Let's Play! Digital and Analog Play Patterns between Preschoolers and Parents

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ABSTRACT

Play is an enjoyable and developmentally useful part of early childhood, and parent-child play is a highly productive mechanism by which children learn to participate in the world. We conducted an observational lab study to examine how 15 parent-child pairs (children age 4-6) respond to and play with tablet apps as compared to analog toys. We found that parents and children were less likely to engage with each other or to respond to each other's bids for attention during play sessions with tablets versus play sessions with toys. We also observed that specific design features of tablet devices and children's apps—such as one-sided interfaces, game paradigms that demand continual attention, and lack of support for parallel interaction—are the primary mechanism shaping these differences. We provide guidance suggesting how children's apps might be re-designed to preserve the advantages of digital play experiences while also evolving to build in the advantages of traditional toys.

Author Keywords

Play; children; parents; parent-child interaction; joint media engagement; child-computer interaction.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

One of the most developmentally productive activities of early childhood is unstructured play. Through play, children imitate others and explore social interactions, hone emergent skills, and engage in creative processes [5,12,13,15,25,48]. Though much of children's play occurs independently or with peers, parent-child play experiences also offer useful opportunities for early childhood learning, cultural participation, and bonding [15,26]. Although parent-child play varies across cultures [11,31], prior research has shown that in Western culture, parent-child play experiences foster content knowledge [43], social competence [22], and social-emotional learning [26].

Technology has the potential to both enhance and displace parent-child play. Some research has shown that parents lean on technology to disengage from their children to attend to necessary chores and self-care [16], while other research has shown that parents and children engage with technology together and experience this co-engagement positively [42]. Joint media engagement between parents and children can increase children's comprehension of digital content [34] as well as their enjoyment of these experiences [38]. Thus, the presence of digital play opportunities for young children may influence the extent to which and the way in which they engage with parents. Documenting this relationship has the potential to help designers understand how their design choices might promote or hinder parent-child play.

In this study, we sought to better understand parent-child play in the presence of traditional toys and digital apps. Both analog toys and apps have the potential to shape and stimulate the ways in which parents and children engage with each other and with their environment. Thus, we set out to perform a close examination of parent-child behaviors in the presence of each. We conducted an observational lab study with 15 parent-child dyads, and analyzed their behavior in the presence of both analog toys and tablet games. While both toys and tablet games are intended to foster play, we hypothesized that there could be systematic differences in the way children engage with each medium.

We chose to focus on preschoolers and their parents, because by this age, children can engage in rich, extended play scenarios [17]. They are also able to learn from digital interfaces and benefit from using technology together with a parent more so than they could as toddlers [34]. An increasing number of commercial offerings seek to monetize the attention of preschoolers and conceive of these children as a distinct user group [7]. Thus, we wanted to provide designers in this space with an understanding of the ways in which design might influence play experiences and parent-child interaction.

We found that children and parents consistently arranged analog toys in a central, shared space, making them equally accessible to both members of the dyad, a possibility that their tablets did not afford. We also observed that parents were more often excluded from play when children were engaged with tablets, and that children were less responsive to parents' bids for attention. As tablets worked to capture and manage children's attention in ways that analog toys did not, children struggled to maintain interactions with parents during digital play. Design affordances like user-paced content, multi-touch support, and symmetric interfaces mitigated some of these struggles.

While children's independent tablet play may always be a core user scenario for app development, supporting parent-child play is also a worthy goal. Through close observation in a controlled environment, we contribute an understanding of systematic ways in which the design of both traditional toys and digital apps can enable and inhibit parent-child play.

BACKGROUND AND RELATED WORK

Children, Parents, and Play
Play is considered one of the fundamental ways that young children learn about and engage with their world. Play that is meaningful, active, and pleasurable becomes a way for children to be intrinsically motivated to learn [42]. When children play with others, they build important communication skills and other abilities central to social and emotional development, such as turn-taking and resolving conflict [13]. Play is considered so important to children's development that the United Nations considers it to be a fundamental human right of all children [51].

Play between children and their parents is particularly useful for a number of reasons, including supporting parent-child bonding [5], fostering communication and connectedness [15], and promoting learning and emotional development [12]. How parents engage with children during parent-child play predicts children's social relations with peers [27]. Moreover, children learn more when playing with an adult who scaffolds their engagement with materials (i.e., provides support that permits the child to try new activities that the child could not accomplish on their own). This occurs through attention management, verbal and nonverbal communication, and reading the child's bids, among other behaviors, and applies to both digital [3] and analog [4] play materials.

A growing body of existing literature explores how parents and children play and interact with each other when using digital media together, a practice known as Joint Media Engagement (JME) [42]. Prior work has established that there are benefits of parents and children engaging with media together [24]. When parents and children engage in discussions and meaning-making together while using media, children learn more from digital content and understand how it relates to family values. Prior work has examined JME in the context of traditional television and movies [35], video games [45], and augmented reality experiences like Pokémon GO [39], among others.

Comparing Digital and Analog Experiences
Prior work has examined parent-child interactions in the context of many different types of stimuli. For example, Miller and colleagues documented that parents and infants interact with each other differently when playing with toys that squeak and provide feedback as compared to toys that provide no feedback [29]. Sosa documented that parents and children communicate with each other less when playing with electronic toys than when playing with traditional toys [40]. Other work comparing television viewing to free-play found that watching television was associated with less time engaging with parents and siblings [44].

Several studies have compared parent-child engagement when using eBooks to parent-child engagement when using traditional print books. Some have found that children are more distracted and understand less when using eBooks [20,30], though others conclude that parents and children derive equal value from the two formats [21]. Yuill and Martin found no differences in children's understanding or recall between the two formats but saw less warmth and shared affect in dyads using screens [49].

Across these many studies, researchers have found that the design of toys, books, and digital objects plays a role in the way parents and children interact with materials and with each other. To our knowledge, no one has examined this question with respect to apps, a common play experience for young children, or compared apps to non-digital toys.

Designing Shared Experiences for Parents and Children
Researchers in human-computer interaction and learning sciences have designed many experiences specifically to support parent-child play and JME. For example, recognizing that basic phone communication is not typically enough to sustain engagement between parents and young children, Yarosh et al. designed the projector-camera system ShareTable [47] to enable a remotely located parent and child to play together over a distance, as in the case of divorced families or a parent living abroad [46].

A number of game experiences have been designed to better support play and JME between children and their parents or siblings. Some have been entirely digital (e.g., Electric Racer [6]), whereas others have included both physical and digital experiences (e.g., Electric Agents [2]). Other work has examined the design of novel eBook experiences for children and their caregivers [33,36], and Cingel and Piper demonstrated that eBooks with haptic feedback increased the extent to which parents elaborated on story narratives [8]. The WaaZam system was designed to support families in engaging in remote play over video chat [19], and OneSpace uses a shared visual scene to promote specific forms of cooperative play [9]. FingAR Puppet was designed to foster pretend play in augmented reality [1].

These studies and others demonstrate a robust interest in designing technologies that foster family interaction, play, and joint media engagement. Here, we present close observations of parent-child interaction in response to toys and tablet apps. We examine how specific affordances and design choices of each medium influence parent-child play and contribute design insights that may be of use to those building systems with a goal of fostering JME.

METHOD

Participants

Fifteen parent-child dyads participated in our study. Families were recruited through mailing lists at our institutions and lists for local parents' groups and preschools. Inclusion criteria for participating in the study were that the parent and child speak English comfortably throughout the study session and that the child engage with apps for entertainment at least once a week on average. Because families were recruited for this study in conjunction with another study, participants were also required to own an Android device.

Our final sample included four boys and 11 girls, and our parents included five fathers and 10 mothers. Seven children were 6-years-old, four children were 5, and four children were 4. Ten children were of Asian or Southeast Asian descent, four children were non-Hispanic White, and one child was Afro-Caribbean. As solicitations were circulated at technology companies in addition to local groups targeting families, our participants were over-representative of families of high socioeconomic status and tech-savvy families.

Materials

We asked families to bring both a tablet with the child's favorite games or apps installed and a collection of the child's favorite toys to the session. Children brought board games, cards, stuffed animals, dolls, and a variety of other favorites.

Because bringing many apps to the session was easier than bringing many physical toys, and because we wanted to ensure a variety of play stimuli were available, we also provided a collection of toys in the usability lab. These were selected using the National Association of Education of Young Children's list of developmentally appropriate toys for this age group [50] and were intended to be familiar and not particularly novel. The toys we provided included:

- A bin of assorted Lego bricks, taken from the Lego City™ series, the Lego Friends™ series, and the Lego Creator™ series. We removed large, prefab pieces from the sets, so that the mixed collection of bricks was composed entirely of multi-purpose pieces
- One picture book, one easy-reader book, and one short chapter book
- A small model house filled with furniture and a collection of rabbit "dolls"
- Candy Land™, a chance-based multi-player board game, in which players take turns drawing cards to move along a path toward a common goal at the end

- A stack of paper and collection of drawing utensils of mixed colors
- A 96-piece wooden puzzle displaying an under-sea scene
- A large, foam, play mat made of colorful, interlocking pieces. Each piece displayed a letter, number, or shape (also made of foam), that could be peeled out of the mat

Study Setup and Procedures

All procedures were conducted in a usability lab, and were audio- and video-recorded. We cleared the user study lab space and placed the foam play mat on the floor in the center of the room, with chairs along the side. Coordinated cameras captured a full view of the room, and one-way glass embedded in one wall allowed the research team to observe the study sessions from an adjacent room.

Before attending the study session, parents completed a short screener survey confirming their eligibility to participate and collecting information about media use and demographics. After families arrived and completed the consent process, they engaged in two consecutive play sessions. In one play session, they were asked to put out the toys they had brought along with the stock toys provided by the research team. A member of the research team then told the parent and child they had 15 minutes to play with any of the toys in the room. In a second play session, the pair was asked to play with the tablet. The order of the sessions (toys vs. tablets) was counterbalanced across participants.

In both sessions, families were instructed that they could play together or not, and that the adult was free to do anything else, as long as they both stayed in the room. The researcher then left for the entirety of the session.

At the conclusion of both sessions, families participated in an unrelated study outside the scope of this investigation. That data is not analyzed here. As a thank-you for their participation in both studies, families received a single gift card to Amazon for US$150.

Data Analysis

The research team divided the sessions, and each researcher watched an independent subset, with one researcher viewing all videos. Using a grounded theory approach [10], the team then met to collaboratively discuss emergent themes. Using these emergent themes, researchers then repeatedly watched sessions to refine themes and pull out examples of parent or child behaviors that illustrated these themes. Using 255 examples, we conducted a collaborative affinity diagramming session, clustering examples into a hierarchy of cross-cutting themes (Figure 1).

After iteration, the final diagram included six high-level categories: joint engagement, parent disengagement, child disengagement, bids for attention, apps managing attention, and orientation/use of space. Collectively, these categories contained 18 categories in the next level, several of which had additional sub-categories, such as coordinating interactions,
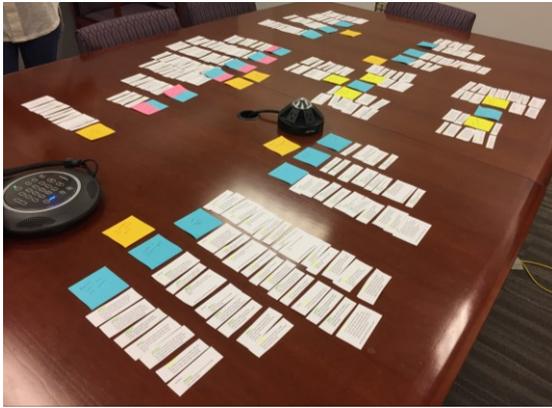
Figure 1. Affinity diagram with hierarchical clusters.

troubleshooting, and waiting for stopping points in the app to engage with each other.

When recounting examples of these themes below, we refer to participants by using "P" to represent "parent" and "C" to represent child. For example, P1 and C1 are a matched dyad. We use this notation throughout our analysis.

RESULTS AND ANALYSIS

Parent-Child Interaction Style

Although we observed many ways in which the play stimuli appeared to influence parents and children's behaviors, the most dominant factor in any play session was the parent and child's personal interaction style. P3 and C3 were both reticent and displayed low-affect throughout both sessions, speaking so quietly that it was often difficult to transcribe their verbatim speech. P14 treated C14 as the expert on play and asked questions throughout both play sessions, saying things like "*One licorice? But I don't get stuck on it, right?*" when playing with the physical Candy Land game, and "*Whoa, what happens when you get all the way to the end?*" when P14 watched C14 play a building game on the tablet.

P12 made domineering statements throughout both play sessions, directing C12's behavior with explicit instructions like, "*No, no. You put it on top and then connect it. Now you put something else on top to join it,*" as she played with Legos, and "*Lower lower. Do the shiny one. The shiny one gives you more,*" as she played a tablet game. C8 made intense demands of her mother in both sessions, shouting, "*ARE YOU READY MOM?*" while playing cards and holding out her hand and shouting, "*MOMMY!*" to stop her mother from sifting through the Lego bin while she played with the tablet, as the shuffling Lego bricks made a great deal of noise and drowned out the tablet's audio.

Within each of our 15 pairs, we saw distinctive patterns of pair-specific play, dialogue, and engagement that spanned both the toy session and the tablet session. Although we observed systematic differences between the cross-cutting tablet sessions as compared to the cross-cutting toy sessions, the differences between pairs were more dramatic and held more sway over the session activity.

Orientation to Materials

Creating a Shared Space with Toys

When playing with analog toys, parents and children often placed materials centrally in a shared space between them, a choice that made play materials accessible to both participants (Figure 2). For example, C7 began playing with toys by selecting the Candy Land board game and placing it centrally on the floor and asking her mother, "*Can we play together?*" When P7 responded affirmatively, C7 made space on the floor and set the game board between herself and this empty space, saying to her mother, "*you need to sit here.*" Similarly, C1 placed a board game grid between herself and her father, such that they could each easily reach all nine squares of the grid. P7 and C7 worked together to set out a game board they had brought and spread out the board and pieces in a shared space between them.

Children and parents placed toys centrally even when using materials that—unlike board games—did not explicitly require partnership. As C6's toy session began, he picked up a bin of Lego bricks that was off to the side of the room and placed it at the center of the mat in front of his father. He then sat on the opposite side, such that the bin was accessible and close to each of them in a central, shared space. After a few minutes of sifting through the box together, P6 and C6 decided together to dump out the entire bin and spread the Legos on the floor between them.

Similarly, P13 began the toy session by picking up a bag of puzzle pieces and spreading them on the floor in front of her. C13 announced, "*I'll join in!*" and scooted her body to position herself opposite from her mother, leaving the set of puzzle pieces in a shared space between them. Using Legos, puzzle pieces, a doll house, art supplies, playing cards, stuffed animals, and a variety of games, children and parents spontaneously created an arms-length space between them that was accessible to both partners and provided room to comfortably spread out materials.

Creating an Individual Space with Tablets

In contrast, children typically did not create this kind of shared space when engaging with digital experiences on their tablet. Eleven of 15 children spent most or all of the tablet play session with the device on their lap, while the other four spent most or all of the session with tablet on the floor immediately in front of their face, either crouched over it or lying down on their stomach (Figure 3). This positioning made shared interactions difficult, and parents and children rearranged themselves if they needed to engage with the tablet jointly. For example, when P12 wanted to participate in his child's tablet experience, he got down on all fours and inserted himself into the space she was occupying:

> *C12 is crouched, kneeling over the tablet playing Fruit Ninja with the device squarely in front of her and her torso hunched over the screen. P12 suggests she cut the fruit on screen in a specific way saying, "Yeah, see? Cut it. You need to cut it," and motioning with his hand in the*

Figure 2. Parents and children create a shared, arms-length space that is equally accessible to both partners. They create a similar configuration for a variety of play materials, including puzzle pieces (top left), Lego bricks (top right), drawing supplies (bottom left), and board games (bottom right).

Figure 3. Children create a solitary space using the tablet.

air. He then gets down on his hands and knees as close as possible to C12 but still without direct access to the screen. He awkwardly reaches across C12's body to swipe at the screen.

Similarly, P4 often craned her neck to see what C4 was doing on the tablet, C1 took the tablet on her lap, and P1 watched over C1's shoulder, and P3 leaned over to look at C3's screen. When P7 attempted to participate in an exploratory game C7 was playing, she had to lean over the top of the screen and engage by awkwardly manipulating the screen content from an upside-down orientation (see Figure 4). When C11 drew on the tablet, P11 repeatedly asked if he could see what she was doing because the content was not preemptively accessible to him.

Children appeared aware that their parents did not have easy access to the tablet play space. When children needed or wanted a parent's input, they would typically reposition themselves, holding out the device, turning it around, or even giving it to a parent. While playing a game, C1 said to P1, "*Papa, watch,*" and then turned her body so that P1 could view the screen. When C9 was unable to move a sprite on screen, she said to P9, "*Mommy, can you get him out?*" and then *"position[ed] the tablet in front of P9."* In these and similar instances, children broke from their typical orientation toward the tablet when they invited a parent to participate, suggesting that their default orientation is insufficient for parent participation.

There were a few notable exceptions to the general rule that children positioned tablets in way that precluded joint participation. Though tablet play sessions were overwhelming dominated by solitary child play, P7 and C7 played several games of tic-tac-toe in a manner that was more consistent with the analog play sessions we observed than the digital ones. In these cases, the pair placed the tablet in a shared space between them, lying flat on the floor. Because the game was symmetric and equally meaningful from all sides, it was possible for parent and child to position themselves as they had with analog toys and still engage fully in the tablet play experience. They sat at arms-length from each other and took turns tapping the screen to place Xs and Os.

Mutual Engagement

Parent Participation with Analog Toys
When playing with analog toys, six dyads spent most or all of the session playing turn-taking games with explicit roles for each of them. In these instances, both members of the pair were fully engaged in the play experience for the entire session, responding promptly to each other's questions and comments and jointly attending to the same objects and actions. For example, P1 and C1 shouted "*rock, paper, scissors…*" in unison to determine who would get the first turn. P14 and C14 took turns flipping over cards with different images on them, and chatting animatedly together about each one as they did so. P14 said "*I have a dog*" and C14 responded by panting like a dog. As she flipped over another card, P14 shouted "*Zebra!*" and C14 made noises in response; P14 then replied, "*Is that what a zebra says? I never knew.*" P17 and C17 played a game of Candy Land, each competing to get to the candy castle first, and each fully engaged in their alternating turns.

We also saw that parents engaged in play experiences and created roles for themselves, even when these were not explicitly defined by a structured game. C13 exclaimed, "*I know what this is; it's a [red] octopus! How about we find*

Figure 4. Mom and child each participate in an exploratory game in which multiple items on screen can be moved at once, such that they can each engage with the screen simultaneously. However, mom struggles to participate from an upside-down orientation and eventually stops playing.

all the reds?" P13 then began to sift through the unclaimed pieces, pulling out red ones and saying things like, "*Look, there's also this red piece*" when she found a new one, and "*I love it! You and me are a good team*" when C13 incorporated one of the pieces P13 had found into the growing puzzle. Later, P13 explained that she would build a separate section of the puzzle, and P13 assembled a treasure chest while C13 finished assembling the octopus. In this way, P13 divided the play activity such that both parent and child could actively participate in interdependent but parallel tasks. Similarly, P6 and C6 coordinated building a vehicle out of Legos, with the child putting pieces together and his father selecting and identifying pieces to use.

Eight parents spent the entire analog-toy session playing together with their child as an active participant, while the other seven participated as playmates some of the time. But even when parents were not actively playing themselves, they often asked questions, offered guidance, or otherwise supported the child in his or her play. For example, P9 held a rubber heart in place over a piece of paper so C9 could trace its outline, C12 asked her father how to spell a word and P12 spelled it out for her, and P4 chatted casually with C4 as he built with Lego bricks, asking questions like, "*Did you have fun at the park today?*" and "*Oh he [the Lego minifigure] has headphones; is he listening to some loud music?*" While parents occasionally engaged in solitary activities or sat watching the child, no parent did this for long stretches of time when children were playing with analog toys.

Parent Participation with Tablets
As children's play sessions with tablets began, we saw that parents sometimes preemptively anticipated that their child's tablet use would be independent and solitary. For example, when C7 began playing on her device, P7 took out her own flip phone saying, "*I wish I had a magazine or a book*," implying that she was looking for an activity to engage in and did not see her child's tablet use as one that was accessible or likely to hold her interest. Another parent sat silently and watched his child play with the tablet for a few minutes before moving to clean up and organize the toys in the room.

As he did so, he laughed and said, "*You don't need me for that [tablet use]*," giving the impression of seeking out something to occupy his time (P1). In these cases and others, parents appeared to assume from the start that their child's tablet play would not involve them.

Other parents responded to the start of their child's tablet play by sitting attentively nearby but without participating and eventually turning to other activities. While C8 played with her tablet, P8 built with Legos on her own, and while C9 played with apps and games, P9 took out a snack for herself and looked around the room as she ate. P13 asked, "*While you are playing, is it ok if I check my email?*" as she pulled out her phone. Eight parents spent nearly the entire session sitting by without participating as the child played on the tablet, engaging only to troubleshoot when the child was stuck and expressly asked for help (e.g., finding an app icon, dealing with an app that had frozen, dismissing an in-app purchase dialog).

Parents often seemed bored as they sat for long stretches without engaging with child or materials. Parents sometimes sought out what the child was doing and asked to participate in the experience, though children were not always receptive to this intrusion. For example, as P1 attempted to reach out and touch the screen C1 pushed his hand away. P6 repeatedly asked C6, "*What's that? Is that a Lego game or...? Let me see. Can I see that?*" Although C6 initially ignored these questions, P6 persisted, saying, "*Let's watch together. I want to see.*" Though C6 shifted and sat on P6's lap, he would not tolerate P6 touching the tablet and pushed his hand away. Eventually, P6 did carve out a role for himself, enforcing that he and the child would take turns playing with the tablet.

While it was rare for a parent to fully engage as an equal participant during tablet play, there were exceptions to this theme. P13 and C13 were the only pair that actively played together throughout most of the tablet session. Engaging with a bubble-popping game in which they could each independently and simultaneously pop bubbles, an animal exploration game in which they could move animals throughout a scene, and a puzzle game in which they could move jigsaw pieces into place, they each engaged with the experience and cooperated to share it simultaneously. The games that they selected to play were ones that supported multiple touches.

As described above, P7 and C7 spent several minutes fully engaged in a two-player game of tic-tac-toe with each participating equally, focusing on the same screen space, and responding promptly to the other. C11 spent several minutes sitting on P11's lap, giving him a clear view of the screen over her shoulder. As they sat together, P11 watched consistently as C11 played, and he participated in the tablet activity a few times. For example, at one point the app instructed the child to "*take a deep breath and let it go;*" in response both child and parent did this and P11 gave her a hug as they did.

In another instance, P12 and C12 spent several minutes playing an open-ended cooking game together. Although C12

maintained control of the tablet, P12 participated actively by asking questions like, "*Do you want to cut it or blend it?*" and statements like, "*Keep juicing it!*" that shaped the activity and moved it forward. Although P16 spent nearly the entire tablet session sitting quietly while C16 played alone, at one point the child held up the device in the air between them and drew her mother into the experience. "*Oh, it's a camera? Are you taking my picture?*" P16 asked. The child replied that she was, and over a period of 90 seconds, the child took several pictures of her mother and showed these to her. P16 actively participated, saying 'cheese' as the shutter button was pressed and asking questions about the pictures.

Responsiveness, Conversation, and Attention

Conversations and Attention while Playing with Toys
During play sessions with analog toys, parents and children regularly engaged in responsively timed, back-and-forth conversation. P14 and C14 said, "*One, two, three, go!*" in unison as they flipped over cards together, and P1 and C1 co-regulated their "*Rock, paper, scissors ...*" statement, reaching their hands out at precisely the same moment. P13 and C13 chatted continuously as they assembled their puzzle, and C9 asked her mother about upcoming holidays as she colored, with P9 responding promptly to questions and expanding up on them by volleying questions of her own back to C9. For example:

> C9: "*When is it Valentine's day?*"
> P9: "*February. So right now, it's July, right?*"
> C9: "*Is next month February?*"
> P9: "*No, next month is August. Then September, October, November, December, January, February. So it's a ways away. It's like 8 months out.*"
> C9: "*It's like 100.*"
> P9: "*100?*"
> C9: "*Days?*"
> P9: "*No, more than 100 days.*"
> C9: "*1,000?*"
> P9: "*Well, not a thousand, less than a thousand.*"
> C9: "*Hmm, eight months.*"
> P9: "*Eight months, good.*"
> C9: "*It could almost be like 10.*"
> P9: "*It's like, more than 200 days away, but less than 300 days.*"

During this exchange, C9 comfortably alternated between looking up at P9 and gazing down at her paper as she colored, and no comments or bids for attention were missed by P9.

As children played with analog toys, the play materials were frequently the subject of parents' and children's joint attention and an anchor for dialogue. For example, as P7 and C7 played together with the dollhouse, each took one rabbit doll and imitated its voice, moving the dolls and speaking on their behalves responsively. P8 and C8 humorously argued about if C8 was cheating during their card game, responding promptly to each other's statements and clearly directing their attention to the conversation and to the cards. P17 and

C17 chatted naturally about the rules of the board game they chose to play.

Conversations and Attention while Playing with Tablets
Conversation between parent and child was less common when children were playing with tablets, and these conversations had a different character than the conversations conducted during toy sessions. Children were more likely to trail off in the middle of a statement or to ignore a parent's comment. For example, when P16 asked C16 to move to a new location in the room, C16 did not respond or look up from the tablet screen. P16 ultimately lifted C16 and set her in the desired location. C16 did not break her gaze from the tablet screen, even as she was physically moved and repositioned.

In another instance, P4 asked C4 if the song playing within an app was his favorite, to which he replied, "*Actually, my favorite song is Michael Jackson.*" P4 then replied, "*Oh, which Michael Jackson song?*" But the child focused intently on moving a runner forward on screen and did not acknowledge or respond to P4's question. At various points when children were playing with tablets, different parents said to their children, "*It was so fun though, right?*" "*Can I do this part and this part? (pointing to the screen),*" "*What is that animal?*" "*Oh, so you can't go off?*" and "*Do you want to play something else?*" Children showed no verbal or nonverbal response to any of these utterances in addition to many other comments and questions, allowing their parents' bids for attention to go unnoticed.

We also observed that when children did engage in dialogue with their parents, visual effects and prompts from the app attracted the child's attention, and children often abandoned the social exchange in response and re-engaged with the app. For example, P2 and C2 once discussed the difficulty of one of his games. As C2 played, P2 pointed out, "*That's too easy,*" and he replied, "*I'm trying to get it. It's too hard. It's hard because ...*" and trailed off as the app presented a new item on screen, which he engaged with as the app intended. The app then told him "*Good job!*" and began describing the next activity, and C2 never returned to his exchange with P2. In another instance, P1 asked C1 a question about her onscreen character jumping within the game. C1 responded, "*If I jump, it will fly. If I don't jump... Ahh! Flying fish!*" shifting her attention from the conversation to tablet as a flying fish jumped out of the water on screen. The game progressed and C1 never returned her attention to this conversation.

In some instances, we saw evidence of "sportscasting" [18], in which children spoke to parents with play-by-play narration of their play experience without checking in to see if the parent was receptive to this narration. For example, C3 spoke about the game he was playing for several minutes, saying things like "*I can get you whenever I want!*" and "*The horse likes to be in that*" without visually referencing his father, who looked on as he spoke. In the middle of this narration, P3 asked, "*What do you mean?*" but C3 did not acknowledge the question or look up from the screen. A minute later, P3 replied to one of C3's comments, but C3 immediately

shouted "*No!*" at the app, and neither partner ever followed up on P3's initial comment. Similarly, as she played, C14 announced, "*Oh, so that's what that does. I was wondering what that does,*" without looking up from the screen before or after her comment for P14's readiness or response.

Not all tablet experiences were equally assertive in managing the child's attention. We saw two systematic types of experiences in which children appeared to maintain control of their own attention. First, we saw that children leveraged natural stopping points in apps and games to look away from the screen, respond to a parent, invite a parent to participate, or share something about their experience. For example, at a break between two levels of a game, C15 looked up at P15 and smiling, explained that she "*did [her] personal best.*" Similarly, during a pause in a game, P16 asked C16 a question about the game mechanics. C16 responded promptly, pointing at the screen and describing her understanding of the game in full.

Second, we saw that some tablet apps required sustained attention while others allowed the child to self-manage their attention and move in and out of the experience as they chose. For example, C12 and P12 sustained engaged play around a user-paced app for selecting, cooking, and serving different foods to restaurant customers. Though the child owned the play experience and was the one interacting with the screen, her father was able to participate because she responded to his comments and questions and followed many of his directives. For example, C12 asked her father, "*Can I give it all the fish? Can I even give it the tail?*" to which her father responded, "*Yeah,*" at which point she fed the tail to the customer. If the app had demanded she follow its pacing, she would not have been able to pause and incorporate P12's feedback into her action. Similarly, P12 asked her, "*What are the other ones [kitchen tools]? Microwave?*" In response, C12 shifted her game play and selected the microwave as her cooking tool, incorporating his input into her play. As she played the game, P12 often crouched on the floor next to her, touched the screen several times, and gave regular feedback about her actions, to which she responded.

Similarly, C14 spent part of her session playing a user-paced block-building game, in which all on-screen action occurred in response to the user. Although P14 did not participate in playing, she asked many questions about the game and listened as C14 explained the game, both in response to P14's questions and of her own volition. C14 invited P14 to observe, saying, "*Want to see what this guy does?*" to which P14 replied "*Sure*" and C14 said, "*Watch this.*" She then demonstrated the purpose of one of the builders within the app. Shortly afterward, she again invited her mother to participate in her on-screen construction, saying, "*Pick a color,*" and bringing up a color-picker and holding out the tablet to make it accessible to P14. P14 replied, "*Uh, how about that one?*" as she reached out and tapped a color, and C14 replied, "*You like that one? Ok,*" as she turned the tablet back toward

herself. If the app had demanded continuous, time-bound interactions instead of leaving the interaction for the user to control, C14 could not have taken the time to invite her mother into the experience or wait for her response, and she could not have selectively pulled up a color-picker or demonstrated the pieces that she felt might interest her mother.

Patterns of Parent Involvement
Across these sessions, we saw that parents engaged in four overarching types of behaviors that defined their role relative to the child's play experience. This taxonomy included:

Bystanders: When parents acted as bystanders, they were physically co-present with children but in no other way were they connected to the child's play. In these moments, they did not engage with their child and they did not actively observe their child's behavior, simply co-existing with their child in the same space. For example, at one point during their session, P9 fixed herself a snack and looked around the room, taking no notice of C9 playing tablet games.

Spectators: When parents acted as spectators, they sat near their child, observed their play, and as needed, repositioned themselves to get a view of the action. In these instances, they did not attempt to interact with children but showed evidence that they were working to maintain awareness of children's activities. For example, as C2 played a train game, P2 looked on, sometimes craning her neck to see the screen, but without offering commentary.

Coaches: When parents acted as coaches, they engaged with their child but not with the play experience directly. They guided children, provided support, asked questions, and praised and critiqued children's behaviors, among other actions. For example, as P12 watched C12 play the Fruit Ninja app, he gave instructions, corrected ineffective gestures, and modeled the correct gesture in the air.

Teammates: When parents acted as teammates, they played alongside their child, engaging in the activity as a participant. For example, P1 and C1 spent their entire toy session playing a matching game on a physical grid. They spent equal time taking turns, argued about who was winning, and each competitively engaged in doing well.

Parents shifted among these roles within any given session, and some parents gravitated more toward certain roles than others. We saw all four types of behaviors with analog toys and with digital games. However, we also saw that parents were systematically more likely to act as bystanders and spectators while children played with tablets and more likely to act as coaches and teammates when children played with toys. As parents' comments and questions often went unanswered while children played with tablets, coaching attempts may have devolved into spectating in these instances.

DISCUSSION
Each of the 15 parent-child pairs who participated in our study displayed a unique signature to their play style, and this baseline pattern of interaction pervaded both their tablet and

toy play. This suggests, unsurprisingly, that families' styles of engagement and interaction will play an important role in shaping parent-child play behaviors, irrespective of the type of play materials that are available. However, aspects of digital design likely interact with the characteristics of the dyad (i.e., child temperament, parenting style, or family stress), as has been demonstrated with television [23]. Our results suggest that designers can play a role in influencing, promoting, or foreclosing parent-child play.

Positioning, Form Factor, and Play

We saw that the spatial and orientation affordances of physical toys accommodated both members of the pair easily. Despite the fact that the play materials came in many shapes and sizes, participants repeatedly chose to arrange them in the same arms-length shape with access points for both partners.

The fact that participants consistently recreated this same orientation with diverse materials suggests that it is well-suited to the sedentary, pair play we solicited in this study. Unlike the analog toys participants used, tablets did not appear to provide this same affordance. Children consistently created a solitary space for their tablet play that was difficult for parents to enter. When children showed the screen to parents or invited them to participate, they typically moved their bodies, turned the screen fully around, or even handed over the tablet, suggesting that their default orientation for using the device was incompatible with sharing the experience.

Our results suggest that novel interfaces that reshape an app's play space to provide the affordances of traditional toys would be more conducive to promoting parent-child play. Projecting app experiences onto an arbitrary surface or providing app experiences on an arms-length interactive screen that is accessible from all sides would allow parents and children to position themselves relative to the experience in the way they do with a variety of other play materials.

Mutual Engagement and Roles for Parents

We observed that as parents and children played with analog toys, parents frequently created roles for themselves and found relevant tasks that coordinated with their child's play while remaining distinct. This is consistent with past work in joint media engagement (JME), which documents that JME is more successful when all participants have multiple roles and parents have the opportunity to engage with content that is complex enough to hold their interest [42]. As children built with Legos, parents searched and sorted through bricks, and as children built with puzzle pieces, parents assembled their own subsections.

We saw that parents struggled to carve out such roles for themselves when children were playing with tablets. This was in part a function of size and positioning of the device; as parents could not easily see or reach the screen, they did not have natural opportunities to participate in screen-based play experiences. The majority of the apps children engaged with also did not provide opportunities for others to participate, and there was no in-app affordance analogous to the pile of extra Lego bricks. As a result, parents were often relegated to bystander and spectator roles.

But across our participants, we saw brief glimmers in which parents found a home within a tablet play experience. One app gave the child the opportunity to take pictures of another person, prompting the child to draw her mother into the play activity. Apps that supported multiple touches allowed parent and child to each contribute simultaneously. In the one instance where P7 and C7 played a tablet game that was symmetric and accessible from all sides, the parent and child placed the device between them, and each had her own role as a full participant in play.

Attention Management and Social Interaction

It was not only the form factor of the tablet that precluded parent participation and joint play. Children struggled to respond to parents or maintain interaction when the app demanded continuous attention. They waited for natural stopping points to share their successes and failures with parents or describe aspects of the game that excited them. Although one might suppose that this was a function of children's deep interest in their play materials, we observed that when playing with analog toys, children focused intently on play experiences while also sustaining conversation with parents.

We saw that user-paced games—in which the child explored the game world at his or her own pace without the app demanding interaction—facilitated parent-child play in two ways. First, parent and child each had the ability to manipulate on-screen items, leaving open the possibility for the parent to have a role of their own. Second, because the app gave children the freedom to manage their own attention without interrupting them, children could respond to parents' bids for attention and include them or share experiences as they felt moved to do so. Children were free to drop in and out of game interactions at will, and if they chose to look up from the screen to respond to a bid or to invite a parent to participate, the game was waiting just as they had left it when they returned their attention to the screen.

Designing for Parent-Child Play

It is not necessary—or likely even desirable—that all of young children's media experiences be shared with parents. Prior work has shown that parents deliberately provide children with media experiences in order to keep them independently occupied, and parents value the ability to disengage from their child during this time [16]. As parents are faced with ideological narratives that romanticize parent-child interaction and disparage screen media [28], it is important that designers remain sensitive to families' values and to these potential sources of guilt.

However, there are many ways in which children's media experiences are enhanced by parent participation [34,38,41,42], making it worthwhile to support this as a possible user scenario. Our results show across the diverse set of apps that participants chose to engage with, the app design (in addition to the design of the tablet itself) made shared

play awkward. Parent-child dialog was more difficult to sustain relative to dialog during play sessions with analog toys, and the apps children used offered few possibilities for parents to have independent roles. Young children with self-regulation difficulties benefit particularly from parent-child play, yet are exhausting to parent and often develop more solo media use habits [32]; thus, improving design for JME might be especially beneficial for these families.

Despite the limitations of the apps participants used, our results are consistent with prior work in this space showing that parent-child play in digital spaces is both possible and rewarding. We saw parents and children collaborating to tackle in-game goals, taking turns in multi-player games, building on each other's ideas, and expressing attachment and affection as they did so. However, these moments were the exception rather than the rule.

Based on our observations, we recommend that designers who wish to create digital experiences that have the potential to be used for joint play consider the following avenues:

Design for shared positioning and ownership: This might mean a novel innovation to map the tablet surface onto an arbitrary material that occupies an arms-length shared space between two people. It might also be as simple as making a game equally accessible from all sides or using an aerial rather than a head-on view to present a game scene. It could mean distributing an experience across two devices; if a parent had insight into their child's screen activity through their own phone and the child were aware of this arrangement, it would be possible for parent and child to engage in joint attention, despite the fact that they would each be attending to their own solitary space. Or it might mean turning to alternative form factors, like the Nintendo Wii, Microsoft Kinect, or Amazon Echo.

Design for interruptible apps, not interruptible users: Children interrupted their play with analog toys to involve parents and maintain conversations. They also interrupted their tablet play to do the same when this was something the app would tolerate. However, when apps demanded engagement (such as timed games, runner games, or the "Flying Fish" that C1 encountered), children allowed the app to capture and direct their attention. Much like a ringing phone intruding on an in-person conversation, apps' interruptions and demands for engagement foreclosed parent-child play possibilities. Apps that never interrupted had more potential for parent-child play. In addition to creating experiences that are entirely user-driven and do not interrupt, designers might seek to create context-aware experiences that can sense when interruptions from the app are likely to be appropriate.

Design for parent roles: Previous work has shown that joint media engagement is most effective when parents have interesting content to attend to [42]. Our results are consistent with this recommendation, and also show that parents' access to meaningful roles in their child's tablet play was limited. Designers might address this by creating multi-touch

scenarios, in which multiple on-screen interactions can happen simultaneously, enabling the kind of parallel but interrelated play we saw with analog toys. We saw that parents spontaneously picked up Lego bricks and joined their children in building, but this casual integration into the play scenario was rarely possible in tablet apps. This might mean designing some components of a play experience to be more challenging than others, such as sections of a jigsaw puzzle with a few large pieces and other sections with a larger number of smaller pieces. We also saw that the simple app mechanic of supporting picture-taking instantly created two roles (one posing for photos, and one capturing them). But without explicit design scenarios that conceive of how parent and child will both simultaneously participate in an activity, app experiences appear to default to solitary ones.

Limitations

Our study included a small number of families, drawn from upper- and middle-class backgrounds and was not representative of the general population. As prior research has shown that attitudes toward parent-child play differ with culture (e.g., [11,31]), it would be useful to explore parent-child interactions when using these play materials in more families with diverse backgrounds.

Our lab setting was also quite different from families' natural environments; parents had no chores to attend to or opportunities to engage in their daily activities. Parents' likelihood of engaging in play behaviors will certainly be different in a context full of other opportunities, demands on their time, and potential distractions. Similarly, the toys that children engaged with were not always their own, and although we attempted to provide a mix of ordinary toys they were likely to have encountered (e.g., Legos, crayons), it is possible that these prompted atypical behaviors. Their behavior is also likely to differ when they are not under observation. However, lab-based play does approximate naturalistic behaviors [14], and because many of these limitations apply both to sessions with analog toys and with tablets, we are optimistic that the distinctions we observed between the two session-types remain meaningful.

CONCLUSION

We presented the first study examining detailed observations of parents' and children's shared reactions to a variety of traditional toys and tablet apps. While children engaged eagerly with both kinds of stimuli, we observed that opportunities remain to make their favorite apps and games more inclusive of play partners and more conducive to shared parent-child experiences. We discussed suggestions on how children's tablet apps might be re-designed to preserve the advantages of digital play experiences while also adopting the benefits of traditional toys.

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