"Jump, Stop, Jump Again": Exploring AI-Supported Physical Activity Play at Home with Parents and Children

Hongfei Ji
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA
hongfeij@alumni.cmu.edu

Yuhan Yuan
Independent Researcher
Zhuhai, Guangdong, China
solaryuan2025@gmail.com

Qiao Jin
Human-Computer Interaction Institute
Carnegie Mellon University
Pittsburgh, Pennsylvania, USA
georgiej@andrew.cmu.edu

Abstract

Physical activity play (PAP) is essential for children's physical, cognitive, and social development. However, constraints such as limited space, parental availability, and social and physical incidents make domestic PAP a substitute for outdoor play. Given the varied forms of AI, the diverse stages of child development, and the complexity of parent-child dynamics, it is critical to understand how AI influences PAP in the domestic context. This research investigates how children engage with AI for PAP at home and how parents participate in these interactions. Through a small-scale pilot study with three families, we examine the forms of AI-supported PAP, parental roles, challenges to children's agency in relation to parents and AI, and limitations of current AI systems. Our findings offer implications for preserving children's embodied intentions, maintaining flexible coherence and contextual awareness of AI behavior, navigating parent-AI dynamics, and outline future directions for investigating domestic PAP for children.

CCS Concepts

• **Human-centered computing → Empirical studies in HCI**; **Empirical studies in collaborative and social computing**.

Keywords

Children-AI Interaction, Physical Activity Play, Parental Mediation

ACM Reference Format:

Hongfei Ji, Yuhan Yuan, and Qiao Jin. 2025. "Jump, Stop, Jump Again": Exploring AI-Supported Physical Activity Play at Home with Parents and Children. In *Companion Proceedings Annual Symposium on Computer-Human Interaction in Play (CHI PLAY Companion '25), October 13–16, 2025, Pittsburgh, PA, USA.* ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3744736.3749349

1 Introduction

Physical activity play (PAP) is a play form addressing dynamic engagement, physical coordination, and spatial interaction [16]. The advantage of PAP has been well documented, including physical, cognitive, and social development [1, 5, 7, 8, 30, 32, 36, 41]. While children traditionally engage in PAP through outdoor or peer-based activities, they have decreased due to constraints such as limited space, digital media use, parental availability, safety concerns, and emergency situations [29]. As a result, the home has become an important but under-examined site for children's PAP.

Previous HCI research has explored how digital technologies can support PAP [21, 33, 39, 40]. However, these systems are often designed for outdoor settings and focus primarily on peer interaction. Despite the increasing prevalence of AI in children's lives, its role in facilitating domestic PAP remains underexplored. In particular, the dynamics among children, parents, and AI have not been fully understood. Therefore, our research investigates how children engage with AI for PAP at home and how parents participate in the process. Given the varied forms of AI, the different stages of child development, and the complexity of family dynamics, it is critical to understand how AI shapes PAP in this new context.

We conducted a pilot study including design ethnography and semi-structured interviews with three families who used AI to support PAP at home. Through these case studies, we identify preliminary forms of AI-supported PAP, parental roles, challenges to children's agency when navigating between parents and AI, and limitations of current AI systems. We conclude by discussing future directions for preserving children's intentions in AI communication, maintaining flexible coherence and contextual awareness in AI behavior, navigating parent-AI dynamics in domestic PAP, and outline our next steps to refine interview protocols and inform the design of future artifacts.

2 Background and Related Work

2.1 Children's Physical Activity Play at Home

Physical activity (PA) is defined across various domains, with an extensive and ongoing discussion of what qualifies as PA. In daily life, PA can be categorized by context into "occupational, sports, conditioning, home, or other activities" [9]. Broader definitions include the physical aspects of domestic social games, such as parlor games [3], and even related pre- and post-routines of PA [20]. For children, physical activity play (PAP) constitutes a significant part of their physical activity. It addresses dynamic engagement, physical coordination, and spatial interaction. Frost et al. [16] identified three forms of physical play: functional play, which includes full-body movements; constructive play, which involves building by gathering materials or assembling parts in the surroundings; and symbolic play, which uses role-playing to create alternative worlds.

CHI PLAY Companion '25, Pittsburgh, PA, USA

ACM ISBN 979-8-4007-2023-9/25/10
https://doi.org/10.1145/3744736.3749349

The importance of PAP for children is well documented, including children's physical [7, 8, 30, 41], cognitive [1, 32, 36], and social development [5]. However, in recent decades, children's engagement in outdoor PAP has decreased due to the consumption of digital media, parental time and safety concerns and diminishing access to outdoor spaces [4, 28]. In addition, emergency conditions such as bad weather or health limitations restrict children's access [7]. In this context, domestic PAP has become a critical substitute. Unlike outdoor PAP, domestic PAP spans a fluid spectrum from light activity to rough-and-tumble play, shaped by interactions with the home environment and daily routines [29, 42]. While outdoor PAP often involves peer interaction and competitive play, domestic PAP is defined by the relational dynamics of the home, frequently involving family members as play partners or facilitators. The shifting trends and distinct characteristics call for greater attention and support for children's physical activity play at home.

2.2 Technologies for Children's Physical Activity Play

Digital technologies supporting children's PAP have been extensively explored in HCI field. A growing body of work has examined PAP in outdoor contexts [21, 28, 33, 39, 40] or in varied settings regardless of location [11, 43]. Much of this research focuses on sensor-based tracking [21, 39, 40] and tangible programming platforms [11, 28, 43], often emphasizing their effects on peer social interaction [21, 39, 40]. While these investigations cover various forms of PAP, research on domestic PAP, particularly how technologies mediate parent–child interactions, remains limited. There are some exceptions [17, 31], but the design and evaluation of intelligent systems rarely considers the role of caregivers [14]. This gap is critical because caregivers play a crucial role in shaping children's access, understanding, and participation in intelligent systems in real-world settings [37]. As AI shows potential in reshaping how these technologies interact with us, there is a growing need to reexamine their influence on children's domestic PAP.

2.3 Designing AI Systems for Children's Domestic Physical Activity Play

In recent years, there has been a proliferation of AI-powered systems for children. From social robots [6, 26] to AI-supported commercial products such as Microsoft Kinect, Nintendo Wii, and IoT-based smart toys and installations [38], AI is increasingly embedded in and likely to become even more pervasive in, children's digital ecosystems. It can support children's learning [23, 35], cultivate emotional intelligence and social skills, enhance well-being, and even inform parenting practices [18, 25]. However, despite their potential, AI is less explored in domains such as PAP except for the commercial products mentioned above. In the few cases found in HCI research, AI is generally used to monitor activity rather than directly engage children [2]. Similarly, the investigation, design, and evaluation of AI systems in mediating parent-child interaction during PAP are almost absent. Thus, our research is located in current AI systems and parent-child co-experience, with the aim of exploring the capabilities, potential benefits, and challenges of AI in supporting children's domestic PAP.

3 Method

We aim to explore how children engage with AI for PAP at home and how parents are involved in the process. As an initial step, we conducted a pilot study with three families to gain preliminary insights into current practices and refine our research protocol for a future larger-scale study.

3.1 Participants and Settings

As this was a small-scale pilot study, we invited families through existing personal networks. This study was approved by the Institutional Review Board (IRB) of our university. All children were between two and ten years old, an age range during which PAP peaks [30]. Three families (F1-F3) participated in our pilot study, each consisting of one parent and one child. Parents signed an informed consent for their own and their child's participation in the study. All families had previous experience using AI to support children's domestic PAP (see Table. 1 and Figure. 1). All studies were conducted online via video call. Parents were asked to choose a location where their child typically engages in PAP activities and to set up a stationary camera for recording. They also need to install AI chatbot applications (ChatGPT or Doubao[1]) on their mobile devices.

3.2 Study Procedure

Each study session lasted one hour and consists of three sections: (1) onboarding and family practice interviews with parents; (2) design ethnography [24, 34], including the co-design of AI prompts with parents (and children) and observation of family play; and (3) semi-structured interviews with both parents and children.

Onboarding and Family Practice Interview with Parents (10 minutes). Each session began with onboarding, including an overview of the study objectives and consent procedures. Researchers provided definitions of AI and PAP to ensure that parents clearly understood the key concepts used in the study. Researchers then conducted a brief interview to understand the current practices of children's PAP at home.

Design Ethnography: AI Prompts Co-Design with Parents (and Children) (10 minutes). AI chatbots are used as accessible entry points to help participants recall their experience and explore new forms of AI interaction. Parents were asked to design a PAP for their child with the chatbot. To support prompt generation, researchers first showed a video example of parents using an AI chatbot to facilitate children's domestic PAP. Parents (and children) then worked with researchers to brainstorm prompts, guided by a design framework (see Appendix A). During this process, researchers provided iterative support, reminding parents of their role, the type of PAP they were aiming to design, and other key considerations. The design process was documented for future analysis.

Design Ethnography: Family Play Observation (10 minutes). Parents and children then participated in a design ethnography session

[1]Doubao is ByteDance's AI chatbot. https://www.doubao.com/
[2]TianTianTiaoSheng is a Chinese mobile application that facilitates jump rope activities. https://www.tiantiantiaosheng.com/
[3]BabyAlpha A2 Intelligent PetBot is an AI-powered pet robot by Deepseek. https://www.weilan.com/product/A2

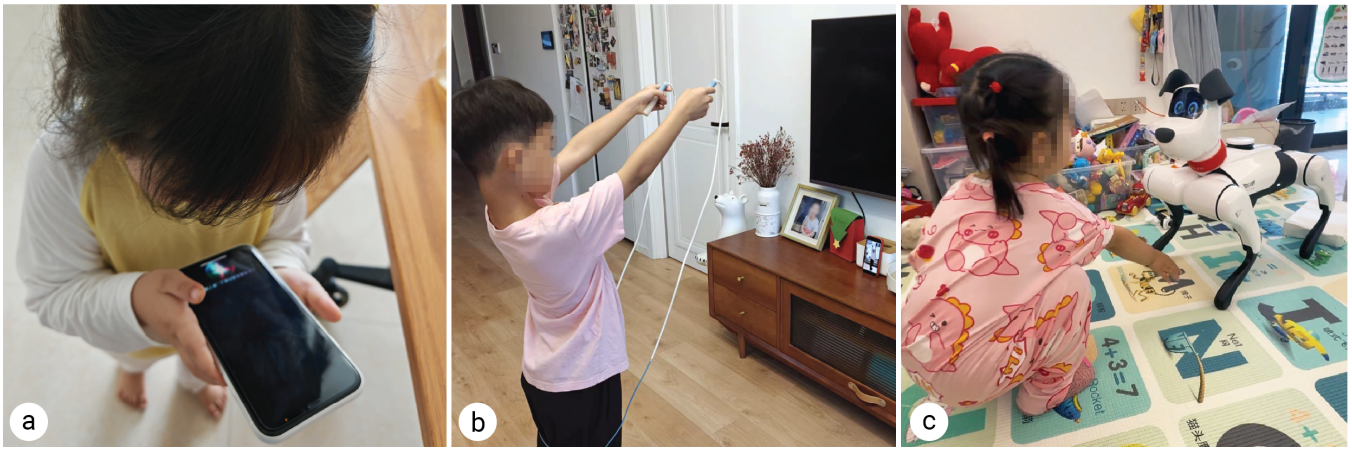

Figure 1: AI tools previously used for PAP and corresponding PAP activities: (a) F1-C: Jumping to music using Siri; (b) F2-C: Jump rope with Tiantiantiaosheng; (c) F3-C: Dancing to music and playing with the BabyAlpha A2 Intelligent PetBot

Table 1: Overview of family demographics: age, gender, previous AI experience for physical activity play

Family ID	Parent (Age, Gender)	Child (Age, Gender)	AI Tools Previously Used for PAP	PAP Previously Guided by AI
F1	F1-P (30-39, M)	F1-C (3, F)	Siri	Jumping with music
F2	F2-P (30-39, F)	F2-C (8, M)	TianTianTiaoSheng[2]	Jumping Ropes
F3	F3-P (30-39, F)	F3-C (3, F)	BabyAlpha A2 Intelligent PetBot[3]	Dancing to music, Play with PetBot

by playing with the AI chatbot using the prompts developed earlier. Fig. 2 illustrates the PAP activities conducted by three families during our pilot study. Parents are asked to livestream it via video call. Visual materials were used as references to inform the interpretation of participant reflections during the post-session interviews. In addition, researchers took handwritten notes to document our observation of participants' behaviors.

Semi-Structured Interviews with Parents and Children (30 minutes). Finally, researchers conducted semi-structured interviews with parents and children to reflect on key moments of the study and understand their experiences with AI-supported PAP at home. The interviews began by revisiting notable or unexpected moments, followed by parent-guided reflections with the child. Parents were also invited to compare the study's AI with those they typically used at home, discuss their roles during AI-supported play, and share practical needs, challenges and long-term expectations for integrating AI into domestic PAP.

3.3 Data Analysis

We conducted an inductive thematic analysis [10] across all qualitative data sources, including interview transcripts, prompt design record, and field notes. Two researchers first familiarized themselves with the data and independently generated initial open codes. In subsequent interpretation sessions, codes were iteratively clustered and organized into broader themes and sub-themes using affinity mapping. Through group discussions, we selected the most salient themes to report in the Results section.

4 Results

We present our key findings from the pilot study, including an overview of AI-Supported PAP practices, parental roles, challenges in mediating parents and AI with children's agency, and the limitations of AI in domestic PAP.

4.1 Overview of AI-Supported PAP Practices

Based on parents' feedback, we summarized AI used in children's domestic PAP into three types: (1) Physically-embodied AI: AI systems with a physical form that can interact with children, such as smart toys and social robots; (2) Interface-mediated AI: AI systems whose physical form is not essential and which interact with children primarily through non-physical interface, such as voice assistants and chatbots; and (3) Environment-situated AI: AI systems that support children's PAP by interacting with the environment rather than directly with the child, such as motion-based games.

The types of PAP observed include both structured and open-ended [7] for all types of AI. For instance, jumping rope (F2) represents a structured activity and is the primary function of the AI exercise application. In contrast, activities that involve Siri (F1)

Figure 2: Activities conducted by the three families following Doubao's generated PAP during the design ethnography: (a) F1-C performing improvised aerobics; (b) F2-C completing a jump rope challenge with varied techniques (e.g., single-leg jumps) while simultaneously finishing a word chain task; (c) F3-C engaging in multiple activities with her mother, including jump rope, ball throwing, sliding, hide-and-seek, and toy pickup.

and PetBot (F3) are often unintentionally triggered by AI speech or movement. While most activities were scaffolded by adult or AI prompts, we observed instances where play evolved dynamically (F3). These family-initiated activities introduced elements of free play, as defined by Bekker et al. [12], where spontaneity and intrinsic motivation drive the activity.

The location of the activity is related to the type of AI. Jumping rope takes place in a specifically cleared space on the balcony. Interactions with Siri and the PetBot occur in areas surrounding the AI, such as a car seat (F1) or the living room play area (F3). The AI chatbot can be relocated with the parent's mobile device to any designated space.

The duration of the activities also varies by structure. Structured AI play tends to impose fixed durations, while open-ended play depends largely on the child's attention span, often emerging and fading spontaneously. While the chatbot can suggest a duration, it is adaptive to the child's engagement.

4.2 Parental Roles in AI-Supported PAP at Home

Across the three families, we identified three potential parental roles: interpreters, co-players, and bystanders.

4.2.1 Translating the Unspoken: Parents as Interpreters. This parental role was consistently observed in PAP involving the AI chatbot. The interpretation provided by parents was bi-directional. Sometimes, parents translated AI instructions for their children, particularly younger ones (e.g., F1). During the design ethnography with F1, F1-C often ignored Doubao's instructions until F1-P repeated them. F1-P explained this behavior as follows: *"I think part of it might be related to the child's age or just their attention span. For example, sometimes Doubao gives a command, but the child doesn't notice it, so I repeat it and emphasize it again."*

In most cases, parents had to interpret their children's actions and surroundings for AI. During the design ethnography with F1, Doubao paused after giving an instruction, leaving both the child and parent without clear direction. F1-P had to actively provide feedback to Doubao for the interaction to continue. A similar situation occurred with F2. F2-P had to repeatedly call Doubao to keep the conversation going. In addition, although Doubao stated it would count F2-C's jump rope counts, it failed to do so, and F2-P had to report the count herself. F2-P described her role when using Doubao: *"My role was mainly working with Doubao to adjust and refine the game rules and some of the instructions."*

4.2.2 Joining the Play: Parents as Co-Players. This role was observed and reported in interactions with both Siri and the AI chatbot. In such cases, AI became an auxiliary tool under the parent's lead. F1-P recalled his experience using Siri for children's PAP: *"As for Siri, it feels more like one-way communication (from me to it), more like a tool, a very simple one."* In the design ethnography with F3, parents actively engaged in children's PAP. Although they initially followed the AI's instructions, their deep involvement in the activity gradually pushed the AI's role into the background. F3-P reflected on this experience: *"It felt like it didn't really play any role: most of the interaction was still between me and my child, and it basically didn't participate."*

4.2.3 Monitoring from a Distance: Parents as Bystanders. This role was common across AI systems, with parents stepping back to let the child interact autonomously and intervening only when necessary. F3-P reflected on her role when her child interacted with the PetBot: *"I can just stay nearby, like when AI (the PetBot) dances with her or engages her in some activity. In such situations, I feel I can*

take a short break and disconnect a bit." She further explained her reasoning: *"I found it really interesting (when children interact with AI), and I didn't want to interrupt her, because when she was talking to it, I felt the communication was going quite well."* However, parents also noticed that AI partially substituted for their presence both behaviorally and emotionally. F1-P recalled that F1-C's attention was transferred to Doubao from parental facilitation during design ethnography: *"The child really wanted to ask when you (Doubao) want to see the things he was holding; he brought you a toy."*

4.3 Challenges in Mediating Parents and AI with Children's Agency

We observed two challenges in maintaining children's agency in domestic PAP with AI in our study: distorted or lost embodied intentions through parental translation; and communication gaps between children and AI.

4.3.1 Children's Embodied Intentions Are Lost and Suppressed Through Parental Translation. Many children, particularly the younger ones, had difficulty articulating the type or structure of physical activities they wanted to perform with AI. As a result, their intentions are often re-encoded through adult language for AI interpretation. However, this process sometimes led to distortion or loss of the child's original intention. In particular, the unconscious embodied aspects are especially difficult to capture. For instance, in the design ethnography of F1, F1-C ran out of the camera frame and began rhythmically running after being prompted to wiggle. However, this behavior was overlooked by the parent, who instead reinforced the AI's original command. This loss of intention weakened children's agency in domestic PAP and reduced their interest in engagement.

4.3.2 Children's Communication Gaps and AI Literacy Limit Direct Engagement with AI. Beyond adult mediation, we found that children's developmental stage and limited AI literacy also constrained their ability to engage directly with AI. Younger children seemed to lack verbal fluency to sustain interaction. For example, during the F1 session, F1-C gradually lost interest when the AI failed to understand her request. Even older children frequently did not realize they were allowed, or expected, to speak to AI or how to do so effectively. For instance, during the F2 session, F2-C whispered his ideas to the parent instead of addressing Doubao directly.

4.4 Limitations of AI Capabilities in Domestic PAP

In our study, we identified two key limitations of AI's ability in facilitating domestic PAP: maintaining fragile play flow; and mismanagement of children's physical states. We focus on limitations that affect the interactive experience, beyond AI's intrinsic technical issues such as hallucination or context length, which fall outside the scope of this study.

4.4.1 Play Flows Are Easily Broken by Misaligned AI Responses. Play flows were carefully curated by parents' prompts but still fragile. In the design ethnography of F1, when F1-C became distracted by candy, AI shifted its response and deviated from its intended focus on PAP. When AI fails to maintain relevance to the topic or align with the child's embodied state, it disrupts the play flow, turning engagement into confusion or boredom. In the design ethnography of F3, Doubao frequently suggested non-PAP activities such as "telling a story" or "building blocks" when prompted for the next game or in response to parental follow-up. As a result, F3-P chose to ignore the AI's suggestions and continued with their own plan.

4.4.2 AI Systems Struggle to Respond to Changes in Physical States. We also observed that AI seemed to be unable to appropriately and timely respond to the physical states of children, particularly physical fatigue. Once the AI delivered an instruction, it did not respond further unless explicitly prompted by the player, regardless of the setting of prompts. This issue was particularly evident during more physically demanding PAP, such as in our study with F2. F2-C continued to jump after receiving the instruction, but when he became too tired to continue, the AI did not show any response. He had to stop and call a timeout. By the end of the session, F2-C was visibly exhausted from the intense rope-jumping activity.

5 Discussion and Future Work

5.1 Research and Design Implications

Our findings indicate potential influences of AI on activity type, play process, and extent of parental involvement. Given the limited research on AI's role in supporting children's PAP, particularly in domestic settings, we relate our findings to previous work on outdoor PAP technologies to identify connections and highlight promising directions for future research.

5.1.1 Designing Children-AI Communication to Preserve Intentions in Domestic PAP. Our preliminary findings suggest that children's intentions are often suppressed or lost during AI-supported play. On the one hand, as discussed in Section 4.3 and 4.4, AI systems currently struggle to capture children's intentions, especially embodied ones, in real time, largely due to power imbalances in children-AI interactions. These imbalances stem from both the developmental stage of the child and the technology-centered nature of AI-initiated play. This highlights the need for future AI systems to better support child-initiated, self-directed activity, and to shift from reactive instruction to more participatory, co-creative guidance. On the other hand, while some AI systems, particularly the AI chatbot, are capable of generating diverse prompts that could support functional, constructive, or symbolic PAP [16], these prompts are frequently interpreted and filtered by parents through their own expectations or concerns. This echoes previous work indicating that parental mediation can constrain exploratory play of children, even when technology can provide greater flexibility [15]. Future efforts should consider how system design, play protocols, and broader social awareness can mitigate these constraints.

5.1.2 Designing for Flexible Coherence and Context Awareness of AI-supported Domestic PAP. While prior work celebrates the flexibility of IoT toys in supporting emerging engagement [22], we observed that AI systems used in our study often struggled to maintain such flexibility in PAP due to their limited capabilities, often drifting into unrelated, non-PAP activities. This limitation highlights the need for improved prompt design and interaction flow to anchor AI responses while preserving adaptability. Unlike peer-mediated

social play in the study by Hitron et al., the absence of such mediation in AI-driven interactions makes it more difficult for AI to detect changes of physical states. Some parents in our study envisioned a hybrid AI system that combines physical embodiment and environmental sensing with the reasoning capabilities of Doubao. This suggests a design opportunity for multi-modal AI systems that more effectively support children's PAP in domestic settings.

5.1.3 Designing for Navigating Parent-AI Dynamics in AI-supported Domestic PAP. Previous research has shown that technologies such as IoT tools can enrich peer interactions in PAP by enabling shared leadership and conflict resolution [15, 22]. In contrast, rather than building connections, some parents in our study perceived AI as replacing their role, a concern not reported with earlier PAP technologies. In our observations, parents' roles seem to depend on the AI capabilities. As AI became more autonomous and functional, parents tended to withdraw from active engagement. This shift may point to emerging dynamics in parent-child-AI interaction that indicates further investigation. Future research should investigate how these roles influence family relationships and children's social development over time.

5.2 Reflection on Methods and Future Work

Our findings revealed several issues with the interview protocol, including how to accommodate limited parental AI literacy [13], determine the appropriate timing for children's participation, address the limitations of AI, and mitigate the influence of children's developmental stages on data collection. Therefore, we need to reconsider how children are involved in the study based on their capabilities, to ensure they can meaningfully contribute to PAP design and data with less noise. For example, older children could be included in the co-design and parents could interview their younger children instead [19, 27]. In addition, it is essential to develop strategies that support both parents and children according to their level of AI literacy and guide them through unexpected situations. Preparation before the interview and a more thorough warm-up phase to help parents and children become familiar with the AI system, such as [13], are critical to the success of co-design.

The findings and discussions above point to two key directions for future work: (1) identifying the AI mediums and characteristics that better support children's domestic PAP given current limitations and (2) examining the power dynamics among parents, children, and AI in these interactions. To address these questions, we plan to recruit more participants with experience across different AI categories to validate our initial findings and deepen our understanding of the benefits and challenges of AI. In addition to contributing to our future larger-scale study, these insights will inform the future design of artifacts to probe the challenges and opportunities in children's interactions with AI and the role of parental involvement.

6 Conclusion

Emerging AI technologies and their impact on family engagement in domestic physical activity play present new challenges that call for further attention. This paper investigates how children engage with AI for PAP at home and how parents participate in the process. Through a pilot study involving three families with prior experience using various AI systems, we identified preliminary forms of AI-supported PAP, parental roles, challenges to children's agency when navigating between parents and AI, and limitations of current AI systems. We discuss future directions for preserving children's embodied intentions in AI communication, maintaining flexible coherence and contextual awareness in AI behavior, and navigating parent-AI dynamics in domestic PAP. We also outline our next steps to include more participants, refine interview protocols, and inform the design of future artifacts.

References

[1] Ohoud Almousa and Sharifa Alghowinem. 2022. Conceptualization and development of an autonomous and personalized early literacy content and robot tutor behavior for preschool children. *User Modeling and User-Adapted Interaction* 33 (Sept. 2022), 1–31. doi:10.1007/s11257-022-09344-9

[2] Swamy Ananthanarayan, Katie Siek, and Michael Eisenberg. 2016. A Craft Approach to Health Awareness in Children. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems* (Brisbane, QLD, Australia) *(DIS '16)*. Association for Computing Machinery, New York, NY, USA, 724–735. doi:10.1145/2901790.2901888

[3] P. Beaver. 1978. *Victorian Parlor Games*. T. Nelson. https://books.google.com.hk/books?id=ulySYbw1qKgC

[4] Tilde Bekker, Janienke Sturm, and Berry Eggen. 2010. Designing playful interactions for social interaction and physical play. *Personal and Ubiquitous Computing* 14, 5 (July 2010), 385–396. doi:10.1007/s00779-009-0264-1

[5] Tilde M. Bekker and Berry H. Eggen. 2008. Designing for children's physical play. In *CHI '08 Extended Abstracts on Human Factors in Computing Systems*. ACM, Florence Italy, 2871–2876. doi:10.1145/1358628.1358776

[6] Ilene R. Berson, Michael J. Berson, Candice McKinnon, Deeksha Aradhya, May Alyaeesh, Wenwei Luo, and Ben Rydal Shapiro. 2023. An exploration of robot programming as a foundation for spatial reasoning and computational thinking in preschoolers' guided play. *Early Childhood Research Quarterly* 65 (Oct. 2023), 57–67. doi:10.1016/j.ecresq.2023.05.015

[7] Boudewijn Boon, Marco Rozendaal, Marry M. van den Heuvel-Eibrink, Janjaap van der Net, and Pieter Jan Stappers. 2016. Playscapes: a Design Perspective on Young Children's Physical Play. In *Proceedings of the The 15th International Conference on Interaction Design and Children (IDC '16)*. Association for Computing Machinery, New York, NY, USA, 181–189. doi:10.1145/2930674.2930713

[8] John A. Byers and Curt Walker. 1995. Refining the Motor Training Hypothesis for the Evolution of Play. *The American Naturalist* 146, 1 (1995), 25–40. doi:10.1086/285785 arXiv:https://doi.org/10.1086/285785

[9] C J Caspersen, K E Powell, and G M Christenson. 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports* 100, 2 (1985), 126–131. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1424733/

[10] Victoria Clarke and Virginia Braun. 2017. Thematic analysis. *The journal of positive psychology* 12, 3 (2017), 297–298.

[11] Noah Cowit and Junnan Yu. 2024. Supporting Physically Active CS-Ed for Children: Exploring the Design of Physical Play Friendly Coding Blocks. In *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems*. ACM, Honolulu HI USA, 1–7. doi:10.1145/3613905.3650973

[12] Linda de Valk, Tilde Bekker, and Berry Eggen. 2013. Leaving room for improvisation: towards a design approach for open-ended play. In *Proceedings of the 12th International Conference on Interaction Design and Children* (New York, New York, USA) *(IDC '13)*. Association for Computing Machinery, New York, NY, USA, 92–101. doi:10.1145/2485760.2485771

[13] Stefania Druga, Fee Lia Christoph, and Amy J Ko. 2022. Family as a Third Space for AI Literacies: How do children and parents learn about AI together?. In *CHI Conference on Human Factors in Computing Systems*. ACM, New Orleans LA USA, 1–17. doi:10.1145/3491102.3502031

[14] Stefania Druga, Sarah T. Vu, Eesh Likhith, and Tammy Qiu. 2019. Inclusive AI literacy for kids around the world. In *Proceedings of FabLearn 2019* (New York, NY, USA) *(FL2019)*. Association for Computing Machinery, New York, NY, USA, 104–111. doi:10.1145/3311890.3311904

[15] Thomas Dylan, Gavin Wood, Abigail C. Durrant, John Vines, Pablo E. Torres, Philip I. N. Ulrich, Mutlu Cukurova, Amanda Carr, Sena Çerçi, and Shaun Lawson. 2020. Designing IoT Resources to Support Outdoor Play for Children. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–12. doi:10.1145/3313831.3376302 event-place: Honolulu, HI, USA.

[16] Joe L. Frost. 1992. *Play and Playscapes*. Wadsworth Publishing Company.

[17] Verena Fuchsberger and Lisa Hofer. 2024. Remote, but Tangible: Activities for Grandparents and Grandchildren across Physical Spaces. In *Proceedings of the Eighteenth International Conference on Tangible, Embedded, and Embodied*

Interaction. ACM, Cork Ireland, 1–7. doi:10.1145/3623509.3635260
[18] R. N. Guérin, E. I. S. Hofmeijer, L. M. Kester, and L. W. Sensmeier. 2025. *The Responsible Implementation of Artificial Intelligence in Childcare.* Springer Nature Switzerland, Cham, 113–133. doi:10.1007/978-3-031-52082-2_8
[19] Mona Leigh Guha, Allison Druin, and Jerry Alan Fails. 2013. Cooperative Inquiry revisited: Reflections of the past and guidelines for the future of intergenerational co-design. *International Journal of Child-Computer Interaction* 1, 1 (2013), 14–23.
[20] Alejandra Gómez Ortega and Beatrice Vincenzi. 2025. Reconfiguring Our Data: A Duoethnography on Chronic Health and Physical Activity through the Lens of Fitness Trackers. In *Companion Publication of the 2025 ACM Designing Interactive Systems Conference*. Association for Computing Machinery, New York, NY, USA, 461–465. https://doi.org/10.1145/3715668.3736373
[21] Tom Hitron, Itamar Apelblat, Iddo Wald, Eitan Moriano, Andrey Grishko, Idan David, Avihay Bar, and Oren Zuckerman. 2017. Scratch Nodes: Coding Outdoor Play Experiences to enhance Social-Physical Interaction. In *Proceedings of the 2017 Conference on Interaction Design and Children (IDC '17)*. Association for Computing Machinery, New York, NY, USA, 601–607. doi:10.1145/3078072.3084331
[22] Tom Hitron, Idan David, Netta Ofer, Andrey Grishko, Iddo Yehoshua Wald, Hadas Erel, and Oren Zuckerman. 2018. Digital Outdoor Play: Benefits and Risks from an Interaction Design Perspective. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (Montreal QC, Canada) *(CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–13. doi:10.1145/3173574.3173858
[23] Deanna Hood, Séverin Lemaignan, and Pierre Dillenbourg. 2015. When Children Teach a Robot to Write: An Autonomous Teachable Humanoid Which Uses Simulated Handwriting. In *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction (HRI '15)*. Association for Computing Machinery, New York, NY, USA, 83–90. doi:10.1145/2696454.2696479
[24] John Hughes, Val King, Tom Rodden, and Hans Andersen. 1995. The role of ethnography in interactive systems design. *Interactions* 2, 2 (April 1995), 56–65. doi:10.1145/205350.205358
[25] Oqab Jabali and Abedalkarim Ayyoub. 2024. "Smart parenting: Effortless routine engagement with AI support: A quantitative study". *Education and Information Technologies* 29, 18 (Dec. 2024), 25403–25425. doi:10.1007/s10639-024-12854-1
[26] Kanae Kochigami, Jun Jiang, Yuriko Kakehashi, Chiwun Au, Yohei Kakiuchi, Kei Okada, and Masayuki Inaba. 2015. Walking together hand in hand: Design and evaluation of autonomous robot system that a robot recognizes moving direction with a child's assistance of pulling its hand. In *2015 IEEE/SICE International Symposium on System Integration (SII)*. 738–743. doi:10.1109/SII.2015.7405071
[27] Panos Markopoulos, Janet C. Read, Stuart MacFarlane, and Johanna Höysniemi. 2008. Chapter 10 - Observation methods. In *Evaluating Children's Interactive Products*, Panos Markopoulos, Janet C. Read, Stuart MacFarlane, and Johanna Höysniemi (Eds.). Morgan Kaufmann, Burlington, 164–184. doi:10.1016/B978-0-12-374111-0.00010-4
[28] Netta Ofer, Idan David, Hadas Erel, and Oren Zuckerman. 2019. Coding for Outdoor Play: a Coding Platform for Children to Invent and Enhance Outdoor Play Experiences. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow Scotland Uk, 1–12. doi:10.1145/3290605.3300394
[29] Sabine Parrish, Anna Lavis, Caroline M. Potter, Stanley Ulijaszek, Paulina Nowicka, and Karin Eli. 2022. How active can preschoolers be at home? Parents' and grandparents' perceptions of children's day-to-day activity, with implications for physical activity policy. *Social Science & Medicine (1982)* 292 (Jan. 2022), 114557. doi:10.1016/j.socscimed.2021.114557
[30] Anthony D Pellegrini and Peter K Smith. 1998. Physical activity play: The nature and function of a neglected aspect of play. *Child development* 69, 3 (1998), 577–598.
[31] Bernd Ploderer, Yaman Mazyed S. Alsahfi, and Stewart G. Trost. 2018. Technologies to engage young children in physical activity: an online study of parenting practices. In *Proceedings of the 30th Australian Conference on Computer-Human Interaction*. ACM, Melbourne Australia, 326–331. doi:10.1145/3292147.3292180
[32] Sara Price and Yvonne Rogers. 2004. Let's get physical: The learning benefits of interacting in digitally augmented physical spaces. *Computers & Education* 43, 1 (Aug. 2004), 137–151. doi:10.1016/j.compedu.2003.12.009
[33] Rasmus Rosenqvist, Jannik Boldsen, Eleftherios Papachristos, and Timothy Merritt. 2018. MeteorQuest - Bringing Families Together Through Proxemics Play In A Mobile Social Game. In *Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '18)*. Association for Computing Machinery, New York, NY, USA, 439–450. doi:10.1145/3242671.3242685
[34] Tony Salvador, Genevieve Bell, and Ken Anderson. 1999. Design ethnography. *Design management journal (former series)* 10, 4 (1999), 35–41.
[35] Samuel Spaulding, Goren Gordon, and Cynthia Breazeal. 2016. Affect-Aware Student Models for Robot Tutors. In *Proceedings of the 2016 International Conference on Autonomous Agents & Multiagent Systems (AAMAS '16)*. International Foundation for Autonomous Agents and Multiagent Systems, Richland, SC, 864–872.
[36] Richard S Strauss, Daria Rodzilsky, Gail Burack, and Michelle Colin. 2001. Psychosocial correlates of physical activity in healthy children. *Archives of pediatrics & adolescent medicine* 155, 8 (2001), 897–902.
[37] Kaiwen Sun, Yixin Zou, Jenny Radesky, Christopher Brooks, and Florian Schaub. 2021. Child Safety in the Smart Home: Parents' Perceptions, Needs, and Mitigation Strategies. *Proc. ACM Hum.-Comput. Interact.* 5, CSCW2 (Oct. 2021), 471:1–471:41. doi:10.1145/3479858
[38] Daniel Tetteroo, Dennis Reidsma, Betsy van Dijk, and Anton Nijholt. 2012. Design of an Interactive Playground Based on Traditional Children's Play. In *Intelligent Technologies for Interactive Entertainment*, Antonio Camurri and Cristina Costa (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 129–138.
[39] Robby van Delden, Dennis Reidsma, Joris P. Weijdom, and Dirk Heylen. 2022. Three Interactive Add-ons for Small Local Playgrounds: Towards Designing for Context-sensitive Play Activities. In *Extended Abstracts of the 2022 Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '22)*. Association for Computing Machinery, New York, NY, USA, 357–363. doi:10.1145/3505270.3558387
[40] Annika Waern, Fredrika Mårtensson, Jon Back, Anna Litsmark, and Eva-Lotta Sallnäs Pysander. 2025. Digital Play in Nature: A Study of Digital Play Installations from a Nature Play Perspective. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI '25)*. Association for Computing Machinery, New York, NY, USA, 1–19. doi:10.1145/3706598.3713303
[41] Margaret Whitehead. 2001. The concept of physical literacy. *European Journal of Physical Education* 6, 2 (2001), 127–138.
[42] World Health Organization. 2019. *Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age.* World Health Organization, Geneva. https://iris.who.int/handle/10665/311664
[43] Junnan Yu, Clement Zheng, Mariana Aki Tamashiro, Christopher Gonzalezmillan, and Ricarose Roque. 2020. CodeAttach: Engaging Children in Computational Thinking Through Physical Play Activities. In *Proceedings of the Fourteenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '20)*. Association for Computing Machinery, New York, NY, USA, 453–459. doi:10.1145/3374920.3374972

A AI Prompt Design Guideline

Prompt Design Guideline for Role Play with LLM Chatbots:

- Assign a clear role and mission.
- Set rules, guidelines, and boundaries and consider the following metrics:
  - **Feasibility**: Ensure instructions are appropriate for indoor play and match the available space and tools.
  - **Safety**: Consider fully the layout of the home and the child's safety.
  - **Everyday Relevance**: Reflect on the typical roles you take when playing with your child in daily life.
  - **Fun**: Ensure the activity is enjoyable for the child and motivating enough to encourage sustained participation.
- Use a strong kick-off prompt.

Prompt example:

You are a (assigned role) guiding my (child's age)-year-old child, (child's name), through a (the game's duration) playful and safe activity called (game name).

We live in a (home type). The activity will take place in the (describe the specific space). Please make sure all your instructions are safe and suitable for this space. Avoid any actions that might lead to bumping into furniture or slipping.

The game concept is (Insert game details here).

Use a warm, child-friendly tone, as if you're a playful, animated friend. Give instructions one small step at a time, check in before moving to the next step, and include plenty of encouragement, surprises, or fun sounds to keep the child motivated and engaged.

Begin by greeting (child's name) warmly, introduce yourself and the game, and let the adventure begin!