Conditions under which college students can be responsive to nudging

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College success requires students to engage with their institution both academically and administratively. Missteps with required processes can threaten students' ability to persist. We experimentally assessed the effectiveness of an artificially intelligent text-based chatbot to provide 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 administrative processes which were acute, time-sensitive, and for which outreach could be targeted to those for whom it was relevant. We draw lessons regarding the effective use of nudge-type efforts to support college success.

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

Abstract

College success requires students to engage with their institution both academically and administratively. Missteps with required processes can threaten students' ability to persist. We experimentally assessed the effectiveness of an artificially intelligent text-based chatbot to provide 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 administrative processes which were acute, time-sensitive, and for which outreach could be targeted to those for whom it was relevant. We draw lessons regarding the effective use of nudge-type efforts to support college success.

JEL I21, I23, I24

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INTRODUCTION

Most recent US high school graduates begin some form of postsecondary education; however, many exit with no degree or credential. Given rising income inequality in the US, differences in degree attainment by socioeconomic status are particularly concerning. Students from wealthier backgrounds not only are more likely to start college, but conditional on enrollment, they also are more likely to complete than their less well-off counterparts. 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 failing to earn a credential is the modal outcome (Kena et al, 2014). Compounding this problem is the fact that many low-income students borrow to attend. A trend in which students enter but do not complete college likely exacerbates income inequality as students assume college debt without the labor market payoff of a college credential.

Given worsening patterns of college completion overall and gaps across socioeconomic backgrounds, institutions have sought solutions to better support students to earn a credential. Academic readiness plays a role, though persistent gaps remain conditional on prior academic achievement (Kena et al, 2014). Diminishing institutional resources – driven by forces like reduced state funding and increased student enrollment – are an especially important factor in declining completion rates (Bound, Lovenheim & Turner, 2010). Indeed, where campuses invest in comprehensive supports 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). Of course, such investments may not be possible for resource-constrained campuses. This context motivates the question of whether universities might leverage low-cost, behavioral strategies to improve students' postsecondary persistence.

Success in postsecondary education requires students to engage with their institution both academically and administratively. Administrative requirements can be substantial, and missteps with required processes can threaten students' ability to persist. For example, students may lose

access to financial aid by failing to (re)file the Free Application for Federal Student Aid (FAFSA) or may face fines for missing administrative deadlines for enrolling in or dropping courses.

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 3.3 percentage points (Page & Gehlbach, 2017).

In this study, we extend the initial GSU effort in three primary ways:

(1) By testing whether a similar communication strategy can bolster student persistence;

(2) By investigating whether chatbot outreach can increase students' use of other campus-based supports; and

(3) By looking across institutional contexts to estimate effects on both two- and four-year college campuses.

On average, students starting at a two-year community college have lower levels of persistence and completion compared to those beginning at a four-year college. Therefore, community college students may especially benefit from proactive outreach and support. 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 how the communication strategy impacts 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), whereas customized campaigns targeted specific students according to 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 implementation and a pre-registered replication, we estimated causal impacts of this chatbot communication on completion of specific actions as well as on overall measures of persistence and success, including term credit attainment, term GPA, and continuation to the subsequent semester. To preview our key 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 topics such as registration holds and outstanding balances that need to be resolved for the student to remain enrolled. In contrast, messages encouraging students to utilize supplemental supports—meeting with advisors or attending course-specific supplemental instruction—yielded little to no effect. We find suggestive evidence that the timing of messages 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 or 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 students.

BACKGROUND

Complex administrative processes can create barriers for students' access to and success in higher education. For example, approximately 10 percent of 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 who start college pursuing an associate degree. Two-year institutions also often lack the financial resources of institutions serving primarily bachelor's degree intending students, spending less per pupil than four-year public universities (Goolsbee et al, 2019). Absent 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 remain enrolled the following year (NSC, 2021). Despite the unique challenges these students face navigating postsecondary education, few studies have tested the effect of virtual, interactive outreach on students enrolled in two-year colleges.

Research has pointed to the potential benefit of behaviorally informed strategies to help students navigate aspects of the college-going experience (see Page & Scott-Clayton, 2016, and

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 take up 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). In addition to these efforts to reduce procedural complexity, another approach has been to acknowledge this complexity and test the effect of proactive outreach and support to "nudge" students 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 (Castleman & Page, 2015, 2017; Castleman, Page & Schooley, 2014) and to file or refile the FAFSA (Castleman & Page, 2016; Page, Castleman & Meyer, 2019; Avery et al, 2021).

Despite the early promise that this body of work suggests, 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 which has a relationship with the students. 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 outreach in their interventions was framed as coming from a centralized entity with which students had no affiliation. They conclude that successful scaling of these types of interventions 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). This study finds positive effects of locally implemented outreach (e.g., outreach to students from their own 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 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 outreach only to students for whom it is pertinent. 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 enabled both the targeting of outreach and the examination of how the targeted outreach improved task completion and timely college matriculation (Page & Gehlbach, 2017).

Finally, Oreopoulos and Petronijevic (2019) report on nudge interventions designed to move student behavior not on discrete, well-defined tasks but on more sustained behavioral changes. 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. From their studies, Oreopoulos and Petronijevic (2019) emerge with a generally pessimistic view of the potential for nudge strategies to improve student academic outcomes, although they do note that the coaching intervention they investigated led to modest increases in study time inputs 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 overall academic outcomes such as course performance and credit attainment.

Overall, these studies raise the question of whether behavioral 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 such as academic achievement. If true, 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.

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 outreach and support to GSU-Atlanta admitted students.[1] Pounce outreach focused primarily on supporting students to navigate administrative tasks required for successful transition to GSU. Using the Mainstay platform, GSU texted students to remind them of required pre-

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[1] For more information on Mainstay, see www.mainstay.com.

matriculation tasks, provide step-by-step guidance on navigating these tasks, and prompt them to ask questions. Thanks to its 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 high enough 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 Mainstay system to respond to the student and to update the system knowledge base.[2]

Pounce outreach increased students' rates of completing pre-matriculation requirements and enrollment in GSU-Atlanta (Page & Gehlbach, 2017). Building on this success, GSU sought to deploy Pounce to provide 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 at GSU. 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 both chatbot implementation and research purposes. Finally, a full-time administrative coordinator monitored and triaged incoming messages daily. The implementation of outreach at the GSU-Perimeter campuses during the 2020-21 academic year involved no additional staff members—although the chatbot took upfront time to develop, it required considerably less staff effort to adapt messages for GSU-Perimeter. At the time of GSU-Perimeter implementation, the chatbot could respond to student queries with greater confidence due to maturation of the system knowledge base through implementation at GSU-Atlanta. In this way, there was limited need for staff to answer student questions in the context of the GSU-Perimeter implementation.

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

- **Administrative processes.** These campaigns aimed to raise student awareness about administrative processes, many of which were required for the student to remain in good standing with the university (e.g., FAFSA filing and resolving an overdue balance).
- **Academic engagement processes.** These messages included reminders about ongoing persistence tasks (such as course registration) and more acute tasks (such as addressing a

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[2] For more information see Page and Gehlbach (2017.

registration hold) and typically offered encouragement to meet with an advisor or academic coach to complete these tasks collaboratively.

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

Some campaigns were directed to all students; others targeted outreach only to those students 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 students 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 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 financial situation.

Messages not only informed students of a task that needed completion but included actionable next steps. A common chatbot 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 implemented (Tables A1 and A2 report on GSU-Atlanta messages and 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.

RESEARCH DESIGN, DATA, AND ANALYSIS

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[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.

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 analysis (Gehlbach & Robinson, 2018, 2021). We registered the study after intervention conclusion but prior to the analysis of outcome data.[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.

A. GSU-Atlanta Sample and Analysis

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 scale up. Separately for each wave and within groups defined by students' year at the university,[5] we randomized students into treatment and control conditions, 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.

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[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.

We present descriptive statistics for the wave 1 and 2 samples by treatment status in Table 1. Students in the wave 1 and 2 samples 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 of the incoming freshmen being included in the wave 1 sample. The typical student was approximately 20 years old in the wave 1 sample and 23 years old in the wave 2 sample.

To assess the impact of treatment on student outcomes, we use fixed effects regression and linear probability models of the following general form:

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

where for student i in randomization wave j, $Treatment_{ij}$ is an indicator equal to 1 if randomized to treatment and zero otherwise, X is a vector of baseline covariates, including those listed in Table 1, and ε_{ij} is the individual error term. Our key coefficient of interest, β, represents the intent-to-treat effect of being assigned to the text-communication treatment group on outcome Y_{ij}. In our presentation of results, we include intent-to-treat (ITT) effects estimated with and without baseline covariate controls.

B. GSU-Perimeter Sample and Analysis

The GSU-Perimeter study sample included 11,561 students at various stages in their academic career, randomized at the start of the 2020-21 academic year. In this study, the first message was distributed on September 10, 2020. Unlike the GSU-Atlanta randomization this study involved only one round of randomization. We present descriptive statistics for the Perimeter sample in Table 1. Here again, we observe balance across a host of baseline student characteristics.

As Table 1 illustrates, the average age of the GSU-Perimeter sample is about 23, in line with the wave 2 GSU-Atlanta sample but older than the initial wave 1 GSU-Atlanta sample. The share of Black students at GSU-Perimeter is slightly higher (51 percent), and slightly more students qualified for the Pell grant at GSU-Perimeter (57 percent). The most striking differences is in prior academic performance. The average high school GPA for the GSU-Atlanta sample was a 3.5 relative to about a 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 affects different student populations. For the GSU-Perimeter sample, we again use regression and linear probability models similar to the form expressed in equation (1) but without the randomization wave fixed effects.

C. Conditional Analysis

At both campuses some messages were directed to all treatment students, whereas other messages were targeted to the subset of treatment 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 students) on having an unpaid bill at the time of the campaign and then estimate the effect of assignment to treatment within this subsample.

Messages were not distributed to all treatment-assigned students due to circumstances including opt out, changed cell phone numbers, and students temporarily "pausing" their engagement with the chatbot, as described below. Although we cannot observe whether a message was received and read by a student, we can observe whether it was successfully distributed. Therefore, we additionally use a two-stage least squares instrumental variables (IV) approach to assess the effect of successful distribution on the outcomes of interest. 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 below are from models that include baseline controls. Because distribution rates were uniformly high, ITT and IV results differ modestly, if at all, across outcomes.

RESULTS

System use and engagement

In Table 2, we present platform usage and student engagement metrics across both campuses. 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 responses (e.g., answering a yes/no question), but students also sent over 5,000 open-ended questions into the system. We note that the number of student inquiries escalated to staff exceeds the number of times staff responded through the system. This is because escalation to staff could prompt the staff member to reach out to the student via other modes of communication and not necessarily through the text platform.

In the remaining columns of Table 2, we present measures of average student engagement, separately by wave. Recall that, 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 with and reflective of outreach over a shorter duration of time. The typical wave 1 treatment student received approximately 57 outreach text messages from Pounce. This consisted primarily of pre-planned campaign outreach messages, a small number of automatic responses provided by the AI capabilities of the system, and an even smaller number of messages that were sent by staff members through the system. The typical student sent approximately 3 messages into the Pounce system, with 2 of these messages being responses to close-ended survey questions and 1 being an open-ended question.

Recall that 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 170 text messages and sent nearly 100 messages 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 actions that required follow up with a campus office

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[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.

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 either temporarily for two weeks or permanently. Among wave 1 treatment-assigned students, approximately 5 percent opted out of receiving outreach from Pounce 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, these rates of opt out and pause are lower among students in the wave 2 sample. In general, the rates of opt out 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. A similar if slightly smaller number of messages required escalation to staff as with GSU-Atlanta. Interestingly, students at GSU-Perimeter were much less likely to fully opt out (almost no students used the #STOP feature) and instead used the #PAUSE feature; 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 of the outreach 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 of interest in column (5). Finally, in column (6), we report the number of students in the sample for whom the content of the message was relevant (i.e., the size of the sample included in treatment effect estimation). We present results for the 2018-19 GSU-Atlanta intervention in Panel A and the results for the 2020-21 GSU-Perimeter intervention in Panel B.

Impact of messaging on students' completion of administrative processes – financial management

In Table 3, we examine whether the chatbot affected FAFSA filing rates. 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 seven 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 a 2.5 percentage point (five 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 to about 1.5 percentage points by the end of the semester.

Notably, as the semester progressed successive FAFSA messages only went to those who had not yet filed. Therefore, the *composition* of FAFSA message recipients shifted as time passed to include fewer "eventual FAFSA filers." For example, during the spring semester at GSU-Perimeter, about 32% of students in the control group 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 diminishes significantly 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). Chatbot outreach about outstanding FAFSA verification tasks substantially increased the likelihood students successfully verified their FAFSA. In the GSU-Perimeter sample, messaging about a verification hold was relevant for 453 students. Yet, for this small group, outreach had a substantial effect on successful navigation of this process. Relative to 22% of selected control group students completing required verification steps, selected treatment group students were 7.9-9.3 percentage points more likely to do so.[7]

We next examined the effect of chatbot outreach on students' management of financial account issues. 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 Panel A of Table 4, we show that few students at GSU-Atlanta had an outstanding balance at the start of the fall or spring semesters (N = 374 and 257, respectively). However, only 22 percent of control students resolved their balance early in the fall semester. 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 spring 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 two weeks after messaging – both control and treated students were more likely to have resolved their balance. 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 the class readings while resolving their balances. Further the overall improvement in cognitive bandwidth by resolving balance earlier may enable students to direct more attention to their studies and start the semester off strong (Mullainathan & Shafir, 2013).

Results across these two tables suggest that text-based outreach is successful when it pertains to discrete, well-defined administrative processes. This is particularly so when the

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[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.

outreach is targeted to those students for whom it is relevant and when it is related to issues where the consequences of inaction are immediate and clear.

Impact of messaging on students' 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 those 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 are able to observe the effects of targeted registration reminders. GSU-Perimeter sent interactive messages in late April / early May to students who had not yet registered for the fall semester. The first set of messages asked students why they had not yet registered, and the second message asked students if they needed help with registration. About 20 percent of recipients replied to these prompts, with about half (48 percent) of respondents 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 letter 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. 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 students meeting with their advisor or resolving any holds.

In sharp contrast, messages that notified students about specific registration holds on their account significantly increased the likelihood of students resolving these holds and attending advising (presumably to discuss the holds in question). 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 of 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 increase 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.

Students' take-up of academic and career-related supports

In Table 7 we examined whether outreach about academic learning and career-related supports could increase student take-up of those services. Across both GSU-Atlanta and GSU-Perimeter 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 appears to be quite low overall, and the campaigns focused on these events appeared to do 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 in the control group.

At GSU-Perimeter, academic support messages took the form of promising supplemental instruction (as noted above) and encouraging students to meet with academic coaches. In the fall, these messages targeted students who were on "early alert" based on their performance in one or more classes. 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 a 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" – a 56 percent increase off the control group enrollment rate of about 22 percent.

Summative outcomes

Finally, in Table 8, we present impacts on a set of 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 spring semester and whether they graduated or persisted (either graduated, enrolled, or, for GSU-Perimeter, transferred to GSU-Atlanta) through the fall of the academic year following the intervention. The outreach had no effect on these summative outcomes. Given that the outreach was particularly beneficial in helping very targeted sets of students navigating required administrative tasks, and no outreach dealt directly with students' core academic responsibilities, it is unsurprising that the chatbot outreach, as implemented, did not translate to improvement in overall academic metrics such as those we consider here.

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[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 assess the implementation and impact of Georgia State University's effort to use an AI-enabled 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. Outreach was most effective at influencing student behavior when its topical focus was on discrete, well-defined administrative tasks for which the consequences of inaction were high. 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. In contrast, but paralleling Oreopoulos and Petronijevic (2019), students were less responsive to outreach promoting tasks related to their academics or future job prospects, for example, where the immediate consequences of inaction were likely less obvious.

We further find that messages earlier in the semester produce larger effects on students' task completion with likely substantial benefits to students – e.g., students who apply for financial aid earlier may have access to larger 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.

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 able to be 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.

For these students, our results suggest that text-based nudging may be particularly effective when focused on required tasks and processes that carry with them a sense of urgency and for which the consequences of inaction are immediate and tangible. 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, we found GSU-Perimeter advising messages were more effective when coupled with information about students having a registration hold on their account, 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.[9] In future iterations, messages about career services supports or supplemental instruction 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.

Targeting and personalization of outreach may also be a key to effectiveness. 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

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[9] 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.

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, in a university setting, using a text-based platform such as Pounce involves centralizing communication and, therefore, 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 is reliant on student-level data (Nurshatayeva et al, 2020) and may be challenging to implement for resource-constrained institutions, particularly those that serve a large number of historically disadvantaged students who may stand to benefit (Scott-Clayton, 2015).

Another point to consider is students' receptivity to receiving outreach from the ostensible sender of the messages. In the intervention we consider 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 and expressions of gratitude from students receiving chatbot messages. At GSU-Atlanta, among students in the first wave of randomization (e.g., those targeted for outreach throughout the entire 2018-19 academic year), approximately 5 percent opted out and another 8 percent paused the outreach at some point during the year.[10] Such opt out (and pause) rates are in line with prior text-based interventions where the outreach was coming from a trusted source and one from which students would expect to hear, given the topical focus of the messaging. In contrast, opt out rates tend to be higher when the outreach is delivered from a less-well-known source or one with which the student may not expect

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[10] 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.

to communicate via text message (e.g., Avery et al, 2020; Page et al, 2019). 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). The present study is 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 that students are receiving through other channels, rather than standing alone.

Relatedly, it is worth noting that in these experiments, 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 and peers. 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. GSU has partnered with faculty to adapt chatbot technology to send students course-specific outreach and encouragement, with promising effects on first-generation students' assignment completion and final grades (Meyer et al, 2022).

In the effort that we investigate here, we find that centralized, text-based outreach to students regarding required (and, often, time sensitive) administrative tasks was highly effective for improving their 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 their low cost. At the same time, these impacts are often still modest in absolute terms. Therefore, we encourage consideration of how such nudges can be incorporated into multi-pronged systems of support. Such systems are

likely to be most successful when they account for the several dimensions – financial, academic, social, administrative – along which students can falter on the path to college success.

WORKS CITED

Avery, C., Castleman, B. L., Hurwitz, M., Long, B. T. & Page, L. C. (2021). Digital messaging to improve college enrollment and success. *Economics of Education Review* 84 (2021): 102170.

Balaban, R., & Conway, P. (2020, May). A Test of Enhancing Learning in Economics through Nudges. In *AEA Papers and Proceedings* (Vol. 110, pp. 289-93).

Bettinger, E. P., Long, B. T., Oreopoulos, P., & Sanbonmatsu, L. (2012). The role of application assistance and information in college decisions: Results from the H&R Block FAFSA experiment. *The Quarterly Journal of Economics*, *127*(3), 1205-1242.

Bird, K. A. (2016). Early bird gets the worm? The impact of application deadlines on the distribution of state grant aid. A dissertation presented to the University of Virginia, May 2016.

Bird, K. A., & Castleman, B. L. (2016). Here today, gone tomorrow? Investigating rates and patterns of financial aid renewal among college freshmen. *Research in Higher Education, 57*, 395-422.

Bird, K. A., Castleman, B. L., Denning, J. T., Goodman, J., Lamberton, C., & Rosinger, K. O. (2021). Nudging at scale: Experimental evidence from FAFSA completion campaigns. *Journal of Economic Behavior & Organization*, *183*, 105-128.Bound, J., Lovenheim, M. F., & Turner, S. (2010). Why have college completion rates declined? An analysis of changing student preparation and collegiate resources. *American Economic Journal: Applied Economics*, *2*(3), 129-57.

Bound, J., Lovenheim, M. F., & Turner, S. (2010). Why have college completion rates declined? An analysis of changing student preparation and collegiate resources. *American Economic Journal: Applied Economics*, *2*(3), 129-57.

Carrell, S. E., & Kurlaender, M. (2020). *My professor cares: Experimental evidence on the role of faculty engagement* (No. w27312). National Bureau of Economic Research.

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

Castleman, B. L., & Page, L. C. (2016). Freshman year financial aid nudges: An experiment to increase FAFSA renewal and college persistence. *Journal of Human Resources*, *51*(2), 389-415.

Castleman, B. L., & Page, L. C. (2017). Parental influences on postsecondary decision making: Evidence from a text messaging experiment. *Educational Evaluation and Policy Analysis*, *39*(2), 361-377.

Castleman, B. L., Page, L. C., & Schooley, K. (2014). The forgotten summer: Does the offer of college counseling after high school mitigate summer melt among college-intending, low-income high school graduates? *Journal of Policy Analysis and Management*, *33*(2), 320-344.

Cochrane D. F., LaManque A., Szabo-Kubitz L. (2010). *After the FAFSA: How red tape can prevent eligible students from receiving financial aid*. Institute for College Access & Success. https://eric.ed.gov/?id=ED515393

Debnam, J. (2017). Peers and persuasion across collegiate social networks. Working paper.

Doss, C., Fahle, E. M., Loeb, S., & York, B. N. (2019). More Than Just a Nudge Supporting Kindergarten Parents with Differentiated and Personalized Text Messages. *Journal of Human Resources*, *54*(3), 567-603.

Dynarski, S., Nurshatayeva, A., Page, L. C., & Scott-Clayton, J. (2022). *Addressing Non-Financial Barriers to College Access and Success: Evidence and Policy Implications* (No. w30054). National Bureau of Economic Research.

Fryer Jr, R. G. (2011). Financial incentives and student achievement: Evidence from randomized trials. *The Quarterly Journal of Economics*, *126*(4), 1755-1798.

Gehlbach, H., & Robinson, C. D. (2018). Mitigating illusory results through preregistration in education. *Journal of Research on Educational Effectiveness*, *11*(2), 296-315. https://doi.org/10.1080/19345747.2017.1387950

Gehlbach, H., & Robinson, C. D. (2021). From old school to open science: The implications of new research norms for educational psychology and beyond. *Educational Psychologist*, 1-11. https://doi.org/10.1080/00461520.2021.1898961

Goldin, C., Katz, L. F., & Kuziemko, I. (2006). The homecoming of American college women: The reversal of the college gender gap. *Journal of Economic perspectives*, *20*(4), 133-156.

Goolsbee, A., Hubbard, G., Ganz, A., & Kearney, M. S. (2019). A policy agenda to develop human capital for the modern economy. Report retrieved from https://www.economicstrategygroup.org/wp-content/uploads/2019/12/Expanding-Economic-Opportunity-for-More-Americans-A-Policy-Agenda-to-Develop-Human-Capital-for-the-Modern-Economy.pdf

Guzman-Alvarez, A., & Page, L. C. (2021). Disproportionate burden: Estimating the cost of FAFSA verification for public colleges and universities. *Educational Evaluation and Policy Analysis*, *43*(3), 545-551.

Hurwitz, M., Smith, J., Niu, S., & Howell, J. (2015). The Maine question: How is 4-year college enrollment affected by mandatory college entrance exams? *Educational Evaluation and Policy Analysis*, *37*(1), 138-159.

Hyman, J. (2017). ACT for all: The effect of mandatory college entrance exams on postsecondary attainment and choice. *Education Finance and Policy*, *12*(3), 281-311.

Kena, G., Aud, S., Johnson, F., Wang, X., Zhang, J., Rathbun, A., ... & Kristapovich, P. (2014). The Condition of Education 2014. NCES 2014-083. *National Center for Education Statistics*.

Kraft, M. A., & Dougherty, S. M. (2013). The effect of teacher–family communication on student engagement: Evidence from a randomized field experiment. *Journal of Research on Educational Effectiveness*, *6*(3), 199-222.

Meyer, K., Page, L. C., Smith, E., Walsh, B. T., Fifield, C. L., & Evans, M. (2021). Let's Chat: Chatbot Nudging for Improved Course Performance. (No. 22-564). EdWorkingPapers.

Mullainathan, S., & Shafir, E. (2013). Scarcity. *Social Policy*, *46*(2), 231-249.

National Student Clearinghouse (2021). Persistence and Retention: Fall 2019 Beginning Cohort. Report retrieved from: https://nscresearchcenter.org/wp-content/uploads/PersistenceRetention2021.pdf

Nurshatayeva, A., Page, L. C., White, C. C., & Gehlbach, H. (2020). Proactive student support using artificially intelligent conversational chatbots: The importance of targeting the technology. Working paper.

Oreopoulos, P., & Petronijevic, U. (2019). *The remarkable unresponsiveness of college students to nudging and what we can learn from it* (No. w26059). National Bureau of Economic Research.

Page, L. C., Castleman, B. L., & Meyer, K. (2020). Customized nudging to improve FAFSA completion and income verification. *Educational Evaluation and Policy Analysis*, *42*(1), 3-21.

Page, L. C., & Gehlbach, H. (2017). How an artificially intelligent virtual assistant helps students navigate the road to college. *AERA Open*, *3*(4).

Page, L. C., Kehoe, S. S., Castleman, B. L., & Sahadewo, G. A. (2019). More than Dollars for Scholars: The Impact of the Dell Scholars Program on College Access, Persistence, and Degree Attainment. *Journal of Human Resources*, *54*(3), 683-725.

Page, L. C., Sacerdote, B. I., Goldrick-Rab, S., & Castleman, B. L. (2022). Financial aid nudges: A national experiment with informational interventions. *Educational Evaluation and Policy Analysis*, 01623737221111403.

Page, L. C., & Scott-Clayton, J. (2016). Improving college access in the United States: Barriers and policy responses. *Economics of Education Review*, *51*, 4-22.

Scott-Clayton, J. (2015). The shapeless river: Does a lack of structure inhibit students' progress at community colleges? In Benjamin L. Castleman, Saul Schwartz, & Sandy Baum (Eds). *Decision Making for Student Success: Behavioral Insights to Improve College Access and Persistence*. New York City, New York: Routledge.

Smith, B. O., White, D. R., Kuzyk, P. C., & Tierney, J. E. (2018). Improved grade outcomes with an e-mailed "grade nudge". *The Journal of Economic Education*, *49*(1), 1-7.

Thaler, R. H., & Sunstein, C. R. (2009). *Nudge: Improving decisions about health, wealth, and happiness*. Penguin.

Wiederspan M. (2019). *Impact of verification on Iowa FAFSA filers* (pp. 1–8). Iowa College Aid. Aid.http://publications.iowa.gov/29868/1/Impact_of_Verification_on_Iowa_FAFSA_Filers.pdf

York, B. N., Loeb, S., & Doss, C. (2019). One step at a time the effects of an early literacy text-messaging program for parents of preschoolers. *Journal of Human Resources*, *54*(3), 537-566.

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).

Table 2: Chatbot engagement and opt-out

Outcome	GSU-Atlanta				GSU-Perimeter		
	Total N	Control mean	Wave 1 ITT	Wave 2 ITT	Total N	Control mean	ITT
N outgoing messages	244,673	0.00	56.721*** (0.345)	10.950*** (0.088)	298,382	0.00	51.623*** (0.308)
N outgoing campaign messages	233,265	0.00	54.243*** (0.332)	10.240*** (0.077)			
N outgoing auto-response messages	5,554	0.00	1.133*** (0.050)	0.434*** (0.029)			
N outgoing staff response messages	16	0.00	0.004*** (0.001)	0.001 (0.000)			
N outgoing triage messages	777	0.00	0.136*** (0.008)	0.089*** (0.007)			
N incoming messages	15,980	0.00	3.323*** (0.077)	1.178*** (0.040)	21,325	0.00	3.689*** (0.068)
N incoming survey response messages	9,056	0.00	1.894*** (0.041)	0.656*** (0.018)			
N incoming question	5,555	0.00	1.134*** (0.050)	0.434*** (0.029)			
N incoming messages escalated to staff member	42	0.00	0.010*** (0.002)	0.002** (0.001)	34	0.00	0.005*** (0.0009)
Opt out		0.00	0.048*** (0.004)	0.011*** (0.002)		0.00	0.0007** (0.0003)
Pause participation		0.00	0.080*** (0.004)	0.048*** (0.004)		0.00	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

Sample	Campaign Topic	Outcome	(1) Control Mean	(2) ITT effect		(3) ITT effect		(4) First-stage		(5) IV effect		(6) N
Panel A: Atlanta												
Full	2019-2020 FAFSA reminder (sent monthly)	Filed FAFSA by March 14	0.406	0.009		0.007		0.729	***	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) Control Mean	(2) ITT effect		(3) ITT effect		(4) First-stage		(5) IV effect		(6) N
Sample	Campaign Topic	Outcome										
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

Term	Campaign Topic	Outcome	(1) Control Mean	(2) ITT effect		(3) ITT effect		(4) First-stage		(5) IV effect		(6) 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)		
		Resolve hold(s)	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)		

Resolve hold(s)	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.

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

Sample	Campaign Topic	Outcome	(1) Control Mean	(2) ITT effect		(3) ITT effect		(4) First-stage		(5) IV effect		(6) 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 (0.150)	7,580	36.067	-0.202 (0.475)	11,553
Semester 1 GPA	2.916	0.015 (0.023)	7,580	2.150	-0.003 (0.024)	11,561
Semester 2 credits earned	71.670	0.071 (0.139)	13,656	41.604	-0.195 (0.492)	11,553
Semester 2 GPA	2.712	-0.009 (0.020)	13,656	1.624	0.017 (0.027)	11,561
Semester 2 graduated	0.046	-0.004 (0.003)	13,656	0.038	0.004 (0.004)	11,561
Semester 3 graduated	0.033	0.005 (0.003)	13,656	0.037	0.000 (0.003)	11,561
Semester 3 persistence	0.802	0.005 (0.007)	13,656	0.572	0.004 (0.009)	11,561
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. 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

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
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

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
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
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 Maymester 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