusion to clarity. So I've been asking you more and more that came out a lot."*

This dynamic continued as Sean (CR) did not agree with what Kat (CP) said and tried to explain his experience that he would turn towards God instead of what Kat (CP) said: *"Oh, well, I, you know, I wake up often, well, not every time... I can ask myself questions, and I can get, I can get through. And of course, the thing I believe in God, and God is, to me, the great mystery...I can make that connection."* In the end, Sean (CR) agreed with the problem and said, "*I don't know how much it annoys her to hear all these questions over and over.*"

Hence, the care partner-driven dynamic between Kat and Sean became evident during the robot design process. Kat (CP) suggested a technology that could assist Sean (CR) during his moments of confusion:

> *"So I see it could be programmed... noticing what time I get going and...it could go through some of the questions you have over and over and over and over. There could be some of them that have to do with your family, like you could say, who is Kat? Who is this woman that's here in the room? Because sometimes you forget who I am, my name, and that's common, you know, and we're both over the pain of it."*

In the beginning, Sean (CR) responded with some skepticism: *"But how do we get this guy to do that? "* Kat (CP) continued to explain her design to Sean: *"You could have it programmed in there... 'what's your problem today?' 'Oh, I don't know who's this woman in my house', or, 'I can't remember my family', and I would imagine they can be easily trained or programmed to provide those answers."*

However, after thinking through and knowing his limitations in dementia, Sean accepted Kat's design and suggested: *"It seems to be easier for me just to remind myself when I think, 'Oh, I gotta ask Kat this' and then go over it in my head rather than saying it just something in the other room."* This example illustrates the dynamic where Kat, the care partner, took the lead in identifying the problem and proposing a design solution. Towards the end, Kat convinced Sean, the care recipient, to accept the idea.

Similarly, Larry (CP, 60/M), caring for his mother, Marian (CR, 99/F), showed a care partner-driven dynamic in the co-design, where the suggestions primarily came from the care partner. This dynamic was evident when Larry (CP) described his relationship with his mother as "*caregiver*," and there were instances where he corrected Marian (CR), showing his influence on Marian. For example, when we asked Marian her age, she replied, "*60*," to which Larry immediately corrected her by saying, "*No, you're not 60....she's almost 100 years old.*" Marian did not say anything and accepted it.

Larry (CP) also exclusively described their relationship's challenge mainly from his mother's sleeping schedule: "*She may not go to sleep after they leave because they put her to bed earlier*," reflecting a direct and somewhat authoritative tone. On the other hand, instead of elaborating on her thoughts about the challenge, Marian (CR) offered brief, one-sentence responses such as "*I sleep in*" or "*A little tense*," leaving Larry to dominate the conversation, explaining the problem from his perspective.

This care partner-driven dynamic continued into the design phase. Larry (CP) initiated the design process by suggesting a robot feature and then explaining the details of this robot to his mother. He began by sharing:

> "*Maybe if the robot periodically peeks into the room, you know, can observe and then go back...So if this is like a screen kind of thing, let's say like in the room, and the robot comes on the screen, lights up a little bit, and does the observation, and then goes black again.*"

After Larry (CP) made his suggestion, we asked Marian for her opinion on the robot, and she immediately responded, "*No.*" However, after Larry provided more details about the robot's function, explaining how it would monitor for signs of discomfort, such as *"restless movement over a period of time,"* or describing it as "*the eyes are shut, faces turned away, but the head could turn around so the head is straight,*" her answer changed from a straight no to "*a little*" helpful for her.

These examples illustrate how the care partner-driven dynamic, present in their everyday lives, also influenced the design process. Despite initial resistance, the care recipients eventually agreed to the design after further discussion and deliberate consideration by the care partner.

4.1.3 Disparity in Identifying Challenges to Conflicting Design Solutions. At times, a dynamic emerged where care partners and people living with dementia had differing perspectives on the challenges in their relationship while describing their experiences before designing technology for such a relationship. Care partners often attribute the relationship challenge to dementia, as a condition confined to their loved ones. In contrast, those living with dementia frame complications as encompassing both themselves and their care partners. This discrepancy was reflected in the proposed designs, where care partners and the people living with dementia had conflicting preferences for whom the robot would interact with. Care partners favored a robot that primarily interacted with the person living with dementia, while the person living with dementia wanted the robot to interact with both people.

For example, Ron (CR, 68/M) and Rosanne (CP, 61/F) expressed different perspectives on how these limitations impact their relationship. Rosanne exclusively stated the challenges she faces due to Ron's narrow focus: "*The challenge comes in is, for me, is ...* ***his*** *world is small,* ***your*** *hands up to* ***your*** *eyes, and that's all* ***he*** *sees. Is his world, and he doesn't see the challenges I face or how things affect me. that's the challenging part of* ***his dementia****, I think, for me.*"

In response, Ron (CR) agreed about his limitations, saying "*Well, I think that's fairly true,*" Ron (CR) still framed this problem as something that could be solved together, unlike Rosanne, who framed the problem as "Ron's dementia": "*Do you want to know how* ***we*** *overcame [the problem of purchasing pills]? "*

This conflict in their perspectives is demonstrated in the proposed designs, where Ron (CR) suggested that the robot be "*nonjudgmental"* and "*prompt [them] to talk about the problem."* In contrast, Rosanne envisioned the robot design as something that interacts with Ron. When asked by the researcher about how she would respond to the robot's prompt for discussing a problem, Rosanne (CP) said she would "*stay out of it and let the robot deal with him in the issue*" and potentially "*walk out of the room.*"

In another example, although Kat (CP, 82/F) and Sean (CR, 84/M) showed some care partner influence in the design, their interaction revealed discrepancies in how they described their relationship and approached the robot design. Kat, the care partner, explained how Sean would occasionally ask questions that he believed were important, interrupting her work. She referred to these moments of solving Sean's questions as a touchstone, saying, "*we take the time for it and treat it as if it was as important as my getting this deposition summary done.*" Kat then continued discussing how the touchstone itself was part of the problem:

> "*Yeah, and some of it is providing* ***you*** *calendar what's going on the right every right to help you orient. And at the same time, when what I call touchstones is more and more,* ***you*** *are taking responsibility for* ***your*** *own pleasure and engagement.*"

In response, Sean (CR) expressed concern about another complication they may face together in the future. Sean was inclusive in his language and spoke about the challenge of not being together in the future:

> "*I'm thinking of how the future is going to become a time where when* ***we are*** *not together every day, all day. ...I don't know how long it's going to be, but far in the future, but it won't be very long before I'm set up in a different place from her, and* ***we get together*** *as often as we can, but it's not going to be the way we've been doing it.*"

As a result, the difference was demonstrated when Kat (CP) and Sean (CR) designed the robot. Kat's design was a robot that would help Sean with answering some of the frequent questions that he would typically ask Kat: "*[The robot] could go through some of the questions you have over and over.*" When asked about what Sean (CR) thought about the idea, he said that Kat's (CP) design was strange: "*the whole thing here just seems strange to me,* " or "*I don't think I could be standing in the same room with you, talking to the [robot].*" While Kat (CP) views the robot as a tool to reduce her caregiving burden, Sean perceives it as a replacement for his connection with Kat.

In both dyads, care partners discussed their relationship challenges due to their loved one's dementia. They decided the robot should primarily interact with the person with dementia to ensure safety and autonomy. However, those living with dementia were not fully comfortable with the robots designed by their care partners, as these designs resulted in feelings of isolation. These differences in the discussion of the relationship and the resulting design outcomes highlight the gap between the care partner's practical objectives and the emotional and social needs of people with dementia.

4.1.4 Viewing the Challenge as a 'We' and Designing a Robot for 'Us'.

Some care partners and recipients agreed that the nature of their relationship challenges was an issue and should be solved as a shared experience during the design workshop. Though care partners often perceived the challenges related to dementia in terms of what they and their loved ones can or cannot do, they described these issues as affecting both of them equally. This inclusive mindset led to designing solutions that reflected their mutual understanding and collaboration.

For instance, Reeve (CR, 67/M) and Elaine (CP, 63/F) began by discussing how they approached challenges together. Both acknowledged that they sometimes lost their temper, with Reeve admitting, "*I found myself losing my temper a couple of times. I rarely curse, but I found myself saying a bad word or two.*" Elaine added, "*I might need to calm down too, you know, because it's frustrating for both of us when he gets frustrated, yeah?*" To address this, they explored finding a balance between collaboration and independence when working on projects together. Reeve described inclusively how they would work together to solve the problem:

> "*Sometimes* ***we*** *start, and then she goes and does something else, and I'm working on it for a while, and then she come back and check on me, that kind of thing. She's usually real, real close by, but she doesn't have to be there for everything, because it's a rather slow, tedious process that doesn't take two people. It just takes time and patience. And I've got the time, I've got the patience. She doesn't have real good patience with waiting for slow things like that. But it all works out.*"

Elaine (CP) also described her role in this process, and said that she tries to *"remind him that he can still do things, he's still capable."*

This approach aligned with Reeve's (CR) design suggestion, where he envisioned a robot that could interact with either Elaine (CP) or himself when facing aggravation and eventually work with Elaine to resolve the challenge together:

> "*I believe that if the robot notices heightened aggravation or angst, that the robot should start speaking to me, and in the interim, be contacting Elaine, if that's possible, and she would try to calm and soothe me in different ways, waiting for Elaine to come in, and when she did, then the robot could hand off to Elaine.*"

Elaine agreed with Reeve's idea and suggested that the robot could later join in if she asked, "*what are your thoughts?.*" In this example, even though both recognized the challenge of the relationship as partly each other's fault or primarily Reeve getting aggravated, they both agreed that the challenge should be solved together, initially with the robot and then with Elaine (CP) coming in.

Similarly, Tim (CR, 83/M) and Sherry (CP, 73/F) agreed to view the challenge as a joint experience. As a result, Tim framed the challenge as something they needed to work through together to start the day:

> "***We*** *figure out is if the challenge is some kind of an appointment.* ***We*** *figured out when* ***we*** *have to be ready or when* ***we*** *have to leave the house, and figure backwards for how long anything* ***we*** *have in mind will take* ***us*** *and arrive at a latest start time for getting ready. And that keeps me on track, and [Sherry] is always on track*

> *anyway. So okay, it's not much of a challenge. It's the challenge is just being sure* ***we're both*** *talking about the same time."*

Sherry (CP) mentioned that this is a joint effort to ensure they work together well: "***we*** *still forget sometimes, but we communicate pretty well in that regard."*

When it came time to pick a topic in which they could design the robot, both Tim (CR) and Sherry (CP) gravitated towards an idea that would involve interactions with both of them. Tim immediately thought of how they interacted together: "*We might be able to* ***coordinate scheduling****. Because we're independent enough that we do our own thing and try to keep connected where they have to be, but not when they don't.*"

Sherry (CP) also elaborated on collaborating and talking using the robot: "*if I was out grocery shopping or something, and I wanted to just talk to Tim, rather than dial up a phone. He could have the robot, and I could just, I don't know how that would work, but I could, he could see me talking to him, kind of like FaceTime through the robot, but without having to go through the phone, like an instantaneous being able to communicate.*"

These discussions highlight how incorporating the perspectives of both participants in the dyad is crucial in ensuring that the design addresses both parties.

4.2 The Researcher's Influence on the Relationship Dynamics

Recognizing the presence and influence of the researchers is equally important as studying the dynamics between the participants during the workshop. In this section, we present how researcher involvement and activity design can shape the dynamics and outcomes of the technology intended to support these relationships.

4.2.1 Researcher's Workshop Design: The Impact of Workshop Difficulty on Relationship Dynamics. Although both the online and in-person workshops aimed to design technology to enhance relationships, with the expectation that care partners would drive the interaction, our initial in-person workshop (iteration 1), which relied heavily on memory recall, proved too challenging for people living with dementia. As a result, the care recipients had limited opportunities to express their own perspectives, leading to a dynamic that heightened our initial expectations, where the care partners dominated the conversation and drove the design process. This imbalance highlighted how the complexity of the activity designed by the researcher inadvertently silenced the voices of care recipients, reinforcing the care partner's influence in the workshop.

For example, the diary reflection of the first co-design iteration had too many recalls, with prompts such as "*What do you enjoy about the journaling experiences?*" or "*How has your relationship changed during the journaling process, if at all?*" Since the care recipients living with dementia had difficulty recalling the content discussed, they had difficulty expressing their voices or understanding the narrative. For example, during the diary session, Jason (CP, 28/M) attempted to help his grandmother, Linda (CR, 91/F), recall her memories by asking her if anything stood out during their conversations at the kitchen table (*"you remember ..., this is what we've talked about"*). However, these efforts met with limited success. Linda's responses, such as "*I don't know what it is about*," flipping through the diary without comment, or smiling without providing direct answers, highlighted her struggles with recalling information from the diary and engaging meaningfully in the conversation.

The brainstorming activity, where participants were randomly assigned technology and situation cards and asked to design use-case scenarios based on them, was particularly challenging for the care recipients. The technology cards included five different robots with varying capabilities, which required the dyads to learn and understand everything during the workshop. The situation cards presented multiple scenarios, some of which were not directly relevant to the dyads. Moreover, the participants were limited to just two minutes to create a drawing, which further exacerbated the difficulty for the care recipients. As a result, Mia (CR, 79/F) showed confusion during the activity. She sought assistance, frequently glancing in multiple directions—at the cards, the other dyads, the moderator, and her care partner, Stacy (Fig. 1 (4)). This level of complexity, introduced by the researchers, inadvertently leaned the dynamic toward the care partner, who had a better grasp of the task and naturally took the lead in the design activity.

However, this kind of problem was not discovered in the second iteration of the workshop, where we could uncover and understand the dynamic a little more, as shown in the findings above.

4.2.2 Researcher's Way of Introducing the Care Partner's Perspective in Diary Writing. As our goal was to design technologies to enhance the relationship between the care partner and recipient living with dementia, we tried to use diaries to understand the real-life situation and perspectives as much as possible. Due to our assumption that the care partner is more active in relationships, along with the cognitive and physical limitations we thought people living with dementia would have in recording the diary, we had the care partner take on this task. This frequently resulted in the care recipient being unaware of what was documented, introducing a new dynamic that may not exist in their relationship. For instance, when we began the diary recall during the workshop, Sean (CR, 84/M) remarked, "*I don't remember any of this, or I've not seen the diary.*" This highlights how the workshop's structure learned the dyad's daily life from the care partner's perspective, creating a dynamic that favored the care partner, who was more informed about what was happening and what had been recorded.

Since our themes were drawn primarily from the diary, we naturally tuned to and favored the care partner's viewpoint. For example, with Kat (CP, 82/F) and Sean (CR, 84/M), we, as moderators of the workshop, described the situation from the care partner's perspective, focusing on the perceived deficiencies of one dyad: "*So there were some times when Sean woke up with confusion. What kind of difficulties did you face when waking up? Kat, would you like to start explaining the scenario?*" By framing Sean (CR) as the one experiencing confusion, we inadvertently reinforced the dynamic suggested by Kat's (CP) diary entry, further contributing to the existing imbalance.

In another instance, when discussing Elaine (CP, 63/F) and Reeve's (CR, 67/M) situation based on the diary, we began by saying, "*So in the diary, you mentioned that his (Reeve's) response is not always good. So you changed things to get Reeve's attention first. Could you elaborate a little more on the techniques you've used to overcome*

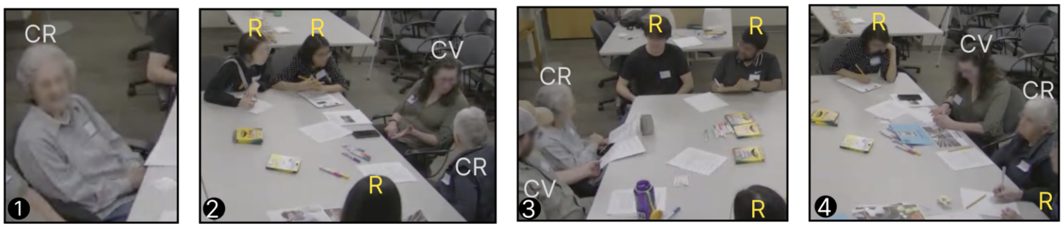

Figure 1: Care-recipient reactions denoted as CR=Care-recipient, CP=Care partner, R=Researcher, are depicted as follows: (1) Linda (CP) shared her name and hometown during the introduction; (2) Mia (CR) attentively listened to Stacy (CP)'s instructions with researchers observing their interaction; (3) Linda (CR) read the diary, yet struggled to understand Jason's (CP) explanations, while researchers listened in; (4) Mia (CR) looked towards the cards, the moderator, other dyads, and Stacy (CP), signaling her need for assistance.

this challenge with Reeve sometimes forgetting his hearing aid or having difficulty understanding?" Here, we again introduced the problem as primarily the care recipient's issue, focusing on Reeve's forgetfulness as the central challenge.

The structure of the diary introduced a dynamic where we leaned toward the care partner's perspective.

4.2.3 Researcher's Moderating Influence. The researcher's presence, especially during moderation, would influence those dynamics. For example, in cases where one side dominated the conversation, and the other dyad member was less vocal, such as Larry (CP, 60/M) and Marian (CR, 99/F), we specifically asked Marian, the quieter member, for her thoughts. This shifted the dynamic from care-partner-driven to incorporating more of her perspective into the conversation:

> LARRY (CP) Mom is always asking me, and I keep telling her, why don't you just ask [Google]? And she doesn't feel comfortable doing it. I can do it, and it will take the day or the weekend. What time is it, right? But I'm saying it because she's from another school, an older time when we didn't have these things. So it's a little bit odd.
> RESEARCHER B Marian, would you feel comfortable asking the robot what the time is?
> MARIAN (CR) Not really.
> RESEARCHER B Do you not trust the robot?
> MARIAN (CR) No.
> LARRY (CP) I can tell you, I've got this little screen thing I talk to...
> RESEARCHER A Marian, I have another question. If this robot can help you, like, call Larry—like you can say, 'Robot, help me call Larry' when you need him—does that make it helpful?
> MARIAN (CR) Not really.
> RESEARCHER A Not really? Okay, so what would be helpful for you?
> MARIAN (CR) I don't know.
> RESEARCHER A You don't know? Okay, well, Larry suggested having this robot that will maybe stay with you while he is sleeping, and then provide some information to Larry while you are sleeping. You don't have to interact with the robot. Will that be okay for you?
> MARIAN (CR) Yeah.
> RESEARCHER A So you don't need to interact with the robot, but the robot will monitor how you are doing at that time. That will be okay?
> MARIAN (CR) Yes.

As seen in this excerpt, we subtly altered the existing dynamic and influenced the design process by involving Marian (CR) in the discussion and ensuring her voice was heard. If we let Larry guide the conversation without asking for Marian's, we would not have discovered that Marian did not want to speak to the robot directly.

In situations with a disparity or lack of consensus between both sides, moderation can help diffuse tension while ensuring that both perspectives are heard. Rather than allowing disagreements to escalate, effective moderation creates a space where both sides can express their views and feel acknowledged. For example, in the case of Rosanne (CP, 61/F) and Ron (CR, 68/M), they had differing perspectives on who was responsible for a challenge in an incident in their relationship—when Rosanne had a headache and required medication, but Ron did not provide the correct one:

> ROSANNE (CP) I interrupted your TV or your game, whatever you were doing.
> RESEARCHER A Um, [Ron], would you like to tell us a little bit more about your side of the story?
> RON (CR) Okay, yeah, initially, I really thought that... so I gave her those [medicine] and yeah, I wasn't really happy now because she had interrupted me and she had told me wrong information, so that just really bothered me.
> RESEARCHER B Sounds like you really trust Rosanne's opinion, then, if you chose specifically the ones on those shelves, even though you knew those weren't the right ones.
> RON (CR) Well, I have to, Researcher B. I can't make my own assumptions about medications because I've made enough mistakes, so I know that's a limitation I have to protect.
> RESEARCHER A Okay, well, Rosanne, how do you feel after hearing [Ron] say that he was a little confused about the medicine that time?

> ROSANNE (CP) It makes me angry because I think he uses his dementia to not do things. Um, he's very capable, like he said...

As seen in the example above, Rosanne (CP) initially framed the issue as Ron's (CR) fault. However, with the researcher's input and moderation, prompting both sides to share their perspectives, the disagreement was reinforced, intensifying the disparity dynamic. Without this prompting, the disagreement might have remained hidden. While the moderation surfaced in the conflict, it also allowed both parties to delve deeper into their reasoning and express their perspectives.

4.2.4 Researchers Subtly Introducing Our Perception of the Dynamic through Storyboard. Toward the end, we designed and presented a storyboard that demonstrated how a robot could enhance the relationships between care partners and people living with dementia based on their design suggestions from their lives. During the workshop, we introduced our interpretation of the participants' dynamics, which inevitably influenced both the dyad's interaction in the workshop and the design outcome. By framing the design and interactions as we perceived them, we prompted participants to consider and discuss the scenario from our perspective.

For instance, in the case of Rosanne (CP, 61/F) and Ron (CR, 68/M), where there was a divide between individual and collaborative design approaches, we needed to find a middle ground when creating the storyboard. We designed a storyboard that subtly supported Ron's (CR) perspective, emphasizing a more cooperative interaction with the robot. Ron had suggested that "*the robot's gonna have to be able to perceive that there's a problem. And I don't, you know, unless Rosanne would tell the robot to talk to me here or something, I just, I don't know how it would sense that.*" This approach prioritized the robot's ability to detect and notify when something was wrong, rather than Rosanne's viewpoint, which focused on using the robot as a simple reminder for Ron ("*I think what [Ron] said is good, just a friendly reminder. Hey, you need to watch this another time, or if you're not interested in the TV show*"). As demonstrated in Fig 2, where the robot would detect and notify: "*the robot would be able to detect something going on. So the robot would break the ice saying something like, 'Hi. It sounds like it's getting a little too loud. How can I help?'* " (Researcher A)

Later, in talking through the storyboard, it eventually made Ron (CR) and Rosanne (CP) compromise to a certain degree, notifying on "*I just think you guys are amazing, because how you're taking this information and how you're going to make this computer or robot work is just, it's beyond me.*"

Our design process sometimes reinforced the dynamics in the participants' relationships. For instance, when Bianca (CP, 60/F) and Carter (CR, 77/M) were working on their design, Bianca leaned toward self-blame and focused on mitigating her impatience with Carter's need for the relationship. We carefully emphasized this dynamic by presenting a technological solution:

> RESEARCHER B So based on that, this is when I thought about what the robot might say. As an example, I know we had talked a little bit about it, or you had mentioned being able to detect noise or understand something within the conversation. So as an example, the robot might say, 'It's gotten quite loud in here. Should we say something to Bianca to make her feel better?' What do you think about that?
>
> BIANCA (CP) The robot says that, and he goes through the window. Okay, so it's gotten quite loud here. Don't you think, Carter, we should be singing? No, this is too procedural.
>
> RESEARCHER B So it just reacts on its own
>
> BIANCA (CP) It's not a teaching moment, you see. I can say to myself, 'Don't be a bitch.' But nobody else is gonna say it without being knocked out of the house.

In this conversation, we introduced a design that reflected our interpretation of the dynamic between the care partner and the care recipient. Although Bianca disagreed with the idea of the robot redirecting her, she still used harsh, self-critical language, demonstrating a tendency to ridicule herself, reinforcing her existing tendency toward self-blame.

By presenting our design ideas, we may subtly reinforce existing dynamics, intentionally deepening our understanding of the relationship. This influence can shape participants' interactions and ultimately affect the overall outcome of the workshop.

5 Discussion

When designing to enhance care partnerships between people living with dementia and informal care partners, HCI researchers often create personas, including specific expectations of relationship dynamics, to guide the design process to enhance those dynamics. However, relationship dynamics are diverse, and so is the design of robots. In this section, we first reflect on our findings on relationship dynamics based on existing literature (section 5.1). We then propose guidelines to support researchers incorporating these findings in future research design (sections 5.2 - 5.5).

5.1 Relationship Dynamics are Diverse and Require Attention

Even within the same series of diary reflections and co-design workshops, we identified four distinct relationship dynamics between people living with dementia and their care partners, some of which even coexist within a single relationship (e.g., Kat and Sean, as discussed in Sections 4.1.3 and 4.1.2). These diverse relationships directly influenced the design of the robots they envisioned. For example, care partners and people living with dementia who experienced self-blame (Section 4.1.1) align with existing research showing that care partners [22] or people living with dementia [21, 66] may feel powerless. Relationships with this dynamic led to designs aimed at addressing self-blame, such as technologies that promote patience, encourage mindset shifts [70], or foster gratitude [37, 69] for the individual blaming. In contrast, relationships where care partners primarily viewed challenges as stemming from care recipients living with dementia (Section 4.1.2) reflected situations where caregiving responsibilities weighed heavily on them, especially as dementia impaired the care recipient's decision-making abilities [67]. Technology in this context focuses on accompanying or assisting people living with dementia, addressing the perceived burden of their disabilities [53]. Meanwhile, dyads collaborating more equally (Section 4.1.4) designed robots to address problems collaboratively without disproportionately empowering one side.

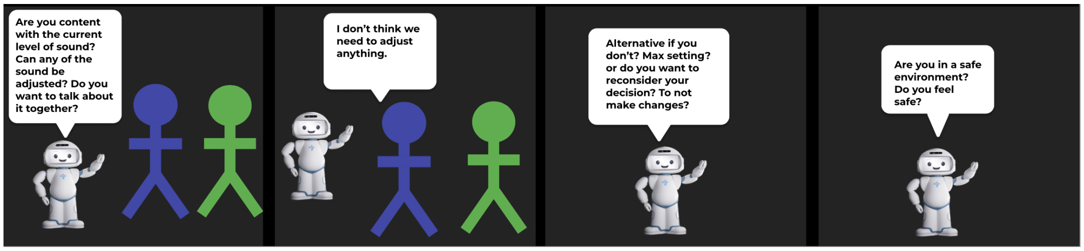

Figure 2: This storyboard was presented to Ron (CR) and Rosanne (CP) by the researchers as a visual demonstration of the scenario they had discussed. Here, Ron was represented by a blue stick figure, and Rosanne was represented by a green stick figure, followed by a QTrobot figure. The storyboard focused on a scenario where a robot would join in the conversation if it noticed that the living room volume became too loud, (1) to which the robot asked, "Are you content with the current level of sound? Can any of the sounds be adjusted? Do you want to talk about it together?" (2) Ron would respond by saying, "I don't think we need to adjust anything."(3) If this is the case, the robot might respond by asking if they "want to reconsider [their] decision." (4) In circumstances where the robot determines that the language might be harmful, the robot might ask Rosanne "Are you in a safe environment? Do you feel safe?."

While the four resulting dynamics and three design outcomes are not new to HCI literature, the diversity observed within a single workshop series highlights the potential for future research to adopt a more open-minded approach, considering the wide range of relationship dynamics before developing personas and setting expectations.

Considering the nuanced complexities of relationship dynamics is especially important because researchers' initial expectations of relationship dynamics could inherently influence the participants in the research process. Although we conducted two iterations of research and the second iteration aimed to empower people living with dementia, both largely focused on the expectation that care partners are more active within the relationship. If we had asked participants to design solutions based on that persona, participants who do not align with the actual relationship could make speculative predictions. Participants may make suggestions that reflect stereotypical or assumed relationships rather than their lived experiences while stating: "*This robot is not for me*" [47] or "*I hope that I never need one*" [12]. Such research design not only limits research outcomes, but the simplified user representations also may not capture the diversity and complexity of user needs [52]. Thus, researchers should carefully consider relationship dynamics throughout the design research process to ensure that both methods and outcomes genuinely capture and reflect the diverse spectrum of relationship dynamics.

Indeed, prior HCI literature has advocated critical reflection on research methods. For example, some discussions focus on approaches to empower people living with dementia and support their personhood [16, 21, 28, 45, 77]. In contrast, others highlight methods that amplify the voices of care partners to alleviate caregiving burdens [23, 31, 36, 71, 75], or explore collaborations in partnerships [46]. Outside care dynamics, scholars have also carefully assessed how to support different participants throughout the research process [51], suggesting examining objectivity in design processes [5, 80]. Previous research has also discussed the importance of recognizing the fluidity of roles [9] and evolving challenges [17] within relationship dynamics. Our research adds to this conversation by suggesting HCI researchers not only be critical of the methods but also critically reflect on the diverse relationship dynamics, how they influence research design and outcome, and how researchers impact these dynamics. By considering these factors, researchers can gain more nuanced insights and develop methods that authentically reflect participants' lived experiences. In the remainder of the discussion, we present guidelines for researchers to consider when conducting studies involving care partnerships between people living with dementia and their care partners.

5.2 Understanding the Relationship Dynamic Before the Co-design

First, **researchers should understand various aspects of participant relationship dynamics before engaging in co-design**. Understanding the relationship dynamics can allow researchers to understand the context and create appropriate approaches, plans, and personalized prompts [16].

Researchers could consider incorporating screening surveys and diaries, as we implemented in our workshop series, to gather preliminary insights into relationship dynamics before the main study activities. For example, in our study, we used a screening survey that captures demographic background to understand the relationship type (parent-child, spousal, grandparent-grandchild) and the type of dementia involved. We also conducted diaries similar to previous studies examining daily activities, self-reported technology use, or reflections on daily life [38, 60]. Diaries can set the stage for more meaningful engagement in workshops [26]. In our study, we tailored the diary process specifically for care partners, asking them to reflect on scenarios and challenges encountered in their daily lives. The dairy helped the care partners to reflect on their relationships and offer more focused insights.

In the same vein, researchers could conduct semi-structured interviews to explore the nuanced dynamics of care relationships before the study [3]. Introducing technology [58, 61] but observing interactions during the introduction can also provide insights into the existing dynamics. Community engagement effort [16] or ethnographic methods [44] can also enable researchers to observe the dyads within their natural environment and provide in-depth insights into relationship dynamics before the study begins.

Nevertheless, researchers should **carefully consider the dynamics introduced or reinforced through research before the co-design**. As observed in our findings (Section 4.2.2), our anticipation that care partners would typically lead the relationship influenced the decision to have only care partners complete the diary. This presumption shaped the workshops, prioritizing care partner perspectives. To avoid embedding such dynamics into the research process, researchers should consider having both participants complete the diary together or individually. Suppose diaries were too challenging for people living with dementia or too burdensome for care partners. In that case, researchers can consider alternatives, such as capturing photographs that represent their relationship [7], conducting brief daily calls, taking a picture each day, or including other observation methods mentioned above.

Researchers could better understand the complexities of relationships before the workshop, facilitating a more tailored and effective co-design process by understanding the dynamics before the workshop and carefully considering these approaches.

5.3 Being Self-Aware of the Researcher's Influence: Observing and Acting on Relationship Dynamics to Support Interaction

Researchers should remain self-aware of their influence during workshops, especially when moderating them. To maintain self-awareness, researchers could carefully observe and reflect on how they introduce their thoughts during a co-design. For example, we emphasized the importance of eliciting opinions from both sides, allowing minor voices to be expressed (Section 4.2.3). Instead of starting the diary reflection session by stating, "*Sean woke up with confusion*" (Section 4.2.2) that revealed a lack of self-awareness, imposing the impression that Sean was at fault for the relationship challenges, researchers could ask open-ended questions such as, "*What usually happens in the morning?*"

Researchers could also reflect on their emotional engagement, attachment [27], and role in the dynamic [9]: Are they emotionally attached to one side, unavoidably acting as dementia experts advocating for and empowering people living with dementia or counselors trying to solve care partner's burden? These questions became more important in moments of conflict. Instead of avoiding conflict, as suggested by previous research [16], researchers could allow natural conflicts to surface to understand differing perspectives better and design considerations closer to their day-to-day lives. Allowing conflict does not mean leaving participants boiling with anger or shouting at each other during co-design sessions. Instead, it involves moderating discussions to ensure all participants can express their views on the conflict, as demonstrated in Section 4.2.3. For example, workshop facilitators could ask if decisions and preferences are mutually acceptable rather than taking sides [46]. Acting as an observer to document the dynamics and facilitate natural communication between participants could better ensure the technology design matches participant dynamics and needs.

5.4 Being Mindful of the Impact of Research Method Choices Reflecting and Iterating for the Dynamics

Researchers should be **cautious of how their decision on workshop methods influences how participants shape their resulting design**. A way to be mindful of the impact of research method choices is through **post-workshop reflection and iterations**, as iterative workshops allowed researchers to create more tailored approaches to the targeted participants [8, 39]. In care dynamics, such iterative methods allow researchers to better understand the complexities of care relationships and design more suitable activities for participants. As described in Section 4.2.1, our reflection on the initial workshop led to revisions, such as shortening the workshop, reducing reliance on memory recall, and limiting the number of artifacts to better align its difficulty with the capabilities of the dyad. Another deliberate way to enhance reflection and workshop iterations involves conducting data analysis explicitly on power dynamics, examining how one participant's voice might be amplified or suppressed during the process [16]. Nevertheless, this iterative approach should not be confined to a single design setting; just as experiments require repeated validation from the broader scientific community, co-design methods and an understanding of specific dynamics should be continuously applied and extended across the wider HCI community. Repeating and refining the co-design process with various co-designers can better understand the diverse dynamics between care partners and people living with dementia [8]. As such, iterative reflection and design of workshops, whether conducted as individual research or for the broader HCI community, enable researchers to develop sessions better aligned with participants' needs and capabilities.

5.5 Rethinking That Research Process as an Act of Care

Researchers could adopt a broader perspective that considers the participants' overall life context. In this view, the real focus becomes the relationship dynamic itself, with technology merely used as a tool to enhance the relationship in a way that aligns with user desires and needs. Take our workshops as an example, the dyad's pre-existing dynamic and influence on the design demonstrate that the robot is merely an artifact within the broader context of the dyad, serving to support the existing relationship. Similar to previous research that emphasized the importance of relationships and experiences that emerged during the study rather than focusing solely on the digital jewelry being designed [76], the true value lies not in the artifact itself but in the interactions and connections it fosters.

Designing technology becomes an act of "care" within the relationship—care that permeates the entire design process, centered on the well-being of both individuals and the relationship itself. For instance, when a care partner experiences self-blame and designs a robot to mitigate their impact, the robot becomes a way to communicate, "*I am sorry that I caused this, and I want the robot to help make things better.*" Similarly, when the care partner identifies a problem, the design process becomes a way to tell the recipient, "*This is the challenge I face every day, and this is how the robot can help us navigate it together.*" Technology, in this context, serves as an artifact of care. The care partner and the recipient use technology to provide and express care, even though they may not recognize it.

The workshop is an activity that is part of the real lives of care partners and people living with dementia, part of what previous research called ecology [5]. Having a researcher or designer in their lives is already a huge boost to their sense of self and well-being, independent of it being a co-design activity with technology. Hence, in the workshop, they are curating something for their relationship—something they can discuss or potentially integrate into their lives. The workshop can also be a fun activity for the dyads. For example, Bianca (CP, 60/F) mentioned how Carter (CR, 77/M) enjoyed the conversation: *"Thank you for an interesting and inspiring opportunity to think today outside our daily routines box! Carter enjoyed the activity, which is precious at times when he is down and depressed."* As researchers, although the workshop aimed to design technology to enhance relationships, it is crucial to critically reflect on the role of the technology, the dynamics it influences, and its overall purpose within the relationship as it facilitates the co-creation of care.

6 Limitations and Future Work

Our study has several limitations that created opportunities for future research. First, the small sample of eight dyads limited the study, requiring further exploration to more clearly define the relationships and how technology can be designed for such relationships. Other forms of research and dynamics may emerge from participants' motivations for the research: care for their loved ones, contribute to society, or help others facing dementia in the future—a sense of formality tied to a commitment to the greater good. Future research could look further at diverse motivations and explore additional types of relationships.

Secondly, we chose to analyze both iterations of the co-design workshops because they both began with the expectation that care partners would lead the relationship and the design, revealing similar findings. However, our two settings—online and offline workshops—may reveal different dynamics, as participants may behave differently in front of a camera [41, 78]. At the same time, they may be more comfortable in their homes, facilitating more natural and life-like interactions. As such, future research could also examine the differences between online and offline co-design sessions and explore other methods to gain a deeper understanding of these dynamics while critically reflecting on the chosen methods and the researcher's influence on the dynamic during the research process.

Thirdly, our co-design approach involves trade-offs that could provide valuable opportunities for exploration in future research. This study began with the assumption that the care partner was the primary driving force in the relationship, which led to a focus on the care partner's perspective. Future research could explore this dynamic further by employing a more neutrally focused co-design workshop, allowing for greater inclusion of perspectives from people living with dementia within the relationship. Moreover, using the diary and conducting the sessions in the lab or online in the dyad's home only allowed us to capture limited aspects of their experiences and dimensions of their relationship dynamics within a constrained time and space. This limitation may miss the opportunity to observe the fluidity of roles [9] and evolving challenges [17], especially with ongoing dementia progression. Future research could explore alternative methods, such as longitudinal observations, to better understand the evolving dynamics that may be difficult to observe in a lab setting or in front of a camera.

The background of the dyad, including factors such as gender and dementia symptoms, can significantly influence the dynamics within the pair. In this study, most dyads consisted of female spouse care partners. While the specific levels of dementia were not formally assessed, we observed varying degrees of cognitive impairment, which may have limited the scope of our findings. Future research could improve by recruiting specific relationship types, such as focusing on romantic dyad relationships, which could offer deeper insights but present more challenges during recruitment. Studies could also concentrate on a specific degree of dementia, allowing a clearer understanding of how dementia severity affects the participants. Incorporating pre-screening questions that prompt participants to reflect on how dementia impacts their daily lives would also provide a more tailored approach to understanding the nuances within these relationships.

The co-design artifact could also influence and add to the existing dynamic because of the participant's knowledge and skill sets regarding the artifact, potentially influencing the co-design process [39]. Participants with greater technological expertise might contribute more actively, while those with less familiarity could be overshadowed. Future research could assess participants' technological backgrounds in advance to create a balanced process to observe the relationship dynamic between the dyads better.

7 Conclusion

When designing technologies to enhance the relationships between care partners and people living with dementia, researchers often begin with preconceived ideas about what should be designed and who should be involved, especially in the context of people living with dementia and their care partners. However, our experience with dyad co-design aimed at developing robot technologies to enhance their dynamics, as detailed in this paper, reveals four distinct relationship dynamics that influence the design outcomes and highlights how researchers can impact workshop outcomes. This prompts us to rethink how workshops should be structured to accommodate these dynamics. We encourage researchers– not only care partners and people living with dementia but also other relationship dynamics or accessibility research that involves designing for more than one party– to consider the context of these relationships when conducting research. Rather than focusing solely on a single relationship dynamic, exploring the existing relationship dynamics between the parties and reflecting on how the researcher's role may shape outcomes can benefit understanding the most genuine interaction. By accounting for relationship dynamics, researchers can design workshops more precisely and effectively to enhance the participants' design in real-world situations.

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