

Early Cost Realization and College Choice

Journal:	<i>Journal of Marketing Research</i>
Manuscript ID	JMR.19.0238.R2
Manuscript Type:	Special Issue Revised Submission
Topics and Methods:	Intertemporal Choice, Financial Decision Making, Decision Aids, Student Debt, Higher Education

The logo for ScholarOne Manuscripts. The word "SCHOLARONE" is in a bold, orange, sans-serif font, with a trademark symbol (TM) to its upper right. Below it, the word "Manuscripts" is in a smaller, orange, sans-serif font.

Early Cost Realization and College Choice

ABSTRACT

We propose a formal *tuition myopia* model of the decision-making process by which students evaluate the financial costs and returns of college. In simulations, surveys, and experiments, we find that even when student loans defer payment of attendance costs until after graduation—the same moment when students can begin earning a salary that reflects their degree—students psychologically realize the financial costs of college much earlier. This early cost realization frames a majority of choices between any pair of colleges as an intertemporal tradeoff between a smaller short-term investment with smaller long-term returns (a low cost-low return college; LC-LR) and a larger short-term investment with larger long-term returns (a high cost-high return college; HC-HR). While a rational model based on projected future cash flows most often favors the HC-HR college, our model predicts a preference for the LC-LR college among students who are financially impatient and in choice pairs where the equilibrium between LC-LR and HC-HR options is at a low discount rate threshold. Our model of a life-altering financial decision that affects millions of students each year offers valuable insights for universities, policymakers, and non-profit organizations advocating for students to treat higher education as an investment decision.

Keywords: Intertemporal Choice, Student Debt, Higher Education, Financial Decision Making, Decision Aids

Author Accepted Manuscript

Higher education is an economic ladder that raises human capital for individual and societal benefit (Becker 1962; Samuelson 1937; Schultz 1961). College graduates earn 202% more than those who do not complete high school and 62% more than people whose highest degree is a high school diploma (Carr 2015). However, the cost of attending college is on the rise, and many students accrue the financial returns of college only after incurring substantial student debt. Tuition alone increased 356% between 1990 and 2015, while real median household income rose merely 7% during the same period (Bureau of Labor Statistics 2016; Bureau of the Census 2016). Accordingly, college debt is now the second-largest source of consumer debt in the United States (Federal Reserve Bank of New York 2016).

42.9 million Americans currently borrow money through federal student loans (National Student Loan Data System 2021). Government-backed loan programs (e.g., Stafford loans and Perkins loans) and private lenders (Avery and Turner 2012) also cover tuition and other attendance costs (e.g., room and board, books). Beyond providing the means to afford college, student loans meaningfully alter the temporal dynamics of a college education's financial costs and benefits. For many, attendance costs are no longer due upon enrollment—student loan payments typically are deferred until after graduation, and the cost is spread over years or decades. The costs of higher education often are realized at the same time as when the financial returns begin to accrue. Typical loan payments are 8–11% of income after graduation, and this debt-to-income ratio has been largely stable even as the average loan amount has grown over time (Avery and Turner 2012; Baum and O'Malley 2003). Considering that higher education opens the door to higher income, additional job opportunities, and increased job stability, the use of student loans to attend college is an economically sensible choice if one does not have enough capital to pay tuition up front. While some students leave college (especially for-profit colleges)

with no degree and thousands of dollars in debt, scholars contend that students as a whole may be more in danger of under-borrowing than over-borrowing (Avery and Turner 2012). Many who do not take out sufficient loans end up financing their tuition and living expenses through the use of credit cards, with much higher interest rates.

Student loans delay costs but do not eliminate the consideration of costs. A majority of students believe that expensive colleges can lead to better education, but as many as 76% eliminate college options based on their cost (Sallie Mae 2017). The high cost of college can lead students to under-borrow or give up on higher education opportunities entirely (Caetano et al. 2011; Callender and Jackson 2005). Even worse, the salience of student loans in financial aid packages can sway prospective students to make financially inferior career choices (Field 2009; cf., Rothstein and Rouse 2011). Burdman (2005) suggests that under-borrowing is due to “debt aversion,” which induces a *student debt dilemma*. Interviews with students and admissions officers support the theory while student loans provide many students with the opportunity to attend college, aversion to the debt associated with student loans impairs college choices, career choices, and decreases the odds of students attending and graduating college (cf., Eckel et al. 2007; Rothstein and Rouse 2011). Other studies report qualitative evidence of the opposite problem (Cottom 2017), students from lower-income and underrepresented backgrounds appear to preferentially enroll in expensive for-profit colleges, which have lower post-graduation returns than non-profit colleges. Students may be attracted to for-profit colleges because they tend to overestimate costs, enabling students to pay off pressing non-academic expenses (e.g., car payments, credit card debt, rent) with their excess student loan disbursements.

To reign in student loan debt, government, non-profit, and for-profit agencies now implore students to consider higher education as an investment decision. Many provide decision

aids to facilitate student financial decision-making—to help students understand the balance between the cost of a college and its expected long-term returns. The White House and Department of Education launched *College Scorecard* (The White House 2015; The White House 2013), a decision aid that provides simple financial metrics, such as the attendance costs (including tuition and other necessary expenses) and expected post-graduation income for each college. Non-profit and for-profit agencies such as Payscale, College Board, Vanguard, and Sallie Mae also provide students with financial information such as the return on investment associated with each college, enabling students to make an explicit comparison of financial costs and benefits. Absent from this initiative, however, is an understanding of the decision process by which students weigh this financial information. Furthermore, it is unknown whether the presentation of the financial information biases students' choices, and if so, which formats and decision aids are most effective at improving choices for students seeking to maximize their net return.

We focus on the process by which students decide which college to attend. We propose a tuition myopia model of pairwise college choices that predicts how students will decide between a lower-cost, lower-return (LC-LR) college and a higher-cost, higher-return (HC-HR) college, assuming that all costs will be covered by student loans at the same interest rate. The idea of choosing between an LC-LR and HC-HR college may conjure thoughts of choosing between a state university and an expensive elite non-profit private college. Note, however, that “LC-LR” and “HC-HR” are relative terms; a state university may be the LC-LR option in one choice pair and the HC-HR option in another choice pair.¹ Thus, roughly two-thirds of potential college

¹ We define HC-HR and LC-LR colleges as options on a relative scale; the same college could be defined as HC-HR or LC-LR depending on the consideration set. For example, Rutgers University-New Brunswick (annual attendance costs: \$20,166; average annual salary post-graduation: \$57,900) is the LC-LR option when compared with Boston University (annual attendance costs: \$34,914; average annual salary post-graduation: \$65,300) and the HC-HR

choices involve a choice between an LC-LR and HC-HR college (see next section). This includes choices between and within public non-profit, private non-profit, and private for-profit institutions.

Our tuition myopia model proposes that students psychologically realize the costs associated with college before loan repayments are actually due (i.e., after graduation), but they both psychologically and actually realize the benefits associated with college after graduation.

The asymmetric psychological realization of costs and benefits causes students to perceive an intertemporal tradeoff even when there is no actual tradeoff. Students, especially the most present-oriented, should thus be more likely to choose the LC-LR college over the HC-HR college than would be expected if costs and benefits were psychologically realized concurrently (i.e., according to a more rational “cash flow” model). We compare the explanatory power of our (irrational) tuition myopia model to a (rational) cash flow model of utility maximization that assumes the costs and benefits are psychologically realized when they are actually realized (i.e., after graduation, when salary is paid and loan payments begin). The cash flow model predicts that students should base their choice on the option that provides greater net cash flow after graduation—usually, the HC-HR college. We find evidentiary support for our tuition myopia model in surveys and experiments with student, online, and nationally representative samples. The preference for the LC-LR college persists even with favorable loan offers and cannot be attributed to student debt aversion or deliberate investment strategies. We discuss theoretical and practical implications of our findings for a profoundly consequential financial decision made by millions of students each year.

option when compared with the University at Buffalo (annual attendance costs: \$17,163; average annual salary post-graduation: \$52,600).

Author Accepted Manuscript

A note on the boundaries of our investigation: We study the choice of a college in the context of student loans not only because a majority of Americans take out student loans (Federal Reserve Board 2020) but also because loans could fundamentally transform the choice between an LC-LR and HC-HR college by reducing the constraints otherwise imposed by the costs of college. We do not examine the more general choice of whether to attend any college; we do not include the option to *not* attend college in the decisions we model, simulate, or test. That decision process has already been explored (e.g., Lawrance 1991; Mischel et al. 2011; Reimers et al. 2009). Finally, while there is considerable heterogeneity in the risk of failing to complete college and in postgraduation returns (Cottom 2017; DiPrete and Buchmann 2006; McDaniel et al. 2011), our models make predictions for the average student who graduates rather than for the average student who matriculates. These boundaries should be taken into consideration when applying our model to make predictions or to draw prescriptive implications for specific cases. We provide more details about these boundaries and limitations in the general discussion.

THEORETICAL DEVELOPMENT

Kinds of College Choices

What kinds of choices and tradeoffs are involved in a financial comparison of two colleges (e.g., attendance costs, expected post-graduation salary)? We collected publicly available financial information about real colleges in the United States to examine all possible

combinations of choice pairs. We then sorted these pairs into categories by their relative costs and benefits.

To begin, we scraped and analyzed the Department of Education’s College Scorecard database (<https://collegescorecard.ed.gov/>), which reports financial information for institutions of higher education in the United States. The database includes the attendance costs and expected salary after graduation, as reported by both the institutions themselves and students who receive federal grants and loans. We scraped data for all 498 US colleges that, as of 2016, were in operation, awarded bachelor’s degrees, and enrolled more than 5,000 students. The 498 colleges generated 123,753 choice pairs ($= {}_{498}C_2$). We categorized each college in each choice pair according to its relative attendance costs and the expected salary after graduation (i.e., higher or lower).

Almost all choice pairs fell into one of two categories (Web Appendix A). The first category includes all choices between a low-cost, high-return (LC-HR) college and a high-cost, low-return (HC-LR) college. The LC-HR college objectively dominates by providing greater financial benefits at a lower cost, so there is no economically rational reason to choose the HC-LR college based on financial characteristics alone. The first category contained 32.41% (40,105) of the 123,753 choice pairs. The second category includes all choices between a high-cost, high-return (HC-HR) college and a low-cost, low-return (LC-LR) college. There is no dominant strategy—higher future financial returns come at a higher cost, and less expensive colleges offer smaller future financial returns; 67.27% (83,250 pairs) fell into this category.²

² In a third category (398 pairs or 0.3%), the colleges had identical costs or future returns. These pairs have an objectively dominant choice: the high-return college dominates when the expected costs are identical, while the low-cost college dominates when the expected returns are identical.

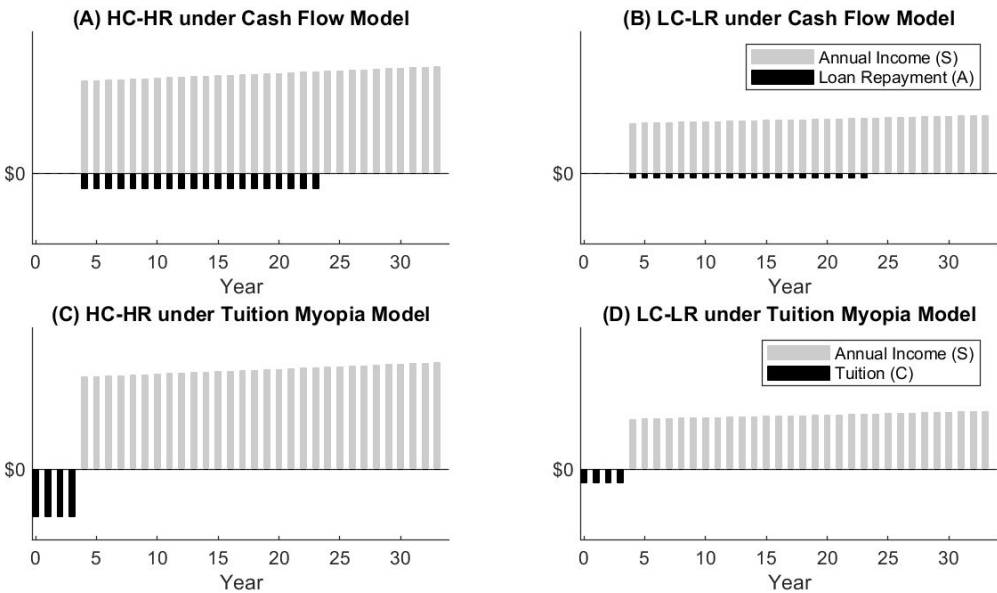
This analysis helped us identify the types of college choices students could face. When choosing between colleges based on financial attributes, students should not experience conflict in one-third of the choice pairs (i.e., LC-HR vs. HC-LR; the first category). They can simply choose the college that is less expensive and offers higher expected financial returns after graduation (i.e., LC-HR). In two-thirds of the pairs, however, students face a tradeoff between how much to pay for college and how much they can expect to earn after graduation (i.e., HC-HR vs. LC-LR; the second category). This second category of 83,250 choice pairs becomes our exploratory dataset.

Two Models of College Choice

We construct and compare two models of how students might choose between an HC-HR college and LC-LR college when planning to use student loans (with the same interest rate for both colleges) to cover all attendance costs. The critical difference between the two models is the timing of the psychological realization of the costs. In a rational *cash flow* model, the present value of each college depends on its projected future cash flow when costs and returns are actually realized: that is, the salary students expect to earn after graduation minus student loan repayments that would begin post-graduation. The model assumes that the psychological realization of costs and returns aligns with the actual realization (see Figure 1, panels A & B). We use the cash flow model as a normative benchmark for our *tuition myopia* model, in which we propose that students psychologically realize the costs of higher education before graduation and psychologically realize the returns after graduation (Figure 1, panels C & D). In other words, costs are psychologically realized before the loan repayments begins. Cost and return realization timings are asynchronous in the tuition myopia model.

FIGURE 1.

PSYCHOLOGICAL REALIZATION OF COLLEGE COSTS AND RETURNS IN THE CASH-FLOW (PANELS A & B) AND TUITION MYOPIA MODELS (PANELS C & D).



The cash flow model. In the United States, the federal government’s subsidized student loan program allows most students to borrow up to \$57,500. Private student loans through lenders such as Sallie Mae can cover additional education expenses. Regardless of the lender, student loan payments are deferred until after graduation, when students theoretically will begin to earn an income that reflects their college education. Effectively, student loans synchronize the actual realization of the financial costs and benefits of college. If students are rational, they will psychologically realize the costs and returns of college at the same time as the costs and returns are actually realized. The financial value of a college at the time of enrolling (Present Value: PV) can be estimated based on the projected cash flow after graduation:

(a)

$PV(\text{College}) = \text{PV of Future Income Stream} - \text{PV of Loan Repayments}$

$$PV(\text{College}) = \frac{S}{(1+r)^{y_1} \cdot (r-g)} \left(1 - \left(\frac{1+g}{1+r} \right)^{y_2} \right) - \frac{A}{(1+r)^{y_1}} \left(\frac{1 - (1+r)^{-y_3}}{r} \right)$$

We assume the expected annual salary after graduation (S) will be received at the end of each working year with certainty and will grow annually at a constant rate (g). For simplicity, we assume that students are risk-neutral when evaluating the expected annual salary after graduation (S). Also, we assume that the loan interest rate (i), years spent in college (y_1), years of employment after graduation (y_2), and loan repayment period (y_3) are identical for both HC-HR and LC-LR colleges. Additionally, we assume that the student pays for all college expenses using the student loan and makes annual loan repayments (A) at the end of each working year.³ The individual discount rate (r) is high for financially impatient students and low for financially patient students. With these assumptions, the present value of each college option is the present value of post-graduation income streams minus the present value of future loan repayments.

The tuition myopia model. We suggest that students do not psychologically realize costs and returns at the same time, even though student loans synchronize the actual realization of costs and returns after graduation. We ground our theory in research suggesting that the psychological temporal distance of an event depends on its valence. Negative events are often

³ The annual loan repayment (A) is calculated assuming equal loan payments, where C represents the annual attendance costs for a college.

$$A = C \left(\frac{(1+i)^{y_1} - 1}{i} \right) \cdot \left(\frac{i(1+i)^{y_3}}{(1+i)^{y_3} - 1} \right)$$

perceived as nearer than positive events, even when their objective temporal distance is the same (Bilgin and LeBoeuf 2010; Van Boven et al. 2010). A conference talk one will give in a week feels psychologically nearer, for instance, if it is dreaded than if it is eagerly anticipated. In the context of college decisions, we suggest that students psychologically realize the financial costs of college earlier than the financial returns, even though they will actually realize the costs and returns at the same time, after graduation. We refer to this misalignment as *tuition myopia*. If students psychologically realize the costs of college while attending but psychologically realize the returns after graduation, then the present value of a college upon enrollment is:

(b)

$PV(College) = \text{PV of Future Income Stream} - \text{PV of Attendance Costs During College}$

$$PV(College) = \frac{S}{(1+r)^{y_1} \cdot (r-g)} \left(1 - \left(\frac{1+g}{1+r} \right)^{y_2} \right) - C(1+r) \left(\frac{1 - (1+r)^{-y_1}}{r} \right)$$

The present value of the future income stream is the same as in the cash flow model, but the present value of attendance costs during college is different. For simplicity, our tuition myopia model assumes that students psychologically realize the annual costs associated with attending a college (C) at the beginning of each school year, and those costs remain constant until graduation. All other assumptions and notations are the same as in the cash flow model.

A choice between an HC-HR and LC-LR college

The only difference between the cash flow and tuition myopia models is the timing of the psychological realization of costs, yet the models make dramatically different predictions for a choice between an HC-HR and LC-LR college. Under the cash flow model, the HC-HR college should dominate the LC-LR college in most choice pairs because the higher projected post-

graduation cash flow compensates for the higher post-graduation loan repayments. Moreover, because both income and student loan payments are psychologically realized when they are actually realized after graduation, the individual discount rate (r) should not induce a preference reversal; the delay in the income stream is the same for HC-HR and LC-LR colleges (though the net amount is different). The decision is conceptually similar to a choice between (a) \$200 in one year and (b) \$100 in one year. The individual discount rate exerts the same influence on the present value of both colleges, so the financially dominant option is unchanged.

Under the tuition myopia model, however, the individual discount rate (r) has a significant effect on the dominant college option. The tuition myopia model posits that costs are psychologically realized before returns. Financially impatient students weigh short-term financial outcomes (costs) more heavily than long-term financial outcomes (returns), so the LC-LR college is more appealing for its lower short-term costs. Financially patient students weigh short-term financial outcomes (costs) less heavily than long-term financial outcomes (returns), so the HC-HR college is more appealing for its larger long-term returns. Thus, the tuition myopia model predicts that the dominant college option varies with the individual discount rate. For each college pair, an $r_{\text{threshold}}$ exists; students below (above) the threshold should prefer the HC-HR (LC-LR) college, and students at the $r_{\text{threshold}}$ should be indifferent.

We tested whether the two models indeed predict different college choices with model simulations using our exploratory dataset of 83,250 HC-HR and LC-LR choice pairs from the College Scorecard database. We tested the predictions of both models under various economic parameters and assumptions. Overall, the simulation using the cash flow model predicted that the HC-HR college dominates the LC-LR college in 85.36% of the pairs regardless of the individual discount rate. The simulation using the tuition myopia model predicted that intertemporal

tradeoffs would determine the dominant option in 90.02% of the pairs—in other words, the individual discount rate influences a large majority of choices. See Web Appendix B for more details.

OVERVIEW OF STUDIES

We report seven studies that examine how students evaluate financial costs and returns when choosing between colleges. In Study 1, we measure the timing of the psychological and actual realization of the costs and returns of a college education; we also directly replicate this measurement with online and nationally representative samples. In Studies 2A and 2B, we test the predictions of the cash flow and tuition myopia models. We examine whether intertemporal tradeoffs and temporal discounting influence pairwise choices between an HC-HR and LC-LR college. In Studies 3A and 3B, we test the robustness of the tuition myopia model by comparing its predictions against student debt aversion (Burdman 2005) and a strategy to maximize the return on investment. We then test in Study 3C whether the model generalizes to more realistic scenarios in which students have access to a greater variety of financial and non-financial college information. Finally, in Study 4, we attempt to attenuate tuition myopia using an alternative presentation format that nudges students to synchronize their psychological realization of costs and returns, after graduation. We also test whether students have asymmetric beliefs about the future returns associated with LC-LR and HC-HR colleges.

STUDY 1

In our first test of the tuition myopia model, we measured the timing of students' psychological realization of the financial costs and returns of a college education to determine whether there is a misalignment between psychological and actual realization. We operationalized costs and returns as College Scorecard's projected attendance costs and post-graduation salary. Undergraduate students imagined that they received a student loan that would cover all college expenses, and they reported when the financial costs and returns of their college education would be *psychologically* realized and *actually* realized. We predicted that students would (1) psychologically realize the financial costs earlier than the financial returns, (2) psychologically realize the financial costs before their actual realization, and (3) psychologically realize the financial returns at the same time as their actual realization. We also directly replicated this study and found similar results with a convenience sample from Amazon Mechanical Turk ($N = 501$) and a nationally representative sample of Americans ($N = 99$; see Web Appendix C).

Method

Participants and exclusions. Four hundred twenty-four undergraduate students from a large non-profit state university in the southern United States (279 women; $M_{\text{age}} = 21.20$, $SD = 5.28$) completed the study. As preregistered (<https://aspredicted.org/blind.php?x=zj8959>), we excluded 36 participants who failed an attention check, leaving a final sample of 388 participants for analyses.

Stimuli and procedure. Participants imagined that they were planning to attend a four-year college (starting in fall 2021) and use a student loan to cover all attendance costs. They were

presented with financial information including the college's annual attendance costs, the annual loan repayment amount after graduation, and the average annual salary after graduation (see Figure W10 in Web Appendix H). Next, participants reported in which year (between 2021 and 2030, inclusive) they would *psychologically* realize the financial costs and returns of college: "In what year would you begin to feel the financial costs of college tuition (i.e., psychologically)?" and "In what year would you begin to feel the financial benefits of college tuition (i.e., psychologically)?" Participants also reported in which year they would *actually* realize the financial costs and returns: "In what year would you actually start paying for the financial costs of college tuition?" and "In what year would you start receiving the financial benefits of college?" The order of the two sets of questions was counterbalanced.

Results and Discussion

A 2 (financial attributes: costs vs. returns; within-subjects) \times 2 (realization: psychological vs. actual; within-subjects) repeated-measures ANOVA revealed significant main effects of financial attributes ($F(1, 387) = 203.65, p < .001, \eta_p^2 = .35$) and realization ($F(1, 387) = 88.08, p < .001, \eta_p^2 = .19$) in addition to the predicted significant interaction effect ($F(1, 387) = 64.10, p < .001, \eta_p^2 = .14$). As illustrated in Figure 2, the psychological realization of the financial costs preceded graduation (2025), when the costs would be actually realized ($\text{Mode}_{\text{psychological_costs}} = 2021, \text{Median}_{\text{psychological_costs}} = 2022, M_{\text{psychological_costs}} = 2023.05, SD = 2.22$ vs. $\text{Mode}_{\text{actual_costs}} = 2025, \text{Median}_{\text{actual_costs}} = 2025, M_{\text{actual_costs}} = 2024.59, SD = 1.83; t(387) = 12.01, p < .001$; Wilcoxon Signed-Ranks Test: $Z = 10.37, p < .001$), but the financial returns were psychologically and actually realized at the time of graduation ($\text{Mode}_{\text{psychological_returns}} = 2025, \text{Median}_{\text{psychological_returns}} = 2026, M_{\text{psychological_returns}} = 2025.48, SD = 2.86$ vs. $\text{Mode}_{\text{actual_returns}} = 2025, \text{Median}_{\text{actual_returns}} = 2025, M_{\text{actual_returns}} = 2025.65, SD = 2.19; t(387) = 1.34, p = .18$;

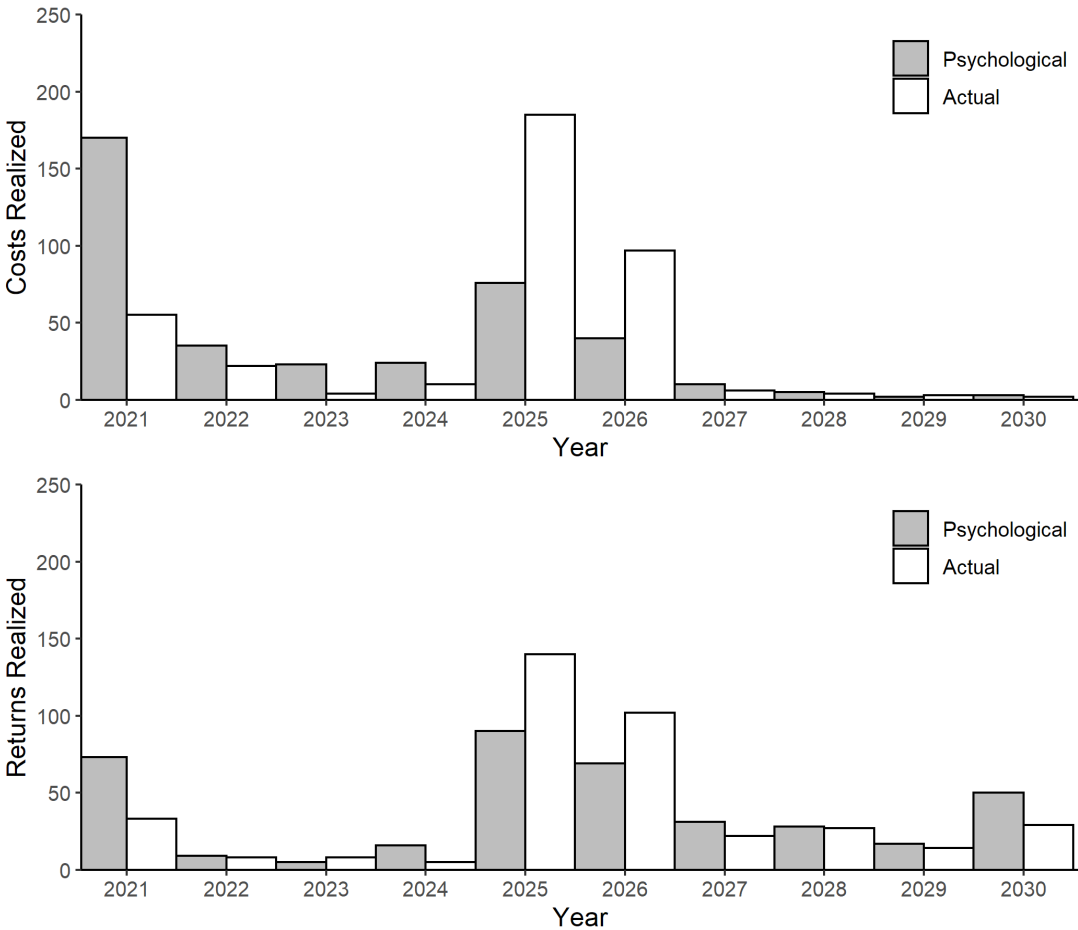
Author Accepted Manuscript

Wilcoxon Signed-Ranks Test: $Z = 1.07, p = .28$). Moreover, the financial costs of college were psychologically realized significantly earlier than the financial returns ($t(387) = 14.55, p < .001$; Wilcoxon Signed-Ranks Test: $Z = 11.57, p < .001$).

Students psychologically realized the costs of college earlier than the date of their first loan repayment (i.e., actual realization) but psychologically realized the returns at the same time as when they could expect to earn an income. In short, students psychologically realized financial costs early than returns, providing initial support for our tuition myopia model.

FIGURE 2.

TIMING OF THE PSYCHOLOGICAL VS. ACTUAL REALIZATION OF COSTS AND RETURNS FOR STUDENTS ENROLLING IN 2021 (STUDY 1)



STUDIES 2A AND 2B

We next compare the predictive validity of the tuition myopia model against the cash flow model by examining preferences among choice pairs in our exploratory dataset.

Our tuition myopia model predicts that people treat a choice between an HC-HR and LC-LR college as an intertemporal tradeoff. The cash flow model predicts that people consider the projected future cash flow, so the HC-HR college should be the dominant option in most choice pairs. How can we compare these models empirically? A general preference for the LC-LR college would violate the predictions of the cash flow model but would not necessarily support the tuition myopia model. To test the tuition myopia model's prediction regarding an intertemporal tradeoff, we examined the modulation of preferences by the individual discount rate (Studies 2A and 2B) and by the threshold discount rate at the pair level (i.e., the $r_{\text{threshold}}$ for each choice pair; Study 2B).

Individual-level prediction. The tuition myopia model predicts that for most choice pairs, the individual discount rate (r) determines whether the student will choose the HC-HR college or LC-LR college. Financially impatient students (high r) should choose the LC-LR college, whereas financially patient students (low r) should choose the HC-HR college. We define $r_{\text{threshold}}$ as the individual discount rate threshold at which this split should occur. All else equal, the tuition myopia model predicts that students should choose the HC-HR (LC-LR) college when their individual discount rate (r) is lower (higher) than the $r_{\text{threshold}}$ of the choice pair.

Pair-level prediction. The $r_{\text{threshold}}$ of the choice pair can also predict the overall choice shares of the HC-HR and LC-LR colleges. The tuition myopia model predicts that the HC-HR college should have a higher choice share in choice pairs with a high $r_{\text{threshold}}$. Only students with very high discount rates will have an individual discount rate that exceeds the threshold and prefer LC-LR colleges. Similarly, the LC-LR college should have a higher choice share in choice pairs with a low $r_{\text{threshold}}$. Only students with very low discount rates will have an individual discount rate that falls below the threshold and prefer HC-HR colleges.

In Study 2A, we test the individual-level prediction of the tuition myopia model by measuring the relationship between the individual discount rate and real college choices. In Study 2B, we repeat the test of the individual-level prediction with hypothetical college choices, and we also test the pair-level prediction by measuring the individual discount rate and using choice pairs with different $r_{\text{threshold}}$ values.

STUDY 2A

In Study 2A, we tested the individual-level prediction of the tuition myopia model by examining whether the individual discount rate is related to real college choices. For each participant, we measured their individual discount rate, their highest level of education, the specific college or university they attended (if any), and basic demographic questions (i.e., gender, age, and self-reported annual income). We categorized colleges and universities as LC-LR or HC-HR using a college group ranking based on the Carnegie Classification (2015 Edition), which was designed by the Indiana University Center for Postsecondary Research (Indiana University Center for Postsecondary Research 2016). The Carnegie Classification categorizes degree-granting post-secondary colleges in the United States based on years of education provided (2 or 4), the ratio of full-time to part-time students, the transfer-in rate, and average test scores (SAT and ACT) of admitted students. We predicted that participants with lower discount rates would be more likely to achieve a higher level of education. Moreover, among participants who attended a college, the likelihood of attending an HC-HR college should be higher among participants with lower discount rates.

Method and Design

Participants and exclusions. We recruited 600 United States residents from Amazon Mechanical Turk (267 women; $M_{\text{age}} = 36.14$, $SD = 12.26$); average self-reported individual annual income was \$37,808. One participant was excluded due to a technical error, and four participants were excluded due to non-positive time preferences (negative discounting or zero discounting).⁴ Of the remaining 595 participants, four participants had not attained a high school diploma, 81 had attained a high school diploma, 188 started but did not finish college, 261 had attained a college degree, and 61 had attained a graduate degree (Web Appendix D).

Procedure. To measure their individual discount rate, participants first completed the ToAD procedure (Yoon and Chapman 2016), which asks ten intertemporal choice questions with three possible responses (e.g., “Would you prefer \$7,215.77 today, \$8,780.08 in 134 days, or \$9,474.01 in 216 days?”) and uses an adaptive algorithm to update choice questions after each answer to estimate the individual discount rate (see Figure W11 in Web Appendix H). We programmed ToAD to present participants with intertemporal choices with an average value of \$10,000 and an average delay of 182 days. Then, participants provided their demographic information, including highest level of educational attainment. Participants who had attended a college reported their alma mater.

After the experiment, we matched participants’ colleges to college financial information using the College Scorecard database and the Integrated Postsecondary Education Data System (IPEDS; National Center for Education Statistics). Of the 510 participants who attended college, we were able to identify the alma mater of 460 participants (representing 323 unique colleges) in

⁴ The current study assumes positive discounting (monotonicity) in Discounted Utility Theory (Koopmans 1960). Positive discounting means that, for example, having \$100 now is more valuable than having \$100 in one year; zero discounting means that having \$100 now is equivalent to having \$100 in one year; negative discounting means that having \$100 now is inferior to having \$100 in one year.

both the IPEDS and Carnegie Classification. We could not retrieve the information for the 47 participants who attended college outside of the United States or submitted inaccurate college names, nor for three participants whose college was omitted from the Carnegie Classification. These participants were included in the educational attainment analysis but were excluded from the college choice analysis.

We used the Carnegie Classification at the undergraduate level to rank-order the colleges from two-year colleges to four-year, full-time, more selective, and lower transfer-in colleges. In other words, the lowest (highest) end of the ranking featured the epitome of LC-LR (HC-HR) colleges. We then segmented participants into five roughly equal groups using their college rank (Web Appendix E).

Results and Discussion

Educational attainment and the individual discount rate. We examined the relationship between educational attainment and the individual discount rate for participants who had attained a high school diploma or more ($n = 591$). Participants who did not have a high school diploma were excluded due to the small sample size ($n = 4$).⁵ We found a negative relationship between the discount rate and level of educational attainment ($\beta = -.15$, $t(589) = -3.79$, $p < .001$), suggesting that financially patient people achieved a higher level of education. As a validity check, we found a positive relationship between level of educational attainment and annual income ($\beta = .35$, $t(589) = 8.96$, $p < .001$); people reporting higher levels of education reported having a higher income. There was no significant correlation between age and the individual discount rate ($r = -.05$, $p = .16$).

⁵ We obtained similar results when we included the four participants without a high school degree. See Web Appendix F.

Author Accepted Manuscript

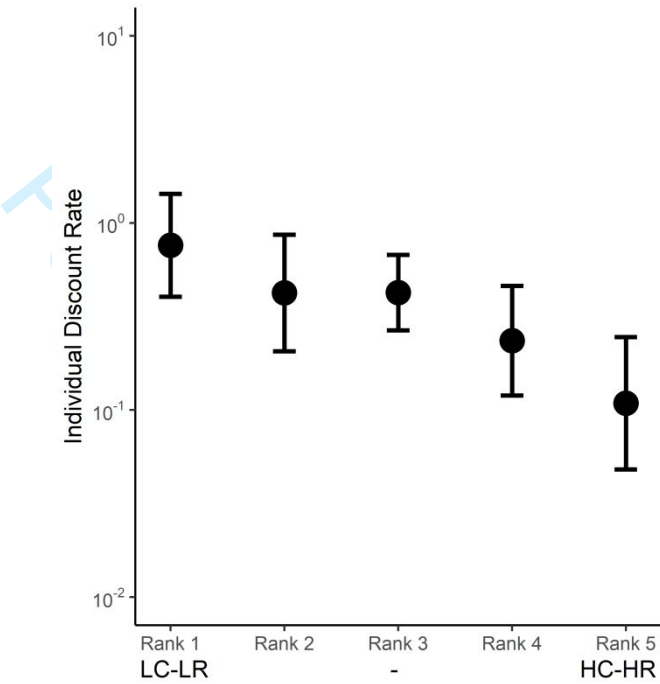
Validation of ranks. We validated the Carnegie Classification ranks by examining the relationship between the attendance costs and annual salary ten years after enrollment, as reported in the College Scorecard database. Enrollment is used as the reference point for post-graduation salary so that it can be compared across 2-year and 4-year colleges. Linear regression analysis showed that both the net attendance costs and tenth-year salary were positively related to the rank order (costs: $\beta = .67$, $t(457) = 19.10$, $p < .001$; salary: $\beta = .74$, $t(454) = 23.72$, $p < .001$),⁶ confirming that higher-ranked (vs. lower-ranked) colleges both were more expensive to attend and yielded higher income after graduation.

College choice and the individual discount rate. We used the rank order to examine the relationship between the rank of the attended college and the individual discount rate ($n = 460$). Figure 3 depicts the negative relationship ($\beta = -.19$, $t(458) = -4.07$, $p < .001$), that is, participants with a higher (lower) discount rate were more likely to attend a lower-ranked (higher-ranked) college.

⁶ The degrees of freedom varied because some colleges did not report the net attendance costs, tenth-year salary, or three-year loan default rate.

FIGURE 3.

RANK OF ATTENDED COLLEGE BY THE INDIVIDUAL DISCOUNT RATE
IN STUDY 2A (95% CI)



The inverse relationship between the individual discount rate and rank of the attended college supports the individual-level prediction of the tuition myopia model. Replicating earlier work (Lawrance 1991; Mischel et al. 2011; Reimers et al. 2009), we also found a negative relationship between the individual discount rate and likelihood of attaining higher education, that is, participants with a lower discount rate were more likely both to have attended any college and to have completed postgraduate studies.

We note one key limitation of the cross-sectional design: We measured the individual discount rate an average of 18 years after participants had made decisions regarding their higher education. Although we did not find a correlation between age and the individual discount rate, it

is possible that education and career choices influenced the discount rate in the years after the original college decision.

STUDY 2B

Study 2B tested both the individual-level and pair-level predictions of the tuition myopia model using hypothetical college choices. At the individual level, the model predicts that participants with a higher (vs. lower) discount rate should be more likely to choose the LC-LR (HC-HR) college in any given choice pair. At the pair level, the model predicts that the choice shares of the LC-LR and HC-HR options should depend on the $r_{\text{threshold}}$ value of the choice pair; the LC-LR (HC-HR) college should have a higher choice share when $r_{\text{threshold}}$ is low (high).

Method and Design

Participants and exclusions. One hundred four undergraduate business majors at a private university in New England (44 women, $M_{\text{age}} = 20.02$, $SD = .81$) participated for course credit. Two participants were excluded due to a technical error during the experiment. We included eight attention check questions that were similar to the main college choice questions but had an objectively dominant option—there was no tradeoff between attendance costs and expected lifetime income (e.g., College A: 30-year return of \$3M and four-year costs of \$100k vs. College B: 30-year return of \$1M and four-year costs of \$100k; College A is the financially dominant option in this example). Prior to the experiment, we established an exclusion criterion of three or more failed attention checks ($> 25\%$ error rate), and we excluded 10 participants on this basis. The following analysis was conducted using the remaining 92 participants.

Stimuli and procedure. From the exploratory dataset of 83,250 choice pairs, we randomly selected 12 choice pairs each from the 20th, 50th, and 80th percentiles ($\pm 5\%$) of the $r_{\text{threshold}}$

values, corresponding to $r_{\text{threshold}}$ values of 13.3%, 24.4%, and 42.9% APR. For each of the 36 choice pairs, participants saw the total four-year costs and 30-year expected financial returns for both colleges (Figure W12 in Web Appendix H). We estimated the individual discount rate with the ToAD procedure, borrowed from Yoon and Chapman (2016) and explained in Study 2A.

Results and Discussion

To test the individual-level prediction of the tuition myopia model, we analyzed the relationship between the individual discount rate and the choice share of the LC-LR colleges using linear regression. We found that the individual discount rate predicted the choice share of the LC-LR colleges, $F(1,90) = 12.25, p < .001, R^2 = .12$, such that the LC-LR choice share was higher among participants with a higher individual discount rate, $\beta = -.74, t(90) = -3.5, p > .001$ (Figure 4, left).⁷

To test the pair-level prediction, we examined the choice shares of the LC-LR colleges across the three $r_{\text{threshold}}$ levels within-participants using a repeated-measures ANOVA. For each participant, we calculated the choice share of the LC-LR colleges at each of the three $r_{\text{threshold}}$ levels. For example, a participant who chose the LC-LR college in 9/12 choice pairs yielded a score of 75% for that cell (Figure 4, right). We found the expected significant difference between $r_{\text{threshold}}$ values, $F(2,182) = 192.0, p < .001, \eta_p^2 = .68$.

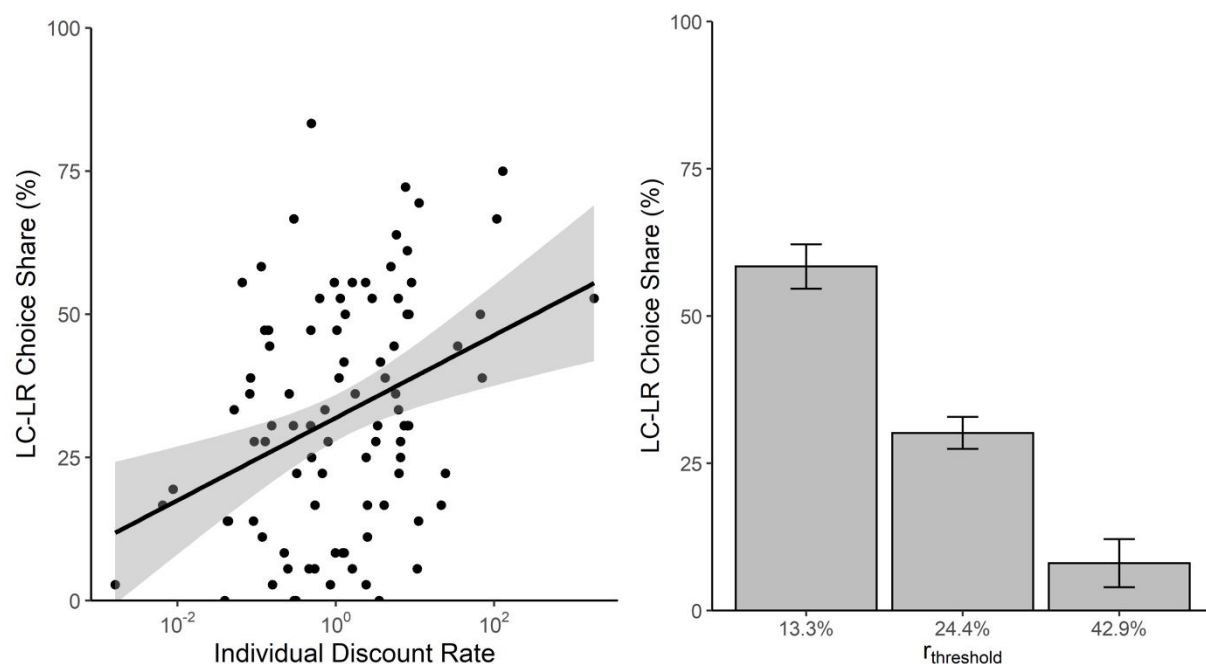
The results provide evidentiary support for the tuition myopia model at both levels of analysis. Supporting the individual-level prediction, financially impatient participants (i.e., those with a higher individual discount rate) were more likely to choose the LC-LR college than their less-impatient peers (Figure 4, left). Supporting the pair-level prediction, participants were more

⁷ We obtained similar results when we included the excluded participants and when we excluded the outliers. See Web Appendix F.

likely to choose the LC-LR (HC-HR) college in choice pairs with a low (high) $r_{\text{threshold}}$ (Figure 4, right).

FIGURE 4.

CHOICE SHARE OF LOW COST-LOW RETURN COLLEGES BY THE INDIVIDUAL DISCOUNT RATE (LEFT) AND $R_{\text{THRESHOLD}}$ (RIGHT; 95% CI) IN STUDY 2B



STUDIES 3A, 3B, and 3C

In Studies 3A–C, we test the robustness of the tuition myopia model by comparing its performance with plausible alternative accounts (3A and 3B) and testing the model's generalizability to a more realistic scenario (3C). In Study 3A, we compare the tuition myopia model with a Return on Investment (ROI) decision strategy, which is recommended by some for-profit and non-profit organizations. It maximizes the ratio of net returns to costs (Lobosco 2014).

In Study 3B, we compare the tuition myopia model with the theory of student debt aversion (Burdman 2005). It implies that students focus predominantly on the cost comparison within a choice pair. In Study 3C, we test the generalizability of our model to situations in which students have access to more types of information, both financial and non-financial. We also varied the amount of student loan information because research on student debt aversion suggests that the provision of more details can reduce debt aversion and increase the attractiveness of the higher-cost college (Burdman 2005).

STUDY 3A

In Study 3A, we compare the predictions of the tuition myopia model with an investment strategy of maximizing ROI. It is important to note here that we are comparing two *descriptive* models, not two *normative* models in this experiment of *how* consumers do choose colleges, not *how should* they choose colleges. A higher ROI reflects a more efficient investment, so consumers can maximize financial portfolio returns by purchasing multiple financial assets with high ROIs. In the context of college choices, PayScale.com provides ROI estimates for colleges (Annual College ROI Report), and the media often cites high ROI colleges as the “best value” (Lobosco 2014). Colleges with high attendance costs (including HC-HR colleges) tend to have a low ROI (see Web Appendix G for analysis results), so students using ROI criteria may prefer less expensive colleges (i.e., LC-LR colleges). Paradoxically, using this investment strategy could thus make their college decisions appear financially impatient. To disentangle the predictions of an ROI strategy and our tuition myopia hypothesis, we vary the $r_{\text{threshold}}$ levels of the choice pairs while holding the ROI level constant, and vice versa, and examine whether the choice share is affected by the varying $r_{\text{threshold}}$ levels or by varying ROI levels.

Method

Participants and exclusions. One hundred residents of the United States were recruited from Amazon Mechanical Turk (60 women; $M_{\text{age}} = 31.26$, $SD = 9.15$). The average self-reported annual household income was \$47,239. Nine participants had attained a postgraduate degree, 39 had attained a college degree, 45 had attended college but did not have a degree, 5 had attained a General Educational Development (GED) or high school diploma, and one participant reported no degree. Two participants were excluded for failing the set of eight attention checks as described in Study 2B. One additional participant was excluded because of a technical error during the experiment. There were no other exclusions.

Stimuli and procedure. For each of the 83,250 choice pairs in the exploratory dataset, we calculated the $r_{\text{threshold}}$ and the ROI difference between the HC-HR and LC-LR colleges. We selected choice pairs from the 5th and 30th percentiles ($\pm 5\%$) of each factor, yielding average ROI differences of 6 and 45 and average $r_{\text{threshold}}$ values of 4.8% and 17.2%. Participants were presented with ten choice pairs for each combination of the two factors (2×2 full factorial design; two ROI levels and two $r_{\text{threshold}}$ levels). Each participant thus encountered 40 choice pairs and 8 attention check pairs in a random order. For each college, we provided the same aggregated financial information as in Study 2B (four-year costs and 30-year returns).

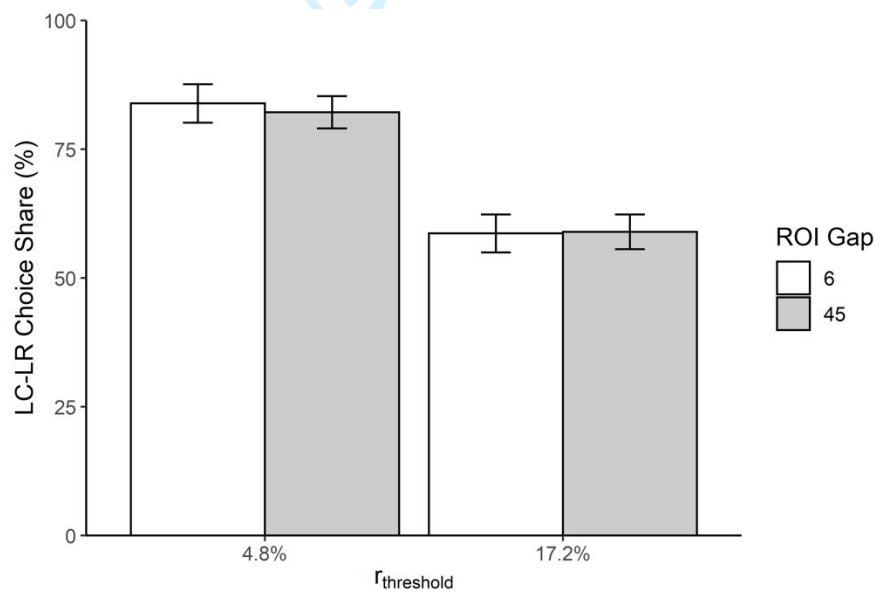
Results and Discussion

First, we calculated the choice share of the LC-LR colleges at each of the two $r_{\text{threshold}}$ levels (as we did in Study 2B), split into two indices by their ROI (Figure 5). We examined the college choices in a 2 (ROI difference: 6, 45) $\times 2$ ($r_{\text{threshold}}$ Annual Percentage Rate: 4.8% APR, 17.2% APR) repeated-measures ANOVA. The analysis revealed a significant effect of $r_{\text{threshold}}$, $F(1,96) = 85.98$, $p < .001$, $\eta_p^2 = .47$, but no main effect of the ROI difference, $F(1,96) = .35$, p

Author Accepted Manuscript

= .55, and no interaction effect between $r_{\text{threshold}}$ and the ROI difference, $F(1,96) = .87, p = .35$. In other words, participants were insensitive to the ROI difference but were sensitive to $r_{\text{threshold}}$, supporting the tuition myopia model and challenging the possibility that the preference for LC-LR colleges reflects the use of an ROI decision strategy. Whether or not ROI is an *appropriate* decision strategy, our results suggest that most people do not employ it when choosing which college to attend.

FIGURE 5.
CHOICE SHARE OF THE LOW COST-LOW RETURN COLLEGES BY ROI DIFFERENCE
AND $R_{\text{THRESHOLD}}$ IN STUDY 3A (95% CI)



STUDY 3B

In Study 3B, we compare whether college choices are explained more parsimoniously by our tuition myopia model or by student debt aversion (Burdman 2005), a form of loss aversion in which the student focuses disproportionately on minimizing costs (vs. maximizing benefits). Students who make decisions based on debt aversion might avoid large immediate financial expenses and ignore long-term returns entirely. To test this possibility, we constructed new choice pairs to disentangle the effects of $r_{\text{threshold}}$ and the cost gap (i.e., the difference in attendance costs between the HC-HR and LC-LR college). We vary $r_{\text{threshold}}$ levels of the choice pairs while holding the cost gap levels constant, and vice versa, and examine whether the choice share is affected by the varying $r_{\text{threshold}}$ levels or by varying cost gap levels.

Method

Participants and exclusions. Ninety-nine undergraduate business majors at a private non-profit university in New England (45 women, $M_{\text{age}} = 19.5$, $SD = 0.86$) participated for course credit. Fifteen participants were excluded for failing the set of attention checks as described in Study 2B. There were no other exclusions.

Stimuli and procedure. We provided aggregated financial information (four-year costs and 30-year returns) for each college. For each of the 83,250 choice pairs in the exploratory dataset, we calculated the cost gap and $r_{\text{threshold}}$. We randomly selected ten choice pairs at the 15th, 50th, and 85th percentiles ($\pm 4\%$) of each factor, yielding average cost gaps of \$6K, \$24K, and \$61K and average $r_{\text{threshold}}$ values 11.2%, 24.1%, and 48.2% APR. We crossed the three cost gap levels with the three $r_{\text{threshold}}$ levels to yield a 3×3 full factorial within-subjects design. Each

participant encountered 90 choice pairs and 8 attention check pairs in a random order on a computer.

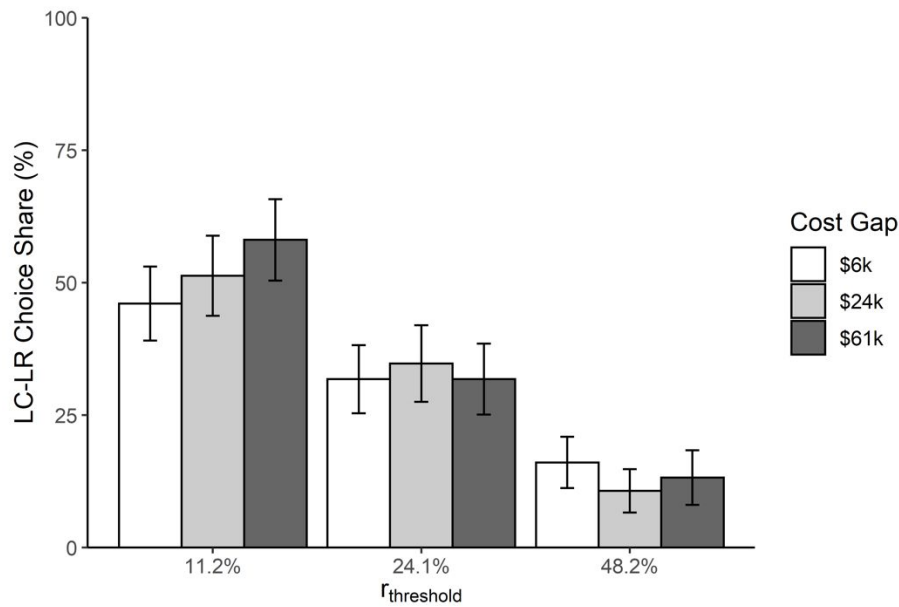
Results & Discussion

We calculated the choice share of the LC-LR colleges in each of the nine cells, as we did in Study 2B (Figure 6), and we analyzed them in a 3 (cost gap: \$6K, \$24K, \$61K) \times 3 ($r_{\text{threshold}}$: 11.2%, 24.1%, 48.2%) repeated-measured ANOVA. We found a main effect of $r_{\text{threshold}}$, $F(2,166) = 130.24, p < .001, \eta_p^2 = .61$, but no main effect of the cost gap, $F(2,166) = 2.28, p = .11$. The analysis showed a significant interaction between the cost gap and $r_{\text{threshold}}$, $F(4,332) = 10.44, p < .001, \eta_p^2 = .11$, which was largely driven by an unexpected difference between the \$6k and \$61k cost gap conditions at 11.2% APR (posthoc analyses using Bonferroni correction). In other words, participants did not always choose the cheaper college even at the highest cost gap level (i.e., \$61K), but they were sensitive to $r_{\text{threshold}}$. These results suggest that participants considered both proximal costs and distant gains when making college choices, in support of the tuition myopia model.

The results from Studies 3A and 3B provide insight into students' approach to evaluating the financial costs and returns of higher education. The results of Study 3A suggest that a focus on the ratio of returns to costs (ROI) does not explain the preference for LC-LR colleges. The results of Study 3B suggest that students consider both immediate financial costs and distant financial returns; their decisions are not driven solely by debt aversion (Burdman 2005). As predicted by the tuition myopia model, when students compare the financial costs and returns of a pair of colleges, they perceive an intertemporal tradeoff, and their choices reflect the $r_{\text{threshold}}$ of the choice pairs.

FIGURE 6.

CHOICE SHARE OF THE LOW COST-LOW RETURN COLLEGES BY THE COST GAP
AND $R_{\text{THRESHOLD}}$ IN STUDY 3B (95% CI).



STUDY 3C

Study 3C examines whether tuition myopia extends to more realistic choice scenarios in which students consider both financial and non-financial college attributes, such as the school's name (and reputation), size, location, and graduation rate. It is possible that students who have access to information about non-financial attributes may use a different decision strategy or ignore one or both financial attributes (e.g., frame the choice as a tradeoff between costs and reputation). We manipulated the presence of these attributes by presenting participants with either the financial information alone (as in previous studies) or with a screenshot of each college's page on the College Scorecard website, which features the same financial information as well as the college's name, size, location, and graduation rate. In addition, we manipulated the

amount of information provided about student loans (such as loan interest rate and repayment period) because a prior qualitative study suggests that student debt aversion decreases when more loan information is provided (Burdman 2005).

Method

Participants and exclusions. Three hundred twenty residents of the United States were recruited from Amazon Mechanical Turk (164 women; $M_{age} = 36.42$, $SD = 12.67$). Twenty-six participants were excluded for failing the set of eight attention check questions as described in Study 2B. The analysis was conducted with the remaining 294 participants.

Stimuli and procedure. The study employed a 2 (information richness: scorecard vs. financial information; between-participants) \times 2 (loan information: general vs. specific; between-participants) \times 3 ($r_{threshold}$: 11.8%, 21.1%, and 37.8% APR; within-participants) mixed design.

Information richness. For each college within each choice pair, participants in the financial-information conditions received only the average annual cost and salary after attending from the College Scorecard website (see Web Appendix H, Figures W13 & W14 for examples) while participants in the scorecard conditions viewed a screenshot from the College Scorecard website that featured the same financial information as well as the college’s name, size, location, and graduation rate benchmarked against the national average (see Web Appendix H, Figures W15 & W16 for examples). We retrieved the college financial information and college scorecard screen shots in January 2017.

Loan information. In the general-loan condition, participants read, “When making your decision, please assume that there are loans available that can help you pay for the tuition and expenses required.” In the specific-loan condition, participants read, “When making your

decision, please assume that you've already decided to take a 30-year student loan that fully covers the tuition and expenses required, regardless of which college you'll attend. The interest rate of the student loan is 3.76%, and you'll start repaying your student loan after you graduate from college." (A 30-year term and 3.76% APR was the most favorable federal student loan offered from July 2016 to June 2017.)

$r_{\text{threshold}}$. From the 83,250 college choice pairs in our exploratory dataset, we randomly selected 10 choice pairs each from the 20th, 50th, and 80th percentiles ($\pm 5\%$) of $r_{\text{threshold}}$, yielding average values of 11.8%, 21.1%, and 37.8% APR.

Results and Discussion

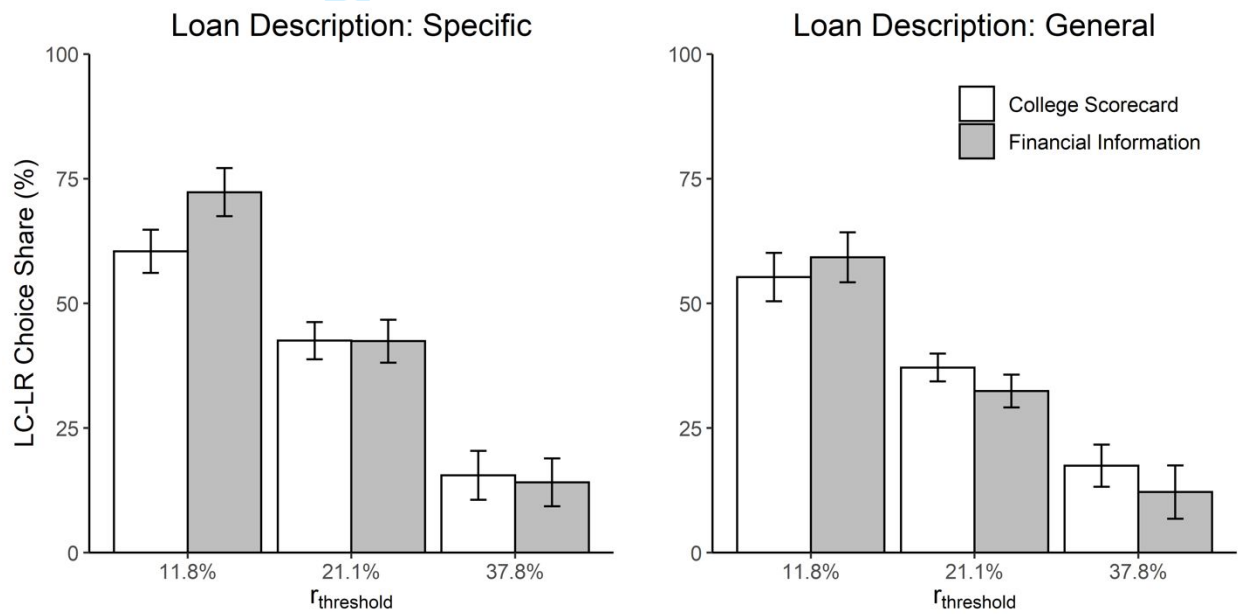
For each participant, we calculated the choice share of the LC-LR colleges at each of the three $r_{\text{threshold}}$ levels, as we did in Study 2B. We then analyzed the choices in a $2 \times 2 \times 3$ mixed ANOVA, which revealed a main effect of $r_{\text{threshold}}$, $F(2,580) = 423.95$, $p < .001$, $\eta_p^2 = .59$; the LC-LR colleges had the lowest (highest) choice share at the lowest (highest) $r_{\text{threshold}}$ level, and significantly more participants chose the LC-LR college than the HC-HR college at the lowest $r_{\text{threshold}}$ value (Figure 7). In other words, as predicted by the tuition myopia model, intertemporal tradeoffs appear to have influenced choices across all manipulations of information richness and loan information.

The main effect of information richness (scorecard vs. financial information) was not significant, $F < 1$, suggesting that participants based their decisions primarily on financial information even when they had access to non-financial information. The specific loan description directionally increased the LC-LR choice share (general vs. specific loan information: $F(1,290) = 3.88$, $p = .05$, $\eta_p^2 = .01$). Notably, the finding contradicts the recommendation of (Burdman 2005) to provide more loan information as a strategy for reducing

student debt aversion. The analysis also revealed two unpredicted interactions with small effect sizes: $r_{\text{threshold}} \times$ information richness, $F(2,580) = 7.49, p < .001, \eta_p^2 = .03$, and $r_{\text{threshold}} \times$ loan information, $F(2,580) = 4.60, p < .05, \eta_p^2 = .02$.

FIGURE 7.

CHOICE SHARE OF THE LOW COST-LOW RETURN COLLEGES BY LOAN DESCRIPTION, INFORMATION RICHNESS, AND $R_{\text{THRESHOLD}}$ IN STUDY 3C (95% CI)



STUDY 4

The purpose of Study 4 was two-fold. First, it tested the tuition myopia model by experimentally manipulating the timing of the psychological realization of costs. Typically, college financial information is displayed such that the average annual attendance costs and expected annual salary after graduation is the information displayed (e.g., College Scorecard). We speculate that this presentation format may inadvertently lead people to psychologically realize costs earlier than returns and perceive intertemporal tradeoffs in college choices. We

attempted to mitigate tuition myopia by modifying the presentation format: the expected annual loan repayment (rather than attendance costs) was presented alongside the expected annual salary after graduation. The alternative presentation format presented both the costs and returns at the same time point—that is, after graduation—so we predicted that it would help synchronize the psychological realization of costs and benefits and thereby increase the choice share of the HC-HR colleges.

Study 4 also examined the influence of uncertain employment prospects, which could influence interpretations of the financial return information. In other words, whereas costs (whether presented as annual attendance costs or loan repayments) are certain, the future financial returns are not. We measured participants' uncertainty about their future employment prospects after graduation from each college to see whether uncertainty reduces the attractiveness of the HC-HR college by undermining confidence in its superior returns.

Method

Participants and exclusions. We requested two hundred United States residents from Prolific, and two hundred participants completed the experiment (106 women; $M_{\text{age}} = 32.97$, $SD = 14.06$). We included three attention check questions of the type described in Study 2B; following our study preregistration (<https://aspredicted.org/blind.php?x=dc4w9g>), we excluded twenty participants who failed one or more questions. The following analysis was conducted with the remaining 180 participants.

Stimuli and procedure. The study employed two conditions (cost information: annual attendance costs vs. annual loan repayment amount; between-subjects). Participants imagined that they were in their senior year of high school and were deciding which four-year college to attend. They imagined that they had already decided to take out a 20-year student loan (interest

rate: 4.37%) that would fully cover the tuition and expenses, regardless of which college they would attend.

We used the same 10 choice pairs from Study 3C at the 11.8% $r_{\text{threshold}}$ level. For each choice pair, participants received financial information (average annual salary after graduation and either the annual attendance costs or annual loan repayment amount, depending on condition; Web Appendix H, Figure W17 and W18). The annual loan repayment amount was calculated using a 20-year fixed monthly payment plan (the median loan repayment period; National Center for Education Statistics 2018) with 4.37% APR, the average federal student loan interest rate from July 2013 to June 2020. After making a choice for each choice pair, participants estimated their employment prospects after graduating from each college ("How likely is it that you would be employed within 1 year of graduating from [college above]?" 0 = highly unlikely, 100 = highly likely).

Results and Discussion

First, we examined whether the presentation of cost information (format: annual attendance costs vs. annual loan repayment amount) influenced college choices. For each participant, we calculated the choice share of the LC-LR colleges, as we did in Study 2B. An independent samples t-test revealed that participants who received the annual loan repayment amount (vs. annual attendance costs) exhibited a significantly lower LC-LR choice share, $M_{\text{annual repayment}} = 45.38\%$, $SD = 34.22$, $M_{\text{annual attendance}} = 72.25\%$, $SD = 30.25$, $t(178) = 5.57$, $p < .001$, $d = .83$.

Next, we examined whether expectations about employment prospects varied with the college type and cost information. A 2 (format: annual attendance costs vs. annual loan repayment amount; between-subjects) \times 2 (college: HC-HR vs. LC-LR; within-subjects) mixed

ANOVA revealed no significant main effect of college type, $F(1, 178) = .36, p = .55$, no significant main effect of format, $F(1, 178) = 3.10, p = .08$, and no interaction effect, $F(1, 178) = .003, p = .96$; $M_{\text{attendance_HC-HR}} = 62.87, SD = 16.17$, $M_{\text{attendance_LC-LR}} = 62.54, SD = 16.30$, $M_{\text{repayment_HC-HR}} = 66.87, SD = 14.97$, $M_{\text{repayment_LC-LR}} = 66.59, SD = 15.46$. In other words, perceived employment prospects were not affected by the type of college or cost information presented.

The results provide insight into a method for reframing the way students consider the financial ramifications of college. Participants who were nudged to psychologically realize the financial costs and returns at the same time—after graduation, when both the costs and returns would be actually realized—were less likely to choose the LC-LR college over the HC-HR college. We also found that participants' uncertainty about future job prospects did not differ between LC-LR and HC-HR colleges, so tuition myopia cannot be explained by a perception that future salaries are more uncertain for graduates of HC-HR colleges.

GENERAL DISCUSSION

In the second quarter of 2010, for the first time in history, student debt surpassed auto loans and credit cards to become the second-largest source of consumer debt in the United States. Government, non-profit, and for-profit agencies now provide college financial information in a variety of formats and advise students and their families to consider the financial ramifications of their college choices. We present an empirically supported model of the financial decision-making process by which students weigh these financial costs and returns. Our tuition myopia model provides insights into and predictions for a choice that profoundly influences one's

lifetime income. Our model also suggests an approach to the presentation of financial information that can help students seek to maximize their lifetime income.

We began by testing two different models of the college decision process. A rational cash flow model considers the expected cash flows of costs (i.e., loan repayments) and returns (i.e., income) at the time of their actual realization (i.e., after graduation). The cash flow model predicts a preference for the HC-HR college over the LC-LR college in most choice pairs, regardless of the financial impatience of the student. In our tuition myopia model, however, the student psychologically realizes the costs before the returns, creating the perception of an intertemporal tradeoff between short-term losses and long-term gains. A student’s choice between an HC-HR and LC-LR college depends on the relationship between the individual discount rate and the $r_{\text{threshold}}$ value of the choice pair.

We find considerable evidentiary support for our tuition myopia model. In Study 1, students (and others) psychologically realized the financial costs of college earlier than the financial returns (see also Web Appendix C). In Study 2A, a retrospective analysis of real college decisions found that, among adults who previously attended college, those who were more (less) financially impatient were more likely to have attended an LC-LR (HC-HR) college. In Study 2B, we systematically varied the discount rate threshold of the choice pair ($r_{\text{threshold}}$) and found that individual-level and pair-level trends exhibited an intertemporal tradeoff, as predicted by the tuition myopia model and in conflict with the predictions of the cash flow model. Studies 3A and 3B suggest that tuition myopia cannot be explained by a ROI maximization strategy or student debt aversion (Burdman 2005). In Study 3C, the tuition myopia model generalized to choice pairs for which both non-financial and financial attributes were available. Finally, Study 4

demonstrated that a modified decision aid can diminish tuition myopia by synchronizing the psychological realization of costs and returns.

Theoretical Contributions

Our tuition myopia model contributes primarily to the literature examining intertemporal choices for higher education. That literature has largely focused on how students decide *whether* to go to college. The decision is framed as a choice between a smaller, sooner reward (i.e., get a job after high school to receive income immediately) and a larger, later reward (i.e. go to college and secure a higher-paying job after graduation; Lawrance 1991; Mischel et al. 2011; Reimers et al. 2009). We extend the scope of the literature by examining intertemporal choices *between* colleges. Students who decide to attend college are postponing their income regardless of the specific college, so there is no “smaller, sooner” or “larger, later” reward. Public and private loans allow students to postpone work and income so they can earn a larger salary and pay back their loans after graduation, regardless of the college they choose. If students psychologically realized the financial costs and returns at the time as their actual realization (i.e., after graduation), as posited by the rational cash flow model, then there should be no intertemporal tradeoff.

With correlational and experimental data, however, we show that the psychological realization of costs before returns creates the perception of an intertemporal tradeoff when the choice involves a smaller short-term investment that should produce a smaller long-term return (LC-LR) and a larger short-term investment that should produce a larger long-term return (HC-HR). We propose and test a quantitative model, and we overcome a limitation of previous research this area by explicitly demonstrating intertemporal tradeoffs (Rick and Loewenstein 2008; Urminsky and Zauberman 2015).

Scope and Limitations

Readers are likely to note the discrepancy between the rising student debt burden and our implicit prescriptive advice that it is often better for students to take on more debt, but our perspective is supported by loan default data from the CFPB (Chopra 2013). The student loan literature continues to argue that students take on too little debt, particularly when coming from low-income and underrepresented backgrounds. Many students miss out on greater lifetime earnings by attending cheaper colleges (e.g., Avery and Turner 2012; Burdman 2005). Students with the highest student loan debt burdens are also not necessarily those who are most likely to default on their student loans or fail to complete college. Loan default rates are highest among people who were already struggling with other forms of debt payments before they took out a student loan: students with less wealth, income, and resources (Cottom 2017). Taking out too little in student loans to finance their college education may compound these pressures. They may be forced to finance their education and other expenses with more expensive credit cards or take on jobs during college that interfere with their coursework.

We recognize that the thought of a choice between an LC-LR and HC-HR college may conjure a mental image of choosing between a public not-for-profit university and an expensive elite private university—ostensibly an uncommon choice. In reality, about two-thirds of the choice pairs of US institutions (including public not-for-profit, private not-for-profit, and private for-profit institutions) involve a choice between an HC-HR and LC-LR college. The terms “HC-HR” and “LC-LR” merely imply that one institution both costs more and returns more than the other, not that it is prohibitively expensive or outrageously advantageous for one’s career. The designations are relative within the choice pair, so any student who receives more than two acceptances can choose an HC-HR option if there is no financially dominant option (i.e., LC-HR

option). Whether it is an Ivy League school or the nearest non-profit public university, an HC-HR option should still yield more lifetime earnings than the LC-LR alternative for most students in the long term.

Our model's predictions rest on four assumptions: (1) student loans eliminate immediate budgetary constraints, (2) students can obtain loans at the same interest rate regardless of the 4-year attendance costs and the student's economic background, (3) the expected annual income after graduation is certain and the same for all students, and (4) students will graduate from the college they attend. Obviously, these assumptions do not hold in all cases. The first assumption may not hold for students with little income or wealth, who may need to use student loans to pay for not only college costs but also immediate expenses such as car repairs and family emergencies. For-profit colleges tend to estimate higher costs and thus enable students to receive larger loan disbursements, so they may be the only realistic option for students with immediate financial needs beyond college costs (Cottom 2017).

Regarding the second assumption, students may not be able to cover all attendance costs with a single type of loan, so the effective interest rate may vary depending on the total 4-year costs and the student's credit history. At the college level, undergraduate students may borrow up to \$57,500 in fixed-rate federal student loans, but many students need to supplement with private loans, which come with higher interest rates. Thus, the effective interest rate depends on the composition of the student's loan package. For the same student, the loan package may differ between an LC-LR and HC-HR college—the lower costs of an LC-LR college may enable a student to take on only low-rate federal loans, while the same student may need to supplement with higher-rate private loans to afford an HC-HR college. At the student level, the interest rates of private loans vary with the credit history of the student or guarantor. Students whose families

1
2
3 have low income or wealth may have to pay a higher interest rate to finance college; again, this
4
5 will be disproportionately costly for the HC-HR college if private loans comprise a higher
6
7 proportion of the student’s loan package. It also is worth noting variations in transaction costs,
8
9 which are not part of our model. Institutions vary in the effective transaction costs for enrolling
10
11 and securing a loan. For-profit universities tend to streamline the enrollment and loan process.
12
13 For working adults, the transaction utility offered by a for-profit institution might outweigh the
14
15 lower costs or greater financial returns they would receive from a more traditional non-profit
16
17 public or private college with more complex enrollment and loan processes (Cottom 2017).
18
19
20
21

22 Regarding the third assumption, the anticipated returns from any given college vary with
23
24 the student’s career goals and undergraduate major. Students who pursue technical
25
26 undergraduate majors, like computer science and engineering, tend to earn significantly more
27
28 over their lifetimes than students who pursue a major in education or the humanities. The relative
29
30 benefits of an LC-LR college may increase for students pursuing less lucrative careers. There is
31
32 also considerable individual heterogeneity even within majors (Avery and Turner 2012).
33
34 Students who are risk-averse or have a strong conviction that they will pursue a less lucrative
35
36 career may assume they will earn less than the amount forecasted by College Scorecard and
37
38 other decision aids.
39
40
41
42

43 The fourth assumption, that all matriculating students will graduate, is clearly untrue.
44
45 Approximately half of all students who pursue a BA degree will leave college with no degree.
46
47 Incompletion rates are substantially lower at not-for-profit (vs. for-profit) institutions, but the
48
49 rate is non-trivial for all colleges (Avery and Turner 2012). Men and students of
50
51 underrepresented minoritized group, particularly Black students, are at the highest risk of not
52
53 completing an undergraduate degree (DiPrete and Buchmann 2006; McDaniel et al. 2011). In
54
55
56
57
58
59
60

short, depending on the student's demographics and the type of institution under consideration, it may be appropriate to discount the forecasted financial benefits of a college, which increases the attractiveness of the LC-LR option.

Policy & Practical Implications

Our tuition myopia model can explain and predict how students consider the financial ramifications of higher education, a decision that now is the driver of the second-largest source of consumer debt in America and affects millions of students every year. Our research benefits policymakers who are attempting to design policies and interventions to help students realize their goals. It is laudable that government, non-profit, and for-profit agencies are providing college financial information to the general public. We discover that the way in which financial information is presented can steer students toward a decision frame in which college choices seem to pose intertemporal tradeoffs. As we show in Study 4, the common practice of displaying the attendance costs and expected post-graduation salary side-by-side may inadvertently prompt students to psychologically realize costs earlier than benefits, evoking the perception of an intertemporal tradeoff in college choices that do not actually involve an intertemporal tradeoff. When combined with temporal discounting and financial impatience, the most common form in which this financial is presented increases the likelihood that students will choose the LC-LR college over the HC-HR college. We hope our findings guide the data-driven development of more effective decision aids and nudges to help students understand the financial attributes of their options for higher education and better align their decisions with personal and financial goals.

It is important to note that although lifetime post-graduation gains are greater for the HC-HR college than for the LC-LR college, even when considering the higher attendance costs and larger loan repayments, we are agnostic about whether preferences for the LC-LR college are unjustified. We envision that the LC-LR college may be the better choice for a student whose aversion to greater debt imposes a psychological cost (e.g., pain of paying) that offsets greater expected financial benefits, who wants to maximize their return on investment, who has the capital to invest in more profitable assets than higher education, or who would need to take on loans with a high interest rate. Admittedly, it is counterintuitive to recommend HC-HR colleges when student loans have become such a large burden for many Americans, but we find that graduates from LC-LR colleges are more likely to default on their student loans (Web Appendix I), implying that the minimization of student debt may not necessarily ensure future financial security. Considerably more work is needed to understand not only the psychology of the financial decision-making process for higher education but also the economic ramifications of those decisions in the context of the opportunity costs, considering the many boundary conditions we have identified.

It is important to understand sources of consumer debt that constrain consumers and society. It is equally important to understand the downside of underinvestment in human capital, which can lead to larger financial disadvantages in the future. A college education is a one-time opportunity for most students. Focusing on maximizing total lifetime income rather than investment efficiency may make more sense for many who wish to use this powerful ladder for economic benefit.

REFERENCES

- Avery, Christopher and Sarah Turner (2012), "Student Loans: Do College Students Borrow Too Much--Or Not Enough?," *Journal of Economic Perspectives*, 26 (1), 165-92.
- Baum, Sandy and Marie O'Malley (2003), "College on Credit: How Borrowers Perceive Their Education Debt," *Journal of Student Financial Aid*, 33 (3), 7-21.
- Becker, Gary S. (1962), "Investment in Human Capital: A Theoretical Analysis," *Journal of Political Economy*, 70 (5), 9-49.
- Bilgin, B. and R. A. LeBoeuf (2010), "Looming losses in future time perception," *Journal of Marketing Research*, 47 (3), 520-30.
- Burdman, Pamela (2005), "The Student Debt Dilemma: Debt Aversion as a Barrier to College Access." UC Berkeley: Center for Studies in Higher Education.
- Bureau of Labor Statistics (2016), "Consumer Price Index for All Urban Consumers: All Items [CPIAUCSL] and College tuition and fees [CUSR0000SEEB01]."
- Bureau of the Census (2016), "Real Median Household Income in the United States [MEHOINUSA672N]."
- Caetano, Gregorio , Harry Anthony Patrinos, and Miguel Palacios (2011), "Measuring Aversion to Debt: An Experiment Among Student Loan Candidates," in Policy Research Working Papers. Washington, DC: World Bank.
- Callender, C. and J. Jackson (2005), "Does the fear of debt deter students from higher education?," *Journal of Social Policy*, 34 (4), 509-40.

- Carr, Peggy G. (2015), "The Condition of Education 2015," National Center for Education Statistics.
- Chopra, Rohit (2013), "Student Debt Swells, Federal Loans Now Top a Trillion," Consumer Financial Protection Bureau.
- Cottom, Tressie McMillan (2017), *Lower Ed: The Troubling Rise of For-Profit Colleges in the New Economy*. New York: The New Press.
- DiPrete, T. A. and C. Buchmann (2006), "Gender-specific trends in the value of education and the emerging gender gap in college completion," *Demography*, 43 (1), 1-24.
- Eckel, C. C., C. Johnson, C. Montmarquette, and C. Rojas (2007), "Debt aversion and the demand for loans for postsecondary education," *Public Finance Review*, 35 (2), 233-62.
- Federal Reserve Bank of New York (2016), "The Center for Microeconomic Data."
- Federal Reserve Board (2020), "Report on the Economic Well-Being of U.S. Households in 2019 - May 2020."
- Field, E. (2009), "Educational debt burden and career choice: Evidence from a financial aid experiment at NYU law school," *American Economic Journal: Applied Economics*, 1 (1), 1-21.
- Indiana University Center for Postsecondary Research (2016), "The Carnegie Classification of Institutions of Higher Education." 2015 ed. Bloomington, IN.
- Koopmans, Tjalling C. (1960), "Stationary Ordinal Utility and Impatience," *Econometrica*, 28 (2), 287-309.

- Lawrance, Emily C. (1991), "Poverty and the Rate of Time Preference: Evidence from Panel Data," *Journal of Political Economy*, 99 (1), 54-77.
- Lobosco, Katie (2014), "Colleges that offer the best return on your investment," in CNN Money.
- McDaniel, A., T. A. DiPrete, C. Buchmann, and U. Shwed (2011), "The Black Gender Gap in Educational Attainment: Historical Trends and Racial Comparisons," *Demography*, 48 (3), 889-914.
- Mischel, W., O. Ayduk, M. G. Berman, B. J. Casey, I. H. Gotlib, J. Jonides, E. Kross, T. Teslovich, N. L. Wilson, V. Zayas, and Y. Shoda (2011), "'Willpower' over the life span: Decomposing self-regulation," *Social Cognitive and Affective Neuroscience*, 6 (2), 252-56.
- National Center for Education Statistics (2018), "Repayment of Student Loans as of 2015 Among 1995–96 and 2003–04 First-Time Beginning Students," Department of Education (Ed.).
- National Student Loan Data System (2021), "Federal Student Aid Portfolio Summary," Department of Education.
- Reimers, S., E. A. Maylor, N. Stewart, and N. Chater (2009), "Associations between a one-shot delay discounting measure and age, income, education and real-world impulsive behavior," *Personality and Individual Differences*, 47 (8), 973-78.
- Rick, S. and G. Loewenstein (2008), "Review. Intangibility in intertemporal choice," *Philosophical Transactions of the Royal Society B: Biological Sciences*, 363 (1511), 3813-24.

Rothstein, J. and C. E. Rouse (2011), "Constrained after college: Student loans and early-career occupational choices," *Journal of Public Economics*, 95 (1-2), 149-63.

Sallie Mae (2017), "How America Pays for College 2017 Report."

Samuelson, P. A. (1937), "A note on measurement of utility," *Review of Economic Studies*, 4 (2), 155-61.

Schultz, Theodore W. (1961), "Investment in Human Capital," *The American Economic Review*, 51 (1), 1-17.

The White House (2015), "Fact Sheet: Empowering Students to Choose the College that is Right for Them," Office of the Press Secretary.

---- (2013), "Remarks by the President in the State of the Union Address," Office of the Press Secretary.

Urminsky, Oleg and Gal Zauberman (2015), "The Psychology of Intertemporal Preferences," in *The Wiley Blackwell Handbook of Judgment and Decision Making*: John Wiley & Sons, Ltd.

Van Boven, L., J. Kane, A. P. McGraw, and J. Dale (2010), "Feeling Close: Emotional Intensity Reduces Perceived Psychological Distance," *Journal of Personality and Social Psychology*, 98 (6), 872-85.

Yoon, Haewon and Gretchen B. Chapman (2016), "A Closer Look at the Yardstick: A New Discount Rate Measure with Precision and Range," *Journal of Behavioral Decision Making*, 29 (5), 470-80.

WEB APPENDIX A. COLLEGE CHOICE PAIRS IN A PAIRWISE COMPARISON

TABLE W1
COLLEGE CHOICE PAIRS

Relative Size of Cost & Return ¹	College A			
	Higher Cost & Higher Return than College B (HC-HR)	Lower Cost & Higher Return than College B (LC-HR)	Higher Cost & Lower Return than College B (HC-LR)	Lower Cost & Lower Return than College B (LC-LR)
Higher Cost & Higher Return than College A (HC-HR)	x	x	x	HC-HR vs. LC-LR pair
Lower Cost & Higher Return than College A (LC-HR)	x	x	LC-HR vs. HC-LR pair	x
Higher Cost & Lower Return than College A (HC-LR)	x	LC-HR vs. HC-LR pair	x	x
Lower Cost & Lower Return than College A (LC-LR)	HC-HR vs. LC-LR pair	x	x	x

Assuming that financial costs and returns differ within each choice pair, overlapping pairs (e.g., HCHR-HCHR or LCHR-LCHR) are improbable and marked with a hyphen (x).

WEB APPENDIX B. MODEL SIMULATION

The cash flow model and the tuition myopia model estimate the present value of graduating from a college given its forecasted financial costs and returns. The models differ only in the timing of the psychological realization of costs: after graduation in the cash flow model (i.e., when the student loan repayment becomes due) versus while attending college in the tuition myopia model (i.e., when student debt is incurred but not yet due for repayment). All other model specifications are the same. In this section, we use model simulations to demonstrate how the timing of the psychological realization of costs affects college choices.

We test the predictions of each model with a simulated decision maker that evaluates all choice pairs (83,250) in our exploratory dataset. For each college choice pair, the simulated decision maker calculates the present value of the HC-HR and LC-LR colleges using the cash flow model or tuition myopia model and indicates one of three outcomes: (1) an intertemporal tradeoff such that the dominant option depends on the individual discount rate, (2) HC-HR always dominant, or (3) LC-LR always dominant. For choice pairs with an intertemporal tradeoff, the simulated decision maker preferred the HC-HR college when the individual discount rate was low (future-focused) and the LC-LR college when the individual discount rate was high (present-focused).

For simplicity, we entered the same economic parameters into both models: the expected annual income growth rate (g), student loan interest rate (i), years spent in college (y_1), years of employment after graduation (y_2), and loan repayment period (y_3). For example, we assumed that students could get the same loan interest rate regardless of whether they chose the HC-HR or LC-LR college. We used fixed parameters for the years spent in college ($y_1 = 4$ years) and years

of employment after graduation ($y_2 = 40$ years). As a robustness check, we varied the student loan interest rate (i), loan repayment period (y_3), and expected annual income growth rate (g). We also varied the type of costs (net attendance costs vs. out-of-state sticker price) used in the models. Details are described in the methods section.

We also tested the potential impact of the sign effect (Hardisty and Weber 2020; Loewenstein 1987; Thaler 1981), in which people demonstrate asymmetry in temporal discounting depending on the sign (i.e., + or -) of the outcome—that is, people discount positive outcomes more than negative outcomes. The cash flow and tuition myopia models described in the main document assume symmetric discounting. We tested whether both models make different predictions when the individual discount rate differs between the costs and returns.

Methods

Loan interest rate. A lower interest rate translates into a smaller total loan repayment amount and, effectively, a lower cost of attending college. We tested the models with three different annual interest rates: 0% (benchmark), 3.76% (the lowest interest rate for government-subsidized student loans available from July 2016 to June 2017), and 11.85% (the highest fixed interest rate from Sallie Mae during the same time).

Loan repayment period. A longer repayment period decreases the size of each individual payment but increases the total costs by allowing for more interest to accrue (assuming a non-zero interest rate). A longitudinal study of federal student loan recipients showed that full repayment takes an average of 20 years (National Center for Education Statistics 2018). We tested the models with three loan repayment periods: 10, 20, and 30 years.

Author Accepted Manuscript

Expected annual income growth rate. A higher expected growth rate increases the benefit of a higher salary, which should increase the attractiveness of the HC-HR college. We tested the models with three expected annual income growth rates: 0% (benchmark), 0.5% (US census: average real wage growth from 1978–2018), and 3.9% (Bureau of Labor Statistics & Federal Reserve, BA degree or above from 1997–2019).

Type of cost. Even for the same college in the same program, the actual attendance costs vary depending on financial aid and the student's status as an in-state or out-of-state resident. We tested the models with both the net attendance costs (tuition, books, supplies, and living expenses, minus financial aid) and the out-of-state sticker price (out-of-state tuition with zero financial aid).

Calculation sequence. For the tuition myopia and the cash flow models, the present value is determined by two separate calculations: the summation of both outcomes and the conversion of the future value into the present value. The calculation sequence should not affect the present value if we assume symmetrical individual discount rates for both positive and negative outcomes. If, however, we consider asymmetrical individual discount rates (i.e., the sign effect), the calculation sequence can affect the present value. Imagine a \$100 gain with a one-year delay and a \$50 loss with a one-year delay; the individual discount rate is 10% APR (Annual Percentage Rate) for the gain and 5% APR for the loss. If we do the summation first and the conversion second, we will discount \$50 for one year ($= \$100 - \50) using 10% APR, leading to \$45.45 for the present value ($= \$50/(1+0.1)$). However, if we do the conversion first and the summation second, we get a different present value: $\$43.29 = \$100/(1+0.1) - \$50/(1+0.05) = 90.91 - 47.62$. We addressed the possibility of the sign effect by creating eight model configurations (M1–M8) with different calculation sequences (Table W2).

Author Accepted Manuscript

Intensity of the sign effect. We systematically varied the intensity of the sign effect by changing the simulated decision maker's individual discount rate. For every possible individual discount rate for positive outcomes, we tested three different individual discount rates for negative outcomes, calculated as 75% (small sign effect), 50% (medium sign effect), and 25% (large sign effect) of the individual discount rate for positive outcomes. For example, an individual discount rate of 10% APR for positive outcomes was paired with individual discount rates of 7.5%, 5%, and 2.5% APR for negative outcomes. We tested the sign effect in conjunction with the calculation sequence (Table W2).

TABLE W2

SIGN EFFECT TESTING SUMMARY

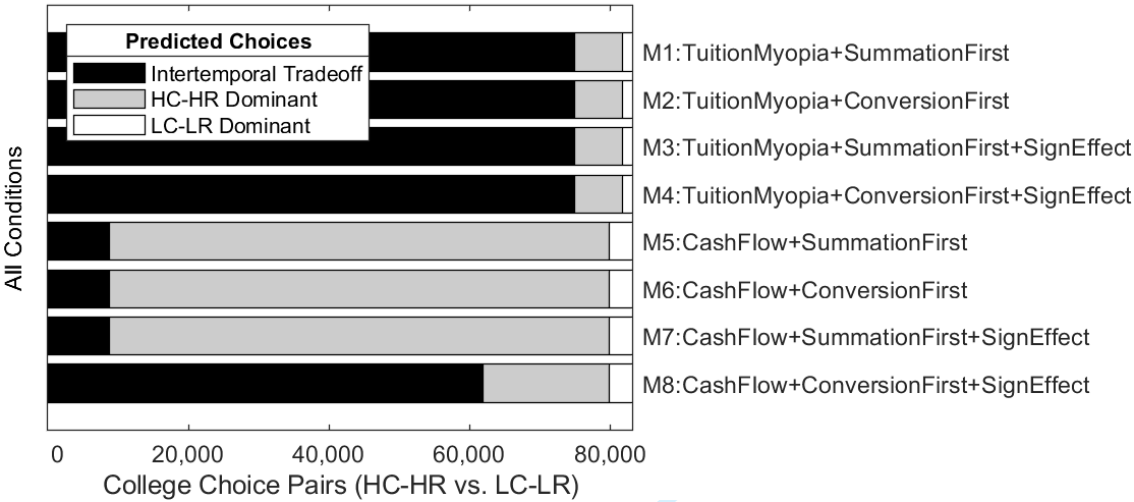
	Base Model	Calculation Sequence	Sign effect
M1	Tuition myopia	Summation First	No
M2	Tuition myopia	Conversion First	No
M3	Tuition myopia	Summation First	Yes
M4	Tuition myopia	Conversion First	Yes
M5	Cash flow	Summation First	No
M6	Cash flow	Conversion First	No
M7	Cash flow	Summation First	Yes
M8	Cash flow	Conversion First	Yes

As a result, the simulated decision maker made 107,892,000 college choices (= 83,250 choice pairs \times 3 loan interest rates \times 3 loan repayment periods \times 3 annual income growth rates \times

2 types of cost information \times 8 model configurations for the sign effect \times 3 sign effect intensities). The simulation was conducted using the Indiana University High Performance Computing cluster (BigRed3, 24 cores per CPU). The simulation took 489 CPU hours to complete.

FIGURE W1.

OVERALL PREDICTED CHOICES



Results & Discussion

Figure W1 summarizes the simulated decision maker's choices for the 83,250 choice pairs in the different model configurations (M1-M8). The black bar represents the number of college choice pairs for which there was an intertemporal tradeoff—that is, the simulated decision maker chose the HC-HR (LC-LR) college when it used a low (high) individual discount rate. In the remaining pairs, the simulated decision maker chose one college regardless of individual discount rates; gray (white) bars represent the number of college choice pairs in which it chose the HC-HR (LC-LR) college.

Author Accepted Manuscript

The tuition myopia model without the sign effect (M1 & M2) was the same as the model configuration we presented in the main document (practically, M1 and M2 are the same because the calculation order does not matter when the sign effect is not considered). As predicted in the theoretical development section of the main document, the model predicted intertemporal tradeoffs in most choice pairs (90.02%, vs. 8.09% with consistent HC-HR dominance and 1.89% with consistent LC-LR dominance). The tuition myopia model yielded similar results when including the sign effect (M3 & M4); the models gave more weight to the negative outcomes but did so equally for both college options, so the asymmetrical discount rates did not change the predicted outcomes.

The cash flow model without the sign effect (M5 & M6) was the same as the model configuration we presented in the main document (again, practically, M5 and M6 are the same because the calculation order does not matter when the sign effect is not considered). As theorized, the HC-HR college dominated consistently in most cases (85.36%, vs. 4.08% with consistent LC-LR dominance and 10.56% with an intertemporal tradeoff).

When we incorporated the sign effect into the cash flow model (M7 & M8), however, its predictions changed substantially. The sign effect did not influence the model prediction when the summation of positive and negative outcomes was performed ahead of the conversion from the future value to the present value (M7). However, when the conversion from the future value to the present value was conducted ahead of the summation of negative and positive outcomes (M8), the cash flow model predicted intertemporal tradeoffs in most cases (74.38%, vs. 21.54% with consistent HC-HR dominance and 4.08% with consistent LC-LR dominance). This dramatic shift is depicted in Figure W2. M8 was the only model configuration affected by the sign effect; The proportion of choice pairs with an intertemporal tradeoff ranged from 51.98% (small sign

effect) to 87.70% (large sign effect). This implies that the cash flow model can also create intertemporal tradeoffs in a majority of choice pairs under a specific condition. However, none of the other model configurations (M1-M7) were affected by the intensity of the sign effect.

This model simulation results focusing on the sign effect informed the design of Study 1. We found that the tuition myopia model makes robust predictions regardless of the calculation sequence or the sign effect. Students should exhibit intertemporal tradeoffs in most college choices as long as they psychologically recognize the financial costs earlier than the returns. The cash flow model can also demonstrate prevalent intertemporal tradeoffs, but only under specific conditions: the student 1) psychologically realizes both costs and returns after graduation, 2) converts the future value to the present value before summing the positive and negative outcomes, and 3) has a strong asymmetry between the discount rates for positive and negative outcomes. Otherwise, the cash flow model predicts that the HC-HR college will consistently dominate in a majority of choice pairs. Thus, we proceeded to empirically test the timing of the psychological and actual realizations of costs and returns to compare the performance of the tuition myopia and cash flow models (see Study 1).

Parameters related to the student loan contract had relatively small effects on the decision outcomes only in the cash flow model. Under the tuition myopia model, the loan repayment period (10, 20, or 30 years after graduation; Figure W3) did not affect college choices; under the cash flow model, a shorter loan repayment period led to a slightly larger proportion of choice pairs with an intertemporal tradeoff (without the sign effect; M5 & M6): 18.28% intertemporal tradeoffs with 10-year repayment versus 4.92% intertemporal tradeoffs with 30-year repayment. A similar pattern occurred for the loan interest rates (0%, 3.76%, or 11.85% APR; Figure W4): there was a small effect on the cash flow model (without the sign effect; M5 & M6) such that a

higher interest rate led to a slightly larger proportion of choice pairs with an intertemporal tradeoff: 5.23% intertemporal tradeoffs at a 0% interest rate versus 18.56% intertemporal tradeoffs at an 11.85% interest rate.

The annual income growth rate (0%, 0.5%, or 3.9% per year; Figure W5) had small effects on the outcomes of both models. An optimistic annual income growth prediction led to a slightly larger proportion of intertemporal tradeoffs under the tuition myopia model (without the sign effect; M1 & M2): 89.42% intertemporal tradeoffs at 0% income growth versus 90.96% intertemporal tradeoffs at 3.9% income growth. The same trend occurred under the cash flow model (without the sign effect; M5 & M6): 9.24% intertemporal tradeoffs at 0% income growth versus 12.60% intertemporal tradeoffs at 3.9% income growth.

Finally, the type of cost information (net attendance costs vs. out-of-state sticker price without financial aid; Figure W6) had larger effects on the outcomes of the tuition myopia model. Under the tuition myopia model (without the sign effect; M1 & M2), the use of net attendance costs led to the almost universal domination of intertemporal tradeoffs (97.96%), while the out-of-state sticker price predicted a smaller majority of intertemporal tradeoffs (82.08%) and an increased proportion of choice pairs in which the HC-HR college consistently dominated (16.19%). Under the cash flow model (without the sign effect; M5 & M6), the proportion of choice pairs with consistent HC-HR dominance was slightly larger when the model used net attendance costs (86.04%) versus the out-of-state sticker price (84.67%); intertemporal tradeoffs were slightly more prevalent with the out-of-state sticker price (11.45%) than with net attendance costs (9.68%).

References

Hardisty, David J. and Elke U. Weber (2020), "Impatience and Savoring vs. Dread: Asymmetries in Anticipation Explain Consumer Time Preferences for Positive vs. Negative Events," *Journal of Consumer Psychology*, 30 (4), 598-613.

Loewenstein, G (1987), "Anticipation and the Valuation of Delayed Consumption," *The Economic Journal*, 97 (387), 666-84.

National Center for Education Statistics (2018), "Repayment of Student Loans as of 2015 Among 1995–96 and 2003–04 First-Time Beginning Students," Department of Education (Ed.).

Thaler, R. (1981), "Some empirical evidence on dynamic inconsistency," *Economics Letters*, 8 (3), 201-07.

FIGURE W2.

SIGN EFFECT (DISCOUNT RATE OF THE NEGATIVE OUTCOME SET TO 75%, 50%, OR 25% OF THE POSITIVE DISCOUNT RATE)

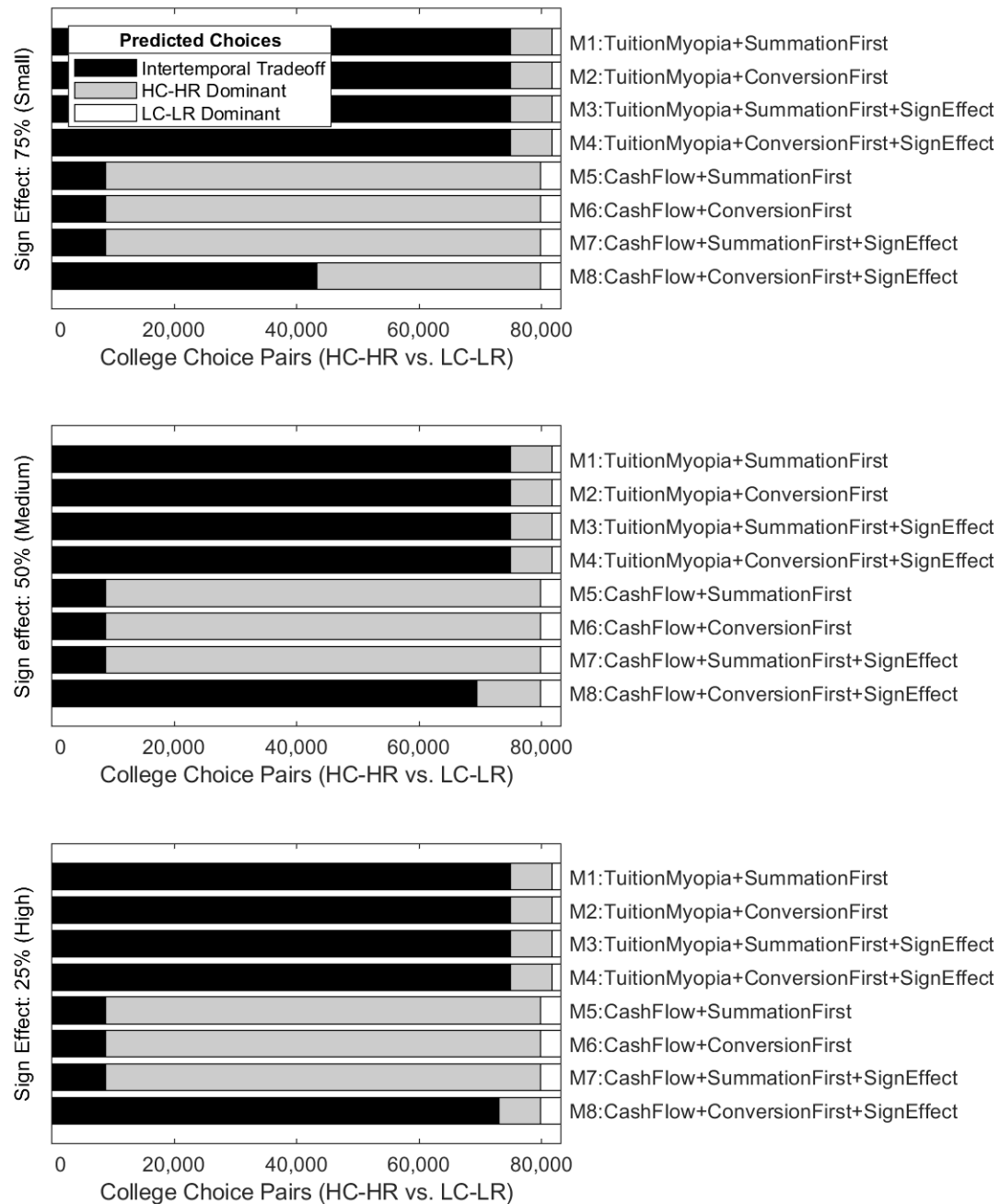


FIGURE W3.

LOAN REPAYMENT PERIODS (10, 20, AND 30 YEARS)

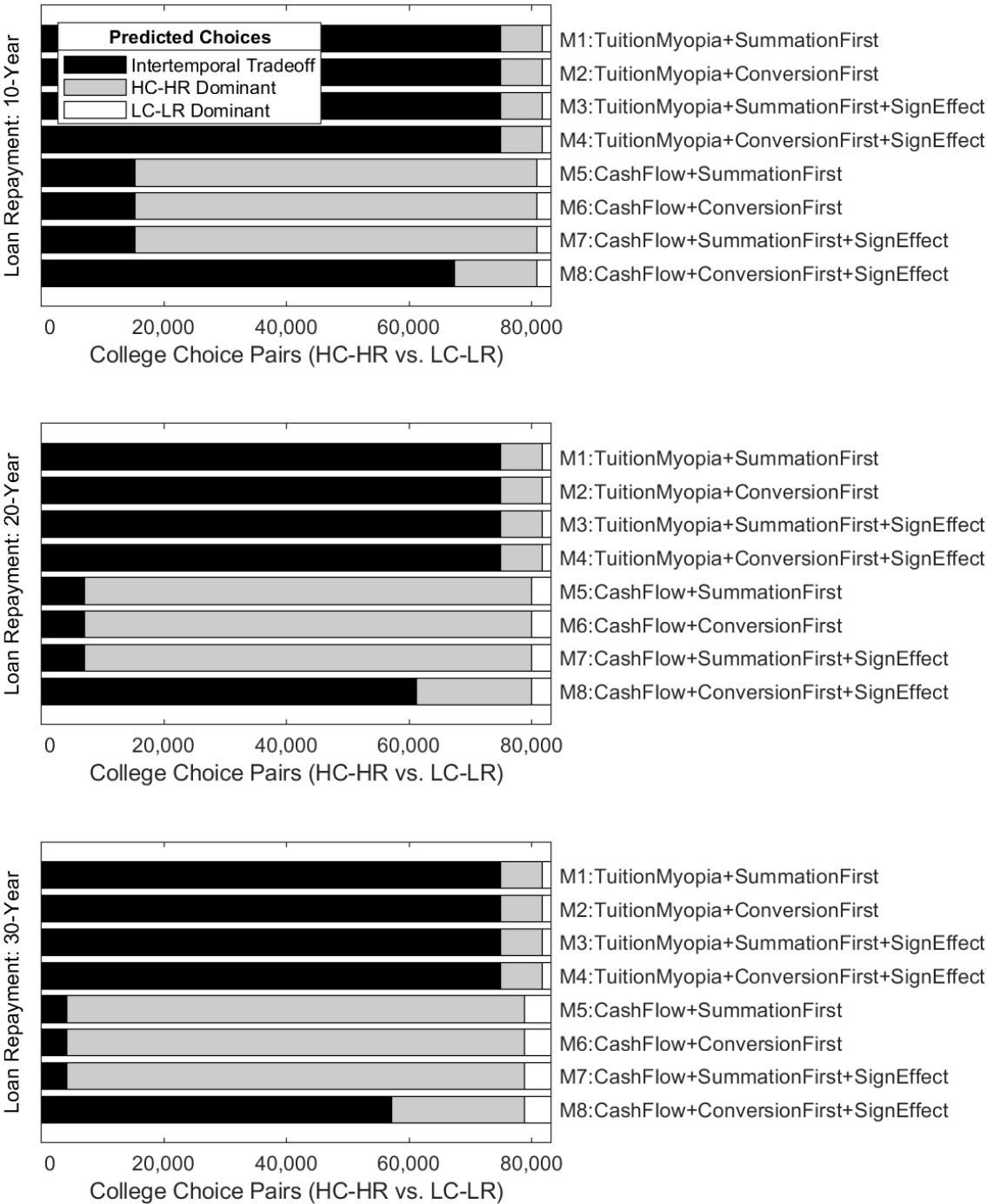


FIGURE W4.

LOAN INTEREST RATE (0%, 3.76%, AND 11.85% APR)

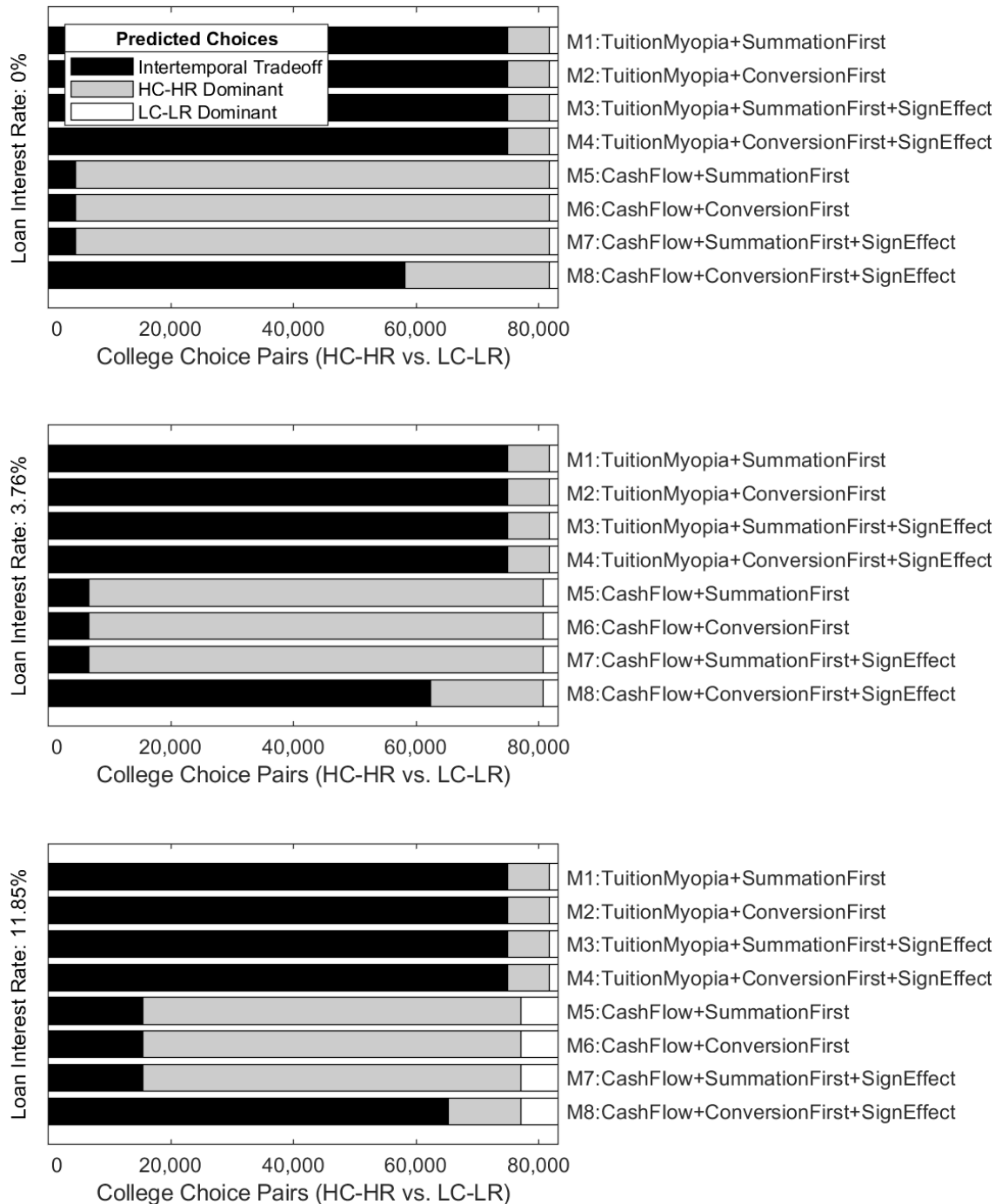


FIGURE W5.

EXPECTED ANNUAL INCOME GROWTH RATE (0%, 0.5%, AND 3.9%)

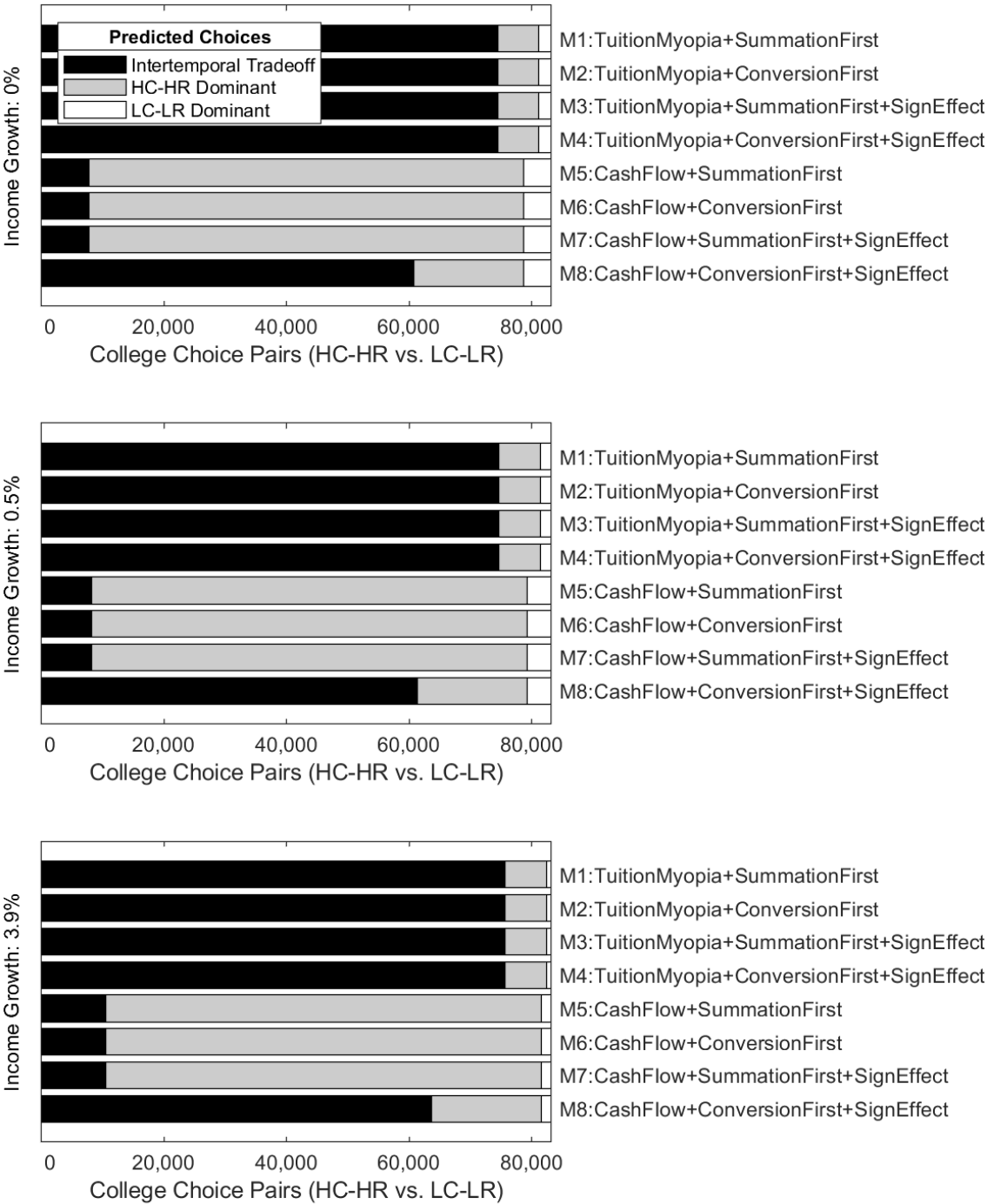
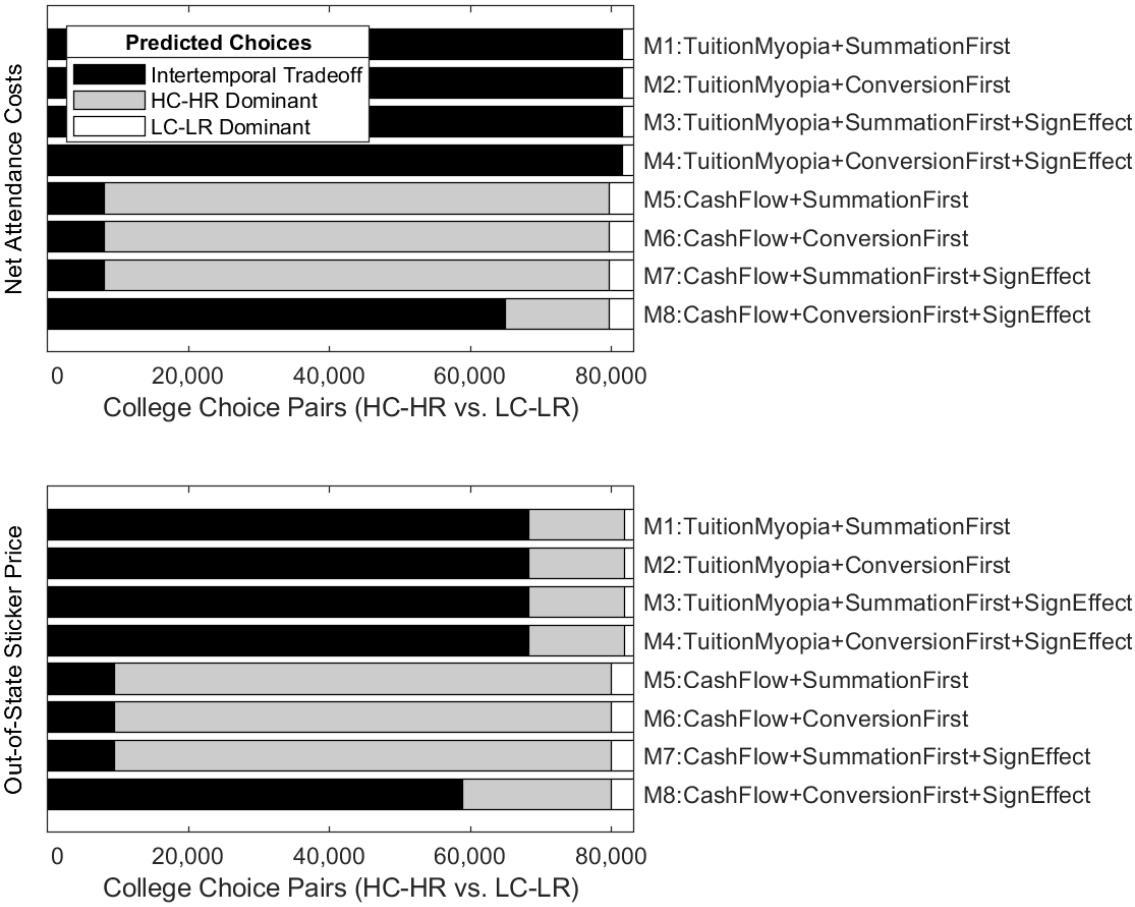


FIGURE W6.

NET ATTENDANCE COSTS VS. OUT-OF-STATE STICKER PRICE



WEB APPENDIX C. TWO PRE-REGISTERED DIRECT REPLICATIONS OF STUDY 1

Direct Replication 1: Amazon Mechanical Turk

Method

Participants and exclusions. Five hundred two United States residents from Amazon Mechanical Turk (226 women; $M_{age} = 39.50$, $SD = 12.28$) completed the study. As pre-registered (<https://aspredicted.org/blind.php?x=5d6ey9>), we excluded one participant who failed an attention check, leaving a final sample of 501 participants for analyses.

Stimuli and procedure. The stimuli and procedure were identical to Study 1.

Direct Replication 1 Results

A 2 (financial attributes: costs vs. returns; within-subjects) \times 2 (realization: psychological vs. actual; within-subjects) repeated-measures ANOVA revealed significant main effects of financial attributes ($F(1, 500) = 172.05$, $p < .001$, $\eta_p^2 = .26$) and realization ($F(1, 500) = 58.67$, $p < .001$, $\eta_p^2 = .11$) in addition to the predicted significant interaction effect ($F(1, 500) = 101.18$, $p < .001$, $\eta_p^2 = .17$). As illustrated in Figure W7, the psychological realization of the financial costs preceded graduation (2025), when the costs would be actually realized ($Mode_{psychological_costs} = 2025$, $Median_{psychological_costs} = 2025$, $M_{psychological_costs} = 2023.82$, $SD = 2.05$ vs. $Mode_{actual_costs} = 2025$, $Median_{actual_costs} = 2025$, $M_{actual_costs} = 2024.96$, $SD = 1.36$; $t(500) = 12.52$, $p < .001$; Wilcoxon Signed-Ranks Test: $Z = 11.88$, $p < .001$), but the financial returns were psychologically and actually realized at the time of graduation ($Mode_{psychological_returns} = 2025$, $Median_{psychological_returns} = 2026$, $M_{psychological_returns} = 2025.75$, $SD = 2.55$ vs. $Mode_{actual_returns} = 2025$, $Median_{actual_returns} = 2025$, $M_{actual_returns} = 2025.66$, $SD = 1.96$; $t(500) = .97$, $p = .33$; Wilcoxon Signed-Ranks Test: $Z = 1.16$, $p = .24$). Moreover, the financial costs of college were

psychologically realized significantly earlier than the financial returns ($t(500) = 14.33, p < .001$; Wilcoxon Signed-Ranks Test: $Z = 11.93, p < .001$).

Direct Replication 2: Nationally Representative LUCID Sample

Method

Participants and exclusions. Ninety-nine United States residents from Lucid Theorem (48 women, $M_{\text{age}} = 46.31, SD = 15.04$) completed the study. As preregistered (<https://aspredicted.org/blind.php?x=bk333n>), we excluded 19 participants who failed an attention check, leaving a final sample of 80 participants for analyses.

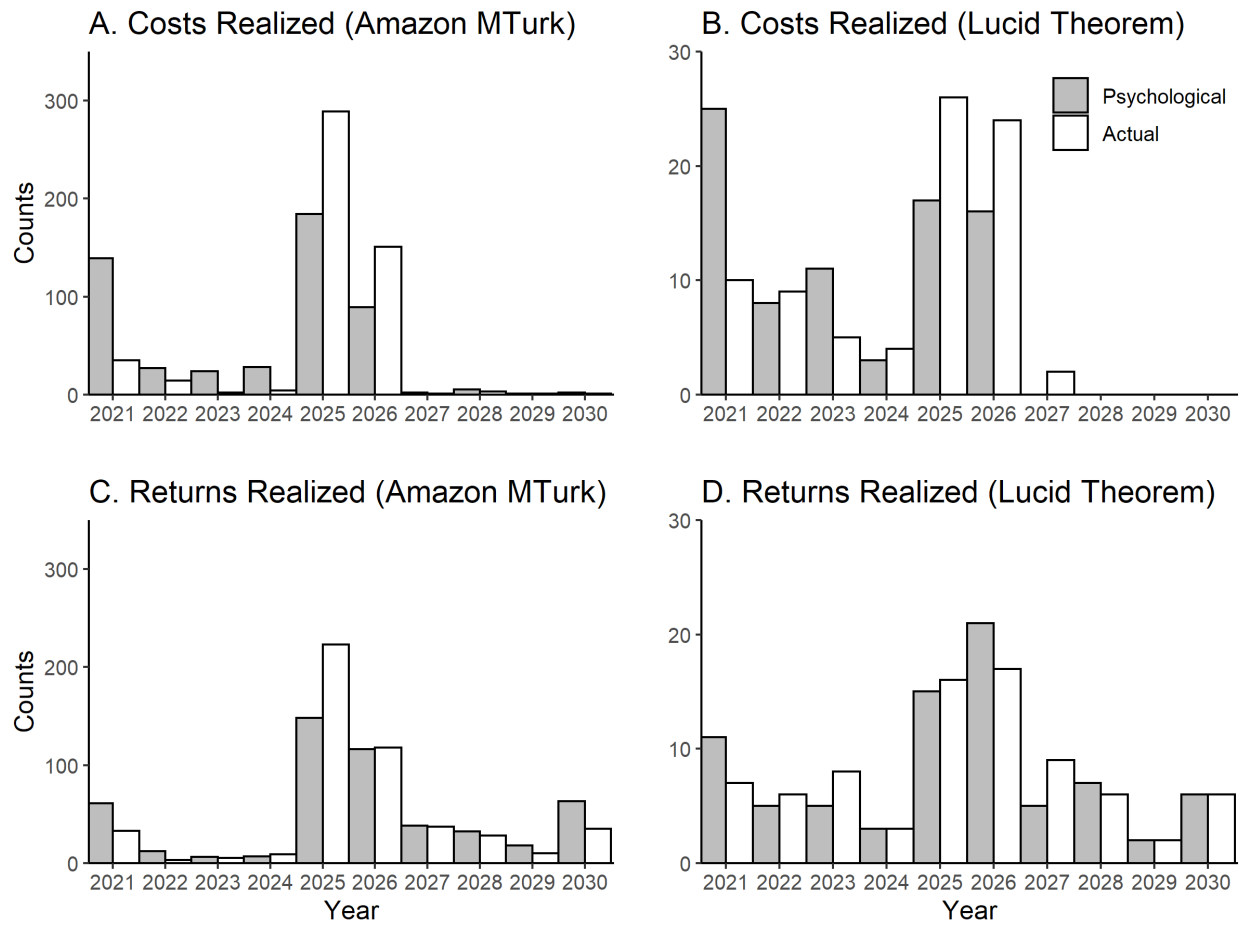
Stimuli and procedure. The stimuli and procedure were identical to Study 1.

Results

A 2 (financial attributes: costs vs. returns; within-subjects) $\times 2$ (realization: psychological vs. actual; within-subjects) repeated-measures ANOVA revealed significant main effects of financial attributes ($F(1, 79) = 36.36, p < .001, \eta_p^2 = .32$) and realization ($F(1, 79) = 9.74, p = .003, \eta_p^2 = .11$) in addition to the predicted significant interaction effect ($F(1, 79) = 11.50, p = .001, \eta_p^2 = .13$). As illustrated in Figure W7, the psychological realization of the financial costs preceded graduation (2025), when the costs would actually be realized ($\text{Mode}_{\text{psychological_costs}} = 2021, \text{Median}_{\text{psychological_costs}} = 2023, M_{\text{psychological_costs}} = 2023.34, SD = 1.99$ vs. $\text{Mode}_{\text{actual_costs}} = 2025, \text{Median}_{\text{actual_costs}} = 2025, M_{\text{actual_costs}} = 2024.34, SD = 1.82; t(79) = 4.39, p < .001$; Wilcoxon Signed-Ranks Test: $Z = 4.02, p < .001$), but the financial returns were psychologically and actually realized at the time of graduation ($\text{Mode}_{\text{psychological_returns}} = 2026, \text{Median}_{\text{psychological_returns}} = 2026, M_{\text{psychological_returns}} = 2025.23, SD = 2.58$ vs. $\text{Mode}_{\text{actual_returns}} = 2026, \text{Median}_{\text{actual_returns}} = 2026, M_{\text{actual_returns}} = 2025.33, SD = 2.47; t(79) = .47, p = .64$; Wilcoxon Signed-Ranks Test: $Z = .24, p = .81$). Moreover, the financial costs of college were psychologically realized

significantly earlier than the financial returns ($t(79) = 6.58, p < .001$; Wilcoxon Signed-Ranks Test: $Z = 5.46, p < .001$).

FIGURE W7. TIMING OF THE PSYCHOLOGICAL VS. ACTUAL REALIZATION OF COSTS AND RETURNS



WEB APPENDIX D. STUDY 2A PARTICIPANTS

	All Participants	Included in the Ranks
No High School	4	
High School	81	
College, No Degree	188	163
College	261	245
Graduate	61	52
Total Included	595	460
Excluded	5 ^a	50 ^b

^aOne participant experienced a technical error. Four participants demonstrated zero discounting or negative discounting.

^bCollege names for 47 participants were not identifiable in IPEDS, and three colleges were identified in IPEDS but were not classified in the Carnegie Classification of Institutions of Higher Education; all 50 were removed from analyses.

Author Accepted Manuscript

WEB APPENDIX E. STUDY 2A COLLEGE RANKING GROUPS

Carnegie Classification (N = Participants in each classification)	Ranking Group
Two-year, higher part-time (N = 54)	Group 1 (N = 84)
Two-year, mixed part/full-time (N = 26)	
Two-year, medium full-time (N = 2)	
Two-year, higher full-time (N = 2)	
Four-year, higher part-time (N = 21)	Group 2 (N = 81)
Four-year, medium full-time, inclusive, higher transfer-in (N = 9)	
Four-year, medium full-time, inclusive, lower transfer-in (N = 1)	
Four-year, medium full-time, selective, higher transfer-in (N = 50)	
Four-year, medium full-time, selective, lower transfer-in (N = 0)	
Four-year, full-time, inclusive, higher transfer-in (N = 21)	Group 3 (N = 104)
Four-year, full-time, inclusive, lower transfer-in (N = 2)	
Four-year, full-time, selective, higher transfer-in (N = 64)	
Four-year, full-time, selective, lower transfer-in (N = 17)	
Four-year, full-time, more selective, higher transfer-in (N = 105)	Group 4 (N = 105)
Four-year, full-time, more selective, lower transfer-in (N = 86)	Group 5 (N = 86)

Note. Detailed criteria for each classification are available online (below). See Undergraduate Profile Classification and Undergraduate Student Profile Methodology in the Carnegie Classification (http://carnegieclassifications.iu.edu/classification_descriptions/undergraduate_profile.php).

Author Accepted Manuscript

WEB APPENDIX F. ROBUSTNESS CHECK FOR STUDY 2A AND 2B

For Study 2A, we conducted a robustness check by including the four participants who did not finish high school in the analysis of the relationship between the individual discount rate and level of educational attainment. The results were similar to those in the main text.

Participants	Regression
N = 591 (Manuscript. Excluded the four participants who did not have a high school degree)	$R^2 = .02$, $F(1,589) = 14.33$, $p < .001$, $\beta = -.154$, $t(589) = -3.79$, $p < .001$
N = 595 (Robustness check: Included the four participants who did not have a high school degree)	$R^2 = .02$, $F(1,593) = 10.60$, $p < .001$, $\beta = -.133$, $t(593) = -3.26$, $p < .001$

For Study 2B, we conducted robustness checks by excluding outliers and including participants who were excluded in the main manuscript in the analysis of the relationship between the individual discount rate and the choice share of the LC-LR colleges. The results were similar to those in the main text.

Participants	Correlation	Regression
N = 92 (Manuscript)	Pearson $r = .35$, $p < .001$, Spearman $\rho = .31$, $p < .01$	$R^2 = .12$, $F(1,90) = 12.25$, $p < .001$, $\beta = .74$, $t(90) = 3.5$, $p < .001$
N = 88 (Excluding outliers identified by the Q-Q plot, Figure W8)	Pearson $r = .29$, $p < .01$, Spearman $\rho = .26$, $p < .05$	$R^2 = .08$, $F(1,86) = 12.25$, $p < .01$, $\beta = .29$, $t(86) = 2.76$, $p < .01$

N = 101
(Including all participants except for
two participants who experienced
technical errors and one who was
automatically exclude by the ToAD
procedure for non-positive
discounting)

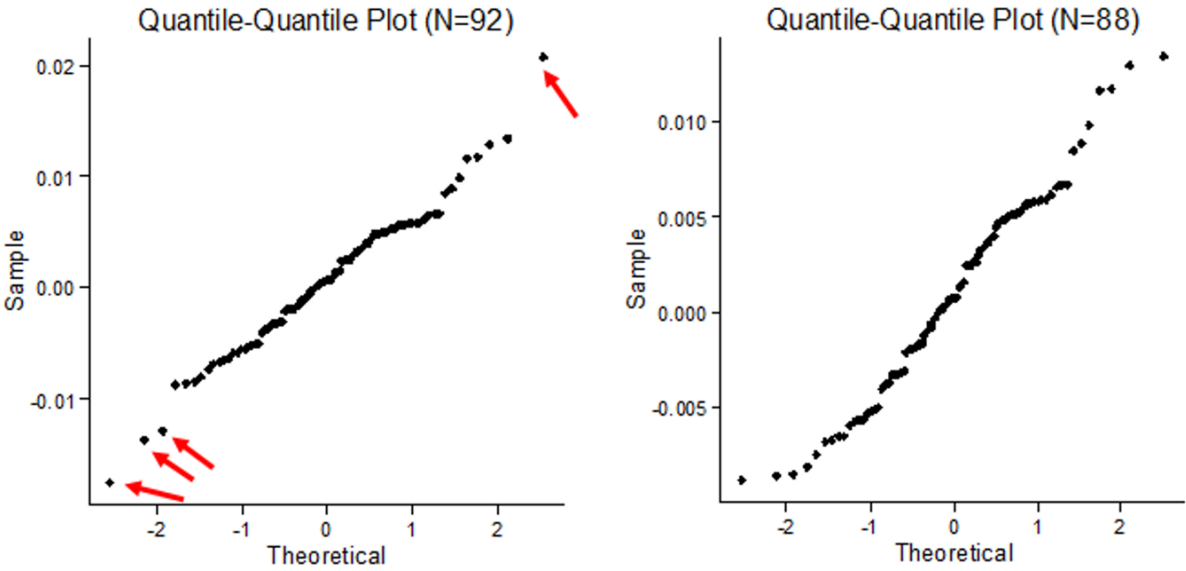
Pearson $r = .36, p < .001,$
Spearman $\rho = .33, p < .01$

$R^2 = .13, F(1,99) = 14.72, p < .001, \beta = .79, t(99) = 3.84, p < .001$

Peer Review Version

FIGURE W8.

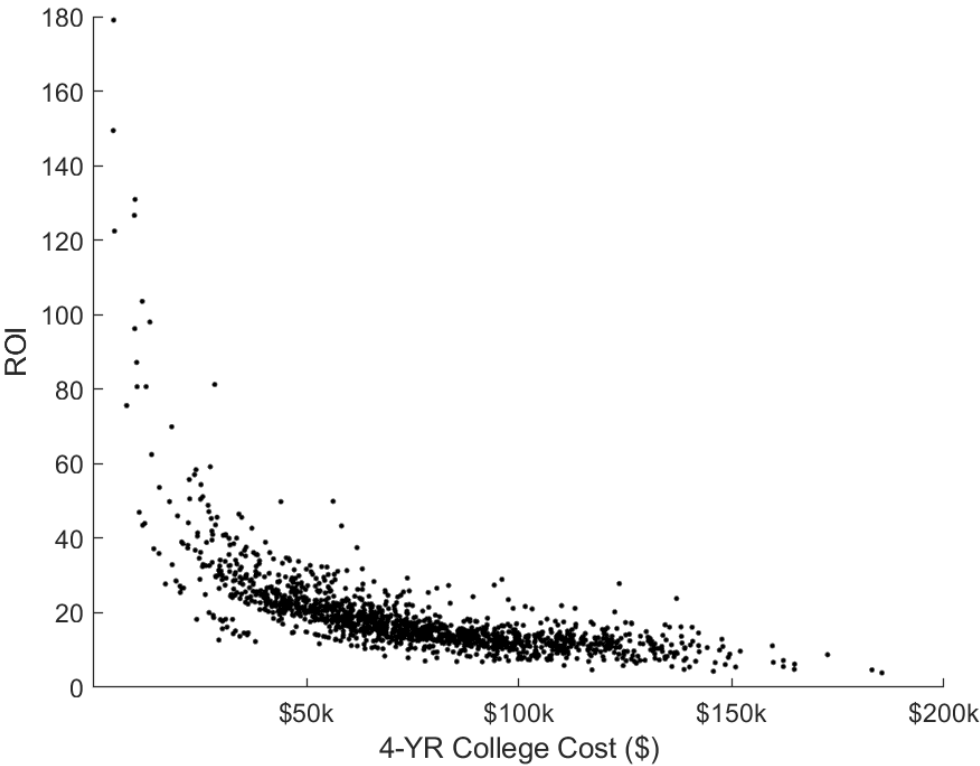
Q-Q PLOT WITH AND WITHOUT OUTLIERS IN STUDY 2B



WEB APPENDIX G. RETURN ON INVESTMENT

The ROI of each college is based on a 30-year income and four-year attendance costs.
(Source: College Scoreboard, N = 1,461 higher education institutions in the United States that have more than 1,000 students enrolled, provide four years of higher education, report four-year costs, average income for the tenth year after enrollment, and were operating as of 2016).

FIGURE W9.
ROI AND COST OF FOUR-YEAR COLLEGE



Author Accepted Manuscript

WEB APPENDIX H. STIMULI EXAMPLES

FIGURE W10.

STUDY 1. FINANCIAL INFORMATION

Imagine your school has finance information as follows

Annual Attending Cost During College (Expected annual attending cost during 4-year college, including tuitions and other expenses, minus financial aids)	\$ 13,464 per year
Loan Repayment After Attending (20-year student loan with interest rate of 4.37% to pay for the above attending cost after graduation)	\$ 4,369 per year
Average Salary After Attending (Expected salary after graduation if you attend this college)	\$ 66,700 per year

FIGURE W11.

STUDY 2A: TOAD INTRODUCTION EXAMPLE QUESTION

In this section of the survey, you will be asked to choose among various monetary options.

You will now complete an example question to make sure that you understand the format of the survey.

Which option would you prefer?

- ☐ Getting \$1000 Today
- ☐ Getting \$1200 in 30 days
- ☐ Getting \$1600 in 90 days

In the last question, were you receiving money or getting money?

- ☐ Getting money
- ☐ Giving money

Author Accepted Manuscript

FIGURE W12.

COLLEGE CHOICE EXAMPLE FOR STUDIES 2B, 3A, AND 3B

Imagine you are a high school graduate and that you are provided with the opportunity to pursue a college education at different schools.

Below, we will show you some information about each option (i.e., the category, 4-years tuition and expenses, and forecasted total return in income over 30 years). Note that total return is the average total amount of income that graduates from both schools earn over 30 years after graduation.

When you make decisions, please assume that there are different types of student loans readily available that can help you pay the tuition.

Press Q or P to answer the question.

Which option would you choose?

	School 12345	School 67890
Category	Research	Research
4-YR Tuition and Expenses	\$230,100	\$90,110
Total Return (Over 30 years)	\$2,966,000	\$2,178,110

School A
(Press Q)

☐

School B
(Press P)

☐

FIGURE W13.

STUDY 3C: INFORMATION RICHNESS (FINANCIAL INFORMATION)
AND LOAN INFORMATION (GENERAL DESCRIPTION)

Imagine you are deciding which of two colleges to attend. Information about each option is listed below. When making your decision, please assume that there are loans available that can help you pay for the tuition and expenses required.

Which option would you choose?

	School 211440	School 199120
Average Annual Cost	\$31,634	\$13,243
Salary After Attending	\$76,200	\$51,000

FIGURE W14.

STUDY 3C: INFORMATION RICHNESS (FINANCIAL INFORMATION)
AND LOAN INFORMATION (SPECIFIC LOAN DESCRIPTION)

Imagine you are deciding which of two colleges to attend. Information about each option is listed below. When making your decision, please assume that you’ve already decided to take a 30-year student loan that fully covers the tuition and expenses required, regardless of which college you’ll attend. The interest rate of the student loan is 3.67%, and you’ll start repaying your student loan after you graduate from college.

Which option would you choose?

	School 211440	School 199120
Average Annual Cost	\$31,634	\$13,243
Salary After Attending	\$76,200	\$51,000

Author Accepted Manuscript

FIGURE W15.

STUDY 3C: INFORMATION RICHNESS (COLLEGE SCORECARD)

AND LOAN INFORMATION (GENERAL DESCRIPTION)

Imagine you are deciding which of two colleges to attend. Information about each option is listed below. When making your decision, please assume that there are loans available that can help you pay for the tuition and expenses required.

Which option would you choose?

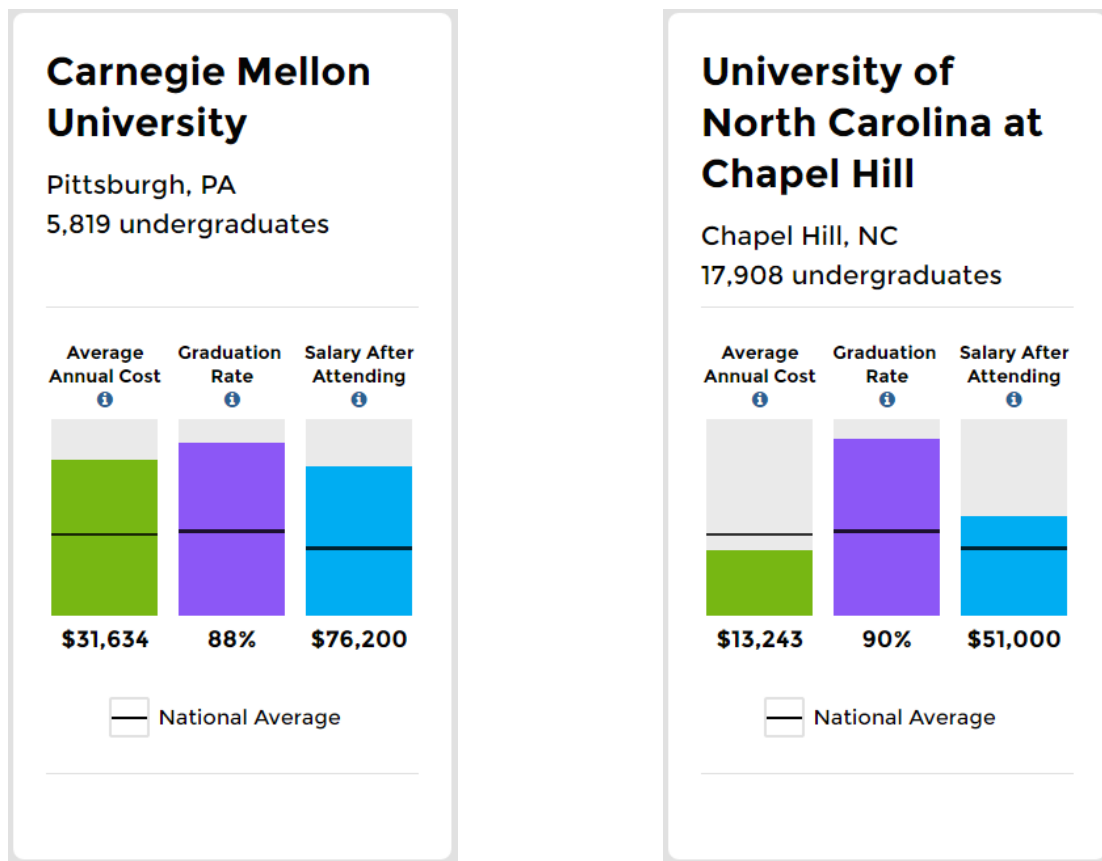
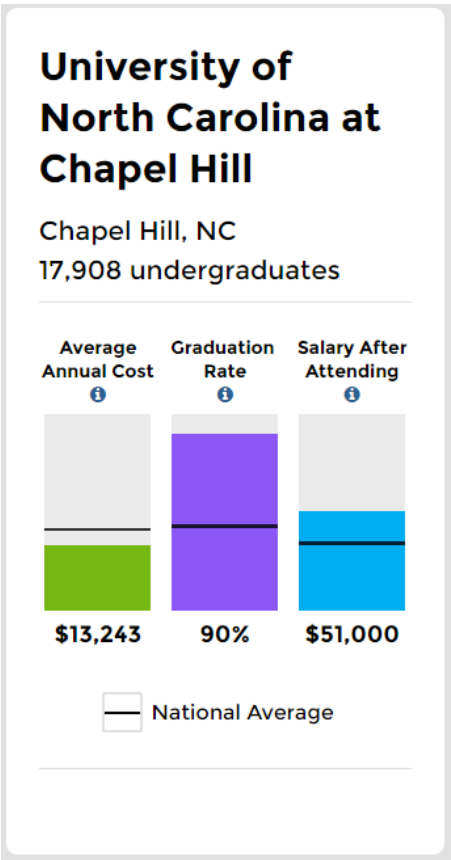
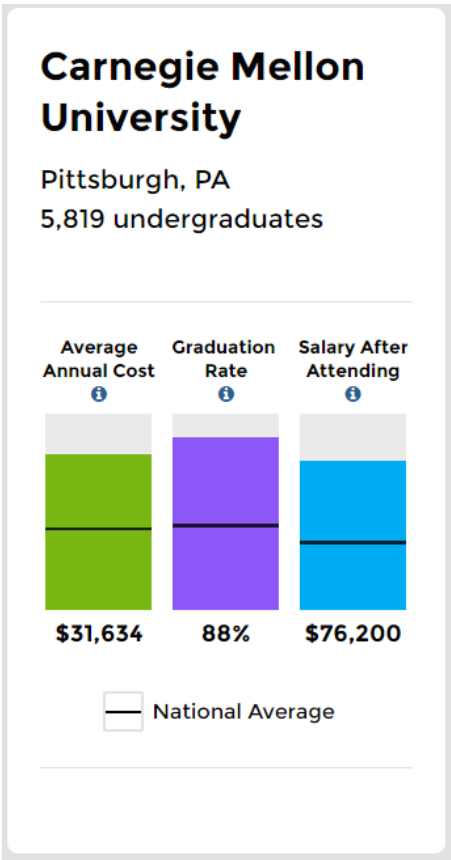


FIGURE W16.

STUDY 3C: INFORMATION RICHNESS (COLLEGE SCORECARD)
AND LOAN INFORMATION (SPECIFIC LOAN DESCRIPTION)

Imagine you are deciding which of two colleges to attend. Information about each option is listed below. When making your decision, please assume that you’ve already decided to take a 30-year student loan that fully covers the tuition and expenses required, regardless of which college you’ll attend. The interest rate of the student loan is 3.67%, and you’ll start repaying your student loan after you graduate from college.

Which option would you choose?



Author Accepted Manuscript

FIGURE W17.

STUDY 4: EXAMPLE ANNUAL ATTENDANCE COSTS CONDITION

Imagine that you are in your senior year of high school and you are deciding which of the following two 4-year colleges to attend.

When making your decision, please assume that you've already decided to take a 20-year student loan that fully covers the tuition and expenses required, regardless of which college you'll attend. The interest rate of the student loan is 4.37%.

Below is the annual salary after graduation and the annual cost of attendance for each of the four years.

Which college would you attend?

School 56789	School 12345
Annual Salary After Attending	Annual Salary After Attending
\$ 72,604	\$ 98,867
Average Annual Cost	Average Annual Cost
\$ 22,528	\$ 57,525



How likely is it that you would be employed within 1 year of graduating from **School 12345**?

Highly unlikely
0 10 20 30 40 50 60 70 80 90 100
Highly likely



How likely is it that you would be employed within 1 year of graduating from **School 56789**?

Highly unlikely
0 10 20 30 40 50 60 70 80 90 100
Highly likely

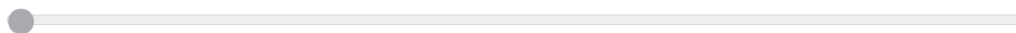


FIGURE W18.

STUDY 4: EXAMPLE ANNUAL LOAN REPAYMENT AMOUNT CONDITION

Imagine that you are in your senior year of high school and you are deciding which of the following two 4-year colleges to attend.

When making your decision, please assume that you've already decided to take a 20-year student loan that fully covers the tuition and expenses required, regardless of which college you'll attend. The interest rate of the student loan is 4.37%.

Below is the annual salary and annual loan repayment after graduation.

Which college would you attend?

School 12345	School 56789
Annual Salary After Attending \$ 98,867	Annual Salary After Attending \$ 72,604
Annual Student Loan Repayment After Attending (20 Years) \$ 14,966	Annual Student Loan Repayment After Attending (20 years) \$ 5,861

How likely is it that you would be employed within 1 year of graduating from **School 12345**?

Highly unlikely

0102030405060708090100

Highly likely

How likely is it that you would be employed within 1 year of graduating from **School 56789**?

Highly unlikely

0102030405060708090100

Highly likely

WEB APPENDIX I. STUDENT LOAN DEFAULT RATES IN THE LAST THREE YEARS

In Study 2A, we found that the student loan default rates in the last three years, as reported by colleges, were higher for lower-ranking colleges than for higher-ranking colleges ($\beta = -.77$, $t(452) = -25.91$, $p < .001$). We found this negative relationship in both our Study 2A sample and an additional analysis of 2,224 colleges in the College Scorecard database (inclusion criteria: were operating as of 2016, provide two-year or four-year degrees, reports the loan default rates, and has an enrollment of over 1,000 students). As shown in Figure W19, we replicated the strong negative relationship between the college ranking group and three-year student loan default rate in the larger sample ($\beta = -.69$, $t(2222) = -45.38$, $p < .001$).

FIGURE W19.

THREE-YEAR STUDENT LOAN DEFAULT RATES STRATIFIED BY RANKING (95% CI)

