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ABSTRACT

College loans are now the second largest source of consumer debt in the United States. In response, government, for-profit, and nonprofit agencies have encouraged students to consider the financial ramifications of their college choice in terms of both its total cost and long-term financial returns. We demonstrate that consumers of higher education exhibit tuition myopia—they psychologically realize the debts associated with college upon enrollment, not upon graduation, when the costs become due and their financial returns begin. Consequently, consumers perceive an intertemporal tradeoff between financial costs and benefits when choosing between colleges. In cases in which more expensive colleges produce larger financial returns and cheaper colleges produce smaller returns, temporal discounting leads financially-impatient consumers to prefer low-cost and low-return colleges in both hypothetical and real choices. We identify and elucidate a consequential phenomenon that potentially affects millions of consumers each year and substantially impacts the long-term benefits of higher education. We further demonstrate that changing the presentation of financial information effectively reduces tuition myopia.

Keywords: Intertemporal Choice, College, Financial Decision Making, Decision Aids

"*And tomorrow, my administration will release a new "College Scorecard" that parents and students can use to compare schools based on a simple criteria—where you can get the most bang for your educational buck*."

- President Barack Obama, *State of the Union* (Feb 2, 2013).

Education is an economic ladder that boosts human capital for individual and societal benefit (Becker 1962; Schultz 1961; Smith 1776). College graduates earn 202% more than people who do not complete high school, and 62% more than people whose highest degree is a high school diploma (Carr 2015). Accordingly, policymakers have long encouraged college enrollment. Programs such as the Higher Education Act of 1965 have successfully increased college enrollment from 45.0% (5.92 million students) in 1963 to a record high of 70.1% (21.31 million students) in 2009 (Bureau of Labor Statistics 2010).

Unfortunately, the cost of college has risen in kind. College tuition increased 356% between 1990 and 2015, while the real median household income rose merely 7% during the same period (Bureau of Labor Statistics 2016; Bureau of the Census 2016). With the rising cost of higher education, college loans have become the second largest source of consumer debt in the United States, after home mortgage debt. Total student loan debt in the United States is more than $1.46 trillion (Federal Reserve Bank of New York 2018). An estimated 43.3 million Americans have outstanding college loans, and they owe an average of $26,700 upon graduation (Haughwout et al. 2015). Many students struggle to repay the cost of college; 6.9 million loans are delinquent (i.e., past due over 90 days) or in default (Federal Reserve Bank of New York 2018).

To address this serious issue that affects consumer welfare, government, nonprofit, and for-profit agencies have implored students to consider higher education as an investment decision and have provided decision aids to facilitate students' financial decision making—to help them balance the cost of colleges against the long-term returns. The White House and the 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 cost of tuition and expenses as well as the expected income for graduates of each college. Nonprofit and for-profit agencies such as Payscale, College Board, Vanguard, and Sallie Mae have also spurred students to consider the financial ramifications of their college choice. They provide students with financial information such as the college's return on investment, which explicitly highlights the financial costs and returns of colleges. Little is known, however, about the consequences of highlighting this kind of financial information on the colleges chosen by students. It surely increases the transparency of the costs and returns associated with each college option, but it could also introduce unintended biases into the decision process.

We focus on the increasingly common decision process of choosing between different colleges. Since 2009, nearly 70% of high school graduates have chosen to pursue higher education (Bureau of Labor Statistics 2010). With more than 7,700 higher education institutions in the United States, most prospective students have multiple college offers among which to choose (though acceptance rates vary widely between institutions). When prospective students are considering different college options, they will likely be exposed to college financial information from various sources.

We report six studies that examine how considering the financial ramifications of higher education influences college choice. We suggest that psychologically realizing costs much earlier

than actual payments are due creates a cascade of effects on the evaluation of college options. This early psychological realization of cost frames college choices as intertemporal tradeoffs, a resource allocation choice between investment now and returns in the future. Thus, present-oriented students are more likely to choose colleges with lower upfront costs that provide smaller long-term financial returns over colleges with larger upfront costs that provide larger long-term financial returns. We find that the preference for low-cost colleges persists even with favorable loan offers and cannot be attributed to misguided heuristics or explicit investment strategies. We discuss theoretical and practical implications of our findings for a profoundly consequential financial decision that millions of students make each year.

THEORETICAL BACKGROUND AND HYPOTHESIS

We suggest a three-step process that explains college choices using college financial information. First, people psychologically realize costs earlier than the actual payments are due. Second, this creates intertemporal tradeoffs between colleges with high cost and high return, and colleges with low cost and low return. Third, individual discount rates predict choices among high-cost, high-return and low-cost, low-return college choice pairs. We will refer to this three-stage process as the *tuition myopia hypothesis* hereafter.

Step 1: Psychological Realization of Costs in College Choices

In the United States, the Higher Education Act of 1965 supports the government in offering several loan programs (e.g., Stafford loans and Perkins loans) that cover tuition and other attendance costs. In addition, several private lenders such as Sallie Mae also provide

student loans to cover education expenses. By removing a temporal gap between tuition costs and actual payment, student loans alter the cost and benefit characteristics of college education in two important ways. First, the cost of college tuition is no longer "immediate" if a student loan is procured. Student loans postpone the cost of higher education until after graduation, and extend its cost over many years, reducing the burden of immediate payments during college education. Second, student loans reduce net income after graduation because of the loan repayments. These loan payments are around 8–11% of income after graduation, and this debt-to-income ratio has been largely stable even as the loan amounts have grown over time (Avery and Turner 2012; Baum and O'Malley 2003). Student loans allow financially-constrained individuals to bridge the temporal gap between the tuition cost and actual payments. Considering that higher education opens the door to higher income, additional job opportunities, and increased job stability, going to college using student loans is an economically sensible choice if one does not have enough capital to pay tuition up front (Avery and Turner 2012).

However, even when student loans allow an individual to pursue higher education by postponing the burden of immediate payments, loans do not lift the psychological burden of the cost completely. Several studies suggest that students psychologically realize costs earlier than when payment is due, even when student loans are available. In a large panel survey, 76% of students answered that they had eliminated college options based on cost, while 61% of the same respondents believed that expensive colleges can lead to better education (Sallie Mae 2017). Caetano et al. (2011) and Callender and Jackson (2005) reported that the salience of student loans during the college decision process lead students to under-borrow or give up on higher education opportunities entirely. Similarly, using a field experiment with prospective NYU law school students, Field (2009) demonstrated that the salience of student loans in financial aid

packages swayed prospective students to choose financially-inferior career choices, demonstrating debt aversion. Burdman (2005) named this phenomenon of under-borrowing or debt aversion as the *student debt dilemma*—student loans provide opportunities to students who would otherwise be financially constrained, but at the same time, loans limit college choices and future career options.

The mental accounting literature also predicts early psychological realization of costs in college choices. Researchers have investigated ways in which payment decoupling leads to changes in the pain of paying (Prelec and Loewenstein 1998; Thaler 1999). Several studies found that credit spending, a form of short-term loan, reduces the pain of paying and thus increases consumer spending (Prelec and Simester 2001; Soman and Gourville 2001). However, the reduced pain of paying may be attributable not to the delay in payment, but rather to the reduced salience of the payment (Shah et al. 2016). In a field study that analyzed shopping behaviors of one thousand households over six months, Thomas et al. (2011) found that less-salient payment methods (i.e., payments using debit and credit card) led to increased purchases of unhealthy products, whereas a salient payment method (i.e., cash payment) led to decreased purchases of unhealthy products. This finding suggests that the salience of the payment event, not the delayed payment itself, may induce the pain of paying. In the context of college decisions, student loans allow students to delay payments until after graduation. However, the salience of the borrowing event during the college enrollment process (e.g., preparing for loan applications) is overwhelming for many students and their parents, and this can increase the pain of paying at the beginning of the college, well before actual payments will be made.

Step 2: Intertemporal Tradeoffs in College Choices

We suggest that the early realization of cost is likely to frame the choice of higher education as an intertemporal tradeoff between proximal costs (tuition and other expenses while attending college) and distal benefits (income from employment after graduation). When students compare the proximal financial costs and distal benefits of any two colleges, their pairwise comparison falls into one of two categories (Appendix 1). The first category involves a choice between a low-cost, high-return (LCHR) college and a high-cost, low-return (HCLR) college. In this choice, the LCHR college always dominates the HCLR college because the former provides greater financial benefits with lower costs than the latter. There is no economically rational reason to choose the HCLR college over the LCHR college, *ceteris paribus*.

The second category, which is our main focus, involves a choice between a high-cost, high-return (HCHR) college and a low-cost, low-return (LCLR) college. This choice entails an intertemporal tradeoff, a resource allocation between present and future; a larger investment now would lead to greater returns in the future (the HCHR college), whereas a smaller investment now would lead to smaller returns in the future (the LCLR college). Note that an intertemporal tradeoff between the HCHR college and the LCLR college is different from a typical binary intertemporal tradeoff between a smaller, sooner option and a larger, later option. Rather, in the context of college choices, both the HCHR and LCLR options yield a series of sooner and later outcomes over the same time period. Thus, in this study, intertemporal tradeoffs refer to the resource allocation between college years and post-graduation years.

Step 3: Temporal Discounting in College Choices

When evaluating college intertemporal tradeoffs, the choice between HCHR and LCLR colleges depends on how people value future outcomes. Prospective students must consider both proximal costs and distal benefits, which occur at different points in time, when evaluating the value of attending each college. When considering these costs and benefits, proximal outcomes are valued more (i.e., receive larger decision weights) than distal outcomes. This devaluation of future outcomes is called temporal discounting: a tendency to devalue an outcome as it moves further away from the present (Frederick et al. 2002; Koopmans 1960; Samuelson 1937). The discount rate is the degree of temporal discounting within a certain time period. For example, impatient (present-focused) people heavily devalue future outcomes, so they have high discount rates, whereas patient (future-focused) people lightly devalue future outcomes, so they have low discount rates. Temporal discounting has been used to explain consumer financial decisions such as home mortgage preferences (Atlas et al. 2017), creditworthiness (Meier and Sprenger 2012), and retirement savings (Hershfield et al. 2011); financially-impatient consumers prefer mortgage options with low upfront costs, have low credit scores, and are less likely to save for their retirement.

Higher education has been indirectly linked to temporal discounting in previous studies, most notably, by tracking adults who participated in the classic "marshmallow experiments" as children in the 1970s (Mischel and Ebbesen 1970; Mischel et al. 1972). Preschoolers who waited patiently for two marshmallows achieved higher levels of education twenty years later (Ayduk et al. 2000; Mischel et al. 2011). Using large-scale panel data, Lawrance (1991) and Reimers et al. (2009) found that people with higher discount rates were less likely to attain college education. This relationship is not constrained to the United States nor specific to higher education. Using

household survey data from Vietnamese villages, Tanaka et al. (2010) also found higher discount rates among people with lower education attainment. Together, these longitudinal and cross-sectional studies suggest a potential connection between temporal discounting and education attainment.

Going one step further, we predict that temporal discounting can explain not just the choice between a high school diploma and a college degree, but also the choice between colleges that differ in proximal costs and distal returns. Financially-impatient students are more likely to prefer LCLR colleges because these students focus on proximal outcomes (i.e., years of school with negative incomes), and LCLR colleges confer lower costs than HCHR colleges. On the other hand, financially-patient students are more likely to prefer HCHR colleges because these students focus on distal outcomes (i.e., positive income streams after graduation), and HCHR colleges provide larger positive income streams than LCLR colleges. In other words, the financially impatient would prefer to invest less money now and receive less money in the future, whereas the financially patient would prefer to invest more money now and receive more money in the future. In the following section, we construct a model that demonstrates how intertemporal tradeoffs and temporal discounting influence college choices.

College Choice Model

We propose a college choice model that captures the present value of each college option. Based on our model, we explain the process by which temporal discounting influences college choices and demonstrate why the financially impatient overvalue the cost of colleges relative to their long-term financial returns, thus choosing LCLR colleges. For simplicity, we assume that the payment of the annual costs associated with attending a college (C) occurs at the beginning of each school year, and that the expected annual salary after graduation (S) will be received at

the end of each working year. Also, we assume that C remains constant until graduation, whereas S grows at a constant rate (g). Under these assumptions, every college entails a negative income stream during the years of enrollment (y_1: years spent in college), but leads to a positive income stream during employment (y_2: years of employment after graduation). When evaluating the value of each college at present, students who use temporal discounting will assign different weights to proximal and distal income streams using a discount rate (r). Formally, the present value of each college, *V (College),* is calculated by formula (a).

(a)

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

The left term in the formula depicts the present value of the expected earnings after graduation, and the right term depicts the present value of the expected costs of attendance. The discount rate (r) is larger for the financially impatient and smaller for the financially patient. The present value of each college, *V (College)*, will be smaller for financially-impatient students because they focus on proximal outcomes (i.e., the negative income associated with years of college). However, the present value of each college will be larger for financially-patient students because they focus on distal outcomes (i.e., the positive income associated with years after graduation).

Realistically, most people fall in between these two extremes, and their discount rates vary accordingly. A student's discount rate determines whether she should prefer the HCHR college or the LCLR college in each choice pair. We define the preference switching point in each HCHR and LCLR choice pair as $r_{threshold}$, which can be estimated using formula (b). S_H and

S_L are the expected annual salaries for the HCHR college and LCLR college, respectively, and C_H and C_L are the expected annual costs of attending each college.

(b)

$$\frac{S_H}{(1+r_{threshold})^{y_1}\cdot(r_{threshold}-g)}\left(1-\left(\frac{1+g}{1+r_{threshold}}\right)^{y_2}\right)-C_H(1+r_{threshold})\left(\frac{1-(1+r_{threshold})^{-y_1}}{r_{threshold}}\right)$$
$$=\frac{S_L}{(1+r_{threshold})^{y_1}\cdot(r_{threshold}-g)}\left(1-\left(\frac{1+g}{1+r_{threshold}}\right)^{y_2}\right)-C_L(1+r_{threshold})\left(\frac{1-(1+r_{threshold})^{-y_1}}{r_{threshold}}\right)$$

The left-hand side of the formula denotes the present value of the HCHR college when $r = r_{\text{threshold}}$, and the right-hand side of the formula denotes the present value of the LCLR college when $r = r_{\text{threshold}}$. Combining formulae (a) and (b), the relationship between an individual discount rate (r) and the $r_{\text{threshold}}$ is as follows.

(c)

$$V(\text{LCLR college}) > V(\text{HCHR college}), \text{ when } r > r_{\text{threshold}}$$

$$V(\text{LCLR college}) < V(\text{HCHR college}), \text{ when } r < r_{\text{threshold}}$$

This relationship suggests that a student should choose the LCLR college when her discount rate (r) is higher than the $r_{\text{threshold}}$ of the choice pair, and the HCHR college when her discount rate is lower than the $r_{\text{threshold}}$ of the choice pair. Similarly, a student should prefer the LCLR colleges in low $r_{\text{threshold}}$ choice pairs and HCHR colleges in high $r_{\text{threshold}}$ choice pairs.

Exploratory Data Analysis

Using publicly available college financial information, we conducted an exploratory data analysis to test whether the tuition myopia hypothesis can potentially explain college choices in

the United States. We analyzed the College Scorecard database (https://collegescorecard.ed.gov/) from the Department of Education, which includes financial information for higher education institutions in the United States; the database includes the net attendance cost and expected salary after graduation, as reported by institutions and students who receive federal grants and loans. We analyzed 498 colleges that provide bachelor's degrees, have an enrollment of over 5,000 students, and are currently operating. These 498 colleges generated 123,753 college choice pairs (= ${}_{498}C_2$).

First, the analysis suggested that Category 2 choices (between LCLR and HCHR colleges, thus entailing intertemporal tradeoffs; see Appendix 1) are not only possible, but can be encountered quite frequently when comparing two college options. Among 123,753 college choice pairs, around two-thirds (83,250) of the college choice pairs involved an HCHR college and an LCLR college. Approximately one-third (40,105) of the college choice pairs fell into Category 1 (involving an LCHR college and an HCLR college; the former always dominates the latter).

Second, we found that the Category 2 choices can be explained by the college choice model as described in formulae (a)–(c). Among the 83,250 Category 2 college pairs in our dataset, we were able to calculate $r_{\text{threshold}}$ values for 81,098 (> 97% of all cases).[1] This means that, for most HCHR and LCLR college pairs, it is theoretically possible to face intertemporal tradeoffs when making college choices using college financial information; a student's preferred college will be determined by their discount rate (r) and the threshold at which both college options are equally appealing to that student ($r_{\text{threshold}}$).

[1] The calculation was conducted using expected salary and average annual cost information from the College Scorecard database. We assumed 4 years of college education, 30 years of employment, and a 3% annual income growth rate.

Lastly, the analysis also suggested that without early realization of costs (i.e., psychologically realizing costs when actually making student loan payments), the college choice no longer involves intertemporal tradeoffs and leads to an overwhelming preference for HCHR colleges. Among the 83,250 Category 2 choice pairs, the removal of early realization of costs from formula (a) made HCHR colleges the dominant option, regardless of temporal discounting (> 93% of all cases; 77,481 pairs). We found similar results under different assumptions, varying the loan repayment period (10–30 years), loan interest rate (3.76–11.85% APR), annual income growth rate (0.4–3%), and college cost (net costs vs. out-of-state tuition without financial aid; sticker price condition). Even under the most conservative condition (10-year repayment, 11.85% APR for the loan interest rate, 0.4% annual income growth, and out-of-state tuition with no financial aid), HCHR colleges still dominated the choice (> 63% of all cases; 52,241 pairs). See Appendix 2 for extended analysis.

OVERVIEW OF STUDIES

We report six studies testing our tuition myopia hypothesis. Study 1 tests whether people face intertemporal tradeoffs as predicted by our hypothesis. Study 2 replicates findings from Study 1 and tests whether temporal discounting is related to choices between HCHR and LCLR colleges. Studies 3 and 4 examine whether alternative hypotheses (uncertainty of future outcomes and the ROI strategy) could lead to similar behavioral outcomes as in our main hypothesis. Study 5 tests the tuition myopia hypothesis using publicly available college financial information and real college choices made by a convenience sample of six hundred Americans.

Lastly, Study 6 tests an alternative presentation of cost information to examine the tuition myopia hypothesis.

STUDY 1

Study 1 tests whether people face intertemporal tradeoffs when choosing between HCHR and LCLR colleges. The tuition myopia hypothesis predicts that early psychological realization of costs will lead to intertemporal tradeoffs; people will prefer LCLR colleges when the $r_{threshold}$ of a choice pair is low, and HCHR colleges when the $r_{threshold}$ of a choice pair is high. In Study 1, we vary $r_{threshold}$ among college choice pairs and test whether college preferences are affected.

Study 1 uses college choice stimuli that include both financial and non-financial attributes. When making college choices, most students also consider non-financial attributes such as each college's name or location. We manipulated the richness of the college information provided in the choice pairs by presenting participants either with financial information only (e.g., net costs and expected salaries from the College Scorecard website) or with a screenshot of each college taken directly from the College Scorecard website. The screenshots included the same financial information for each college, plus other consequential attributes including its name, size, location, and graduation rate. This manipulation tested whether tuition myopia influences college choice when non-pecuniary attributes of colleges are salient.

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). We included

eight attention check questions (i.e., choice pairs with dominant options involving no tradeoff between costs and returns), and 26 participants failed the attention check. The analysis was conducted with the remaining 294 participants.

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

Loan information. We provided each participant with one of two college loan descriptions: general or specific. The general loan description stated, "When making your decision, please assume that there are loans available that can help you pay for the tuition and expenses required." The specific loan description stated, "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 loan term and 3.76% APR was the most favorable loan term provided by the government from July 2016 to June 2017.

Information richness. For each choice pair, participants were presented with either the actual screenshot from the College Scorecard (scorecard condition; see Appendix 3, Figure W5 & Figure W6 for examples) or only the essential financial information from the same website (financial information condition; see Appendix 3, Figure W7 & Figure W8 for examples). The financial information condition showed the net cost and expected salary for each college. The scorecard condition included this financial information as well as the name, size, location, and completion rate of each college, benchmarked against national averages.

$r_{threshold}$. From the 83,250 college choice pairs in our exploratory analysis dataset (College Scorecard database), we randomly selected 30 pairs of HCHR and LCLR colleges, with ten pairs at each of the three $r_{threshold}$ levels: on average, 11.8%, 21.1%, and 37.8% APR, which correspond to the 20th, 50th, and 80th percentiles (± 5%) of the $r_{threshold}$ values from all pairs in the total sample. The participant's choices among these pairs was the critical dependent variable in the experiment.

Results and Discussion

For each participant, we calculated the choice share of LCLR colleges at each of the three $r_{threshold}$ levels. Each participant's choices at each level were averaged; for example, a participant who chose LCLR colleges for 7/10 choice pairs yielded a score of 70% for that cell (Figure 1).

We then analyzed the choices in a 2×2×3 mixed ANOVA, which revealed a main effect of $r_{threshold}$ ($F(2,580) = 423.95$, $p < .001$, $\eta_p^2 = .59$). The choice share of LCLR colleges was greatest at the lowest $r_{threshold}$ level, and vice versa. The specific loan description condition increased the preference for LCLR colleges, but the effect was only marginally significant (general vs. specific loan information: $F(1,290) = 3.88$, $p = .05$, $\eta_p^2 = .01$). Main effects of information richness (scorecard vs. financial information) were not significant ($F < 1$). The analysis also revealed two interactions with small effect sizes: $r_{threshold}$ × information richness ($F(2,580) = 7.49$, $p < .001$, $\eta_p^2 = .03$) and $r_{threshold}$ × loan information ($F(2,580) = 4.60$, $p < .05$, $\eta_p^2 = .02$).

Providing a specific loan description, which stated the most favorable student loan term available at the time of the study, did not significantly reduce the preference for LCLR colleges—rather, it marginally increased the preference for them. Also, we did not find a

significant main effect between scorecard and financial information conditions, suggesting that respondents made their decisions mainly using college financial information. However, we found strong evidence that respondents faced intertemporal tradeoffs when making college choices, supporting the tuition myopia hypothesis. The choice share of LCLR colleges was sensitive to the $r_{threshold}$ level ($\eta_p^2 = .59$); when the $r_{threshold}$ level was low, significantly more participants preferred LCLR to HCHR colleges even though LCLR colleges would provide a smaller lifetime income than HCHR colleges.

STUDY 2

The tuition myopia hypothesis suggests that temporal discounting adjusts the subjective value of a college by changing the relative weight of its proximal costs and future returns. The hypothesis predicts that people with higher discount rates (i.e., more financially-impatient and present-oriented) put more weight on proximal costs, and thus prefer LCLR to HCHR colleges; by contrast, people with lower discount rates (i.e., more financially-patient and future-oriented) put more weight on future returns, and thus prefer HCHR to LCLR colleges. In Study 2, we examined these predictions by eliciting individual discount rates and examining preferences among choice pairs of LCLR and HCHR colleges.

We predicted that participants with higher discount rates would exhibit a greater preference for LCLR colleges than participants with lower discount rates. Furthermore, participants' choices should depend on the $r_{threshold}$ value of each choice pair, as predicted by the tuition myopia hypothesis. That is, participants should prefer LCLR colleges when $r_{threshold}$ is low, and HCHR colleges when $r_{threshold}$ is high.

Method and Design

Participants and exclusions. One hundred and four undergraduate business majors at a private university in New England (44 women, M_{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 Study 1, and 10 participants failed (exclusion criteria: failing more than 25% of the check questions). The following analysis was conducted using the remaining 92 participants. There were no other exclusions.

Stimuli and procedure. We selected three $r_{threshold}$ levels (13.3%, 24.4%, and 42.9% APR) using the college choice pairs in our dataset from the College Scorecard database. This corresponded to the 20th, 50th, and 80th percentiles (± 5%) of the $r_{threshold}$ values of all the LCLR-HCHR college pairs in our dataset (83,250 pairs). For each $r_{threshold}$ level, we randomly selected 12 pairs of LCLR-HCHR colleges, resulting in a final set of 36 pairs for which each participant made choices. Participants received the total 4-year cost and 30-year expected return for each college within the 36 pairs.

We estimated individual discount rates with the three-option adaptive discount rate procedure (ToAD), borrowed from Yoon and Chapman (2016). ToAD 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 an individual's precise discount rate. We programmed ToAD to present participants with intertemporal choices with an average value of $10,000 and an average delay of 182 days.

Results and Discussion

First, we analyzed the correlation between individual discount rates elicited by the ToAD procedure and the average preference for LCLR colleges, quantified as the choice share of LCLR colleges. For example, a participant who chose 27 LCLR colleges out of the 36 college choice pairs would have an average LCLR preference of 75% (27/36). We found a significant positive correlation between participants' discount rates and their average LCLR preferences, $r = .35$, $p < .001$ (Figure 2, left).

Next, we examined preferences across the three $r_{threshold}$ levels using a repeated-measures ANOVA, comparing the choice share of LCLR colleges at each level within participants. Choices at each $r_{threshold}$ level were averaged, as described above, to yield an average LCLR preference for each participant (Figure 2, right). LCLR preferences were significantly affected by the $r_{threshold}$, $F(2,182) = 192.0$, $p < .001$, $\eta_p^2 = .68$.

Financially-impatient participants preferred LCLR colleges more than their less-impatient peers (Figure 2, left). Furthermore, replicating our findings from Study 1, participants were more likely to prefer LCLR colleges in the low $r_{threshold}$ choice pairs, and more likely to prefer HCHR colleges in the high $r_{threshold}$ choice pairs (Figure 2, right). These results support the tuition myopia hypothesis, suggesting that intertemporal tradeoffs explain the variation in college choices that were made based on financial information. The large effect size of $r_{threshold}$ on these preferences ($\eta_p^2 = .68$) suggests that temporal discounting and intertemporal tradeoffs have a substantial impact.

STUDY 3

In Study 3, we tested whether college preferences could be explained more parsimoniously by uncertainty regarding the colleges' projected financial returns. While the cost of attending each prospective college is certain, its future returns are not. Uncertainty in future outcomes can lead to a conservative estimation of projected returns when considering a college (Blanton et al. 2001), a phenomenon that would logically increase the preference for LCLR colleges. If students exhibit a pessimism bias toward future returns, meaning that they expect their own future returns to be lower than the projected average future returns (Alloy and Ahrens 1987; Blanton et al. 2001), then the perceived advantages of the HCHR colleges would decrease, increasing the relative preferences for LCLR colleges.

In Study 3, participants chose between LCLR and HCHR colleges after viewing the tuition and average lifetime income associated with each. Participants then estimated their future returns if they were to graduate from each college; specifically, they were asked how much they thought they would earn after graduation (i.e., estimated returns) and how likely they were to earn the average lifetime income as reported in the college financial information (i.e., likelihood estimate). If pessimism underlies the preference for LCLR colleges, then participants who chose the LCLR college should have reported lower estimated returns than participants who chose the HCHR college.

Method

Participants and exclusions. One hundred seventeen undergraduate business majors at a private university in New England (61 women, M_{age} = 19.6, SD = .92) participated for course credit. None were excluded from the analyses.

Procedure. Students first made a hypothetical choice between two colleges in a presentation format similar to Study 2. For each of the two colleges, students were provided with 4-year costs ($90,110 for the LCLR college and $230,100 for the HCHR college) and 30-year returns ($2,178,110 for the LCLR college and $2,966,000 for the HCHR college).

Next, students made two predictions (the order was randomized): the total lifetime income they would expect to earn if they were to attend each of the two colleges, and the likelihood that they would earn the projected 30-year return. For their estimated returns, students used a slider scale with endpoints of $0 and double the expected return (i.e., $4,356,220 and $5,932,000 for LCLR and HCHR, respectively). For their likelihood estimates, students used a slider scale marked at 0% (Definitely would earn less than the expected total return), 50% (Would earn the expected total return), and 100% (Definitely would earn more than the expected total return).

Results

We first examined whether students expressed pessimism in their estimated returns or likelihood estimates. Overall, students were optimistic about their estimated returns for both colleges (Figure 3, left). One-sample t-tests revealed that students' estimated returns for both the HCHR and LCLR college exceeded average lifetime incomes ($t(116) = 8.89$, $p < .001$ and $t(116) = 6.79$, $p < .001$, respectively). Students also predicted for both the HCHR and LCLR college

that they were more likely to exceed than fall short of the average lifetime income of graduates ($t(116) = 9.41$, $p < .001$ and $t(116) = 7.45$, $p < .001$, respectively).

We then conducted two paired sample t-tests, one for expected returns and another for likelihood estimates (Figure 3, right). First, students did believe that going to the HCHR college would yield more future income than going to the LCLR college (M_H = \$3,863,464, SD_H = 1,091,252, M_L = \$2,690,939, SD_L = 816,021, $t(116) = 15.36$, $p < .001$, $d = 1.42$). Second, students were marginally more optimistic in their likelihood estimate for the HCHR college than for the LCLR college ($M_H = 67.56\%$, $SD_H = 20.18$, $M_L = 64.28\%$, $SD_L = 20.72$, $t(116) = 1.97$, $p = .051$, $d = .18$).

Most important, we tested whether preferences for LCLR and HCHR colleges were predicted by the degree of optimism in expected returns or likelihood estimates. Approximately half of the students in the experiment (48.7%) preferred the LCLR college, suggesting that the analysis would not be constrained by a ceiling or floor effect. A logistic regression (Table 1) suggested that neither the expected returns nor the likelihood estimates predicted preferences for the HCHR versus LCLR option (all p's > .14).

Discussion

Preferences for LCLR relative to HCHR colleges did not appear to be driven by uncertainty nor pessimism regarding expected financial returns after graduation. Participants were optimistically biased in their expected returns and likelihood estimates. Moreover, neither expected returns nor likelihood estimates predicted the participants' choice of colleges. Both students who preferred the LCLR college and students who preferred the HCHR college believed they were likely to earn considerably more than the average lifetime income reported by each

college, in line with previous investigations exploring optimistic forecasts for the future (Kruger and Burrus 2004; Seaward and Kemp 2000; Weinstein 1980). In other words, this bias ran in the opposite direction of an uncertainty explanation.

STUDY 4

In Study 4, we tested whether college preferences could be explained more parsimoniously by return on investment (ROI), a financial metric that is utilized in many investment strategies. ROI is the ratio of the net return to the cost—so higher values reflect more efficient investments. By purchasing multiple financial assets with high ROIs, consumers can maximize their financial portfolio returns.

Likewise, ROI can be used to compare colleges. PayScale.com provides ROI estimates for colleges in its database (Annual College ROI Report). The annual report has received considerable media attention; high ROI colleges are often cited as the "best value" colleges (Lobosco 2014). However, colleges with high attendance costs tend to have a low ROI (see Appendix 4 for analysis), so students using ROI criteria may prefer less expensive colleges (namely, those in the LCLR category) to more expensive colleges (namely, those in the HCHR category). Thus, students with high financial literacy may paradoxically make college decisions that appear financially impatient, but that are actually savvy investment strategies to maximize their ROI.

Study 4 is designed to disentangle the ROI explanation from the tuition myopia hypothesis regarding preferences for LCLR colleges. We developed a task that tested both decision strategies simultaneously by holding the ROI constant within each choice pair while

varying $r_{threshold}$ within the same choice pair. This allowed us to distinguish whether the college preference is explained by the tuition myopia hypothesis or ROI maximization.

Method

Participants and exclusions. One hundred residents of the United States were recruited from Amazon Mechanical Turk (60 women; M_{age} = 31.26, SD = 9.15). Average self-reported household income was $47,239. Of the 100 participants, 9 had a postgraduate degree, 39 had a college degree, 45 had attended college but did not have a degree, 5 had a General Educational Development (GED) or high school diploma, and one participant reported no degree.

We included eight attention check questions (i.e., choice pairs with dominant options involving no tradeoff between costs and returns), which two participants failed (exclusion criteria: failing more than 25% of the attention check questions). One additional participant experienced a technical error during the experiment. These three participants were excluded from all subsequent analyses. There were no other exclusions.

Stimuli and procedure. Drawing from LCLR-HCHR choice pairs from the exploratory data analysis, we calculated the ROI difference (i.e., the difference between the ROI of an HCHR and an LCLR college) in addition to the $r_{threshold}$ for all LCLR-HCHR choice pairs. College pairs were selected from the 5th and 30th percentiles (± 5%) of each factor, yielding an average ROI difference of 6 and 45, respectively, and an $r_{threshold}$ of 4.8% and 17.2% APR, respectively. These low percentile ranks were selected because of the restricted parameter space in which pairs could satisfy the two factors in each of the four (2 x 2) cells. Participants were presented with ten college pairs for each combination of the two factors (2 × 2 full factorial design; two ROI levels and two $r_{threshold}$ levels). Each participant thus made choices for a total of

40 college pairs and 8 attention check pairs, in a random order. We provided aggregated financial information (the 4-year costs and 30-year returns for each college), as in Study 3.

Results and Discussion

College preferences were examined in a 2 (ROI difference: 6, 45) x 2 ($r_{threshold}$: 4.8% APR, 17.2% APR) repeated-measures ANOVA. The analysis revealed a significant effect of $r_{threshold}$, $F(1,96) = 85.98$, $p < .001$, $\eta_p^2 = .47$, but no main effect nor interaction of ROI, $F(1,96) = .35$, $p = .55$, and $F(1,96) = .87$, $p = .35$, respectively (Figure 4). Participants showed insensitivity to differences in ROI but sensitivity to $r_{threshold}$, providing further support for the tuition myopia hypothesis and robust evidence against the ROI strategy as an explanation for college preferences.

Whether or not ROI is an appropriate strategy by which to choose a college, our results suggest that most people do not employ this investment strategy when making college choices. It is possible that tuition myopia might have beneficial effects if it guides consumers to (unwittingly) choose high ROI colleges. We believe, however, that ROI may not be an ideal metric by which to evaluate colleges, because unlike typical investment products, a college degree is a unique investment opportunity that many people choose once in their lifetime. A student who chooses a high ROI college may achieve the "biggest bang for their higher-education buck," but may receive a low overall financial return because ROI measures the ratio between the net return and costs, not the total return. Because college is a non-fungible investment (i.e., education consumers cannot sell their diplomas to other consumers or purchase multiple diplomas to maximize their financial returns), and because financing is readily available in the form of student loans, it may make more sense to choose the college that maximizes one's lifetime income, even if it has a lower ROI than its alternatives.

STUDY 5

Study 5 tested our main hypothesis by examining whether individual discount rates are related to real college choices. We measured participants' individual discount rates, education attained, and specific college or university attended (if any). We categorized these colleges and universities as LCLR or HCHR, using a college group ranking (Appendix 5) based on their Carnegie Classification (2015 Edition), which was designed by the Indiana University Center for Postsecondary Research and categorizes degree-granting post-secondary colleges in the United States based on years of education provided (i.e., 2 or 4 years), the proportion of full-time to part-time students, transfer-in rates, and admission test scores (SAT and ACT). We predicted that participants with lower temporal discount rates would be more likely to achieve a higher level of education and, if they attended a college, would be more likely to have attended a HCHR college than a LCLR college, relative to participants with higher discount rates.

Method and Design

Participants and exclusions. We recruited 600 United States residents from Amazon Mechanical Turk (267 women; M_{age} = 36.14, SD = 12.26, see Table 2 for the participant breakdown). Average self-reported individual 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 and zero discounting).[2] For the remaining 595 participants, education attainment was as follows: four participants did not have a high school degree, 81 had

[2] The current study assumes a positive time preference (monotonicity) in Discounted Utility Theory (Koopmans 1960). This preference means that, for example, having $100 now is more valuable than having $100 in one year. By contrast, zero discounting means that having $100 now is equivalent to having $100 in one year, and negative discounting means that having $100 now is inferior to having $100 in one year. The four participants who deviated from the positive time preference assumption were excluded.

a high-school diploma, 188 started but did not finish college, 261 had a college degree, and 61 had a graduate degree (Table 2, left column).

Procedure. As a measure of individual discount rates, participants first completed the ToAD procedure (Yoon and Chapman 2016), as in Study 2. Then, participants provided their demographic information, including their education background. Participants who attended a college reported their alma mater.

After the experiment, we matched the reported 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 (323 unique colleges) in both IPEDS and the Carnegie Classification. We could not retrieve this information for the 47 participants who attended colleges outside the United States or submitted inaccurate college names, nor for three participants who attended colleges omitted from the Carnegie Classification. These participants were included in the education attainment analysis but were excluded from the college choice analysis.

We used the Carnegie Classification at the undergraduate level to categorize colleges as LCLR or HCHR. Using this classification, we rank-ordered colleges from two-year colleges to four-year, full-time, more selective, and lower transfer-in colleges. In other words, the lowest end of the rankings featured the epitome of LCLR colleges, and vice versa. We then created 5 ranks of participants, using their college ranks to divide the participants into 5 groups of roughly equal size (Appendix 5).

[a]One participant experienced a technical error. Four participants demonstrated zero discounting or negative discounting. [b]College names for 47 participants were not identifiable in IPEDS. Three colleges were identified in IPEDS but were not classified in the Carnegie Classification of Institutions of Higher Education, so they were removed from analyses.

Results and Discussion

Education level and elicited discount rates. First, we examined the relationship between education and individual discount rates for participants who had attained a high school degree or higher (n = 591). Respondents who did not have a high school degree were excluded due to small sample size (n = 4). We found that participants who had attained higher levels of education demonstrated lower discount rates (β = -.15, t(589) = -3.79, $p < .001$). As a validity check, respondents who had attained higher levels of education also reported earning more income (β = .35, t(589) = 8.96, $p < .001$). There was no significant correlation between age and individual discount rates (r = -.05, p = .16).

Validation of ranks. Second, we validated our rankings from the Carnegie Classification by examining the relationship between the attendance cost and salary (specifically, the annual salary ten years after enrollment) as reported in the College Scorecard database. Linear regression analysis showed that both the net attendance cost and the tenth-year salary were positively related to our rank order (β = .67, t(457) = 19.10, $p < .001$ and β = .74, t(454) = 23.72, $p < .001$, respectively),[3] confirming that higher-ranked colleges were more expensive to attend but yielded higher income after graduation, relative to lower-ranked colleges.

[3] Some colleges did not report the net attendance costs, tenth-year salary, or three-year loan default rates. Differences in the degrees of freedom were caused by these missing college reports.

College choice and elicited discount rates. Most important, we used the rank order to examine the relationship between the type of college attended and elicited discount rates (n = 460). Illustrated by Figure 5, the college rank order was negatively related to individual discount rates (β = -.19, t(458) = -4.07, $p < .001$). Respondents with higher discount rates were more likely to attend lower-ranked (i.e., LCLR) colleges, whereas respondents with lower discount rates were more likely to attend higher-ranked (i.e., HCHR) colleges.

The results demonstrate a relationship between individual discount rates and real higher education choices. Participants with higher discount rates were more likely to have attended LCLR colleges, while participants with lower discount rates were more likely to have attended HCHR colleges. In addition, we found a positive relationship between individual discount rates and education attained, replicating previous findings (Lawrance 1991; Mischel et al. 2011; Reimers et al. 2009); participants with lower discount rates were more likely to have attended college and attained post-graduate education, relative to participants with higher discount rates.

Together with the lab experiments in Studies 1–5, the current findings based on real college choices provide converging evidence for the tuition myopia hypothesis. However, it is important to note several limitations given this study's cross-sectional design. We measured participant discount rates an average of 18 years after participants had made decisions regarding their higher education. Although we did not find a correlation between age and individual discount rate, it is possible that participants' education history and career choices influenced their discount rates. In addition, unlike in our lab experiments, we did not collect the options among which participants chose when deciding on their higher education. Thus, we do not have a full picture of their preferences for HCHR or LCLR colleges.

STUDY 6

Study 6 tested an alternative presentation of the student loan information. Our hypothesis assumes that the psychological realization of costs before actual payment is due leads to intertemporal tradeoffs in college decisions. Typically, college financial information is displayed such that attendance costs and long-term returns appear side-by-side, and this presentation may facilitate early psychological realization of costs by framing college choices as intertemporal tradeoffs (i.e., invest now and get returns later). Moreover, even if consumers recognize that they do not have to pay the costs until graduation, the lack of exact repayment amounts may prevent them from making cost and benefit comparisons for future time periods.

In Study 6, we mitigated early psychological realization of costs by providing annual loan repayment estimates—rather than the tuition cost for each year of college or the total cost of attendance—adjacent to annual salary information. This presentation was designed to reduce the perception of the choice as an intertemporal tradeoff because, after graduation, students simultaneously begin to repay loans and earn a salary from employment. We predicted that presenting both cost and benefit information as realized within the same time period (after graduation) would reduce early psychological realization of costs and ease the difficulties of comparing financial outcomes of HCHR and LCLR colleges. By shifting the focus to the future time frame, this alternative cost format should make HCHR colleges more attractive because these colleges provide better financial benefits in the future.

Method

Participants and exclusions. Two hundred residents of the United States were recruited from Amazon Mechanical Turk (77 women; $M_{age} = 36.20$, SD = 10.37). We included eight attention check questions as we did in the previous studies; 26 participants failed the attention check and were excluded from the analyses. The following analysis was conducted with the remaining 174 participants.

Stimuli and procedure. The study employed a 2 (cost information: annual cost vs. annual loan repayment; between-participants) × 3 ($r_{threshold}$: 11.8%, 21.1%, and 37.8% APR; within-participants) design. The stimuli for the annual cost condition were identical to the financial information provided in the general loan description condition in Study 1; specifically, the condition provided the annual cost of attendance for each of the four years, and expected salary after graduation (Appendix 3, Figure W9). The annual loan repayment condition was similar, but provided annual loan repayments after graduation instead of the annual cost of attendance (Appendix 3, Figure W10). The annual loan repayments were calculated using a 20-year fixed monthly payment plan with 3.76% APR. For all college choice pairs, HCHR colleges always provided higher net income than LCLR colleges (see Appendix 2 for detailed calculations under various loan parameters such as loan interest rates and repayment durations).

Results and Discussion

For each participant, we calculated the choice share of LCLR colleges at each of the three $r_{thresholds}$ levels, as we did in the previous studies (Figure 6). We analyzed the participants' choices in a 2×3 mixed ANOVA, which revealed a main effect of cost information ($F(1,172) = 6.57$, $p = .011$, $\eta_p^2 = .04$), indicating that the participants' preference for LCLR colleges decreased (that is, their preference for HCHR colleges increased) when presented with the annual loan repayments as opposed to the annual cost of attendance. We also find an interaction

between $r_{threshold}$ and cost information ($F(2,344) = 9.80$, $p < .001$, $\eta_p^2 = .05$), suggesting that the decreased preference for LCLR colleges is more pronounced with a lower $r_{threshold}$ for the choice pairs. The current study suggests that providing information about future costs and future returns, instead of proximal costs and future returns, can decrease preferences for LCLR colleges and increase preferences for HCHR colleges.

In addition, we found a main effect of $r_{threshold}$ ($F(2,344) = 211.82$, $p < .001$, $\eta_p^2 = .55$), replicating the findings in Study 1, Study 2, and Study 4. Again, the choice share of LCLR colleges was higher when the $r_{threshold}$ level for choice pairs was low. Respondents faced an intertemporal tradeoff when the costs and benefits of colleges were presented in terms of their impact on income streams over time ($\eta_p^2 = .55$). We found the same results in the previous studies with large effect sizes (Study 1, $\eta_p^2 = .59$; Study 2, $\eta_p^2 = .68$; Study 4, $\eta_p^2 = .47$).

DISCUSSION

The second quarter of 2010 was an alarming time for American consumers—for the first time in history, student debts surpassed auto loans and credit card loans to become the second-largest source of consumer debt in the United States. The government, nonprofit, and for-profit agencies have started to provide college financial information for concerned students and parents. Despite the accessibility of this information, however, there is little evidence about the potential impacts of college financial information on choices between different colleges. Our research explores how education consumers respond to common types of this information, focusing on the effects of proximal costs and future returns when presented with varying degrees of salience.

The current study suggests that college financial information can convey an intertemporal tradeoff. Financially-impatient people tend to prefer less expensive colleges even when long-term financial returns are smaller than the returns from expensive colleges, because people who use temporal discounting weigh proximal outcomes (negative income streams during school years) more than distal outcomes (positive income streams after graduation). Thus, financially-impatient people who focus on proximal outcomes are more likely to prefer LCLR colleges over HCHR colleges. We found that this preference could not be explained by the uncertainty of future financial returns nor by an ROI strategy. Student loans that were designed to alleviate the pain of immediate payments did not fully eliminate the psychological pain of paying. Our findings suggest that intertemporal tradeoffs and temporal discounting may lead education consumers to choose LCLR colleges, thus failing to maximize their lifetime earnings.

The current findings provide converging evidence about the important role of temporal discounting in college choices. Extant literature suggests a relationship between temporal discounting and decisions about whether to pursue higher education at all (Lawrance 1991; Mischel et al. 2011; Reimers et al. 2009). We extended these findings to the current educational climate, in which most high school graduates choose to pursue higher education and make choices between different colleges. In addition, the current study addressed some of the concerns about the previous literature—namely, the lack of explicit intertemporal tradeoffs in college choices, and the reliance on temporal discounting as a surrogate variable that predicts other factors, such as students' non-disruptive behavior or self-discipline (Bartels and Urminsky 2015; Rick and Loewenstein 2008; Urminsky and Zauberman 2015). We did not rule out these factors, but we clarified the role of explicit intertemporal tradeoffs in college choices using the tuition myopia hypothesis. Given the large effect sizes of the intertemporal tradeoffs in our studies (η_p^2

> .47), along with the replication of the previous literature in Study 5, we offer a robust challenge to the skepticism about the connection between temporal discounting and education.

In addition, the current study introduces a new approach to test intertemporal tradeoffs in investment contexts using $r_{threshold}$. Typically, the test for intertemporal tradeoffs is bounded by a binary choice between a smaller, sooner outcome and a larger, later outcome; researchers identify whether a participant prefers a sooner or a later outcome. However, this binary choice between now and later is not applicable for investment options that involve concurrent sooner and later outcomes, such as a financial investment option that entails both proximal payments and distal returns. The current study uses $r_{threshold}$ to quantify the extent to which a person wants to allocate their wealth to proximal investments versus future returns, and subsequently to make inferences about their degree of intertemporal tradeoffs. This new experimental paradigm is useful for investigating intertemporal tradeoffs involving financial investments, retirement savings, or home mortgage decisions that involve both proximal investments and future financial returns.

Policy Implications

It is laudable that the government, nonprofit, and for-profit agencies have provided college financial information to the general public, but these agencies also need to educate prospective students about how to use this financial information when making college choices. We strongly recommend choosing HCHR colleges even if one has to use loans to pay the bills. Lifetime gains after graduating from HCHR colleges exceed lifetime gains after graduating from LCLR colleges even when considering a higher cost of attendance and larger loan repayments (Appendix 2). It is important to note that HCHR colleges are not limited to top Ivy League schools—everyone can choose an HCHR college among his or her college options because we

define HCHR and LCLR colleges as options on a relative scale; the same college could be defined as HCHR or LCLR depending on the consideration set. For example, Rutgers University—New Brunswick (average annual cost: $20,166; salary after attending: $57,900) would be an LCLR option when compared with Boston University (average annual cost: $34,914; salary after attending: $65,300), but would be an HCHR option when compared with University at Buffalo (average annual cost: $17,163; salary after attending: $52,600). Our findings apply to a wide range of choices for higher education.

It is important to note that we are agnostic about whether or not preferences for LCLR colleges are unjustified. LCLR colleges may be beneficial for someone who finds a greater consumer debt to be more emotionally burdensome than a larger future income is emotionally appealing. An LCLR college may also be justified if someone wants to maximize the return on investment in higher education and has the capital to invest in more profitable products than higher education. Or, it would be wise to choose an LCLR college if low interest rate student loans are not available. Admittedly, it is counterintuitive to recommend expensive HCHR colleges, especially when student loans have become such a large burden for many Americans. However, it is equally important to understand the downside of underinvestment in human capital, which can lead to larger financial disadvantages in the future. College education is a one-time opportunity. Focusing on total lifetime income, rather than investment efficiency, may make more sense. We also find that graduates from LCLR colleges are more likely to default on their student loans (Appendix 6), implying that having smaller student debt may not necessarily ensure financial security in the future.

APPENDIX 1. COLLEGE CHOICES IN A PAIRWISE COMPARISON

		College A			
	Relative Size of Cost & Return[1]	HCHR	LCHR	HCLR	LCLR
College B	HCHR	-	-	-	Category 2
	LCHR	-	-	Category 1	-
	HCLR	-	Category 1	-	-
	LCLR	Category 2	-	-	-

[1] The first and second characters indicate the cost relative to the paired school (HC = high cost; LC = low cost), and the third and fourth characters indicate the return relative to the paired school (HR = high return; LR = low return). For example, LCHR indicates a college that is low-cost and high-return compared with the alternative.

APPENDIX 2. COLLEGE CHOICE WITHOUT EARLY REALIZATION OF COSTS

Our main hypothesis assumes the psychological realization of costs before the actual payment is due, even when student loans are available. In this section, we examined how college choices would be different in the absence of early realization of costs. For simplicity, let us assume that the loan interest rate (i) and repayment periods (y_3) are identical for both college options, and the student pays all expenses using student loans; A represents annual loan repayments.[4] Notations for other symbols are identical to the college choice model (a) in the main text (C: annual attending costs, S: expected annual salary after graduation, g: annual salary growth, y_1: years spent in college, y_2: years of employment after graduation, r: individual discount rate). The present value of each college option with student loans is denoted as follows:

W1.

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

Simply put, the present value of each college option is the sum of positive and negative income streams during the loan repayment periods (in which loan repayments reduce the net income), and of positive income streams after the loan has been paid in full. By definition, the net income after paying off student loans will be larger for HCHR colleges than LCLR colleges. During the loan payment period, however, the net income varies with the loan repayment amount (A), which

[4] The annual loan repayment (A) is calculated assuming equal loan payments:

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

where i represents the loan interest rate.

is affected by various factors (e.g., salary and income growth rates), but most notably by the specific loan terms (interest rates and repayment periods). The net income during the loan payment period will be lower for individuals who have loans with high interest rates and short repayment periods, and higher for individuals who have loans with low interest rates and longer repayment periods.

We conducted a calculation to examine how student loans change normative prescriptions for the value of HCHR and LCLR colleges. College choices with student loans without early psychological realization of costs are predicted by formula W1, which yields different results depending on specific assumptions regarding the loan (i.e., loan repayment periods, loan interest rates, annual income growth, and in-state or out-of-state tuition). We tested various parameter combinations using publicly available college financial information.

Method

We examined the choice between HCHR and LCLR colleges (83,250 choice pairs) using information from the College Scorecard database about postgraduate salary and annual cost of attendance (including tuition, books, supplies, and living expenses, minus financial aid). To begin, we assumed 4-year college education and 30-year employment. Next, we tested three loan repayment periods (10-, 20-, and 30-year repayments after graduation), two loan interest rates (3.76% APR, the lowest government subsidized student loan interest rate available from July 2016 to June 2017, and 11.85% APR, the highest fixed interest rate from Sallie Mae during the same time), and two income growth levels (3% and 0.4% annual growth rates). In addition, we examined out-of-state tuition with zero financial aid for a more conservative test.

We used formula W1 to compute the normative choices between HCHR and LCLR colleges. For each choice pair and parameter combination (e.g., a specific loan interest rate and repayment period), we identified $r_{threshold}$ values by numerically solving formula W1. A choice pair with an identified $r_{threshold}$ value was categorized as an intertemporal tradeoff pair, meaning that people would face intertemporal tradeoffs with this choice pair even with the student loan options. If we could not identify an $r_{threshold}$ value, meaning that there was a dominant option, then we compared the present value of both options and categorized the choice pair as HCHR Dominant (i.e., the present value was always larger for the HCHR college than for the LCLR college, regardless of temporal discounting) or LCLR Dominant (i.e., the present value was always larger for the LCLR college than for the HCHR college, regardless of temporal discounting).

Results

Across all conditions, our calculations demonstrated that HCHR colleges dominate the college choices in most cases when student loans are available (Figures W2–W4, upper panels). When the student loan interest rate was low (i.e., 3.76% APR) and the loan repayment period was sufficiently long (i.e., 30 years), HCHR colleges were the dominant option in most cases (> 93%) regardless of the annual income growth rate or financial aid (Figures W2–W4, far right). Even when the loan interest rate was high (i.e., 11.85% APR) and the loan repayment period was short (i.e., 10 years), HCHR colleges were dominant in the majority of the cases (> 69%). This was true even when there was no financial aid (> 62%, Figures W2–W4, far left).

FIGURE W2.

DOMINANT CHOICE BETWEEN HCHR AND LCLR COLLEGES WITH STUDENT LOANS (3% ANNUAL INCOME GROWTH RATE)

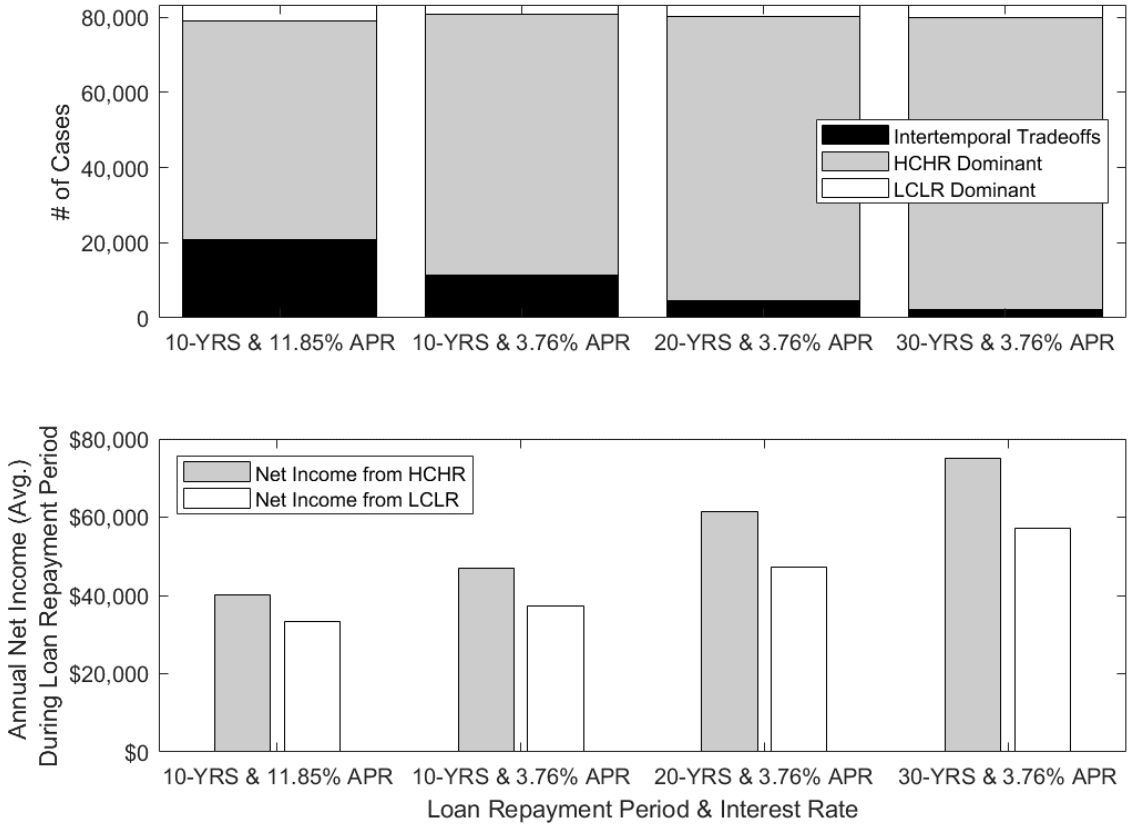


FIGURE W3.

DOMINANT CHOICE BETWEEN HCHR AND LCLR COLLEGES WITH STUDENT LOANS (0.4% ANNUAL INCOME GROWTH RATE)

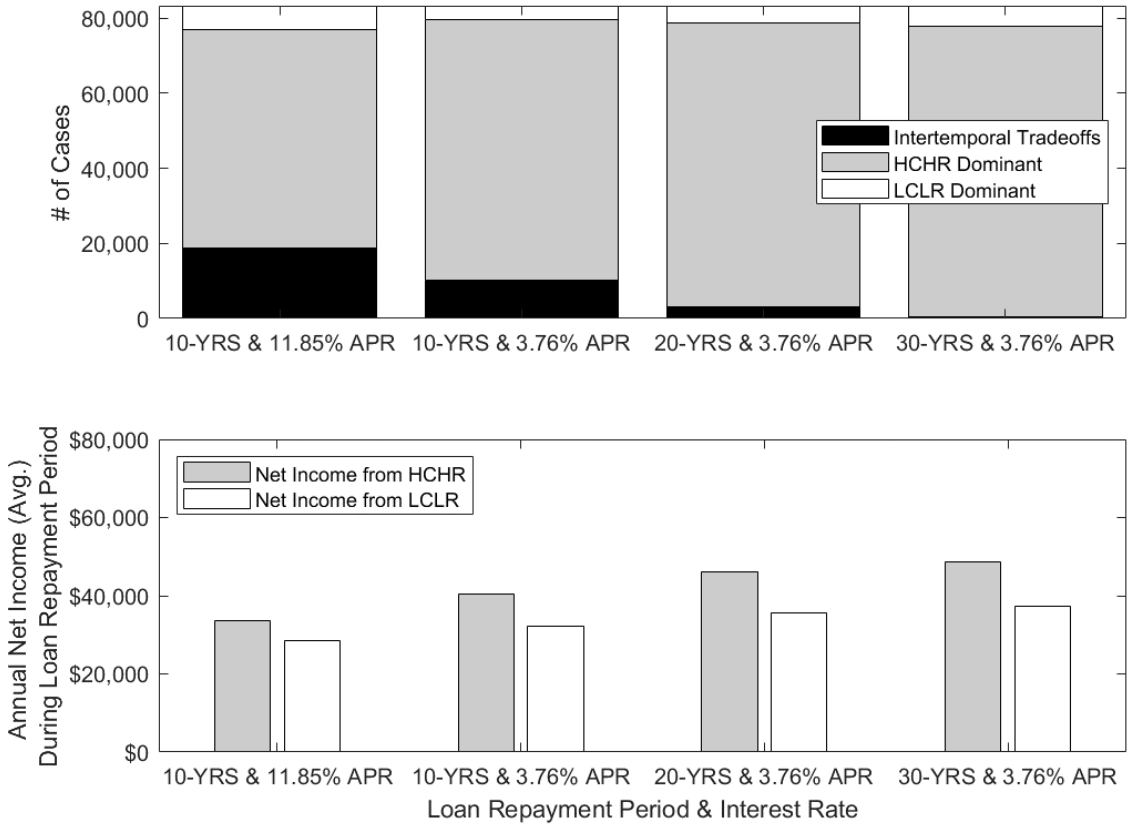
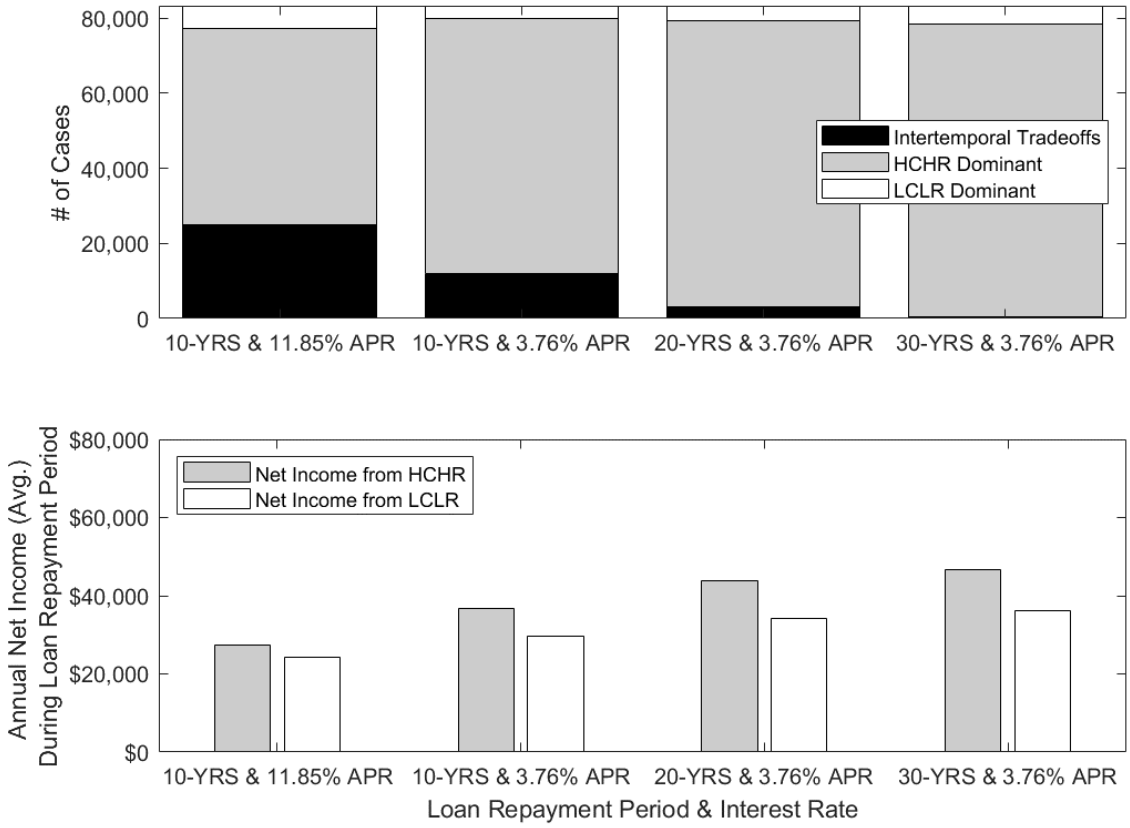


FIGURE W4.

DOMINANT CHOICE BETWEEN HCHR AND LCLR COLLEGES WITH STUDENT LOANS (OUT-OF-STATE TUITION WITH NO FINANCIAL AIDS AND 0.4% ANNUAL INCOME GROWTH RATE)



Intertemporal tradeoffs occur only in a small portion of the college choice pairs when student loans are available. When loans are available, HCHR colleges offer greater present value than LCLR colleges in the majority of college choice pairs (Figures W2–W4, bottom panel) because net income before and after the loan repayment is greater for HCHR colleges than for LCLR colleges.

Conclusion

This calculation illustrates that student loans change the financial costs and returns of a college education, but under both favorable and unfavorable loan terms, HCHR colleges are financially superior to LCLR colleges in the majority of cases. When they are not, the financially-superior option is determined by the individual student's discount rate.

APPENDIX 3. EXAMPLES OF STUDY 1 AND STUDY 6 STIMULI

FIGURE W5.

STUDY 1: INFORMATION RICHNESS (COLLEGE SCORECARD) & 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?

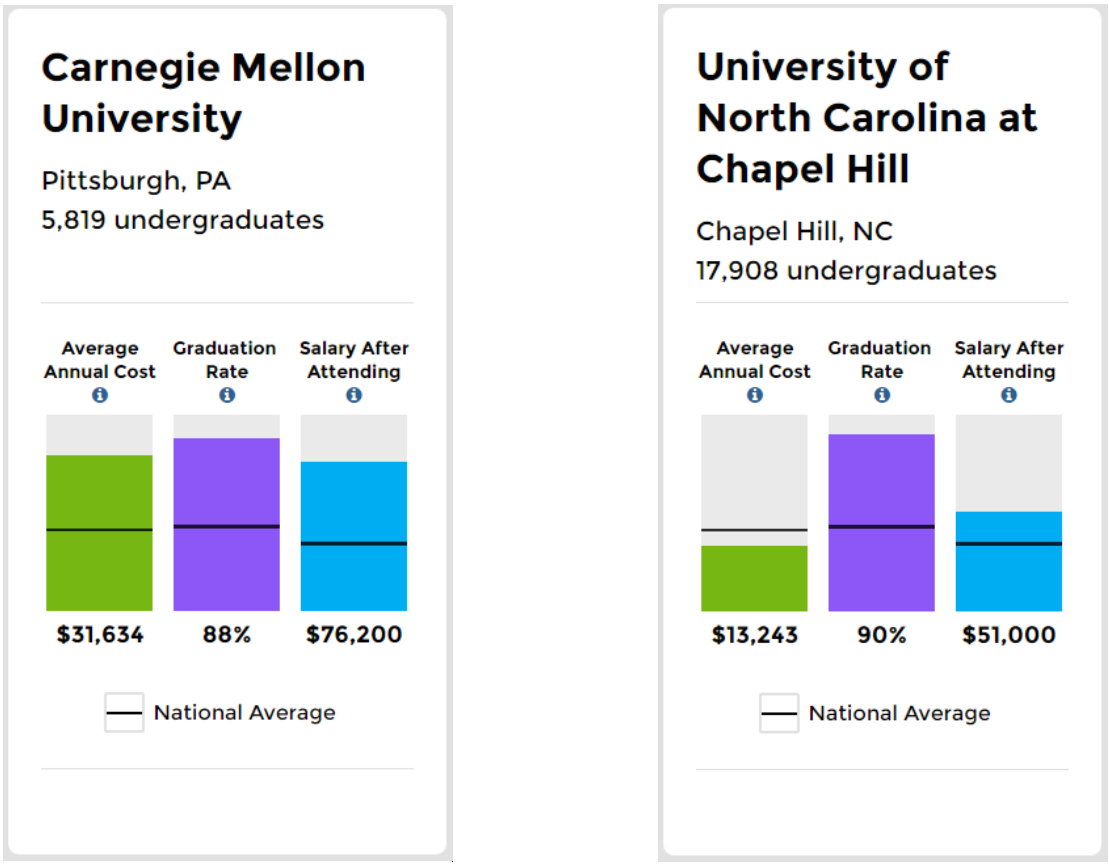
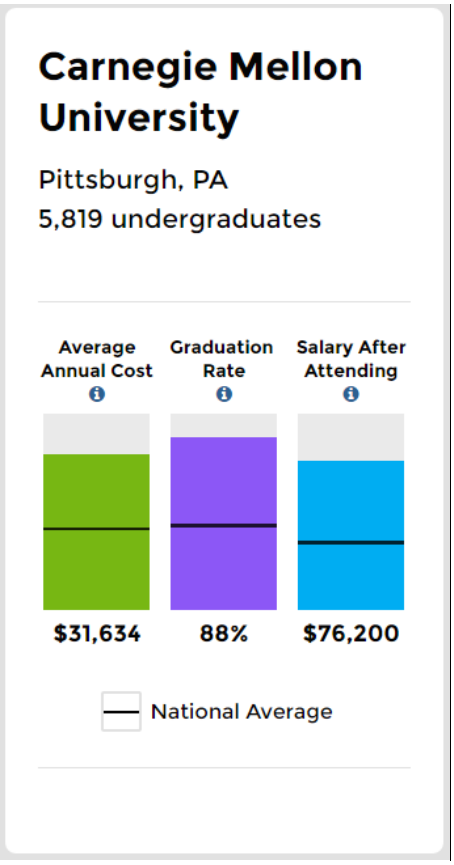


FIGURE W6.

STUDY 1: INFORMATION RICHNESS (COLLEGE SCORECARD) & 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?



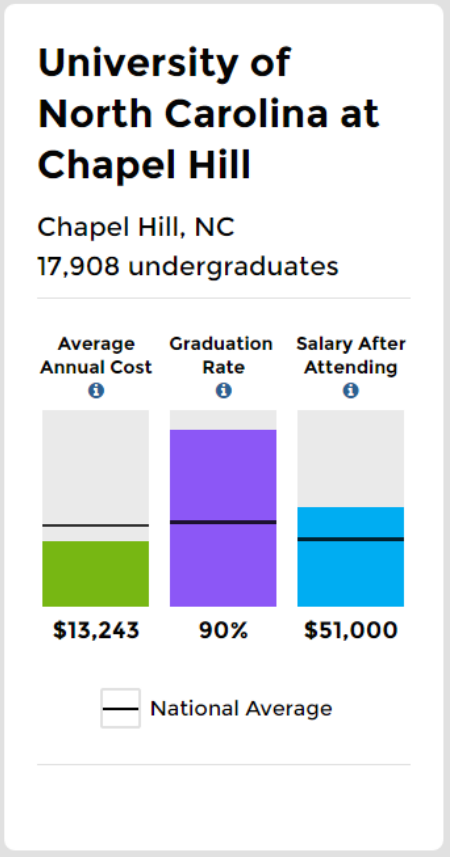


FIGURE W7.

STUDY 1: INFORMATION RICHNESS (FINANCIAL INFORMATION) & 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 W8.

STUDY 1: INFORMATION RICHNESS (FINANCIAL INFORMATION) & 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

FIGURE W9.

STUDY 6: ANNUAL COST CONDITION

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 392033	School 298252
Annual Salary After Attending	$ 98,867	$ 72,604
Average Annual Cost	$ 57,525	$ 22,528

FIGURE W10.

STUDY 6: ANNUAL LOAN REPAYMENT CONDITION

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?

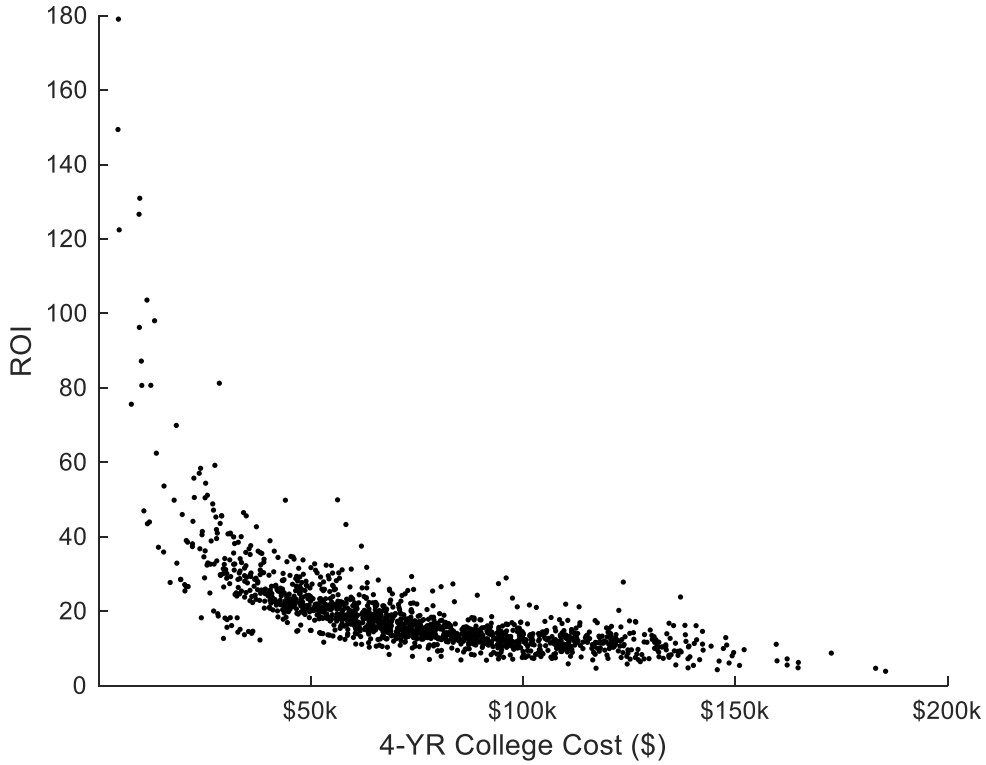
	School 392033	School 298252
Annual Salary After Attending	$ 98,867	$ 72,604
Annual Student Loan Repayment After Attending (20 Years)	$ 14,966	$ 5,861

APPENDIX 4. RETURN ON INVESTMENT

The ROI of each college is based on a 30-year income and 4-year college attendance costs. (Source: College Scoreboard, N = 1461 higher education institutions in the United States that have more than 1000 students enrolled, provide 4 years of higher education, and report 4-year costs and average income for the tenth year after graduation).

FIGURE W11.

ROI AND COST OF 4-YEAR COLLEGE



APPENDIX 5. COLLEGE GROUP RANKING

Carnegie Classification (N = Participants in each classification)	Group Ranking
Two-year, higher part-time (N = 54) Two-year, mixed part/full-time (N = 26) Two-year, medium full-time (N = 2) Two-year, higher full-time (N = 2)	Group 1 (N = 84)
Four-year, higher part-time (N = 21) 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)	Group 2 (N = 81)
Four-year, full-time, inclusive, higher transfer-in (N = 21) 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)	Group 3 (N = 104)
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)

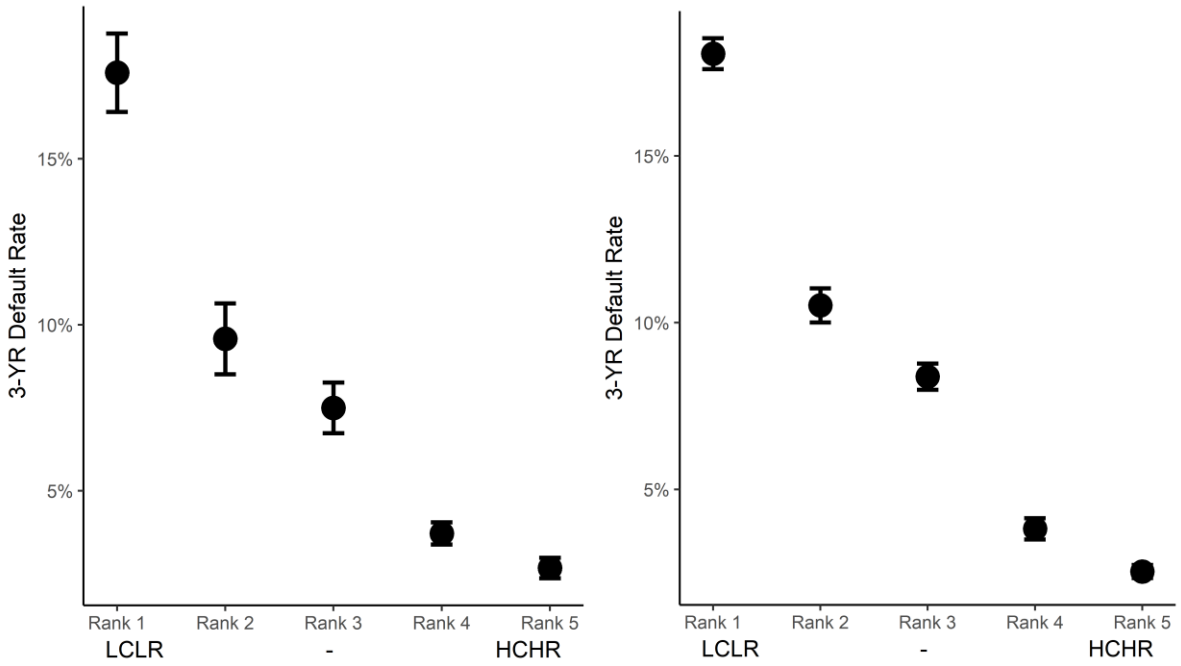
Note. Detailed criteria for each classification are available online (below). See Undergraduate Profile Classification and Undergraduate Student Profile Methodology in the Carnegie Classification (http://carnegieclassifications.iu.edu/classification_descriptions/undergraduate_profile.php).

APPENDIX 6. STUDENT LOAN DEFAULT RATES IN THE LAST THREE YEARS

In Study 6, we found that the student loan default rates in the last three years, as reported by the colleges, were higher for the lower-ranking colleges than the higher-ranking colleges (β = -.77, t(452) = -25.91, $p < .001$). We found this negative relationship between the student loan default rates and the college rankings not only in our samples in Study 6, but also across a wide range of colleges. Figure W12 demonstrates further analysis using 2,224 colleges in the College Scorecard database (inclusion criteria: currently operating, provide 2-year or 4-year degrees, report the loan default rates, and have enrollment of over 1,000 students). This also demonstrated a strong negative relationship between the college rank order and three-year student loan default rates (β = -.69, t(2222) = -45.38, $p < .001$).

FIGURE W12.

THREE-YEAR STUDENT LOAN DEFAULT RATES



Three-year student loan default rates are shown for the colleges attended by participants in Study 5 (left) and for the colleges in the College Scorecard database, stratified by ranking (right); error bars: 95% CI.

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FIGURE 1.

STUDY 1. PREFERENCES FOR LCLR COLLEGES ACROSS DIFFERENT STIMULI, LOAN DESCRIPTIONS, AND $R_{THRESHOLD}$ (ERROR BARS: 95% CI)

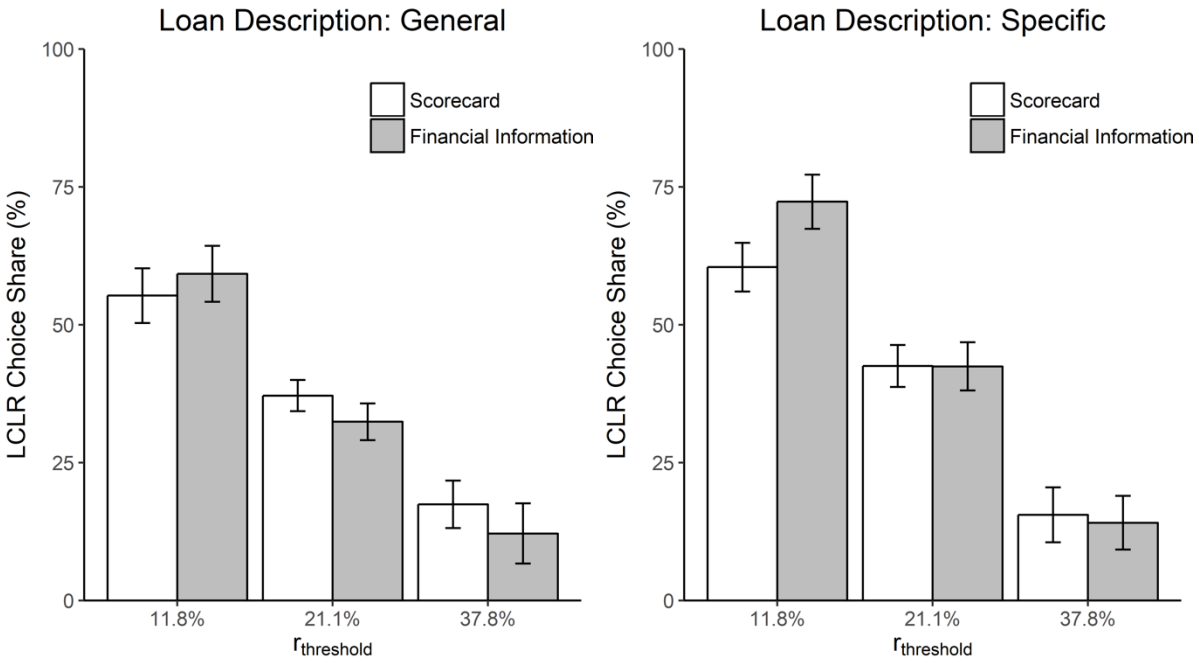

FIGURE 2.

STUDY 2: CHOICE SHARE OF LCLR COLLEGES BY INDIVIDUAL DISCOUNT RATES (LEFT) AND $R_{THRESHOLD}$ (RIGHT) (BARS AND BAND INDICATE 95% CI)

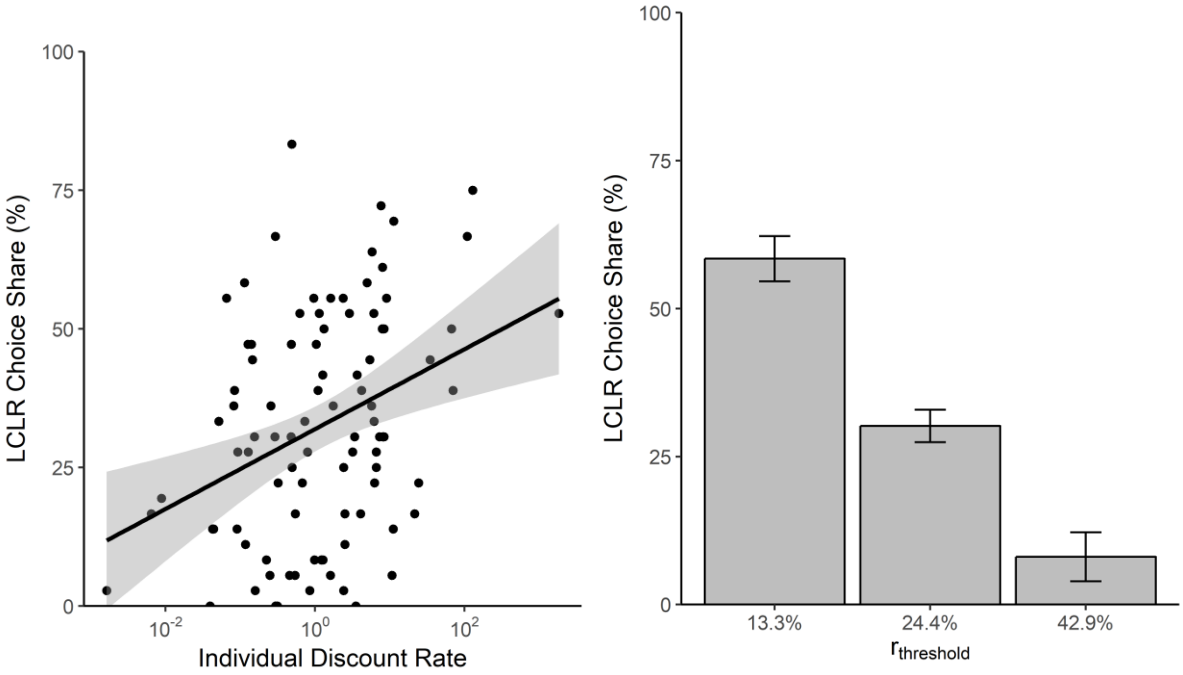

FIGURE 3.

STUDY 3: INCOME PROJECTIONS BY TYPE OF COLLEGE

(ERROR BARS: 95% CI)

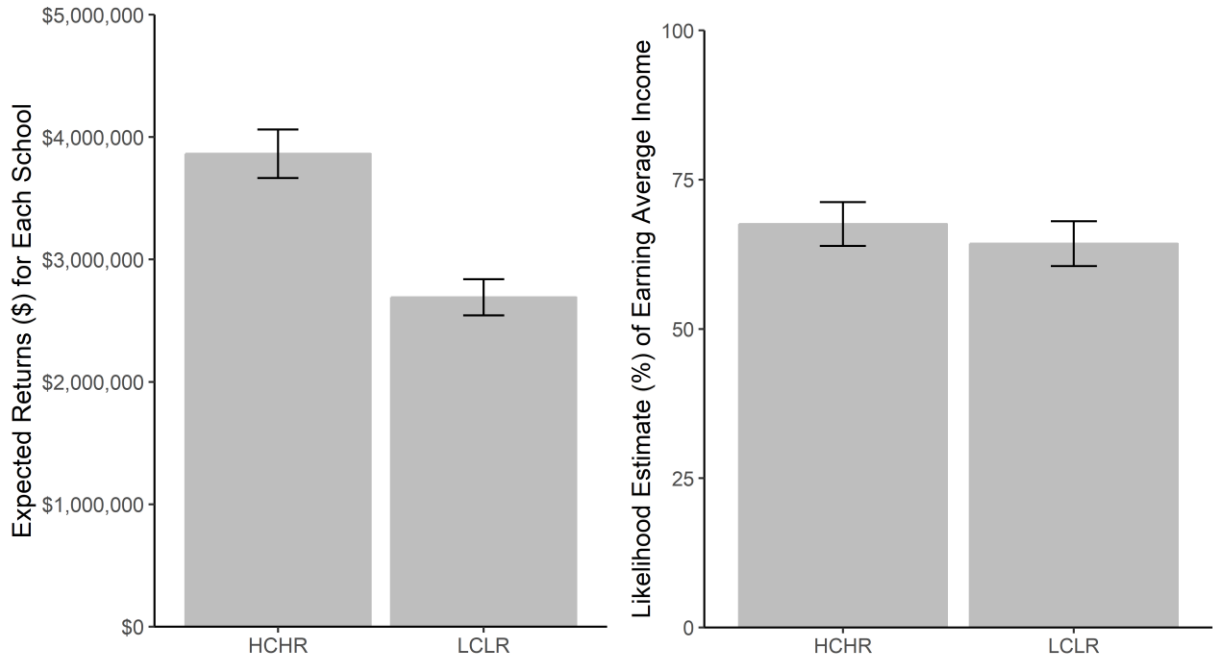

FIGURE 4.

STUDY 4: CHOICE SHARE OF LCLR COLLEGES BY DIFFERENCES IN ROI AND $r_{threshold}$ (ERROR BARS: 95% CI)

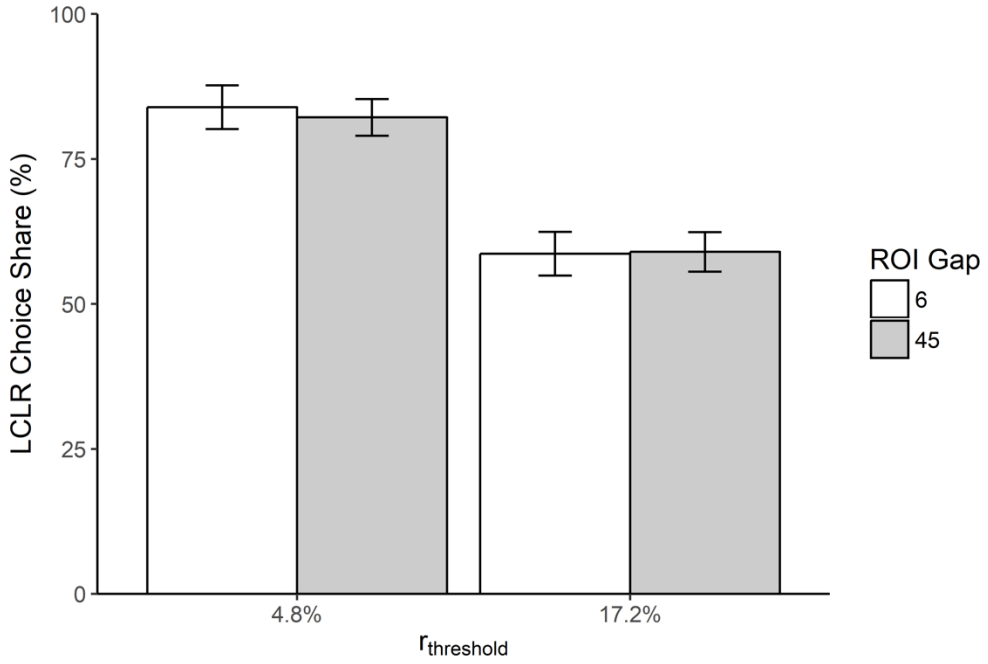

FIGURE 5.

STUDY 5. INDIVIDUAL DISCOUNT RATES BY COLLEGE ATTENDED

(ERROR BARS: 95% CI)

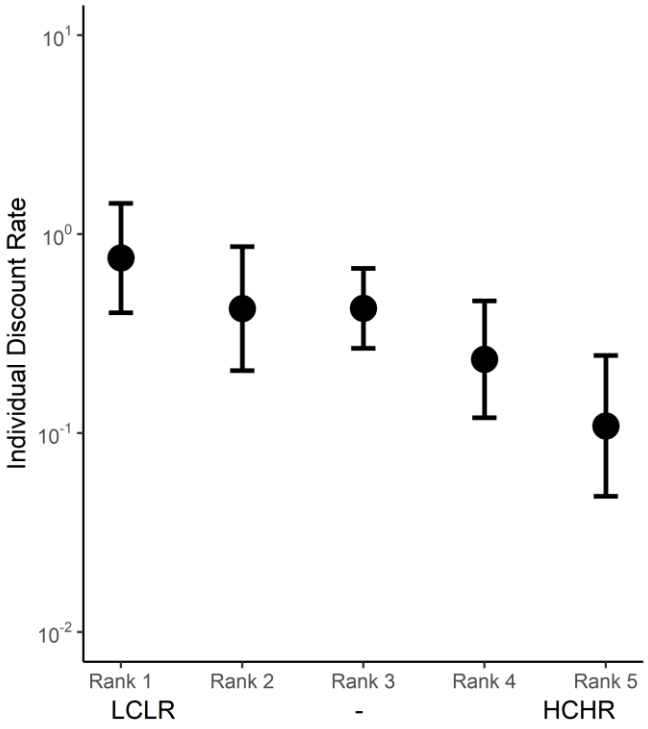

FIGURE 6.

STUDY 6. PREFERENCES FOR LCLR COLLEGES ACROSS DIFFERENT COST CONDITIONS AND $R_{THRESHOLD}$ (ERROR BARS: 95% CI)

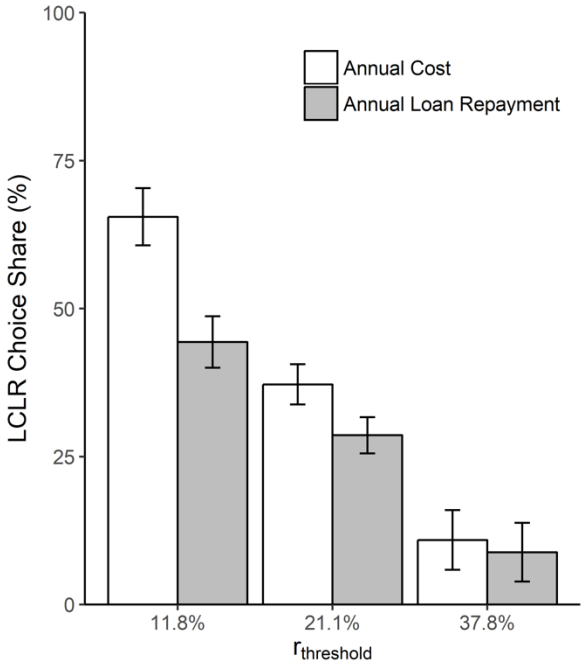

TABLE 1.

STUDY 3: PREFERENCES FOR THE LCLR COLLEGE BY EXPECTED RETURNS AND LIKELIHOOD ESTIMATES

Variables		β	SE	χ^2	Odd Ratio	*p*
Likelihood Estimate	HCHR	-.026	.020	1.767	.974	.184
	LCLR	.000	.000	.023	1.000	.881
Expected Returns	HCHR	.030	.021	2.090	1.030	.148
	LCLR	.000	.000	.447	1.000	.504

TABLE 2.

STUDY 5: EDUCATION

	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]