Caring for a Robot, to Care for You

An Exploration of Robot Care as an Interaction Design to Support Wellbeing

Danika Passler Bates
Department of Computer Science
University of Manitoba
Winnipeg, MB, Canada
passlerd@myumanitoba.ca

Skyla Y. Dudek
Department of Computer Science
University of Manitoba
Winnipeg, MB, Canada
dudeks@myumanitoba.ca

James M. Berzuk
Department of Computer Science
University of Manitoba
Winnipeg, MB, Canada
berzukj@myumanitoba.ca

Adriana Lorena González
Department of Computer Science
University of Manitoba
Winnipeg, MB, Canada
gonzala1@myumanitoba.ca

James E. Young
Department of Computer Science
University of Manitoba
Winnipeg, MB, Canada
young@cs.umanitoba.ca

ABSTRACT

In this paper, we explore how having robots that require care can be used as a human-robot interaction design strategy to support people's wellbeing. We present an original companion robot design that requires care, to support people who feel lonely. Following a longitudinal deployment, we present results which suggest that caring for a robot can help people by promoting companionship with the robot and providing a sense of purpose and daily life structure. We further provide suggestions for future robot designs that use requiring care as an interaction design strategy to support wellbeing.

KEYWORDS

Companion robots, Support robots, Domestic robots

1.1. Introduction

Research has provided a multitude of examples and avenues for how social companion robots can support people's wellbeing, for example, by being designed and behaving as a proxy social companion or pet [13]. Social robots can increase motivation to exercise [2,3], and children's engagement in education [5], provide emotional support [6], can improve social engagement of people living with dementia [6] or children with autism [7], and overall generally improve quality of life [10]. Following this thread, we wish to promote the approach of designing a social robot *itself to require care* from the user as an avenue for indirectly providing wellness benefits to the person.

We posit that caring for a robot can form a key component of the wellbeing benefits provided by that robot. Caring for the robot could promote companionship with the robot, similar to the sense of companionship [1] and social support [8] that pet owners report[1]. We expect that this could help provide support for loneliness, as pet owners tend to be less lonely [8]. Similarly, attachment and emotional engagement can be created by caring for virtual pets (e.g., Tamagotchi toys [14]) or for dolls. In doll therapy, dementia patients care for dolls by feeding and dressing them [9], and can have some of their attachment needs [4] met through this therapy. Care in doll therapy [9] and pet ownership [8] has also been found to provide a sense of purpose, and caring for pets can also promote a sense of life structure [8].

Figure 1: A person hugs our cuddly companion robot which requires care, to support coping with loneliness.

With these potential benefits in mind, we designed an original social companion robot for loneliness support that included caring for the robot as a key interaction design strategy. We developed this design into a standalone (not monitored, offline) robot, and conducted a study where we deployed the robot into homes for at

least 7 weeks (optionally up to 6 months). The results indicate that our design strategies were overall successful in encouraging participants to engage in care for the robot, and further, most self-reported potential wellbeing benefits because of providing care for the robot. In contrast, some reported that caring for the robot could sometimes feel like a chore, despite the benefits. However, overall our design and deployment results supports the approach of designing robots that need to be cared for, as a mechanism for supporting a person's wellbeing, with our findings highlighting areas for improvement for care as interaction design for a robot that cares for a person.

2. SnuggleBot: The Cuddly Robot that Requires Care

We designed a cuddly companion robot called SnuggleBot (Figure 1) to support coping with loneliness. The primary goal of our prototype design was to develop initial candidates that enable our longitudinal in-home qualitative inquiry, to gain real-world in-use data. Thus, we opted for a less formal design process to quickly generate candidate designs that we can deploy and iterate on, rather than more time-intensive and formal methods which would delay deployment.

We selected a set of three robot interaction strategies to support coping with loneliness and, using these, designed and implemented a novel robot prototype including new interaction designs. Drawing from wellbeing literature, we selected the following three robot interaction strategies: physical comfort, social engagement, and requiring care. For this paper, we focus on the requiring care interaction strategy, which we included due to our expectations that providing care for the robot would provide wellbeing benefits for people.

When selecting our methods of care that the robot would require, we aimed for methods of care that would also support our social engagement and physical comfort goals. We further guided our selection by aiming for methods of care with a simple implementation, to enhance deployability and robustness. We brainstormed solutions to care for the robot by sketching out ideas and iterated on our best ideas by sketching out more variations of them, while informally sharing our ideas with our research group to further develop them.

2.1 Design for Care

We designed our robot to require care in three distinct ways: people need to keep it warm, give it hugs, and charge its battery. To communicate its needs to people, we elected to give SnuggleBot a glowing horn which changes colour depending on its needs.

To keep the robot warm, we designed a heat pad (Figure 2) which people need to keep warm by removing it from the robot's tummy pouch and microwaving it. We selected keeping the robot warm as a method of care because it also supported one of our other interaction strategies of providing physical comfort: we expected it would be comforting to hold a warm robot. SnuggleBot indicates to people that it is cold by turning its horn blue, with colour interpretation supported by an embroidered legend on the heat pad (Figure 2).

Figure 2: Embroidered heat pad explains the horn colours and warms the robot.

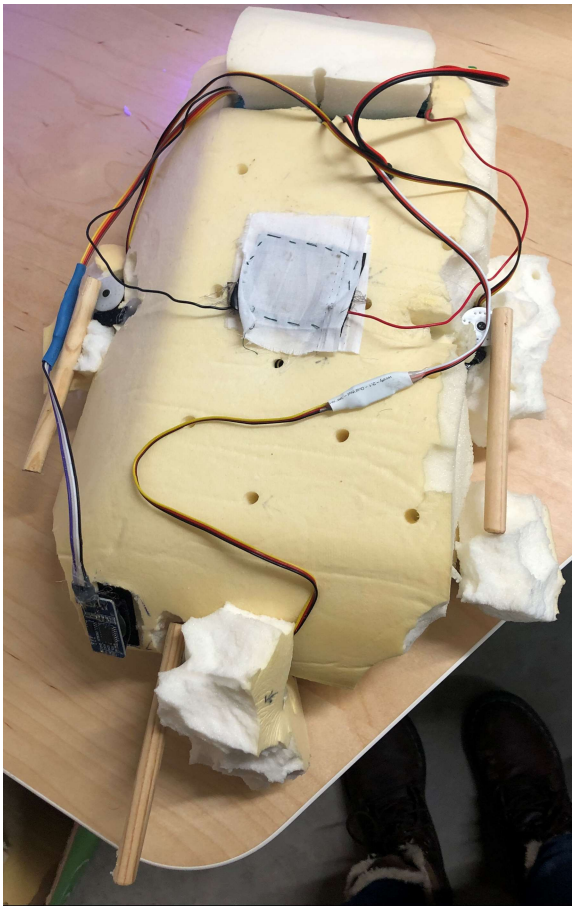

Figure 3: Foam skeleton housing robot motors and circuitry.

We also designed SnuggleBot to require hugs to maintain a happy state: without sufficient hugs SnuggleBot gets lonely, which it

communicates by turning its horn purple and intermittently flipping its pectoral fins to attract attention. We expected that interacting socially and showing care for SnuggleBot may encourage people to socially engage with it and contribute to bonding similar to a pet.

Finally, participants need to maintain the robot's battery charge as another method of care. Participants charge the robot via a port on its belly (resembles a navel), and SnuggleBot communicates a low battery level by turning its horn red.

2.1. Implementation

We custom build SnuggleBot using a combination of custom and off-the-shelf sensors and electronics (including a Pro Micro form factor Arduino clone by KeeYees), and custom wiring and software. We created an internal skeleton and casing to cover the electronics but allow actuation (Figure 3), with custom software to read the sensors, update the robot state, and perform actuation (full implementation details are available [11])

2.2. Evaluation

We deployed our robot into homes to learn about participants' interactions with, reactions to, and thoughts regarding our robot interaction designs, including the robot's need for care. We deployed the robots for a minimum of 7 weeks (up to 6 months based on participant interest [11]) into homes of people 18 years of age and above who self-identified as being lonely and who lived alone, and conducted a series of semi-structured interviews, weekly diaries, and questionnaires to reflect on our design strategies.

We conducted a thematic qualitative analysis on our data, using a mix of inductive and deductive coding, analyzing our data for participant use patterns, including evaluating the extent to which people cared for the robot and reflections on the care. Our study protocol was reviewed and approved by our institution's research ethics board.

Results

We recruited 7 participants from a range of backgrounds, who kept the robot for at least 7 weeks, and optionally up to 6 months. Here we focus on the results of our qualitative analysis pertaining to our design approach of requiring care. Throughout this section we use participant self-selected pseudonyms for presenting results: Pester, Vanessa, David, Art, Dancer, Sheila, and Leslie. Our participants were gender balanced, with three men (Pester, Dancer, David,) three women (Vanessa, Sheila, Leslie), and one non-binary participant (Art). Signs of gender differences with regards to care did not emerge in our analysis.

Overall, all participants engaged in the care behaviors that we intended, including warming, responding when it needed a hug, and charging. Participants reported responding to the robot's need for hugs more often than the need to be warmed, with participants reporting responding to the hug need up to 8 times a day on average, and warming the robot up to 5 times a day on average. Participants generally kept the robot charged, but most (Pester, Vanessa, Art, Sheila, Leslie) reported leaving the robot uncharged for a day or longer at least once. One dominant theme that emerged from our qualitative analysis was secondary impact of the care on participants. Below we discuss impact on companionship, sense of purpose, and life structure:

Companionship - Some participants reported that caring for the robot contributed to a sense of companionship (Vanessa, Dancer, Leslie), for example,

> *"Having something to take care of, it's giving you that sense of companionship and responsibility, helps reduce loneliness."* -Dancer

As highlighted in this quote, some felt that caring for the robot also helped with loneliness (Vanessa, Dancer), or had the potential to help with loneliness (Pester). However, the sense of companionship faded over time for some participants (Pester, Art), and some participants expressed difficulty bonding with the robot altogether (David, Sheila).

> *"I was curious to see if it would develop into more of a bond. So, I mean it hasn't yet. It could maybe but um... since it hasn't happened yet, it probably won't happen but... at the same time I try to keep an open mind with it."* -David

Sense of purpose - Most participants reported that caring for the robot provided a sense of purpose (Pester, Vanessa, Dancer, Leslie), and some expressed that they enjoyed that caring for the robot made them feel needed (Vanessa, Dancer, Sheila).

> *"Makes you feel like needed or appreciated when you take care of the robot, it makes you feel like you did something good for the robot."*-Vanessa

> *"…it makes you feel happy that he's happy type of thing. That something needs you I guess."* -Sheila

Life structure – Some participants expressed that they found it helpful that caring for the robot helped them to establish a routine (Art, Dancer).

> *"I feel like it gives a little bit more structure in my life, it's one extra thing to take care of, just like in my daily routine"*-Art

One participant highlighted how, particularly for people who live alone, it could be helpful to have the added structure to their daily lives.

> *"Living alone, my days can be a little unstructured beyond work, so having the robot to take care of has helped provide some routine and companionship in my day to day life."*-Dancer

At the same time, our qualitative analysis highlighted the possibility of downsides of requiring care. For example, some participants reported that the robot demanded too much attention and caring for the robot could feel like a chore at times (Pester, Art, Sheila). Participants reported feeling this way when the robot

interrupted them with its requests for attention during tasks (Pester, Art).

"sometimes it was a pain in the ass those instances is probably when I was leaving the bedroom going to the washroom oh damn it! You know I gotta hug"-Pester

Or when the participant was tired or sick (Pester, Art, Sheila).

"Because I've been so sluggish, it's been like flapping for attention and it's like 'I'm right here, I'm just not moving'"-Sheila

On a related note, we found that some participants aimed to reduce the workload in how they engage the care. For example, some participants discovered that they could simply push on the robot (Pester) or move the robot's flippers (Vanessa, David) when it was lonely, instead of hugging it. While this constitutes "care" in a strict sense, it contradicts our designed goal of requiring hugs to promote empathic engagement with the robot. By the end of the study, Pester and David reported that they did not hug the robot at all. We note that Pester and David also reported not feeling a sense of companionship with the robot at the end of the study, suggesting that there could be a link between companionship and engaging empathically with the robot.

Some participants noted that the robot was not alive, limiting impact of actions and bonding potential (Pester, David, Sheila).

"it's not life or death like a plant or a pet, like the light turns red... it's fine. Warm up his pouch or plug him in and he'll bounce right back so it's not like high stakes."-Sheila

Overall, interaction with the robot decreased over the course of the study (further usage and engagement details are accessible [11]). This may be because of becoming accustomed to the robot.

"at the start I was trying to like interact with the robot a lot to learn about the robot and yeah take care of the robot a lot but now I feel like I kind of know the robot and <laughs> I feel like it's more chill now than trying to always like get the heat pack"-Vanessa

Or, because of the sense of responsibility fading, even after three days for one participant.

"the initial start of feeling the responsibility to tend to it was fairly strong. But has dwindled over time." -Art

Future Designs

Requiring care was successful in that most reported wellbeing benefits because of caring for the robot. On a scientific level, future work should study actual impact on wellbeing from designs, using study approaches more suited to hypothesis testing (e.g., using appropriate sample sizes). From a design perspective, our study highlights both potential avenues for successfully engaging participants with care, but also potential problems with our design that requires further exploration: the sense of care being a chore, participants finding workarounds, and sustained use.

Drawing from our findings of care feeling like a chore, and that participants who used only workarounds to care for the robots loneliness need also reported a lack of companionship with the robot at the end of the study, perhaps future work could investigate how to increase the stakes or importance of caring for the robot, to create a perception of sufficient benefits (vs. being a chore), as this may help develop companionship. One way that the stakes of caring for the robot could be increased is by making the needs of the robot more authentic and believable to a person; for example, people know that a robotic toy does not actually "need" hugs. Instead, we can continue to improve needs design to reflect real impacts. For example, the robot could need to be kept clean, or it could need to have its fur brushed to remain soft. We could also emphasize needs of the robot's mechanical components, for example, perhaps the robot needs its wires adjusted, or it needs to be allowed to cool down after doing calculations or other computer-style work.

Another way to increase the stakes of care could be to incorporate consequences for delinquent care. For example, if the user does not care for the robot, they will lose progress with the robot. Perhaps the robot evolves over time, like a Tamagotchi, and gains more abilities if properly cared for, but it will reset if it does not have its needs met.

Conclusion

We designed a cuddly robot that requires care from people who feel lonely and deployed our robot into homes. Participants reported that caring for our robot was helpful for their own wellbeing, which supports the use of requiring care in robots that are designed to care for people. Based on participant feedback, in this paper we present future avenues for robots that require care to explore: making care feel more authentic, and having consequences for not caring for the robot.

REFERENCES

1. Cynthia K. Chandler, Delini M. Fernando, Casey A. Barrio Minton, and Torey L. Portrie-Bethke. 2015. Eight Domains of Pet-Owner Wellness: Valuing the Owner-Pet Relationship in the Counseling Process. *Journal of Mental Health Counseling*. https://doi.org/10.17744/mehc.37.3.06
2. Juan Fasola and Maja Mataric. 2013. A Socially Assistive Robot Exercise Coach for the Elderly. *Journal of Human-Robot Interaction* 2, 2: 3–32. https://doi.org/10.5898/jhri.2.2.fasola
3. Denise Hebesberger, Tobias Koertner, Christoph Gisinger, Juergen Pripfl, and Christian Dondrup. 2016. Lessons learned from the deployment of a long-term autonomous robot as companion in physical therapy for older adults with dementia: A mixed methods study. In *ACM/IEEE International Conference on Human-Robot Interaction*. https://doi.org/10.1109/HRI.2016.7451730
4. Thomas Hewett, Ronald Baecker, Stuart Card, Tom Carey, Jean Gasen, Marilyn Mantei, Gary Perlman, Gary Strong, and William Verplank. 1992. *ACM SIGCHI Curricula for Human-Computer Interaction*. https://doi.org/10.1145/2594128
5. Zeng Wei Hong, Yueh Min Huang, Marie Hsu, and Wei Wei Shen. 2016. Authoring robot-assisted instructional materials for improving learning performance and motivation in EFL classrooms. *Educational Technology and Society* 19, 1.
6. Lillian Hung, Cindy Liu, Evan Woldum, Andy Au-Yeung, Annette Berndt, Christine Wallsworth, Neil Horne, Mario Gregorio, Jim Mann, and Habib Chaudhury. 2019. The benefits of and barriers to using a social robot PARO in care settings: A scoping review. *BMC Geriatrics* 19, 1: 1–10.

https://doi.org/10.1186/s12877-019-1244-6

7. Hideki Kozima, Cocoro Nakagawa, and Yuriko Yasuda. 2005. Interactive robots for communication-care: A case-study in autism therapy. *Proceedings - IEEE International Workshop on Robot and Human Interactive Communication* 2005: 341–346. https://doi.org/10.1109/ROMAN.2005.1513802
8. Allen R. McConnell, Christina M. Brown, Tonya M. Shoda, Laura E. Stayton, and Colleen E. Martin. 2011. Friends with benefits: On the positive consequences of pet ownership. *Journal of Personality and Social Psychology*. https://doi.org/10.1037/a0024506
9. Gary Mitchell, Brendan McCormack, and Tanya McCance. 2016. Therapeutic use of dolls for people living with dementia: A critical review of the literature. *Dementia*. https://doi.org/10.1177/1471301214548522
10. Wendy Moyle, Marie Cooke, Elizabeth Beattie, Cindy Jones, Barbara Klein, Glenda Cook, and Chrystal Gray. 2013. Exploring the effect of companion robots on emotional expression in older adults with dementia: A pilot randomized controlled trial. *Journal of Gerontological Nursing* 39, 5. https://doi.org/10.3928/00989134-20130313-03
11. Danika Passler Bates, Skyla Y. Dudek, James M. Berzuk, Adriana Lorena González, and James E. Young. 2024. SnuggleBot the Companion: Exploring In-Home Robot Interaction Strategies to Support Coping With Loneliness. In *Designing Interactive Systems Conference (DIS '24)*. https://doi.org/10.1145/3643834.3660702
12. Danika Passler Bates and James E. Young. 2022. SnuggleBot: A Simple Cuddly Companion Robot Prototype. *Proceedings of the 2nd International Workshop on Designerly HRI, at the 2022 ACM International Conference of Human Robot Interaction*.
13. Sarah M. Rabbitt, Alan E. Kazdin, and Brian Scassellati. 2015. Integrating socially assistive robotics into mental healthcare interventions: Applications and recommendations for expanded use. *Clinical Psychology Review* 35: 35–46. https://doi.org/10.1016/j.cpr.2014.07.001
14. Sherry Turkle. 2007. Authenticity in the age of digital companions. *Interaction Studies. Social Behaviour and Communication in Biological and Artificial Systems* 8, 3. https://doi.org/10.1075/is.8.3.11tur