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Making the invisible visible: Supporting older adults' expression of emotional needs for companion robots through visual co-design tools

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Abstract: As populations age, companion robots are increasingly explored to support emotional well-being in later life. However, older adults often find it difficult to express abstract emotions or imagine interactions with unfamiliar technologies, limiting their participation in early-stage design. This study develops and validates a structured toolkit designed to support emotional articulation and co-design participation. The toolkit, consisting of companionship cards, robot role cards, and recording canvases, was refined through expert evaluation and user testing, and validated through comparative interviews with older adults (n=10). Results show that the toolkit supported richer emotional expression, smoother dialogue, and more sustained engagement, helping participants transform lived emotional experience into design-relevant insights. The study contributes a new and replicable approach for emotion-centred participatory design, showing how structured visual scaffolding can foster emotional and conceptual inclusion, empower older adults to articulate their perspectives, and help their voices more actively shape more resonant Human–Robot Interaction.

Keywords: Ageing; Companionship; Emotional Expression; Co-Design

1. Introduction

Loneliness is increasingly recognised as a major public health issue, especially among older adults, where it is associated with heightened risks of depression, cognitive decline, and reduced quality of life (Courtin & Knapp, 2017; World Health Organization, 2021). To address this, technological interventions—particularly social and companion robots—are gaining increasing attention to support emotional well-being and reduce social isolation (Ahmed et al., 2024; Scoglio et al., 2019). This growing interest is also reflected in market trends: the global companion robot sector was valued at around USD 3.1 billion in 2024 and is projected to reach approximately USD 15.8 billion by 2033 (Growth Market Reports, 2024). While

these data reflect a broad range of companion technologies, they still signal increasing demand for robots capable of supporting emotional well-being, not merely performing tasks.

At the same time, advances in artificial intelligence accelerated this shift. Robots today can simulate affective cues, sustain conversation, and even shape personality traits, opening the possibility of more relational forms of interaction (Dautenhahn, 2007; de Graaf et al., 2015; Esterwood & Robert, 2021). These developments have shifted expectations: robots are no longer viewed simply as tools but as potential partners in everyday emotional life. Therefore, to design meaningful AI companion robots, it is essential to understand how older adults themselves perceive companionship—what it feels like, how it is formed, and how such qualities might be translated into human–robot relationships (Dörrenbächer et al., 2022; Kolling et al., 2016; Pedell et al., 2022).

Yet this understanding is difficult to obtain in practice. Many older adults find it difficult to articulate abstract emotional concepts such as "companionship" and to engage in discussions about future-oriented interactions with unfamiliar technologies like robotics (He et al., 2022; Studer et al., 2025). These barriers limit their ability to influence the development of technologies intended for them and risk reinforcing their marginalisation within the participatory design process (Davis et al., 2016). Co-design research offers useful strategies to address this gap. Tangible and visual tools—such as card-based methods—can help participants externalise feelings, reduce cognitive load, and navigate emotionally charged or speculative topics (Halskov & Dalsgård, 2006; Sanders & Stappers, 2014; Wölfel & Merritt, 2013). Still, when discussing emerging AI technologies, visual aids alone are not enough. Older adults also require structured and progressive interview formats that scaffold their engagement (Rogers et al., 2022; Stegner et al., 2023), which helps them move from familiar experiences of human–human companionship toward the more speculative realm of human–robot relationships.

This paper presents the development and evaluation of a structured, visual toolkit designed to support this process. The toolkit includes companionship cards, robot role cards, and recording canvases that scaffold emotional articulation and co-design dialogue. Through iterative expert evaluation and user testing, the toolkit was refined to enhance usability, accessibility, and emotional resonance. A comparative study—contrasting interviews with and without the toolkit—shows that the structured visual approach strengthens emotional expression, smooths conversational flow, and deepens participant engagement. By empowering older adults to voice how companionship is emotionally experienced—rather than only what a robot should do—this research not only strengthens their influence in shaping AI companion technologies, but also demonstrates the methodological value of structured visual aids in supporting emotionally complex design conversations. In this way, the study contributes to Inclusive Design by creating more supportive conditions for participation when feelings are difficult to articulate and technological futures are difficult to imagine.

2. Background and research rationale

2.1 Companion robots and the missing emotional dimension

Companion robots are intended to offer emotional presence and social connection, distinguishing them from service robots that focus on practical assistance (Fong et al., 2003; Rogge, 2023). Despite this intention, much of the current landscape still treats companionship as a functional or clinical outcome (Bemelmans et al., 2012; Yu et al., 2022). Many well-known robots—such as PARO, AIBO, and NAO—have been shown to facilitate social interactions and improve affect in institutional or therapeutic settings (Abbott et al., 2019; Chen et al., 2024; Robaczewski et al., 2021). However, these effects typically emerge under therapeutic protocols or anthropomorphic novelty, revealing little about how companionship is experienced and valued in everyday life. Consumer-oriented "emotional" robots such as Eilik or Vector attempt to move beyond clinical use to home-based interaction, but are often marketed toward younger users. Consequently, older adults may see them as playful gadgets rather than meaningful relational partners. In parallel, Human Robot Interaction (HRI) research has traditionally focused on cognitive and acceptance frameworks (e.g., UTAUT, Almere)—prioritising perceived ease of use, usefulness, and intention to use —while offering limited insight into older adults' emotional expectations or lived experiences of companionship (Heerink et al., 2010; Venkatesh et al., 2003).

Together, these patterns reveal a persistent issue: companion robots are becoming more technologically capable, but their design rarely begins with older adults' emotional experience of companionship. Addressing this gap requires methods that emphasise the construction of emotional meanings, helping older adults express these meanings and ensuring they shape future robot design.

2.2 From human–human to human–robot companionship

Designing emotionally meaningful companion robots requires attending to how people draw on existing interpersonal models when interacting with artificial agents. Research in HCI and HRI consistently shows that even minimal social cues—such as politeness, responsiveness, or contingent turn-taking—can prompt users to treat machines as social actors (Reeves & Nass, 1996; Nass & Moon, 2000; Fink, 2012). These cues invite mind attribution, activating relational expectations such as trust (Fox & Gambino, 2021; Ogawa et al., 2019), empathy (Park & Whang, 2022), and reciprocity (Chen et al., 2022). Such reactions extend beyond momentary impressions. People can build rapport with relational agents (Bickmore & Cassell, 2001) and may even feel guilt or discomfort when asked to harm or turn off a social robot (Darling et al., 2015).

In later life, these tendencies become especially pronounced. Studies show that older adults often interpret robots through familiar frames—pet-like warmth, friend-like support, or caregiver-like reassurance—depending on their emotional needs and social histories (Gasteiger et al., 2022; Irfan et al., 2024; Wada & Shibata, 2007). These suggest that companionship with robots is not created from scratch but emerges through reinterpretations of existing relational templates. Users draw on prior relational experiences to make sense of artificial partners.

Understanding these templates requires grounding design in older adults' lived experiences of companionship, rather than assuming universal emotional needs. This theoretical insight forms the bridge that motivates the methodological focus of the present study: eliciting, structuring, and translating human–human companionship into human–robot contexts.

2.3 Rationale for the present study

To support this translation, designers need methods that help older adults express emotional concepts, reflect on diverse relational experiences, and gradually imagine their extension into robotic contexts. Existing co-design tools provide precedents for using visual and tangible materials, but few focus specifically on emotional companionship or the conceptual shift required for imagining robot partners. The present study addresses this gap by developing and validating a structured, visual toolkit that makes emotionally laden ideas discussable and designable within early-stage co-creation with older adults.

3. Research design and methodology

3.1 Research approach and context

This study forms part of a broader research project exploring how older adults conceptualise companionship and how such understandings can inform the design of emotionally meaningful companion robots. Within this larger aim, the focus of the present study is methodological: to develop and validate a visual, structured toolkit that enables older adults to articulate their emotional experiences of companionship and to engage more confidently in early-stage co-design processes.

The research adopts a qualitative, participatory, and design-led approach, following a research-through-design logic in which iterative making and reflection act as both inquiry and intervention. Rather than evaluating robotic functionality, the study investigates how emotional and relational experiences can be elicited and translated into design-relevant insights.

The research was carried out in collaboration with Brunel Older People's Reference Group (BORG)—a long-established network of local residents aged 50 and above who are interested in ageing-related research. This partnership ensured that older adults were involved not only as participants but also as informants and co-creators, embedding their lived experiences throughout the research process. All procedures received institutional ethical approval from Brunel University's College Research Ethics Committee.

3.2 Participants and recruitment

The research involved two participant groups:

1. older adult participants (aged 50–85) recruited from Brunel Older People's Reference Group (BORG), forming the core participant group; and
2. expert participants from Human–Computer Interaction (HCI), inclusive design, gerontology, and robotics fields, who contributed to toolkit refinement.

Setting the lower age limit at 50 (rather than the traditional 65) aims to capture a broader continuum of ageing experiences. Those in their fifties, often still employed and digitally literate, are beginning to reconsider social priorities and future independence, offering anticipatory insights into evolving companionship needs. In contrast, participants in their sixties and seventies, typically retired, reflected on companionship in the context of solitude and changing routines, providing perspectives grounded in lived experience. Including both groups enabled comparison across life stages, revealing how emotional and social meanings of companionship shift over time. To preserve this diversity, participants were evenly distributed across three age bands (50–60, 61–70, and 71–85) with balanced gender representation.

Across the study, participants were engaged as follows:

- Stage 1 – Pilot Study: older adults (n = 10) participated in unstructured interviews exploring companionship without toolkit support.
- Stage 3 – Toolkit Evaluation: experts (n = 5) and older adults (n = 5) assessed the preliminary toolkit.
- Stage 4 – Main Comparative Study: older adults (n = 10) took part in structured interviews using the refined toolkit.

All sessions were conducted on campus, lasting 60–90 minutes. Interviews were audio-recorded with facilitator notes, while participant-created canvases were used only in toolkit-supported sessions (Stages 3 and 4). The overall research process is outlined in the following section.

3.3 Research design and procedures

The development and validation of the card-based toolkit and structured interview protocol followed a four-stage research design (Figure 1). Rather than functioning as separate stand-alone studies, these stages were built iteratively on one another: an initial pilot study identified barriers to emotional articulation and to imagining robotic companionship; literature-informed insights shaped the conceptual content of the toolkit; expert review and user testing supported iterative refinement; and a final comparative study evaluated their effectiveness in supporting older adults' emotional expression and engagement.

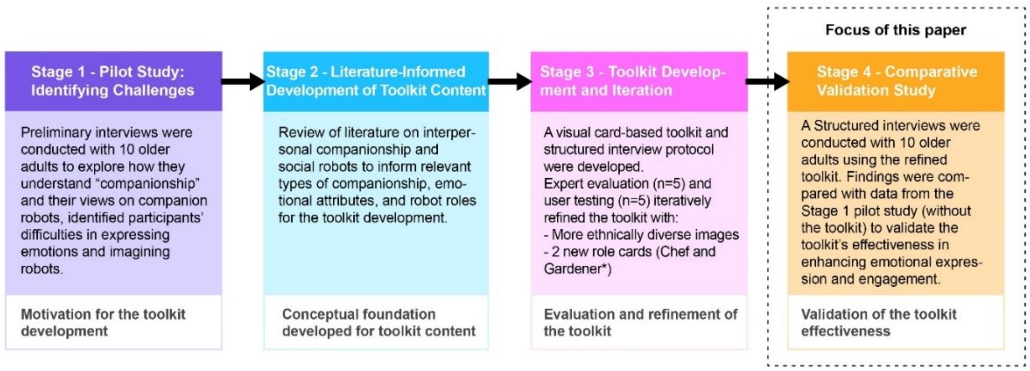

Figure 1 Overview of the four-stage research design used to develop and validate the co-design toolkit and structured interview protocol. The figure illustrates how pilot findings, literature-

informed content development, iterative refinement, and comparative validation informed the final study. (This paper focuses on Stage 4.)

3.3.1 Stage 1: Pilot study – identifying challenges in participation

The first stage involved pilot interviews with ten older adults to explore how they conceptualised companionship and initially imagined companion robots. While these interviews generated useful preliminary insights, they also revealed several barriers that later shaped the toolkit design.

Many participants found it difficult to articulate what companionship truly meant to them. Their responses were often abstract or focused on practical aspects—such as help, presence, or activity—rather than the emotional depth behind these experiences. This reflects wider evidence that abstract emotional concepts are challenging to verbalise and may benefit from external supports, such as visual or tangible prompts (Lucero et al., 2016; Page et al., 2022). Although many participants mentioned various sources of companionship—family, pets, even mobile phones—their reflections tended to emphasise functional benefits rather than emotional meaning, echoing critiques that HRI research often privileges functionality and acceptance over affective experience.

A second challenge emerged when the conversation shifted from human companionship to robot companionship. Several participants described this as abrupt or difficult, and limited familiarity with social robots made it difficult to imagine their roles or emotional value. Prior research similarly shows that familiarity strongly shapes older adults' engagement with new technologies (Flandorfer, 2012; Wu et al., 2014). Introducing short examples of existing robots, however, immediately increased curiosity and openness, suggesting that a more gradual and visually guided approach could better scaffold reflection and imagination (Rogers et al., 2022).

Taken together, Stage 1 identified three interrelated challenges: difficulty expressing abstract emotions, a tendency to overemphasise functionality in companionship conversation, and conceptual discontinuity when moving from human to robot companionship. These findings motivated the development of a method that was both visually supported and emotionally grounded to help older adults externalise feelings, connect concepts, and participate more meaningfully in co-design.

3.3.2 Stage 2: Literature-informed development of toolkit Content

Following the pilot study, relevant literature across psychology, gerontology, social sciences, and HCI/HRI was reviewed to inform the conceptual content of the toolkit. This review identified key companionship types, emotional and relational attributes, and common robot-role framings that could support reflection and discussion. These insights were translated into the relationship cards, emotional prompt words, and robot-role cards described in Section 3.4. Rather than functioning as a separate empirical study, this literature-informed step provided the conceptual foundation for the subsequent design and refinement of the toolkit.

3.3.3 Stage 3: Toolkit development and iteration

Building on the pilot findings and literature-informed content, Stage 3 focused on developing a visual card-based toolkit and structured interview protocol to support older adults' emotional reflection and co-design participation. The initial version was refined through expert evaluation and user testing.

The expert review involved five specialists from HCI, inclusive design, gerontology, and robotics. Experts examined the toolkit using a structured questionnaire combining Likert-scale ratings and open-ended feedback, followed by a brief interview. To complement this, five older adults aged 65+ took part in user testing, in which they used the toolkit in an interview session and completed a similar questionnaire and follow-up interview. Across both groups, feedback focused on the toolkit's clarity, usability, inclusivity, and emotional resonance.

This process led to several targeted refinements. First, the imagery used on the companionship cards was revised to include more ethnically diverse representations, responding to feedback that the original set did not fully reflect the cultural diversity of older adults. Second, facilitator guidance was expanded with clearer transition prompts and clarification cues to improve continuity across interview activities. Third, two additional robot role cards—Chef and Gardener—were introduced in response to older adults' suggestions, broadening the range of everyday relational and domestic roles represented in the toolkit. By contrast, requests to further differentiate some role cards (e.g., Assistant, Butler, and Housekeeper) were not fully incorporated, as a degree of interpretive openness was considered valuable for eliciting participants' own perspectives on companionship and interaction. The resulting toolkit and structured interview process—outlined in Sections 3.4 and 3.5—were then prepared for comparative validation in the next stage.

3.3.4 Stage 4: Comparative validation study

The final stage validated the effectiveness of the refined toolkit and structured interview protocol. Ten new participants took part in toolkit-supported structured interviews, and their responses were compared with those from the pilot study (Stage 1), in which the same topics had been explored without toolkit support. Both studies were conducted under comparable conditions with audio recordings and facilitator notes collected in both, and canvases produced only in the toolkit-supported sessions. This comparative approach enabled a focused evaluation of how the toolkit influenced emotional articulation, thematic richness, and participant engagement. The results are presented in Section 4.

3.4 Toolkit overview

To address the expressive and cognitive challenges identified in the pilot study, a visual, card-based toolkit was developed to support older adults' participation in co-design discussions on companionship and companion robots. The toolkit was designed to stimulate associative thinking, deepen emotional articulation, and scaffold reflective dialogue—helping participants express complex experiences that are often difficult to verbalise.

The design process was guided by Gillian Rose's (2016) visual methodology, which emphasises that the meaning of visual materials emerges through four interconnected "sites" of meaning-making—the site of production, the site of the image itself, the site of

circulation, and the site of audiencing. This framework helped guide design decisions and ensured that the toolkit remained coherent, emotionally engaging, and accessible for older adults. In practice, the design aimed to balance clarity and openness—using simple, tangible, and visually appealing materials that encouraged empathy, imagination, and personal interpretation.

The final card-based toolkit consists of three main components:

Companionship cards: A set of ten cards representing diverse companionship patterns (e.g., spouse/romantic partner, pet, parent-child, community). The front side presents a visually evocative image with a simple label, while the reverse contains a list of emotional and relational attributes (e.g., empathy, trust, reciprocity) to support reflection (shown in Figure 2).

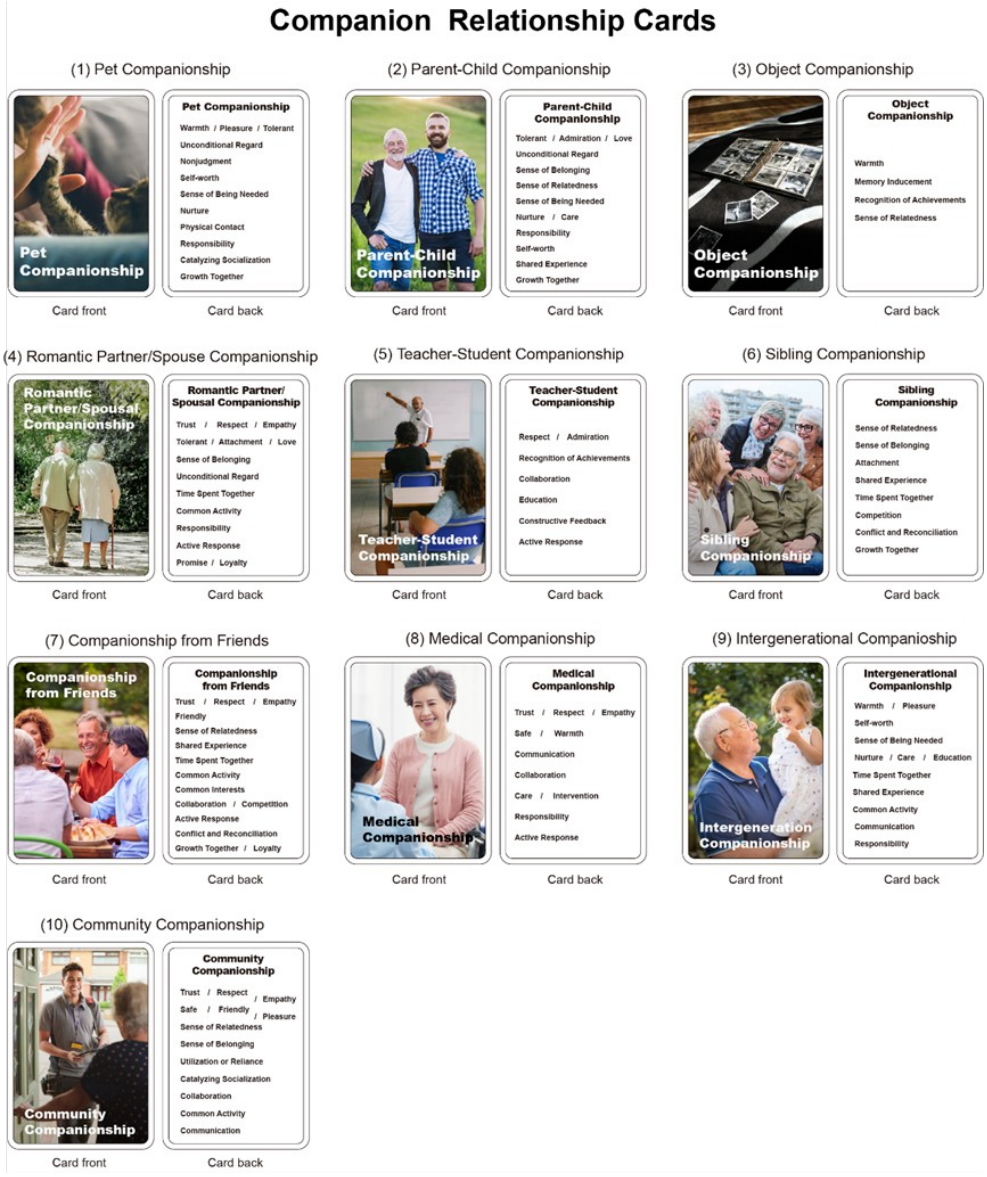

Figure 2 Companion relationship cards of the toolkit

Robot role cards: Twelve cards depicting potential roles a companion robot could play (e.g., caregiver, entertainer, tutor/mentor). These cards feature abstract illustrations with only a role label to avoid narrowing participant interpretation. Participants assign percentage weights to the roles, reflecting their expectations and emotional preferences for robotic companionship (shown in Figure 3).

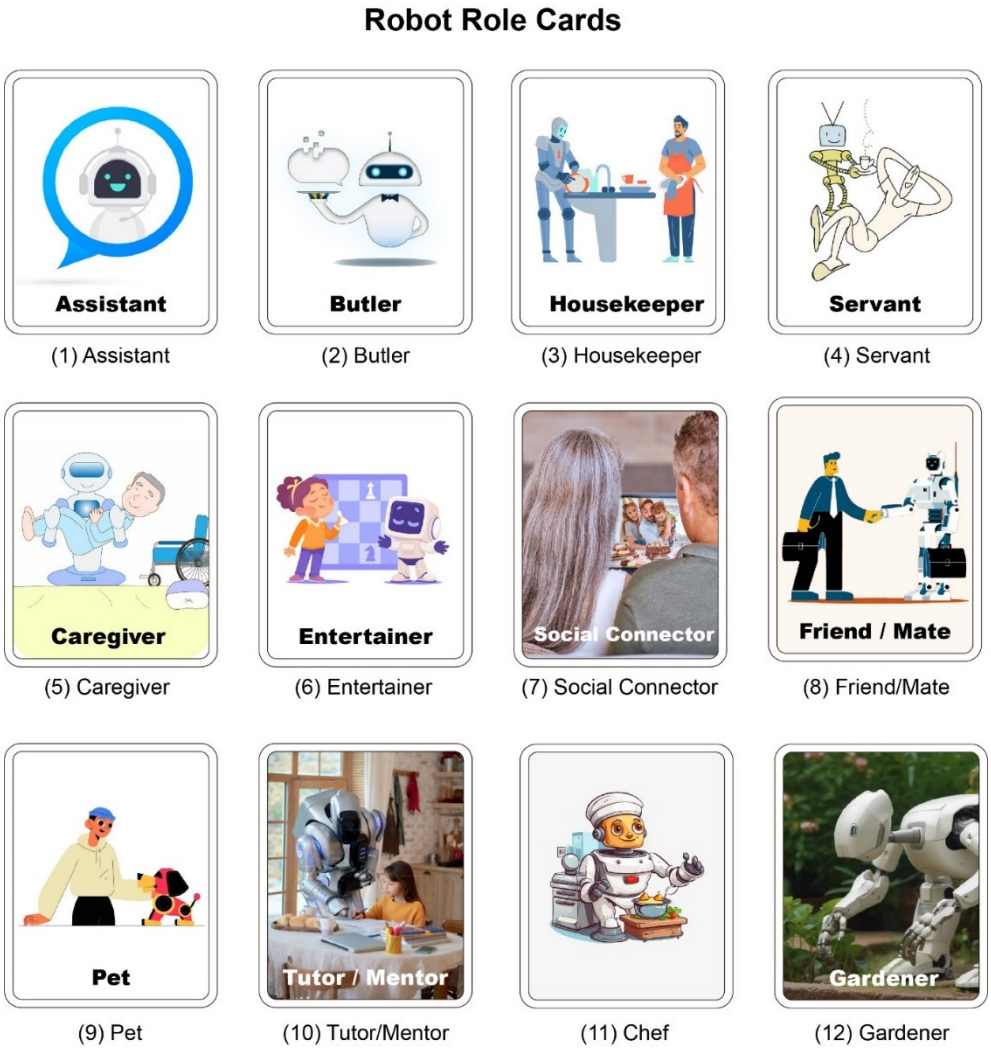

Figure 3 Robot role cards of the toolkit

Recording canvases: Two structured sheets that guide and record participant responses. The first canvas supports the ranking and emotional reflection on human companionship; the second captures role selections and imagined qualities of robotic companions. Participants are encouraged to annotate, draw, or write, allowing non-verbal forms of expression (shown in Figure 4).

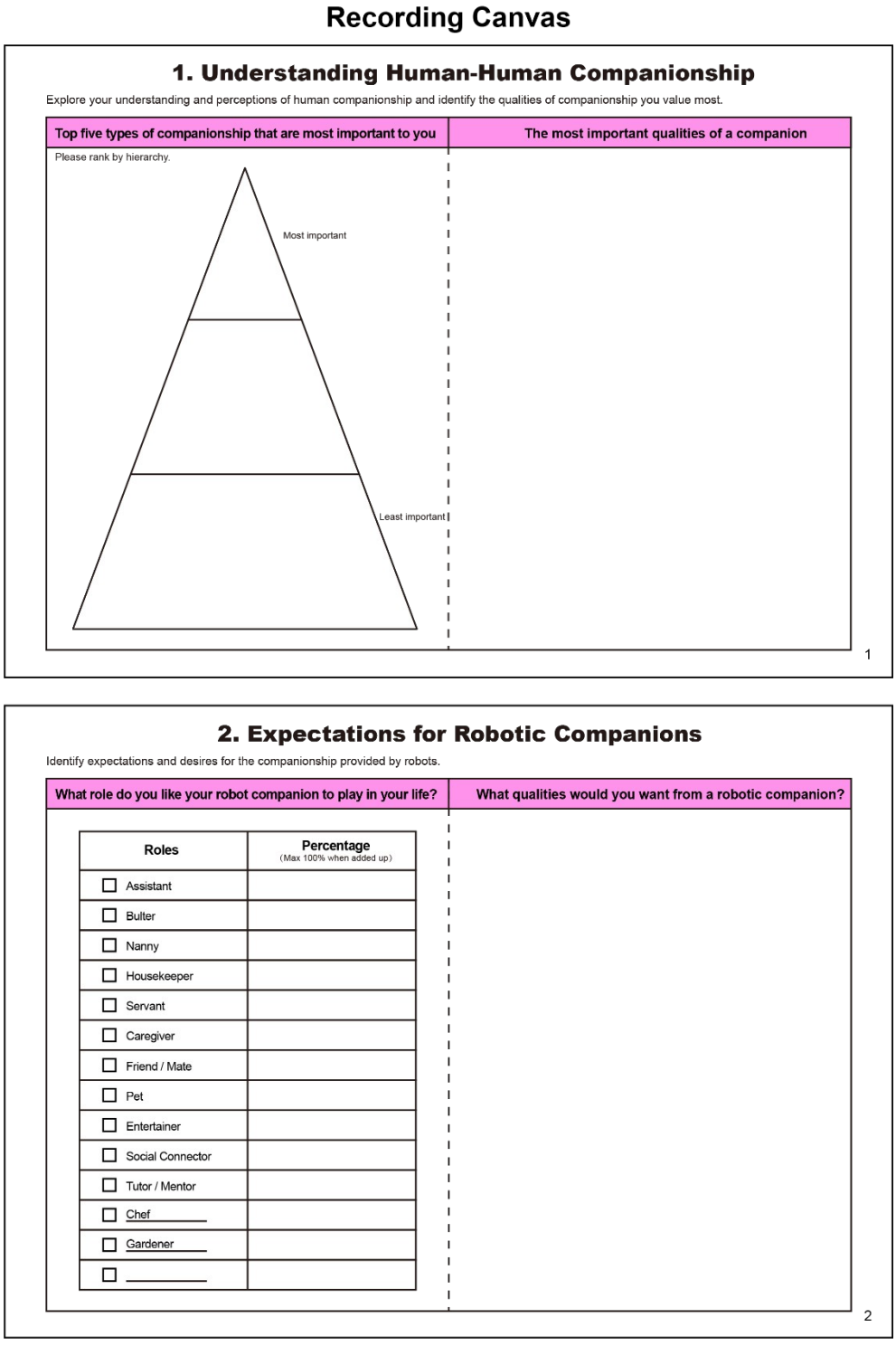

Figure 3 Recording canvas of the toolkit

Together, these components scaffold a gradual transition from familiar human relationships to speculative forms of human–robot companionship. The robot role cards were designed with a degree of interpretive openness, allowing participants to bring their own relational meanings and expectations into the discussion.

3.5 Structured interview protocol

To enable meaningful participation and reduce the abruptness noted in the pilot study, the interview process was redesigned into a gradual, scaffolded structure of five phases:

- **Warm-up:** The facilitator introduced the study's aims, clarified the procedure and participants' rights, and obtained informed consent.
- **Companionship card activity:** Participants used the companionship cards as visual prompts to share how they understand and experience companionship. They then selected and prioritised the most meaningful relationship types, using emotional prompt words to explain their choices and reflect on what makes companionship meaningful.
- **Robot introduction:** A short video and explanation of existing companion robot examples were presented to enhance participants' awareness and stimulate imagination.
- **Robot role card activity:** Participants used the cards as visual prompts to share how they understand and experience companionship. They then selected and prioritised the most meaningful relationship types, using emotional prompt words to explain their choices and reflect on what makes companionship meaningful.
- **Wrap-up reflection:** Participants reflected on their overall impressions, potential benefits, and concerns about companion robots.

This protocol was designed to support progressive transition from the familiar (human–human relationships) to the speculative (human–robot relationships), offering multiple entry points for engagement. To minimise potential bias or prompting effects, especially when using emotional and relational cue words, the facilitator adopted an adaptive prompting approach. Open-ended questions were always posed first; prompt cards were introduced only when participants found it difficult to articulate feelings or towards the end of the session for reflection. This ensured participants' responses emerged from their own interpretations rather than from predefined language.

3.6 Data analysis

Data analysis examined how the toolkit influenced participants' emotional articulation, engagement, and thematic richness compared with the pilot study. All interviews were audio-recorded, transcribed verbatim, and supplemented with facilitator notes and participant-created canvases (Stages 3 and 4).

Thematic analysis (Braun & Clarke, 2006) was applied to all textual data to explore how older adults defined companionship and envisioned human–robot relationships. Coding followed an inductive–deductive process: open codes captured emerging emotional and relational ideas, while focused coding linked these to the study's companionship framework. NVivo software supported data management and comparison.

For the comparative analysis, we focused on transcript data from both the pilot study (without the toolkit) and the main study (with the toolkit) to ensure methodological consistency. The canvases were treated as supportive materials that aided participants' reflection, but their written and visual content was analysed qualitatively within the same thematic framework, rather than as separate content analysis. Therefore, the comparison centred on how the two groups differed in thematic richness, emotional depth, and engagement—reflected in the level of elaboration, reflection, and conversational flow. The results are presented in Section 4.

4. Results and findings

To evaluate the effectiveness of the toolkit and structured interview protocol, findings from the pilot study (Stage 1, without the toolkit) and the main study (Stage 4, with the toolkit) were compared. Both explored the same themes, enabling a direct comparison of participants' emotional expression, conversational flow, and engagement. Analyses drew primarily on interview transcripts, supported by facilitator notes and, where applicable, participant-created canvases. Although no statistical testing was conducted, descriptive comparisons reveal clear differences in emotional depth, fluency, and participation.

4.1 Enhanced emotional expression and thematic depth

Toolkit-supported interviews produced richer, more personal, and emotionally grounded narratives. In the pilot, responses were typically brief or generic— "someone to talk to" or "being cared for." With the toolkit, participants drew on specific experiences and emotional cues (e.g., trust, reciprocity, time-together), linking them to concrete stories and memories.

Interviews using the toolkit lasted 75–90 minutes on average, compared with 30–40 minutes in the pilot, and yielded nearly twice as many subthemes. Participants also spoke for longer periods and shared more personal stories. The companionship cards and emotional prompt words appeared to encourage memory recall and deeper introspection, helping participants move beyond functional or surface-level descriptions toward more reflective accounts of companionship and its emotional meaning.

Expectations of robotic companionship also became more specific. Participants described future companion robots in relation to their everyday routines and emotional preferences—for instance, robots that could share daily rituals, provide reassurance, or express attentiveness through presence. Some participants even adopted metaphors to convey nuanced ideas about companionship: "Friendship is like stars—you may not always see them, but they're always there," or "The perfect companion is a mind reader—someone who knows without being told." Others likened robots to pets— "like a cat or dog… It's a kind of two-way interaction." These expressions signalled a shift from functional talk to more relational, affective reflection.

4.2 Reduced silence and cognitive load

Observation and participants' feedback indicated that the toolkit reduced communicative friction and improved conversational flow. In the pilot sessions, participants often paused for

long periods, requested clarification, or provided short, surface-level answers. With the toolkit, responses became smoother and more sustained.

Prolonged pauses (over 5 seconds) appeared to decrease, and facilitators noted fewer repeated and rephrased questions. Importantly, the nature of silence also appeared to shift. In pilot sessions, silence often signalled uncertainty or withdrawal; in toolkit-supported sessions, it reflected thoughtful engagement, as participants examined or rearranged cards before responding. Following these moments, their answers were typically deeper and more emotionally nuanced. As one participant noted, "It's easier to think with something in front of me." Another added, "The cards helped me find words for feelings."

4.3 Increased engagement and co-design quality

The structured, visual format fostered stronger engagement and collaboration. Participant speaking time rose from roughly 60% in the pilot to over 80% in toolkit-supported interviews, reflecting a shift from facilitator-led questioning to participant-led dialogue. Participants showed greater self-confidence and initiative, often extending their responses beyond the question itself and even anticipating upcoming topics of discussion.

Facilitator observations also revealed notable behavioural changes: participants appeared more relaxed and expressive, smiling more often and showing fewer signs of cognitive strain (e.g., less frowning or hesitation) with the toolkit. Compared with the pilot study, older adults in the toolkit-supported sessions demonstrated greater confidence, spontaneity, and sustained involvement when discussing companionship and human–robot interaction.

5. Discussion and limitations

This study introduced and validated a structured visual interview toolkit designed to support older adults in articulating their emotional understanding of companionship, thereby generating deeper insights for human–robot companionship design. Comparing pilot interviews without the toolkit and toolkit-supported sessions demonstrated that the toolkit enhanced emotional expression, reduced hesitation, and fostered more sustained and reflective engagement. Rather than viewing these improvements simply as better interview performance, the discussion interprets them as evidence that structured visual scaffolding can expand emotional participation in inclusive co-design and help older adults translate abstract emotional experiences into design-relevant insights for Human–Robot Interaction.

5.1 From hesitation to reflection: reframing silence as cognitive engagement

A notable finding concerns the transformation of participant silence. In the pilot interviews, long pauses often appeared to signal uncertainty, difficulty, or disengagement. In contrast, in toolkit-supported sessions, silence more often functioned as a reflective interval: participants looked at, handled, or rearranged the cards before responding, and these moments were frequently followed by more detailed and emotionally nuanced accounts. This suggests that the toolkit did not simply reduce hesitation; it changed the conditions under which reflection could take place.

This finding is important for both inclusive design and HRI research. Work in participatory design has shown that tangible artefacts can support distributed cognition and lower the

demands of verbal expression, especially when participants are asked to discuss complex or emotionally laden issues (Halskov & Dalsgård, 2006; Sanders & Stappers, 2014). This study extends this insight by showing how visual and tactile scaffolding can make silence productive rather than problematic. Instead of being treated as a communicative breakdown, silence became part of the meaning-making process. For research involving older adults—and especially for design conversations about abstract or unfamiliar topics such as robotic companionship—this has practical implications: emotional insight may require not only prompts, but also materials that give participants time and space for reflection.

5.2 Co-constructing emotional and relational meaning in HRI

The toolkit also changed the quality of what participants were able to express. Rather than describing companionship only in functional terms, participants articulated relational meanings such as trust, reciprocity, reassurance, and attentiveness. Grounded in personal stories and metaphors, these expressions can be understood as situated design knowledge: forms of insight that make tacit emotional experience available for interpretation and design development (Brandt et al., 2012; Sleeswijk-Visser et al., 2005). In this sense, the toolkit did not simply encourage participants to say more; it also appeared to support greater emotional granularity in how companionship was described, which is significant because more differentiated emotional categories can offer more actionable material for design (Desmet, 2012).

This emotional articulation also shaped how participants understood human–robot relationships. Participants' analogies—such as likening robots to pets, or describing an ideal companion as a "mind reader" or a "star"—suggest that older adults interpret human–robot companionship through familiar relational frames. This aligns with HRI literature showing that social robots are often understood through existing interpersonal schemas rather than as wholly new forms of interaction (Doyle & Hodges, 2023; Fox & Gambino, 2021). It also resonates with work on the domestication of robots in the home, where their meanings are negotiated through everyday routines, care practices, and existing relationships rather than determined by functionality alone (Søraa et al., 2021). The contribution of this study is to show how such relational meanings can be actively elicited in design conversations, rather than inferred after technology has already been built. In that respect, the study expands emotional and relational HRI by demonstrating that abstract emotional experiences can be translated into design-relevant knowledge through inclusive co-design processes. This also resonates with recent work in HCI and HRI that foregrounds emotion, affect, relation, and imagination as central to the design of future technologies (Fritsch, 2025; Sanchez et al., 2025).

5.3 Methodological and practical contributions

Methodologically, this research shows how the intangible and abstract can become tangible and discussable in inclusive design for ageing. It demonstrates that abstract emotional ideas —such as companionship or connection—can be explored, discussed, and even shaped through a scaffolded participatory process. In this sense, the toolkit functioned not simply as a data-gathering device but as a conversation catalyst: a structured visual medium that supported memory recall, emotional reflection, and speculative thinking. By guiding

participants from familiar human relationships toward imagined forms of robotic companionship, it enabled emotion to surface through interaction rather than interrogation.

This contribution is significant because it extends inclusive design beyond accessibility and usability toward emotional and conceptual participation. Emotional inclusivity was supported by the toolkit's visual and linguistic prompts, which helped participants express feelings that might otherwise remain unspoken. Conceptual inclusivity was supported by metaphors and staged transitions, which made unfamiliar ideas—such as robotic companionship—easier to imagine and discuss. Together, these features allowed older adults to contribute not only opinions, but also values, expectations, and relational interpretations that are often missing from standard interview-based design research.

In practice, the toolkit provides a replicable and adaptable framework for designers co-designing with older adults in companion robotics and related domains. It provides a structured way to surface emotional and relational insights early in the design process, before assumptions become fixed in technical specifications. Such insights can inform interaction styles, role framing, and early ideation or evaluation activities in ways that better resonate with older adults' lived experiences. More broadly, this study contributes a methodological stance as well as a tool: that socially intelligent technologies should be designed from the emotional and relational meanings people bring to them, rather than treating those meanings as secondary to functionality or adoption.

5.4 Limitations and future work

The findings of this study should be interpreted within the context of its participant group. Participants were recruited from a research-engaged and relatively well-educated older cohort, whose perspectives may not represent the wider diversity of ageing experiences, particularly among people with lower educational attainment or lower digital literacy. Future studies should therefore examine how the toolkit performs with broader and less research-familiar populations, including cross-cultural or community-based contexts.

In addition, the current analysis was qualitative and descriptive. Although it revealed clear comparative patterns, future research could incorporate quantitative indicators—such as behavioural engagement coding, or frequency-based analysis of emotional expressions—to strengthen analytic robustness. Finally, although prompt words effectively supported articulation, allowing participants to generate their own prompts may further increase authenticity and ownership. Together, these limitations indicate the need to test and refine the toolkit across more diverse social, educational, and cognitive contexts in order to assess its broader applicability in participatory design practice.

6. Conclusion

This study developed and validated a structured visual co-design toolkit that enables older adults to articulate emotionally rich understandings of companionship and its translation into human–robot interaction. By addressing the persistent challenge of eliciting abstract and emotionally charged concepts, the toolkit facilitated deeper reflection, smoother dialogue, and more grounded design insights. These insights can be translated into

actionable design knowledge, offering designers a richer understanding of how companionship is experienced, communicated, and imagined in later life.

Beyond its practical application, the study also establishes a replicable methodological approach for emotion-centred participatory design. Through structured visual scaffolding, the toolkit supported both emotional articulation and conceptual transition, enabling older adults to engage more fully in discussions of unfamiliar technological futures. In this way, the approach strengthens two dimensions of inclusivity that are often difficult to achieve in co-design with marginalised groups: emotional inclusivity, by supporting the expression of subjective and abstract feelings, and conceptual inclusivity, by making unfamiliar ideas such as robotic companionship more accessible and meaningful for reflection.

Overall, this work demonstrates how facilitating emotional articulation can support more inclusive early-stage design and contribute actionable insights to the development of companion technologies. It highlights the value of designing not only for functionality or adoption, but for the emotional and relational meanings through which technologies become significant in later life.

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