

Plan & Play: Supporting Intentional Media Use in Early Childhood

Alexis Hiniker^{1,2}
alexisr@uw.edu

Bongshin Lee¹
bongshin@microsoft.com

Kiley Sobel^{1,2}
ksobel@uw.edu

Eun Kyoung Choe³
echoe@ist.psu.edu

¹Microsoft Research, Redmond, WA, USA

²Human Centered Design and Engineering, University of Washington, Seattle, WA, USA

³College of IST, The Pennsylvania State University, University Park, PA, USA

ABSTRACT

Parental controls allow parents to set limits on children's use of technology, but prior work suggests that controlling children alone is unlikely to foster the development of healthy media habits. We took elements from evidence-based preschool curricula that teach self-regulation and translated them to the digital space by creating a tool for preschoolers and parents to plan their device-based play-time. In an observational lab study with 11 parent-child dyads and follow-up interviews with 14 parents, we found that children demonstrated intentionality and made goal-directed choices as they planned, the mediating factor in developing self-regulation. We observed that parents prompted their child to be intentional and solicited children's input. When children played through their plan, they transitioned to the next activity without intervention 93% of the time. Our results suggest that evidence-based practices for teaching self-regulation in a non-digital context can be applied productively to children's use of technology. As parents supported children in trying the tool for the first time, a further contribution of this work is a hierarchical model of parents' approaches to scaffolding children's use of a novel technology.

Author Keywords

Child-computer interaction; parental mediation; self-determination theory; preschool; screen time; tablets; parental controls.

ACM Classification Keywords

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

INTRODUCTION

With technology more embedded in daily life than ever before, concerns about young children's use of digital media abound. Pediatric and child development researchers

caution that extensive leisure time with screen-based media and exposure to violent media content in early childhood can each have a negative impact on children's long-term outcomes [35,37]. On the other hand, prior work has demonstrated that watching *Daniel Tiger's Neighborhood* (a television show for preschoolers) can increase empathy [28], while engaging with other specific content predicts gains in literacy [29], creativity [39], and appreciation for racial diversity [5]. Taken together, prior work on the use of digital media in early childhood leaves parents with the challenging role of guiding young children toward healthy media habits by providing opportunities to engage with technology, while also vetting content, setting limits, and engaging in media use together with their child [1,7,36].

A variety of commercial offerings promise to support parents in managing their child's use of digital media. These parental controls offer to filter content, turn off specific functionality, enforce digital time limits, and impose other restrictions. While these tools effectively enforce limits in the moment, they do not attempt to address the larger task of mentoring children in becoming thoughtful, self-regulated consumers [40]. They also do not attempt to support parents in providing this mentorship [40].

The goal of this work was to build on what is already known about how children acquire self-regulation skills, and to examine how technology might play a role in facilitating this process. To do so, we drew on two existing bodies of work. First, we examined the developmental arc of self-regulation and the way in which evidence-based preschool curricula support the development of this skill. Second, we grounded our work in self-determination theory to understand what structures are likely to foster children's long-term intrinsic motivation to self-regulate their use of technology.

Using this foundation, we conducted a participatory design workshop with preschoolers to elicit design insights for a tool for this scenario [19]. We used this design guidance to develop "Plan & Play," a system-level interface for Android devices. Plan & Play supports children and parents in collaboratively planning out their use of apps with intention. We then conducted an observational lab study with 11 parent-child dyads and follow-up interview study with 14

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

IDC 2017, June 27–30, 2017, Stanford, CA, USA.

Copyright is held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-4921-5/17/06...\$15.00.

DOI: <http://dx.doi.org/10.1145/3078072.3079752>

parents to understand how preschoolers and their parents use and experience this system.

We found that all children made choices with intention as they created a plan for their play time and that parents used language to highlight children's autonomy and choice-making. We also found that within the context of the lab, children were highly responsive to transition cues from Plan & Play and only required parent intervention 7% of the time. Parents reported that they struggle with the tension between forcing children to make choices they approve of and trusting them with the freedom to make these choices autonomously. For many parents, the Plan & Play interface offers promise as a way of addressing this conflict.

BACKGROUND AND RELATED WORK

Planning and Early Childhood

By the time children are three years old, they are capable of making thoughtful, self-regulated decisions, a skill they refine between the ages of three and six [12]. High-quality, evidence-based preschool curricula provide explicit mechanisms for supporting this development, and one of the most effective mechanisms for doing so is providing opportunities for planning [12]. When children are regularly prompted to thoughtfully plan out their actions in advance, their behavior becomes more intentional and they become more capable of learning across domains [25]. By supporting preschoolers in making plans, parents and teachers help them identify and internalize norms and become more intentional, self-regulated learners [12,15].

Tools of the Mind (TotM) is an evidence-based curriculum for three-to-six-year-old children that provides opportunities for making, executing, and reflecting on plans [4]. A randomized controlled trial of TotM with more than 200 3- and 4-year-old children showed that preschoolers exposed to the curriculum demonstrated improved executive function (the capacity for being goal-oriented) and greater learning gains relative to those who were not [3]. A core component of TotM is making "Play Plans," child-created plans describing how the child intends to play.

The *High/Scope* preschool curriculum also emphasizes the importance of planning and includes a "Plan-Do-Review" sequence for children to engage in activities of their choosing in an intentional way [33]. A longitudinal, randomized controlled trial of the *High/Scope* curriculum demonstrated that children who experienced this curriculum as preschoolers were higher earners, more likely to have graduated from high school, and dramatically less likely to have an arrest record as adults than peers in traditional preschool classrooms [32]. Researchers attribute these differences in community and social behaviors to *High/Scope's* emphasis on planning and child initiative.

This prior work demonstrates that providing opportunities to plan is both effective for improving self-regulation and a developmentally appropriate tool for preschoolers. We build on this work in early childhood education by translat-

ing the planning steps developed by these curricula to a digital context and explicitly adopt components of these curricula in the design of our system.

Self-Determination Theory

Self-determination theory (SDT) is a well-developed model of the role of internal and external motivation in supporting learning, well-being, and participation [30]. Work in SDT has repeatedly shown that individuals who feel agency and self-direction with respect to a particular activity will be more likely to both: 1) self-regulate their behavior in a way that enables them to perform the activity successfully, and 2) internalize these regulatory processes such that they are intrinsically motivated to enact them [14]. As a result, environmental factors that foster a sense of self-determination improve individuals' intrinsic motivation and self-regulation. For example, adults who are given freedom of choice are more likely to persist in tedious tasks than adults who are told that they are required to complete these exercises [9].

Though the majority of studies on SDT have been conducted with adults, prior work shows that this model is also applicable to children [8,10,13]. Sheehan and colleagues report that children's sense of self-determination predicts their intrinsic motivation to exercise [34], and a series of studies have shown that parenting approaches that are more supportive and less controlling are more effective at facilitating long-term compliance [14]. A field study of first- and second-grade children showed that rules for a painting activity accompanied by controlling language undermined children's creativity and motivation relative to the same rules accompanied by neutral language [22]. Other work has shown that preschoolers with disabilities benefit from support structures that foster self-determination [27].

We build on this work by framing children's ability to self-regulate their use of entertainment media in the context of SDT. It is well-understood that children need autonomy to regulate their behaviors and develop the intrinsic motivation to comply with social norms. It is also well-documented that self-regulating stimulating media experiences is a challenge, even for adults [2,20,21]. Combining this prior knowledge with the fact that existing parental controls emphasize controlling children rather than mentoring them, we set out to investigate how technology might go beyond the lock-out mechanisms that are available today and explicitly foster the autonomy and self-determination children need to self-regulate their screen media use.

Designing for Parental Mediation

Many commercially available technologies include features that allow parents to set limits on their children's media use. A recent review of this design space categorizes existing filters and restrictions, all of which strive to prevent risky situations (such as using digital media for an extended period of time, making in-app purchases, or encountering adult content) [40]. Existing tools do not yet strive to support children in developing resilience to such situations

when they do occur [40], despite the fact that internalized resilience has more protective effects than external restrictions [38].

However, the child-computer interaction research community is beginning to explore more nuanced solutions. Hashish and colleagues developed a system called “Kid-in-the-Loop” that provides children and parents with tools to collaboratively set content filters on a device [17], and Hartikainen and colleagues call for tools that work to build trust between parents and children [16]. A value-sensitive design exploration to understand parents’ values with respect to parental controls found that parents value being involved and exercising control with respect to their children’s use of technology, but they also value children’s independence and the development of an internal moral compass that children can use to guide their own decisions [26]. We contribute to this space by exploring the design of parental controls that emphasize children’s autonomy, intrinsic motivation, and acquisition of self-regulation. We also examine parents’ role in mentoring and supporting their children in forming habits and not just their role as authority figures setting limits.

SYSTEM DESIGN

Using elements from Tools of the Mind, the High/Scope curriculum, and design insights from a workshop we conducted with 7 children age 4–6 [19], we created a set of initial sketches for a system-level app to support planning screen time activities on a phone or tablet. We then iteratively developed and revised storyboards which we used to implement an Android app called *Plan & Play*.

Planning

Plan & Play first takes the user through a series of screens for planning out a session of device-based activity. A cartoon panda narrates the experience and asks the child to first set a total time limit in minutes. On the next screen, the user can select apps to put in the plan by tapping to include or exclude them (Figure 1a). On the next screen, the user sees a numbered list of apps, with the first app in the plan at the top (Figure 1b). Dragging and dropping on this screen allows the user to swap the order of the apps.

On the next screen, the user is presented with a slider with multiple thumbs (Figure 1c). The slider represents the total duration of the plan, and each segment within it represents the duration of a single app. Dragging any thumb in the slider gradually reapporitions time. On the last screen, the plan is presented along with a picture of the parent and a picture of the child (Figure 1d). Each picture has a button next to it, and tapping the button turns it into a checkmark. When both buttons have been tapped and display checkmarks, a “play” button appears at the bottom of the screen. Pressing this button begins the plan.

Playing

When the user presses the play button, the first app in the plan launches automatically, and a widget is overlaid above

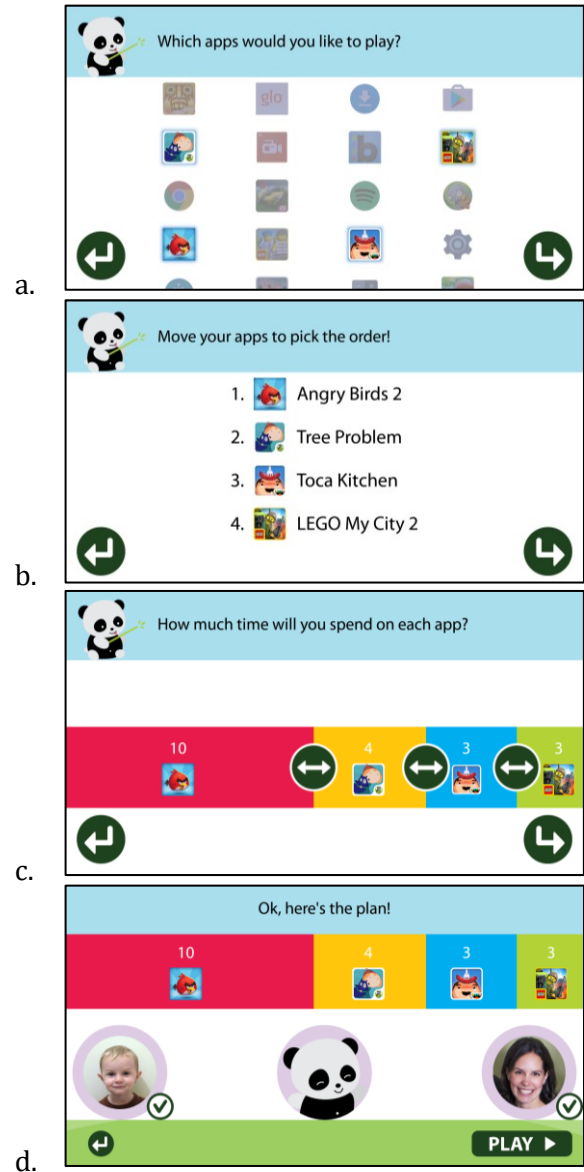


Figure 1. Screens for planning. a) Selecting apps by tapping to select/unselect, b) ordering apps by dragging and dropping, c) changing app duration by sliding thumbs of a slider, d) parent and child agree to the plan by tapping their own buttons; after both agree, play button appears.



Figure 2. Three possible states of the Plan & Play widget that is displayed in the top right corner above all screen content whenever a plan is active. Widget states: the active app is the planned app (left), counting down before a transition (center), the active app is not the planned app (right).

the app content in the top-right corner. This persistent widget displays one of three images: a cheering panda when the currently planned app in the foreground, a sad panda

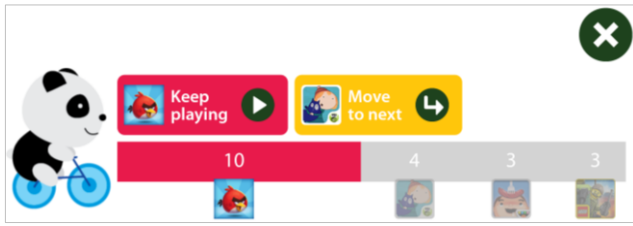


Figure 3. Plan & Play dialog box. Dialog options reflect the state of the plan and in other cases might say, “Return to Plan” or “End Plan.” The dialog box opens when the user taps the Plan & Play widget (Figure 2) that floats above all screen content. The dialog box is also displayed spontaneously when it is time to transition. It can always be dismissed.

when a different app in the foreground, or a countdown with the appropriate number of seconds whenever the user is within 30 seconds of a transition (Figure 2).

During the users’ play time, a dialog box (Figure 3) is displayed whenever: 1) the user taps the widget or 2) the plan dictates that it is time to transition. The content of the dialog box changes slightly depending on the context. For example, it displays options like “Keep Playing” when the user is currently engaged in the planned activity and “Return to Plan” when the child has deviated from the planned activity.

The dialog box also has a close button and can always be dismissed. If the dialog box notifies the user of a transition and the user chooses to dismiss it without transitioning, the widget changes to display the “sad” panda (Figure 2, right). Thus, Plan & Play always provides visible information about whether the user is currently following the plan but never forces the user to comply. A central feature of Plan & Play is that it surfaces norms (i.e., that following the plan is a valued choice) but provides both the freedom to deviate from these norms, and information about this departure.

METHODS

We combined lab observations with interviews to conduct an initial evaluation of Plan & Play. The goals of this study were to determine how parents and children collaborate to use the system and how parents feel about this approach to mediating their child’s use of digital media. Study procedures and materials were reviewed by the Microsoft Research privacy manager assigned to this space.

Participants

Fourteen parent-child dyads participated in our study (11 in the observation portion, as the other three brought incompatible devices to the study session). Our child participants included 4 boys and 10 girls, and our parents included 5 fathers and 9 mothers. Six children were 6-years-old, three children were 5, and five children were 4. Nine children were of Asian or Southeast Asian descent, four children were non-Hispanic White, and one child was Afro-Caribbean. Families were recruited through institutional mailing lists, and mailing lists for local parents’ groups and local preschools. Inclusion criteria for participating in the

study were that parent and child speak English comfortably throughout the study session and that the child use an Android device to play apps for entertainment at least once a week on average.

Participants were instructed to bring the Android device that their child uses to the study session. Three families enrolled in the study but brought a device to the study session that did not support Plan & Play. In these cases, the family was not included in the observational portion of our study and only participated in the parent interview.

Materials and Procedures

Planning and Playing

All procedures were conducted in a user research laboratory and audio and video recorded. A researcher installed Plan & Play on the family’s device and then handed the device to the child. The researcher told the child that she had put a new app on the device and showed the child where to find it. The researcher explained that this app would let the child plan out what to play on the tablet and asked the child to make a plan for 15 minutes of play time. The researcher further said that the child should make the plan, and that mom or dad could help. The researcher then left the room.

The research team then gave the parent and child time to collaboratively create a plan for 15 minutes of play time and for the child to play through the plan. After observing this experience in its entirety, two researchers returned to lab. One researcher stayed in the room with the child to perform a follow-up exercise, and the other escorted the parent to an adjoining room to conduct the parent interview.

Child Follow-up Task

In the follow-up exercise, the researcher asked the child if he or she could show the researcher how to use the Plan & Play app. The child then led a walk-through of Plan & Play by setting up a 3-minute plan while the researcher watched and asked questions about each screen. The child then played through the planned activities.

Parent Interview

While the child completed the follow-up tasks, the parent was interviewed in a separate room by another researcher. The semi-structured protocol included 12 questions and explored the child’s typical screen media use, the limits the family sets on these activities, whether the family uses any parental controls, what the parent hopes for the child’s future technology use, and feedback about the Plan & Play app.

In addition to these tasks, all participants also completed a separate set of activities as part of a second study outside the scope of this investigation. This data is not analyzed here. As a thank-you for their participation in both studies, each family received one gift card to Amazon for US\$150.

Data Analysis

The research team transcribed all parent-child Plan & Play sessions into field notes documenting participants’ physical

actions, interactions with the screen, and dialogue. This process was repeated for the follow-up session between child and researcher. All parent interviews were transcribed by a professional transcription service and spot-checked by the research team for accuracy.

We performed a holistic open coding of each set of transcripts and used this to develop a code book. After collaboratively narrowing our focus to a subset of the most relevant themes, we conducted a directed coding to identify instances of each theme in each subset of the data. The final code book included codes about children’s intentionality, parents’ attempts to scaffold children’s interactions, statements that children and parents made about the app’s authority, parents’ statements about the child’s authority, children’s responses to transition events, children’s understanding of the interface, and parents’ perspectives on parental controls, child autonomy, child compliance, and children’s technology use. One researcher conducted a directed coding of the entire dataset. A second researcher coded a randomly selected subset of the data for comparison. Nearly all codes matched, and disagreements were discussed until consensus was reached.

RESULTS

Children’s Intentionality

As children used the app with their parent to construct a plan, they consistently showed evidence of using it with purpose to achieve specific objectives. All children showed this intentionality during the process of selecting the apps they wanted to play. In some cases, children narrated their choices as they made them, saying things like, “*I love these apps! I wanna play this one*” (C7), or “*I want to play...(pause)...this (pointing to app)*” (C10). Many children scrolled slowly through the full list of apps with their index finger hovering over the screen, appearing to search carefully for specific app icons. In one instance, the app crashed after the child had finished selecting her apps to play (C17) and then restarted. The child re-selected the same apps, suggesting she was making choices with intention and not at random.

All children engaged in activities like scrolling past apps without selecting them and saying things like, “*That’s not one I want to play*” (C2), and announcing when they had finished making their selections. Many children showed this same intentionality as they ordered apps and specified their duration. These children said things like, “*I wanna do equal time [on each]*” (C11) while specifying each app’s duration, and “*So I already played that one... maybe we can do that last, because I played it*” (C9) while ordering the list of apps.

As children described their intentions, they sometimes directed their statements to the adult they were with, saying things like, “*[I want] this one*” (C16). In other instances, children’s descriptions of their intentions took the form of private speech [23] and were not directed at any audience,

such as, “*I’ll spend two on that (pause) I want (pause) no. There we go. I think I’ll do (pause) I think I’ll do (pause) equal*” (C14). Thus, in a variety of forms, children’s statements demonstrated that they were making choices and doing so with intention. All 11 children made statements of this type when constructing their plans.

Parents’ Support for Children’s Intentionality

During the planning phase, parents’ language not only respected children’s autonomy but also actively encouraged it. Parents said things like, “*Let’s pick the [apps] you really, really want,*” (P1), “*So what would you like to play?*” (P2), “*How much time do you want to play Lego?*” (P10), “*Is that a good order now?*” (P14), and “*Are you happy with this?*” (P3). All 11 parents made statements throughout the planning process prompting their children to identify their own intrinsic interests and take ownership of constructing a plan built with intention.

In addition to encouraging children’s agency, parents also played a central role in helping children learn to use the app interface. Though all children were able to construct and execute a plan the first time they used the app, they did not do so in a vacuum, and parents’ behaviors were central to children’s interactions. A few children mastered all components of the UI spontaneously and without support, but many others looked to their parent for help at least once.

Across all 11 children’s encounters with our planning interface, parents collectively provided 96 different facilitation attempts to teach children to use these controls correctly. We coded the ways that parents scaffolded children’s understanding and found that their approaches clustered into eight different techniques, such as modeling the correct interaction, asking a question about the purpose of a control, or describing the intended interaction (Table 1).

Further, we observed that parents frequently provided multiple types of scaffolding and that the order in which they engaged in each type of scaffolding was not arbitrary. If a

Intervention	<i>Mom reaches out and adjusts the time limit immediately to 15 without saying anything to the child.</i>
Modeling	<i>Dad reaches over and demonstrates reordering, saying, “Set the order like this, wheep!”</i>
Purpose Description	<i>“So you’re telling each one how long you’re going to play.”</i>
Purpose Question	<i>“Which one do you want to play first?”</i>
Purpose Instruction	<i>“Pick which apps you would like to play.”</i>
UI Description	<i>“So if you move that it will add more time and take away time from that.”</i>
UI Question	<i>“Do you think you hit the next [arrow]?”</i>
UI Instruction	<i>“Just drag it left to right.”</i>

Table 1: Categories of parent facilitation with examples.

child did not engage in a productive interaction pattern after one attempt at facilitation, the parent would try another approach. We saw that parents tended to move from more open-ended instructions to more explicit ones, ostensibly providing more hands-on support if the child continued to struggle. For example, in the following exchange, the parent supports the child in using the duration control (Figure 1c) correctly but only after increasingly explicit attempts at facilitation:

P9: "So do you want it to be 5 minutes on each one? Or do you want more time on one?"
Child leans in, has her pointing finger out, but hesitates and doesn't seem to have a clear mission.
C9: "I... want... one." (Doesn't touch the screen)
P9: "Ok. Which one do you want more time on?"
C9: "This one." (Points to the first app)
P9: "The building one? Ok, so if you move that" (pointing to thumb) "it will add more time" (pointing to first app) "and take away time from that" (pointing to second app)
Child taps the thumb.
P9: "Oh. Drag it."
Child taps in several spots around the thumb and it jumps.
P9: "Oh, drag it that way" (motions back and forth with her index finger demonstrating the drag).
Child drags it smoothly and allocates more time to the app she had specified that she wanted to play longer.
P9: "There ya go."

To better understand the systematic pattern to parents' scaffolding attempts, we coded each instance of support that parents provided to children according to the eight themes we identified. We modeled parents' 96 collective facilitation attempts as a directed graph, with each type of scaffolding (purpose question, model, etc.) as its own node, and each sequential pair of facilitation attempts as a directed edge from the first type of facilitation to the type that followed.

We then ordered the vertices of the graph using the minimum linear arrangement algorithm [6], which assigns an ordering that minimizes the distances among nodes. Because minimum linear arrangement does not account for directionality, we applied the sum back-edge modification [24], which minimizes the amount of error introduced by backward edges. This approach showed that parents systematically applied facilitation strategies that followed the progression in Figure 4, consistent with the impression that parents' facilitation became increasingly more explicit if hands-off attempts failed.

Children's and Parents' Responses to Transitions

After planning out their play time, all children initiated and engaged in their planned play session. Using data from these sessions, we next examined children's interactions with and responses to the cues Plan & Play provided to support the user in sticking to his or her plan. Collectively,

1. Purpose Description
2. Purpose Question
3. {UI Description, UI Question}
4. Model
5. Purpose Instruction
6. UI Instruction
7. Intervention

Figure 4. Hierarchical order to parents' attempts at facilitating their child's understanding of the interface.

children encountered 41 transition points. In these cases, Plan & Play indicated that it was time to either move on to the next app or stop playing. In 31 instances, the child immediately responded to Plan & Play's cue and transitioned to the next activity without parent input. For example, a child transitioned from one app to the next on schedule as follows:

Countdown finishes for the second app and the Plan & Play dialog box appears.
P14: "Did you finish?"
C14: "Yeah, I did."
P14: "Nice."
C14: "Next is Toca!"
Child taps the "Start Next App" button in the dialog box.

In an additional five instances, the child did not make the transition immediately and instead spent a brief period of time continuing the current activity, then transitioned without parent intervention. In two instances, the parent did not give the child the opportunity to make this choice; when Plan & Play presented the cue, the parent intervened immediately and moved the child to the next activity before the child had a chance to respond. Finally, in three instances, the child ignored the cue and the parent eventually intervened.

As children played through their plans, both children and parents made comments describing the Plan & Play app as authoritative. Parents said things like, "So you get 8 minutes with this app" (P2), "It looks like your 6 minutes are up," (P9), and "Ok, so now it says 'Start Next App,' so press 'Start Next App'" (P11), implying that the on-screen prompts should be followed. Children similarly said things like, "It looks like we're all done" (C7) and "I have 28 seconds" (C14). Some children also made statements tying these directions to their original planning like, (laughing) "This one's gonna be only one minute, I did one minute for this one!" (C1), though this was less common.

Usability and Follow-up

Children created a second plan during their follow-up session in which they taught a researcher to use Plan & Play. In their second encounter with these UI elements, children spontaneously performed the correct interaction with no support 88% of the time (53 out of 60 instances). Furthermore, children described their own actions and the controls

they were using, saying things like “[this is] how many minutes I play all the games together” (C14) to describe the interface for setting the initial time limit, and “This one you can also, like, move... which one you wanna play first” (C9) to describe the screen for reordering apps (Figure 2b). Though several children required parent support to use aspects of the interface the first time they tried it, 10 out of 11 children could either explain the purpose of all six controls or use them purposefully during this second encounter.

Parent Perspectives

In addition to our observational data about children’s use of our app, we also analyzed parents’ responses to Plan & Play and their broader perspectives on their children’s media use. As one measure of parents’ interest in our approach, we offered to delete the Plan & Play app off the device at the end of each session. All 11 parents who brought a compatible device declined, saying things like, “Do you need to delete it?” (P9) and, “Actually, can you leave it?” (P1). Two parents spontaneously told their child at the end of the session that they thought they should start using the app at home, saying things like, “So did you like making a plan to play? Do you think we should do that when you watch a screen?” (P2). We did not ask parents at any point if they would be interested in trying Plan & Play again or using it at home, but at the end of the study session, several parents spontaneously mentioned that they felt inspired to make planning a part of their screen-time routine, saying things like, “After seeing this, I am definitely motivated to set that kind of a plan for him.” (P10). And all 11 parents elected to take Plan & Play home.

We explored parents’ perspectives by asking them about topics relevant to Plan & Play. Here, we describe themes that emerged from the parent interview portion of our study.

Inevitability of Technology Use

Across participants, interviewees continually brought up the inevitability of their child’s use of digital media now and in the future. Some parents framed this negatively, saying things like, “I know she’s gonna get way too much just because it’s gonna be part of her world” (P7) while others described this neutrally, saying things like, “I know that as they grow older, since the schools use tablets and things like that, they’re going to take notes on that” (P8). Though their value judgments of the phenomenon varied, parents consistently told us that they expect digital media of all kinds to be deeply embedded in their child’s daily life as they grow.

As a result, a recurring concern for parents is the need for their child to eventually become capable of limiting their use of technology to appropriate contexts and quantities. When describing their hopes for their child’s future use of technology, parents told us things like, “I hope that she’ll be able to limit herself pretty well on how much time she’s spending on screen time or tablet time” (P9) and that, “He should know, ‘Okay, this is not the time to do it’” (P10). Across participants, we heard that parents believe technolo-

gy is going to play an increasingly prominent role in their child’s life, and that this prominence is going to require children to develop the discipline and awareness to use it thoughtfully.

Child Compliance vs. Child Autonomy

All 14 parents told us that they set bounds on their child’s media use and feel this is important. We pointed out that Plan & Play solicits child input in setting these limits, and we asked parents, “How would that kind of approach fit with your family’s values?” Though 13 parents explicitly said that it would be a natural fit, as they believe children should be part of the conversation, parents surfaced two different perspectives on how these limits should be enforced.

Some parents felt strongly that children need to be regulated by parents, saying things like, “You can [try to] rely on kids being good...but they are not. In all honesty, kids will try to push the boundaries wherever they can” (P2). A non-trivial minority of parents expressed this view, and explained that, while children’s voices should be part of the limit-setting process, children cannot be trusted to adhere to limits. However, the more dominant view among our participants was that children need a balance of both oversight and independence. These parents said things like, “You have to trust a little bit that your kids are gonna make smart choices” (P7). Of 14 interviewees, 9 said that in addition to soliciting children’s input when setting limits, they also want their child to take some agency and responsibility in regulating their behavior.

Despite their proactive interest in giving children control, this second group of parents explained that compliance and self-determination, both of which they value, are in natural conflict. As one parent said:

“It’s very hard to give her a sense of control in things, because, as a parent, you kind of just want them to do it the right way rather than do it their way in a lotta things. And so when I think about it, I do want her to make her own choices...those are good skills to develop because then it’s going to help her become self-disciplined rather than parent-disciplined.” (P9)

Similarly, another participant described the challenge of valuing both compliance and self-regulation by saying that:

“We definitely try to give them choices and let them decide. Sometimes it becomes really difficult because sometimes as parents we think that, ‘Okay, we are telling you something. Just do it!’” (P8)

Despite this tension, these parents felt that it is essential to give children some control over the limits they live by and the opportunity to self-regulate. As another parent explained:

“I feel like that’s...necessary in this generation. The sooner...he figures out where his limits are and where the boundary is where like, ‘Oh, I spent too much time

and now I feel weird,' or like, 'I really wish I wouldn't' – it's good for him to figure that our earlier.' (P4)

While these parents feel it is important for children to have bounds on the time they spent with entertainment media, they also feel that internalizing the ability to set and adhere to those limits is an important skill in the media-rich world that their children will inherit.

Parents surfaced this same theme in response to our open-ended prompt asking for positive and negative feedback about Plan & Play. Parents repeatedly told us that the most useful aspect of the app from their perspective was its ability to give children agency and ownership within defined parameters. As P11 explained:

"I like the idea of us defining the time limit, total, but I like the idea of her deciding, within that time limit, what it is she can do, cause I think that's good for just building up those planning skills and kind of giving her a sense of control."

Others spoke about Plan & Play, telling us that giving their child some input into explicitly setting up limits *"might give her a sense of responsibility"* (P7), or would lead to *"a conversation about it [the limits]. I think he would prefer that"* (P3). Similarly, another parent echoed that the approach would provide a valuable blend of boundaries and freedom, saying, *"I really like the idea... because we can say 'Totally you get this much time. It's now your decision'"* (P10). The majority of our parent participants felt that an experience that both encouraged limits and supported autonomy would align with parents' values and appeal to children as well.

Perspectives on Parental Controls

To further explore families' likelihood of adopting such a tool in daily life, we also asked parents about their interest in and experience with parental controls. Even though our parent participants want their children to use digital media within certain limits, very few currently use technology support to enforce these boundaries. For some parents, parental controls are both unnecessary and insufficient, as they believe children in this age range require supervision. They told us things like, *"Honestly, I don't want him to be using technology at this age without me being around"* (P2), and *"We try to just keep a close eye on what they're doing"* (P17).

For other parents, the idea of using parental controls had appeal, but their past experience with these tools has been too laborious or buggy. These parents described the controls they had tried as *"a hassle"* (P12) and said that they *"don't have time really"* (P1), *"don't know exactly how it's set up"* (P9), and *"don't really use those anymore as much as I did when we first got them"* (P4). They described their lack of useful tools as a problem that they expect to get worse as children grow, saying things like, *"I have no idea how I'm going to be able to control that as he kind of grows*

up, and to make sure that he's kind of safe by playing these games" (P3).

While these parents are interested in reinforcement from technology, they reported a generally negative experience with the options that they have tried and a sense that they are not fully aware of the options that are available. Despite their dissatisfying past experiences, seven parents had tried using parental controls and 13 reported that they would like to do so in the future, suggesting that among our participants there is widespread interest in this space.

DISCUSSION

Children's Behaviors When Planning and Playing

Prior work shows that between the ages of 3 and 6, children have the capacity to engage in planning activities, and exercises that explicitly prompt planning are accessible and pedagogically valuable in the development of self-regulation [4,12]. Consistent with these recommendations for non-digital settings, we saw that all 11 children were capable of understanding and using the Plan & Play interface to make intentional choices about their playtime. Children made two different plans over the course of the study; for several participants, their first attempt required notable parent support, but by their second encounter with the interface, children were able to set a time limit, select apps, order them, and set a duration for each. However, the parents in our study provided attentive, hands-on support, and we do not know if children would have been able to navigate the interface or understand its purpose without this aid.

As they planned, all 11 children stated goals out loud and showed instances of initiative, the mediating factor in achieving gains in self-regulation through planning [31]. This evidence of children making self-directed, goal-oriented choices about the structure and content of their play experience is of particular interest, because it demonstrates the possibility for the interface to nudge children toward the autonomous behaviors that foster intrinsic motivation. While we saw that all children displayed purposeful decision making when selecting apps, a few of our participants did not show the same intentionality as they chose app durations, suggesting that their emerging understanding of order and magnitude could be a barrier to developing intentions about these components of their plan.

Finally, we saw that children understood the transition cues that Plan & Play presented as they played and used these as a guide to adhere with minimal intervention to their self-defined choices. Both parents and children treated the app as a kind of third-party mediator. A few children referenced their own decision-making when they deferred to the authority of the plan.

Parent Perspectives on Child Autonomy

When we asked parents if they want their child to participate in limit-setting, nearly all of our participants told us that they do. The majority of parents further said that they value giving children some autonomy in living up to these

limits, and that they feel it is essential for children to practice self-regulating. However, they also reported that giving children the freedom to exercise autonomy and self-regulation is not always straightforward. Even parents who value such opportunities, explain that there is an inherent tension between giving children control and keeping children within bounds. The majority of our parents reported that they value both, and that they struggle with the contradiction between them.

A minority of parents said that, though they want to solicit children's input when setting limits, they do not trust children to adhere to them without parent intervention. These parents reported wanting to maintain control over enforcing limits and did not place the same value on children's autonomy or opportunities for self-regulation. One contribution of this work is to identify these two distinct schools of thought among parents of young children.

Though we designed Plan & Play with the intention that children would have opportunities to proactively choose for themselves whether or not to comply with limits, it is clear from our small set of participants alone that the desire to foster children's self-determination is not universal among parents. We see the potential for Plan & Play to fit the lifestyles of families with diverse perspectives on this topic, and all parents proactively chose to bring the app home. However, future work remains to understand how families with these differing values and mediation styles use our tool in practice.

Parent Support

Independent of our exploration of self-regulation, we saw that parents played a central role in children's mastery of the UI. When children planned for the second time with a member of the research team, they were almost always able to work with all aspects of UI independently, but this was not true when they initially encountered the app with a parent. Many of our child participants' initial interactions were bolstered by support from their parents, and parents' facilitation attempts clustered into a taxonomy of eight techniques which they used hierarchically. Without prompting, parents spontaneously attempted to support their children with indirect techniques first and increasingly became more hands-on.

This progression is consistent with prior work in other domains demonstrating that providing instructions and support in a least-to-most intrusive fashion is an effective way of increasing children's learning [11,18]. Our parent participants' spontaneous use of this hierarchy suggests that adults may have an inherent or learned awareness of how they can best support their children in mastering novel interfaces.

However, other work has shown that scaffolding children's use of digital media can be challenging [36], thus it may be valuable to develop a formal theory to define effective practices for scaffolding child users. The systematic pattern to participants' successful facilitation suggests that this hierar-

chy is worth exploring as a general-purpose model for supporting novices learning to use new interfaces. Future work remains to determine whether the categories we identified and the progression our participants followed are useful in other contexts.

Limitations and Future Work

We do not yet know what children's experiences with Plan & Play will be like in the wild or with repeated use for a longer period of time. While it is likely that children will continue to be capable of using the interface, we do not know whether they will continue to respond to the app's cues or follow their own plans. It is possible that children will habituate to these cues and ignore them, or even that repeated instances of planning without follow-through lead to diminished self-regulation. Through a future field deployment, we intend to evaluate children's media use, autonomy, and self-regulation after extended use of Plan & Play. We hope that these efforts will help us characterize the habits children develop in response to our system, and the role that the family plays in this habit formation.

We conducted our study with a small number of families from a single geographic area, and we recruited from high-tech populations. We saw that the ways in which parents engaged in the interaction together with their children played a central role in the child's experience, and we do not know how different parenting styles, levels of parent involvement, parent familiarity with technology, or parent attitudes toward technology will change children's experience with Plan & Play. While our lab setting gave us the opportunity to perform a close and detailed study of users' interactions with our system, the contribution of these findings is knowledge of these users' values, mental models, and interactions, not a generalizable understanding of the effects of Plan & Play.

CONCLUSIONS

Today's preschoolers will come of age in a world where they have the opportunity to engage with digital media at almost any moment. Technology has the potential to support them in the challenging task of becoming self-regulated individuals who take advantage of all that technology has to offer, but who also proactively disengage from technology as they feel is conducive to their well-being. Current mediation tools are effective in setting and enforcing limits, but this restriction-only approach is unlikely to catalyze development of the regulatory skills children need to become responsible and independent digital citizens.

Here, we present a system called Plan & Play for guiding preschoolers in using digital media purposefully. We show that, in the short-term, this system prompts intentionality and guides children in following through on these intentions. Parents play an integral role in determining the way children use and respond to digital media, and we show that, for most our parents, our system directly addresses the tension they wrestle with as they strive to both set bounda-

ries for their children and give children the opportunity to learn to set boundaries for themselves.

REFERENCES

1. American Academy of Pediatrics. 2014. Where We Stand: TV Viewing Time. *Healthy Children*. Retrieved from <http://www.healthychildren.org/English/family-life/Media/Pages/Where-We-Stand-TV-Viewing-Time.aspx>
2. Morgan Ames. 2013. Managing mobile multitasking: the culture of iPhones on Stanford campus. *CHI '13*, ACM Press, 1487–1498. <http://doi.org/10.1145/2441776.2441945>
3. W. Steven Barnett, Kwanghee Jung, Donald J. Yarosz, Jessica Thomas, Amy Hornbeck, Robert Stechuk, Susan Burns. 2008. Educational effects of the Tools of the Mind curriculum: A randomized trial. *Early Childhood Research Quarterly* 23, 3, 299–313. <http://doi.org/10.1016/j.ecresq.2008.03.001>
4. Elena Bodrova and Deborah J. Leong. 2007. *Tools of the Mind: The Vygotskian Approach to Early Childhood Education*. Pearson Education, Upper Saddle River, NJ.
5. Sherryl Browne Graves. 1999. Television and prejudice reduction: When does television as a vicarious experience make a difference? *Journal of Social Issues* 55, 4, 707–727. <http://doi.org/10.1111/0022-4537.00143>
6. Moses Charikar, Mohammad Taghi Hajiaghayi, Howard Karloff, and Satish Rao. 2006. 122 spreading metrics for vertex ordering problems. *Proc. SODA '06*. Society for Industrial and Applied Mathematics, 1018–1027.
7. Common Sense Media. 2014. Screen Time. Retrieved August 1, 2015 from <https://www.commonsensemedia.org/screen-time>
8. Edward L. Deci, Robert E. Driver, Lucinda Hotchkiss, Robert J. Robbins, and Ilona McDougal Wilson. 1993. The relation of mothers' controlling vocalizations to children's intrinsic motivation. *Journal of Experimental Child Psychology* 55, 2, 151–162. <http://doi.org/10.1006/jecp.1993.1008>
9. Edward L. Deci, Haleh Eghrari, Brian C. Patrick, and Dean R. Leone. 1994. Facilitating internalization: the self-determination theory perspective. *Journal of Personality* 62, 1, 119–142. <http://doi.org/10.1111/j.1467-6494.1994.tb00797.x>
10. Edward L. Deci, John Nezlek, and Louise Sheinman. 1981. Characteristics of the rewarder and intrinsic motivation of the rewardee. *Journal of Personality and Social Psychology* 40, 1, 1–10. <http://doi.org/10.1037/0022-3514.40.1.1>
11. Patricia M. Doyle, Mark Wolery, Melinda Jones Ault, and David L. Gast. 1988. System of least prompts: a literature review of procedural parameters. *Research and Practice for Persons with Severe Disabilities* 13, 1, 28–40. <http://doi.org/10.1177/154079698801300104>
12. Ann S. Epstein. 2003. How planning and reflection develop young children's thinking skills. *Young Children* 58, 5, 28–36.
13. Ann Frodi, Lisa Bridges, and Wendy Grolnick. 1985. Correlates of mastery-related behavior: a short-term longitudinal study of infants in their second year. *Child Development* 56, 5, 1291. <http://doi.org/10.2307/1130244>
14. Wendy S. Grolnick, Edward L. Deci, and Richard M. Ryan. 1997. *Internalization within the family: The self-determination theory perspective*. John Wiley & Sons Inc.
15. Wendy S. Grolnick and Richard M. Ryan. 1989. Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology* 81, 2, 143–154. <http://doi.org/10.1037/0022-0663.81.2.143>
16. Heidi Hartikainen, Netta Iivari, and Marianne Kinnula. 2016. Should we design for control, trust or involvement? *Proc. IDC '16*, ACM Press, 367–378. <http://doi.org/10.1145/2930674.2930680>
17. Yasmeen Hashish, Andrea Bunt, and James E Young. 2014. Involving children in content control: a collaborative and education-oriented content filtering approach. *Proc. CHI '14*, ACM Press, 1797–1806. <http://doi.org/10.1145/2556288.2557128>
18. Lindsay Hilsen. 2013. *A step-by-step ABA curriculum for young learners with autism spectrum disorders (age 3-10)*. Jessica Kingsley Publishers.
19. Alexis Hiniker, Kiley Sobel, and Bongshin Lee. 2017. Co-designing with preschoolers using fictional inquiry and comicboarding. *Proc. CHI '17*, ACM Press, to appear. <http://dx.doi.org/10.1145/3025453.3025588>
20. Alexis Hiniker, Kiley Sobel, Hyewon Suh, Yi-Chen Sung, Charlotte P. Lee, and Julie A. Kientz. 2015. Texting while parenting: How adults use mobile phones while caring for children at the playground. *Proc. CHI '15*, ACM Press, 727–736. <http://doi.org/10.1145/2702123.2702199>
21. Minsam Ko, Subin Yang, Joonwon Lee, Christian Heizmann, Jinyoung Jeong, Uichin Lee, Daehee Shin, Koji Yatani, Junehwa Song, and Kyong-Mee Chung. 2015. NUGU: A group-based intervention app for improving self-regulation of limiting smartphone use. *Proc. CSCW '15*, ACM Press, 1235–1245. <http://doi.org/10.1145/2675133.2675244>
22. Richard Koestner, Richard M. Ryan, Frank Bernieri, and Kathleen Holt. 1984. Setting limits on children's

- behavior: The differential effects of controlling vs. informational styles on intrinsic motivation and creativity. *Journal of Personality* 52, 3, 233–248. <http://doi.org/10.1111/j.1467-6494.1984.tb00879.x>
23. Lawrence Kohlberg, Judy Yaeger, and Else Hjertholm. 1968. Private speech: Four studies and a review of theories. *Child Development* 39, 3, 691. <http://doi.org/10.2307/1126979>
 24. Laszlo Kozma. 2012. Ordering Cyclic Graphs. *LK Blog*. Retrieved from <http://lkozma.net/blog/ordering-cyclic-graphs/>
 25. Shannon Lockhart. 2010. Play: An important tool for cognitive development. *Extensions Curriculum Newsletter from HighScope* 24, 3, 1–8.
 26. Marije Nouwen, Maarten Van Mechelen, and Bieke Zaman. 2015. A value sensitive design approach to parental software for young children. *Proc. IDC '15*, ACM Press, 363–366. <http://doi.org/10.1145/2771839.2771917>
 27. Susan B. Palmer, Jean Ann Summers, Mary Jane Brotherson, Elizabeth J. Erwin, Susan P. Maude, Vera Stroup-Rentier, Hsiang-Yi Wu, Nancy F. Peck, Yuzhu Zheng, Cindy J. Weigel, Szu-Yin Chu, Greg S. McGrath, and Shana J. Haines. 2013. Foundations for self-determination in early childhood: An inclusive model for children with disabilities. *Topics in Early Childhood Special Education* 33, 1, 38–47. <http://doi.org/10.1177/0271121412445288>
 28. Eric E Rasmussen, Autumn Shafer, Malinda J. Colwell, Shawna White, Narissra Punyanunt-Carter, Rebecca L. Densley, and Holly Wright. 2016. Relation between active mediation, exposure to *Daniel Tiger's Neighborhood*, and US preschoolers' social and emotional development. *Journal of Children and Media* 10, 4, 443–461. <http://doi.org/10.1080/17482798.2016.1203806>
 29. Mabel L. Rice, Aletha C. Huston, Rosemarie Truglio, and John C. Wright. 1990. Words from “Sesame Street”: Learning vocabulary while viewing. *Developmental Psychology* 26, 421–428.
 30. Richard M. Ryan and Edward L. Deci. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American psychologist* 55, 1, 68–78.
 31. Lawrence J. Schweinhart and David P. Weikart. 1997. The High/Scope preschool curriculum comparison study through age 23. *Early Childhood Research Quarterly* 12, 2, 117–143. [http://doi.org/10.1016/S0885-2006\(97\)90009-0](http://doi.org/10.1016/S0885-2006(97)90009-0)
 32. Lawrence J Schweinhart, Jeanne Montie, Zongping Xiang, William S. Barnett, Clive R. Belfield, and Milagros Nores. 2005. *Lifetime effects: the High/Scope Perry Preschool study through age 40*. High/Scope Press.
 33. Lawrence J. Schweinhart and D. P. Weikart. 1988. The High/Scope Perry Preschool. *14 ounces of prevention: A casebook for practitioners*. John Wiley.
 34. Dwayne P. Sheehan, Sue Scott, Nadine van Wyk, Cynthia Watson, Kim Nagan, and Miranda MacCallum. 2013. Using self-determination theory to assess the attitudes of children and youth towards physical activity. *Physical & Health Education Journal* 79, 4, 40.
 35. Aric Sigman. 2012. Time for a view on screen time. *Archives of disease in childhood* 97, 11, 935–42. <http://doi.org/10.1136/archdischild-2012-302196>
 36. Lori Takeuchi and Reed Stevens. 2011. The new coviewing: Designing for learning through joint media engagement. *New York, NY: The Joan Ganz Cooney Center at Sesame Workshop*.
 37. Barbara J. Wilson. 2008. Media and children's aggression, fear, and altruism. *Future of Children* 18, 1, 87–118.
 38. Pamela Wisniewski, Haiyan Jia, Na Wang, Saijing Zheng, Heng Xu, Mary Beth Rosson, and John M. Carroll . 2015. Resilience mitigates the negative effects of adolescent Internet addiction and online risk exposure. *Proc. CHI '15*, ACM Press, 4029–4038. <http://doi.org/10.1145/2702123.2702240>
 39. Nicola Yuill, Yvonne Rogers, and Jochen Rick. 2013. Pass the iPad: collaborative creating and sharing in family groups. *Proc. CHI '13*, ACM Press, 941–950. <http://doi.org/10.1145/2470654.2466120>
 40. Bieke Zaman and Marije Nouwen. 2016. Parental controls: advice for parents, researchers and industry. *EU Kids Online*. Retrieved from <http://eprints.lse.ac.uk/65388/>