Conditions under which college students can be responsive to text-based nudging

Lindsay C. Page, Katharine Meyer, Jeonghyun Lee, and Hunter Gehlbach*

Abstract

College success requires students to engage with their institution academically and administratively. Missteps with required administrative processes can threaten student persistence and success. Through two experimental studies, we assessed the effectiveness of an artificially intelligent text-based chatbot that provided proactive outreach and support to college students to navigate administrative processes and use campus resources. In both the two-year and four-year college context, outreach was most effective when focused on discrete administrative processes such as filing financial aid forms or registering for courses which were acute, time-sensitive, and for which outreach could be targeted to those for whom it was relevant. In the context of replicating studies to better inform policy and programmatic decision making, we draw three core lessons regarding the effective use of nudge-type efforts to promote college success.

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*Page: Brown University, 164 Angell Street, Providence, RI 02906 (email: lindsay_page@brown.edu); Meyer: Brookings Institution, 1775 Massachusetts Ave, Washington, DC 20036 (email: kmeyer@brookings.edu); Lee: Georgia Institute of Technology, North Avenue, Atlanta, GA 30332 (email: jonnalee@gatech.edu); Gehlbach: Johns Hopkins University, 2800 N. Charles Street, Baltimore, MD 21218 (email: gehlbach@jhu.edu). We gratefully acknowledge Georgia State University and especially Dr. Timothy Renick and C. Lindsey Fifield for their support and engagement with this study. In addition, we gratefully acknowledge members of the Mainstay team for their insights and feedback. We thank the Michael and Susan Dell Foundation (MSDF) for providing financial support to make this research possible, and we acknowledge both MSDF and the ECMC Foundation for their financial support of project implementation. All errors are our own. This paper does not reflect the opinions of Georgia State University, Mainstay, the Michael and Susan Dell Foundation, or the ECMC Foundation.

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INTRODUCTION

Currently, most US high school graduates pursue some form of postsecondary education (Irwin et al, 2021). Of those who enter higher education, however, many exit with no degree or credential. Given the rising tide of US income inequality, differences in degree attainment by socioeconomic status are particularly concerning. Not only are students from wealthier backgrounds more likely to access college, but conditional on enrollment, they are also more likely to complete their degree (Kena et al, 2014; McFarland et al, 2017). For example, among 2002 high school graduates, approximately three-quarters of students from high-SES backgrounds, compared to about half of students from low-SES backgrounds, earned a postsecondary degree or credential within eight years of high school completion. For college entrants from low-income backgrounds, obtaining some postsecondary education but not earning a degree or credential is the modal outcome (Kena et al, 2014). Compounding this problem is the fact that many low-income students take out loans to attend. A trend in which students enter but do not complete college has the potential to exacerbate income inequality if students from low-income backgrounds disproportionately assume college debt without the labor market payoff of a college credential.

With this trend in mind, institutions have sought solutions to better support students to earn a credential. Diminishing institutional resources – driven by forces like reduced state funding and increased student enrollment – contribute to declining completion rates (Bound, Lovenheim & Turner, 2010) and may inhibit the implementation of these support efforts. Where campuses do invest in comprehensive support for undergraduates from low-income backgrounds, persistence and degree attainment outcomes have been improved (see Dynarski, Nurshatayeva, Page & Scott-Clayton, 2022, for a recent review). However, such investments prove challenging for resource-

constrained campuses. This context motivates the questions of whether universities can leverage low-cost, behavioral strategies to improve students' postsecondary outcomes and, if so, how such efforts can be made as effective as possible.

Success in college requires students to engage with their institution academically and administratively, and challenges in both domains can hinder students' success. Many college-intending students, particularly those from low-income backgrounds, fail to navigate the administrative steps required in the transition to and persistence through college (Castleman & Page, 2014, 2015). Once enrolled, students may lose access to financial aid by failing to (re)file the Free Application for Federal Student Aid (FAFSA; Bird & Castleman, 2016) or may face fines for missing administrative deadlines for enrolling in or dropping courses.

However, missteps with such processes do not necessarily threaten students' ability to persist uniformly. First-generation, low-income, and minoritized students can face substantial, unique challenges to college completion (Jack, 2019). Working within social and cultural capital frameworks, students' access to informational networks and resources affects their engagement with postsecondary systems. These students, in particular, may not have access to the "dominant cultural capital" that can be required to navigate complex postsecondary education processes and systems (Bourdieu, 1983; Carter, 2005; Perna, 2006).

Since 2016, Georgia State University (GSU) has employed an artificially intelligent, text-based, conversational chatbot to proactively support would-be first-year students as they navigate the required administrative enrollment processes. This outreach improved GSU-committed students' completion of several required pre-matriculation tasks and increased their timely matriculation at GSU by a significant 3.3 percentage points (Page & Gehlbach, 2017). Given the success of this effort, GSU scaled its matriculation chatbot as a standard means of communication

with students through their summer transition to GSU. The university then sought to test the effectiveness of the same chatbot technology to improve navigation and completion of administrative and other processes among their enrolled undergraduates. In this paper, we report on the experimental expansion of the chatbot tool to support undergraduates enrolled at both the two-year and four-year campuses of the GSU system.

We experimentally tested chatbot implementation on GSU's four-year Atlanta campus (hereafter, GSU-Atlanta) in 2018-19 and on GSU's two-year Perimeter College campuses (GSU-Perimeter) in 2020-21 and consider whether the communication strategy affected students similarly across contexts. In both contexts, outreach was tailored to student needs where possible. General messages were sent to all students (e.g., messages providing information on course add/drop deadlines). However, customized campaigns targeted individual students according to their specific needs as indicated by administrative records held by the university. For example, messages regarding registration holds were sent only to students required to resolve holds, and messages regarding FAFSA filing were sent only to those who had not yet filed. Across the two campuses, campaigns targeted similar domains and engaged in the same level of customization and targeting to ensure students only received relevant outreach.

Through a pair of randomized trials, including an initial, exploratory implementation and a pre-registered replication, we estimate causal impacts of this chatbot communication on completion of specific actions as well as on overall measures of persistence and success. To preview our findings, the chatbot outreach most consistently affected student behavior when it addressed "acute" administrative processes, meaning that an administrative task was serious, time-sensitive, or both. These include issues such as registration holds and outstanding balances that needed to be resolved for the student to remain enrolled. In contrast, communication encouraging

students to utilize supplemental supports—meeting with advisors, attending course-specific supplemental instruction, and other less acute issues—yielded little to no effect. We also find suggestive evidence that the timing of outreach matters, with messages distributed earlier in the semester having a larger effect on task completion. Outreach did not have a significant effect on overall indicators of academic success, including credit hours attempted / earned or term GPA. Nevertheless, by the end of the spring term, treatment group students were 1.5 and 3 percentage points more likely to have filed the FAFSA at GSU-Atlanta and GSU-Perimeter, respectively, and approximately two percentage points more likely to have registered for the following fall semester. Given these findings, the GSU administration judged that the study results were compelling enough to conclude the experiments and roll the chatbot system out to all matriculated students.

BACKGROUND

Nudging: early promise and learning from efforts to scale

Multiple, complex administrative processes can hinder students' access to and success in college. For example, approximately 10 percent of first-year Pell grant recipients in good academic standing fail to refile the FAFSA for their sophomore year, forfeiting an average of $3,550 in federal aid (Bird & Castleman, 2016). These administrative processes can be even more daunting for students pursuing an associate degree. Two-year institutions often have fewer financial resources and spend less per pupil than four-year public universities (Goolsbee et al, 2019). Consequently, their support systems for their students may be more tenuous than for students at better-resourced institutions. Absent adequate advising, students can struggle to navigate the "shapeless river" through community college (Scott-Clayton, 2015). While some 85 percent of students starting at a public four-year college persist into their second year, only 62 percent of students starting at a two-year institution do so (NSC, 2021). Despite the unique challenges these

students face, few studies have tested the effect of virtual, interactive outreach on students enrolled in two-year colleges.

Research points to the benefit of behaviorally informed strategies to help students navigate aspects of the college-going process (see Page & Scott-Clayton, 2016; Dynarski et al., 2022, for recent reviews). Even before college enrollment, coupling college entrance exams with the regular school day and filing the FAFSA together with annual tax filing have both increased completion of these key college-going tasks with subsequent effects on college enrollment and persistence (Bettinger et al., 2012; Hurwitz, Smith, Niu & Howell, 2015; Hyman, 2017). Both efforts represent reductions in procedural complexity. Another approach has been to acknowledge existing complexity and proactively communicate with and support students to "nudge" them toward task completion (Thaler & Sunstein, 2009). Several studies have tested interventions to support college-intending high school students and/or recent graduates through the administrative steps required to apply to and enroll in college and to file or refile the FAFSA (Castleman & Page, 2015, 2016, 2017; Castleman, Page & Schooley, 2014; Page, Castleman & Meyer, 2019; Avery et al, 2021).

Despite the early promise that this body of work suggested, subsequent efforts to scale nudge-type interventions or apply them to a broader range of behaviors paint a more complicated picture. For example, perhaps nudges work, but only when they come from a trusted, local source with which students have a relationship. In large-scale, state and national efforts to bolster FAFSA filing and reapplications (Bird et al, 2021; Page et al, 2022), impacts on FAFSA submission and completion are modest to null. Bird and colleagues note that in their intervention, outreach was framed as coming from a centralized entity with which students had no affiliation. They conclude that successful scaling of such efforts needs to happen "locally," institution by institution, rather than "globally" through a centralized entity. Indeed, another pair of experiments supports the

hypothesis that outreach framed as coming from a student's own institution is more promising for affecting completion of key college-going tasks than outreach from a more distal sender, such as The College Board (Avery et al, 2021). The Avery et al. study finds positive effects of locally implemented outreach (e.g., outreach to students from their own high school counselor).

In addition to having previously established relationships, local organizations may be better positioned to nudge students because they have better insight into the context in which students are operating, the particular tasks students need to complete, the required timing for those tasks, and students' status with those required processes. These factors enable crafting outreach that is tailored and relevant to students' needs. For example, by incorporating student-level administrative data into the outreach strategy, organizations can target communication only to students for whom it is relevant. Such data integration was possible in GSU's first chatbot experiment focused on supporting students with required pre-matriculation processes. Data on students' status with required processes facilitated the targeting of outreach as well as the examination of how the targeted outreach improved task completion and college matriculation (Page & Gehlbach, 2017).

Finally, Oreopoulos and Petronijevic (2019) report on nudge interventions designed to move student behavior on more sustained behavioral changes (as opposed to discrete, well-defined tasks). Specifically, the authors tested interventions focused on (1) goal-setting; (2) mindset; and (3) coaching on how to be a successful student, all tasks with different foci, more complex components, and with longer time-horizons than the acute, discrete tasks on which we observe impacts in the current study. The authors emerge with a pessimistic view of the potential for nudge strategies to improve academic outcomes, although they do note that the coaching intervention they investigated led to modest increases in study time and other non-academic outcomes, including students' feelings of support and well-being. Nevertheless, the magnitude of the effects

on these intermediate outcomes were not sufficient to drive changes in academic outcomes such as course performance and credit attainment. This work raises questions of whether nudges may be effective when they target discrete, time-bound tasks but hold less efficacy for influencing sustained behavioral change over time—a quality that may be needed for driving outcomes like academic achievement. If so, this conclusion would align with earlier work on incentivizing academic achievement. For example, Fryer (2011) found that well-defined educational inputs can be shifted effectively by incentives, but that incentivizing outputs without guidance on the steps necessary to attain a given level of academic achievement yields little to no effect.

In sum, from this growing body of literature, we draw several hypotheses regarding the conditions that contribute to success of nudge-type interventions in shaping student behavior. First, outreach should be framed as coming from a trusted source with whom students would expect to communicate via a particular mode. Trust will be greater, the stronger the student-entity relationship and/or the more "local" the entity is to the student. Second, outreach should be targeted using data to ensure that students are receiving communication that is relevant to their personal needs and circumstances. Irrelevant messages will add noise to and reduce the potential effectiveness of any communication channel. Third, outreach may be most successful when it focuses on tasks that are well defined and required. If the consequences of inaction are ambiguous, we hypothesize that students will be less likely to respond. The experimental studies on which we report here do not test these hypotheses specifically. Nevertheless, these characteristics of this study's outreach efforts may be critical to the success that we document here. In this way, we add nuance to collective understanding of the conditions under which college students can be responsive to nudging.

The role of replication studies for shaping policy

We additionally situate our work within ongoing conversations that increasingly appreciate the importance of replication studies for guiding policy development (Plucker & Makel, 2021). Replication studies remain less common than policymakers might like. Yet, there is consensus that policies ought to be developed around consistently empirical trends (Makel & Plucker, 2014). While new and exciting findings may indeed be new and exciting, policy design based on such studies can lead to the misallocation of resources if results fail to generalize across contexts. At the same time, heterogeneity of treatment effects across contexts is likely the natural state of the world (Bryan et al., 2021). Given that assumption, to what extent should we realistically expect results to replicate across contexts? The fidelity with which the key ingredients of the intervention are executed, the relationships between people delivering and those receiving the treatment, the characteristics of the individual receiving the intervention, and many other features will all vary from one situation to the next. Thus, perhaps for most interventions most of the time, it may be more realistic for policymakers to expect substantial variation in results.

On the other hand, open science scholarship suggests that, while some heterogeneity is to be expected, some interventions may lend themselves to more consistent main effects. In contrast, some of the replication challenges witnessed in education over recent years may be due to illusory results (Gehlbach & Robinson, 2018) brought about by researchers being rewarded for testing multiple models, finding significant results, and making a case that they contribute to theory (Gehlbach & Robinson, 2021). For the broader policy community and for the context of the studies on which we report, three takeaways from this ongoing conversation seem important. First, policy decisions ought to benefit from replication studies; designing policy based on a single study in a single context seems profoundly unwise. Second, we endorse thinking of replication results along

a continuum (rather than a binary outcome). Studies may replicate to greater or lesser degrees: on more or less similar populations, in more or less comparable contexts, with weaker or stronger effect sizes, on similar or different outcomes, and so forth. Finally, per the recommendations of Bryan et al (2021), studies that inform our understanding of the conditions under which intervention effects can be reproduced (e.g., by identifying moderating factors) are especially valuable.

RESEARCH SITES AND INTERVENTION DESIGN

In summer 2016, Georgia State University (GSU) contracted with Mainstay (formerly AdmitHub) to build "Pounce," an artificially intelligent chatbot with the persona of the GSU mascot to provide text-message based outreach and support to GSU-Atlanta admitted students.[1] Pounce outreach focused primarily on supporting students to navigate administrative tasks required for on-time, initial matriculation to GSU. Using the Mainstay platform, GSU texted students to remind them of required pre-matriculation tasks, provide step-by-step guidance on navigating these tasks, and prompt them to ask questions. Enabled with artificial intelligence (AI) capacities, the platform also responded to students' questions. Questions that matched to information in the system knowledge base were answered immediately. When the AI could not match a question to an answer with a sufficiently high probability of success, the question was routed, via email, to a university staff member. The staff member's response was then routed back through the system platform both to respond to the student and to update the knowledge base.[2]

Pounce outreach increased students' rates of completing pre-matriculation requirements (e.g., submitting final transcripts, submitting housing deposits) and enrollment in GSU-Atlanta (Page & Gehlbach, 2017). Building on this success, GSU sought to deploy Pounce to provide

[1] For more information on Mainstay, see www.mainstay.com.
[2] For more information see Page and Gehlbach (2017).

proactive outreach and support to *enrolled* students, with the goal of improving persistence and success. During the 2018-2019 academic year, GSU-Atlanta chatbot implementation involved three full-time staff members. A project director within the university's Office of Enrollment Management and Student Success oversaw and directed the work. A full-time project associate facilitated data gathering and management for chatbot implementation and research purposes. Finally, a full-time administrative coordinator monitored and triaged incoming messages. Subsequent chatbot implementation at the GSU-Perimeter campuses during the 2020-21 academic year involved no additional staff members—although the chatbot took upfront time to develop, adapting it to the GSU-Perimeter context required considerably less staff effort. At the time of GSU-Perimeter implementation, the chatbot could respond to student queries with greater confidence due to maturation of the knowledge base through implementation at GSU-Atlanta. As a result, there was limited need for staff to answer student questions in the context of the GSU-Perimeter implementation, despite the expansion of the tool to many more students.

The university planned and deployed text-based message campaigns to GSU-Atlanta and GSU-Perimeter undergraduates in three primary domains, as follows:

- **Administrative processes.** These campaigns aimed to raise student awareness about administrative processes, many of which were financially related and/or were required for the student to remain in good standing with the university (e.g., FAFSA filing, resolving an overdue balance).
- **Academic engagement processes.** These messages included reminders about ongoing persistence tasks related to academics (e.g., course registration) and more acute tasks (e.g., addressing a registration hold due to academic performance) and typically offered encouragement to meet with an advisor to complete these tasks collaboratively.

- **Personal/professional supports.** These campaigns aimed to raise student engagement in supports that relate to students' academic success (e.g., participating in supplemental instruction), and other non-academic opportunities (e.g., career services events).[3]

Some campaigns were directed to all students; others targeted outreach only to those for whom it was relevant by integrating the platform with the university's administrative data. For example, campaigns related to registration holds were sent only to those with holds to resolve. Similarly, over the course of the spring semester, successive messages regarding FAFSA refiling were sent only to those students who had not yet filed. In situations when students had multiple holds, the chatbot team prioritized messaging students about the hold which would involve the greatest likelihood of needing to speak with a staff member – with the logic that in these complicated situations, the best use of the chatbot was to direct a student to connect with a human better equipped to help them navigate their complex situation.

Messages informed students of tasks that needed completion and identified actionable steps. A common message structure included the *what* ("looks like you have a balance hold on your account"), the *consequence* ("this will stop you from registering for summer & fall"), and a *call to action* ("You can take care of this hold through your account. For questions, email XXX"). In Appendix Tables A1 - A4, we provide date and topic information for all campaigns (Tables A1 and A2 report on GSU-Atlanta messages; Tables A3 and A4 report on GSU-Perimeter messages). We also detail whether the outreach was sent to all students or to a targeted subset. Finally, we indicate whether we report outcome data related to the behavior the outreach sought to encourage.

[3] These also included reminders about social, community-building events, such as a Thanksgiving feast for international students and (for the GSU-Perimeter chatbot) reminders about campus COVID-19 testing and vaccine resources. GSU also launched additional campaigns in the GSU-Perimeter administration to understand students' adaptation to online learning and instructional modality preferences; these campaigns were designed to collect student feedback rather than designed to change student behavior.

RESEARCH DESIGN, DATA, AND ANALYSIS

We evaluated the impact of the GSU-Atlanta and GSU-Perimeter retention chatbots through separate randomized controlled trials. The GSU-Atlanta implementation took the form of an exploratory design and analysis, piloting messages and exploring what student tasks were best aligned with chatbot outreach. Following best practices in open-science, the GSU-Perimeter implementation then served as a preregistered, confirmatory study (Gehlbach & Robinson, 2018, 2021). We registered the study after the intervention concluded but prior to outcome data analysis.[4] Leveraging insights from the GSU-Atlanta implementation, we focused messages on key administrative processes at GSU-Perimeter to examine the generalizability of the retention chatbot effectiveness on an associate-degree intending student body. Here, we describe the randomization process, data, and analytic samples for each site.

GSU-Atlanta Sample and Analysis

On the GSU-Atlanta campus, students were incorporated into the study in two waves. At the beginning of the Fall 2018 semester, the initial study sample included 7,580 GSU-Atlanta students (wave 1 sample). Students in the sample were at various stages of their undergraduate career, but the sample included greater shares of first-time freshmen and recent transfers to GSU. Students in the wave 1 sample received their first message on October 2, 2018. In March 2019, the university expanded the sample by another 6,076 students (wave 2 sample) after judging the system ready to handle additional student volume. Separately by wave and within groups defined by students' year at the university,[5] we randomized students into treatment and control conditions,

[4] See Registry of Efficacy and Effectiveness Studies—Registry ID 8740.

[5] Specifically, for each wave, we stratified students into groups according to the following classifications: first-time freshmen in Fall 2017; first-time freshmen in Fall 2018; seniors in Fall 2018; transfers from other colleges / universities in Fall 2018; transfers from Perimeter College in Fall 2018; and all other students. Then, within each wave, we randomized students to treatment or control within these groups.

in approximately equal shares. Treatment students received text-based outreach from Pounce, whereas control students received business-as-usual university communication via other channels.

For both waves, after randomization we checked balance on baseline characteristics including indicators of student race/ethnicity, gender, financial aid status and prior academic achievement. We observed balance on all baseline characteristics; students assigned to treatment and control conditions were not systematically different, on average, on any dimensions that we observed. In sum, the randomization procedures were successful, and any subsequent differences in outcomes between the treatment and control groups can be attributed to the targeting of treatment students for outreach via Pounce.

We present descriptive statistics for the wave 1 and 2 samples by treatment status in Table 1. Across waves, students were largely similar on socio-demographic features. In both, the sample was approximately 13 percent Hispanic, 45 percent Black, and 30 percent White. About one-quarter of students were first-generation college-goers, and half qualified for a Pell Grant. The sample was about 60 percent female, in line with trends of women outpacing men in college enrollment (Goldin, Katz & Kuziemko, 2006). The two waves differed in their age and associated year in college, due to most incoming freshmen being included in the wave 1 sample. The typical wave 1 student was approximately 20 years old (23 years old in wave 2).

To assess the impact of treatment on student outcomes, we use fixed effects regression (controlling for randomization waves) and linear probability models of the following general form:

$$Y_{ij} = \alpha_j + \beta \times Treatment_{ij} + \boldsymbol{X\gamma} + \varepsilon_{ij} \quad (1)$$

where for student *i* in randomization wave *j*, $Treatment_{ij}$ is an indicator equal to 1 if randomized to treatment and zero otherwise, $\boldsymbol{X}$ is a vector of baseline covariates, including those in Table 1, and ε_{ij} is the individual error term. Our coefficient of interest, β, represents the intent-to-treat

effect of assignment to the text-communication treatment group on outcome Y_{ij}. In our results, we report intent-to-treat (ITT) effects estimated with and without baseline covariate controls.

Messages were not distributed to all treatment-assigned students due to circumstances such as opt out, changed phone numbers, and students temporarily "pausing" chatbot engagement, as described below. Although we cannot observe a student received and read a message, we can observe whether it was successfully distributed. Therefore, we use a two-stage least squares instrumental variables (IV) approach to assess the effect of successful distribution. In the first stage, we use treatment assignment to instrument for message distribution, and in the second stage, we model the outcome as a function of message distribution. The IV results that we report are from models that include baseline controls. Because distribution rates were uniformly high, ITT and IV results differ modestly, if at all, across outcomes.

GSU-Perimeter Sample and Analysis

The GSU-Perimeter study sample included 11,561 students at various stages in their undergraduate career, randomized in a single wave at the start of the 2020-21 academic year. The first study message was distributed to the GSU-Perimeter treatment students on September 10, 2020. We present descriptive statistics for the Perimeter sample in Table 1. We again observe balance across a host of baseline student characteristics. As Table 1 illustrates, the average age of the GSU-Perimeter sample is about 23. Compared to GSU-Atlanta, the share of Black students is slightly higher (51 percent), and slightly more students qualified for the Pell grant (57 percent) at GSU-Perimeter. The most striking differences is in prior academic performance. The average high school GPA was 3.5 for the GSU-Atlanta sample and about 2.8 for the GSU-Perimeter sample. The admissions criteria for GSU-Atlanta are higher than for GSU-Perimeter, and students who do not meet admissions criteria for GSU-Atlanta are automatically offered GSU-Perimeter admission.

These differences enable us to examine the extent to which similar intervention message content has a consistent effect on a different student population. For the GSU-Perimeter sample, we fit models similar to the form expressed in equation (1) but without the randomization wave fixed effects.

Conditional Analysis

On both campuses, some messages were directed to all treatment students, whereas others were targeted to the subset of students for whom they were relevant. To assess impact in these targeted instances, we first condition the sample on whether the message topic is relevant and then estimate the treatment effect within this conditional sample. For example, in the case of a message related to an unpaid bill, we first condition the sample (both treatment and control) on having an unpaid bill at the time of the campaign and then estimate the effect of assignment to treatment within this subsample.

RESULTS

System use and engagement

In Table 2, we present platform usage and student engagement metrics across both campuses. There was no control group crossover, and so system usage and engagement data pertain only to treatment-assigned students. In the first column, we report overall counts of outgoing (from Pounce to students) and incoming (from students to Pounce) messages. During the GSU-Atlanta intervention, the system distributed nearly a quarter-million messages to treatment group students. Most of these messages were planned outreach campaigns. Another 5,000 messages were generated by the AI capabilities of the system in response to student inquiries. Nearly 800 messages to students were “triaged” responses such that a member of the chatbot team directly intervened and responded to a student inquiry, and only a handful of the messages were

staff responses to messages escalated to them.[6] Throughout the year, students sent approximately 16,000 text messages into the Pounce system. Most commonly, these were responses to closed-ended question (e.g., answering a yes/no question), but students also sent over 5,000 open-ended questions into the system. The number of student inquiries escalated to staff exceeds the number of times staff responded through the system, because staff members could reach out to the student via channels other than the text platform.

In the remaining columns of Table 2, we present measures of average student engagement, separately by wave. For GSU-Atlanta, wave 1 students received outreach throughout the entire 2018-19 academic year, whereas the wave 2 students were added midway through the spring term. Here, we focus our discussion on the wave 1 results and note that wave 2 results are largely consistent but reflective of outreach over a shorter duration. The typical wave 1 treatment student received approximately 57 outreach messages. This consisted primarily of pre-planned campaign messages, a small number of automatic responses provided by the system's AI capabilities, and an even smaller number of messages sent by staff members through the system. The typical student sent approximately three messages to Pounce, with two of these messages being responses to close-ended survey questions and one being an open-ended question.

GSU used administrative data to customize and target outreach to students when possible. Given this targeting, the modest overall levels of student engagement mask substantial heterogeneity in student use of the system. For example, although many students primarily received the general outreach directed to all students, the most engaged student received a total of

[6] Escalation occurred when student messages were too specific or nuanced for the AI system to answer directly. In instances of escalation, the message was manually forwarded to the most relevant administrative unit among the following: Advising Office, Career Services, Financial Aid, International Student and Scholar Services, Registrar Office, and Student Success. In most cases, responses flowed back through the chatbot system in order to further update the system knowledge base.

170 text messages and sent nearly 100 texts during the year. Of these incoming messages, the majority were open-ended questions that the system handled automatically. Further, the modest level of engagement of students through the platform can also be explained by the fact that many of the messages sought to prompt follow up with a campus office rather than communicating through the text system necessarily. As we show below, the targeted outreach was highly successful in eliciting this type of response.

Finally, when students indicated that they no longer wished to interact with Pounce, the system prompted them to text "#PAUSE" and asked them to choose if they wanted to pause outreach temporarily for two weeks or permanently. Among wave 1 treatment students, approximately 5 percent opted out of receiving outreach entirely and another 8 percent employed the "pause" option, whereby they requested a two-week hiatus before outreach resumed. As would be expected for the shorter-duration intervention, opt out and pause rates are lower among students in the wave 2 sample. In general, opt out rates even among the wave 1 students are on par with opt-out rates in prior, shorter duration text-based interventions and suggest that students generally are willing to receive university communication via text message over a more sustained period.

While we collected more limited information from the GSU-Perimeter implementation, we observe similar distribution and response patterns. The GSU-Perimeter implementation distributed about 298,000 messages and received about 21,000 replies from students. Each treated student received about 52 messages throughout the academic year and messaged in about 3.9 times. Fewer messages required escalation to staff. Students at GSU-Perimeter were much less likely to fully opt out, and about 4.4 percent of treated students paused their campaign at least once.

Impact analysis

In the tables that follow for each student outcome, we first report the control group average – either for the full control group or the subset of the control group who would have been targeted for a given campaign were they assigned to the treatment condition (column 1). In columns (2) and (3), we report ITT effects with and without baseline covariate controls. In columns (4) and (5), we report results from our IV estimation, with first-stage effects of treatment assignment on message distribution in column (4) and the instrumented effect on the outcome in column (5). In column (6), we report the number of students for whom the message was relevant (i.e., the size of the sample included in treatment effect estimation). We present results for the GSU-Atlanta intervention in Panel A and the results for the GSU-Perimeter intervention in Panel B.

Impact of messaging on completion of administrative processes – financial management

In Table 3, we examine whether the chatbot affected FAFSA filing. About 59 percent of control students in the GSU-Atlanta sample filed the FAFSA by the end of the academic year; treated students were about three percentage points more likely to file the FAFSA. Our treatment-on-the-treated estimates suggest a 4.5 percentage point (almost eight percent) increase in FAFSA filing. GSU-Perimeter effects were similar. About 47 percent of control students at GSU-Perimeter filed the FAFSA by the end of the year. The chatbot increased filing by 1.5-2.1 percentage points, and our treatment on the treated estimates suggest an 8.6 percentage point (about eighteen percent) increase for the students to whom the FAFSA prompts were sent. At GSU-Perimeter, FAFSA reminder messages were particularly effective at nudging early FAFSA completion – the chatbot effect on FAFSA filing by March 14 was 2.3 percentage points, before fading somewhat to about 1.5 percentage points by the end of the semester.

As the semester progressed, successive FAFSA messages only went to those who had not yet filed. Therefore, the *composition* of FAFSA message recipients shifted over time to include fewer "eventual FAFSA filers." For example, during the spring semester at GSU-Perimeter, about 32% of control group students who hadn't filed the FAFSA by mid-February eventually completed the application, while only 16% of students in the control group who hadn't filed the FAFSA by early May eventually did so. Put differently, the likelihood of successfully nudging a student to complete the FAFSA diminished later in the application cycle. Not only do we expect there to be fewer marginal FAFSA filers later in the academic year, but the share of potential marginal FAFSA filers is skewed between control and treatment groups – treated students have received messages prompting marginal filers to act sooner, and therefore fewer treatment students are eligible for reminders later in the semester. This offers one plausible explanation for why messages earlier in the semester had a larger effect on filing than messages later in the semester.

At GSU-Perimeter we also observed the effect of a targeted message about FAFSA verification, a federally mandated process in which selected students are required to verify information reported on their FAFSA. FAFSA verification disproportionately affects low-income students (e.g., would-be Pell grant recipients) and imposes substantial administrative costs on postsecondary institutions, with little improvement to the efficiency of aid distribution (Guzman-Alvarez & Page, 2021; Page et al, 2020; Wiederspan, 2019). Students who fail to verify their FAFSA information lose access to several sources of financial aid (Cochrane et al., 2010). In the GSU-Perimeter sample, messaging about a verification hold was relevant for 453 students. Yet, for this small group, outreach had a positive effect on successful navigation of this process.

Relative to 22% of selected control group students completing required verification steps, selected treatment group students were approximately 8 percentage points more likely to do so.[7]

The effect of chatbot outreach on students' management of financial account issues also seemed promising. Some students have an outstanding balance on their account at the start of the semester, and if they persist in having an outstanding balance, they may be dropped from enrollment that semester. In Table 4, Panel A, we show that few students at GSU-Atlanta had an outstanding balance at the start of the fall or spring semesters (*N*s = 374 and 257, respectively). However, only 22 percent of control students resolved their balance early in the fall semester. In the fall, treated students were 7-9 percentage points more likely to resolve their balance and 10 percentage points less likely to have been withdrawn for non-payment within a week of receiving a chatbot reminder. In the spring, about 55 percent of control students resolved their balance early in the semester, and treated students were 17 percentage points more likely to resolve their balance the week following chatbot outreach. The treatment effect in the spring was smaller and not statistically significant but still practically meaningful in magnitude two weeks after messaging. At Perimeter (Table 4, Panel B), many students held a balance at the start of the spring term (N = 1,984), and we observe a significant reduction in balance-related withdrawals and increased likelihood of never being dropped or being reinstated after drop. Perimeter also messaged students about additional financial aid packages students could accept; we find mixed results with an increased take-up of one-time, pandemic-related emergency aid and no effect of messaging on student take-up of an ongoing GSU supplemental grant initiative.

[7] At GSU-Atlanta, one focus of spring semester outreach was financial aid-related holds. These messages pertained to FAFSA verification as well as other missing documents. This outreach had effects on hold resolution of a similar magnitude to the Perimeter verification messaging, although these effects were not statistically significant.

As with FAFSA filing, there may be benefits to *early* completion of administrative processes like resolving outstanding balances. For example, students with outstanding balances may be dropped from their courses and lose access to online course materials while resolving their balances. Further the overall improvement in cognitive bandwidth by resolving a balance earlier may enable students to direct more attention to their studies and start the semester off strong (Mullainathan & Shafir, 2013).

Impact of messaging on completion of administrative processes – academic planning

We report on course registration outcomes in Table 5. Students received periodic messages during the spring semester reminding them to enroll in classes for the following fall / academic year. At GSU-Atlanta, about two-thirds of control students had registered for the next academic year by June, and the chatbot increased course registration by almost three percentage points. Similarly, at GSU-Perimeter, the intervention increased next-year registration by about two percentage points, relative to a lower control group registration rate of 28 percent. At GSU-Atlanta, the chatbot was even more effective at encouraging early registration – improving registration as of April 16 by 4.7 percentage points relative to 2.8 percentage points as of June 24. As we posit above, early completion of administrative tasks likely benefits students beyond the benefits of ever registering – for example, enabling students to register for courses that best fit their program of study and work schedules before preferred sections fill up.

While we did not see a meaningful difference in the treatment effect at GSU-Perimeter for early or comparatively later registration, at GSU-Perimeter we did observe effects for targeted registration reminders. GSU-Perimeter sent interactive messages in late April / early May to students who had not yet registered for the fall. The first set of messages asked students why they had not yet registered, and the second set asked students if they needed help with registration.

About 20 percent of recipients replied to these prompts, with nearly half (48 percent) indicating they planned to register later, and 17 percent of respondents noting they weren't sure what classes to take. When asked a few days later via the chatbot if they needed help registering, about 12 percent of recipients replied, and half of those indicated "yes" that they needed assistance. These interactive engagement messages significantly increased earlier registration – registering by May 21 – by 2.3 percentage points relative to about 15 percent of the control students in this subsample. Interactive messages that gather these high-level responses both enable targeted outreach from support staff and provide insights to administration about the barriers students face to completing academic administrative processes. Additionally, interactive messaging can open the door to communication between students and support staff to identify and address student needs.

In Table 6 we report on the effect of chatbot outreach on students' resolution of academic holds and on their take-up of advising support services. At GSU-Atlanta, the chatbot sent all wave 1 treatment students a fall reminder to visit their advisor (sent a few weeks before registration). These reminders had a small but statistically significant effect on whether students met with their advisor the week after they were sent, but no effect on whether students ever met with their advisor. Notably, the control means are quite low for take up of these advising activities. Similarly, when the GSU-Perimeter bot sent students general encouragement to meet with their advisor in the spring semester, this outreach had no effect on advisor meetings or resolving any holds.

In sharp contrast, messages that notified students about specific registration holds on their account significantly increased the likelihood of students attending advising (presumably to discuss the holds in question) and resolving these holds. At GSU-Atlanta, messages about registration holds in the fall increased the likelihood treated students resolved the hold by about eight percentage points, relative to 37 percent in the control group; in the spring, the same targeted

registration hold messages increased hold resolution for treated students by about eight percentage points, relative to 23 percent of the control group. Targeted messages about registration holds at GSU-Perimeter increased the likelihood students met with their advisor by about seven percentage points – relative to 54 percent of the control group – and reduced the likelihood of having a hold on their account by the end of the term by about six percentage points – relative to 79 percent of students in the control group who had a hold on their account earlier in the semester.

Taken together, the results across sites suggest that messaging students about specific administrative processes they need to complete – such as resolving a registration hold – can effectively increase the likelihood students complete that task and the likelihood students visit an advisor (presumably for assistance with that task). Sending students general encouragement to attend advising is comparatively less effective. Such general encouragement may need to make explicit the reasons why meeting with their advisor would be beneficial or signal urgency around the timing of meeting with their advisor.

Impact of messaging on take-up of academic and career-related supports

In Table 7 we examined whether outreach about academic- and career-related supports increased take-up. Across contexts, we find no evidence that sending students messages about supplemental instruction (SI) opportunities increased take-up. We note that student use of SI services was low at both sites – only about a quarter of students in the control group who met the "target" criteria at GSU-Atlanta ever attended SI, and at GSU-Perimeter, attendance rates were even lower (about 10 percent of control students in the fall, 13 percent in the spring). Similarly, at GSU-Atlanta, outreach encouraging students to attend graduate school or career fairs had no effect in either the fall or spring semesters. Student take-up of these opportunities was quite low overall, and the campaigns focused on these events did little to sway student participation. A potential

exception is the all-majors, GSU-Atlanta career and internship fair for which Pounce improved attendance by one percentage point, over a very low base of 3.3 percent.

At GSU-Perimeter, academic support messages took the form of encouraging participation in supplemental instruction (as noted above) and academic coach meetings. In the fall, these messages targeted students who were on "early alert" based on their academic performance. This fall outreach had no effect on students' likelihood of visiting an academic coach.[8] In contrast, similar spring coaching messaging increased coaching visits and enrollment in the campus "Comeback Camp" program – a series of extra support services targeting students with GPAs below 1.99. Treated students were 6-7.5 percentage points more likely to meet with their academic coach in the spring (relative to 27 percent of control group students) and 12 percentage points more likely to enroll in "Comeback Camp" compared to a control group rate of about 22 percent.

Impact of messaging on summative outcomes

Finally, in Table 8, we present impacts on summative outcomes including fall and spring GPA and credits earned as well as indicators for whether students graduated by the end of the intervention year and whether they graduated in or persisted (either graduated, enrolled, or, for GSU-Perimeter, transferred to GSU-Atlanta) into the following fall. The outreach had no effect on these summative outcomes. Given that the outreach was particularly beneficial in helping targeted sets of students navigating required administrative tasks, and no outreach dealt directly with students' core academic responsibilities, it is perhaps unsurprising that the chatbot outreach, as implemented, did not translate to improvement in overall academic performance metrics such as GPA or course credits earned.

[8] These messages took the following general form: "Hi XX, looks like you might need some help in one of your classes. Your academic coach can help <link>. Are you ready to meet with <Name>, your academic coach and make a plan?"

DISCUSSION AND CONCLUSION

In this study, we experimentally assessed the implementation and impact of GSU's effort to use an AI-enabled text message chatbot to provide outreach and support to a selected set of undergraduates on their four-year Atlanta campus during the 2018-19 academic year and on their two-year Perimeter campuses during the 2020-21 academic year. We regard the GSU-Atlanta experiment as exploratory in nature and the GSU-Perimeter experiment as confirmatory, as indicated by the preregistration of Perimeter study (Gehlbach & Robinson, 2018, 2021). Studies focused on text-based nudging in educational contexts have reached a level of maturity where we can hypothesize about which characteristics of such nudges make them effective in shaping the behavior of late-adolescent and / or young adult students and where we can acknowledge the limitations of their effectiveness. We hypothesize that outreach to this group is likely to differ from, for example, that of outreach to parents regarding activities with their preschool (e.g., Doss, Fahle, Loeb & York, 2019; York, Loeb & Doss, 2019) or school-aged (e.g., Kraft & Dougherty, 2013) children. Whereas parents of young children likely are more future oriented, traditionally-aged college students may succumb comparatively more to limited attention, present bias, and the challenges associated with navigating complex and competing demands. Further, college students' comparatively lower cognitive bandwidth to navigate administrative processes associated with college-going was likely further exacerbated by the COVID-19 pandemic and the related uncertainty around university operations and job market volatility.

The impacts that we estimate are remarkably consistent across the two- and four-year GSU campuses and are consistent with several hypotheses, informed by prior research, about the conditions under which students are responsive to this type of communication. These conditions relate to the extent of the existing relationship between the student and the entity aiming to nudge

student behavior; the relevance of outreach to the student's needs and circumstances; and the student behaviors that the messaging encourages.

Our results are consistent with the notion that text-based outreach can be effective in shaping student behavior when the ostensible sender is an entity that the student knows, trusts, and would expect to communicate with, in our case, via text. In the interventions considered here, outreach was framed as coming from Pounce, a friendly embodiment of the university central administration. Anecdotally, GSU-Perimeter staff reported receiving many "thank you" messages from students receiving chatbot communication. At GSU-Atlanta, among students in the first wave of randomization (e.g., those targeted for outreach for the entire 2018-19 academic year), approximately 5 percent opted out and another 8 percent paused outreach at some point during the year.[9] Such opt out (and pause) rates are in line with prior text-based interventions where the outreach was from a trusted source and one from whom students would expect to hear, given the topical focus of the messaging. In contrast, opt out rates tend to be higher when outreach is from a less-well-known source or one with which the student may not expect to communicate (e.g., Avery et al, 2021; Page et al, 2022). Thus, a key takeaway is that the ostensible sender of the messages matters, with students likely to be more receptive to outreach and communication from organizations and / or individuals with which they are affiliated (e.g., Debnam, 2017). Our findings are consistent with this observation. In addition, if text-based communication is one component of a broader student communication strategy, it can be used to reinforce communication distributed through other channels, rather than standing alone.

A second condition of successful outreach is that it is carefully tailored to be relevant to the student. High relevance will help to foster a student's trust in and attention to the

[9] Opt out and pause rates were lower for GSU-Atlanta students in the wave 2 randomization who received outreach over a shorter duration of time and were, on average, further along in their studies than wave 1 students.

communication. As text-based outreach becomes more common and students become increasingly inundated with messages, they may pay less attention, the potency of individual messages may get diluted, or students may opt out entirely. If outreach is generic and not well tailored to a given student's needs, these risks may increase. One strategy for personalizing outreach is to integrate communication systems with the institution's student information system. By incorporating student data into proactive messaging efforts, institutions can increase message relevance and credibility, target messaging appropriately to students when needed, and provide students with more specific guidance on the steps that they need to take to move forward. Such targeting has been used successfully in this effort as well as prior efforts focused on FAFSA filing (Page, Castleman & Meyer, 2019; Avery et al, 2021) and the summer college transition (Page & Gehlbach, 2017) as well as in targeting outreach to students in the context of more comprehensive student success programs (e.g., Page, Kehoe, Castleman & Sahadewo, 2019).

Nevertheless, using a centralized communication platform, such as Pounce, could require substantially more and different data sharing procedures across university administrative offices absent a robust, centralized student information system. Such data sharing routines and procedures are an important foundation to the successful implementation of a chatbot tool that relies on student-level data (Nurshatayeva et al, 2021) but may be challenging to implement for resource-constrained institutions or those that otherwise are operationally siloed.

Third, our results are consistent with the hypothesis that for college students, text-based nudging may be particularly effective when focused on discrete, required tasks and processes that carry with them a sense of urgency and for which the consequences of inaction are immediate and tangible. These are tasks like managing an unpaid portion of a tuition bill or resolving registration holds which, if left unattended, would result in a student being required to withdraw. Within the

studies that use text-based nudging to support students in the transition from high school to college, the focal college-transition tasks (e.g., FAFSA completion and verification, placement testing, vaccinations, tuition payment, etc.) can be characterized in this way (Castleman & Page, 2015; 2017; Page & Gehlbach, 2017). Thus, text-based nudges may be best for encouraging discrete, high-stakes actions or else may need to communicate more explicitly to students about the consequences of inaction / the benefits of action. For example, GSU-Perimeter advising messages were more effective when coupled with information about students having a registration hold on their account, and the spring coaching messages may have more effectively induced coaching take-up due to the "Comeback Camp" information that provided students with a concrete reason for how meeting with a coach would improve their academic standing.[10] In contrast, messages that encouraged students to take up career services supports or supplemental instruction did not affect behavioral change. These messages may have lacked a sense of urgency, as the immediate consequences of inaction were likely less obvious. In future iterations, messages on such topics might be more effective the more explicit they are about what students stand to gain or what they are missing in the short run by not attending or participating.

In addition to the alignment of our findings with hypotheses that emerge from prior work, our studies point also to the effect of outreach on the timing of task completion, and the benefits of promoting early completion of key college-related tasks. We find that messages earlier in the semester produce larger effects on students' completion of some tasks with potential downstream benefits to students – e.g., students who apply for financial aid earlier may have access to larger

[10] The spring coaching encouragement may also have been more effective than fall messages; fall messages targeted students who were behind in the semester but had not yet faced any final grade consequences. In the spring, messages took the general form of "Hi XX. If Fall didn't go how you expected or you want to learn the best way to stay on track in your classes your academic coach can help." Those spring messages referenced students back to their final grades from the fall and students may have been more motivated by their prior semester final grades than their to-date performance in the current semester to attend coaching.

financial aid awards (Bird, 2016). Registering early for classes may also enable students to get into the classes that best match their graduation requirements and course sections that best align with their work or personal schedules (e.g., enabling students to enroll in courses at times when they have childcare available). Further, registering for a suitable number of credits well in advance of the semester facilitates accurate financial aid award processing. Such early registration also can help the institution operate more effectively if earlier registration helps departments adequately staff their courses and plan how many additional or excess sections they may have or need. We note that while this intervention significantly moved up the timing of registration, students may face additional barriers to registering early, such as financial constraints (e.g., wanting to save up money over winter break to pay their tuition bills). For students to actualize the benefits of early registration, institutions may need to complement the types of nudge outreach with financial resources to facilitate early registration.

Despite the consistent positive effects that we observe on student management of various administrative processes, we find no effects on summative measures of student academic success. Perhaps this lack of overall effect in the academic domain is unsurprising, however, as the outreach was not integrated into students' core academic experiences. That is, it did not directly relate to university curricula and assigned course work. Where outreach did engage with academics, it pertained to supplemental curricular opportunities for students who were struggling academically and to administrative procedures for students who were failing to meet Satisfactory Academic Progress. Outreach on such topics has the potential to feel stigmatizing to students and, if sent centrally, may feel detached from students' experiences in the classroom with their course faculty. The lack of impact that we observe on academic actions (e.g., participation in supplemental instruction) and outcomes (e.g., GPA and credit attainment) aligns with findings from Oreopoulos

and Petronijevic (2019). However, in neither their study nor this one were course faculty ostensibly involved with communication to students. When nudges are framed as coming from course faculty and thoughtfully aligned with important course milestones (e.g., Carrell & Kurlaender, 2020; Balaban & Conway, 2020; Smith et al, 2018), they have been more effective at influencing students' academic engagement and performance. Indeed, more recently, GSU has partnered with faculty to adapt this chatbot technology for use in specific, large-enrollment courses, with promising initial results (Meyer et al, 2022).

In our investigation, we find that centralized, text-based outreach to students regarding required (and, often, time sensitive) administrative tasks was highly effective for improving students' attention to and success with navigating administrative barriers to their ongoing progress. Across this and other studies, impacts on the order of magnitude that we observe on administrative processes can be considered impressive, given the tool's low cost and potential for scale. At the same time, these impacts might still be considered modest in absolute terms, as many students still did not overcome administrative hurdles, despite the additional outreach. It may be that nudge-type efforts may have the potential to be even more effective if incorporated into multi-pronged systems of support that account for the several dimensions – financial, academic, social, administrative – along which students can falter on the path to college success. As administrators and policymakers consider how such efforts may fit into their own student-support context, they face a challenging task of sifting through studies on different populations, set in different contexts, and implemented in different ways. To be sure, we find some heterogeneity between our results and previous literature. Yet, our findings replicate across the two experiments on which we report and are consistent with hypotheses informed by prior literature. Our hope is that this should give

practitioners and policymakers some confidence regarding the promise and limitations for how such strategies can be deployed in service of improving student outcomes.

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TABLES AND FIGURES

Table 1: GSU-Atlanta and GSU-Perimeter Analytic Samples

	GSU-Atlanta (N=13,656)				GSU-Perimeter (N=11,561)	
	Wave 1 (N=7,580)		Wave 2 (N=6,076)			
	Control	Treatment	Control	Treatment	Control	Treatment
Freshman	0.53	0.52	0.10	0.10	0.22	0.22
Sophomore	0.27	0.27	0.19	0.19		
Junior	0.07	0.06	0.41	0.41		
Senior	0.13	0.14	0.30	0.30		
Transfer	0.08	0.09			0.06	0.06
Female	0.59	0.59	0.62	0.61	0.64	0.64
Hispanic	0.14	0.13	0.12	0.12	0.16	0.16
Asian	0.16	0.17	0.12	0.13	0.11	0.10
Black	0.42	0.43	0.47	0.46	0.51	0.52
Multi-racial	0.09	0.08	0.08	0.08	0.07	0.07
White	0.30	0.29	0.29	0.30	0.26	0.25
Age (years)	20.24	20.26	23.48	23.45	23.70	23.87
	(5.34)	(5.21)	(6.97)	(6.81)	(7.92)	(7.90)
First-generation college goer	0.24	0.24	0.27	0.25	0.25	0.24
Filed FAFSA	0.93	0.93	0.88	0.89	0.82	0.81
Received Pell grant	0.48	0.47	0.49	0.51	0.58	0.57
High school GPA	3.47	3.47			2.84	2.83
	(0.33)	(0.34)			(0.56)	(0.57)
GSU GPA	2.04	2.03	2.96	2.96	2.03	2.00
	(1.59)	(1.60)	(0.82)	(0.82)	(1.36)	(1.36)
N Students	3,856	3,724	3,037	3,039	5,781	5,780

Source: GSU administrative records.

Notes: Each cell reports sample average. For continuous measures, standard deviation reported in parentheses. Statistically significant differences in baseline characteristics assessed by regressing each baseline characteristic on an indicator of treatment assignment and fixed effects for group within which randomization was conducted. We observe balance on all baseline measures (for GSU-Atlanta we observe balance on all baseline measures when assessed for the waves separately and for the data pooled across waves). FAFSA filing refers to the year prior to intervention.

Table 2: Chatbot engagement and opt-out

	GSU-Atlanta			GSU-Perimeter	
Outcome	Total N	Wave 1 ITT	Wave 2 ITT	Total N	ITT
N outgoing messages	244,673	56.721*** (0.345)	10.950*** (0.088)	298,382	51.623*** (0.308)
N outgoing campaign messages	233,265	54.243*** (0.332)	10.240*** (0.077)		
N outgoing auto-response messages	5,554	1.133*** (0.050)	0.434*** (0.029)		
N outgoing staff response messages	16	0.004*** (0.001)	0.001 (0.000)		
N outgoing triage messages	777	0.136*** (0.008)	0.089*** (0.007)		
N incoming messages	15,980	3.323*** (0.077)	1.178*** (0.040)	21,325	3.689*** (0.068)
N incoming survey response messages	9,056	1.894*** (0.041)	0.656*** (0.018)		
N incoming question	5,555	1.134*** (0.050)	0.434*** (0.029)		
N incoming messages escalated to staff member	42	0.010*** (0.002)	0.002** (0.001)	34	0.005*** (0.0009)
Opt out		0.048*** (0.004)	0.011*** (0.002)		0.0007** (0.0003)
Pause participation		0.080*** (0.004)	0.048*** (0.004)		0.044*** (0.003)
N		7,580	6,076		5,781

+p < 0.10 *p < 0.05 **p<0.01, ***p<0.001

Source: GSU administrative records. Notes: Each row reports results from fitting equation (1) to outcome data for outcomes reported in first column. No covariates were included in modeling these outcomes. Robust standard errors in parentheses.

Table 3: Experimental effects of text-based outreach on financial aid outcomes

			(1)	(2)		(3)		(4)		(5)		(6)
Sample	Campaign Topic	Outcome	Control Mean	ITT effect		ITT effect		First-stage		IV effect		N
Panel A: Atlanta												
Full	2019-2020 FAFSA reminder (sent monthly)	Filed FAFSA by March 14	0.406	0.009		0.007		0.732	***	0.009		13,656
				(0.008)		(0.008)		(0.005)		(0.011)		
		Filed FAFSA by April 18	0.553	0.037	***	0.033	***	0.732	***	0.045	***	13,656
				(0.008)		(0.008)		(0.005)		(0.011)		
		Filed FAFSA by end of semester	0.591	0.037	***	0.033	***	0.732	***	0.045	***	13,656
				(0.008)		(0.008)		(0.005)		(0.010)		
Targeted	Financial Aid Award hold	Resolve financial aid hold	0.229	0.060		0.058		0.873	***	0.067		438
				(0.042)		(0.042)		(0.023)		(0.047)		
Panel B: Perimeter												
Full	2019-2020 FAFSA reminder (sent monthly)	Filed FAFSA by March 14	0.337	0.023	**	0.027	***	0.328	***	0.084	***	11,561
				(0.009)		(0.008)		(0.006)		(0.026)		
		Filed FAFSA by April 18	0.383	0.028	**	0.033	***	0.248	***	0.134	***	11,561
				(0.009)		(0.008)		(0.006)		(0.035)		
		Filed FAFSA by end of semester	0.472	0.015	+	0.021	**	0.248	***	0.086	**	11,561
				(0.009)		(0.008)		(0.006)		(0.035)		
Targeted	Financial Aid Award hold	Complete FAFSA verification	0.224	0.079	+	0.082	*	0.877	***	0.093	*	453
				(0.041)		(0.041)		(0.022)		(0.046)		
		Covariates				X		X		X		

+p < 0.10 *p < 0.05 **p<0.01, ***p<0.001

Source: GSU administrative records. Notes: Each row reports on a series of regression models to assess the impact of chatbot outreach on a given outcome. Each row reports the topical focus of the campaign as well as the specific outcome assessed. Results columns 1 and 2 report the control average outcome and ITT effect from a regression without any covariates (and that includes only fixed effects for groups within which randomization was conducted for the Atlanta sample). Column 3 reports covariate controlled ITT effects from a model including all campus covariates listed in Table 1. Column 4 reports the first-stage effect of assigning a student for outreach on actual message distribution. Column 5 reports the IV-adjusted effect of message distribution on the outcome of interest. Robust standard errors in parentheses.

Table 4: Experimental effects of text-based outreach on financial balance outcomes

			(1)	(2)		(3)		(4)		(5)		(6)
Term	Campaign Topic	Outcome	Control Mean	ITT effect		ITT effect		First-stage		IV effect		N
Panel A: Atlanta												
Fall	Outstanding balance on fall term bill	Resolved balance, one week later	0.222	0.090	*	0.077	+	0.969	***	0.080	+	374
				(0.045)		(0.046)		(0.013)		(0.046)		
		Withdrawn for nonpayment, one week later	0.206	-0.101	**	-0.103	**	0.969	***	-0.107	**	374
				(0.036)		(0.036)		(0.013)		(0.036)		
Spring	Outstanding balance on spring term bill	Resolved balance, one week later	0.550	0.173	**	0.181	**	0.838	***	0.215	***	257
				(0.061)		(0.061)		(0.036)		(0.069)		
		Resolved balance, two weeks later	0.725	0.087		0.091		0.838	***	0.108	+	257
				(0.055)		(0.055)		(0.036)		(0.063)		
Panel B: Perimeter												
Fall	Outstanding balance on fall term bill	Withdrawn for nonpayment, end of term	0.247	0.079	+	0.051		0.904	***	0.057		365
				(0.047)		(0.048)		(0.023)		(0.051)		
		Held end of term balance	0.169	0.003		0.003		0.904	***	0.003		365
				(0.039)		(0.040)		(0.023)		(0.043)		
Spring	Outstanding balance on spring term bill	Withdrawn for nonpayment, end of term	0.185	-0.063	***	-0.062	***	0.938	***	-0.066	***	1,984
				(0.016)		(0.016)		(0.008)		(0.017)		
		Never dropped or reinstated	0.901	0.032	**	0.030	**	0.938	***	0.032	**	1,984
				(0.012)		(0.012)		(0.008)		(0.013)		
	Inform about additional financial aid available	Accepted GEER grant	0.182	0.102	+	0.119	*	0.926	***	0.128	*	237
				(0.055)		(0.058)		(0.025)		(0.059)		
		Accepted College Completion grant	0.515	-0.098		-0.065		0.872	***	-0.075		128
				(0.089)		(0.099)		(0.050)		(0.105)		
		Covariates				X		X		X		

+p < 0.10 *p < 0.05 **p<0.01, ***p<0.001

Source: GSU administrative records. Notes: Each row reports on a series of regression models to assess the impact of chatbot outreach on a given outcome. Each row reports the topical focus of the campaign as well as the specific outcome assessed. Results columns 1 and 2 report the control average outcome and ITT effect

from a regression without any covariates (and that includes only fixed effects for groups within which randomization was conducted for the Atlanta sample). Column 3 reports covariate controlled ITT effects from a model including all campus covariates listed in Table 1. Column 4 reports the first-stage effect of assigning a student for outreach on actual message distribution. Column 5 reports the IV-adjusted effect of message distribution on the outcome of interest. Robust standard errors in parentheses. GEER grant refers to the Governor's Emergency Education Relief funds, a special COVID-19 pandemic response grant. The College Completion grant is an on-going program at GSU to support students in need of additional aid in their final semesters of study.

Table 5: Experimental effects of text-based outreach on course registration

			(1)	(2)		(3)		(4)		(5)		(6)
Sample	Campaign Topic	Outcome	Control Mean	ITT effect		ITT effect		First-stage		IV effect		N
Panel A: Atlanta												
Full	Fall 2019 registration (sent monthly)	Registered for fall by April 16	0.495	0.047	***	0.043	***	0.821	***	0.053	***	13,657
				(0.008)		(0.008)		(0.005)		(0.010)		
		Registered for fall by May 22	0.631	0.032	***	0.029	***	0.821	***	0.036	***	13,657
				(0.008)		(0.008)		(0.005)		(0.009)		
		Registered for fall by June 24	0.659	0.028	***	0.025	***	0.821	***	0.030	***	13,657
				(0.008)		(0.008)		(0.005)		(0.009)		
Panel B: Perimeter												
Full	Fall 2019 registration (sent monthly)	Registered for fall by April 14	0.096	0.018	***	0.020	***	0.864	***	0.023	***	11,561
				(0.006)		(0.006)		(0.004)		(0.006)		
		Registered for fall by May 21	0.234	0.027	***	0.029	***	0.864	***	0.034	***	11,561
				(0.008)		(0.008)		(0.004)		(0.009)		
		Registered for fall by June 15	0.284	0.021	**	0.024	**	0.864	***	0.027	**	11,561
				(0.008)		(0.008)		(0.004)		(0.010)		
		Covariates				X		X		X		

+p < 0.10 *p < 0.05 **p<0.01, ***p<0.001

Source: GSU administrative records. Notes: Each row reports on a series of regression models to assess the impact of chatbot outreach on a given outcome. Each row reports the topical focus of the campaign as well as the specific outcome assessed. Results columns 1 and 2 report the control average outcome and ITT effect from a regression without any covariates (and that includes only fixed effects for groups within which randomization was conducted for the Atlanta sample). Column 3 reports covariate controlled ITT effects from a model including all campus covariates listed in Table 1. Column 4 reports the first-stage effect of assigning a student for outreach on actual message distribution. Column 5 reports the IV-adjusted effect of message distribution on the outcome of interest. Robust standard errors in parentheses.

Table 6: Experimental effects of targeted text-based outreach on academic progress

			(1)	(2)		(3)		(4)		(5)		(6)
Term	Campaign Topic	Outcome	Control Mean	ITT effect		ITT effect		First-stage		IV effect		N
Panel A: Atlanta												
Fall	Visit advisor	Meet with advisor within 1 week	0.071	0.019	**	0.020	***	0.914	***	0.021	***	7,580
				(0.006)		(0.006)		(0.005)		(0.007)		
		Ever met with advisor	0.217	-0.011		-0.010		0.914	***	-0.011		7,580
				(0.009)		(0.009)		(0.005)		(0.010)		
	Maintaining SAP	Attended SAP meeting	0.000	0.007	*	0.008	*	0.922	***	0.008	*	1,085
				(0.004)		(0.004)		(0.012)		(0.004)		
	Registration hold(s)	Resolve hold(s)	0.368	0.081	***	0.074	***	0.994	***	0.074	***	1,670
				(0.023)		(0.023)		(0.003)		(0.023)		
Spring	Maintaining SAP	Attended SAP meeting	0.050	0.019		0.018		0.836	***	0.021		425
				(0.023)		(0.023)		(0.026)		(0.027)		
	Academic Improvement Plan hold	Resolve hold	0.228	0.076	*	0.071	+	0.866	***	0.082	+	529
				(0.039)		(0.039)		(0.022)		(0.044)		
Panel B: Perimeter												
Fall	Registration hold(s)	Attend advising	0.541	0.069	**	0.066	**	0.896	***	0.073	**	1,332
				(0.027)		(0.027)		(0.012)		(0.030)		
		Had hold at end of term	0.789	-0.056	**	-0.057	**	0.896	***	-0.064	**	1,332
				(0.023)		(0.023)		(0.012)		(0.025)		
Spring	Spring advising nudge	Attend advising	0.466	0.012		0.012		0.907	***	0.013		10,683
				(0.010)		(0.010)		(0.004)		(0.011)		

	Had hold at end of term	0.228	-0.003	-0.007	0.907	***	-0.008	10,683
			(0.008)	(0.007)	(0.004)		(0.008)	
	Covariates			X	X		X	

+p < 0.10 *p < 0.05 **p<0.01, ***p<0.001

Source: GSU administrative records. Notes: Each row reports on a series of regression models to assess the impact of chatbot outreach on a given outcome. Each row reports the topical focus of the campaign as well as the specific outcome assessed. Results columns 1 and 2 report the control average outcome and ITT effect from a regression without any covariates (and that includes only fixed effects for groups within which randomization was conducted for the Atlanta sample). Column 3 reports covariate controlled ITT effects from a model including all campus covariates listed in Table 1. Column 4 reports the first-stage effect of assigning a student for outreach on actual message distribution. Column 5 reports the IV-adjusted effect of message distribution on the outcome of interest. Robust standard errors in parentheses. SAP refers to Satisfactory Academic Progress.

Table 7: Experimental effects of targeted text-based outreach on academic and career support services

			(1)	(2)		(3)		(4)		(5)		(6)
Sample	Campaign Topic	Outcome	Control Mean	ITT effect		ITT effect		First-stage		IV effect		N
Panel A: Atlanta												
Fall	Career Fair, Fall	Attend fair	0.033	0.010	*	0.010	*	0.935	***	0.010	*	7,580
				(0.004)		(0.004)		(0.004)		(0.005)		
	Graduate and Professional School Fair, Fall	Attend career fair	0.012	-0.004		-0.004		0.892	***	-0.004		1,517
				(0.005)		(0.005)		(0.011)		(0.006)		
	SI Encouragements	Attend SI	0.257	-0.008		-0.007		0.941	***	-0.007		2,659
				(0.017)		(0.017)		(0.007)		(0.018)		
Spring	Career Week, Spring	Attend career week	0.011	0.000		0.000		0.860	***	0.000		6,780
				(0.003)		(0.003)		(0.006)		(0.003)		
Panel B: Perimeter												
Fall	SI Encouragements	Attend SI	0.098	0.027		0.029		0.960	***	0.030		828
				(0.022)		(0.022)		(0.010)		(0.023)		
	Coaching	Attended coaching	0.126	0.022		0.023		0.930	***	0.025		1,619
				(0.017)		(0.017)		(0.009)		(0.018)		
Spring	SI Encouragements	Attend SI	0.133	0.022		0.016		0.939	***	0.017		474
				(0.032)		(0.031)		(0.016)		(0.032)		
	Coaching	Attended coaching	0.268	0.058		0.075	+	0.937	***	0.080	+	419
				(0.045)		(0.044)		(0.017)		(0.046)		
		Attended comeback camp	0.217	0.122	**	0.123	**	0.937	***	0.132	**	419
				(0.043)		(0.044)		(0.017)		(0.046)		
		Covariates				X		X		X		

+p < 0.10 *p < 0.05 **p<0.01, ***p<0.001

Source: GSU administrative records. Notes: Each row reports on a series of regression models to assess the impact of chatbot outreach on a given outcome. Each row reports the topical focus of the campaign as well as the specific outcome assessed. Results columns 1 and 2 report the control average outcome and ITT effect from a regression without any covariates (and that includes only fixed effects for groups within which randomization was conducted for the Atlanta sample). Column 3 reports covariate controlled ITT effects from a model including all campus covariates listed in Table 1. Column 4 reports the first-stage effect of assigning a student for outreach on actual message distribution. Column 5 reports the IV-adjusted effect of message distribution on the outcome of interest. Robust standard errors in parentheses.

Table 8: Experimental effects of text-based outreach on overall outcomes

	GSU-Atlanta			GSU-Perimeter		
	Control Mean	ITT Effect	N	Control Mean	ITT Effect	N
Semester 1 credits earned	48.434	-0.005	7,580	36.054	-0.215	11,561
		(0.150)			(0.475)	
Semester 1 GPA	2.916	0.015	7,580	2.150	-0.003	11,561
		(0.023)			(0.024)	
Semester 2 credits earned	71.670	0.071	13,656	41.592	-0.210	11,561
		(0.139)			(0.492)	
Semester 2 GPA	2.712	-0.009	13,656	1.624	0.017	11,561
		(0.020)			(0.027)	
Semester 2 graduated	0.046	-0.004	13,656	0.038	0.004	11,561
		(0.003)			(0.004)	
Semester 3 graduated	0.033	0.005	13,656	0.037	0.000	11,561
		(0.003)			(0.003)	
Semester 3 persistence	0.802	0.005	13,656	0.572	0.004	11,561
		(0.007)			(0.009)	
Covariates included		X			X	

+p < 0.10 *p < 0.05 **p<0.01, ***p<0.001

Source: GSU administrative records. Notes: Each row reports on a series of regression models to assess the impact of chatbot outreach on a given outcome. Each row reports the outcome assessed. GSU-Atlanta began the intervention with a smaller wave of students before adding additional students in the second implementation semester, hence the smaller sample size for semester 1 outcomes. Semester three persistence defined as graduating in semester 2, graduating the summer between semesters 2 and 3, graduating in semester 3, enrolling in semester 3, or (for students at GSU-Perimeter) transferring to GSU-Atlanta through the end of semester 3. Results in columns 1 and 2 report the control average outcome and ITT effect from a regression without covariates (and that only includes fixed effects for groups within which randomization was conducted for the Atlanta sample). Column 3 reports covariate controlled ITT effects from a model including all campus covariates listed in Table 1. Robust standard errors in parentheses.

ONLINE APPENDIX TABLES

Table A1. Schedule of Fall 2018 GSU-Atlanta Text Campaigns

Date	**Message topic**	**Domain**	**Target**	**Outcome(s)**
October 2	Launch Message	General	All students	No measurable outcome expected
October 2	All Majors Career & Internship Fair 2018	Non-academic supplemental	All students	Fair attendance
October 4	Outstanding balance on student bill	Administrative	Students with balance of $258 or more as of 10/4	Open case with Financial Services within 1 week; withdraw as of 10/12 (withdrawal deadline)
October 5	Withdrawal deadline	General	All students	No measurable outcome expected
October 9	Midterm time	General	All students	No measurable outcome expected
October 11	Supplemental Instruction Campaign	Academic supplemental	All students enrolled in supplemental instruction course(s)	Attendance in supplemental instruction; course/term GPA
October 16	FAFSA filing	Administrative	Students who filed 2018-2019 FAFSA	FAFSA filing
October 18	Career Services intro campaign	Non-academic supplemental	All students	Aggregate use of career services
October 18	Registration hold campaign	Administrative	Students with administrative hold(s) on registration as of 10/16	Hold resolution
October 22	Registration for spring semester (seniors only)	Administrative	All seniors who are not planning to graduate in Spring	Spring registration
October 24	Graduate and professional school fair campaign	Non-academic supplemental	Juniors and seniors	Fair attendance
October 25	Maintaining SAP information session	Academic supplemental	Students at risk of not meeting SAP and losing financial aid in next semester	SAP information session attendance

Date	Message topic	Domain	Target	Outcome(s)
October 26	Registration for spring semester (non-seniors)	Administrative	All non-senior students	Spring registration
November 1	Nudge: financial literacy (freshman)	Non-academic supplemental	All freshmen	No measurable outcome expected
November 1	Financial Literacy (seniors)	Non-academic supplemental	All seniors	No measurable outcome expected
November 1	Financial Literacy (transfer/transition)	Non-academic supplemental	Fall 2018 new transfer and transition students	No measurable outcome expected
November 2	Nudge: meet with your advisor (Fall 2018)	Academic supplemental	All students	Meeting with academic advisor (whether / when)
November 5; December 5	Registration for spring semester	Administrative	Students not yet registered for Spring	Spring registration
November 6	International Education Week	Non-academic supplemental	All students	No measurable outcome expected
November 8	International Thanksgiving Feast	Non-academic supplemental	International students	No outcome (target N too small)
November 14	Spring financial aid award	Administrative	All students	No measurable outcome expected
November 15	Portfolium	Non-academic supplemental	Students who had not created a Portfolium account	Creation of Portfolium account
November 19	Fall break	General	All students	No measurable outcome expected
December 3	Last day of classes	General	All students	No measurable outcome expected
December 11	End of term, grade reporting	General	All students	No measurable outcome expected

Table A2. Schedule of Spring 2019 GSU-Atlanta Text Campaigns

Date	**Message topic**	**Domain**	**Target**	**Outcome**
January 7, 17	Spring 2019 registration – Students with/without holds	Administrative	Students who have not yet registered for Spring	Spring registration
January 7, 22	Spring 2019 registration – balance reduction	Administrative	Students who have registered but have remaining balances on their accounts	Resolution of student balance
January 14	First day back: Spring 2019	General	All students	No measurable outcome expected
January 20	MLK Day	General	All students	No measurable outcome expected
January 21; February 28	Internship & Co-Op Fair	Non-academic supplemental	Sophomores and juniors	Event registration and attendance
February 7 (& monthly)	FAFSA filing	Administrative	All students; messages targeted over time to subset not filed	FAFSA filing (whether / when)
February 8, 13	AIP hold (warning, supervision, probation)	Administrative	Students with an AIP-related hold	Hold resolution
February 11, 20	Financial aid award flag	Administrative	Students with flags that would prevent them from receiving financial aid for Spring term and are at risk of being withdrawn for non-payment	Flag resolution
February 14	Study abroad	General	All students	No measurable outcome expected
February 18, 25	Career Week	Non-academic supplemental	All students	Event registration and attendance
February 26; April 23	Registration for summer semester	Administrative	All continuing students	Registration outcome
March 4	UAC Mini Major Fair	Academic supplemental	Students with undeclared major	No outcome (target N too small)

Date	Message topic	Domain	Target	Outcome
March 5	Withdrawal deadline	General	All students	No measurable outcome expected
March 8, 19	ISSS & ISAC Cross-Cultural Trip	Non-academic supplemental	International students and students who have participated in Summer 2018 study abroad program	No measurable outcome expected
March 12	Spring 2019 launch	General	Wave 2 students	No measurable outcome expected
March 14	Spring break/Study Abroad IG link	General	All students	No measurable outcome expected
March 25	Commencement fair	Non-academic supplemental	Degree candidates for Spring 2019 graduation	Fair attendance and graduation outcome
March 26 (& monthly)	Fall 2019 registration	Administrative	All continuing students. Messages targeted over time to subset not registered	Registration outcome
April 1	International Spring Festival	Non-academic supplemental	International students	No measurable outcome expected
April 2, 5, 16	Registration hold resolution	Administrative	Students with one or more administrative holds on registration	Hold resolution
April 10	SAP (Satisfactory Academic Progress) warning	Academic supplemental	Students at risk of not meeting SAP and losing financial aid in next semester	Open case with Financial Services
April 15	Summer Part-Time Job Fair	Non-academic supplemental	All students who are not graduating seniors	Event registration and attendance
April 29	Final exams	General	All students	No measurable outcome expected
May 2	Commencement	General	Degree candidates for Spring 2019 graduation	Degree award status
May 10	Grade posting	General	All students	No measurable outcome expected

Table A3. Schedule of Fall 2020 GSU-Perimeter Text Campaigns

Date	**Message topic and target**	**Domain**	**Outcome(s)**
9/10/20	Introducing the bot to students	General	N/A
9/16/20	Encourage students to take care of their balance	Administrative	Contact financial services
9/22/20	Encourage students to visit advising early to take care of their AIP hold	Administrative	Visit advising
9/23/20	Encourage students to visit supplemental instruction for their class(es)	Academic supplemental	Attend SI
9/24/20	Encourage students to visit advising early to take care of their AIP hold	Administrative	Visit advising
9/24/20	Encourage students to visit advising early to take care of their AIP hold	Non-academic supplemental	Visit advising
9/25/20	Checking in with students in at least 1 online class	General	Survey response
9/30/20	Inform students who had not logged into their online PCO 1020 class (into to college course) that it counts as part of their GPA	Academic supplemental	N/A
10/1/20	Survey asking enrolled students their preferred Spring 2021 course modality (in person, blended, online)	General	Survey response
10/2/20	Encourage students not enrolled in PCO 1020 introduction to college course to complete academic advising	Administrative	Visit advising
10/5/20	Informing students the 21/22 FAFSA application is open	Administrative	File FAFSA
10/6/20	Encourage students on Early Alert status to make an appointment with their specific academic coach	Administrative	Visit coaching
10/8/20	Survey asking enrolled students their preferred online learning structure for Spring 2021 (synchronous/asynchronous)	General	Survey response
10/12/20	Encourage students to meet with their advisor and take care of their advising hold before registration	Administrative	Visit advising
10/12/20	Encourage transfer students to meet with their advisor	Administrative	Visit advising
10/14/20	Follow-up reminder about supplemental instruction	Academic supplemental	Attend SI
10/15/20	Informing students the Spring 2021 course schedule is available	General	Register for classes
10/16/20	Reminding students who are close to graduating to apply for graduation	Administrative	Apply for graduation
10/20/20	Encourage students to visit advising to take care of their hold	Administrative	Visit advising
10/20/20	Encourage students to contact financial aid/pay their balance to take care of their hold	Administrative	Contact financial services

Date	Message topic and target	Domain	Outcome(s)
10/20/20	Encourage students to contact the Dean of Students office to take care of their hold	Administrative	Contact Dean of Students
10/20/20	Encourage students to contact the International Student & Scholar Services office to take care of their hold	Administrative	Contact IS&SS
10/20/20	Encourage students to take care of their advisement and balance holds	Administrative	Contact financial services
10/22/20	Follow-up to students on early alert to meet with their academic coach and make a plan	Administrative	Visit coaching
11/5/20	Encourage students to contact Admissions to take care of their hold	Administrative	Contact Admissions
11/6/20	Reminding students of the deadlines to apply to graduate	Administrative	Apply for graduation
11/9/20	Informing students of the free COVID-19 testing on campus	Non-academic supplemental	N/A
11/10/20	Encouraging freshmen not enrolled in math to register for math to stay on track	Administrative	Register for math
11/10/20	Encouraging freshmen not enrolled in English to register for English to stay on track	Administrative	Register for English
11/12/20	Nudging students without holds to register for spring	Administrative	Register for classes
11/13/20	Encourage students to make a virtual appointment with Financial Aid to fix FAFSA errors	Administrative	Contact financial services
11/13/20	Encourage students enrolled for Spring 2021 to complete a 20/21 FAFSA	Administrative	File FAFSA
11/13/20	Nudging graduates to sign up for tickets to the graduation ceremony	Administrative	Sign up for graduation tickets
11/16/20	Asks students to set up a preferred refund method in their account	Administrative	Contact financial services
11/16/20	Nudging active, not currently enrolled students to register for Spring 2021	Administrative	Register for classes
11/18/20	Encourage students with a hold to take care of their hold and register for Spring 2021	Administrative	Register for classes
11/18/20	Encourage students to get free COVID-19 testing prior to the Thanksgiving break	Non-academic supplemental	N/A
11/20/20	Encourage note before Thanksgiving & reminding students to complete the 21/22 FAFSA	Administrative	File FAFSA
12/1/20	Encourage students to register for Spring 2021	Administrative	Register for classes
12/3/20	Encourage students with a hold to take care of their hold and register for Spring 2021	Administrative	Register for classes

Date	Message topic and target	Domain	Outcome(s)
12/7/20	Encourage students to register for Spring 2021	Administrative	Register for classes
12/8/20	Wishing students encouragement on their finals	General	N/A
12/9/20	Encourage active students not enrolled Fall 20 to register for Spring 2021	Administrative	Register for classes
12/10/20	Letting students know they're registered for a course that might not be eligible for fin aid	Administrative	Contact financial services
12/11/20	Encourage students to get free COVID-19 testing prior to winter break	Non-academic supplemental	N/A
12/15/20	Wishing students a good break and Encourage them to register for Spring 2021	Administrative	Register for classes
12/15/20	Encourage message to registered students withing them a good break	General	N/A
12/17/20	Encourage Spring 2021 registered students to complete the 20/21 FAFSA	Administrative	File FAFSA
12/17/20	Encourage students with aid awards to register for Spring 2021	Administrative	Register for classes
10/27-11/2/2020	Inform enrolled students of the Spring 2021 registration date changes	Administrative	N/A

Table A4. Schedule of Fall 2020 GSU-Perimeter Text Campaigns

Date	**Message topic and target**	**Domain**	**Outcome(s)**
1/4/2021	Encourage students to register for spring	Administrative	Register for classes
1/5/2021	Inform students they were registered for a course they previously passed and might not be eligible for aid	Administrative	Adjust registrations
1/6/2021	Engage registered students the week before spring classes started	Administrative	N/A
1/11/2021	Engage registered students on the first day of classes	General	N/A
1/11/2021	Encourage students to register for spring during late registration	Administrative	Register for classes
1/11/2021	Nudge students to take care of their spring balance	Administrative	Resolve balance
1/13/2021	Encourage active students not enrolled fall to register for spring	Administrative	Register for classes
1/14/2021	Nudge students to take care of their spring balance	Administrative	Resolve balance
1/14/2021	Nudge students to complete missing information and schedule a virtual Student Financial Services appointment	Administrative	Contact financial services
1/15/2021	Nudge students to accept available financial aid to cover their balance	Administrative	Resolve balance
1/19/2021	Encourage students to take advantage of the online career closet	Non-academic supplemental	Visit career closet
1/20/2021	Nudge students dropped for balance to take care of their balance and be reinstated for the semester	Administrative	Resolve balance
1/25/2021	Target students with a balance and eligible for additional forms of aid	Administrative	Resolve balance
1/28/2021	Encourage students not engaged in iCollege to log in regularly to their classes	General	Log in regularly
1/29/2021	Ask students dropped for nonpayment if they planned to take care of their balance and reinstate their courses	Administrative	Resolve balance
1/29/2021	Ask students if they planned to pay their balance and stay in classes prior to being dropped. Campaign sent to wrong students in error-additional notes in main document	Administrative	Resolve balance
2/1/2021	Nudge eligible students to accept funds from the College Completion Grant	Administrative	Accept financial aid
2/3/2021	Final reminder to students to take care of their spring balance	Administrative	Resolve balance

Date	Message topic and target	Domain	Outcome(s)
2/4/2021	Notify additional students to accept funds from College Completion Grant	Administrative	Accept financial aid
2/8/2021	Encourage students to visit supplemental instruction	Academic supplemental	Visit SI
2/11/2021	Encourage students to take advantage of Study Abroad free passport program	General	Apply for passport
2/16/2021	Ask students with an AIP Supervision hold if they planned to make an appointment with their advisor to resolve it	Non-academic supplemental	Visit advising
2/18/2021	Ask students with an AIP Probation hold if they planned to make an appointment with their advisor to resolve it	Non-academic supplemental	Visit advising
2/23/2021	Ask students if they planned to complete the 21/22 FAFSA by the priority deadline	Administrative	File FAFSA
2/24/2021	Ask targeted students if they were ready to make an appointment with their academic coach. Spring coaching campaigns also nudged students toward 'Comeback Camp' success initiative	Academic supplemental	Schedule coaching
2/25/2021	Nudge students on SAP warning status to make a virtual Student Financial Services appointment	Administrative	Contact financial services
3/1/2021	Ask targeted students if they were ready to make an appointment with their academic coach. Spring coaching campaigns also nudged students toward 'Comeback Camp' success initiative	Academic supplemental	Schedule coaching
3/3/2021	Ask students with an AIP Warning hold if they planned to make an appointment with their advisor to resolve it	Non-academic supplemental	Visit advising
3/9/2021	Encourage eligible students to take advantage of Governor's Emergency Education Relief (GEER) program	Administrative	Accept financial aid
3/9/2021	Nudge students to take care of their active registration holds	Administrative	Resolve holds
3/19/2021	Encourage targeted students to apply for summer or fall graduation	Administrative	Apply for graduation
3/19/2021	Provide graduation information to spring graduates	Administrative	N/A
3/22/2021	Notify students the fall 21 schedule was posted	General	Register for classes
3/23/2021	Ask students if they attended supplemental instruction and if they needed extra academic assistance	Academic supplemental	Visit SI

Date	Message topic and target	Domain	Outcome(s)
3/24/2021	Ask students if they planned to get the COVID-19 vaccine on campus when available	General	N/A
3/25/2021	Encourage students to take care of their SAP appeal and schedule a virtual Student Financial Services appointment	Administrative	Contact financial services
3/29/2021	Inform students about the start of fall 21 registration and encourage them to visit advising drop-ins	Administrative	Visit advising
3/30/2021	Inform students they might be missing a key English or Math course and encourage them to meet with their advisor to get on track	Non-academic supplemental	Visit advising
3/31/2021	Ask students if they planned get the COVID-19 vaccine. Students who responded "no" or "unsure" were asked to provide a reason (multiple choice)	General	N/A
4/1/2021	Encourage targeted students to apply for summer graduation	Administrative	Apply for graduation
4/2/2021	Nudge students to take care of their AIP advisement hold	Administrative	Resolve holds
4/6/2021	Encourage eligible students to apply for the English 1101 Accelerator Academy	Academic supplemental	Apply for accelerator
4/6/2021	Nudge students to complete 21/22 FAFSA verification	Administrative	File FAFSA
4/7/2021	Remind students to complete their free passport application before the end of the program	General	Apply for passport
4/8/2021	Nudge students to complete 21/22 FAFSA	Administrative	File FAFSA
4/12/2021	Remind eligible students to apply for the English 1101 Accelerator Academy	Academic supplemental	Apply for accelerator
4/13/2021	Ask students with holds if they planned to take care of their holds and register for fall	Administrative	Resolve holds
4/15/2021	Encourage eligible students in additional courses to apply for Accelerator Academy	Academic supplemental	Apply for accelerator
4/16/2021	Ask students if they planned to register for fall and linked to a video message encouraging them to register early	Administrative	Register for classes
4/19/2021	Encourage active students not enrolled spring to register for fall	Administrative	Register for classes
4/20/2021	Inform eligible students the Accelerator Academy application deadline was extended	Academic supplemental	Apply for accelerator

Date	Message topic and target	Domain	Outcome(s)
4/21/2021	Ask students their course modality preference for fall. "Online" respondents were asked if they preferred completely online or hybrid and students with no plans to return were asked for a reason.	General	N/A
4/23/2021	Encourage students to take care of their SAP appeal and meet with Student Financial Services	Administrative	Contact financial services
4/26/2021	Encourage students on spring finals	General	N/A
4/28/2021	Ask students to provide a reason why they hadn't registered yet for fall	Administrative	Register for classes
5/4/2021	Nudge students to complete additional financial aid documents for fall	Administrative	File FAFSA
5/5/2021	Nudge students to take care of their Semester balance	Administrative	Resolve balance
5/5/2021	Ask students not registered for fall if they needed help	Administrative	Register for classes
5/6/2021	Nudge students to complete 21/22 FAFSA	Administrative	File FAFSA
5/7/2021	Remind eligible students to apply for Accelerator Academy	Academic supplemental	Apply for accelerator
5/11/2021	Encourage 2nd group of eligible students to apply for Accelerator Academy	Academic supplemental	Apply for accelerator
5/17/2021	Encourage 3rd group of eligible students to apply for Accelerator Academy	Academic supplemental	Apply for accelerator
5/19/2021	Nudge students to meet with their advisor & register for additional hours to be eligible for aid	Non-academic supplemental	Visit advising
5/19/2021	Encourage students to register for summer classes	Administrative	Register for classes
5/20/2021	Remind eligible students to apply for Accelerator Academy	Academic supplemental	Apply for accelerator
5/26/2021	Nudge students to take care of their summer balance and accept aid if eligible	Administrative	Resolve balance
6/3/2021	Nudge students to take care of their summer balance and accept aid if eligible	Administrative	Resolve balance
6/7/2021	Remind students to take care of their summer balance prior to being dropped for nonpayment	Administrative	Resolve balance
6/10/2021	Ask students if they planned to stay in summer classes and provide payment resources	Administrative	Resolve balance