Designing for In-Home Long-Term Family-Robot Interactions: Family Preferences, Connection-Making, and Privacy

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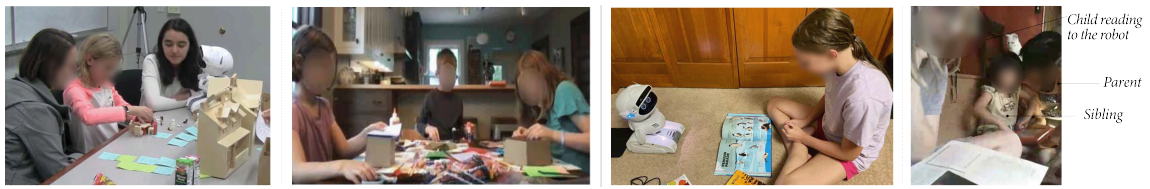

Fig. 1. Illustrating prior work efforts on exploration, design, and field deployments for in-home, long-term, family-robot interactions. Participatory design sessions with children (aged 8-12) and families informed the design of in-home social robots. We then deployed a reading companion robot in children's homes. Children read aloud to the robot, showed special tags placed on book pages to indicate which pages they read, and the robot responded with comments that supported social connection, interest in reading, or science knowledge. Family members such as parents and siblings were often involved around the robot.

Participatory approaches to designing technology *with families, for families* allow designers to have a first-hand understanding of needs, desires, and preferences of families toward new technology. For example, in my prior work, I conducted participatory design studies with children and their families in order to design social robots that could facilitate long term interactions, with multiple users, in their homes. Our design sessions identified that children and families preferred an in-home robot to have the role of a *companion* or an *assistant*, be able to hold *group interactions* and participate in shared recreation activities, and had concerns about the robot's ability to follow *conversational privacy* norms (i.e., within a family, what information is shared with whom). In a long-term field deployment, I explored how children engaged in dyadic interactions with a reading companion robot in their homes and how interactions with multiple family members formed with and around the robot. However, family-centered insights are limited in the Human-Robot Interaction field. In my research I aim to further explore long-term family-robot interactions in group settings, with social companion robots that serve as a playmate or a confidant. I seek to design social robots that can facilitate connection-making between family members and mitigate communication privacy conflicts in these group interactions.

CCS Concepts: • **Human-centered computing** → **Participatory design**; *Empirical studies in interaction design*; • **Computer systems organization** → Robotics.

Additional Key Words and Phrases: Child-robot interaction, social robots, interaction design, family-centered design, multi-party

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1 MOTIVATION AND RESEARCH OBJECTIVES

Family systems are complex and dynamic, and we cannot apply a one-size-fits-all approach when designing in-home social robots for families. To understand human-robot interaction design for complex systems like families, Jung and Hinds [26] call for Human-Robot Interaction (HRI) researchers to *"examine design elements in multiple different contexts,"* for example homes with different types of family structures such as a nuclear family, inter-generational family, or a single-parent family and *"explore a robot's influence on processes and dynamics of groups and the consequences of such influence."* This requires a flexible design for social robots that includes a multitude of ways to adopt social robots for family life. However, a family-centered approach, *e.g.,* family-robot interaction[1], has been limited in the field of HRI.

I respond to this call to action in my research and aim to design for in-home and long-term family-robot interactions by exploring the **preferences** of children and family members for having social robots in their homes, how a social robot can facilitate **connection-making** between family members, and how a social robot can mitigate **privacy** conflicts that occur in this family-robot interaction. In my prior work, I explored family preferences for in-home robots and designed and deployed social robots that hold dyadic interactions with children in homes.

Motivated by the need for more family-centered approaches, in my current and future work, I focus on exploring how in-home social robots can facilitate group interactions between children and family members in two contexts:
(Context 1) Family *connection-making* in shared recreation activities (*e.g.,* family game nights),
(Context 2) Family *communication privacy management* in daily conversations.

My overarching research questions are:

> ***RQ1.*** *How a robot, acting as a playmate, can facilitate family interactions and connection-making during a shared recreational activity?*
>
> ***RQ2.*** *How a robot, acting as a confidant, can mitigate conversational privacy concerns between family members?*

Addressing these questions requires different approaches. The playmate role referred to in **RQ1** is better understood in research, which allows us to design interactions based on established literature and conduct field deployments to test how the playmate robot can facilitate connection-making. However, for **RQ2**, there is limited domain knowledge around designing a social robot with the role of "confidant" and determining how exactly a robot should manage communication privacy in families. Thus, research activities for RQ2 will take an exploratory approach consisting of an interdisciplinary literature review followed by a technology probe study to explore family perceptions towards communication privacy management with a confidant robot.

The organization of this proposal is as follows: In Section 2, I summarize fundamental interdisciplinary related work for my research as it relates to RQ1 and RQ2. In Section 3, I address contributions and results to date, regarding exploring family preferences for in-home social robots and designing social robots for children and families. In Section 4, I address planned future work, research approach, methods, and rationale. Finally, I highlight the expected next steps, as well as open questions and challenges as part of my research (Section 5) and my long-term goals (Section 6). Overall, this proposed research differs from past work by taking a family-centered approach to designing in-home social robots for and with children and families, with a specific focus on family connection-making and conversational privacy.

[1]US Census defines "family" as *"a group of two people or more (one of whom is the householder) related by birth, marriage, or adoption and residing together; all such people (including related subfamily members) are considered as members of one family."* However, such definitions are not inclusive in many ways.

The primary focus of my Ph.D research is to design social robots that can facilitate connections between children and their families of any diverse form and structure. For this purpose, my definition of a "family" is considered broadly as *"any family structure or household that consists of a group of two people or more, which at least one member is a child under the legal age of adulthood."*
I define *"family-robot interaction"* as any social interaction between a robot and the aforementioned family definition.

2 RELATED WORK

Long-term interactions with robots can motivate children to perform household tasks, such as tidying their room [20] or motivate children to read and support their reading comprehension [30]. However, user acceptance of social robots in homes and maintaining long-term engagement with social robots still remains an open challenge [16, 17]. Social robots embody different *roles* and provide companionship to their users. Past research highlights roles ranging from robotic home assistants [15, 18], socially assistive agents that deliver autism interventions [37] or educational interventions [4]. Children form close connections with social robots and perceive them as companions [30], adolescents desire social robots to take roles as a coach, companion, and a confidant [2], and [11] observed elderly treating social robots as a confidant by opening up about their frustrations. Our prior work [8] has also found similar perceptions of children and families for an in-home robot's role. In my research, I focus on two types of robot roles: playmate and confidant.

Related work suggests that robots acting as a *playmate* can promote creative play practices of children [23] and effective play strategies can facilitate the participation of shy children [1]. Shared recreation activities (*e.g.,* playing a board game, going bowling) improve family adaptability, cohesion [42], and resilience [6]. Voice agents support children's engagement in social play [31] and children establish social bonds with robots and have positive experiences during interactions including games and entertainment [3]. A social robot can support family playtime and encourage the participation of all members by expressing *"verbal activities, reading stories, or playing cards."* [27]

While many users expect their companionship with a social robot to form into a trusted *confidant*, the process of this companionship is not well understood. Very limited work in HRI explores the specific application of robots as confidants (*i.e.,* [38]). The confidant role suggests that users desire to share secrets or private information with a social robot, which introduces the challenge of maintaining the interpersonal privacy of family members. Communication Privacy Management Theory (CPM) [34] is a framework that explains how people set boundaries when sharing private information in daily conversations, transfer co-ownership of private information, how privacy violations may lead to boundary turbulence, and discusses ways to resolve and manage these boundaries through modifying existing rules or creating new rules. There is no work to our knowledge that explores the intersection of how social robots as confidants should adhere to communication privacy management rules when interacting with children and families at home.

Designing technologies *for children, with children* [19] empower children to be partners in the design of new technologies. In the home context, family members might have distinct goals and perspectives that could be at odds with one another. Involving multi-generational family members in the design process can facilitate real-life use scenarios and introduce playfulness to family dynamics [12], while the simple, flexible, and adaptable nature of technology probes can support the process of designing technology for families [24]. Including children and parents together in design sessions uncover unique aspects of parent-child intimacy, *i.e.,* increased involvement, affiliation, and sense of responsibility [14] and in-depth insight into family interactions in the design of novel technologies [41]. Family Systems Theory (FST) [13] describes families as a complex social system, where members interact to influence each other's behavior. From this perspective, a social robot in the home is a member of the household and family system, which influences the behaviors of family members. There is a growing number of studies designing in-home technologies that follow a family-centered design approach involving the perspectives of parents and children [25]. In-home voice assistants are incorporated into the day-to-day activities of families [36] and smart speakers influence family dynamics by fostering communication, disrupting access, and augmenting parenting [5]. However, HRI research has a limited focus on families as a whole, *i.e.,* family-robot interactions, and future work should involve more family-centered design approaches that capture the perspective of diverse family members when designing in-home social robots.

3 CONTRIBUTIONS TO DATE: FAMILY PREFERENCES FOR IN-HOME SOCIAL ROBOTS

Exploring and Designing Robots for Families. In my prior work [8] I explored children's and families' design preferences for an in-home social robot through participatory design sessions and identified three key insights. Firstly, families expected robots to play two main **roles**: a *companion* and/or an *assistant*. As a companion, the robot might serve as a playmate, reading companion, conversational partner, or confidant. As an assistant, the robot might provide informational assistance in day-to-day tasks, such as cooking, using household tools, or doing homework. I built on this work by designing robots that took various roles in different activities, including a playmate that facilitates math learning [22], reading companion for structured reading [10, 40], and a companion robot that children take care of [9].

Secondly, families expected the robot to be included in **group interactions** and shared recreation activities, where these activities provide opportunities to fortify *interpersonal connections* within the family and between family members and the robot. Families expected a playmate robot to be included in family game nights, play board games, dance, or play sports together. Inspired by this finding, we further explored how children preferred to unbox their social robots in a co-design study [28]. We found similar insights regarding group interactions—specifically, when interacting with their robot for the first time, children wanted to dance and play songs with the robot, ask questions, and play icebreaker games in order to get to know the robot. These findings motivate RQ1 of my research, to explore how social robots can support group interactions and shared connections in family playtime.

Thirdly, families expressed conversational **privacy concerns** regarding how a robot would manage sensitive information shared in private or group conversations. Consider the following confidant privacy dilemma(adapted from examples in [33]): if two siblings confide to the robot about a problem they are facing with their older sibling, and request to keep this as a secret, the robot is placed in an unclear situation. The robot can either tell other family members to help the problem, or keep it as a secret by honoring the children's request. However, by keeping this as a secret, the robot cannot help the children resolve the problem, but breaking their word and not protecting their privacy could offer help to the children. So how would the robot decide to disclose this secret or not, and what would be the consequences of such actions? Motivated by this finding, we designed a privacy controller for social robots that used contextual metadata (*e.g.,* sentiment, relationships, topic) from conversations to model privacy boundaries [39]. However, this application does not yet adopt a family-centered approach to conversational privacy. To address RQ2 of my research, I draw from Family Systems Theory (FST) [13] and Communication Privacy Management Theory (CPM) [34] to better understand the everyday privacy issues that families face and how we can design robot interactions that can mitigate these dialectical tensions related to privacy disclosure between family members and a social robot.

Overall, these three key insights related to the robot's role, families' preferences in group interactions, and privacy concerns motivate the proposed work for my research.

Factors for Children's Engagement in In-Home Long Term Human-Robot Interaction. In my recent work, we designed a fully autonomous reading companion robot and deployed it in 16 families' homes for one month. From these unsupervised field deployments, we found different motivators for children's long-term engagement with the robot. Children's interest changed in the reading activity, and environmental factors such as parental influence, the immediacy of robot placement, changes to routines, and how well the robot activities conformed to those daily routines influenced engagement, interest, and adoption of the technology [10]. Although many children in our one-month deployment adopted the robot, some families felt limited by a single type of interaction and had difficulties in integrating the robot into their routines which challenged their long-term engagement. Some children adapted and changed how they interacted with the robot based on their personal preferences, some were interrupted by external factors, and some

discontinued the use of the robot. We further analyzed the daily interaction videos of families and explored how group interactions formed with and around the robot [29] and observed that many family members seemed eager to participate in group interactions but were unable to as the robot could only afford dyadic interactions. These shortcomings motivate the need for more family-centered approaches to facilitate families' group interactions, described in this proposal.

4 FUTURE WORK

Our prior work highlighted a need for family-centered design to account for the idiosyncratic nature of family dynamics. Below, I describe my planned work to address the overarching research questions: *(RQ1)* how a robot, acting as a playmate, can facilitate family interactions and connection-making during a shared recreational activity and *(RQ2)* how a robot, acting as a confidant, can mitigate conversational privacy concerns between family members.

Interaction Design for a Playmate Robot that Facilitates Family Interactions and Connection-Making in Shared Recreation Activities. To expand my prior work, I will co-design a collaborative board game with and for families' playtime routines that combines verbal and physical activities with a playmate robot. In these activities, the robot will be able to support dyadic and group interactions, along with awareness of dynamic changes in the group formation (*e.g.,* a family member joins or leaves an interaction). The robot will be an active playmate that will use verbal, pro-social supports for children and family members to share and take turns during the game. I will conduct design sessions with children and families to develop specific behaviors for the robot to promote family interactions, connection-making, and pro-social behaviors. I will evaluate this design in field deployments at homes with families of different structures. Overall, this work will explore the design of a playmate robot that facilitates pro-social behaviors in group interactions, how different family members interact with the robot in a shared recreational activity, and how family members build connections and benefit from the presence of the robot in their playtime routine.

Interaction Design for a Confidant Robot that Manages Dialectical Tensions of Communication Privacy in Family Group Conversations. For social robots, maintaining the privacy of families is complex due to the dynamic settings in which they function, such as being able to overhear household conversations at different locations in the home, or due to the unique relationships they can form with family members such as being a confidant [8]. Informed by CPM [33, 35] and FST [13], I aim to explore how families navigate private disclosures and how these theories apply when incorporating social robots in family households. This will first require conducting an extensive interdisciplinary literature review in the domains HRI, HCI, communication, family studies, and related areas to understand the privacy field and identify design requirements for a social robot acting as a confidant. I will then conduct an exploratory technology probe study where we deploy a social robot in homes with basic conversational privacy management capabilities identified in our prior work [39] and new capabilities identified from the literature review. The activities that I anticipate for this study include family members holding daily conversations and children keeping diaries with the robot. However, this context may change depending on the findings from the literature review. Participants interacting with the confidant robot will label their perceived sensitivity to the information shared, express which household members are the co-owners of the private information, and who could or could not access that information, *i.e.,* boundaries. Overall, this work will explore how families prefer to set communication privacy boundaries with the robot, how children and families perceive disclosure to a confidant robot in private conversations, how violations of current family privacy rules could lead to family boundary turbulence, and how to renegotiate these boundaries with a social robot to mitigate dialectical tensions. We anticipate that our literature review and exploratory studies will not reveal one single solution to communication privacy for families but it will be bound to diversities in family structures, culture, and context.

Participants and Analysis. To support diversity and inclusion, I will recruit families from a range of socioeconomic status and family structures [32] in our studies, *e.g.,* children with; co-parenting, grandparenting or single parenting households, blended, extended, or step families etc. Diversity in family structures will allow us to have an inclusive design and better understand themes and contrasts between family structures regarding the robot's influence on group interactions. I will primarily employ *qualitative* analysis methods in my research such as Grounded Theory [21] and Reflexive Thematic Analysis [7] across data sources including semi-structured interviews, video recordings, and robot interaction logs. Qualitative research methods allow researchers to internalize the data and get a deep understanding of the themes surrounding the topic at hand, which is a valuable method to study complex and uncontrolled field studies proposed in this research. I will also support my analysis with *quantitative* findings where applicable.

5 EXPECTED NEXT STEPS AND OUTLOOK

I am currently working toward the first step of the research described for RQ2. By the time of the CHI Doctoral Consortium, I will have completed and reported my literature review as part of my qualifying examination and will submit the literature review for publication. I plan to initiate the research plans for RQ1 in Fall 2023, complete the interaction design for the shared family recreation activities by Spring 2024, and complete field deployments in Summer 2024. Afterwards, I will focus on extracting design requirements for RQ2 based on the literature review, and I plan to initiate the technology probe study in Spring 2025. I plan to complete my Ph.D. research and defend my dissertation by the end of Spring 2026. Overall, the timing of the CHI 2023 doctoral consortium is crucial for my research agenda which will allow me to get actionable and valuable feedback from the CHI community for my remaining research plans.

Some challenges I foresee for my research stem from the possible limitation for recruiting diverse family structures in Wisconsin area. I plan to establish connections with the UW-Madison Extension community and with academic collaborators located in the Chicago area to expand diversity in recruitment. This limitation extends to cross-cultural applicability, *i.e.,* findings reported in my studies only capture family culture in the Midwest area of the United States. As I advance in my academic career I aspire to establish cross-cultural collaborations to explore more inclusive family-centered HRI design. Other technical challenges arise from maintaining long-term engagement in homes and designing robots that are able to hold meaningful interactions with multiple users. While my prior experience in long-term field studies build a solid foundation, long-term engagement in HRI still remains an open issue. I anticipate participants modifying their interaction with the robot or dropping out from the study, however, these will be captured by qualitative analysis methods and will still point to valuable insights for the CHI and HRI communities.

6 DISSERTATION STATUS AND LONG-TERM GOALS

I am in the third year of the University of Wisconsin-Madison Computer Sciences department's 6-year Ph.D. program, with a Ph.D. minor from the School of Human Ecology, Human Development and Family Studies program. My primary advisor is Dr. Bilge Mutlu. I have not attended any doctoral consortium at any other SIGCHI event. At the time of the doctoral consortium, I will have completed my qualification examination and will be in the process of preparing my dissertation proposal. My career aspiration is to become an established HCI researcher as a full professor, with a specific focus in family-centered Human-Robot Interaction design. I aim to continue working with children and families of diverse structures to better design social robots and assistive technology that would support the social and intellectual development of children and facilitate family connections. I take an interdisciplinary lens, with the intersection of computer science, cognitive science, social robotics, design, and family studies where I mainly employ qualitative research methods. This diverse research background strongly influences my Ph.D. research.

REFERENCES

[1] Kasumi Abe, Chie Hieida, Muhammad Attamimi, Takayuki Nagai, Takayuki Shimotomai, Takashi Omori, and Natsuki Oka. 2014. Toward playmate robots that can play with children considering personality. In *Proceedings of the second international conference on Human-agent interaction*. 165–168. https://doi.org/10.1145/2658861.2658913

[2] Patrícia Alves-Oliveira, Elin A Björling, Patriya Wiesmann, Heba Dwikat, Simran Bhatia, Kai Mihata, and Maya Cakmak. 2022. Robots for Connection: A Co-Design Study with Adolescents. In *2022 31st IEEE International Conference on Robot and Human Interactive Communication (RO-MAN)*. IEEE, 578–583. https://doi.org/10.1109/RO-MAN53752.2022.9900534

[3] Tony Belpaeme, Paul Baxter, Robin Read, Rachel Wood, Heriberto Cuayáhuitl, Bernd Kiefer, Stefania Racioppa, Ivana Kruijff-Korbayová, Georgios Athanasopoulos, Valentin Enescu, et al. 2012. Multimodal child-robot interaction: Building social bonds. *Journal of Human-Robot Interaction* 1, 2 (2012). https://doi.org/10.5555/3109688.3109691

[4] Tony Belpaeme, James Kennedy, Aditi Ramachandran, Brian Scassellati, and Fumihide Tanaka. 2018. Social robots for education: A review. *Science robotics* 3, 21 (2018). https://doi.org/10.1126/scirobotics.aat5954

[5] Erin Beneteau, Ashley Boone, Yuxing Wu, Julie A Kientz, Jason Yip, and Alexis Hiniker. 2020. Parenting with Alexa: exploring the introduction of smart speakers on family dynamics. In *Proceedings of the 2020 CHI conference on human factors in computing systems*. 1–13. https://doi.org/10.1145/3313831.3376344

[6] Keri Black and Marie Lobo. 2008. A conceptual review of family resilience factors. *Journal of family nursing* 14, 1 (2008), 33–55. https://doi.org/10.1177/1074840707312237

[7] Virginia Braun and Victoria Clarke. 2019. Reflecting on reflexive thematic analysis. *Qualitative research in sport, exercise and health* 11, 4 (2019), 589–597. https://doi.org/10.1080/2159676X.2019.1628806

[8] Bengisu Cagiltay, Hui-Ru Ho, Joseph E. Michaelis, and Bilge Mutlu. 2020. Investigating family perceptions and design preferences for an in-home robot. In *Proceedings of the Interaction Design and Children Conference*. 229–242. https://doi.org/10.1145/3392063.3394411

[9] Bengisu Cagiltay, Joseph Michaelis, Sarah Sebo, and Bilge Mutlu. 2022. Exploring Children's Preferences for Taking Care of a Social Robot. In *Proceedings of the Interaction Design and Children Conference*. Association for Computing Machinery, 382–388. https://doi.org/10.1145/3501712.3529721

[10] Bengisu Cagiltay, Nathan Thomas White, Rabia Ibtasar, Bilge Mutlu, and Joseph Michaelis. 2022. Understanding Factors That Shape Children's Long Term Engagement with an In-Home Learning Companion Robot. In *Proceedings of the Interaction Design and Children Conference* (Braga, Portugal) *(IDC '22)*. Association for Computing Machinery, 362–373. https://doi.org/10.1145/3501712.3529747

[11] Wan-Ling Chang and Selma Šabanović. 2015. Interaction expands function: Social shaping of the therapeutic robot PARO in a nursing home. In *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction*. 343–350. https://doi.org/10.1145/2696454.2696472

[12] Peter Knøsgaard Christensen, Christoffer Øland Skovgaard, and Marianne Graves Petersen. 2019. Together together: Combining shared and separate activities in designing technology for family life. In *Proceedings of the 18th acm international conference on interaction design and children*. 374–385. https://doi.org/10.1145/3311927.3323141

[13] Martha J Cox and Blair Paley. 1997. Families as systems. *Annual review of psychology* 48, 1 (1997), 243–267. https://doi.org/10.1146/annurev.psych.48.1.243

[14] Thomas Dalsgaard, Mikael B Skov, Malthe Stougaard, and Bo Thomassen. 2006. Mediated intimacy in families: understanding the relation between children and parents. In *Proceedings of the 2006 conference on Interaction design and children*. 145–152. https://doi.org/10.1145/1139073.1139110

[15] Kerstin Dautenhahn, Sarah Woods, Christina Kaouri, Michael L Walters, Kheng Lee Koay, and Iain Werry. 2005. What is a robot companion-friend, assistant or butler?. In *2005 IEEE/RSJ international conference on intelligent robots and systems*. IEEE, 1192–1197. https://doi.org/10.1109/IROS.2005.1545189

[16] M.M.A. de Graaf. 2015. *Living with robots: investigating the user acceptance of social robots in domestic environments*. Ph. D. Dissertation. University of Twente. https://doi.org/10.3990/1.9789036538794

[17] Maartje MA de Graaf, Somaya Ben Allouch, and Jan AGM van Dijk. 2016. Long-term evaluation of a social robot in real homes. *Interaction studies* 17, 3 (2016), 462–491. https://doi.org/10.1075/is.17.3.08deg

[18] Boris De Ruyter, Privender Saini, Panos Markopoulos, and Albert Van Breemen. 2005. Assessing the effects of building social intelligence in a robotic interface for the home. *Interacting with computers* 17, 5 (2005), 522–541. https://doi.org/10.1016/j.intcom.2005.03.003

[19] Allison Druin. 1999. Cooperative inquiry: developing new technologies for children with children. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. 592–599. https://doi.org/10.1145/302979.303166

[20] Julia Fink, Séverin Lemaignan, Pierre Dillenbourg, Philippe Rétornaz, Florian Vaussard, Alain Berthoud, Francesco Mondada, Florian Wille, and Karmen Franinović. 2014. Which robot behavior can motivate children to tidy up their toys? Design and Evaluation of" Ranger". In *Proceedings of the 2014 ACM/IEEE international conference on Human-robot interaction*. 439–446. https://doi.org/10.1145/2559636.2559659

[21] Jaber F Gubrium, James A Holstein, Amir B Marvasti, and Karyn D McKinney. 2012. *The SAGE handbook of interview research: The complexity of the craft*. Sage Publications. https://doi.org/10.4135/9781452218403

[22] Hui-Ru Ho, Bengisu Cagiltay, Nathan Thomas White, Edward M Hubbard, and Bilge Mutlu. 2021. RoboMath: Designing a Learning Companion Robot to Support Children's Numerical Skills. In *Proceedings of the Interaction Design and Children Conference*. 283–293. https://doi.org/10.1145/3459990.3460709

[23] Layne Jackson Hubbard, Yifan Chen, Eliana Colunga, Pilyoung Kim, and Tom Yeh. 2021. Child-robot interaction to integrate reflective storytelling into creative play. In *Creativity and Cognition*. 1–8. https://doi.org/10.1145/3450741.3465254

[24] Hilary Hutchinson, Wendy Mackay, Bo Westerlund, Benjamin B Bederson, Allison Druin, Catherine Plaisant, Michel Beaudouin-Lafon, Stéphane Conversy, Helen Evans, Heiko Hansen, et al. 2003. Technology probes: inspiring design for and with families. In *Proceedings of the SIGCHI conference on Human factors in computing systems*. 17–24. https://doi.org/10.1145/642611.642616

[25] Sara Isola and Jerry Alan Fails. 2012. Family and design in the IDC and CHI communities. In *Proceedings of the 11th International Conference on Interaction Design and Children*. 40–49. https://doi.org/10.1145/2307096.2307102

[26] Malte Jung and Pamela Hinds. 2018. Robots in the wild: A time for more robust theories of human-robot interaction. , 5 pages. https://doi.org/10.1145/3208975

[27] SunKyoung Kim, Masakazu Hirokawa, Atsushi Funahashi, and Kenji Suzuki. 2022. What Can We Do with a Robot for Family Playtime?. In *2022 17th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*. IEEE, 847–849. https://doi.org/10.1109/HRI53351.2022.9889425

[28] Christine P Lee, Bengisu Cagiltay, and Bilge Mutlu. 2022. The Unboxing Experience: Exploration and Design of Initial Interactions Between Children and Social Robots. In *CHI Conference on Human Factors in Computing Systems*. 1–14. https://doi.org/10.1145/3491102.3501955

[29] Joseph E Michaelis, Bengisu Cagiltay, Rabia Ibtasar, and Bilge Mutlu. 2023 (in press). Off Script: Design Opportunities Emerging from Long-Term Social Robot Interactions In-the-Wild. In *Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (HRI '23)*. https://doi.org/10.1145/3568162.3576978

[30] Joseph E Michaelis and Bilge Mutlu. 2018. Reading socially: Transforming the in-home reading experience with a learning-companion robot. *Science Robotics* 3, 21 (2018), eaat5999. https://doi.org/10.1126/scirobotics.aat5999

[31] Luiza Superti Pantoja, Kyle Diederich, Liam Crawford, and Juan Pablo Hourcade. 2019. Voice agents supporting high-quality social play. In *Proceedings of the 18th ACM International Conference on Interaction Design and Children*. 314–325. https://doi.org/10.1145/3311927.3323151

[32] Kay Pasley and Raymond E Petren. 2016. Family structure. *Encyclopedia of family studies* (2016), 1–4. https://doi.org/10.1002/9781119085621.wbefs016

[33] Sandra Petronio. 2002. *Boundaries of privacy: Dialectics of disclosure*. Suny Press.

[34] Sandra Petronio. 2017. Communication privacy management theory: Understanding families. In *Engaging theories in family communication*. Routledge, 87–97. https://doi.org/10.4135/9781452204420.n3

[35] Sandra Petronio, Susanne Jones, and Mary Claire Morr. 2003. Family privacy dilemmas: Managing communication boundaries within family groups. *Group communication in context: Studies of bona fide groups* (2003), 23–55.

[36] Martin Porcheron, Joel E Fischer, Stuart Reeves, and Sarah Sharples. 2018. Voice interfaces in everyday life. In *proceedings of the 2018 CHI conference on human factors in computing systems*. 1–12. https://doi.org/10.1145/3173574.3174214

[37] Brian Scassellati, Laura Boccanfuso, Chien-Ming Huang, Marilena Mademtzi, Meiying Qin, Nicole Salomons, Pamela Ventola, and Frederick Shic. 2018. Improving social skills in children with ASD using a long-term, in-home social robot. *Science Robotics* 3, 21 (2018), eaat7544. https://doi.org/10.1126/scirobotics.aat7544

[38] Walter Dan Stiehl, Jun Ki Lee, Cynthia Breazeal, Marco Nalin, Angelica Morandi, and Alberto Sanna. 2009. The huggable: a platform for research in robotic companions for pediatric care. In *Proceedings of the 8th International Conference on interaction Design and Children*. 317–320. https://doi.org/10.1145/1551788.1551872

[39] Brian Tang, Dakota Sullivan, Bengisu Cagiltay, Varun Chandrasekaran, Kassem Fawaz, and Bilge Mutlu. 2022. CONFIDANT: A Privacy Controller for Social Robots. In *Proceedings of the 2022 ACM/IEEE International Conference on Human-Robot Interaction* (Sapporo, Hokkaido, Japan) *(HRI '22)*. IEEE Press, 205–214. https://dl.acm.org/doi/10.5555/3523760.3523790

[40] Nathan Thomas White, Bengisu Cagiltay, Joseph E Michaelis, and Bilge Mutlu. 2021. Designing Emotionally Expressive Social Commentary to Facilitate Child-Robot Interaction. In *Proceedings of the Interaction Design and Children Conference* (Athens, Greece) *(IDC '21)*. Association for Computing Machinery, New York, NY, USA, 314–325. https://doi.org/10.1145/3459990.3460714

[41] Jason C Yip, Tamara Clegg, June Ahn, Judith Odili Uchidiuno, Elizabeth Bonsignore, Austin Beck, Daniel Pauw, and Kelly Mills. 2016. The evolution of engagements and social bonds during child-parent co-design. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. 3607–3619. https://doi.org/10.1145/2858036.2858380

[42] Ramon B Zabriskie and Bryan P McCormick. 2001. The influences of family leisure patterns on perceptions of family functioning. *Family relations* 50, 3 (2001), 281–289. https://doi.org/10.1111/j.1741-3729.2001.00281.x