Supporting Executive Function Development through Parent-Child Book Reading

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Abstract

Executive functioning (EF) is a key element of school readiness. Despite evidence for the influential role parents can play in supporting child EF development, current EF-directed interventions rarely focus on parents. And although shared book reading is a particularly promising context within which parents might support child EF, it too has rarely been studied. In order to address these limitations, this study explores the extent to which parents can support child EF through adopting novel book-reading tips aimed at supporting self-regulation, delayed gratification, and rule following. We recruited 46 parents of two- to five-year-old children and assigned them to either learn EF or more general dialogic reading tips (i.e., active control). We observed parent-child book reading pre-intervention, and at two subsequent time points, each two- to four-weeks apart, and measured child EF at the final study session. As hypothesized, we observed that parents adopted the EF tips, and that their tip use was generally sustained over time, although effects varied by tip type. Unexpectedly, children in the EF condition performed no differently than those in the active control group on EF tasks. Implications for early EF intervention are discussed.

Keywords: school readiness, executive functioning, parents, book reading

Introduction

Many children enter school underprepared, with negative implications for their academic achievement and engagement (Rimm-Kaufman, Pianta, & Cox, 2000). Poor academic progress, which is often accompanied by negative disciplinary and peer interactions, can in turn cause children to resist or disengage further from school (Vitaro, Brendgen, Larose, & Trembaly, 2005). Given how important school readiness is to students' long-term academic success, it is imperative to identify ways to optimize it.

Evidence suggests that one particularly important contributor to school readiness is executive functioning (EF). EF includes three key components: 1) set shifting (i.e., flexibly and adaptively responding to stimuli), 2) response inhibition (i.e., inhibiting a prepotent reaction to stimuli), and 3) working memory (i.e., holding information in mind while manipulating some component thereof) (Garon, Bryson, & Smith, 2008). As these components of EF develop, they can facilitate, "planning, future-directed thinking, and monitoring of behavior," (Blair, 2016, pg. 418), which are all critical to successful cognitive, social, and behavioral classroom functioning.

One particularly important way in which EF appears to support classroom functioning is by facilitating self-regulation. Self-regulation involves the balanced integration of emotional and cognitive control (Blair & Diamond, 2008), which is critical for optimizing attention and executing efficient goal-directed behaviors aligned with classroom expectations (Blair & Diamond, 2008; Blair & Raver, 2015). Likely due at least in part to its contributions to self-regulation, EF is predictive of children's effective employment of positive approaches to learning (e.g., persistence, curiosity, frustration tolerance) (Vitiello, & Greenfield, 2017), social adjustment to school (Masten et al., 2012), as well as mathematical and reading achievement (Blair & Razza, 2007).

Blair and Diamond (2008) describe EF as developing dynamically and nonlinearly with a host of other concurrently maturing physiological systems involved in stress and attention regulation (also see Garon et al., 2008). More specifically, Blair's (2016) psychobiological model suggests that early experiences, and the influence these impress on relevant physiological systems, explains differences in EF developmental trajectories and abilities. Salient aspects of children's environments such as the richness of their early learning opportunities (e.g., preschool; Watts, Gandhi, Ibrahim, & Masucci, 2018), poverty-associated stress exposure (Blair & Raver, 2015; Merz, Wiltshire, & Noble, 2019), and caregiver relationships (Bernier, Carlson, Deschênes, & Matte-Gangé, 2012) can all influence EF development. Though arguably the most dramatic changes in EF are evident in early childhood, EF continues to develop through adolescence (Zelazo et al., 2013) and into adulthood (Zelazo & Müller, 2002).

Consistent with Blair's (2016) model, evidence suggests that intervening in children's early learning environments can support EF development, as well as school readiness more generally speaking (Blair & Diamond, 2008; Watts et al., 2018; Wenz-Gross, Yoo, Upshur, & Gambino, 2018). But in some respects, existing interventions are limited. For example, because interventions are typically implemented in preschools and daycares (Murray, Rosanbalm, & Christopoulos, 2016), they rely heavily on specialized teacher training and classroom resources that are not universally available (Bassok & Galdo, 2016). It is therefore important to identify alternate EF interventions that are equally accessible to all families.

One way of broadening access to early EF interventions might be to focus on parents and the home environment, as opposed to teachers and preschool or daycare centers, as a context for supporting development of these critical skills. Not only do positive parenting (e.g., sensitivity, mind-mindedness, autonomy support) and attachment correlate with children's EF (Bernier et al.,

2012), but evidence also suggests that positive parenting can protect children from suboptimal EF development associated with early experiences of physical and psychosocial stress (e.g. family conflict, maternal depression) (Blair et al., 2011; Evans & Kim, 2013). One study found that, for example, positive parenting can mediate the otherwise negative relationship between maternal depression and child EF (Baker & Kuhn, 2018). Despite parents' potentially influential role, parent-directed interventions are underutilized; only 20% of self-regulation interventions occur in a home context (Murray et al., 2016).

Modeling, teaching, and scaffolding are specific parenting behaviors which might explain *why* positive parenting is associated with child EF. Parents can model self-regulation and skillful EF expression, teach which behaviors are acceptable by imposing disciplinary consequences, and guide problem solving so that, over time, their children can succeed independently (Edwards, Sheridan, & Knoche, 2010). In one particularly illustrative demonstration of the value of these parenting behaviors for supporting child EF, Putnam, Spritz, and Stifter (2002) found that 30-month-olds who inhibited their impulse to touch a new and tempting toy were more likely to have mothers who used distraction techniques to help them self-regulate.

Interactive book reading might be a particularly fertile context in which parents can model, teach, and scaffold child EF skills. On a national level, shared book reading is a common activity practiced by 81% of families with pre-kindergarten age children (Corcoran, Steinley, & Grady, 2019). Though parent-child reading is less prevalent among families experiencing poverty, community programs that facilitate access to free books (e.g. Imagination Library) make this a viable activity for almost everyone (Skibbe & Foster, 2019). Dickinson and colleagues (2019) argue that interactive book reading provides opportunities for children's self-regulation development (also see Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008). For example, during book reading children can practice sustained attention and patience during delays as

storylines are incrementally revealed, as well as remain calm while excited about story content. When parents ask questions during book reading, they further engage children's EF by requiring them to hold information about the book in mind while predicting future events (i.e., working memory), and considering multiple characters' perspectives based on their unique experiences in the story (i.e., set shifting). Moreover, parents can use co-regulation strategies during reading to scaffold children's inhibitory control by helping them to sit still, refocus their attention, and patiently wait before turning each page. Consistent with these opportunities for modeling and practicing EF skills, evidence suggests that book reading activates EF-related brain areas in young children (Hutton et al., 2017). Moreover, book reading might promote children's EF development indirectly by supporting children's language development (Gooch, Thompson, Nash, Snowling, & Hulme, 2016).

While interactive book reading naturally offers opportunities for supporting EF development, it might be possible to bolster its impact even further by more explicitly focusing the adult reader's attention on EF in this context. Howard and colleagues (2017) investigated this possibility in preschool classrooms by creating books embedded with interactive EF challenges (e.g., requiring the child to "help" the main character quickly cross an obstacle on his path by saying "hiss" when the teacher points to a frog and "ribbit" when they point to a snake). Children whose teachers read the books with these embedded elements demonstrated significantly greater EF improvement than those in an interactive reading control condition. Although this is an exciting finding, this type of intervention is limited in that teachers must purchase specially designed books, thus creating a barrier to access among those with limited financial resources. Moreover, the study did not involve parents, an important shortcoming given their potential for facilitating EF development.

The current study investigates parents' willingness to practice an EF intervention with their children within the context of shared book reading, as well as the efficacy of that intervention. Specifically, we trained parents on how to use three novel EF-directed tips during reading and assessed whether they successfully integrated these tips into their reading habits, as well as whether their adoption of the tips was sustained over time. To investigate the efficacy of the intervention, we compared children's EF performance in this experimental condition to that of children whose parents were instead trained to use dialogic reading tips that are more typical of interactive reading interventions.

Methods

Participants

Forty-six parents and their children (30 girls and 16 boys) with a mean age of 3.84 years (range = 2.30 - 5.25 years) were recruited from a population of middle-class families in the Nashville, Tennessee area. Thirty-six children were White, four were Black, and six were mixed race. Twenty-nine parents had graduate degrees, and seventeen had bachelor's degrees. Based on parent report, all children and parents understood English and had no diagnosed hearing or language impairments. Participants were compensated $20 for each of three sessions, for a total of $60. Parents were assigned to one of two conditions: 1) EF book reading tips, or 2) dialogic book reading tips (active control group). Parent-child dyads were assigned to conditions on a constrained random basis to ensure comparability on gender and age composition.

Procedure

Parent-child dyads visited Vanderbilt University's Little Learner's Lab three times with two- to four-weeks breaks in between.

Session 1. During their first visit, parent-child dyads were filmed reading *Little Cloud* by Eric Carle. Parents then watched an instructional video detailing either the EF or dialogic book reading tips according to their condition assignment. Following the video, the experimenter read the first half of the book *Goodnight Gorilla* by Peggy Rathman with the parent and child to model the tips, and then the parent was given an opportunity to practice applying the tips while reading the second half of the book.

Session 2. During the second visit, parent-child dyads were filmed reading *Little Cloud* by Eric Carle (a second time) and *Rabbits and Raindrops* by Jim Arnosky. Parents also completed a survey about their experience using the book reading tips since the previous visit.

Session 3. During the third visit, parent-child dyads were filmed reading *Little Cloud* by Eric Carle (a third time) and *Oonga Boonga* by Frieda Wishinsky, and parents again answered questions about their experience using the tips. Parents also completed Tufts Medical Center's (2010) Survey of the Wellbeing of Young Children (SWYC) questionnaire at this time, and children completed a battery of EF tasks as described below.

Materials

Intervention Videos. Videos were used to share the book reading tips with parents. Videos were approximately four minutes long and featured a young woman describing the condition-specific book reading tips (either EF or dialogic reading). The videos for both EF and dialogic reading conditions were comparable in length, instructor, and instructional method. We designed the EF tips to teach parents how to create opportunities for their child to practice emotion and behavioral regulatory processes, delay of gratification, and rule following during book reading (see Table 1 for examples of tips). The "Stay in Touch" tip (ST) encourages parents to support their children in identifying their feelings during book reading (e.g. "I am

feeling antsy right now"), their goal (i.e. to finish reading), an action they can take to meet their goal (e.g. deep breaths, a dance break, etc.), and to physically take this action. It also suggests that parents initiate conversation with their child about the feelings and behaviors of characters in the book, and to relate this to their child's own experience (e.g. "How do you act when you feel like Character X does?"). The "Make 'em Wait" tip (MW) advises that parents create opportunities during book reading for their child to practice patiently waiting, (i.e. "Oops- I forgot something in the other room, please wait to open the book until I return so we can start the book together."). The "Game Time all the Time" tip (GT) advises parents to devise rule-governed mini-games (e.g. "let's take turns flipping the page while we read"), to play these throughout the book, and to remind the child of the rule as needed.

Parents in the dialogic reading active control group were taught two acronyms, "CROWD" and "PEER" previously developed to facilitate dialogic reading (Pearson Education, 2002; Whitehurst et al., 1988). Dialogic reading is an interactive approach to reading where parents and children engage in dialogue about the book, express their thoughts about the story, and make outside connections to the book.

Take-Home Materials. Parents were provided informational pamphlets that described the tips and provided examples of how to use them in conjunction with books they were sent home with. Specifically, children chose three out of a possible five books to take home, with corresponding pamphlets attached, at the end of session one, and took the remaining two books home at the end of session three. The book options included: 1) *Corduroy* by Don Freeman, 2) *The Tale Peter Rabbit* by Beatrix Potter, 3) *The Snowy Day* by Ezra Jack Keats, 4) *Fire Engines* by Anne Rockwell, and 5) *Gilberto and the Wind* by Marie Hall Ets. At the end of session two,

children chose one book to take home that was completely unrelated to those listed above, and which did not have an attached pamphlet.

Table 1

EF Tips and Examples as Explained in EF Tip Intervention Video and as Coded for in Parent-Child Book Reading

EF Tips	Tip Subcomponents	Tip Examples
ST: Stay in Touch	SI: Identifying the child's current emotion or attention state, and prompting the child to identify these	SI: "I notice you are moving around a lot right now, how do you feel?"
	SG: Reminding the child that the goal is to finish the book	SG: "We're reading right now, and then we can go play."
	SR: Supporting the child to identify whether they needed to take some action in order to meet this goal	SR: "Do you want to move around and get your wiggles out before we keep reading?"
	SA: Encouraging the children to take the previously identified action	SA: Child acts (e.g., take deep breaths, jog around the room, jump around)
	ST: Prompting the child to talk about the character's feelings	ST: "How do you think she feels now? Have you ever felt like that? What did you do?"
MW: Make 'em Wait	MB: Making the child wait before reading the book	MB: "I forgot something in the other room, wait to open the book until I get back!"
	MD: Making the child wait during the book	MD: "Let's wait to see what happens next!"
	MT: Talking with the child about the challenges of waiting and strategies for waiting	MT: "Was it hard to wait? What helped you do it?"
GT: Game Time All the Time	GS: Establishing a game or rule to follow throughout the book	GS: "While we're reading today let's play the page flip game. I'll take a turn and then you take a turn."
	GR: Reminding the child to follow rule	GR: "It's your turn to flip the page."
	GF: Making attempts to follow the rule	GF: Parent or child follows the rule.
	GC: Changing the rule partway through the book	GC: "Now let's play a new game! Say 'oink' when you see an animal and I'll say 'hello' when I see a person."

Measures

Executive Function.

Tower Building and Clean-up. The tower building and clean-up task measured child inhibitory control and self-regulation through gauging child willingness to rule follow (Denham, 2006). To begin, the experimenter presented the child with twelve blocks and explained, "In the tower building game we have to take turns, taking turns looks like this." The experimenter proceeded to model turn taking with the child, prompting the child to take turns placing blocks. After confirming that the child understood the turn taking rule, and that the tower should be built vertically, the experimenter put all the blocks back in a storage box. The experimenter then picked up one block and stated, "I'll go first," placed the block and then prompted the child with, "now it's your turn." Thereafter, the experimenter did not use any additional verbal or social cues to remind the child of the turn taking rule. If the child said, "Your turn," made prolonged eye contact with the experimenter to indicate it was their turn, or handed the experimenter a block, then the experimenter placed a block on the tower. The experimenter took note of how many blocks the child placed, and how many she placed. Willingness to rule follow was measured by the percentage of child-placed blocks.

For the tower clean-up task, the child was instructed to place the blocks back in the storage box within one minute. The experimenter explained they would remind the child when there was thirty seconds left. The experimenter recorded how many blocks the child cleaned up at thirty seconds and at one minute. Willingness to rule follow was measured by number of blocks cleaned up at thirty seconds.

Marshmallow Test. A delay of gratification task was used to measure inhibitory control and self-regulation (Mischel, Shoda, & Rodriguez, 1989). In order to build trust in the

experimenter's reliability, and to ensure that the child was not hungry before the task (Kidd, Palmeri, & Aslin, 2013), the experimenter presented the child with multiple empty, individual-sized snack bags, and asked the child to choose which snack they wanted to eat. She then exclaimed, "Oh no! Someone must have eaten that snack. You wait right here and I'll go to the other room to get a new snack for you. I'll be right back." The researcher left the room for two minutes, and then returned with the child's preferred snack, which the child ate immediately. The experimenter then began the tower tasks (described above), followed by the delay of gratification test itself. The experimenter facilitated this task by placing one marshmallow in front of the child and explaining, "I have to go do some work right now. You have a choice about how you want to eat your treat. You can either eat it while I am gone and that will be the only one you can eat, or, if you don't eat your marshmallow while I'm gone, you can have two marshmallows when I get back." After verbally confirming that the child understood the rules of the task, the experimenter left the room and started a stopwatch. The experimenter recorded the time when the child took a nibble or lick of the marshmallow and ended the experiment if the child took a clearly discernible full bite, left the room, or showed any signs of distress. If the child did not eat the marshmallow in fifteen minutes, the experimenter ended the task at that time. All children were provided a second marshmallow regardless of task performance. Performance was measured by the time when the child first took a bite, left the room, or showed any sign of distress.

Survey of the Wellbeing of Young Children. Parents reported their children's externalizing behaviors (e.g., has trouble playing with other children; break things on purpose; fight with other children) and attention problems (e.g., has trouble paying attention; has a hard time calming down) through Tufts Medical Center's (2010) SWYC Preschool Pediatric

Symptom Checklist (PPSC). For the purposes of analysis, we chose to focus on parents' responses to these five survey questions, each answered on a three-point rating scale.

Parent Tip Usage. Parents' adoption of the EF book reading tips was coded from video-taped sessions as specified in Table 1. Additionally, the experimenter asked parents survey questions about their experience using the tips at both sessions two and three. The survey included questions about the extent to which the parent used the tips over the past several weeks, and if they did use them, which tips they and their children did or did not enjoy, as well as the extent to which they felt the tips changed the way they read with their child.

Results

Tip Adoption

Missing Data. One participant was disinterested in reading *Rabbits & Raindrops* at session two, and another participant moved away before session three. This missing data was replaced with median tip usage values for the corresponding book.

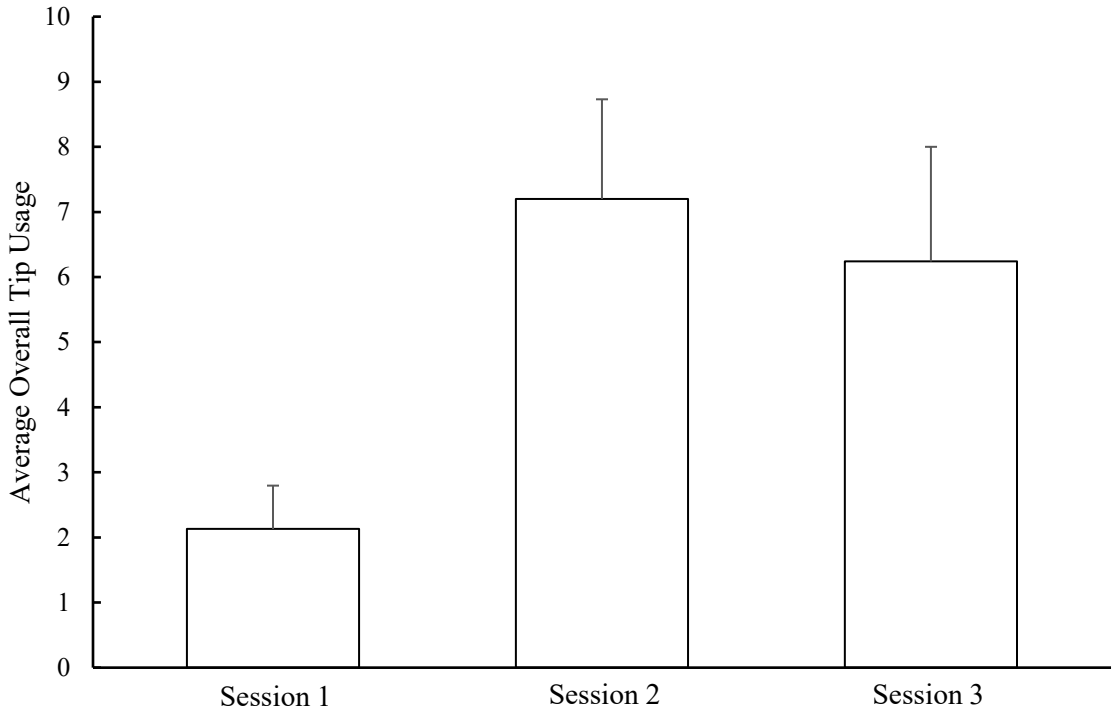
Overall Tip Usage. Preliminary analyses revealed no effect of book title on tip usage. Thus, we averaged parents' use of each of the three tip types across the two books read at session two (i.e., *Little Clou*d and *Rabbits & Raindrops*) and at session three (i.e., *Little Cloud* and *Oonga Boonga*) in all subsequent analyses. To test our hypothesis that parents would adopt the EF book reading tips after training, we used SPSS to perform a repeated measures ANOVA on overall tip usage (i.e., the combined usage of Game Time All The Time (GT), Stay in Touch (ST), and Make 'em Wait (MW)) across sessions (one vs. two vs. three).

As predicted, we identified a large effect of session on tip usage, $F(1.36, 29.99) = 6.14$, $p = .012$, $\eta_p^2 = .218$ (see Figure 1). Simple orthogonal contrasts revealed that this effect is primarily due to large improvements in tip usage from session one to two, $F(1, 22) = 9.41$, $p =$

.006, $\eta_p^2 = .30$. This improvement relative to the session one baseline was maintained at session three, $F(1,22) = 4.77$, $p = .04$, with a large effect size, $\eta_p^2 = .178$.

Figure 1

Average Overall Tip Usage



Note. Mean overall parent tip usage at each session. Error bars represent standard errors.

In addition to our analysis of observed tip usage, we considered parents' self-reported tip usage at home. Because preliminary analyses revealed no difference in parents' responses across sessions two and three, we averaged parents' responses across both sessions. Parents most often reported using the tips "about half the time" (*Mdn* = 3) and that their "reading style had changed a little bit," (*Mdn* = 3) suggesting some perceived impact of the intervention. However, mean responses did not differ significantly from chance for reported practice frequency (M = 3.13, SD

= 1.12), $t(22) = .558$, $p = .582$, $d = .116$, or reading style change (M = 3.13, SD = .607), $t = 1.03$, $p = .314$, $d = .214$.

Specific Tip Usage. In order to explore whether tip adoption was consistent across tip type, we performed a repeated measures MANOVA predicting the three types of tip usage from session (one vs. two vs. three). We observed a large effect of session for the GT tip, $F(1.42, 31.29) = 7.94$, $p = .001$, $\eta_p^2 = .265$, and the MW tip, $F(1.32, 28.92) = 5.11$, $p = .023$, $\eta_p^2 = .188$ (see Table 2). However, this effect did not hold for the ST tip, $F(2, 44) = .125$, $p = .859$, $\eta_p^2 = .006$.

Simple orthogonal contrasts further revealed that GT tip usage increased from session one to two, $F(1, 22) = 10.80$, $p = .003$, $\eta^2 = .329$, and that this improvement over baseline was sustained at session three, $F(1, 22) = 6.73$, $p = .017$, $\eta^2 = .234$. MW tip usage also increased from session one to two, $F(1, 22) = 6.64$, $p = .017$, $\eta^2 = .232$, but then declined to be statistically indistinguishable from baseline performance at session three, $F(1, 22) = 2.10$, $p = .162$, $\eta^2 = .087$.

Table 2

Tip Usage Means and Standard Deviations per Session

	Session 1		Session 2		Session 3	
EF Tip Type	M	SD	M	SD	M	SD
Game Time All the Time	0	0	5.02*	7.17	3.93*	7.12
Stay in Touch	2.13	3.19	1.96	1.82	2.22	1.97
Make ‘em Wait	0	0	.174*	.317	.043	.141
Overall	2.13	3.19	7.20*	7.35	6.24*	8.42

Note. $n = 23$

* $p < .05$ in relation to session 1

To further understand parents' tip adoption habits, we analyzed parents' self-reported tip preferences. To see if parents' preferences varied by tip type, we performed a repeated measures ANOVA with tip type (i.e., GT vs. MW vs. ST) predicting the number of times (0,1 or 2) parents listed each tip in response to each prompt. We observed a large effect of tip type on which tips parents reported to be hard to find ways to use, $F(2, 44) = 3.86$, $p = .028$, $\eta_p^2 = .149$. We clarified the source of this main effect by conducting post-hoc paired comparisons across tip types. Analyses indicated the GT (M = .370, SD = .376) and MW (M = .435, SD = .434) were rated as equally difficult, $t(22) = -.514$, $p = .613$, $d = .160$, and that both were rated as significantly harder to use than the ST tip (M = .109, SD = .299), $t(22) = 2.23$, $p = .036$, $d = .768$ and $t(22) = 2.55$, $p = .018$, $d = .875$, respectively. We also observed a large effect of tip type on which tips parents reported that their child liked engaging with, $F(2, 44) = 14.21$, $p < .001$, $\eta_p^2 = .392$. Post-hoc paired comparisons indicated that children liked the GT tip (M = .478, SD = .412) more than the MW tip (M = .022, SD = .104) tip, $t = 4.865$, $p < .001$, $d = 1.52$, which they in turn liked significantly more than the ST tip (M = .174, SD = .286), $t(22) = -2.30$, $p = .031$, $d = .748$. Because we did not detect a significant main effect of tip type on which tips parents liked using, $F(2, 44) = .824$, $p = .445$, $\eta_p^2 = .036$, or on which tips their child struggled with, $F(2, 44) = .028$, $p = .972$, $\eta_p^2 = .001$, we did not conduct more fine-grained comparisons on this data.

Executive Function Outcomes

On initial examination of descriptive statistics, it became clear that the parent-report SWYC was insufficiently sensitive, as scores were near ceiling with minimal variability. Therefore, we did not include this measure in our analyses. The remaining child executive function tasks (i.e., tower building, tower clean-up, and marshmallow task) were standardized and averaged into a single composite variable for subsequent analysis.

Missing Data. One participant moved away before the child tasks were completed. Two additional children were unwilling to participate in the marshmallow task (one in each condition). One child in the classic condition also refused to participate in the tower building and clean-up tasks. Missing data was replaced with the respective median values for that measure.

Condition-level Differences. In order to test whether EF performance was significantly different for children in the EF vs. dialogic reading conditions, we performed an unpaired t-test. Although we hypothesized that EF performance would be better in the EF condition, this analysis revealed no significant difference between the EF (M = .691, SD = .252) and dialogic reading (M = .608, SD = .280) conditions, $t(43) = .305$, $p = .762$, $d = .312$.

Discussion

Given the importance of early EF development for school readiness, it is critical that researchers identify ways to optimize EF before children enter school. Previous interventions have rarely focused on the role parents can play in supporting child EF, despite evidence that parenting behaviors are associated with EF development (Baker & Kuhn, 2018; Bernier et al., 2012). Because shared book reading is a particularly promising context in which parenting behaviors could support child EF, this study investigated whether parents would adopt novel, EF-directed book-reading tips, and whether these would effectively support their children's EF.

Overall, parents did adopt the EF tips, and they continued to use these newly learned skills over several weeks. These findings suggest that parents are willing and capable of learning and implementing novel tips within the context of book reading. Interestingly, however, tip adoption was not uniform. Results indicated that tip adoption consistently increased for GT, initially increased but then decreased for MW, and failed to change for ST. Given that the GT and MW tips involved parents' engagement in particularly novel behaviors (i.e. creating mini-

games with rules to play during reading, and requiring the child to patiently wait before or during reading), their adoption of these tips suggests that parents are willing to engage with their children in ways that are not explicitly related to book reading itself.

Several explanations are possible for why we found these patterns in tip adoption. Parents' sustained adoption of GT might suggest that this tip was particularly easy to implement and enjoyable for parents to use, even over time. Parents' self-reports were, however, only partially consistent with this possibility. Although parents reported that their children liked using GT the most, they did not indicate that they themselves liked it more than the other tips. Indeed, they reported that it (along with the MW tip) was difficult to find ways to use. Perhaps, then, it is the *child's* engagement and enjoyment that plays a key role in parents' adoption habits. This explanation is also consistent with the observation that parents were less likely to report that their children liked the MW tip, and their use of the MW tip dropped off over time. Some parents, however, also mentioned that using MW disrupted the process of transitioning from other activities to reading, which can sometimes be difficult in and of itself. Use of the ST tip, which was not affected by the intervention, was the only tip that some parents were already using at our baseline observation (session one). Perhaps parents' greater familiarity with this tip lead them to assume that they already were using it optimally, and to feel less compelled to practice it.

Our second question considered the efficacy of the intervention in supporting children's EF development. Although we had predicted that children in the EF condition would perform better on the EF tasks than those in the dialogic reading condition, we observed no difference in performance. These findings do not align with theoretical arguments (Bierman et al., 2008; Dickinson et al., 2019) and empirical evidence (Howard et al., 2017) suggesting that book reading can provide a rich context for EF development.

There are a host of reasons why the tips may have been unsuccessful at facilitating EF development. First, it is possible that too little time passed to see any effect of EF tip usage on child EF. Indeed, it might not be feasible to measure changes in child EF across the course of just four to eight weeks (the range of time between session one and three) using available measures. Though there is theoretical reason to believe that our EF tasks connected to the specific EF tips parents learned, perhaps we could have seen more change in children's skills if we had used a standardized battery, such as the National Institute of Health's toolbox (Gershon et al., 2013). Given wide ranging views about the nature, composition, and development of EF, it will be important for future investigations to consider measurement issues carefully (Blair, 2016).

Alternatively, or additionally, it is possible that the intensity and/or frequency with which parents used the tips during book reading was not adequate to influence EF. Although we observed substantial tip adoption during laboratory sessions, parents may have used the tips less at home, thereby suppressing the opportunity for consistent tip usage to significantly influence EF. This possibility is especially salient given that parents' self-reported tip usage and reading style change was not statistically different than chance, suggesting that their reported tip usage may be unreliable. To control for the possibility of poor practice consistency, future studies could make use of home recording technology, such as Language Environment Analysis (LENA), to observe the extent to which parents practiced using the tips at home (Warren, 2015).

If it were the case that parents infrequently practiced the tips, then perhaps a different intervention delivery method would have been easier for parents to frequently practice at home, and, thus, would have yielded a larger impact on child EF outcomes. Indeed, parents reported that the MW and GT tips were hard to find ways to use, suggesting that a different method might have aided their implementation. In comparison to our intervention, for example, Howard et al.'s

(2017) activity-embedded books outlined exactly what the adult reader should say and do during reading, making it very simple and straightforward for the reader to facilitate child engagement in the EF-directed activities as they read. This approach, or others like it, might lead caregivers to create more consistent and frequent child EF practice opportunities.

Notably, Howard et al.'s (2017) intervention also focused on a more comprehensive array of executive function skills than ours. It is possible that our tips were simply less effective than these. Specifically, whereas our tips were most explicitly geared towards inhibitory control, Howard et al.'s (2017) books included embedded activities directed towards set shifting, working memory, and inhibitory control. It is possible that this approach was more effective given previous literature suggesting the interconnected nature of these distinct EF components in young children (Willoughby, Wirth, & Blair, 2012). That said, Howard and colleagues (2017) only found intervention effects for children's set shifting and working memory, not inhibitory control. This is concerning given the clear importance of inhibition for school readiness (see Blair & Razza, 2007; Brown, Ackerman, & Moore, 2013). Thus, future interventions should consider supporting all components of EF (set shifting, working memory, and inhibitory control), and focusing, specifically, on identifying how to best support inhibitory control.

Finally, our failure to include a baseline measure of EF leaves open the possibility that our EF group did actually improve more than the control, but that this could not be detected because children in this group began with lower scores that merely caught up to the control group after the intervention. Although unlikely, this is an especially important limitation given the possibility that child EF could influence whether and how parents adopt the EF tips, with potentially cascading effects on the frequency with which parents use the tips, and, thus, child EF outcomes. For example, if a child had relatively low EF and, related difficulties self-regulating

their behavior, it may be challenging for parents to practice using the tips during reading, because they may have to focus instead on supporting the child to sit still and focus enough to read the story at all.

Despite these limitations, our tip adoption findings suggest this is an exciting area for future research. Given that parents were willing and capable of adopting the EF tips, future interventions should further consider ways to target parents in order to support child development through book reading. Differences in parents' use and adoption of the three EF tips targeted here, however, suggest that in doing so it will be important to consider, a priori, parent's and children's interest in, and enjoyment of, intervention content. Once content and training approaches have been refined, the next step will be to ensure parents are implementing the tips in optimally effective ways with fidelity. The fact that parents can effectively scaffold their children's development of new skills through modeling and teaching in other domains (Edwards et al., 2010; Putnam et al., 2002) suggests that this should ultimately be possible.

Another potentially interesting direction for future research involves focusing on more fundamental questions about relationships between EF development and book reading. To our knowledge, no empirical studies have explored whether aspects of parents' typical interactive reading habits support EF development. This is entirely possible given that aspects of typical interactive reading practices might prompt EF development. If so, this offers yet another explanation for why we might not have observed differences between our conditions (i.e., that dialogic reading supports EF development indirectly to the same extent that direct EF tips do).

Future studies should also move beyond the shared book reading context to investigate other ways parent-focused interventions can support EF. These might include targeting parents' own EF skills, or providing support for positive parenting behaviors, which have both been

linked to child EF (Bernier et al., 2012; Cuevas et al., 2014). Interventions could also focus on supporting parents to buffer toxic stressors, which have been associated with suboptimal EF development (Evans & Kim, 2013).

In conclusion, this study serves as a valuable foundation for future studies to continue investigating the feasibility of supporting EF development within the context of book reading, and through parent-child interaction more generally. We know that a child's school readiness, which relies heavily on EF, can have cascading effects on various aspects of their short- and long-term school success along social and academic lines (Blair & Razza, 2007; Masten et al., 2012; Vitiello, & Greenfield, 2017). Moreover, school readiness contributes to long-term disparities in academic achievement, with repercussions on economic earnings, and overall wellness across the lifespan (see McEwen & McEwen, 2017; Shonkoff et al., 2012). Given the important role EF plays in school readiness, it is critical that we continue to work towards identifying efficient and effective ways to optimize early EF, especially before children enter kindergarten.

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