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Reducing Savings Gaps Through Pennies Versus Percent Framing

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Abstract

Many companies and policymakers would like to reduce retirement savings gaps between ethnicities, gender, and income bands. Choice architecture, such as automatic enrollment, is one tool to help reduce such gaps. Yet not all employers want automatic features. This raises the question whether information architecture tools can be an additional tool to promote equality in saving. In this paper, we investigate an alternative to employees deciding what percent of pay they wish to save. Percentages are abstract, and evidence suggests that using them affects the judgments of less numerate consumers in other contexts, such as the health domain. Here, we examine the impact of using percentages to show savings rates, finding that they may lead to less desirable outcomes for some subpopulations (e.g., those with lower income who may be less financially literate or less numerate). We then introduce a new information architecture tool meant to help these segments: a pennies reframing of savings rates. A randomized controlled trial including 2,255 participants across eighty-six employers was conducted with participants assigned to either a pennies or percent treatment for making retirement savings elections. For those who submitted a savings rate, pennies framing had a positive impact on savings rates and reduced gaps between those with lower and higher income. The effects were largest for those with lower salaries (a proxy for numeracy), and those in the lowest salary tercile (annual income less than $46,000) elevated their savings rates by approximately 115 basis points compared to a control savings rate of 6.88%. Floodlight analysis suggests that those with less than $50,000 in annual salary are those most helped by pennies reframing. Pennies reframing can serve as a powerful information architecture tool for reducing gaps between the haves and have nots and democratizing savings.

Keywords: choice architecture, behavioral economics, saving, financial decisions

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1. Introduction

Many companies and policymakers seek to close financial outcome gaps between ethnicities, gender, and income bands. In the financial domain, a study of 2.4 million employees found that African-Americans and Hispanics typically had much lower participation rates, savings rates, and account balances compared to whites and Asian-Americans (Ariel and Aon/Hewitt, 2012). Retirement savings gaps between low- and high-income individuals are also widely observed around the world (Alling and Clark, 2021; Ariel and Aon/Hewitt, 2012; Feng et al., 2019; Notley and Mann, 2021). While potential policy approaches to reduce such gaps can involve mechanisms such as tax restructuring (e.g., shift from deductions that benefit high income and high tax bracket individuals toward flat rate tax credits, or targeted credits for low income individuals), financial education, or labor policies (e.g., relative to work interruptions, such as related to the birth and care of children), the use of nudges informed by behavioral science has shown general promise in terms of cost efficiency and effectiveness in improving behavioral outcomes (Benartzi et al., 2017). Yet, more work could be done to investigate the use of behavioral science to specifically address these gaps and democratize outcomes, with some calling for a "heterogeneity revolution" within the behavioral field to change behavior globally (Bryan et al., 2021). In this paper, we examine whether a specific type of "information architecture" intervention can help close the income gap in savings behavior.

Prior work has employed choice architecture tools to address savings gaps (Johnson et al., 2012). For example, auto-enrolling employees into a retirement plan raised participation rates from approximately 37% to 86% overall when controlling for employee tenure. Moreover, the gap in participation rates before auto-enrollment between males and females (6.4 percentage points) was essentially eliminated by implementing auto-enrollment. Additionally, gaps in participation rates before auto-enrollment between whites and African-Americans (19.0 percentage points), and whites and Hispanics (23.7 percentage points) was dramatically reduced (6.9 and 13.1 percentage points, respectively) by implementing auto-enrollment (Madrian and Shea, 2001).

Yet auto-enrollment and the use of higher defaults (Beshears et al., 2009) to reduce gaps in savings is limited by nature. First, not all plan sponsors in the US wish to use auto-enrollment, and adoption may be levelling off (Alling and Clark, 2021; Plan Sponsor Council of America, 2019). And second, for those plans that already use auto-enrollment, there may be opportunities for other non-automatic touch points with end users (e.g., when users maker periodic changes to their plan elections or opt in to annual rate escalation).

To address non-auto retirement plans, non-automatic situations, and decision contexts where end users engage more actively with decisions (Carroll et al., 2009), it is helpful to consider another category of behavioral tools: how choices are described (Johnson et al., 2012), sometimes referred to as "information architecture." For example, changing the description of fuel consumption from miles per gallon to gallons per mile has helped people to better understand the financial consequences of replacing certain cars (Larrick and Soll, 2008). And, presenting retirement wealth in terms of monthly income instead of equivalent lump sums led to different assessments of retirement income (Goldstein et al., 2016), and reframing a savings program from $150 per month to $5 per day quadrupled the number of people who decided to participate (Hershfield et al., 2020).

However, information architecture may not affect all people equally, and to that end, it may be an important tool for reducing inequality in behavioral outcomes. For example, when health risks were framed in terms of frequency rather than percent (e.g., "10% of patients get a bad blistering rash" versus "10 out of every 100 patients get a bad blistering rash"), consumers who scored higher in numeracy rated the riskiness of a pill similarly whether they saw percentages or frequencies, but those who were less numerate saw differences in risks depending on the framing (Peters et al., 2011). Crucially, differences between the less numerate and more numerate were eliminated by using frequency instead of percentage framing. In the financial domain, reframing a savings program opportunity as $5 a day instead of $150 per month had a disproportionally larger impact on those who were lowest in income, and eliminated the savings program participation gaps between those with lower and higher income (Hershfield et al., 2020). So, can information architecture be a tool to help reduce savings rate gaps in retirement plans?

In this paper, we test whether a specific type of information architecture – reframing savings behavior in terms of pennies contributed per dollar earned rather than percent of salary – can disproportionally help those consumers at the lower end of the income spectrum.

1.1. Background on Pennies Versus Percent Framing and Savings Decisions

When employer-based retirement programs were first introduced, employees often indicated their contribution rates as a function of how many dollars per paycheck they wanted to save for retirement. Psychologically speaking, saving a fixed dollar amount per pay period is a relatively concrete concept. However, when salaries increased, having a fixed dollar contribution means that savings rates will go down over time (all else equal). To resolve this issue, many retirement plans shifted to a percent-of-pay framing, even though percentages represent a more abstract concept than dollars do. In theory, such a shift allowed employees to save more over time as their incomes increased. But especially for lower income, less numerate, or lower financially literate individuals, framing information into more abstract terms such as percentages could backfire.

Before describing the studies in this paper, it is useful to consider why reframing retirement choices for the less numerate is important. First, saving for retirement is a relatively infrequent and complicated decision that requires both judgments and choices to be made relative to numbers and money (such as how much to save and where to invest money). Second, numerical competency can be thought of in terms of at least three competencies[1] which relate to one another, and these competencies affect judgments and decision making (Peters, 2020): 1) an evolutionary ability to intuitively discriminate between two numbers (e.g., an "approximate number system" which affects how precisely we perceive how far numbers are apart from one another),

[1] Financial literacy likely also plays a role in aspects of retirement savings decision (Lusardi and Mitchell, 2007; 2011), but has been excluded relative to this paper as direct financial literacy concerns are somewhat alleviated by the retirement system user interface implemented in the field study (such as showing long-run, retirement income projections to end users).

2) objective numeracy (how good one is at understanding and using math), and 3) subjective numeracy (how confident one is about using numbers). So, those with less numeracy may have less capacity or facility on multiple dimensions.

Here, we formally test whether reframing savings choices in a pennies-based frame will impact savings decisions relative to a traditional percent-based frame.[2] We first hypothesize that those who see savings choices in a pennies-based frame will select higher savings rates than those in a percent-based frame; that is, we predict a main effect given that many people, regardless of income, have a difficult time interpreting information when framed in percentage terms. Second, we hypothesize that those with lower numeracy would be helped to a greater extent through pennies reframing. In cases where it was infeasible to directly measure numeracy, we anticipated that income would act as a proxy for numeracy, and moderate choice with pennies-based framing. Specifically, we hypothesized that the pennies-based framing would help those with lower numeracy (proxied by lower income) more than those with high numeracy (proxied by higher income).

1.2. Overview of Studies

We test these propositions in two studies. In Study 1, we conducted an online study using hypothetical choices in which we compared a pennies-based framing to a more traditional percent-based framing. Relative to a percent-framing, the pennies-framing approximately doubled the intended savings rates of participants. Directionally – but not significantly – we also found that subjective numeracy moderated framing, with lower-numerate participants being most impacted by the pennies frame relative to the percent frame.

In Study 2, we employ a field study design and find that for employees who submitted a savings rate, the pennies framing had positive results on increasing submitted rates (50 basis points with 8.02% for pennies versus 7.52% for percent). Yet, a crucial moderation occurred: the effects are largest for those with lower salaries, and those in the lowest salary tercile elevated their savings rates by approximately 115 basis points from a baseline control savings rate of 6.88%. Floodlight analysis suggests that those with less than $50,000 in annual salary may be those most helped by pennies reframing.

[2] The notion of reframing savings decisions in terms of pennies is credited to discussions with George Fraser, a financial professional who works in the retirement plan space and has had thousands of one-on-one retirement savings discussions with employees at a range of organizations. He has used the pennies concept with a number of companies, usually with populations containing a significant proportion of lower income employees, that have typically had extremely low participation rates (e.g., 30-40 percent) in their retirement plans. While neither a scientific study or randomized controlled trial has ever been run to date prior to the studies presented here, he has anecdotally had success getting companies to increase participation rates to over 95 percent by getting employees to consider saving just 1 penny per dollar of their salary and increasing that by 1 penny every year (which is equivalent to saving 1% per year with a 1% rate escalator).

2. Study 1: Pennies X% and 7% Anchor Lab Study

2.1. Context and Sample Selection

Study 1 was conducted in conjunction with Voya Financial, a retirement services and recordkeeping provider that provides services to thousands of corporate customers and millions of employees. At the time of the study, the provider had made available approximately 2,000 potential participants from a digital user group. These users had pre-consented to optionally respond to various surveys related to new designs of websites by the provider for no compensation. Users became part of the digital user group at some point during their tenure with a company that was a customer of the provider, although an estimated one-fifth of the respondents may not have had active status with their employers. Based on the context for joining the digital user group, it is reasonable to characterize potential participants as having prior experience with retirement savings choices. Email recruitment for this study was targeted to those between the ages of 18 and 70 years old.

Given the limited power of this limited pool of potential participants and response rates, (especially given the inclusion of moderator requirements), a target sample size was not specified, but recruitment was allowed for ten days, and recruitment ran from July 22 to August 1, 2019.

2.2 Research Design and Methods

Eligible participants were invited by email to take part in an online research study to better understand how people make financial decisions about retirement. If participants did not participate upon the first email request, they were sent a second email invitation after a week from the original request. Eligible participants were told that if they took part, they would be asked questions about hypothetical financial decisions and their attitudes.

In the primary intervention, all participants were instructed to assume that their employer provided them with an opportunity to participate in a retirement savings plan that enables them to save a portion of their salary each pay period. They

were told that the plan would enable them to save and invest their money pre-tax (within government limits) until retirement. Participants were then told to consider that they had just logged into the retirement savings plan website.

In addition to our crucial pennies versus percent framing, we also included one other factor in this initial study. Namely, we varied whether respondents could list their retirement contribution in an unconstrained free response format, or if instead, they could respond with a savings contribution that was already anchored on 7%[3]. The research design thus took the form of a 2x2 between-subject factorial design with two between-subjects factors (Format: pennies versus percent; Response: free response versus "7-percent anchored"), with participants randomized into one of the four conditions.

In the free response conditions, depending on whether participants were assigned to the pennies or percent condition, participants saw a screen which showed either "I would like to save ___ pennies for every dollar I earn" or "I would like to save ___ % of what I earn." In the "7-percent anchored" conditions, depending on whether participants were assigned to the pennies or percent frame, participants saw a screen which indicated either "I would like to save - 7 pennies + for every dollar I earn" or "I would like to save - 7% + of what I earn." (See Figure 1). All participants were then asked to enter how much they would like to save by either filling in the blank for the statement "___ pennies for every dollar I earn" or "___ % of what I earn" depending on whether they were assigned to the pennies or percent factorial dimension.

Figure 1. Screens for Study 1: Hypothetical Retirement Saving Choice

Participants were then asked, in two separate questions, to rate whether they found the option to be affordable, and clear and understandable. Responses to both questions were made on a 6-point Likert scale (1 – strongly disagree, 6 – strongly agree). Participants were then asked questions about their subjective sense of numeracy, using the SNS-3 scale (McNaughton et al., 2015) (range: 3-18; M = 15.7; SD = 2.8; alpha = .796). Finally, participants reported their demographics (age, gender, income, and educational level). See Online Appendix S2 for all questions.

[3] This 7% value is based on the current, commercial implementation of Voya Financial with scientific evidence that such an anchor rate maximizes savings rate elections by participants while minimizing opt outs (Beshears et al, 2017).

2.3 Results

2.3.1. Summary Statistics and Experimental Balance

A total of 270 participants were recruited (mean age = 54.1 years old; 59.4% identify as male; mean income of 10.3[4]; and 81.9% had college or advanced degrees). Table 1 provides a summary of the characteristics of participants in terms of the four treatment groups. Age, education, income, and subjective numeracy did not differ by condition (Fs < 2.63, ps > 0.4; $\chi 2 < 9.07$, p = 0.17), although due to chance, the percentage of males in the pennies / anchor treatment condition was significantly higher than the other conditions ($\chi 2 = 10.5$, p = 0.02).

2.3.2. Main Results

The main outcome variable in this analysis is the intended savings rate chosen by participants. As shown in Figure 2, there was a main effect of condition; with the Pennies framing leading to higher intended savings rates (mean for PenniesFree condition = 29.5%, mean for Pennies7%Anchor condition = 25.5%, mean for PercentFree condition = 14.5%, and mean for Percent7%Anchor condition = 20.9%). This main effect was driven by a marginally significant interaction, such that the impact of pennies was greater in the free responses conditions compared to the anchored conditions. See Table 2 for more detailed regression analyses.

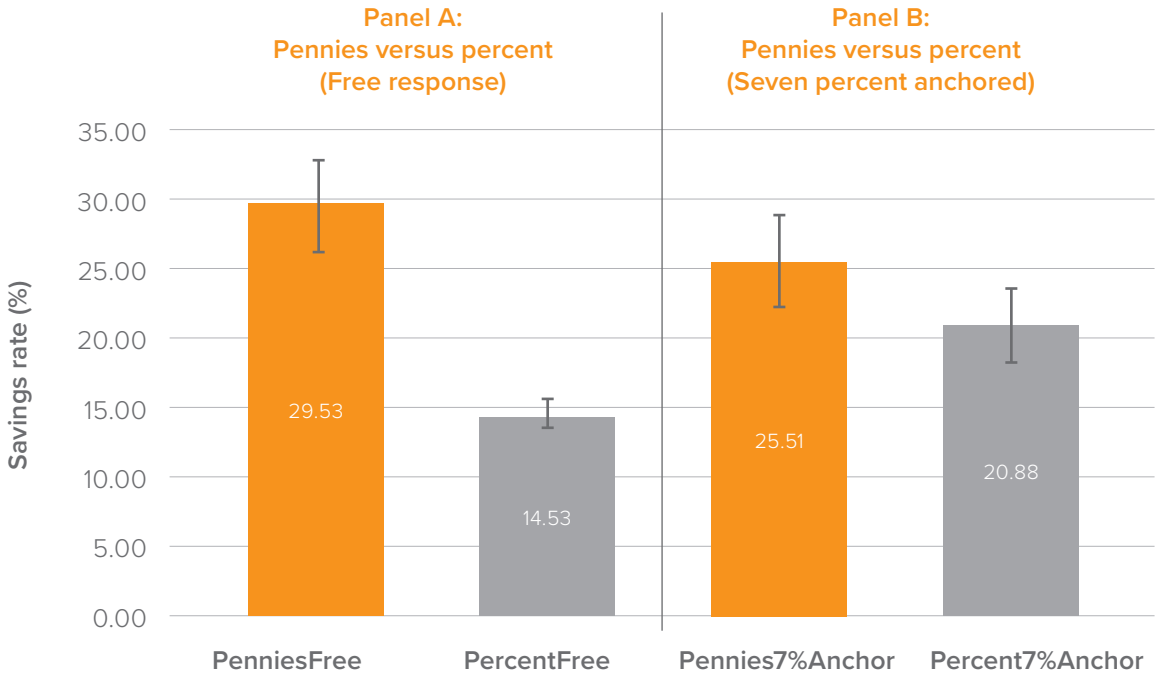


Figure 2. Summary of Savings Rates for Study 1 and Hypothetical Retirement Savings Choices by Condition

[4] Note that an income level of 10 indicates an annual salary from $90,000 to $99,999 a year, and an income level of 11 indicates an annual salary from $100,000 to $109,999 a year.

2.3.3. Additional Analyses

2.3.3.1. Exploratory Analysis of Subjective Numeracy as a Moderator

Although statistical power is low for measuring interactions in this study, for an exploratory analysis of how subjective numeracy may affect intended savings, OLS regressions were run with savings rate as the outcome variable and independent variables of pennies condition treatment indicator (pennies = 1, percent = 0), subjective numeracy, and the interaction between subjective numeracy and treatment condition. The coefficient on the interaction term was not significant, but directionally negative without controls (β = -1.45, p=0.30) and with controls of age, gender, income, and education (β = -1.40, p=0.34), which is consistent with a pattern of positive effects on pennies framing are largest on those with lower subjective numeracy and decrease as subjective numeracy scores increase. To better illustrate how the proposed intervention of pennies versus percent framing affects people based on their subjective numeracy, a floodlight-type analysis (Spiller et al., 2013) was performed to understand the treatment difference between pennies and percent in the free response frames according to subjective numeracy. The results of this analysis (without controls) are depicted in Figure 3, and illustrate that pennies framing has significant, non-negative effects relative to percent framing across a broad range of subjective numeracy levels (Johnson-Neyman significance region for $6 \leq SNS3 \leq 18$). For example, at SNS3=6 (a low subjective numeracy level) the treatment difference between pennies and percent is about 29 percentage points (β = 29.46, p=0.04). At SNS3=18 (a high subjective numeracy level) the treatment difference is about 12 percentage points (β = 12.07, p<0.001).

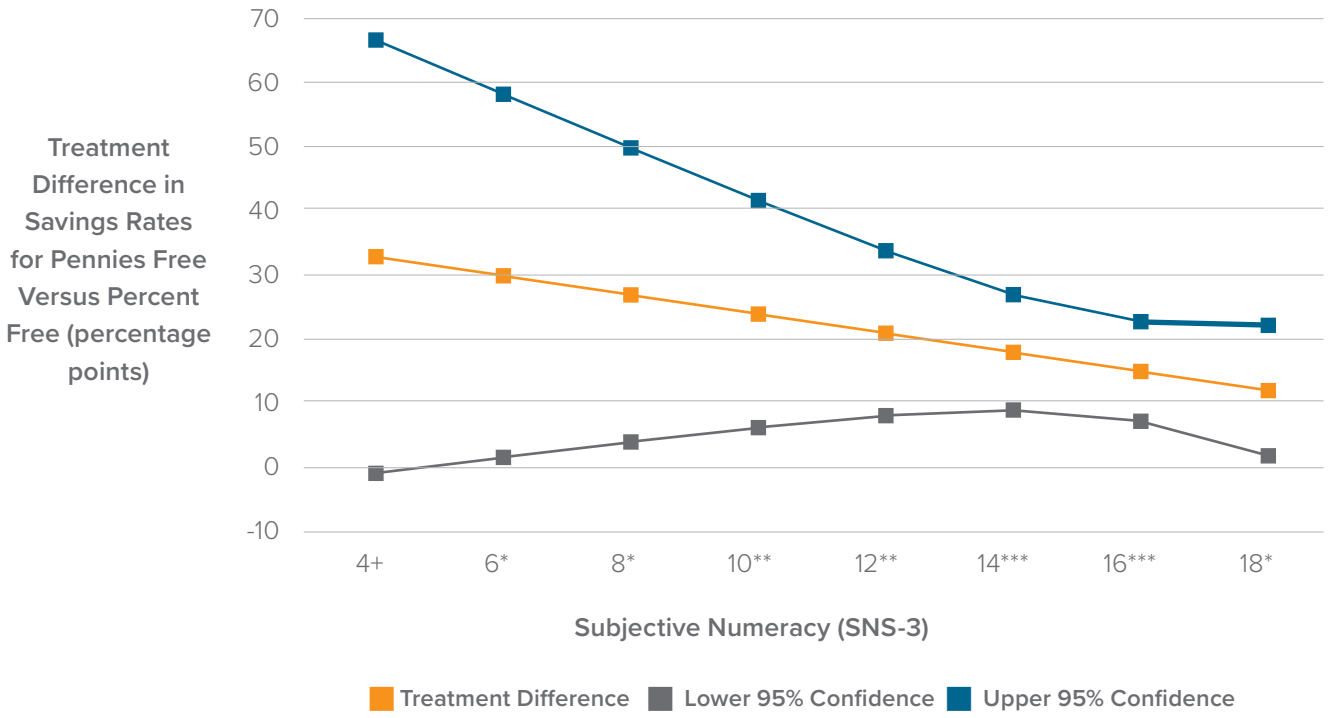


Figure 3. Treatment Differences in Savings Rates for Lab Study by Subjective Numeracy Score

2.3.3.2. Robustness Check of Main Results

As a robustness check of the main results, a structural equation model (SEM) analysis was performed using 1,000 bootstrap replications and savings rate as the outcome variable. Pennies Condition Indicator, the Seven Anchor Indicator, the interaction between Pennies Condition Indicator and Seven Anchor Indicator, and demographic controls were modeled, along with perceptions of affordability and understandability as hypothesized mediators between Pennies Condition Indicator and savings rate. Coefficients on the Pennies Condition Indicator (b=14.475, z=4.05, p=<.001), Seven Anchor Indicator (b=7.624, z=2.52, p=.01), and interaction between Pennies Condition Indicator and Seven Anchor Indicator (b=-12.376, z=-2.21, p=0.03) were all significant and had similar valences to those coefficients in Table 2, Model 4 covering the main regression analysis results. Perceptions of affordability and understandability did not mediate outcomes. More details on the SEM analysis can be found in Online Appendix S3: Supplemental SEM Analyses as outlined in Table S3-1 and Figure S3-1.

We note that the intended savings rates in this hypothetical choice seem quite high relative to what people would choose to save in a real-world setting (ignoring tax strategies where people may contribute very high rates until regulatory caps on total amounts are reached). As opposed to looking at specific savings levels and the calibration of these hypothetical choice results to real-world decisions, Study 1 mostly provides insights about the between-condition differences in intentions.

3. Study 2: Pennies X% Field Study

3.1. Context and Sample Selection

Study 2 was conducted in conjunction with the same retirement services and recordkeeping provider as described for Study 1. The study involved recruitment efforts from a potential pool of hundreds of tax-exempt organizations, such as those in the healthcare, education, government, religious, public services, and arts areas. To maximize the percentage of active decisions by individuals in the study, we specifically recruited non-auto enrollment plans and plans which had enrollment activity just prior to the launch of the field study (i.e., during the first six months of 2019). To try to recruit and obtain consent from these tax-exempt organizations, the Voya customer relations team was provided with a standard presentation deck to be used with the recruitment of the tax-exempt organizations to consent to participate in the study. The presentation deck outlined that the research would be about testing what effect reframing participant savings choices in terms of pennies or percent has on savings elections, in a randomized controlled trial. To minimize potential contamination, no results from the prior lab study were shared, and the presentation deck did not include the hypotheses for the research. The Voya customer relations team had discussions with hundreds of retirement plan administrators, and eighty-six qualified organizations opted-in to participate in the study.

For conceptual purposes, each tax-exempt organization can be thought of as getting their own retirement plan website on the recordkeeping provider's technology platform. This technology platform represents two systems, as depicted in Figure 4. The first system is the enrollment system, which is the first step as part of the retirement savings process for any employee who chooses to consider retirement savings choices. The enrollment system is where eligible employees can opt-in to retirement savings, choose an initial savings rate, utilize tools to view estimated monthly retirement income based on savings rate, and choose their investment allocations. As described in more depth below, the pennies reframing intervention is only implemented in the enrollment system, and the intervention is limited to only the initial portion of the enrollment process.

The second system is the ongoing system, and it comprises all the user interface processes where employees who have previously enrolled in retirement savings may manage their accounts on an ongoing basis. This could include viewing their accounts or changing their savings rates and investment choices, among other activities. Since the pennies intervention was only implemented for a portion of the process in the enrollment system and was not implemented in the ongoing system (e.g., to minimize costs of changing the technology systems)[5], the primary study measurements of interest for this paper are outcomes (e.g., initial savings rates) from the enrollment system[6].

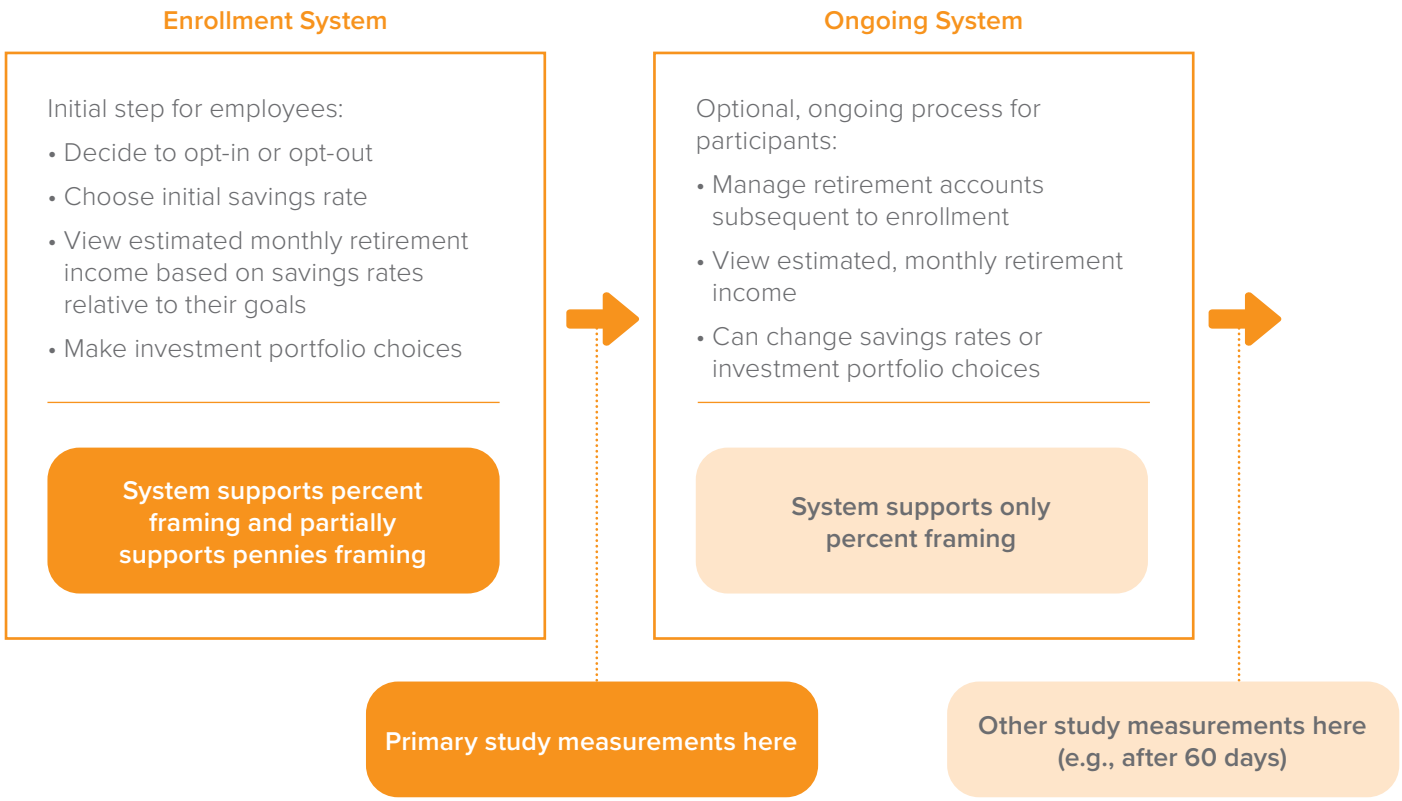


Figure 4. Conceptual Study 2 Overview of Systems, Limitations, and Measurements

It should be noted that retirement plans may differ between organizations, such as in terms of their employee eligibility rules (e.g., new employees or tenure requirements), open enrollment periods (during which all eligible employees can join the plan), employee communications, employer matching contributions formulas, investment options, hiring, turnover, paper forms, financial professional support, etc. The study did not require any of these pre-existing processes to be changed.

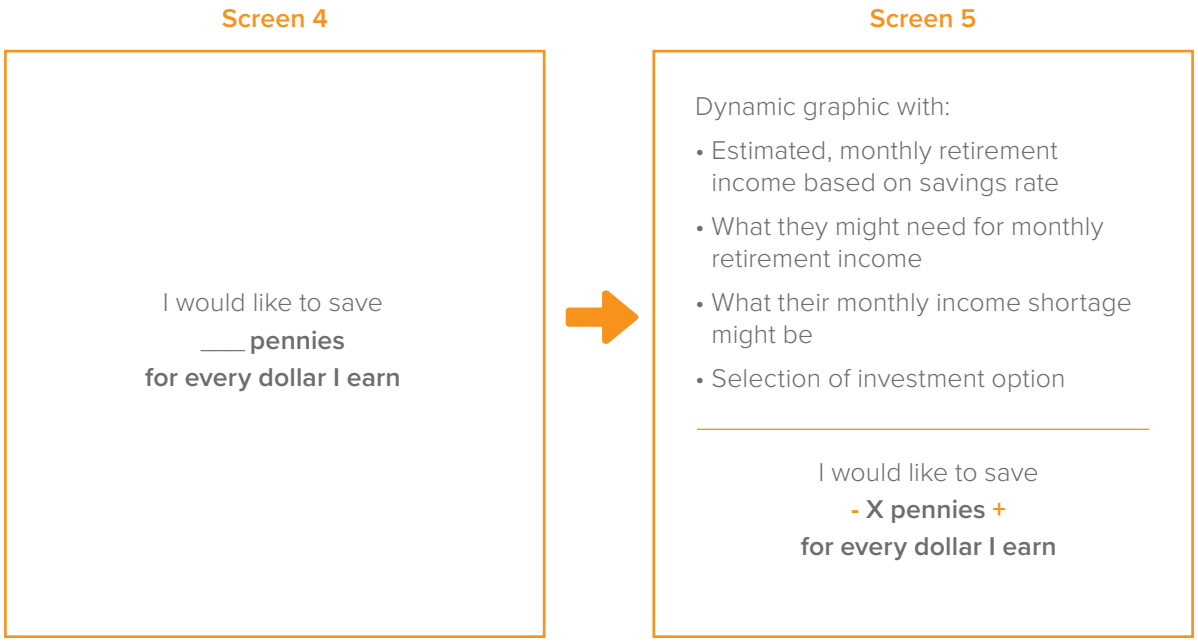
Participant enrollment data was collected between October 24, 2019 through May 20, 2020, during which the intervention treatments were implemented in the enrollment system, and retirement account changes were tracked for an additional 60 days. As additional context, local governments in the United States started to implement lockdown policies related to the COVID-19 pandemic around March 2020 (Goolsbee et al, 2020), which occurred roughly in the middle of the data collection period of the study.

[5] While it was theoretically desirable to implement pennies framing throughout the entire enrollment process in the first system (enrollment system) and second system (ongoing system), at the time the study was conducted the retirement system provider could not implement changes throughout, and so the focus was on changes to a small subset of user interface screens of the first system.

[6] Other study measurements are also provided 60-days after participants have made initial elections, but these measurements are not the primary focus of the paper as some participants may have revisited their accounts using the ongoing system. Any decisions made in that system would have been only in the traditional, percent framing. Participants may have also made subsequent, retirement election changes by calling into a call center or filling out a form with their employer. Such means of changing elections would also have only been in a traditional, percent framing environment.

3.2 Research Design and Methods

Study 2 was implemented as a between-subjects design with participants randomly assigned into one of two conditions (i.e., pennies versus percent treatment). The enrollment process involved the user proceeding through eight screens, starting with a log-in screen and ending with a confirmation of retirement savings elections screen. The critical part of the intervention occurs in the middle of the process (Screen 4), where users are asked to enter their desired savings rate. Depending on which treatment condition users were randomly assigned to, they were asked to complete the sentence on the screen which reads, "I would like to save [___ pennies for every dollar I earn] [____ % of what I earn]." On Screen 5, users can continue to understand and refine their selections. A conceptual overview of Screens 4 and 5 is illustrated in Figure 5, and a more detailed account of the enrollment process is outlined in Online Appendix S1.[7]



Participants in the percent condition instead saw "___ % of what I earn" for the bold text,
All other information was the same between conditions.

Figure 5. Conceptual Overview of the Primary Treatment in Study 2 and Screens Impacted in the Enrollment System

[7] Users may complete the enrollment process by logging into the website multiple times and completing the steps across multiple sessions before submitting their elections. If cookies have been allowed by the user, then users would be put into the same experimental treatment that they were originally randomized into (i.e., pennies or percent treatment condition).

Data from the provider consisted of the following at the participant-level: 1) treatment they received (e.g., which could be inconsistent between sessions if the participant visited the enrollment website multiple times and disabled cookies in their Internet browser), 2) whether they submitted or did not submit contribution elections during the session, 3) initially submitted retirement savings contribution elections (i.e., either the savings rate or fixed dollar amount per pay period initially submitted by a participant in the enrollment system), 4) savings rate elections in effect after 60 days, 5) demographic data including plan id (to uniquely identify an employer plan), salary, pay frequency, gender, and age; and 6) other account information (i.e., Roth contributions elected, after-tax contributions elected, rate escalation elections, and account status).

The field study was pre-registered prior to the collection of any data[8], with the follow exclusions specified. Participants were excluded if they were already making Roth contributions, if the online interface failed to put the user in a treatment condition (e.g., for software infrastructure technical reasons), if they terminated from their employer within 60 days of their initial intervention, if their selections were overridden by a plan-wide intervention within 60 days of their initial intervention, and if they were part of a plan sponsor who utilized financial professionals to interact with participants (e.g., to try to control for potential contamination by financial professionals who may interfere with the intended treatment).

In terms of additional exclusions that were not pre-registered, for the base analysis participants making after-tax contributions were also excluded for the same two reasons as for excluding those making Roth contributions. The first reason is that the pennies intervention was targeted at pre-tax contributions and so there was no theoretical reason why such an intervention would also have direct effects on accounts with different taxable treatments (e.g., Roth and after-tax). The second reason is that including observations that enable different tax strategies (such as Roth and after-tax accounts) would likely create additional variance in the main outcome variable of interest, the pre-tax savings rate. Furthermore, the base analysis case only includes participants who saw consistent treatments within the enrollment system. Participants received consistent treatments if they saw the assigned treatment condition on Screens 4 and 5 during each visit to the enrollment system (i.e., in each web session). Although this exclusion rule decreases the number of participants in the study (because some participants are contaminated in their received treatment versus assigned condition), it eliminates the need to make theoretical assumptions about which treatment most directly applies when the participant ultimately makes a retirement savings election decision since the treatment condition is the same for the user for all web sessions. This issue was not anticipated a priori (which is why we did not pre-register that we would exclude participants if they were shown different treatments). Finally, extreme outliers were dropped, namely those with annual salaries less than $500 or greater than $1,000,000, as such extreme outliers were not anticipated a priori. Upon inspection, many of these extreme outliers were deemed to be either data entry errors with implausible values or very far from the target population being researched (e.g., salaries amounting to millions or tens of millions of dollars per year).

Since the main purpose of the study was to assess the effect of pennies reframing on savings rates, the main outcome variable for the base analysis was on those treated who completed the enrollment process relative to their pre-tax, initial submitted savings rate (referred to as the initial submitted savings rate). The savings rate in effect 60 days after initial submission was also analyzed, although as noted prior, the pennies treatment was only in effect within the enrollment system and not the ongoing system where subsequent changes to savings elections would occur. Note that participants were able to submit either a savings rate or a fixed amount to save per pay period. If a participant indicated a fixed amount to be saved per pay period, then for analytical purposes, this amount was converted to a savings rate by annualizing the fixed savings amount. Specifically, we multiplied the fixed amount by the number pay periods per year on record, and then divided the result by the participant's annual salary.

[8] The pre-registration for the study is available at https://aspredicted.org/blind.php?x=5zr3jk.

Additionally, to assess the extent of any effects of pennies reframing on opt-outs (i.e., 0% savings rates), an indicator variable was constructed for a 0% savings rate at initial submission. Furthermore, as a test of whether pennies reframing might cause significant differences in participants treated versus not treated between conditions (e.g., people hesitating to enroll online), an indicator variable for 0% savings rate at initial treatment is also constructed.

Certain outcomes were also censured and treated as null values: 1) savings rates greater than 100% were censured, 2) cases where the savings rate needed to be estimated from fixed dollar amounts and paycheck frequency but where salary had been winsorized[9] , and 3) cases where enrollment elections were submitted but where the savings rate was not recorded for some technical reason.

3.3 Field Study Results

3.3.1. Summary Statistics and Experimental Balance

As employees entered the enrollment system between the dates of October 24, 2019 through May 20, 2020, they were randomly assigned to either a pennies or percent treatment group. Table 3 summarizes the characteristics of participants for the field study by treatment group with statistical tests reported for checks of experimental balance. A total of 2,255 participants were recruited, and based upon random assignment, 1,104 participants were assigned to the pennies condition and 1,151 participants were assigned to the percent condition. Initial analyses indicated that there were no significant differences between condition in terms of age (mean = 38.3), gender (percentage male = 28.5%), or income (mean = $68,577).

3.3.2. Main Results

In the base analysis, we first examined the submitted saving rates of those who completed Screens 1 through 8 in the enrollment system (i.e., treatment effects on the treated, N = 1884).[10] Based on an OLS regression analysis of submitted savings rates with controls for age, gender, log of winsorized income, and plan fixed effects, the simple main effect of pennies versus percent framing was significant ($\beta = 14.23$, $p = 0.03$), and the interaction between treatment condition and log of winsorized income was significant ($\beta = -2.88$, $p = 0.003$).[11]

Our second analysis was to assess whether the pennies framing differentially helped those at higher or lower levels of income, since we treated income as a proxy for numeracy. To do so, a floodlight analysis was performed using OLS regressions using log income as a continuous variable in contrast to the categorical treatment prior. Regressions have submitted savings rate as the outcome variable (e.g., 1 unit equates to a 1 percent submitted savings rate) with independent variables of pennies treatment condition indicator (pennies frame = 1, percent frame = 0), demographic controls for age (mean centered), gender (contrast coded male = 1, unknown = 0, and female = -1), log of winsorized income, the interaction between treatment condition and log of winsorized income, and plan fixed effects. The floodlight over the range of income is provided in the panels of Figure 6.[12] The range of significance for the interaction of treatment condition with log of winsorized income is from the lowest income level to log income of 4.7 (which is about $50,000). Above $50,000 in income, the treatment difference is not significant, although estimation projects a crossover point somewhere around log income of 5.0 (which is about $100,000). Most notably, as shown in Figure 6, in contrast to percent framing which has a floodlight plot that slopes upward as income increases, pennies framing tends to flatten the floodlight plot with those with lower incomes saving at rates more comparable to those with higher income. That is, pennies reframing tended to reduce the gaps in submitted savings rates between those with lower and higher income.

[9] Winsorization details are described in more detail later in this paper, but savings rates estimated based on a winsorized salary are deemed an unreliable measure.

[10] Of the 2,255 participants who start the enrollment process, 371 participants either never complete the enrollment process (e.g., browse the website) or have censured outcomes as described previously in the section on research design and methods.

[11] When running the OLS regression without the interaction term, the main effect of pennies versus percent framing was marginally significant without plan-fixed effects ($\beta = 0.62$, $p = 0.07$) and directional with plan-fixed effects ($\beta = 0.49$, $p = 0.15$).

[12] This floodlight covers pennies and percent conditions with age and gender controls plus plan fixed effects. Shaded regions indicate Johnson-Neyman significance regions. Data points for the floodlight are listed below the diagram (N = 1883).

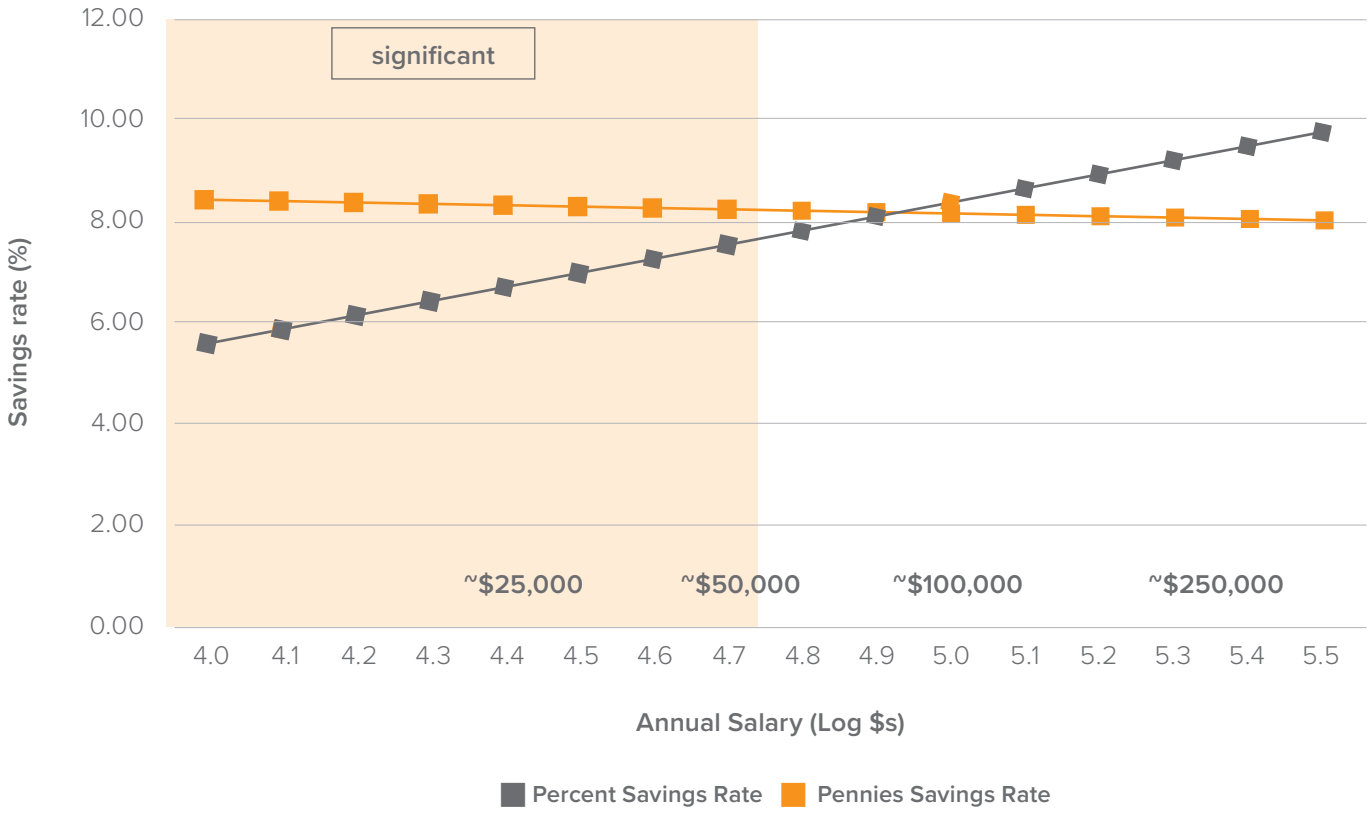


Figure 6. Floodlight Diagram of Submitted Savings Rates by Treatment Condition Across the Range of Income for Those Who Completed the Enrollment System Process

Salary (log $)	Salary ($)	Treatment Difference (Pennies Versus Percent)	Lower 95% Confidence Interval	Upper 95% Confidence Interval	t(1795)	p-value	Constant (Percent Savings Rate)	Pennies Savings Rate
4.0	$ 10,000	2.713	0.601	4.825	2.52	0.012	5.645	8.357
4.1	$ 12,589	2.425	0.558	4.292	2.55	0.011	5.918	8.343
4.2	$ 15,849	2.137	0.510	3.763	2.58	0.010	6.191	8.328
4.3	$ 19,953	1.849	0.456	3.242	2.60	0.009	6.465	8.313
4.4	$ 25,119	1.561	0.390	2.732	2.61	0.009	6.738	8.299
4.5	$ 31,623	1.273	0.305	2.241	2.58	0.010	7.011	8.284
4.6	$ 39,811	0.985	0.187	1.783	2.42	0.016	7.284	8.269
4.7	$ 50,119	0.697	0.009	1.385	1.99	0.047	7.558	8.255
4.8	$ 63,096	0.409	-0.257	1.075	1.20	0.229	7.831	8.240
4.9	$ 79,433	0.121	-0.620	0.862	0.32	0.749	8.104	8.225
5.0	$ 100,000	-0.167	-1.056	0.722	-0.37	0.713	8.377	8.211
5.1	$ 125,893	-0.455	-1.535	0.625	-0.83	0.409	8.651	8.196
5.2	$ 158,489	-0.743	-2.038	0.553	-1.12	0.261	8.924	8.181
5.3	$ 199,526	-1.031	-2.555	0.494	-1.33	0.185	9.197	8.167
5.4	$ 251,189	-1.319	-3.081	0.444	-1.47	0.142	9.470	8.152
5.5	$ 316,228	-1.607	-3.612	0.399	-1.57	0.116	9.744	8.137

For illustration purposes, we also decompose this result by income terciles, which were constructed based on the total pool of participants who started the enrollment process and received consistent treatment throughout (N = 2255 with one missing value for income in the pennies treatment group; see Table 4 for descriptive stats).

The average submitted savings rates of those who completed the enrollment process by treatment condition, as a function of income tercile is shown in Figure 7.

The general pattern from this analysis is that the pennies reframing (relative to percent framing) results in higher submitted savings rates for those with the lowest income tercile (Income Tercile 1: $b = 1.154$, $p < 0.056$) and no significant condition and income interaction effects for the other terciles (ps > .156). See Table 5 for regression and post-estimation results. Whereas percent framing results in a wider gap in savings rates between lower and higher income salary participants, pennies reframing tends to reduce the gaps.

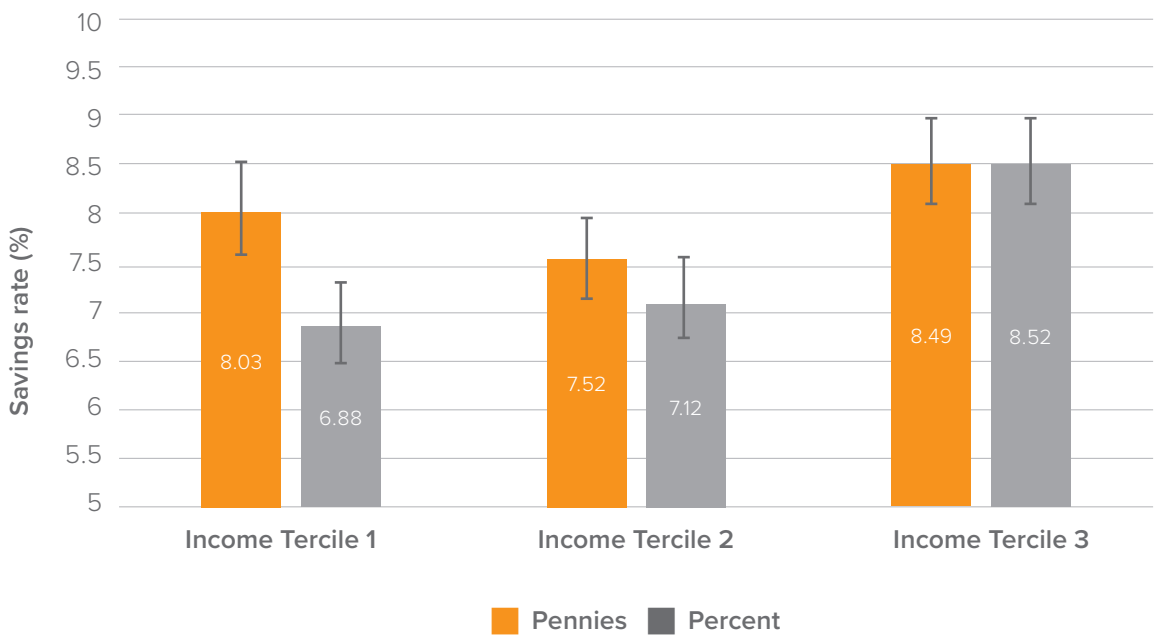


Figure 7. Submitted Savings Rates by Treatment Condition by Income Tercile for Those Who Completed the Enrollment System Process.

Note that postestimation margin results are based on running an OLS regression with winsorized submitted savings rate[13] as the outcome variable with independent variable of treatment condition, winsorized age (mean centered), gender (contrast coded), income tercile (categorical), interaction between treatment condition and income tercile (categorical), and plan fixed effects (using the plan with the largest number of participants as the base reference point).

[13] Submitted savings rates (and other savings rates in this paper) are winsorized at the 0%/99% levels (i.e., winsorized from the top).

3.3.3. Additional Analyses

The focus of the analysis so far has been on those treated, specifically those who completed the enrollment process. A potential concern of focusing solely on the fully treated may be that pennies versus percent framing could potentially cause more participants to exit the online enrollment process early (e.g., due to the process feeling less natural in the pennies frame). To address this issue, an indicator variable was constructed which was set to 1 if participants on their initial treatment either did not submit a savings rate or submitted a 0% savings rate during their initial session and was set to 0 otherwise. In other words, this indicator variable can be thought of as a flag whether people had a 0% savings rate after their initial treatment. Using this indicator variable as the outcome variable, four OLS[14] regressions were performed (See Table 6). In Model 1, the sole independent variable was an indicator variable for the pennies treatment condition, and the simple main effect of pennies framing was positive, marginally significant, and small ($\beta = 0.032$, $p = 0.08$). Model 2 added demographic controls of winsorized age (mean centered), gender (contrast coded male = 1, female = -1, other = 0), and log of winsorized income (centered at log of mean winsorized income), and the simple main effect of pennies framing continued to be marginally significant and small ($\beta = 0.033$, $p = 0.07$). Finally, given the prior evidence of potential interaction effects between treatment condition and income, an interaction variable between the two was included in Model 3. When adding the interaction term, the simple main effect was marginally significant and small ($\beta = 0.035$, $p = 0.07$) and the coefficient on the interaction was not significant ($\beta = 0.032$, $p = 0.65$). Model 4 added plan fixed effects, and the resulting simple main effect was trend-level ($\beta = 0.034$, $p = 0.08$). To provide additional color, when Model 4 is instead run as a logistic regression, the simple main effect was not significant ($B = 0.193$, $eB = 1.21$, $p = 0.08$). Altogether, this evidence suggests that pennies framing may have a marginal effect on increasing the propensity of people to hesitate to save (for example, some may be surprised to see an elicitation to save pennies and then exit the web session to attempt to enroll later). Additional secondary analyses are included in the Online Appendix S3 which indicate that that people who complete the online enrollment process do not submit 0% rates with increased frequency and that the general pattern of pennies framing helping those with lower income is still directionally apparent after 60 days.

[14] Ordinary least squares (OLS) regression may be used to analyze and estimate treatment effects for indicator variables (Angrist and Pischkle, 2009).

4. General Discussion

Prior research has demonstrated that companies and policy makers can use tools of choice architecture to help reduce gaps in financial outcomes between different groups of people, such as ethnic, gender, and income groups. One major choice architecture tool in the area of retirement savings has been the use of auto-features, such as using auto-enrollment and higher default savings rates. However, while choice architecture is great tool, it is not the only tool, and some may even prefer to use tools other than auto-features. We suggest that tools of information architecture (e.g., reframing of information) should also be part of the broader toolkit used to address financial outcome gaps.

To that end, in two studies we examined whether a pennies-based framing would impact savings elections relative to a percent-based framing, and if it would do so with differential success for those across the numeracy spectrum. In an online study (Study 1), the pennies reframing had a positive, simple main effect of dramatically increasing intended savings rate contributions. Results did not include a significant interaction effect, although those with lower subjective numeracy scores directionally boosted their intended savings rates the most. Likely explanations for failing to detect an interaction include both low statistical power and use of a higher-income study population (whereas the pennies intervention seems best suited for those with lower numeracy and lower income). The positive effects on savings intentions were not limited to those with the lowest subjective numeracy, and non-negative effects were observed across the full range of subjective numeracy. It is noteworthy to mention that the correlation between income and subjective numeracy in the lab study was large ($r = 0.42$; $p < 0.001$).

In a field study (Study 2), which covers a population that is comparatively closer in terms of average annual salary (roughly $70,000) to the overall United States population, pennies reframing had a simple main effect of boosting initial submitted savings rates. Importantly, we also observed a significant interaction between pennies framing and income, with those in the lowest income tercile (income less than $46,000) being boosted by 115 basis points. Based on a floodlight analysis of the interaction between treatment condition and income, those who earn less than around $50,000 seemed to be helped by pennies framing.

It is worthwhile to highlight some limitations of the research in this paper and potential for future research. First, the pennies framing only occurred for a small portion of the enrollment and ongoing retirement savings processes. It is possible that effects would be different if consistent treatments were provided throughout the entire experience. Second, in the field study, income was used as a proxy for subjective numeracy. While such measures are correlated (e.g., as evidenced by the lab study) and subjective numeracy seems theoretically appropriate to act as a proxy, future studies should nonetheless directly explore how subjective numeracy (and potentially objective numeracy and financial literacy) affects real decision outcomes. Third, to address differences in numeracy and financial literacy, other forms of information architecture should also be explored, such as those involving decisions involving employer matching formulas, rate escalators, and visualization of rates (e.g., savings, spending versus saving).

Another future area of research should be relative to the use of thinking architecture, which would involve providing more structure to the overall decision-making processes of individuals and encouraging individuals to reflect more deeply. As research on numeracy has shown, there is a significant percentage of people who are less capable in translating numbers or performing analyses that require multiple steps (Peters, 2020). By using thinking architecture to decompose decisions into more relatable and concrete steps, we may be able to nudge better financial outcomes despite the gaps in the capabilities of individuals. As an example of thinking architecture and as motivated by Query Theory (Johnson et al., 2007), decision making could be made broader (and perhaps more holistic) by having end users reflect on saving or spending first before making savings decisions.

This research explores an information architecture approach to reducing gaps in savings, and is, to the best of our knowledge, the first empirical examination of pennies versus percent reframing in a consequential savings domain. The use of pennies reframing is particularly important because it provides an alternative to employers who want to improve employees' retirement outcomes but who do not want to implement automatic enrollment features in their retirement plans. The pennies intervention is relatively inexpensive and easy to implement, and pennies reframing seems to close savings gaps between those with lower income (often those with lower subjective numeracy) and those with higher income. Put differently, pennies reframing provides an opportunity to democratize savings by reducing discrimination caused by percent framing. The main policy caveat is that institutions should consider whether such an intervention should be targeted as opposed to used broadly. Targeting could conceivably be implemented at a plan, demographic (e.g., income), or individual behavioral difference level (e.g., subjective numeracy).

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Appendix

Table 1. Experimental Balance of Covariates for Study 1 (Pennies X% and 7% Anchor Lab Study)

This table summarizes the characteristics of participants for the lab study. Note that the second to last row reports chi-squared statistics for education and the percentage of male. The last row reports for all other covariates both statistical tests for means and variances. For the means, a one-way ANOVA is reported with an F-statistic and p-value. For variances, a Bartlett's test for equal variances is reported. For statistical tests, the null hypothesis is that the groups are equal. +, p<0.10; *, p<0.05; **, p<0.01; ***, p<0.001.

	Mean Age (standard deviation)	Percentage Male[†] (standard deviation)	Mean Annual Income[††] (standard deviation)	Percent Education (% high school/% college/% advanced degree)	Subjective Numeracy (SNS-3) (standard deviation)[†††]	Observations
Pennies Free	54.66 (9.59)	51.4	10.08 (4.40)	18.57% / 51.43% / 30.00%	15.9 (2.7)	70
Percent Free	53.79 (11.64)	58.2	10.00 (3.88)	17.54% / 43.86% / 38.60%	15.4 (2.8)	57
Pennies Seven Anchor	53.17 (11.12)	75.4	10.46 (4.14)	21.43% / 48.57% / 30.00%	15.5 (3.0)	70
Percent Seven Anchor	54.74 (10.50)	52.8	10.61 (4.26)	15.07% / 34.25% / 50.68%	15.7 (2.8)	73
Overall	54.11 (10.65)	59.4	10.32 (4.18)	18.15% / 44.44% / 37.41%	15.7 (2.8)	270
Chi-squared for percentage male and education [p-value]	N/A	10.5 [0.02*]	N/A	9.07 [0.17]	N/A	
(F-statistic for means, Bartlett's χ2 for variance) [p-value mean, p-value variance]	(0.34, 2.63) [0.79, 0.45]	N/A	(0.29, 0.86) [0.83, 0.84]	N/A	(0.35, 0.74) [0.79, 0.86]	

[†] Note that this only includes participants reporting either male or female for gender and excludes those reporting "other" or "prefer not to say." Of 270 participants, 4 participants reported a gender of either "other" or "prefer not to say" with 1 in the Pennies Seven Anchor, 2 in the Percent Free, and 1 in the Percent Seven Anchor conditions.

[††] Income is ordinally coded into 16 bins with $10,000 increments with a 1 indicating a salary of $9,999 a year or less, 2 indicating salary from $10,000 to $19,999 a year, and 16 indicating a salary of $150,000 a year or more.

[†††] The SNS-3 is a scale that can range from a minimum of 3 (lowest subjective numeracy) to a maximum of 18 (highest subjective numeracy). Cronbach's alpha for the SNS-3 items were acceptable at 0.796.

Table 2. Regression Analysis of Study 1 (Pennies X% and 7% Anchor Lab Study)

This table reports the results of ordinary least squares regressions where the outcome variable is the savings rate intentions of the participant. +, p<0.10; *, p<0.05; **, p<0.01; ***, p<0.001.

Saving Rate	Model 1	Model 2	Model 3	Model 4
	b/se	b/se	b/se	b/se
Pennies Condition Indicator	9.487*** (2.80)	10.426*** (3.00)	10.414*** (3.01)	16.313*** (3.86)
Seven Anchor Condition Indicator	0.937 (2.82)	0.728 (3.04)	0.762 (3.06)	6.457* (2.96)
Age		0.021 (0.14)	0.021 (0.12)	0.012 (0.14)
Gender		-0.080 (1.72)	-0.115 (1.69)	0.348 (1.76)
Income		-0.797+ (0.46)	-0.817+ (0.46)	-0.837+ (0.47)
Education		-0.265 (2.35)	-0.306 (2.40)	-0.435 (2.42)
SNS-3			0.089 (0.54)	0.060 (0.53)
PenniesCondition=1 # SevenAnchorCond=1 (interaction)				-10.844+ (6.15)
Constant	17.566*** (1.76)	24.965** (9.11)	23.898* (11.75)	21.813+ (11.29)
R^2	0.039	0.065	0.065	0.076
Dfres	267	235	234	233

For ease of interpreting coefficients for the OLS, contrast coding for gender is used such that male = 1, female = -1, and other = 0. Those who prefer not to report their gender or income are excluded from the analysis with controls. Age is an integer between 18 and 99. Education is coded with high school = 1, college degree = 2, and advanced degree = 3.

Table 3. Experimental Balance of Covariates for Study 2 (Pennies X% Field Study)

This table summarizes the characteristics of participants for the field study. Note that the second to last row reports chi-squared statistics for gender. The last row reports for all other covariates both statistical tests for means and variances. For the means, a one-way ANOVA is reported with an F-statistic and p-value. For variances, a Bartlett's test for equal variances is reported. For statistical tests, the null hypothesis is that the groups are equal. +, p<0.10; *, p<0.05; **, p<0.01; ***, p<0.001.

	Mean Winsorized Age[†] (standard deviation)	Percentage Gender (% male / female / unspecified)	Mean Winsorized Annual Income[†, ††] (standard deviation)	Observations
Pennies	38.25 (11.78)	28.3% / 64.3% / 7.4%	68667.42 (44377.22)	1104
Percent	38.14 (11.90)	28.8% / 64.9% / 6.3%	68489.38 (45115.31)	1151
Overall	38.20 (11.84)	28.5% / 64.6% / 6.9%	68576.51 (44745.81)	2255
Chi-squared for gender [p-value]	N/A	1.0 [0.59]	N/A	
(F-statistic for means, Bartlett's χ2 for variance) [p-value mean, p-value variance]	(0.10, 0.21) [0.90, 0.90]	N/A	(0.01, 0.31) [0.92, 0.58]	

Table 4. Descriptive Stats on Income Terciles for Study 2

The income terciles below were constructed based on the total pool of participants who started the enrollment process and received consistent treatment throughout (N = 2255 with one missing value for income in the pennies treatment group).

Salary Tercile	N	Mean Winsorized Salary ($)	Min Winsorized Salary ($)	Max Winsorized Salary ($)
1	752	31,718	$ 11,340	$ 45,760
2	756	59,118	$ 46,000	$ 74,000
3	746	115,316	$ 74,500	$ 275,000
Total	2254	68,577	$ 11,340	$ 275,000

[†] Age and annual income are winsorized at the 1% and 99% level. Note that extreme outliers with annual income < $500 or > $1,000,000 were dropped prior to winsorization.

[††] 1 observation has a missing value for income in the pennies frame.

Table 5. Regression Analysis of Submitted Savings Rate as a Function of Condition and Income Tercile

This table reports the results of ordinary least squares regressions where the outcome variable is winsorized submitted savings rate with independent variables of treatment condition (with percent as the base reference), winsorized age (mean centered), gender (contrast coded), income tercile (categorical with the lowest income bracket as the base reference), interaction between treatment condition and income tercile (categorical), and plan fixed effects (using the plan with the largest number of participants as the base reference point). +, p<0.10; *, p<0.05; **, p<0.01; ***, p<0.001. Parentheses reflect p-values.

submitted_savings_rate	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
pencond	1.153968	0.60419	1.91	0.056	-0.03102	2.338959
age_wmc	0.032795	0.015227	2.15	0.031	0.002931	0.062659
web_gender_recode	-0.358	0.194855	-1.84	0.066	-0.74017	0.024169
salary_tercile						
tercile 2	0.244093	0.594492	0.41	0.681	-0.92188	1.410062
tercile 3	1.637494	0.611236	2.68	0.007	0.438685	2.836303
pencond#salary_tercile						
pennies x tercile 2	-0.75092	0.836156	-0.9	0.369	-2.39086	0.889021
pennies x tercile 3	-1.17978	0.832042	-1.42	0.156	-2.81165	0.452099
plan fixed effects						
_cons	7.164665	0.480851	14.9	0	6.221578	8.107752
N	1883					

Table 6. Regression Analysis of Initial 0% Savings Rate Based On First Treatment Encounter

This table reports the results of ordinary least squares regressions where the outcome variable is an indicator variable indicating an effective 0% savings rate based on initial treatment of the participant. +, p<0.10; *, p<0.05; **, p<0.01; ***, p<0.001. Parentheses reflect p-values.

initial_rate_zero_flag	Model 1	Model 2	Model 3	Model 4
pencond	0.0324+	0.0330+	0.0354+	0.0338+
	(0.082)	(0.073)	(0.065)	(0.077)
age_wmc		-0.00452***	-0.00454***	-0.00361***
		(0.000)	(0.000)	(0.000)
web_gender_recode		-0.00880	-0.00890	-0.0199+
		(0.395)	(0.389)	(0.063)
logweb_salary_wmc		-0.131***	-0.146**	-0.180***
		(0.000)	(0.003)	(0.001)
pencondxlogsalarywmc			0.0323	0.0499
			(0.652)	(0.486)
plan fixed effects				varies
_cons	0.247***	0.233***	0.232***	0.147***
	(0.000)	(0.000)	(0.000)	(0.000)
N	2249	2248	2248	2248

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