IES Institute of Education Sciences

APPENDIXES
December 2022

Regional Educational Laboratory Southwest
At American Institutes for Research

Encouraging Families to Visit a Literacy Website: A Randomized Study of the Impact of Email and Text Message Communications

See https://ies.ed.gov/ncee/rel/Products/Publication/100918 for the full report.

Appendix A. Study design

The Arkansas Department of Education wanted to encourage families to visit the Reading Initiative for Student Excellence (R.I.S.E.) state literacy website, which provides families with resources that support the development of reading proficiency. In partnership with the Regional Educational Laboratory Southwest, the department sent short email and text message communications—referred to as nudges—to households with children in kindergarten-grade 6 in Arkansas public schools during the 2021/22 school year. Elementary schools were randomly assigned to one of eight conditions, which varied the mode of communication (email only or email and text message), the presentation of information (no graphic or with a graphic), and the type of sender (generic sender or known sender [school principal]). The eight conditions are in figure 1 in the main report.

Nudges were sent in English unless the family had selected Spanish as the preferred language when they enrolled their child for the 2021/22 school year. As of 2017/18, 8 percent of K-12 students in Arkansas were English learner students, and 83 percent of these English learner students spoke Spanish at home, followed by Marshallese at 8 percent; Vietnamese, Arabic, and Lao at 1 percent each; and nearly 90 other languages at less than 1 percent each (Arkansas Bureau of Legislative Research, 2019). This means that approximately 1.4 percent of Arkansas K-12 students are in households that may not speak English or Spanish and thus may not have been able to understand the messages sent through the campaign.

Household "contactability" tests were carried out in November 2021. To determine which modes of communication were operative for each household, test messages were sent to households via email and text message. For text message communication a message was first sent using multimedia messaging service (MMS). If the sender received a message indicating that the message was not delivered, this was followed up with a short message service (SMS) message. Only 4.6 percent of the initial 180,531 households were sent a text message through SMS, indicating that most households had MMS capability (see table C1 in appendix C). The contactability tests provided households with the ability to opt out of further contact. A total of 11,784 households (6.5 percent) opted out, with most (10,933 households, or 93 percent) opting out of text messages.

In January 2022 schools were randomly assigned to one of the eight study conditions. All households with children in those schools, except households that opted out, were sent three rounds of communications developed by the Arkansas Department of Education. Each school was provided with a specific R.I.S.E. landing page URL that was included in the communications to enable the study team to examine differences in the number of new users and the amount of time they spent on the R.I.S.E. website.[1] The content of the communications varied by date but not by study condition (table A1 and figures A1–A3). English and Spanish versions had the same content. For communications with a graphic, the same image was sent in both emails and text messages (and translated into Spanish for the Spanish versions). Graphics were included only for MMS text messages to households in applicable study conditions; if the MMS message was not delivered, then an SMS without a graphic was sent. For households in the known sender study conditions, the sender information in both the emails and the text messages was changed from the Arkansas Department of Education to the school principal's name. For emails this meant replacing the sender field with the principal's name. For text messages this meant including the school principal's name in the body of the text message; the number from which the text message was sent did not vary.[2]

Table A1. Email and text message dates and content

Message date	Content
January 11, 2022	Let's Empower Our Readers! Did you know? There are 44 sounds in the English language and ALL of them help a child learn to read. Learn more [URL]
January 18, 2022	Let's Empower Our Readers! You can spell 50% of all English words accurately by listening to the sounds. Learn more [URL]
January 20, 2022	Let's Empower Our Readers! You can grow your child's vocabulary by approximately 1.4 million words by regularly reading to them. Learn more [URL]

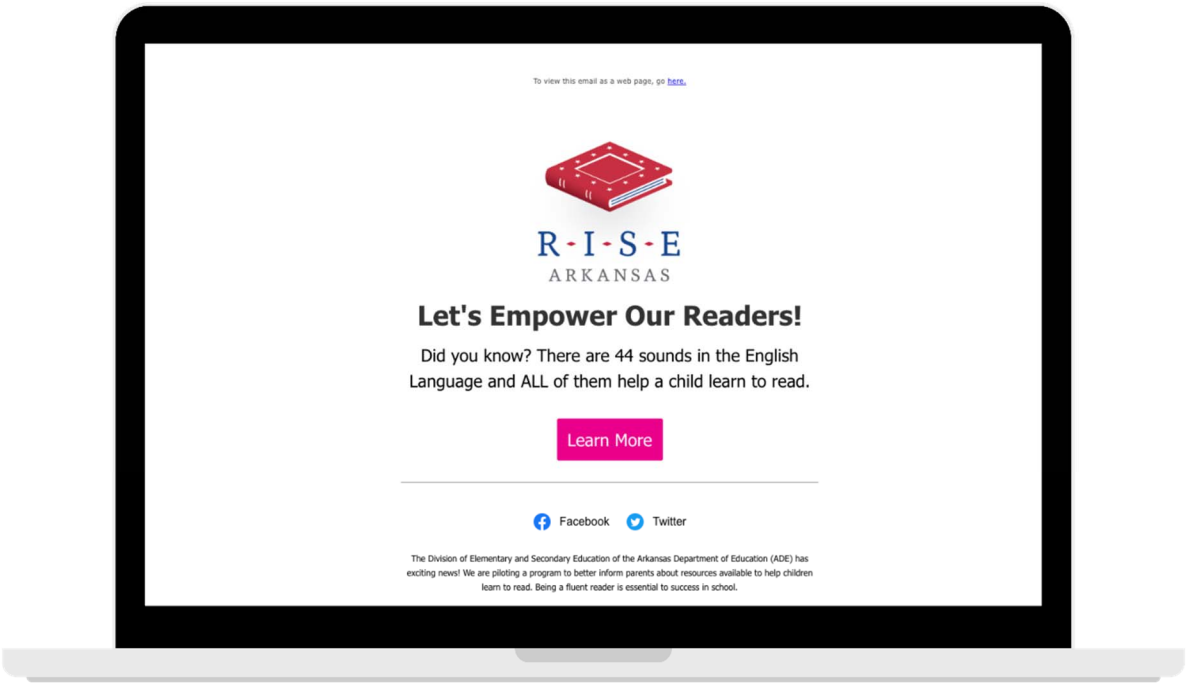
Source: Authors' compilation.

[1] However, in error, the email and text message vendor redirected clicks in the four email and text message conditions to a single school's URL, making it impossible to determine the time on page for each study condition separately. It was possible, however, to determine the time on the page for each mode of communication.

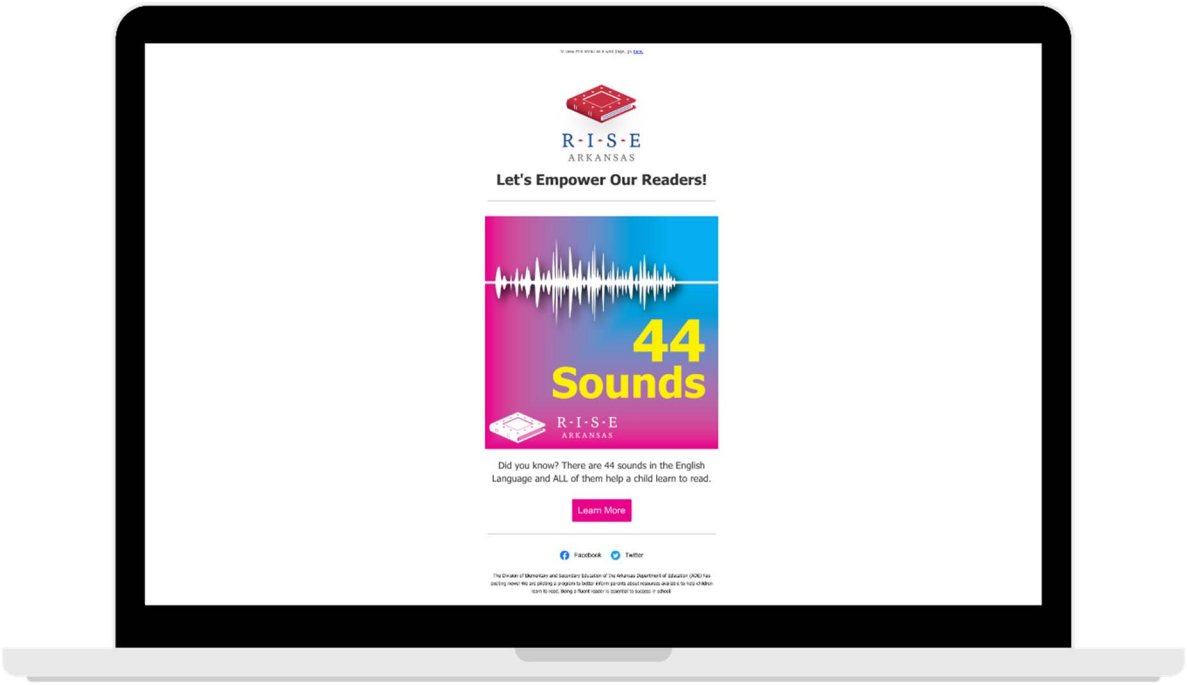
[2] The text message vendor sent the text messages using a shorter number that does not resemble a typical phone number (a short code), which showed as 21086.

Figure A1. Email and text communications sent on January 11, 2022

Email, no graphic

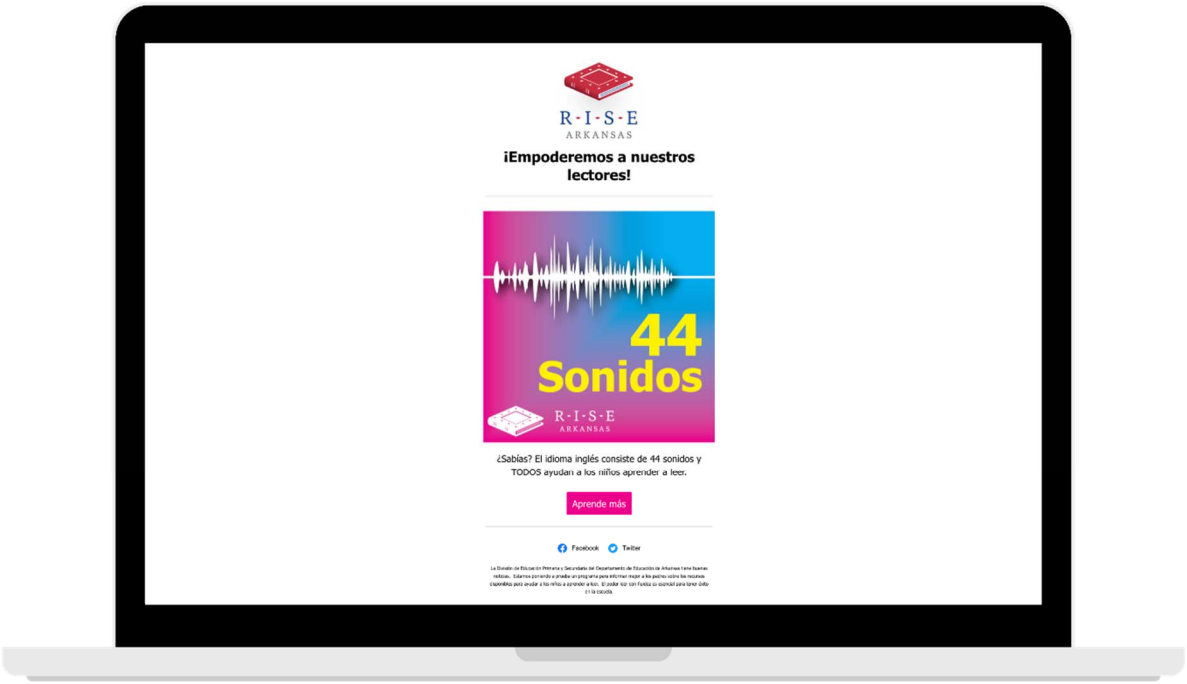


Email, with graphic

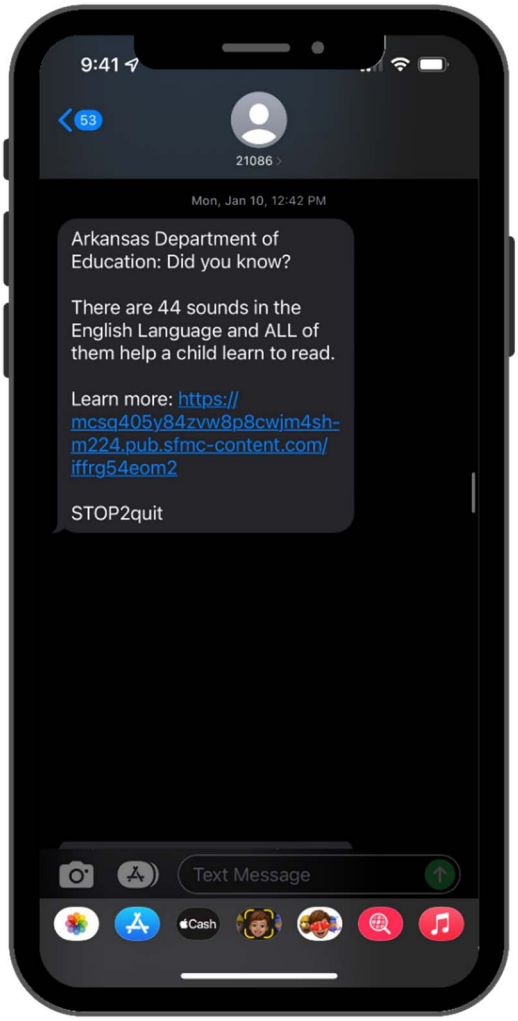


Email, Spanish, no graphic

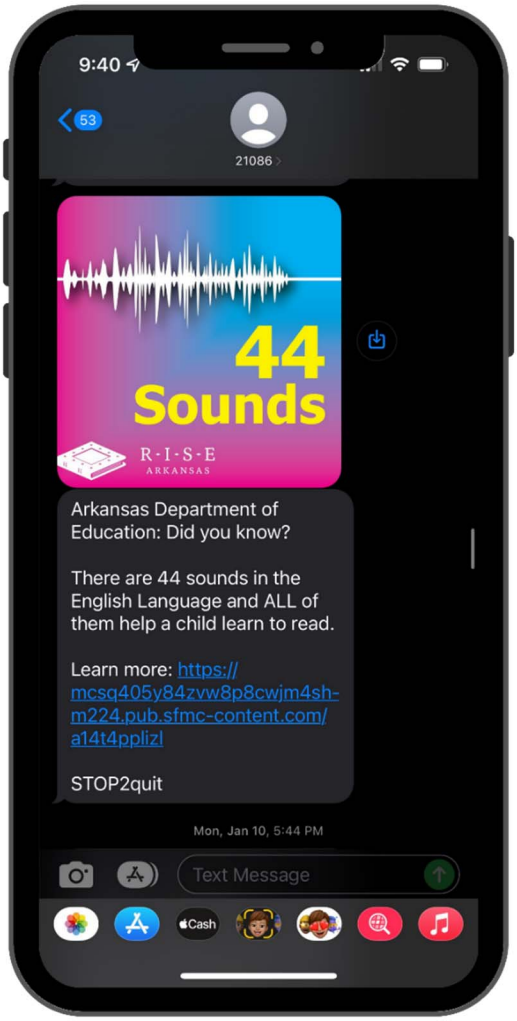
Email, Spanish, with graphic



Text message, no graphic



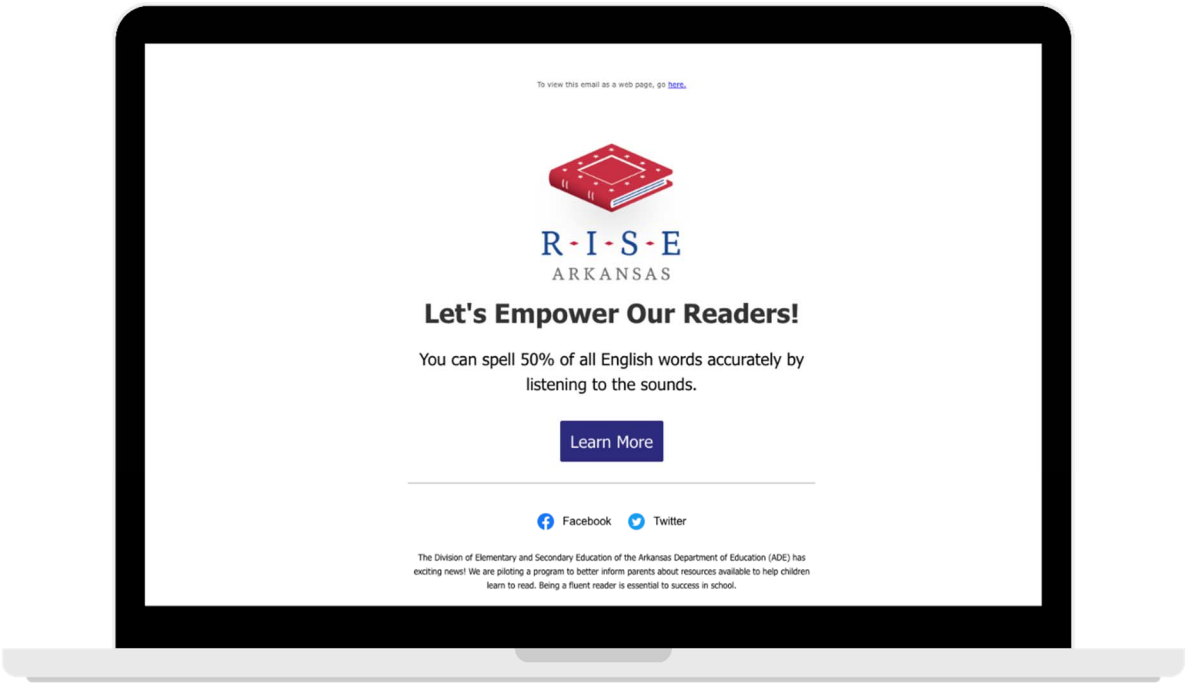
Text message, with graphic



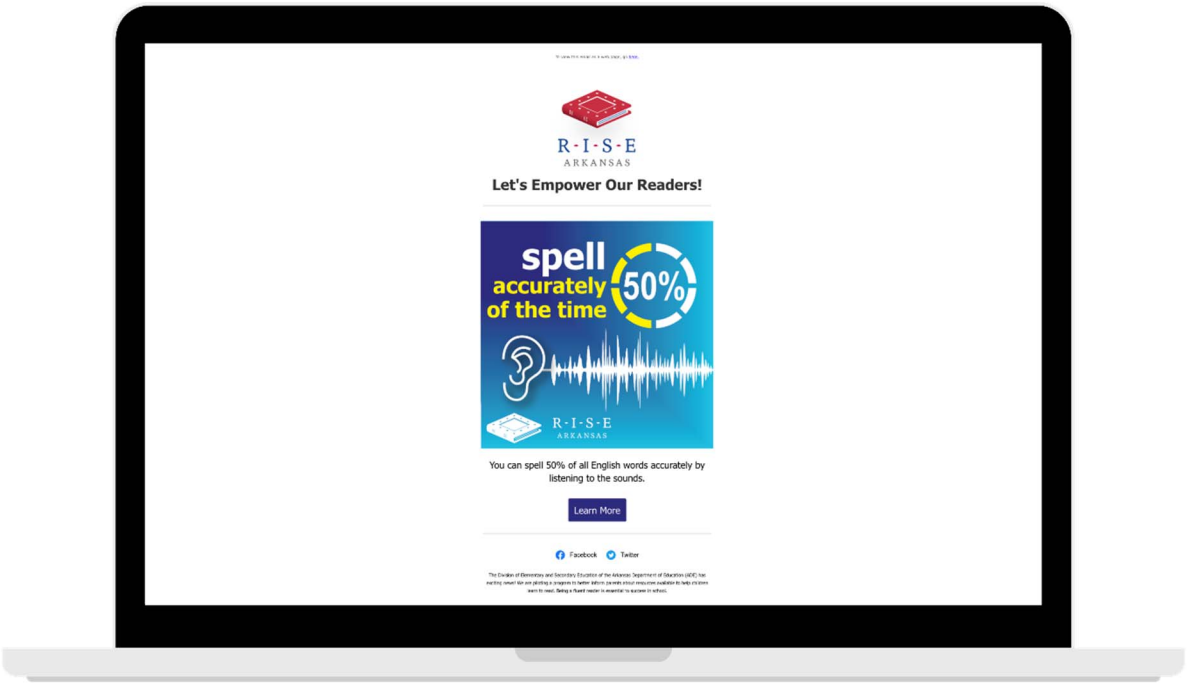
Source: Email and text message vendor.

Figure A2. Email and text communications sent on January 18, 2022

Email, no graphic

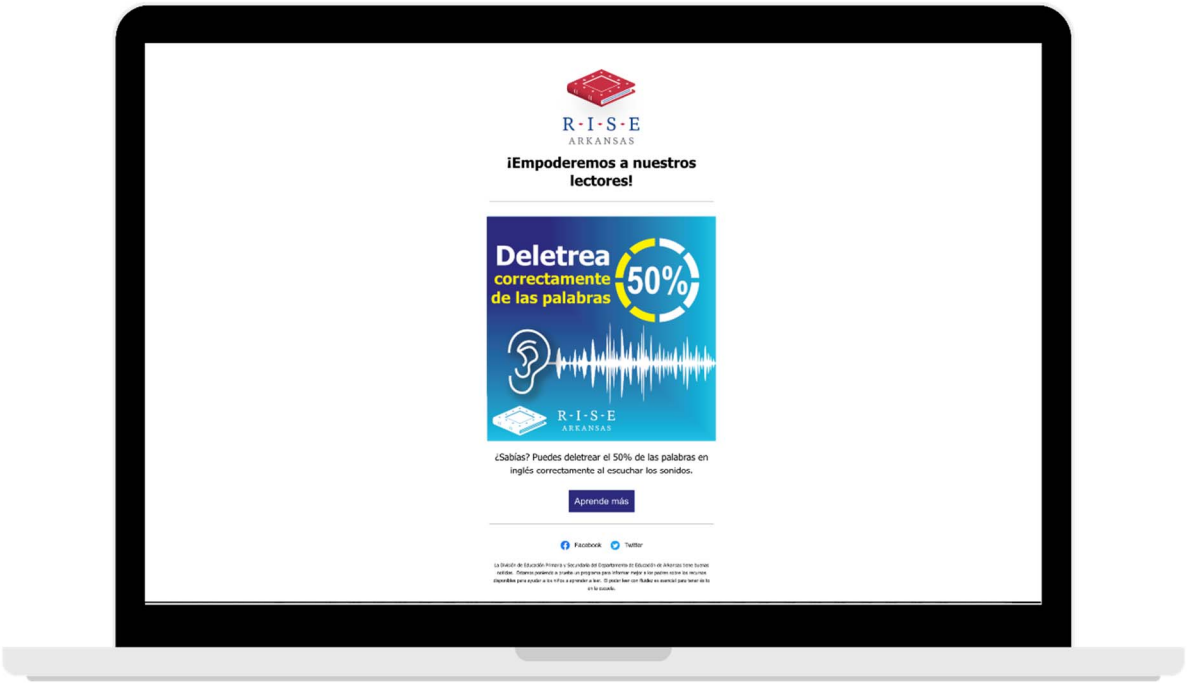


Email, with graphic

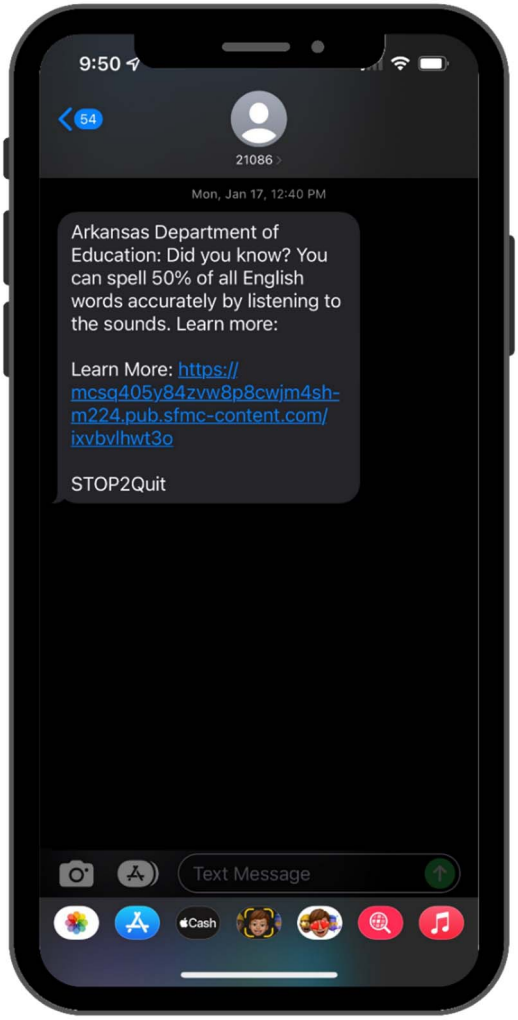


Email, Spanish, no graphic

Email, Spanish, with graphic



Text message, no graphic

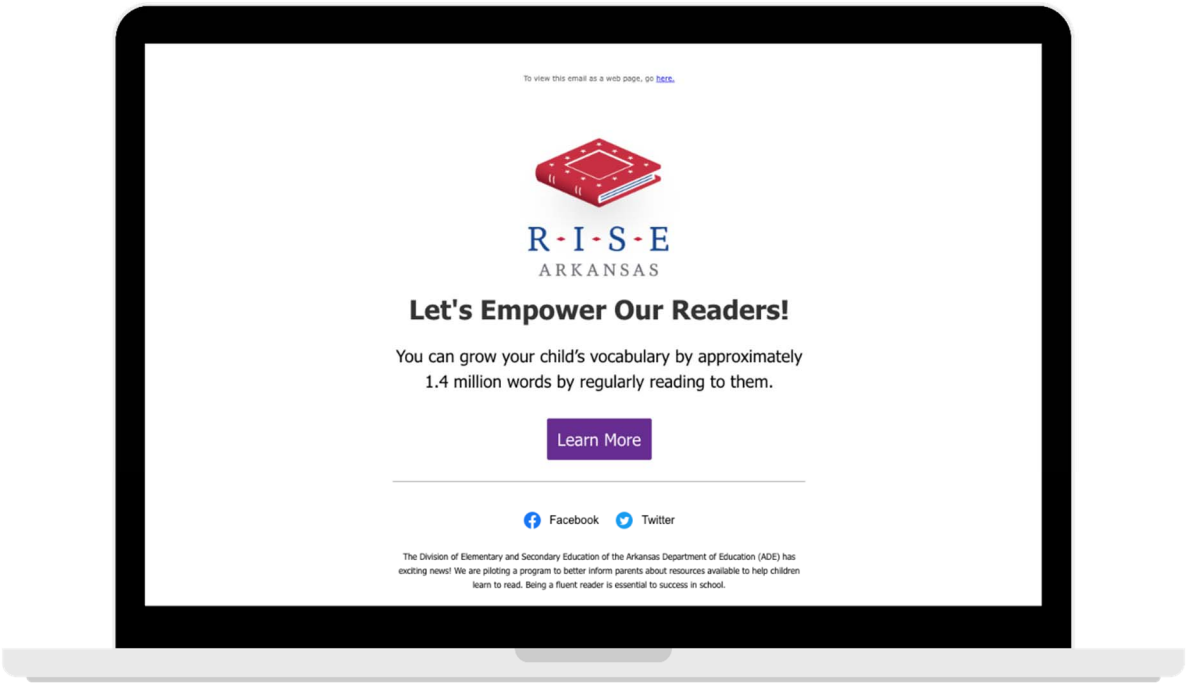


Text message, with graphic

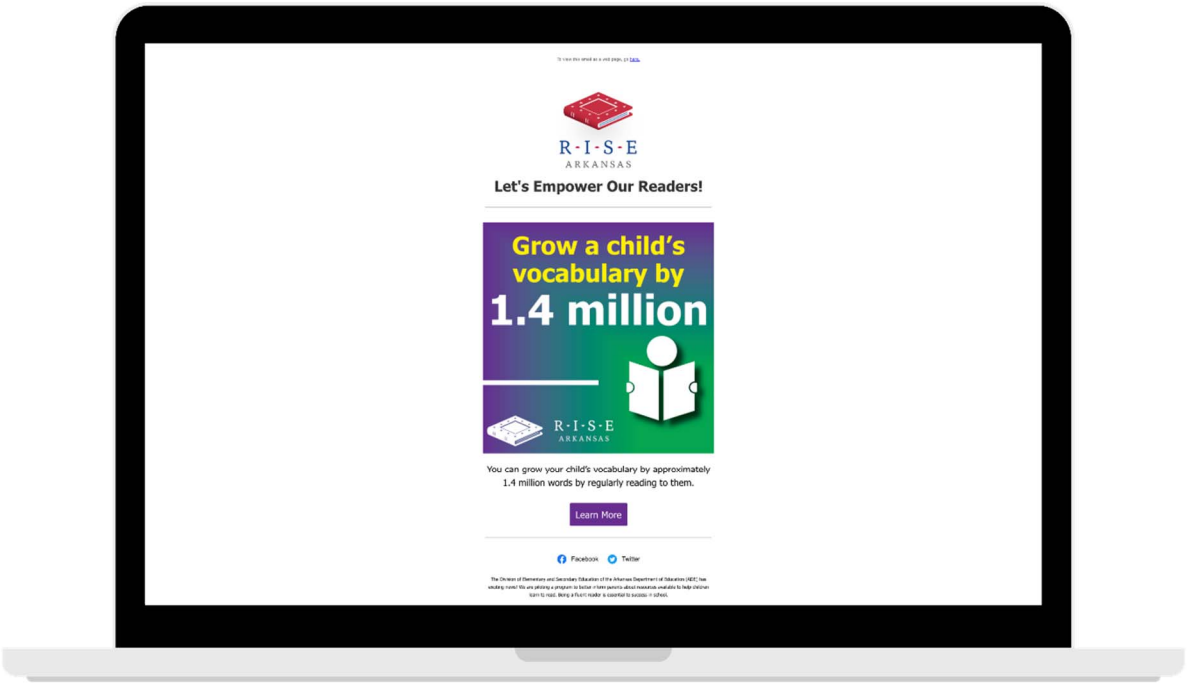
Source: Email and text message vendor.

Figure A3. Email and text communications sent on January 20, 2022

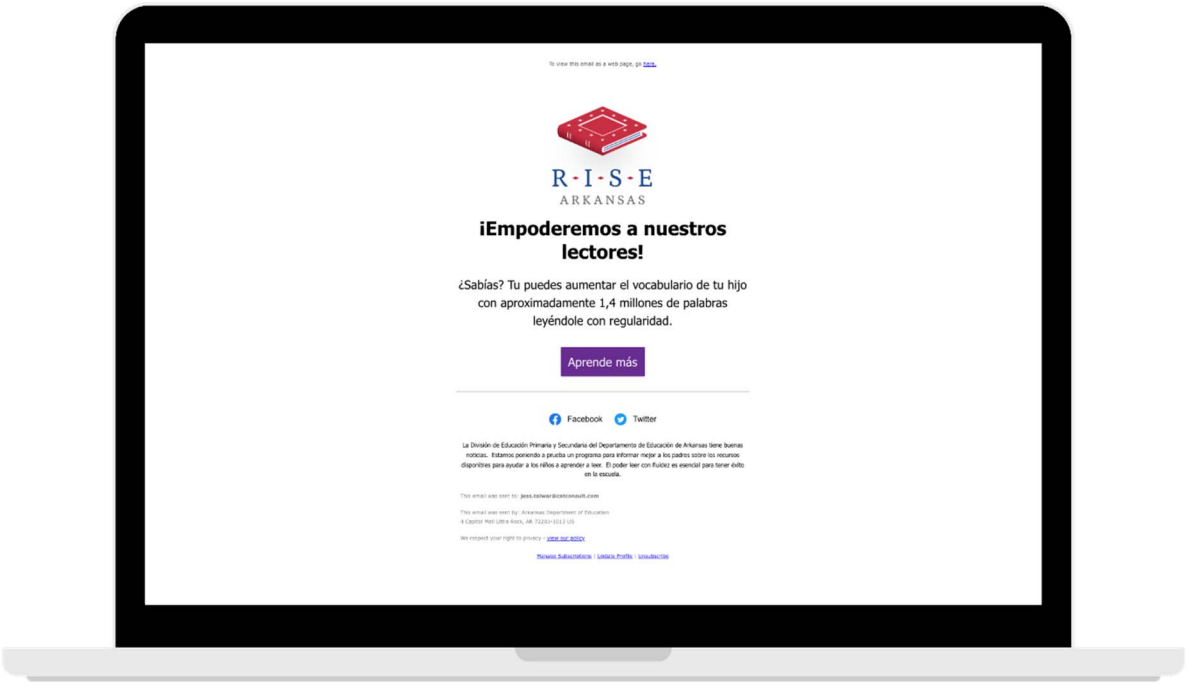
Email, no graphic



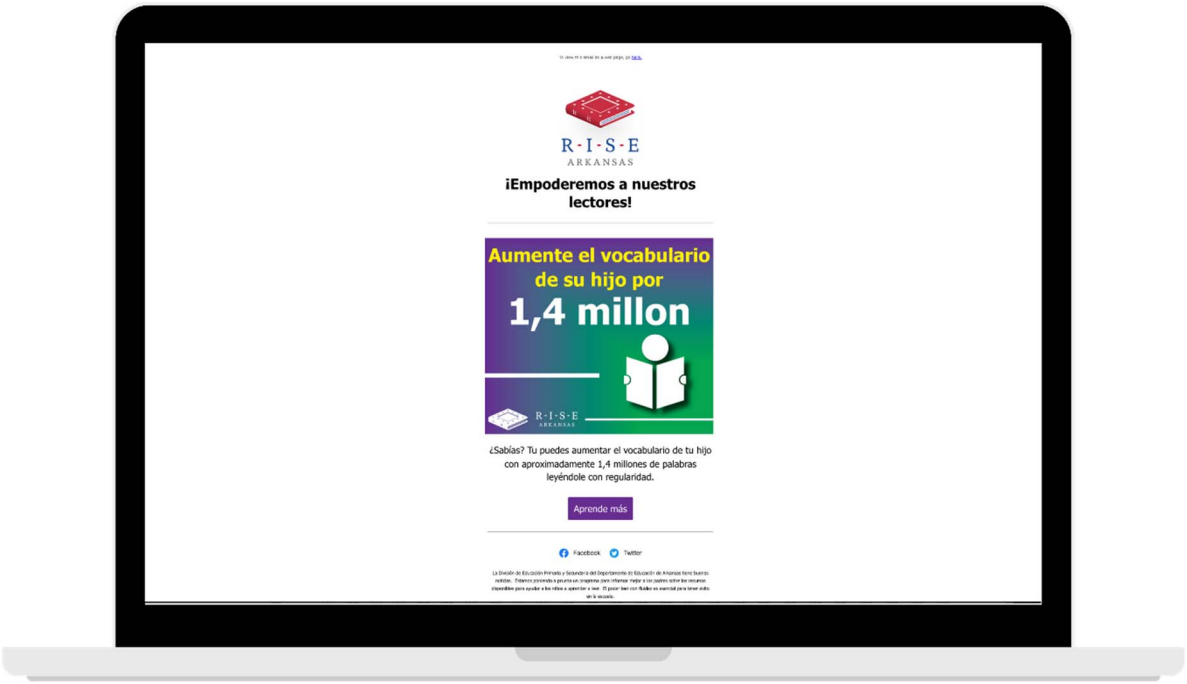
Email, with graphic



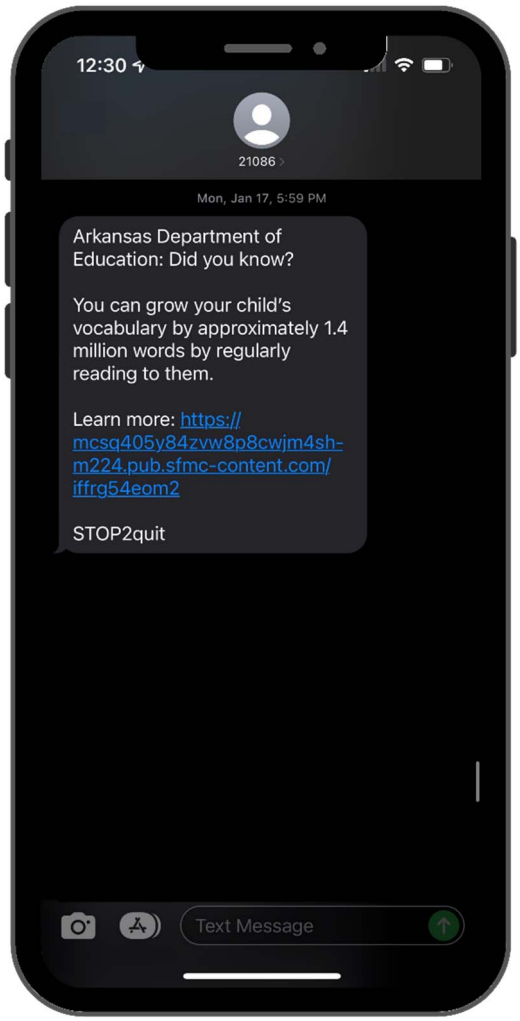
Email, Spanish, no graphic



Email, Spanish, with graphic



Text message, no graphic



Note: The email and text message vendor was not able to provide an image of the January 20, 2022, text with graphic. The text with graphic was sent to the appropriate condition groups and included the same graphic as the email with graphic.
Source: Email and text message vendor.

Reference

Arkansas Bureau of Legislative Research. (2019). *English language learners state categorical funding review*. https://www.arkleg.state.ar.us/Calendars/Attachment?committee=410&agenda=2978&file=Handout+D2+CategoricalELLFundingReport.pdf.

Appendix B. Methods

This appendix details the study data, sample, and methodology.

Data

The study team used data provided by the Arkansas Department of Education from its Student Information System, the email and text message vendor, and Google Analytics (table B1).

The Arkansas Department of Education provided student demographic information for each school, including total enrollment and percentages of students by eligibility for the National School Lunch Program (an indicator of economic disadvantage), by race/ethnicity, by English learner status, by special education status, and by grade level. The department also provided the number of unique households with enrolled students in its encrypted Student Information System and, for each school, the number of households with an email address, cell phone number, and both an email address and a cell phone number. The study team did not have access to information about the characteristics of individual students or households except for a link between households and school identification number and primary home language.

The email and text message vendor provided records about the campaign communications overall, by school, and by treatment condition group. These records included information about which households had working contact information (email address or cell phone number), which households opened an email or were delivered a text message during at least one of the three rounds of campaign messaging, and which households clicked the link in an email or text message during at least one of the three rounds of campaign messaging. Information about opening emails and delivery of text messages was not available separately for each round of messaging.

Finally, the Arkansas Department of Education tracks visits to the Reading Initiative for Student Excellence (R.I.S.E.) state literacy website using Google Analytics tools. The variables in the Google Analytics data included information on total website users and average session duration in seconds by school-specific URL.

Table B1. Data sources and variables, by research question

Data source	Variable	Research questions
Arkansas Department of Education	• Household, school, and district IDs. *School characteristics* • Enrollment by grade level (kindergarten–grade 6). • Percentage of students by racial/ethnic category. • Title I status. • Percentage of students eligible for the National School Lunch Program. • Percentage of English learner students. • Geographic locale (city, suburb, town, rural). • Number of unique households with enrolled students. • Number of households with an email address and cell phone number for each school.	1–4
Text message and email vendor records	• Whether household had a working email address or cell phone number. • Whether household opened at least one email or was delivered at least one text message. • Whether household clicked the link for at least one message.	1–4
Arkansas Department of Education and Google Analytics	• Treatment condition indicator. • Total number of website users. • Number of new website users. • Average duration of time on the website.	3 and 4

Source: Authors' compilation.

Missing data. This study had minimal missing data. Data on economic disadvantage (eligibility for the National School Lunch Program) and on race/ethnicity were not available for 19 of the 700 schools. Data on school locale (city, suburb, town, rural) were not available for one school. The study team conducted listwise deletion for analyses that used these data elements, resulting in a sample of 681 schools (with 165,933 households) for analyses including school racial/ethnic composition and economic disadvantage.[3] There were no missing data from Google Analytics or the messaging vendor.

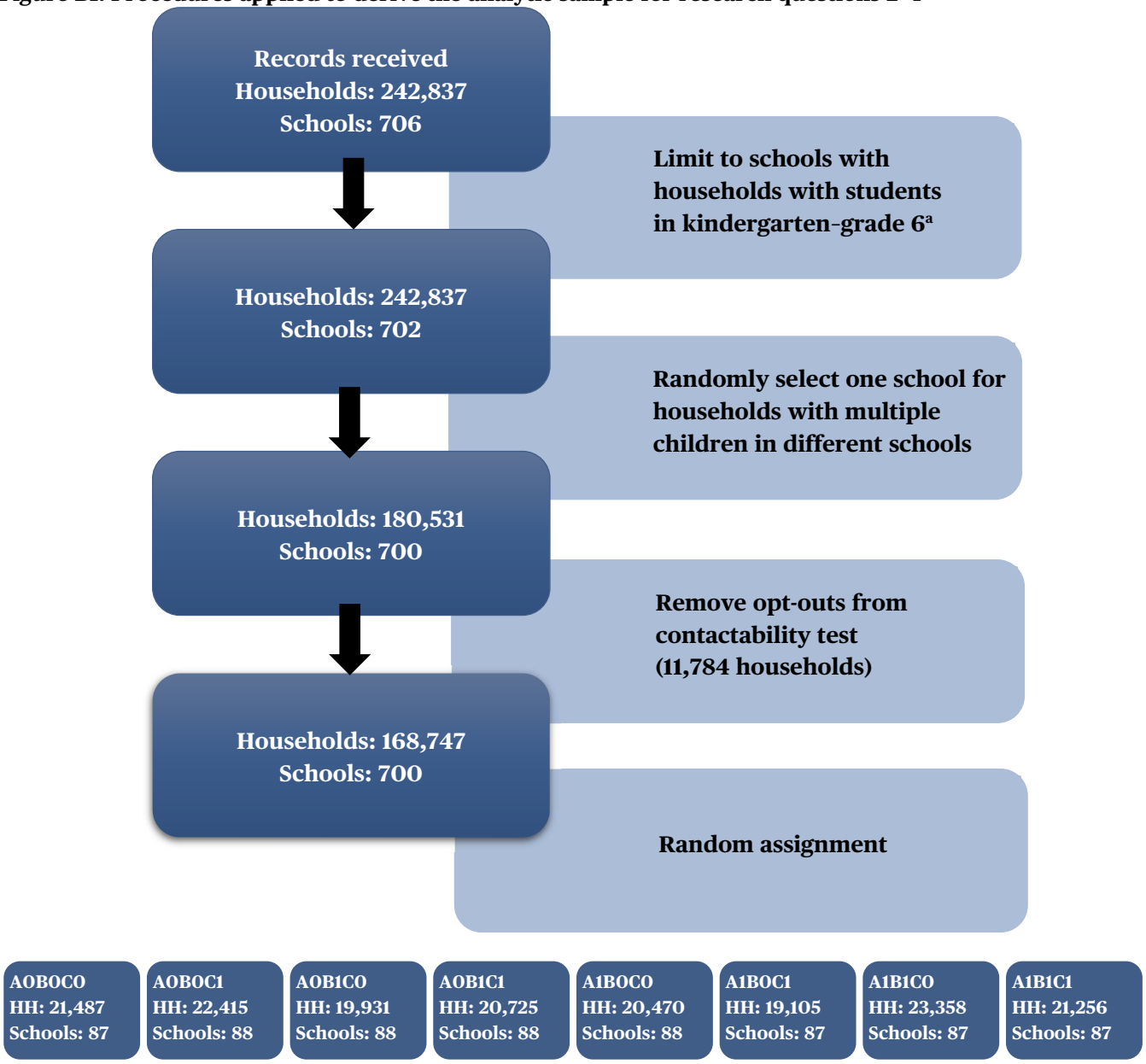
Sample

The study population included households with children in kindergarten–grade 6 in Arkansas public schools. In 2021/22 there were 242,837 records of households with children in 706 public schools with at least one grade of grades K–6. Some households had duplicate records because they had more than one child in elementary school and the children attended different schools. In these cases the study team randomly selected one school, which resulted in a final sample of 180,531 households with children in 700 public schools. To distinguish among households, the Arkansas Department of Education provided the study team with unique household IDs linked to the primary parent or guardian of each student in the database who had an email address or cell phone number and to the respective school ID for each of these households.

In November 2021 the Arkansas Department of Education worked with an email and text message vendor to send two initial test messages to the 180,531 households in the sample (sample for research question 1). At this stage 11,784 households (6.5 percent) opted out of receiving messages. The remaining 168,747 households with children in 700 schools constituted the randomized sample (sample for research questions 2–4; figure B1).

[3] These 19 schools were randomly assigned to one of the eight conditions separately from the 681 schools that were not missing information.

Figure B1. Procedures applied to derive the analytic sample for research questions 2–4



A0 indicates email only, A1 indicates email and text, B0 indicates no graphic, B1 indicates with graphic, C0 indicates generic sender, and C1 indicates known sender. HH is household.

a. One school (a virtual school) did not have any enrolled students with test score data. Three other schools did not have students in kindergarten–grade 6. These schools were listed as serving students in these grades, but data examination showed that no students were enrolled in grade 5 or 6.

Source: Authors' compilation.

Methodology

Research question 1: What percentage of households had a working email address or cell phone number at the beginning of the study period? Did the percentage vary by school locale or demographic composition? The percentage of households in each study condition that had a working email address and cell phone number was calculated overall and by school locale (city, suburb, town, rural) and demographic composition. If the email and text message vendor did not receive an email bounce back or a message indicating that the text message was not delivered, the email address or cell phone number was considered to be working.

Research question 2: What percentage of households opened an email or were delivered a text message in any of the three rounds of communications? Did the percentage vary by school locale or demographic composition? The study

team calculated the percentages of households that opened an email and that were delivered a text message from at least one of the three messaging campaigns overall and by school locale and demographic composition.

Research question 3: Did communication mode, presentation, or sender impact the average percentage of households that visited the R.I.S.E. website? Did the impact vary by school locale or demographic composition? The methodology used to answer this question involved random assignment and study contrasts using a standard factorial design.

Random assignment. The 700 schools in the study were randomly assigned to conditions within blocks of eight schools (corresponding to the eight conditions in the study, described below). Ideally, each district would have served as a block, but many districts had fewer than eight schools. A multistage process was used to identify the blocks to account for schools with missing data, districts with eight or more schools, and districts with fewer than eight schools.

First, the study team identified schools with missing data related to eligibility for the National School Lunch Program and to race/ethnicity. Of the 700 schools, 19 were missing these data.[4] The study team randomized these schools independently of the other 681 schools in the sample to allow for their removal from the analyses if needed (for example, if there were an interest in estimating the impact among schools for which it was possible to evaluate baseline equivalence). The 19 schools were randomly assigned within three blocks. For two blocks eight schools were randomly assigned to the eight conditions. For the third block the remaining three schools were randomly assigned to three randomly chosen conditions.

Second, of the 681 schools without missing data, 207 were in 13 districts with eight or more schools, and 474 schools were in districts with fewer than eight schools. Among the 207 schools in districts with eight or more schools, the study team created 21 blocks of eight schools chosen at random within each district; 39 schools were left over. Within each of the 21 blocks, schools were randomly assigned to one of the eight conditions.

Third, the study team pooled the schools in the 474 districts with fewer than eight schools with the 39 leftover schools from the larger districts. These 513 schools were stratified by locale (city, suburb, town, rural). Within each of the four strata, Mahalanobis distances among schools were calculated and used to identify maximally similar blocks of eight schools each.[5] The covariates used to calculate the distances were school percentages of economically disadvantaged students, English learner students, students from households that had a working email address but no cell phone number, students from households that had a working cell phone number but no email address, and students from households that had neither a working email address nor a working cell phone number. The study team randomly assigned schools to conditions within each block of eight schools. Seventeen "remainder" schools were pooled, yielding two blocks of eight randomly selected schools and one singleton, which was randomly assigned to a condition.

To randomize schools to conditions in each block of eight, schools were placed in random order (based on randomly generated numbers), and then conditions were assigned in random order to the schools. For blocks with fewer than eight schools, the schools were randomly ordered. A condition was selected at random without replacement (to avoid duplicate conditions within blocks) and assigned to the schools in order until the schools were exhausted.

During implementation of the campaign communications, a small percentage of households assigned to receive only an email received both an email and a text message due to an error. The study team mitigated this by

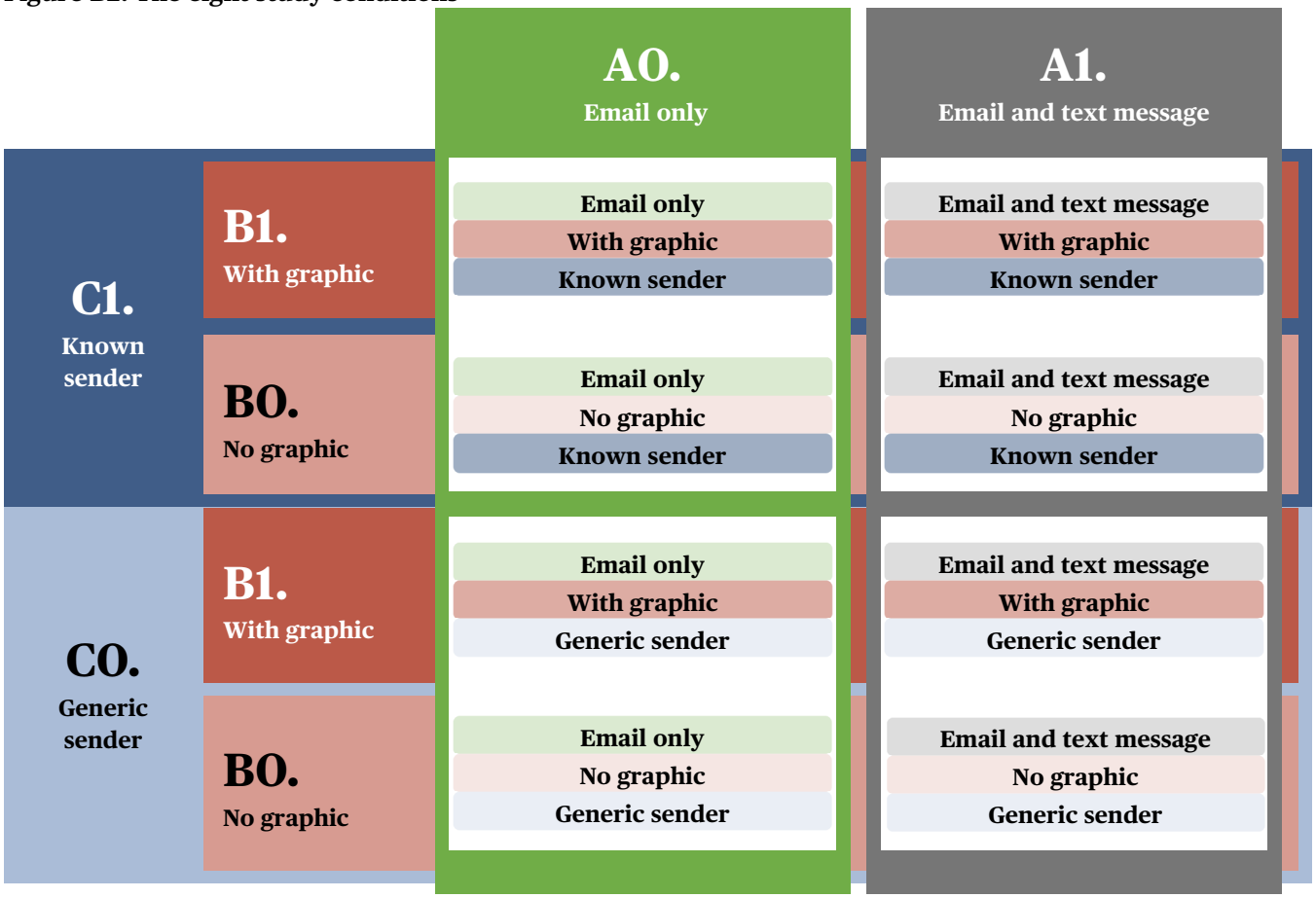
[4] The 19 schools missing these data were newly constituted.

[5] An algorithm was used to minimize distances among schools within each block and maximize distances between the blocks using the blockTools package in R. Mahalanobis distance was used rather than other distance measures to account for the correlations among variables included in a multivariate distribution.

conducting intent-to-treat analyses, with the analysis based on random assignment rather than on the communication that was actually sent or received (described in more detail below).

Study contrasts. The study used a standard factorial design (Montgomery, 1991) with three factors (mode, presentation, and sender) and two treatment conditions per factor, creating eight study conditions (figure B2). The study was powered to examine differences in the probability of visiting the R.I.S.E. website between levels of each factor. The factorial design provides an advantage to statistical power for evaluating the main effects for each of the three factors because it uses the same sample for all three contrasts.

Figure B2. The eight study conditions



Source: Authors' compilation.

The impact analyses evaluated the impact of each of the three factors in the A×B×C study design on school average click rates. The impact for each of the three contrasts is considered confirmatory (table B2).

First, the team calculated the school average click rates by condition. The study team then used the following covariate-adjusted regression model:

$$y_i = \beta_0 + \beta_A X_{Ai} + \beta_B X_{Bi} + \beta_C X_{Ci} + \sum_{j=1}^{N} \gamma_j BLOCK_{ij} + \sum_{k=1}^{R} \alpha_k Z_{kj} + \varepsilon_i \qquad \text{(B1)}$$

where y_i is the observed proportion of households that clicked on a link in at least one email or text message in school I; $BLOCK_{ij}$ indicates school membership in randomized blocks, with the variable taking a value of 1 if school i is in block j and 0 otherwise; the Z_i terms are school-level demographic variables, including school locale, the percentage of economically disadvantaged students, the percentage of Black students and Hispanic students, and Title I status.

Table B2. Equation B1 parameters

Variable	Factor	Values
X_{Ai}	Assignment status of school *i* on factor *A*	X_{Ai} = 0 if assigned to A0 X_{Ai} = 1 if assigned to A1
X_{Bi}	Assignment status of school *i* on factor *B*	X_{Bi} = 0 if assigned to B0 X_{Bi} = 1 if assigned to B1
X_{Ci}	Assignment status of school *i* on factor *C*	X_{Ci} = 0 if assigned to C0 X_{Ci} = 1 if assigned to C1

Source: Authors' compilation.

The intercept in the model represents the response rate in the base condition (email only, no graphic, generic sender) for the reference block and for the case where covariates assume a value of 0. The impact of A1 (email and text message) versus A0 (email only) is estimated as $\widehat{\beta_A}$. The impact of B1 (with graphic) versus B0 (no graphic) is estimated as $\widehat{\beta_B}$. The impact of C1 (known sender) versus C0 (generic sender) is estimated as $\widehat{\beta_C}$.

The study team used full maximum likelihood to obtain intent-to-treat estimates for each factor. The study team did not weight contributions of individual schools to the results based on their sample sizes. Giving schools equal weight is consistent with a school-level analysis, in which each unit received equal consideration.

The study team conducted sensitivity analyses to understand how the impact results might vary based on removing covariates, adding more covariates, using random effects instead of fixed effects for blocks, and weighting to account for the sample size of the school (see appendix D). The weighting used the inverse of the school-level variances depending on the number of households (that is, schools with fewer households had a lower weight).

Descriptive statistics for the covariates used in the analyses are in tables B3 and B4. The results from baseline equivalence tests are in table B5.

Table B3. Descriptive statistics for the covariates used in the main analysis, 2022

School characteristic	Number of schools	Mean	Median	Standard deviation
Percentage of Black students and Hispanic students	681	0.328	0.227	0.290
Percentage of economically disadvantaged students	681	0.715	0.716	0.244
Title I	681	0.825	0.997	0.335
Locale				
City	699	0.255	0.000	0.436
Suburb	699	0.116	0.000	0.320
Town	699	0.202	0.000	0.402
Rural	699	0.428	0.000	0.495

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

Table B4. Descriptive statistics for additional covariates used in sensitivity analyses, 2022

School characteristic	Number of schools	Mean	Median	Standard deviation
Percentage of English learner students	700	0.085	0.034	0.125
Percentage of households with cell phone number but no email address	700	0.273	0.190	0.256
Percentage of households with email address but no cell phone number	700	0.091	0.053	0.136
Percentage of households with neither email address nor cell phone number	700	0.025	0.015	0.032

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

Table B5. Baseline equivalence analyses, 2022

Baseline covariate and parameter	Estimate	Standard error	Degrees of freedom	*t*-value	*p*-value	Effect size
Percentage of Black students and Hispanic students						
With text messages	0.017	0.015	592	1.19	.234	0.060
With a graphic	-0.000	0.015	592	-0.03	.975	-0.002
With known sender	-0.007	0.015	592	-0.49	.627	-0.024
Percentage of economically disadvantaged students						
With text messages	-0.002	0.012	592	-0.15	.884	-0.007
With a graphic	-0.006	0.012	592	-0.49	.626	-0.024
With known sender	0.005	0.012	592	0.40	.686	0.020
Title I school						
With text messages	-0.022	0.021	592	-1.05	.292	-0.067
With a graphic	0.010	0.021	592	0.47	.642	0.029
With known sender	-0.000	0.021	592	-0.01	.994	-0.000
City locale						
With text messages	0.003	0.010	608	0.29	.770	0.007
With a graphic	0.013	0.010	608	1.28	.201	0.030
With known sender	0.004	0.010	608	0.41	.682	0.010
Suburban locale						
With text messages	-0.005	0.010	608	-0.55	.586	-0.016
With a graphic	-0.013	0.010	608	-1.36	.174	-0.041
With known sender	-0.020	0.010	608	-2.04	.042	-0.061
Town locale						
With text messages	-0.002	0.007	608	-0.32	.746	-0.006
With a graphic	0.008	0.007	608	1.10	.273	0.020
With known sender	-0.004	0.007	608	-0.49	.625	-0.009
Rural locale						
With text messages	0.005	0.010	608	0.44	.658	0.009
With a graphic	-0.008	0.010	608	-0.77	.439	-0.016
With known sender	0.019	0.010	608	1.84	.067	0.038

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

To determine whether the impact varied by school locale or demographic composition, the analyses were conducted separately for four subsamples: households with children in rural schools, households with children in schools with higher percentages of economically disadvantaged students (more than 71.6 percent, the 50th

percentile for the state), households with children in schools with higher percentages of Black students and Hispanic students (more than 22.7 percent, the 50th percentile for the state), and households with children in schools with higher percentages of English learner students (more than 3.4 percent, the 50th percentile for the state).

To estimate the impact of the fully enhanced communication, the study team conducted the analysis using the model described in equation B1. The added-value impact of the combination of the three enhancements (that is, adding text messages, adding a graphic, and sending communications from a known sender) relative to the base condition is estimated as $\widehat{\beta_A} + \widehat{\beta_B} + \widehat{\beta_C}$.

Research question 4: Did time spent on the R.I.S.E. website vary by communication mode (email only or email and text message)? The study team calculated time spent on the website in seconds for the four conditions that were assigned to receive emails only and for the four conditions that were assigned to receive both emails and text messages. The Arkansas Department of Education created a dedicated R.I.S.E website URL for each school to enable the study team to use data from Google Analytics to determine the time that each household with children in a given school spent on the website. These data were expected to yield descriptive statistics, such as a school average time on page for each study condition. However, in error, the email and text message vendor redirected clicks in the four email and text message conditions to a single school's URL. Therefore, it was not possible to determine the time on page for each study condition separately, but it was possible to determine time on page for each mode of communication.

References

Montgomery, D. C. (1991). *Design and analysis of experiments*. Wiley.

Appendix C. Supporting analyses

This appendix includes additional analyses that support information in the body of the report.

Research question 1

The following tables include information about the percentages of households with working contact information overall (table C1) and by school locale and demographic composition (tables C2–C5).

Table C1. Number and percentage of households with working contact information, November 2021

Type of contact	Number	Percentage of households
At least one working email address[a]	132,008	73.1
At least one working email address and at least one working cell phone number	117,599	65.1
At least one working email address but no working cell phone number	14,409	8.0
At least one working cell phone number but no working email address[a]	44,638	24.7
At least one working cell phone number (MMS or SMS)	162,237	89.9
At least one working cell phone number (MMS)	153,955	85.3
At least one working cell phone number (SMS)	8,282	4.6
No working email address or cell phone number[a]	3,885	2.2
Total number of households	180,531	100.0

MMS is multimedia messaging service. SMS is short message service.

Note: To test the cell phone number, an MMS was sent first. If the MMS was not delivered, then an SMS was sent. Types of contacts are not mutually exclusive unless otherwise noted.

a. Mutually exclusive and exhaustive categories.

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

Table C2. Percentage of households with working contact information, by school locale, November 2021

Type of contact	All schools	Rural schools	Nonrural schools
At least one working email address[a]	73.1	69.2†	75.3
At least one working email address and at least one working cell phone number	65.1	59.2†	68.4
At least one working email address but no working cell phone number	8.0	10.0	6.9
At least one working cell phone number but no working email address[a]	24.7	28.6	22.6
At least one working cell phone number (MMS or SMS)	89.9	87.8	91.1
At least one working cell phone number (MMS)	85.3	83.5	86.3
At least one working cell phone number (SMS)	4.6	4.3	4.8
No working email address or cell phone number[a]	2.2	2.2	2.1
Total number of households	180,531	64,071	116,218

† Difference between rural and nonrural schools is 5 percentage points or more, which was considered meaningful.

MMS is multimedia messaging service. SMS is short message service.

Note: Rural status was unknown for one school, which affected 225 households. To test the cell phone number, an MMS was sent first. If the MMS was not delivered, an SMS was sent. Types of contacts are not mutually exclusive unless otherwise noted.

a. Mutually exclusive and exhaustive categories.

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

Table C3. Percentage of households with working contact information, by school percentage of economically disadvantaged students, November 2021

Type of contact	All schools	Schools with lower percentages of economically disadvantaged students	Schools with higher percentages of economically disadvantaged students
At least one working email address[a]	73.1	82.9	60.7†
At least one working email address and at least one working cell phone number	65.1	74.4	53.6†
At least one working email address but no working cell phone number	8.0	8.5	7.1
At least one working cell phone number but no working email address[a]	24.7	15.8†	36.1
At least one working cell phone number (MMS or SMS)	89.9	90.3	89.7
At least one working cell phone number (MMS)	85.3	87.2	83.3
At least one working cell phone number (SMS)	4.6	3.1	6.4
No working email address or cell phone number[a]	2.2	1.3	3.2
Total number of households	180,531	100,653	76,906

† Difference between households with children in schools with lower percentages of economically disadvantaged students and households with children in schools with higher percentages of economically disadvantaged students is 5 percentage points or more, which was considered meaningful.

MMS is multimedia messaging service. SMS is short message service.

Note: Percentage of economically disadvantaged students was unknown for 19 schools, which affected 2,814 households. To test the cell phone number, an MMS was sent first. If the MMS was not delivered, an SMS was sent. Types of contact are not mutually exclusive unless otherwise noted. Schools with lower percentages of economically disadvantaged students are those where the percentage of students eligible for the National School Lunch Program was below 71.6 percent, the 50th percentile for the state; schools with higher percentages of economically disadvantaged students are those where the percentage of students eligible for the National School Lunch Program exceeded 71.6 percent.

a. Mutually exclusive and exhaustive categories.

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

Table C4. Percentage of households with working contact information, by school percentage of Black students and Hispanic students, November 2021

Type of contact	All schools	Schools with lower percentages of Black students and Hispanic students	Schools with higher percentages of Black students and Hispanic students
At least one working email address[a]	73.1	75.6	72.5
At least one working email address and at least one working cell phone number	65.1	65.2	65.5
At least one working email address but no working cell phone number	8.0	10.4	7.0
At least one working cell phone number but no working email address[a]	24.7	22.6	25.3
At least one working cell phone number (MMS or SMS)	89.9	87.8	90.8
At least one working cell phone number (MMS)	85.3	84.3	85.9
At least one working cell phone number (SMS)	4.6	3.5	4.9
No working email address or cell phone number[a]	2.2	1.8	2.2
Total number of households	180,531	46,702	130,857

MMS is multimedia messaging service. SMS is short message service.

Note: Percentage of Black students and Hispanic students was unknown for 19 schools, which affected 2,814 households. To test the cell phone number, an MMS was sent first. If the MMS was not delivered, an SMS was sent. Types of contact are not mutually exclusive unless otherwise noted. Schools with lower percentages of Black students and Hispanic students are those where the percentage of both groups combined did not exceed 22.7 percent, the 50th percentile for the state; schools with higher percentages of Black students and Hispanic students are those where the percentage of both groups combined exceeded 22.7 percent.

a. Mutually exclusive and exhaustive categories.

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

Table C5. Percentage of households with working contact information, by school percentage of English learner students, November 2021

Type of contact	All students	Schools with lower percentages of English learner students	Schools with higher percentages of English learner students
At least one working email address[a]	73.1	71.1	74.8
At least one working email address and at least one working cell phone number	65.1	62.3†	67.5
At least one working email address but no working cell phone number	8.0	8.9	7.3
At least one working cell phone number but no working email address[a]	24.7	26.4	23.3
At least one working cell phone number (MMS or SMS)	89.9	88.7	90.8
At least one working cell phone number (MMS)	85.3	83.9	86.4
At least one working cell phone number (SMS)	4.6	4.8	4.4
No working email address or cell phone number[a]	2.2	2.4	1.9
Total number of households	180,531	81,918	98,613

† Difference between households with children in schools with lower percentages of English learner students and households with children in schools with higher percentages of English learner students is 5 percentage points or more, which was considered meaningful.

MMS is multimedia messaging service. SMS is short message service.

Note: To test the cell phone number, an MMS was sent first. If the MMS was not delivered, an SMS was sent. The types of contact are not mutually exclusive unless otherwise noted. Schools with lower percentages of English learner students are those where the percentage was below 3.4 percent, the 50th percentile for the state; schools with higher percentages of English learner students are those where the percentage exceeded 3.4 percent.

a. Mutually exclusive and exhaustive categories. Percentages may not sum to 100 due to rounding.

Source: Authors' analysis of data provided by the Arkansas Department of Education and the email and text message vendor.

Research question 2

The following tables include information about the percentage of households opening emails or being delivered text messages overall (table C6) and by school locale and demographic composition (tables C7–C10). These results correspond only to the three nudges sent in January 2022 and do not include results of the contactability tests, which are included in tables C1–C5.

Table C6. Households that opened an email or were delivered a text message, January 2022

Household condition	Total number of schools	Total number of households	Opened any email		Any text was delivered	
			Number of households	Percent of households	Number of households	Percent of households
Email only						
No graphic + generic sender	87	21,487	3,907	18.2	582	2.7
No graphic + known sender	88	22,415	4,464	19.9	555	2.5
With graphic + generic sender	88	19,931	3,416	17.1	452	2.3
With graphic + known sender	88	20,725	4,399	21.2	470	2.3
Email and text message						
No graphic + generic sender	88	20,470	3,503	17.1	15,952	77.9
No graphic + known sender	87	19,105	4,297	22.5	15,123	79.2
With graphic + generic sender	87	23,358	3,923	16.8	18,041	77.2
With graphic + known sender	87	21,256	4,069	19.1	16,532	77.8
Total	700	168,747	31,978	18.9	65,648[a]	78.0[a]

Note: The sample included 168,747 households with children in 700 schools.

a. Some households in the email only condition were delivered text messages in error, with delivery rates of 2.3–2.7 percent. These values refer to households assigned to the email and text message condition and exclude the small number of households assigned to the email only condition that were delivered text messages in error.

Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C7. Households that opened an email or were delivered a text message, by school locale, January 2022

School characteristic	Total number of schools	Total number of households	Opened any email		Any text was delivered[a]	
			Number of households	Percent of households	Number of households	Percent of households
Nonrural	400	108,765	21,758	20.0	41,420	78.8
Rural	299	59,757	10,169	17.0	24,058	76.6
Unknown	1	225	51	22.7	170	75.6
Total	700	168,747	31,978	19.0	65,648	78.0

Note: The sampled included 168,747 households with children in 700 schools.
a. These values refer to households assigned to the email and text message condition and exclude the small number of households assigned to the email only condition that were delivered text messages in error.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C8. Households that opened an email or were delivered a text messages, by school percentage of economically disadvantaged students, January 2022

School characteristic	Total number of schools	Total number of households	Opened any email		Any text was delivered[a]	
			Number of households	Percent of households	Number of households	Percent of households
Higher percentage of economically disadvantaged students	340	72,672	9,281	12.8†	28,694	76.0
Lower percentage of economically disadvantaged students	341	93,261	22,343	24.0	36,120	79.7
Unknown	19	2,814	354	12.6	834	72.6
Total	700	168,747	31,978	19.0	65,648	78.0

† Difference between households with children in schools with higher percentages of economically disadvantaged students and households with children in schools with lower percentages of economically disadvantaged students is 5 percentage points or more, which was considered meaningful.
Note: The sample included 168,747 households with children in 700 schools. Schools with higher percentages of economically disadvantaged students are those where the percentage of students eligible for the National School Lunch Program exceeded 71.6 percent, the 50th percentile for the state; schools with lower percentages of economically disadvantaged students are those where the percentage of students eligible for the National School Lunch Program was below 71.6 percent.
a. These values refer to households assigned to the email and text message condition and exclude the small number of households assigned to the email only condition that were delivered text messages in error.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C9. Households that opened an email or were delivered a text message, by school racial/ethnic composition, January 2022

School characteristic	Total number of schools	Total number of households	Opened any email		Any text was delivered[a]	
			Number of households	Percent of households	Number of households	Percent of households
Higher percentage of Black students and Hispanic students	341	83,941	14,023	16.7	32,458	77.2
Lower percentage of Black students and Hispanic students	340	81,992	17,601	21.5	32,356	78.9
Unknown	19	2,814	354	12.6	834	72.6
Total	700	168,747	31,978	19.0	65,648	78.0

Note: The sample included 168,747 households with children in 700 schools. Schools with higher percentages of Black students and Hispanic students are those where the percentage of both groups combined exceeded 22.7 percent, the 50th percentile for the state; schools with lower percentages of Black students and Hispanic students are those where the percentage of both groups combined did not exceed 22.7 percent.
a. These values refer to households assigned to the email and text message condition and exclude the small number of households assigned to the email only condition that were delivered text messages in error.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C10. Households that opened an email or were delivered a text message, by school percentage of English learner students, January 2022

School characteristic	Total number of schools	Total number of households	Opened any email		Any text was delivered[a]	
			Number of households	Percent of households	Number of households	Percent of households
Higher percentage of English learner students	350	92,511	17,690	19.1	35,877	78.7
Lower percentage of English learner students	350	76,236	14,288	18.7	29,771	77.2
Total	700	168,747	31,978	19.0	65,648	78.0

Note: The sample included 168,747 households with children in 700 schools. Schools with higher percentages of English learner students are those where the percentage exceeded 3.4 percent, the 50th percentile for the state; schools with lower percentages of English learner students are those where the percentage was below 3.4 percent.

a. These values refer to households assigned to the email and text message condition and exclude the small number of households assigned to the email only condition that were delivered text messages in error.

Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Research question 3

The following tables include information about click rates by factor and condition (tables C11 and C12), estimated impacts on click rates overall (table C13) and by school locale and demographic composition (tables C14–C17), and the estimated impact of the fully enhanced communication (table C18).

Table C11. Average click rates for each level of each factor, January 2022

Condition	Number of schools	Mean	Median	Standard deviation	Average number of households per school
Email only	351	0.015	0.012	0.016	241
Email and text message	349	0.081	0.078	0.035	241
No graphic	350	0.048	0.032	0.043	239
With graphic	350	0.049	0.041	0.042	244
Generic sender	350	0.041	0.024	0.039	244
Known sender	350	0.056	0.044	0.045	239

Note: The sample included 700 schools. For the email only condition and the email and text message condition, statistics are averaged across conditions with no graphic/with graphic and known sender/generic sender. For the no graphic/with graphic and known sender/generic sender conditions, statistics are averaged across conditions with email only and with email and text message.

Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C12. Average click rates for each of the eight conditions, January 2022

Condition	Number of schools	Mean	Median	Standard deviation	Average number of households per school
Email only					
No graphic + generic sender	87	0.010	0.009	0.008	247
No graphic + known sender	88	0.024	0.019	0.020	255
With graphic + generic sender	88	0.009	0.007	0.010	226
With graphic + known sender	88	0.019	0.016	0.018	236
Email and text message					
No graphic + generic sender	88	0.068	0.067	0.035	233
No graphic + known sender	87	0.089	0.091	0.041	220
With graphic + generic sender	87	0.075	0.073	0.027	268
With graphic + known sender	87	0.092	0.088	0.029	244

Note: The sample included 700 schools.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C13. Impacts on average click rates, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.016	0.014	586	.240
Added impact of adding text messages	0.065	0.002	586	<.001
Added impact of adding a graphic	0.001	0.002	586	.466
Added impact of sending from a known sender	0.015	0.002	586	<.001
Percentage of Black students and Hispanic students	-0.006	0.005	586	.244
Percentage of economically disadvantaged students	0.003	0.007	586	.707
Title I	0.004	0.004	586	.276
Locale				
Suburb	-0.004	0.010	586	.683
Town	-0.002	0.012	586	.857
Rural	0.004	0.009	586	.642

Note: The sample included 681 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C14. Impacts on average click rates, rural schools only, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.003	0.013	247	.823
Added impact of adding text messages	0.064	0.003	247	<.001
Added impact of adding a graphic	0.003	0.003	247	.202
Added impact of sending from a known sender	0.014	0.003	247	<.001
Percentage of Black students and Hispanic students	-0.007	0.008	247	.405
Percentage of economically disadvantaged students	0.024	0.010	247	.016
Title I	0.010	0.006	247	.117

Note: The sample included 295 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C15. Impacts on average click rates, schools with higher percentages of economically disadvantaged students only, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.035	0.032	261	.284
Added impact of adding text messages	0.070	0.003	261	<.001
Added impact of adding a graphic	0.005	0.003	261	.059
Added impact of sending from a known sender	0.015	0.003	261	<.001
Percentage of Black students and Hispanic students	-0.010	0.006	261	.125
Percentage of economically disadvantaged students	-0.014	0.018	261	.422
Title I	-0.000	0.008	261	.961
Locale				
Suburb	-0.030	0.015	261	.041
Town	-0.037	0.018	261	.043
Rural	-0.010	0.014	261	.451

Note: The sample included 341 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown. Schools with higher percentages of economically disadvantaged students are those where the percentage of students eligible for the National School Lunch Program exceeds 71.6 percent, the 50th percentile for the state.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C16. Impacts on average click rates, schools with higher percentages of Black students and Hispanic students only, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.024	0.023	259	.318
Added impact of adding text messages	0.070	0.003	259	<.001
Added impact of adding a graphic	0.002	0.003	259	.446
Added impact of sending from a known sender	0.014	0.003	259	<.001
Percentage of Black students and Hispanic students	0.009	0.009	259	.319
Percentage of economically disadvantaged students	-0.025	0.011	259	.019
Title I	0.007	0.006	259	.185
Locale				
Suburb	-0.008	0.014	259	.584
Town	0.003	0.019	259	.856
Rural	-0.006	0.013	259	.661

Note: The sample included 341 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown. Schools with higher percentages of Black students and Hispanic students are those where the percentage of both groups combined exceeds 22.7 percent, the 50th percentile for the state.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C17. Impacts on average click rates, schools with higher percentages of English learner students, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.021	0.024	254	.387
Added impact of adding text messages	0.074	0.002	254	<.001
Added impact of adding a graphic	-0.002	0.002	254	.318
Added impact of sending from a known sender	0.011	0.002	254	<.001
Percentage of Black students and Hispanic students	0.018	0.009	254	.045
Percentage of economically disadvantaged students	-0.014	0.010	254	.155
Title I	0.002	0.005	254	.750
Locale				
Suburb	-0.004	0.013	254	.742
Town	-0.012	0.014	254	.384
Rural	-0.008	0.009	254	.422

Note: The sample included 350 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown. Schools with higher percentages of English learner students are those where the percentage exceeds 3.4 percent, the 50th percentile for the state.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table C18. Impact of the fully enhanced communication relative to the basic communication (represented by the intercept) on average click rate, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.038	0.020	77	.063
Fully enhanced communication	0.082	0.002	77	<.001
Percentage of Black students and Hispanic students	-0.010	0.008	77	.220
Percentage of economically disadvantaged students	0.013	0.011	77	.243
Title I	0.002	0.006	77	.654
Locale				
Suburb	-0.053	0.016	77	.001
Town	-0.034	0.025	77	.185
Rural	-0.026	0.016	77	.114

Note: The sample included 170 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, or sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Research question 4

Table C19 includes information about time spent on page by mode of communication (email only compared with email and text message).

Table C19. Time spent on page by mode of communication among those who clicked on a link in the email or text communication, January 2022

Condition	Number of schools	Average time spent on page (seconds)	Median time spent on page (seconds)	Minimum time spent on page (seconds)	Maximum time spent on page (seconds)
Email only	351	37.2	0.0	0.0	919.5
Email and text	349	35.5	11.0	0.0	522.5

Note: The sample included 700 schools, including 19 schools for which school characteristic information was missing. These results are not adjusted for school characteristics.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Appendix D. Supplemental analyses

This appendix includes a summary table of all estimates (table D1) and separate tables for sensitivity analyses that test alternate model specifications for research question 3, including:

- Using no covariates (table D2).
- Using random block effects (table D3).
- Including additional covariates (percentage of English learner students, percentage of households with a cell phone number but no email address, percentage of households with an email address but no cell phone number, and percentage of households with neither an email address nor a cell phone number; table D4).
- Including additional covariates and using weighted variances (table D5).
- Using random block effects and including additional covariates (table D6).
- Using random block effects, including additional covariates, and using weighted variances (table D7).

Models that incorporate weighted variances use weights that are the inverse of school-level variances, which depend on the number of households. That is, schools with fewer households (and therefore less reliable results) receive lower weights. The resulting estimates are considered the best linear unbiased estimators. The results using alternate model specifications were not meaningfully different from those using the model specifications in the main analyses.

Table D1. Summary of estimated impacts on average click rates across base model and sensitivity analyses, January 2022

Parameter	Base model estimate	No covariates estimate	Random block effects estimate	Additional covariates estimate	Additional covariates and weighted variance estimate	Random block effects and additional covariates estimate	Random block effects, additional covariates, and weighted variance estimate
Intercept	0.016	0.016	0.019***	0.019	0.038*	0.013**	0.015
Added impact of adding text messages	0.065***	0.066***	0.065***	0.065***	0.063***	0.065***	0.063***
Added impact of adding a graphic	0.001	0.001	0.001	0.002	0.006**	0.002	0.006**
Added impact of sending from a known sender	0.015***	0.015***	0.015***	0.016***	0.017***	0.016***	0.018***
Percentage of Black students and Hispanic students	-0.006	na	-0.004	-0.009	-0.015*	-0.004	-0.011
Percentage of economically disadvantaged students	0.003	na	-0.002	0.007	0.008	0.009	0.005
Title I	0.004	na	0.002	0.005	0.007	0.002	0.004
Percentage of English learner students	na	na	na	0.043***	0.073***	0.034***	0.056***
Percentage with cell phone number but no email address	na	na	na	-0.034***	-0.038***	-0.026***	-0.034***
Percentage with email address but no cell phone number	na	na	na	-0.052***	-0.054***	-0.042***	-0.057***
Percentage with neither email address nor cell phone number	na	na	na	-0.085	0.059	-0.105	0.019
Locale							
Suburb	-0.004	na	-0.009*	-0.002	-0.023*	-0.001	-0.008
Town	-0.002	na	-0.015***	0.006	-0.032*	-0.004	-0.008
Rural	0.004	na	-0.014***	0.005	-0.006	-0.003	-0.004

* Significant at $p < .05$; ** significant at $p < .01$; *** significant at $p < .001$.

na is not applicable.

Note: The sample included 681 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts of adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown. Full results are available in table C13 and tables D2-D7.

Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table D2. Impacts on average click rates, no covariates, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.016	0.008	609	.065
Added impact of adding text messages	0.066	0.002	609	<.001
Added impact of adding a graphic	0.001	0.002	609	.453
Added impact of sending from a known sender	0.015	0.002	609	<.001

Note: The sample included 700 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts of adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table D3. Impacts on average click rates, with random block effects, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.019	0.004	85	<.001
Added impact of adding text messages	0.065	0.002	586	<.001
Added impact of adding a graphic	0.001	0.002	586	.471
Added impact of sending from a known sender	0.015	0.002	586	<.001
Percentage of Black students and Hispanic students	-0.004	0.005	586	.335
Percentage of economically disadvantaged students	-0.002	0.005	586	.660
Title I	0.002	0.003	586	.499
Locale				
Suburb	-0.009	0.004	586	.019
Town	-0.015	0.003	586	<.001
Rural	-0.014	0.003	586	<.001

Note: The sample included 681 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts of adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table D4. Impacts on average click rates, with additional covariates, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.019	0.014	582	.152
Added impact of adding text messages	0.065	0.002	582	<.001
Added impact of adding a graphic	0.002	0.002	582	.337
Added impact of sending from a known sender	0.016	0.002	582	<.001
Percentage of Black students and Hispanic students	-0.009	0.005	582	.107
Percentage of economically disadvantaged students	0.007	0.007	582	.269
Title I	0.005	0.003	582	.154
Percentage of English learner students	0.043	0.011	582	<.001
Percentage with cell phone number but no email address	-0.034	0.008	582	<.001
Percentage with email address but no cell phone number	-0.052	0.012	582	<.001
Percentage with neither email address nor cell phone number	-0.085	0.055	582	.125
Locale				
Suburb	-0.002	0.010	582	.824
Town	0.006	0.011	582	.599
Rural	0.005	0.009	582	.573

Note: The sample included 681 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table D5. Impacts on average click rates, with weighted variances and additional covariates, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.009	0.012	582	.467
Added impact of adding text messages	0.066	0.001	582	<.001
Added impact of adding a graphic	0.000	0.001	582	.930
Added impact of sending from a known sender	0.015	0.001	582	<.001
Percentage of Black students and Hispanic students	-0.004	0.005	582	.374
Percentage of economically disadvantaged students	0.010	0.006	582	.116
Title I	0.005	0.003	582	.108
Percentage of English learner students	0.027	0.010	582	.007
Percentage with cell phone number but no email address	-0.026	0.008	582	<.001
Percentage with email address but no cell phone number	-0.041	0.011	582	<.001
Percentage with neither email address nor cell phone number	-0.162	0.059	582	.006
Locale				
Suburb	0.006	0.008	582	.488
Town	0.014	0.010	582	.137
Rural	0.004	0.007	582	.591

Note: The sample included 681 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts of adding text messages, adding a graphic, and sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table D6. Impacts on average click rates, with random block effects and additional covariates, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.013	0.004	85	.001
Added impact of adding text messages	0.065	0.002	582	<.001
Added impact of adding a graphic	0.002	0.002	582	.309
Added impact of sending from a known sender	0.016	0.002	582	<.001
Percentage of Black students and Hispanic students	-0.004	0.005	582	.341
Percentage of economically disadvantaged students	0.009	0.005	582	.083
Title I	0.002	0.003	582	.616
Percentage of English learner students	0.034	0.008	582	<.001
Percentage with cell phone number but no email address	-0.026	0.006	582	<.001
Percentage with email address but no cell phone number	-0.042	0.008	582	<.001
Percentage with neither email address nor cell phone number	-0.105	0.043	582	.016
Locale				
Suburb	-0.001	0.003	582	.685
Town	-0.004	0.003	582	.205
Rural	-0.003	0.003	582	.386

Note: The sample included 681 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts from adding text messages, adding a graphic, or sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.

Table D7. Impacts on average click rates, with random block effects, additional covariates, and weighted variances, January 2022

Parameter	Estimate	Standard error	Degrees of freedom	*p*-value
Intercept	0.014	0.003	85	<.001
Added impact of adding text messages	0.066	0.002	582	<.001
Added impact of adding a graphic	0.001	0.002	582	.724
Added impact of sending from a known sender	0.015	0.002	582	<.001
Percentage of Black students and Hispanic students	-0.002	0.004	582	.611
Percentage of economically disadvantaged students	0.008	0.005	582	.103
Title I	0.002	0.003	582	.462
Percentage of English learner students	0.032	0.007	582	<.001
Percentage with cell phone number but no email address	-0.022	0.006	582	<.001
Percentage with email address but no cell phone number	-0.037	0.007	582	<.001
Percentage with neither email address nor cell phone number	-0.144	0.048	582	.003
Locale				
Suburb	-0.003	0.003	582	.375
Town	-0.005	0.003	582	.077
Rural	-0.004	0.003	582	.149

Note: The sample included 681 schools. The intercept is an estimate of the average click rate for the basic communication (email only, no graphic, and generic sender) for the reference block, where covariates take the average value. Estimates of the added impacts of adding text messages, adding a graphic, or sending from a known sender are compared with the intercept. Estimates of block fixed effects are not shown.
Source: Authors' analysis of data provided by the Arkansas Department of Education, the email and text message vendor, and website analytics.