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ABSTRACT

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Supporting Parenting through Differentiated and Personalized Text-Messaging: Testing Effects on Learning During Kindergarten

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Abstract: Recent studies show that texting-based interventions can produce educational benefits in children across a range of ages. We study the effects of a text-based program for kindergarten parents, distinguishing a general program from one that adds differentiation and personalization based on the child's developmental level. Children in the differentiated and personalized program were 50 percent more likely to read at a higher level ($p<0.01$) compared to the general group; and their parents reported engaging more in literacy activities by 0.31 standard deviations ($p<0.01$) compared to the control group. Effects were driven by children further from average levels of baseline development.

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Introduction:

Educational interventions based on behavioral economics principles have shown promise for combatting some of the persistent disparities in education outcomes. Some of these interventions focus on helping participants hold their attention to tasks that need to be completed repeatedly over long periods of time (Bergman 2016). Others provide small bits of information regularly with easily operationalized tasks in order to overcome both information asymmetries and the cognitive load required for behavior change (York, Loeb, and Doss 2016). This information and support encourages parents and students to behave in ways that are more consistent with positive educational outcomes. Researchers have fielded successful interventions at all levels of education ranging from prekindergarten (York, Loeb, and Doss 2016), to K-12 (Kraft and Rogers 2015; Bergman 2016), to the transition to college (Hoxby and Turner 2013; Castleman and Page 2015). Such programs provide researchers with opportunities not only to directly support students and parents but also to test the mechanisms underlying these support programs due to their low cost and ease of implementation.

This study aims to identify the importance of personalization and differentiation within a text-messaging program for parents of young children. Personalization conveys a combination of child-specific information and a potential increased sense of familiarity. It may provide parents with better information and encourage a sense of connection that could lead to greater incentives for behavior change. Differentiation provides activities for parents that are more targeted to their child's level of development and thus is potentially more effective for generating learning gains. Differentiation may, in turn, also encourage parents to engage more with the program if their children more successfully complete the developmentally appropriate activities. On the other hand, if program-inspired behavior change comes solely or primarily from holding attention through

regular reminders ("nudges"), we would not expect either differentiation or personalization to affect program effectiveness.

We field a randomized control trial to explicitly test the additional benefits of differentiating and personalizing information in a program for kindergarten parents modeled after the original READY4K! program for prekindergarten parents. The READY4K! program has been shown to increase the number academic activities done at home with parents and in turn to increase some pre-literacy skills of children (York, Loeb, and Doss 2016). This study follows participants of the original experiment into their kindergarten year, recruits additional kindergarten families, and randomizes families to receive control text messages unrelated to literacy, general literacy texts, or literacy texts that are differentiated and personalized.

We employ a "light touch" differentiation and personalization that leverages extant data to adjust text messages. We personalize the texts by informing parents how well their child knew a particular skill based on the child's performance on formative assessments. We then differentiate the texts by aligning the activity more closely to the child's skill level. Through this experimental design we are able to test whether the differentiated and personalized information provision generates a greater parental response and greater academic gains in reading when compared to a general provision of information. Thus, we are able to identify the causal effect of differentiation and personalization separate from the effect of information provision alone.

We find that differentiation and personalization increases parental take up of the program as measured by parental surveys and increases the reading ability of students as measured by district assessments. Specifically, differentiation and personalization caused students to be 50 percent more likely to move up a reading level than their peers in the general program ($p<0.01$), with the academic effects particularly pronounced for students in the bottom and top quartiles of

the baseline skill distribution. The differentiated and personalized texts also positively affected parents reports on the ease of building reading skills by 44 percent of a standard deviation ($p<0.01$) when compared to the general texting program, while increasing parental engagement in literacy activities with their child by 31 percent of a standard deviation ($p<0.01$) when compared to the control group. The greater amount of information in the texts, however, may have caused parents to visit the school less often, as reported by teachers in surveys.

2. Background

Recent experiments in education have demonstrated that parent texting interventions containing student-specific information, sometimes combined with targeted support, are effective in improving students' educational outcomes from attendance, to homework completion, to the transition to college. On the K-12 level, Bergman (2016) used a combination of email, text messaging, and phone calls to inform parents of their child's missing assignments. The information given was student-specific and very detailed, often containing specific class assignments and page numbers, and clearly personalized for specific parents and students. The intervention led to a 21 percent of a standard deviation increase in student GPA, a 25 percent increase in assignment completion, and a 28 percent decrease in classes missed. Kraft and Rogers (2015) used the same three mediums of communication to establish weekly teacher-parent communication in the summer school context. In one treatment arm teachers conveyed positive messages regarding their child's behavior and academic performance. In another treatment arm, teachers highlighted areas where the child could improve. The authors found that this intervention increased the probability of passing the summer school class by 6.5 percentage points – a 41 percent reduction in failing the class. The results were driven mostly by the child-specific suggestions parents received on where

the child could improve. Receiving positive information regarding child-specific successes produced positive, though imprecise, point estimates.

Texting has also been done at the post-secondary level. Castleman and Page (2015) fielded an intervention to help ease the transition to college for new high school graduates. A text messaging arm of the treatment sent differentiated and personalized reminders during the summer regarding deadlines for filling out the required paperwork to matriculate into college. The information in the messages was specific to the requirements of the college in which the student was accepted and planned to matriculate. Students received reminders to access important paperwork, register for orientation, register for placement tests, complete housing forms, and complete health insurance forms. If a student needed help, they could respond to the text message to receive personalized guidance from their assigned counselor. A second treatment arm used in-person peer mentors that reached out to students directly to offer help in completing the required tasks. The authors conclude that both treatments increased college enrollment among students who had less access to college counseling during the academic year.

Unlike the prior three studies, the READY4K! experiment conducted in the prekindergarten context provided a more generic, though detailed, parenting curriculum. Families in the treatment group received three literacy texts per week for eight months. The program provided a parenting curriculum focused on early literacy development and was designed to break down the complex task of engaging in academic activities with a child into small, easy-to-achieve steps. Over eight months these simple activities led to substantial increases in literacy development. The program, implemented in the San Francisco Unified School District (SFUSD), increased take up of home literacy activities and parental involvement in schools by approximately

20 percent of a standard deviation and increased some pre-literacy test scores by approximately 15 percent of a standard deviation (York, Loeb and Doss 2016).

The current study seeks to add to this line of literature by testing whether texting programs are more effective because they hold individuals' attention over a period of time (a "nudge") or because they provide personalized and differentiated information to program participants. In this vein, we test whether differentiating and personalizing the READY4K! intervention increases (or decreases) program effectiveness. We personalize the text messages by providing information to parents about their child's skill level, as measured by formative assessments already administered by the district. We differentiate the text messages by providing parents a literacy activity tailored roughly to their child's skill level. The motivation for this light-touch personalization and differentiation is based on Vygotsky's concept of the Zone of Proximal Development. According to Vygotsky, students advance in knowledge when adults teach concepts that are slightly beyond, but still close to, the student's ability. Adults can promote learning gains for children with proper scaffolding and guidance as they teach these concepts (Vygotsky 1978a, 1978b).

Formative assessments provide useful information to parents and teachers on where a child's Zone of Proximal Development may lie so as to more efficiently teach students. Many studies have shown that the use of formative assessments and data can improve the educational outcomes of children. In a meta-analysis of studies conducted between 1988 and 1998, Black and William (1998a, 1998b) find that the use of formative assessments can increase student performance by 40 to 70 percent of a standard deviation, with effects especially prominent for low-performing children. In kindergarten, benefits of using formative assessments have been seen in reading, math, and science outcomes (Bergen and Sladeczek 1991). Researchers have used formative assessment systems to guide instruction in first and third grade and found that it benefits

reading ability and comprehension (Connor et al. 2004a, 2004b, 2007). Even training district and school leaders to use formative assessment can lead to school reform that ultimately improves student performance (Carlson et. al. 2011).

Grouping of students by ability within classrooms has been demonstrated to be a practical and effective way to tailor instruction and activities to students whose Zone of Proximal Development lie in approximately the same place. Kulik and Kulik's (1984, 1992) meta-analyses of ability grouping in elementary schools found that within-class grouping increases performance on achievement tests by a quarter of a standard deviation and benefitted all students, regardless of their academic strength at baseline. Slavin's meta-analysis (1987) and own study (Slavin and Karweit, 1985) of elementary school grouping practices came to a similar conclusion. More recently, Robinson (2009) found that within-class grouping benefits Hispanic language minority students in kindergarten and first grade, but that the effect fades if grouping is not continued. The results, however, are not uniformly positive. A meta-analysis of within-class grouping by Lou et al. (1996) found that homogenous grouping leads to achievement increases but those benefits are seen by medium ability students only, and that low ability students are slightly hurt by the grouping. Overall, the research provides evidence that within-class ability grouping can help some teachers produce better educational outcomes.

While this approach has been successful in teacher practice, this study tests whether these concepts can be extended to parent-child academic interactions. In order to differentiate the texts, we use formative assessments to place students into one of four ability groups for a given skill. We use four ability groups due to the feasibility of implementation and ability to meaningfully differentiate the tasks among different levels. In our study, we will be unable to directly disentangle the effect of differentiation and personalization, though we explore if the intervention was more

successful for students of average baseline ability or for students who started at the tails of the baseline ability.

Motivation to personalize the texts rests on the theory that a child's academic outcomes may improve if the mere knowledge that the texts are tailored to a child induces the parent to engage with the texting program more regularly. To our knowledge no study has tested to see if the personalization of interventions engenders more trust and fidelity to treatment from participants. However, behavioral economics has produced a robust line of literature that shows that how information is presented to people affects subsequent behavior. For example, the social norms literature shows that presenting someone with information on their peers' behavior can lead to lower energy use (Allcott 2011), increased savings (Kast et al. 2012), increase charitable giving (Frey and Meier 2004), and voter turnout (Gerber and Rogers 2009). The text messages in this experiment do not provide information about the behavior of the parents' peers, but do provide information about the parents' child. Receiving this information may induce the parents to interact with the texts and activities to a greater extent.

Though theory and prior studies predict that the personalized and differentiated program should produce differential parent and child outcomes, this will be the case only if the program does more than merely maintain a parent's attention or "nudge" a change in behavior via reminders. Prior literature has shown that simpler "nudge" type interventions have been effective in promoting weight loss (Patrick et al. 2009), smoking cessation (Rodgers et al. 2005), controlling glycemic levels (Yoon and Kim 2008), and maintaining a medication regimen (Petrie et al. 2012). A significant, differential effect of the personalized and differentiated version of the text messages will provide evidence that parents are actively engaged with the program content. The program can reduce the cognitive load inherent in parenting, provide novel information to parents, engender

a greater fidelity to the program through personalization, or improve outcomes through a developmentally appropriate form of the activity, only if parents absorb the content of the messages.

3. The Intervention

This study is an extension of the READY4K! intervention run in conjunction with the San Francisco Unified School District (SFUSD) starting in the 2013-2014 school year. In the original program, treatment families received three texts per week. The "FACT" text was sent on Mondays and informed families of the skill of the week and the importance of that skill for the academic growth of their child. On Wednesdays families received a "TIP" message that suggested a home literacy activity based on that skill. These literacy activities were meant to fit into the parents' day and to capitalize on items and materials found in their home and neighborhood. The activities were designed so that parents would not need to purchase any materials and so the activities would fit into everyday life as seamlessly as possible, requiring little time of parents. These "TIP" texts aimed to provide an easy choice to parents and thus reduce the cognitive load inherent in parenting that stems from making multiple and ambiguous choices. Finally, on Fridays, families received a "GROWTH" text that contained a more advanced activity that was meant to extend the learning opportunity presented earlier in the week as well as encouragement aimed to provide some immediate gratification. Control families received one text every two weeks that contained general district information and did not promote parent-child interactions. The eight month long program touched on a variety of pre-literacy skills such as letter recognition, letter sounds, rhyming, and early literacy behaviors. Participants could choose to receive the texts in English, Spanish, or Chinese (York, Loeb, and Doss 2016). For this study, we built on the original READY4K! format of FACT/TIP/GROWTH but created new texts to match the skills covered in kindergarten. We

created both a generic version and a differentiated and personalized version targeted to students' developmental level.

To field the study we followed the original participants into their kindergarten year and recruited more of their kindergarten peers. The original participants in the control condition remained in the control condition in the second year. The original participants in the treatment condition were re-randomized to either continue receiving general literacy texts or to receive differentiated and personalized literacy texts. Newly recruited participants were randomized to receive either general literacy texts, differentiated and personalized literacy texts, or control texts. To keep the proportion of families treated the same in each cohort, half the new participants were randomized to receive control texts, and half were randomized into the two treatment arms.

To recruit new participants in the study, we worked with parent liaisons in each elementary school. In August 2014 we provided a brief training to liaisons to explain the study, its purpose, and provided materials with which to recruit families. Through their regular course of business, liaisons recruited families to participate in the study. Families that consented to participate completed a baseline survey to elucidate their home literacy habits and the skill level of their children on a variety of literacy skills. We used some of the same questions from the baseline survey in the original year so that we could pool answers between cohorts and use the responses as covariates in an effort to increase the precision of our estimates. As an incentive, liaisons were paid $10 for every family they recruited into the study. Participants in both the treatment and control conditions were paid $10 a month as long as they remained in the program, with the aim of covering texting costs for parents without unlimited texting plans.

We began texting at the end of October 2014 and continued for ten months. We used fall first grade literacy assessments as the primary outcome of interest. Details regarding the three randomized conditions are as follows:

(1) *Differentiated and Personalized Text Treatment:* Treatment followed the same general design as the first year of the experiment. Families received three texts a week: a "FACT" text on Mondays, a "TIP" text on Wednesdays, and a "GROWTH" text on Fridays. Only the TIP and GROWTH texts were differentiated and personalized using child level formative assessment data on skills that corresponded to the week's topic. The literacy texts reviewed skills from prekindergarten such as letters, letter sounds, and rhyming. Then they eased parents into asking their child to read and helped parents teach their children to read with greater accuracy and comprehension. Figure 1 presents the differentiated and personalized versions of the texts (see Figure A1 for additional examples). We insert two pieces of information in the TIP texts. First, we personalize the texts by giving parents an indication as to where their child falls in the distribution of skills. As seen on Figure 1 we indicate that the child is "beginning" to learn the skill, "growing" in their knowledge of the skill, has a "solid" understanding, or has a "strong" knowledge of the skill. We positively framed each text so that parents of children on the lower end of the distribution would not become frustrated. This framing is akin to an "injuctive norm" in the behavioral economics literature. Additionally, the texts are differentiated such that parents receive one of four different activities based on their child's prior academic information. At first we used parental responses from the baseline surveys, and once available, we switched to data from the fall, winter, and spring administrations of the Fountas and Pinnell Benchmark Assessment System (BAS) administered by the child's kindergarten teacher. We identified the relevant skill for each week as measured by the BAS and divided the skill's scale into four equal intervals. Students scoring in

each interval received different TIP and GROWTH texts. Those on the lower end of the distribution received easier versions of the TIP and GROWTH, while those at the upper end of the distribution received more advanced versions of the activities. A child was not necessarily in the same category each week because a child may be weaker on one skill, but stronger in another.[3] The information in the TIP text often would not fit into one text. In those cases, families received two texts on Wednesday, one right after the other. This means that families in this condition received one extra text message per week.

(2) *General Text Treatment:* The families randomized into the general text treatment also received FACT, TIP, and GROWTH texts each week. The FACT texts were identical to those received in the differentiated and personalized text condition. The TIP and GROWTH texts, however, did not include the strength of their children on the particular skill, and every family in this condition received the same exact activity. The activity was most often similar to, if not the identical to, the activity given to families in one of the middle two groups in the differentiated and personalized text treatment. This treatment condition is directly analogous to the original texting experiment. Examples of the general texts are given in Figures 1 and A1.

(3) *Control Text Condition:* Families in the control condition received one text, every other week, with information about the school district. The two examples presented in Figure 1 provide information on emergency preparedness and on how the food in SFUSD is prepared.

For all conditions, parents could choose to receive the texts in English, Spanish, or Chinese.

[3] While we explicitly informed parents that the tip was based on their child's formative assessment performance, we did not explicitly indicate to parents that "beginning," "growing," "solid," and "advanced" were terms that indicated a child's performance along a continuum of skill levels. Parents could have deduced the implied meaning of these words if their child fell in different groups over time, across skills. This was the case for almost all parents. Only 1 child was consistently in a group throughout the experiment.

Figure 1: Text Examples

	General Example 1	**Personalized Example 1**			
		Quartile 1	Quartile 2	Quartile 3	Quartile 4
Monday	FACT: Beginning word sounds are often made up of multiple letters like “th” or “st”. Learning these sounds is a key to reading.				
Wednesday	TIP: As your child gets dressed ask: what sound does SHOE start with? What letters are in ‘shh’? (s and h) What else starts with ‘shh’? Shirt!	TIP: Your child’s fall K test shows s/he is starting to learn beginning word sounds. Support this progress with simple activities! As your child gets dressed say: Shhh-oe starts with shhh. Do you know what else starts with shhh? Shh-irt!! What letters are in shhh? (s and h)	TIP: Your child’s fall K test shows his/her knowledge of beginning word sounds is growing. Support this progress with simple activities! As your child gets dressed ask: what sound does SHOE start with? What letters are in ‘shh’? (s and h) What else starts with ‘shh’? (Shirt)	TIP: Your child’s fall K test shows his/her knowledge of beginning word sounds is solid. Support this progress with simple activities! As your child gets dressed say: What are 2 things you wear that start with the ‘shhh’ sound? (Shoes and Shirt) What letters are in shhh? (s and h)	TIP: Your child’s fall K test shows his/her knowledge of beginning word sounds is strong. Support this progress with simple activities! As your child gets dressed say: Name things we wear that start with the ‘shhh’ sound. (shoes shorts shirt) What letters are in shhh? (s and h)
Friday	GROWTH: Keep practicing word sounds! Now ask: what sound does brrr-eakfast start with? (Brrr) What foods start with brrr? (Bread, brownie)	GROWTH: Keep practicing word sounds! Ask: what sound does brr-eakfast start with? (Brrr) Name a food that starts with brrr (Bread)	GROWTH: Keep practicing word sounds! Ask: what sound does brrr-eakfast start with? (Brrr) What 2 foods start with brr? (Bread, brownie)	GROWTH: Keep practicing word sounds! Ask: what sound does brr-eakfast start with? What foods start with brr? (Bread, brownie, broccoli)	GROWTH: Keep practicing word sounds! Say: Name as many foods as you can that start with the same sound as brrr-eakfast (Bread, brownie)

	Control Example 1	**Control Example 2**
Wednesday	TIP: Planning for school emergencies is important. Make sure that you filled out the Emergency Card and returned it to the school office.	TIP: SFUSD is all about great food. Did you know local chefs hand prepare our meals fresh daily? Go to www.sfusd.edu to learn more.

4. Data and Empirical Strategy

4a. Data and Sample

The initial sample is composed of 504 children and families from the original experiment and 290 newly recruited children and families. These 794 students were randomized into one of the three conditions and received texts from October 2014 through August 2015. We collected three primary sources of outcome data on these children. In May 2015 we surveyed the kindergarten teachers of all the children in the study. We asked questions regarding how well the teacher knew the parents of the children, how often parents talked to the teacher, how often parents asked questions regarding specific academic skills, and how well the child performed on specific academic skills. Teachers were not informed of the treatment status of individual children so as not to bias the results and were compensated $50 for completing the survey.

In September 2015, after texting was complete, we sent parents enrolled in the program a post-survey. We asked questions regarding their attitudes towards building literacy skills in their children, how often they engaged in specific learning activities with their children, how often they interacted with their child's teacher, and how they viewed the texts they received. We also compensated parents $50 for completing the survey.

Finally, we use the fall first grade administration of the Fountas and Pinnell Benmark Assessment System (BAS) as a measure of children's academic skills. The BAS is a formative assessment tool that has been shown to be a valid assessment of literacy development in children (Fountas and Pinnell, 2012). Teachers first assess the ability of children to recognize upper and lower case letters, letter sounds, initial word sounds, 25 high frequency words, their ability to rhyme, blend sounds into words, and demonstrate early literacy behaviors. After mastering six of

the eight foundational skills children are asked to read books of increasing difficulty. The teacher begins with the easiest books, level A. After the child reads with sufficient accuracy and comprehension, they move on to harder books (levels B-Z). A teacher stops after reaching a book that the child cannot read with sufficient accuracy and comprehension. In kindergarten most children are still mastering foundational skills, while in first grade the vast majority of children are reading books of varying difficulty. The texts are therefore primarily differentiated and based on a child's performance on foundational skills, while the outcome of interest is whether children are reading more complex books and if they reach development benchmarks set forth by Fountas and Pinnell and followed by the district.

Of the 794 participating families, teachers provided information on 442 (56% response rate) students, 519 families responded to the survey (65% response rate), and fall first grade BAS data was collected on 641 students (81% assessment rate). The 153 students who do not have assessment data left the district. This level of mobility in the early grades is not uncommon. Only 28 children that we recruited in the beginning of the year left during the year or in transition to first grade. The remaining 125 children left the district between enrolling prekindergarten and transitioning to first grade.

To obtain the final analytical sample we restrict the data in three ways. We first eliminate a small number of students in the district's Transitional Kindergarten program. The texting program was designed for students in traditional kindergarten programs and Transitional Kindergarten students are exposed to a curriculum that emphasizes more foundational literacy skills. By eliminating these students we can more cleanly elucidate the effects of the intervention

on the intended audience and for a sample of children in the same grade.[4] For both outcome surveys, we restrict the data to those teachers and families that answered all questions. We do this so that the sample size remains constant in analyzing specific questions and factors of the questions in our analyses.

Last, we restrict the sample to those parents who answered enough baseline survey questions to construct three measures of their pre-treatment characteristics. The baseline survey was designed to measure three constructs: baseline child skills, baseline frequency of literacy activities in the home, and background characteristics of the parent. To get a measure of each construct, we estimated a graded response model separately on each subsection of the survey. Graded response models (GRMs) are used frequently in survey analysis with Likert-type items, and provide an estimate for all respondents of where they fall along the construct of interest, termed their "ability" estimate. We selected GRMs over factor analysis due to their ability to produce estimates in the presence missing data, avoiding imputation (Samejima, 1997). We use these ability estimates, rather than the individual questions, as control variables in our analyses.

In the end we have three analytic samples. The final parent survey sample consists of 388 families, the final teacher survey sample consists of 348 children, and the final BAS sample consists of 540 children. Though this is a significant decrease in sample size we check to ensure that attrition and pre-treatment covariates remain balanced in all samples. Finally, we merge this data to administrative data provided by the district. The district provided data on student background characteristics such gender, ethnicity, and date of birth.

[4] All survey and academic outcomes are robust to including Transitional Kindergarten students. These students were unintentionally recruited by liaisons at the kindergarten school site.

Table 1 presents the descriptive statistics on each analytic sample. Though there are slight differences among samples, the demographics are largely similar. Panel A presents the characteristics of children in the sample. Looking at the academic outcome sample, 51% of the children are male. The two largest ethnicities are Hispanic (35%) and Asian (32%), with fewer white children (7%) and children from other ethnicities (19%). The average age in the sample is 5.5 years old. At baseline parents rated their children 3 out of 4 in letter knowledge and a 3 out of 5 in letter sounds and rhyming, on average. In comparison, the broader SFUSD kindergarten cohort has more white students (16 percent) and fewer Hispanic and Asian students (29 percent and 26 percent, respectively). Both samples, however, have approximately the same proportion of males, students from other ethnicities, and students of approximately the same age.

Panel B presents descriptive statistics on the parents. Most have less than a bachelor's degree (65%) and are on average 34 years old. Over half (53%) chose to receive the text messages in English, with fewer choosing to receive them in Spanish (26%) and Chinese (20%). A little less than half the sample (45%) is new to the program this year. On average parents rated themselves between 2.8 and 3 out of 4 when asked how frequently they engage in literacy activities with the child. The texting program served minority and lower-income families.

Table 1: Descriptive Statistics

	Parent Survey Sample (N=388)		Teacher Survey Sample (N = 348)		Academic Outcomes Sample (N=540)		SFUSD Kindergarten Cohort (N=4,507)	
Variable	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Panel A: Children								
Male	0.528	0.500	0.534	0.500	0.509	0.500	0.512	0.500
Hispanic	0.327	0.470	0.316	0.466	0.354	0.479	0.286	0.452
Asian	0.317	0.466	0.368	0.483	0.324	0.468	0.262	0.440
Decline To State Ethnicity	0.046	0.211	0.063	0.244	0.061	0.240	0.125	0.331
White	0.077	0.267	0.078	0.268	0.072	0.259	0.156	0.363
Other	0.178	0.383	0.175	0.381	0.189	0.392	0.172	0.377
Age in Years	34.825	5.986	5.470	0.278	5.466	0.276	5.497	0.297
Parent rating of letter knowledge	3.090	0.906	3.080	0.904	3.061	0.911		
Parent rating of letter sounds	3.229	1.136	3.200	1.180	3.250	1.167		
Parent rating of rhyming	3.112	1.238	3.090	1.250	3.061	1.250		
Panel B: Parents								
Has less than a bachelor's degree	0.598	0.491	0.621	0.486	0.648	0.478		
Received Texts in English	0.572	0.495	0.523	0.500	0.533	0.499		
Received Texts in Spanish	0.224	0.418	0.230	0.421	0.263	0.441		
Received Texts in Chinese	0.204	0.403	0.247	0.432	0.204	0.403		

First Year Receiving Texts	0.392	0.489	0.445	0.498	0.448	0.498
Age in Years	34.825	5.986	34.364	5.898	34.237	6.285
How many times per week read to child	2.990	0.863	2.934	0.878	2.936	0.870
How many times per week told stories to child	2.810	0.849	2.767	0.848	2.756	0.853
How many times per week sang to child	2.899	0.853	2.807	0.839	2.818	0.838
How many times per week does child ask to be read to	2.943	0.925	2.933	0.905	2.920	0.908

Note: Parents rated the letter knowledge of their child in one of four categories: 1=The child knows no letters, 2=Some, 3=Most, 4=All. Parents rated how well their child can produce letter sounds and rhyme in one of five categories: 1=Not at all, 2=Not very well, 3=Somewhat well, 4=Well, 5=Very Well. Answer options for weekly parental activities and how often the child asks to be read to include: 1=Not at all, 2=Once or twice per week, 3=Three to six times, 4=Every day. Missing values set at the sample average. For families in first year of experiment the baseline survey questions were given in September 2014. For families in the second year of the experiment the baseline survey questions were given in September 2013.

4b. Empirical Strategy

We use two models when estimating the effect of the texting program on student and family outcomes. Equation 1, below, shows our primary model:

$$Y_{is} = \beta_0 + \beta_1 GeneralText_{is} + \beta_2 PersonalizedText_{is} + \boldsymbol{X}_{is}\beta_3 + \alpha_s + \varepsilon_{is} \quad (1)$$

In Equation 1 we regress an outcome Y_{is} for student, i, in school, s, on $GeneralText_{is}$, an indicator for receiving the general literacy texts, $PersonalizedText_{is}$, an indicator for receiving differentiated and personalized texts, $\boldsymbol{X_{is}}$, a vector of baseline characteristics, and α_s, a school fixed effect. ε_{is} is a stochastic error term. $\boldsymbol{X_{is}}$ contains an indicator for receiving the texts in English, Spanish, or Chinese, the child's gender, ethnicity, age in years, and factors of baseline survey questions on literacy skills and rates of home literacy activities. Randomization occurred within school site, and the school fixed effect, α_s, is the school site where randomization took place. For children in their second year of the experiment this is their prekindergarten school site and for children in their first year of the experiment this is their kindergarten school site. There is no variation in first or second year status within randomization school sites. We therefore do not include an indicator for being new to the experiment in $\boldsymbol{X_{is}}$. The coefficients of interest are β_1 and β_2, which will provide an estimate of the effect of receiving general and personalized/differentiated texts, respectively on the outcome of interest. The omitted group in this case is the control group. We cluster all standard errors at the randomization site level.

Our second model is given in Equation 2:

$$Y_{is} = \beta_0 + \beta_1 AnyLiteracy\,Text_{is} + \beta_2 PersonalizedText_{is} + \boldsymbol{X}_{is}\beta_3 + \alpha_s + \varepsilon_{is} \quad (2)$$

Equation 2 is similar to Equation 1 except we replace the indicator for receiving general texts with an indicator for receiving *any* literacy text, $AnyLiteracyText_{is}$, which is equal to one for students in either the general text treatment or the differentiated and personalized text treatment. All other elements of the equation remain the same. In this specification β_2 will provide an estimate of the effect of the personalization and differentiation, separate from the effect of receiving text messages. It is the coefficient on the interaction between receiving literacy texts and receiving differentiated and personalized texts. β_1 will provide an estimate of receiving literacy text messages, independent of personalization and is the causal effect of literacy text messages in relative to the control group. In all tables we refer to Equation 1 as "Model 1" and Equation 2 as "Model 2." In an effort to be parsimonious, our main results in Tables 3 through 5 present the results of Model 1 and Appendix Tables A4 through A6 present estimates from Model 2. We reference the results of Model 2 only when they provide additional information.

The outcomes, Y_{is}, are the individual teacher and parent survey questions and the reading level of the child as measured by the BAS. To reduce the number of outcomes from the surveys we also use exploratory factor analysis to judge which questions are measuring the same underlying construct. The questions in the parent survey load onto four separate factors: (1) a parent belief factor regarding the ease of building literacy skills and the support they feel in building those skills, (2) a literacy activity factor regarding the frequency with which the parents engaged in literacy activities with their child, (3) a teacher factor regarding the frequency with which parents interacted with their child's teacher, and (4) a text factor regarding parental attitudes to the texting program. For the teacher survey we took the analogous questions from the parent

survey and created a teacher version of that factor, so that the two are directly comparable. In creating the final factors we used principal components analysis and rotated the loading matrix to create orthogonal factors. Table A8 presents each question contained in each of these factors and the weighting of the elements variables for each of these factors.

4c. Randomization Checks

First we explore whether the covariates are balanced between treatment and control for each analytic sample. Tables A1 and A2 present these results for 13 covariates tested in each of the three samples, for a total of 39 tests. Looking at Table A1, the parent survey sample, children were older in the differentiated and personalized text group ($p<0.05$). In the teacher survey sample, one variable was unbalanced at the 10 percent level (probability of being white) and two variables were unbalanced at the 5 percent level (male and child age). In the academic sample, one variable was unbalanced at the 10 percent level (the composite home activities factor) and one was unbalanced at the one percent level (probability of being white). The rate of imbalance is about what one would expect to occur by chance in the parent survey and academic samples, but is a little higher in the teacher survey sample. All our main specifications include covariates and we present all results with and without covariates. For all outcomes, addition of the covariates does little to change the point estimates, and ultimately does not change our inferences. This provides some indication that imbalance is not a concern in this study.

We also test to see if students differentially attrit from the analytic samples. Table 2 shows that, overall, students did not differentially attrit from any sample to a statistically significant extent. We further check to see if there is differential attrition by covariate. Appendix Table A3 shows that no imbalance is found in the academic sample, but males are marginally less likely to

attrit from the differentiated and personalized group in the parent and teacher survey samples, and younger students are less likely to attrit from the general group in the teacher survey sample. Because the point estimate on the overall attrition is larger (but insignificant) in the teacher sample, and the attrition by covariates are most imbalanced in the teacher sample, we implement Lee (2009) style bounds on the teacher survey sample as a robustness check.

Table 2: Overall attrition

	Model 1		Model 2	
	(1)	(2)	(3)	(4)
	General Text Treatment	Personalized Text Treatment	General Text Treatment	Personalized Text Treatment
Not in Parent Survey Sample	-0.0139	0.0064	-0.0139	0.0203
	(0.0478)	(0.0434)	(0.0478)	(0.0440)
Not in Teacher Survey Sample	-0.0653	-0.0367	-0.0653	0.0286
	(0.0403)	(0.0362)	(0.0403)	(0.0472)
Not in Academic Sample	-0.0025	0.0099	-0.0025	0.0124
	(0.0412)	(0.0397)	(0.0412)	(0.0428)

Note: Each pair of cells represents the results of a separate regression of the treatment effect on an indicator for not being in the sample defined by the row header. Column headers indicate the model and model components. N = 794. Models include randomization site fixed effects. Standard errors are clustered by randomization site. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

5. Main Results

Tables 3 through 5 present the main results of the intervention and show that the differentiated and personalized texts had numerous positive effects. Table 3 presents the results on the fall first grade Fountas and Pinnell BAS. Panel A shows the effects of the texting program on the reading level of children, with level A being the easiest book and level Z being hardest book. A small minority of children (8%) were not yet reading. We analyze the results in two ways. First we capitalize on the ordinal nature of the grading scale and use ordinal logit models to provide a summary measure of the effect of the program on reading ability. We also present the results of linear probability models that show how the intervention affected the probability of reading at level

A, C, E, or G and above. We choose these cut points because level A indicates that the child is first able to read, and levels C, E, and G represent approximately the 25th, 50th, and 75th percentiles of the reading distribution. Panel B presents the effects of the program on the probability of meeting district expectations benchmarks. These SFUSD-specific benchmarks closely track the Fountas and Pinnell recommended benchmarks. Levels C, D, and E are the cutoffs for approaches, meets, and exceeds expectations, respectively.

The academic results indicate that differentiated and personalized text messages had a significant effect on the reading ability of children. Column 3 indicates that across all outcomes the general texts did not have a significant effect compared with the control texts. Column 4 indicates that differentiated and personalized texts increased the reading level of children. Children whose parents received the differentiated and personalized texts messages were 1.47 times as likely as the control group to move up a reading level ($p<0.01$). These children were also 9.67 percentage points ($p<0.05$) more likely to read at level E or above, were 11.87 percentage points ($p<0.001$) more likely to exceed expectations, and 9.23 percentage points ($p<0.01$) more likely to meet or exceed expectations. Table A4, which presents the results from Model 2, supports the conclusion that differentiation and personalization drove the results, separate from the base effect of the literacy text messages.

Tables 4 and 5 present the survey results which can give clues as to the mechanisms that gave rise to the academic results. We present the results of the factors of survey questions in Panel A, as well as the results of individual questions in Panels B and C. We present the factors as a concise measure of the effect of the intervention on each type of outcome. The activities literacy factor includes questions not presented in our main tables. Table A8 presents all questions that compose each factor.

Table 4 shows the results on parent reports of their beliefs towards home literacy activities and the frequency with which they engaged in home literacy activities. Overall, the texting program had limited effects on parent beliefs towards activities and building academic

Table 3: Effects on Fountas and Pinnell Benchmark Assessment System academic outcomes

	(1)	(2)	(3)	(4)
	General Text Treatment	Personalized Text Treatment	General Text Treatment	Personalized Text Treatment
Panel A: Reading Level Outcomes				
Reading level (ordinal logit)	0.037	0.3731*	0.0021	0.3899**
	(0.1796)	(0.1473)	(0.1886)	(0.1408)
Pr(Reading Level A or Above)	0.0192	0.0276+	0.0187	0.0241
	(0.0161)	(0.0155)	(0.0161)	(0.0156)
Pr(Reading Level C or Above)	0.0329	-0.0053	0.029	-0.0098
	(0.0463)	(0.0464)	(0.0430)	(0.0416)
Pr(Reading Level E or Above)	0.0045	0.1027*	0.0069	0.0967*
	(0.0498)	(0.0400)	(0.0503)	(0.0377)
Pr(Reading Level G or Above)	-0.0023	0.0508	-0.0124	0.0465
	(0.0488)	(0.0403)	(0.0506)	(0.0418)
Panel B: District Academic Benchmarks				
Exceeds Expectations	-0.0036	0.1209**	-0.011	0.1187***
	(0.0504)	(0.0360)	(0.0500)	(0.0335)
Meets or Exceeds Expectations	0.0234	0.0973*	0.0236	0.0923**
	(0.0429)	(0.0388)	(0.0396)	(0.0339)
Approaches, Meets, or Exceeds Expectations	0.0393	0.0163	0.0347	0.0347
	(0.0506)	(0.0483)	(0.0469)	(0.0469)
Randomization Site Fixed Effects	✓	✓	✓	✓
Language of Texts	✓	✓	✓	✓
Factors of Baseline Survey Responses			✓	✓
Administrative Covariates			✓	✓

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant academic outcome. Column headers indicate the model and model components. Row headers indicate the academic outcome. A Graded Response Model was used to create the factors of baseline survey responses. Factors were made from parent reports of parent age and education, parent reports of the child's knowledge of letters, letter sounds, and rhyming, parents reports of the frequency with which the parent read to, told stories to, and sang to their child, and parent reports of how often the child asks questions. Administrative covariates include age and indicators for gender and race. All standard errors are clustered at the randomization site level. N = 540 for all regressions +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

skills in their children. The program had the greatest effects on parent perceptions of being supported and parent ratings of how easy it is to build literacy skills in their children. Columns 3 and 4 indicated that the differentiated and personalized text treatment caused a marginally

significant 23 percent of a standard deviation increase on parent ratings of feeling supported, while the general text treatment had a near zero and insignificant effect on this question. Interestingly, general texting treatment also caused a marginally significant 30 percent of a standard deviation *reduction* in parent ratings on the extent to which they feel building literacy skills is easy. Additionally, Table A5 shows that the differentiated and personalized intervention significantly mitigated the negative effects on the how easily parents thought they could build skills in their children. Parents in the personalized treatment group responded 44 percent of a standard deviation ($p<0.01$) higher along this measure compared to parents in the general group. These results are consistent with the notion that knowledge of a child's skill level, with an appropriately differentiated activity, can positively affect parent beliefs. If general text messages were not aligned to the child's skill level and too hard for parents, this could cause parents to believe that building literacy skills is a hard endeavor for which they have little support.

The program had a much stronger effect on the frequency with which parents engaged in home literacy activities. Panel C of Table 4 shows that the greatest effects are in taking books when leaving the house, reviewing parts of a book, reviewing the direction of reading, correcting mistakes while reading, and practicing rhyming, with effect sizes ranging from 28 to 44 percent of a standard deviation. Table A5 confirms that differentiation and personalization drove many of these results. When combining all activities questions into an activities factor, Panel A of Table 4 shows that that general texts had a positive, but insignificant point estimate of 19 percent of a standard deviation and that personalized texts had a significant 31 percent of a standard deviation ($p<0.01$) effect on home activities compared to the control group. As Panel A of Table A5 shows, we do not have the power to separate a differentiation and personalization effect from a base texting effect for this composite variable.

Table 5 presents the results of the intervention on parent involvement at school both from the parent perspective (Panel B) and the teacher perspective (Panel C). From the parent perspective, the largest effect is seen on how well they know their child's teacher. Columns 3

Table 4: Effects on parent beliefs and home activities

	(1)	(2)		(3)	(4)
	General Text Treatment	Personalized Text Treatment		General Text Treatment	Personalized Text Treatment
Panel A: Parent Outcome Factors					
Parent Belief Factor	-0.1141	0.1084		-0.1515	0.0837
	(0.1563)	(0.1565)		(0.1582)	(0.1398)
Activities Factor	0.1579	0.3230**		0.1945	0.3144**
	(0.1528)	(0.1106)		(0.1523)	(0.1132)
Panel B Parent Beliefs					
Enjoys home literacy activities	-0.1221	-0.0236		-0.1607	-0.0335
	(0.1476)	(0.1641)		(0.1522)	(0.1578)
Knows literacy skills needed for first grade	-0.0881	0.1608		-0.116	0.1334
	(0.1482)	(0.1465)		(0.1479)	(0.1302)
Believes can build literacy skills	-0.1216	-0.0091		-0.1508	-0.0341
	(0.1606)	(0.1587)		(0.1657)	(0.1494)
Believes he/she plays an important role in building literacy skills	-0.0344	0.0009		-0.0579	-0.0004
	(0.1357)	(0.1579)		(0.1393)	(0.1359)
Building reading skills is easy	-0.2632	0.1784		-0.2967+	0.1444
	(0.1594)	(0.1526)		(0.1489)	(0.1402)
Feels supported	0.0218	0.2592+		-0.018	0.2290+
	(0.1653)	(0.1318)		(0.1684)	(0.1211)
Panel C: Parent Activities					
Read words with child	0.3001*	0.2424		0.2822+	0.1969
	(0.1426)	(0.1473)		(0.1455)	(0.1500)
Wrote notes with child	0.0674	0.1569		0.0881	0.1484
	(0.1574)	(0.1539)		(0.1658)	(0.1654)
Took books when left the house	0.2574+	0.3021*		0.2789*	0.2868+
	(0.1301)	(0.1484)		(0.1254)	(0.1578)
Read books to child	0.0976	0.1514		0.1276	0.1676
	(0.1178)	(0.1342)		(0.1125)	(0.1294)
Had child read books to parent	0.1591	0.0439		0.1916	0.0054
	(0.1614)	(0.1262)		(0.1400)	(0.1173)
Reviewed parts of a book	-0.0133	0.2903**		-0.01	0.2727*
	(0.1259)	(0.1018)		(0.1168)	(0.1210)
Reviewed direction of reading	-0.0426	0.4341***		-0.019	0.4391***
	(0.1579)	(0.0896)		(0.1565)	(0.0962)
Corrected mistakes while reading	0.1258	0.3845**		0.1182	0.3329*
	(0.1374)	(0.1327)		(0.1441)	(0.1251)
Asked child questions about book	0.1251	0.2337+		0.1682	0.2503+
	(0.1264)	(0.1253)		(0.1401)	(0.1329)
Practiced rhyming	0.1208	0.3964**		0.1662	0.4148***
	(0.1631)	(0.1232)		(0.1619)	(0.1152)
Practiced writing child's name	0.0208	0.2243+		0.0681	0.2126
	(0.1427)	(0.1228)		(0.1451)	(0.1370)
Randomization Site Fixed Effects	✓	✓		✓	✓
Language of Texts	✓	✓		✓	✓

Factors of Baseline Survey Responses			✓	✓
Administrative Covariates			✓	✓

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant outcome. Column headers indicate the model and model components. Row headers indicate the literacy outcome. All literacy outcomes are standardized. Factor analysis was used to determine the outcome factors. See Table A8 for a list of survey questions that compose each factor. Covariates are detailed in Table 3. All standard errors are clustered at the randomization site level. N = 388 in all regressions. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

and 4 indicate that, compared to the control group, the general texts increased the knowledge of perspective, the largest effect is seen on how well they know their child's teacher. Columns 3 and 4 indicate that, compared to the control group, the general texts increased the knowledge of the teacher by 36 percent of a standard deviation (p<0.01) but the personalized texts did not have an effect. Columns 3 and 4 of Table A6 confirm that the differentiated and personalization aspect of the treatment significantly decreased the positive effect generated by the general texts with a point estimate of -28 percent of a standard deviation (p<0.05) when compared to the general text message group. The remainder of the estimates shows that the texts increased specific questions parents asked teachers by about 20 percent of a standard deviation. Differentiation and personalization did not have much of a differential effect on these questions. The point estimates in Table 5 are generally close to that of the general texts and of approximately the same significance level. When combining these measures into one factor in Panel A that overall story remains true. General texts have a larger effect on teacher interactions of 27 percent of standard deviation (p<0.10), while personalized texts had a slightly smaller effect of 20 percent of a standard deviation (p<0.10).

The results are fairly consistent when analyzing the same questions from the teacher perspective. Column 3 of Panel C in Table 5 shows that the general text treatment had significantly positive effects on parents talking to their child's teacher about their child's interest and home activities with effect sizes of 24 percent of a standard deviation (p<0.10) and 30 percent of a

standard deviation ($p<0.05$) respectively. The remainder of the point estimates are generally positive, but not significant. Column 4 however shows that the point estimates on the personalized texts are, for most questions, negative though not significant. Looking at Column 4 of Panel C of Table A6, the differentiation and personalization interaction estimate had a

Table 5: Effects on parent interactions with teachers

	(1)	(2)		(3)	(4)
	General Text Treatment	Personalized Text Treatment		General Text Treatment	Personalized Text Treatment
Panel A: Outcome Factors					
Parent Report of Interactions Factor	0.2571+	0.2565*		0.2710+	0.1956+
(N = 388)	(0.1395)	(0.1055)		(0.1379)	(0.1000)
Teacher Report of Interactions Factor	0.1785	-0.2122		0.2019	-0.1749
(N = 348)	(0.1320)	(0.1532)		(0.1328)	(0.1590)
Panel B: Parent Reports On Interactions With Teacher (N = 388)					
Talked to teacher	0.2378	0.1595		0.2501+	0.1456
	(0.1534)	(0.1147)		(0.1437)	(0.1126)
Talked to teacher about child's	0.0999	0.1950+		0.1105	0.1236
interests	(0.1316)	(0.1017)		(0.1287)	(0.1066)
Talked to teacher about how well	0.2823+	0.2315*		0.2968+	0.1947+
child is getting along with others	(0.1441)	(0.1044)		(0.1500)	(0.1116)
Talked to teacher about how well	0.1652	0.2636*		0.1788	0.2180*
child is doing in school	(0.1430)	(0.1132)		(0.1391)	(0.1034)
Talked to teacher about child's early	0.1312	0.1619		0.1232	0.1133
literacy skills	(0.1402)	(0.1095)		(0.1399)	(0.1111)
Talked to teacher about child's	0.2133	0.1602		0.2075	0.0969
reading skills	(0.1425)	(0.1234)		(0.1426)	(0.1199)
Asked for book and home activity	0.2245	0.3152*		0.2506+	0.2564+
recommendations	(0.1393)	(0.1443)		(0.1321)	(0.1462)
How well does parent know teacher	0.3289**	0.1201		0.3615***	0.0817
	(0.1037)	(0.1111)		(0.1020)	(0.0979)
Panel C: Teacher Reports On Interactions With Parents (N = 348)					
Parent talks about child's interests	0.2119	-0.129		0.2464+	-0.0838
	(0.1288)	(0.1753)		(0.1305)	(0.1784)
Parent asks how well child gets along	0.072	-0.1105		0.0952	-0.1092
with others	(0.1294)	(0.1755)		(0.1224)	(0.1854)
Parent asks how well child is doing	0.103	-0.2111		0.1639	-0.1818
in school	(0.1688)	(0.1958)		(0.1641)	(0.2105)
Parent asks about child's literacy	0.1805	-0.2166*		0.2111	-0.1719
skills	(0.1371)	(0.1070)		(0.1392)	(0.1270)
Parent asks how to help child learn	0.1798	-0.1809		0.1675	-0.1686
to read	(0.1548)	(0.1816)		(0.1573)	(0.1842)
Parent asks for book recommendations	0.0543	-0.1641		0.0552	-0.1479
	(0.1336)	(0.1478)		(0.1424)	(0.1681)
Parent talks about home activities	0.2840*	-0.0708		0.3061*	-0.0046
	(0.1292)	(0.1780)		(0.1337)	(0.2010)
How well does teacher know parent	-0.0714	-0.2239		-0.1047	-0.2213
	(0.1729)	(0.1459)		(0.1877)	(0.1597)
Randomization Site Fixed Effects	✓	✓		✓	✓
Language of Texts	✓	✓		✓	✓

Factors of Baseline Survey Responses		✓	✓
Administrative Covariates		✓	✓

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant outcome. Column headers indicate the model and model components. Row headers indicate the outcome. All outcomes are standardized. Factor analysis was used to create the outcome factors. The parent report of interactions factor is made up of the questions in Panel A, the teacher report of interactions factor is made up questions in Panel B. Covariates are detailed in Table 3. All standard errors are clustered at the randomization site level. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

significant or marginally significant effect of -34 to -39 percent of a standard deviation for many questions when compared to the general text messages. This negative effect is also seen in the composite of the teacher reports in Panel A. These point estimates indicate that the personalization of the texts may have induced parents to talk to teachers less when compared with the general text messages and mute any gains in teacher interactions generated by the general text messages. These results, as well as the results from the parent questions, are plausible if the greater amount of information regarding the child skill level, in combination with greater success in implementing the differentiated literacy activity, produced less of an incentive to talk to the teacher regarding how their child is progressing in school.

6. Heterogeneity of Results

Prior research on social information experiments indicates that the effects of such interventions can vary significantly by baseline characteristics. Allcott (2011) demonstrates that providing families with information on their neighbor's energy usage will, on average, decrease their own energy use. Perhaps predictably, the effects are concentrated on the highest pre-intervention energy users, with no effects seen on the lowest pre-intervention energy users. Gerber and Rogers (2009) illustrate that presenting voters with a script that frames an upcoming election as a "high turnout" election will, on average, induce people to vote more compared to a script that frames the election as a "low turnout" election. They present evidence that the intervention was

more effective for participants who voted less frequently in prior elections. Beshears et al. (2015) present a more nuanced result and show that the same intervention can have opposite effects depending on where participants fell in the baseline distribution. Their intervention provided social behavior regarding 401(k) savings and found that the intervention encouraged those who were previously contributing at high rates to save more, but discouraged those who were not previously saving much from contributing to their plans.

In this study, we analyze heterogeneity by the baseline skill distribution.[5] Specifically we estimate the effects of the intervention separately on students who fall in the middle two quartiles of the baseline skill distribution and on students who fall in the tails of the distribution. To do this analysis we must restrict the sample to those families who are new to the program. York, Loeb and Doss (2016) showed that texting in the first year positively affected pre-literacy skills, which means that there will be a positive correlation between fall kindergarten test scores and texting treatment status for those families in the second year of the program.

Ex ante, it is unclear how the effects might vary across these groups. On one hand the personalization and differentiation may have greater effects on the tails of the distribution if the differentiation provides the greatest benefit for these children and if parents are particularly motivated by signals that their child is doing relatively well or poorly. Similarly, the intervention

[5] We also have analyzed the results by texting language and length of time in the program. Splitting the sample into three languages greatly reduces the power to detect effects. Generally, the children of the parents receiving texts in Chinese saw the greatest academic gains, while parents who received the texts in English and Chinese engaged with the activities to a greater extent. In analyzing the effect on first and second year families, we find little heterogeneity in academic outcomes. Both sets of families benefited to about the same extent, with differentiation and personalization driving the results. However, the positive effect on activities and the substitution away from teacher engagement was stronger for second year families, while the opposing effects of the general and differentiated and personalized text messages on parent beliefs was concentrated on the first year parents. Results are available on request.

could have smaller, or negative, effects at tails of the distribution if parents on the low end of the distribution are discouraged by the knowledge that their child is doing relatively poorly, or if parents at the top of the distribution feel less compelled to engage in the activities after learning their child is already advanced.

Table 6 shows the results of the heterogeneity analysis on the academic outcomes.[6] Panel A presents effects on the middle two quartiles and Panel B presents the effects on the 1st and 4th quartiles. Column 3 of Panel A in Table 6 shows that there is a marginally statistically significant effect of the general texts on the probability of meeting or exceeding expectations of 17.13 percentage points ($p<0.10$). Differentiation and personalization, however, produce no differential effect with a quantitatively similar coefficient in Column 4. Meanwhile neither the general nor the differentiated and personalized texts had a detectable effect on the probability of approaching expectations or exceeding expectations. The ordinal logit model is imprecisely estimated. The results are quite different in Panel B, which presents results for families whose children are in the first and fourth quartiles of baseline academic skills. Column 3 and 4 indicate that the general texts had no effect on the academic skills of the children at any level, but that differentiation and personalization had a large effect on the probability of exceeding expectations and on the overall ordinal logit. Differentiation and personalization caused students to be 2.5 as likely to move up a reading level and increased the probability of exceeding expectations by 22.5 percentage points ($p<0.05$).

In the end, the differentiation and personalization had the greatest effect on the tails of the baseline distribution. This result may not be surprising because the general texts and the

[6] Sample sizes are too small to draw conclusions from the parent and teacher survey samples.

differentiated texts were most similar in the middle of the distribution. Personalization may also have been differentially effective for families in the tails of the baseline skill distribution. If parents did not previously realize their child was performing relatively poorly, the new information may have spurred them to more faithfully adhere to the program. Similarly, receiving positive feedback on their child's performance may have encouraged parents at the top of the distribution to build on that success by engaging in the texts to a greater extent.[7]

Table 6: Heterogeneity of academic outcomes by baseline academic performance (first year of experiment only)

	(1)	(2)		(3)	(4)
	General Text Treatment	Personalized Text Treatment		General Text Treatment	Personalized Text Treatment
Panel A: Quartiles 2 and 3 (N=123)					
Reading level (ordinal logit)	0.3831	0.2581		0.3545	0.4253
	(0.3317)	(0.3491)		(0.3405)	(0.3780)
Exceeds Expectations	-0.015	0.0227		0.0092	0.0495
	(0.0981)	(0.0757)		(0.1089)	(0.0799)
Meets or Exceeds Expectations	0.1192	0.1419		0.1713+	0.2196
	(0.0864)	(0.1031)		(0.0882)	(0.1346)
Approaches, Meets, or Exceeds Expectations	0.0424	0.0253		0.051	0.046
	(0.0733)	(0.1310)		(0.1015)	(0.1515)
Panel B: Quartiles 1 and 4 (N=119)					
Reading level (ordinal logit)	-0.7534	0.4952		-0.3068	0.9128*
	(0.4731)	(0.3216)		(0.7124)	(0.4183)
Exceeds Expectations	-0.1797+	0.1990**		-0.0757	0.2247*
	(0.1018)	(0.0630)		(0.1122)	(0.0846)
Meets or Exceeds Expectations	-0.1507	0.1017		-0.078	0.0998
	(0.1273)	(0.0593)		(0.1165)	(0.0769)
Approaches, Meets, or Exceeds Expectations	-0.0732	0.0633		-0.019	0.0767
	(0.1162)	(0.0429)		(0.1192)	(0.0653)

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant academic outcome. Column headers indicate the model and model components. The reference category is the control group. Row headers indicate the academic outcome. Panel headers indicate the subsample. All models include randomization site fixed effects, controls for texting language, factors of baseline survey responses, and administrative covariates. Covariates are detailed in Table 3. All standard errors are clustered at the randomization site level. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

[7] Though we do not have the power to analyze each quartile independently, the fact that the differentiation and personalization results are concentrated on the propensity to exceed expectations may indicate that the differentiation was most effective with children who were performing in the highest quartile at baseline.

7. Robustness Checks

One threat to internal validity of a randomized control trial is differential attrition between treatment and control groups. If different types of people are attriting from each condition our results could be biased. Table 2 presented the overall probability of attrition in each both of our models. The probability of attrition is not significantly different from any of the samples. In Table A3 we further assessed if there was differential attrition status by covariate. The results in Panel C indicate that attrition was well balanced for the academic outcomes sample. Panel A shows that younger children were perhaps less likely to attrit from the personalization group ($p<0.10$) in the parent survey sample. Panel B shows that males may be more likely to attrit from the teacher survey sample ($p<0.10$) and younger children were less likely to do so ($p<0.05$).

Both because the teacher survey has the greatest amount of differential attrition, and because the point estimate is on the overall attrition is largest (though insignificant) for that sample, we engage in a Lee (2009) style bounding exercise for that sample of students. Point estimates indicate that fewer people attrited from the two treatment groups. We therefore calculate a trimming proportion, p, for each treatment arm, compared to the control group. We then trim each treatment arm at their respective pth and 1-pth quantile. Re-running our models on these trimmed samples will provide our upper and lower bounds, respectively.

Table 7 presents the results of this bounding exercise. Column 1 and 2 (bolded) present the original estimates from Columns 3 and 4 of Panel C of Table 5. Comparing the original and upper bound estimates, little changed. The effects on the base text treatment remain positive with approximately the same magnitude, and become more significant. Coefficients on the differentiated and personalized text messages generally become slightly more positive (or less negative) but their lack of significance remains. In our lower bound estimates, all point estimates

become predictably more negative. Point estimates from the general text messaging arm become insignificant and near zero or slightly negative. Estimates for the differentiated and personalized arm become more negative, and in some cases, significant.

Table 7: Bounds on teacher survey outcomes

	Original Estimates		Upper Bounds		Lower Bounds	
	(1)	(2)	(3)	(4)	(5)	(6)
	General Text Treatment	Personalized Text Treatment	General Text Treatment	Personalized Text Treatment	General Text Treatment	Personalized Text Treatment
Teacher Report of	**0.2019**	**-0.1749**	0.2892*	-0.0305	0.007	-0.1571
Interactions Factor	**(0.1328)**	**(0.1590)**	(0.1253)	(0.1725)	(0.1417)	(0.1789)
Parent talks about child's	**0.2464+**	**-0.0838**	0.3033+	-0.0643	0.0125	-0.1559
interests	**(0.1305)**	**(0.1784)**	(0.1547)	(0.1863)	(0.0938)	(0.1620)
Parent asks how well child	**0.0952**	**-0.1092**	0.2418+	0.0146	-0.0685	-0.2305
gets along with others	**(0.1224)**	**(0.1854)**	(0.1344)	(0.1977)	(0.1045)	(0.2104)
Parent asks how well child	**0.1639**	**-0.1818**	0.1892	-0.0652	-0.0502	-0.2067
is doing in school	**(0.1641)**	**(0.2105)**	(0.1700)	(0.2025)	(0.1728)	(0.2143)
Parent asks about child's	**0.2111**	**-0.1719**	0.2327	-0.1056	0.005	-0.2711*
literacy skills	**(0.1392)**	**(0.1270)**	(0.1590)	(0.1324)	(0.1597)	(0.1256)
Parent asks how to help	**0.1675**	**-0.1686**	0.291	-0.0475	-0.1186	-0.3924**
child learn to read	**(0.1573)**	**(0.1842)**	(0.1737)	(0.1631)	(0.1510)	(0.1453)
Parent asks for book	**0.0552**	**-0.1479**	0.1189	-0.1127	-0.1383	-0.3156*
recommendations	**(0.1424)**	**(0.1681)**	(0.1371)	(0.1821)	(0.1493)	(0.1496)
Parent talks about	**0.3061***	**-0.0046**	0.4222**	0.0958	0.1087	-0.0896
home activities	**(0.1337)**	**(0.2010)**	(0.1332)	(0.1959)	(0.1336)	(0.2023)
How well does teacher	**-0.1047**	**-0.2213**	0.0131	-0.1951	-0.2749	-0.2624+
know parent	**(0.1877)**	**(0.1597)**	(0.1484)	(0.1820)	(0.2017)	(0.1479)

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant outcome. Row headers indicate the outcome. All outcomes are standardized. Factor analysis was used to create the outcome factors. Upper and lower bound estimates were calculated by the procedure recommended by Lee (2009). All models include randomization site fixed effects, controls for texting language, factors of baseline survey responses, and administrative covariates. Covariates are detailed in Table 3. Standard errors are clustered at the randomization site level. N = 327 in all regressions. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Recall our general conclusion was that there was tentative evidence that the general texting treatment increased parental-teacher contact, but that the differentiation and personalization treatment arm mitigated that effect. The upper bound estimates provide more robust evidence for

this inference, while the lower bound estimates indicate that, at worst, the general texts did not affect parent-teacher interaction, and the differentiated and personalized text messages may have significantly decreased interactions. Importantly, the effect of differentiation and personalization relative to the general texting program remains the same in all three estimates. As seen in Table A7, the differentiation and personalization interaction coefficient is negative in all three estimates, with the upper bound estimate generating the largest and most significant effects. Our overall conclusion therefore remains the same: relative to the general texting program, differentiation and personalization resulted in less parent-teacher contact. This substitution may be due to the greater amount of information contained in the differentiated and personalized texts. The general texts most likely had positive effect on these interactions, though in our most extreme robustness checks they could have had null results.

8. Discussion and Conclusions

In this study we demonstrate that a low-cost personalized literacy texting intervention can have a substantial effect on student academic outcomes above and beyond a general texting program. Specifically, the differentiation and personalization of the messages caused children to be 50 percent more likely to move up a reading level. Tailoring instruction based on formative assessments has previously been associated with increased student learning in K-12 classrooms (Kulik and Kulik 1984, 1992; Slavin and Karweit 1985; Slavin 1987; Bergen and Sladeczek 1991; Black and William 1998a, 1998b; Connor et al. 2007; Robinson 2009), but this is the first study to show that this approach can also improve parent-child academic interactions. Further, this study provides evidence that text messaging interventions can do more than merely maintain parents' attention or "nudge" behaviors via reminders. The significant effects of personalization on parent and student outcomes indicate that parents interact with, and absorb the content of the messages

as well. This finding supports our hypothesis that the original READY4K! program was effective because it took the complex task of parenting and broke it down into small and easy tasks that were meant to fit into daily life and capitalize on everyday objects.

There are two main mechanisms through which the additional gains seen in this study could have been realized. We hypothesized that personalization aspect of the texts could have engendered more trust with the program which would lead to a greater uptake in the activities and thus greater gains in literacy outcomes. Meanwhile the differentiation of the messages helped to better align the difficulty of the task with the child's developmental ability, thus increasing the chance that a parent could successfully engage in the activity with their child. This success may also encourage parents to persist in the program. Our heterogeneity analysis indicates that the effects of the differentiation and personalization were particularly concentrated on the tails of the baseline skills distribution. Parents of children who were performing relatively poorly or relatively well at baseline received tips that were differentiated to the greatest extent. Parents may have more faithfully interacted with the program after receiving information that their child is doing relatively poorly. Conversely, by informing parents that their child is doing relatively well we may have induced them to engage in more activities so as to build on that success.

The parent and teacher surveys provide additional clues as to how the program changed parent behavior. Parent survey results indicate that recipients of the general text messages thought it was harder to build literacy skills in their children. If the program successfully caused parents to engage in literacy based activities with their child, it is possible that parents realize how hard it is to build academic skills in their children, particularly if the activity and the child's skill level are mismatched. The differentiated and personalized texts successfully mitigated this negative effect and caused parents to report that they feel more supported, indicating that the differentiating of the

texts may have indeed aligned the child's skill to the activity. This may have then encouraged parents to persist longer in the program, contributing to the additional gains seen in the study. The one unanticipated result, however, is that parents in the differentiated and personalized group may have substituted away from engaging with teachers.

These results highlight that programs that break down complex tasks, such as building skills in children, can be effective and produce positive outcomes, but that a mismatch between the difficulty of the task and the ability of the parent to carry out that task can attenuate any potential gains. Differentiation and personalization of these programs can extract larger gains by minimizing these mismatches, and we demonstrate that even "light-touch" differentiation and personalization based on preexisting extant data can generate these gains. The ease and ubiquity of text messaging make it a nimble medium through which educational stakeholders can deliver this differentiated and personalized interventions that minimize frictions caused by mismatch.

Scaling the intervention will be particularly cost effective. The only additional costs over a base texting program are the costs of organizing students into groups according to formative assessment results, the costs of differentiating the activities, and the cost of one sending one extra text message. With the use of current technology we can automate the assignment of students to groups, such that the per-family cost of differentiating the tip tends towards zero as more families are added to the program. The only cost that grows with membership is the texting cost, which is very small compared to the other interventions. Overall, differentiating and personalizing text-message interventions based on formative assessment has the promise to produce additional education gains with relatively little additional costs.

References

Allcott, H. (2011). Social norms and energy conservation. *Journal of Public Economics, 95*(9-10), pp. 1082-1095.

Bergen, J.R., Sladeczek, I.E., and Schwarz, R.D. (1991). Effects of a measurement and planning system on kindergarteners' cognitive development and educational programming. *American Educational Research Journal, 28*(3), pp. 683-714.

Bergman, P. (2016). Parent-Child information frictions and human capital investment: Evidence from a field experiment. *Working Paper*. Retrieved April 8, 2016 from: http://www.columbia.edu/~psb2101/BergmanSubmission.pdf

Beshears, J., Choi, J.J., Laibson, D., Madrian, B.C., Milkman, K.L. (2015). The effect of providing peer information on retirement savings decisions. *The Journal of Finance, 70*(3), pp. 1161-1201.

Black, P., and Wiliam, D. (1998a). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan, 80*(2), pp. 139-148.

Black, P., and William, D. (1998b). Assessment and classroom learning. *Assessment in Education, 5*(1), pp. 7-74.

Carlson, D., Borman, G.D., and Robinson, M. (2011). A multistate district-level cluster randomized trial of the impact of data-driven reform on reading and mathematics achievement. *Educational Evaluation and Policy Analysis, 33*(3), pp. 378-398.

Castleman, B.L. and Page, L.C. (2015). Summer nudging: Can personalized text messages and peer mentor outreach increase college going among low-income high school graduates? *Journal of Economic Behavior and Organization, 115*, pp. 144-160.

Connor, C. M., Morrison, F.J., Fishman, B.J., Schatschneider, C., and Underwood, P. (2007). Algorithm-guided individualized reading instruction. *Science, 315*(5811), pp. 464-465.

Connor, C.M., Morrison, F.J., and Katch, L.E. (2004a). Beyond the reading wars: Exploring the effect of child instruction interactions on growth in early reading. *Scientific Studies of Reading, 8*(4), pp. 305-336.

Connor, C.M., Morrison, F.J., and Petrella, J.N. (2004b). Effective reading comprehension instruction: Examining Child x Instruction Interactions. *Journal of Educational Psychology, 96*(4), pp. 682-698.

Frey, B. S., and Meier, S. (2004). Social comparisons and pro-social behavior: Testing "conditional cooperation" in a field experiment. *American Economic Review, 94*(5), pp. 1717–1722.

Fountas and Pinnell (2012). Field study of reliability and validity of the Fountas and Pinnell Benchmark Assessment Systems 1 and 2. Retrieved, July 8, 2015 from http://www.heinemann.com/fountasandpinnell/research/BASFieldStudyFullReport.pdf

Gerber, A. S., and Rogers, T. (2009). Descriptive social norms and motivation to vote: everybody's voting and so should you. *The Journal of Politics*, *71*(1), pp. 178-191.

Hoxby, C., and Turner, S. (2013). Expanding college opportunities for high-achieving, low income students. *Stanford Institute for Economic Policy Research Discussion Paper*, (12-014).

Kast, F., Meier, S., and Pomeranz, D. (2012). Under-Savers anonymous: Evidence on self-help groups and peer pressure as a savings commitment device. *NBER Working paper 18417*. Retrieved March 30, 2016 from http://www.nber.org/papers/w18417.pdf

Kraft, M.A. and Rogers, T.A. (2015). The underutilized potential of teacher-to-parent communication: Evidence from a field experiment. *Economics of Education Review, 47*, pp. 49-63.

Kulik, C.C., and Kulik, J.A. (1984). Effects of ability grouping on elementary school pupils: A meta analysis. Presented at the 92nd annual meeting of the American Psychological Association in Toronto, Ontario, Canada.

Kulik, J.A. and Kulik, C.C. (1992). Meta-analytic findings on grouping programs. *Gifted Child Quarterly, 36*(2), pp. 73-77.

Lee, D.S. (2009). Training, wages, and sample selection: Estimating sharp bounds on treatment effects. *Review of Economic Studies, 76*(3), pp. 1071-1102.

Lou, Y., Abrami, P.C., Spence, J.C., Poulsen, C., Chambers, B., and d'Apollinia, S. (1996). Within-class grouping: A meta-analysis. *Review of Educational Research*, *66*(4), pp. 423-458.

Patrick, K., Raab, F., Adams, M., Dillon, L, Zabinski, M., Rock, C., Griswold, W., and Norman, G. (2009). A Text Message-Based Intervention for Weight Loss: Randomized Controlled Trial. *Journal of Medical Internet Research*, *11*(1), pp. 1-9.

Robinson, J.P. (2009). Evidence of a differential effect of ability-grouping on the reading achievement growth of language-minority Hispanics. *Educational Evaluation and Policy Analysis*, *30*(2), pp. 141-180.

Rodgers, A., Corbett, T., Bramley, D., Riddell, T., Wills M., Lin, R. and Jones, M. (2005). Do U Smoke After Txt? Results of a Randomised Trial of Smoking Cessation Using Mobile Phone Text Messaging. *Tobacco Control*, *14*, pp. 255-261.

Samejima, F. (1997). Graded Response Model. In W. J. van der Linden and R. K. Hambleton (Eds.), Handbook of Modern Item Response Theory (pp. 85–100). New York, NY: Springer New York. Retrieved from http://link.springer.com/10.1007/978-1-4757-2691-6_5

Slavin, R.E. (1987). Ability grouping and student achievement in elementary schools: A best evidence synthesis. *Review of Educational Research*, *57*(3), pp. 293-336.

Slavin, R.E., and Karweit, N.L. (1985). Effects of whole class, ability grouped, and individualized instruction on mathematics achievement. *American Educational Research Journal*, *22*(3), pp. 351-367.

Vygotsky, L.S. (1978). Interaction between learning and development. *Readings on the development of children*, *23*(3), pp. 34-41.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological. *Cambridge, MA: Harvard University*.

Yoon, K. and Kim, H. (2008). A Short Message Service by Cellular Phone in Type 2 Diabetic Patients for 12 months. *Diabetes Research and Clinical Practice*, *79*(2), pp. 256-261.

York, B.N., Loeb, S, and Doss. (2016). One step at a time: The effect of an early literacy text messaging program for parents of preschoolers. NBER Working Paper 20659. Retrieved December 2, 2014 from: http://www.nber.org/papers/w20

Appendix

Figure A1: Additional Text Examples

	General Example 2	**Personalized Example 2**			
		Quartile 1	Quartile 2	Quartile 3	Quartile 4
Monday	FACT: Spelling can be a fun way for your child to practice his/her reading and writing skills in a new way!				
Wednesday	TIP: Say: Let's spell the word "he". Sound it out. What makes the "hhh" sound? What makes the "eee" sound? "He" is spelled H-E. Try we and be.	TIP: Here is a tip based on your child's K literacy exam. Say: "Let's spell the word 'he'. Sound it out. 'H' makes the 'hhh' sound. 'E' makes the 'eee' sound 'He' is spelled H-E." Do it again with we and be.	TIP: Here is a tip based on your child's K literacy exam. Say: "Let's spell the word 'he'. Sound it out. What makes the 'hhh' sound? What makes the 'eee' sound? 'He' is spelled H-E. Now you try to spell we and be."	TIP: Here is a tip based on your child's K literacy exam. Say: "Let's spell the word 'he'. Sound it out. What makes the 'hhh' sound? What makes the 'eee' sound? 'He' is spelled H-E. What rhymes with 'he' (we, be, she). Can you spell those words?"	TIP: Here is a tip based on your child's K literacy exam. Say: "Let's spell the word 'he'. Sound it out. What makes the 'hhh' sound? What makes the 'eee' sound? 'He' is spelled H-E. What rhymes with 'he' (we, be, she). Can you spell those words? Can you write them down?"
Friday	GROWTH: Keep spelling! Have a spelling bee at home. First you spell a word (my, is, no). Then ask your child to spell one (by, it, go).	GROWTH: Keep spelling! Now ask your child spell words like 'my', 'by', and 'shy'.	GROWTH: Keep spelling! Have a spelling bee at home. First you spell a word (my, is, no). Then ask your child to spell one (by, it, go).	GROWTH: Keep spelling! Have a spelling bee. You spell a word (my, is, no). Then your child spells one (by, it, go). Take turns writing them down.	GROWTH: Keep spelling! Have a spelling bee. You spell a word (my/no). Then your child spells a rhyming word (by/go). Take turns writing them.

Table A1:Model 1 covariate balance (randomized to receive general texts or personalized texts)

	Parent Survey Sample (N=388)		Teacher Survey Sample (N=348)		Academic Sample (N=540)	
	(1)	(2)	(3)	(4)	(5)	(6)
	General Text Treatment	Personalized Text Treatment	General Text Treatment	Personalized Text Treatment	General Text Treatment	Personalized Text Treatment
Panel A: Factors of Baseline Survey Questions						
Literacy Skills	0.0432	0.1348	0.1113	0.0592	0.041	0.0082
	(0.1058)	(0.1062)	(0.1123)	(0.1086)	(0.0777)	(0.0810)
Home Activities	-0.0184	-0.0184	0.0102	-0.2752	-0.033	-0.2196+
	(0.1669)	(0.1669)	(0.1752)	(0.1964)	(0.1099)	(0.1234)
Parent Background	0.2358	0.1973	0.1572	0.014	0.1003	0.0417
	(0.1651)	(0.1903)	(0.1622)	(0.2543)	(0.1443)	(0.1850)
Panel B: Child Covariates						
Male	0.0152	-0.0363	-0.0709	-0.1223*	-0.0233	-0.0487
	(0.0600)	(0.0574)	(0.0673)	(0.0598)	(0.0479)	(0.0493)
Hispanic	0.0059	0.0027	-0.0314	0.0011	0.0154	0.0079
	(0.0578)	(0.0545)	(0.0469)	(0.0411)	(0.0408)	(0.0337)
Asian	0.0307	0.0022	0.063	0.0314	0.0513	-0.0078
	(0.0458)	(0.0605)	(0.0575)	(0.0682)	(0.0363)	(0.0416)
Decline To State Ethnicity	-0.0383	0.0041	-0.0169	-0.0154	-0.0057	-0.0093
	(0.0232)	(0.0282)	(0.0242)	(0.0401)	(0.0253)	(0.0290)
White	-0.0327	-0.0134	-0.0468+	-0.0264	-0.0636**	-0.0332
	(0.0339)	(0.0274)	(0.0239)	(0.0407)	(0.0234)	(0.0225)
Other	0.0057	0.0151	0.0322	0.0092	0.0026	0.0423
	(0.0525)	(0.0499)	(0.0635)	(0.0591)	(0.0379)	(0.0455)
Age in Years	-0.0114	0.0928*	0.029	0.0931*	-0.0085	0.0506
	(0.0399)	(0.0393)	(0.0366)	(0.0391)	(0.0269)	(0.0330)
Panel C: Parent Covariates						
Received Texts in English	0.0342	-0.0062	-0.0004	-0.03	0.0131	0.0056
	(0.0426)	(0.0412)	(0.0393)	(0.0414)	(0.0341)	(0.0331)
Received Texts in Spanish	-0.0067	-0.0029	-0.0053	0.0114	-0.0115	-0.0024
	(0.0332)	(0.0376)	(0.0385)	(0.0395)	(0.0234)	(0.0301)
Received Texts in Chinese	-0.0275	0.0091	0.0057	0.0186	-0.0016	-0.0032
	(0.0302)	(0.0444)	(0.0254)	(0.0370)	(0.0249)	(0.0313)

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant covariate. Column headers indicate the sample and model components. The reference category is the control group. Row headers indicate the covariate tested. A Graded Response Model was used to create the covariate factors. The literary skills factor was made from the parent ratings of the child's letter knowledge, letter sounds, and rhyming. The home activities factor was made from parent reports of how often they read, told stories, and sang with their child, and how often the child asked to be read to. The parent background factor was made with parent age and education. All regressions include randomization site fixed effects. Standard errors are clustered at the randomization site level. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table A2: Model 2 covariate balance (indicator for any text message and interaction for personalized text message)

	Parent Survey Sample (N=388)		Teacher Survey Sample (N=348)		Academic Sample (N=540)	
	(1)	(2)	(3)	(4)	(5)	(6)
	Any Text Treatment	Any Text Treatment * Personalization	Any Text Treatment	Any Text Treatment * Personalization	Any Text Treatment	Any Text Treatment * Personalization
Panel A: Factors of Baseline Survey Questions						
Literacy Skills	0.0432	0.0916	0.1113	-0.0521	0.041	-0.0328
	(0.1058)	(0.1208)	(0.1123)	(0.1512)	(0.0777)	(0.1076)
Home Activities	-0.0184	-0.1308	0.0102	-0.2854	-0.033	-0.1866
	(0.1669)	(0.1891)	(0.1752)	(0.1848)	(0.1099)	(0.1404)
Parent Background	0.2358	-0.0385	0.1572	-0.1432	0.1003	-0.0585
	(0.1651)	(0.1902)	(0.1622)	(0.2268)	(0.1443)	(0.2039)
Panel B: Child Covariates						
Male	0.0152	-0.0515	-0.0709	-0.0514	-0.0233	-0.0254
	(0.0600)	(0.0732)	(0.0673)	(0.0610)	(0.0479)	(0.0474)
Hispanic	0.0059	-0.0032	-0.0314	0.0325	0.0154	-0.0074
	(0.0578)	(0.0529)	(0.0469)	(0.0508)	(0.0408)	(0.0492)
Asian	0.0307	-0.0285	0.063	-0.0315	0.0513	-0.059
	(0.0458)	(0.0589)	(0.0575)	(0.0592)	(0.0363)	(0.0428)
Decline To State	-0.0383	0.0424	-0.0169	0.0015	-0.0057	-0.0036
Ethnicity	(0.0232)	(0.0258)	(0.0242)	(0.0418)	(0.0253)	(0.0302)
White	-0.0327	0.0193	-0.0468+	0.0205	-0.0636**	0.0304
	(0.0339)	(0.0364)	(0.0239)	(0.0369)	(0.0234)	(0.0273)
Other	0.0057	0.0094	0.0322	-0.0229	0.0026	0.0397
	(0.0525)	(0.0569)	(0.0635)	(0.0661)	(0.0379)	(0.0501)
Age in Years	-0.0114	0.1042**	0.029	0.0641	-0.0085	0.0591+
	(0.0399)	(0.0309)	(0.0366)	(0.0432)	(0.0269)	(0.0344)
Panel C: Parent Covariates						
Received Texts	0.0342	-0.0404	-0.0004	-0.0296	0.0131	-0.0075
in English	(0.0426)	(0.0497)	(0.0393)	(0.0500)	(0.0341)	(0.0410)
Received Texts	-0.0067	0.0037	-0.0053	0.0166	-0.0115	0.0091
in Spanish	(0.0332)	(0.0456)	(0.0385)	(0.0421)	(0.0234)	(0.0300)
Received Texts	-0.0275	0.0367	0.0057	0.013	-0.0016	-0.0016
in Chinese	(0.0302)	(0.0544)	(0.0254)	(0.0461)	(0.0249)	(0.0407)

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant covariate. Column headers indicate the sample and model components. The reference category is the control group. Row headers indicate the covariate tested. A Generalized Rasch Model was used to create the covariate factors. The literary skills factor was made from the parent ratings of the child's letter knowledge, letter sounds, and rhyming. The home activities factor was made from parent reports of how often they read, told stories, and sang with their child, and how often the child asked to be read to. The parent background factor was made with parent age and education. All models include randomization site fixed effects. Standard errors are clustered at the randomization site level. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table A3: Attrition by student characteristic

	Model 1		Model 2	
	(1)	(2)	(3)	(4)
	General Text Treatment * Covariate	Personalized Text Treatment * Covariate	General Text Treatment * Covariate	Personalized Text Treatment * Covariate
Panel A: Not in Parent Survey Sample				
English	-0.0176	-0.0244	-0.0176	-0.0068
	(0.0884)	(0.0820)	(0.0884)	(0.0909)
Spanish	0.0286	0.0784	0.0286	0.0498
	(0.0921)	(0.0924)	(0.0921)	(0.1040)
Chinese	-0.007	-0.058	-0.007	-0.051
	(0.1133)	(0.1487)	(0.1133)	(0.1736)
Male	-0.0996	0.0638	-0.0996	0.1634+
	(0.0802)	(0.0927)	(0.0802)	(0.0909)
Age in Years	-0.0814	-0.2266+	-0.0814	-0.1452
	(0.1263)	(0.1185)	(0.1263)	(0.1171)
First Year in Program	-0.0315	-0.0242	-0.0315	0.0072
	(0.1077)	(0.0887)	(0.1077)	(0.0871)
Panel B: Not in Teacher Survey Sample				
English	0.0012	0.037	0.0012	0.0358
	(0.0808)	(0.0680)	(0.0808)	(0.0999)
Spanish	0.0605	-0.069	0.0605	-0.1296
	(0.1036)	(0.0700)	(0.1036)	(0.1095)
Chinese	-0.0808	0.0383	-0.0808	0.1191
	(0.0851)	(0.1085)	(0.0851)	(0.1518)
Male	0.0532	0.1315+	0.0532	0.0783
	(0.0843)	(0.0714)	(0.0843)	(0.0938)
Age in Years	-0.3034*	-0.1709	-0.3034*	0.1325
	(0.1219)	(0.1188)	(0.1219)	(0.1151)
First Year in Program	0.1079	0.0777	0.1079	-0.0302
	(0.0787)	(0.0644)	(0.0787)	(0.0901)
Panel C: Not in Academic Sample				
English	0.0277	-0.0581	0.0277	-0.0858
	(0.0828)	(0.0843)	(0.0828)	(0.1052)
Spanish	0.0309	0.0283	0.0309	-0.0026
	(0.0912)	(0.1091)	(0.0912)	(0.1080)
Chinese	-0.091	0.0581	-0.091	0.149
	(0.0812)	(0.1408)	(0.0812)	(0.1595)
Male	-0.0711	0.0476	-0.0711	0.1187
	(0.0835)	(0.0825)	(0.0835)	(0.0914)
Age in Years	-0.036	-0.0924	-0.036	-0.0565
	(0.1575)	(0.1302)	(0.1575)	(0.1298)
First Year in Program	-0.0222	-0.0429	-0.0222	-0.0207
	(0.0842)	(0.0805)	(0.0842)	(0.0861)

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the on an indicator for not being in the sample defined by the panel header. Column headers indicate the model and model components. Row headers indicate the baseline covariate with which the treatment indicators are interacted. N = 794. Models include randomization site fixed effects. Standard errors are clustered by randomization site. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table A4: Alternate model of effects on Fountas and Pinnell Benchmark Assessment System academic outcomes

	(1)	(2)		(3)	(4)
	Any Text Treatment	Any Text Treatment * Personalization		Any Text Treatment	Any Text Treatment * Personalization
Panel A: Reading Level Outcomes					
Reading level(ordinal logit)	0.037	0.3362		0.0021	0.3878+
	(0.1796)	(0.2101)		(0.1886)	(0.2200)
Pr(Reading Level A or Above)	0.0192	0.0084		0.0203	0.0049
	(0.0161)	(0.0137)		(0.0162)	(0.0137)
Pr(Reading Level C or Above)	0.0329	-0.0382		0.0316	-0.0406
	(0.0463)	(0.0474)		(0.0440)	(0.0425)
Pr(Reading Level E or Above)	0.0045	0.0981+		0.0118	0.0874
	(0.0498)	(0.0537)		(0.0499)	(0.0539)
Pr(Reading Level G or Above)	-0.0023	0.0531		-0.0071	0.0554
	(0.0488)	(0.0522)		(0.0495)	(0.0499)
Panel B: District Academic Benchmarks					
Exceeds Expectations	-0.0036	0.1245*		-0.0065	0.1272*
	(0.0504)	(0.0530)		(0.0493)	(0.0488)
Meets or Exceeds Expectations	0.0234	0.0739		0.0295	0.0669
	(0.0429)	(0.0530)		(0.0394)	(0.0488)
Approaches, Meets, or Exceeds Expectations	0.0393	-0.023		0.0355	-0.0244
	(0.0506)	(0.0490)		(0.0468)	(0.0443)
Randomization Site Fixed Effects	✓	✓		✓	✓
Language of Texts	✓	✓		✓	✓
Factors of Baseline Survey Responses				✓	✓
Administrative Covariates				✓	✓

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant academic outcome. Column headers indicate the model and model components. Row headers indicate the academic outcome. A Graded Response Model was used to create the factors of baseline survey responses. Factors were made from parent reports of parent age and education, parent reports of the child's knowledge of letters, letter sounds, and rhyming, parents reports of the frequency with which the parent read to, told stories to, and sang to their child, and parent reports of how often the child asks questions. Administrative covariates include age and indicators for gender and race. All standard errors are clustered at the randomization site level. N = 540 for all regressions +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table A5: Alternate model of effects on parent beliefs and home activities

	(1)	(2)		(3)	(4)
	Any Text Treatment	Any Text Treatment * Personalization		Any Text Treatment	Any Text Treatment * Personalization
Panel A: Parent Outcome Factors					
Parent Belief Factor	-0.1141	0.2225		-0.1515	0.2352
	(0.1563)	(0.1731)		(0.1582)	(0.1708)
Activities Factor	0.1579	0.165		0.1945	0.1199
	(0.1528)	(0.1456)		(0.1523)	(0.1366)
Panel B Parent Beliefs					
Enjoys home literacy activities	-0.1221	0.0986		-0.1607	0.1272
	(0.1476)	(0.1664)		(0.1522)	(0.1634)
Knows literacy skills needed for first grade	-0.0881	0.249		-0.116	0.2495
	(0.1482)	(0.1622)		(0.1479)	(0.1599)
Believes can build literacy skills	-0.1216	0.1125		-0.1508	0.1167
	(0.1606)	(0.1577)		(0.1657)	(0.1622)
Believes he/she plays an important role in building literacy skills	-0.0344	0.0354		-0.0579	0.0576
	(0.1357)	(0.1666)		(0.1393)	(0.1575)
Building reading skills is easy	-0.2632	0.4415**		-0.2967+	0.4411**
	(0.1594)	(0.1615)		(0.1489)	(0.1634)
Feels supported	0.0218	0.2373		-0.018	0.247
	(0.1653)	(0.1827)		(0.1684)	(0.1826)
Panel C: Parent Activities					
Read words with child	0.3001*	-0.0577		0.2822+	-0.0853
	(0.1426)	(0.1328)		(0.1455)	(0.1191)
Wrote notes with child	0.0674	0.0895		0.0881	0.0604
	(0.1574)	(0.1678)		(0.1658)	(0.1815)
Took books when left the house	0.2574+	0.0447		0.2789*	0.0079
	(0.1301)	(0.1470)		(0.1254)	(0.1418)
Read books to child	0.0976	0.0538		0.1276	0.04
	(0.1178)	(0.1524)		(0.1125)	(0.1309)
Had child read books to parent	0.1591	-0.1152		0.1916	-0.1863
	(0.1614)	(0.1546)		(0.1400)	(0.1343)
Reviewed parts of a book	-0.0133	0.3036*		-0.01	0.2827*
	(0.1259)	(0.1359)		(0.1168)	(0.1239)
Reviewed direction of reading	-0.0426	0.4767**		-0.019	0.4581**
	(0.1579)	(0.1412)		(0.1565)	(0.1375)
Corrected mistakes while reading	0.1258	0.2587*		0.1182	0.2148+
	(0.1374)	(0.1263)		(0.1441)	(0.1267)
Asked child questions about book	0.1251	0.1086		0.1682	0.0821
	(0.1264)	(0.1162)		(0.1401)	(0.1206)
Practiced rhyming	0.1208	0.2756+		0.1662	0.2486+
	(0.1631)	(0.1548)		(0.1619)	(0.1402)
Practiced writing child's name	0.0208	0.2035		0.0681	0.1446
	(0.1427)	(0.1588)		(0.1451)	(0.1871)
Randomization Site Fixed Effects	✓	✓		✓	✓
Language of Texts	✓	✓		✓	✓
Factors of Baseline Survey Responses				✓	✓
Administrative Covariates				✓	✓

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant outcome. Column headers indicate the model and model components. Row headers indicate the literacy outcome All literacy outcomes are standardized. Factor analysis was used to determine the outcome factors. See Table A8 for a list of survey questions that compose each outcome factor. Covariates are detailed in Table 3. All standard errors are clustered at the randomization site level. N = 388 in all regressions. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table A6: Alternate model of effects on parent involvement at school

	(1)	(2)		(3)	(4)
	Any Text Treatment	Any Text Treatment * Personalization		Any Text Treatment	Any Text Treatment * Personalization
Panel A: Outcome Factors					
Parent Report of Interactions Factor	0.2571+	-0.0006		0.2710+	-0.0754
(N = 388)	(0.1395)	(0.1451)		(0.1379)	(0.1485)
Teacher Report of Interactions Factor	0.1785	-0.3907*		0.2019	-0.3769+
(N = 348)	(0.1320)	(0.1941)		(0.1328)	(0.2012)
Panel B: Parent Reports On Interactions With Teacher (N = 388)					
Talked to teacher	0.2378	-0.0783		0.2501+	-0.1044
	(0.1534)	(0.1579)		(0.1437)	(0.1604)
Talked to teacher about child's	0.0999	0.0951		0.1105	0.013
interests	(0.1316)	(0.1481)		(0.1287)	(0.1489)
Talked to teacher about how well	0.2823+	-0.0508		0.2968+	-0.1021
child is getting along with others	(0.1441)	(0.1584)		(0.1500)	(0.1690)
Talked to teacher about how well	0.1652	0.0984		0.1788	0.0392
child is doing in school	(0.1430)	(0.1513)		(0.1391)	(0.1535)
Talked to teacher about child's early	0.1312	0.0307		0.1232	-0.0099
literacy skills	(0.1402)	(0.1485)		(0.1399)	(0.1489)
Talked to teacher about child's	0.2133	-0.0531		0.2075	-0.1106
reading skills	(0.1425)	(0.1513)		(0.1426)	(0.1602)
Asked for book and home activity	0.2245	0.0906		0.2506+	0.0058
recommendations	(0.1393)	(0.1556)		(0.1321)	(0.1554)
How well does parent know teacher	0.3289**	-0.2088+		0.3615***	-0.2798*
	(0.1037)	(0.1102)		(0.1020)	(0.1192)
Panel C: Teacher Reports On Interactions With Parents (N = 348)					
Parent talks about child's interests	0.2119	-0.3409+		0.2464+	-0.3302+
	(0.1288)	(0.1795)		(0.1305)	(0.1729)
Parent asks how well child gets along	0.072	-0.1826		0.0952	-0.2044
with others	(0.1294)	(0.2307)		(0.1224)	(0.2293)
Parent asks how well child is doing	0.103	-0.3141		0.1639	-0.3456+
in school	(0.1688)	(0.2063)		(0.1641)	(0.2049)
Parent asks about child's literacy	0.1805	-0.3971*		0.2111	-0.3829*
skills	(0.1371)	(0.1518)		(0.1392)	(0.1751)
Parent asks how to help child learn	0.1798	-0.3607		0.1675	-0.336
to read	(0.1548)	(0.2152)		(0.1573)	(0.2302)
Parent asks for book	0.0543	-0.2184		0.0552	-0.2031
recommendations	(0.1336)	(0.1482)		(0.1424)	(0.1791)
Parent talks about home activities	0.2840*	-0.3548		0.3061*	-0.3107
	(0.1292)	(0.2498)		(0.1337)	(0.2570)
How well does teacher know parent	-0.0714	-0.1525		-0.1047	-0.1165
	(0.1729)	(0.1945)		(0.1877)	(0.2101)
Randomization Site Fixed Effects	✓	✓		✓	✓
Language of Texts	✓	✓		✓	✓
Factors of Baseline Survey Responses				✓	✓
Administrative Covariates				✓	✓

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant outcome. Column headers indicate the model and model components. Row headers indicate the outcome. All outcomes are standardized. Factor analysis was used to create the outcome factors. The parent report of interactions factor is made up of the questions in Panel A, the teacher report of interactions factor is made up questions in Panel B. Covariates are detailed in Table 3. All standard errors are clustered at the randomization site level. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table A7: Alternate model for bounds on teacher survey outcomes

	Original Estimates		Upper Bounds		Lower Bounds	
	(1)	**(2)**	(3)	(4)	(5)	(6)
	Any Text Treatment	**Any Text Treatment * Personalization**	Any Text Treatment	Any Text Treatment * Personalization	Any Text Treatment	Any Text Treatment * Personalization
Teacher Report of Interactions	**0.2019**	**-0.3769+**	0.2892*	-0.3197	0.007	-0.1641
Factor	**(0.1328)**	**(0.2012)**	(0.1253)	(0.2112)	(0.1417)	(0.1791)
Parent talks about child's interests	**0.2464+**	**-0.3302+**	0.3033+	-0.3676*	0.0125	-0.1683
	(0.1305)	**(0.1729)**	(0.1547)	(0.1672)	(0.0938)	(0.1581)
Parent asks how well child gets	**0.0952**	**-0.2044**	0.2418+	-0.2272	-0.0685	-0.1621
along with others	**(0.1224)**	**(0.2293)**	(0.1344)	(0.2430)	(0.1045)	(0.1927)
Parent asks how well child is doing	**0.1639**	**-0.3456+**	0.1892	-0.2544	-0.0502	-0.1564
in school	**(0.1641)**	**(0.2049)**	(0.1700)	(0.1828)	(0.1728)	(0.1711)
Parent asks about child's literacy	**0.2111**	**-0.3829***	0.2327	-0.3383+	0.005	-0.2761
skills	**(0.1392)**	**(0.1751)**	(0.1590)	(0.1922)	(0.1597)	(0.1900)
Parent asks how to help child learn	**0.1675**	**-0.336**	0.291	-0.3384	-0.1186	-0.2738
to read	**(0.1573)**	**(0.2302)**	(0.1737)	(0.2211)	(0.1510)	(0.1686)
Parent asks for book	**0.0552**	**-0.2031**	0.1189	-0.2316	-0.1383	-0.1773
recommendations	**(0.1424)**	**(0.1791)**	(0.1371)	(0.1985)	(0.1493)	(0.1714)
Parent talks about home activities	**0.3061***	**-0.3107**	0.4222**	-0.3264	0.1087	-0.1983
	(0.1337)	**(0.2570)**	(0.1332)	(0.2292)	(0.1336)	(0.2454)
How well does teacher know parent	**-0.1047**	**-0.1165**	0.0131	-0.2082	-0.2749	0.0125
	(0.1877)	**(0.2101)**	(0.1484)	(0.2209)	(0.2017)	(0.2129)

Note: Each pair of cells represents the results of a separate regression of the treatment effect on the relevant outcome. Row headers indicate the outcome. All outcomes are standardized. Factor analysis was used to create the outcome factors. Upper and lower bound estimates were calculated by the procedure recommended by Lee (2009). All models include randomization site fixed effects, controls for text language, factors of baseline survey questions, and administrative covariates. Covariates are detailed in Table 3. Standard errors are clustered at the randomization site level. The sample size is 327 in all regressions. +indicates p<0.10, *p<0.05, **p<0.01, ***p<0.001

Table A8: Factor analysis details

Component	Scoring Coefficient
Panel A: Parent belief factor (N=388)	
I enjoy doing activities with my child that build his/her reading skills	0.19328
I know which literacy skills my child needs to be ready for first grade	0.20282
I know what I can do to help my child build the literacy skills necessary for 1st	0.20612
I play an important role in building my child's reading skills	0.19448
Building my child's reading skills is easy	0.17166
I feel supported in helping prepare my child for first grade	0.19843
Eigenvalue: 4.39286 (73.21% of variance explained)	
Panel B: Activities factor (N=388)	
Last week, how many times did you do each of the following reading related activities with your child?	
Practiced reading words	0.06515
Write a note to you child for him/her to read	0.06600
Brought books when leaving the house	0.05686
Read to your child	0.06054
Had your child read to you	0.07050
Showed your child the different parts of a book	0.06892
Showed your child that we read from left to right	0.06494
Asked your child to follow the words with her/her finger as your read	0.07611
Asked questions about the pictures in a book	0.07818
Worked with your child to correct his/her mistakes as s/he read	0.06800
Asked your child questions about a book or story s/he recently read or heard	0.07453
Last week how many times did you do each of the following literacy skills activities with your child?	
Said beginning word sounds with your child	0.07194
Hunted for lower and upper case letters in a book or magazine	0.07205
Said a new word to your child and talked about what it means	0.07448
Asked your child questions to spark his/her imagination	0.06711
Said ending word sounds with your child	0.07553
Hunted for small words in a book or magazine	0.07107
Said rhyming words with your child	0.07785
Helped your child write his/her name	0.05772
Had your child describe the things s/he sees	0.07349
Had your child help you with a daily routine	0.06077
Played a game with your child like "I spy"	0.07008
Eigenvalue: 9.42567 (42.84% of variance explained)	
Panel C: Parent reports of school involvement factor (N=388)	
During a typical week, how many times did you talk to your child's teacher	0.12308
How well did you know your child's kindergarten teacher	0.12465
Since January, how times did you talk to your child's teacher about:	
Your child's interests	0.16217
How your child is getting along with other children	0.16097
How your child is doing in school	0.17049
Your child's early literacy skills	0.16836
Your child's reading skills	0.17497
Books that your child might like or activities to do at home with your child	0.16740
Eigenvalue: 5.01445 (62.68% of variance explained)	
Panel D: Teacher reports of parent involvement factor (N=348)	
How well do you know the parents of (child's name)	0.12044
How often do parents of (child's name) ask you about the following topics	
Their child's interests	0.16465
How their child gets along with others	0.16182
What their child is doing in school	0.17867
Their child's understanding of early literacy skills like letter sounds	0.17965
Things they can do to help their child learn to read	0.18343
Book recommendations	0.14714
Tell you about what they are doing at home to help their child learn	0.17163
Eigenvalue: 4.61365 (57.67% of variance explained)	