Text to talk: Effects of a home-school vocabulary texting intervention on prekindergarten vocabulary

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ABSTRACT

This paper presents the results of an intervention study focused on understanding how a 5-month, vocabulary-focused texting program called Text to Talk can enhance home-school connections concerning vocabulary and preschool children's language learning. Classrooms (49) were randomly assigned to intervention or control status in an urban preschool program in the eastern United States. Intervention teachers delivered Text to Talk, a curriculum-aligned program that provides weekly texts for teachers to send to families that include vocabulary words and related activities from books being read in the classroom. Children's target word knowledge and receptive language skills (PPVT) were measured at baseline and follow-up, with treatment effects on target word knowledge ($d = 0.17$). Treatment families reported much higher use of texting as a source of communication with teachers, but otherwise rates of home-school communication in person, phone, and with paper were unchanged; family self-report of general home learning activities was also unaffected by treatment status. Implementation analysis showed moderate to high fidelity among teachers and families, with greater family fidelity associated with larger treatment impacts. The findings suggest that a family-focused texting-based program, aligned with the school curriculum, leads to improved taught-word knowledge among children from under-resourced communities.

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Introduction

A significant gap in vocabulary knowledge divides young children in poverty from their more advantaged peers, undermining their success in learning to read, and in school more generally (Fernald, Marchman & Weisleder, 2013; Lervåg, Hulme & Melby-Lervåg, 2017; Morgan, Farkas, Hillemeier, Hammer & Maczuga, 2015; Shavlik, Davis-Kean, Schwab & Booth, 2021; Suggate, Schaughency, McAnally & Reese, 2018). Although families in poverty are involved in their children's learning and deeply invested in building essential skills (Lareau, 2003; Snell, Hindman & Wasik, 2020; Weiss et al., 2003), there is often less talk and use of vocabulary, relative to middle-income households, and talk and involvement may not be as aligned with the expectations of schools (Lareau, 2003; Wasik & Hindman, 2010). This paper explores a novel intervention approach to helping families promote children's vocabulary learning at home.

Learning new words across early school and home settings

Our work is based on current research on how children learn words, offering insight into how young children can most successfully build vocabulary, and informing our intervention. Empirical research on word learning in early childhood shows that children need multiple, meaningful exposures to words to learn them (Biemeller & Boote, 2006; Hoff, 2003; Rowe & Snow, 2020). Word learning is enhanced through more extensive language exchanges with adults who invite children to talk about words and provide meaningful feedback (Barnes, Dickinson & Grifenhage, 2017; Justice, Jiang & Strasser, 2018). High-quality teacher-child exchanges during free play and book reading are linked to gains in children's language production and comprehension (Bauer, Booth & McGroarty-Torres, 2016; Lenhart, Lenhard, Vaahtoranta & Suggate, 2020; Toub et al., 2018) when these extended conversations involve open-ended prompts, extensions on children's remarks (Cabell, Justice, McGinty, DeCoster, & Forstonl, 2015), and complex, conceptually challenging feedback (Barnes et al., 2017; Cabell, Justice, McGinty, DeCoster & Forston, 2015; Wasik & Hindman, 2014; Zucker, Cabell, Justice, Pentimonti & Kaderavek, 2013). Children also need opportunities to construct a word's meaning across varied contexts (Spencer, Quinn & Wagner, 2017) that are meaningful and engaging for the child (Harris, Golinkoff & Hirsh-

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Pasek, 2011; Neuman & Dwyer, 2009). Successful interventions that have formally tested various approaches to boosting children's vocabulary also have found that children are more likely to learn words when provided with child-friendly definitions of new words (Dickinson et al., 2019; Justice, Meier & Walpole, 2005), when presented with images or props of the word (Wasik, Bond & Hindman, 2006), and when practicing new words in small group activities (Marulis & Neuman, 2013; Wasik & Hindman, 2020). Specifically, when adults engage young children in rich, extended conversations talking about words, and providing background information to help children construct the meaning of words, children are successful in learning vocabulary (Biemiller & Boote, 2006; Dickinson et al., 2019; Rowe & Snow, 2020). These principles have guided our intervention strategies.

Common early childhood curricula, such as Teaching Strategies' Creative Curriculum (Dodge, Heroman, Colker & Bickart, 2010) have increasingly included target words and definitions in their instructional units. However, curricula generally do not specify how often, or through what instructional techniques, new words should be taught (Neuman & Dwyer, 2011), despite these activities' importance consistent with empirical literature on word learning in early childhood. Whether due to lack of curriculum guidance or the general demands on teacher time, teacher-child conversation about words remains rare in classrooms (Pelatti, Piasta, Justice & O'Connell, 2014), and with a few exceptions (Wasik & Hindman, 2020; Weiland & Yoshikawa, 2013; Wilcox, Gray & Reiser, 2020), effects of even high-quality curricula on child vocabulary are small to nonexistent (Dickinson & Porche, 2011; Justice, Mashburn, Hamre & Pianta, 2008; PCER, 2008). The field is still trying to identify the most effective strategies to increase children's word learning (Rowe & Snow, 2020).

However, because vocabulary is often learned through language interactions between children and adults, families might be well-positioned to offer one-on-one interactions around new words and relate new words to children's personal experiences and knowledge (Leech, Wei, Harring & Rowe, 2018; Rowe, 2018; Schwab, Rowe, Cabrera & Lew-Williams, 2018). These conversations can also draw on shared cultural activities, experiences, and traditions that comprise family strengths (Gonzalez, Moll & Amanti, 2005). Unfortunately, most early childhood programs have not engaged families as partners in vocabulary teaching and learning (Graue, Clements, Reynolds & Niles, 2004; Snell et al., 2020); when there are such partnerships, they have rarely been evaluated using random-assignment methodologies, nor shown to be effective at increasing child vocabulary (Hindman, Wasik & Snell, 2016).

The current paper describes results from a randomized-controlled trial of a texting-based vocabulary program (Text to Talk) that aims to bridge the home-school vocabulary gap through a novel approach, by harnessing the potential of text messaging to extend engaging vocabulary activities into the household context. The goal of Text to Talk is to provide multiple, active interactions with words, across various contexts, caregivers, and time. We know from current research that learning often requires multiple exposures to new words, both definitional and contextual information, and active, or deep, processing of new words and ideas. If a child requires active interaction with a word, merely hearing the word once during a storybook reading will not be enough (Rowe & Snow, 2020). Having opportunities to interact with vocabulary through caregivers' questions and discussion of images illustrating the word can allow for additional opportunities to learn and practice new vocabulary and thus enhance vocabulary growth (Bojczyk, Davis & Rana, 2016; Uscianowski, Almeda & Ginsburg, 2020). The goal of the Text to Talk intervention is to allow children to gain additional opportunities to learn about, understand, and use new words, across time and across contexts, including their home context.

Below, we review the nascent but promising literature on texting-based interventions in early childhood and school settings.

A review of texting interventions

Extensive societal use of mobile technologies presents novel and exciting opportunities to enhance support of child development (Dore et al., 2019; Hall & Bierman, 2015), especially through connections with families. These new technologies include apps, social media, YouTube, email, and texting, among others. Of these, texting is particularly promising due to its wide adoption, even among communities in poverty; 99% of American adults aged 18–49 have a cell phone, with over 90% having a smart phone (Pew Research Center, 2018). Surveys suggest that Millennials (the predominant generation with preschool-aged children) prefer texting as a form of communication over voice calls and email (Newport, 2014). In addition, free or low-cost services such as Remind, Class Dojo, and EdModo allow teachers to text families (individuals, groups, or the whole class) privately and securely via the web, an app, or their own phone without using their own personal mobile phone number (Snell et al., 2020).

Other human service programs and health interventions have found texting to be a successful tool to enhance communication and impact client outcomes (Hall, Cole-Lewis & Bernhardt, 2015) and nudge families to engage in desired behaviors despite competing demands (Gennetian, Darling & Aber, 2017; Jacob, Berger, Hart & Loeb, 2016). For example, texting is increasingly used in health interventions targeting under-resourced, expectant, new, and/or experienced parents by delivering targeted, personalized text messages (Chen, Chai, Dong, Niu & Zhang, 2018). Texting has also been shown to be helpful for increasing engagement in, and completion of, parent training programs (Murray, Woodruff, Moon & Finney, 2015).

Perhaps most encouraging, randomized trials have found that texting families information about child development increases their home involvement (Doss, Fahle, Loeb, & York, 2019; Hurwitz, Lauricella, Hanson, Raden & Wartella, 2015; York, Loeb & Doss, 2019). Hurwitz et al. (2015) texted low-income preschool parents about learning activities over 6 weeks; parents who received the texts engaged in more learning activities, particularly fathers and parents of boys. As another example, the Ready4K! intervention (York et al., 2019) sent preschool parents 3 literacy texts per week for 8 months, which increased home and school involvement, as well as preschool and kindergarten gains in reading comprehension and other literacy skills (Doss et al., 2019). And, broader still, mobile technologies have reduced "summer slide" in elementary school (Kraft & Monti-Nussbaum, 2017), increased parent-child reading time (Mayer, Kalil, Oreopoulos & Gallegos, 2019), raised school performance, and lowered absenteeism (Smythe-Leistico & Page, 2018) in kindergarten as well as middle and high school (Bergman & Chan, 2021).

In some cases, effects of texting interventions have been more nuanced. In a study of pre-kindergarten children within a suburban school district, Cabell, Zucker, DeCoster, Copp and Landry (2019) did not find main effects of texting, but did find language-and literacy-related texts raised knowledge for more skilled children, while lower skilled children saw greater benefits from health-focused texts. The home-visiting-aligned texting program, PC Talk, also found no main effects on parent engagement, parent fidelity to program strategies, or child language, although families who received more messages were more likely to have positive program outcomes (Bigelow, Walker, Jia, Irvin & Turcotte, 2020).

Yet, none of these texting-based interventions have targeted vocabulary, nor have any studies examined the impact of aligning texted learning activities with what is being focused on at

school, particularly among under-resourced families. The goal of Text to Talk is to provide multiple, active interactions with words, across various contexts, caregivers, and time. We know from learning science and vocabulary-learning research that word-learning is dependent on multiple exposures to each word, including definitional and contextual information, and active, or deep, processing. If word-learning requires active interaction with a word, merely hearing the word once during a storybook reading at school will not be enough in many cases. In Text to Talk, children also receive opportunities to interact with vocabulary through caregivers' questions and discussion of pictures or videos illustrating the word, which allows for practice understanding and using new vocabulary and thus enhanced vocabulary growth. The goal of the intervention is to allow children to gain additional opportunities to process and practice new words, across time and across contexts, with multiple caregivers who know them well.

We aimed for Text to Talk to address this gap in the field, developing a feasible intervention in collaboration with teachers and families and rigorously testing its effectiveness.

Research questions

We conducted a random-assignment evaluation of the Text to Talk intervention, which included teachers and families from public school prekindergarten and Head Start programs in a large East Coast city, to examine the potential of texting for supporting home-school connection and child vocabulary learning in early childhood programs. The study aimed to answer the following questions:

1) Do children in Text to Talk increase their knowledge of the target words and of vocabulary in general, compared to peers?
2) Does participation in Text to Talk influence teacher communication and texting behaviors, and do Text to Talk teachers implement program strategies with fidelity (i.e., send families frequent, high-quality text messages about vocabulary)?
3) Are there effects of Text to Talk on home-school connection? Do families in Text to Talk report using the text message vocabulary with children? To what degree do they also support children's vocabulary more generally (e.g., conversations, book reading)?
4) Among project participants, does higher teacher fidelity and/or more family-reported use of the intervention predict vocabulary growth?

Method

Participants

All teachers in the urban school district's Head Start and public preK programs were contacted by the first author with the permission of the school district's Office of Early Learning and asked if they wanted to participate in the project. Forty-nine classrooms agreed, representing 35% of the total population of 140 classrooms. After consent, teachers were randomly assigned (via a random number generator) to treatment or control classrooms. Next, teachers were asked to recruit families to participate in Text to Talk and the study; teachers provided paper handouts with information about the project and study. Families in treatment classrooms could elect to receive texts from teachers without being enrolled in the study, but no data were collected on these families or their children.

Power analyses conducted during the study design phase (Optimal Design 3.01; Raudenbush et al., 2011) recommended an average of 6 children per classroom for adequate power with $\alpha = 0.05$ and an effect size of 0.40 with at least 90% probability. Due to ex-

pected attrition, teachers were encouraged to enroll at least 8 children and their families in the study; some enrolled as few as 4, while some enrolled all children in the class (up to 20 children). Up to 8 children were then randomly selected to be "study children;" these children were given the vocabulary assessments in the fall (pre-intervention) and spring (post-intervention), their families were given surveys in the fall (pre-intervention) and spring (post-intervention), and their teachers were surveyed in the spring (post-intervention) about each family's engagement with the program. In the final study sample, the average number of children per classroom was 6.3.

Control teachers received no information about Text to Talk. Control teachers could use texting, Remind, or another class messaging system if they chose (52% of control teachers reported messaging their students' families at least occasionally during the Text to Talk school year), but none sent vocabulary words home to families over the course of the school year.

In total, 173 treatment children (and 24 lead teachers) and 173 control children (and 25 lead teachers), and these children's parents or guardians, were enrolled at baseline in the study. All recruitment procedures and study methods were approved by the university's institutional review board (IRB).

Demographics of participants. See Table 1 for complete demographics of teachers, families, and students. See Table 2 for a description of classroom characteristics.

Teachers were predominantly female (48 females, 1 male). Most teachers were highly experienced, averaging over 16 years of experience. Nearly three-quarters had Master's degrees. Teachers reported on child gender (47.5% male and 52.5% female), child race (58.7% African American, 14.3% Hispanic, 8.9% White, 10.6% Asian, and 7.6% Other), and the predominant language spoken in the child's home (74.7% English, 9.9% Spanish, and 15.4% other). Teachers also provided the child's date of birth, which was used for the administration and scoring of the PPVT and to calculate their age as a control variable in the analyses. At the time of the baseline assessment, 26% of the children were 3 years old, 60% were 4 years old, and 14% were 5 years old.

Intervention procedures

The study took place over 7 months, with 1 month in the fall devoted to pre-testing, 5 months in the fall and winter to the intervention, and 1 month in the spring to post-testing. Teachers were recruited in August via an email request to participate in a study of texting and children's vocabulary development. A total of 49 lead teachers from 30 different schools were recruited and randomly assigned to the intervention (24 teachers) and control group (25 teachers). Since random assignment was performed at the classroom level, teachers in the same school could be assigned to different conditions.

Intervention teachers had a three-hour training in September explaining the rationale for, and evidence supporting, targeting vocabulary via texts, how to use a Remind account, and how to choose and send Text to Talk texts. A check-in training in January addressed emerging issues or concerns. Control teachers attended a three-hour September training on rationale and evidence for targeting vocabulary in the classroom but received none of the texting or logistical content, while their January check-in trained them on the unrelated matter of student motivation. In September, parents completed consent forms and family surveys. In October, study staff performed baseline measurements in intervention and control classrooms, including assessing children and recording a video of the teacher reading a book.

In November, treatment teachers began sending texts via Remind (or Class Dojo) to families. All teachers used the Creative Curriculum as a classroom curriculum guiding lessons (CC; Dodge

Table 1
Description of participants.

Teachers	Percentage
Gender	
Female	98.0%
Male	2.0%
Race	
African American	18.4%
Hispanic	6.1%
White	71.4%
Other	2.0%
Education	
BA only	26.5%
Master's	73.5%
Years of experience	
0–5 y	14.3%
6–10 y	10.2%
11–15 y	18.4%
16+ y	57.1%

Families	Percentage
Relationship to child participating	
Mother	82.3%
Father	11.7%
Other	6.0%
Age of family member	
Less than 20 years	1.5%
20–29 years	38.2%
30–39 years	43.8%
40–49 years	11.8%
50 years or more	4.4%
Education of family member	
No degree	10.2%
GED or high school	48.5%
AA or certificate	18.3%
BA	13.7%
Graduate degree or more	9.4%
Employment status	
Not working by choice	22.3%
Not working and seeking employment	12.7%
Working part-time	21.6%
Working full-time	43.4%

Children	Percentage
Sex	
Male	47.5%
Female	52.5%
Race	
African American	58.7%
Hispanic	14.3%
Asian	10.6%
White	8.9%
Other	7.6%
Primary language spoken at home	
English	74.7%
Spanish	9.9%
Other	15.4%

et al., 2010); they all had libraries of curriculum-recommended books and were required by the district to read three books every day. For Text to Talk, treatment teachers were instructed to choose one book they read that week, and send the two texts related to that book. Thus, teachers all had access to the same texts but sent only the sub-set that aligned with their instruction, in the sequence that matched their instruction. The only exception to this approach was that study staff asked all treatment teachers to send all 15 of the texts that included words from the "Target Word Assessment" to ensure that all treatment families received a "dose" of all 20 assessed target words via a text. Teachers were also free to send additional texts for other books as they chose. In sum, there was no classroom component to Text to Talk; instead, teachers texted families about vocabulary from CC books they were already reading in class.

Each week, Text to Talk implementation staff recorded which texts and words were sent by each teacher and if families responded to the texts. Remind and Class Dojo can translate texts into other languages; we did not explicitly track how many texts were sent in other languages.

Control teachers received no information about texting families generally, or texting vocabulary specifically, nor were they introduced to Remind or Class Dojo (although, as teachers, they did have access to any freely available service they wished to use). We asked treatment teachers not to discuss the intervention with the control teachers. Given how busy teachers are, and the fact that the treatment consisted of carefully crafted, weekly text messages only accessible by Treatment teachers, it is unlikely that any control teachers implemented the program.

Description of project

We originally planned to have teachers compose their own texts for one or two books they read each week, but pilot-testing during the previous year revealed that it was too challenging, and/or time-consuming for teachers to do on a weekly basis. Consequently, for each CC study, we reviewed all recommended books (approximately 7–20 per study), chose four words from each book, and created pre-written texts for those four words. The vast majority (90%) of the words selected were Tier 2 words (Beck, McKeown & Kucan, 2013).

For each book, we prepared a set of two texts. Teachers could send the texts at the same time or send the texts on two different days. Some teachers preferred sending the texts prior to reading a book and some after reading the book in class. The first text introduced the words, and the second offered family activities that featured the words. For example, from the book *Peeny Butter Fudge,* by Maya Angelou, the words patience, fudge, recipe, and rhythm were selected. The text read: "This week's words are patience, fudge, recipe, rhythm. Click here for definitions." Clicking that link took families to a Text to Talk website that provided child-friendly definitions, images of the words, suggested activities, and, if available, a link to the book being read. (Pilot testing showed that including this information directly in the text made the texts too long.) The second text featured an activity targeting one or more of the words. For example, the second text for *Peeny Butter Fudge* said, "Ask your child what a recipe is. Tell him or her what your favorite recipe is. If you have time, make the recipe together." Texts were constructed to be easy to read and understand, at a 3rd–5th grade reading level and were pilot tested with school district parents prior to the RCT. See Appendix for more detail about the content of the texts. Although Remind provides the ability for families to text back to teachers, we did not require families to respond by text to teachers as a component of the program, given the demands it might place on teachers' time.

Teachers could send the texts via Remind, used by approximately 50% of U.S. public schools at the time of the study (Remind, 2018), or Class Dojo. Family members could receive messages in their standard SMS message window, or in the Remind or Class Dojo app, obviating the need for a smart phone. All but one teacher chose to use Remind; one chose Class Dojo, a similar platform.

Ongoing technical assistance and implementation monitoring

The aim of this trial was to examine the efficacy of texting families classroom-aligned vocabulary words and activities to discuss with their children on a weekly basis. Teachers' messages were monitored by project staff for fidelity to the intervention and to record which messages and words (noting in particular the target words for our assessment) had been sent. When more than two

Table 2
Classroom characteristics (fall teacher survey, pre-intervention).

	Mean	SD
Number of children in class	17.4	3.5
	Percentage	
Number of parents in class with limited English proficiency		
None	26.5%	
1–2	14.3%	
3–5	24.5%	
6 or more	32.7%	
Not sure	2.4%	
Number of times a day teacher reads a book		
Once	4.1%	
Twice	14.3%	
Three or more times	81.6%	
Number of times teacher explains the meaning of a word from the book during a read-aloud		
A few times a week	10.4%	
At least once each read-aloud	27.1%	
Multiple times during a read-aloud	62.5%	

weeks had passed without teachers sending a Text to Talk message, the project director contacted the teacher and provided assistance if needed. This high level of implementation monitoring ensured that all families enrolled in Text to Talk received a minimum standard dosage of Text to Talk texts, thus giving all treatment children the possibility of being exposed to Text to Talk words at home, if their family members implemented the Text to Talk text activities.

Measures

Child vocabulary

Child knowledge of target vocabulary words was assessed at baseline and follow-up. *TWA – Expressive.* Twenty target words (taken from texts sent during the project) were selected for the Target Word Assessment (TWA). All the words were from books read at least twice in the Creative Curriculum; thus, both treatment, and control children would be exposed to these words during book reading or classroom activities during the day at school. The target words sent for the texting program were a mix of nouns and verbs, 90% of which were "Tier 2″ level words, but with a range in difficulty from easy (e.g., hammer) to challenging (e.g., algae). Words that were difficult to represent as a picture were not chosen (e.g. magnificent, bask, protect), and words were not chosen based on frequency of appearance in the books.

Target word images were selected from a web library of images; they were not images from the books being read in class, but they were the same images that had been used on the project website linked in the texts. These images were pilot tested with a group of 30 children to confirm that the children could identify what they were. The foils were randomly selected from the same library of images. Children were shown a picture of the word and asked, "What is this?" Children received 2 points for correctly naming a word.

PPVT. Immediately following this expressive target word assessment, child receptive vocabulary was assessed with the Peabody Picture Vocabulary Test-4 (PPVT-4; Dunn & Dunn, 2007). The PPVT has a high internal reliability (0.94) and test-retest reliability (0.93).

TWA – Receptive. Finally, the assessor returned to the TWA, and assessed the words the child had not known expressively. The target image was shown with 3 different foils and the child was asked to identify the target word. If the child identified the word correctly on the receptive portion of the TWA only, he or she received one point. The TWA had high internal reliability (alpha coefficient = 0.84) and test-retest reliability (fall and spring corre-

lation of target word measure total score = 0.78). Assessors were blind to children's treatment status. In addition, neither control nor treatment teachers were informed about which words were on the TWA.

Home-school connection. Teachers and families were administered the following surveys to measure home-school connection and family engagement around general home learning and project-specific vocabulary activities. All surveys were created by the Text to Talk research team, because to our knowledge, no measures had yet been established in the field.

Teacher communication. In the fall (pre-intervention) and spring (post-intervention), teachers were surveyed regarding the frequency with which they communicated with families via: speaking face to face; speaking on the phone; using a texting service such as Remind, Class Dojo, or other app; texting using a personal phone number (rather than an app such as Remind); emailing; and sending home notes or papers.

> *Family communication.* To measure family familiarity with texting, families were surveyed in the fall (pre-intervention) regarding whether they had ever received texts (via an app or their personal phone) from a teacher for their preK child, or any other child in their family. In the spring (post-intervention), we asked respondents if they had received texts from their child's preK teacher in the current school year; we assumed that all (or most) treatment families would answer "yes," but we wanted to assess whether control families had received any texts.
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> *Family beliefs about home-school connection, communication, and engagement.* We asked respondents in the fall and the spring to indicate their agreement (a 5-point Likert scale, from strongly agree to strongly disagree) with the following four statements: "It is important to me to be in communication with my child's teacher;" "I like to have ideas from my child's teacher about what to do at home to help my child learn;" "It is important to me to help my child learn;" and "It is important to me that my child is ready for kindergarten."
>
> *Family home learning activities.* On the fall and spring family surveys, respondents were asked the frequency (daily, few times a week, few times a month, not often, or never) with which they engaged in the following activities with their child: teach letter names; tell stories; help their child learn how to write words such as his or her own name; teach letter sounds; read books to their child; ask questions about the books they read; and explain the meaning or definition of new words to their child. We created a standardized index of home learning activities (Home Learning Index; HLI)

using these 7 items for the fall, and another for the spring. In the fall, the average interitem correlation was 0.42, and the scale reliability coefficient was 0.84. In the spring, the average interitem correlation was 0.50, and the scale reliability coefficient was 0.88.

Teacher vocabulary use during book-reading. Although the intent of the intervention was not to change teacher's instructional strategies or quality in the classroom, we recorded and coded a whole-class read-aloud in fall and spring for each teacher. The purpose of these videos was to examine whether there was any evidence that the intervention did in fact change teacher vocabulary use during book-reading. The book-reading video was transcribed, and the transcription was coded for: a) number of times a teacher defined a word or described the meaning of a word; b) number of times the teacher used a prop (e.g., toy, drawing, or photograph) to illustrate word; c) number of different words defined or described; and d) number of questions teachers asked children about the meaning of a word. We created a standardized index of vocabulary use during book-reading (Vocabulary Use During Book-Reading; VUDBR) using these four items for the fall, and another for the spring. In fall, the average interitem correlation was 0.35, and the scale reliability coefficient was 0.77. In spring, the average interitem correlation was 0.37 and the scale reliability coefficient was 0.80.

Implementation measures

Total words. As noted above, teachers were asked to text about one book each week and send all texts with words linked to the TWA. We tracked the total number of texts sent in the 5-month intervention window (November 1–March 31), the total number of weeks teachers sent a Text to Talk text in the 5-month window, and the total number of Target Word Assessment words sent by text. We created a teacher implementation index using the total number of words sent over the intervention, with "Low" implementation assigned to teachers who sent fewer than 100 words, and "High" to those who sent 100 words or more.

Text to Talk associated instructional strategies. Although we did not train treatment teachers in any classroom instructional strategies, we asked whether (yes/no) any of their classroom practices had changed, including "I spend more time teaching and talking about vocabulary words;" "I spend more time reading the Creative Curriculum books that had Text to Talk words;" and "I encourage children to practice using Text to Talk words in class." Reporting yes to any of the 3 behaviors yielded a score of 1, for a maximum of 3 points.

Family connectedness. Teachers were asked whether Text to Talk made them feel more connected with students' families (yes/no/not sure).

Satisfaction. We asked how satisfied teachers were with Text to Talk (5-point Likert scale, from very satisfied to very unsatisfied), whether they would continue to use Remind the next year (yes/no/not sure), and whether they would continue to use Text to Talk the next year (yes/no/not sure).

Family engagement (teacher report). Teachers were asked to report on the degree to which family members used Text to Talk by reading and talking with their child about the texts (all texts, most texts, some texts, no texts, or not sure). Teachers also reported on the engagement of the child's family in their preK education in general (very engaged, somewhat engaged, not engaged, not sure). Teachers reported as to whether they noticed the child learning Text to Talk words (all, most, some, none, or not sure). They also reported whether they noticed the child learning more words in general, compared to other children in the class (many more words, some more words, no difference, not sure). Using these four measures, we created a standardized index of family en-

gagement. Responses of "not sure" were coded as missing and not included in the index. The reliability coefficient of this index was 0.76. Teachers also reported on whether problems with reading or understanding English created any problems for the family's participation in Text to Talk.

Family engagement (family self-report). In the Spring survey, respondents were asked about *frequency*, or how often they did the following Text to Talk activities with their preK child (daily; a few times a week; a few times a month; not often; and never). The activities listed were all activities that had been suggested in various Text to Talk messages and included: "explain a Text to Talk word's definition or meaning;" "ask your child questions about a Text to Talk word;" "show your child pictures or objects of a Text to Talk word;" "Play 'I spy' or finding games about a Text to Talk word;" "make-up a game or play activity with a Text to Talk word;" "watch a Text to Talk story video on YouTube" and "look at a Text to Talk web page." We created a standardized index of these activities. The reliability coefficient of the family report of family engagement index was 0.89.

We also asked *when* families talked about Text to Talk words with their child. Respondents could indicate "at mealtime;" "at bedtime;" "while child is playing;" "while going or coming from school;" "while driving in a car;" "while on public transportation;" "while shopping;" "at a museum;" "at a library" and/or "other (please describe)." Respondents could also indicate "I did not talk about Text to Talk words with my child."

Respondents could also indicate *who*, among other family members, received Text to Talk texts, and did Text to Talk activities. Finally, respondents indicated how *satisfied* they were with Text to Talk, from very satisfied to very dissatisfied. All measures of family engagement were from family self-report. We were not able to track how many times families "clicked" on text messages, looked at web pages, or interacted with the activities in any way.

Missing data

In the current study, approximately 20% of children had incomplete child assessment data at one or both time points due to school absence or unavailability on the day of assessment or failure to reach basal on the PPVT, or because their families did not return surveys. Data were assumed to be missing at random (MAR), which requires that all variables associated with missingness are included in the imputation model and all other patterns of missingness are random (Graham, 2009). Analyses (Appendix Table A1) showed that students with missing data at the spring data collection point did not differ from the rest of the intervention sample in regard to age, gender, or parental education, English Language Learner Status, and fall PPVT score. Overall, rates of missing data were fairly low (Appendix Table A2) and there was no evidence of differential attrition or non-response by treatment status, and thus it was reasonable to assume that data were missing at random (Acock, 2012). Imputation was performed using the MI (multivariate imputation) command in StataSE 15 (StataCorp, 2017) for multilevel data (children nested in classrooms). Fifty imputed files were produced and results of each analysis of were pooled. Analyses using only observed data were conducted in parallel to identify any sensitivity to the imputations in the statistical conclusions (Appendix Table A3).

Results

Baseline comparisons and intraclass correlation coefficients

At the start of the study, we checked baseline equivalence between randomized conditions on all characteristics listed on Table 1, as well as pretest Target Word Assessment (TWA), PPVT,

Table 3

Regression predicting spring vocabulary and Home Learning Index (clustered by class).

	Target Word Assessment (Raw Score)	Target Word Assessment (Standardized)	PPVT	Home Learning Index
Treatment group	1.01*	0.17*	−0.89	0.05
	(0.46)	(0.07)	(1.17)	(0.08)
Fall Target Word Score	0.44**	0.44**		
	(0.06)	(0.05)		
Fall PPVT Standard Score	0.10**	0.02**	0.70**	
	(0.02)	(0.00)	(0.04)	
Child is male	−0.25	−0.05	−1.53	0.09
	(0.39)	(0.06)	(1.17)	(0.08)
Child's age (in years)	3.23**	0.51**	1.59	−0.01
	(0.45)	(0.07)	(0.96)	(0.06)
Child is ELL	−1.19*	−0.19*	−0.88	−0.12
	(0.49)	(0.08)	(1.68)	(0.09)
Parent education	−0.07	−0.01	0.45	0.03
	(0.19)	(0.03)	(0.57)	(0.03)
Fall Home Learning Index	0.39	0.06	−0.11	0.51**
	(0.27)	(0.04)	(0.85)	(0.08)
Constant	−9.02**	−3.75**	26.12**	−0.07
	(2.27)	(0.45)	(5.21)	(0.29)
Observations	309	309	296	300

Robust standard errors in parentheses.

* significant at 5%;

** significant at 1%.

Table 4

Teacher modes of communication with families.

	Fall (pre-intervention) (n = 49)			Spring (post-intervention) (n = 48)		
	Treatment Group	Control Group	t-test	Treatment Group	Control Group	t-test
Use of the following once a week or more:						
Remind or Class Dojo	13.0%	29.2%	N.S.	65.2%	34.8%	*
Texting	26.1%	40.0%	N.S	34.8%	36.0%	N.S.
Paper notes	26.1%	42.3%	N.S.	18.2%	16.7%	N.S.
Phone calls	30.4%	24.0%	N.S.	21.7%	20.8%	N.S.

* t-test difference $P < 0.05$.

and Home Learning Index (HLI) scores (Appendix Table A4). No between-group differences were found. Classroom intraclass correlation coefficients (ICC) were low, with ICCs of 0.05 for PPVT, 0.05 for TWA, and 0.13 for HLI.

Impact analyses (Question 1)

All impact analyses were conducted using regressions clustered by classroom, accounting for the nesting of teachers within, schools and controlling for pretest score. The treatment variables were coded dichotomously (treatment = 1; control = 0). All analyses were conducted using Stata/SE 15 (StataCorp, 2017).

Children's post-test scores were regressed on condition, controlling for pre-test scores, age, gender, whether the child was an English Language Learner, and the HLI. Impacts of Text to Talk were found for those words targeted by the intervention ($d = 0.17$; $P < 0.05$) but not generalized receptive vocabulary on the PPVT (see Table 3). On average, children in the treatment group gained 1.01 additional points on the TWA over the intervention, compared to the control group. On average, this amounted to an additional word learned receptively out of the 20 words sampled on the assessment.

Teacher communication and texting behaviors (Question 2)

In the fall (pre-intervention), there were no statistically significant differences in forms of communication between treatment and control teachers. In the spring (post-intervention), treatment teachers were much more likely to report using Remind or Class Dojo on a weekly basis (65%), compared to control teachers (35%).

There were no treatment-control differences in the frequency of use of other forms of communication (see Table 4).

Table 5 presents information on the 24 treatment teachers' texting behaviors. The mean number of words sent was 99, range 55–149 with a SD 23.9. Between November and March, the average treatment teacher sent a message for 15.0 weeks, with a range 6–20 weeks, and a SD of 3.4 weeks. On average, intervention teachers sent 90% of the texts that included words from the Target Word Assessment. Teachers reported that participating in Text to Talk resulted in more time teaching and talking about vocabulary words (67% agreed), more time reading the Creative Curriculum books that had Text to Talk words (43% agreed), and more encouragement for children to practice using Text to Talk words in class (74% agreed). Teachers also found the program made them feel more connected to families (78% agreed). However, there were no differences across conditions, or across time, in self-report on book reading frequency or on observed vocabulary-use during the teacher book-reading (Vocabulary Use During Book-Reading; VUDBR).

Effects on measures of home-school connection (Question 3)

First, we examined impacts on our more general four-item index of family beliefs about home-school connection, communication, and engagement. The mean score on this index was 3.9/4 (SD = 0.34) in the fall and the spring for both treatment and control families, and we found no evidence of an intervention effect on the index of family beliefs. There were also no impacts on the standardized 7-item index of home learning activities (Home Learning Index; HLI) (Table 3).

Table 5

Implementation data for treatment teachers (n = 24).

	Mean	SD	Min	Max
Total number of vocabulary words sent, from November to March (app data)	99.4	23.9	55	149
Total number of weeks between November and March that teachers texted a Text to Talk message (App data)	15.0	3.4	6	20
Average % of Target Words sent by teachers (App data)	90%			
More time teaching and talking about vocabulary words (Teacher report)	67%			
More time reading the Creative Curriculum books that had program words (Teacher report)	43%			
Encouraged children to practice using program words in class (Teacher report)	74%			
Did not change any classroom practices (Teacher report)	0%			
Felt more connected to families (Teacher report)	78%			

Table 6

Treatment family report of Text to Talk activities (n = 161).

	Daily	A few times a week	A few times a month	Not often	Never
Explain a Text to Talk word's definition or meaning	31.7%	50.3%	9.3%	7.5%	1.2%
Ask your child questions about a Text to Talk word	32.9%	47.2%	8.7%	8.1%	3.1%
Show your child pictures or objects of a Text to Talk word	31.7%	44.7%	10.6%	9.3%	3.7%
Play "I Spy" or finding games about Text to Talk words	23.0%	38.5%	13.0%	19.9%	5.6%
Make-up a game or play activity with a Text to Talk word	14.8%	38.9%	16.7%	21.0%	8.6%
Watch a Text to Talk story video on YouTube	15.5%	29.2%	18.0%	21.7%	15.5%
Look at a Text to Talk web page	14.3%	29.2%	12.4%	26.7%	17.4%

Table 7

Treatment family report of Text to Talk activities (n = 161).

	%
Location/Time of talking about program vocabulary words	
While going or coming from school	52%
At bedtime	46%
At mealtime	43%
While driving in a car	42%
While child is playing	34%
While shopping	22%
Other	15%
At a library	15%
While on public transportation	11%
At a museum	4%
Did other family members besides yourself talk about words with your child?	30%
Family was satisfied or very satisfied with program	90%

Second, we examined implementation of Text to Talk from family surveys and teacher report of family implementation. Treatment families reported performing the intended Text to Talk activities with fairly high frequency (Table 9). The most frequent activities were "explain a Text to Talk word's definition or meaning" (82% a few times a week or daily), "ask your child questions about a Text to Talk word" (80%), "show your child pictures or objects of a Text to Talk word" (76%). Families also reported playing "I spy" or finding games about Text to Talk words (62% a few times a week or daily), making up games or playing activities with a Text to Talk word (54%), watching a Text to Talk story video on YouTube (45%), and looking at a Text to Talk web page (44%).

We also asked families where and when they talked about Text to Talk words (Table 7). Families reported talking about the words in multiple locations and times, including going to/from school (52%), at bedtime (46%), at mealtime (43%), while driving in a car (42%), while child is playing (34%), while shopping (22%), at a library (15%), while on public transportation (11%), or at a museum (4%). The categories were not mutually exclusive but served to capture a description of various locations or times when vocabulary might be talked about. Families also could write in other places not listed (15% did), and this text entry included: anytime something

applies to the words; when we get a notification; in the morning; after nap; after school; during story-time; in the park; while taking walks; when playing words games; when doing homework with other kids; with other siblings; and at bedtime.

Finally, we asked teachers to report on families' engagement in Text to Talk (Table 8). Teachers reported that 57% of children's families read and talked about all or most texts with their child; 18% some texts, 2% no texts, and 23% were not sure. Teachers reported that 94% of families were somewhat or very engaged in their child's overall preK education. Teachers reported that 36% of children learned most or all Text to Talk words, 44% some, 14% none, and 7% not sure. Teachers were also asked whether a child learned more words in general, compared to other children in the class; 29% said many more words; 44% said some more words; 22% said no difference; and 5% said they were not sure.

Fidelity and word learning among treatment children (Question 4)

To answer this question, we performed 4 additional regressions using only children in the treatment group. We ran the same models as above, with Target Word Assessment, Spring PPVT, and Home

Table 8
Treatment teacher report on families (*n* = 140).

	%
How much did child's parent (or family members) use Text to Talk? Did they read and talk with their child about:	
All texts	29%
Most texts	28%
Some texts	18%
No texts	2%
I'm not sure	23%
Overall engagement level of child's family in preK education	
Very engaged	56%
Somewhat engaged	38%
Not engaged	6%
I'm not sure	0%
How many program words did child learn?	
All words	10%
Most words	26%
Some words	44%
No words	14%
I'm not sure	7%
Did child learn more words in general, compared to other children in class?	
Many more words	29%
Some more words	44%
No difference	22%
I'm not sure	5%
Problems with reading or understanding English create problems for family's participation in Text to Talk	
Many problems	2%
Some problems	6%
No problems	82%
I'm not sure	9%

Learning Index as outcomes, but added one of the following implementation measures: (1) the teacher implementation index (high vs low number of words sent), (2) teacher report of classroom behaviors (total number of project-related classroom behaviors), (3) teacher report of family engagement index (TRPEI), and (4) family report of family engagement index (FRFEI).

Regarding (1) teacher implementation, because we provided oversight on texting, there was little variation in teacher fidelity in sent target words (i.e., on average, teachers sent 90% of the words target words). Most (87.5%) of teachers sent 85% or more of the target word texts. More than half of the teachers sent all 20 target words. However, we performed the same regressions as our impact analyses, only with treatment children, and we added each of the following variables separately: the total number of target words that teachers texted over the course of the experiment ($b = 0.43$, $P = 0.57$), the total number of all words that teachers sent ($b = 0.01$, $P = 0.73$). We found no evidence that any of these measures were associated with increased growth in child target word knowledge.

Similarly, (2) we tested whether the summary variable of Text to Talk-associated instructional strategies was linked to child word learning, finding null effects ($b = -0.22$, $P = 0.61$).

Our next set of analyses (3) suggested that the index measure of teacher report of parent engagement in the program was predictive of growth in Target Word scores as well as the PPVT among treatment group children. Even controlling for Fall Target Word Score and Fall PPVT Standard Score, the TRPEI predicted a $d = 0.17$ ($P < 0.05$) higher score on the Target Word Assessment. Controlling for baseline PPVT, the TRPEI predicted 3.94 additional points on the PPVT ($P < 0.01$). The TRPEI did not predict improvements in the Home Learning Index.

Interestingly, (4) family report of their own engagement (FRFEI) was not predictive of word growth or the home learning index.

Discussion

Text to Talk was designed to bridge the home-school gap for vocabulary learning. Vocabulary words taught in preschool classrooms were texted to families along with supporting information to help families talk with their children about the words. Findings reveal that children in the intervention group learned significantly more target words than children in the control group ($d = 0.17$), even though all children were exposed to the target words as part of the Creative Curriculum. There were no differences in the intervention vs control groups on the standardized measure of receptive vocabulary (PPVT). Interestingly, families whom teachers perceived to be more engaged with the texting had children who advanced more on the target word and standardized assessments.

Effects on child outcomes. As research and theories of word learning suggest, providing efficient, meaningful ways for parents to talk with their children about words that they are learning in school can promote children's vocabulary development (Hoff, 2003; Rowe & Snow, 2020). Children's exposure to, and application of, new words and concepts across contexts and time, supported by caring adults who share cultural activities, experiences, and knowledge, can help them better understand, remember, and use and apply the new information they are learning in school (Gonzalez et al., 2005; Leech et al., 2018; Rowe, 2018; Schwab et al., 2018).

These results suggest that Text to Talk families can successfully reinforce words used in classrooms at home, enhancing children's word learning. We note that the significant effects on target words are promising but small, with an effect size of $d = 0.17$ on target vocabulary. Given the absence of main effects for the standardized (PPVT) outcome, it is likely that the intervention is not intensive enough in promoting families to not only talk about the words that they were tested but also vocabulary words more generally.

Table 9

Teacher report of treatment family engagement as mediator of outcomes.

	Target Word Assessment Std Score	Target Word Assessment Raw Score	PPVT	Home Learning Index
Teacher Report of Family Engagement Index (Spring)	0.17*	1.11*	3.94**	0.04
	(0.06)	(0.40)	(1.00)	(0.09)
Fall Target Word Score	0.40**	0.41**		
	(0.08)	(0.08)		
Fall PPVT Standard Score	0.02**	0.10**	0.63**	
	(0.00)	(0.02)	(0.06)	
Child is male	0.04	0.29	−0.07	0.03
	(0.10)	(0.60)	(2.12)	(0.12)
Child's age (y)	0.49**	2.90**	0.94	−0.07
	(0.07)	(0.44)	(1.85)	(0.10)
Child is ELL	−0.26*	−2.02**	−1.97	0.05
	(0.11)	(0.60)	(2.36)	(0.13)
Parent education	−0.02	−0.15	−0.54	−0.02
	(0.04)	(0.24)	(0.79)	(0.05)
Fall Home Learning Index	−0.04	−0.20	−0.77	0.47**
	(0.08)	(0.51)	(1.48)	(0.11)
Constant		−6.25*	36.99**	0.34
		(2.45)	(10.69)	(0.44)
Observations	149	149	139	150

Robust standard errors in parentheses.

* significant at 5%;

** significant at 1%.

These findings are consistent with the majority of vocabulary interventions which demonstrate target word learning but no increases in standardized measures of vocabulary (Wasik, Hindman & Snell, 2016). It is possible that parents may need more explicit, nuanced, or extended training, coaching, and/or practice with how to best talk with their children about new vocabulary words to further increase children's word-learning. Interestingly, although the program's texts and website content were explicitly focused on vocabulary and word meanings, in exploratory ethnographic and qualitative research with similar populations of parents, we have found that many families are very interested in advancing their children's code-related skills and reading fluency, but vocabulary knowledge is of less central focus.

Further work is needed to identify how to best communicate to parents about how children develop early language and vocabulary skills, and how these foundational skills shape future success in reading and school more broadly; perhaps more importantly, more work is needed to identify how to best support and encourage parent-child behaviors and activities that support child language and vocabulary learning over early childhood and beyond.

There were also no impacts on parent-report of home learning behaviors. Due to the already very high self-report of learning behaviors at baseline, it is possible that any potential impact of Text to Talk on the broader home learning environment was subject to a ceiling effect due to the self-report measure utilized in this study.

Usability among teachers. The demonstrated impacts on child vocabulary are aligned with high scores on administrative and self-report measures of teacher fidelity to the program. Treatment teachers were able to successfully implement the program using the texting services, Remind and Class Dojo, sending an average of 99 words over the course of the intervention. Text to Talk teachers did receive implementation support from the program; project staff monitored whether texts had been sent each week, and reminded teachers to send them if they had not. Although most teachers had not previously used texting or texting-based services with their classes, they were successful at using the intervention. Treatment teachers were much more likely to report using Remind or Class Dojo on a weekly basis, compared to control teachers.

However, there were no treatment-control differences in the frequency of use of other forms of communication. That is, there were no negative treatment impacts on face-to-face communication, use of phone calls, or paper. This suggests that texting services such as Remind and Class Dojo served as complements to existing forms of home-school connection and communication rather than "crowding out" analog approaches. Text to Talk teachers' relative ease of use of the Remind and Class Dojo software demonstrate the potential for technology-facilitated home-school interventions in early childhood settings (Bergman & Chan, 2021; Doss et al., 2019). The intervention itself was designed as a simple, easy to use, curriculum-aligned "nudge" to facilitate teacher implementation. Text to Talk used ready-made texts aligned with the school district's pre-K curriculum, making it easier for teachers to implement with fidelity. This is a beneficial aspect of the intervention especially because it limits the burden on the teacher with the promise of improving child outcomes. However, we note that because Text to Talk was a curriculum-aligned vocabulary intervention, this also means that Text to Talk would likely not be as effective if not paired with classroom instruction of the same vocabulary words sent over text, but further research needs to be conducted to substantiate this claim.

Usability among families. Overall, families reported high rates of engagement with Text to Talk messages and activities. Four out of 5 parents reported explaining Text to Talk words and meanings and asking questions about program words at least a few times a week. More than three-quarters showed children pictures or objects of Text to Talk words on a weekly basis, while more than half reported playing games using the words with their children. This suggests that parents want to be engaged and Text to Talk – or other texting-based programs - can support these efforts. We did not find, however, that parents who reported higher levels of Text to Talk activities had children with larger increases in vocabulary scores, nor were parents' self-reports of engagement in activities correlated with the teacher report of how frequently a family used texts.

In contrast, teacher report of overall parent engagement in their children's learning was predictive of increased target vocabulary growth. Children whose parents were rated by their teachers as being 1 SD higher in parent engagement saw an additional $d = 0.17$ increase in target word learning. This measure of parent engagement was also predictive of growth in the PPVT, so it is likely that it is not just capturing parent engagement in Text to Talk, but parent engagement in children's learning in general. These findings suggest that family engagement with word learning that is aligned with words presented in school may have an impact on

children's vocabulary development. The findings may also illustrate the "Matthew Effect," where "the rich get richer, and the poor get poorer" (Merton, 1988; Stanovich, 1986). In the current study, it was children whose families were more involved, who benefited the most from increased teacher-parent communication and parental involvement at home. We note, however, that the parents and families being served in the school district pre-kindergarten program in this sample are predominantly low-income. It may indeed be the case that those low-income parents who are already involved with their children's schooling are the ones most likely to take-up additional programming, but it is not accurate to describe the sample as "rich" or well-resourced.

Our findings highlight the promise of "light touch" interventions in supporting effective family-school engagement programs (Doss et al., 2019; Hurwitz et al., 2015; York et al., 2019). Although Text to Talk was easy for teachers to implement and parents to use, it did result in improved outcomes for children, although of a relatively small amount. Importantly, the intervention was also low cost in terms of financial resources (i.e., a free app and based on books that teachers already had in classrooms) as well as teacher time. Perhaps, through training, parents could be taught to focus on the conceptual understanding of words and, this, in turn, may increase children's word learning.

Limitations

Several limitations constrain the findings and implications of the current study and provide avenues for future research. First, the program was implemented in only 49 classrooms. This limits our ability to detect smaller-sized effects on outcomes of interest. Second, random assignment was conducted at the level of the classroom, despite some classrooms being in the same school. This could lead to treatment contamination, if control teachers used the program in their classrooms. We instituted several safeguards against contamination, by asking treatment teachers not to share the intervention with control teachers. In addition, control teachers were told they would be free to use the intervention the following school year. A year-end survey showed that no control teacher used Text to Talk and that rates of texting were far lower among control teachers than treatment teachers. Third, this study followed teachers and children over 5 months; it would be important to study how change might continue to occur over an entire school year, or years, or perhaps even more important, how change could be sustained after the intervention was complete. Fourth, the study relied on parent report of engagement with project activities and other home learning activities and teacher report of parent engagement in the project. Future research should aim for these to be complemented with observational measures or administrative measures of engagement with the intervention. Fifth, Text to Talk's texts and materials were mainly in English. A few teachers occasionally translated texts into Spanish if they had a predominantly Spanish-speaking class, but most teachers did not. Given approximately 25% of sample families did not speak English as their primary language, future work should consider whether the texts and materials would be more efficacious if translated for non-English speaking families. Sixth, the sample could be biased toward families willing to sign a consent form. These families might be more engaged and willing to participate than families who did not sign a consent form. Finally, the current data are drawn from one community; future work might replicate this study in other preschool sites. The intervention was able to be systemized because all classrooms in the school district used the same curriculum; this would be more challenging in a school district that did not use the same books, although we should note that most of the books used for Text to Talk text messages are popular preschool read-alouds, and

program scale-up would be feasible in schools or districts that used a different curriculum.

Nature of the Text to Talk intervention

An important issue is whether Text to Talk is a home-school connection intervention aimed at changing parent behavior, or whether it changes both teacher behavior and parent behavior. The goal of the program was to inform parents what children were learning about at school and to encourage them to talk about these new ideas and words at home to help children learn the words. The program did not ask teachers to do anything differently in the classroom. Teacher self-report and observational measures indicated that neither treatment nor control teachers changed day-to-day practice in reading aloud or defining vocabulary words over the course of the intervention. Future work could test whether the effectiveness of Text to Talk could be further enhanced with additional classroom components, by asking teachers to give additional emphasis to Text to Talk vocabulary words during book-reading, circle time, or other small group activities.

Relatedly, is Text to Talk a child- or a family- intervention? Theoretically, could children have learned the words if their parents merely pointed them to the project website? This seems unlikely, as the written component of the project website (the definitions and suggested activities) would be mostly inaccessible to the children. The website did have pictures and a YouTube video of the book being read aloud. However, we believe that merely looking at images of the vocabulary words, or a video of a book being read-aloud, would not have been a strong enough treatment to have resulted in child language gains. The parent implementation data (Table 6) also suggest parents were more likely to talk about the words and the definitions with their children rather than merely looking at the website.

Although the study did not find impacts on parent-report of home learning behaviors, this could be because of the ceiling effect for these measures. Both treatment and control parents scored themselves high on these measures at the beginning and end of the intervention, thus there was no room for there to be an impact. This means that we were unable to test whether this measure mediated impacts on child target word vocabulary. However, implementation measures of the actual activities targeted by the intervention (i.e., teacher report of parent engagement with the intervention) did predict more target word learning (over and above the main effect of the intervention) as well as increases in the PPVT, a standardized measure of receptive vocabulary.

Although we were unable to verify that teachers had in fact read the book for which they sent texts, we note that teachers in this school-district associated program were required to read three times a day, were required to use the Creative Curriculum and its books, and had a fair amount of oversight and support so as to achieve these goals; it seemed unlikely that they were not reading the books they were assumed to be reading.

Implications and directions for future research

Results from this study suggest texting can be a promising tool in the service of supporting families and their children's development. Many other home-school programs experience high (e.g., 50% or more) attrition rates, indicating that implementation is challenging especially for families who face many stressors, or for teachers, who are asked to do too much, or asked to do things that do not align or complement their current practice or curriculum. In Text to Talk, less than 1% of families requested to stop receiving texts, and teachers also found the intervention relatively easy to implement, with all but one teacher planning to continue to use the program in the following year. In Text to Talk, teachers merely

had to send texts that were aligned with what they were already doing in class. It is critical to recognize, however, that the intervention was paired with a district-wide curriculum and classroom instruction that included exposure to the vocabulary words in the classroom setting through teacher book-reading. Sending the vocabulary words, without them also being presented in the classroom through books, may not be nearly as effective.

These findings indicate the promise of Text to Talk. Future research, however, can aim to further boost the effectiveness of the program. One possibility would be to enhance the program with more explicit, curriculum-aligned guidance on precisely *how* parents might most effectively talk about Text to Talk words with their children; for example, the program could provide video demonstrations of step-by-step procedures to use with the texts and activities. Furthermore, Text to Talk only targeted vocabulary. It would be interesting to see whether a more expansive program, targeting other literacy skills, such as phonological awareness, or math or social-emotional skills, could lead to gains in other kindergarten readiness skills. Alternatively, Text to Talk could be tested with a more comprehensive teacher professional development program targeting vocabulary instruction during read-alouds, large group, or small group instruction. Such a pairing could increase program effectiveness. In most cases, merely hearing a new vocabulary word once during a storybook reading will not be enough to understand its meaning, or know how to use it in context (Rowe & Snow, 2020).

Conclusions

Text to Talk is designed to bridge the school--home learning gap by sending families texts about vocabulary words their children are learning in school. Most early childhood programs have not engaged families as partners in vocabulary teaching and learning (Snell et al., 2020); Text to Talk serves as the first school-home aligned texting intervention focused on vocabulary, guiding families in focusing on classroom vocabulary at home to provide extra practice through extended interactions, with rigorous, experimental evidence of effectiveness for children's vocabulary.

Authors' contribution

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ecresq.2021.12.011.

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