# The Effects of Social Learning and Projected Account Balances on Saving Behavior Across Cognitive Reflection, Financial Literacy, and Abstract Reasoning

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**Abstract**

Employer-sponsored retirement plans are commonplace in the United States. Since their inception in 1978, defined-contribution plans have continued to grow popular in the private sector while traditional pension plans have been phased out. The public sector has resisted a similar shift, although there is an active debate about whether this is best for public-sector employees, namely teachers. This trend has shifted the burden of retirement planning onto private-sector employees in the form of decisions such as how much money to contribute and which investment funds to select. These decisions, which are not present in traditional pension plans, represent opportunities for poor heuristics and financial illiteracy to cripple retirement security. Previous research has documented the effectiveness of several interventions which seek to prevent people from falling prey to faulty heuristics, procrastination, and myopic thinking. Despite the demonstrated success of these interventions, it is unclear which combination of interventions, if any, an employer should implement when designing their employees' retirement plan experience. I propose a laboratory experiment to investigate the isolated and interactive effects of two retirement interventions: social learning and projected account balance. I intend to compare the effects of these interventions on saving behavior in a simple economic game across three individual metrics: cognitive reflection, financial literacy, and abstract reasoning. This experiment will expand the limited literature which directly compares retirement interventions and may precede small-scale field experiments within private companies with the long-term goal of developing individualized retirement interventions.

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# 1 Background

## 1.1 Retirement Plan Archetypes

Retirement plans in the United States can be divided into two primary categories: defined-benefit and defined-contribution. There also exist hybrid and cash-balance plans, although they simply combine qualities of both primary archetypes, and describing them would be superfluous to the relevant literature and my experiment.

### 1.1.1 Defined-Benefit Plans

Defined-benefit plans are colloquially thought of as traditional pension plans: employees are required to contribute a percentage of their income throughout their career in exchange for a guaranteed annuity upon retirement. Typical pension plans are characterized by a formula which converts an employee's years of service and final average salary into an annual benefit to which they are entitled upon retirement; the generic formula is below:

$$\text{Benefit} = \text{m} \times \text{FAS} \times \text{YOS}$$

For instance, public-school teachers in New York City who make less than $45,000 per year must contribute 3% of their salary to the Qualified Pension Plan and must acquire 10 years of service to be eligible for pension benefits (NYC, 2020). Pension plans also typically define criteria for retirement. Teachers in New York City are eligible for retirement at age 55 with 10 years of service, but their benefit will be reduced by 6.5% per year they are younger than 63 years old (NYC, 2020). Similarly, public school teachers in California can retire at age 60 with 5 years of service, but their benefit multiplier increases with age until 63 (Clark & Hanson, 2013). If a teacher stops working at a young age but is vested in their state's pension plan, they must wait until they reach their employer's normal retirement age to collect their pension benefits. In this sense, defined-benefit plans are similar to Social Security because employees pay into them throughout their career and, if eligible, collect benefits upon reaching retirement age.

### 1.1.2 Defined-Contribution Plans

Defined-contribution plans exist in stark contrast to defined-benefit plans and are typically characterized by voluntary employee contributions distributed between funds offered by their employer. Common defined-contribution plans are the 403(b) and 401(k). Most public-school teachers in the United States have the option of participating in a 403(b) plan (Clark & Hanson, 2013) and employees in the private sector are likely to have access to a 401(k). Benefits earned from contributions to 401(k) and 403(b) plans are not guaranteed by employers but depend only on the funds employees choose to invest in and their performance over time. Employers can also contribute to defined-contribution plans by matching employee contributions; in 2018, 55% of Vanguard plans allowed employer matches and 71% of these plans offered a 50% match up to 6% of salary (Vanguard, 2019). Annual 401(k) contributions are limited to $19,500 with an additional catch-up contribution of $6,500 allowed for individuals older than 50 (IRS, 2021). Employees are typically entitled to their account balance upon retirement and, depending on the specific plan, have the option to rollover their balance into an IRA when changing employers. Defined-contribution plans are fairly similar to individual retirement accounts, such that no benefits are guaranteed and employees must make decisions about how much to invest and how to distribute their money between funds. The key distinction is defined-contribution plans are employer-sponsored; employers typically work with

a company such as Vanguard or Fidelity to provide investment funds to employees. Employers might also offer matching contributions which makes each dollar invested worth more than if it were invested in an IRA, all else held equal.

### 1.2 A Brief History of Retirement Plans

Pensions were established for individuals who served in the colonies' naval forces and United States army in 1775 and 1776, respectively (Iekel, 2018). Pensions did not pervade the private sector until 1875, when the American Express Company established a pension for its workers (Georgetown, 2010; Iekel, 2018). Social Security was established in the United States in 1935 as a nation-wide retirement plan backed by the federal government. Like a defined-benefit plan, a tax is imposed on eligible employees during their careers in exchange for a monthly annuity upon claiming Social Security benefits. In the case of a defined-benefit plan, the annuity is guaranteed by the respective employer, while in the case of Social Security the annuity is guaranteed by the United States. The number of employees covered by a defined-benefit plan in the United States grew dramatically throughout the twentieth century and is illustrated in the figure below:

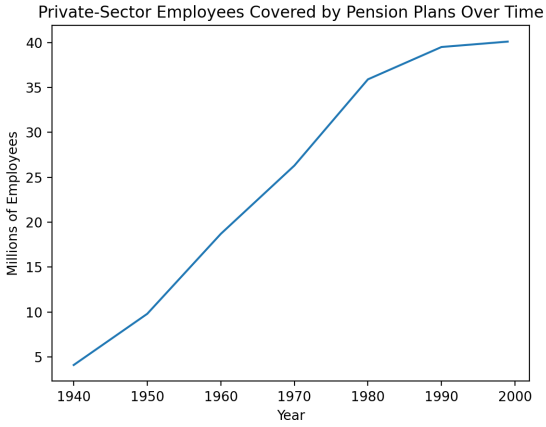


Figure 1: Figure created by author with data from Georgetown (2010)

The proliferation of pension coverage in the private sector was somewhat dramatic throughout the middle part of the twentieth century and leveled off during the last quarter. This is, perhaps, in part due to the establishment of defined-contribution plans via the Revenue Act of 1978. Congress allowed individuals to contribute an annual maximum of $7,500 to a deferred-compensation plan; employees were also permitted a catch-up rate of $15,000 under certain circumstances (Congress, 1978). The key innovation was the tax-free contribution which would spark the emergence of defined-contribution plans in the United States. In 1980, approximately 7% of private-sector workers participated in employer-sponsored defined-contribution plans while roughly 28% participated in an employer-sponsored defined-benefit plan. By 2000 these estimates were nearly reversed, and by 2017 roughly 35% of private-sector workers participated in defined-contribution plans while only 3% participated in defined-benefit plans (EBRI, 2019).

Defined-contribution plans might have quickly dominated the retirement landscape in the private sector for several reasons. First, employees bear a most of the risk when participating in defined-contribution plans. They are responsible for deciding how much of their salary and wages to

contribute, which funds to contribute to, and how to adjust those settings over time. The employer is typically not responsible for guaranteeing benefits nor liable for fund values over time. On the other hand, employers bear most of the risk in defined-benefit plans because they are responsible for guaranteeing an annuity upon retirement. Second, defined-contribution plans are, by design, more portable than defined-benefit plans. Although some employers require employees to work for a minimum number of years before being eligible for their matching contributions, these vesting periods are typically shorter than those in defined-benefit plans. Furthermore, many defined-benefit plans, such as the one made available to public-school teachers in California (Clark & Hanson, 2013), offer a benefit multiplier which increases with age; defined-contribution plans do not typically offer the incentive to remain with the same employer for many years. This portability was likely a desirable quality because the median tenure for workers in the private sector has fluctuated between only 3 and 4 years from 1981 to 2018 (Copeland, 2019).

### 1.3 Which Retirement Plan Archetype is Best?

There is no strictly dominant type of retirement plan; comparing and evaluating retirement plans must be done at the employee or company level. An employee seeking to work for the same employer for their entire career with little financial knowledge would likely prefer the security and low risk associated with a traditional pension as opposed to the volatility and decision-making inherent in a 401(k). On the contrary, an employee seeking to change jobs many times throughout their career in the private sector would likely prefer the flexibility of a 401(k) as opposed to traditional pensions, which reward long careers and typically have vesting periods of several years. Similarly, employers seeking to shed as much risk and liability as possible would likely prefer to offer employees a 401(k) as opposed to a pension, while employers looking to reward and retain employees for many years or even their entire career might prefer to offer a generous and back-loaded pension. Even in specific sectors and industries, it is not easy to answer the question of which retirement plan archetype is best; the teaching industry in the public sector has been a focal point of debate in recent years about whether defined-benefit or defined-contribution plans best serve its employees.

### 1.4 Retirement Plans for Teachers in the Public Sector

Clark and Hanson (2013) summarize the retirement plans offered to teachers and find most public-school teachers in the United States are eligible to participate in a defined-benefit plan; Alaska is the only state which has implemented a mandatory defined-contribution plan as the primary retirement vehicle for teachers hired after 2006. Similarly, Indiana, Michigan, and Oregon offer a hybrid plan, Nebraska offers a cash-balance plan, and Utah offers teachers hired after 2011 a choice between a defined-contribution plan and a hybrid plan. In addition to the primary retirement plan which varies by state, teachers can expect the option to enroll in a supplemental defined-contribution plan. Nearly all public-school teachers in the United States can become eligible for a state or district managed 403(b) plan in addition to their primary pension plan. Although most teachers are eligible for a pension plan, qualities such as vesting period, benefit multipliers, and final average salary vary at the state level. For instance, teachers in Colorado, Florida, and Georgia vest after 5, 6, and 10 years, respectively. Similarly, teachers in Kansas reach retirement age at age 65 with 5 years of credit, age 62 with 10 years of credit, or when the rule of 85 is satisfied, while teachers in Michigan reach retirement age at age 60 with 5 years of credit or at any age with 30 years of credit. Furthermore, some states offer various supplemental plans in addition to the standard 403(b): Arkansas offers a supplemental 457 plan, Arizona offers a 401(a) and two 457 plans, California offers a 457(b), and Colorado offers a 457 and 401(k) plan (Clark & Hanson, 2013). The retirement plan landscape

for public school teachers in the United States is homogeneous at the plan archetype level, but heterogeneous between plan details.

The retirement landscape for public school teachers has not experienced the same shift as it has in the private sector; defined-contribution plans are typically supplemental and most public school teachers can rely on a traditional pension. That is not to say retirement plan reforms have not been attempted in the past. In 2011, Utah passed legislature which provided newly hired teachers with a choice between a defined-contribution plan and a hybrid plan. This change was largely in response to the financial crisis of 2008 to transfer some of the risk associated with funding retirement benefits onto employees. The new defined-contribution plan guaranteed an annual employer contribution equal to 10% of employee salary, although the defined-benefit component of the hybrid plan was less generous than the previous pension plan (Clark, Hanson, & Mitchell, 2015). Similarly, following a teacher strike in West Virginia, public school teachers hired after 1991 were offered a primary defined-contribution plan. Unlike the reform in Utah, this retirement restructuring did not last. The defined-contribution plan was frozen in 2005 and the defined-benefit plan was reinstated in 2008 (Marchitello, 2019). Furthermore, Washington State enrolled new hires in a hybrid retirement plan in 1996 instead of the traditional defined-benefit plan offered previously. This primary hybrid plan lasted until 2007, at which point Washington made the previous iteration of the defined-benefit plan available as an alternative option for new hires (Goldhaber, Grout, & Holden, 2017). Nebraska established a defined-contribution plan in 1967 and eventually switched eligible members to a cash-balance plan in 2002 (Illinois, 2019). The shift from defined-benefit plans to defined-contribution plans in the private sector gained some ground in the public sector, but ultimately had very little success in the teaching industry. Despite the consistent structure of a primary defined-benefit plan supplemented by a defined-contribution plan and the dotted success of retirement reforms, there is an active debate about which plan best serves public school teachers.

### 1.4.1 Debate in the Teaching Industry

There are two main reasons for the ongoing debate. First, there are conflicting findings in the literature about the effects a shift from defined-benefit plans to defined-contribution plans will have on employee retention. Goda, Jones, and Manchester (2013) took advantage of a retirement plan shift within a large research university; employees before the shift were only eligible for a defined-benefit plan while employees after the shift could choose between a defined-benefit and defined-contribution plan. Goda et al. (2013) finds that employees with higher mobility tendencies have a propensity to sort themselves into defined-contribution plans and the introduction of defined-contribution plans decreased job mobility among employees. Goldhaber et al. (2017) investigated attrition rates following the 1996 pension reform in Washington State and failed to find evidence that the switch to a hybrid plan increased job mobility or employee turnover. In 2012, a district in Palm Beach, Florida, closed its defined-benefit plan for all public employees and opened a hybrid plan in its place. In the years following the transition, many public employees left Palm Beach in favor of districts which still offered a defined-benefit plan (Illinois, 2019). There is not a consistent answer to the question of how employees will respond to a shift from defined-benefit to defined-contribution plans. This is a focal point in the teaching industry because teacher turnover is an especially salient problem for students in low-income schools (Garcia & Weiss, 2019).

Second, there is an argument about how well defined-benefit plans serve teachers. This point is

salient because teachers in more than 10 states do not receive Social Security benefits, which means they rely fully on personal and employer-sponsored retirement savings. Aldeman (2017) argues the back-loaded benefits typically associated with traditional pension plans exert push and pull effects on teachers around retirement age. These effects highlight a potentially poor incentive structure; it is unlikely a state or school district can choose a perfect retirement age for all of its employees, so perhaps replacing traditional pension plans with more portable defined-contribution plans and lower vesting periods would improve teachers' mobility and retirement outcomes (Aldeman, 2017).

Conversely, Rhee and Fornia (2016) find roughly half of teachers in California retire with 30 years of service and approximately 75% of current teachers have at least 20 years of service, defending the back-loaded nature of pension benefits. Morrissey (2017) further defends back-loaded benefits via an analysis which shows a teacher who works 15 years each in two different states will only lose about 26% of their pension benefits. Furthermore, Rhee and Fornia (2016) also find approximately one in seven teachers would benefit by switching to a defined-contribution plan, all else held equal. This heuristic is corroborated by Rhee and Joyner Jr. (2019) who find 77% of teachers in six states are better off with their employer-funded pension plan and would have to contribute more money to a defined-contribution plan to break even on benefits. Rhee and Fornia (2016) find that, although about 40% of teachers quit before vesting, they only compromise about 6% of active teachers; there is high attrition early in teaching careers and a sharp decline as teachers rise in seniority. This point is also supported by Morrissey (2017), who claims critics of teacher pensions unfairly give equal weight to short-term and long-term teachers.

Aldeman (2019) argues that, although traditional pension plan might be generous to long-term teachers as Morrissey (2017) advocates, the damage they do to short-term teachers is exacerbated in states without Social Security benefits for teachers. For instance, the number of years a teacher must work to receive retirement benefits equivalent to those paid by Social Security is 25 in Maine, 19 in Kentucky, 25 in Illinois and 22 in Massachusetts. Although pension benefits eventually surpass those offered by social security and defined-contribution plans, they are only received by long-term teachers (Aldeman, 2019). Even if only 5% of teachers would be better off with a defined-contribution plan, this still translates to many people across the country who could be better off given more portability and retirement plan options.

## 2 Motivation

Retirement plans have existed since the foundation of the United States, with defined-contribution plans displacing defined-benefit plans within the private sector in the last forty years. This shift failed to take hold in the public sector despite various reforms. Defined-contribution plans are still a key component of retirement security for public-sector employees; most teachers can expect the opportunity to contribute to a 403(b) plan even if their primary plan is a pension. Regardless of the recent trend and ongoing debate, it is clear that defined-contribution plans are not going anywhere anytime soon. Since employees can essentially trust in their pension benefits without making any decisions other than to stay with their current employer, it is worthwhile to turn attention towards how employees fare when they are responsible for making decisions and bearing risk, namely in defined-contribution plans.

### 2.1 What if We Let People Fend for Themselves?

People only get to plan for retirement once. Failing to make good retirement planning decisions early in life can cause long-term financial damage which isn't felt until retirement. At the age of 70, the difference between $6,000 invested at the age of 25 and $6,000 invested at the age of 30, assuming a 10% interest rate, is approximately $165,000. If you plan to withdraw $3,000 per month in retirement, that's at least 4.5 years of financially stable life. A survey conducted by Reserve (2020) shows roughly 25% of adults in the United States do not have any money saved for retirement. This finding is complemented by an analysis conducted by Rhee (2013), who finds, on average, roughly 45% of households do not have any retirement savings between ages 25 and 64; this includes over 38 million households. Rhee (2013) also finds households aggregately fall short of age-specific retirement targets set by Fidelity by roughly $14 trillion. Furthermore, only 33% of surveyed adults had an IRA and only 13% had non-retirement account savings. In the survey conducted by Reserve (2020), when asked if they were mostly or very comfortable investing in self-directed retirement savings, only 60% of men with bachelor's degrees said yes compared to 32% of women.

In a study conducted by Goldin, Homonoff, and Tucker-Ray (2017), the authors found only 43% of military service members participate in their employer sponsored retirement plan. Similarly, in a Congressional Research Brief, Topoleski and Myers (2020) report approximately 73% of eligible private-sector workers and 49% of eligible public-sector workers participate in their employer-sponsored defined-contribution plans. Among the firms investigated in a study conducted by Clark, Morrill, and Allen (2012), only 60 to 80 percent of employees enrolled in their employer-sponsored retirement plans, citing concerns about limited budgets and debts despite a guaranteed employer match. Furthermore, Clark et al. (2012) found employees enrolled in their retirement plan scored higher on a financial literacy quiz than those not enrolled, suggesting such literacy is a barrier to making efficient long-term decisions. At one of the companies investigated by J. Choi, Laibson, and Madrian (2006) in a field experiment, the authors found a baseline 50% participation rate among its employees despite guaranteed employer matches. People struggle to even save for retirement, let alone make the active decision to enroll in their employer's defined-contribution plan and make appropriate decisions about how much money to invest in which funds. The burden of decision-making is one way in which defined-contribution and personal retirement plans can cause individuals to allow procrastination and poor financial literacy to cause irreversible damage to their retirement security. This is certainly a problem given the prevalence of defined-contribution plans in both the public and private sectors, especially for individuals who cannot even rely on Social Security.

### 2.2 What is at Stake?

There are two broad reasons improving retirement enrollment and contribution decisions is of economic and humanitarian interest. First, when considering retirement account balances and benefits at the national level, a lot of money is on the table. For instance, in 2016, approximately $578 billion of pension benefits was paid in the United States, of which approximately $200 billion went private-sector retirees. These pension payouts subsequently supported roughly $1.2 trillion in national economic output and contributed approximately $685 billion to GDP (Boivie, 2019). When factoring in the $14 trillion target gap reported by Rhee (2013), it is clear the impact retirement benefits can have on the economy is massive.

Second, people struggle significantly with financial security during retirement. Given the poor re-

tirement preparation demonstrated by Clark et al. (2012) and the survey conducted by Reserve (2020), it is no surprise nearly 10% of adults over the age of 65 were below the poverty threshold in the United States in 2019 (Li & Dalaker, 2021). This percentage increases with age and gender, reaching nearly 14% for women over the age of 80; similarly, roughly 20% of black women over the age of 65 were below the poverty threshold. The analysis conducted by Li and Dalaker (2021) shows the removal of social security would increase the percentage of adults in poverty by over 32%, which suggests retirement income has a highly significant impact on financial welfare in later years of life.

More efficient retirement contributions made by individuals across the country would have a positive impact on the economy and the welfare of adults near and older than retirement age in the United States. Given the dominance of defined-contribution plans in the private-sector and their supplemental manifestation in the public sector, improving these decisions is of high interest and importance. To this end, a number of interventions have already been developed and tested in the field.

### 2.3 Existing Interventions

There is a spectrum of retirement interventions which ranges from strong nudges to passively making resources available. On the more intense end of the spectrum, Madrian and Shea (2001) tested the effects of automatic enrollment at a single company. This intervention enrolls employees in their employer's retirement plan at a default contribution rate and fund as soon as they become eligible; the active decision to enroll is not left up to employees, but they may opt out at any time. The authors found automatic enrollment increased participation rates from 49% to 86% for employees who were immediately eligible to enroll in the retirement plan. To provide additional context, the participation rate for employees with a tenure of more than 20 years was only 83%. As Madrian and Shea (2001) note, this suggests procrastination contributes to a lack of participation and retirement contributions. Clark et al. (2012) acknowledges a similar participation rate increase given automatic enrollment.

Moving in a more passive direction, Quick Enrollment is an intervention which does not automatically enroll employees but gives them an extremely easy and clear opportunity to enroll at a default rate and fund allocation. J. Choi et al. (2006) tested different versions of a Quick Enrollment intervention at two companies. Their intervention provides employees with an enrollment card and the option of checking a box to enroll in a default fund with a 2% or 3% contribution rate. If an employee does not wish to enroll, they can either not return the card or check the other box. The second version of Quick Enrollment was web-based and allowed employees to choose any contribution rate in a meeting with a company representative. J. Choi et al. (2006) report a 22 percentage point increase in participation rates for employees between ages 30 and 50 at the first company, and a company-wide participation rate increase of 2% at the second company.

There is an argument to be made that strong nudges, such as the default rates and allocations used in automatic and Quick Enrollment interventions, fail to treat people as individuals because the plan designer cannot possibly gather enough information to know what is best for every individual (Glod, 2015). Moving in this direction, Thaler and Benartzi (2004) tested an intervention called Save More Tomorrow. This program seeks to help employees overcome procrastination by allowing them to commit, far in advance, to contribution rate increases coincident with raises until a specified rate is reached. This takes away the opportunity for procrastination while making the perceived

loss of saving money seem less severe as it is suppressed by the gain of a raise. At one company, by the end of the fourth pay raise and coincident contribution rate increase, participants who joined the program had an average saving rate of 13.6% versus 5.9% for those who declined to join. At a second company, Thaler and Benartzi (2004) report saving rate increases of 0.84 percentage points and 2.02 percentage points for employees who were already saving and not already saving, respectively.

There are also interventions which are even more passive and do not directly affect retirement plan choice architecture but rather provide employees with opportunities to improve their decision-making when planning for retirement. Employers can offer or encourage access to financial advisors who can learn about an individual's specific circumstances and suggest tailored advice. Burke and Hung (2015) survey previous literature and find that, although, consultations with financial advisors seem to have a positive impact on saving behavior and tangential metrics such as retirement confidence, it is difficult to rule out self-sorting biases and reverse causality. A step down from financial advisors, which might be an expensive option for small business, employers can also offer workplace retirement seminars to their employees. Burke and Hung (2015) find this is a fairly common practice among employers and report such educational infrastructure leads to a change in retirement plans, such as a decision to open an IRA, planned retirement age, more balanced investment portfolios, and increased saving for employees who do not save enough. Similarly, Clark et al. (2012) analyzed one firm and found financial education scores increased following a retirement seminar and circulating information about retirement wealth increased participation rates. Song (2019) found retirement contributions increased by about 40% after providing education about compound interest to workers in rural China.

One of the most passive interventions employers can implement is a matching rate; employees are simply offered free money in exchange for making retirement contributions. J. J. Choi (2015) surveys some of the literature which analyzes the effects of matching rates on contributions to defined-contribution plans and finds a wide variety of results, but the overall trend in the selected literature seems to point towards a positive impact. The success of these varied interventions suggests low participation and contribution rates are not optimal decisions but rather due to flaws such as inertia, procrastination, and financial illiteracy.

## 3 The Big Question

Consider an employer who recently started a company; reasonably they will have to decide which type of retirement plan to offer their employees. Based on recent trends in the United States, assume they decide to offer a typical 401(k) plan. The employer now faces an extremely complex design problem with severe socio-economic implications for their employees. Even if choices such as whether to require employees to submit paper forms or make their contributions electronically, how often to allow employees to re-balance their portfolio, how many funds to offer, and so on, are put aside, the employer still faces a pressing problem. Previous research highlights the difficulty people face when making financial decisions and saving for retirement, but also documents the success of various retirement interventions. Between Save More Tomorrow, Quick Enrollment, retirement seminars, financial advisors, and education and literacy training, there are many to choose from. Reasonably, the employer will be forced to invest time and resources into a small subset of interventions due to budget and time constraints. Furthermore, not all interventions work well together; Quick Enrollment wouldn't quite work with Save More Tomorrow and access

to financial advisors, education modules, and retirement seminars might be excessively redundant. Which combination of retirement interventions, if any, should the employer provide their employees?

### 3.1 Why Don't We Have an Answer Yet?

Pension plans have existed since the founding of the United States and defined-contribution plans have existed for more than forty years. Congress has passed many acts to improve retirement infrastructure, such as the Employee Retirement Security Act of 1974 and the Pension Protection Act of 2006, and there are several retirement interventions which have been studied and refined. Furthermore, there is a substantial amount of money at stake in the retirement arena and people tend to struggle with financial decisions, leading to poor planning and poverty past retirement age. Given the long history of retirement plans, the financial impacts of minor improvements in savings decisions, and respectable literature on the subject, it might seem natural there is a clear understanding of which interventions and methods of encouraging better retirement decisions are best. This is not the case. Field experiments which tested the effects of retirement interventions are unique to a specific company, region, time, demographic, and so on. Although such experiments offer invaluable insight into how these interventions affect saving decisions with real employees, they do not offer a proper test of the underlying fundamentals. Perhaps there is something unique about the company culture in J. Choi et al. (2006) which allowed Quick Enrollment to be successful while Save More Tomorrow would have failed. Would the educational intervention investigated by Song (2019) have been more or less effective than providing access to financial advisors or retirement seminars? Laboratory experiments provide invaluable insight into the fundamentals of human behavior in controlled environments, but the experimental literature on retirement interventions is sparse.

### 3.2 Previous Experiments

There have been a variety of laboratory experiments which seek to better understand how people make saving decisions, whether in the context of retirement or not. Del Ponte and DeScioli (2019) analyzed subject behavior in a saving game with an uncertain stream of income and found people tend to spend too much following windfalls and save too much following downturns when compared to an efficient benchmark. Ballinger, Hudson, Karkoviata, and Wilcox (2011) analyzed saving behavior in a laboratory experiment in which subjects made repeated decisions given varying income streams. After the experiment, subjects participated in several tasks to measure cognitive ability including tests of nonverbal cognitive ability and working memory span. The authors found cognitive abilities are reliable predictors of saving efficiency when controlling for individual metrics such as age, sex, gender, and motivation. Ballinger, Palumbo, and Wilcox (2003) analyzed the effects of intergenerational learning on saving behavior in a laboratory experiment and reports a positive effect on saving behavior, although the specific outcomes differed significantly across intergenerational subject groups. Carbone and Duffy (2014) also tested the effects of social learning on saving behavior in a deterministic environment with certain income. The authors find subjects in the control spend too much early in their experimental lives, however, subjects in the social learning treatment over-reacted to the social information and deviated even further from the optimal sequence of decisions on average. Tasneem, Azerot, Montaignac, and Engle-Warnick (2018) compared the effects of savings nudges and financial literacy in a precautionary savings game similar to the one used in Ballinger et al. (2003) and Ballinger et al. (2011). Their nudge automatically placed a percentage of subjects' income in their savings account at the start of each period. The authors found only the largest 30% nudge had a significant effect on saving behavior, while the financial

literacy intervention improved saving decisions in the small nudge groups and reduced consumption volatility in the large nudge groups. McKenzie and Liersch (2011) found showing full-time employees their projected 401(k) balance at retirement had a significant impact on their motivation and willingness to save, compared to employees who were only shown their current 401(k) balance.

There have been experiments which compare the effects of different interventions, such as Tasneem et al. (2018), and experiments which investigate how individual metrics affect saving behavior, such as Ballinger et al. (2011), but to the best of my knowledge the literature lacks experimental evidence of how different retirement interventions compare across various individual metrics. Are there specific qualities, such as cognitive ability and spatial reasoning, which can be measured to determine which retirement intervention will have the most significant and beneficial effect on an individual's retirement planning? This is the specific question I seek to answer with the goal of developing a systematic approach employers can take to select from a wide variety of unique retirement interventions at the employee level. It seems unreasonable there exists a universal gold-standard retirement intervention for all employees the same way a single retirement plan cannot satisfy every company across different industries and sectors. Can an individualized retirement program be developed which measures core metrics about each employee and provides them with a unique combination of interventions?

### 3.3 My Experimental Approach

I propose a laboratory experiment, conducted at the Economic Science Institute at Chapman University, to directly compare two retirement interventions across three individual metrics while avoiding potentially spurious results due to unique real-world environments and company cultures. I will compare the isolated and interactive effects of social learning, similar to Ballinger et al. (2003), and projected account balance, similar to McKenzie and Liersch (2011). This experiment will allow me to test if the individual and combined effects of social learning and projected account balances differ across cognitive reflection, financial literacy, and abstract reasoning. I want to investigate if these three metrics significantly impact which intervention is most effective. I also expect this experiment to serve as a first-step in a research agenda which will hopefully progress to small-scale field experiments within companies and, in the long-term, lead to the development of a standardized individual assessment to tailor retirement interventions to each employee within a company.

## 4 Experimental Design

I will recruit 96 students at Chapman University using the recruitment software in place at the Economic Science Institute. The experiment will be divided into four experimental groups (i.e., a 2x2 full-factorial design) and there will be 24 subjects in each group. Each subject will enter the laboratory and read on-screen instructions before beginning the experiment.

### 4.1 Overview

The following aspects of the experiment will be identical for subjects in all four experimental groups. Each subject will make decisions for 10 periods. In each of the first five periods, each subject will receive 100 coins (i.e., experimental currency). Subjects must decide how to divide their income of 100 coins between saving for future periods and spending on current consumption. In each period, subjects' savings account balances will earn an interest of 10%, rounded down to the nearest whole

number. This is similar to the interest rate of 5% in a 25 period environment used by Carbone and Duffy (2014). Spending on consumption will yield utility points which convert to USD once the experiment is over at the following rate:

$$3 \text{ Utility Points} = 1 \text{ USD}$$

Subjects must spend or save all their income in each of the first five periods; subjects will have 30 seconds to make their decision in each period. The first five periods are considered the working phase because subjects earn an income and choose between spending and saving. In the first five periods, subjects may not withdraw from their savings. In periods six through 10, subjects will not earn an income and must decide how much of their savings to spend on consumption. Periods six through 10 are considered the retirement phase because subjects no longer receive an income and must survive off the money they accrued during their working phase to maintain consumption. After subjects make their final decision in the tenth period, they will be paid according to the total utility points they accrued throughout the experiment. Subjects should seek to maximize their payoff by maximizing their lifetime utility which can be achieved by solving for the optimal sequence of decisions across the ten periods.

### 4.2 Consumption Model

Since I am investigating how people make saving decisions, I need to mathematically model these decisions over time. A perfectly rational person will make financial decisions to maximize the total benefit they receive throughout their lifetime subtracted from the total costs. For instance, a person might choose to save money for back surgery instead of spending it on a vacation because the cost of living with back problems is greater than the benefit of going on vacation. I define utility as the difference between the benefit and cost born from a single decision. This is rather difficult and likely intractable to quantify and express meaningfully in the real world, but in an experiment it is simple. In the real world, people perform some form of planning for the future, whether they look ahead 10 minutes or 10 years. This can be expressed mathematically, as was done by Ballinger et al. (2003), as follows:

$$\max_{a}\{u(a_0) + \sum_{i=1}^{i=T} \beta_i u(a_i)\}$$

where $a_0$ is an action at time zero, $\beta_i$ is the discount factor at time $i$, and $u(a_i)$ is the utility received at time $i$ from action $a_i$. An individual will seek to maximize their total utility over the next $T$ periods by choosing an appropriate sequence of actions. In the real world, people might only look forward one or two weeks, while others might look forward several years. This myopic thinking can be captured by $\beta$ rapidly approaching zero for small $i$. This notation should also highlight the challenge people face when saving for retirement; if an individual only looks ahead several years at the age of 25, they will not see the value in saving money for when they are 55 and will choose to increase their current utility, perhaps via fancy dinners, instead of increasing their utility during their retirement years by saving. This is a basic model of making decisions over time, however, it is necessary to specify a utility function appropriate for my experimental environment and research question.

There are several guidelines which can be considered when choosing a utility function. First, I want to ensure decreasing marginal utility with respect to consumption within a period because

otherwise it will simply be optimal to spend everything in the current period. Second, I want to make sure I have adequate control over the nominal values of the utility function without having to modify the functional form or behavior; for this purpose, one or more scaling parameters will be necessary. Third, I want to use a function which is grounded in previous literature to avoid the risk of an inappropriate or indefensible model. There are two prime choices here: first the precautionary savings model used by Ballinger et al. (2003) and Tasneem et al. (2018):

$$U(x) = \kappa + \theta \frac{(x+\epsilon)^{1-\sigma}}{1-\sigma}$$

where $\kappa$ and $\theta$ are scaling parameters, x is the amount of money spent on consumption, $\epsilon$ is a base consumption amount, and $\sigma$ is the coefficient of relative risk aversion. This utility function produces a precautionary motive and is in the family of constant relative risk aversion functions, which means it ensures the subject's wealth does not impact their level of risk aversion. This model provides me with all of the features I need, except it is not defensible because the coefficient of relative risk aversion is irrelevant to my experimental environment since subjects earn a certain income each period. Instead, I will use a similar concave model which was used by Carbone and Duffy (2014) in a deterministic experiment with certain income:

$$U(x) = \kappa - \frac{1}{r} e^{-rx}$$

where $\kappa$ and $r$ are simply scaling constants. Like the previous model, this model is also in the family of constant relative risk aversion, except it is in the exponential class. This model will exhibit decreasing marginal utility and was designed for a deterministic environment, and as such is apt for my experiment. The utility function is shown below for illustrative purposes:

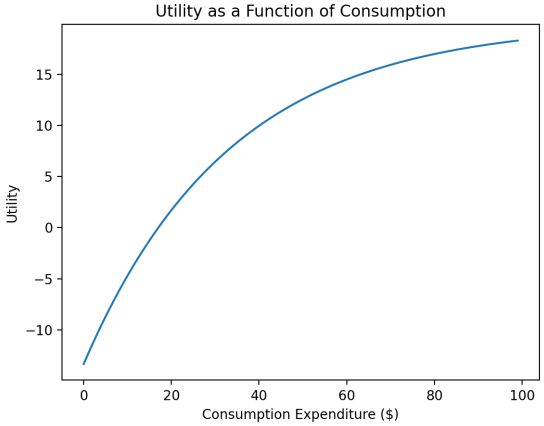


Figure 2: Plot of specific utility function over consumption values

It is clear from the functional form and the graph that there will be an expenditure level at which the utility gained is zero. This point is:

$$x_0 = \frac{\ln(\kappa r)}{-r}$$

Allowing this crossover point to be positive creates a sustenance cost in the experiment. Subjects must spend a minimum amount of money to receive any utility, analogous to paying bills in the

real world. Carbone and Duffy (2014) elected to make payoffs strictly positive, but I think this is an interesting and relevant modification. I will set $\kappa = 20$ and $r = .03$, the reasons for which I will explain below.

### 4.3 Choosing Parameters

I started with a few simple assumptions to significantly reduce the number of eligible parameter combinations. I do not want the optimal sequence of decisions to be too obvious to subjects, especially those with advanced mathematical and programming skills. Therefore, having less than five periods is likely a poor design. Similarly, the subjects should receive a large enough income during the working phase such that there will be opportunity for significant variation between individual strategies. If subjects only received 10 coins each period and only played for five periods, the optimal sequence of decisions might be too easy to estimate and variation across subjects might be too low to find statistically significant treatment effects.

I do not want the optimal sequence of decisions to be trivial, such as saving the same amount of coins each period. It is, in expectation, more beneficial to save early in life because of compound interest. Consider \$5,000 saved at the age of 25 and \$5,000 saved at the age of 45, each of which earn an annual interest rate of \$10%. The \$5,000 invested at the age of 25 will be worth approximately \$226,000 at the age of 65 while the \$5,000 invested at the age of 45 will only be worth approximately \$34,000 at the age of 65. Therefore, I generally prefer the optimal sequence of decisions yields a decreasing savings rate throughout the working phase. On the other hand, I want to be careful and ensure the savings rate does not drop too dramatically or collapse to zero at any point. For these reasons, interest rates lower than 5% and higher than 90% will not be tenable.

Choosing coefficients for the consumption model requires a slightly different strategy. I can choose the scaling constants freely to obtain utility values which will likely not be absurd to subjects (e.g., millions of times larger or smaller than one). Otherwise, selecting parameters is largely a method of starting with figures from previous research and repeatedly testing larger perturbations until the optimal sequence of decisions has the features described above.

Beyond basic heuristics and guiding features, it is necessary to computationally determine the optimal sequence of decisions for various combinations of parameters and compare them. In addition, it is important to compare payoff outcomes for random strategies to the optimal payoff; if the differences are too small, this will make it difficult to determine if any of the treatments had a significant effect because it will be impossible to statistically differentiate an erratic subject from one who benefited from a treatment. For these purposes, dynamic programming and Monte Carlo simulations will be invaluable tools. The parameters I ultimately chose for this experiment are summarized in the table below:

| Parameter | Value |
|---|---|
| $\beta$ | 1 |
| $r$ | 0.03 |
| $\kappa$ | 20 |
| income | 100 |
| periods | 10 |
| interest rate | 0.10 |
| working phase periods | 5 |

Table 1: Specific parameters

#### 4.3.1 Dynamic Programming Solution

Dynamic programming is a method of solving problems which can be broken down into homogeneous sub-problems. In this experiment, the problem of determining the optimal sequence of decisions is a large problem which can be broken down into ten sub-problems of deciding how much to spend and save each period. Dynamic programming problems like this can be solved using the bellman equation:

$$V(s_0) = \max_{a_0}\{G(s_0, a_0) + \beta V(s_1)\}$$

where V is the value function which takes the current state, $s_0$, as an input, and returns a numerical value as an output. $V(s_0)$ is the maximum value which can be achieved starting from state $s_0$ if the optimal sequence of decisions is chosen. The value function is maximized by determining the best decision in each state, for instance $a_0$ in state $x_0$, which maximizes the sum of the total immediate value, $G(s_0, a_0)$ and the value from all future states. The bellman equation is recursive and requires the solver to transition from one state to the next based on the action chosen in the former state, for instance from $s_0$ to $s_1$ based on $a_0$. In simple dynamic programming problems with the bellman equation, the only information which matters when solving for the optimal decision in a given state is the current state and how each action will impact the possible value which can be earned in future states based on the current action; previous states and actions are irrelevant. The bellman equation looks very similar to the consumption model; in a sense, saving for retirement is one big stochastic dynamic programming problem.

For this experimental environment, the bellman equation can be written as:

$$U(x_0) = \max_{s_0}\{F(x_0, s_0) + U(x_1)\}$$

where $U(x_0)$ is the maximum utility which can be earned in state $x_0$ and $F(x_0, s_0)$ is the immediate utility earned in state $x_0$ from the decision to spend $s_0$ coins. This bellman equation can be solved by defining the set of possible spending decisions in each state, which will be a function of income, savings, and the current period, and recursively calling the algorithm while storing the decision in each period which maximizes the total utility. The recursive algorithm will terminate when the state reaches period 11, since there are only 10 periods in the experiment. The optimal sequence of decisions is below:

| Period | Income | Coins Spent | Savings |
|---|---|---|---|
| 1 | 100 | 50 | 0 |
| 2 | 100 | 55 | 55 |
| 3 | 100 | 57 | 110 |
| 4 | 100 | 58 | 168 |
| 5 | 100 | 61 | 231 |
| 6 | 0 | 67 | 297 |
| 7 | 0 | 70 | 253 |
| 8 | 0 | 71 | 201 |
| 9 | 0 | 73 | 143 |
| 10 | 0 | 77 | 77 |

Table 2: The optimal payoff is $\approx$ 149.39 utility points $\approx$ \$50 USD

Several important features of the optimal sequence of decisions can be observed. First, the optimal decision in each period is unique and it is most beneficial to save more in early years and increase spending steadily throughout the experiment. The savings account reaches a maximum value of 297 coins in period 6, at which point only 219 coins have been saved. It is optimal to spend the entire savings balance in the last period, which is intuitive because any coins left unspent on utility are lost forever. Other than the last period, it is never optimal to save or spend extreme portions of incomes (e.g., 5% or 95%). It should be sufficiently difficult for subjects to determine this optimal sequence of decisions during the experiment, and it has all of the features, or lack thereof, which satisfy my guiding heuristics. The next key step in validating parameters is to compare the payoffs of random strategies against the optimal payoff.

#### 4.3.2 Monte Carlo Simulations

There are 10 billion combinations of decisions within the first five periods alone (100 to the power of 5). It is infeasible to determine payoffs for the entire set of unique strategies. I define a strategy as a list of 10 numbers which correspond to how many coins to spend in each of the 10 periods. In this case, I used Monte Carlo simulations to sample large numbers of random strategies to approximate the true distribution. In each simulated period, a number between 0 and the total available amount is chosen randomly. This method is further justified by the convergence observed as the number of samples increases:

| Number of Random Strategies | $\bar{U}$ | $\sigma_U$ |
|---|---|---|
| 10 | 80.2 | 19.3 |
| 100 | 79.8 | 24.2 |
| 10,000 | 75.4 | 29.0 |
| 1,000,000 | 75.8 | 29.1 |
| 10,000,000 | 75.8 | 29.0 |

Table 3: Convergence to random payoff mean via Monte Carlo simulations

It is clear the random strategy performance convergence to a mean of approximately 75.8 Utility Points with a standard deviation of approximately 29.0 Utility Points. Random payoffs are

illustrated below:

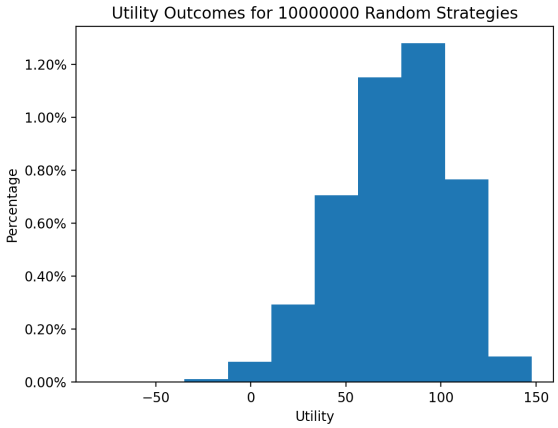


Figure 3: Payoff distribution from random strategies

It is important to note the maximum random payoff is approximately 147.7 and the minimum random payoff is approximately -80.5. The spread of the distribution is approximately 228.2. The probabilities of randomly achieving a payoff near the true minimum or true maximum are negligible. The optimal payoff of approximately 149 utility points is more than two standard deviations away from the mean random payoff. The large spread of random payoffs shows small variations in decisions translate to significant changes in payoffs. It should not be difficult to detect meaningful differences between subjects making good decisions because of a treatment effect and subjects making random decisions.

#### 4.3.3 Heuristic Strategies

A third and final approach to verifying and fine-tuning parameters is to compare the payoffs of typical heuristic strategies against the optimal payoff. Since the optimal sequence of decisions is nuanced and participants are unlikely to solve for each unique number, heuristic strategies should yield similar but sufficiently lower payoffs. It also seems appropriate for at least one heuristic to lead to a near-optimal outcome because otherwise interventions would have to be too detailed and unrealistically blatant to move subjects towards the optimal sequence of decisions. The payoffs of some heuristic strategies I expect subjects to employ are summarized below:

| Working Phase Spend/Save Strategy | Retirement Phase Strategy | Payoff (Utility Points) |
|---|---|---|
| 80/20 | $\frac{\text{balance}}{\text{periods left}}$ | 120.9 |
| 75/25 | $\frac{\text{balance}}{\text{periods left}}$ | 132.1 |
| 50/50 | $\frac{\text{balance}}{\text{periods left}}$ | 147.4 |
| 25/75 | $\frac{\text{balance}}{\text{periods left}}$ | 116.5 |
| 20/80 | $\frac{\text{balance}}{\text{periods left}}$ | 104.7 |

Table 4: Payoffs of common heuristic strategies

All of the tested heuristic strategies yield payoffs which should be significantly discernible from making random decisions. The 50/50 strategy is clearly the best heuristic and closely approximates the optimal outcome. This might be thought of as target heuristic for the treatment effects to nudge subjects towards. Although over-saving is punished more than under-saving, both can cause problems in the real world and these heuristics should be discernible from the near-optimal 50/50 heuristic. The goal of the interventions is to nudge subjects away from the over- and under-saving heuristics and towards a more efficient and balanced strategy.

### 4.4 Treatments

I propose a 2x2 full-factorial design with a social learning and projected account balance intervention. Each subject will participate in one experimental group and there will be 24 subjects in each group.

#### 4.4.1 Social Learning

People are often exposed to financial advice via social media, news outlets, friends and family, movies and tv shows, and so on. It is unreasonable to believe people make financial decisions in a bubble, especially in the 21st century given the amount of information that is only seconds away. Previous research highlights the relationship between social infrastructure such as retirement seminars (Burke & Hung, 2015) and inter-generational learning (Ballinger et al., 2003), and saving behavior, although there is some evidence of over-reactions in response to peer behavior (Carbone & Duffy, 2014). I propose a social learning intervention in which subjects are randomly assorted into groups of four. At the end of each period, subjects will be shown all previous decisions, current savings balance, and total utility for each member in their group. This is an extension of the intervention implemented by Carbone and Duffy (2014) in which subjects only saw the average consumption of their peers in the previous period. I think this is an interesting adaptation because providing more information should better capture the bombardment of information people likely receive when attending seminars and browsing social media.

This treatment is intended to represent interventions such as workplace retirement seminars and the opportunities for employees to discuss strategies and update their retirement plan elections based on information gained from coworkers who are presumably in similar financial situations.

### 4.4.2 Projected Account Balance

Previous research highlights how people struggle to plan for retirement (Reserve, 2020; Rhee, 2013) and how educational interventions can significantly increase retirement contributions and saving behavior (Burke & Hung, 2015; McKenzie & Liersch, 2011; Song, 2019; Tasneem et al., 2018). People tend to underestimate the long-term effects of compound interest and it is clear from the success of various interventions this is a barrier to better retirement planning. I propose a projected account balance intervention in which subjects constantly see a graphical projection of the growth of their savings for the remainder of the experiment. The projection will update at the start of each period so that it only reflects permanently saved money and not elections which have not been submitted yet. This is similar to the intervention tested by McKenzie and Liersch (2011) but goes one step further by providing a repeated projection which should allow subjects to update their projections and correct inaccurate heuristics about how their money will grow throughout the experiment.

## 4.5 Personal Metrics

It is highly unlikely social learning or a projected account balance is the best intervention for every individual in a company. Ballinger et al. (2003) reports compelling evidence that saving behavior is correlated with measures of cognitive ability, which suggests the best intervention for an individual might depend on some measures of their innate ability or factual knowledge. It is imperative to understand how individuals respond to each intervention across core metrics to determine if such tests can be used to develop individualized retirement interventions. Subjects in all four experimental groups will participate in all three assessments.

### 4.5.1 Cognitive Reflection Test II

The cognitive reflection test is standard in the experimental literature and quantifies an individual's ability to reflect on their gut response and critically analyze a tricky problem. The standard test is composed of three questions which seem simple, but the correct answer is typically not the one most people immediately think. One key concern when administering such tests in a laboratory experiment is its overuse. Since so many experiments rely on the cognitive reflection test, subject pools are becoming saturated with people familiar with the questions and therefore the answers; it is no longer an appropriate and trustworthy measure. To this end, a second version of the standard cognitive reflection test, which has a lesser emphasis on mathematical reasoning, has been developed and tested with on-line workers (Thomson & Oppenheimer, 2016). I will use this secondary version because the widespread familiarity with the original set of questions is especially a concern at Chapman University, in which students typically remain in the subject pool for four years and participate in many experiments.

### 4.5.2 Financial Literacy Test

It would be inappropriate not to include a financial literacy test in a group of individual metrics intended to determine the best retirement intervention for an employee. Financial literacy is a broad term which measures an individual's possession of financial knowledge and ability to make informed decisions and solve problems using that knowledge. There are many different methods of estimating an individual's financial literacy level, but for the purposes of this experiment and research agenda, a short and succinct task is ideal. Lachance (2014) uses data from the National Financial Capability Study and reports neighborhood effects and informal social relationships have a significant impact

on specific components of financial literacy. The NFCS used a set of five multiple-choice questions to measure financial literacy which I will use as the second metric. These questions cover the following categories: bond pricing, diversification, mortgages, inflation, and compound interest.

#### 4.5.3 Raven's Progressive Matrices

Raven's Progress Matrices were developed in the early twentieth century to test students who did not speak English and are correlated with intelligence (Bolton, 1955). This metric is also common in the experimental literature and is intended to test general intelligence and abstract reasoning. The test presents subjects with a number of multiple-choice questions. For each question, subjects are required to look at a series of geometric patterns with a missing piece, and select the piece from the available choices which best fits in the presented patterns.

### 4.6 Hypotheses

There are several hypotheses which are pertinent to my experiment and background literature.

**Education** Previous research shows people are more likely to save and increase their retirement contributions following educational interventions and a better understanding of compound interest (McKenzie & Liersch, 2011; Song, 2019), while the average person struggles to plan for retirement well (Rhee, 2013). I predict subjects in the projected account balance treatment will perform closer to the optimal decision path and achieve higher payoffs than participants in the control group, who will save too little.

**Social Learning** The reported effects of social influence on saving behavior are mixed (Ballinger et al., 2003; Carbone & Duffy, 2014). I predict subjects in the social learning treatment will perform closer to the optimal decision path and achieve higher payoffs than subjects in the control group, but will under-perform compared to subjects in the projected account balance and interaction treatments. The effects of social learning will likely not be immediate, and subjects might over-react to information about their peers' behavior. These concerns are not salient in the projected account balance treatment.

**Level Playing Field** Previous research has demonstrated a relationship between cognitive abilities and saving behavior (Ballinger et al., 2011). I predict the disparity of outcomes between subjects with high and low aggregate scores on the individual assessments will be largest in the control group. Both interventions and their interaction will reduce the advantages subjects might have from intelligence or ability.

**Subject-Specific Interventions** The purpose of this experiment is to determine if core individual metrics are correlated with the retirement intervention which has the most beneficial effect on saving behavior. I predict subjects will low aggregate scores on the assessments will perform best in the social learning treatment, while subjects with high aggregate scores will perform best in the projected account balance treatment.

## 5 Conclusion

Defined-benefit plans have existed in the United States since its founding, while defined-contribution plans dominated the private-sector from their creation in 1978. This radical shift did not occur in the public sector, where defined-contribution plans primarily serve as supplements to traditional pension plans. The apparent choice between these two retirement plan archetypes has given rise to reforms with varying success in the public sector and debates about which plan best serves employees, especially in the teaching industry. Despite the debate, the recent trend has made it clear that defined-contribution plans are here to stay and, since they put the onus on employees to adequately save for retirement, it is important to investigate how well people make contribution decisions. Previous research shows people typically struggle to save for the future, a lapse which has highly negative socio-economic impacts. To this end, a variety of interventions to improve saving decisions have been shown to be successful with different companies and demographics. Despite the numerous available and well-studied interventions, directly comparing them is difficult and there is a paucity of experimental literature on this subject. I propose a laboratory experiment to fill this gap and compare the effects of two retirement interventions, social learning and projected account balance, across three personal metrics: cognitive reflection, financial literacy, and abstract reasoning. The long-term goal of this research agenda is to develop a systematic program to design individualized retirement interventions for employees based on several core metrics.

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