Financial literacy and academic outcomes

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Introduction: Student Debt

- Total U.S. student debt reached $1.58 trillion in the third quarter of 2021; this is an increase of close to $650 billion from a decade before Federal Reserve Bank of New York (2021)
- Leading factors cited as an explanation for the increase:
  - Rising tuition
  - Inadequate household savings
  - Low interest rates
  - The lure of debt forgiveness
- One factor discussed less frequently: *Delayed Graduation*

Introduction: Delayed Graduation

- A 2019 report by the National Center for Education Statistics found that only 41% of full-time, first-time students earned degrees in 4 years, and only 59% did so in 6 years de Brey et al. (2019)
- The report also found significant heterogeneity by gender, race, and income with males, minorities, and low-income students graduating at slower rates
- Given current borrowing rates and tuition costs, these results suggests another mechanism - graduation rates - for addressing rising student debt loads

Introduction: Delayed Graduation

- Factors that may influence a student's rate of progress Kolodner (2017)
  - Lack of preparation before entering college (falling behind)
  - Taking too few credits (the 12-credit fallacy)
  - Transferring or changing majors
  - Spending too much time working
  - To much socializing or social media
- More broadly, students mail fail to connect short- and medium-term academic decisions with long-run academic and financial outcomes Lavecchia et al. (2016)
  - There is a psychological tendency, up the age of 25, to over-weight short-run costs (e.g.,academic effort) relative to long-run benefits Giedd et al. (2012)
  - Research suggests this deficiency in executive decision-making can be influenced by educational interventions Becker and Mulligan (1997); Alan and Ertac (2018)

Our Solution: Financial Literacy Education

- Hypothesis: increased financial literacy will decrease the cost of college by emphasizing the connection between increased academic effort in the short run and the reduced long-run cost of college due to better rates of on-time graduation

- Approach: randomly invite (and incentivize) students to participate in a 10 minute financial literacy tutorial highlighting these connections

- Sample:
  - First-year students at UP Campus in the Fall of 2020
  - Excludes all adult learners and international students

Literature

- Large literature demonstrating positive effective of financial literacy education on financial knowledge and behavior Kaiser et al. (2021)
  - Effect sizes for interventions targeting financial knowledge similar to interventions targeting math and reading outcomes in education
  - Effect sizes for interventions targeting financial behavior similar to interventions in healthcare and energy conservation
- Recent applications in higher education using ”debt letters” as a low-touch intervention to connect borrowing and academic activities Stoddard et al. (2017); Darolia and Harper (2018)
  - Conclusion: debt letters did not change borrowing behavior, but did impact academic outcomes - credits taken and GPA

◂ References

Literature

- Low-touch (nudge) interventions used to enhance the college application process, enrollment, and persistence have shown promise Bettinger et al. (2012); Dynarski et al. (2021); Castleman and Page (2016)
- Low-touch interventions designed to impact academic effort have shown less promise Oreopoulos and Petronijevic (2019)
- Financial interventions, such as merit- and need-based grants, lead to improvements in academic outcomes - GPA, credit accumulation, and persistence - as well as increases in graduation rates Goldrick-Rab et al. (2016); Castleman and Long (2016); Page et al. (2019); Denning et al. (2019)
  - Effects larger for higher-achieving high school students and minorities

◂ References

Research questions

We address two questions in this paper focused on the short-run:

1. Does financial information on the costs of delayed graduation increase academic effort?
   → Yes, credits and earned and GPAs increase
2. What type of students are most affected?
   → Under-represented minority and less-prepared students are much more responsive to treatment

Research questions

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experimental design

Setting

- We collaborated with Penn State Institutional Research to access student records
- First experiment was a “pilot” with incoming first-year students starting in Fall 2020
  - Excluded adult learners and international students
  - 7,602 first year students
- Randomized selected 2,229 to receive an invitation
  - 50% received an email
  - 25% $10 in LionCash
  - 25% $20 in LionCash
  - Treatment sample constrained by budget ($10,000)
- Stratified on:
  - Under-represented minority (non-white & non-Asian)
  - First-generation college students
  - Paying in-state tuition
  - Quartiles of incoming evaluation score from admissions office

Balance

	Invitation (N=2226)		No Invitation (N=5373)		
	Mean	SD	Mean	SD	*p*-value
Minority	0.19	0.39	0.19	0.39	0.92
First-Gen	0.14	0.35	0.14	0.35	0.89
Evaluation	3.26	0.26	3.25	0.27	0.79
In-State	0.62	0.49	0.62	0.49	0.94
First-Time	0.74	0.44	0.75	0.43	0.24
Female	0.50	0.50	0.53	0.50	0.06
F-test *p*-value		0.4551			

Timing

Sent the invitations via emails in waves due to budget constraints

- First wave of 1201 invites sent Dec 9, 2020
- Second wave of 1026 invites sent Jan 11, 2020
- Third wave of all non-respondents invites sent Jan 18, 2020
- Respondents had one week to complete the survey
- All waves had two reminders (3 days and 1 day left)

Intervention

Online tutorial with four parts

1. Questions about your financial situation
2. Questions about your financial literacy
3. Information about the costs of college and benefits
4. Financial literacy resources at Penn State

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Costs of delayed graduation

The table below shows how long it takes the average Penn State student to graduate.

Time to graduate	% of Students
4 years	62.5%
5 years	82.6%
6 years	84.9%

Based on these results, 20% of Penn State undergraduates spend at least one extra year in school.

Suppose you are considering dropping a class, which would force you to stay an extra semester.

What might this decision cost you in the long run? What are the tradeoffs?

Costs of delayed graduation

The Costs

Current Penn State estimates for annual tuition and fees for in-state students are:

- Tuition and Fees (in-state): **$18,450**
- Room and Board: **$11,884**

Since you will likely need to pay for food and lodging regardless of whether you are at Penn State, we will only include tuition and fees. The cost estimates are as follows:

- Tuition and fees for one semester= **$9,225**
- If you take out a student loan to pay for these costs the **typical student loan is repaid in 10 years at a 4.5%** interest rate.
- Interest payments = **$2,225**.
- Monthly payment for 10 years = **$95**
- That is an **extra $95 every month for 10 years** for dropping one class!

Note that interest rates change over time, and a higher rate will lead to a larger debt burden. If you take out loans for living expenses, like room and board, your debt will be even higher.

Costs of delayed graduation

The Tradeoffs

We now know that delaying graduation even one semester can cost a lot. But, there may be benefits if having a higher GPA gets you a better job or into a better graduate school.

There are some rules of thumb about the necessary starting salary to comfortably repay student loans. (The typical debt of a Penn State graduate is $25,000.)

Penn State provides the following template which suggests that total annual payments on debt should be less than 8% of your starting salary.

Debt and Recommended Salaries

	Amount Borrowed	Estimated Monthly Payments	Recommended Annual Salaries
Average Penn State Undergrad	$25,000	$259.10	$38,865.00
Average Penn State Undergrad plus an extra semester	$34,225	$354.70	$53,205.00

Costs of delayed graduation

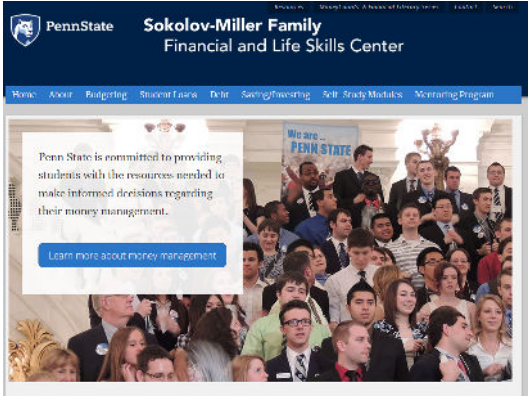
From our scenario, dropping a class and staying an extra semester would add $9,225 in debt bringing you to **$34,000 in total debt** at graduation.

In order to comfortably pay for the initial ($25,000) in debt you would need a **starting salary of $39,000**, but with the new debt ($34,225) you would need a **starting salary of $53,000**.

Financial literacy resources

Track clicks for:

- General Center information
- Online resources
- Book individual appointment



methods

Empirical setup

- We cannot force students to take the tutorial (yet)
- Use a randomized encouragement design
- We randomize two different encouragements:
  1. invitation email
  2. an invitation email + financial incentive ($10 or $20)

Empirical setup

Notation

- Our outcome variables are academic performance of student i in semester t
  - $Y_{it} = \{\text{Credits}_{it}, \text{GPA}_{it}\}$
- Our treatment variable is whether student i took the tutorial by semester t (not randomized):
  - $D_{it} = \text{Treat}_{it}$
- Our random assignment is the encouragement
  - $Z_i = \{\text{Email}_{it}, \text{Incentive}_{it}\}$

Treatment effects

First Stage

$$\text{Treat}_{it} = \alpha + \delta_1 \text{Email}_i + \delta_2 \text{Incentive}_i + \phi_{it}$$

ITT

$$Y_{it} = \alpha + \pi_1 \text{Email}_i + \pi_2 \text{Incentive}_i + \epsilon_{it}$$

LATE = ATT via 2SLS

$$Y_{it} = \alpha + \beta \widehat{\text{Treat}_{it}} + \nu_{it}$$

◂ more methods

data & results

Participation

	(1)	(2)	(3)
Email	0.145***	0.145***	0.145***
	(0.011)	(0.011)	(0.011)
Incentive	0.342***		0.333***
	(0.014)		(0.020)
$10		0.333***	
		(0.020)	
$20		0.352***	0.019
		(0.020)	(0.029)
Observations	7,599	7,599	7,599

Outcome data

	Mean	SD	N
Classes			
Total	5.36	0.92	14985
Passed	5.06	1.21	14985
Failed	0.14	0.60	14985
Dropped	0.07	0.37	14985
Credits			
Attempted	15.67	2.36	14985
Earned	14.76	3.35	14985
Grades			
GPA	3.41	0.54	14754
Treatment			
% Invited	0.29	0.46	14985
% Completed	0.05	0.22	14985

Treatment Effects

	Credits (1)	GPA (2)	Credits (3)	GPA (4)
A. Intent to Treat				
Email	0.172*	-0.014	0.075	-0.022
	(0.093)	(0.016)	(0.094)	(0.016)
Incentive	0.269***	0.042***	0.170*	0.034**
	(0.091)	(0.015)	(0.092)	(0.015)
B. Treatment Effect on the Treated				
Treatment	0.907***	0.107**	0.550*	0.079*
	(0.279)	(0.045)	(0.285)	(0.046)
F-statistic	2,141.4	2,140.6	2,058.4	2,057.7
Fixed Effects (Semester)	No		Yes	
Observations	14,985	14,754	14,985	14,754
Control Group Mean	14.72	3.41	14.72	3.41

Cumulative Effects

	Fall 2020 (1)	Spring 2021 (2)
A. Intent to Treat		
Email	0.038	0.066
	(0.143)	(0.171)
Incentive	0.188	0.320*
	(0.125)	(0.168)
B. Treatment Effect on the Treated		
Treatment	0.678	0.883*
	(0.466)	(0.475)
F-statistic	916.0	1,102.1
Observations	7,599	7,386
Control Group Mean	14.47	29.63

Heterogeneity

	Treatment		Credits	GPA
	Email	Incentive		
	(1)	(2)	(3)	(4)
Minority	0.014	0.096**	-0.607***	-0.068***
	(0.028)	(0.038)	(0.116)	(0.018)
First Gen.	0.010	0.002	-0.685***	-0.167***
	(0.032)	(0.042)	(0.131)	(0.022)
In-State	0.019	0.019	-0.172**	-0.014
	(0.022)	(0.030)	(0.078)	(0.013)
Eval. Q2	0.051*	0.044	0.521***	0.093***
	(0.029)	(0.038)	(0.112)	(0.019)
Eval. Q3	0.030	0.122***	0.938***	0.226***
	(0.028)	(0.039)	(0.106)	(0.018)
Eval. Q4	0.066**	0.183***	1.50***	0.444***
	(0.030)	(0.040)	(0.112)	(0.016)
Observations	1,077	1,088	10,594	10,420

Heterogeneity - cumulative credits

	Non-Minority	Minority	Non-First-Gen.	First-Gen.	Out-of-State	In-State	Lower Eval.	Upper Eval.
	Spring 2021	Spring 2021	Spring 2021	Spring 2021	Spring 2021	Spring 2021	Spring 2021	Spring 2021
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Intent to Treat								
Email	0.098	-0.116	-0.042	0.775	-0.272	0.271	0.190	-0.046
	(0.170)	(0.539)	(0.178)	(0.554)	(0.260)	(0.225)	(0.245)	(0.233)
Incentive	0.155	1.07**	0.349**	0.196	0.381	0.282	0.669***	-0.035
	(0.177)	(0.450)	(0.172)	(0.549)	(0.261)	(0.218)	(0.231)	(0.239)
B. Treatment on the Treated								
Treatment	0.499	2.37**	0.894*	0.997	0.884	0.903	2.24***	-0.104
	(0.523)	(1.08)	(0.492)	(1.48)	(0.778)	(0.599)	(0.798)	(0.577)
F-statistic	832.0	275.5	942.7	159.7	395.3	708.7	421.1	704.5
Observations	6,008	1,378	6,383	1,003	2,801	4,585	3,706	3,680
Control Group Mean	29.9	28.4	29.8	28.2	29.6	29.6	28.7	30.6

Survey data

	Non-Minority (N=413)		Minority (N=123)			
	Mean	Std. Dev.	Mean	Std. Dev.	Diff. in Means	Std. Error
Duration	7.36	5.76	7.99	6.14	0.63	0.62
Loans	0.49	0.50	0.57	0.50	0.08	0.05
Debt	20024	18477	23699	19437	3675	1974
Family Help	0.85	0.36	0.80	0.40	-0.05	0.04
Work	0.70	0.46	0.70	0.46	-0.00	0.05
Fin. Lit.	2.28	1.15	1.96	1.17	-0.32	0.12
Center	0.44	0.50	0.54	0.50	0.10	0.05
Click	0.17	0.38	0.26	0.44	0.09	0.04

Robustness + other results

- Different instruments $\Rightarrow$ different treatment effects ▸ instruments
  - $\rightarrow$ Incentive lead to fewer fails, email fewer
  - $\rightarrow$ Different effects on GPA
- Retention ▸ retention
  - $\rightarrow$ Higher probability of treated group to be enrolled in Fall 2021 (pretty big effect)
- Standardized effects ▸ standardized
  - $\rightarrow$ .16 SD for credits; .15 SD for GPA
- Randomization inference and multiple hypothesis testing ▸ inference
  - $\rightarrow$ Main effects still hold some subgroup effects are no longer significant

concluding remarks

Big picture

- These are short-run effects; what are the implications?
- Assume that four courses dropped or failed leads to an extra semester
- Tuition savings is almost $700,000
- One dollar spent on incentives saves $115 in tuition

Summary and implications

- We deployed a low-touch nudge using financial motivation to promote academic effort
- Short-run results are very promising
- Similar treatment effect to interventions that costs thousands of dollars per student
- Questions remain on persistence, cohort effects, and ultimately student debt
- Larger experiment at PSU currently in the field

Thanks and feedback welcome!

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[back-up slides]

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Back to literature

Treatment effects

There are three equations/parameters of interest

1. First stage selection/participation equation

$$\text{Treat}_{it} = \alpha + \delta_1 \text{Email}_i + \delta_2 \text{Incentive}_i + \phi_{it} \quad (1)$$

- Measures the effect of the random assignment of Email_i and Incentive_i on the probability of taking the survey (Treat_{it})

Back to methods

Treatment effects

2. Intent to treat (ITT)

$$Y_{it} = \alpha + \pi_1 \text{Email}_i + \pi_2 \text{Incentive}_i + \epsilon_{it} \tag{2}$$

- Measures the effect of the random assignment of Email_i and Incentive_i on outcomes.
- Due to random assignment any difference in outcomes should be due to students actually taking the tutorial Treat_{it}
- Underestimates the average treatment effect because not everyone in Email_i and Incentive_i is actually treated
- Also called the reduced form

Back to methods

Treatment effects

3. Local average treatment effect (LATE)

$$Y_{it} = \alpha + \beta \widehat{\text{Treat}}_{it} + \nu_{it} \tag{3}$$

- Estimated by 2SLS
- $\widehat{\text{Treat}}_{it}$ is instrumented with Email_i and Incentive_i
- Captures the treatment effect for those who are affected by Email_i and Incentive_i

◂ Back to methods

LATE

Let's decompose LATE a bit:

$$\frac{E[Y_{it}|Z_i = 1] - E[Y_{it}|Z_i = 0]}{E[D_{it}|Z_i = 1] - E[D_{it}|Z_i = 0]} = \frac{\text{ITT}}{\text{First Stage}} = \frac{\pi}{\delta}$$

- Effect of randomized encouragement (ITT) scaled by the impact of encouragement on treatment
- "Local" because it estimates the treatment effect for those induced into treatment by the randomized encouragement (compliers)
- With perfect one-sided non-compliance the LATE is equal to the average treatment effect on the treated (ATT)
  - no invite = no treatment $\Rightarrow$ no defiers or always-takers

Back to methods

Heterogeneity by instrument

	Credits (1)	GPA (2)	# Drop (3)	# Fail (4)
A. All Treatments (ATT)				
Treatment	0.550*	0.079*	-0.035	-0.117**
	(0.285)	(0.046)	(0.032)	(0.046)
Observations	14,985	14,754	14,985	14,985
B. Only Email (LATE)				
Treatment	0.579	-0.172	-0.162**	0.018
	(0.738)	(0.129)	(0.071)	(0.145)
Observations	13,299	13,091	13,299	13,299
C. Only Incentive (LATE)				
Treatment	0.548*	0.109**	-0.023	-0.132***
	(0.292)	(0.047)	(0.033)	(0.045)
Observations	13,306	13,093	13,306	13,306
Control Sample Mean	14.72	3.41	0.08	0.15

▸ robustness

Retention

	Spring 2021 (1)	Fall 2021 (2)
A. Intent to Treat		
Email	0.005	-0.020***
	(0.006)	(0.007)
Incentive	-0.007	-0.016**
	(0.005)	(0.007)
Observations	7,599	7,599
Control Group Mean	0.028	0.066

▸ robustness

Standardized results

	Credits (1)	GPA (2)	Credits (3)	GPA (4)
A. Intent to Treat				
Email	0.051*	-0.025	0.022	-0.041
	(0.028)	(0.030)	(0.028)	(0.030)
Incentive	0.080***	0.078***	0.051*	0.062**
	(0.027)	(0.027)	(0.027)	(0.028)
B. Treatment on the Treated				
Treatment	0.271***	0.198**	0.164*	0.145*
	(0.083)	(0.082)	(0.085)	(0.085)
F-statistic	2,141.4	2,140.6	2,058.4	2,057.7
Fixed Effects (Semester)	No		Yes	
Observations	14,985	14,754	14,985	14,754
Control Sample Mean	14.72	3.41	14.72	3.41
Control Sample Std. Dev.	3.41	0.55	3.41	0.55

▸ robustness

Randomization inference & multiple hypothesis testing

Outcome	Variable	p-value RI	p-value Adj.	p-value
Credits	Email	0.43	0.42	0.56
GPA	Email	0.18	0.14	0.35
Cumulative Credits	Email	0.70	0.79	0.70
Credits	Incentive	0.06	0.07	0.18
GPA	Incentive	0.02	0.02	0.10
Cumulative Credits	Incentive	0.06	0.19	0.19

▸ robustness

Randomization inference & multiple hypothesis testing

Sub-Sample	Variable	p-value	p-value RI	p-value Adj.
Minority	Email	0.83	0.87	1.00
First-Gen.	Email	0.16	0.34	0.77
In-State	Email	0.23	0.39	0.84
Upper Eval.	Email	0.84	0.88	0.98
No Minority	Email	0.57	0.69	0.98
No First-Gen.	Email	0.81	0.87	1.00
Out-of-State	Email	0.30	0.48	0.91
Lower Eval.	Email	0.44	0.58	0.96
Minority	Incentive	0.02	0.13	0.19
First-Gen.	Incentive	0.72	0.81	1.00
In-State	Incentive	0.20	0.37	0.81
Upper Eval.	Incentive	0.88	0.92	0.89
No Minority	Incentive	0.38	0.53	0.95
No First-Gen.	Incentive	0.04	0.16	0.36
Out-of-State	Incentive	0.14	0.31	0.76
Lower Eval.	Incentive	0.00	0.06	0.05