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Decisions about life annuities are an important part of consumer decumulation of retirement assets, yet they are relatively underexplored by marketing researchers studying consumer financial decision making. In this article, the authors propose and estimate a model of individual preferences for life annuity attributes using a choice-based stated-preference survey. Annuities are presented in terms of consumer-relevant attributes such as monthly income, yearly adjustments, period certain guarantees, and company financial strength. The authors find that these attributes directly influence consumer preferences beyond their impact on the annuity's expected present value. The strength of the direct influence depends on how annuities are described: when annuities are represented only through basic attributes, consumers undervalue inflation protection, and preferences are not monotonically increasing in duration of period certain guarantees. When descriptions of annuities are enriched with cumulative payment information, consumers no longer undervalue inflation protection, but nonlinear preferences for period certain options remain. The authors find that among annuities with the same expected payout but different annual increases and period certain guarantees, the proportion of consumers who choose the annuity over self-management can vary by more than a factor of 2.

Keywords: financial decision making, annuities, conjoint analysis

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Consumer Preferences for Annuity Attributes: Beyond Net Present Value

With baby boomers now retiring at the rate of almost 10,000 per day, the issue of decumulation of retirement assets is increasingly important to economists, public policy experts, and the financial services industry. It should also be of interest to researchers in marketing because consumers in the market for decumulation products, such as annuities, face a choice problem with large financial stakes, limited learning opportunities, difficult consumption trade-offs, multiple sources of uncertainty, issues of trust and branding, and long time periods. All of these aspects of the decumulation problem are topics on which marketing research can offer important insights.

This article examines the structure of consumer preferences for life annuities, an important class of decumulation products. We employ a choice-based conjoint analysis to measure consumer preferences and relate them to the underlying financial value of the products. Annuities, as well as many other financial products, provide a unique setting for choice modeling because most annuity attributes have calculable expected present value that can be directly compared with consumers' revealed utilities. Consequently, we are able to see whether an attribute influences demand only through its contribution to the normative net present value (NPV) of the annuity product or whether attribute values have psychological worth beyond NPV. We find that a typical consumer choosing from a set of annuities does not merely maximize the expected financial

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value but also reacts to several product attributes directly—expressing preferences beyond the effect of attributes on the financial value. For example, most consumers overvalue medium (10–20 years) levels of period certain guarantee relative to their financial impact, but they generally undervalue inflation protection with respect to annual increases in payments.

Our second goal is to understand how annuity attribute valuations are affected by changes in information presentation. Varying information presentation has long been part of the tool kit available to marketers and is increasingly seen as a tool available to policy makers in their efforts to "nudge" consumers toward purchases that can increase consumer welfare (Thaler and Sunstein 2008). We predict that the strength of the influence of attributes on consumer preferences beyond their impact on NPV will depend on how the annuity products are described. In one of the presentation conditions of our study, we describe each annuity product in terms of its basic attributes as per current industry norms. In another presentation condition, we enrich the product description with nondiscounted cumulative payment information for a few representative "live-to" ages. Note that this "enriched information" condition does not provide consumers with additional information—it merely helps them get a sense of possible payouts given exactly the same underlying attributes. Not surprisingly, we find that consumers in the enriched information condition undervalue inflation protection attributes less than consumers in the basic information condition. In contrast to this partial de-biasing effect of the enriched information, with respect to period certain guarantees, consumers in the enriched information condition continue to exhibit under- and overvaluation very similar to that seen in the basic information condition. We also find that enrichment of information increases the baseline preference for annuitization over self-management.

In each information condition, we also find significant individual differences in preferences for annuity attributes correlated with consumer characteristics such as amount saved for retirement, subjective life expectancy, numeracy, and perceived annuity fairness. Most of these characteristics are correlated with preferences in a qualitatively similar manner regardless of the product description condition, with the exception of subjective life expectancy, which is positively correlated with a preference for annual increases only in the enriched information condition.

Our findings provide several insights regarding consumer annuity choice and ways that marketers can improve consumers' acceptance of annuitization without paying out more money in expectation. For example, a marketer can increase demand for an annuity of a fixed expected present value by reducing the amount of an annual increase and using the resulting savings to fund an increase in the duration of the period certain guarantee up to 20 years. Which products the issuer should offer depends on the way they will be described (e.g., shorter period certain guarantees are more optimal under enriched information than under basic information). Regardless of the information presentation, we find that such "repackaging" of the payout stream can have a large effect on demand, sometimes even doubling the take-up rate of annuities in the population we study. Before presenting the detailed methods and results of the conjoint analysis of annuity product features, we next turn to a brief review of the role of annuities in the retirement journey.

THE ROLE OF ANNUITIES IN CONSUMER DECUMULATION

As one approaches retirement, there are a number of difficult decisions, including questions of when to retire from work and when to begin claiming Social Security benefits (Coile et al. 2002; Knoll 2011). The most complex decision of all, however, is how to optimally spend down saved assets. In the growing body of research on consumer financial decision making (Lynch 2011), the emphasis has often been on the accumulation stage of wealth management, addressing issues such as retirement savings decisions (Hershfield et al. 2011; Soman and Cheema 2011) and investment choice (Morrin et al. 2012; Strahilevitz, Odean, and Barber 2011). Although these issues of how to accumulate wealth during the 30 years prior to retirement are crucially important for workers, the decumulation of wealth in the 30 years after retirement is also an important problem and thus far has been relatively unaddressed in marketing research.

The size of the decumulation problem is substantial, with approximately $9.2 trillion in retirement assets held in either defined contribution plans (e.g., a 401k) or IRAs (Benartzi, Previtero, and Thaler 2011). The consumer's risks in consuming saved assets include either spending too quickly, which might lead to running out of money, or spending too slowly, which severely constrains consumption and might lead to the consumer dying with unused funds. Also complicating this decision is the large uncertainty about life expectancy, a crucial piece of knowledge for determining the optimal intertemporal consumption path (Payne et al. 2013).

The economics literature has long recognized that life annuities are a compelling marketplace solution to the decumulation problem (for reviews, see Benartzi, Previtero, and Thaler 2011; Brown 2007; and Davidoff, Brown, and Diamond 2005). The simplest form of a life annuity is the immediate single-payer life annuity, in which a consumer exchanges a lump sum for a guaranteed stream of payments for as long as he or she lives. In a sense, life annuities offer the opportunity for the retiree to convert retirement assets saved through a defined contribution plan into an income stream more similar to a defined benefit (pension) plan. The implied insurance against outliving one's assets is the biggest advantage of life annuities. Another advantage is that life annuities often pay out higher percentage returns than is normally feasible with self-managed accounts. For example, a life annuity might pay a 6.8% annual rate of return rather than the 4%–5% one would collect from a self-managed account. This higher return is a result of benefits to survivorship, because accounts of those who die early are used, in part, to pay income to annuity holders who continue to live. However, a consumer's purchase of a life annuity carries some disadvantages. First, one's estate (i.e., heirs) receives no payment when one dies with a traditional type of life annuity; the money remains with the company that issued the annuity, implying a possible loss or negative return on the original purchase. Another disadvantage is a loss of control over the assets because the investment funds are given to the annuity company to manage, which may result in not benefiting from potential returns from stocks and other risky financial products (Milevsky and Young 2007). Issuing companies vary in financial strength ratings, which is clearly important given the fact that the choice to purchase an annuity has implications for many years and because government backing for such products is dependent on state-level regulations. Finally, life annuities typically provide relatively poor liquidity (i.e., cash availability) in case of emergencies. Nonetheless, most economic analyses have concluded that purchasing a life annuity should be part of the decumulation strategies of most consumers. It has therefore been a puzzle that life annuities have not been more popular: research on choices among pre-retirees who are able to choose between annuities and lump-sum payouts for their retirement savings has found that, often, less than 10% choose the annuity (Johnson, Burman, and Kobes 2004; Poterba, Venti, and Wise 2011).

As a result, companies that offer life annuities have introduced a variety of product features in an effort to make annuities more attractive. These options include attributes such as period certain guarantees, deferred start dates, annual income increases to compensate for inflation, and joint annuities (e.g., for married couples). Period certain options guarantee payments for a specified number of years, even if the annuitant passes away, with remaining payments going to designated heirs; after the specified number of years, a period certain annuity becomes like a standard annuity, with payments that continue until the individual dies. These annuities thus protect against total loss of the principal investment due to early death while still being able to offer income for life. Annuities with deferred start dates, also called longevity annuities, require a lower up-front payment, in exchange for delayed payouts that will not begin until a certain time in the future, assuming the purchaser is still alive then. Offering annuities with consumer-oriented options, such as period certain guarantees, carries financial trade-offs; the issue for the offering company is whether consumers are willing to accept higher prices in exchange for these benefits.

Our focus is on understanding how the product features discussed in the previous paragraph are valued by consumers. The features are presumably offered in response to consumers' needs. These needs consist of both economic concerns (e.g., risks of inflation, probability of receiving payouts) and psychological concerns (e.g., desire to provide for family, issues of fairness). Research on annuities has tried to assess the strength of these different needs, particularly to explain differences in overall consumer demand for annuity products. Although rational economic arguments can explain demand for some annuity features, several researchers have suggested that psychological factors also need to be considered (Brown 2007; Goldstein, Hershfield, and Benartzi 2015). Whether the demand is based on purely economic concerns or driven by psychological needs can significantly influence a consumer's willingness to pay for a given feature. A feature that addresses strong psychological concerns might be worth more to the consumer than it costs the company to offer; conversely, a feature that does not meet a psychological need may be undervalued by the consumer relative to its full financial impact.

Consider first one of the most popular annuity options: a period certain guarantee, which ensures payouts for a set number of years even in the case of the annuitant's death. A consumer's concerns about leaving a bequest in case of an early death might account for less than full annuitization during retirement (Brown 2007; Davidoff, Brown, and Diamond 2005; Yaari 1965). Such bequest concerns could explain preference for period certain guarantees as a way to ensure that money is provided for heirs in the case of early death. However, bequest motives cannot explain patterns in which people without heirs choose period certain guarantees and/or almost no annuitization. A different explanation for the popularity of period certain options can be found by considering the decision using concepts from cumulative prospect theory (Tversky and Kahneman 1992). For example, loss aversion might make annuities unattractive when consumers perceive the forfeiture of the annuity purchase price due to early death as a loss either to themselves or to their family and heirs (Hu and Scott 2007). Furthermore, prospect theory suggests that the risk of losing the full value of the annuity can be further highlighted by consumers' tendency to overweight small probabilities. Finding that period certain guarantees are overvalued by consumers relative to their expected financial value could indicate that these psychological concerns play a role in consumer demand for this feature.

Risks of inflation might also be expected to worry consumers, and annuity providers sometimes offer annual increases as a feature to address this financial concern. Although having inflation protection makes rational sense, consumers might think of an annuity purchase more as a gamble or an investment than as a source of consumption income, which could weaken the perceived benefit of inflation protection (Agnew et al. 2008; Brown et al. 2008; Hu and Scott 2007). Further complicating valuation of annual increases are psychological biases in judging intertemporal payouts, especially those described in percentage terms rather than fixed terms (McKenzie and Liersch 2011). Studies on intertemporal choice that document differential discounting of gains and losses, predictions of resource slack, myopia and hyperopia, construal, procrastination, and/or intertemporal consumption have all offered evidence that consumers are likely to undervalue long-term annual increases (e.g., Shu 2008; Soman 1998; Zauberman and Lynch 2005). Furthermore, consumer uncertainty surrounding judgments of future health, economic outcomes (e.g., inflation), and life expectancy can lead to biased evaluations of the future utility of those payouts. Considering these facts together, we expect that consumers will undervalue the financial benefits of annual increases when selecting annuities.

Finally, rational consumers might worry about risk of default by the annuity issuer. In the annuity marketplace, default risk is captured through financial strength ratings (e.g., AA, AAA) of the issuing company. Actual risk of default for companies with high ratings is quite low,[1] but overweighting of small probabilities may cause consumers to perceive the risk as much higher. Babbel and Merrill

[1]For example, from 1981 to 2008, no companies rated AAA by Standard & Poor's ever defaulted, and mean annual default rate for companies rated AA was .02%.

(2006) show that even a small objective default risk can have a large economic impact on annuity purchasing.

Given the complexity of annuity products and the psychological processes that affect how these attributes are evaluated, consumers' preferences might be significantly influenced by the way information about the annuities is presented during the choice process. As noted earlier, research on the impacts of different ways to present the same information has a long history in the field of consumer behavior (e.g., Bettman and Kakkar 1977; Russo 1977), and it is increasingly seen as a way to influence consumer welfare through variations in information architectures. A recent example of such changes in information architecture is the new credit card statements that provide calculations on how long it will take a consumer to pay off his or her credit card balance with just the minimum required payment or a slightly increased monthly payment (Soll, Keeney, and Larrick 2013). Specific to annuities, Kunreuther, Pauly, and McMorrow (2013, p. 142) suggest providing "better and more convincing information on the attractive properties of annuities" and their potential long-term payout as a solution to the annuity puzzle; our enriched presentation format offers an initial test of such a solution.

Beyond general population judgmental biases, individual differences in how consumers handle financial purchase decisions are important to consider. For example, recent findings regarding consumers' financial knowledge (both objective and subjective knowledge), financial literacy, numeracy, and overall cognitive ability offer important predictions of how consumers who differ in individual abilities may react to annuity offerings (Fernandes, Lynch, and Netemeyer 2014; Frederick 2005; Peters et al. 2006). A comprehensive survey of all individual factors that can influence annuity choice is outside the feasibility of a relatively short consumer study, so we focus on individual measures that closely relate to the trade-offs inherent in our chosen attribute set. In particular, we measure age, gender, retirement savings, numeracy, loss aversion, perceived fairness of annuity products, and subjective life expectations. We now turn to an experimental study designed to investigate how consumers value annuity attributes beyond their impact on NPV.

A STUDY OF CONSUMER PREFERENCES FOR ANNUITY ATTRIBUTES

To carefully measure how consumers value and make trade-offs between annuity attributes, the remainder of this article proposes and estimates a model of individual preferences for annuities using a discrete-choice experiment (DCE). Our model is distinct from other applications of DCE in the sense that the product attributes jointly imply an expected present financial value of the product. Knowing the financial value of each product in our DCE allows us to see whether an attribute influences demand only through its contribution to the financial value or whether it also has psychological worth beyond NPV. We also apply our estimated model to the product-design problem and characterize how marketers and policy makers can increase consumer acceptance of annuities without necessarily increasing the expected payout.

The remaining sections proceed in four stages, as follows. First, we lay out our model, including how we chose attributes and how those attributes can be converted to an expected present value that is central to our model specification. Second, we describe our subject population and our methods, including an enriched information presentation treatment hypothesized to affect participants' valuation of particular attributes. Third, we describe our results, presenting both model-free evidence and choice-model estimates. Finally, we suggest implications for the marketing of annuities and suggest how specific attributes make annuities more appealing to particular demographic groups.

Study Design: Attribute Selection, Model Specification, and Statistical Optimization

Our DCE consists of 20 choice tasks. In every choice task, we asked participants, "If you were 65 and considering putting $100,000 of your retirement savings into an annuity, which of the following would you choose?" They then saw three annuity options and a fourth no-choice option that read, "None: If these were my only options, I would defer my choice and continue to self-manage my retirement assets."

Attribute selection. The attributes we use include starting income, insurance company financial strength ratings, amount and type of annual income increases, and period certain guarantees. Each attribute can take on several levels selected to span the range of levels commonly observed in the market today (see Table 1).

We now briefly explain our motives in selecting these attributes and their levels for our study. Beyond starting income, which is clearly one of the most important financial attributes for an annuity, we include insurance company financial strength ratings to test the theory by Babbel and Merrill (2006) that even a small default risk can have a large economic impact on annuity purchasing. We included only AA and AAA rating levels to focus on small differences in default risk near the top of the financial strength range, where many real-world annuity providers operate.

Including annual increases as one of our primary attributes allows us to test the importance of inflation protection in annuity purchases. The seven levels of annual income increase we use in this study include three increases expressed additively (e.g., "every year, payments increase by an amount $X"), three increases expressed multiplicatively (e.g., "every year, payments increase by Y%"), and one level for no increase. We chose levels of additive increase and multiplicative increase that roughly match each other in the initial years of the annuity in terms of the expected payout; for example, a 7% annual increase is roughly equal to a $500 annual increase for an annuity with starting monthly payments of $600. Inclusion of both percentage and fixed increases of similar amounts tests the possibility that individuals underestimate income growth for rates expressed in percentages (McKenzie and Liersch 2011; Wagenaar and Sagaria 1975). This misunderstanding of exponential growth may be especially important for individuals who have low skills in financial literacy and numeracy (Lusardi and Mitchell 2007).

The third attribute we focus on is the period certain guarantee. Period certain guarantees include periods of 0 years (no period certain), 5 years, 10 years, 20 years, and an extreme option of 30 years. As documented by Scott, Watson, and Hu (2011) and Benartzi et al. (2011), the

Table 1
ATTRIBUTE LEVELS USED IN THE CONJOINT ANALYSIS

Level	Starting Monthly Income	Company Financial Strength Rating	Annual Increase in Payments	Period Certain Guarantee
1	Monthly payments start at $300 ($3,600/year)	Company rated AA (very strong)	Fixed payments (no annual increase)	No period certain
2	Monthly payments start at $400 ($4,800/year)	Company rated AAA (extremely strong)	3% annual increase in payments	5-year period certain
3	Monthly payments start at $500 ($6,000/year)		5% annual increase in payments	10-year period certain
4	Monthly payments start at $600 ($7,200/year)		7% annual increase in payments	20-year period certain
5			$200 annual increase in payments	30-year period certain
6			$400 annual increase in payments	
7			$500 annual increase in payments	

purchase of a period certain guarantee on a life annuity is economically dominated by buying a combination of a bond and a deferred-start annuity, making the popularity of this attribute in the marketplace a puzzle for standard economic theory. We do not examine this puzzle directly because our choice sets include only annuities and not combinations of annuities and bonds. Beyond standard risk aversion, several behavioral explanations are possible for why consumers value period certain guarantees. First, they may misestimate a guarantee's impact on payout relative to life expectations. The most likely misestimation situation is that consumers overestimate the impact of short guarantees (e.g., in reality, a 5-year guarantee has almost no impact) and underestimate the impact of very long guarantees. Second, they may be concerned about the loss of the annuity principal (especially for heirs) in the case of an unexpected early death. Such prospective loss aversion could make short period certain options especially appealing but have less effect on longer options. By assessing the valuation of period certain attributes beyond their impact on NPV, we may gain some insight into these potential explanations for the popularity of period certain guarantees.

Finally, we note that our design includes annuities with combinations of income and period certain terms not currently available in the market but potentially available in the future. We also test annuities with expected (actuarial) values substantially in excess of what would be available on the market relative to their $100,000 purchase price. These design choices represent a strength of our stated-preference approach for two reasons: first, they allow us to separately identify the impacts of different attributes that might be correlated in secondary data, and second, they allow us to base counterfactuals on data rather than extrapolation.

Individual differences. The multiple responses per individual enable us to estimate the indirect utility of an annuity contract for each individual as a function of the contract's attributes, both directly and via each attribute's contribution to the expected payout (calculated using the Social Security Administration's gender-specific life expectancy tables). To try to explain some of the population heterogeneity we observe, we collected several key demographic and psychographic measures for each participant. Because life expectancy is a key life-cycle input for decumulation choices, we asked each individual how long they expected to rely on their retirement funds by having them estimate the probabilities that they would live to ages 65, 75, 85, and 95 (Payne et al. 2013). Longer life expectancy should raise consumers' preference for annuitization, increase the value they place on inflation protection, and reduce the value they place on period certain guarantees. We also collected other demographic information, including gender and amount of retirement assets, that should, theoretically, influence preferences for annuities.

Given the complexity of annuities, we expect more numerate people to like annuities more and to better understand attributes such as annual increases. To assess numeracy and analytical thinking ability, we included five numeracy questions and three cognitive reflection task questions for a subset of our total survey population (Frederick 2005; Weller et al. 2012).[2]

We also administered an additional set of questions to measure other individual differences in key behavioral constructs that are thought to affect preference for annuities, including perceived annuity fairness and loss aversion (Benartzi et al. 2011; Hu and Scott 2007) (see the Web Appendix for details on all questions). Research has suggested that perceived fairness is an important consideration for consumers of financial products as well as a strong input into attitude measures for such products (Bies et al. 1993). We measure perceived fairness of annuities through a single direct question based on Kahneman, Knetsch, and Thaler (1986). Finally, because loss aversion has been posited as a potential explanation for why consumers do not like to purchase annuities in general (the "annuity puzzle"), participants responded to a set of nine questions that asked them to choose between mixed gambles, thus providing individual-level measures of loss aversion (Brooks and Zank 2005).

Information presentation treatment. To test how presentation of information about annuity choices affects attribute valuation, our study tests two versions of the annuity-choice task, between subjects. In the basic information

[2]Numeracy measures were limited to a subset (about 65%) of the total population. For participants who did not complete the numeracy scale, we substituted median numeracy during the analysis. This substitution creates an error-in-variable problem, making all of our inference about the effects of numeracy conservative.

Figure 1

SAMPLE ANNUITY CHOICE TASK IN BASIC AND ENRICHED CONDITIONS, AND RESULTING CHOICE SHARES

A: Sample Conjoint Choice Task

If you were 65 and considering putting $100,000 of your retirement savings into an annuity, which of the following would you choose?

Monthly payments start at $400 ($4,800/year) 7% annual increase in payments 30 years period certain Company rated AA (very strong)	Monthly payments start at $600 ($7,200/year) 5% annual increase in payments 10 years period certain Company rated AAA (extremely strong)	Monthly payments start at $500 ($6,000/year) $400 annual increase in payments 20 years period certain Company rated AAA (extremely strong)	None: if these were my only options, I would defer my choice and continue to self-manage my retirement assets.
❍ A	❍ B	❍ C	❍ none

B: Sample Conjoint Choice Task with Cumulative Payouts

In the enriched information treatment, the following table was shown directly under the task:

Cumulative amount paid to you by different ages if you live to that age

Age	70	75	80	85	90	95
Option A	$27,600	$66,300	$120,600	$196,800	$303,600	$453,400
Option B	$39,800	$90,600	$155,400	$238,100	$343,600	$478,400
Option C	$34,000	$78,000	$132,000	$196,000	$270,000	$354,000

C: Choice Shares of the Three Alternatives for the Sample Task in Figure 1, Panel A

		Option A	Option B	Option C	None
Expected present value (V)	**V**	**$264,900**	**$174,100**	**$165,700**	?
	V without period certain guarantee	$142,400	$167,800	$134,400	?
Observed choice shares	Basic treatment	15%	28%	20%	36%
	Enriched treatment	14%	50%	12%	24%

condition, each annuity is described based only on its primary attributes of starting monthly (and annual) payments, annual increases, period certain options, and company rating. This presentation is modeled on typical presentations of annuity attributes by issuers in the market today. Our second, enriched information condition provides the same information but also includes a table of cumulative payout per annuity, conditional on living until the ages of 70, 75, 80, 85, 90, and 95. These cumulative tables do not provide any additional information beyond what the participant could calculate directly using the provided attributes in the basic information condition. However, we predict that by seeing the results of these calculations, participants will be able to more clearly see the joint cumulative impact of all attributes on expected payouts and thus better align their choices with the outcomes. We show sample presentations for each condition in Figure 1, Panels A and B.

Model specification. Each of the 20 choice sets in our study consists of k = 3 alternatives (annuities), with the kth alternative in the nth choice set characterized by a combination of the attributes presented in Table 1.[3] Our baseline utility specification is based on the variables that should theoretically drive annuity choice, namely, the expected payout and the financial strength rating of the issuer. We denote the expected payout of the annuity V and calculate it from the monthly income, period certain, and annual increase (if any) of the kth annuity in the nth choice set, as follows:

[3]Full details on the exact attributes tested in all 20 choice tasks are provided in the Web Appendix.

(1)

$$V_{n,k} = \underbrace{\sum_{age=65}^{65+pc_{n,k}} \delta^{(age-65)}\left(12 \times income_{n,k,age}\right)}_{\text{guaranteed income during the period certain } pc_{n,k}} + \underbrace{\sum_{age=66+pc_{n,k}}^{120} \delta^{(age-65)} \Pr(\text{alive at age})\left(12 \times income_{n,k,age}\right)}_{\text{uncertain income conditional on living until a given age}},$$

where $pc_{n,k}$ is the length of the period certain guarantee (if any); $\Pr(\text{alive at age})$ is the probability of being alive at a given age past 65 (conditional on being alive at 65),[4] according to the gender-specific life expectancy Social Security tables[5]; δ is an annual discount factor set to .97, following 2011 Office of Management and Budget (1992) guidelines; and $income_{n,k,age}$ is the monthly income provided by the kth annuity in the nth choice set when the buyer reaches the given age. This last variable is in turn determined by the starting income and the annual increases (if any). Note that for annuities with the period certain guarantee, we implicitly assume that the annuity buyer cares equally about payout to himself/herself and about the payout to beneficiaries in the case of an early death. In our choice model, we assume that the buyer cares about the expected net present gain over the purchase price $V_{n,k} - price_{n,k}$. Because all annuities in our study cost p = \$100,000, the variation in expected gain is driven completely by the variation in $V_{n,k}$, so the model specification is almost identical to assuming consumers care about $V_{n,k}$. A rational buyer should also care about the financial strength of the company as measured by the AAA versus AA ratings. We include both the main effect of financial strength and its interaction with expected gain in our model. To understand why we include the interaction, note that the same expected gain is more certain when provided by an AAA versus an AA company, so a rational buyer should value it more, ceteris paribus.

In addition to the effect of the total expected gain and the company's financial strength suggested by normative theory, we let several attributes enter utility directly to capture the "beyond NPV" idea discussed previously. Specifically, we include the type and amount of annual increase and the level of the period certain guarantee. All levels of these additional attributes are dummy-coded and contained in a row attribute vector $X_{k,n}$.[6] We exclude starting income from $X_{k,n}$ to avoid strong collinearity; we find that the expected gain is too correlated with starting income for the model to separately identify the impact of starting income on utility beyond its impact on the expected payout. However, we did analyze an alternative specification of our model that replaces the expected net present gain with starting income, keeping the rest the same. (Estimates of this specification are available later in the article and are further detailed in the Web Appendix.) Comparing our estimates with those from the alternative specification will be useful in interpreting our results.

Given the expected payout $V_{n,k}$, the dummy variable $AAA_{n,k}$, the price of the annuity p (which we fixed to \$100,000 throughout the study by design) and the $X_{k,n}$ variables, we model the utility for respondent j's of the kth annuity in the nth choice set as a linear regression:

(2)

$$U_{n,k,j} = \underbrace{\alpha_j + \beta_j\left(V_{n,k} - p\right) + \gamma_j AAA_{n,k} + \delta_j AAA_{n,k} \times \left(V_{n,k} - p\right)}_{\text{normative model}} + \underbrace{X_{n,k}\theta_j}_{\substack{\text{direct effect}\\ \text{beyond NPV}}} + \varepsilon_{n,k,j},$$

where $\varepsilon_{n,k,j} \sim N(0, 1)$ and we normalize the utility of the outside ("none of the above") alternative k = 0 to zero to identify the parameters[7]: $U_{n,0,j} = 0$. This normalization implies that the utility of inside alternatives should be interpreted as relative to self-management of a \$100,000 investment. Together with a simplifying assumption that $\varepsilon_{n,k,j}$ are independent, our model becomes a constrained version[8] of the multinomial probit model (Hausman and Wise 1978). The individual-level utility parameters to be estimated are $\{\alpha_j, \beta_j, \gamma_j, \delta_j, \theta_j\}_{j=1}^{J}$, where θ_j is a column vector of the same length as $X_{k,n}$, and the rest are scalars.

To pool data across respondents j = 1, 2, ..., J while allowing for heterogeneity of preferences, we use the standard hierarchical approach following Lenk et al. (1996) (for an overview of hierarchical linear models, see Rossi et al. 2005). A row vector of M characteristics Z_j characterizes each respondent, and respondents with similar characteristics tend to have similar preferences following a multivariate regression:

$$(3) \qquad \left[\alpha_j, \beta_j, \gamma_j, \delta_j, \theta_j'\right] = Z_j\Delta + \tau_j, \text{ where } \tau_j \sim N(0, \Sigma),$$

where [. . .] indicates a concatenation of all parameters into a row vector, Σ is an $A \times A$ matrix, and Δ is an $M \times A$ matrix, where A is the number of individual-level utility parameters and M is the number of individual-level demographic and psychographic characteristics. The baseline parameter from which individuals deviate according to their characteristics Z is the first row of Δ in that we set the first element of each Z_j to unity. To complete the model, we use standard conjugate priors for Σ and Δ, namely,

(4)

$$\Sigma \sim \text{Inverse Wishart}\left(\kappa_0, S_0\right) \text{ and } \text{vec}\left(\Delta\right)|\Sigma \sim N\left(\text{vec}\left(\Delta_0\right), \Sigma \otimes I\sigma_\Delta^2\right).$$

4Note that the study participants were asked to imagine they were already at age 65 when they chose the annuity, and thus no adjustment should be made for actual current age or the chance of living until 65.

5The 2001 version of the table is available at https://www.ssa.gov/oact/STATS/table4c6.html. Annuity issuers often maintain their own mortality tables that are adjusted for possible adverse selection among annuity purchasers. The effect on our estimates of using mortality data from Social Security tables rather than issuer-specific rates is a possible underestimation of the expected NPV per annuity. Thus, any estimates of undervaluation per attribute should be considered conservative.

6We do not include interactions of these direct effects with AAA rating for two reasons: (1) The normative effect of a risk reduction due to stronger financial health is already captured in the interaction between AAA rating and expected NPV, and (2) Estimating such interactions in addition to all the other parameters of interest requires a significantly larger number of survey questions, which is important to trade off against respondent fatigue.

7See McCulloch and Rossi (1994) for a detailed discussion of parameter identification in a multinomial probit.

8The restriction of *one* of the scalar elements of the covariance of the $\varepsilon_{n,j}$ vector to unity is standard. The restriction of the *entire* covariance matrix to identity simplifies estimation and reflects our belief that the unobserved shocks associated with the individual annuity profiles are not heteroskedastic and not mutually correlated. The resulting model is sometimes called "independent probit" (Hausman and Wise 1978).

Table 2
RESPONDENT DEMOGRAPHIC AND PSYCHOGRAPHIC CHARACTERISTICS

Demographic or Psychographic Characteristic	Basic Information Treatment (334 Respondents)			Enriched Information Treatment (323 Respondents)			Both Treatments	
	M	*Mdn*	*SD*	*M*	*Mdn*	*SD*	*Min*	*Max*
Age (years)	52.87	53	6.83	52.80	53	7.02	40	65
Male	.41	0	.49	.40	0	.49	0	1
Retirement savings $75,000–$150,000	.13	0	.34	.17	0	.38	0	1
Retirement savings >$150,000	.18	0	.38	.21	0	.41	0	1
Perceived fairness of annuities	.59	.67	.22	.57	.67	.22	0	1
Loss aversion	.66	.7	.29	.68	.7	.29	0	1
Numeracy	.50	.5	.16	.50	.5	.15	.125	1
Life expectancy (age at death)	85.77	87	8.03	84.80	86	9.01	59	99

Notes: Male characteristic and both retirement savings characteristics were dummy-coded as 1 if the given characteristic applied and 0 otherwise. Perceived fairness was measured using the four-point fairness scale of Kahneman, Knetsch, and Thaler (1986) and then rescaled between 0 and 1. Loss aversion was measured using a set of nine choices between mixed (gain and loss) gambles and then rescaled between 0 and 1. Numeracy was measured with a set of eight questions, five of which tested numeracy through questions of probability and likelihood following Peters et al. (2006) and an additional three that were taken from the cognitive reflection task (Frederick 2005). The total number of correct answers was rescaled between 0 and 1 to arrive at our numeracy measure. Note that 38% of the respondents did not complete the numeracy questions; we substituted the population median in those cases, and the table reflects the statistics after this substitution. Life expectancy is based on the individual-level subjective assessment of the probability of surviving until ages 65, 75, 85, and 95. The subjective probabilities were used to estimate a Weibull survival model via maximum likelihood (see Payne et al. 2013), and each individual life expectancy was then derived as a plug-in estimate of the expected value of the Weibull random variable at the maximum likelihood parameter estimates.

Although these priors allow us to add a priori scale information in S_0 and effect information in Δ_0, we try to let the data speak, and use proper but diffuse priors. Our specific settings are κ_0 = #UtilityParams + 3, $E(\Sigma) = I$, $\Delta_0 = 0$, and $\sigma^2_\Delta = 100$.

Statistical design optimization. Given the attribute levels in Table 1 and the model described in the previous subsection, we used SAS software (an industry standard) to generate the optimal choice-based survey design. We created the 20 choice sets using the %ChoicEff macro in SAS (Kuhfeld 2005), which finds utility-balanced efficient designs for choice-based conjoint tasks (Huber and Zwerina 1996; Kuhfeld et al. 1994). Because the design of the choice tasks is not intended to be the main contribution of our study, we merely strive to follow current practice and arrive at a reasonable design. Note that the design cannot be orthogonal by construction: the expected NPV is a combination of the other attributes. The nonlinearity of the NPV formula allows us to still estimate the direct (beyond NPV) impact of each attribute other than starting income.

Estimation methodology. To estimate the parameters of our choice model, we follow a standard Bayesian procedure to generate draws from the posterior distribution of all parameters using a Gibbs sampler (for a detailed description of setting up the Gibbs sampler for a hierarchical linear model, see Rossi et al. 2005). We ran the Gibbs sampler for 50,000 iterations, discarding the first 10,000 as burn-in iterations and using the remaining 40,000 draws to conduct our counterfactual exercises. As in the case of the experiment design, the estimation method is standard in the field.

Study Implementation: Subject Recruitment and Detailed Survey Procedure

Participants. We recruited participants through a commercial online panel from Qualtrics. For this project, we limited participation to people between the ages of 40 and 65 because this target group is the most appropriate for annuity purchases. We placed no limit on current retirement savings, but we collected data on savings as part of our demographic measures so that we could perform an analysis of how financial status affects preferences.

Because any survey attracts some respondents who either do not understand the instructions or do not pay attention to the task, we included an attention filter at the start of the survey and excluded participants who did not pass the filter. Our estimation sample consists of 334 respondents in the basic information treatment and 323 in the enriched information treatment. Table 2 summarizes the respondent demographic and psychographic characteristics exactly as they are coded in the Z variables in Equation 3 of the model.

Procedure. We first presented participants with short descriptions of the annuity attributes being investigated (monthly income level, annual income increase, period certain guarantee, and company rating) as well as the full range of levels for each of these attributes. We told them the annuities were otherwise identical and satisfactory on all omitted characteristics. We also told them all annuities were based on an initial purchase price of $100,000 at age 65, consistent with prior experimental work on annuity choices (e.g., Brown et al. 2008). We then asked each participant to complete 20 choice tasks from one of the two conditions. To control for order effects, we presented the choice tasks in random orders. Figure 1 provides a sample choice task and illustrates the enriched information treatment. After completing all 20 choice tasks in their assigned condition, participants were asked to fill out the additional demographic and psychographic measures.

Preliminary Model-Free Evidence of Attribute Impact on Utility Beyond NPV and the Importance of the Information Presentation Treatments

Before we turn to estimation results for the model in Equation 2, we present model-free evidence that annuity attributes matter beyond their impact on the expected present value. Consider first the aggregate results for the choice task provided in Figure 1. Figure 1, Panel C, presents the average (across genders) expected payouts and total expected payouts, as well as the choice shares in each treatment, for the three

Table 3

MODEL-FREE EVIDENCE THAT ATTRIBUTES HAVE "BEYOND NPV" EFFECT ON PREFERENCES

	Analysis of 7% Annual Increase			*Analysis of 20-Year Period certain*		
	Percentage of Times Highest-NPV Alternative Selected in Tasks in Which This Alternative ...			*Percentage of Times Lowest-NPV Alternative Selected in Tasks in Which This Alternative ...*		
Information Treatment	*Involves 7% Annual Increase (5 Tasks)*	*Does Not Involve 7% Annual Increase (13 Tasks)*	*Difference in Probability of Selection*	*Involves 20-Year Period certain Guarantee (6 Tasks)*	*Does Not Involve 20-Year Period certain Guarantee (12 Tasks)*	*Difference in Probability of Selection*
Basic (334 subjects)	17.3%	20.9%	**–3.6%**	25.2%	14.5%	**10.7%**
Enriched (323 subjects)	20.0%	29.2%	**–9.2%**	19.7%	15.9%	**3.8%**

Notes: The analysis includes only tasks in which the identity of the highest-NPV or lowest-NPV alternative does not depend on gender. Boldface indicates an effect with $p < .05$. Number of observations is set to the number of subjects.

alternatives. If consumers cared most about the expected payout, they should prefer annuity Option A in Figure 1 because it delivers substantially more expected value than the other two options. Instead, respondents prefer B (which offers greater payouts than C but lower payouts than A), especially in the enriched treatment, suggesting that the annuity attributes have an impact on preferences beyond the effect of expected payout, and the enriched information treatment alters this impact. In addition to considering which option respondents selected given that they selected an annuity, we can also examine the choice to self-manage their retirement assets. Figure 1, Panel C, shows that 36% of respondents selected "none" despite all three annuities offering expected payouts greater than $160,000 for a purchase price of $100,000, suggesting that about a third of our respondents dislike annuitization in general. The proportion of respondents who select "none" drops to 24% when the information is enriched, suggesting that some but not all of the general dislike of annuitization can be explained by consumers' inability to "do the math."

Drawing conclusions from a single task is limiting, so we conducted a more systematic investigation of both the "beyond NPV" impact of attributes and the effect of information enrichment across all choice tasks. Consider the "beyond NPV" effects first. Our analysis focuses on two specific attribute levels—the 7% annual increase and the 20-year period certain guarantee—but in principle, it could be conducted for any other level. In 5 of the 20 choice tasks encountered by study participants, the highest-NPV alternative for each gender involved a 7% annual increase (and each of those highest-NPV alternatives had a payout solidly above $100,000). If consumers cared mostly about the expected payout, they should have chosen the highest-NPV alternative most frequently, but Table 3 shows that in the basic information treatment, the highest-NPV alternative was selected only about 17% of the time in these five choice tasks. That number is not only surprisingly low, it is also significantly smaller than the 21% of the time the highest-NPV alternative was selected in the 13 other tasks, in which the highest-NPV alternative did not involve a 7% annual increase ($p < .01$, according to a test that first computes the differences in probabilities within each subject and then averages over subjects).[9] This same difference in the enriched information condition is also significant and has the same sign. These results suggest that the 7% annual increase attribute level is undervalued by consumers, that is, that it has a negative "beyond NPV" effect on preferences.

Among the 20 choice tasks, the lowest-NPV alternative for 6 of the tasks involved a 20-year period certain guarantee. If consumers cared mostly about the expected payout, the lowest-NPV alternative should have been selected least frequently. Yet Table 3 shows that in the basic information condition, the lowest-NPV alternative was selected 25% of the time in these 6 tasks. This percentage is significantly ($p < .001$) higher than the 15% of the time the lowest-NPV alternative was selected among the 12 other tasks, in which the lowest-NPV alternative did not involve 20-year period certain. These results suggest that the 20-year period certain attribute level is overvalued by consumers, that is, that it has a positive "beyond NPV" effect on preferences. An important caveat to the comparisons discussed in the previous two paragraphs is that the two groups of tasks in which the highest- or lowest-NPV alternative does or does not involve a particular attribute also differ in other ways, so the effects we find are not necessarily attributable solely to the attribute levels we put under the microscope. However, thanks to the near-orthogonality properties of experimental designs, the potential confound due to systematic variation in other attributes between the two groups of tasks is minimal.

Now, consider the suggestion from Figure 1, Panel C, that information enrichment might increase the attractiveness of annuities and reduce the number of people who choose to self-manage their decumulation.[10] Table 4 confirms this effect more systematically by displaying data across all choice tasks: we find that information enrichment increases the percentage of subjects who never select the outside option from 23.7% to 38.7% (SE = 3.6%; $p < .01$) and increases the average number of tasks in which a subject selects one of the inside choices from 14.6

[9]We analyze fewer than 20 choice tasks (5 + 13 = 18 < 20) because the NPV ordering depends on gender in two tasks.

[10]It is important to note that the expected payout of most of the annuities we offer exceeds the price of $100,000, so an increased understanding of the payout amount should increase the number of people who choose to annuitize. Thus, we are not measuring the effect of information enrichment per se, but the effect of enrichment combined with annuity alternatives that should be attractive to a rational buyer.

Table 4

MODEL-FREE ANALYSIS OF THE EFFECT OF INFORMATION ENRICHMENT ON ANNUITIZATION

	Percentage of Times Highest-NPV Alternative Selected When an Inside Alternative Is Selected	*Percentage of Times Lowest-NPV Alternative Selected When an Inside Alternative Is Selected*	*Average Number of Inside Alternative Selections per Subject*	*Percentage of Subjects ...*	
				Who Never Selected Outside Option	*Who Always Selected Outside Option*
Basic information treatment (334 subjects)	33.3%	32.0%	14.61	23.7%	20.1%
Enriched information treatment (323 subjects)	39.9%	26.6%	15.83	38.7%	15.8%
Effect of enriched information	*6.6%*	−5.4%	**1.22**	**15.1%**	−4.3%
SE of effect of enriched information (number of observations = number of subjects)	3.8%	3.5%	.44	3.6%	3.0%
SE of effect of enriched information (number of observations = number of choice tasks)	1.0%	.9%	N.A.		

Notes: Boldface indicates an effect with $p < .05$ regardless of how the standard error is calculated. Italics indicate an effect with $p < .05$ when SE is calculated using the number of choice tasks as the number of observations. N.A. = not applicable.

to 15.8 (SE = .4; $p < .01$). Given that a subject selects one of the annuities instead of self-management, the enriched information steers him or her toward higher-NPV alternatives, but the effect is small: across all choices, when an annuity is selected, the information enrichment increases the choice share of the highest-NPV alternative from 33% to 40% (SE with N set conservatively to number of subjects = 3.8%; $p = .08$) and reduces the choice share of the lowest-NPV alternative insignificantly from 32% to 27% ($p = .12$). All these results together imply that the enrichment improves the alignment of choices with the expected payout, but the resulting alignment is far from perfect, leaving room for effects of attributes beyond NPV.

Estimation Results: Population Average Parameters and Their Interpretation

Although our experiment involved 20 choices among four options (three annuities and one outside option), a substantial proportion of respondents did not like any of the annuities on offer. Specifically, between 15% and 20% of respondents selected self-management in every task (see Table 4 for details). Some of the annuities in our design provided well over $200,000 in expected payout, in exchange for the $100,000 price of the annuity (which was held constant throughout). Therefore, we conclude that some people simply dislike the idea of an annuity a priori and are unwilling to consider these products. To be conservative in our analysis, we retain these "annuity haters" in the full estimation.[11]

Tables 5 and 6 show the estimated posterior means of all the model parameters, with the individual-level parameters ($\alpha, \beta, \gamma, \delta, \theta$) averaged over the respondents, by information treatment. The posterior means of the population-averaged $\alpha, \beta, \gamma, \delta$, and θ parameters can be interpreted as the average marginal effects on utility of the associated attribute. Note that other than the expected gain attribute (the expected value minus price), all other attributes enter utility as dummy variables, and so they measure the *change* in utility relative to the baseline level set to {AA, no annual increase, no period certain}. For example, the −.54 coefficient of the "annual increase 3%" attribute in the basic information treatment (Table 5) means that, on average, annuities with an annual increase 3% are valued .54 utiles less than annuities that deliver the same expected gain with no annual increases, ceteris paribus. Note that the population mean of each coefficient is not the marginal effect of the associated attribute on probability of choice. One can only interpret the sign of a coefficient to infer the direction of the effect. The counterfactual simulations in the next section will offer a precise measurement of the marginal effects on the probability of choice (i.e., demand).

Because we are estimating a choice model, the parameters cannot be directly compared across treatments because of the well-known scaling problem (Swait and Louviere 1993). One transformation of the parameters that can be meaningfully compared is their ratio, and the most noteworthy ratio to consider is the ratio of "beyond NPV" parameters (α, γ, θ) to the expected gain parameter (β for AA annuity, $\beta + \delta$ for AAA annuity). Table 7 reports the standardized estimates for a AAA annuity, by treatment, with the unit of currency set to $100. We call this ratio a "willingness to pay beyond NPV" (hereinafter, WTPbNPV) because for every attribute level, it measures the amount of expected present gain (delivered through changing starting income or other attributes) that would compensate for the presence of an attribute level relative to the baseline level of the same attribute. For example, the −$27.1 WTPbNPV of the "3% annual increase" attribute means that, on average, our respondents are indifferent between an annuity that includes a 3% annual increase and delivers an expected gain of $100 and another annuity that does not include annual

[11]Analyzed in isolation, these respondents do not provide information about the parameters of interest. However, the Bayesian hierarchical prior partially pools their responses with responses of demographically and psychographically similar people, allowing inference. Analyses done both with and without excluding these individuals yield consistent results; authors will provide details on request.

Table 5

POPULATION-LEVEL REGRESSION: MARGINAL EFFECTS OF THE DEMOGRAPHICS AND PSYCHOGRAPHICS ON THE UTILITY PARAMETERS IN THE BASIC INFORMATION TREATMENT

	Intercept	*Expected NPV – Price*	*AAA-Rated Issuer (vs. AA)*	*Expected NPV – Price) × AAA-Rated Issuer*	*Annual Increase 3% (vs. 0)*	*Annual Increase 5% (vs. 0)*	*Annual Increase 7% (vs. 0)*	*Annual Increase $200 (vs. 0)*	*Annual Increase $400 (vs. 0)*	*Annual Increase $500 (vs. 0)*	*Period Certain 5 Years (vs. 0)*	*Period Certain 10 Years (vs. 0)*	*Period Certain 20 Years (vs. 0)*	*Period Certain 30 Years (vs. 0)*
Population mean	**–1.03**	**1.31**	–.08	**.76**	**–.54**	**–.74**	**–1.32**	*–.17*	–.58	**–.63**	**–.52**	*.18*	**.55**	**–.81**
Unexplained population standard deviation[a]	2.59	.93	.82	.61	.70	.94	1.46	.68	.87	1.19	.97	1.35	1.73	2.35
Constant	**–1.21**	**1.11**	–.06	**.58**	**–.53**	**–.84**	**–1.32**	–.10	**–.53**	**–.60**	**–.65**	.20	**.81**	*–.45*
Age (in 100 years, demeaned)	–2.83	1.22	–1.17	.51	–.24	.07	.00	–.12	–.08	–.46	–.15	1.09	1.88	1.34
Life expectancy (in 100 years, demeaned)	.13	–.58	–.01	–.18	.17	.98	1.00	.45	.86	1.38	–1.19	–1.44	–.41	1.06
Male	.50	.24	–.12	.24	.09	*.34*	.18	.00	.15	.06	–.14	–.32	**–.72**	**–.92**
Retirement savings $75,000–$150,000	–.14	.32	–.14	.23	–.35	–.29	–.39	–.25	*–.48*	–.48	**.57**	.39	.15	–.02
Retirement savings >$150,000	–.04	.30	.26	.25	–.03	–.01	–.12	–.22	–.25	.02	**.61**	.36	.12	.10
Perceived fairness of annuities (z-score)	**.78**	–.09	.14	**–.25**	**.26**	**.32**	**.40**	*.18*	**.35**	**.33**	–.03	.00	.05	.20
Loss aversion (z-score)	–.23	–.11	–.03	.02	–.05	–.06	.01	–.02	–.04	–.04	–.11	–.07	–.02	.04
Numeracy (z-score)	.18	**.23**	–.10	*.15*	**–.21**	**–.21**	**–.32**	**–.31**	**–.24**	**–.36**	.06	.00	.00	–.18

[a]Unexplained heterogeneity is calculated as the square root of the diagonal of the Σ matrix.

Notes: Data are posterior means of Δ (the marginal effects of demographic and psychographic variables on the utility parameters). Boldface indicates that 97.5% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 5% level. Italics indicate that 95% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 10% level. See Table 3 for summary statistics of the explanatory variables in this regression, but note that several were further statistically transformed to improve the interpretability of results (age and life expectancy were demeaned and personal traits measured by scales were expressed as z-scores).

Table 6

POPULATION-LEVEL REGRESSION: MARGINAL EFFECTS OF THE DEMOGRAPHICS AND PSYCHOGRAPHICS ON THE UTILITY PARAMETERS IN THE ENRICHED INFORMATION TREATMENT

	Intercept	*Expected NPV – Price*	*AAA-Rated Issuer (vs. AA)*	*Expected NPV – Price) × AAA-Rated Issuer*	*Annual Increase 3% (vs. 0)*	*Annual Increase 5% (vs. 0)*	*Annual Increase 7% (vs. 0)*	*Annual Increase $200 (vs. 0)*	*Annual Increase $400 (vs. 0)*	*Annual Increase $500 (vs. 0)*	*Period Certain 5 Years (vs. 0)*	*Period Certain 10 Years (vs. 0)*	*Period Certain 20 Years (vs. 0)*	*Period Certain 30 Years (vs. 0)*
Population mean	**–.38**	**1.87**	–.05	**.90**	**–.27**	**–.27**	**–.95**	**–.22**	**–.38**	**–.44**	–.04	**.20**	**–.25**	**–1.94**
Unexplained population standard deviation[a]	3.17	1.50	.85	.71	.63	.88	1.73	.58	.76	.98	.65	.99	1.70	2.81
Constant	–.10	**1.56**	–.01	**.69**	**–.36**	**–.45**	**–1.15**	*–.21*	**–.51**	–.55	–.08	*.23*	–.13	**–1.59**
Age (in 100 years, demeaned)	2.33	1.85	–.89	.93	–.92	–1.18	–2.11	–.27	–.50	–1.21	–1.17	–1.43	–2.34	–3.72
Life expectancy (in 100 years, demeaned)	–.65	1.50	–.35	.45	**1.58**	**3.43**	**5.37**	**1.86**	**3.00**	**4.04**	–1.07	.35	1.25	1.78
Male	.18	.17	*–.27*	.31	.02	.14	.32	–.24	.17	.12	–.02	–.13	–.38	–.59
Retirement savings $75,000–$150,000	**–1.17**	.30	*.36*	.09	.24	.03	.20	.19	.19	.17	.22	.18	*.56*	.60
Retirement savings >$150,000	–.73	**.91**	.03	.30	.20	**.56**	.21	.27	.15	.17	.04	–.04	–.25	**–.99**
Perceived fairness of annuities (z-score)	**1.22**	**.32**	–.04	.15	–.07	–.02	–.22	–.11	–.11	–.12	.04	.00	–.11	–.27
Loss aversion (z-score)	–.24	*–.21*	.10	–.07	*.17*	.16	.20	.08	.12	*.19*	.09	.09	.16	.30
Numeracy (z-score)	–.36	**.35**	.12	.13	**–.18**	–.06	–.23	.06	–.14	*–.20*	*.12*	.10	–.03	–.30

[a]Unexplained heterogeneity is calculated as the square root of the diagonal of the Σ matrix.

Notes: Data are posterior means of Δ (the marginal effects of demographic and psychographic variables on the utility parameters). Boldface indicates that 97.5% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 5% level. Italics indicate that 95% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 10% level. See Table 3 for summary statistics of the explanatory variables in this regression, but note that several were further statistically transformed to improve the interpretability of results (age and life expectancy were demeaned and personal traits measured by scales were expressed as z-scores).

Table 7
EFFECT OF ENRICHED INFORMATION: AVERAGE WTPbNPV

	Proposed Model Specification					*Starting-Income Model Specification*				
	Basic Information Treatment		*Enriched Information Treatment*			*Basic Information Treatment*		*Enriched Information Treatment*		
	Average WTPbNPV	*Posterior SD of WTPbNPV*	*Average WTPbNPV*	*Posterior SD of WTPbNPV*	*Difference in Average WTPbNPV (Enriched – Basic)*	*Average WTP*	*Posterior SD of Average WTP*	*Average WTP*	*Posterior SD of Average WTP*	*Difference in Average WTP (Enriched – Basic))*
Expected gain of \$100 ($V_{n,k}$ – p = 100)	**\$100.0**	\$.0	**\$100.0**	\$.0	\$100.0					
Starting monthly income of \$100						**\$100.0**	\$.0	**\$100.0**	\$.0	\$.0
AAA rated issuer (vs. AA)	–\$4.0	\$3.6	–\$1.9	\$2.5	\$2.1	–\$23.1	\$45.3	\$49.6	\$39.7	\$72.7
Annual increase 3% (vs. 0)	**–\$27.1**	\$4.5	**-\$9.6**	\$3.3	**\$17.5**	**\$40.3**	\$16.1	**\$125.2**	\$15.6	**\$84.8**
Annual increase 5% (vs. 0)	**–\$36.4**	\$4.1	**–\$9.7**	\$3.6	**\$26.6**	**\$95.0**	\$15.4	**\$223.0**	\$17.8	**\$128.0**
Annual increase 7% (vs. 0)	**–\$64.5**	\$4.7	**–\$34.1**	\$3.9	**\$30.4**	**\$144.7**	\$17.2	**\$283.3**	\$19.3	**\$138.6**
Annual increase \$200 (vs. 0)	**–\$8.8**	\$4.4	**–\$7.8**	\$3.7	\$1.0	**\$81.3**	\$16.7	**\$93.2**	\$15.1	\$11.9
Annual increase \$400 (vs. 0)	**–\$28.8**	\$4.1	**–\$13.7**	\$3.4	**\$15.1**	**\$108.0**	\$17.5	**\$187.7**	\$16.1	**\$79.7**
Annual increase \$500 (vs. 0)	**–\$31.8**	\$4.6	**–\$15.8**	\$3.6	**\$16.0**	**\$177.0**	\$19.6	**\$263.5**	\$20.0	**\$86.5**
Period certain 5 years (vs. 0)	**–\$25.8**	\$6.1	–\$1.4	\$2.6	**\$24.4**	**–\$109.0**	\$23.1	–\$11.3	\$11.5	**\$97.7**
Period certain 10 years (vs. 0)	\$8.6	\$5.5	**\$7.4**	\$2.7	–\$1.2	**\$59.0**	\$21.4	**\$46.9**	\$12.1	–\$12.2
Period certain 20 years (vs. 0)	**\$26.6**	\$5.9	**–\$8.9**	\$3.3	**–\$35.4**	**\$218.2**	\$25.5	**\$89.7**	\$13.8	**–\$128.5**
Period certain 30 years (vs. 0)	**–\$39.8**	\$6.6	**–\$70.0**	\$5.1	**–\$30.3**	**\$119.3**	\$25.8	\$29.9	\$16.5	**–\$89.4**

Notes: The computations assume a AAA annuity. Average WTPbNPV parameters are derived from the individual parameters as follows: For each iteration of the Gibbs sampler, we divide the population average of all utility parameters by the population average of the coefficient of the expected payout ($\beta + \delta$ in Equation 2 because we are considering a AAA annuity). The resulting draws of the population-average WTPbNPV are then used in computing both the posterior mean and the posterior standard deviation over all post-burn-in draws. In the starting-income model specification, the same computations result in the more standard total WTP. Boldface indicates that 97.5% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 5% level.

increases and somehow (presumably through other attributes) delivers the same expected gain plus –$27.1, namely, an expected gain of $72.9. Thus, WTPbNPV is willingness to pay while the expected payout is kept constant.

The WTPbNPV concept arising naturally from our proposed model specification can be contrasted with a more standard marginal willingness to pay (hereafter, WTP) that results when the same ratio is calculated under the starting-income model specification, in which the expected gain is replaced with starting income. Table 7 also contains all such "standard" WTP estimates; the raw parameter estimates of that specification (analogues of Tables 5 and 6) are available in Table 8 and Table A4 in the Web Appendix. For example, the WTP of $40.3 for the 3% annual increase means that, on average, our respondents are indifferent between an annuity that includes a 3% annual increase and $100 of additional starting income and an otherwise identical annuity that does not include annual increases but involves $140.3 ($100 + $40.3) of starting income.

Comparing WTPbNPV with WTP highlights the novelty of our model. Note that because WTPbNPV is measured in terms of expected gain and WTP is measured in terms of starting monthly income, the dollar quantities are not comparable between the two model specifications. However, one can safely compare their signs. In the case of 3% increase, the WTP is positive, meaning that 3% increase is more valuable than no increase while initial monthly income and all other attributes are kept the same. On the other hand, the WTPbNPV is negative, meaning that 3% is less valuable than no increase while the expected payout is kept the same.

Estimation Results: Average Preferences in the Basic Information Treatment

We first consider the results for the basic information treatment. Several conclusions can be drawn from the parameters (in Table 5) and their associated WTPbNPV values (in Table 7). As expected, the average coefficients of both the expected gain and its interaction with the AAA rating are positive. The insignificant coefficient of the AAA dummy shows that consumer preference for financially safe issuers manifests itself solely through an increased weight on expected gain, not as a shift in the intercept of the utility function. A qualitative comparison with the starting-income model specification rules out a simplistic theory about the antecedents of the significant interaction between AAA and expected gain: Under the starting-income model specification (Table 8), neither the AAA dummy nor its interaction with starting income is significant at the population level, suggesting that the significant coefficient for Expected_gain × AAA is not merely capturing the respondents' higher valuation of starting income when the annuity is provided by a AAA issuer. Instead, the respondents seem to value some NPV-like combination of the starting income with other attributes (annual increases and/or certainty guarantees) more when the annuity is provided by an AAA issuer.

The coefficients of the annual-increase and period certain dummies are mostly significant and often large, indicating that consumer behavior is not well captured by only the expected-payout and financial-strength variables. We discuss each of the "beyond NPV" influences from these different attributes in turn.

Annual increases. The negative signs on all of the percentage increase coefficients suggest that consumers systematically undervalue the benefits of annual payment increases. From the WTPbNPV estimates, we can see that the magnitude of the undervaluation can be large, especially for the percentage increases. For example, the WTPbNPV of –$64.5 on the 7% annual increase means our respondents are indifferent between an annuity that generates an expected gain of $100 with a constant monthly income and another annuity that generates an expected gain of $164.50 by starting at a lower monthly income level and adding 7% per year. In contrast, the WTP values under the starting-income model specification are all positive. Together, these results indicate that consumers pay attention to increases and value them positively, but they systematically undervalue them relative to their true expected values.

The additive increases exhibit a similar pattern, but they are generally undervalued less, which echoes the results of McKenzie and Liersch (2011). To see the difference in Table 7, recall that we selected the levels of annual increase as pairs matched across the type of increase (additive vs. percentage). Specifically, the $500/year increase results in approximately[12] the same expected payout as the 7%/year increase, and the $300/5% increase and $200/3% increase pairs are matched analogously. Therefore, we can compare the WTPbNPV values within these matched pairs and conclude that the average consumer prefers additive increases to percentage increases, ceteris paribus. In the later section "Counterfactual Simulations of Market Demand," we quantify the difference in terms of demand by simulating the magnitude of the effect of various increases on total market demand using counterfactual experiments.

Period certain guarantees. The positive average coefficient of the 20-year period certain guarantee suggests that consumers like this option beyond its impact on the expected payout. Conversely, the short (5-year) and very long (30-year) period certain guarantees are undervalued. The WTP values under the starting-income model specification reveal that not only do consumers undervalue the 5-year period certain when expected payout is the same, they also undervalue it relative to no period certain when other attributes are the same. Moreover, the WTP for a 30-year period certain is about half the WTP for a 20-year period certain despite the much higher expected payout from the former. Therefore, the inverse-U pattern we find is not an artifact of our specification or our particular calculation of the expected gain.

Note that this inverse-U pattern does not fit well with either of the theories proposed in the literature as explanations for consumers' overall preference for period certain options: both underestimation of life expectancies and prospective loss aversion should lead to overvaluation of short (5-year) options. Our empirical results suggest consumers do not simply prefer any period certain guarantee to no guarantee. Instead, they have a strong preference for medium-length periods but generally dislike long and short

[12]The magnitude of the difference in expected payout depends on gender, starting income, and other attributes.

Table 8

POPULATION-LEVEL REGRESSION UNDER A STARTING-INCOME MODEL SPECIFICATION (STARTING INCOME REPLACES EXPECTED GAIN), BASIC INFORMATION TREATMENT

	Intercept	*Starting Monthly Income ($100)*	*AAA-Rated Issuer (vs. AA)*	*Starting Monthly Income × AAA-Rated Issuer*	*Annual Increase 3% (vs. 0)*	*Annual Increase 5% (vs. 0)*	*Annual Increase 7% (vs. 0)*	*Annual Increase $200 (vs. 0)*	*Annual Increase $400 (vs. 0)*	*Annual Increase $500 (vs. 0)*	*Period Certain 5 Years (vs. 0)*	*Period Certain 10 Years (vs. 0)*	*Period Certain 20 Years (vs. 0)*	*Period Certain 30 Years (vs. 0)*
Population mean	**–4.32**	**.48**	–.04	.06	**.22**	**.52**	**.81**	**.45**	**.59**	**.98**	**–.58**	**.33**	**1.23**	**.67**
Unexplained population standard deviation[a]	3.64	.45	.85	.22	.35	.42	.52	.39	.46	.55	1.05	1.44	1.68	1.97
Constant	**–4.08**	**.43**	–.05	.07	.14	**.31**	**.62**	**.47**	**.52**	**.84**	**–.72**	*.33*	**1.34**	**.73**
Age (in 100 years, demeaned)	–5.43	.42	.02	–.24	.12	.68	*1.32*	.11	.49	.48	–.30	1.11	2.36	2.49
Life expectancy (in 100 years, demeaned)	1.85	–.27	.45	–.15	–.17	.38	.05	.20	.33	.70	–1.16	–1.44	–.65	.29
Male	.17	.02	–.07	–.02	.17	**.39**	.25	.03	.22	.15	–.11	–.30	**–.50**	–.45
Retirement savings $75,000–$150,000	–.90	.11	–.38	.08	–.16	.02	.14	–.13	–.25	–.12	**.57**	.40	.31	.28
Retirement savings >$150,000	–1.08	.17	.51	–.03	.18	.29	*.36*	–.06	.05	**.48**	**.63**	.43	.31	.48
Perceived fairness of annuities (z-score)	**1.31**	–.06	.07	–.01	.14	*.16*	.07	.11	**.21**	.14	–.01	–.04	–.08	.00
Loss aversion (z-score)	–.11	–.03	–.11	.02	–.09	*–.13*	–.08	–.05	–.10	–.12	–.12	–.07	–.02	–.03
Numeracy (z-score)	**–.97**	**.18**	.29	–.06	–.02	.06	.13	**–.15**	.03	.05	.08	.06	.17	.18

[a]Unexplained heterogeneity is calculated as the square root of the diagonal of the Σ matrix.

Notes: Data are posterior means of Δ (the marginal effects of demographic and psychographic variables on the utility parameters). Boldface indicates that 97.5% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 5% level. Italics indicate that 95% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 10% level. See Table 3 for summary statistics of the explanatory variables in this regression, but note that several were further statistically transformed to improve the interpretability of results (age and life expectancy were demeaned, and personal traits measured by scales were expressed as z-scores).

options. In the section "Counterfactual Simulations of Market Demand," we measure the magnitude of the effect of the period certain guarantee on total market demand, using counter-factual experiments. We now consider how the average preferences shift due to the enriched information treatment.

Effect of the Enriched Information Treatment on Average Preferences

Recall that only the standardized coefficients (WTPbNPV in Table 7) can be meaningfully compared across treatments. Table 7 provides both the WTPbNPV for the enriched information treatment and the difference in WTPbNPV between treatments.

We offer three observations: First, the magnitudes of the values of WTPbNPV for annual increases are much smaller in the enriched condition, which indicates that the apparent dislike of the increases observed in the basic treatment could be due to the subjects' inability to "do the math" on compounding, rather than to a more fundamental aversion to annual increases. The WTP values under the starting-income model specification all increase, in support of the interpretation that respondents value increases more in the enriched information condition. At the same time, however, the WTPbNPV values are still negative, indicating that the respondents undervalue annual increases even in the enriched information condition.

Second, the difference between additive and percentage increases mostly vanishes in the enriched treatment, with the exception of the $500/7% annual increase pair, for which a larger undervaluation of the percentage increase is observed. But even for that extreme pair, the difference between the values of WTPbNPV is reduced from about $33 to about $18. This finding agrees with prior work on individuals' difficulty with compounding in financial decisions (e.g., McKenzie and Liersch 2011; Wagenaar and Sagaria 1975). By seeing a table of cumulative payouts, individuals can better appreciate the impact of the percentage increases over time.

Finally, respondents in the enriched treatment continue to exhibit the inverse-U relationship pattern between preferences and the duration of period certain guarantees (even under the starting-income model specification), but the peak of the preference shifts toward shorter period certain durations (10-year period certain becomes the most overvalued). The persistence of the inverse-U pattern across the two information treatments suggests the relationship is not fundamentally driven by consumers' miscalculation or inability to "do the math" when estimating the impact of a guarantee on payout.

Estimation Results: Population Heterogeneity of Preferences

We find a lot of heterogeneity in preferences, some of which can be explained by variance in demographics and psychographics and some of which remains unexplained. We show the unexplained part (the square root of the posterior mean of Σ) in Tables 5 and 6 to give a sense of its magnitude. The average of the Δ parameter (also in Tables 5 and 6) captures the part of the heterogeneity of preferences that is explained by demographics and psychographics (see Equation 3).

The most easily interpreted effects are those of demographics and psychographics (Z) on the intercept of utility (α), that is, on the individual's baseline liking of annuities. One effect stands out as large: regardless of the information treatment,[13] we find that an individual's perceived fairness of annuities is strongly correlated with that person's baseline liking of annuities. In the enriched information treatment, individuals with higher perceived fairness value expected gain more. In the basic information treatment, individuals with higher perceived fairness show increased liking of annual increases beyond NPV, but not increased enough to reverse their undervaluation of annual increases.

Several other effects of demographics and psychographics also deserve a mention. As one would expect, more numerate individuals care more about the expected payout regardless of treatment. More surprisingly, they undervalue annual increases even more than less numerate people, especially in the basic information treatment. Finally, as a rational model would predict, higher life expectancy increases the liking of annual increases, but this effect exists only in the enriched information treatment. To see how much longer than average a respondent needs to expect to live to eliminate the undervaluation of annual increases, one can calculate the ratios of the population-average beyond-NPV coefficients and the Δ coefficient of demeaned life expectancy. The result is between 8 and 17 years, that is, between one and two standard deviations of life expectancy (see Table 8). Thus, we find that the enriched treatment leads to more accurate valuation of annual increases for people who expect to live more than one standard deviation longer than the average life expectancy—an important finding for annuity sellers who are concerned about both consumer targeting and adverse selection.

The population-level parameters (Δ) also shed light on which consumers are most sensitive to period certain guarantees. The undervaluation of 5-year period certain guarantees is present only in the basic information treatment, and it is almost completely driven by people with less than $75,000 of savings; the Δ coefficients of retirement savings of more than $75,000 on the beyond-NPV valuation of 5-year period certain (.57 and .61) compensate for the −.65 constant in the same regression. Surprisingly, neither lower life expectancy nor greater loss aversion significantly increases the preference for a longer period certain guarantee in either information condition. Instead, we find that the undervaluation of 30-year period certain is correlated with being male, especially in the basic information condition. In the enriched information condition, the same undervaluation is also correlated with having retirement savings of more than $150,000. Why individuals with low savings undervalue short guarantees in the basic treatment and individuals with high savings undervalue long guarantees in the enriched treatment is unexplored in any current theories of annuity choice; further research on how individuals interpret such options is needed.

[13]Recall that we cannot compare the coefficients between Tables 6 and 7 directly (Swait and Louviere 1993). We thus confine ourselves to broad qualitative observations of the effect of the enriched information on our estimates.

Retirement savings also play another role: people with a high level of retirement savings (>$75,000) show stronger overall dislike for annuities when they see the contingent cumulative payout tables. Whether these individuals are confident that they can self-manage their assets better without annuities or they are evaluating the payback on an annuity in an investment frame (Brown et al. 2008), providing them with cumulative payout information does not seem to increase their overall liking for annuities as much as it does for other respondents. Since we did not collect information about Social Security eligibility from our respondents, it is possible that this retirement-savings measure is correlated with expected Social Security benefits, and the Δ parameter for retirement savings may simply be capturing the unmeasured effect of Social Security eligibility as a substitute for annuitization.

Counterfactual Simulations of Market Demand

Population averages of the utility coefficients provide only limited insight into the marginal effects of annuity attributes on demand. In this section, we conduct a series of counterfactual simulations to assess the magnitude of these effects. In all our simulations, we consider a specific focal annuity offering along with a no-choice option (i.e., the outside option) as the set of alternatives available to the customer. We then separately estimate the probability of buying the focal annuity for every individual in our sample, using the estimated posterior distributions of individual-level utility parameters. Adding the probabilities together yields an estimate of total demand within our subject sample. To account for estimation error, we compute the probability separately for each of the 40,000 post-burn-in posterior draws of $[\alpha_j, \beta_j, \gamma_j, \delta_j, \theta'_j]$ and then average the probabilities over the draws. To account for the random component of utility given a particular draw, we average each probability over 100 draws of the random utility ε drawn independently and identically distributed from normal (0,1). One way to think about our simulation strategy is to imagine each respondent generating four million pseudopeople, each with his or her own $[\alpha_j, \beta_j, \gamma_j, \delta_j, \theta'_j, \varepsilon_j]$ vector. Assume each of the four million pseudopeople picks his or her utility-maximizing alternative, and the original respondent's choice probability is the percentage of the respondent's alter egos (i.e., the pseudopeople who have the same vectors as the respondent) who select the given choice. In the statistical literature, this kind of posterior predictive simulation is the standard approach (Rossi et al. 2005). We now turn to the specific simulations and the results.

Result 1: Fixed annual increases boost demand more than equal-payout percentage increases in the basic, but not the enriched, treatment condition. The left side of Figure 2 displays the estimated demand from women (results for men are available from the authors) for an annuity from a AAA-rated company with $400 starting monthly income, no period certain guarantee, and different types and magnitudes of annual increase. The top left plot shows the demand for the basic information treatment, and the bottom left plot shows it for the enriched information treatment. The dashed "control" lines in each plot indicate predicted demand for annuities that do not include annual increases but deliver higher expected present value through higher starting incomes. Thus, we interpret demand above the control line as an overvaluation of the particular level of annual increase relative to payout-equivalent increases in the starting income, and demand below the control line as an undervaluation.

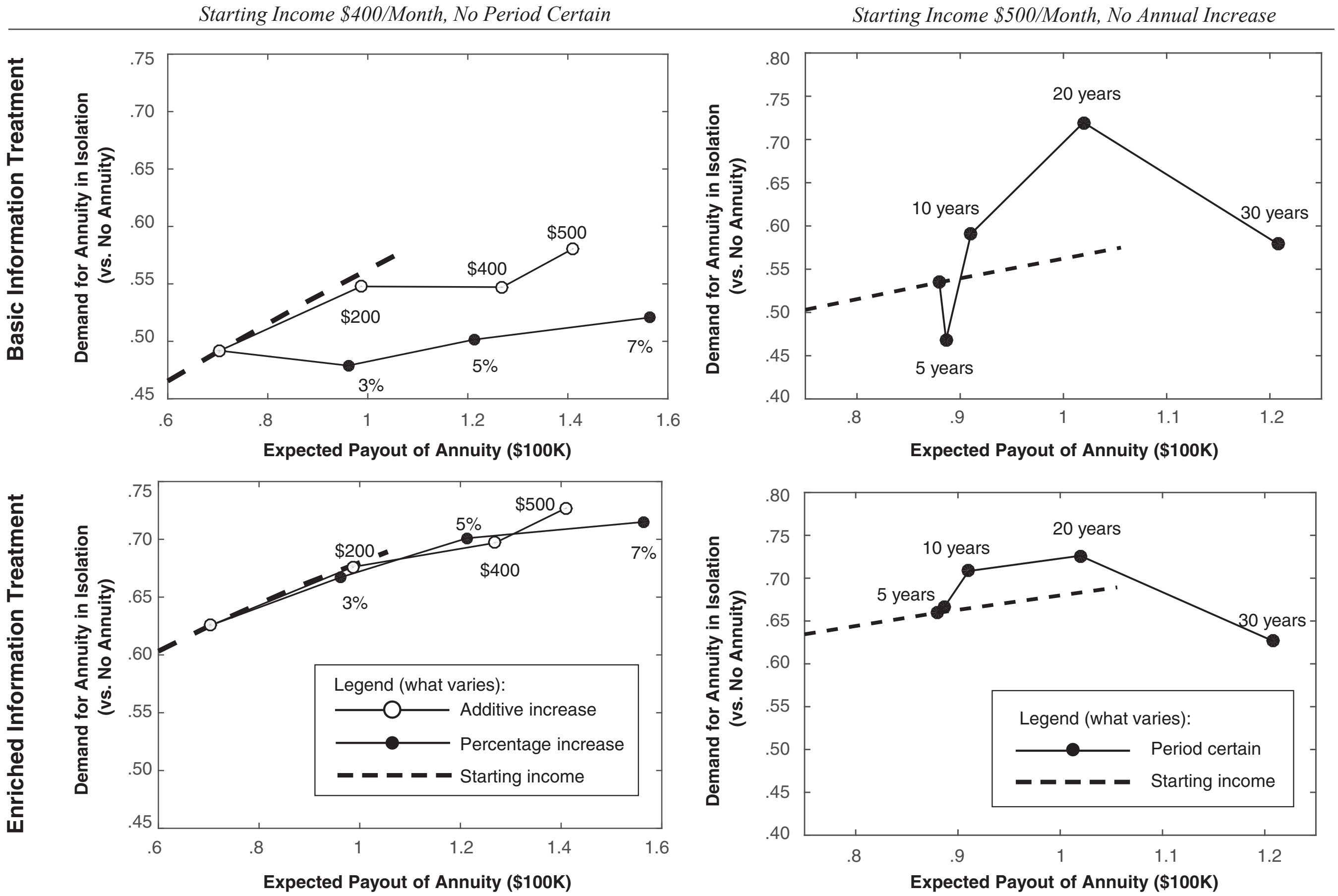
Looking first at the basic-treatment data in the top left plot of Figure 2, we see that additive increases generate consistently higher demand relative to payout-equivalent percentage increases. Whereas the $200 increase is valued about as much as the payout-equivalent increases in the starting income, the 3% increase is clearly undervalued. Interestingly, raising either the additive yearly increase above $200 or the percentage increase above 0 does not raise demand very much at all. For example, the implied elasticity of demand due to raising the yearly additive increase from $200 to $500 is only about .04. In other words, even if expected payout can be increased for free, the only large boost to demand available in the basic information treatment is the boost from no increase to $200 annual increase.

The demand curves look completely different in the enriched information treatment: undervaluation is no longer present, and a relative preference for additive increases over percentage increases no longer exists. In other words, annual increases are valued at almost exactly their financial value in the enriched information condition, because lines for both types of increases match the control line. Thus, as suggested by the estimation results described previously, providing consumers with a table of cumulative payouts appears to bring their attribute valuations for annual increases more in line with expected present value.

Result 2: Medium-length period certain guarantees boost demand, whereas short ones decrease it. The right side of Figure 2 displays the estimated demand from women for an annuity from a AAA-rated company with a $500 starting monthly income, no annual increases, and different lengths of period certain guarantees. The top right plot shows the demand for the basic information treatment, and the bottom right plot shows it for the enriched information treatment. Consider the basic treatment (top right plot) first. As in the case of annual increases, overall market demand is consistent with the average consumer's preferences: the 20-year period certain guarantee yields the highest demand and is dramatically overvalued relative to control (increasing demand by about a third compared to the payout-equivalent increase in starting income). By contrast, the no-guarantee option is preferred to a 5-year period certain guarantee. This finding is surprising in the sense that even a 5-year period certain guarantee provides some protection from full loss in case the buyer unexpectedly dies soon after purchasing the annuity, perhaps after being hit by the proverbial bus. Finally, the demand for 30-year period certain guarantees is slightly below that for 10-year guarantees, despite the much larger expected payout of the 30-year guarantee. These results suggest consumers will not respond positively to issuers' offers of very short or very long period certain guarantees.

The inverse-U shape of demand for period certain guarantees is also visible for annuities presented in the enriched information treatment. The persistence of the inverse-U shape across both treatments, as well as its

Figure 2
DEMAND FOR ANNUITIES WITH DIFFERENT LENGTHS OF PERIOD CERTAIN GUARANTEE AND DIFFERENT TYPES OF ANNUAL INCREASE



Notes: Predicted female demand for a AAA annuity. The dashed line without markers represents annuities with different starting incomes, no annual increase, and no period certain guarantee.

persistence among individuals with high numeracy, suggests that it is not a result of mathematical miscalculation but instead reflects real preferences for certain levels of period certain guarantee over others. The primary difference in the shape of demand for period certain guarantees between the treatments is that the preference for no guarantee over a 5-year guarantee is not evident in the enriched information condition. To summarize, 10- and 20-year period certain guarantees make annuities more attractive beyond their effects on NPV, regardless of the information presentation condition, whereas 5-year and 30-year guarantees (both unusual in today's marketplace and thus perhaps suspicious to consumers) are valued only at or even below their expected value.

Result 3: Among annuities with the same expected payout but different combinations of annual increases and period certain guarantees, the proportion of consumers who choose the annuity over self-management can vary by more than a factor of 2. In other words, by structuring the annuity using attribute levels consumers prefer, the annuity issuer has an opportunity to more than double demand without increasing the expected present value of the product (and hence the issuer's cost). Results 1 and 2 suggest that the annuities with small additive annual increases and medium-length period certain guarantees can generate higher consumer demand than payout-equivalent annuities with higher starting incomes but no additional features. To assess the size of this "free" demand boost and find the best combinations of managerially relevant attributes under the issuer's control, we estimate market demand for 15 annuities that all have the same expected payout but differ in the amount of their annual increase (none, 3%, or $200) and the length of their period certain guarantee (0, 5, 10, 20, or 30 years). For every combination of period certain and annual increase, we adjust the starting income of the annuity to result in an expected NPV of exactly $100,000—the purchase price of the annuity and, thus, the maximum expected payout a fair issuer could offer without losing money. We exclude higher levels of annual increase from this exercise because the starting income that would keep the expected NPV at $100,000 in these cases is often below the minimum level considered in our study ($300). As in the analyses underlying results 1 and 2, we then compute the market demand each of the 15 possible annuities would receive if it were the only offering in the market other than self-management.

Figure 3 plots the estimated demand as a function of period certain, by gender and information treatment.[14] Under both information treatments and for both genders, the demand-maximizing (hereinafter called "optimal") annuities do not involve any annual increases, consistent with the average preferences in Tables 5 and 6. Gender does not affect the optimal annuity beyond starting income, and providing enriched information lowers the optimal period certain length from 20 years to 10 years. Specifically, the optimal annuity under the basic information condition includes a 20-year period certain guarantee and a starting income of $491 for females and $510 for males (see Table A3 in the Web Appendix for the starting incomes). The optimal annuity under the enriched information treatment includes a 10-year period certain guarantee for both genders and a starting income of $550 for females and $601 for males. Enriching the information thus reduces but does not eliminate the disadvantage of annual increases in the eyes of consumers.

The most striking aspect of Figure 3 is the large difference between the demand for the optimal annuities discussed previously and the lowest-demand annuities. Even when we ignore the unpopular 30-year period certain guarantee as unrealistic, the difference can be large: under the basic information condition, the female demand for an expected-payout-equivalent annuity with a starting income of $329, 5-year period certain, and 3% annual increase is about half of the demand for the optimal annuity. Enriching the information reduces but does not eliminate this gap: the worst-performing annuity in the male market ($377 starting income, 3% annual increase, and 20-year period certain) generates only 73% of the demand for the optimal annuity.

DISCUSSION

This study presents a case for marketing research about decumulation products, proposes a model of consumer preferences for attributes of immediate life annuities, and estimates the model using stated preferences in a DCE with a national panel of people aged 40–65 years. Our main methodological contribution is a model specification that allows direct measurement of the direct influence of attributes on preferences beyond their impact through the expected NPV of the annuity, or what we call "beyond NPV." We find that consumers' valuation increases with the expected NPV of the payout, but some annuity attributes also influence consumer preferences directly, beyond their impact on financial value.

One attribute that influences preferences beyond NPV is inflation protection through annual payment increases, and its influence depends on the way product information is presented. We find that consumers who see only basic attribute information undervalue annual increases and show stronger preference for fixed nominal annual increases relative to percentage increases, when the expected payout is held constant. However, consumers who also see a table of the annuities' contingent cumulative payouts undervalue annual increases much less and do not care whether the increases are expressed in the form of percentages or fixed dollar amounts. These findings are consistent with prior behavioral research on consumers' biases in understanding compounding interest (McKenzie and Liersch 2011; Wagenaar and Sagaria 1975). Consistent with the recommendations of Kunreuther et al (2013), our findings suggest that policy makers trying to align consumer annuity choices with expected payout should encourage annuity issuers to include cumulative payout information in their marketing materials, rather than simply listing attributes, as seems to be current industry practice.

Another attribute with a strong influence beyond NPV is the period certain guarantee. We find that regardless of the information presentation, consumers (especially women) overvalue medium-length (10-year and 20-year) period certain guarantees, and they (especially men) undervalue very long (30-year) guarantees. In the basic information condition, consumers also undervalue very short (5-year) guarantees, an effect mostly driven by people with low retirement savings. The demographics one would expect to drive preferences for period certain guarantees, such as loss aversion and life expectancy (Brown et al. 2008), do not correlate strongly with the pattern of over- and undervaluation we find, and additional research is clearly needed.

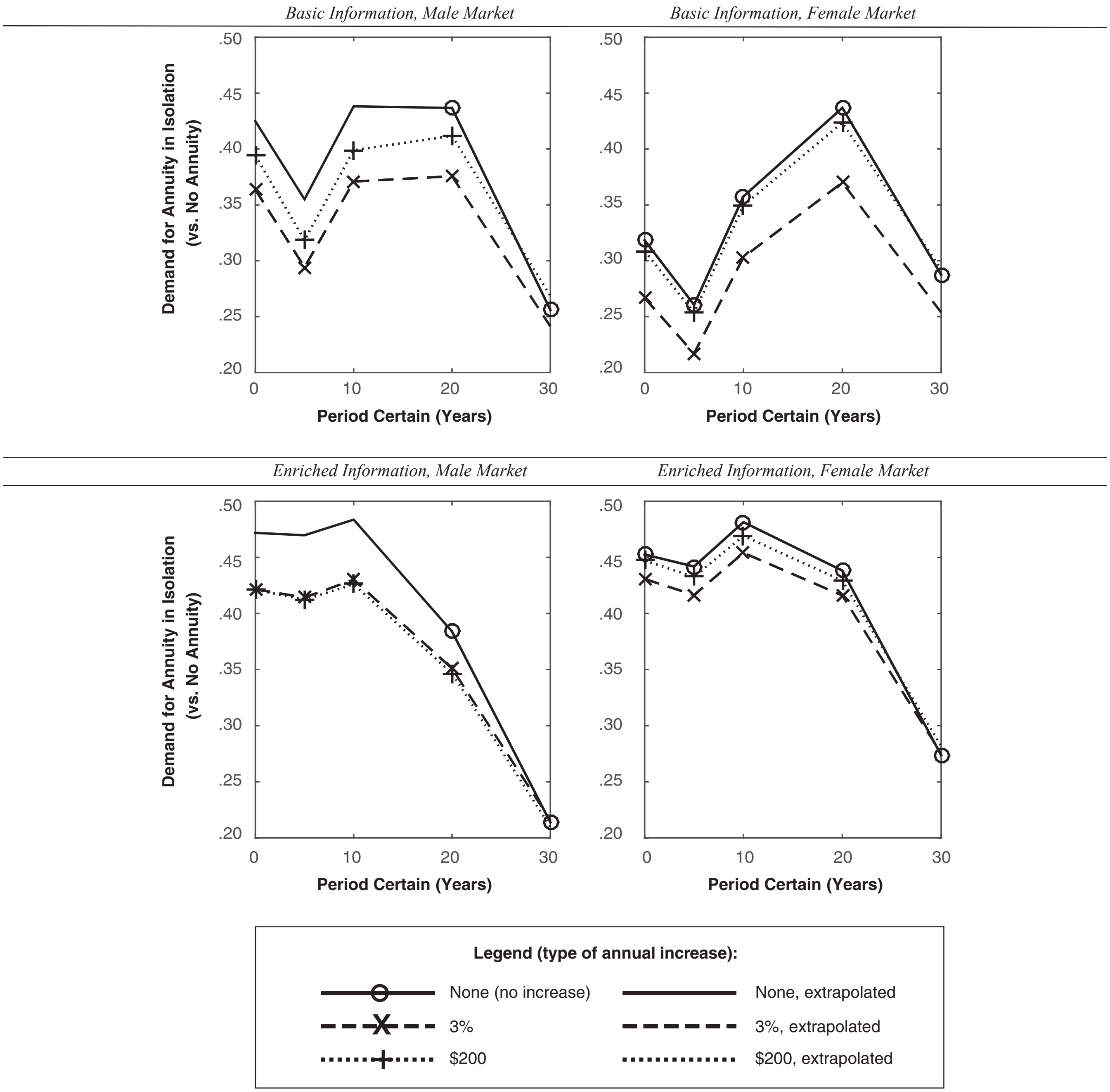
Finally, company financial strength rating is also important to consumers, with AAA-rated companies preferred to those with an AA rating. Interestingly, preference for financially safe issuers manifests solely through an increased weight on expected financial gain, and not as an upward shift in the utility function intercept. This result adds to prior evidence that consumers consider insurance company financial strength during annuity purchase (Babbel and Merrill 2006).

Demand for annuities is correlated with demographics and psychographics. Three correlations are consistent across both information treatments. First, respondents who have more money saved for retirement (>$75,000) like annuities less. This finding is a bit of a paradox, whereby the people who can afford annuitization are the same people who are not interested in it. Second, more numerate consumers exhibit a higher preference for maximizing expected financial gain (the slope of their utility in expected gain is about 18% steeper than that of less numerate consumers), consistent with the idea that annuities are complex financial products that require the ability to "do the math" to understand. Surprisingly, more numerate individuals also undervalue annual increases more (especially in the basic information treatment), which suggests that their choices might not necessarily be better aligned with higher expected payout. Finally, respondents who consider annuities to be fair (measured by the scale of Kahneman, Knetsch, and Thaler [1986]) like annuities more, consistent with behavioral explanations for the annuity puzzle (Benartzi, Previtero, and Thaler 2011; Hu and Scott 2007). Perceived fairness plays other roles in our model, depending on the information treatment: in the enriched information treatment, individuals with higher

[14]Table A3 in the Web Appendix contains the data behind this figure, including the starting incomes needed for each combination of annual increase and period certain guarantee to achieve the same expected payout of $100,000. Note that holding expected payout constant leads to a direct tradeoff between higher starting incomes and annual increases.

Figure 3

DEMAND FOR ANNUITIES WITH EXACTLY $100,000 EXPECTED PAYOUT



Notes: Each line depicts market demand for a AAA annuity that pays out $100,000 in expected NPV and has a particular type of annual increase, as a function of the period certain guarantee. Starting income is adjusted to achieve the constant payout. Markers indicate combinations that do not require extrapolation beyond the range of starting incomes in the study ($300–$600 per month). See Table A3 in the Web Appendix for details.

perceived fairness both like annuities more and value expected gain more. In the basic information treatment, individuals with higher perceived fairness also show increased liking of annual increases beyond NPV, but not increased enough to reverse their undervaluation of these increases. Efforts to better understand drivers of consumers' perceived fairness may be a key strategy to help policy makers and annuity providers increase interest in these products.

Other individual differences we expected to affect preferences seem to matter less than hypothesized. Individual measures of loss aversion affect annuity preference only marginally in the enriched information condition (see Table 6). Life expectancy does not correlate with the baseline liking of annuities, but it does affect preference for annual increases in the enriched information treatment, with those expecting to live longer valuing such increases more highly.

One of the major limitations of our study is the inherent incompleteness of its individual difference measures. We made the strategic choice to focus on a limited number of measures that have been mostly unexplored in annuity research but have also been suggested as theoretically important, such as perceived annuity fairness and loss aversion. Future studies should continue testing both demographics and psychographics that may correlate with annuity preferences, such as Social Security eligibility, the existence of beneficiaries, wealth illusion, and intertemporal patience.

One of the main managerial contributions of our model is the design of products that maximize demand without increasing the expected payout. The highest-demand products are good "smart defaults" (Smith, Goldstein, and Johnson 2013), candidates for policy makers interested in increasing annuitization. We find that when we consider a set of annuity products with equivalent NPVs, careful selection of an optimal mix of attributes can more than double demand for annuity products relative to the poorest-performing attribute mixes. Regardless of the information treatment, the demand-maximizing annuities involve medium-length period certain guarantees and no annual increases. The optimal length of the period certain guarantee depends on the information treatment: it is shorter when information is enriched. This dependence makes Tables 3 and 4 an incomplete measure of the information enrichment's potential to increase the frequency of purchase of annuities in the market. Whereas Tables 3 and 4 show that enriching the product information increases demand averaged over a fixed set of annuities (the set used in our experimental design), we need to compare the demand between the annuities that managers would select under each treatment (20-year period certain under basic and 10-year period certain under enriched). For each gender, this comparison reveals that enriching information increases achievable demand by about 10%. Further investigation of such information presentation options may offer a deeper understanding of how choice architecture can help address the annuity puzzle.

Although our study provides several insights about how consumers respond to different annuity attributes, both individually and in aggregate, several open questions remain. The first major open question concerns what else we can understand about the decision process, and especially how consumers actively make trade-offs between annuity attributes. The current study provides a step forward by measuring individual-level preferences for annuity attributes through their effects on both expected payout and value beyond financial measures and then seeing how individual-level characteristics interact with those attribute preferences. To get an even better understanding of the actual decision process, researchers can turn to methods such as eye tracking to directly observe which attributes respondents attend to.

A second open question is how individuals value other annuity attributes that exist in the marketplace but are unaddressed in this particular study. One attribute of importance is the start date of the annuity. All of the choice tasks presented in this study involve immediate life annuities that begin payment at age 65. However, the marketplace also offers annuities with delayed start dates (known as deferred annuities, advanced life deferred annuities, or longevity insurance), and recent government reports encourage greater use of such annuities. Our methodology could be used to assess the value of this recommendation by including a deferred start date as an attribute.

A final question regards the options available to marketers and public-policy experts for increasing consumers' preference for annuities. Our findings provide some insight into this question through our testing of a cumulative payout information display. However, our results from both treatment conditions assume particular presentations of the annuity attributes; given the extensive findings in the behavioral literature on how information presentation affects preferences, we expect that different ways of presenting the information will result in further differences in preferences. For example, our participants' responses to percentage versus fixed annual increases were significantly affected when payments were shown in cumulative rather than per-period formats, but the pattern of sensitivity to period certain guarantees was generally unchanged. Other information presentation formats that might highlight the probability of death and/or certainty of payouts at certain ages could potentially reverse this finding. Testing of these types of presentational styles for annuity attributes could provide additional useful insights for interventions that would address the annuity puzzle.

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ONLINE APPENDIX

Consumer Preferences for Annuity Attributes: Beyond NPV

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Details on study design and participant selection

Study Design. Our conjoint-analysis survey consists of 20 choice tasks. In every choice task, we asked participants, "If you were 65 and considering putting $100,000 of your retirement savings into an annuity, which of the following would you choose?" They then saw three annuity options and a fourth no-choice option that read, "None: If these were my only options, I would defer my choice and continue to self-manage my retirement assets." We test four attributes, each with between two and seven levels. The full set of possible attributes is in Table 1.

Each participant faced the same 20 choice sets. To generate the 20 choice sets, we used SAS software (an industry standard) to generate the optimal choice-based survey design. We created the 20 choice sets using the %ChoicEff macro in SAS (Kuhfeld 2005), which finds utility-balanced efficient designs for choice-based conjoint tasks (Kuhfeld et al. 1994, Huber and Zwerina 1996). This software includes many of the design advances in the recent statistical and marketing literature. The survey software randomly determined the order of the choice sets seen by each participant. The complete listing of attributes for each of the 20 choice sets is provided in Table A1a.

Each annuity in the design implies an expected payout—a highly nonlinear combination of the attributes (equation 1 in the paper). To set up the estimation, we code the attributes using standard dummy coding, add the expected payout to the utility model (equation 2 in the paper), and obtain the coded regression matrix used in estimation. The design matrix of the multivariate linear regression underlying the choice model (displayed in Table A1b) has 60 pseudo-observations (20 choice sets x 3 alternatives per choice set) and 13 columns (intercept, expected payout, and 11 columns corresponding to the dummy-coded attributes).

The %ChoicEff macro is well known to generate efficient designs for estimating the impact of dummy-coded attributes on preferences. The goal of our estimation is to include the expected payout in the utility function, and allow each attribute level to have an impact beyond the expected payout. If expected payout were a linear combination of the attribute-level dummies, collinearity would render such an estimation infeasible. However, the nonlinearity of the expected payout as a function of the attributes makes our approach feasible. Specifically, the R^2 of the regression of the expected payout on the rest of the columns in Table A1b (other than the interaction with AAA, of course) is only 0.63. The correlation matrix of the entire Table A1b is shown in Table A1c. All correlations of the expected payout and the attributes are below 0.5, and only two are over 0.3 in magnitude. The variables most highly correlated with the expected payout, and hence most difficult to estimate, are (predictably) the 7% increase and the 30-year period-certain guarantee. Despite their correlation with the expected payout, both of them have highly significant estimated effects “beyond NPV.” We conclude that our estimation strategy is feasible. However, we do not want to claim optimality of our design in any sense. An even more efficient design could doubtlessly be constructed now that we know something about the model parameters (see, e.g., Arora and Huber 2001).

Table A1a: Details for attribute levels of all 20 choice sets

Set	Annuity Option A	Annuity Option B	Annuity Option C
1	Monthly pmts start at $500 7% annual increase 5 years period certain Company rated AA	Monthly pmts start at $300 5% annual increase 30 years period certain Company rated AAA	Monthly pmts start at $600 No annual increase 20 years period certain Company rated AA
2	Monthly pmts start at $400 No annual increase 30 years period certain Company rated AAA	Monthly pmts start at $300 $500 annual increase 20 years period certain Company rated AAA	Monthly pmts start at $600 $200 annual increase 10 years period certain Company rated AA
3	Monthly pmts start at $500 5% annual increase No years period certain Company rated AAA	Monthly pmts start at $400 3% annual increase 30 years period certain Company rated AA	Monthly pmts start at $600 No annual increase 5 years period certain Company rated AAA
4	Monthly pmts start at $400 7% annual increase 30 years period certain Company rated AA	Monthly pmts start at $600 5% annual increase 10 years period certain Company rated AAA	Monthly pmts start at $500 $400 annual increase 20 years period certain Company rated AAA
5	Monthly pmts start at $300 7% annual increase 5 years period certain Company rated AAA	Monthly pmts start at $400 3% annual increase No years period certain Company rated AAA	Monthly pmts start at $300 $200 annual increase 30 years period certain Company rated AA
6	Monthly pmts start at $500 $400 annual increase 5 years period certain Company rated AAA	Monthly pmts start at $400 7% annual increase 10 years period certain Company rated AA	Monthly pmts start at $300 $500 annual increase 30 years period certain Company rated AA
7	Monthly pmts start at $400 5% annual increase 20 years period certain Company rated AA	Monthly pmts start at $500 $500 annual increase No years period certain Company rated AAA	Monthly pmts start at $300 $400 annual increase 30 years period certain Company rated AA
8	Monthly pmts start at $300 No annual increase 30 years period certain Company rated AAA	Monthly pmts start at $400 $200 annual increase 5 years period certain Company rated AAA	Monthly pmts start at $500 3% annual increase 10 years period certain Company rated AA
9	Monthly pmts start at $300 $200 annual increase 20 years period certain Company rated AAA	Monthly pmts start at $600 $400 annual increase No years period certain Company rated AA	Monthly pmts start at $400 No annual increase 10 years period certain Company rated AAA
10	Monthly pmts start at $500 No annual increase No years period certain Company rated AAA	Monthly pmts start at $300 3% annual increase 20 years period certain Company rated AAA	Monthly pmts start at $400 $500 annual increase 5 years period certain Company rated AA

Table A1a (continued): Details for attribute levels of all 20 choice sets

Set	Annuity Option A	Annuity Option B	Annuity Option C
11	Monthly pmts start at $600 $200 annual increase No years period certain Company rated AA	Monthly pmts start at $300 $400 annual increase 10 years period certain Company rated AAA	Monthly pmts start at $400 5% annual increase 5 years period certain Company rated AA
12	Monthly pmts start at $600 $200 annual increase 30 years period certain Company rated AAA	Monthly pmts start at $500 7% annual increase 30 years period certain Company rated AA	Monthly pmts start at $600 $400 annual increase 20 years period certain Company rated AAA
13	Monthly pmts start at $300 7% annual increase 10 years period certain Company rated AAA	Monthly pmts start at $500 3% annual increase 5 years period certain Company rated AA	Monthly pmts start at $400 $400 annual increase No years period certain Company rated AAA
14	Monthly pmts start at $500 $400 annual increase 20 years period certain Company rated AA	Monthly pmts start at $600 3% annual increase 5 years period certain Company rated AAA	Monthly pmts start at $300 $500 annual increase 30 years period certain Company rated AA
15	Monthly pmts start at $500 7% annual increase 10 years period certain Company rated AA	Monthly pmts start at $600 3% annual increase 5 years period certain Company rated AAA	Monthly pmts start at $300 5% annual increase 30 years period certain Company rated AAA
16	Monthly pmts start at $500 $200 annual increase 30 years period certain Company rated AA	Monthly pmts start at $400 $500 annual increase 20 years period certain Company rated AAA	Monthly pmts start at $600 5% annual increase 10 years period certain Company rated AA
17	Monthly pmts start at $500 7% annual increase No years period certain Company rated AAA	Monthly pmts start at $600 No annual increase 20 years period certain Company rated AA	Monthly pmts start at $400 $400 annual increase 10 years period certain Company rated AAA
18	Monthly pmts start at $500 $500 annual increase 10 years period certain Company rated AAA	Monthly pmts start at $600 5% annual increase 20 years period certain Company rated AA	Monthly pmts start at $300 7% annual increase 30 years period certain Company rated AAA
19	Monthly pmts start at $500 7% annual increase 20 years period certain Company rated AAA	Monthly pmts start at $500 3% annual increase 30 years period certain Company rated AAA	Monthly pmts start at $600 5% annual increase 30 years period certain Company rated AA
20	Monthly pmts start at $400 $200 annual increase 10 years period certain Company rated AAA	Monthly pmts start at $600 3% annual increase No years period certain Company rated AA	Monthly pmts start at $500 $500 annual increase 5 years period certain Company rated AA

Table A1b: Design matrix as it enters estimation

Set	Exp. NPV of payout - price	AAA-rated issuer (vs. AA)	(ENPV of payout - price)XAAA	Annual increase 3% (vs. 0)	Annual increase 5% (vs. 0)	Annual increase 7% (vs. 0)	Annual increase $200 (vs. 0)	Annual increase $400 (vs. 0)	Annual increase $500 (vs. 0)	Period certain 5 years (vs. 0)	Period certain 10 years (vs. 0)	Period certain 20 years (vs. 0)	Period certain 30 years (vs. 0)
1	0.62	0	0	0	0	1	0	0	0	1	0	0	0
1	0.44	1	0.44	0	1	0	0	0	0	0	0	0	1
1	0.18	0	0	0	0	0	0	0	0	0	0	1	0
2	-0.04	1	-0.04	0	0	0	0	0	0	0	0	0	1
2	0.37	1	0.37	0	0	0	0	0	1	0	0	1	0
2	0.24	0	0	0	0	0	1	0	0	0	1	0	0
3	0.28	1	0.28	0	1	0	0	0	0	0	0	0	0
3	0.43	0	0	1	0	0	0	0	0	0	0	0	1
3	-0.04	1	-0.04	0	0	0	0	0	0	1	0	0	0
4	1.63	0	0	0	0	1	0	0	0	0	0	0	1
4	0.61	1	0.61	0	1	0	0	0	0	0	1	0	0
4	0.61	1	0.61	0	0	0	0	1	0	0	0	1	0
5	-0.03	1	-0.03	0	0	1	0	0	0	1	0	0	0
5	-0.17	1	-0.17	1	0	0	0	0	0	0	0	0	0
5	0.21	0	0	0	0	0	1	0	0	0	0	0	1
6	0.25	1	0.25	0	0	0	0	1	0	1	0	0	0
6	0.34	0	0	0	0	1	0	0	0	0	1	0	0
6	0.95	0	0	0	0	0	0	0	1	0	0	0	1
7	0.32	0	0	0	1	0	0	0	0	0	0	1	0
7	0.36	1	0.36	0	0	0	0	0	1	0	0	0	0
7	0.71	0	0	0	0	0	0	1	0	0	0	0	1
8	-0.28	1	-0.28	0	0	0	0	0	0	0	0	0	1
8	-0.13	1	-0.13	0	0	0	1	0	0	1	0	0	0
8	0.1	0	0	1	0	0	0	0	0	0	1	0	0
9	-0.1	1	-0.1	0	0	0	1	0	0	0	0	1	0
9	0.4	0	0	0	0	0	0	1	0	0	0	0	0
9	-0.33	1	-0.33	0	0	0	0	0	0	0	1	0	0
10	-0.21	1	-0.21	0	0	0	0	0	0	0	0	0	0
10	-0.2	1	-0.2	1	0	0	0	0	0	0	0	1	0
10	0.21	0	0	0	0	0	0	0	1	1	0	0	0

11	0.17	0	0	0	0	0	1	0	0	0	0	0	0
11	-0.03	1	-0.03	0	0	0	0	1	0	0	1	0	0
11	0.03	0	0	0	1	0	0	0	0	1	0	0	0
12	0.94	1	0.94	0	0	0	1	0	0	0	0	0	1
12	2.28	0	0	0	0	1	0	0	0	0	0	0	1
12	0.8	1	0.8	0	0	0	0	1	0	0	0	1	0
13	0	1	0	0	0	1	0	0	0	0	1	0	0
13	0.05	0	0	1	0	0	0	0	0	1	0	0	0
13	0.09	1	0.09	0	0	0	0	1	0	0	0	0	0
14	0.61	0	0	0	0	0	0	1	0	0	0	1	0
14	0.26	1	0.26	1	0	0	0	0	0	1	0	0	0
14	0.95	0	0	0	0	0	0	0	1	0	0	0	1
15	0.67	0	0	0	0	1	0	0	0	0	1	0	0
15	0.26	1	0.26	1	0	0	0	0	0	1	0	0	0
15	0.44	1	0.44	0	1	0	0	0	0	0	0	0	1
16	0.7	0	0	0	0	0	1	0	0	0	0	0	1
16	0.57	1	0.57	0	0	0	0	0	1	0	0	1	0
16	0.61	0	0	0	1	0	0	0	0	0	1	0	0
17	0.6	1	0.6	0	0	1	0	0	0	0	0	0	0
17	0.18	0	0	0	0	0	0	0	0	0	0	1	0
17	0.14	1	0.14	0	0	0	0	1	0	0	1	0	0
18	0.43	1	0.43	0	0	0	0	0	1	0	1	0	0
18	0.99	0	0	0	1	0	0	0	0	0	0	1	0
18	0.97	1	0.97	0	0	1	0	0	0	0	0	0	1
19	1.09	1	1.09	0	0	1	0	0	0	0	0	1	0
19	0.79	1	0.79	1	0	0	0	0	0	0	0	0	1
19	1.88	0	0	0	1	0	0	0	0	0	0	0	1
20	-0.1	1	-0.1	0	0	0	1	0	0	0	1	0	0
20	1.25	0	0	1	0	0	0	0	0	0	0	0	0
20	1.37	0	0	0	0	0	0	0	1	1	0	0	0

Table A1c: Correlation matrix of the coded design matrix in Table A2b

	AAA-rated issuer (vs. AA)	(ENPV of payout - price)XAAA	Annual increase 3% (vs. 0)	Annual increase 5% (vs. 0)	Annual increase 7% (vs. 0)	Annual increase $200 (vs. 0)	Annual increase $400 (vs. 0)	Annual increase $500 (vs. 0)	Period certain 5 years (vs. 0)	Period certain 10 years (vs. 0)	Period certain 20 years (vs. 0)	Period certain 30 years (vs. 0)
Exp. NPV of payout - price	-0.39	0.34	-0.11	0.14	0.32	-0.15	-0.04	0.15	-0.17	-0.21	0.01	0.42
AAA rated issuer (vs. AA)	1.00	0.41	0.00	-0.09	-0.04	-0.04	0.10	-0.04	0.00	0.03	0.03	-0.14
(ENPV-price) XAAA		1.00	-0.05	0.07	0.17	-0.08	0.08	0.09	-0.14	-0.13	0.19	0.11
Annual increase 3% (vs. 0)			1.00	-0.18	-0.19	-0.16	-0.18	-0.16	0.16	-0.09	-0.09	-0.04
Annual increase 5% (vs. 0)				1.00	-0.19	-0.16	-0.18	-0.16	-0.08	0.02	0.02	0.06
Annual increase 7% (vs. 0)					1.00	-0.18	-0.19	-0.18	0.02	0.11	-0.11	0.03
Annual increase $200 (vs. 0)						1.00	-0.16	-0.15	-0.06	0.05	-0.07	0.10
Annual increase $400 (vs. 0)							1.00	-0.16	-0.08	0.02	0.14	-0.15
Annual increase $500 (vs. 0)								1.00	0.07	-0.07	0.05	-0.01
Period certain 5 years (vs. 0)									1.00	-0.24	-0.24	-0.29
Period certain 10 years (vs. 0)										1.00	-0.25	-0.30
Period certain 20 years (vs. 0)											1.00	-0.30
Period certain 30 years (vs. 0)												1.00

Note: The shaded areas indicate natural correlations between dummy-coded variables.

Individual-difference measures. Our individual-difference measures included psychographic measures such as loss aversion and perceived fairness, as well as demographics such as age, gender, race, and retirement savings. A description of each measure, in the order experienced by the participants, is provided in Table A2. Actual text is provided in the table for any measures that do not come from previously published research. Perceived fairness is measured using the four-point fairness scale of Kahneman, Knetsch, and Thaler (1986) and then rescaled between 0 and 1. Loss aversion is measured using a set of nine choices between mixed (gain and loss) gambles; the number of loss-averse gambles selected from within each pair are summed into a 0-9 measure and then rescaled between 0 and 1. Numeracy was measured through a set of eight questions; the total number of correct answers is rescaled between 0 and 1 to arrive at our numeracy measure. Note that 38% of the respondents did not complete the numeracy questions due to survey-length considerations; we substituted the population median, and the table reflects the statistics after this substitution. Life expectancy is based on the individual-level subjective assessment of the probability of surviving until 65, 75, 85, and 95. The subjective probabilities are used to estimate a Weibull survival model via maximum likelihood (see Payne et al. 2013), and the individual life expectancy is then derived as a plug-in estimate of the expected value of the Weibull random variable at the maximum-likelihood parameter estimates. For the demographics, gender is a standard binary measure and age is kept as a continuous measure. We collected retirement savings using a dropdown list of 12 categories of increasing ranges; because several categories ended up having less than 1% of respondent, we recategorized these 12 groups into three groups of below $75K (60% of respondents), between $75K and $150K (15%), and above $150K (20%), thus giving us groups of respondents whose retirement savings were below, on par with, and above the purchase price of the $100K annuity. Finally, measures of race and subjective health proved to be insignificant predictors in all estimated models, and are not discussed further.

Table A2: Individual-difference measures

Measure	Source and/or content
Life expectations	"The chance that I will live to be xx years old or more is:" (slider for 0-100% for ages 65, 75, 85, and 95) From Payne et al. 2013
Loss aversion	9 questions of the form: "Please evaluate the following 2 gambles and report which gamble you'd like to play: • Gamble 1: 45% chance of -$400, 10% chance of $0, 45% chance of $400 • Gamble 2: 45% chance of -$600, 10% chance of $0, 45% chance of $700" Adapted from Zank 2010, Brooks & Zank 2005
Fairness	"Please rate how fair you think a life annuity product is" (completely fair, acceptable, somewhat unfair, very unfair) Adapted from Kahneman, Knetsch, and Thaler 1986
Numeracy	8 questions: 5 questions test numeracy through questions of probability and likelihood, and the additional 3 questions are taken from the cognitive reflection task (CRT) From Peters et al. 2006, Frederick 2005
Age	"How old are you?" (select from pulldown)
Gender	"What is your gender?" (select from pulldown)
Race	"Please select one or more of the following racial categories to describe yourself" (checklist)
Retirement savings	"In total how much money do you currently have saved for your retirement?" (checklist)
Subjective health	"How would you rate your overall health compared to people of your age?" (7 pts, very poor to very good)

Participants. We recruited participants through a commercial online panel from Qualtrics. We limited participation to individuals between the ages of 40 and 65. Our estimation sample consists of 334 respondents in the basic treatment, and 323 in the enriched-information treatment, all of whom passed an attention filter. The range and mean values of each demographic characteristic, including the individual-difference measures included in our model, is provided in Table 3.

Table A3: Estimated demand for annuities with expected NPV of $100,000

annual increase in payments	basic / **enriched** / *starting*	Male market: Period certain guarantee 0 years	5 years	10 years	20 years	30 years	Female market: Period certain guarantee 0 years	5 years	10 years	20 years	30 years
none	basic	0.43	0.36	0.44	0.44	*0.26*	0.32	0.26	0.36	0.44	0.29
	enriched	**0.47**	**0.47**	**0.48**	**0.38**	**0.21**	**0.45**	**0.44**	**0.48**	**0.44**	**0.27**
	starting	*$636*	*$628*	*$601*	*$510*	*$416*	*$569*	*$565*	*$550*	*$491*	*$414*
3%	basic	0.36	*0.29*	0.37	0.38	0.24	0.27	0.22	0.30	0.37	0.25
	enriched	**0.42**	**0.41**	**0.43**	**0.35**	**0.22**	**0.43**	**0.42**	**0.45**	**0.42**	**0.28**
	starting	*$481*	*$476*	*$457*	*$377*	*$280*	*$417*	*$414*	*$404*	*$355*	*$278*
$200	basic	0.39	0.32	0.40	0.41	0.27	0.31	0.25	0.35	0.42	0.29
	enriched	**0.42**	**0.41**	**0.43**	**0.35**	**0.21**	**0.45**	**0.43**	**0.47**	**0.43**	**0.28**
	starting	*$491*	*$484*	*$458*	*$351*	*$211*	*$408*	*$405*	*$391*	*$322*	*$208*
5%	basic	0.37	0.30	0.37	0.38	0.25	0.25	0.20	0.28	0.34	0.24
	enriched	**0.44**	**0.43**	**0.45**	**0.37**	**0.23**	**0.43**	**0.42**	**0.45**	**0.41**	**0.27**
	starting	*$391*	*$388*	*$373*	*$303*	*$209*	*$330*	*$329*	*$321*	*$280*	*$207*
$400	basic	0.37	0.30	0.37	0.38	0.25	0.26	0.22	0.30	0.37	n/a
	enriched	**0.42**	**0.41**	**0.43**	**0.35**	**0.22**	**0.42**	**0.40**	**0.44**	**0.40**	**n/a**
	starting	*$346*	*$341*	*$316*	*$192*	*$6*	*$248*	*$245*	*$232*	*$153*	*<$0*

Note: For each combination of annual increase and period certain, the table lists three numbers: in *italics* is the starting income that results in an expected NPV of $100,000. In standard font is the estimated demand for the annuity under basic information conditions. In **bold** font is the estimated demand for the annuity under enriched information conditions. Values corresponding to extrapolating the range of starting income beyond the range in the survey ($300 to $600) are shown in gray font. The predicted demand is normalized to a population of unit mass and in a market that includes only the focal annuity and the outside alternative (self-management of retirement assets). The highest demand in each information condition is highlighted in **green**, the lowest is highlighted in **red**.

Table A4: Population-level regression under an starting income model specification (starting income replaces expected gain), enriched information treatment

	Intercept	Starting monthly income ($100)	AAA rated issuer (vs. AA)	Starting monthly income X AAA rated issuer	Annual increase 3% (vs. 0)	Annual increase 5% (vs. 0)	Annual increase 7% (vs. 0)	Annual increase $200 (vs. 0)	Annual increase $400 (vs. 0)	Annual increase $500 (vs. 0)	Period certain 5 years (vs. 0)	Period certain 10 years (vs. 0)	Period certain 20 years (vs. 0)	Period certain 30 years (vs. 0)
Population mean	**-4.96**	**0.69**	0.34	0.01	**0.87**	**1.55**	**1.97**	**0.65**	**1.30**	**1.83**	-0.08	**0.33**	**0.62**	***0.21***
Unexplained population std. dev. $\sqrt{diag(\Sigma)}$	3.93	0.65	0.58	0.23	0.55	1.06	1.30	0.38	0.97	1.33	0.69	1.04	1.34	1.49
Constant	**-3.62**	**0.41**	0.04	0.05	***0.50***	**0.90**	**0.88**	***0.37***	**0.71**	**1.05**	0.35	**0.79**	0.69	0.00
Age (in 100 years, demeaned)	-2.19	0.79	-0.05	-0.11	0.13	0.45	0.92	0.54	1.21	1.03	-1.31	-1.30	-1.38	-1.12
Life expectancy (in 100 years, demeaned)	-1.98	-0.04	0.49	-0.17	0.66	1.00	1.19	0.46	0.83	***1.42***	0.55	1.04	0.81	0.97
Male	-1.85	0.43	0.60	-0.04	0.65	0.96	1.39	0.40	0.64	1.11	-0.86	-1.21	-0.45	-0.28
Retirement savings 75to150K	1.31	-0.13	-0.01	-0.04	-0.17	-0.06	0.24	0.25	0.26	-0.03	0.02	0.55	0.38	0.69
Retirement savings over 150K	**-1.80**	**0.21**	-0.08	-0.01	0.16	0.32	**0.59**	-0.07	***0.39***	***0.43***	0.09	0.08	0.16	0.34
Perceived fairness of annuities (z-score)	***-0.62***	0.03	0.12	0.00	***0.14***	0.10	***0.22***	0.13	***0.17***	0.18	0.08	0.06	**0.24**	**0.28**
Loss aversion (z-score)	**-1.40**	**0.17**	0.30	-0.05	**0.35**	**0.60**	**0.67**	**0.30**	**0.41**	**0.56**	0.03	-0.01	0.06	0.04
Numeracy (z-score)	0.30	**0.16**	-0.08	0.03	0.12	**0.28**	***0.26***	-0.02	0.17	**0.29**	0.05	0.01	0.02	0.08

Note: Posterior means of Δ (the marginal effects of demographic and psychographic variables on the utility parameters). **Bold** indicates that 97.5% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 5% level. ***Bold&Italic*** indicates that 95% or more of the posterior mass has the same sign as the posterior mean—a Bayesian analogue of significance at the 10% level. See Table 3 for summary statistics of the explanatory variables in this regression, but note that several were further statistically transformed to improve the interpretability of results (age and life expectancy were de-meaned, and personal traits measured by scales were expressed as z-scores).

Table A5: More detailed life-expectancy variables, population-level regression, enriched information treatment

	Intercept	Starting monthly income ($100)	AAA rated issuer (vs. AA)	Starting monthly income X AAA rated issuer	Annual increase 3% (vs. 0)	Annual increase 5% (vs. 0)	Annual increase 7% (vs. 0)	Annual increase $200 (vs. 0)	Annual increase $400 (vs. 0)	Annual increase $500 (vs. 0)	Period certain 5 years (vs. 0)	Period certain 10 years (vs. 0)	Period certain 20 years (vs. 0)	Period certain 30 years (vs. 0)
Population mean	**-0.37**	**1.90**	-0.05	**0.89**	**-0.26**	**-0.26**	**-0.95**	***-0.19***	**-0.37**	**-0.43**	-0.05	**0.19**	**-0.26**	**-1.98**
Unexplained population st. d. $\sqrt{diag(\Sigma)}$	3.20	1.51	0.84	0.70	0.62	0.87	1.72	0.54	0.74	0.97	0.64	0.98	1.69	2.83
Constant	-0.12	1.60	0.00	0.68	-0.35	-0.43	-1.16	-0.18	-0.51	-0.55	-0.08	0.21	-0.15	-1.66
Age (in 100 years, demeaned)	2.53	1.95	-0.90	0.88	-0.88	**-1.07**	***-1.85***	-0.18	***-0.33***	**-1.09**	-1.25	***-1.42***	-2.21	-3.49
Perceived chance live to 75 (probability)	-1.95	-0.42	-0.18	-0.04	0.72	1.28	1.90	0.54	0.96	1.62	0.48	1.09	1.00	1.37
Perceived chance live to 85 (probability)	0.54	1.16	0.19	0.59	-0.04	-0.09	-0.48	-0.03	-0.30	-0.25	-0.70	-1.09	-0.86	-1.39
Perceived chance live to 95 (probability)	0.53	-0.33	-0.08	-0.32	0.17	0.35	1.00	0.39	0.68	0.53	-0.08	0.46	0.58	1.25
Male	0.21	0.17	-0.28	0.33	0.04	0.14	0.34	-0.22	0.18	0.14	-0.03	-0.13	-0.39	-0.58
Retirement savings 75to150K	-1.12	0.28	***0.35***	***0.07***	0.21	-0.02	0.17	0.16	0.17	0.13	0.22	0.17	0.57	0.61
Retirement savings over 150K	***-0.73***	0.85	***0.02***	0.29	0.21	0.57	0.25	0.28	0.18	0.17	0.05	-0.03	***-0.23***	-0.92
Perceived fairness of annuities (z-score)	1.27	**0.30**	-0.05	0.13	-0.10	**-0.04**	-0.24	-0.16	-0.14	-0.14	0.04	0.01	-0.11	***-0.28***
Loss aversion (z-score)	**-0.22**	**-0.23**	0.09	-0.08	0.16	0.16	0.20	0.08	0.12	0.20	0.08	0.08	0.15	0.31
Numeracy (z-score)	-0.38	***0.37***	0.12	0.14	***-0.19***	-0.07	-0.24	0.05	-0.14	***-0.21***	0.12	0.09	-0.03	-0.32

Note: See note to Table A4

Table A6: Proposed model with unrestricted mutinomial probit covariance of random utility error terms within task. Population-level regression, enriched information treatment

	Intercept	Starting monthly income ($100)	AAA rated issuer (vs. AA)	Starting monthly income X AAA rated issuer	Annual increase 3% (vs. 0)	Annual increase 5% (vs. 0)	Annual increase 7% (vs. 0)	Annual increase $200 (vs. 0)	Annual increase $400 (vs. 0)	Annual increase $500 (vs. 0)	Period certain 5 years (vs. 0)	Period certain 10 years (vs. 0)	Period certain 20 years (vs. 0)	Period certain 30 years (vs. 0)
Population mean	-0.20	**1.64**	-0.08	**0.84**	**-0.29**	**-0.27**	**-0.94**	**-0.26**	**-0.34**	**-0.41**	0.00	**0.23**	**-0.17**	**-1.57**
Unexplained population std. dev.	2.88	1.25	0.71	0.61	0.51	0.74	1.46	0.47	0.65	0.80	0.56	0.88	1.45	2.37
Constant	0.05	**1.35**	-0.05	**0.64**	**-0.35**	**-0.41**	**-1.09**	**-0.24**	**-0.44**	**-0.48**	-0.02	**0.25**	-0.06	**-1.26**
Age (in 100 years, demeaned)	1.65	1.51	-0.77	0.78	-0.74	-1.03	-1.77	-0.18	-0.45	-0.96	-0.99	-1.21	-1.94	-3.27
Life expectancy (in 100 years, demeaned)	0.02	1.36	-0.34	0.47	**1.25**	**2.70**	**4.49**	**1.34**	**2.42**	**3.32**	-0.96	0.37	1.15	1.65
Male	0.20	0.19	***-0.22***	***0.32***	-0.02	0.09	0.23	-0.24	0.12	0.08	-0.04	-0.12	***-0.36***	-0.56
Retirement savings 75to150K	***-1.02***	0.32	***0.32***	0.09	0.18	0.02	0.11	0.12	0.13	0.09	0.18	0.15	***0.46***	0.48
Retirement savings over 150K	-0.73	**0.77**	0.02	0.28	0.20	**0.48**	0.17	0.24	0.15	0.13	0.04	-0.02	-0.18	***-0.81***
Perceived fairness of annuities (z-score)	**1.15**	**0.28**	-0.03	0.13	-0.08	-0.05	-0.21	-0.11	-0.12	-0.12	0.04	-0.01	-0.10	-0.24
Loss aversion (z-score)	-0.19	***-0.19***	0.08	-0.06	***0.13***	0.13	0.17	0.06	0.10	***0.17***	0.07	0.08	0.13	0.25
Numeracy (z-score)	***-0.36***	**0.31**	***0.10***	0.11	**-0.16**	-0.07	***-0.22***	0.05	***-0.13***	**-0.17**	***0.11***	0.09	0.00	-0.24

Note: In this model specification, the error vector $\left[\varepsilon_{n,1,j},\varepsilon_{n,2,j},\varepsilon_{n,3,j}\right]$ in each choice set is assumed to follow the multivariate Normal distribution with an unrestricted (other than the (1,1) element set to unity for identification) 3x3 covariance matrix. The off-diagonal covariances capture unobserved similarity of positions on the screen. The estimated covariance matrix has positive off-diagonal elements (1,3) and (2,3), and approximately zero (1,2) element. Also see note to Table A4 for more information about coding of table.

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