IES Institute of Education Sciences

Appendix

Study of College Transition Messaging in GEAR UP: Impacts on Enrolling and Staying in College

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Study of College Transition Messaging in GEAR UP: Impacts on Enrolling and Staying in College

February 2021

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APPENDIX A. ADDITIONAL DETAILS ABOUT COLLEGE TRANSITION MESSAGING

This appendix provides additional information about the text-message-based advising, including the specific college transition messages that the study sent to students and the training it provided to advisors. This detail is intended to allow others to use or build upon the messaging program this study tested.

A.1 Text Messages

The transition messaging incorporated promising approaches emerging from recent rigorous research investigating low-cost ways to address common barriers to college enrollment and persistence (Exhibit A.1).

Exhibit A.1 Research-Based Approaches to Address Common Barriers

Barrier	Approach
Lack of information about key milestones (informational) Students lack information or have trouble digesting information about key college milestones.	Provide semi-customized real-time text reminders about key milestones, such as required pre-matriculation tasks and financial aid requirements including refiling the Free Application for Federal Student Aid (FAFSA) and meeting schools' Satisfactory Academic Progress (SAP) benchmarks to maintain aid (Bird and Castleman 2016; Castleman and Page 2015; Page, Castleman, and Meyer 2020; Roderick et al. 2008; Schudde and Scott-Clayton 2014).
Procrastination and limited attention to milestones (behavioral) Students who are aware of key milestones could nonetheless procrastinate and miss important deadlines as they juggle academic, work, and family commitments.	Provide action-oriented prompts tied to specific deadlines (Castleman and Page 2016; Castleman, Schwartz, and Baum 2015; Karlan et al. 2010).
Limited connections to professional advising (logistical) Even students who know about important milestones and have plans to complete key tasks could struggle. Access to professional advising might be limited during key stages of the academic pipeline, particularly the summer after students leave high school and the first year of college when they are still learning how to navigate their college campus.	Provide ongoing access to professional advisors who reach out to students and share links to on-campus supports (Bettinger and Baker 2014; Bettinger et al. 2012; Barr and Castleman 2017; Castleman and Page 2015, 2016; Castleman, Schwartz, and Baum 2015; Oreopoulos and Petronijevic 2016).
Fixed mindset and feelings of alienation (psychological) Students could doubt whether they belong in college or their own potential to adjust to the demands of college-level work.	Provide brief reminders that ease students' stress and anxiety about adapting academically and socially to new situations (Aronson, Fried, and Good 2002; Walton and Cohen 2011; Yeager et al. 2014).

The GEAR UP transition messaging consisted of 44 text messages adapted from previous promising research with the support of leading academic researchers in behavioral economics and social psychology. The purpose of the individual messages varied, including addressing a milestone, encouraging an adaptive mindset, or providing a tip for success or logistical information about the text messaging.

- ***Reminders about key milestones*** related to enrolling and persisting in college. These messages included:
    - *Action-planning milestone* messages that inform students about key upcoming college milestones—for example, to create a study plan for approaching midterms or explore options for summer internships or work opportunities.

- *Action-taking milestone* messages that prompt students to complete a task, such as paying tuition by the due date or registering for classes, and that direct students where to go to complete it by providing a web link or the name of an on-campus office.

- ***Mindset prompts*** that promote an adaptive mindset by incorporating social psychological concepts from research. These messages included:
  - *Growth mindset* messages to encourage students' belief that abilities, particularly academic abilities, can be developed through effort. For example, these messages reference research showing that the brain grows as it is challenged.
  - *Social belonging* messages to inform students that everyday worries about fitting in at college are normal at first, and pass with time.

- ***Success strategies*** offering concrete tips and suggesting campus resources where students could seek additional support. Examples of success strategies included taking advantage of professors' office hours and forming a study group to prepare for exams.

- ***Texting logistics*** messages that communicate information related to the implementation of the texting program itself, such as the start and end of the program.

A.1.1 Developing the Messages

Adapting the Messages from Other Text Messaging Programs

The text messages for this study were adapted from messages used in prior research conducted by Castleman and Page (2015, 2016). Dr. Benjamin Castleman from the University of Virginia was a consultant on this study, and he provided guidance and feedback on how to adapt all of the messages for the GEAR UP students. This study also added new "mindset" messages that drew on prior research that found promising effects of encouraging students to have a growth mindset and to recognize that social belonging struggles are common. Dr. Chris Hulleman of the University of Virginia helped to adapt this mindset content for text messaging, a delivery mode not used previously. Dr. Hulleman is Director of the Motivate Lab, where he researches how growth mindsets and social belonging relate to learning and student success.

Using Pilots to Structure Text Messages

In addition to drawing on experts with prior experience in text-message-based advising and in developing a growth mindset, the study also solicited student feedback on how to best structure text messages to encourage student engagement with the advising. First, prior to sending any text messages, the study team conducted focus groups in which high school and college students not participating in the effectiveness study provided feedback on the wording and format of specific messages. The study team then conducted an additional round of focus groups, this time with students from cohort 1 being sent the text messages. The study team took student feedback into account in a number of ways. For example, the study team revised the wording of the messages to include the advisor's name so that students knew who would be responding to their messages; the study team also varied the greeting, from "Hi" to "Hey" to "Hi again," so that the messages seemed less generic.

In addition to personalization to make the text messages appear more natural and less automated, the structure of the text messages varied such that some asked questions that were open-ended, whereas others were closed-ended. For example, an open-ended message asked students, "Need info about tuition payments?" whereas a closed-ended question asked, "Have you completed the federal financial aid application (also known as FAFSA)? Reply YES or NO." Programming of the closed-ended messages generated structured autoreplies that depended on how students responded. For example, for the closed-ended question of "Still going to UMass in the fall? Reply Yes or NO," if the student replied YES, the autoreply was "Great to hear! Thanks for letting me know."

The study also incorporated experiences from cohort 1 students into the timing of when messages were sent. In general, students received messages between 11 a.m. and 3 p.m. local time and never on holidays. The send dates and timeframe were chosen to correspond with advisors' working hours while ensuring that, if students were in a time zone different than their advisor's, messages did not come unreasonably early in the morning or late in the evening. For students in cohort 2, the study team also minimized weekend messages. Findings from cohort 1 drove this decision: among cohort 1 students who received messages, most responded soon afterwards, and advisors were not available to respond quickly to students' messages on weekends.

Personalizing Text Messages to Colleges that Students Planned to Attend

The study personalized some of the text messages based on where students planned to attend or actually attended college. This was a key feature of the text messaging program because prior studies suggested that individuals are more likely to take action if the information they receive is relevant to them (Castleman and Page 2015). Personalized messages included college-specific dates for new student orientation, start dates for the fall and spring terms, start dates for fall and spring final exams, tuition due dates, and state and college FAFSA filing deadlines. Personalized messages also contained links to the college's student account portal, academic calendar, and webpages for new student requirements, tuition information, and the college tutoring center.

College-specific personalizing required knowing which college the students in the text messaging group planned to attend in the fall. For that, the study team used (a) students' responses on a student survey administered at the end of their senior year of high school; and (b) updates received from students via text message about their intended or actual college. Updates via text message came in response to programmed messages that began at the start of the summer and in ad hoc text messages from students to their advisor. The process of obtaining the names of colleges the students intended to and did enroll in yielded very accurate data. For 86 percent of students, the college name provided via the survey or text message response matched where they actually enrolled (Exhibit A.2).

The study team then manually looked up key information about the named colleges, such as financial aid deadlines, links to the registrar, and orientation dates, in order to populate the text messages with information relative to each student.

Exhibit A.2 Extent to which College Where Messaged Students Enrolled Matched Information Provided via Survey or Text

	Number of Enrolled Students	Percentage of Enrolled Students[a]
College enrolled matched college information provided	1,622	86
Via survey only	205	11
Via text only	613	33
Via both survey and text	804	43
College enrolled matched neither survey nor text information	198	11
No survey or text information provided	60	3

[a] Percentages for mutually exclusive categories may not add to 100% due to rounding.

Pilot Experiments

To further test different message options with students, the study team conducted a series of four pilot experiments, focused on testing message structures that researchers could easily adjust. Across the four experiments, students in cohort 1 were randomly assigned to receive one of two versions of certain messages (Exhibit A.3). Response rates for each version were compared to determine which version yielded more student response. Specifically, these experiments explored student responsiveness to messages with:

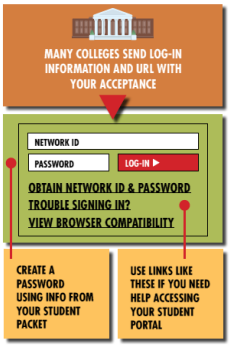
1. An infographic and text versus text only;

2. An open-ended question versus a structured "yes/no" question about a key college milestone;

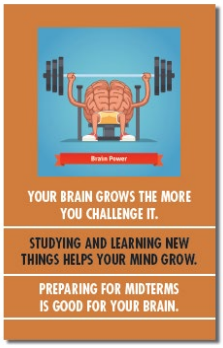
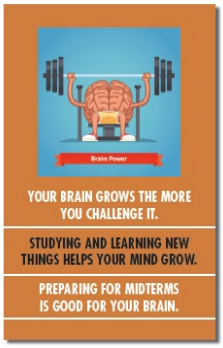
3. An open-ended question versus a question asking for a "1 to 10" reply; and

4. An open-ended question versus a structured "yes/no" question with growth mindset content (this experiment included two sets of messages of each type).

Exhibit A.3 Messages from Four Experiments Comparing Student Responsiveness

<table>
<tr><th colspan="2">Experiment 1: An infographic and text versus text only</th></tr>
<tr><th>Version 1: Message with infographic</th><th>Version 2: Message without infographic</th></tr>
<tr><td>(1/2) Hi [first name]! If you haven't yet, log on to your college's online account. Colleges post key info there, including updated financial aid.
 

(2/2) To log on: [url_webportal]. I've included a pic to show you generally how colleges organize their portals. Need any tips on navigating the site?
 
</td><td>(1/2) Hi [first name]! Have you already logged on to your college's online account? Colleges post key info there, including updated financial aid.
(2/2) To log on: [url_webportal]. Need any tips on navigating the site?</td></tr>
<tr><th colspan="2">Experiment 2: An open-ended question versus a structured "yes/no" question about a key college milestone</th></tr>
<tr><th>Version 1: Open-ended message</th><th>Version 2: Structured "yes/no" message</th></tr>
<tr><td>(1/2) Hi! Now is an important time to finalize financial aid for the fall.
(2/2) Many students find the FAFSA and financial aid award letter from colleges confusing at first. Can I answer any questions for you?</td><td>(1/2) Hi! Have you completed your federal financial aid application (also known as FAFSA)? Reply YES or NO.
 
</td></tr>
</table>

<table>
<tr><td> 
</td><td>If YES: Great! That's a major step to take on the road to college. Have you already received your financial aid award letter from [college abbreviation]? Reply YES or NO.
If YES: Good to hear. Understanding the difference between grants and loans can be tricky. Would you like some pointers on how to decode your bill?
If NO: OK. It may be on the way, but I'd check the [college abbreviation] online account. Do you want some suggestions on how to look into this?
If NO: (1/2): That's OK, you can still complete it. Doing the FAFSA can qualify you for thousands of dollars in grants—money you don't have to pay back!
(2/2) What questions can I answer about completing the FAFSA?</td></tr>
<tr><th colspan="2">Experiment 3: An open-ended question versus a question asking for a "1 to 10" reply</th></tr>
<tr><th>Version 1: Open-ended message</th><th>Version 2: Structured message with "1 to 10" reply</th></tr>
<tr><td>Hi [first name]! Just wanted to touch base and see how you're feeling about transitioning to college in a few weeks?</td><td>Hi [first name]! How are you feeling about transitioning to college in a few weeks? Reply 1-10, 1=anxious, 10=excited.
If 7 OR ABOVE: Great to hear! Some students go back and forth between being excited and nervous. That's totally normal when you're going into a new situation.
If 4-6: That's OK, it's normal to be a bit nervous. Most students find over time that their nervousness goes away. Text me if you want to talk.
If 3 OR UNDER: It's normal to feel nervous. Most students find that they feel less nervous over time. Let me know if you want to talk.</td></tr>
<tr><th colspan="2">Experiment 4: An open-ended question versus a structured "yes/no" question with growth mindset content</th></tr>
<tr><th>Version 1a: Open-ended message</th><th>Version 2a: Structured "yes/no" message</th></tr>
<tr><td>Just wanted to see how your coursework is going. Are you finding any of your classes particularly challenging?
 
</td><td>Just wanted to see how your coursework is going. Are you finding any of your classes particularly challenging? Reply YES or NO.
 

If YES: (1/2) Many students struggle with college-level courses and find it helpful to connect w/ an advisor or tutor. Text me for help connecting w/ someone on campus.
(2/2) Also, here are some concrete study strategies that some students find useful: http://bit.ly/1SCdbjj. Text me back if I can help w/ study tips.
If NO: Keep up the good work! Probably on your radar already, but midterms may be coming up in a few weeks. Visit http://bit.ly/1SCdbjj for great midterm study tips.</td></tr>
</table>

Version 1b: Open-ended message	Version 2b: Structured "yes/no" message
Hi [first name]. How's the social side of college going? Have you made personal connections with anyone on campus?	Hi [first name]. How's the social side of college going? Have you made personal connections with anyone on campus? Reply YES or NO. If YES: Great to hear. Having a strong friend network and campus connections goes a long way to helping students succeed in college. If NO: (1/2) That's pretty common for students, actually. It can take some time to transition to college. (2/2) One way to connect socially is getting involved with campus groups and activities. Text back if I can help you connect.

From pilot experiment 1, the study team learned that students were slightly more likely to respond to the text version without the infographic (version 2: 14.1 percent) than to the version with the infographic (version 1: 10.9 percent), but the difference was small (3 percentage points) and not statistically significant.[1] Therefore, because students in the focus groups had consistently said they enjoyed receiving the infographics, the study team included infographics in some additional messages.

From pilot experiments 2 to 4, the study team learned that students were consistently more likely to respond to the closed-ended version than the open-ended version of each message (Exhibit A.4). The difference in students' responsiveness was particularly large for experiment 2, in which 44 percent of students sent the closed-ended version of the message (version 2) responded to it versus only 13 percent of students sent the open-ended version (version 1).[2] These results led the study team to incorporate closed-ended questions when possible into the messages for the remainder of the study.

Exhibit A.4 Student Engagement with Text Messages in Four Experiments

Experiment	Percentage of Students Who Responded to Message		Percentage Point Difference	*p*-Value
	Version 1	Version 2		
1	10.90	14.20	−3.29	.319
2	13.27	43.94	−30.70	.000
3	32.17	37.26	−5.09	.272
4	12.96	16.42	−3.45	.335

Sample Sizes:
Experiment 1: 230 students sent version 1, 219 students sent version 2
Experiment 2: 212 students sent version 1, 198 students sent version 2
Experiment 3: 230 students sent version 1, 212 students sent version 2
Experiment 4: 216 students sent version 1, 201 students sent version 2

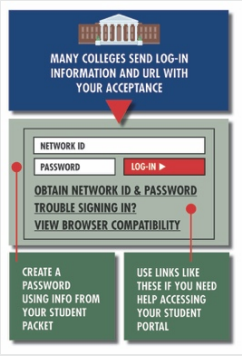
[1] From these experiments, the study team also learned that some students' phone providers did not allow transmission of multimedia messaging service (MMS) messages, a capability that was required for the infographics. Because information on which phone providers did not allow MMS messages was available, the study team sent students who could not receive MMS messages texts with the same content but no infographic for the remainder of the study.

[2] The study team did note for experiment 2, however, that students' responses to the closed-ended version did not contain as much substantive information as their responses to the open-ended version, and that the open-ended version elicited more sentiments (as rated using the National Research Council Canada's Word-Emotion Association Lexicon) in key categories, such as "joy," despite less responsiveness overall.

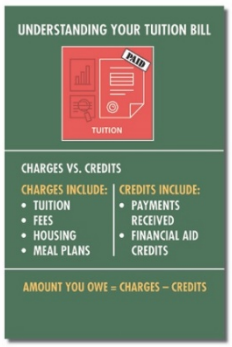
A.1.2 Full Set of Programmed Text Messages

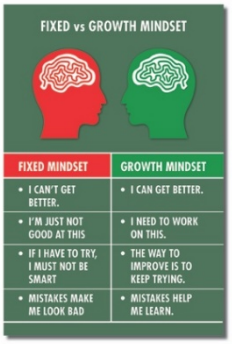
To provide support throughout the students' transition from high school to college, the study sent messages starting in June after high school and continuing until the following May. Across the 12-month transition year, students were sent the series of programmed text messages shown in Exhibit A.5.[3]

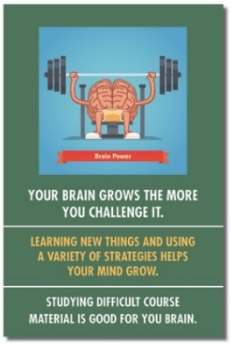
Exhibit A.5 Programmed GEAR UP Text Messages—Timing, Topic, and Content

Date Sent	Message Topic	Message Content
Early June[a]	Introduction to texting program	(1/2) Hi [S: first_name], this is [P: advisor_name] from [P: program_name]. I will be sending you messages with important college info. (2/2) Visit http://bit.ly/2k4fYXY to learn more. You can text this # w/ questions and I'll respond to you personally.
Mid-June	Confirmation of choice of college	Hi, it's [P: advisor_name] again. Still going to [C: coll_abbrev] in the fall? Reply YES or NO. If YES: Great to hear! Thanks for letting me know. If NO: Thanks for letting me know. Do you plan to go to college in the spring?
Late June	College student online account	(1/2) Hi [S: first_name]! If you haven't yet, log on to your college's online account. Colleges post key info there, including updated financial aid.  (2/2) To log on: [C: url_webportal]. Need any tips on navigating the site? 

[3] GEAR UP grantees could participate in the study in spring 2016 (cohort 1), spring 2017 (cohort 2), or both years. Between the first and second cohorts, the study team made small changes to the text messages in response to feedback from cohort 1 participants and changes in FAFSA policy. These changes included adding two more school-year messages about financial aid for cohort 2.

Date Sent	Message Topic	Message Content
Late June	FAFSA and financial aid letter	Hi! Have you completed the federal financial aid application (also known as FAFSA)? Reply YES or NO.  If YES: Great! That's a major step to take on the road to college. Have you already received your financial aid award letter from your college? Reply YES or NO. If YES: Good to hear. Understanding the difference between grants and loans can be tricky. Would you like some pointers on how to decode your bill? If NO: OK. It may be on the way, but I'd check your college's online account. Do you want some suggestions on how to look into this? If NO: That's OK, you can still do it. Doing the FAFSA can qualify you for thousands of dollars in grants—money you don't have to pay back! Text back if I can help.
Varied; Late June[b]	New student orientation	(1/2) Hey [S: first_name]! Have you signed up for the [C: coll_abbrev] orientation? (2/2) Need to register? Visit [C: url_orient] for more information. Text back if I can help.
Early July	Tuition bill reminder	Hi there! Your tuition bill may be coming soon. Need info about tuition payments? Visit [C: url_tuition]. Text back for suggestions.  
Early July	New student requirements	(1/2) Hi again! Need help w/ new student requirements like placement tests or housing forms at [C: coll_abbrev]? (2/2) Visit [C: url_admit] or text back with questions.
Mid-July	Feelings about college transition	Hi [S: first_name]! How are you feeling about transitioning to college at the end of the summer? Reply 1-10, 1=anxious, 10=excited. If 7 OR ABOVE: Great to hear! Some students go back and forth between being excited and nervous. That's totally normal when you're going into a new situation. If 4-6: That's OK, it's normal to be a bit nervous. Most students find over time that their nervousness goes away. Text me if you want to talk. If 3 OR BELOW: It's normal to feel nervous. Most students find that they feel less nervous over time. Let me know if you want to talk.
Mid-July	Financial aid options	Hi [S: first_name]! Does your college plan feel affordable? Loan options and financial aid can be confusing. Text back with any questions.
Varied; Late July[b]	Tuition bill due date	Hi [S: first_name]. Your tuition bill is due [C: tuit_duedate]. Need info about tuition payment options? Visit [C: url_tuition]. Text back for help.

Date Sent	Message Topic	Message Content
Late July[a,c]	College enrollment plans	Hey [S: first_name], this is [P: advisor_name]. Just checking: Are you still planning to enroll in college this fall? Reply YES or NO. If YES: That's great! Where will you be going? If NO: Thanks for letting me know. Do you plan to go to college in the spring?
Varied; Early August[b]	Travel to college	(1/2) Hi. Right now is the time to finalize your travel plans to college. Your school calendar with important dates is here: [C: url_schcal]. (2/2) Have you run into any last minute issues I can help you with?
Varied; Early August[b]	Feelings about the start of classes	(1/2) Hi [S: first_name]! Can you believe the first day of classes at [C: coll_abbrev] is [C: fall_start]? (2/2) How are you feeling about starting up? Reply 1-10, 1=nervous and 10=excited. If 7 OR ABOVE: Great to hear! I hope the semester gets off to a great start. I'll write during the year and you can always text me for help. Good luck! If 4-6: That's OK, it's common to feel nervous. These feelings usually fade over time. I'll check in over the semester and am here if you need help or want to talk. If 3 OR BELOW: That's actually very normal. It can take time to feel comfortable at a new place. I'll check in over the semester. Would it help to talk?
Late August	Introduction to GEAR UP tips	(1/2) Hi, it's [P: advisor_name]. In addition to messages about important milestones, I'll send tips about concrete college success strategies. (2/2) I'll send one or two tips a month, and they'll start with "GEAR UP TIP." Let me know if they're helpful!
Early September[a,c]	Start of classes	Hi [S: first_name]. Have college classes started or are they starting soon? Reply YES or NO. If YES: Good luck with the start of college! Text back to let me know what college you are attending. If NO: Are you still planning on going to college this fall?
Varied; Early September[b]	Encourage growth mindset	(1/2) Hi there. Did you know that believing that you can get smarter matters for how well you do in school?  (2/2) How're you feeling about the start of the college term? Reply 1-10, 1=not so good, 10=great. If 7 OR ABOVE: Great to hear! Really glad things are getting off to a good start. Feel free to write back if anything comes up. If 4-6: That's OK, the transition to college takes time for most students. Do you feel like you're able to stay on top of your coursework? Reply YES or NO. If YES: Good to hear. Joining campus groups can ease the transition. Try Googling your college's student activities office or searching Facebook. Text for more ideas. If NO: At first, many students are uncertain how they'll do in college. I suggest meeting with your advisor or the tutoring center. Text back if I can help. If 3 OR BELOW: It's normal for the transition to college to take some time. What's feeling most challenging?
Mid-September	Tutoring center	GEAR UP TIP: You're not alone when it comes to figuring out assignments. Working w/ tutors can help—have you visited the tutoring center? [C: url_tutor]

Date Sent	Message Topic	Message Content
Mid-September	Check-in on coursework	Just wanted to see how your coursework is going. Are you finding any of your classes particularly challenging? Reply YES or NO.  If YES: Many students struggle w/ college courses and find it helps to talk w/ an advisor or tutor. Visit http://bit.ly/2kIC1oQ for study tips. Text if I can help. If NO: Keep up the good work! Probably on your radar already, but midterms may be coming up in a few weeks. Visit http://bit.ly/2kIC1oQ for great midterm study tips.
Late September	Place to study	(1/2) GEAR UP TIP: Finding a comfortable place to study free from distractions is a key success strategy for many students. (2/2) Have you tried studying or doing assignments in the library?
Late September	Social belonging	Hi [S: first_name]. How's the social side of college going? Have you made personal connections with anyone on campus? Reply YES or NO. If YES: Great to hear. Having a strong friend network and campus connections goes a long way to helping students succeed in college. If NO: That's actually pretty common for students. Transitioning can take time. Joining campus groups and activities can help you connect socially. Text if I can help.
Early October[d]	FAFSA refiling open	The 2018-19 FAFSA opened Oct. 1. Complete it early to qualify for as much financial aid for next year as possible. Text back if I can help.
Early October	Study schedule	GEAR UP TIP: Are midterms coming up in the next couple weeks? Writing out a study schedule can help you stay on track to prepare for your exams/papers.
Mid-October[e]	Encourage growth mindset	(1/2) Hi there. Your brain grows the more you challenge it, like taking difficult courses or learning something new: https://www.khanacademy.org/youcanlearnanything# (2/2) Watch this short 90-second video for inspiration. Creating a study plan or working w/ a tutor can help you do your best. Text if I can help.
Mid-October	Professor office hours	GEAR UP TIP: Most professors have office hours devoted to meeting with students. This is a great way to get questions answered and connect with faculty.
Early November	Midterms	Hi! Just checking in to see if you've already been through midterms. If so, were you happy with how you did? Reply YES or NO. If YES: Wonderful! Doing well on your first round of midterms is a real accomplishment, and sets you up well for the rest of the semester. Keep it up! If NO: That's OK. Adjusting to college takes time. It may be about adjusting study strategies. We can work on developing study skills. Text me to find time to connect.
Early November	Personal health	GEAR UP TIP: Staying healthy is just as important as studying to do well in college. Taking time to exercise can help you do your best in the classroom.
Mid-November	Registration for spring classes	Hi [S: first_name]. At many colleges this is when students start to register for classes for next term. Have you already registered? Reply YES or NO. If YES: Great to hear! Text me back if it would be helpful to discuss your course choices. If NO: OK. Feel free to text me back if I can help you explore course options or figure out the registration process at your college.
Late November	Studying with peers	GEAR UP TIP: Working with study groups is a great way to cover a lot of course material. Are there classmates you can study with for finals?

Date Sent	Message Topic	Message Content
Late November[e]	Encourage growth mindset	(1/2) As finals approach, it's a good time to remember that your hard work can make you smarter. Remember this 90-second video on growing your intelligence? https://www.khanacademy.org/youcanlearnanything# (2/2) You're not in this alone. Advisors and tutors can help you on campus, and you can always text me for help. Good luck!
Mid-December[a]	Congratulations on first term	Congrats on your first term of college! I hope you enjoy the winter break. I'll send more texts in the new year.
Early January	Start of spring term	Happy new year [S: first_name], it's [P: advisor_name]. Are you looking forward to the start of the new term? Reply YES or NO. If YES: Great! You're already that much closer to your college degree. I hope the term gets off to a smooth start. If NO: Sorry to hear that. Are you planning to re-enroll? Reply YES or NO. If YES: Good to hear. What in particular are you not looking forward to about the start of the new term? If NO: Thanks for letting me know. Do you want to explore the pros and cons of taking a break from college? Text me back to set up a time.
Mid-January[d]	State grants and scholarships	(1/2) Hi [S: first_name]. You may qualify for state grants and scholarships for the 2018-19 year. (2/2) Check out [P: state_fin_aid] for required steps in applying for aid other than submitting the FAFSA. Text back for help.
Varied; Late March[b]	FAFSA deadline	(1/2) Hi [S: first_name]. Remember, if you get financial aid, you need to refile FAFSA to renew aid for the 2018-19 school year. (2/2) Filing by [C: fafsa_file] may help you qualify for thousands of dollars in additional grant aid. Have you already refiled FAFSA? Reply YES or NO.  If YES: Great job! Keep an eye on your email, since FAFSA may email you with questions about the info you provided on the application. If NO: That's OK, you still have time. To get started, visit https://www.fafsa.gov. Can I help you refile the FAFSA?
Early February	Satisfactory Academic Progress	(1/2) Hi there. If you got financial aid this year, you need to meet Satisfactory Academic Progress (SAP), a minimum GPA, to keep aid for next year. (2/2) Some students find this process tricky. You can ask your financial aid office for more info, or text me back and we can look this up together.
Mid-February	Summer plans	(1/2) Hi [S: first_name]. Now's the perfect time to get a jump start on great summer internship, travel, or work opportunities. (2/2) Try Googling your college's summer learning or career opportunities office, or text me back if you want to explore options.
Late February	Midterm study plans	(1/2) Hi. As midterms approach, remember that studying actually strengthens your brain and expands what you can learn! (2/2): Creating a study plan or working with a tutor can help you do your best. Can I help make these connections?

Date Sent	Message Topic	Message Content
Varied; Late March[b]	FAFSA deadline	(1/2) Hi, it's [P: advisor_name]. [C: coll_abbrev] gives more aid to students who file by [C: fafsa_file]. (2/2) Just checking to see if you've been able to submit the FAFSA for next year's financial aid. Reply YES or NO. If YES: Great. Depending on when you refiled the FAFSA, you may have gotten an email from FAFSA about next steps w/ your aid. Text me w/ any questions. If NO: There's still time. Getting your FAFSA in on time can unlock thousands of additional dollars in aid. Text me if you need help w/ FAFSA.
Late March	Post-midterm mindset	Hi, it's [P: advisor_name]. Just checking in to see if you've already been through midterms. If so, how did they go? Reply 1-10, 1=not so good, 10=great. If 7 OR ABOVE: That's fantastic—keep up the great work! If 4-6: That's pretty common—it takes time to adjust to college work, even into the spring. Would it help to connect to an academic advisor or tutor? Reply YES or NO. If YES: Great. Can I help you connect with a tutor or advisor? If NO: OK. Here's a link with some concrete study strategies that some students find useful: http://bit.ly/2kIC1oQ. Text me back if I can help w/ study tips. If 3 OR BELOW: Many students find that academic advising or tutoring can help them catch up. I'm happy to help you connect with your advisor or a tutor. Feel free to text me.
Late March[a]	Upcoming end of text messaging	(1/2) Hi. Just a quick note that I'll be here to help you through the end of May. (2/2) I'll keep sending you texts through then. Text with any questions, and we can also discuss where you can go for 1:1 help after May.
Mid-April	Fall registration	Hi [S: first_name]. At many colleges this is the time when students start to register for fall classes. Have you already registered for the fall? Reply YES or NO. If YES: Great to hear! Text me back if it would be helpful to discuss your fall course choices. If NO: OK. Feel free to text me back if I can help you explore course options or figure out the registration process at your college.
Mid-April	Financial award letters	Hi [S: first_name]. This is the time of spring when students often get their financial aid award letters. Have you gotten yours yet? Reply YES or NO. If YES: Great. Someone in the financial aid office can help you answer any questions you have, or you can text me back w/ any questions. If NO: OK. Do you remember when you filed your FAFSA?
Varied; Mid-May[b]	Final exams	(1/2) Hi [S: first_name]. Finals are approaching for many college students. This is just a quick reminder that your intelligence grows with effort! (2/2): And you're not in this alone. [C: coll_abbrev] advisors and tutors can help, and I'm here, too. Good luck!
Late May[a]	Final text – Congrats on term	(1/2) Congrats on your first year of college! I hope you've found these messages helpful and that you've had a great first year. (2/2) This is our last text, but if you need help this summer don't hesitate to contact someone at your college. I wish you the best in your college career!

[a] *Texting logistics* message—Logistics messages were not counted as part of the 37 programmed messages as these messages were focused on managing the texting program rather than on delivering message-based advising content to students.
[b] Message was programmed to be sent on a date that was anchored to a specific college's milestone, such as orientation, the start of classes, or the tuition due date, provided that the college-specific date was known.
[c] Sent to subset of students who had not shared their college enrollment plans.
[d] Message sent only to students in cohort 2 based on feedback from cohort 1 participants and changes in FAFSA policy.
[e] Contained embedded video.
Note: Students who indicated that they would not be starting college until the spring were sent an abbreviated set of messages.

A.1.3 Advising through Messaging

The programmed text messages provided support, either by encouraging students to connect to their GEAR UP advisors directly (via texting or another mode) or by referring students to supports available on their college

campus. Each GEAR UP advisor had his or her own account on the text messaging platform that included only students from that advisor's group(s) and allowed the advisor to respond to replies, questions, and inquiries for help from those students.

In addition to the programmed text messages, advisors could write and send their own text messages to individual students or groups of students. The study asked advisors to check their accounts daily, respond promptly to messages, and announce when they were typically available, such as Monday to Friday from 9 a.m. to 5 p.m., as well as when they would be away for an extended period of time. Advisor support to students spanned the full 12-month texting period, from June of students' senior year of high school through May of their first year in college.

A.2 Training of Advisors

The study provided a series of trainings to GEAR UP advisors to help them support students after they leave high school and disperse to colleges. A series of four 60-minute webinars trained advisors on using the text messaging platform, the content of the text messages, and best practices in college advising using text messages. The webinars occurred at strategic time points in order to avoid overloading advisors with information. Two webinars occurred in May, before text messaging to students started; the third in August, at the start of students' first year of college; and the fourth during January of students' first year of college. Information provided in each webinar focused on upcoming issues students might face, such as adjusting to college courses or making connections on campus, and activities students might need to complete soon. Each advisor received a handbook that included key content from the webinars and suggested text responses to common student questions, as well as where to find additional information about financial aid and planning, campus support services, and learning mindsets.

During the first webinar, the provider of the text messaging platform instructed advisors on how to use the platform. Advisors could access additional ongoing technical support throughout the text messaging program. A non-profit organization that had experience providing text-message-based advising led the training about key college advising topics addressed in the text messages and best practices and strategies for advising via text messages. Throughout the study, the study team provided information to advisors about the study timeline and successful communication practices identified during the focus groups conducted with students in cohort 1 and through monitoring the messaging platform.

In addition, advisors and staff from GEAR UP grantees participating in both cohort 1 and cohort 2 advising were invited to attend an in-person refresher training session, held during the summer between cohort 1 and cohort 2, about how to use the texting platform, answer questions, and provide referrals to campus resources in response to students' text messages.

APPENDIX B. ADDITIONAL INFORMATION ABOUT HOW THE STUDY WAS DESIGNED AND IMPLEMENTED

This appendix provides details about the study design and its implementation to address the study's research questions. This detail is intended to answer questions about the sample, data sources and measures, analytic methods, and the achieved power of the study.

B.1 Study Design

The study design aimed to answer the following three key questions:

- **Did the college transition messaging improve college enrollment and persistence rates for GEAR UP students?** Addressing this central question adds to emerging evidence about the effectiveness of college transition messaging in general and, specifically, as a strategy for GEAR UP grantees to provide supports to students in the year after high school graduation.
- **Do impacts vary by key student characteristics or the GEAR UP high schools students attended?** This information could be useful to the GEAR UP program office in providing technical assistance to grantees about using text messaging to reach students, or to individual GEAR UP grantees trying to determine whether adopting the college transition messaging is appropriate for them.
- **How intensively was the text messaging implemented?** Descriptive information about student and advisor engagement in the text messaging provides context for understanding the effectiveness of the college transition messaging, which could be important to the ongoing development of strategies like the one evaluated in this study.

To answer these questions, the study team recruited GEAR UP grantees and high schools they serve to participate in the study. Within each GEAR UP high school, the study randomly assigned students either to receive regular GEAR UP services plus the college transition messages or to receive regular GEAR UP services only during the year after high school. This section describes how the study team recruited grantees, schools, and students for the study and how it randomly assigned students to the grantee treatment or control groups.

B.1.1 Study Sample

The study focused on the first group of GEAR UP grantees that planned to extend services to students for an additional year after high school. To identify the eligible grantees, the study used the list of GEAR UP grantees maintained by the U.S. Department of Education (ED) from the 2011 fiscal year (FY) onward. All 80 GEAR UP grantees funded with FY 2011 funds that served high school seniors in either the 2015-16 or 2016-17 school year and planned to provide services to students in their first year of college were eligible to participate in the study. Of these grantees, 16 volunteered to participate in either spring 2016 (cohort 1), spring 2017 (cohort 2), or both years.[4] These 16 grantees served 282 high schools, of which 81 volunteered for the study. Those 81 high schools included 11,805 seniors who were GEAR UP participants.[5]

The GEAR UP grantees participating in the study were not selected to represent the full set of 80 eligible grantees. However, the similarity of the participating grantees to other eligible grantees suggests that results from this study could be used to inform decisions on whether or not to implement text-message-based advising across GEAR UP

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[4] Three grantees participated in cohort 1 only, 11 participated in cohort 2 only, and two participated in both cohorts.

[5] Not all seniors in the study high schools were GEAR UP participants. GEAR UP schools can choose to serve all students in a grade level; all students in a grade level who reside in public housing; or students who particularly need GEAR UP services, such as students eligible for free or reduced-price lunch, limited English proficient students, or students from groups that are traditionally underrepresented in postsecondary education.

grantees. Exhibit B.1 shows that participating grantees were similar to the full set of eligible grantees on important dimensions, with one exception: participating grantees were less likely to be located in a rural area than were all eligible grantees.[6]

Exhibit B.1 Characteristics of Participating GEAR UP Grantees versus All Eligible Grantees

Characteristic	All Eligible Grantees (%)[a]	Participating Grantees (%)	Non-Participating Grantees (%)[b]
Gender Composition			
Female	49.5	49.8	49.4
Racial Composition			
White	29.5	29.8	29.4
Black	19.0	18.6	19.1
Other	13.3	10.8	14.0
Ethnic Composition c			
Hispanic	38.1	40.8	37.4
Historical College Enrollment Rate			
Seniors enrolling in college	47.6	51.5	46.7
AP and IB Course Taking			
Students completing AP course	7.5	10.0	6.9
Students completing IB course	0.8	1.1	0.8
Locale			
Schools in rural location	52.7	39.4	56.3
Eligibility for Title Id			
Schools eligible for Title I funds	84.5	84.1	84.6
TOTAL N	80	16	64

[a] The joint F-test *p*-value comparing all eligible grantees to participating grantees on the characteristics shown above is .9751.
[b] The joint F-test *p*-value comparing participating versus non-participating grantees on the characteristics shown above is .9173.
[c] A single racial/ethnic composition variable cannot be created at the grantee level because the source for these data (GEAR UP Annual Performance Reports in fiscal year 2016) reports on race and ethnicity separately for some grantees.
[d] Title I of the Elementary and Secondary Education Act provides funds to local educational agencies and schools with high numbers or percentages of students from low-income families.
Note: AP is Advanced Placement. IB is International Baccalaureate.
Sample Sizes:
Gender: All=80 grantees, Participating=16 grantees, Not participating=64 grantees
Race and ethnicity: All=62 grantees, Participating=13 grantees, Not participating=49 grantees
Historical college enrollment rate: All=64 grantees, Participating=12 grantees, Not participating=52 grantees
AP/IB course taking: All=79 grantees, Participating=15 grantees, Not participating=64 grantees
Locale: All=76 grantees, Participating=16 grantees, Not participating=60 grantees
Title I status: All=76 grantees, Participating=16 grantees, Not participating=60 grantees
Source: GEAR UP Annual Performance Report fiscal year 2016, Common Core of Data 2014-15 and 2015-16.

It is also important to look at similarities between schools that participated and those from the same grantee that did not participate. If the schools that participated differ in student composition, college enrollment rates, or locale then the overall results from this study may not be applicable to all schools in these grantees. Schools[7] that volunteered for the study were similar to that full set of 282 schools in the 16 participating grantees on important

[6] Due to missing data, the sample sizes varied for different grantee characteristics; sample sizes for each characteristic are included in the exhibit notes.

[7] Of these schools, 22 participated in cohort 1 only, 54 participated in cohort 2 only, and five participated in both cohorts.

dimensions, including historical college enrollment rate, school locale, and eligibility for Title I funds. Participating schools had a higher proportion of Hispanic students and a lower proportion of Black, non-Hispanic students than did eligible schools that did not volunteer (Exhibit B.2). However, statistical comparisons of the participating schools to all schools in participating grantees and to non-participating schools did not reveal significant differences between the sets of schools.

Exhibit B.2 Characteristics of Participating Schools versus All High Schools in Participating Grantees

Characteristic	All Schools in Participating Grantees (%)[a]	Participating Schools (%)	Non-Participating Schools (%)[b]
Gender Composition			
Female	48.4	48.3	48.5
Racial and Ethnic Composition			
Hispanic	25.8	35.0	22.0
White, non-Hispanic	41.1	42.1	40.8
Black, non-Hispanic	23.2	14.4	26.9
Other, non-Hispanic	9.8	8.6	10.3
Historical College Enrollment Rate			
Seniors enrolling in college	51.6	54.7	50.6
Locale			
Schools in rural location	47.1	43.2	48.7
Eligibility for Title Ic			
Schools eligible for Title I funds	75.4	79.0	73.8
TOTAL N	282	81	201

[a] The joint F-test *p*-value comparing all schools in eligible grantees to participating schools on the characteristics shown above is .6753.
[b] The joint F-test *p*-value comparing participating versus non-participating schools on the characteristics shown above is .3583.
[c] Title I of the Elementary and Secondary Education Act provides funds to local educational agencies and schools with high numbers or percentages of students from low-income families.
Sample Sizes:
Gender: All=275 schools, Participating=81 schools, Not participating=194
Race/ethnicity: All=275 schools, Participating=81 schools, Not participating=194
Historical college enrollment rate: All=140 schools, Participating=35 schools, Not participating=105
School locale: All=276 schools, Participating=81 schools, Not participating=195
Title I status: All=276 schools, Participating=81 schools, Not participating=195
Source: GEAR UP Annual Performance Report fiscal year 2016, Common Core of Data 2014-15 and 2015-16.

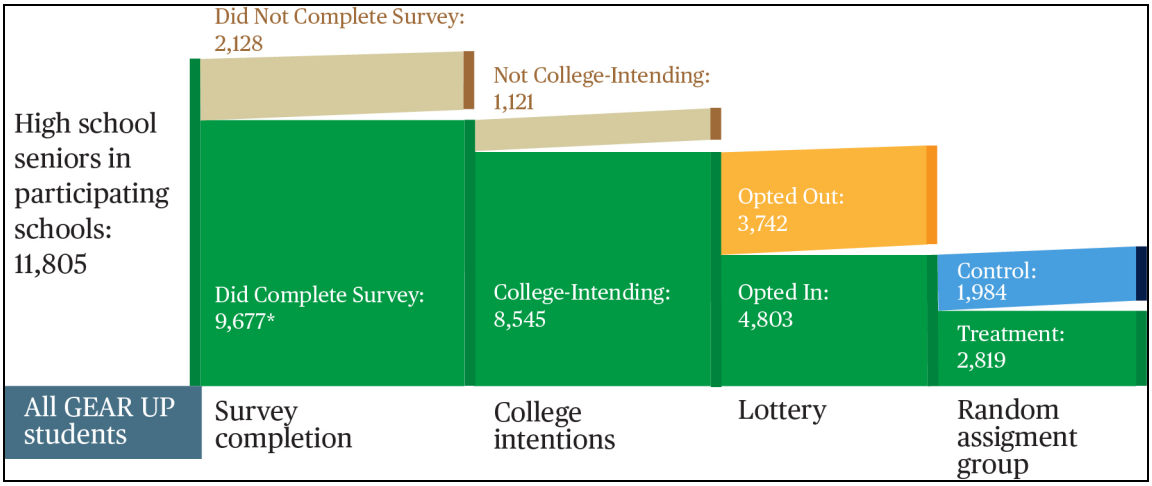
Within the participating schools, only certain students were eligible for the study. To be eligible for the study and be randomly assigned, students needed to complete the survey administered near the end of their senior year of high school, indicate that they intended to enroll in college in the fall after high school, and provide a cell phone number. Taken together, the study criteria ensured that eligible students could be identified before random assignment, and that students would be attending college in the fall and had a phone to receive text messages.

All 11,805 seniors who were GEAR UP participants in the 81 participating schools were surveyed. The survey gathered information from the 9,677 students who completed it about college advising services that they received in high school and determined their eligibility to participate in the study. Students who completed the survey and indicated they intended to enroll in college in the fall after high school were eligible. Of the 9,677 students who completed the survey, 8,545 students did intend to enroll. Finally, students had to provide a cell phone number and agree to participate in a lottery that would randomly assign them to either receive the regular GEAR UP supports

coupled with college transition messages (the "messaged"/treatment group) or to receive regular GEAR UP supports only (the "non-messaged"/control group).[8]

Of the 8,545 students who completed the survey and intended to enroll in college, 4,803 opted into the lottery[9] and 3,752 students did not. Those 4,803 students formed the study sample. Of them, 2,819 were randomly assigned to the treatment group and 1,984 to the control group (Exhibit B.3; see section B.1.2 for additional details on the random assignment).

Exhibit B.3 Flow from Recruitment of Grantees and Schools to Student Study Sample



* 11 students were not eligible for the study because they did not complete the survey before the lottery.

Because students had to opt in to participate in the study, the participating students may not represent the full set of eligible students. Specifically, the students who opted to participate in the lottery are not similar to all eligible students nor to eligible students who did not opt into the lottery on the characteristics shown in Exhibit B.4. Because of the differences, the study's results may not be applicable to students who differ from the students included in this study.

Exhibit B.4 Characteristics of Eligible Students Who Opted into the Lottery versus Eligible Students Who Did Not Opt In

Characteristic	All Eligible[a] Students (%)[b]	Eligible Students Who Opted into the Lottery (%)	Eligible Students Who Opted out of the Lottery (%)[c]
Gender			
Female	54.7	58.9	49.2
Race/Ethnicity			
Hispanic	45.9	50.7	39.7
White, non-Hispanic	26.2	19.9	34.4
Black, non-Hispanic	15.0	16.4	13.1
Other, non-Hispanic	12.8	12.9	12.8
Household Characteristics			
Single-parent household	31.8	32.8	30.5
First generation to college	67.4	71.4	62.1

[8] Eleven students who completed the survey after the lottery were excluded from the study.

[9] Of them, 876 students participated in cohort 1 (school year 2015-16) and 3,927 students in cohort 2 (school year 2016-17).

Characteristic	All Eligible[a] Students (%)[b]	Eligible Students Who Opted into the Lottery (%)	Eligible Students Who Opted out of the Lottery (%)[c]
Academic Achievement			
Taken one or more AP/IB courses	52.3	54.2	49.7
Unweighted cumulative GPA			
3.67–4.00 (mostly As)	26.5	27.4	25.3
2.67–3.66 (mostly Bs)	44.5	45.3	43.4
1.67–2.66 (mostly Cs)	27.2	25.6	29.1
0.67–1.66 (mostly Ds)	1.7	1.6	1.9
0.00–0.66 (mostly Fs)	0.2	0.1	0.3
Expects a bachelor's degree or higher	77.0	80.3	72.6
College Enrollment Steps Taken before the Lottery			
Provided college name where student plans to enroll	77.0	76.8	77.2
Intends to enroll in a two-year college[d]	42.6	40.1	45.7
Paid a deposit to a college or received a waiver	26.4	26.5	26.3
Completed or plans to submit the FAFSA	91.0	93.5	87.8
TOTAL N	8,545	4,803	3,742

[a] Eligible students are those who completed the survey before the lottery, indicated that they intended to enroll in college in the fall after high school, and provided a cell phone number.
[b] The joint F-test *p*-value comparing All eligible students to Eligible students who opted into the lottery on the characteristics shown above is .0001.
[c] The joint F-test *p*-value comparing Eligible students who opted into the lottery to Eligible students who opted out of the lottery on the characteristics shown above is .0001.
[d] Intention to enroll in a two-year college was not included in either of the joint tests because of collinearity with the indicator of the student having provided a college name.
Note: AP is Advanced Placement; FAFSA is Free Application for Federal Student Aid; GPA is grade point average; IB is International Baccalaureate.
Sample Sizes:
Gender: All=8,377 students, Opted in=4,726, Did not opt in=3,651
Race/ethnicity: All=8,364 students, Opted in=4,713, Did not opt in=3,651
Single-parent household: All=8,384 students, Opted in=4,730, Did not opt in=3,654
First generation to college: All=7,870 students, Opted in=4,453, Did not opt in=3,417
Taken AP/IB course: All=8,296 students, Opted in=4,680, Did not opt in=3,616
GPA: All=7,954 students, Opted in=4,474, Did not opt in=3,480
Expects bachelor's degree or higher: All=7,986 students, Opted in=4,533, Did not opt in=3,453
Provided college name: All=8,545 students, Opted in=4,803, Did not opt in=3,742
Intends to enroll in two-year college: All=6,516 students, Opted in=3,646, Did not opt in=2,870
Paid deposit or received waiver: All=8,446 students, Opted in=4,762, Did not opt in=3,684
Completed or plans to submit FAFSA: All=8,428 students, Opted in=4,750, Did not opt in=3,678
Source: Student survey 2016 and 2017.

B.1.2 Random Assignment

The goal of random assignment was to create treatment and control groups that were similar, before the start of the college transition messaging, on characteristics likely to be related to college enrollment and persistence. That way, any differences in college enrollment and persistence can be attributed to the college transition messaging rather than to initial differences between the groups. This study randomly assigned students who opted into the lottery to one of two experimental groups: to receive the regular GEAR UP supports with the addition of college transition messages (the "messaged"/treatment group) or to receive regular GEAR UP supports only (the "non-messaged"/control group). Random assignment occurred before the start of the college transition messaging, in the summer of students' senior year of high school (June 2016 for cohort 1, June 2017 for cohort 2). To help ensure that treatment and control group students were similar on key school characteristics and in terms of the regular GEAR

UP supports and advising they received, the study team grouped students into random assignment blocks based on cohort and school. Within each block, the team randomly assigned students to an experimental group.[10]

The study offered schools in each cohort the option to serve as many students as possible through the college transition messaging. Schools had the option of giving students a 50 percent chance of being assigned to the treatment group (a 1-to-1 treatment-to-control ratio) or a higher chance (67 percent) of being assigned to the treatment group (a 2-to-1 treatment-to-control ratio).[11] When there were multiple siblings who opted into the study, one sibling was randomized and the other sibling(s) was assigned to the same group, to minimize the possibility that a sibling assigned to the control group might be exposed to the text messaging if his or her sibling was assigned to the treatment group.[12]

The random assignment procedures resulted in treatment and control groups comprising students with similar characteristics before the lottery (Exhibit B.5). Two minor differences in the characteristics of the groups are that the treatment group students were more likely to be Hispanic and less likely to have taken one or more AP or IB courses. However, this small set of differences is about what would be expected to occur by chance, given the number of characteristics examined. Even so, these differences were taken into account in the statistical models that estimate the impact of the college transition messaging.[13]

Exhibit B.5 Characteristics of Students in Each Group before the Lottery

Characteristic	Treatment Group Students (%)	Control Group Students (%)	Estimated Difference	*p*-Value[a]
Gender				
Female	58.9	58.9	0.1	.962
Race/Ethnicity				
Hispanic	48.6	46.1	2.5	.023
White, non-Hispanic	21.0	22.2	-1.2	.208
Black, non-Hispanic	17.9	18.9	-1.0	.184
Other, non-Hispanic	12.4	12.7	-0.3	.749

[10] College transition text messages purposefully did not begin until after the end of high school. Messages began in June, after high school ended, minimizing the extent to which students in the control group might be exposed to the text messages via peers from their high school who were assigned to the treatment group. This timing was chosen to minimize spillover to the extent possible. To further minimize the chance that control group students had access to the treatment, at the point of recruitment, grantees agreed to refrain from systematically texting students in the control group. However, it is possible that close peers from the same high school who were assigned to different experimental groups (treatment versus control) could have communicated during the text messaging and that the treatment group student might have shared with the control group student some of the information or strategies received via the text messaging.

[11] Of the 81 schools, 27 requested a 2-to-1 treatment-to-control assignment ratio; the other 54 schools used the 1-to-1 assignment ratio. To ensure that the analysis accounted for the differing probability of randomization, preserving the integrity of the random assignment, the study team included an indicator (or dummy) variable for each randomization block (based on cohort and school). The Institute of Education Sciences' *What Works Clearinghouse*™ considers this approach an acceptable way to account for the differing probability of randomization.

[12] This only occurred for one set of siblings in the same school and cohort.

[13] The Institute of Education Sciences' *What Works Clearinghouse*™ considers this approach an acceptable way to establish baseline equivalence on characteristics for which the mean difference between the treatment and control groups is less than .25 standard deviations. In this study, differences between the treatment and control groups on all measured characteristics were less than .25 standard deviations.

Characteristic	Treatment Group Students (%)	Control Group Students (%)	Estimated Difference	*p*-Value[a]
Household Characteristics				
Single-parent household	32.9	33.1	−0.2	.913
First generation to college	71.4	69.0	2.4	.070
Academic Achievement				
Taken one or more AP/IB courses	52.1	55.0	−2.9	.038
Unweighted cumulative GPA	2.99	3.00	0.0	.562
Expects a bachelor's degree or higher	79.2	81.3	−2.1	.082
College Enrollment Steps Taken Before the Lottery				
Provided college name where student plans to enroll	77.5	78.1	−0.6	.588
Intends to enroll in a two-year college	39.6	38.2	1.4	.350
Paid a deposit to a college or received a waiver	27.4	28.0	−0.6	.646
Completed or plans to submit the FAFSA	93.4	92.9	0.4	.535

[a] The joint F-test *p*-value comparing treatment versus control students on the characteristics shown above is .0968.
Notes: AP is Advanced Placement; FAFSA is Free Application for Federal Student Aid; GPA is grade point average; IB is International Baccalaureate. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
Sample Sizes:
Gender: Treatment group=2,781 students, Control group=1,945 students
Race/ethnicity: Treatment group=2,775 students, Control group=1,938 students
Single-parent household: Treatment group=2,783 students, Control group=1,947 students
First generation to college: Treatment group=2,613 students, Control group=1,840 students
Taken AP/IB course: Treatment group=2,755 students, Control group=1,925 students
GPA: Treatment group=2,633 students, Control group=1,841 students
Expects bachelor's degree or higher: Treatment group=2,658 students, Control group=1,875 students
Provided college name: Treatment group=2,819 students, Control group=1,984 students
Intends to enroll in two-year college: Treatment group=2,120 students, Control group=1,526 students
Paid deposit or received waiver: Treatment group=2,800 students, Control group=1,962 students
Completed or plans to submit FAFSA: Treatment group=2,793 students, Control group=1,957 students
Source: Student survey 2016 and 2017.

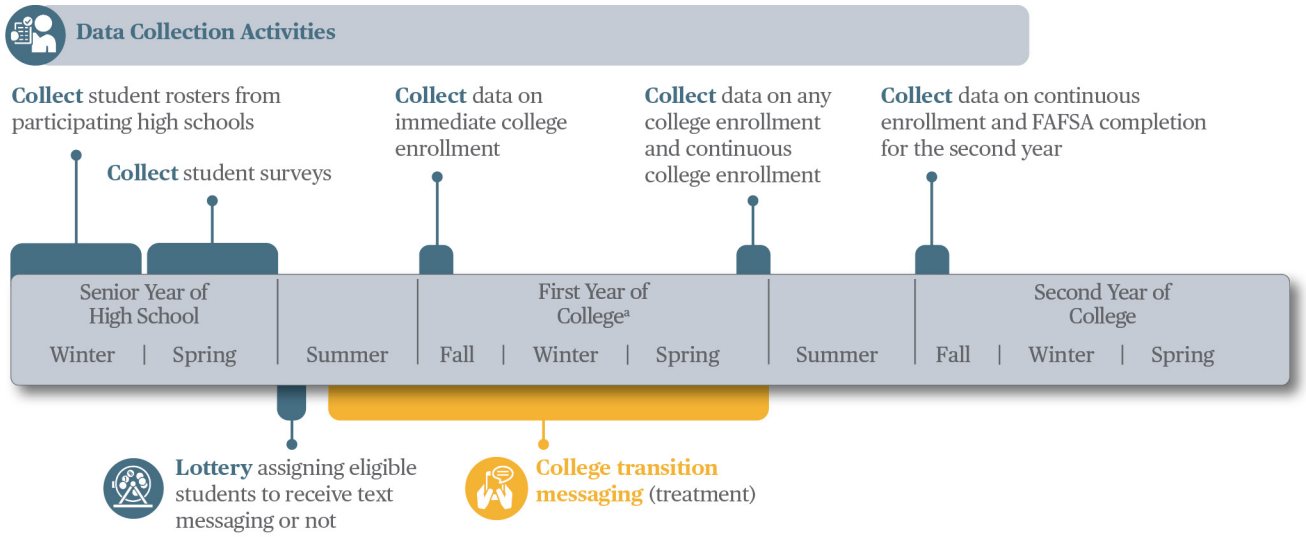
B.2 Data Collection

The study team collected data from several sources to assess the effects of the college transition messaging and describe its implementation. This section first presents the timing of data collection and then details about the data sources used to create the study measures.

B.2.1 Timing of Data Collection for the Study

As Exhibit B.6 illustrates, data were collected starting in students' senior year of high school through the start of their second year of college.

Exhibit B.6 Timing of Data Collection, Lottery, and College Transition Messaging



[a] Assumes immediate college enrollment in the fall after high school.

B.2.2 Data Sources Used to Create Study Measures

Data come from a student survey conducted as part of this study, as well as from administrative data maintained by ED and other sources. Exhibit B.7 details each of the study's data sources.

Exhibit B.7 Data Sources, including the Sample, Timing of Data Collection, Response or Coverage Rate, and Content Used for Each

Data Source	Sample	Timing of Data Collection	Response Rate (N)	Data Obtained
Survey Data				
Student survey[a]	11,805 high school seniors participating in GEAR UP	• Spring 2016 (cohort 1) • Spring 2017 (cohort 2)	82% (9,667)[b]	Students' college intentions and expectations, academic background, demographic characteristics, and willingness to participate in lottery
Administrative and National Data				
Rosters of high school seniors participating in GEAR UP	81 high schools	• Winter 2015-16 (cohort 1) • Winter 2016-17 (cohort 2)[c]	100% (81)	Records of students who would be rising seniors participating in GEAR UP
GEAR UP Annual Performance Reports (APRs)	80 grantees[d]	• School Year 2014-15 and Fiscal Year 2016	100% (80)	Reports submitted by each GEAR UP grantee, which include an entry for all participating schools
Common Core of Data (CCD)	282 high schools[e]	• School Years 2014-15 and 2015-16	94% (265)	Data on high school characteristics such as Title I status and locale
Integrated Postsecondary Education Data System (IPEDS)	529 colleges[f]	• School Year 2015-16	97% (512)	Data on college characteristics

Data Source	Sample	Timing of Data Collection	Response Rate (N)	Data Obtained
National Student Clearinghouse (NSC) and Federal Student Aid (FSA) office	4,803 students	• Fall 2016, 2017 (cohort 1) • Fall 2017, 2018 (cohort 2)	[g]	Student-level information on college enrollment (NSC) and receipt of federal student aid documenting college enrollment, and college to where financial aid was sent (FSA)
Federal Student Aid (FSA) office	4,803 students	• Fall 2017, 2018, 2019 (cohort 1) • Fall 2017, 2018, 2019 (cohort 2)	76% (3,649)[h]	Student-level information on FAFSA completion
Study's program monitoring system	2,819 students 16 grantees	• School Year 2016-17 (cohort 1) • School Year 2017-18 (cohort 2)	100% (2,819 students) 100% (16 grantees)	Records of advisors' attendance at training webinars and of messages sent by and to students and advisors

[a] The study survey can be found at https://www.reginfo.gov/public/do/PRAViewIC?ref_nbr=201503-1850-002&icID=215771.
[b] The response rate for cohort 1 was 91% (1,784 students) and for cohort 2 was 80% (7,893 students).
[c] Five high schools participated in both cohorts.
[d] Data were collected for all eligible grantees across both cohorts. These data were used to compare participating grantees to all eligible grantees and to non-participating grantees (see Exhibit B.1).
[e] Data were collected for all high schools in participating grantees. These data were used to compare participating high schools to all schools and to non-participating schools (see Exhibit B.2).
[f] Data were collected for all colleges in which students planned to enroll (as reported on the survey). These data were used to determine whether students intended to enroll in a two-year college (see Exhibit B.4).
[g] Of the 4,803 students in the study sample, records were found in both NSC and FSA for 42.3% of students (2,031), in NSC only for 19.1% of students (917), and in FSA only for 4.9% of students (235). Students who do not have records (33.7%, or 1,620 students) do *not* have missing values for variables constructed from this data source, because students without records are classified as not having achieved the outcome—for example, not enrolling in college.
[h] Percentage (and number) of students with records in the data source. Students who do not have records do *not* have missing values for variables constructed from this data source, because students without records are classified as not having achieved the outcome—for example, not completing the FAFSA.

B.3 Analytic Methods

The study created measures about students' college going and estimated the effectiveness of college transition messaging on these measures of college going for all students and for particular groups of students and schools. This section describes the approach for examining the effectiveness of the study's college transition messaging. First, it describes the rationale for selecting the study measures used to examine the effects of the study's college transition messaging and how these and other study measures were constructed. Measures were constructed to capture (a) students' college going; (b) student, school, and grantee characteristics before the study started; and (c) implementation of the college transition messaging and college advising that students received in high school. Second, the section provides details on the study's analytic methods, including the samples and methods used to estimate effects of the college transition messaging on students' college going measures. The final section provides the study-achieved power for each measure.

B.3.1 Study Measures

Student College Going Measures

The study examined the effects of the college transition messaging on multiple measures of college going (Exhibit B.8). Study measures most directly related to the text messages are discussed in the main body of the report and make up the "main" measures. Two of the main measures focus on college enrollment: immediate college enrollment after high school and any college enrollment in the year after high school. The study also examined two main measures of college persistence: continuous college enrollment in the year after high school and continuous

enrollment into the second fall after high school. In addition, because securing financial aid is likely to be an essential step for GEAR UP students to persist in college, the study also examined students' FAFSA completion. This appendix examines additional related "exploratory" measures.

Exhibit B.8 Rationale for Study Measures Examined

Challenge to College Enrollment and Persistence	How Text Messages Target that Challenge	Study Measure Used to Test the Effectiveness of College Transition Messaging
During the summer after high school, students must complete multiple pre-college steps such as paying deposits, registering for classes, filling out housing and health insurance forms, and signing up for a college account. Students are often without support to complete these necessary steps, as high school services have ended and college supports have yet to begin.	Text messages starting at the end of high school included reminders about pre-college steps such as paying the tuition bill, attending orientation, taking placement tests, and completing housing forms. Students who did not enroll in college immediately after high school were sent a modified set of messages in the fall that encouraged and supported enrollment in the second semester.	Immediate college enrollment after high school **(main measure)** Any college enrollment during year after high school **(exploratory measure)**
Students might enroll in college may fail to return for a second year.	Text messages during the first year after high school focused on keeping students in college by directing them to on-campus resources, reminding them of deadlines throughout the year, and assuring them that struggles with social belonging and fitting in are normal.	Continuous college enrollment during year after high school **(main measure)** Continuous college enrollment into the second fall after high school **(main measure)** College enrollment in the second fall after high school, regardless of any prior enrollment **(exploratory measure)**
One reason students might not continue into a second year of college is difficulty funding their education. Renewing the FAFSA provides access to various types of financial aid.	Text messages during the first year of college encouraged students to renew their FAFSA.	FAFSA completion by October 1, the second fall after high school **(main measure)** FAFSA completion by October 1, the first fall after high school **(exploratory measure)**[a]

[a] The study explored four additional measures of FAFSA completion (that is, submission without being rejected) and submission (including those rejected): (1) FAFSA completion by the second fall after high school among students who were enrolled in year 1; (2) FAFSA submission by the first fall after high school; (3) FAFSA submission by the second fall after high school; and (4) FAFSA submission by the second fall after high school among students who were enrolled in year 1. Findings are not reported; however, they were consistent with reported findings.

No bias was introduced into the estimate of the effect of college transition messaging because there were no missing data for any of the outcome measures. For all outcome measures, students who had a record of the outcome occurring, such as enrolling in college immediately after high school, were classified as achieving the outcome, whereas students for whom there was no recorded occurrence were classified as not having achieved the outcome. As a result, the full randomized sample was used to analyze the impact of the college transition messaging on all outcomes. Exhibit B.9 provides information on how each of the outcome measures was constructed.

Exhibit B.9 Outcome Measures Examined: Data Source and Measure Construction

Measure	Data Source	Definition/Coding
Immediate college enrollment after high school **(main measure)**	NSC and FSA	1 = Enrollment is documented in any college on October 1, 2016 (cohort 1) or October 1, 2017 (cohort 2) 0 = Enrollment is not documented in any college on October 1, 2016 (cohort 1) or October 1, 2017 (cohort 2)
Any college enrollment during year after high school **(exploratory measure)**	NSC and FSA	1 = Enrollment is documented in any college at any point between July 1, 2016, and June 30, 2017 (cohort 1) or July 1, 2017, and June 30, 2018 (cohort 2) 0 = Enrollment is not documented in any college between July 1, 2016, and June 30, 2017 (cohort 1) or July 1, 2017, and June 30, 2018 (cohort 2)
Continuous college enrollment during year after high school **(main measure)**	NSC and FSA	1 = Enrollment is documented in any college between July 1, 2016, and June 30, 2017 (cohort 1) or July 1, 2017, and June 30, 2018 (cohort 2) with any break in enrollment of less than 5 consecutive months during this period **and/or** student is enrolled on October 1, 2016 (cohort 1) or October 1, 2017 (cohort 2) and graduates from college after October 1 0 = Enrollment is not documented in any college between July 1, 2016, and June 30, 2017 (cohort 1) or July 1, 2017, and June 30, 2018 (cohort 2) with any break in enrollment of less than 5 consecutive months during this period **and/or** student is enrolled on October 1, 2016 (cohort 1) or October 1, 2017 (cohort 2) and does not graduate from college after October 1
Continuous college enrollment into the second fall after high school **(main measure)**	NSC and FSA	1 = Continuous college enrollment during year after high school **and** enrollment is documented in a college on October 1, 2017 (cohort 1) or October 1, 2018 (cohort 2) 0 = Continuous college enrollment during year after high school is not documented **or** enrollment is not documented in a college on October 1, 2017 (cohort 1) or October 1, 2018 (cohort 2)
College enrollment in the second fall after high school, regardless of any prior enrollment **(exploratory measure)**	NSC and FSA	1 = Enrollment is documented in any college on October 1, 2017 (cohort 1) or October 1, 2018 (cohort 2) 0 = No enrollment is documented in any college on October 1, 2017 (cohort 1) or October 1, 2018 (cohort 2)
FAFSA completion by October 1 the second fall after high school **(main measure)**	FSA	1 = Administrative record of student submitting a FAFSA that was not rejected in time to receive aid for fall 2017 (cohort 1) or fall 2018 (cohort 2) 0 = No administrative record of student submitting a FAFSA that was not rejected in time to receive aid for fall 2017 (cohort 1) or fall 2018 (cohort 2)
FAFSA completion by October 1 the first fall after high school **(exploratory measure)**	FSA	1 = Administrative record of student submitting a FAFSA that was not rejected in time to receive aid for fall 2016 (cohort 1) or fall 2017 (cohort 2) 0 = No administrative record of student submitting a FAFSA that was not rejected in time to receive aid for fall 2016 (cohort 1) or fall 2017 (cohort 2)

Note: FSA is Federal Student Aid office; NSC is National Student Clearinghouse. Treatment group ("messaged" students) received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged" students) received regular GEAR UP supports only.
Sample Sizes: 2,819 treatment group students and 1,984 control group students. There are no missing data for any of the outcome measures.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018.

Measures Describing Students, Schools, and Grantees

The study uses characteristics measured before the lottery (called "baseline" characteristics) to describe participating students, schools, and grantees. Some of the student baseline characteristics act as covariates in the statistical models examining the effects of the college transition messaging to take into account possible existing differences between the treatment and control group students and to improve the precision of the estimated effects.[14]

Data for all student characteristics come from questions in the student survey, administered in the spring of students' senior year, before the lottery. The study survey had a 100 percent response rate for the students in the college transition messaging study because completing the survey was a prerequisite to opting into the lottery and participating in the study. However, some students skipped individual survey items, resulting in missing data for some of the student characteristics. Exhibit B.10 shows the definition of each student characteristic and the percentage of students missing data for it.

Exhibit B.10 Student Characteristics

Characteristic	Definition/Coding[a]	Students Missing Data (%)		
		Treatment Group	Control Group	Overall
Demographic Characteristics				
Race/ethnicity	Question 21 (Are you Hispanic or Latino/Latina?) Question 22 (What is your race?) 1 = Hispanic 2 = White, non-Hispanic 3 = Black, non-Hispanic 4 = Other/multiracial, non-Hispanic	1.56	2.32	1.87
Gender[b]	Question 20 (What is your gender?) 1 = Female 0 = Male	1.35	1.97	1.60

[14] To identify which characteristics to include as covariates in each of the statistical models, the study team used a backward selection with forward checking procedure, using a *p*-value less than .20 as the criterion for covariate inclusion. Research has demonstrated that this approach is effective for identifying covariates for inclusion in order to minimize the standard error of the impact estimate (Budtz-Jorgensen et al. 2007; Maldonado and Greenland 1993; Price, Goodson, and Stewart 2007). In the backward selection method, all covariates are entered in the statistical model. Then the covariate with the largest *p*-value that is also greater than .20 is dropped from the model. This step is repeated until the only covariates remaining in the model meet the $p < .20$ criterion. In the forward checking step, each of the previously eliminated covariates is added back one at a time into the model. Any previously eliminated covariate that has a *p*-value less than .20 when re-introduced is retained in the model.

Three characteristics were included as covariates in the statistical models regardless of their *p*-value: gender, potential first-generation college student status, and intent to enroll in a two-year college. These covariates were included because research on similar college transition programs suggests that effects may differ for groups of students defined by these characteristics. Given the study's investigation of group differences in effects, the study retained these covariates in all statistical models.

Characteristic	Definition/Coding[a]	Students Missing Data (%)		
		Treatment Group	Control Group	Overall
Socioeconomic Status				
Potential first-generation college student[b]	Question 23/26 (What is this parent's or guardian's relationship to you?) Question 24/27 (What is the highest level of education he/she has completed?) 1 = Neither parent/guardian received a college degree 0 = At least one parent/guardian received a college degree	7.31	7.26	7.29
Single-parent household	Question 25 (Do you have another parent or guardian in the same household as you?) 1 = From single-parent/guardian household 0 = Not from single-parent/guardian household	1.28	1.86	1.52
Academic Achievement				
Grade point average (GPA)	Question 13 (Indicate your cumulative grade point average (GPA) for all classes you took in high school through the end of your junior year (last year).) Unweighted GPA on a scale of 0.0 to 4.0 converted from letter-grade survey responses[c]	6.60	7.21	6.85
Advanced Placement, International Baccalaureate course taking	Question 10 (Have you taken any Advanced Placement (AP) or International Baccalaureate (IB) courses? Include any courses you are taking now.) 1 = Student has taken an AP or IB course (or both) 0 = Student has not taken an AP or IB course, or does not know	2.27	2.97	2.56
College Intentions and Expectations				
Intention to enroll in a two-year college[b]	Question 3 (Which college are you most likely to attend next year, during the [2016-17 for cohort 1 or 2017-18 for cohort 2] school year?) 1 = College name provided is a two-year institution 0 = College name provided is not a two-year institution	24.80[d]	23.08	24.09
Educational expectations	Question 7 (As things stand now, how far in school do you think you will actually get?) 1 = Student thinks she/he will obtain a bachelor's degree or higher 0 = Student thinks she/he will obtain less than a bachelor's degree	5.71	5.49	5.62
College Going Steps Completed Prior to Lottery				
Completed or plans to complete FAFSA	Question 4 (Have you/your family completed and submitted a FAFSA to apply for financial aid for your education?) 1 = Yes / No, not yet, but I'm planning to submit a FAFSA 0 = No, I'm not planning to submit a FAFSA / No, I haven't thought about this yet / No, I don't know if I or anyone in my family will apply / I don't know what a FAFSA is	0.92	1.36	1.10

Characteristic	Definition/Coding[a]	Students Missing Data (%)		
		Treatment Group	Control Group	Overall
Provided college name	Question 3 (Which college are you most likely to attend next year, during the [2016-17 for cohort 1 or 2017-18 for cohort 2] school year?) 1 = Provided at least one college name 0 = Else	0.00	0.00	0.00
Paid deposit	Question 5 (Have you paid a deposit or received a fee waiver to enroll at your intended college/university?) 1 = Yes 0 = No / I don't know	0.67	1.11	0.85

[a] All data are from the student survey, administered in spring 2016 (cohort 1) and spring 2017 (cohort 2). The survey can be found at https://www.reginfo.gov/public/do/PRAViewIC?ref_nbr=201503-1850-002&icID=215771.
[b] Measure was included as a covariate in impact analysis, regardless of *p*-value. All other variables were included if *p*-value is less than .20.
[c] For conversion chart see http://www.collegeboard.com/html/academicTracker-howtoconvert.html.
[d] For this measure to be non-missing, students had to provide a valid college name that they planned to attend and the name had to match a college in the IPEDS data. Most students who were missing this measure did not provide a college name (Treatment: 680 students, 24.12%; Control: 434 students, 21.88%). Fewer provided an invalid college name or a name that could not be matched to IPEDS because the college was outside of the United States or was a small vocational school that was not included in IPEDs (Treatment: 19 students, 0.67%; Control: 24 students, 1.21%).
Note: Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged" students) received regular GEAR UP supports only.

Data for all school and grantee characteristics come from multiple administrative sources. Exhibits B.11 and B.12 show the data source, definition, and percentage of missing data for the school and grantee characteristics, respectively.

Exhibit B.11 School Characteristics

Characteristic	Data Source and Timing	Definition/Coding	Schools Missing Data[a] (%)
Gender composition	CCD, 2015-16	Number of female students in the school divided by the total number of students in the school Number of male students in the school divided by the total number of students in the school	0.00
Racial/ethnic composition	CCD, 2015-16	Number of Hispanic students in the school divided by the total number of students in the school Number of White, non-Hispanic students in the school divided by the total number of students in the school Number of Black, non-Hispanic students in the school divided by the total number of students in the school Number of other race students in the school divided by the total number of students in the school	0.00
Historical college enrollment rate[b]	APR, School Year 2014-15	Number of seniors in the school who immediately enrolled in college divided by the total number of seniors in the school	57.69
Title I status	CCD, 2015-16	1 = School is eligible for Title I funds 0 = School is not eligible for Title I funds	0.00
Rural locale	CCD, 2015-16	1 = School is located in a rural setting 0 = School is located in a non-rural setting (city, suburb, town)	0.00
Completion rate of the FAFSA	Federal Student Aid Data Center, 2016-17 Cycle CCD, 2015-16	Number of students in the school who completed a FAFSA application divided by the number of seniors in the school	0.00

[a] Missing data rates are provided for study schools. Because the lottery was conducted within schools, all schools have both treatment group students and control group students.
[b] Missing data rates are high for this characteristic because data could not be obtained from four of the 16 grantees. In addition, data could not be obtained from four high schools within the remaining 12 grantees. In total, data were missing for 46 of the 81 high schools.
Note: APR is Annual Performance Report; CCD is Common Core of Data; FAFSA is Free Application for Federal Student Aid.

Exhibit B.12 Grantee Characteristics

Characteristic	Data Source and Timing	Definition/Coding	Grantees Missing Data[a] (%)
Gender composition	APR, FY 2016	Number of female students served by the grantee divided by total number of students served by the grantee Number of male students served by the grantee divided by total number of students served by the grantee	0.00
Racial composition	APR, FY 2016	Number of White students served by the grantee divided by total number of students served by the grantee Number of Black students served by the grantee divided by total number of students served by the grantee Number of other race students served by the grantee divided by total number of students served by the grantee	18.75
Ethnic composition	APR, FY 2016	Number of Hispanic students served by the grantee divided by total number of students served by the grantee	18.75
Historical college enrollment rate[b]	APR, School Year 2014-15	Number of high school seniors served by the grantee immediately enrolling in college divided by total number of high school seniors served by the grantee	25.00
AP course-taking rate	APR, FY 2016	Number of students served by the grantee taking AP courses divided by total number of students served by the grantee	6.25
IB course-taking rate	APR, FY 2016	Number of students served by the grantee taking IB courses divided by total number of students served by the grantee	6.25
Title I status	CCD, 2014-15 and 2015-16	Number of schools served by the grantee that are eligible for Title I funds divided by total number of schools served by the grantee	0.00
Rural locale	CCD, 2014-15 and 2015-16	Number of schools served by the grantee that are in a rural locale divided by total number of schools served by the grantee	0.00

[a] Missing data rates are provided for study grantees. Because the lottery was conducted within schools, all grantees have both treatment group students and control group students.
[b] Missing data rates are high for this characteristic because enrollment rate data could not be obtained from four of the 16 study grantees.
Note: AP is Advanced Placement; APR is Annual Performance Report; CCD is Common Core of Data; FY is Fiscal Year; IB is International Baccalaureate.

Several of the baseline characteristics described above were also used to examine the effectiveness of college transition messaging for particular groups of students or schools ("subgroups"). The study included five subgroups that were of policy interest and for which there was existing research suggesting that text-message-based advising might have different impacts for students in these groups (Exhibit B.13).

Exhibit B.13 Rationale for Exploring Effects for Subgroups of Students and Schools

Subgroup	Rationale
Student-Level Measures	
Intention to enroll in a two-year college	Students at two-year, but not four-year, colleges benefit from text messages (Castleman and Page 2016). Students at two-year colleges often have less access to campus-based advisors (Carlstrom and Miller 2013; Gallagher 2010; Scott-Clayton 2015), suggesting that text messaging could fill a void in supports for students who intend to enroll in two-year colleges. Examining impacts by whether or not a student plans to enroll in a two-year college could provide useful information about where to focus resources when engaging in college transition text messaging.
Potential first-generation college student	The impacts of text messaging on college enrollment might be larger for students from families where neither parent has attended college than for students from families where at least one parent attended college (Bird et al. 2019). Examining impacts by first-generation status could help policymakers understand whether text messaging can boost the college enrollment rate for first-generation students.
Gender	College enrollment rates are consistently lower for male students than for female students (McFarland et al. 2018; Bailey and Dynarski 2011). Further, text messaging could have different impacts on male students than on female students (Castleman and Page 2016). Examining the impacts by gender could help policymakers understand whether text messaging holds promise as means to increase male students' college enrollment rate.
School-Level	
Rural locale	Proximity to nearby colleges is associated with college enrollment (Turley 2009), with students in rural locations less likely to enroll in college (Hu 2003). Examining impacts by rural locale could provide useful information about where to focus resources when engaging in college transition text messaging.
FAFSA completion rate of high school	Text messaging increases college enrollment for students with less access to college advising support in high school and who were not far along in their college planning by the end of high school (Castleman and Page 2015). The FAFSA completion rate of a student's high school serves as an indirect measure of access to college supports in high school and likelihood of completing important steps on the path to college by the end of high school. Examining impacts by high schools above and below the national average FAFSA completion rate of 60 percent could provide district, state, and federal policymakers with information about where to most effectively target resources devoted to text messaging.

Implementation Measures of College Transition Messaging

The study collected and analyzed information about implementation of the college transition messaging to measure the extent to which advisors and students engaged with the text messages. If the messages did not go out as intended or if advisors and students did not engage with the messages, then students' college going might not be affected as expected. The program monitoring system captured data on how the college transition messaging went; the implementation measures created from that data appear in Exhibit B.14. There are no missing data on any of these measures.

Exhibit B.14 Measures of Implementation of College Transition Messaging (Treatment Group Only)

Variable	Definition/Coding
Students Sent Messages	
Sent all programmed messages[a]	Number (percentage) of students who were sent all college transition text messages 1 = Student sent all text messages 0 = Student not sent all text messages
Sent each programmed message	For each college transition text message, number (percentage) of students who were sent the message 1 = Student sent the text message 0 = Student not sent the text message
Average number of programmed messages sent	Average number of college transition text messages sent to students
Sent at least one message	Number (percentage) of students who were sent at least one college transition text message 1 = Student sent at least one GEAR UP text message 0 = Student not sent at least one GEAR UP text message
Not sent messages because student opted out	Number (percentage) of students who opted out of the college transition text messages 1 = Student opted out of the text messages 0 = Student did not opt out of the text messages
Not sent messages because student had an invalid phone number	Number (percentage) of students who had an invalid phone number but did not opt out of the text messages 1 = Student had an invalid phone number but did not opt out 0 = Student had a valid phone number
Not sent messages because student is not going to college	Number (percentage) of students who indicated they were not going to college but did not opt out or have an invalid number 1 = Student indicated s/he not going to college 0 = Student did not indicate s/he was not going to college
Not sent messages because student is starting college in spring	Number (percentage) of students who said they planned to start college in the spring semester but did not opt out, have an invalid number, or indicate that they were not going to college 1 = Student was a spring starter 0 = Student was not spring starter
Not sent message because advisor stopped a message	Number (percentage) of students who were not sent the message because the advisor stopped a message 1 = Student's advisor stopped the message 0 = Student's advisor did not stop the message
Student Responsiveness to Messages	
Responded to at least one programmed message	Number (percentage) of students who responded to at least one of the college transition text messages, excluding responses that were opt-out requests, invalid number notifications, and responses to advisor outreach 1 = Student responded to at least one college transition text message 0 = Student did not respond to any college transition text message
Average number of student responses	Average number of college transition messages students responded to, excluding responses that were opt-out requests, invalid number notifications, or responses to advisor outreach
Advisor Support Through Messages	
Student sent additional non-programmed message from advisor	Number (percentage) of students to whom an advisor sent at least one additional non-programmed text message (excludes programmed messages, auto replies, confirmations, and away messages) 1 = Student to whom advisor sent at least one message in addition to programmed messages 0 = Student to whom advisor did not send any message beyond programmed messages

Variable	Definition/Coding
Average number of additional non-programmed messages sent to students	Average number of additional non-programmed text messages advisor sent to students, excluding programmed messages, auto replies, confirmations, and away messages
Student received advisor response	Number (percentage) of students who received at least one message from an advisor in response to the student's message 1 = Student sent at least one response from advisor 0 = Student not sent at least one response from advisor
Webinar Attendance	
Grantee had at least one advisor attend all webinars	Number (percentage) of grantees with at least one advisor in attendance at all four training webinars 1 = Had at least one advisor attend each of the four webinars 0 = Did not have at least one advisor attend each of the four webinars

[a] "All programmed messages" refers to the 37 core messages (35 for cohort 1) and excludes texting logistics messages (such as the initial message introducing the messaging) and those sent only to students who were starting college in the spring term.

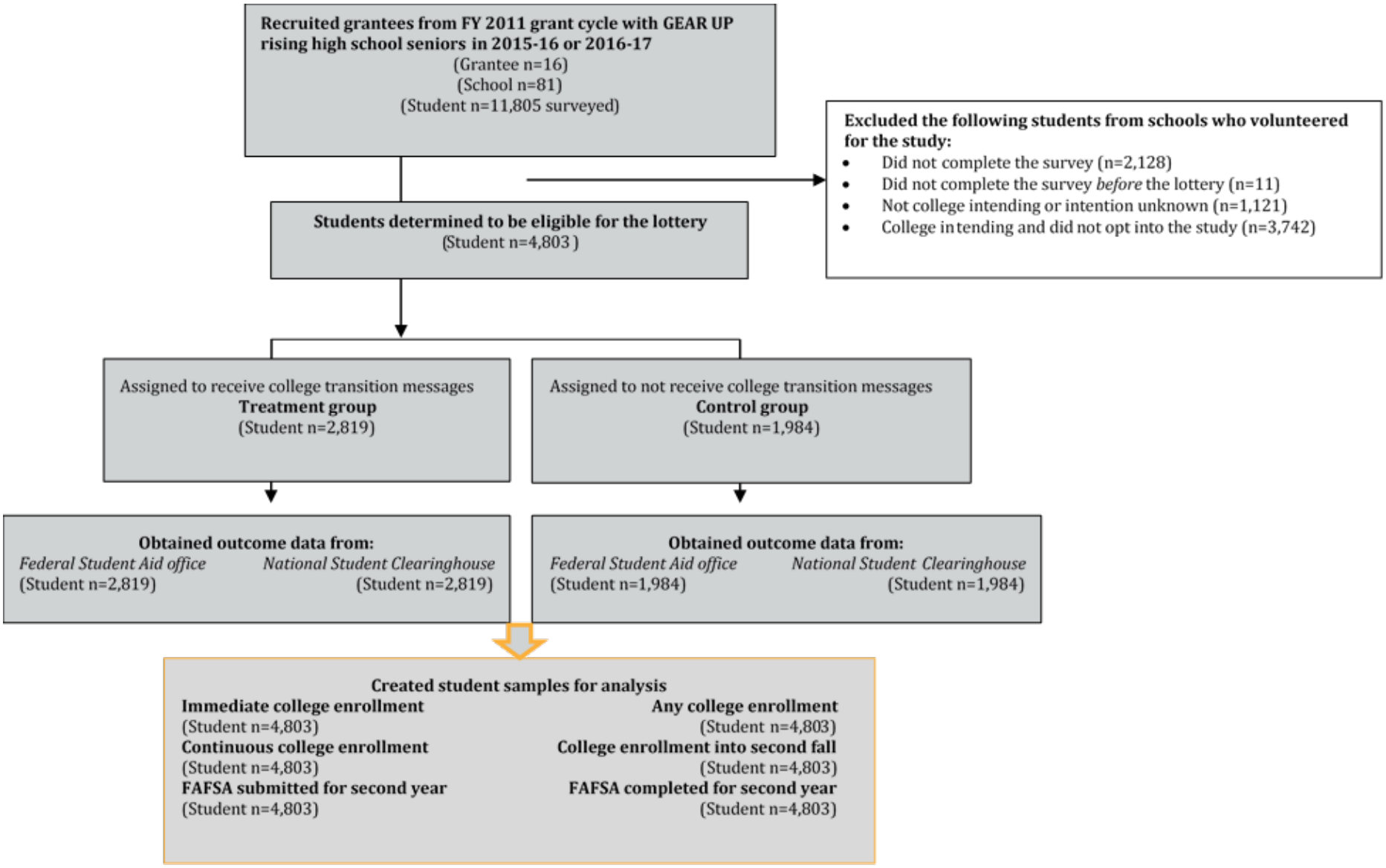
Note: Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.

B.3.2 Estimating the Effects of College Transition Messaging

Sample Used for Analysis of the Effectiveness of College Transition Messaging

The study defined the sample as all students who participated in the lottery. This definition helped to ensure that the estimates reflected unbiased effects of the college transition messaging on students. Exhibit B.15 diagrams the flow of study participants from the recruitment of GEAR UP grantees to the analytic study samples used to investigate the effectiveness of college transition messaging on college going measures.

Exhibit B.15 Flow from Recruitment of Grantees and Schools to Student Study Sample



Estimation Models

The study estimated the overall effects of the college transition messaging using a statistical model. Specifically, a linear model with a fixed treatment effect was used, which estimated the average treatment effect across all participating schools and both cohorts.[15] Linear models with conventional standard errors instead of non-linear models were used even though the outcomes, such as enrolled versus not enrolled in college, are binary. This is because linear models are simpler to estimate and to interpret; they yield unbiased estimates of the treatment effect; they yield standard error estimates that are approximately correct even when the underlying data-generating process is nonlinear (Judkins and Porter 2016); and they have been used by many random assignment evaluations in education.[16]

Main estimation model

The following regression model estimated the effects of the study's college transition messaging:

$$(1) \qquad Y_{ij} = \sum_{j=1}^{J-1} \beta_{0j} \, Block_j + \beta_1 T_{ij} + \sum_{k=1}^{k} \lambda_{kj} \, BaselineStudentChar_{ij} + \varepsilon_{ij}$$

where *i* indexes students and *j* indexes randomization blocks (students were randomized in blocks defined by school and cohort). Y_{ij} is the value of the outcome, such as on-time college enrollment, for the i^{th} student in the j^{th} randomization block; $Block_j$ is 1 if student *i* was enrolled in block *j* (for example, school 1, cohort 2), and 0 otherwise;[17] T_{ij} is 1 if student *i* is randomized to the treatment group in block *j* and 0 if assigned to the control group in block *j*; $BaselineStudentChar_{ij}$ are baseline student characteristics, such as academic achievement measures, educational expectations, and demographic characteristics, and ε_{ij} is random error, assumed to be identically and independently distributed. The effect of the transition messaging is given by the parameter β_1, which represents the difference in the proportion of treatment and control group students achieving the outcome of interest. To test for impacts, the study conducted two-tailed *t*-tests using an alpha-level criterion of $p < .05$.

The mean outcomes for the control and the treatment groups were calculated as:

$\overline{Y_c}$ = the (unadjusted) control group mean of the outcome variable (multiplied by 100 to convert it into a percentage)

$\overline{Y_t} = \overline{Y_c} + \widehat{\beta_1}$ = the (model-adjusted) treatment group mean of the outcome variable (multiplied by 100 to convert it into a percentage)

Covariates. All models controlled for random assignment block fixed effects to improve the precision of the estimated effects and to preserve the integrity of the random assignment because of the differing probabilities of random assignment to treatment or control group within each block. In addition, the models controlled for baseline student-level covariates. (Exhibit B.10 above shows the definition for each student characteristic included in the estimation model.)

Treatment of missing data. As noted previously, there were no missing data for any of the study college going measures, and the study used the full randomized sample to analyze the impact of college transition messaging on

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[15] This model estimates the overall treatment effect by calculating a weighted average of the treatment effect in each randomization block; that is, in each school or cohort within a school if the school participated in the study in both cohorts.

[16] Examples include the evaluations of the Teacher Incentive Fund (Max et al. 2014) and Transfer Incentives for High-Performing Teachers (Glazerman et al. 2013).

[17] The inclusion of this set of dummy variables for randomization blocks accounts for the varying ratios of treatment to control students (ratios were either 1:1 or 2:1 within a block) by ensuring that a treatment-control difference is calculated within each randomization block and that the overall estimate is calculated as a precision weighted mean of within-block treatment-control differences.

all college going measures. This implies that no bias was introduced into the estimate of the effect of the study's transition messaging because of missing outcomes.

The analysis included students with missing covariate values because some students were missing data for individual items from the student survey. In these cases, missing values were imputed using the dummy variable method. The missing covariate values were replaced with a placeholder (0) and created an indicator for the covariate having a missing value, which was included in the model. Simulations by Puma et al. (2009) showed that this approach to handling missing covariate data is likely to keep estimation bias at less than 0.05 standard deviations.

Estimation model for subgroups

In addition to examining the average effects of the college transition messaging on student outcomes, the study also investigated the effects of the college transition messaging for subgroups defined by student and school characteristics. Exhibit B.13 summarizes the subgroup characteristics that were analyzed. (Exhibit B.10 above described how the students were grouped and Exhibit B.11 described how schools were grouped.) These subgroups could be defined for both treatment and control students based on their characteristics at the start of the study, before the lottery. Therefore, the study can calculate rigorous estimates of the effects of the college transition messaging separately for these subgroups. However, because the study is designed to detect effects for the full sample, not differences in effects between subgroups, a difference in effects between subgroups can only be detected when the true difference is large.

Models both (a) estimated the impact of the college transition messaging for each of the subgroups and (b) tested for differences in impacts among levels of a subgroup indicator. Both types of results are reported; for example, impact estimates are reported for both male and female students, and the result is reported for a test of whether the magnitude of the impact for male students differs from the magnitude of the impact for female students. Because these tests are exploratory, multiple comparison adjustments were not made. It is important to note that with this approach, even if there were no significant differences, one might expect to detect at least four differences across the 70 tests conducted (7 outcomes × 10 subgroup categories) as significant due to chance.

Student subgroups. To address questions about impacts within subgroups and variation in impacts for subgroups of students, an interaction between the subgroup variable and the treatment indicator was added to Equation 1, as shown in Equation 2:

$$(2) \qquad Y_{ij} = \sum_{j=1}^{J-1} \beta_{0j} Block_j + \beta_1 T_{ij} + \beta_2 Subgrp_{ij} + \beta_3 T_{ij} * Subgrp_{ij} + \sum_{k=1}^{k} \lambda_{kj} BaselineStudentChar_{ij} + \varepsilon_{ij}$$

where β_3 is the difference in the treatment impact between students in the two subgroups, such as students who are potential first-generation college students and students who are not.

School subgroups. To address questions about impacts for subgroups of schools, a term for the interaction between the treatment indicator and the subgroup indicator, such as rural versus non-rural locale. Notably, this model does not include a main effect term for the subgroup indicator because it would be co-linear with the block dummies. But the interaction term estimates the difference in the average impact between the two subgroups, and impact estimates for the two subgroups can be obtained as functions of the coefficients for the treatment indicator and the treatment-by-subgroup interaction term. The model has the form

$$(3) \qquad Y_{ij} = \sum_{j=1}^{J-1} \beta_{0j} Block_j + \beta_1 T_{ij} + \beta_2 T_{ij} * SchSubgrp_j + \sum_{k=1}^{k} \lambda_{kj} BaselineStudentChar_{ij} + \varepsilon_{ij}$$

where $SchSubgrp_j$ is the school subgroup, such as 1=rural schools and 0=non-rural schools; β_1 is the treatment impact for the reference category, such as non-rural schools; β_2 is the difference in the treatment impact between the two subgroups; and $\beta_1 + \beta_2$ is the treatment impact for the subgroup.

Sensitivity Analyses

The study conducted sensitivity analyses to examine whether the particular statistical models used to estimate the effects of college transition messaging affected the findings. The sensitivity analyses tested whether findings remained the same when the following three alternative statistical models were used:

- Logistic regression models were estimated because logistic, rather than linear, regression is commonly used for binary outcomes.
- A heteroscedasticity adjustment was included to further test the sensitivity of using linear models to estimate impacts for binary outcomes.
- Linear models were re-estimated without covariate adjustment because randomization should yield treatment and control groups that are equivalent on both observed and unobserved characteristics, making covariate adjustment unnecessary.[18]

Findings from the sensitivity analyses were similar to findings from the main analyses (see Appendix C for details).

B.3.3 Power Analyses

Power analyses determine how large a sample is needed for a study with a particular outcome in mind; or, once a sample has been identified, to determine how large of an effect can be measured with confidence. This study design detects a minimum effect of 3.6 to 4.1 percentage points (depending on the control group's enrollment rate) for immediate college enrollment, based on a targeted number of 4,803 students with an 80 percent probability of detecting a statistically significant effect at the 5 percent level. The study-achieved minimum detectable effects (MDEs) for immediate college enrollment was 4.6 percentage points.

The left column of Exhibit B.16 shows the study's design phase assumptions and expected MDE, whereas the right column shows the observed statistics and achieved MDE that the study, as conducted, had 80 percent power to detect on *immediate college enrollment*. The initial power analysis was based on specific assumptions about the number of schools recruited, average number of students per school in the study sample, proportion of variance explained by covariates, and the success rate in the control group. The achieved MDEs were slightly higher than the range of the expected MDEs for two reasons: (1) the student-level R-squared was higher than assumed (19.49 percent compared to 0.0 percent); and (2) enrollment rates in the control group were close to the high end of the range assumed in the study's design phase. The achieved MDEs for the other study measures—*enrollment, persistence,* and *FAFSA renewal*—ranged from 4.4 to 4.9 percentage points, shown in Exhibit B.17, all slightly higher than the range of the expected MDEs for same two reasons described above. This implies that the study sample was powered to detect slightly larger effects than the design phase assumptions.

Exhibit B.16 Comparison of Design Assumptions and Sample Statistics

	Design Phase Assumption	Observed Statistics in Study Sample for College Enrollment
Number of schools-by-cohort randomization blocks	86	86
Average number of students per school	59.30	55.80
Total number of students	4,803	4,803
Proportion assigned to treatment group	0.50	0.59
Student-level R-squared	0.00	0.19
Minimum Detectable Effect (in SD)	0.082	0.097

[18] The main analyses adjusted for baseline student characteristics in an effort to improve precision of the impact estimates, even though covariate adjustment was not necessary to account for baseline differences between treatment and control groups.

	Design Phase Assumption	Observed Statistics in Study Sample for College Enrollment
Success rate in control group	0.50, 0.60, 0.75	0.66
Minimum Detectable Difference (in percentage points)	**4.1, 4.0, 3.6**	**4.6**

Note: SD is standard deviation.

Exhibit B.17 Achieved Minimum Detectable Effects (MDEs) for All Outcomes

Variable	Achieved MDEs
Immediate college enrollment after high school	4.6
Any college enrollment during year after high school	4.7
Continuous college enrollment during year after high school graduation	4.5
Continuous college enrollment into the second fall after high school graduation	4.4
FAFSA completion by October 1 of second year after high school graduation	4.9
FAFSA completion by October 1 of first year after high school graduation	4.9

APPENDIX C. SUPPLEMENTAL TABLES AND INFORMATION ON STUDY FINDINGS

This appendix includes statistical details on findings presented in the report body, as well as additional findings that are not in the report. The details are intended to supplement the findings presented in the report and provide the statistical information for readers interested in the technical details of the study's findings. A summary of the findings from studies of similar text messaging programs is also included in this appendix to provide context for the study findings in the larger literature.

C.1 Additional Details about Findings in the Report

The underlying statistics used to generate the exhibits on the effects of the college transition messaging on college going outcomes found in the report may be of interest to some readers. This information is reported for the outcome measures discussed in the report ("main" measures) as well as for the exploratory measures listed in Appendix Exhibit B.9. Additionally, the exhibits below provide the results for particular groups of students or schools ("subgroups") as well as results from analyses examining the sensitivity of these effects to the statistical model chosen.

Specifically, this section reports on the statistics for the following outcome measures:

- Immediate college enrollment after high school (main measure)
- Any college enrollment during year after high school (exploratory measure)
- Continuous college enrollment during year after high school (main measure)
- Continuous college enrollment into the second fall after high school (main measure)
- College enrollment in the second fall after high school (exploratory measure)
- FAFSA completion for the first fall after high school (exploratory measure)
- FAFSA completion for the second fall after high school (main measure)

In the report, Exhibit 4 shows that the college transition messaging had no effect on immediate college enrollment after high school. Here Exhibit C.1 presents the estimated effects of the college transition messaging on immediate college enrollment after high school and corresponding *p*-values. It also shows that the college transition messaging had no effect on immediate college enrollment after high school for any subgroups of students, but did have different effects for one subgroup of schools: Students in rural schools who received the college transition messages were more likely to enroll in college immediately after high school than were rural students who did not receive the messages.[19] Exhibit C.2 shows that the college transition messaging had no effect on immediate college enrollment after high school regardless of the statistical model used for analysis.

[19] Rural schools were less likely to volunteer for the study, which could indicate some selection bias in what types of rural schools participated in the study. However, the positive effect for students from rural schools does not seem conclusive. The corresponding effect for students from urban schools is negative and there is no reason to believe that the college transition messaging negatively affected these students. Further, given the number of statistical tests conducted, at least one significant result is expected to be found by chance alone.

Exhibit C.1 Effects on Immediate College Enrollment, Overall and for Subgroups

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Overall Impact					
	66.3	66.3	0.0	1.2	.992
Impact by Student Characteristics					
Gender					
Male	60.1	58.1	1.9	2.0	.324
Female	71.0	72.9	−1.9	1.6	.246
F-test of difference[b]			*p*=.133		
Potential First-Generation College Student Status					
Not a potential first-generation student	71.5	72.2	−0.7	2.4	.780
Potential first-generation student	65.8	65.3	0.5	1.5	.761
F-test of difference[b]			*p*=.690		
Intending to Enroll in a Two-Year College					
Intend to enroll in a four-year college	77.4	76.7	0.7	1.9	.687
Intend to enroll in a two-year college	52.9	51.8	1.1	2.3	.618
F-test of difference[b]			*p*=.894		
Impact by School Characteristics					
Rural Locale					
Not rural	65.8	68.4	−2.6	1.5	.093
Rural	67.8	62.9	4.9	2.1	.020*
F-test of difference[b]			*p*=.004		
Completion Rate of the Free Application for Federal Student Aid (FAFSA)					
FAFSA completion rate ≤ 60%	60.0	61.8	−1.8	2.3	.425
FAFSA completion rate > 60%	69.3	68.5	0.8	1.5	.589
F-test of difference[b]			*p*=.336		

[a] *p*-Values shown in this column are for tests of whether there was a statistically significant impact for the subgroup category in the row.
[b] *p*-Values shown in this row are for a test of whether impacts statistically differed between the categories of the subgroup in the rows above.
Notes: Treatment group percentages and impacts are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
* Effect is statistically significant at the .05 level, two-tailed test.
Sample Sizes:
Overall impact: Treatment group=2,819 students, Control group=1,984 students
Gender: Treatment group=2,781 students, Control group=1,945 students
Potential first-generation college student status: Treatment group=2,613 students, Control group=1,840 students
Intent to enroll in two-year college: Treatment group=2,120 students, Control group=1,526 students
Locale: Treatment group=2,819 students, Control group=1,984 students
FAFSA completion rate: Treatment group=2,819 students, Control group=1,984 students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.2 Sensitivity Analyses for Effects on Immediate College Enrollment

Model	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value
Linear regression (main model)	66.3	66.3	0.0	1.2	.992
Logistic regression	66.2	66.3	−0.1	1.1	.925
Heteroscedasticity adjustment	66.3	66.3	0.0	1.3	.992
No covariates used in model	65.5	66.3	−0.8	1.4	.546

Notes: Treatment group percentage and impact are estimated using the study's regression model. Treatment group ("messaged" students) received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged" students) received regular GEAR UP supports only.
None of the effects is statistically significant at the .05 level, two-tailed test.
Sample = 2,819 treatment group students and 1,984 control group students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Because text messages were sent to the students who delayed college enrollment, the study also examined the effect of the college transition messaging on any college enrollment in the first year after high school. Exhibit C.3 shows that the college transition messaging had no effect on college enrollment at any point during the year after high school. It also shows that the college transition messaging had no effect on college enrollment at any point during the year after high school for any subgroups of students or schools. Exhibit C.4 shows that the college transition messaging had no effect on college enrollment at any point during the year after high school regardless of the statistical model used for analysis.

Exhibit C.3 Effects on Any College Enrollment during Year after High School, Overall and for Subgroups

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Overall Impact					
	71.9	72.0	−0.1	1.2	.928
Impact by Student Characteristics					
Gender					
Male	66.3	63.4	2.9	1.9	.119
Female	75.9	79.0	−3.1	1.6	.052
F-test of difference[b]			*p*=.014		
Potential First-Generation College Student					
Not a potential first-generation student	77.8	77.8	0.0	2.3	.997
Potential first-generation student	70.8	71.3	−0.5	1.5	.716
F-test of difference[b]			*p*=.841		
Intending to Enroll in a Two-Year College					
Intend to enroll in a four-year college	82.0	81.7	0.3	1.8	.852
Intend to enroll in a two-year college	60.2	60.0	0.1	2.2	.956
F-test of difference[b]			*p*=.940		
Impact by School Characteristics					
Rural Locale					
Not rural	71.6	73.8	−2.2	1.5	.132
Rural	73.0	69.1	3.9	2.0	.054
F-test of difference[b]			*p*=.014		

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Completion Rate of the Free Application for Federal Student Aid (FAFSA)					
FAFSA completion rate ≤ 60%	67.5	68.0	−0.5	2.2	.820
FAFSA completion rate > 60%	74.0	73.9	0.1	1.4	.966
F-test of difference[b]			*p*=.832		

[a] *p*-Values shown in this column are for tests of whether there was a statistically significant impact for the subgroup category in the row.
[b] *p*-Values shown in this row are for a test of whether impacts statistically differed between the categories of the subgroup in the rows above.
Notes: Treatment group percentages and impacts are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
None of the effects is statistically significant at the .05 level, two-tailed test.
Sample Sizes:
Overall impact: Treatment group=2,819 students, Control group=1,984 students
Gender: Treatment group=2,781 students, Control group=1,945 students
Potential first-generation college student status: Treatment group=2,613 students, Control group=1,840 students
Intent to enroll in two-year college: Treatment group=2,120 students, Control group=1,526 students
Locale: Treatment group=2,819 students, Control group=1,984 students
FAFSA completion rate: Treatment group=2,819 students, Control group=1,984 students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.4 Sensitivity Analyses for Effects on Any College Enrollment during Year after High School

Model	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value
Linear regression (main model)	71.9	72.0	−0.1	1.2	.928
Logistic regression	71.9	72.0	−0.2	0.5	.770
Heteroscedasticity adjustment	71.9	72.0	−0.1	1.2	.929
No covariates used in model	71.2	72.0	−0.8	1.3	.547

Notes: Treatment group percentage and impact are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
None of the effects is statistically significant at the .05 level, two-tailed test.
Sample = 2,819 treatment group students and 1,984 control group students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

In the report, Exhibit 4 also shows that the college transition messaging had no effect on continuous college enrollment during the year after high school. Here Exhibit C.5 presents the estimated effects on continuous college enrollment during the year after high school and *p*-values. It also shows that the college transition messaging had no effect on continuous college enrollment during the year after high school for any subgroups of students, but did have different effects for one subgroup of schools: Students in schools that had a FAFSA completion rate less than or equal to 60 percent and who received the college transition messages were less likely to be continuously enrolled in college during the year after high school than were students who did not receive the college transition messages.[20] Exhibit C.6 shows that the college transition messaging had no effect on continuous college enrollment during the year after high school regardless of the statistical model used for analysis.

[20] The negative effect for students from schools with FAFSA completion rate less than or equal to 60 percent is not conclusive; given the number of statistical tests conducted, at least one significant result is expected to be found by chance alone.

Exhibit C.5 Effects on Continuous College Enrollment during Year after High School, Overall and for Subgroups

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Overall Impact					
	60.2	60.6	−0.4	1.3	.764
Impact by Student Characteristics					
Gender					
Male	52.8	50.9	1.9	2.0	.329
Female	65.6	68.3	−2.7	1.7	.103
F-test of difference[b]			*p*=.073		
Potential First-Generation College Student					
Not a potential first-generation student	65.7	66.4	−0.7	2.4	.770
Potential first-generation student	59.7	60.0	−0.2	1.6	.888
F-test of difference[b]			*p*=.865		
Intending to Enroll in a Two-Year College					
Intend to enroll in a four-year college	71.4	71.5	−0.1	1.9	.959
Intend to enroll in a two-year college	44.7	44.8	−0.1	2.3	.973
F-test of difference[b]			*p*=.995		
Impact by School Characteristics					
Rural Locale					
Not rural	60.6	63.2	−2.7	1.6	.088
Rural	60.1	56.2	4.0	2.2	.066
F-test of difference[b]			*p*=.013		
Completion Rate of the Free Application for Federal Student Aid (FAFSA)					
FAFSA completion rate ≤ 60%	52.2	56.8	−4.6	2.3	.046*
FAFSA completion rate > 60%	63.9	62.4	1.5	1.5	.336
F-test of difference[b]			*p*=.028		

[a] *p*-Values shown in this column are for tests of whether there was a statistically significant impact for the subgroup category in the row.
[b] *p*-Values shown in this row are for a test of whether impacts statistically differed between the categories of the subgroup in the rows above.
Notes: Treatment group percentages and impacts are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
* Effect is statistically significant at the .05 level, two-tailed test.
Sample Sizes:
Overall impact: Treatment group=2,819 students, Control group=1,984 students
Gender: Treatment group=2,781 students, Control group=1,945 students
Potential first-generation college student status: Treatment group=2,613 students, Control group=1,840 students
Intent to enroll in two-year college: Treatment group=2,120 students, Control group=1,526 students
Locale: Treatment group=2,819 students, Control group=1,984 students
FAFSA completion rate: Treatment group=2,819 students, Control group=1,984 students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.6 Sensitivity Analyses for Effects on Continuous College Enrollment during Year after High School

Model	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value
Linear regression (main model)	60.2	60.6	−0.4	1.3	.764
Logistic regression	60.3	60.6	−0.2	0.7	.727
Heteroscedasticity adjustment	60.2	60.6	−0.4	1.3	.766
No covariates used in model	59.4	60.6	−1.2	1.4	.409

Notes: Treatment group percentage and impact are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
None of the effects is statistically significant at the .05 level, two-tailed test.
Sample = 2,819 treatment group students and 1,984 control group students.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

In the report, Exhibit 5 shows that the college transition messaging had no effect on FAFSA completion in the second fall after high school. Here Exhibit C.7 presents the estimated effects on FAFSA completion in the second fall after high school and *p*-values. The college transition messaging had an effect on FAFSA completion in the second fall after high school for female students and students in rural schools: Female students who received the college transition messages were less likely to complete the FAFSA application in the second fall after high school than were students who did not receive the college transition messages. Students in rural schools who received the college transition messages were more likely to complete the FAFSA application in the second fall after high school than were students who did not receive the college transition messages. Exhibit C.8 shows that the college transition messaging had no effect on FAFSA completion in the fall after high school regardless of the statistical model used for analysis.

Exhibit C.7 Effects on FAFSA Completion in Second Fall after High School, Overall and for Subgroups

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Overall Impact					
	54.4	56.7	−2.2	1.4	.105
Impact by Student Characteristic					
Gender					
Male	48.7	46.9	1.8	2.1	.399
Female	58.3	63.8	−5.5	1.8	.002*
F-test of difference[b]			*p*=.009		
Potential First-Generation College Student					
Not a potential first-generation student	60.4	61.5	−1.0	2.6	.690
Potential first-generation student	53.1	55.6	−2.6	1.7	.129
F-test of difference[b]			*p*=.627		
Intending to Enroll in a Two-Year College					
Intend to enroll in a four-year college	64.8	66.8	−2.0	2.0	.326
Intend to enroll in a two-year college	39.8	42.4	−2.5	2.5	.309
F-test of difference[b]			*p*=.863		
Impact by School Characteristics					
Rural Locale					
Not rural	54.5	58.5	−4.0	1.7	.018*
Rural	54.8	53.6	1.2	2.3	.619
F-test of difference[b]			*p*=.073		

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Completion Rate of the Free Application for Federal Student Aid (FAFSA)					
FAFSA completion rate ≤ 60%	48.0	51.6	−3.7	2.5	.140
FAFSA completion rate > 60%	57.5	59.0	−1.6	1.6	.334
F-test of difference[b]			*p*=.484		

[a] *p*-values shown in this column are for tests of whether there was a statistically significant impact for the subgroup category in the row.
[b] *p*-values shown in this row are for a test of whether impacts statistically differed between the categories of the subgroup in the rows above.
Notes: Treatment group percentages and impacts are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
* Effect is statistically significant at the .05 level, two-tailed test.
Sample Sizes:
Overall impact: Treatment group=2,819 students, Control group=1,984 students
Gender: Treatment group=2,781 students, Control group=1,945 students
Potential first-generation college student status: Treatment group=2,613 students, Control group=1,840 students
Intent to enroll in two-year college: Treatment group=2,120 students, Control group=1,526 students
College enrollment steps taken: Treatment group=2,803 students, Control group=1,966 students
Locale: Treatment group=2,819 students, Control group=1,984 students
FAFSA completion rate: Treatment group=2,819 students, Control group=1,984 students
Source: FSA 2017, 2018, 2019; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.8 Sensitivity Analyses for Effects on FAFSA Completion in Second Fall after High School

Model	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value
Linear regression (main model)	54.4	56.7	−2.2	1.4	.105
Logistic regression	54.0	56.7	−2.7	1.5	.081
Heteroscedasticity adjustment	54.4	56.7	−2.2	1.4	.108
No covariates used in model	53.8	56.7	−2.8	1.5	.054

Notes: Treatment group percentage and impact are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
None of the effects is statistically significant at the .05 level, two-tailed test.
Sample = 2,819 treatment group students and 1,984 control group students.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

In the report, Exhibit 5 also shows that the college transition messaging had no effect on continuous college enrollment into the second fall after high school. Exhibit C.9 presents the estimated effects on continuous college enrollment into the second fall after high school and *p*-values. The college transition messaging had an effect on continuous college enrollment into the second fall after high school for male students and students in rural schools: Male students and students in rural schools who received the college transition messages were more likely to be continuously enrolled in college into the second fall after high school than were students who did not receive the college transition messages. Exhibit C.10 shows that the college transition messaging had no effect on continuous college enrollment into the second fall year after high school regardless of the statistical model used for analysis.

Exhibit C.9 Effects on Continuous College Enrollment into Second Fall after High School, Overall and for Subgroups

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Overall Impact					
	50.8	50.8	0.0	1.3	.996
Impact by Student Characteristics					
Gender					
Male	44.2	40.1	4.1	2.0	.043*
Female	55.7	59.0	−3.2	1.7	.059
F-test of difference[b]			*p*=.006		
Potential First-Generation College Student					
Not a potential first-generation student	56.4	55.7	0.7	2.5	.784
Potential first-generation student	50.5	50.4	0.1	1.6	.939
F-test of difference[b]			*p*=.850		
Intending to Enroll in a Two-Year College					
Intend to enroll in a four-year college	62.8	60.9	1.9	1.9	.312
Intend to enroll in a two-year college	33.5	34.8	−1.3	2.4	.584
F-test of difference[b]			*p*=.286		
Impact by School Characteristics					
Rural Locale					
Not rural	51.8	54.4	−2.7	1.6	.093
Rural	49.8	44.8	5.1	2.2	.021*
F-test of difference[b]			*p*=.004		
Completion Rate of the Free Application for Federal Student Aid (FAFSA)					
FAFSA completion rate ≤ 60%	41.9	45.7	−3.8	2.3	.100
FAFSA completion rate > 60%	54.9	53.2	1.7	1.5	.279
F-test of difference[b]			*p*=.049		

[a] *p*-Values shown in this column are for tests of whether there was a statistically significant impact for the subgroup category in the row.
[b] *p*-Values shown in this row are for a test of whether impacts statistically differed between the categories of the subgroup in the rows above.
Notes: Treatment group percentages and impacts are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
* Effect is statistically significant at the .05 level, two-tailed test.
Sample Sizes:
Overall impact: Treatment group=2,819 students, Control group=1,984 students
Gender: Treatment group=2,781 students, Control group=1,945 students
Potential first-generation college student status: Treatment group=2,613 students, Control group=1,840 students
Intent to enroll in two-year college: Treatment group=2,120 students, Control group=1,526 students
College enrollment steps taken: Treatment group=2,803 students, Control group=1,966 students
Locale: Treatment group=2,819 students, Control group=1,984 students
FAFSA completion rate: Treatment group=2,819 students, Control group=1,984 students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.10 Sensitivity Analyses for Effects on Continuous College Enrollment into Second Fall after High School

Model	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value
Linear regression (main model)	50.8	50.8	0.0	1.3	.996
Logistic regression	51.2	50.8	0.3	3.5	.921
Heteroscedasticity adjustment	50.8	50.8	0.0	1.3	.996
No covariates used in model	50.0	50.8	−0.8	1.5	.578

Notes: Treatment group percentage and impact are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
None of the effects is statistically significant at the .05 level, two-tailed test.
Sample = 2,819 treatment group students and 1,984 control group students.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Because the study sent text messages to the students who delayed college enrollment or took time off during the year immediately after high school, the study also examined the effect of the college transition messaging on college enrollment in the second fall after high school. Exhibit C.11 shows the messaging had no effect on college enrollment in the second fall after high school; however, students in rural schools who received the college transition messages were more likely to be enrolled in college in the second fall after high school than were students who did not receive the college transition messages.[21] Exhibit C.12 shows that the college transition messaging had no effect on college enrollment in the second fall year after high school regardless of the statistical model used for analysis.

Exhibit C.11 Effects on College Enrollment in Second Fall after High School, Overall and for Subgroups

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Overall Impact					
	57.3	57.3	0.0	1.3	.989
Impact by Student Characteristics					
Gender					
Male	50.4	48.0	2.4	2.0	.247
Female	62.2	64.3	−2.1	1.7	.216
F-test of difference[b]			*p*=.093		
Potential First-Generation College Student					
Not a potential first-generation student	62.5	62.0	0.5	2.5	.839
Potential first-generation student	56.6	56.8	−0.2	1.6	.917
F-test of difference[b]			*p*=.820		
Intending to Enroll in a Two-Year College					
Intend to enroll in a four-year college	68.5	67.3	1.2	1.9	.550
Intend to enroll in a two-year college	42.0	42.7	−0.7	2.4	.764
F-test of difference[b]			*p*=.540		

[21] Rural schools were less likely to volunteer for the study, which could indicate some selection bias in what types of rural schools participated in the study. However, the positive effect for students from rural schools does not seem conclusive. The corresponding effect for students from urban schools is negative and there is no reason to believe that the college transition messaging negatively affected these students. Further, given the number of statistical tests conducted. at least one significant result is expected to be found by chance alone.

	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value[a]
Impact by School Characteristics					
Rural Locale					
Not rural	58.6	61.0	−2.5	1.6	.122
Rural	55.7	50.9	4.8	2.2	.031*
F-test of difference[b]			*p*=.008		
Completion Rate of the Free Application for Federal Student Aid (FAFSA)					
FAFSA completion rate ≤ 60%	49.7	52.3	−2.5	2.4	.283
FAFSA completion rate > 60%	60.8	59.6	1.1	1.6	.468
F-test of difference[b]			*p*=.195		

[a] *p*-values shown in this column are for tests of whether there was a statistically significant impact for the subgroup category in the row.
[b] *p*-values shown in this row are for a test of whether impacts statistically differed between the categories of the subgroup in the rows above.
Notes: Treatment group percentages and impacts are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
* Effect is statistically significant at the .05 level, two-tailed test.
Sample Sizes:
Overall impact: Treatment group=2,819 students, Control group=1,984 students
Gender: Treatment group=2,781 students, Control group=1,945 students
Potential first-generation college student status: Treatment group=2,613 students, Control group=1,840 students
Intent to enroll in two-year college: Treatment group=2,120 students, Control group=1,526 students
College enrollment steps taken: Treatment group=2,803 students, Control group=1,966 students
Locale: Treatment group=2,819 students, Control group=1,984 students
FAFSA completion rate: Treatment group=2,819 students, Control group=1,984 students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.12 Sensitivity Analyses for Effects on College Enrollment in Second Fall after High School

Model	Treatment Group Students (%)	Control Group Students (%)	Impact	Standard Error	*p*-Value
Linear regression (main model)	57.3	57.3	0.0	1.3	.989
Logistic regression	57.4	57.3	0.1	3.1	.973
Heteroscedasticity adjustment	57.3	57.3	0.0	1.3	.990
No covariates used in model	56.4	57.3	−0.8	1.4	.575

Notes: Treatment group percentage and impact are estimated using the study's regression model. Treatment group ("messaged") students received the regular GEAR UP supports with the addition of college transition messages; control group ("non-messaged") students received regular GEAR UP supports only.
None of the effects is statistically significant at the .05 level, two-tailed test.
Sample = 2,819 treatment group students and 1,984 control group students.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

C.2 Effects of College Transition Messaging by GEAR UP Grantee

Researchers have suggested that familiarity with the advisor on the other end of the text message is important to students. If the students receiving the messages are disconnected from the advisors sending them, the students might not pay attention to the text messages. This study examined whether the effects of the college transition messaging differed by GEAR UP grantee to understand whether the effects of the messaging varied by students' familiarity with advisors. This study did not find any differences based on whether the advisors were from the students' high schools or located elsewhere, for example a district or state office or a college. In contrast to the

hypotheses discussed but not directly tested in prior studies, the college transition messaging in this study did not appear to be any more effective when advisors were familiar staff.[22]

This section provides information on exploratory analyses conducted to examine the effects of the college transition messaging by GEAR UP grantee. Grantees used advisors who were located in

- the student's GEAR UP high school;
- the student's college;
- the GEAR UP central office; or
- the student's GEAR UP high school and the student's college or the GEAR UP central office (combination).

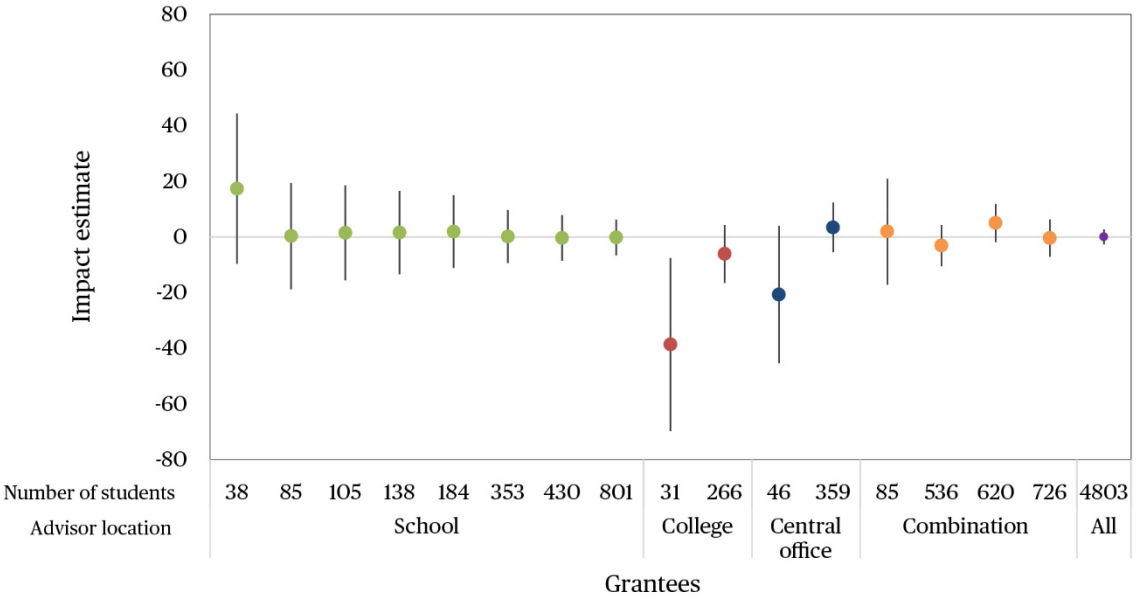
This section provides graphs that show the effect for each grantee, the overall effect across all grantees, and corresponding confidence limits of the effects (Exhibits C.13, C.14, C.15, and C.16). They sort grantees by the location of the advisors who sent the text messages to students. The section reports this information for the outcome measures discussed in the report ("main" measures). Specifically, information is reported for the following outcomes:

- Immediate college enrollment after high school
- Continuous college enrollment during year after high school
- Continuous college enrollment into the second fall after high school
- FAFSA completion for the second fall after high school.

Exhibits C.13 – C.16 present the estimated effects of the college transition messaging on each of the four outcomes and the corresponding confidence limits for each grantee and overall. Across advisor locations, the college transition messaging had no effect on any of the outcomes. The precision of the effects is low for three of the grantees because of their small numbers of students who participated in the study (N<50). As observed by the wider confidence limits, the conclusions for these grantees should be interpreted with caution.

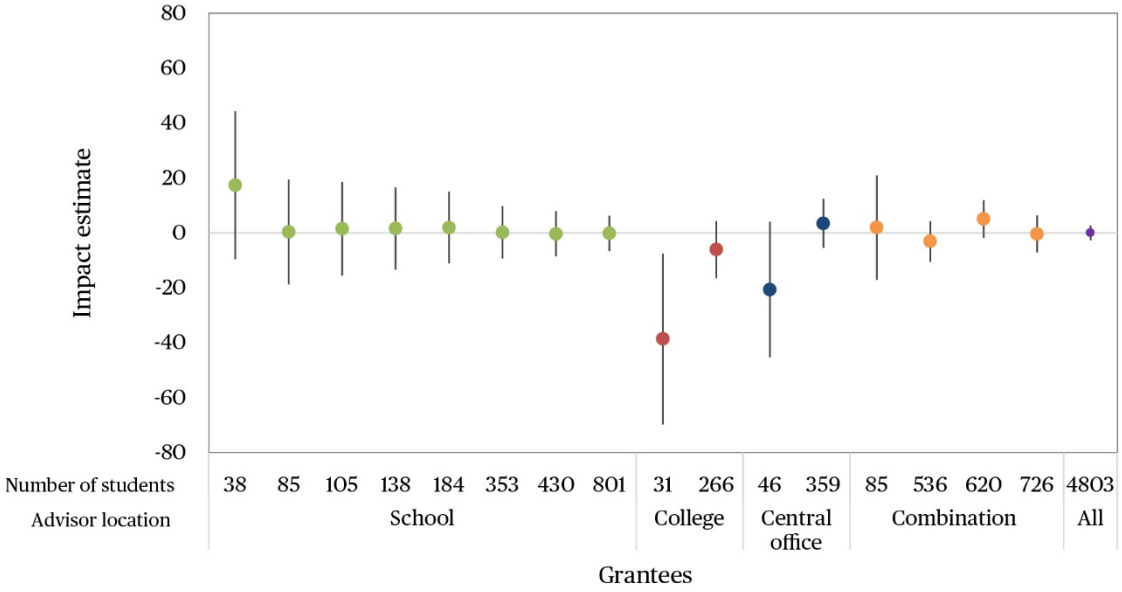
[22] Avery, Castleman, Hurwitz, Long, and Page 2020; Page, Sacerdote, Goldrick-Rab, and Castleman 2019

Exhibit C.13 Sensitivity Analyses for Effect on Immediate College Enrollment after High School, by Grantee



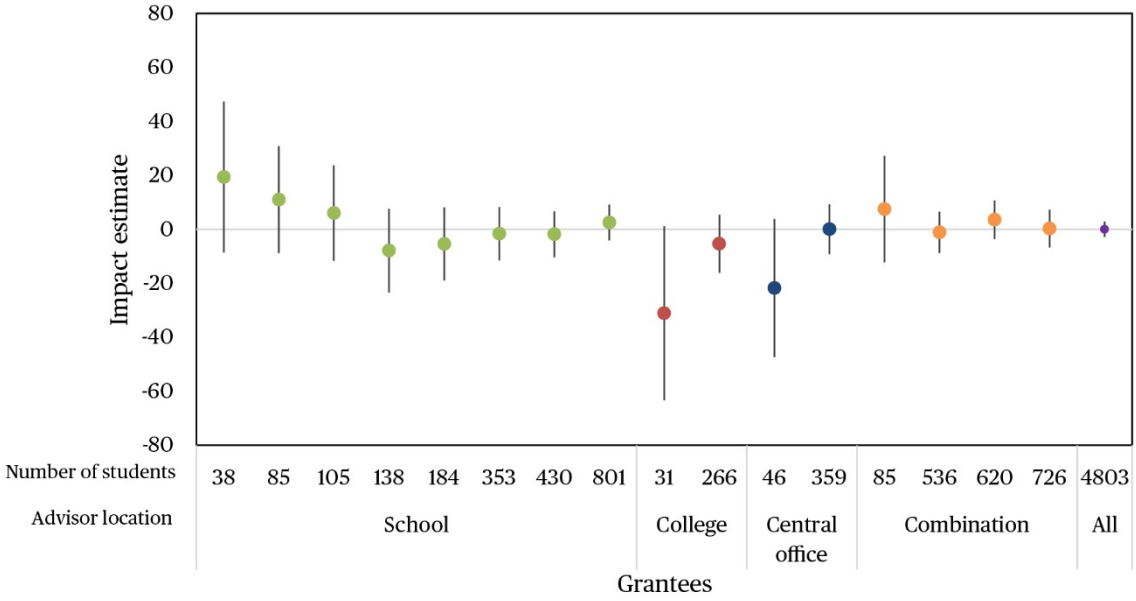
Notes: Effects and confidence limits are estimated using the study's regression model. "Combination" indicates that advisors were located in the student's GEAR UP high school and the student's college or the GEAR UP central office.
Sample Sizes:
Grantee 1: Treatment group=19 students, Control group= 19 students
Grantee 2: Treatment group=56 students, Control group=29 students
Grantee 3: Treatment group=68 students, Control group=37 students
Grantee 4: Treatment group=90 students, Control group=48 students
Grantee 5: Treatment group=121 students, Control group=63 students
Grantee 6: Treatment group=235 students, Control group=118 students
Grantee 7: Treatment group=215 students, Control group=215 students
Grantee 8: Treatment group=529 students, Control group=272 students
Grantee 9: Treatment group=20 students, Control group=11 students
Grantee 10: Treatment group=138 students, Control group=128 students
Grantee 11: Treatment group=25 students, Control group=21 students
Grantee 12: Treatment group=179 students, Control group=180 students
Grantee 13: Treatment group=56 students, Control group=29 students
Grantee 14: Treatment group=272 students, Control group=264 students
Grantee 15: Treatment group=314 students, Control group=306 students
Grantee 16: Treatment group=482 students, Control group=244 students
All grantees: Treatment group=2,819 students, Control group=1,984 students
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.14 Sensitivity Analyses for Effect on Continuous College Enrollment during Year after High School, by Grantee



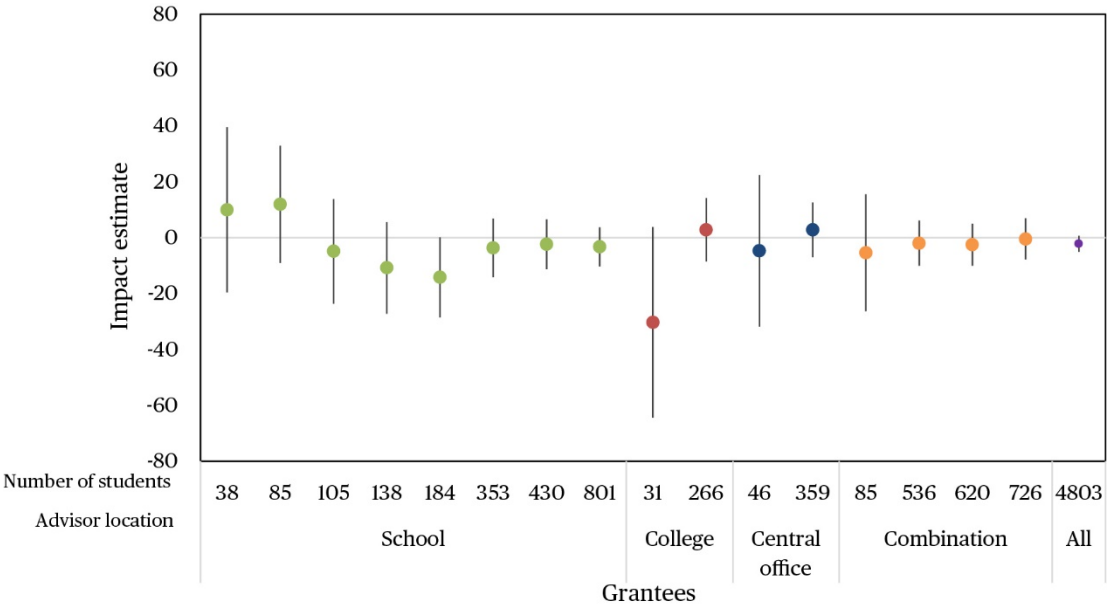
Notes: Effects and confidence limits are estimated using the study's regression model. "Combination" indicates that advisors were located in the student's GEAR UP high school and the student's college or the GEAR UP central office.
Sample Sizes: Same as Exhibit C.13.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.15 Sensitivity Analyses for Effect on Continuous College Enrollment into the Second Fall after High School, by Grantee



Notes: Effects and confidence limits are estimated using the study's regression model. "Combination" indicates that advisors were located in the student's GEAR UP high school and the student's college or the GEAR UP central office.
Sample Sizes: Same as Exhibit C.13.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

Exhibit C.16 Sensitivity Analyses for Effect on FAFSA Completion for the Second Fall after High School, by Grantee



Notes: Effects and confidence limits are estimated using the study's regression model. "Combination" indicates that advisors were located in the student's GEAR UP high school and the student's college or the GEAR UP central office.
Sample Sizes: Same as Exhibit C.13.
Source: FSA 2017, 2018, 2019; NSC 2016, 2017, 2018; CCD 2014-15 and 2015-16; IPEDS 2015-16; student survey 2016 and 2017.

C.3 Findings from Prior Studies of Text Messaging

A thorough review of prior studies that used text messaging as the primary means of supporting high school students to transition into college or of supporting college students to persist to another year of college provides context for this study's findings. Exhibit C.17 summarizes the findings from prior studies that used text messaging as the primary form of support for students, though some studies also used other services, such as an initial goal-setting activity. This study's findings of no effect of college transition messaging is consistent with accumulating evidence from those prior studies. The exhibit also shows that this study was appropriately powered to detect the effects of the text messaging on its college going measures.

Exhibit C.17 Summary of Impacts Found in Prior Studies

Study Citation	Target Population	Design	Main Enrollment or Persistence Measure	Impacts	
				Overall Confidence Interval[a]	Subgroup Confidence Intervals[a]
Page, Castleman, and Meyer (2020)	High school seniors	RCT	Immediate enrollment	(−0.2, 6.4)	na
Bird et al. (2019)	First-generation or low-income high school seniors	RCT	Immediate enrollment	(−1.1, 2.5)[b]	na[c]
Castleman and Page (2017)	High school graduates	RCT	Immediate enrollment	(0.0, 5.8)[d]	**EFC $0 (1.7, 11.1)** EFC not $0 (−4.4, 6.6) **First-generation (1.0, 12.4)** Not first-generation (−4.5, 6.5)
Castleman and Page (2015)	High school graduates	RCT	Immediate enrollment	(−0.6, 4.4)	Dallas (−0.9, 5.7) Boston (−6.7, 3.5) **Lawrence/Springfield (0.2, 14.0)**[e]
Avery et al. (2020)	High school juniors who took the PSAT in 15 states	RCT	Immediate enrollment	(−2.6, 0.2)	na
	High school juniors in 8 Texas school districts	RCT	Immediate enrollment	(−1.2, 4.6)	**Low-GPA, non-FRL (3.2, 13.8)**[f] Low-GPA, FRL (−1.9, 3.9) High-GPA, non-FRL (−6.7, 1.1) High-GPA, FRL (−5.6, 1.8)
Phillips and Reber (2018)	Academically on-track low-socioeconomic-status high school juniors	RCT	Immediate enrollment	(−1.9, 3.1)[g]	Female (−1.4, 5.2) Male (−7.6, 2.6) Hispanic, Spanish is home language (−1.4, 6.4) Hispanic, English is home language (−7.8, 2.4) All other race/ethnicities and languages (−5.6, 5.0) Parent education less than college (−1.4, 4.8) Parent education at least some college (−5.3, 3.3)
				(−1.1, 4.7)	Female (−0.9, 6.1) Male (−5.7, 5.3)

Study Citation	Target Population	Design	Main Enrollment or Persistence Measure	Impacts	
				Overall Confidence Interval[a]	Subgroup Confidence Intervals[a]
			Enrollment in first and second fall semesters		Hispanic, Spanish is home language (−1.2, 7.4) Hispanic, English is home language (−6.0, 5.8) All other race/ethnicities and languages (−4.9, 6.9) Parent education less than college (−1.5, 5.9) Parent education at least some college (−3.1, 6.7)
Page and Gehlbach (2017)	Admitted students	RCT	Immediate enrollment	(−0.2, 2.2)	Committed to Georgia State prior to messaging (−0.4, 3.2) Did not commit to Georgia State prior to messaging (−0.6, 2.2)
			Enrollment at Georgia State University	(−0.6, 3.0)	**Committed to Georgia State prior to messaging (0.2, 6.4)** Did not commit to Georgia State prior to messaging (−1.6, 2.8)
Castleman et al. (2017)	In-state University of Virginia (UVA) applicants	QED[h]	Enrollment at UVA	(−7.7, 3.3)	Regular decision (−10.5, 3.7) Early action (−9.3, 7.9) Below-median SAT score (−12.0, 5.6) Above-median SAT score (−8.3, 5.5) Underrepresented minority (−7.9, 5.1) Non-underrepresented minority (−14.1, 7.1)
			Enrollment at highly selective college	(−2.2, 6.0)	Regular decision (−3.3, 7.7) Early action (−4.5, 7.7) Below-median SAT score (−5.8, 8.4) Above-median SAT score (−2.5, 7.7) Underrepresented minority (−3.3, 6.5) Non-underrepresented minority (−4.4, 10.6)

Study Citation	Target Population	Design	Main Enrollment or Persistence Measure	Impacts	
				Overall Confidence Interval[a]	Subgroup Confidence Intervals[a]
Castleman and Meyer (2020)	College freshmen	QED	Fall-to-spring retention in freshman year	**(1.4, 12.0)[h]**	**EFC $0 (0.3, 8.9)** **EFC not $0 (0.6, 14.8)** **Partner college (1.7, 8.7)** Not partner college (−0.7, 10.3) **Rural high school (0.1, 15.1)** **Not rural high school (1.5, 8.1)**
Castleman and Page (2016)	College freshmen	RCT	Enrollment in sophomore fall	(−4.5, 5.7)	Two-year (−0.9, 23.9) Four-year (−8.8, 1.8)
			Enrollment in sophomore spring	(−0.5, 9.7)	**Two-year (1.9, 26.3)** Four-year (−4.4, 6.6)
			Continuous enrollment during sophomore year	(−2.4, 9.0)	**Two-year (1.0, 26.6)** Four-year (−6.8, 5.4)
Mabel, Castleman, and Bettinger (2017)	College students	RCT	Re-enrollment in spring after text messaging	(−0.5, 4.5)	Predicted dropout risk (−1.6, 1.2)
			Graduation in year of text messaging	(−3.2, 2.6)	Predicted dropout risk (−0.9, 1.9)
			Graduation in fall of text messaging year	(−2.9, 1.1)	Predicted dropout risk (−1.5, 0.5)
			Graduation in spring of text messaging year	(−1.9, 3.1)	Predicted dropout risk (−0.1, 2.3)
Oreopoulos, Patterson, Petronijevic, and Pope (2019)	College students	RCT	Enrollment in semester after text messaging	Univ. Toronto main campus (−0.2, 0.6)[i] Univ. Toronto commuter campus (−0.1, 0.3) Western Governors Univ. (−3.2, 0.0)	na[c]
Dobronyi, Oreopoulos, and Petronijevic (2019)	College students	RCT	Enrollment in year after text messaging	(−6.2, 2.8)	na[c]

Study Citation	Target Population	Design	Main Enrollment or Persistence Measure	Impacts	
				Overall Confidence Interval[a]	Subgroup Confidence Intervals[a]
Page, Sacerdote, Goldrick-Rab, and Castleman (2019)	College students	RCT	Total months enrolled	(−8.9, 25.3)[j]	FAFSA not completed (−15.1, 24.5)
					FAFSA not completed but was enrolled in semester prior to text messaging (−13.7, 42.4)
			Graduation	(−0.6, 4.7)	FAFSA not filed (−2.9, 2.9)
					FAFSA not completed but was enrolled in semester prior to text messaging (−6.3, 3.5)

EFC is Expected Family Contribution; FAFSA is Free Application for Federal Student Aid; FRL is free or reduced-price lunch eligible; GPA is grade point average; na is not applicable; QED is quasi-experimental design; RCT is randomized controlled trial.

Notes: **Bold** indicates a statistically significant impact at $p<.05$.

[a] A confidence interval is a measure of the precision of the impact estimate. If a study of text messaging were repeated many times, the estimated impact would be expected to fall within the confidence interval 95 percent of the time. A narrow 95 percent confidence interval (for example, spanning 3 or 4 percentage points) reflects a more precise estimate, whereas a wide 95 percent confidence interval (for example, spanning 10 percentage points) reflects a less precise estimate.

[b] Results shown are for the "advising" treatment arm, which is the most similar to this study because students in the treatment arm were invited to text back to connect to an advisor, whereas students in the other treatment arms received information-only outreach. The authors state that they "consistently find no effect [of] these messages on student enrollment" regardless of treatment arm (p. 3).

[c] Study does not provide subgroup results for this treatment arm.

[d] Results shown are for the treatment arm that included students only, not students and parents.

[e] Sample sizes were not provided for the other subgroups discussed (that is, subgroups by GPA, FAFSA completion status, and college plans), so confidence intervals could not be calculated.

[f] Study also examined but did not report subgroup results by student race, ethnicity, and gender.

[g] All results shown are for the "complete" treatment arm, which included both automated messages and access to a personal virtual advisor and is the most similar to this study. Results are not sensitive to the choice of treatment arm.

[h] Results reported here are for the authors' "main" comparison group – students who intended to apply for financial aid but did not opt in to the messages. Results are not sensitive to the choice of comparison groups.

[i] Results shown are for the pooled sample that received reminder messages (including students in the goal-setting only treatment arm and the goal-setting plus mindset messages treatment arm). Study does not provide results pooled across sites.

[j] Results shown are for the most comprehensive treatment arm, which included information, reminders, and invitations to receive individualized assistance from an advisor via text. Results are not sensitive to the choice of treatment arm.

APPENDIX D. BAYESIAN ANALYSIS OF IMMEDIATE COLLEGE ENROLLMENT RESULT

All of the results presented elsewhere in this appendix are based on classical (or traditional), frequentist statistical analysis approaches to estimating the effects of the college transition messaging on college going measures.[23] This appendix reports effect of college transition messaging on immediate college enrollment after high school using a Bayesian approach. Bayesian analysis is an alternative method to reporting *p*-values to determine the effectiveness of an intervention. In recent years, and possibly partially due to the American Statistical Association's "ASA Statement on Statistical Significance and P-Values," there has been renewed interest in alternatives to reporting *p*-values (Wasserstein and Lazer 2016). Some statisticians and researchers suggest that consumers of research can more easily understand the results of Bayesian analyses they can results from traditional, frequentist approaches to impact analyses.[24]

This appendix describes the Bayesian analysis that this study conducted and presents its results. Because the application of Bayesian analysis is relatively new in education research,[25] the methods used are described below in sufficient detail that other researchers might scrutinize, replicate, and improve on the approach. Specifically, the description of the methodology is presented so that an analyst with a moderate amount of experience conducting statistical analyses and programming equations with statistical software such as SAS, R, Stata, or SPSS could reproduce the Bayesian analysis results, and therefore fully understand the approach, using the data presented herein. Section D.6 contains all of the technical details and can be skipped by readers not wishing to delve into them.

D.1 A Bayesian Approach to Interpreting Study Results in the Context of Other Studies

Using the traditional, frequentist approach, the current study found practically no evidence that the college transition messaging made a difference in whether students enrolled in college immediately after high school. This study, however, is only one of several studies examining the effects (or impacts) of text-message-based advising on college enrollment after high school. That collection of studies all used similar designs that compared students who were offered text messaging versus students who were not. Despite these similarities, some of the studies concluded that text messaging had a positive effect on college enrollment immediately after high school, whereas others found no evidence of such an impact.

The conclusions for each of those studies are based on a traditional approach to investigating potential impacts that relies solely on the evidence gathered during a single study and on the results of tests of statistical significance.

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[23] For each outcome, the classical, frequentist statistical approach produces an estimate of the size of the intervention effect on the outcome and a statement, in the form of a *p*-value, about whether the estimate of the size of the intervention impact was statistically significant. For example, in the current study, that approach estimated a 0.01 percentage point increase in immediate college enrollment after high school due to the college transition messaging (the intervention), reported a *p*-value of .99, and concluded that the intervention effect was not significantly different than zero. The *p*-value of .99 from the classical analysis indicates that the result is highly consistent with what would have been expected if college transition messaging had no effect on the percentage of students who enroll in college immediately after high school. Specifically, the classical analysis estimates that given the sample size, study design, and analytic model, there would have been a 99 percent chance of obtaining an intervention effect estimate of 0.01 percentage points or larger when, in fact, the true effect was zero.

[24] A stated goal of a 2017 research methods meeting sponsored by the Office of Planning, Research, and Evaluation titled "Bayesian Methods for Social Policy Research and Evaluation" was to "encourage attendees to question their assumptions around traditional frequentist approaches and explore the leading alternative, Bayesian methods" (OPRE 2017). All four of the papers posted as products resulting from that meeting indicate that the primary motivator for considering Bayesian over traditional, frequentist approaches to impact analyses in the social sciences is that research consumers will more easily understand the probabilistic statements produced from Bayesian analyses than they will results from traditional, frequentist approaches to impact analyses.

[25] For example, in a 2018 review of the use of Bayesian statistics in educational research, authors König and van de Schoot identified only one study that used results of prior studies in its Bayesian analysis, and that study was not an impact evaluation examining impacts on student outcome measures.

However, rather than rely on a single study to understand whether text messaging or any other intervention works, the Bayesian approach presented here combines evidence from a single study with information from prior studies.[26]

The analyses described in this section interpret the results from the current study in the context of what has been learned from prior studies.[27] The results of the Bayesian analysis indicate that:

- It is a little more likely that college transition messaging has a positive effect rather than a negative effect on college enrollment immediately after high school, but it is unlikely that the messaging increases or decreases the percentage of students who immediately enrollment by more than 1 percentage point.
- Specifically, there is a 58 percent chance of a positive effect versus a 42 percent chance of a negative effect, and a 20 percent chance of a 1 percentage point increase versus a 10 percent chance of a 1 percentage point decrease in immediate enrollment due to the messaging. The probabilities that the messaging increases or decreases immediate enrollment by 2 percentage points or more are each less than 3 percent.

There are multiple decision-points in any Bayesian analysis, and different choices can be made at each point. Therefore, it is important to determine whether the results found through this study's chosen approach to Bayesian analysis are sensitive to particular decisions. This section first presents a primary approach to the analysis, followed by a series of sensitivity analyses. The sensitivity analyses presented include an alternative approach to identifying relevant prior studies, alternative assumptions about the effects of publication bias,[28] an alternative statistical method to estimate the "prior distribution," an alternative statistical method to estimate the "posterior distribution."[29] They also include the use of what Deke and Finucane (2020) refer to as "benchmark priors"—estimates of the mean and standard deviation of the "prior distribution" that they have calculated from all studies in the What Works Clearinghouse™ (WWC) database that met evidence standards with or without reservations, and that they argue represent reasonable, broad, evidence-based priors for use with Bayesian analyses of the effects of education interventions.

Differences across these dimensions in the primary approach and the sensitivity analyses are summarized in Exhibit D.1, with the key difference of each approach in red text.

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[26] Deke and Finucane 2019; König and van de Schoot 2018.

[27] Bayesian approaches do not necessarily have to use results from prior studies. Some Bayesian analyses use "non-informative priors"; that is, use prior information based on expert judgement. In the current application of Bayesian analysis, the study team is following the recommendations of Deke and Finucane (2019) and using prior information obtained from prior studies.

[28] Publication bias occurs when the results of the study, such as a finding of a large effect or no effect, influence whether the study is published or the results are reported. If there is publication bias, small effects or no effects, are less likely to be reported.

[29] The choices of these sensitivity analyses were guided by recommendations in Deke and Finucane (2019, 2020).

Exhibit D.1 Details about Key Dimensions of the Primary Approach and Each Sensitivity Analysis

Analysis	Prior Studies	Publication Bias	Analysis Method Used to Estimate Prior Distribution	Analysis Method Used to Estimate Posterior Distribution
Primary Approach	Relevant prior studies identified by literature review	No adjustment for potential publication bias	Closed-form equations used to estimate mean and standard deviation	Closed-form equations used to estimate mean and standard deviation
Sensitivity Analysis 1	Relevant prior studies identified in *What Works Clearinghouse™* database of reviewed studies	No adjustment for potential publication bias	Closed-form equations used to estimate mean and standard deviation	Closed-form equations used to estimate mean and standard deviation
Sensitivity Analysis 3	Relevant prior studies identified by literature review	Adjustment made for potential publication bias – assume published effects are inflated by a factor of two	Closed-form equations used to estimate mean and standard deviation	Closed-form equations used to estimate mean and standard deviation
Sensitivity Analysis 4	Relevant prior studies identified by literature review	Adjustment made for potential publication bias – assume that all published effects are zero	Closed-form equations used to estimate mean and standard deviation	Closed-form equations used to estimate mean and standard deviation
Sensitivity Analysis 4	Relevant prior studies identified by literature review	No adjustment for potential publication bias	Iterative procedure used to estimate mean and standard deviation	Closed-form equations used to estimate mean and standard deviation
Sensitivity Analysis 5	Relevant prior studies identified by literature review	No adjustment for potential publication bias	Closed-form equations used to estimate mean and standard deviation	Iterative procedure used to estimate mean and standard deviation
Use of "Benchmark Priors" Recommended by Deke and Finucane (2020) and reported in Herrmann et al. (2019)				
Sensitivity Analysis 6	All studies in *What Works Clearinghouse™* database of reviewed studies that met standards with or without reservations	No adjustment for potential publication bias	Mean and standard deviation of prior distribution reported in Table D.1 of Herrmann et al. (2019)	Closed-form equations used to estimate mean and standard deviation
Sensitivity Analysis 7	All studies in *What Works Clearinghouse™* database of reviewed studies that met standards with or without reservations	"File drawer correction" as reported in Appendix D of Herrmann et al. (2019)	Mean and standard deviation of prior distribution reported in Table D.1 of Herrmann et al. (2019)	Closed-form equations used to estimate mean and standard deviation

With two exceptions, the results from the sensitivity analyses point to similar conclusions as the primary analysis—that there is a greater than a 50 percent chance that the effect of college transition messaging on college enrollment immediately after high school is greater than zero, but it is unlikely that the effect is larger than 1 or 2 percentage points. In the two exceptions, described below, the sensitivity analyses resulted in an estimate of equal chances of positive and negative effects, but these results agreed with the others in that the probabilities were low that effects were greater than 1 or 2 percentage points in either direction.

The current study found that the college enrollment rates immediately after high school were nearly identical for students who were offered the college transition messages compared to those who were not offered college transition messages. The enrollment rates were 66.34 percent and 66.33 percent, respectively. The results from the traditional analysis described in the main report included a statistical test for this small difference of 0.01 percentage points that resulted in a *p*-value equal to .99. That *p*-value from the traditional analysis indicates that the

result is highly consistent with what would have been expected if college transition messaging had no impact on the percentage of students who enroll in college immediately after high school.

Despite the current study's very small, near zero, estimate of the effect of the messaging on immediate college enrollment, it is not surprising that the conclusions from the Bayesian analysis indicate a greater than 50 percent chance of a positive, yet small, effect. In the broader context, all but one of the prior studies (identified using the primary approach) used in the Bayesian analysis had positive estimates of the effect of text messaging, and all of the estimated effects were 3 percentage points or less.

D.2 Identifying Relevant Prior Studies

A central aspect of the Bayesian analysis as implemented here is that it incorporates prior knowledge into the current analysis. Holzwart and Wright (2018) suggest that determinations about what prior knowledge to incorporate should often be made in collaboration between researchers and stakeholders. Deke and Finucane (2019) recommend using only prior knowledge that comes from existing studies and not using expert judgement or non-informative prior information such as assuming an arbitrary mean as the basis of prior knowledge. Based on their simulation results, Deke and Finucane argue that even when prior evidence is not available from interventions that are closely matched to the current intervention, that the use of imperfect but thoughtfully selected evidence from prior studies is the preferred approach for conducting Bayesian analyses and will produce useful results. For education interventions, they specifically recommend the use of a database of reviewed studies as a source of prior information on plausible distributions of intervention effects, and they also recommend use of their "benchmark priors," which were calculated from all evidence reported in the WWC database of reviewed studies that met standards with or without reservations. Additionally, they recommend assessing the sensitivity of results to the choice of which prior studies are used.

Given the timeline of this study, collaboration with stakeholders was not possible for the current Bayesian analysis. The study team did, however, make the decision to restrict the "prior knowledge" that informs the current Bayesian analysis to results from prior studies. In addition, in order to assess the sensitivity of the results to the choice of prior studies, the team used three different approaches to identifying relevant prior studies.

The first approach used a broad-based literature review strategy, whereas the second used only studies in the WWC database of reviewed studies that met standards with or without reservations. The third approach used "benchmark priors." The first approach was chosen as the primary approach because it identified studies of programs that were closely aligned with the text-message-based advising implemented in this study. Specifically, the studies that were identified using the first approach each estimated the impact of text messaging on college enrollment immediately after high school, whereas the studies identified using the second approach involved programs and strategies beyond text messaging that targeted difficulties students face in transitioning to college. The first approach identified eight relevant studies, whereas the second identified five. Only two studies were identified by both approaches.[30]

D.2.1 Literature Review Approach – Primary Approach

The primary approach to selecting prior studies was based on an extensive review of the literature for any studies of text messaging as the sole or primary program delivered to high school students before they entered college. These included programs that primarily used text messaging to send reminders and encouragement to students but might also have included other activities, such as an initial online goal-setting exercise. To be included, studies examined impacts on immediate college enrollment after high school. Studies also had to use a design that was likely to

[30] Though Deke and Finucane (2019) recommend conducting sensitivity analyses based on "a broader or narrower population of prior studies," the study team was not able to identify any sensible ways of broadening the population of prior studies beyond the literature-review-based and the WWC-based approaches to identifying studies.

produce rigorous evidence of the effect of the program.[31] When multiple variations of text messaging were examined—that is, in studies with multiple treatment arms, the impact estimate for the treatment arm closest to the college transition messaging examined in this study was used. A summary of the current study and the prior studies identified through the literature review approach is in Exhibit D.2. All impacts and standard errors are from the full study samples, not for particular groups of students ("subgroups").

Exhibit D.2 Summary of Impacts from Current Study and Relevant Prior Studies Identified by Literature Review Approach

WWC Evidence Rating	Study Name	Total Sample Size	Impact on Immediate College Enrollment[a]	Impact Standard Error[b]
Current Study				
Not reviewed	Linkow et al. (2020)	4,803	0.0001[c]	0.012
Prior Studies				
Met without reservations	Castleman and Page (2015)	5,753	0.019[d]	0.013
Not reviewed	Bird et al. (2019)	271,365	0.007[e]	0.009
Not reviewed	Page and Gehlbach (2017)	7,489	0.010[f]	0.006
Not reviewed	Castleman and Page (2017)	3,392	0.029[g]	0.015
Met without reservations	Page, Castleman, and Meyer (2020)	17,731	0.031[h]	0.017
Not reviewed	Phillips and Reber (2018)	6,640	0.006[i]	0.013
Not reviewed	Avery et al. (2020) National	70,285	−0.014[j]	0.006
Not reviewed	Avery et al. (2020) Texas	21,001	0.017[j]	0.015

[a] Impacts are the studies' estimated effects of text messaging on the proportion of students who enrolled in college immediately after high school. Multiplying the proportions by 100 converts them to percentage points. For example, the results from Castleman and Page (2015) indicate that the percentage of treatment group students who enrolled in college immediately after high school was 1.9 percentage points higher than the percentage of control group students who did so.

[b] Impact standard errors are measures of the precision of the impact estimates and are needed, in addition to the impact estimates, to replicate the Bayesian analysis results. Smaller standard errors indicate greater precision.

[c] Linkow et al. (2020): Effect of text-message-based advising.

[d] Castleman and Page (2015): Effect of text-message-based advising.

[e] Bird et al. (2019): Effect of multi-modal campaign (text message, email, and postal) encouraging students to complete the FAFSA. Estimates here focus on treatment arm that included offer of one-on-one virtual advising.

[f] Page and Gehlbach (2017): Effect of text-message-based outreach sent by a virtual assistant/artificially intelligent (AI) system. Admissions staff responded via the system when the AI could not answer.

[g] Castleman and Page (2017): Effect of text-message-based information and advising to students. Estimates here focus on treatment arm that included texts to students only, not parents.

[h] Page, Castleman, and Meyer (2020): Effect of text-message-based information and assistance to complete the FAFSA. Students could write back for assistance or follow up in-person with their school counselor.

[i] Phillips and Reber (2018): Effect of information, reminders, and advising delivered via text messages, the internet, phone, email, and social networking platforms. Estimates here focus on treatment arm that included offer of one-on-one virtual advising.

[j] Avery et al. (2020): Effect of text-message-based advising. National sample: Text-message-based advising from virtual advisors. Texas sample: Text messages from high school counselors with option to follow up via text or in-person.

[31] This means that to be included, the study had to compare measures of immediate college enrollment of treatment students (that is, students who were offered the text messaging) to those of comparison students (that is, students who were not offered the text messaging). If assignment to treatment or comparison groups was not via lottery, then in order to be included, the study needed to provide evidence that the treatment and comparison groups were similar prior to the start of the text messaging.

D.2.2 *What Works Clearinghouse*™ (WWC) Search Approach – Sensitivity Analyses

The second approach used only studies in the WWC database of reviewed studies.[32] Studies were those that met WWC standards with or without reservations, examined impacts on immediate college enrollment after high school, and offered advising to college-intending seniors targeted to the issue of transitioning to college. This approach identified eight studies.[33] Exhibit D.3 summarizes the findings from the current study and the prior studies identified by the WWC search approach.

Exhibit D.3 Summary of Impacts from Current Study and Relevant Prior Studies Identified by WWC Search Approach

WWC Evidence Rating	Study Name	Total Sample Size	Impact on Immediate College Enrollment[a]	Impact Standard Error[b]
Current Study				
Not reviewed	Linkow et al. (2020)	4,803	0.0001[c]	0.012
Prior Studies				
Met without reservations	Castleman, Arnold, and Wartman (2012)	162	0.13[d]	0.08
Met without reservations	Castleman, Page, and Schooley (2014)	2,166	0.035[e]	0.017
Met without reservations	Castleman and Page (2015)	5,753	0.019[f]	0.013
Met without reservations	Castleman, Owen, and Page (2015a)	3,281	0.035[h]	0.019
Met without reservations	Castleman, Owen, and Page (2015b)	1,602	−0.001[g]	0.015
Met with reservations	Barr and Castleman (2017)	2,422	0.070[i]	0.016
Met without reservations	Page, Castleman, and Meyer (2020)	17,731	0.03[j]	0.017
Met with reservations	Bettinger and Evans (2019)	122,276	0.000[k]	0.008

[a] Impacts are the studies' estimated effects of the program on the proportion of students who enrolled in college immediately after high school. Multiplying the proportions by 100 converts them to percentage points. For example, the results from Castleman and Page (2015) indicate that the percentage of treatment group students who enrolled in college immediately after high school was 1.9 percentage points higher than the percentage of control group students who did so.

[b] Impact standard errors are measures of the precision of the impact estimates and are needed, in addition to the impact estimates, to replicate the Bayesian analysis results. Smaller standard errors indicate greater precision.

[c] Linkow et al. (2020): Effect of text-message-based advising.

[d] Castleman, Arnold, and Wartman (2012): Effect of providing proactive college counseling to low-income students during the summer.

[e] Castleman, Page, and Schooley (2014): Effect of two to three hours of summer counseling.

[f] Castleman and Page (2015): Effect of text-message-based advising.

[g] Castleman, Owen, and Page (2015a): Effect Summer monitoring and follow up via virtual platform used by high school counselors.

[h] Castleman, Owen, and Page (2015b): Effect of summer outreach by public high school or university based counselor.

[i] Barr and Castleman (2017): Effect of "Bottom Line" advising program. Advisors meet with students for an hour every three or four weeks during senior year.

[j] Page, Castleman, and Meyer (2018): Effect of text-message-based information and assistance to complete the FAFSA. Students could write back for assistance or follow up in-person with their school counselor.

[k] Bettinger and Evans (2019): Effect of near-peer mentoring by recent college graduates to high school seniors.

[32] The study team downloaded the database on April 24, 2019.

[33] Five of these studies were included in the *What Works Clearinghouse*™ *Summer Counseling Intervention Report* (https://ies.ed.gov/ncee/wwc/Docs/InterventionReports/wwc_summer_counseling_032718.pdf).

D.2.3 Use of "Benchmark Priors"

Deke and Finucane (2020) argue that for education interventions, such as the one being evaluated in the current study, benchmark priors calculated from all evidence reported in the WWC database of reviewed studies that met standards with or without reservations provide a reasonable set of prior evidence. They recommend that benchmark priors be included in sensitivity analyses. Therefore, the study included benchmark priors. The benchmark numbers were reported in Deke and Finucane (2020) and in Appendix D of Herrmann et al. (2019).

D.3 Assumptions about and Approaches to Addressing Publication Bias

Because publications served as the source for prior knowledge in the current Bayesian analysis, it is important to have an understanding of what studies may or may not be published and to be explicit about any assumptions made. Publication bias occurs when the results of a study influence whether the study is published or the results are reported. For example, if null or small effects are less likely to be reported, then there is publication bias. Because there is no way to know whether publication bias has occurred, researchers recommend conducting sensitivity analyses with several different assumptions regarding its presence (Deke and Finucane 2019).

D.3.1 Assumptions about Publication Bias

According to Deke and Finucane (2019), three different assumptions to test are the following:

1. Assume that the literature can be taken at face value and do no adjustments to the results from the prior studies.

2. Assume that the impacts in the literature are overstated by a factor of two.

3. Account for possible overestimation of impacts in the literature more stringently by assuming that, on average, past impacts in this set of interventions equal zero.

Because there are multiple published studies where the effect of text messaging on immediate college enrollment after high school was tested, the primary approach assumes no publication bias and takes the literature at face value. The assumption is that it would be a rare occurrence for a study team to go through the trouble of implementing an intervention and conducting a rigorous evaluation of the intervention's effects on immediate college enrollment after high school, only to fail to report the results in the public domain. But, of course, it is unknown whether the assumption about the lack of publication bias is correct. Therefore, two sensitivity analyses were conducted using the latter two assumptions.

D.3.2 Approaches to Addressing Publication Bias

To carry out the primary approach, which takes the literature at face value, the impacts shown in Exhibit D.2 above, in the column labeled "Impact on Immediate College Enrollment," were used in the Bayesian analysis without any adjustment to the numbers.

To carry out the sensitivity analysis under assumption 2, which assumes impacts in the literature are exaggerated by a factor of two, six additional simulated studies were added to the analysis. This approach assumed that these additional six studies were otherwise identical to the six shown in Exhibit D.2 in their sample sizes and standard errors, but that these six additional, unpublished studies had found impacts that were equal to zero. This sensitivity analysis therefore includes a total of 12 prior studies.

Assumption 3 takes the stringent assumption that the average of prior impacts of text messaging interventions was zero. The Bayesian analysis uses the mean and standard deviation of impact estimates from prior studies. To

operationalize this sensitivity analysis, the mean of the impact estimates from prior studies was set to zero, and used the standard deviation of the impact estimates that was calculated using the primary approach.[34]

In addition to the approaches described above, the study also used a set of "benchmark priors" reported in Herrmann et al. (2019) that included an adjustment for publication bias in a sensitivity analysis.

D.4 Analysis Methods Used to Estimate Prior and Posterior Distributions

The Bayesian analysis involved three broad steps:

Step 1: Calculate the mean and standard deviation of impact estimates from relevant prior studies. The results are called "the priors."

Step 2: Use the priors from Step 1 in combination with the results from the current study to estimate the mean and standard deviation of impacts in the "posterior distribution."

Step 3: Using the mean and standard deviation of the posterior distribution, calculate the probability that the intervention impact is greater than a particular number (for example, greater than zero or greater than 2 percentage points).

D.4.1 Two Methods to Calculate the Mean and Standard Deviation from Relevant Prior Studies

The study team identified two approaches for calculating the mean and standard deviation from relevant prior studies. One was easier to implement and required no specialized software beyond what any analyst would have at their disposal, the other approach required specialized software but could be considered to be more "state-of-the-art"—so the study implemented both. The first approach used closed-form equations that can be easily programmed in any statistical analysis package such as SAS, Stata, SPSS, R, or even Excel. The second approach used iterative procedures for the calculations implemented with the "RStan" package in R software. (Section D.6, Technical Details, describes how these approaches were implemented, for interested readers.)

The results were not sensitive to choice of either of the two approaches. The closed-form-equations approach was designated as primary and the iterative approach as a sensitivity analysis because the former was easier to understand and implement. Two studies (Michalopoulos 2012; Herrmann et al. 2019) that have implemented Bayesian analyses using priors from relevant prior studies do not provide sufficient detail to ascertain the methods used to calculate the mean and standard deviation from the prior studies they used.

D.4.2 Two Methods to Estimate the Mean and Standard Deviation of the Posterior Distribution

Similar to above, the study identified two methods for estimating the mean and standard deviation of the posterior distribution, and for similar reasons both were implemented. The first approach similarly used closed-form equations. The second approach similarly used iterative procedures for the calculations, but implemented them using the "GenMod" procedure in SAS software.[35] (Section D.6, Technical Details, describes how these approaches were implemented, for interested readers.)

Again the results were not sensitive to choice of either of the two approaches. The closed-form-equations approach was designated as primary and the iterative approach as a sensitivity analysis because the former was easier to understand and implement and could be implemented using only summary statistics from the current and prior studies, whereas the latter approach required the use of the original student-level micro data. Because the study

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[34] An alternative approach to operationalizing the recommendation by Deke and Finucane (2019) to assume all prior studies had a mean of zero would have been to specify "flat priors," wherein the mean is assumed to be zero and the standard errors are assumed to be infinitely large. This approach was not utilized because they strongly argue against the use of flat priors.

[35] Michalopoulos (2012) used the closed-form-equations approach. Herrmann et al. (2019) does not provide detail on the method used to estimate the mean and standard deviation of the posterior distribution.

team no longer had access to the original student-level micro data, nor would analysts wishing to reproduce the results from the Bayesian analyses presented herein, the team simulated student-level micro data to assess the sensitivity of the results to the choice of the closed-form-equations approach versus the iterative approach. (Details on the simulation of data are provided in Section D.6.)

D.5 Results of Primary and Sensitivity Analyses

The Bayesian analysis incorporates evidence from prior studies into the interpretation of the impact found in the current study. The Bayesian analysis results indicate a slightly higher likelihood that college transition messaging advising had a positive than a negative effect on student enrollment in college immediately after high school. The results also indicate that the probability that the effect is greater than a one percentage point increase or a one percentage point decrease in immediate enrollment is small, and very unlikely to be larger than a two or three percentage point increase or decrease (see Exhibits D.4a and D.4b). Specifically, the primary analysis indicates that:

- There is a 58 percent chance of a *positive* effect, and a 42 percent chance of a *negative* effect of the messaging.
- There is a 20 percent chance of a one percentage point *increase* in enrollment, and a 10 percent chance of a one percentage point *decrease* in enrollment due to the messaging.
- There is a three percent chance of a two percentage point *increase* in enrollment, and a one percent chance of a two percentage point *decrease* in enrollment due to the messaging.

There is a less than 0.1 percent chance of a three percentage point *increase* in enrollment, and a less than 0.1 percent chance of a three percentage point *decrease* in enrollment due to the messaging.The results from the Bayesian analysis can be contrasted to and/or reported along with the results from the traditional, frequentist analysis based on the current study alone. The traditional results indicated that the estimated size of the intervention effect was a 0.01 percentage point increase in college enrollment immediately after high school, with a *p*-value of 0.99 which indicates that the impact estimate is highly consistent with what would have been expected if college transition messaging had no impact on the percentage of students who enroll in college immediately after high school.

Exhibit D.4a Results of Bayesian Analysis – Likelihoods that College Transition Messaging Had a Positive Impact on Immediate College Enrollment after High School

Primary Approach or Sensitivity Analysis	Percent Chance that the Impact of College Transition Messaging Interventions Is Greater Than:			
	Zero	1 Percentage Point	2 Percentage Points	3 Percentage Points
Primary Approach • Relevant prior studies identified by literature review • No adjustment for potential publication bias • Closed-form equations used to estimate prior mean and standard deviation • Closed-form equations used to estimate posterior mean and standard deviation	58.3%	20.0%	2.9%	0.1%
Sensitivity Analysis 1 • Relevant prior studies identified in *What Works Clearinghouse™* database	63.1%	28.5%	7.1%	0.1%
Sensitivity Analysis 2 • Adjustment to assume published impacts are inflated by a factor of two	57.0%	13.8%	0.9%	<0.1%
Sensitivity Analysis 3 • Adjustment to assume that mean of published impacts is zero	50.2%	14.7%	1.8%	<0.1%

Primary Approach or Sensitivity Analysis	Percent Chance that the Impact of College Transition Messaging Interventions Is Greater Than: Zero	1 Percentage Point	2 Percentage Points	3 Percentage Points
Sensitivity Analysis 4 • Iterative procedure used to estimate prior distribution	67.1%	27.1%	4.8%	0.3%
Sensitivity Analysis 5 • Iterative procedure used to estimate posterior distribution	58.9% (Used simulated data)	21.9% (Used simulated data)	3.8% (Used simulated data)	0.3% (Used simulated data)
Use of "Benchmark Priors" Recommended by Deke & Finucane (2020) and reported in Herrmann et al. (2019)				
Sensitivity Analysis 6 • All studies in *What Works Clearinghouse™* database of reviewed studies that met standards with or without reservations Mean and standard deviation of prior distribution reported in Table D.1 of Herrmann et al. (2019)	53.6%	23.5%	6.2%	0.1%
Sensitivity Analysis 7 • "File drawer correction" as reported in Appendix D of Herrmann et al. (2019) • All studies in *What Works Clearinghouse™* database of reviewed studies that met standards with or without reservations Mean and standard deviation of prior distribution reported in Table D.1 of Herrmann et al. (2019)	51.0%	21.5%	5.5%	<0.1%

Exhibit D.4b Results of Bayesian Analysis –Likelihoods that College Transition Messaging had a Negative Impact on Immediate College Enrollment

Primary Approach or Sensitivity Analysis	Percent Chance that the Impact of College Transition Messaging Interventions is More Negative Than: Zero	1 Percentage Point	2 Percentage Points	3 Percentage Points
Primary Approach • Relevant prior studies identified by literature review • No adjustment for potential publication bias • Closed-form equations used to estimate prior mean and standard deviation • Closed-form equations used to estimate posterior mean and standard deviation	41.7%	10.3%	1.0%	<0.1%
Sensitivity Analysis 1 • Relevant prior studies identified in *What Works Clearinghouse™* database	36.9%	10.9%	1.6%	0.1%
Sensitivity Analysis 2 • Adjustment to assume published impacts are inflated by a factor of two	43.0%	7.5%	0.3%	<0.1%
Sensitivity Analysis 3 • Adjustment to assume that mean of published impacts is zero	49.8%	14.4%	1.7%	<0.1%

Primary Approach or Sensitivity Analysis	Percent Chance that the Impact of College Transition Messaging Interventions is More Negative Than: Zero	1 Percentage Point	2 Percentage Points	3 Percentage Points
Sensitivity Analysis 4 • Iterative procedure used to estimate prior distribution	32.9%	6.7%	0.5%	<0.1%
Sensitivity Analysis 5 • Iterative procedure used to estimate posterior distribution	41.1% (Used simulated data)	11.0% (Used simulated data)	1.3% (Used simulated data)	<0.1% (Used simulated data)
Use of "Benchmark Priors" Recommended by Deke & Finucane (2020) and reported in Herrmann et al. (2019)				
Sensitivity Analysis 6 • All studies in *What Works Clearinghouse™* database of reviewed studies that met standards with or without reservations • Mean and standard deviation of prior distribution reported in Table D.1 of Herrmann et al. (2019)	46.4%	18.3%	4.3%	0.6%
Sensitivity Analysis 7 • "File drawer correction" as reported in Appendix D of Herrmann et al. (2019) • All studies in *What Works Clearinghouse™* database of reviewed studies that met standards with or without reservations • Mean and standard deviation of prior distribution reported in Table D.1 of Herrmann et al. (2019)	49.0%	20.1%	4.9%	<0.1%

Results from the primary approach and the sensitivity analyses were in agreement that it is unlikely that the transition messaging had effects greater than 1 percentage point in a positive or negative direction, and very unlikely that the effects were greater than 2 percentage points in either direction. But the probabilities of a greater than zero effect varied from 50 or 51 percent for the sensitivity analyses that most stringently adjusted for publication bias (Sensitivity Analyses 3 and 7) to 58 percent for the primary approach, to 67 percent for the approach that used the iterative procedure to estimate the prior distribution (Sensitivity Analysis 4). Perhaps these variations in probabilities are not very important because all analyses lead to the conclusion that the effects of the transition messaging on immediate college enrollment are likely to be close to zero. That is, the effects are likely to be at best small and positive, or at worst negative but small.

D.6 Technical Details about the Analysis Methods

This section contains technical details that can be used to replicate the analyses and results presented above. Notes on use of the "benchmark priors" are presented at the end of this section.

To recap: the Bayesian analysis involved three broad steps:

Step 1: Calculate the mean and standard deviation of impact estimates from relevant prior studies. The results are called "the priors."

Step 2: Use the priors from Step 1 in combination with the results from the current study to estimate the mean and standard deviation of impacts in the "posterior distribution."[36]

[36] The "posterior distribution" is an estimate of a probability distribution that describes how likely it would be to observe an impact of any particular size within the population of impacts from text-message-based interventions targeting summer melt. The study team's analysis

Step 3: Using the mean and standard deviation of the posterior distribution, calculate the probability that the intervention impact is greater than a particular number (for example, greater than zero or greater than 3 percentage points).

D.6.1 Step 1: Calculate Weighted Mean and Standard Deviation from Relevant Prior Studies (Two Methods)

Mean and SD Calculated Using Closed-Form Equations – Primary Method (PriD-1)

Let I_{Prior} and SD_{Prior} denote the mean and standard deviation of combined impact estimates from the relevant prior studies, and w_i and $w_i^{Normalized}$ denote raw and normalized weights, respectively used in the calculation of weighted means and standard deviations.

(1) $I_{Prior} = \frac{\sum w_i I_i}{\sum w_i} = \frac{\sum w_i^{Normalized} I_i}{\sum w_i^{Normalized}}$ where I_i is the i^{th} impact estimate from Exhibit D.2 or D.3, and

(2) $w_i = 1/(SE_i^2)$ where SE_i is the i^{th} standard error of the impact estimate from Exhibit D.2 or D.3, and

(3) $w_i^{Normalized} = (n * w_i)/\sum w_i$, where n is the number of prior studies (e.g., n=6 in Exhibit D.2 and n=5 in Exhibit D.3), and

(4) $SD_{Prior} = \sqrt{\frac{\sum w_i^{Normalized}(I_i - I_{Prior})^2}{(\sum w_i^{Normalized}) - 1}}$

Exhibit D.5 shows the meta-analytic means (I_{Prior}) and standard deviations (SD_{Prior}) of the impact estimates from the relevant prior studies identified using either the literature review or WWC search approach. The prior meta-analytic mean and standard deviation are larger using the WWC search approach than using the literature review approach.

Exhibit D.5 Mean and Standard Deviation of Impact Estimates Calculated Using Closed-Form Equations for Each of the Two Approaches to Identifying Relevant Prior Studies

Approach to Selecting Prior Studies	Prior Studies	
	Mean Impact (I_{Prior})	Standard Deviation (SD_{Prior})
Literature review approach	0.0047	0.0147
WWC search approach	0.0183	0.0249

For readers interested in reproducing the results, Exhibit D.6 shows the R and SAS code to calculate I_{Prior} and SD_{Prior} using the data in Exhibit D.2.

Exhibit D.6 R and SAS Program Code Using Closed-Form Equations to Calculate Prior Mean and Standard Deviation of Impact Estimates from Studies Selected using Literature Review Approach

```
######## R Code #########
# Data from Exhibit D.2
I.i = c(0.019,0.007,0.010,0.029,0.031,0.006,-0.014,0.017)
SE.i = c( 0.013,0.009,0.006,0.015,0.017,0.013,0.006,0.015)

# Calculate Raw Weights
w.i = 1 / SE.i^2
```

assumes that the impacts from these interventions have a normal (bell-shaped) distribution that can be characterized by a normal probability density function, a mean, and a standard deviation.

```
# Calculate n
n = length(I.i)

# Calculated Normalized Weights
normalized.wt = (n * w.i) / sum(w.i)

# Calculate I.Prior
I.Prior = sum(normalized.wt * I.i) / sum(normalized.wt)

# Calculate SD.Prior
SD.Prior = sqrt( sum(normalized.wt * (I.i - I.Prior)^2) / (sum(normalized.wt) - 1) )

## Show Results
cbind(I.Prior, SD.Prior)

#> cbind(I.Prior, SD.Prior)
# I.Prior SD.Prior
#[1,] 0.004723355 0.0147245
```

```
/* ********** SAS Code **********/
/* data from Exhibit D.2 */
data temp; input Y sigma ; cards;
0.019 .013
0.007 .009
0.010 .006
0.029 .015
0.031 .017
0.006 .013
-0.014 .006
 0.017 .015
;
/* calculate raw weights */
data t2; set temp;
w_i = 1/sigma**2;
ones=1;
run;

/* sum the raw weights and get "n" */
proc means sum; var w_i;
output out=t3 sum= sum_w_i ;
data t4; set t3;
rename _Freq_ = n ; ones=1; drop _type_;

/* Calculate normalized weights and look at data*/
data t5; merge t2 t4; by ones;
Normalized_w_i = (n * w_i) / sum_w_i;
proc print; run;


/* Use Proc Means to calculate I_Prior and SD_Prior */
proc means mean std vardef=wdf; var y; weight Normalized_w_i; run;

/* Results (Mean is I_Prior, Std Dev is SD_Prior */
 Analysis Variable : Y

 Mean Std Dev
```

```
----------
0.0047234 0.0147245
----------
*/
```

Mean and SD Calculated Using Iterative Procedures – Sensitivity Analysis (PriD-2)

As a sensitivity analysis, a package in the R software package named "RStan"[37] was used to calculate the mean and standard deviation of impact estimates from the prior studies. To facilitate replication of the methods, in Exhibit D.7 the R code that was used is provided.

A comparison of the means and standard deviations obtained using the RStan package versus those obtained from the closed-form equations shows that the two methods produced similar results (Exhibit D.8).

Exhibit D.7 R Program Code Using RStan Package to Calculate Prior Mean and Standard Deviation of Impact Estimates from Studies Selected Using Literature Review Approach

```
# set seed for replicability
set.seed(621412)

# Invoke the RStan package
library("rstan") # observe startup messages

## Options recommended in RStan documentation
options(mc.cores = parallel::detectCores())
rstan_options(auto_write = TRUE)

## Set up STAN model code

stanmodelcode = "
data {
 int<lower=0> J; // number of studies
 real y[J]; // estimated treatment effects
 real<lower=0> sigma[J]; // standard error of effect estimates
}
parameters {
 real mu; // population treatment effect
 real<lower=0> tau; // standard deviation in treatment effects
 vector[J] eta; // unscaled deviation from mu by school
}
transformed parameters {
 vector[J] theta = mu + tau * eta; // study treatment effects
}
model {
 target += normal_lpdf(eta | 0, 1); // prior log-density
 target += normal_lpdf(y | theta, sigma); // log-likelihood
}
"

# Create data set containing impact estimates and standard errors
# from studies identified with literature review-based approach

LitBased_dat <- list(J = 6,
y = c(0.019,0.007,0.010,0.029,0.031,0.006 ,-0.014,0.017),
```

[37] For more information about RStan, see https://cran.r-project.org/web/packages/rstan/vignettes/rstan.html and https://cran.r-project.org/web/packages/rstan/vignettes/rstan.html#write-a-stan-program.

```
sigma = c( 0.013,0.009,0.006,0.015,0.017,0.013, 0.006,0.015))

### Run the model and examine results
fit1 = stan(model_code = stanmodelcode,
 data = LitBased_dat,
            control = list(adapt_delta = 0.9999)
 )

print(fit1, pars = c("mu", "tau"),digits_summary = 5)
```

```
## Output from print statement:
Inference for Stan model: 32af4e878d1455a0a170e2073248307e.
4 chains, each with iter=2000; warmup=1000; thin=1;
post-warmup draws per chain=1000, total post-warmup draws=4000.

 mean se_mean sd 2.5% 25% 50% 75% 97.5% n_eff Rhat
mu 0.00993 0.00019 0.00718 -0.00356 0.00537 0.00962 0.01407 0.02501 1475 1.00082
tau 0.01481 0.00023 0.00734 0.00453 0.00981 0.01351 0.01814 0.03279 1063 1.00050
```

Exhibit D.8 Comparison of Mean and Standard Deviation of Prior Study Impact Estimates Calculated Using Closed-Form-Equations and Iterative Procedure

	Prior Studies	
Approach to Selecting Priors	**Mean Impact (I_{Prior})**	**Standard Deviation (SD_{Prior})**
Primary – Closed-form equations	0.0047	0.0147
Sensitivity – Iterative approach	0.0099	0.0148

D.6.2 Step 2: Estimate the Posterior Distribution (Two Methods)

Because the study team identified two methods to estimating the posterior distribution, both methods were implemented so that sensitivity to the method could be assessed.

The first (primary) method uses closed-form equations that require only summary statistics (specifically, the impact estimate and its standard error) from the current study and the mean and standard deviation estimated from prior studies in Step 1. The second method (sensitivity) requires student-level data from the current study and needs to be implemented using iterative procedures. The second method was implemented using the Bayesian procedures built into SAS's GENMOD procedure.

The first method was selected as primary because it has three advantages over the second method. First, it can be easily programmed in any standard software, or even a spreadsheet, requiring only summary statistics as the data inputs. Second, analysts can program the equations in their own software, and need only the data shown in this report to replicate the results. Third, some analysts may find it easier to understand estimation of the posterior distribution using the closed-form equations than estimating with a built-in procedure such GENMOD. In contrast, the second method might seem more like a "black box," and it requires access to micro data (such as individual student records).

Estimating Posterior Distribution Using Closed-Form Equations – Primary Method (AM-1)

The method calcuates the mean of the posterior distribution as a weighted average of the current study's impact estimate and an assumed distribution of impact estimates from prior studies. The following equation for estimating

the mean impact (I_{Postr}) of the posterior distribution assumes that the impacts from the current study, the prior studies, and the posterior distribution of impacts are all normally distributed:[38]

$$I_{Postr} = I_{Prior}\left(1 - \frac{(SD_{Prior})^2}{(SD_{Prior})^2 + \left(SE_{Study}\right)^2}\right) + I_{Study}\left(\frac{(SD_{Prior})^2}{(SD_{Prior})^2 + \left(SE_{Study}\right)^2}\right)$$

where

I_{Prior} is the average of impact estimates from prior studies (calculated in Step 1)
SD_{Prior} is the standard error of impact estimates from prior studies (calculated in Step 1)
I_{Study} is the impact estimate from the current study
SE_{Study} is the standard error of the impact estimate from the current study

The formula indicates that if SE_{Study} is small relative to SD_{Prior}, then more weight will go to I_{Study} than to I_{Prior}. This means that the larger the sample and more precisely estimated the current study's impact is, the smaller SE_{Study} will be and the more weight I_{Study} will have relative to I_{Prior}. Similarly, if impact estimates from prior studies are based on small samples, or vary widely from study to study, then SD_{Prior} may be large relative to SE_{Study} , weighting the current study's estimate (I_{Study}) more heavily.

The standard deviation of the posterior distribution is estimated as:[39]

$$SD_{Postr} = \sqrt{\frac{(SD_{Prior})^2\left(SE_{Study}\right)^2}{(SD_{Prior})^2 + \left(SE_{Study}\right)^2}}$$

Exhibit D.9 shows the posterior distributions obtained using in the closed-form equations for each of the two approaches to identifying relevant prior studies. The mean of the impacts and standard deviation of the posterior distribution are larger using the WWC search approach than the literature review approach.

Exhibit D.9 Estimates of Posterior Mean and Standard Deviation from Each of the Two Approaches to Identifying Relevant Prior Studies

Approach to Selecting Prior Studies	Current Study		Prior Studies		Posterior Distribution	
	Impact (I_{Study})	Standard Error (SE_{Study})	Impact (I_{Prior})	Standard Error (SD_{Prior})	Impact (I_{Postr})	Standard Deviation (SD_{Postr})
Literature review approach	0.0001	0.0124	0.0047	0.0147	0.0020	0.0095
WWC search approach	0.0001	0.0124	0.0183	0.0249	0.0037	0.0111

For readers interested in reproducing the results, Exhibit D.10 shows the R and SAS code to calculate I_{Prior} and SD_{Prior} using the data in Exhibit D.2.

[38] This formula is documented in Michalopoulos (2012).

[39] Michalopoulos (2012).

Exhibit D.10 R and SAS Program Code Using Closed-Form Equations to Calculate Posterior Mean and Standard Deviation

```
######## R Code #########
#Define an R function named Posterior.fnc
Posterior.fnc= function(I.Study, SE.Study, I.Prior, SD.Prior){
I.Postr = I.Prior*(1-(SD.Prior^2 / (SD.Prior^2 + SE.Study^2) ) ) + I.Study* ( (SD.Prior^2 / (SD.Prior^2 + SE.Study^2) ) )
SD.Postr = sqrt( (SD.Prior^2 * SE.Study^2) / (SD.Prior^2 + SE.Study^2) )
round(cbind(I.Study,SE.Study,I.Prior,SD.Prior,I.Postr,SD.Postr),4)
}

# Call the function using current study mean and SE and prior mean and SE
# arguments
Posterior.fnc(I.Study=.0001, SE.Study=.0124,I.Prior=0.0047234, SD.Prior=0.0147245)

#Results
# I.Study SE.Study I.Prior SD.Prior I.Postr SD.Postr
#[1,] 1e-04 0.0124 0.0047 0.0147 0.002 0.0095
```

```
/* ********** SAS Code **********/
data b1; input
I_Study    SE_Study I_Prior   SD_Prior; cards;
0.0001 0.0124       0.0047   0.0147
;
data b2; set b1;
I_Postr = I_Prior*(1-(SD_Prior**2 / (SD_Prior**2 + SE_Study**2) ) ) + I_Study* ( (SD_Prior**2 / (SD_Prior**2 +
SE_Study**2) ) );
SD_Postr = sqrt( (SD_Prior**2 * SE_Study**2) / (SD_Prior**2 + SE_Study**2) );
run;
proc print; run;
/*
Obs I_Study SE_Study I_Prior SD_Prior I_Postr SD_Postr
 1 .0001 0.0124 .0047 0.0147 .002012386 .009478207
*/
```

Estimating Posterior Distribution Using Iterative Procedures – Sensitivity Analysis (AM-2)

A second method to estimating the posterior distribution uses student-level data coupled with procedures built into SAS's GENMOD procedure. The GENMOD procedure fits a linear probability model of the same form as the original impact model used to estimate impacts of the college transition messaging on immediate enrollment (Section B.4.1). The "Bayes" option was applied to the model with the specifications that:

- The "priors" are normally distributed.
- The priors for the intervention effect, I_{Prior} and (SE_{Prior}), were calculated as described in Step 2 above.
- The priors for other model covariates were "flat priors." This means that for model covariates, the prior means are set to zero and the prior variances are set to an arbitrarily larger number (for example, 1 million).[40]

[40] Flat priors for the other independent variables (that is, the model covariates) were used for two reasons: (1) because of lack of obvious alternatives—information on the prior distributions of the covariates was not available; and (2) the choice of priors for covariates is

Because one of the objectives for this appendix is that readers and analysts who wish to fully understand the approach used can replicate the results presented, and because those readers and analysts will not have access to the original micro-level data set with records for individual students that would be needed to implement the iterative approach presented in this section, code is provided to simulate data and then apply the procedure to the simulated data. The simulated data have the same sample size (n=2,819 students in the treatment group, n=1,984 students in the control group) as the original data; and they have a similarly small, near zero difference between treatment and control group members in the immediate college enrollment outcome (denoted Y in the simulated data). The simulated data include two covariates (denoted X1 and X2 in the simulated data). These are included to show how the team coded priors for covariates in the SAS GenMod procedure. The SAS program code for simulating the data and using Proc GenMod to estimate the mean and standard deviation of the posterior distribution is shown in Exhibit D.11.

Exhibit D.11 SAS Program Code to Simulate Study Data and Estimate Posterior Mean and Standard Deviation Using Iterative Procedure

```
/* ********************************************************
      Create simulated data set
 * ******************************************************** */
data temp;
call streaminit(132); /* Setting seed for replicability */
/*Generate data for the Treated group (pop. percent immediately enrolling = 66.3) */
i=0; do while (i<2819);
i = i+1; TrtGrp=1; Y=rand("Bernoulli",0.663); X1 = rand("Normal",100,10); X2 = rand("Normal",0,1);
output; end;
/* Generate data for the control group (pop.percent immediately enrolling = 66.3)*/
j=0; do while (j<1984);
j = j+1; TrtGrp=0; Y=rand("Bernoulli",0.663); X1 = rand("Normal",100,10); X2 = rand("Normal",0,1);
output; end;
drop i j;
run;

proc means n mean; class TrtGrp; run;

/* Descriptive statistics from simulated data set
 N
 TrtGrp Obs Variable N Mean
------------------------------------------------------------
 0 1984 Y 1984 0.6628024
 X1 1984 99.9855649
 X2 1984 -0.0177498

 1 2819 Y 2819 0.6630011
 X1 2819 99.8533178
 X2 2819 -0.0125334
------------------------------------------------------------
*/

/* ********************************************************
      Calculate the "Prior Variance" as the square of the "prior standard deviation"
      from the prior studies
```

expected to be inconsequential. The current study used a random assignment design. Covariates were used to reduce residual error and therefore increase power to detect effects. Because the study used random assignment, it would produce unbiased estimates with or without covariates. Therefore the choice of priors for the covariates is expected to be inconsequential to the Bayesian analysis.

```
      (literature review based approach to identifying relevant prior studies)
 * ******************************************************* */
data b1;
input      PriorMean      PriorSD; cards;
           0.004723355 0.0147245
;
data b2; set b1;
PriorVar = PriorSD**2;

proc print; run; /*
Obs PriorMean PriorSD PriorVar

 1 .004723355 0.014725 .000216811

/* ********************************************************
      Create a data set named "NormalPrior" that will be used in ProcGenMod
      to specify the priors
 * ******************************************************* */

data NormalPrior; input
_type_ $ Intercept TrtGrp X1 X2; datalines;
 Mean 0.0        .004723355 0.0   0.0
 Var 1000000 .000216811  1000000 1000000
 ; run;

/* ********************************************************
      Use Proc GenMod to estimate the posterior mean and standard deviation
 * ******************************************************* */

proc genmod data=temp;
model Y = TrtGrp X1 X2 / dist=normal ;
 bayes seed=6752 plots=none coeffprior=normal(input=NormalPrior) ;
run;

/* Output from Proc GenMod
Bayesian Analysis
 Posterior Summaries

 Standard
Parameter N Mean Deviation

Intercept 10000 0.6413 0.0689
TrtGrp 10000 0.00225 0.0100 <== Posterior mean and SD
X1 10000 0.000205 0.000683
X2 10000 0.0109 0.00700
Dispersion 10000 0.2237 0.00459
```

The iterative procedure was applied and the closed-form equations methods to the simulated data. The two approaches produced the same estimates of the mean and standard deviation of the posterior distribution (Exhibit D.12).[41]

Exhibit D.12 Comparison of Estimates of Posterior Mean and Standard Deviation from Closed-Form Equation Method and Iterative Method (USING SIMULATED DATA)

Approach to Estimating Posterior Distribution	Current Study (Simulated Data)		Prior Studies		Posterior Distribution	
	Impact (I_{Study})	Standard Error (SE_{Study})	Impact (I_{Prior})	Standard Error (SE_{Prior})	Impact (I_{Postr})	Standard Deviation (SD_{Postr})
Approach 1: Closed-form equation using summary of simulated data	0.0002	0.0139	0.0047	0.0147	0.0023	0.0101
Approach 2: Iterative solution using SAS GENMOD and simulated student-level data	0.0002	0.0139	0.0047	0.0147	0.0023	0.0100

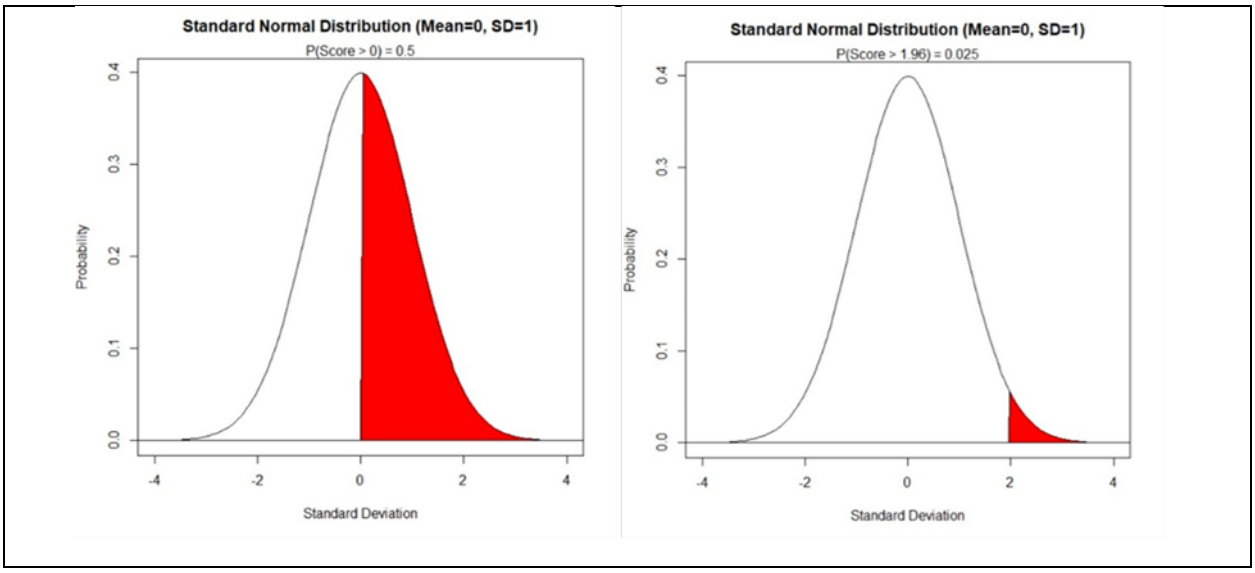
D.6.3 Step 3: Calculate the Probability that the Intervention Impact Is Greater than a Particular Number

Using the mean and standard deviation of the posterior distribution, and assuming that the posterior distribution is normal, the next step is to calculate the probability that college transition messaging has a positive impact on immediate college enrollment (or an impact larger than some particular size deemed to be meaningful). This is done by calculating the area under the normal curve for impacts greater than zero (or greater than a particular number).

This calculation may be more familiar to some analysts if it is first demonstrated using a standard normal distribution with a mean of zero and a standard deviation of 1. With a standard normal distribution, the probability of a score greater than zero is 50 percent (Exhibit D.13, left panel) and the probability of a score greater than 1.96 is 2.5 percent (Exhibit D.13, right panel).

[41] Because the iterative solution used in the second approach has a random starting point, the posterior means and standard deviations vary slightly over repeated analyses. Any differences in results between the iterative and closed-form approaches were at the fourth or fifth decimal place.

Exhibit D.13 Probabilities from a Standard Normal Distribution

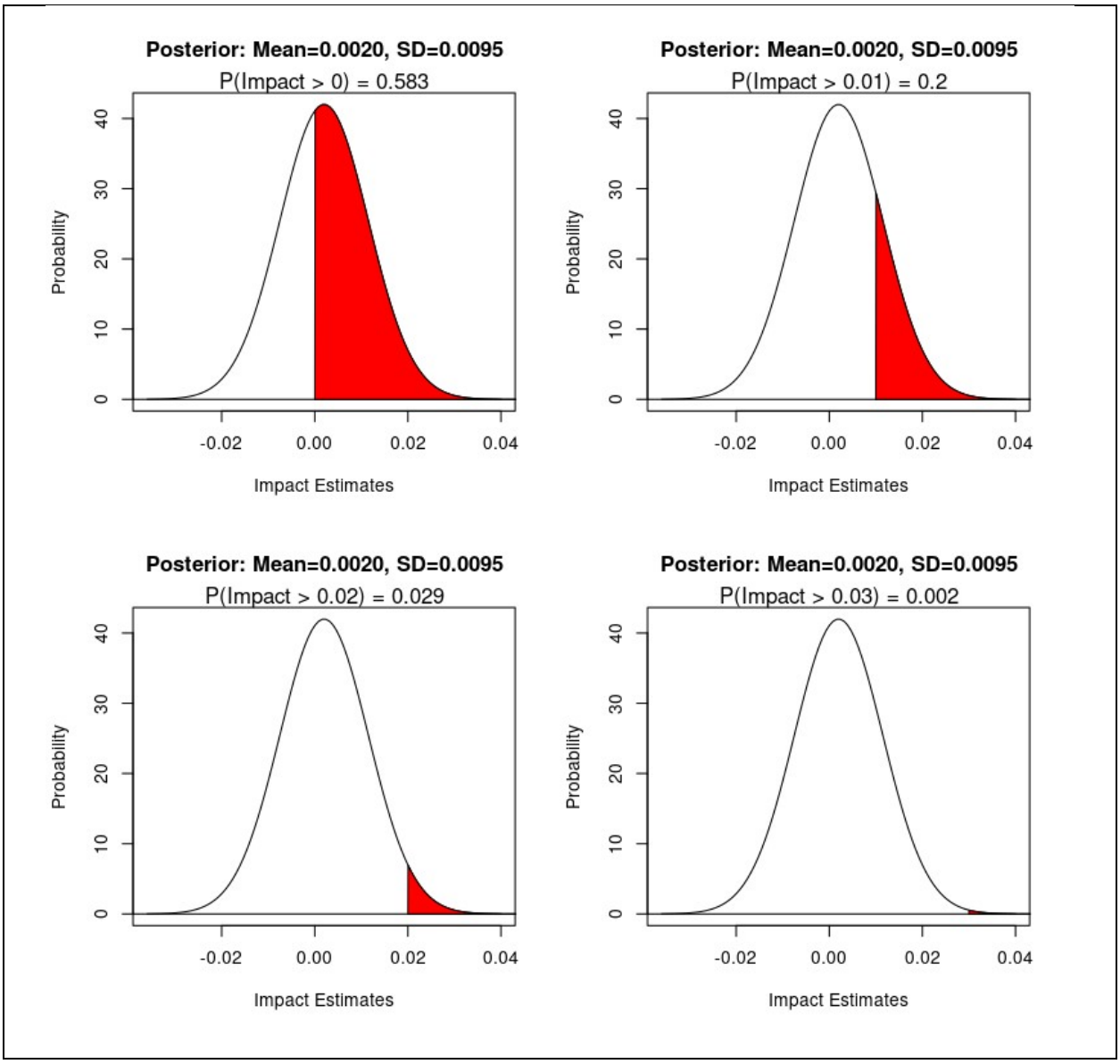


Notes: In order to facilitate replication of results, examples of how to calculate the probability of a score greater than, for example, 1.96 under a normal distribution with mean =0 and standard deviation =1 are provided as follows:
Using R software: 1-pnorm(q=1.96,mean=0,sd=1)
Using SAS software: DATA NORMAL; MU=0; SIGMA=1; q=1.96; Z=(q-MU)/SIGMA; PROBABILITY = 1-PROBNORM(Z);
Using Stata software: display 1-normprob((1.96-0)/1)

As indicated in the top row of Exhibit D.9, the posterior distribution obtained from the primary approach to the Bayesian analysis had a mean and standard deviation equal to I_{Postr} = 0.0020 and SD_{Postr} = 0.0095, respectively.[42] From that posterior distribution the probability that college transition messaging has a positive impact on immediate college enrollment can be calculated, and the probabilities that the impact is larger than 1, 2, or 3 percentage points can be calculated. The results are obtained from examination of the probabilities shown in Exhibit D.14. For example, the top left panel of the exhibit shows that the probability that college transition messaging has an impact that is greater than zero is 58.3 percent.

[42] As a reminder, the primary approach to the Bayesian analysis used a literature review to identify relevant prior studies, did not make an adjustment for potential publication bias, and used closed-form equations for calculating the prior and posterior distributions.

Exhibit D.14 Probabilities of Impacts that are Greater than 0, 1, 2, or 3 Percentage Points



Notes: Examples of how to calculate the probability of an impact greater than, for example, 0.01 under a normal distribution with mean =0.0020 and standard deviation =0.0095 are as follows:

Using R software: 1-pnorm(q=0.01,mean=0.0020,sd=0.0095)
Using SAS software: DATA NORMAL; MU=0.0020; SIGMA=0.0095; q=0.01; Z=(q-MU)/SIGMA; PROBABILITY = 1-PROBNORM(Z);
Using Stata software: display 1-normprob((0.01-0.0020)/0.0095)

D.6.4 Notes on Use of the "Benchmark Priors"

Deke and Finucane (2020) recommended use of "benchmark priors," and the study team obtained the relevant numbers from Herrmann et al. (2019, Table D.1), from the row labeled "All findings from WWC that met standards." The numbers used were from the columns "Average effect size, Precision adjusted = 0.20," "Standard deviation of effect sizes, Precision adjusted = 0.26," "Average effect size, File drawer adjustment = 0.04," and "Standard deviation of effect sizes, File drawer adjustment = 0.23." The benchmark numbers presented in that table are in standard deviation units, whereas the Bayesian analysis presented here uses impact estimates in the metric of proportions. For example, the impact estimate from Linkow et al. (2020) is 0.0001 proportion units, or 0.01 percentage points. In order to use the benchmark numbers, they needed to be converted into proportion units or percentage points. The

following formulas were used to convert benchmark means and standard deviations (SDs) from standard deviation units into percentage points or proportion units:

$$Mean_{\ in\ Percentage\ Point\ Units} = Mean_{in\ SD\ Units} * 100 * \sqrt{BaseRate * (1 - BaseRate)}$$

$$Mean_{\ in\ Proportion\ Units} = Mean_{in\ SD\ Units} * \sqrt{BaseRate * (1 - BaseRate)}$$

$$SD_{\ in\ Percentage\ Point\ Units} = SD_{in\ SD\ Units} * 100 * \sqrt{BaseRate * (1 - BaseRate)}$$

$$SD_{\ in\ Proportion\ Units} = SD_{in\ SD\ Units} * \sqrt{BaseRate * (1 - BaseRate)}$$

The "*BaseRate*" used in these calculations was the average rate, across both the treatment and control groups students, of immediate college enrollment reported in the main analyses of Linkow et al. (2020). That *BaseRate* was 0.663 (66.3 percent of students enrolled in college immediately after high school). For example, the benchmark number "Average effect size, Precision adjusted in standard deviation units = 0.20" in standard deviation units corresponds to "Average effect size, Precision adjusted in proportion units = 0.0945":

$$Mean_{\ in\ Proportion\ Units} = 0.20 * \sqrt{.663 * (1 - .663)} = 0.0945$$

The benchmark number "Standard deviation of effect sizes, Precision adjusted in standard deviation units = 0.26" corresponds to "Standard deviation of effect sizes, Precision adjusted in proportion units = 0.1229."

Exhibit D.15 provides R and SAS program code to calculate posterior means and standard deviations, from the converted benchmark priors, and to estimate the probabilities that impacts are greater than zero, or greater than 1, 2, or 3 percentage points.

Exhibit D.15 R and SAS Program Code Using Benchmark Priors to Calculate Posterior Mean and Standard Deviation, and to Estimate Probabilities that Impact is Greater than Zero or 1, 2, or 3 Percentage Points

```
######## R Code #########
#Define an R function named Posterior.fnc
Posterior.fnc= function(I.Study, SE.Study, I.Prior, SD.Prior){
I.Postr = I.Prior*(1-(SD.Prior^2 / (SD.Prior^2 + SE.Study^2) ) ) + I.Study* ( (SD.Prior^2 / (SD.Prior^2 + SE.Study^2) ) )
SD.Postr = sqrt( (SD.Prior^2 * SE.Study^2) / (SD.Prior^2 + SE.Study^2) )
round(cbind(I.Study,SE.Study,I.Prior,SD.Prior,I.Postr,SD.Postr),4)
}

# Call the function using current study mean and SE and prior mean and SE
# arguments
Posterior.fnc(I.Study=.0001, SE.Study=.0124,I.Prior=0.0945, SD.Prior=0.1229)

#Results
 I.Study SE.Study I.Prior SD.Prior I.Postr SD.Postr
[1,] 1e-04 0.0124 0.0945 0.1229 0.0011 0.0123

##########################
Given these observed data, and the benchmark priors, the probability that texting intervention has an impact on on-time
college enrollment that is greater than zero, one, two or three percentage points is calculated:
##########################
1-pnorm(q=0.00,mean=0.0011 ,sd= 0.0123)
1-pnorm(q=0.01,mean=0.0011 ,sd= 0.0123)
1-pnorm(q=0.02,mean=0.0011 ,sd= 0.0123)
1-pnorm(q=0.03,mean=0.0011 ,sd= 0.0123)

## Results
```

```
> 1-pnorm(q=0.00,mean=0.0011 ,sd= 0.0123)
[1] 0.5356303
> 1-pnorm(q=0.01,mean=0.0011 ,sd= 0.0123)
[1] 0.2346627
> 1-pnorm(q=0.02,mean=0.0011 ,sd= 0.0123)
[1] 0.06219744
> 1-pnorm(q=0.03,mean=0.0011 ,sd= 0.0123)
[1] 0.009396962
```

```
/* ********** SAS Code **********/
data b1; input
I_Study    SE_Study I_Prior   SD_Prior; cards;
0.0001 0.0124       0.0945   0.1229
;
data b2; set b1;
I_Postr = I_Prior*(1-(SD_Prior**2 / (SD_Prior**2 + SE_Study**2) ) ) + I_Study* ( (SD_Prior**2 / (SD_Prior**2 + SE_Study**2) ) );
SD_Postr = sqrt( (SD_Prior**2 * SE_Study**2) / (SD_Prior**2 + SE_Study**2) );
run;
proc print; run;
/*
Obs I_Study SE_Study I_Prior SD_Prior I_Postr SD_Postr
 1 .0001 0.0124 0.0945 0.1229 .00105129 0.012337
*/
```

##########
Given these observed data, and the benchmark priors, the probability that texting intervention has an impact on on-time college enrollment that is greater than zero, one, two or three percentage points is calculated:
##########

```
DATA NORMAL; MU=0.0011; SIGMA=0.0123; q=0.00; Z=(q-MU)/SIGMA; PROBABILITY = 1-PROBNORM(Z);proc print; run;
DATA NORMAL; MU=0.0011; SIGMA=0.0123; q=0.01; Z=(q-MU)/SIGMA; PROBABILITY = 1-PROBNORM(Z);proc print; run;
DATA NORMAL; MU=0.0011; SIGMA=0.0123; q=0.02; Z=(q-MU)/SIGMA; PROBABILITY = 1-PROBNORM(Z);proc print; run;
DATA NORMAL; MU=0.0011; SIGMA=0.0123; q=0.03; Z=(q-MU)/SIGMA; PROBABILITY = 1-PROBNORM(Z);proc print; run;

Obs MU SIGMA q Z PROBABILITY
 1 .0011 0.0123 0 -0.089431 0.53563
 1 .0011 0.0123 0.01 0.72358 0.23466
 1 .0011 0.0123 0.02 1.53659 0.062197
 1 .0011 0.0123 0.03 2.34959 0.009396962
```

APPENDIX E. COLLEGE ADVISING EXPERIENCES

The appendix provides information about students' reported college advising experiences in the participating GEAR UP high schools. This detail is intended to provide information about the context in which the study's college transition messaging occurred.

The survey of students participating in GEAR UP at high schools in the study collected data on college advising experiences for all students who responded to the survey at the start of the study (n=9,677).[43] The survey asked students how often they had discussed common college advising topics with a college counselor or advisor at their school during their junior or senior year.[44] Exhibit E.1 presents information about how each college advising measure was constructed, along with the missing data rates on each of the eight college advising topics asked about on the survey.

Exhibit E.1 Measures of College Advising Topics that GEAR UP Students Discussed with High School Counselor/Advisor

College Advising Topic	Definition/Coding Question 16: Since the beginning of last school year, that is, your junior year, how many times have you discussed the following topics with a college counselor/advisor at your high school? [5=5 or more times, 4=4 times, 3=3 times, 2=2 times, 1=1 time, 0=0 times]	Percentage of Students Missing Data (%)	
		Treatment Group	Control Group
College outcomes	College graduation rates, employment rates, and/or other student outcomes at different colleges)	3.41	3.23
Admissions requirements	Admissions requirements [such as SAT/ACT scores, transcripts, and letters of recommendation] for different types of colleges)	3.55	3.07
Application timelines	Timelines for applying to college	3.58	3.48
How to complete the Common Application	How to complete the Common Application	3.94	3.68
Options for paying for college	Your family's options for paying for college	3.97	3.78
Cost of college with financial aid	How much you and your family will have to pay for college if you get financial aid)	4.40	3.98
How to complete the FAFSA	How to complete the FAFSA form	3.69	3.48
College fit	Colleges that would be a good fit for you based on your grades, resources, and interests	5.11	4.64

Source: Student survey 2016 and 2017.

Information about the relative frequency with which students in GEAR UP high schools participating in this study discussed college-related topics with their high school counselor/advisor is presented in Exhibit E.2. More than half of students reported doing so *at least three times* about timelines, admissions, cost after financial aid, outcomes, fit, and their family's options for paying for college. In contrast, fewer than half of students reported talking as frequently with their counselor/advisor about how the FAFSA or the Common Application.

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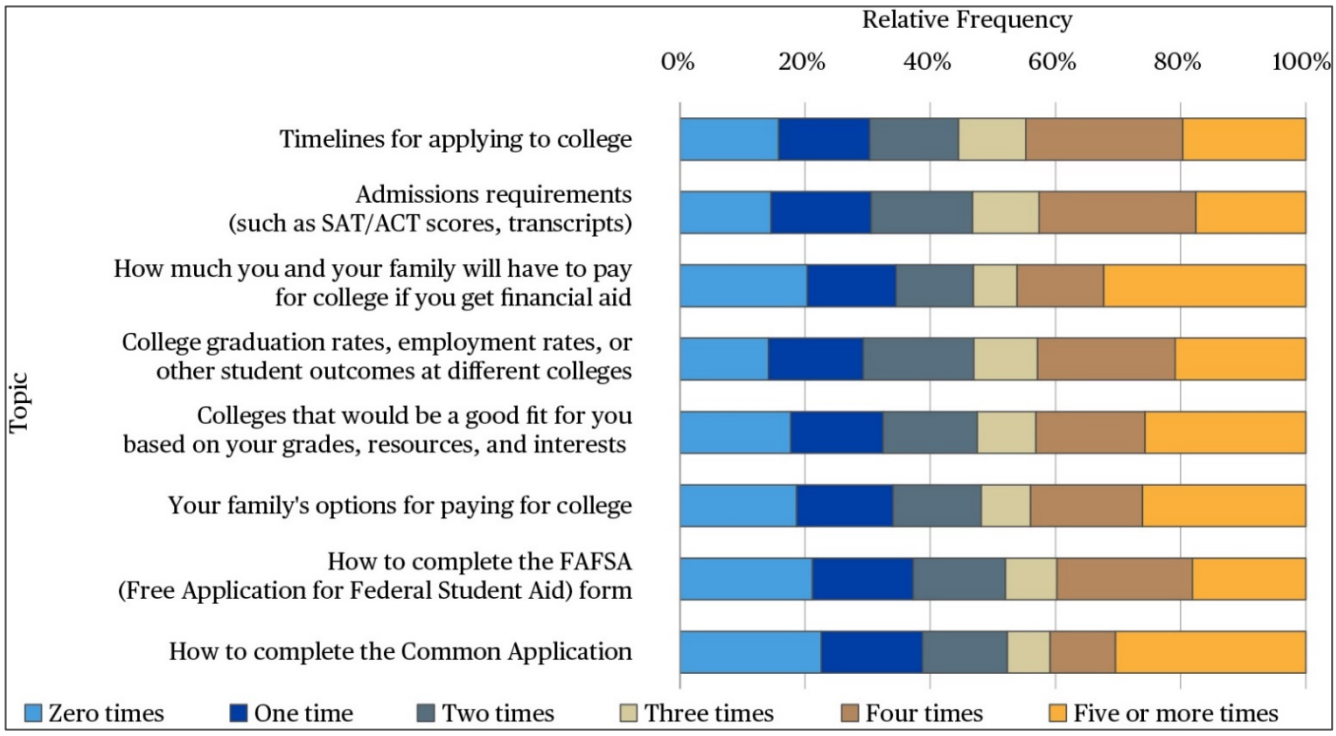
[43] Some 82 percent of high school seniors from participating schools responded to the student survey. No data are available for the survey non-respondents to check for potential non-response bias. However, because the response rate for the survey is higher than 80 percent, the study team can assume that the survey responses represent the sample of high school seniors from participating schools. The student survey can be found at: https://www.reginfo.gov/public/do/PRAViewIC?ref_nbr=201503-1850-002&icID=215771.

[44] Topics were identified based on other surveys of high school students (for example, the High School Longitudinal Survey of 2009 and the Consortium on Chicago School Research's Spring 2005 Survey of Chicago Public Schools Senior Student Edition).

It is important to note that these results may not capture other types of preparation for college that students received while in high school, and that students may have discussed these and other college-related topics with other adults.

Exhibit E.2 How Often GEAR UP Students from Study High Schools Discussed College-related Topics with High School Counselor/Advisor



Notes: Percentages represent share of students, of those who responded to the survey, who said they discussed a certain topic with their high school college counselor a given number of times (from zero to five or more). Results shown are for all students surveyed, which include students not eligible for the text-message-based advising study because they did not plan to enroll in college after high school.
Sample Sizes:
Timelines for applying to college: 9,190 students
Admissions requirements: 9,215 students
How much college likely to cost with financial aid: 9,124 students
Outcomes at different colleges: 9,233 students
College fit: 9,063 students
Options for paying for college: 9,181 students
How to complete the FAFSA: 9,199 students
How to complete the Common App: 9,180 students
Source: Student survey 2016 and 2017.

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