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Intended college attendance: Evidence from an experiment on college returns and costs[☆]

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ABSTRACT

We conduct an information experiment about college returns and costs embedded within a representative survey of US household heads. Baseline perceptions of college costs and benefits are substantially biased, with larger biases among lower-income and non-college households. Respondents are randomly exposed to objective information about average college "returns" or costs. We find a significant impact of the "returns" experiment, persisting in a follow-up survey two months later: intended college attendance expectations increase by about 0.2 of the standard deviation in the baseline likelihood, and gaps by household income or parents' education decline by 20–30%. We find no impact of the cost information treatment. Further analysis supports the information's salience, as opposed to information-based updating, as the main channel through which the returns intervention impacts intentions.

1. Introduction

College enrollment rates, defined as the percent of high school graduates who have enrolled in a two- or four-year college, have hovered between 60 and 70% in the United States over the last two decades (National Center for Education Statistics (NCES), 2013). Over the same time period, the average degree attainment rate in the US has been about 35%; that is, only about a third of young adults have gone on to complete a four-year college degree (OECD, 2013). Strikingly, these trends are not driven by a low or declining college premium; in fact, the college premium appears to have been quite large and unchanged throughout the period (Oreopoulos and Petronijevic, 2013). Another notable and rather alarming fact is the large and persistent gap in college enrollment by both income and parental education (Bailey and Dynarski, 2011).[1] Problematically, straightforward cost-benefit analysis would imply that these gaps should go in the opposite direction: college returns have been shown to be magnified for non-college households (Card, 1995), and government subsidies and private financial aid tend to make college costs lower for low-income households (Dynarski and Scott-Clayton, 2013).

In this paper, we focus on biased information about college costs and benefits as a possible explanation for these gaps in enrollment.[2] Households (especially disadvantaged households) may have incomplete and biased information leading them to underestimate the benefits and overestimate the costs of college, which could lead them to make suboptimal decisions. There are several reasons to believe that the

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[1] Our analysis of the Current Population Survey shows a 24–30 percentage point gap in immediate post-secondary enrollment by household income and by parents' educational attainment between 2013 and 2015, which is somewhat larger than those gaps' 15-year average. In 2013–2015, 68.4% of high school graduates from households with earnings over $50,000 immediately enrolled full-time in (a 2- or 4-year) college, compared to only 42.7% of high school graduates from lower-earning households. Likewise, high school graduates whose household-head parent held a bachelor's degree had a 79.4% college enrollment rate, whereas high school graduates whose parent had no more than a high school degree had a 50.5% enrollment rate.

[2] There are certainly other possible explanations for these patterns. Rising college costs may have made more American households—in particular, lower-income and less-educated households—face severe credit constraints (Lochner and Monge-Naranjo, 2012), which might then leave them unable to invest in further education in the short-term despite the long-term benefits. Changes in students' college preparation and changes in resources at colleges over time could also partly explain the aggregate patterns as well as the gaps observed by socioeconomic background (Bound et al., 2010).

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role of information frictions may have increased in recent years. First, college net tuition has become increasingly individualized, with the gap between average sticker prices and average net prices increasing even among public schools from 26% to 45% between 1994 and 2013 (Baum and Ma, 2013). Second, while the average college premium remains stable, wage dispersion has increased substantially within educational categories and demographic groups (Autor et al., 2008; Altonji et al., 2014), which – even with persistent educational segregation – would suggest that information gaps could play an increasing role in education trends over time (Scott-Clayton, 2012).[3] Furthermore, given consistently and increasingly high levels of educational and income segregation in the US (Watson, 2009; Reardon and Bischoff, 2011) and individuals' propensity to gather information from their local networks, disadvantaged households are less likely to have accurate information about college costs and benefits.

To examine the role of information gaps, we conduct two randomized information experiments, embedded within a survey, in which respondents are provided with objective information about average college returns or costs. For this purpose, we added a novel set of questions to the January 2015 Survey of Consumer Expectations (SCE), a representative monthly survey of roughly 1300 US household heads run by the Federal Reserve Bank of New York. Conducting these experiments on the SCE sample provides substantial benefits–the sample is large, nationally-representative, willing to respond to a long battery of questions, and tracked over time—though has the drawback of a relatively small proportion on the margin of actually making college attendance decisions.

At the baseline, we elicit respondents' beliefs about college costs and returns.[4] We also elicit two measures of respondents' college attendance expectations. All respondents are asked for the expected likelihood with which they would recommend college attendance for a friend's child. Respondents with children under the age of 18 are also asked for the expected likelihood of their child attending college in the future. The advantage of eliciting intended behavior about a future action is that we can investigate its relationship with respondents' current stock of knowledge, as well as measure how it changes in our information experiments. In addition, beliefs about intended behavior tend to be strong predictors of actual future educational choices, above and beyond standard determinants of schooling (Jacob and Linkow, 2011; Beaman et al., 2012), and tend to be strongly associated with actual future outcomes (Dominitz, 1998; Delavande and Rohwedder, 2011). However, whether experimentally-induced variation in expectations impacts actual choices is less understood.[5]

In the intermediate stage, respondents are randomly assigned to either a control group or to one of two information treatments. In the first, which we refer to as the "returns" experiment, respondents are provided with the actual ratio of the average earnings of college graduates to those of non-college workers.[6] In the second, the "cost" experiment, respondents are provided with the actual average net costs of both public and non-profit private universities.[7] The control group is provided with no additional information. In the final stage, we re-elicit beliefs about college returns and costs, as well as the intended likelihood of future college attendance, from all respondents. Finally, to investigate the longer-term impacts of information, we re-elicit beliefs about college returns, costs, and intended attendance from the same respondents in a follow-up survey two months later.

At the baseline, we find that nearly three-quarters of respondents underestimate average returns to a college degree. Moreover, both college-educated and higher-income respondents have significantly lower absolute errors in their perceptions of average college returns, suggesting that biased beliefs about college returns may play a role in college attendance gaps by income and education. While about 60% overestimate average college net costs, there are no notable disparities in beliefs regarding net public college cost across education or income.

The mean expected probability that one's child will attend college in our sample is 80% with a standard deviation of 25 points, indicative of substantial heterogeneity. The heterogeneity in personal college attendance expectations is partly explained by individuals' locations: individuals living in higher-income areas, counties with higher actual relative college returns, and areas located near flagship public universities – all endogenous variables – have higher attendance expectations. We find a statistically and economically significant gap of between 10 and 15 points in college attendance expectations by parents' income or education level: for example, the mean expected likelihood of one's child attending college is 86% for higher-income households but 71% for lower-income households.[8] We also find that intended college attendance is strongly associated with beliefs about that child's college returns. In turn, beliefs about a specific child's college costs and returns are based on perceptions of *average* college costs and returns in the population. Thus, if the latter perceptions are biased, then information interventions that provide objective information about college returns and costs may impact intended choices. We test for this directly using our information experiments.

We find that the college returns intervention immediately increases parents' reported likelihood of sending their child to college by an average 4.9 percentage points, and increases the likelihood of recommending college for a friend's child by an average 2.3 points. This corresponds to a 0.2 standard deviation increase in college attendance expectations.[9] Furthermore, the impact is substantially larger for disadvantaged respondents. As a result, the education and income gaps in parents' college attendance expectations close by around 30% (and the recommendation gaps close by 15%). The follow-up survey, conducted two months after the intervention, affirms the returns experiment's persistence (in the aggregate as well as at the individual level).

The college cost intervention, on the other hand, is found to have no statistically significant impact on either measure of expected college attendance, for the full sample or any of the demographic sub-groups. As a result, the college cost intervention has no significant impact on the magnitude of the demographic gaps. We speculate on possible reasons for this result later in the paper, but the question of why the cost experiment does not lead to any significant impacts (at least in the short term) needs further research.

Information interventions may have an impact on (intended) behavior if (1) the provided information was ex-ante unknown, or (2) if the targeted individuals already had the information, but the

[3] The ratio of average annual earnings by college-educated and non-college respondents to the Current Population Survey, however, has been largely stable, remaining between 1.78 and 1.83 from 2002 to 2012.

[4] We refer to income differentials by education levels as "returns" to education, but we do not mean to use this term to imply causal returns to schooling.

[5] There is a small and growing literature that shows that experimentally-induced changes in expectations impact behavior. Wiswall and Zafar (2015b), for example, show that providing college students with information on major-specific earnings causes some students to change their intended major, and that the students are more likely to graduate with the reported post-information major than the pre-information major. In an application to investment in housing, Armona et al. (2016) show that experimentally-induced revisions of home price expectations lead to revisions in the share of one's investment portfolio that is allocated to a housing fund.

[6] We use the term "non-college" to refer to individuals who do not have a four-year bachelor's degree.

[7] We refer to objective statistics based on national-level datasets (such as the Current Population Survey) as "actual" or "true", when in fact they are just estimates based on (representative) samples of the population. After all, this is the kind of objective information that individuals have access to when making related choices.

[8] We define households to be higher-income if their annual income is over $50,000 per year, and lower-income otherwise.

[9] Hoxby and Turner (2013) find that providing information on population net college costs and college application procedures to high-achieving low-income students increases students' enrollment in "peer institutions" by 0.12 standard deviations; Carrell and Sacerdote (2012) find that a combined information and fee-waiver intervention in New Hampshire public schools increases college enrollment by 0.11 standard deviations. The cost of these interventions varies drastically: $6 per student for the former and around $600 per student for the latter (Hoxby and Turner, 2013). Note, however, that these are changes in actual enrollments rather than changes in the intended likelihood of enrollment.

intervention increases information's salience (Schwarz and Vaughn, 2002; Dellavigna, 2009; Chetty et al., 2009). The two channels have different policy prescriptions. Our study design allows us to investigate the underlying channels. We find limited evidence of post-treatment revisions being systematically associated with pre-treatment biases in respondents' beliefs, as would be implied by information-based updating (for example, as in Rockoff et al., 2012). Instead, the primary channel through which the returns experiment impacts intended college attendance seems to be the salience of the returns information. The policy implication of this finding is that the timing of individuals being exposed to such information is crucial.

In summarizing respondents' perceptions (about college costs and returns) and parents' college attendance beliefs, and in documenting the experimental link between the two, this paper contributes to the literature on people's stock of information about college returns and costs. However, existing work in this area either relies on small sample sizes or convenience samples, generally focuses on either college costs or benefits (but not both), or rarely makes a distinction between individuals' average population beliefs and beliefs as they pertain to the individuals themselves. Furthermore, most of the evidence is from the 1990s, and both college costs and returns (as well as the availability of information about each) have increased in the intervening years.[10]

Our information experiment is also similar in spirit to information interventions conducted in the education literature.[11] Our contribution is to explicitly outline the mechanisms through which such interventions may have an impact, and to conduct two such interventions in an experimental setting. Our interventions are conducted on a large nationally-representative sample of American households, allowing us to examine broad average treatment effects that other studies, either due to small sample size or non-random sample selection, are unable to estimate in an unbiased manner. Moreover, these studies, with a few exceptions (Jensen, 2010; Wiswall and Zafar, 2015a,b; Hastings et al., 2015, 2016), do not collect data on baseline priors (regarding population costs or returns) and usually collect insufficient information to illuminate the channels through which such interventions have an impact.

This paper proceeds as follows. We describe the study design in the next section. Section 3 presents survey respondents' baseline beliefs about college returns, costs, and intended attendance. Section 4 outlines the theoretical argument supporting our information experiments. Section 5 analyzes the results of our two experiments and investigates the underlying mechanisms. Finally, Section 6 concludes.

[10] On the returns side, Smith and Powell (1990), Dominitz and Manski (1996), and Betts (1996) find that undergraduates' perceptions of the average college return are close to actual average college returns, while Avery and Kane (2004) find that high school students in the Boston area tend to substantially overestimate college returns. On the cost side, Horn et al. (2003) find that parents of high school students who intend to attend a four-year college overestimate the average college net total costs by 11–26%; Avery and Kane (2004) find much larger overestimations for public school tuition (excluding room and board) among Boston high school students. They also find that more than 55% of both low-income and non-college parents of high school students report being not able to estimate college costs, far higher than their respective counterparts.

[11] Wiswall and Zafar (2015a) find that students at a selective US university are misinformed about returns to college majors, and providing such information impacts intended major choice. Hoxby and Turner (2013) find that low-income high ability students in the US are responsive to net college cost information in their choice of where to apply and enroll. In a developing country setting, Jensen (2010) and Nguyen (2008) find that students and households have poor schooling returns information, providing which increases educational attainment. Bettinger et al. (2012) and Dinkelman and Martínez (2014) find that providing information on financial aid improves certain educational outcomes. Oreopoulos and Dunn (2013) and McGuigan et al. (2012) find that providing information about college returns to high school students has an impact on the students' beliefs about both college rewards and expected educational attainment. Finally, Hastings et al. (2015) find that providing returns and cost information to Chilean high school students leads lower-income students to enroll in higher-return degrees.

2. Survey design and administration

Our data are from a special module added to the Survey of Consumer Expectations (SCE), a monthly survey fielded by the Federal Reserve Bank of New York. The SCE is a nationally representative internet-based survey of a rotating panel of approximately 1300 household heads. Respondents participate in the panel for up to twelve months, with a roughly equal number rotating in and out of the panel each month.

The monthly survey is conducted over the internet by the Demand Institute, a non-profit organization jointly operated by The Conference Board and Nielsen. The sampling frame for the SCE is based on that used for The Conference Board's Consumer Confidence Survey (CCS). Respondents to the CCS, itself based on a representative national sample drawn from mailing addresses, are invited to join the SCE internet panel. Each survey typically takes 15 to 20 minutes to complete, and respondents receive $15 for completing each survey. The response rate for first-time invitees hovers around 55%.

In January 2015, repeat panelists (that is, those who were not participating in the SCE for the first time) were invited to participate in the special module. Out of a total sample of 1407 household heads on the panel invited to participate in the survey, 1123 did so during January, implying a response rate of 80%. We drop 46 respondents with any missing data on the key variables used in the analysis, leaving us with a sample of 1077 respondents, 305 of whom have children under age 18.

Two months later in March 2015, respondents who still remained in the SCE panel were invited to participate in a short follow-up module. Of the 951 household heads still in the panel, 779 did so (194 with children under age 18), for a repeat response rate of 82%. The follow-up module was fielded between March 1 and 31.

2.1. Survey design

We next summarize the design of the two surveys. We show the precise wording of some questions in the empirical section, and provide the complete questionnaire in Appendix A.

2.1.1. First survey

The survey consists of three stages.

Baseline stage: The first stage elicits respondents' perceptions regarding returns to a college degree and the costs of a college education, as well as beliefs regarding a child's college attendance. The data can be classified into three broad categories:

1. Population beliefs:
   - Respondents are asked about the average earnings of current 40-year-olds working full-time, conditional on their having or not having a college degree. We refer to these as "*population earnings*" beliefs, since they pertain to perceptions of average college benefits for the entire US population.
   - Respondents are asked about the average annual total net and sticker cost (including room, board, and tuition) of four-year public as well as non-profit private universities. We refer to these as "*population cost*" beliefs.
2. Self child's beliefs:
   - Respondents with children under age 18 in their household are asked about the likelihood of their oldest child attending college, beliefs about the child's earnings at age 30 conditional on having or not having a college degree, and beliefs about the annual total cost of her college attendance. We refer to these as "*self*" beliefs.
3. Self friend's child's beliefs:
   - Respondents are asked about their likelihood of recommending a four-year college education for a hypothesized

15-year-old child of a friend who is currently performing well in high school. Those without a child under age 18 were also asked for their beliefs about the friend's child's earnings at age 30 conditional on having or not having a college degree.

The distinction between "population beliefs" and "self beliefs" is important. Population beliefs measure an individual's stock of knowledge at a given point in time and can be directly validated, while self beliefs form the basis of the individual's own decision-making. A naïve comparison of self beliefs with population statistics – an approach not uncommon in the prior literature – is ill-advised, since (for example) individuals may have private information about the child (such as ability and interests) that may justify having different self beliefs.

Intermediate stage: After we elicit baseline beliefs, respondents are randomly assigned to one of three blocks (with an equal likelihood of being assigned to each block).

1. Respondents in the first block, which we refer to as the "returns treatment", are first reminded of their population beliefs regarding college returns, and then receive objective information about college returns: "*Analysis based on the 2012–2013 Current Population Survey shows that college-educated full-time workers in fact earn 1.80 times as much as non-college workers (that is, 80% more than non-college workers).*"
2. Respondents in the second block, which we refer to as the "cost treatment", are first reminded of their population beliefs regarding college costs, and then receive objective information about college costs: "*According to the College Board Annual Surveys of Colleges, the average annual net cost of a 4-year public university in 2013–2014 was $12,620, while that of a 4-year nonprofit private university was $23,290.*"
3. Respondents in the third block, which we refer to as the "control group", are simply reminded of their population beliefs regarding college returns and costs.

Final stage: Respondents assigned to either of the first two (treatment) blocks are next asked how useful and credible they found the presented information. We then re-elicit self beliefs about college returns, costs, and child's intended college attendance from all respondents.

2.1.2. Follow-up

In order to assess the persistence of the experimental effect in the medium-term, we follow up with survey respondents two months later. We first re-elicit respondents' population beliefs about earnings and college costs. We then elicit college attendance expectations regarding a friend's child, as well as parents' expectations about their own child's college attendance.

Our study design is motivated by prior research that has found a close connection between self and population beliefs (Wiswall and Zafar, 2015a,b). The idea is that if (1) individuals have biased population beliefs, (2) population and self beliefs are causally linked, and (3) decision-making is contingent on one's self beliefs, then information campaigns providing accurate information about population earnings and costs can affect self beliefs and thus decisions. In this paper, we do not present a formal model of the relationship between perceived public information and self beliefs; interested readers are instead referred to Wiswall and Zafar (2015b). Appendix B presents two stylized examples to illustrate why there might be a relationship, and to show that the direction of that relationship is ambiguous *a priori*.

2.2. Other data sources

We use several additional data sources in order to assess the accuracy of respondents' population beliefs, and to understand the correlates of the heterogeneity in these beliefs. In order to calculate the "true" average earnings of college-educated and non-college 40-year-olds, we compute the average full-time earnings of age 38–42 respondents in the 2012 and 2013 Current Population Survey (CPS).[12] The College Board's 2013 *Annual Survey of Colleges* (Baum and Ma, 2013) provides a point estimate of the 2012–2013 enrollment-weighted average net tuition, fees, room and board for public and non-profit private universities.[13]

We use the 2012–2013 American Community Survey to calculate *local* average earnings of college-educated and non-college 40-year-olds at the Public Use Microeconomic Area (PUMA) level.[14] We also derive local average public and private college sticker costs (at the state level, weighted by school enrollment) using the 2012 Integrated Post-secondary Education Data System (IPEDS).[15]

These external data sources are also used to estimate several geographic variables that are included in our analysis. We use 2012–2013 ACS data to calculate both the fraction of adult residents in each PUMA who have at least a bachelor's degree and the median household income in each PUMA. Lastly, we use the IPEDS data to identify counties in which there is a "flagship" university (defined as one of the two largest four-year public universities in the state) and counties in which there is an "elite" university (defined as the 102 colleges and universities whose students' 75th percentiles of reading and mathematics SAT scores are at least at the 90th percentile of such scores in the US).

2.3. Sample statistics

The first column of Table 1 shows the demographic characteristics of our sample. Our sample has respondents with higher income and higher educational attainment, and also has more white respondents, than the US population overall; 63% have annual household income greater than the $50,000 US median, while 53% have bachelor's degrees and 83% are white. This may partly reflect differential internet access and computer literacy across various demographics. To make our sample representative, we use rim target weighting to match the targets for income, education, age, and region in the population.[16] Column (2) of Table 1 shows that after weighting the sample, 47% of respondents are lower-income, 34% are college graduates, and 52% are male. The average age of the respondents is 51 years (with a standard deviation of 15), and 63% have high numeracy.[17] Even after weighting the sample, 82% of respondents are white, suggesting that we somewhat over-sample that population. Since we are interested in the impact of information interventions in the broader population, all analysis reported in the paper uses sample weights; results are qualitatively similar without them.

Column (2) also shows other household characteristics of our

[12] This aggregated sample of the CPS (over the twelve months in 2012) includes 13,815 respondents, though due to the sampling methodology of the CPS, some people appear in the dataset twice (in different months). Note that we obtain similar statistics about relative college earnings (the object of interest in our analysis) when using the CPS data from the other years in the 2000s.

[13] College Board surveys 3,7463746 two- and four-year universities, with a response rate of 98% among public and non-profit universities and 38% for for-profit universities.

[14] PUMAs are the smallest geographic data available in public-use ACS data. Each PUMA holds at least 100,000 people. PUMAs tend to follow county boundaries (without ever crossing state boundaries) and are larger than counties. There are 2,3782378 PUMAs in the United States. To calculate local 40-year-old average earnings, we average the earnings of individuals between the ages of 36 and 44 in order to preserve sample size. ACS data is provided by the Integrated Public Use Microdata Series (IPUMS).

[15] IPEDS includes total price information for 2,0142014 schools in its sample of 7,5657565 US colleges and universities. IPEDS is maintained by the Department of Education's National Center for Education Statistics.

[16] The sources of the targets are as follows: for income, we use the Annual Social and Economic Supplement (ASEC) of the 2010 Current Population Survey. For education, we use the 2010 American Community Survey. For age, we use the 2010 Census data for household heads, combined with estimates of total population by age. For region, we use the 2011 Census Bureau state-level population estimates.

[17] The SCE includes a battery of 5 numeracy questions drawn from Lipkus et al. (2001) and Lusardi (2009). We code respondents answering at least 4 of the 5 questions correctly as "high numeracy".

Table 1
Sample characteristics.

	January sample		Control	Rewards	Cost		March sample
	Unweighted	Weighted	Group	Experiment	Experiment	P-values[a]	Unweighted
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Observations	1077	1077	357	360	360		779
% four-year college degree (college)	53.1	34.4	34.5	34.2	34.4	1.00	53.4
% income > $50,000 (higher-income)	62.6	52.9	53.1	52.2	53.3	0.97	60.7*
% male	53.7	52.2	50.8	52.8	53.2	0.86	54.6
% White	83.2	82.3	82.7	82.4	81.7	0.95	83.7
% high numeracy[b]	71.5	63.4	61.7	65.8	62.9	0.67	70.6
Age	50.4	50.6	50.6	49.8	51.4	0.51	51.5***
	(15)	(15)	(15)	(16)	(14)		(15)
% has child under age 18	28.3	27.8	27.8	29.5	26.1	0.69	24.6***
Has child age 14–17	8.7	9.2	8.1	11.4	8.0	0.40	7.7*
Local area % college-educated	31.7	29.8	29.4	30.4	29.7	0.66	32.0
	(14)	(14)	(13)	(14)	(14)		(14)
Local area median income (000's)	60.0	58.8	59.4	58.7	58.2	0.79	60.3
	(21)	(20)	(21)	(20)	(20)		(21)
Local area relative college earnings[c]	1.84	1.82	1.83	1.82	1.80	0.65	1.84
	(0.42)	(0.39)	(0.39)	(0.40)	(0.39)		(0.44)
% live in flagship university county	17.9	16.2	12.8	19.4	16.5	0.11	18.1
% live in elite university county	23.4	21.6	21.1	23.8	19.9	0.55	24.1
Average state private univ. sticker cost	42.2	42.5	42.2	42.4	43.0	0.38	42.2
	(7.1)	(6.9)	(6.7)	(7.4)	(6.6)		(7.1)
Average state public univ. sticker cost	23.5	23.5	23.3	23.6	23.6	0.52	23.5
	(3.3)	(3.2)	(3.3)	(3.1)	(3.3)		(3.3)

Standard deviation in parentheses. Pairwise tests conducted for equality of the variable mean (t-test) or proportion (chi-square test) for the follow-up sample versus initial sample (column (7) versus column (1)). *, **, *** denote estimates statistically significant at the 10, 5, and 1% levels, respectively.

[a] Adjusted Wald test of mutual equality between the three groups.

[b] High-numeracy respondents are those who answer at least 4 of the 5 numeracy questions correctly.

[c] Relative College Earnings (RCE) is the ratio of the average earnings of 40-year-olds with a college degree to that of those without a college degree.

weighted sample. More than a quarter of respondents have children under 18 years old, and 9% have children between the ages of 14 and 17 in their household. On average, respondents live in areas in which 30% of adults are college graduates and in which the median income is $58,800. 16% of respondents live in the same county as a "flagship" university, and 22% of respondents live in the same county as an "elite" university.

Table 1 also sub-divides the sample by the three experimental groups: the control group, those who participated in the returns experiment, and those who participated in the cost experiment. Respondents are randomly assigned into these three groups, and we unsurprisingly find no evidence of systematic differences in any of the summary statistics by group at the five 5% level (using Wald tests of mutual equality).

Finally, column (7) of Table 1 shows the unweighted demographic characteristics of the 779 respondents to the March follow-up survey. 42% of the attrition (126 respondents) can be explained by structural rotation out of the SCE panel, which occurs after 12 months, with the rest due to non-response. Column (7) shows that the March sample is slightly older and less likely to have young children than the full sample, but that the two samples are otherwise similar. Appendix Table A1 presents estimates of a multivariate linear regression of a follow-up participation indicator. With the exception of age and having a child under age 18, none of the variables are statistically significant at the 5% level.

3. Descriptive analysis

3.1. Population beliefs

3.1.1. Earnings beliefs

Respondents were asked for their beliefs about the earnings of college and non-college workers.[18] The first two rows in Table 2 show that the average population non-college and college earnings beliefs in our sample are $36,300 and $58,000, respectively.[19] College-educated and higher-income respondents report significantly higher beliefs than their counterparts. The third row in the table reports the ratio of these two beliefs, which we refer to as the population relative college earnings (RCE). The mean in the sample is 1.63; that is, on average, respondents believe that current 40-year-old college-graduate workers earn 1.63 times more than non-college workers. The average population RCE is significantly higher among college-educated respondents (1.67 versus 1.61), but there is no statistical difference in the population RCE conditional on respondents' household income.

One purpose of eliciting respondents' population beliefs is to gauge their accuracy compared to objective statistics. The 2012–2013 CPS reveals that average earnings of full-time college-graduate (non-college) workers were $75,500 ($42,200). Comparing these estimates with respondents' population earnings beliefs, we see that our respondents tended to underestimate college-graduate workers' earnings by about $18,000 (23%) and non-college workers' earnings by about $6000 (14%). Interestingly, every sub-group that we consider in Table 2 underestimates earnings of both college and non-college workers on average.

The actual population RCE, based on the 2012–2013 CPS data, is

[18] For example, population beliefs about earnings of non-college workers were elicited as follows: "*Consider all non-college individuals (that is, individuals without a Bachelor's degree) currently aged 40 who are working full time right now. What do you believe is the average amount that these workers currently earn per year, before taxes and other deductions?*"

[19] In order to limit the impact of outliers on the results presented in this paper, we winsorize all elicited beliefs and expectations–as well as changes in those beliefs–by experimental block at the top and bottom 2.5%. Results are qualitatively similar if we instead trim the data.

Table 2
Baseline beliefs.

	All	Non-college[a]	College	Lower-inc.[b]	Higher-inc.
Observations	1077	505	572	403	674
Panel A: Population earnings beliefs					
Earnings of non-college workers (000's)	36.3	35.6	37.6**	32.2	39.9***
	(12) [35]	(12)	(11)	(11)	(12)
Earnings of college workers (000's)	58.0	56.4	61***	52.3	63.1***
	(18) [55]	(19)	(17)	(18)	(17)
Population Relative College Earnings (RCE)[c]	1.63	1.61	1.67**	1.63	1.63
	(0.4) [1.54]	(0.4)	(0.4)	(0.5)	(0.4)
Proportion who overestimate pop. RCE	28.9	28.4	29.9	28.7	29.1
Absolute error in population RCE[d]	0.41	0.43	0.35***	0.45	0.37***
Panel B: Population cost beliefs					
Public university sticker cost (000's)	30.6	31.3	29.3	30.5	30.7
	(22) [25]	(22)	(21)	(22)	(22)
Public university net cost (000's)	23.3	23.2	23.5	22.8	23.8
	(20) [16]	(20)	(20)	(20)	(21)
Private university sticker cost (000's)	43.4	42.2	45.6**	41.4	45.2**
	(24) [40]	(24)	(22)	(24)	(23)
Private university net cost (000's)	35.2	33.6	38.2***	33.6	36.6*
	(24) [28]	(24)	(24)	(24)	(24)
Prop. overestimate public sticker cost	65.2	65.1	65.5	65	65.4
Prop. overestimate public net cost	59.2	58	61.6	58.8	59.6
Prop. overestimate private sticker cost	44.9	41.8	50.6***	40.6	48.6**
Prop. overestimate private net cost	59.9	56.2	67***	56.5	62.9*
Panel C: Self beliefs					
Own child's RCE	1.77	1.76	1.8	1.82	1.75
	(0.6) [1.67]	(0.6)	(0.4)	(0.7)	(0.5)
Friend's child's RCE	1.57	1.53	1.65***	1.56	1.58
	(0.4) [1.50]	(0.5)	(0.4)	(0.5)	(0.4)
Own child's net college cost	25.2	22.6	29.8***	23.7	26.2
	(21) [20]	(20)	(23)	(21)	(21)
Own child's likelihood of coll. attendance	80.3	75.9	88***	71.4	86.1***
	(25) [90]	(26)	(19)	(29)	(19)
Likelihood to recommend coll. to friend	82.0	77.8	90.1***	75.8	87.5***
	(26) [100]	(29)	(18)	(30)	(21)

Weighted mean reported in first row; standard deviation in parentheses. Medians in square brackets in first column. Pairwise tests conducted for equality of the variable mean/proportion for college versus non-college respondents; and for lower-income and higher-income respondents. *, **, ***estimate statistically significant at the 10, 5, and 1% levels, respectively.

[a] Non-college refers to households in which the household head does not have a four-year college degree.

[b] Lower-income refers to households with annual income of less than or equal to $50,000.

[c] Relative College Earnings (RCE) is the ratio of the average earnings of 40-year-olds with a college degree to that of those without a college degree.

[d] The absolute gap between the subjective population RCE and actual RCE.

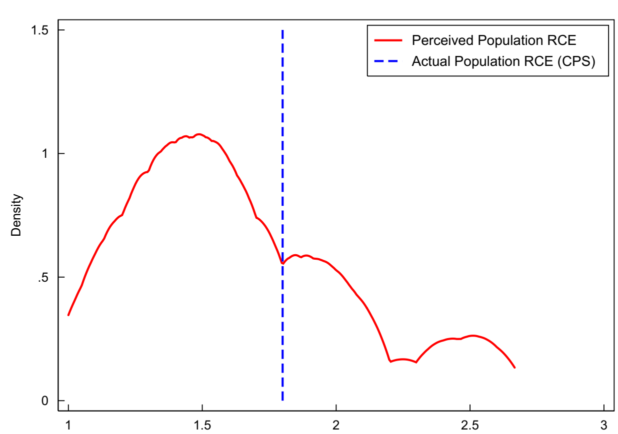


Fig. 1. Distribution of perceived average population RCE. Kernel density function of respondents' believed level of population Relative College Earnings (RCE defined as the ratio of perceived average college earnings to perceived average non-college earnings). The true RCE, as estimated using the 2012–2013 CPS, was 1.80.

1.80 (in fact, the CPS shows that the population RCE had remained between 1.76 and 1.83 since 2000). Fig. 1 shows the right-skewed distribution of respondents' population RCE beliefs; about 70% of our respondents, uniformly across education and income groups, underestimate the RCE. As a result, the median population RCE belief is 1.54, even lower than the mean.[20] The last row in Panel A of Table 2 reports the average absolute error in the RCE (that is, the absolute value of the difference between respondents' perceived population RCE and 1.8); college-educated and higher-income respondents have mean absolute population RCE errors that are significantly smaller than those of their counterparts.[21]

The first two columns of Appendix Table A4 show correlates of heterogeneity in the population RCE beliefs and the absolute error in population RCE beliefs. Female, high-numeracy, and white respondents tend to hold higher population RCE beliefs, while individuals who live

[20] Appendix Table A2 shows median population beliefs by subgroup, all of which exhibit the same trends as the means shown in Table 2.

[21] Appendix Table A3 uses alternative definitions for the objective/true population RCE. We see that our conclusions regarding the tendency of respondents to underestimate returns, and the socioeconomic differences in the gaps, are robust to these alternative measures.

in high-income areas tend to have slightly lower population RCE beliefs. Interestingly, respondents who reside in areas with a high actual RCE do not have measurably higher RCE beliefs than those in lower RCE areas. Column 2 of the table shows that, even conditional on these other demographic characteristics, lower-income and non-college respondents tend to have larger average absolute errors in their population RCE beliefs than their counterparts.

3.1.2. Cost beliefs

We next turn to respondents' beliefs about college costs. Respondents were asked about the average sticker and net costs of both public and private universities.[22]

Panel B of Table 2 shows that, on average, respondents believe that the average annual sticker (net) cost – including room, board, and tuition – of a four-year Bachelor's degree at a public college is $30,600 ($23,300), and at a non-profit private college is $43,400 ($35,200). Higher-income and college-educated respondents tend to believe non-profit private college costs are higher than do their counterparts, but there is little difference in public college perceived costs by respondents' education or income.

How do respondents' perceived college costs compare with actual costs? According to the College Board, the average annual total net cost of a four-year public college was $12,600 for the 2013–2014 school year, while the average annual total sticker price was $18,400. Similarly, the average annual total sticker (net) cost at a four-year private college was $40,900 ($23,300) for the 2013–2014 school year. Fig. 2 shows the distribution of population college cost beliefs. Respondents' beliefs about net public and private college costs are concentrated around the true values, but the distributions are non-centered and right-skewed; 60% of respondents overestimate each net cost, with median net cost beliefs of $16,000 for public universities and $28,000 for non-profit private universities.

College cost beliefs exhibit substantial heterogeneity; for example, the standard deviation of sticker public college cost beliefs is $22,000. The last two columns of Appendix Table A4 show that this heterogeneity is not explained by either education or income: column (3) of the table, for example, shows that only about 4% of the variation in population sticker cost beliefs for public colleges can be explained by our full suite of demographic information.

The analysis so far reveals both substantial heterogeneity in respondents' population beliefs and substantial errors in their perceptions. Moreover, the errors in population beliefs are systematic, with respondents more likely to underestimate the population RCE and generally more likely to overestimate college costs. Notably, the heterogeneity in population beliefs is largely unexplained by our rich set of covariates; for example, the covariates only explain 8.2% of the variance in population RCE.[23] We investigate two additional possible explanations for these substantial errors: respondents' use of local information to construct their national population beliefs, and their rational ignorance of population information due to non-participation in the higher education market.

First, to what extent are our conclusions driven by respondents using local information to report their perceptions? In order to assess the role of geographic variation in these measures driving our conclusions, we instead evaluate the accuracy of our respondents' population beliefs by comparing them to local benchmarks; for the population RCE, we compare their beliefs with the actual population RCE in the respondent's PUMA, while for college costs we compare respondents' perceptions with a weighted average of 2012 sticker college costs in the respondent's state of residence. We find that the average population RCE error is statistically indistinguishable from the *local* average population RCE error (0.172 vs. 0.189), and that the average population RCE *absolute* error is actually significantly lower than the *local* average population RCE absolute error (0.41 vs. 0.50). However, we do find that average population public college sticker cost error is substantially smaller when using local public college costs ($12,300 national error vs. $7000 local error), though the average absolute errors are very close ($17,300 national vs. $16,500 local); the same pattern holds for private college sticker costs. Finally, Panels (a) and (b) of Fig. 3 show the distribution of public and private net cost beliefs separately for respondents who reside in the same county as a flagship state university or an elite university (see definitions above). We find minimal differences in cost beliefs across these groups, though respondents in elite university counties have a somewhat-narrower right tail in their private net cost beliefs. However, none of these distributions is statistically different from each other (within each panel). These results suggest that geographic variation in actual college returns and costs can explain only a small part of the underlying heterogeneity in respondents' population beliefs.

Second, to what degree have our respondents remained 'rationally ignorant' of university rewards and costs as a result of not having pre-college-aged children? A central feature of our experiment is the national representativeness of its sample, and many respondents may have

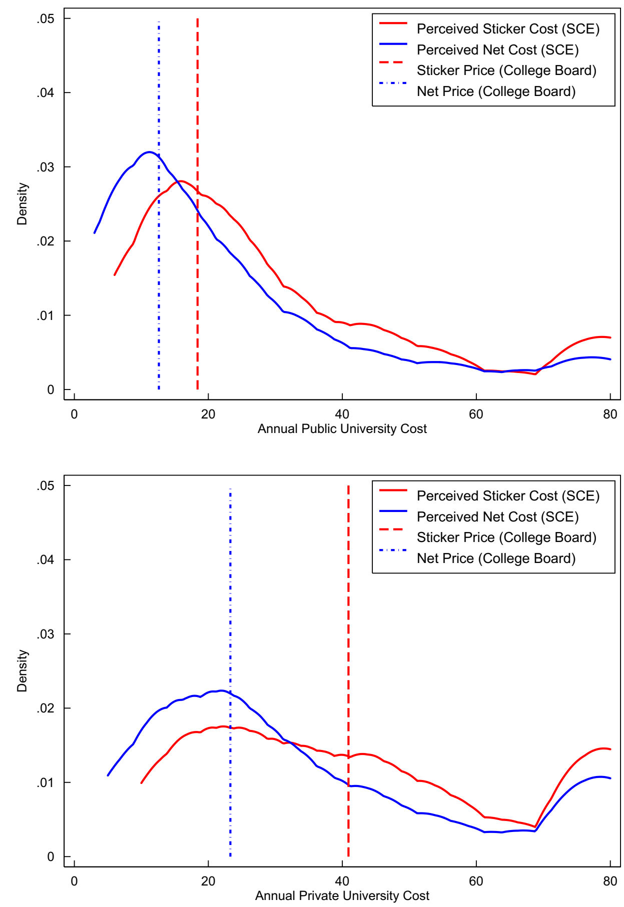


Fig. 2. Distribution of perceived average public and private university costs. Kernel density function of respondents' believed level of average sticker and net costs for students at public (top) and non-profit private (bottom) universities, including tuition, room, and board. The College Board reported that true average sticker (net) costs for the 2013–2014 academic year were $18,400 ($12,600) at public universities and $40,900 ($23,300) at non-profit private universities.

[22] The net cost, for example, was elicited as follows: "*Many students who go to college quality for grants and scholarships (money that students get that they don't have to work for or pay back), and as a result end up paying less than the sticker cost. This cost of college after taking into account grants and scholarships is referred to as the* ***net*** *college cost. This is the amount that students actually have to pay. What is your best guess of the current* *average annual* ***net*** *cost of a 4-year Bachelor's degree at a [public / nonprofit private] university?*"

[23] Panel A of Fig. A1 shows that there is no systematic relationship between respondents' beliefs about the population RCE and population net public costs.

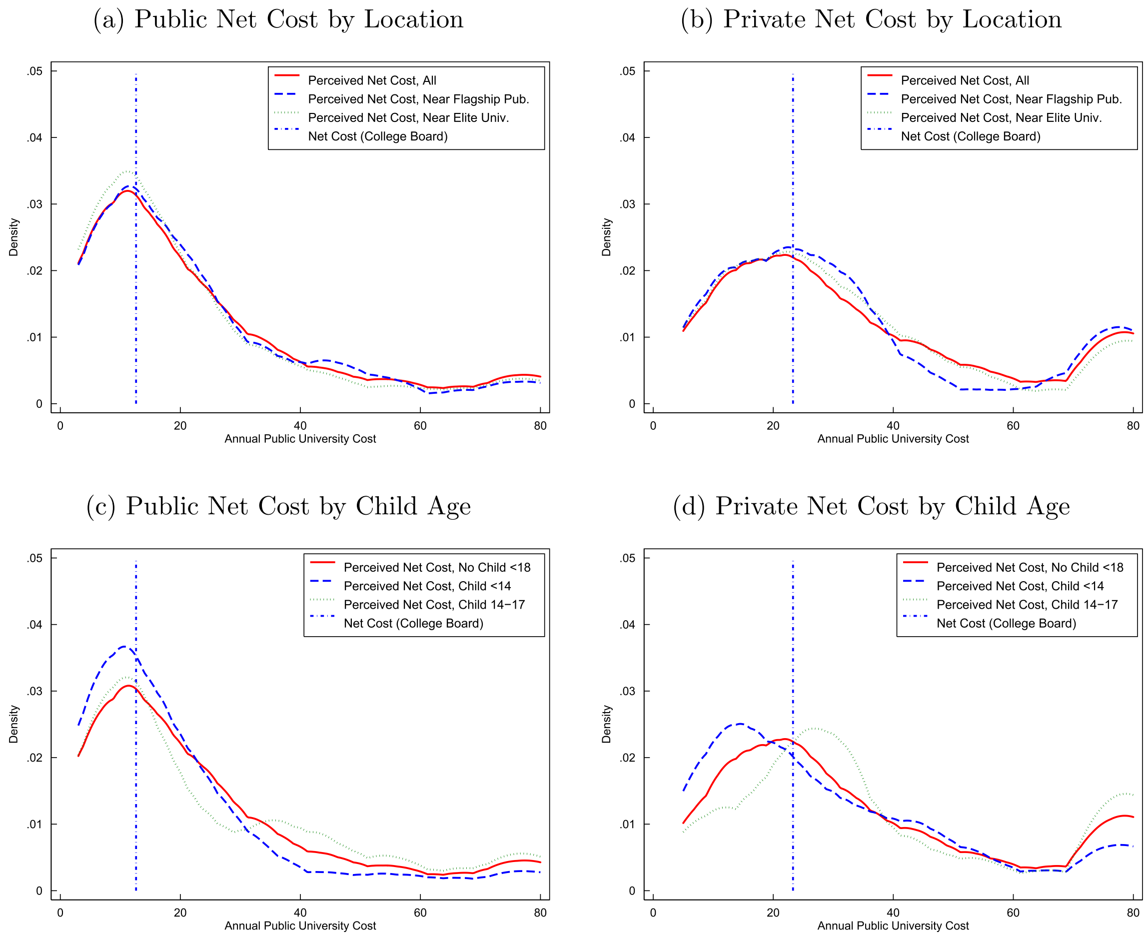


Fig. 3. Heterogeneity in population cost beliefs. Kernel density functions of respondents' believed level of average public and private university net costs–including tuition, room, and board–by demographic characteristics. Panels (a) and (b) show beliefs by whether the respondents reside in the same county as a flagship public or 'elite' private university; Panels (c) and (d) show beliefs by whether the respondents have children below age 18, below age 14, or between age 14 and 17 ('pre-college-age').

little reason to keep track of university-related information. Panels (c) and (d) of Fig. 3 show the distribution of public and private net cost beliefs separately for respondents with no children below age 18, respondents with children between ages 14 and 17 (households which may soon face college attendance decisions), and respondents with children under the age of 14. Differences across groups are small– in particular, it is not the case that parents of pre-college-age (ages 14–17) children hold more accurate beliefs about net college costs than their counterparts. Fig. 4 confirms this pattern by plotting average population RCE and cost beliefs by the age of respondents' oldest child (below age 18). While Panel (a) shows that parents' population RCE beliefs increase in the age of their children (though never reaching the true population RCE),[24] Panel (b) shows that parents' population net public cost beliefs diverge from the truth as their children age. This evidence suggests that our respondents' non-participation in the higher education market also fails to substantially explain the errors or heterogeneity in our respondents' population beliefs.

3.2. Self beliefs

We next turn to analysis of respondents' self beliefs: that is, parents' beliefs about the expected earnings, college costs, and likelihood of college attendance of their oldest child below age 18 (pre-college age), as well as all respondents' expected earnings or likelihood of recommending college for a hypothetical 15-year-old child of a friend.[25] We also elicit non-parents' expectations for a friend's child's earnings with and without a college education, though we do not ask for their friend's child's expected college costs. In our sample, 305 respondents reported having a pre-college age child in their household. As above, we calculate the self child's and friend's child's RCE as the ratio of expected earnings with a bachelor's degree to expected earnings without a bachelor's degree.[26]

3.2.1. Earnings beliefs

Panel C of Table 2 shows that child's RCE beliefs in our sample average 1.77, while friend's child's RCE belief average 1.57. Respondents' own child's RCE beliefs tend to be significantly higher than their population beliefs, while respondents' friend's child's RCE beliefs

[24] The average absolute population RCE error is also not related to the presence of a child in the household. The average absolute error is 0.42 for households with no child, 0.39 for households with the oldest child under the age of 14, and 0.36 for households with the oldest child in the 14–17 age range (none of the averages are significantly different, either pairwise or jointly).

[25] An example question is: "*A friend of yours has sought your advice about whether to send their 15-year-old child to college for a 4-year degree. The child is currently in high school and performing well. What is the percent chance that you would recommend a college education for the child to your friend?*"

[26] These self RCE perceptions differ from population perceptions in two ways. First, they are evaluated as projections about the future, when the population RCE may be higher or lower than it is presently. Second, they are estimated given private knowledge about the characteristics of one's own (or one's friend's) child, which may influence respondents' expectations about their future earnings. Thus, respondents who report own and friend's child's RCE beliefs that are greater than their population RCE beliefs may believe that the population RCE will increase, or may believe that the child will earn a higher-than-average premium.

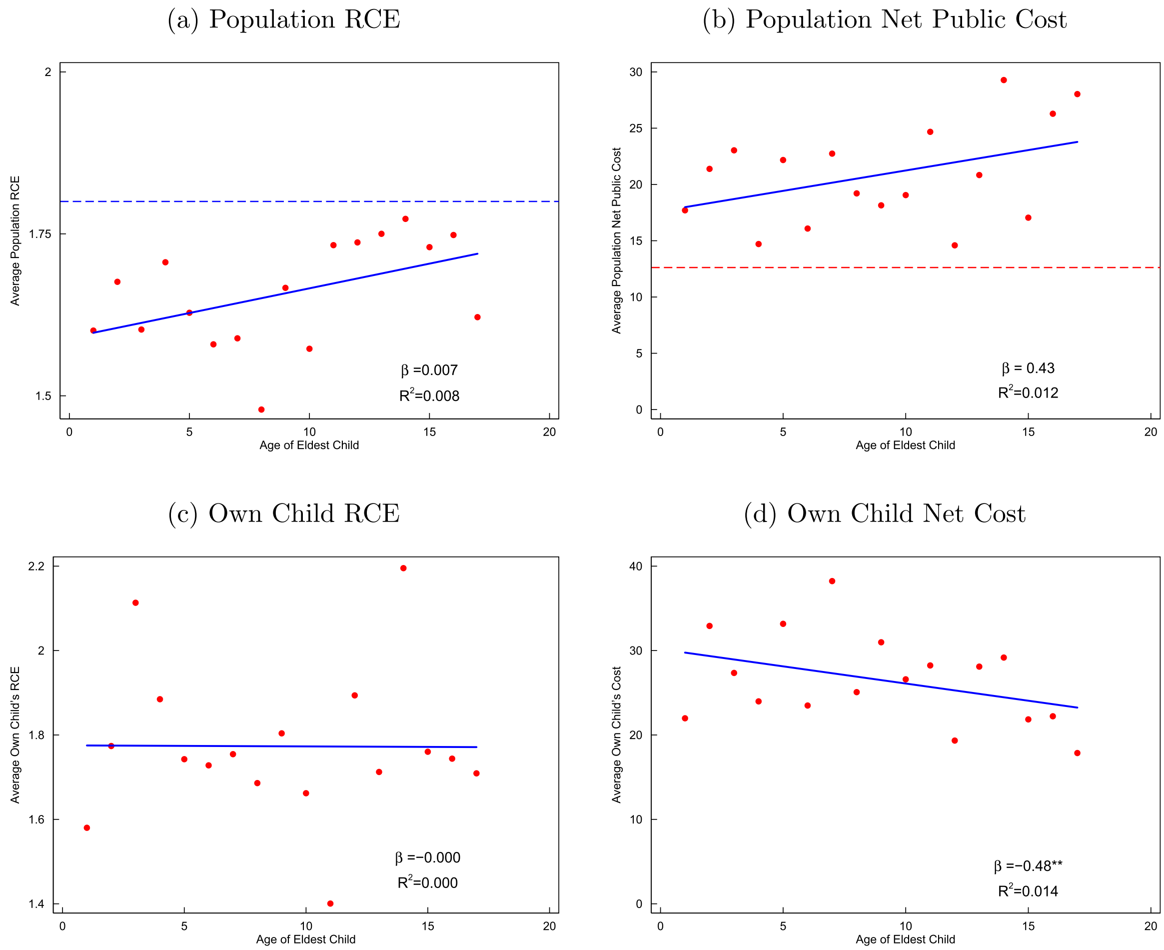


Fig. 4. Population and self beliefs by eldest child age. Binned scatter plots of respondent beliefs by the age of their eldest child below age 18. Fitted lines and statistics estimated at the individual level. Dotted lines show corresponding true values for population beliefs. For beta coefficients, *, **, *** denote estimates statistically significant at the 10, 5, and 1% levels, respectively.

are significantly lower than their population beliefs (at the 10% level). College-educated respondents have higher friend's child's RCE beliefs than non-college respondents on average, but there is otherwise no discernible heterogeneity across income and education subgroups despite substantial variation in both RCE beliefs (a standard deviation of 0.6 for child's RCE and 0.4 for friend's child's RCE).

3.2.2. *Cost beliefs*

Panel C also shows respondents' expected child's net college costs, which average $25,200. This expected cost is more than double than the actual average public school net cost. Surprisingly, higher-income respondents' expected costs are only slightly (and statistically insignificantly) larger than those of lower-income respondents, despite lower-income households typically facing far lower net college costs than higher-income households (Dynarski and Scott-Clayton, 2013). We do not elicit whether respondents expect their children to enroll at public or private universities (nor do we elicit expected sticker costs), so these cost beliefs may conflate expectations of quality with those of price. Panel b of Fig. A1 shows that there is no clear relationship between self beliefs about the child's RCE and college costs.

3.2.3. *College attendance beliefs*

Finally, Panel C shows that the mean expected likelihood that parents' oldest children will attend college is 80.3%, with substantial heterogeneity in the belief (a standard deviation of 25 points). On average, college-educated (higher-income) respondents report an 12 (15) point higher likelihood of their child attending college than their counterparts, statistically significant differences at the 1% level. Similarly, the average likelihood of an individual recommending college for a friend's child is 82.0%, and college-educated and higher-income respondents report significantly higher likelihoods than their counterparts (at the 1% level).[27] Fig. 5 (a) shows the distribution of respondents' college attendance beliefs, which are left-skewed but concentrated at high values. Fig. 5 (b) displays a binned scatter plot relating parents' 'own child' attendance beliefs to their 'friend's child' beliefs; though the latter tends to be reported on a more-condensed scale, the two are highly correlated.

While expectations tend to be strong predictors of educational choices above and beyond other standard determinants of schooling (Jacob and Linkow, 2011; Beaman et al., 2012), the mapping of intentions to actions is not necessarily one-to-one. An average likelihood of college attendance for one's own child being 88% for higher-income respondents does not imply that 88% of such children will enroll in college. Likewise, the 15 percentage point gap child's college

[27] Columns (1) to (4) of Appendix Table A5 show the demographic heterogeneity in college attendance expectations for respondents' own child. Even after including an exhaustive set of controls, lower-income respondents have substantially and significantly lower college attendance expectations for their children. Individuals who live near flagship state universities or in higher income areas report significantly higher likelihood of sending their children to college, while individuals who live in states with high average private university sticker prices report lower attendance likelihoods. Columns (5) to (8) of Appendix Table A5 show that, even conditional on the rich set of controls, both lower-income and non-college respondents are far less likely to recommend college for their friend's child.

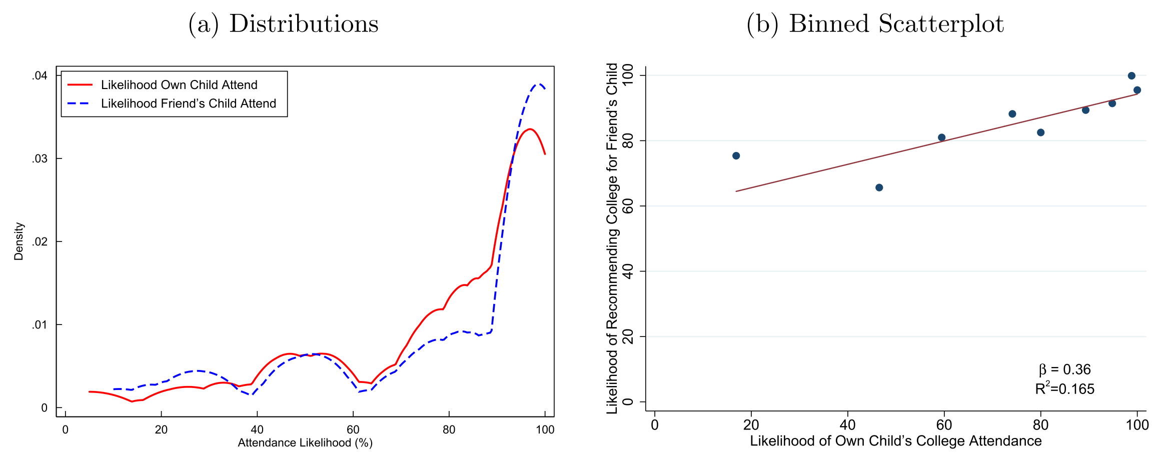


Fig. 5. Own and friend's child's college attendance expectations. Panel (a) shows kernel density functions of respondents' expected likelihood of their own child attending college (conditional on having a child below age 18) and respondents' expected likelihood of recommending college to a friend's child. Panel (b) shows a binned scatter plot of friend's child college attendance expectations against own child college attendance expectations for respondents with children below age 18. Fitted line and statistics estimated at the individual level; the estimated beta coefficient is statistically significant at the 0.1% level.

attendance expectations by household income need not mirror the actual gap in college enrollment by income.[28] For intended actions and expectations to be of interest, they must only be causally relevant for future actions. Indeed, several studies show that schooling choices can be partially explained by ex-ante expectations (Attanasio and Kaufmann, 2017; Stinebrickner and Stinebrickner, 2014; Wiswall and Zafar, 2015a) .

4. Theoretical motivation

We next introduce some notation that is useful for motivating the experimental analysis.

4.1. Self beliefs and population beliefs

Let RCE_{it}^{child} be individual i's expectation at time t about a child's future RCE (either one's own child or a friend's child), $\mathbf{RCE_i}$. Let Ω_{it} denote i's information set at time t, and X_i a vector of demographic characteristics. Respondent i reports her beliefs about the child's RCE as:

$$RCE_{it}^{child} = E(\mathbf{RCE_i}|\Omega_{it}) = f(\mathbf{X_i}, \Omega_{it}).$$

The function $f(\cdot)$ maps the individual's demographic characteristics and information set to self beliefs. We take a broad view of the individual's information set Ω_{it}, which may contain both self (private) information, such as the individual's perception of the child's ability, and population information like the individual's perception of average relative earnings for college-educated workers (that is, RCE_{it}^{pop}). Note that respondents' perceptions about the population distribution could differ from objective measures. Hence, the information set about the population distribution of earnings could vary over time and across individuals. Demographic characteristics X_i are included to allow for preference heterogeneity distinct from variation in information sets.

In the information experiments that we discuss in Section 5, we will test whether, and to what extent, individuals' expectations of their child's RCE depend on their perceived population RCE: that is, whether $\frac{\partial f(\mathbf{X_i}, \Omega_{it})}{\partial RCE_{it}^{pop}} \neq 0$. First, however, we analyze whether individuals' self beliefs are systematically related with their population beliefs. In column (1) of Table 3, we regress RCE_{it}^{child} for respondents' own children onto our suite of demographic controls as well as RCE_{it}^{pop}. Perceived population RCE is economically and statistically significantly related to beliefs about the child's RCE: A 0.17 point increase in RCE_{it}^{pop} (the average amount by which respondents underestimate the population RCE) is associated with a 0.12 point increase in RCE_{it}^{child}. Column (2) of Table 3 shows a similar, though somewhat smaller, relationship between population RCE beliefs and friend's child's RCE beliefs.

Table 3
Self beliefs and population beliefs.

Dependent variable:	Own child's RCE[d]	Friend's child's RCE	Own child's net cost	
	(1)	(2)	(3)	(4)
Population RCE[a]	0.72***	0.41***		
	(0.08)	(0.06)		
Pop. public net cost			0.47***	0.44**
			(0.06)	(0.14)
Pop. public sticker cost				−0.087
				(0.13)
Pop. private net cost				−0.090
				(0.12)
Pop. private sticker cost				0.33***
				(0.10)
Demographics[b]	Yes	Yes	Yes	Yes
F-statistic[c]	6.22	5.07	21.2	20.6
R^2	0.51	0.22	0.41	0.46
Number of observations	305	772	305	305
Mean of dep. var.	1.8	1.6	25	25

Weighted OLS estimates of a regression of the dependent variable on various controls. Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels, respectively.

[a] Relative College Earnings (RCE) is the ratio of the average earnings of 40-year-olds with a college degree to that of those without a college degree.

[b] Demographics include binned indicators for income (11), education (9), numeracy (6), and age of eldest child under 18 (where applicable), as well as gender and race indicators, indicators for residing in a flagship or elite university county, and measures of local area % BAs, local area income, local area RCE, state public university cost, and state private university cost. See the text, and the survey text, for more information.

[c] F-statistic for a joint test of the significance of the covariates.

[d] Ratio of expected average earnings of the child with a college degree to the expected average earnings without a college degree.

[28] For example, analysis of the CPS shows that the immediate enrollment rate of high school graduates (mostly 18-year-olds) was 58.2% in 2013–2015, with an enrollment rate of 68.4% from higher-income households and 42.7% from lower-income households, where lower (higher) income is defined as having household earnings of below (above) $50,000.

Table 4
Baseline college attendance expectations and beliefs.

Dependent variable:	Own child's attendance[a]			Friend's child's attendance[b]			Friend's child's (if have own child)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pop. RCE	6.48*		3.24	9.61***		2.86	7.13***		5.71*
	(3.5)		(4.0)	(2.6)		(3.4)	(2.7)		(3.2)
Child's RCE[c]		5.79**	4.38					4.47**	2.00
		(2.6)	(2.9)					(1.9)	(2.3)
Friend's child's RCE					17.0***	15.8***			
					(3.0)	(3.4)			
Pop. pub. net cost	0.051		−0.0014	−0.030		−0.041	0.0027		0.012
	(.067)		(.080)	(.055)		(.062)	(.046)		(.056)
Child's net cost		0.14**	0.14*					0.0020	−0.0085
		(0.063)	(0.077)					(0.058)	(0.057)
Demographics[d]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-statistic	3.02	2.99	2.91	3.92	4.24	4.33	3.93	3.73	3.8
R^2	0.30	0.31	0.31	0.21	0.24	0.24	0.44	0.44	0.44
Number of observations	305	305	305	1077	772	772	305	305	305
Mean of dep. var.	80	80	80	82	80	80	87	87	87

Note: Weighted OLS estimates of a regression of the dependent variable on various controls. Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels, respectively.

[a] The expected likelihood of a respondent's child attending college.

[b] The expected likelihood of a respondent recommending college for a friend's 15-year-old child.

[c] Ratio of expected average earnings of the child with a college degree to the expected average earnings without a college degree.

[d] See Table 3 notes for the set of demographic characteristics.

Columns (3) and (4) of Table 3 examine the relationship between population cost beliefs and own child's cost beliefs. We find that, of the four population cost beliefs discussed above (sticker and net costs for public and nonprofit private universities), the strongest association exists between average public net cost beliefs and own child's cost beliefs, with a $10,000 increase in population net cost beliefs being associated with a $4000–$5000 increase in expected child's net college costs. We focus on the relationship between public net cost beliefs and self child's cost beliefs in our experimental analysis below.

In short, Table 3 shows a strong relationship between self and population beliefs.

4.2. Intended college attendance and beliefs

A respondent's reported likelihood at time t of the child's college attendance, denoted by $College_{it}^{child}$, is a function of the respondent's information set Ω_{it} and demographic characteristics $\mathbf{X_i}$. As above, the information set may contain private information about the child, such as the the child's expected returns to a college education (that is, RCE_{it}^{child}), as well as population information, such as the perceived costs of a college education.

Table 4 estimates the relationship between child's college attendance expectations and both population and self beliefs about the returns and costs of college attendance. OLS estimates are reported; we also estimate the model as fractional logit and get qualitatively similar results. The dependent variable in columns (1)-(3) is own child's intended college attendance. In column (1), we see that respondents with higher population RCE beliefs also tend to be slightly more likely to expect their child to attend college: an 0.17 point increase in population RCE beliefs is associated with a 1 percentage point increase in the expected likelihood of child's college attendance. There is no significant relationship between population college cost beliefs and child's college attendance expectations. Column (2) shows a similar positive relationship between child's RCE beliefs and expected college attendance. Column (2) shows that individuals who expect higher college costs for their children are more likely to send them to college; this may reflect the aid structure of college costs, which are higher for higher-income households (though the regression flexibly controls for that demographic), or may reflect cost expectations as a proxy for expected university quality. Column (3) combines the covariates from the first two columns, and shows qualitatively similar patterns.

Columns (4) to (6) of Table 4 show broadly similar relationships for friend's child's college attendance expectations, with a significantly more-positive relationship between self RCE beliefs and college recommendation expectations for a friend's child – an increase in friend's child's RCE beliefs of 0.17 is associated with an increase in the likelihood of recommending college of almost 3 percentage points. Since some of our analysis below combines these two measurements of college attendance expectations, columns (7) to (9) replicate the friend's child's attendance estimates restricted to the sample of respondents with children.[29] The estimates are very similar in magnitude to those estimating respondents' own child's attendance (columns (1)-(3)), though parents' expectations about their own children's costs are not correlated with their likelihood to recommend college to a friend. Broadly, Table 4 presents evidence suggesting that individuals with higher RCE beliefs tend to have higher child's college attendance expectations.

We have shown that household heads, on average, underestimate population relative college earnings (RCE) and overestimate college net costs. Respondents' self beliefs about their (own or friend's) child's RCE and college costs are shown to be related to their population beliefs (Table 3), and these self beliefs are important correlates of the child's college attendance likelihood (Table 4). If these relationships are causal, then misinformed population beliefs may bias self beliefs, which may adversely affect the expected likelihood of the child's college attendance, which previous research suggests is causally relevant for actual college attendance decisions. We investigate these causal links in the next section.

5. Experimental analysis

This section examines the effect of experimentally-provided

[29] Respondents with children were not asked about their friend's child's expected RCE, so we include respondents' own child's RCE and cost expectations in these models.

Table 5
Summary of immediate experimental impacts.

	All	Non-college	College	Diff.[d]	Lower-inc.	Higher-inc.	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Pre-information averages							
Own child's attendance[a]	80.3	75.9	88.0	12.1	71.4	86.1	14.8
Observations	305	143	162		90	215	
Friend's child's attendance[b]	82.0	77.8	90.1	12.3	75.8	87.5	11.7
Observations	1077	505	572		403	674	
Panel B: Control group							
Δ Own child's attendance[c]	0.9*	1	0.6*	−0.4	1.1	0.7	−0.4
	(0.5)	(0.7)	(0.3)	(0.8)	(1.0)	(0.4)	(1.1)
Observations	111	55	56		32	79	
Δ Friend's child's attendance	0.1	0.1	−0.1	−0.2	0.0	0.1	0.0
	(0.1)	(0.2)	(0.1)	(0.2)	(0.2)	(0.1)	(0.3)
Observations	357	174	183		141	216	
Panel C: Returns experiment							
Δ Own child's attendance	4.9***	6.1***	3.2***	−2.9	8.5***	2.3***	−6.2**
	(1.3)	(2.0)	(1.0)	(2.3)	(2.6)	(0.8)	(2.7)
Observations	98	41	57		30	68	
Δ Friend's child's attendance	2.3***	2.8***	1.2***	−1.6**	3.1***	1.5***	−1.6**
	(0.4)	(0.6)	(0.3)	(0.7)	(0.8)	(0.4)	(0.9)
Observations	360	164	196		130	230	
Panel D: Cost experiment							
Δ Own child's attendance	−1.6	−2	−0.8	1.2	−3.7	−0.4	3.2
	(1.6)	(2.3)	(1.3)	(2.6)	(3.3)	(1.5)	(3.7)
Observations	96	47	49		28	68	
Δ Friend's child's attendance	0.2	0.2	0.2	0.0	0.2	0.2	0.0
	(0.3)	(0.5)	(0.2)	(0.5)	(0.6)	(0.3)	(0.6)
Observations	360	167	193		132	228	

Weighted mean estimates presented. Standard errors in parentheses.
For Panels B, C, and D, we test for whether the cell mean is different from zero. *, **, *** denote mean is statistically different from zero at the 10, 5, and 1% levels, respectively.

[a] The expected likelihood of a respondent's child attending college.

[b] The expected likelihood with which a respondent would recommend college for a friend's 15-year-old child.

[c] The Δ's are the final minus baseline beliefs.

[d] The difference in average revisions for college-educated households versus non-college households.

objective information on individuals' self beliefs, focusing in particular on their expectations about the (own and friend's) child's college attendance. We also examine the channels through which the information interventions may impact intended choices.

5.1. Treatment effect

Panel A of Table 5 shows the baseline beliefs. The first row, which summarizes own child's college attendance expectations, displays averages for the sample of respondents with children under age 18. The second row, summarizing friend's child's college attendance expectations, covers the full sample. As discussed above, respondents' average college attendance expectation for their own child and friend's child is similar: 80.3 and 81.5%, respectively. College-educated and high-income respondents have higher college attendance likelihoods, with average gaps of 11.7–14.8 percentage points compared to their counterparts. Panel B shows that college attendance expectations changed minimally for the control group, with no statistically significant changes at the five 5% level. We do see a small 0.9 average increase (significant at the 10% level) in the likelihood of own child's college attendance. The mere act of taking a survey may prompt respondents to think more carefully about their responses, and may lead them to revise their beliefs between the initial and final stages (see Zwane et al., 2011, for a discussion of how surveying people may change their subsequent behavior). The purpose of including a control group in the study design is precisely to purge these confounding effects from the treatment groups' revisions.

5.1.1. Returns experiment

5.1.1.1. Immediate impact. Panel C of Table 5 displays the average (immediate) change in college attendance expectations for the returns experiment.[30] Own child's intended college attendance expectations rise by 4.9 percentage points on average, a 7% increase. Moreover, non-college and lower-income respondents revise their beliefs to a greater extent than their counterparts, which leads to a decline in the college attendance expectations gap by socioeconomic status (as shown in columns 4 and 7 of Table 5, respectively), though the former is statistically insignificant. Non-college respondents revise their expected attendance likelihood up by 6.1 percentage points, compared to 3.2 percentage points for college-educated respondents, narrowing the college gap by 24% (though the drop is not statistically significant); lower-income respondents revise their expected attendance up by 8.5 percentage points, compared to 2.3 percentage points among higher-income respondents, shrinking the income gap in intended college attendance by 42%. We find a similar impact pattern for friend's child's intended college attendance, which increases by 2.3

[30] Because only one-third of respondents were randomly selected to participate in the returns experiment and sample sizes are not very large, Panel A may not necessarily provide a proper baseline comparison (since baseline college attendance beliefs may differ between these participants and all respondents). For this reason, we display post-information average *changes* in beliefs instead of average post-information beliefs.

Table 6
Medium-term experimental impact.

	All	Non-college	College	Diff.[c]	Lower-income	Higher-income	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Baseline averages							
Friend's child's attendance[a]	81.6	77.3	89.7	12.4	75.5	87.3	11.8
Observations	779	363	416		473	306	
Panel B: Control group							
Δ Friend's child's attendance[b]							
Initial survey	0.1	0.1	0.0	-0.1	0.1	0.2	0.2
	(0.2)	(0.2)	(0.1)	(0.3)	(0.3)	(0.2)	(0.3)
Follow-up survey	−0.7	−1.1	0.1	1.2	−2.8*	1.2	4.0**
	(1.0)	(1.4)	(0.9)	(1.7)	(1.7)	(1.0)	(1.9)
Observations	257	123	134		106	151	
Panel C: Returns experiment							
Δ Friend's child's attendance							
Initial survey	2.8***	3.4***	1.5***	−1.9**	3.8***	1.8***	−2.0*
	(0.6)	(0.8)	(0.4)	(0.9)	(1.0)	(0.5)	(1.1)
Follow-up survey	3.6**	4.5**	2.0	−2.4	7.5***	−0.2	−7.7**
	(1.6)	(2.2)	(1.3)	(2.6)	(2.6)	(1.6)	(3.0)
Observations	256	119	137		102	154	
Panel D: Cost experiment							
Δ Friend's child's attendance							
Initial survey	0.1	0	0.3	0.3	−0.1	0.3	0.3
	(0.4)	(0.6)	(0.3)	(0.6)	(0.7)	(0.3)	(0.8)
Follow-up survey	0.1	0.2	0.0	−0.3	−1.5	1.7**	3.2
	(1.4)	(2.0)	(1.0)	(2.3)	(2.6)	(1.1)	(2.8)
Observations	266	121	145		98	168	

Weighted mean estimates presented. Standard errors in parentheses. Sample restricted to follow-up survey participants. For Panels B, C, and D, we test for whether the cell mean is different from zero. *, **, *** denote mean is statistically different from zero at the 10, 5, and 1% levels, respectively.

[a] The expected likelihood with which a respondent would recommend college for a friend's 15-year-old child.

[b] The Δ's are the post-information (initial/follow-up) beliefs minus initial survey baseline beliefs.

[c] The difference in average revisions for college-educated households versus non-college households.

percentage points. Again, the impact is larger for non-college and lower-income respondents, and the college and income gaps in intended college attendance both decrease by about 15%.[31]

5.1.1.2. Medium-term impact. Our follow-up survey allows us to examine whether these changes in beliefs persisted over time. Panel C of Table 6 summarizes the impact of receiving the information treatment in January on college attendance expectations in March, two months later. Due to sample size constraints, Table 6 restricts the analysis to friend's child's college attendance expectations, though our findings for own child expectations are qualitatively similar (Appendix Table A7). We find that our results persist strongly in the medium-term. Respondents increase their friend's child's college attendance expectations by 3.6 percentage points (compared to the control group's 0.7 percentage point decline), a slightly larger revision than in the initial January survey (2.8 percentage points in the follow-up sample). The increase is largely driven by lower-income respondents, and the income gap in intended college attendance expectations closes by more than half (7.7 percentage points, statistically significant at the 5% level). The education gap also closes, though the 2.4 percentage point change is statistically insignificant.[32] In addition, we find that the revisions persist at the individual level as well: controlling for demographics, a one percentage point January increase in college attendance expectations implies a (statistically-significant) 0.88 percentage point increase in March.

5.1.2. Cost experiment

5.1.2.1. Immediate impact. We next turn to findings from the cost experiment, which are summarized in Panel C of Table 5. We find no evidence that respondents in the cost experiment revise either their child's expected likelihood of college attendance or the likelihood of their recommending college attendance for a friend's child, on average, overall or for any of the four demographic groups that we examine. As a result, there is no significant impact on expectations gaps by income or education.[33]

5.1.2.2. Medium-term impact. Panel D of Table 6 summarizes the medium-term impact of the cost experiment, again restricting our analysis to friend's child's college attendance expectations (own child impacts are shown in Table A7). As in the initial survey, we find no measurable impact of participation on expectations; expectations increase by an average of 0.1 percentage points (standard error 1.4) relative to a control group decline of 0.7 percentage points. Only higher-income respondents experience a statistically significant increase in expectations, by 1.7 percentage points.[34]

Table 7 shows the treatment effects in a regression framework. The dependent variable in column (1) is the change in the child's expected college attendance (final minus baseline).[35] For simplicity, we use only one observation per respondent- the revision in own child's college attendance expectations, and if that is not applicable, the revision in beliefs regarding friend's child's college attendance expectations; qualitative conclusions are the same if we analyze each separately or jointly (see Appendix Table A8). By including the control group, who were provided no new information but were reminded of their own population RCE and cost beliefs, we purge revisions attributable to the act of taking the survey and thus identify the causal effect of the information. Column (1) shows that respondents in the returns experiment revise the child's college attendance expectations upwards by 3.1 percentage points on average (significant at 1%). On the other hand, the cost experiment leads to no statistically significant effect.[36]

[31] All results presented in this section are weighted using the sample weights described above. However, results are robust to the exclusion of these weights (Table A6). Unweighted individuals treated with returns information are 3.7 percentage points more likely to send their children to school and 1.7% more likely to recommend college for a friend's child, both significant at the 1% level. All four demographic groups experience significant increases in both measures of expected college attendance, and three of the four demographic gaps experience significant declines. We also corroborate the medium-term effects presented below; the effects on the unweighted sample are nearly identical to those on the weighted sample in sign, magnitude, and statistical significance.

[32] Panel C of Table A7 shows similar persistent impacts for own child expectations. The initial impact of a 5.1 percentage point increases to 6 percentage points in the follow-up. However, the follow-up impact is less precise.

[33] As in the returns experiment, we find highly similar effects on the unweighted sample. The impact of the cost experiment is small and statistically insignificant in the short- and medium-term: for the likelihood of recommending college for a friend's child, for example, the treatment effects are 0.2 percentage points and 0.6 percentage points, respectively.

[34] Table A7 shows a significant medium-term impact of a 4.5 percentage point increase for own child's attendance expectations (an impact that was not present in the initial survey). Without additional data, we can only speculate on why this might have happened. The cost experiment, for example, may have caused respondents with college-age children to look up additional sources of information on college costs (between the initial and follow-up survey).

[35] OLS estimates are reported in the table. We also estimate tobit regressions, since the dependent variable is censored. Results (available upon request from the authors) are qualitatively similar and even stronger.

[36] Table A9 is the analog of Table 7, except that it does not weight the data. We see that results are qualitatively similar.

Table 7
Mechanisms underlying experimental impacts.

Dependent variable:	Δ Child's college		Δ Child's	Δ Own child's
	Attendance[a]		RCE[b]	Net cost[c]
	(1)	(2)	(3)	(4)
Returns experiment[d] (β_1)	3.05***	2.97***	0.024	0.50
	(0.51)	(0.51)	(0.023)	(1.2)
Returns exp. × RCE error[e] (β_5)		−0.64	−0.18***	−3.55
		(1.1)	(0.052)	(3.0)
Cost experiment (β_2)	−0.56	−0.50	0.007	−5.66***
	(0.45)	(0.49)	(0.015)	(1.6)
Cost exp. × Cost error[f] (β_6)		−0.005	−0.001	−0.35***
		(0.024)	(0.001)	(0.10)
RCE error (β_3)		−0.57	0.011	−1.57
		(0.59)	(0.02)	(2.2)
Cost error (in \$1,0001000s) (β_4)		0.001	0.001*	−0.002
		(0.013)	(0.0006)	(0.027)
Demographics[g]	Yes	Yes	Yes	Yes
R^2	0.22	0.22	0.12	0.47
Number of observations	1074	1074	1074	305
Mean of dep. var.	0.78	0.75	0.018	−3.9

Weighted OLS estimates of a regression of the dep. variable on correlates. Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels, respectively.

[a] Revision in the expected likelihood reported by respondent that (own or friend's) child will attend college.

[b] Revision in the Relative College Earnings (RCE) reported by respondent for (own or friend's) child.

[c] Revision in net cost beliefs for own child.

[d] Dummy that equals 1 if respondent is assigned to the returns treatment.

[e] Returns error is the subjective population RCE minus the true population RCE.

[f] Cost error is perceived public university cost minus true public university cost (in \$1,0001000s).

[g] See Table 3 notes for the set of demographic characteristics.

5.2. Mechanisms

Because we collect data on respondents' priors about the information presented in our treatments, we can shed light on the mechanisms that lead to their belief revisions. Let $T_{\text{Returns},i}$ ($T_{\text{Cost},i}$) be an indicator for respondent i being assigned to the returns (cost) treatment, and let $Err_{\text{Return},i}$ denote the error in i's perception of college returns, defined as the perceived population RCE minus the true population RCE, so a positive (negative) error indicates over-estimation (under-estimation) of college returns. Likewise, $Err_{\text{Cost},i}$ is the error in i's average public university net cost beliefs.[37] Consider the following regression framework:

$$\begin{aligned}\Delta\text{College}\quad\text{Attendance}_i = {} & \beta_0 + \beta_1 T_{\text{Returns},i} + \beta_2 T_{\text{Cost},i} + \beta_3 Err_{\text{Return},i} \\ & + \beta_4 Err_{\text{Cost},i}\beta_5(T_{\text{Returns},i} \times Err_{\text{RCE},i}) \\ & + \beta_6(T_{\text{Cost},i} \times Err_{\text{Cost},i}) + \varepsilon_i,\end{aligned} \tag{1}$$

where the dependent variable is the revision in i's reported intended college attendance. The constant term, β_0, captures the average revision for the Control group. $\beta_0 + \beta_1$, for example, reflects the average revision for respondents assigned to the returns treatment whose error in college returns is zero. β_3 captures average revisions related to error in college returns for respondents in the control and cost treatment groups (to whom true college returns were never revealed). Finally, β_5 (β_6) shows the mean revision with respect to a unit error in college returns (costs) for respondents assigned to the returns (cost) treatment.

Salience-based updating would imply systematic revisions simply due to exposure to information related to college attendance; in that case, β_1 and/or β_2 would be statistically different from zero. Information-based updating would imply that revisions are systematically related to the informativeness of the provided information; that is, β_5 and/or β_6 would be non-zero. We do not expect β_3 or β_4 to be systematically different from zero.

We first present visual evidence on the relationship between belief errors and post-treatment revisions (for own child). Fig. 6 displays binned scatter plots of the mean revisions in beliefs for participants in the Returns and Cost Experiments by the relevant error bin decile. Panel (a) shows some evidence of respondents in the Returns Experiment systematically revising their own child's expected RCE, with a weak negative relationship between revisions and the error. That is, respondents who over- (under-) predict the population RCE revise down (up) the child's RCE. Panel B shows that participants with a lower $Err_{\text{Return},i}$ (that is, those with greater underestimation or less overestimation of population RCE beliefs) experienced larger increases in their child's college attendance expectations than those with a larger $Err_{\text{Return},i}$. This pattern would be consistent with respondents updating in a way that is proportional to the informational content of the provided signal. However, all but one bin (even those with positive $Err_{\text{Return},i}$) reported increased college attendance expectations; the fitted trend line suggests a range of 2–6 percentage point average experimental increases across the distribution of initial population RCE beliefs. The Cost Experiment, on the other hand, had minimal effect on college attendance expectations for most population net public cost bins despite large and systematic adjustments in expected net costs shown in Panel (c); the fitted line of changes in college attendance expectations in Panel (d) is approximately horizontal at 0.

OLS estimates of Eq. (1) are presented in column (2) of Table 7. Neither β_5 nor β_6 is precisely estimated (and both are small in magnitude), indicating that observed revisions are unlikely to have resulted from information-based updating. Notably, the estimate of β_1 is positive and significant, further collaborating our conclusion that the treatment effect in the Returns experiment is a result of saliency. For the cost treatment, we do not find any evidence of either salience or information-based updating.

5.2.1. Discussion

Our analysis suggests that the returns treatment impact is primarily driven by information salience, while the cost experiment does not have any meaningful impact. Importantly, college attendance expectations react to the salience of *new population information* provided by treatment, not just the emphasis of the returns of university attendance; the control group were provided the latter emphasis but did not meaningfully revise their attendance expectations. While we cannot rule out alternative explanations like Hawthorne or experimenter demand effects, we believe that information salience better rationalizes our findings for several reasons. First, revisions of the returns treatment group are markedly different from those of the control group (who were also reminded of their baseline returns beliefs). Second, revisions of the returns treatment group persist into the medium term. Third, we observe systematic differential response by socioeconomic groups, which would otherwise be very hard to explain; under a Hawthorne model, survey demand effects would have to differentially and systematically impact socioeconomic groups.

We next investigate the channel through which the salience of the information treatment affects respondents' college attendance expectations, focusing on revisions in their beliefs about the child's RCE and net college costs. Recall that, after the provision of the information, self beliefs regarding college returns were re-elicited, as were self beliefs regarding own child's net college costs. Column (3) of Table 7

[37] Results are qualitatively similar if we use average private university net costs to construct the cost error.

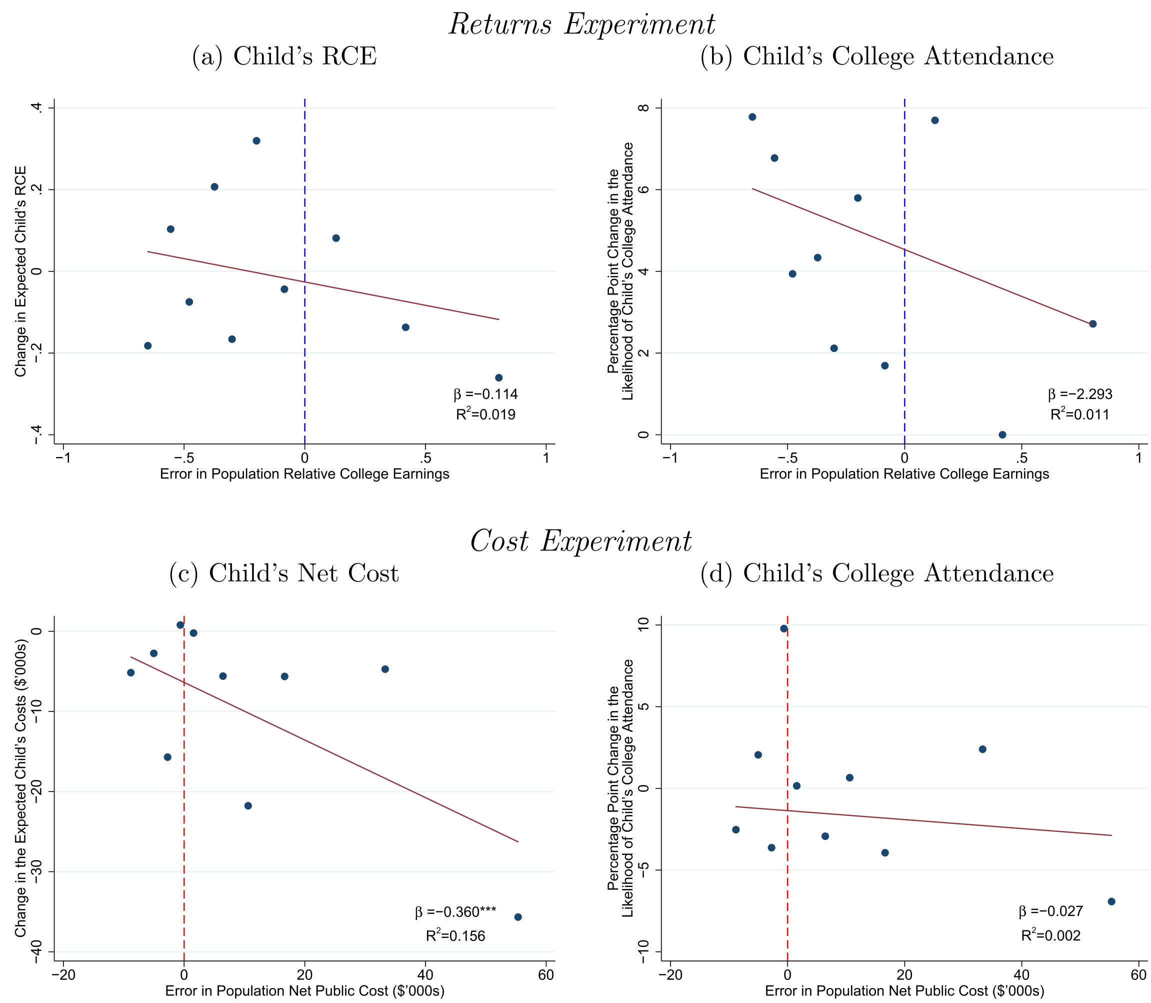


Fig. 6. Experimental revisions in own child expectations by initial population beliefs. Binned scatter plots of experimental revisions in own child self beliefs on pre-treatment errors in population RCE and average net public university cost beliefs. Error is defined as belief minus true value; overestimation is reflected by positive error. Fitted lines and statistics estimated at the individual level. Dotted lines show corresponding true values for population beliefs. For beta coefficients, *, **, *** denote estimates statistically significant at the 10, 5, and 1% levels, respectively.

reports estimates of a regression similar to that in Eq. (1) except that the dependent variable is the revision in *i*'s child's RCE beliefs. The perceived child's RCE of respondents in the returns treatment decreases by 0.18 points for each one-unit baseline overestimation of the population RCE. Likewise, column (4) shows a sizable impact of the cost treatment on respondents' beliefs regarding college costs: own child's net cost beliefs decline by $350 for each $1000 overestimation in average public university net cost, on top of a $5660 fixed decline in average college cost beliefs for respondents in the cost treatment. Thus, both the returns and cost treatments impact respondents' beliefs about college returns and costs (as also seen in Panels a and c of Fig. 6).

That the cost experiment leads to a revision in college cost beliefs but not intended college attendance remains a puzzle. One concern for information experiments is the degree of credibility assigned to the provided information. In the returns experiment, we inform respondents that the information presented comes from a survey "jointly sponsored by the US Bureau of Labor Statistics and the Census Bureau." On a credibility scale from 1 to 5, where 1 is "absolutely not credible/ useful" and 5 is "absolutely credible/useful", 57% of respondents rated the information's credibility 4 or 5 (which we consider finding the information credible), with another 29% rating its credibility 3.[38] Column (1) of Table 8 shows that respondents who found the returns information credible revised their college attendance expectations upwards by about 2.8 percentage point more than those who did not find the information credible.[39]

Credibility played a more important role in the impact of the cost experiment on expected college attendance. The cost experiment presents information "according to the College Board," which many respondents likely recognized as the nonprofit corporation that facilitates the popular SAT college examination. Respondents' distribution of credibility was very similar to that of respondents in the returns experiment: 62% of respondents found the information credible (rating the information's credibility 4 or 5 out of 5), with another 23% rating

[38] College-educated respondents were more likely to report finding the information credible. Respondents with higher population returns beliefs were also more likely to find the information credible, suggesting that those whose beliefs conformed more closely to the information were more likely to believe it.

[39] We also find more positive revisions in child's RCE expectations for respondents who find the information credible versus those who do not. The mean revision in own child RCE expectations is 0.07 for those who find the information credible versus -0.11 for the counterparts (difference statistically significant at 10%). The corresponding changes for friend's child are 0.10 versus 0.01 (also significantly different at 10%).

Table 8
Experimental impacts - mechanisms.

Dependent variable:	Δ College		
	Attendance expectations[a]		
	(1)	(2)	(3)
Returns experiment	1.40**	0.86	2.76***
	(0.65)	(0.54)	(0.46)
⋯ ×Credibility dummy[b]	2.79***	3.40***	
	(0.92)	(0.85)	
⋯ ×Population RCE error[c]		−2.01	
		(1.2)	
⋯ ×Cred. × RCE err.		1.68	
		(2.1)	
⋯ ×Δ Child's RCE[d]			5.46***
			(1.4)
Cost experiment	−1.65**	−1.75**	−0.26
	(0.75)	(0.85)	(0.46)
⋯ ×Credibility dummy	1.73**	1.92**	
	(0.82)	(0.97)	
⋯ ×Population cost error[e]		0.002	
		(0.03)	
⋯ ×Cred. × Cost err.		−0.009	
		(0.04)	
⋯ ×Δ Child's net cost			0.13**
			(0.054)
Population RCE error		−0.70	
		(0.61)	
Population Cost error		0.004	
		(0.01)	
Demographics[f]	Yes	Yes	Yes
R^2	0.24	0.25	0.26
Number of observations	1074	1074	1074
Mean of dep. var.	0.78	0.78	0.78

Weighted OLS estimates of a regression of the dep. variable on correlates. Robust standard errors in parentheses. *, **, *** denote sig at the 10, 5, and 1% levels, respectively.

[a] Revision in the expected likelihood reported by respondent that (own or friend's) child will attend college.

[b] An indicator for whether the respondent rated the experimental information's credibility 4 or 5 (high-credibility), on a 5-point scale.

[c] Difference between population RCE belief and the true value (1.80).

[d] The revision in child's RCE beliefs.

[e] Difference between population net public cost belief and the true value ($12,620).

[f] See Table 3 notes for the set of demographic characteristics.

its credibility 3. As in the returns experiment, people with more accurate population net public college costs found the information more credible. Column (1) of Table 8 shows that respondents who found the information credible were largely unaffected by the treatment, while those who did not find the information credible in fact revised their attendance expectations downward by 1.7 points.[40] Column (2) interacts credibility with the coefficients estimated in Eq. (1); we see that the interaction terms of credibility with RCE and net cost error are estimated as small and statistically insignificant, indicating that responsiveness to error in the prior is not related to the perceived credibility of the information.

Finally, column (3) of Table 8 interacts experimental participation with respondents' (final minus baseline) change in self beliefs, which for the returns (cost) experiment entails interacting the treatment with revisions in the child's expected RCE (net costs). If revisions in self beliefs are a channel through which respondents revise the intended likelihood of the child's college attendance, we would expect these interaction terms to be statistically significant. Indeed, respondents who increase their perceived child's RCE by 0.1 points have a 0.55 point higher increase in the expected likelihood of their child attending college. Somewhat surprisingly, respondents who decrease college cost beliefs for their child by $10,000 decrease child's attendance beliefs by 1.3 percentage points, mirroring a similar result in the baseline correlations.[41] Notably, the indicator for the returns experiment retains a large and highly statistically significant relationship with college attendance expectations, implying the presence of important alternative channels (alongside individuals' updating self beliefs about college returns). The continued significance of the indicator for the returns experiment is consistent with respondents revising their college attendance beliefs as a result of the salience of the provided information (Dellavigna, 2009).

6. Conclusion

This paper focuses on biased information as one explanation for the United States' stagnant college enrollment rate and socioeconomic gradient in college attendance. We report results from two randomized information experiments. In the first, respondents are informed about college-educated workers' annual earnings relative to those of non-college workers. In the second experiment, respondents are informed about the average annual net costs of public and non-profit private universities in the US.

We find that respondents are more reactive to college returns information than to college cost information. At the baseline, household heads tend to underestimate benefits and overestimate net costs of a college degree. The bias in population beliefs is not systematically related to the presence of a college-age child in the household, as would be the case if the information gaps were due to rational inattention. The underestimation of college benefits is greater among disadvantaged respondents. We find that the college returns intervention has an immediate positive impact on the intended likelihood of parents sending their child to college or recommending college for their friend's child, and has substantially larger impacts on disadvantaged respondents, closing each of the education and income gaps in parents' expectations of their children's college attendance by about 30% (and the recommendation gaps by 15%). We show that changes in college attendance expectations are partly a result of respondents revising the child's expected college returns, but largely due to the salience of college returns. Finally, we confirm the persistence of these results with a follow-up survey two months later.

On the other hand, we find no descriptive or experimental evidence of a relationship between cost beliefs and expected college attendance. The lack of any meaningful impact of the cost experiment is somewhat surprising, since respondents (1) substantially revise beliefs regarding the child's college costs in a sensible way as a result of the cost information, and (2) find the cost information to be as credible as the returns information. One explanation for the muted impact of the cost experiment is the finding in the literature that individuals discount costs/losses at a higher rate (Loewenstein and Prelec, 1992; Abdellaoui et al., 2010), but given that college costs are incurred far in advance of the associated returns, the discount rate for costs would have to be substantially higher. Another possibility is that, given the large variation in net college costs, personalized college cost information (as in Hoxby and Turner, 2013) is needed for individuals to respond to cost information. The cost information may also be more difficult to interpret, presented as dollar amounts separately for public and private universities (instead of the simple RCE ratio for rewards information), and may only be interpreted as covering one of the many costs associated with college attendance (mitigating its impact on respondents'

[40] Revisions in child's net cost expectations were similar among those who reported finding the information credible (-$10,100) versus not credible (-$8,9008900).

[41] It could be that individuals who are more responsive to the cost treatment – and hence revise their child's expected college costs to a greater degree – also are impacted more by a negative salience effect of the cost information.

cost-benefit analysis). In addition, it is possible that the cost intervention had no effect on attendance because it revised expected costs from one too-large-to-comprehend number to a smaller-but-still-too-large-to-comprehend number. These explanations are speculative, and warrant future research.

We show an impact of college-relevant information on *expectations* (or recommendations) of child's college attendance. Our impact of a 0.2 standard deviation increase in intended college attendance expectations is higher than the 0.11–0.12 standard deviation increase in actual college enrollment found for more targeted and expensive informational interventions (Carrell and Sacerdote, 2012; Hoxby and Turner, 2013). It could be that expectations overstate actual responsiveness. Likewise, while we show that the socioeconomic gaps in expected college attendance decline substantially as a result of the intervention, the impact on actual gaps will depend on the extent to which the different demographic groups follow through on their intentions. Thus, it would be useful to conduct an intervention similar to that in the current study to study impacts on *actual* outcomes.

On the policy front, the large biases regarding perceived college costs and benefits, and the sizable impacts of our (returns) information experiment, suggest a role for broader information campaigns focused on providing accurate information on schooling returns. Given the low cost of information interventions and the large gaps in individuals' knowledge that we document, the policy case for conducting such campaigns is clear. In addition, our results, based on a representative sample of household heads, are informative about the effects of various current and proposed informational interventions (such as the Department of Education's College Scorecard), and the channels through which they may impact choices. For example, our finding that the impact of the returns treatment is largely driven by salience suggests that repeated dissemination of information, or increasing the visibility of information at key points in time (such as around the deadline for applying to college) may be more impactful than one-time interventions.

In our study, respondents do not get to *choose* the information to which they are exposed. Outside of our experimental setting, individuals' decisions to seek, avoid, or ignore certain information is endogenous. Information regarding actual college costs and benefits is already in the public domain (in yearly reports like Baum and Ma (2013) and NCES (2013), the College Scorecard, and popular journalism like Pérez-Peña (2013)), implying that our respondents have chosen to stay uninformed about these statistics. Our finding that households with pre-college-aged children are not being better informed at the baseline suggests that the choice to stay misinformed is not entirely a result of rational inattention. In addition, our information treatments provide information about average returns and costs only. It would be useful to investigate the impact of providing information about other statistics of the underlying distribution. We believe understanding the process of information acquisition and how to target information effectively is an important avenue for future research. Finally, our intervention targets household heads only. In the real world, educational choices are likely to be made jointly by the student and other members of the household such as the parent (see, for example, Giustinelli, 2016). It would be useful to conduct information interventions (and collect data similar to those in this study) that target both the student and other relevant household members to understand human capital investment decisions.

Appendix A. Questionnaire

A.1. Main survey

We would next like to ask you a few questions about education.

Q1. What is the highest level of school you have completed, or the highest degree you have received?

- Less than high school
- High school diploma (or equivalent)
- Some college but no degree
- Associate/Junior College degree
- Bachelor's Degree (For example: BA, BS)
- Master's Degree (For example: MA, MBA, MS, MSW)
- Doctoral Degree (For example: PhD)
- Professional Degree (For example: MD, JD, DDS)
- Other (please specify) _______

Q2. Have you or any other member of your household **ever** taken out a student loan? *Please select all that apply*.

(a) I have taken out a student loan
(b) My spouse has taken out a student loan
(c) My child (or children) has taken out a student loan
(d) None of the above

Q3. Roughly speaking, what are your **current annual** earnings, before taxes and other deductions?

[If Q1 ≥ Bachelor's Degree] Q4a. Roughly speaking, what do you think your **annual** earnings would be, before taxes and other deductions, IF you only had a high school diploma?

[If Q1 < Bachelor's Degree] Q4b. Roughly speaking, what do you think your **annual** earnings would be, before taxes and other deductions, IF you only had a Bachelor's Degree?

Q5a. Consider all non-college individuals (that is, individuals without a Bachelor's degree) currently aged 40 who are working full time right now. What do you believe is the average amount that these workers currently earn per year, before taxes and other deductions? _______ dollars per year

Q5b. Consider all college graduate individuals (that is, individuals with at least a Bachelor's degree) currently aged 40 who are working full time right now. What do you believe is the average amount that these workers currently earn per year, before taxes and other deductions? _______ dollars per year

Q6a. **Sticker** cost is a college's published cost of attendance. The cost of attendance includes tuition, fees and housing as well as other important costs like books, supplies and transportation. What is your best guess of the current average annual **sticker** cost of a 4-year Bachelor's degree at a:

public university? _______

nonprofit private university? _______

Q6b. Many students who go to college qualify for grants and scholarships (money that students get that they don't have to work for or pay back), and as a result end up paying ***less*** than the sticker cost. This cost of college after taking into account grants and scholarships is referred to as the **net** college cost. This is the amount that students actually have to pay. What is your best guess of the current average annual **net** cost of a 4-year Bachelor's degree at a:

public university? _______

nonprofit private university? _______

Q7a. Do you have any children under the age of 18?

- Yes, ____ child/children
- No

[If Q7a = yes] Q7b. Consider the oldest child in your household under the age of 18. How many years old is this child? [show drop-down menu that goes from 1 to 18]

[If Q7a = yes] Q8a. Consider the oldest child in your household under the age of 18. What is the percent chance that this child will attend college in the future?

[If Q7a = yes] Q8b. If this child were to attend college, what do you think the annual net college cost (the cost that the child and/or the family will actually have to pay) would be? Please ignore the effects of inflation.

[If Q7a = yes and Q8a > 0] Q8c. What is the percent chance that you or this child would have to take out a student loan for the child's college education?

[If Q7a = yes] Q8d. And, what is the percent chance that this child will attend college if college was totally free (that is, the cost was zero)?

[If Q7a = yes] Q9. Look ahead to when this child will be 30 years old, and working full time. Think about the child's earnings at age 30. When answering these questions, please ignore the effects of price inflation on earnings. That is, assume that one dollar today is worth the same as one dollar when the child is 30 years old. What do you think the child will be earning annually, before taxes and other deductions, at age 30:

- if he/she had at least a Bachelor's Degree? _______
- if he/she did not have a 4-year college degree? _______

Q10. A friend of yours has sought your advice about whether to send their 15-year old child to college for a 4-year degree. The child is currently in high school and performing well. What is the percent chance that you would recommend a college education for the child to your friend?

[If Q7a = no] Q11. Look ahead to when this child will be 30 years old, and working full time. Think about the child's earnings at age 30. When answering these questions, please ignore the effects of price inflation on earnings. That is, assume that one dollar today is worth the same as one dollar when the child is 30 years old. What do you think the child will be earning annually, before taxes and other deductions, at age 30:

- if he/she had at least a Bachelor's Degree? _______
- if he/she did not have a 4-year college degree? _______

Respondents are randomly placed into one of three equally-sized blocks: A, B, and C.

Questions for Block A

[Note: all information and questions below are shown on the same page, but sequentially]

Earlier in the survey you stated that you think current 40-year-old college-educated individuals (that is, individuals with at least a Bachelor's degree) working full-time earn $[Q5b] per year on average, and that non-college individuals earn $[Q5a] per year.

That is you think, on average, college-educated workers earn **[Q5b / Q5a]** times as much as non-college workers (that is, **[(Q5b / Q5a − 1) * 100] %** [more/less]).

Analysis based on the 2012–2013 Current Population Survey shows that college-educated full-time workers in fact earn 1.80 times as much as non-college workers (that is, 80% *more* than non-college workers)

The Current Population Survey is a survey jointly sponsored by the US Bureau of Labor Statistics and the Census Bureau.

Q12. On a scale of 1–5, how credible and useful do you find this information?

(a) Absolutely not credible/useful
(b) Absolutely credible/useful

In light of this information, we would like to re-ask some questions.

[If Q7a = yes] Q13a. Again consider the oldest child in your household under the age of 18. What is the percent chance that this child will attend college in the future?

[If Q7a = yes] Q13b. If this child were to attend college, what do you think the annual net college cost (the cost that the child and/or the family will actually have to pay) would be? Please ignore the effects of inflation.

[If Q7a = yes] Q13c. And, what is the percent chance that this child will attend college if college was totally free (that is, the cost was zero)?

[If Q7a = yes] Q14. As before, look ahead to when this child will be 30 years old, and working full time. Think about the child's earnings at age 30. When answering these questions, please ignore the effects of price inflation on earnings. That is, assume that one dollar today is worth the same as one dollar when the child is 30 years old. What do you think the child will be earning annually, before taxes and other deductions, at age 30:

- if he/she had at least a Bachelor's Degree? _______
- if he/she did not have a 4-year college degree? _______

Q15. A friend of yours has sought your advice about whether to send their 15-year old child to college for a 4-year degree. The child is currently in high school and performing well. What is the percent chance that you would recommend a college education for the child to your friend?

[If Q7a = no] Q16. As before, look ahead to when this child will be 30 years old, and working full time. Think about the child's earnings at age 30. When answering these questions, please ignore the effects of price inflation on earnings. That is, assume that one dollar today is worth the same as one dollar when the child is 30 years old. What do you think the child will be earning annually, before taxes and other deductions, at age 30:

- if he/she had at least a Bachelor's Degree? _______
- if he/she did not have a 4-year college degree? _______

Questions for Block B

[Note: all information and questions below are shown on the same page, but sequentially]

Earlier in the survey we had asked you about college **net** costs. This is the cost of college after taking into account grants and scholarships (money that students get that they don't have to work for or pay back), and is the price that students *actually* have to pay. In many cases, this is less than the published college cost (the sticker cost).

You had stated that you expect the average annual **net** cost of a Bachelor's degree at a 4-year public university to be $**[Q6a1]** and at a 4-year nonprofit private university to be $**[Q6a2]**.

According to the College Board Annual Survey of Colleges, the average annual net cost of a 4-year public university in 2013–2014 was $12,620, while that of a 4-year nonprofit private university was $23,290.

Q12. On a scale of 1–5, how credible and useful do you find this information?

(a) Absolutely not credible/useful
(b) Absolutely credible/useful

In light of this information, we would like to re-ask some questions.

[If Q7a = yes] Q13a. Again consider the oldest child in your household under the age of 18. What is the percent chance that this child will attend college in the future?

[If Q7a = yes] Q13b. If this child were to attend college, what do you think the annual net college cost (the cost that the child and/or the family will actually have to pay) would be? Please ignore the effects of inflation.

[If Q7a = yes] Q13c. And, what is the percent chance that this child will attend college if college was totally free (that is, the cost was zero)?

[If Q7a = yes] Q14. As before, look ahead to when this child will be 30 years old, and working full time. Think about the child's earnings at age 30. When answering these questions, please ignore the effects of price inflation on earnings. That is, assume that one dollar today is worth the same as one dollar when the child is 30 years old. What do you think the child will be earning annually, before taxes and other deductions, at age 30:

- if he/she had at least a Bachelor's Degree? _______
- if he/she did not have a 4-year college degree? _______

Q15. A friend of yours has sought your advice about whether to send their 15-year old child to college for a 4-year degree. The child is currently in high school and performing well. What is the percent chance that you would recommend a college education for the child to your friend?

[If Q7a = no] Q16. As before, look ahead to when this child will be 30 years old, and working full time. Think about the child's earnings at age 30. When answering these questions, please ignore the effects of price inflation on earnings. That is, assume that one dollar today is worth the same as one dollar when the child is 30 years old. What do you think the child will be earning annually, before taxes and other deductions, at age 30:

- if he/she had at least a Bachelor's Degree? _______
- if he/she did not have a 4-year college degree? _______

Questions for Block C

[Note: all information and questions below are shown on the same page, but sequentially]

Earlier in the survey you stated that you think current 40-year-old college-educated individuals (that is, individuals with at least a Bachelor's degree) working full-time earn $[Q5b] per year on average, and that non-college individuals earn $[Q5a] per year. That is you think, on average, college-educated workers earn **[Q5b/Q5a]** times as much as non-college workers (that is, **[(Q5b / Q5a − 1) * 100] %** [more/less]). We had also asked you about college **net** costs. This is the cost of college after taking into account grants and scholarships (money that students get that they don't have to work for or pay back), and is the price that students actually have to pay. In many cases, this is less than the published college cost (the sticker cost). You had stated that you expect the average annual **net** cost of a Bachelor's degree at a 4-year public university to be $**[Q6a1]** and at a 4-year nonprofit private university to be $**[Q6a2]**.

[If Q7a = yes] Q13a. Again consider the oldest child in your household under the age of 18. What is the percent chance that this child will attend college in the future?

[If Q7a = yes] Q13c. And, what is the percent chance that this child will attend college if college was totally free (that is, the cost was zero)?

Q15. A friend of yours has sought your advice about whether to send their 15-year old child to college for a 4-year degree. The child is currently in high school and performing well. What is the percent chance that you would recommend a college education for the child to your friend?

A.2. Follow-up survey

We would next like to ask you a few questions about education.

Q5a. Consider all non-college individuals (that is, individuals without a Bachelor's degree) currently aged 40 who are working full time right now. What do you believe is the average amount that these workers currently earn per year, before taxes and other deductions? _______ dollars per year

Q5b. Consider all college graduate individuals (that is, individuals with at least a Bachelor's degree) currently aged 40 who are working full time right now. What do you believe is the average amount that these workers currently earn per year, before taxes and other deductions? _______ dollars per year

Q6b. Many students who go to college qualify for grants and scholarships (money that students get that they don't have to work for or pay back), and as a result end up paying ***less*** than the sticker cost. This cost of college after taking into account grants and scholarships is referred to as the **net** college cost. This is the amount that students actually have to pay. What is your best guess of the current average annual **net** cost of a 4-year Bachelor's degree at a:

public university? _______
nonprofit private university? _______

Q7a. Do you have any children under the age of 18?

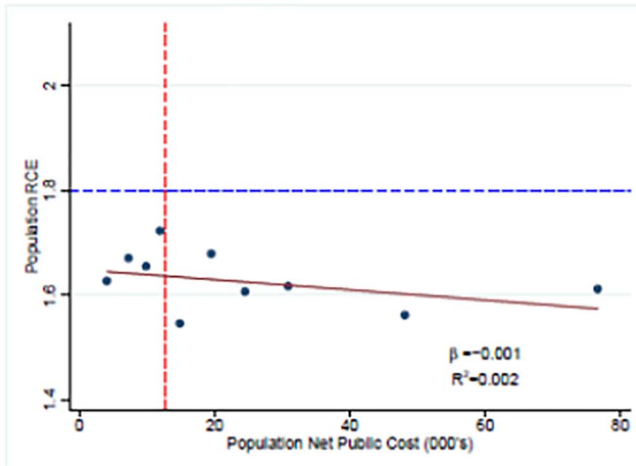
- Yes, ___ child/children
- No

[If Q7a = yes] Q8a. Consider the oldest child in your household under the age of 18. What is the percent chance that this child will attend college in the future?

[If Q7a = yes] Q8b. If this child were to attend college, what do you think the annual net college cost (the cost that the child and/or the family will actually have to pay) would be? Please ignore the effects of inflation.

Q10. A friend of yours has sought your advice about whether to send their 15-year old child to college for a 4-year degree. The child is currently in high school and performing well. What is the percent chance that you would recommend a college education for the child to your friend?

(a) Population Beliefs



(b) Self Beliefs

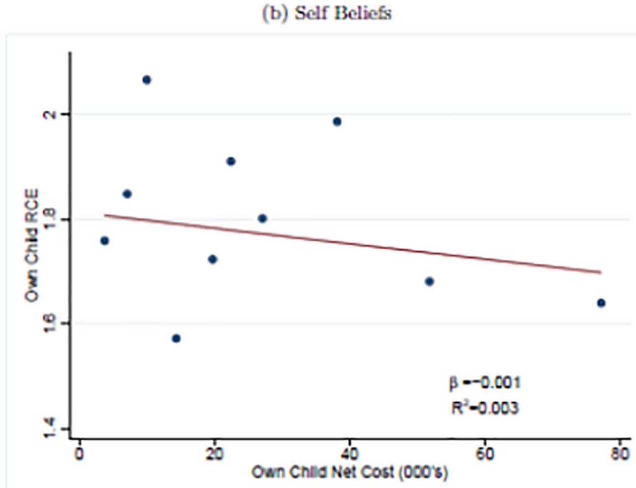


Fig. A1. Comparison between RCE and cost beliefs. Binned scatter plots of respondents' population and RCE beliefs by their population and self net university cost beliefs. Fitted lines and statistics estimated at the individual level. Dotted lines show corresponding true values for population beliefs. For beta coefficients, *, **, *** denote estimates statistically significant at the 10, 5, and 1% levels, respectively.

Table A1

Selection into the follow-up survey.

Dep var: Participation in the follow-up survey			
	(1)	(2)	(3)
Population RCE belief[a]		3.67	12.1
		(3.3)	(9.3)
Pu. univ. net cost belief[b]		−0.058	0.30*
		(0.07)	(0.16)
Child RCE[c]			−7.78
			(7.1)
Child net univ. cost[d]			−0.29*
			(0.16)
Child's college likelihood[e]			−0.16
			(0.14)

Friend's child's likelihood[f]			.011
			(0.17)
Returns experiment dummy		−0.43	2.27
		(3.6)	(7.7)
Cost experiment dummy		1.63	11.7
		(3.7)	(7.6)
Low income	4.91	4.6	10.1
	(3.6)	(3.6)	(8.3)
Non-college	2.43	2.31	13.4**
	(3.0)	(3.0)	(6.8)
Male	3.68	3.92	10.2
	(3.1)	(3.1)	(6.3)
White	2.88	2.55	−11.1
	(4.7)	(4.7)	(6.9)
Age	0.41***	0.43***	0.48
	(0.12)	(0.11)	(0.38)
High numeracy	−0.56	−0.92	3.28
	(3.5)	(3.5)	(7.5)
Has child under age 18	−11.5**	−11.9**	
	(5.2)	(5.1)	
Has child age 14–17	8.76	8.94	6.26
	(6.9)	(6.8)	(8.2)
Local area % BAs	0.08	.06	−.14
	(0.19)	(0.19)	(0.46)
Local area median inc. (000s)	−.003	.005	−.02
	(0.12)	(0.12)	(0.27)
Local area RCE	0.15	0.24	−6.16
	(3.9)	(4.0)	(11)
Flagship county	−4.11	−3.77	4.16
	(4.5)	(4.4)	(7.6)
Elite university county	2.98	2.95	8.59
	(3.7)	(3.7)	(8.0)
State pub. univ. sticker cost	0.31	0.37	0.073
	(0.52)	(0.52)	(1.0)
State priv. univ. sticker cost	−0.10	−0.11	0.14
	(0.27)	(0.26)	(0.46)
Constant	50.6***	44.3***	49.6
	(15)	(16)	(39)
F-statistic	3.94***	3.37***	1.51*
R^2	0.07	0.07	0.12
Number of observations	951	951	272
Mean of dep. variable	81	81	70

Weighted OLS estimates of a linear probability model for participation in the follow-up survey on various controls. Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels,respectively. Col (3) restricted to those with college-age children.

[a] Relative College Earnings (RCE) is the ratio of the average earnings of 40-year-olds with a college degree to that of those without a college degree.

[b] Population public university net cost belief.

[c] RCE and public university net cost beliefs for one's own child.

[d] The expected likelihood of a respondent's child attending college.

[e] The expected likelihood of a respondent recommending college for a friend's child.

[f] F-statistic of a test of the joint significance of the covariates.

Table A2
Baseline beliefs (medians).

	All	Non-college[a]	College	Lower-inc.[b]	Higher-inc.
Observations	1077	505	572	403	674
Panel A: Population earnings beliefs					
Earnings of non-college workers ('000)	35	35	35***	30	40***
	(12)	(12)	(11)	(11)	(12)
Earnings of college workers ('000)	55	55	60***	50	60***
	(18)	(19)	(17)	(18)	(17)
Population Relative College Earnings (RCE)[c]	1.54	1.50	1.62***	1.50	1.57***
	(.41)	(.43)	(.38)	(.45)	(.38)
Absolute error in population RCE[d]	0.36	0.39	0.30***	0.40	0.30***
	(0.27)	(0.28)	(0.26)	(0.28)	(0.26)

Panel B: Population cost beliefs					
Public university sticker cost ('000s)	25	25	20***	25	23***
	(22)	(22)	(21)	(22)	(22)
Public university net cost ('000s)	16	16	15***	17.5	15***
	(20)	(20)	(20)	(20)	(21)
Private university sticker cost ('000s)	40	36	44***	35	40***
	(24)	(24)	(22)	(24)	(23)
Private university net cost ('000s)	28	25	30***	25	30***
	(24)	(24)	(24)	(24)	(24)
Panel C: Self beliefs					
Own child's RCE	1.67	1.6	1.67***	1.67	1.67
	(0.6)	(0.6)	(0.4)	(0.7)	(0.5)
Friend's child's RCE	1.5	1.5	1.6***	1.5	1.57***
	(0.4)	(0.5)	(0.4)	(0.5)	(0.4)
Own child's net college cost	20	18	20***	17	20
	(21)	(20)	(23)	(21)	(21)
Own child's likelihood of coll. attendance	90	80	95***	80	95***
	(25)	(26)	(19)	(29)	(19)
Likelihood to recommend coll. to friend	100	95	100	90	100
	(26)	(29)	(18)	(30)	(21)

Weighted median reported in cells; standard deviation in parentheses.
Pairwise non-parametric tests conducted for equality of the variable median (null hypothesis: the two samples were drawn from populations with the same median) for college versus non-college respondents; and for lower-income and higher-income respondents. *, **, *** estimate statistically significant at the 10, 5, and 1% levels, respectively.
[a] Non-college refers to households in which the household head does not have a four-year college degree.
[b] Lower-income refers to households with annual income of less than or equal to $50,000.
[c] Relative College Earnings (RCE) is the ratio of the average earnings of 40-year-olds with a college degree to that of those without a college degree.
[d] The absolute gap between the subjective population RCE and actual RCE.

Table A3
Alternative true population RCE specifications.

	All	Non-college	College	Lower-inc.	Higher-inc.
Observations	1077	505	572	403	674
Absolute error in pop. RCE					
BA / non-BA earnings [1.80]	.406	.434	.354***	.45	.367***
	(.27)	(.28)	(.26)	(.28)	(.26)
BA / AB grad. earn. [1.57]	.347	.365	.313**	.382	.316***
	(.3)	(.31)	(.28)	(.33)	(.27)
BA / HS grad. earn. [1.77]	.394	.421	.342***	.437	.355***
	(.27)	(.28)	(.26)	(.29)	(.26)
BA / HS drop-out earn. [2.44]	.882	.912	.825***	.908	.859*
	(.35)	(.36)	(.32)	(.36)	(.33)
BA / non-BA earn., age 30 [1.65]	.356	.379	.312***	.395	.321***
	(.29)	(.29)	(.27)	(.31)	(.26)
Proportion who overestimate pop. RCE					
BA / non-BA earn.	28.9	28.4	29.9	28.7	29.1
BA / AB grad. earn	49	45.6	55.3***	46	51.6
BA / HS grad. earn.	31	30.4	32.1	29.9	32
BA / HS drop-out earn.	7.37	7.72	6.7	9.7	5.3**
BA / non-BA earn., age 30	41.3	37.9	47.7***	38.1	44.1

Note: Weighted average absolute error in population RCE beliefs and proportion who overestimate population beliefs, overall and by subgroup, for various definitions of 'true' population RCE beliefs. Baseline is defined as the earnings of full-time-employed age-40 college graduates over the earnings of full-time-employed age-40 non-graduates. Alternatives include defining the denominator as age-40 individuals with only an AB (two-year) post-secondary degree, individuals with only a high school degree, or individuals who dropped out of high school, or using age-30 estimates of average college and non-college wages. 'True' statistics calculated using the 2012–2013 Current Population Survey. *, **, *** estimate statistically significant at the 10, 5, and 1% levels, respectively.

Table A4
Heterogeneity in baseline population beliefs.

Dependent variable:	Population	Abs. err. in	Pop. public	Pop. private
	RCE[a]	Pop. RCE[b]	Sticker cost	Sticker cost
	(1)	(2)	(3)	(4)
Non-college	−0.049	0.045**	1.5	−0.87
	(−1.6)	(2.3)	(0.97)	(−0.61)
Lower-income	0.027	0.051**	−2.5	−1.5
	(0.77)	(2.1)	(−1.3)	(−0.94)
Male	−0.056*	−0.0023	−3.1*	−0.56
	(−1.8)	(−0.11)	(−1.9)	(−0.38)
White	0.080**	0.005	−1.7	−0.43
	(2.2)	(0.17)	(−0.77)	(−0.21)
Age	−0.0002	0.001	0.20***	0.15***
	(−0.18)	(1.5)	(3.6)	(2.6)
High numeracy	0.10***	−0.063**	−1.1	−0.60
	(2.7)	(−2.5)	(−0.62)	(−0.37)
Has child under age 18	0.030	0.0088	−4.0*	−2.4
	(0.73)	(0.28)	(−1.9)	(−1.3)
Has child age 14–17	0.076	−0.052	2.6	5.5*
	(1.2)	(−1.2)	(0.92)	(1.8)
Local area % college-educated	0.004*	−0.001	0.10	−0.016
	(1.8)	(−0.88)	(1.0)	(−0.19)
Local area median inc (000's)	−0.003**	0.001	−0.05	0.002
	(−2.0)	(1.6)	(−0.82)	(0.040)
Local area RCE	−0.0097	0.042	−0.96	0.57
	(−0.24)	(1.6)	(−0.43)	(0.29)
Flagship county	−0.067*	0.017	−0.25	−1.4
	(−1.9)	(0.68)	(−0.12)	(−0.79)
Elite university county	−0.055	0.011	−3.0	−2.4
	(−1.3)	(0.44)	(−1.6)	(−1.3)
Local private sticker cost	0.003	−0.001	−0.12	−0.11
	(1.1)	(−0.93)	(−0.98)	(−1.0)
Local public sticker cost	−0.003	−0.0006	0.37	0.72***
	(−0.53)	(-0.18)	(1.3)	(2.9)
Constant	1.6***	0.29**	23.8***	5.8
	(8.9)	(2.6)	(3.1)	(0.73)
F-statistic[c]	2.5***	2.83***	2.5***	2.2***
R^2	0.041	0.049	0.043	0.034
Number of observations	1077	1077	1077	1077
Mean of dep. var.	1.6	0.41	30	23

Weighted OLS estimates of a regression of the dependent variable on various controls.
Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels, respectively.
[a] Relative College Earnings (RCE) is the ratio of the average earnings of 40-year-olds with a college degree to that of those without a college degree.
[b] The absolute gap between the subjective population RCE and actual population RCE.
[c] F-statistic of a test of the joint significance of the covariates.

Table A5
Heterogeneity in baseline self beliefs.

Dependent variable:	Own child's attendance[a]				Friend's child's attendance[b]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Own child's RCE[c]			4.26	3.20				
			(1.6)	(1.0)				
Friend's child's RCE							16.4***	15.4***
							(5.6)	(4.5)
Own child's college cost			0.16**	0.13				
			(2.3)	(1.6)				
Population RCE		6.12*		3.66		9.02***		1.59
		(1.8)		(0.83)		(3.4)		(0.44)
Pop. public net cost		0.010		0.039		0.0060		−0.014
		(1.4)		(0.45)		(0.11)		(−0.22)
Non-college	−4.54	−5.08*	−3.03	−4.20	−7.44***	−6.79***	−4.99**	−5.23**

	(−1.5)	(−1.8)	(−1.0)	(−1.5)	(−3.9)	(−3.6)	(−2.3)	(−2.4)
Lower-income	−11.3***	−11.2***	−11.7***	−11.4***	−6.75***	−7.40***	−9.64***	−9.61***
	(−2.9)	(−2.8)	(−3.0)	(−2.9)	(−3.0)	(−3.3)	(−3.8)	(−3.7)
Male	−3.74	−4.49	−3.07	−3.96	−3.80*	−4.48**	−1.69	−2.45
	(−1.1)	(−1.3)	(−0.87)	(−1.1)	(−1.8)	(−2.1)	(−0.67)	(−0.97)
White	−7.26*	−8.78**	−7.14*	−8.68**	−0.20	−0.27	0.80	1.13
	(−1.8)	(−2.1)	(−1.78)	(−2.1)	(−0.07)	(−0.10)	(0.22)	(0.31)
Age	0.0005	−0.0043	−0.022	−0.030	0.021	0.050	0.034	0.057
	(0.0)	(−0.02)	(−0.10)	(−0.13)	(0.26)	(0.62)	(0.41)	(0.68)
High numeracy	5.50	7.00*	6.42	7.43*	6.46**	7.04***	7.07**	7.70**
	(1.4)	(1.8)	(1.6)	(1.9)	(2.5)	(2.8)	(2.3)	(2.5)
Has child under age 18					4.52	4.07		
					(1.6)	(1.4)		
Has child age 14–17	2.05	1.62	2.36	2.73	9.03***	8.24**		
	(0.48)	(0.38)	(0.58)	(0.65)	(2.8)	(2.5)		
Local % college-educated	−0.41*	−0.47*	−0.40*	−0.48*	0.26**	0.21	0.34**	0.32**
	(−1.8)	(−1.9)	(−1.7)	(−1.9)	(2.0)	(1.6)	(2.5)	(2.3)
Local med. income (000's)	0.24*	0.26**	0.22*	0.25*	−0.083	−0.070	−0.17*	−0.17*
	(1.9)	(2.0)	(1.7)	(1.9)	(−1.0)	(−0.85)	(−1.9)	(−1.8)
Local area RCE	6.47	7.50	5.34	6.71	−2.17	−1.73	−2.31	−2.046
	(1.5)	(1.6)	(1.2)	(1.4)	(−0.83)	(−0.66)	(−0.74)	(−0.66)
Flagship county	8.55**	8.96**	8.84**	9.06**	0.29	1.04	−0.79	−0.75
	(2.3)	(2.3)	(2.4)	(2.3)	(0.10)	(0.36)	(−0.23)	(−0.21)
Elite university county	5.12	5.81	5.15	5.47	−1.11	−1.61	1.40	0.82
	(1.2)	(1.3)	(1.2)	(1.3)	(−0.40)	(−0.59)	(0.45)	(0.26)
Local private uni sticker cost	−0.45*	−0.43*	−0.46**	−0.44*	−0.027	−0.0085	−0.047	0.0013
	(−1.9)	(−1.9)	(−2.0)	(−2.0)	(−0.15)	(−0.05)	(−0.22)	(0.01)
Local public uni sticker cost	−0.67	−0.74	−0.65	−0.70	−0.42	−0.40	−0.36	−0.35
	(−1.2)	(−1.3)	(−1.2)	(−1.3)	(−1.2)	−1.1)	(−0.88)	(−0.84)
Constant	105.3***	93.2***	97.1***	91.7***	89.3***	72.5***	64.8***	60.6***
	(7.6)	(5.9)	(6.4)	(5.7)	(8.0)	(6.1)	(4.9)	(4.3)
F-statistic[d]	2.5***	2.7***	2.6***	2.7***	5.5***	5.9***	6.6***	6.3***
R^2	0.185	0.211	0.211	0.224	0.114	0.14	0.18	0.181
Number of observations	305	305	305	305	1077	1077	772	772
Mean of dep. var.	80	80	80	80	81	82	80	80

Weighted OLS estimates of a regression of dependent variable on various controls.
Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels, respectively.
[a] The expected likelihood with which a respondent's child will attend college.
[b] The expected likelihood with which a respondent would recommend college for a friend's 15-year-old child.
[c] Ratio of expected average earnings of the child with a college degree to the expected average earnings without a college degree.
[d] F-statistic of a test of the joint significance of the covariates.

Table A6
Summary of immediate experimental impacts, unweighted.

	All	Non-college	College	Diff.[d]	Lower-inc.	Higher-inc.	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Pre-information vverages							
Own child's attendance[a]	83.5	78.5	88.0	9.5	75.8	86.8	11.0
Observations	305	143	162		90	215	
Friend's child's attendance[b]	85.7	80.5	90.3	9.8	80.4	88.9	8.4
Observations	1077	505	572		403	674	
Panel B: Control group							
Δ Own child's attendance[c]	0.4	0.2	0.5	0.3	0.1	0.5*	0.4
	(0.3)	(0.4)	(0.4)	(0.5)	(0.6)	(0.3)	(0.7)
Observations	111	55	56		32	79	
Δ Friend's child's attendance	0.0	−0.1	0.0	0.0	0.0	−0.1	0.0
	(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	(0.1)	(0.2)
Observations	357	174	183		141	216	
Panel C: Returns experiment							
Δ Own child's attendance	3.7***	4.5***	3.1***	−1.4	6.3***	2.5***	−3.8**
	(0.8)	(1.4)	(0.9)	(1.6)	(0.8)	(0.8)	(1.9)
Observations	98	41	57		30	68	
Δ Friend's child's attendance	1.7***	2.4***	1.2***	−1.2**	2.4***	1.3***	−1.1*

	(0.3)	(0.5)	(0.3)	(0.6)	(0.5)	(0.3)	(0.6)
Observations	360	164	196		130	230	
Panel D: Cost experiment							
Δ Own child's attendance	−1.2	−1.5	−0.9	0.7	−2.5	−0.7	1.8
	(1.1)	(1.7)	(1.3)	(2.1)	(2.1)	(1.2)	(2.5)
Observations	96	47	49		28	68	
Δ Friend's child's attendance	0.2	0.1	0.3	0.2	0.2	0.2	0.0
	(0.2)	(0.3)	(0.2)	(0.4)	(0.4)	(0.2)	(0.4)
Observations	360	167	193		132	228	

Unweighted mean estimates presented. Standard errors in parentheses.
For Panels B, C, and D, we test for whether the cell mean is different from zero. *, **, *** denote mean is statistically different from zero at the 10, 5, and 1% levels, respectively.
[a] The expected likelihood of a respondent's child attending college.
[b] The expected likelihood with which a respondent would recommend college for a friend's 15-year-old child.
[c] The Δ's are the final minus baseline beliefs.
[d] The difference in average revisions for college-educated households versus non-college households.

Table A7
Medium-term experimental impact.

	All	Non-college	College	Diff.[c]	Lower-income	Higher-income	Diff.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Baseline averages							
Own child's attendance[a]	80.0	75.0	88.2	13.1	71.7	85.6	13.9
Observations	194	89	105		60	134	
Friend's child's attendance[a]	81.6	77.3	89.7	12.4	75.5	87.3	11.8
Observations	779	363	416		473	306	
Panel B: Control group							
Δ Own child's attendance[b]							
Initial survey	1.3	1.5	0.9	−0.7	1.1	1.4*	0.3
	(0.7)	(1.1)	(0.6)	(1.2)	(1.3)	(0.8)	(1.5)
Follow-up survey	0.9	0.4	1.9	1.5	−2.8	3.7***	6.5***
	(1.3)	(1.8)	(1.2)	(2.2)	(2.1)	(1.0)	(2.4)
Observations	62	30	32		20	42	
Δ Friend's child's attendance[b]							
Initial survey	0.1	0.1	0.0	−0.1	0.1	0.2	0.2
	(0.2)	(0.2)	(0.1)	(0.3)	(0.3)	(0.2)	(0.3)
Follow-up survey	−0.7	−1.1	0.1	1.2	−2.8*	1.2	4.0**
	(1.0)	(1.4)	(0.9)	(1.7)	(1.7)	(1.0)	(1.9)
Observations	257	123	134		106	151	
Panel C: Returns experiment							
Δ Own child's attendance							
Initial survey	5.1***	6.7**	2.9**	−3.8	9.0***	1.7*	−7.4**
	(1.8)	(2.7)	(1.3)	(3.0)	(3.1)	(0.9)	(3.3)
Follow-up survey	6.0	7.5	3.8	−3.7	11.2	1.3	−9.9
	(3.9)	(6.5)	(2.1)	(6.7)	(7.1)	(2.5)	(7.6)
Observations	59	25	34		21	38	
Δ Friend's child's attendance							
Initial survey	2.8***	3.4***	1.5***	−1.9**	3.8***	1.8***	−2.0*
	(0.6)	(0.8)	(0.4)	(0.9)	(1.0)	(0.5)	(1.1)
Follow-up survey	3.6**	4.5**	2.0	−2.4	7.5***	−0.2	−7.7**
	(1.6)	(2.2)	(1.3)	(2.6)	(2.6)	(1.6)	(3.0)
Observations	256	119	137		102	154	
Panel D: Cost experiment							
Δ Own child's attendance							
Initial survey	−1.4	−2.0	−0.4	1.6	−6.2	1.0	7.2
	(2.0)	(2.9)	(1.3)	(3.3)	(4.3)	(1.6)	(4.6)
Follow-up survey	4.5***	5.9***	2.0**	−3.9*	5.8*	3.9***	−1.9
	(1.2)	(1.8)	(0.9)	(2.0)	(3.0)	(1.0)	(3.2)
Observations	73	34	39		19	54	
Δ Friend's child's attendance							

Initial survey	0.1	0	0.3	0.3	−0.1	0.3	0.3
	(0.4)	(0.6)	(0.3)	(0.6)	(0.7)	(0.3)	(0.8)
Follow-up survey	0.1	0.2	0.0	−0.3	−1.5	1.7**	3.2
	(1.4)	(2.0)	(1.0)	(2.3)	(2.6)	(1.1)	(2.8)
Observations	266	121	145		98	168	

Weighted mean estimates presented. Standard errors in parentheses. Sample restricted to follow-up survey participants. For Panels B, C, and D, we test for whether the cell mean is different from zero. *, **, *** denote mean is statistically different from zero at the 10, 5, and 1% levels, respectively.

[a] The expected likelihood with which a respondent would recommend college for a friend's 15-year-old child.

[b] The Δ's are the post-information (initial/follow-up) beliefs minus initial survey baseline beliefs.

[c] The difference in average revisions for college-educated households versus non-college households.

Table A8
Mechanisms underlying experimental impacts.

Dependent variable:	Δ Own child's college		Δ Own child's	Δ Own child's	Δ Friend's child's college		Δ Friend's
	Attendance[a]		RCE[b]	Net cost[c]	College attendance		Child's RCE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Returns experiment[d] (β_1)	4.05***	3.67***	−0.021	−1.31	2.21***	2.15***	0.029
	(1.4)	(1.3)	(0.052)	(0.93)	(0.44)	(0.43)	(0.029)
Returns exp. × RCE error[e] (β_5)		−2.24	−0.087	−2.60		−0.38	−0.181***
		(3.3)	(0.11)	(3.4)		(0.94)	(0.065)
Cost experiment (β_2)	−2.48	−2.32	−0.0078	−6.40***	0.12	0.034	0.0044
	(1.7)	(1.8)	(0.018)	(2.1)	(0.34)	(0.4)	(0.018)
Cost exp. × Cost error[f] (β_6)		−0.016	−0.002	−0.36***		0.0086	−0.0004
		(0.067)	(0.001)	(0.12)		(0.02)	(0.001)
RCE error (β_3)		−0.27	−0.030	0.54		−0.63	0.020
		(2.0)	(0.02)	(3.0)		(0.4)	(0.02)
Cost error (in $1,0001000s) ($\beta_4$)		−0.011	0.001	0.004		0.005	0.001
		(0.025)	(0.0009)	(0.019)		(0.013)	(0.0008)
Demographics[g]	No	No	No	No	No	No	No
R^2	0.09	0.09	0.03	0.26	0.05	0.06	0.06
Number of observations	305	305	305	305	1074	1074	769
Mean of dep. var.	1.3	1.3	−0.013	−3.6	0.83	0.83	0.021

Weighted OLS estimates of a regression of the dep. variable on correlates. Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels, respectively.

[a] Revision in the expected likelihood reported by respondent that (own or friend's) child will attend college.

[b] Revision in the Relative College Earnings (RCE) reported by respondent for (own or friend's) child.

[c] Revision in net cost beliefs for own child.

[d] Dummy that equals 1 if respondent is assigned to the returns treatment.

[e] Returns error is the subjective population RCE minus the true population RCE.

[f] Cost error is perceived public university cost minus true public university cost (in $1000s).

[g] See Table 3 notes for the set of demographic characteristics.

Table A9
Mechanisms underlying experimental impacts, unweighted.

Dependent variable:	Δ Child's college		Δ Child's	Δ Own child's
	Attendance[a]		RCE[b]	Net cost[c]
	(1)	(2)	(3)	(4)
Returns experiment[d] (β_1)	2.52***	2.42***	0.035*	0.37
	(0.37)	(0.38)	(0.019)	(1.1)
Returns exp. × RCE error[e] (β_5)		−0.61	−0.17***	−0.90
		(0.83)	(0.047)	(2.9)
Cost experiment (β_2)	−0.247	−0.13	0.002	−5.28***
	(0.34)	(0.37)	(0.01)	(1.6)
Cost exp. × Cost error[f] (β_6)		−0.01	−0.001	−0.39***
		(0.024)	(0.001)	(0.10)
RCE error (β_3)		0.23	0.010	−0.75
		(0.46)	(0.01)	(2.0)
Cost error (in $1,0001000s) ($\beta_4$)		0.002	0.001	−0.027
		(0.009)	(0.0004)	(0.027)

Demographics[g]	Yes	Yes	Yes	Yes
R^2	0.14	0.15	0.10	0.46
Number of observations	1074	1074	1074	305
Mean of dep. var.	0.76	0.76	0.018	−3.8

Unweighted OLS estimates of a regression of the dep. variable on correlates. Robust standard errors in parentheses. *, **, *** denote significance at the 10, 5, and 1% levels, respectively.
[a] Revision in the expected likelihood reported by respondent that (own or friend's) child will attend college.
[b] Revision in the Relative College Earnings (RCE) reported by respondent for (own or friend's) child.
[c] Revision in net cost beliefs for own child.
[d] Dummy that equals 1 if respondent is assigned to the returns treatment.
[e] Returns error is the subjective population RCE minus the true population RCE.
[f] Cost error is perceived public university cost minus true public university cost (in $1,0001000s).
[g] See Table 3 notes for the set of demographic characteristics.

Appendix B. Examples regarding response to information

We next provide two examples of possible ways individuals could update their self expectations when they receive new information about population earnings.

In the first example, the household head believes that earnings are the product of an individual's level of skill and the skill price per unit of skill. The household head is certain about her child's level of skill but uncertain about the skill price. She uses the (perceived) average population earnings of college graduates (relative to non-college workers) to infer skill prices. If this individual underestimates true population college earnings (and, hence, underestimates skill prices), her beliefs about her child's relative college earnings would also be biased downward. In this example, self earnings beliefs and population earnings beliefs are positively linked, and had the individual been provided with accurate information about population earnings (which are higher than her ex ante beliefs), she would revise her beliefs about her child's college earnings upwards. And if earnings positively impact the likelihood of attending college, then the individual would revise upward her beliefs regarding the child's college attendance.

In the second example, the household head believes earnings are based on the individual's level of skill relative to the population average skill. The household head is certain about the level of the child's skill but uncertain about the population average level of skill. She uses the (perceived) average population earnings of college graduates to infer the average relative level of skill of college graduates. If she underestimates true population college earnings (and, hence, underestimates the average population skill level), she is overestimating her child's relative position in the population skill distribution. In this case, where earnings are based on the individuals' relative skills, underestimation of population college earnings would lead the individual to overestimate beliefs about her child's college earnings (that is, the two are negatively linked). Providing accurate information about population beliefs in this case would lead the individual to revise her beliefs about her child's college earnings (and college attendance) downwards.

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