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# Complexity and asset legitimacy in retirement investment☆

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ABSTRACT

Despite their importance, many individuals do not actively manage their retirement investment accounts. We use a laboratory experiment to examine the role that complexity plays in retirement investment decisions. We find that complex fee structures significantly increase both decision errors and default option choices compared with simple fees. We also find evidence of myopic risk aversion while complexity has no effect on the risk profile of investment decisions. The complexity effect is robust to increased asset legitimacy by having subjects earn the investment money in the experiment, although earning the investment money leads to faster learning.



## 1. Introduction

Recent years have witnessed a surge in empirical evidence for bounded rationality in consumer choice, especially in the domain of household finance. One area where consumers are especially struggling is with saving and investment for retirement. Many individuals, for example, do not participate in (attractive) retirement savings plans (Choi et al., 2004) and if they do, they put a disproportionate share of their wealth in bonds (Siegel and Thaler, 1997) or they fail to take advantage of employer matching (Choi, Laibson and Madrian, 2011). Such behavior can be attributed to financial illiteracy (Van Rooij, Lusardi and Alessie, 2011), present-biased preferences (Laibson, 1997) or myopic loss aversion (Gneezy and Potters, 1997) among other things. In this paper, we examine the effect of complexity on retirement investment decisions.

Our main contribution is the following. Using a laboratory experiment, we find that complexity of retirement investment products leads to costly mistakes. The detrimental effects of complexity are due to individuals failing to minimize account fees or choosing the inferior default option. The complexity effect is robust to increased asset legitimacy by having subjects earn the investment money in the experiment and the use of a more representative subject pool. On the other hand, complexity per se has no effect on portfolio risk allocation in our experiment.

Retirement investment decisions are inherently complicated. The complexity of these decisions can potentially lead individuals to make costly errors by failing to minimize on mutual fund fees (Choi, Laibson and Madrian, 2010), remain in the default investment option (Carroll et al., 2009) or even put off saving for retirement altogether (Madrian and Shea, 2001). Despite the prevalence of complexity in financial decisions and increasing acceptance of the potential implications (Carlin and Manso, 2011) there is little empirical research.[1]

One potential consequence of complexity is reliance on the status quo or default option rather than active management of the

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[1] There is field evidence in the retirement investment domain that suggest complexity leads to inferior choices. However, complexity in these studies is varied solely through the number of options available to individuals. For example, Iyengar and Kamenica (2010) find that a larger choice set is associated with certainty bias and an increased preference towards investment in bonds. Similarly, Beshears et al. (2013) find that replacing all available retirement plans with a new plan that features a pre-selected contribution rate and asset allocation leads to higher participation rates. Even though the number of available options should be expected to result in cognitive load similar to the complexity mechanism we use in our experiment we believe our method is cleaner in at least two ways. First, while we can objectively identify mistakes in our experiment, as we induce subjects' preferences, the above mentioned field studies cannot, as they do not control for individual preferences (for example, preferences for risk). Second, apart from being a source of complexity, large choice sets can also be beneficial for some individuals with less common preferences and might also affect saliency of individual options in these choice sets.

funds. Choi et al. (2002) describe such behavior as choosing "the path of least resistance" and document the prevalence of passive decision making in U.S. saving behavior. The pattern is similar in other developed countries such as Australia where the majority of employees remain in the default option in their retirement plan (Bateman et al., 2014).

In this paper, we use a laboratory experiment to examine how complex fee structures affect retirement investment decisions. Laboratory experiments are particularly suited to examine these research questions for a number of reasons. First, by inducing subjects' preferences we can clearly identify when a decision mistake occurs. While such mistakes may involve remaining with the default option, we can also identify broader types of mistakes than is possible with naturally occurring data. Second, in our laboratory environment we are able to vary the complexity of decisions without also changing other elements such as number of options, flexibility, and risk profile of available options.[2] That is, we can isolate the impact of complexity per se.

The main task we use in the experiment is as follows. Subjects are given an endowment and are asked to choose among ten investment options. The investment options exhibit three risk levels and for each risk level, there are three options with differing levels of fees. Hence, the subjects' task is to find options that reflect their risk preferences and choose the option that has the lowest fees among those options. In addition to these nine options, there was one option called the "default option" that had the same risk profile as the least risky option but exhibited the highest fees. The endowment is invested in the subject's retirement account of choice for thirty rounds (reflecting thirty years); hence, a subject's payoff for her choice is her accumulated earnings (net of the fees) from the thirty rounds of investment. Finally, to examine learning, the task is repeated six times.

The main treatment dimension in our experiment is the complexity level. We vary complexity in the following way. In the simple treatment the fees for an investment option consists of just a single weekly fee. On the other hand in the complex treatment the fees are divided into three sub-fees; hence, the subject needs to aggregate these fees to find the actual cost of an investment option.

Our results show that complexity of fees leads to costly mistakes. On average, subjects choose options with higher fees nearly twice as often when fees are complex than when fees are simple. Around half of this effect occurs because complexity leads subjects to choose the (costly) default option significantly more often. Importantly, the effect of complexity diminishes with experience. On the other hand, complexity does not affect the risk profile of investment decisions.

We also examine the external validity of our results by running additional sessions. In one set of sessions we made subjects earn their investment money (endowment) using a word-encoding task. We find that the source of the investment money has no effect on decision errors and default option choices. However, earned investment money leads to less risk-averse account choices than unearned investment money. Note however, that many subjects in our experiment display myopic risk aversion (as in Benartzi and Thaler, 1999) since taking risks in our experiment is optimal due to the long investment horizon. In this sense, our results support the idea that individuals learn to make better decisions for themselves when the investment money is earned in the experiment. In another set of sessions we used a non-standard subject pool. Specifically, we use subjects that have work experience and experience with making actual retirement investment decisions. We find no difference in their decision accuracy in the experiment compared to student subjects.

Our results contribute to a growing literature on complexity and decision-making. Caplin, Dean and Martin (2011) find in a laboratory experiment that higher complexity leads to lower quality choices. Kalaycı and Serra-Garcia (in press) investigate the relationship between complexity of loan contract terms and credit choices, and find that complexity leads to errors, and, in particular to overweighting of salient contract terms . Beshears et al. (2010) find that simplified disclosure has no effect on mutual fund choice and most subjects fail to minimize on mutual fund fees. On the other hand, Beshears et al. (2013) find in a field study that simplification leads to greater enrollment in retirement saving accounts and can potentially increase contribution rates of employees who are already saving. Similarly, in a hypothetical choice experiment, Agnew and Szykman (2005) find that subjects, particularly those with lower literacy, feel overwhelmed and make more default option choices when faced with a complex information format compared to a simple information format.

In other domains, Frank and Lamiraud (2009) find that complexity leads to consumer confusion in health insurance, while Schram and Sonnemans (2011) show that increasing the number of alternatives lead to inferior decisions in health insurance. In similar vein, Hanoch et al. (2011) find that increasing the size of the choice set in Medicare Part D leads to poor quality decisions, especially for older participants. Relatedly, Brown, Hossain and Morgan (2010) find that consumers on eBay ignore shipping costs while Chetty, Looney and Kroft (2009) find similar effects for prices that are displayed exclusive of sales tax. Task complexity is also shown to be a good predictor of equilibrium selection in games (Ho and Weigelt, 1996) and decision time in lottery choice (Wilcox, 1993).

The previous literature shows procrastination, status-quo bias, anticipated regret, aging, and choice overload to be contributing factors for individuals to choose "the path of least resistance" (Choi et al., 2002; Madrian and Shea, 2001; Besedes et al., 2012; Agnew and Szykman, 2005). Our results show that complexity of retirement investment decisions is also an important reason for sticking with the default option. This finding is in line with Payne, Bettman and Johnson (1993) and Payne, Bettman and Luce (1996) who suggest that individuals adapt their choice rules when faced with complex choices and use strategies that require lower cognitive effort.

Our results also contribute to the literature on financial literacy that documents correlation between financial literacy and retirement savings decisions (e.g., Lusardi and Mitchell, 2009; Van Rooij, Lusardi and Alessie, 2011). With regards to retirement investment decisions, financial literacy has been found to be predictive of choosing a low fee investment portfolio (Choi, Laibson and Madrian, 2011; Hastings, Hortacsu and Syverson, 2013) and stock market participation (Van Rooij, Lusardi and Alessie, 2011). In our regression analysis however, we find no effect of financial literacy on participants' decision errors or on their investment risk profile.

## 2. Experimental design

### 2.1. Overview and hypotheses

To investigate how complexity affects retirement investment decisions, we designed an investment task where subjects choose their preferred investment option in each of six rounds. There are three different accounts, each with a different risk profile, to choose from, and three different companies offer each account. The distribution of returns (i.e. risk profile) for each account is the same across companies, but each company charges different fees for their accounts. Thus for each account type, there is one

[2] For example, Beshears et al. (2013) introduce simplicity to retirement decisions by eliminating all the options and offering only one simple enrolment option. Although such a method has important policy implications, it does not allow one to identify the exact source of the effect.

company that offers the lowest total fee. This important design feature enables us to measure whether decision errors, defined as not selecting the lowest fee company for the chosen account type, have occurred. By including a tenth option, the default choice, which is never the cheapest option, we can also observe the types of errors that occur.

The main treatment dimension in our experiment is the complexity level (Simple versus Complex). We focus on one specific type of complexity, that of differences in the fee structure, with only one fee type in the Simple treatment and three types in the Complex treatment (explained in detail in the next section). We have two hypotheses regarding the role of complexity.

**Hypothesis 1.** Complex fee structures result in more frequent decision errors than simple fee structures.

This hypothesis is based on the standard random utility (Luce, 1959) framework . According to this framework, an individual's utility is the sum of a deterministic component, the net payoff from each company in the present case, plus a random utility (error) component. If the error component is distributed according to an extreme value distribution with scale factor $\mu$, McFadden and Zarembka (1973) shows that the probability of choosing the company with the highest net payoff increases with $\mu$. Hence, mistakes may occur, especially for small $\mu$ values. We interpret the scale factor of the errors, $\mu$, to decrease with the noise in the environment. In the complex treatments noise is large due to the complexity of the fees.

**Hypothesis 2.** Complex fee structures result in more default option choices than simple fee structures.

Our second hypothesis follows recent theories of salience (Bordalo, Gennaioli and Shleifer, 2013; Köszegi and Szeidl, 2013) that suggests that complexity leads individuals to pay more attention to the salient features of the choice problem. In the investment task the default option is more salient than the other options as it is presented on a separate part of the screen and is "chosen by default".

In addition to the complexity treatments we ran treatments to study how the source of the investment money affects decisions. In the Earned treatment subjects had to complete an encryption task to earn their money to invest in the investment task, while subjects in the Unearned treatment are simply given $E5000 to invest in each round.[3] In the encryption task subjects have 10 min to encode as many words as possible and their success at this task determines the amount of investment money they earn for the following task.[4] We chose this particular task because it does not require much skill and has generated earned money effects in other contexts (e.g. Cason, Gangadharan and Nikiforakis, 2011). We conjectured that unearned money would lead to more frequent errors (due to potential detachment and hence less effort being exerted) and more risky investment choices (akin to related "house money" effects, see Thaler and Johnson, 1990) than earned money, leading to the following two hypotheses.

**Hypothesis 3.** Decision errors are less frequent when investing earned money than unearned money.

**Hypothesis 4.** Earned money results in less risky investment choices than unearned money.

The experiment proceeds as follows. Following some general instructions, subjects begin by answering three financial questions designed to measure financial literacy. We asked these questions at the beginning to avoid any influence from the task itself either due to the context or due to fatigue and lack of concentration by the end. The encryption task follows in the Earned treatments. The main investment task then follows and is repeated for six rounds. Before the main task, subjects are given comprehensive instructions and are asked to answer quiz questions to ensure their understanding of the task. At the end of the experiment, one investment round is selected randomly for payment purposes using a die roll. Subjects also answer demographic, personality, and retirement savings questions. The experiment was computerized using the software z-Tree (Fischbacher, 2007), although a simple calculator was provided to assist subjects.

In total, 120 subjects were recruited from the general student body at the University of Queensland using the ORSEE software (Greiner, 2015). The subjects were randomly assigned to the four treatments: Simple-Unearned, Simple-Earned, Complex-Unearned, and Complex-Earned with 30 participants in each treatment (one session each). Approximately half (54%) of the participants were males, with 45% locally born, and 43% born in Asia. Less than half (43%) were business or economics students and very few had previous experience with economics experiments. Each session lasted around 90 min and average earnings were AUS$36.03 (approximately US$36 at the time of the experiment) with the range from $28.32 to $43.24.[5] Finally, note that although we use retirement terminology in the paper for ease of exposition, in the experiment itself the more neutral language of "financial decisions" and "investments" were used. Experimental instructions for the Complex-Earned treatment are included in the Appendix.

### 2.2. The investment task

We designed the main experimental task to reflect some key features of retirement choices. In each round, subjects choose which account and company to invest their funds in. In all treatments, there are three companies each offering three different accounts, X, Y, and Z. There is also a default account. There are fees for each account. We focus on one specific type of complexity; differences in the fee structure.[6] Subjects in Complex face three fees for each option, while subjects in Simple face only one fee for each option. Although the number of fees differs, the total value of the fees for each account is identical across the Simple and Complex treatments, and thus any observed differences between the two treatments can be attributed to complexity.

In the Simple treatment, subjects only face a single weekly administration fee, which is calculated by multiplying the fee by 52 to derive the annual administration fee. In the Complex treatment, subjects face an additional fee type and a rebate for each account in addition to the weekly administration fee, making a total of three fee elements. The additional fee is an annual contribution fee, which is calculated as a percentage of the contribution amount in each year. Each account also receives an annual rebate, which reduces the total fee. These fee values change each round. Fig. 1

[3] All earnings in the tasks are denoted in experimental dollars ($E), which are converted at a rate of $E10,000=AU$1.

[4] The task had three achievement levels: earn $E2000 per year for 30 years for encoding 0–15 words, $E3500 for 16–29 words, and $E5000 for encoding 30 or more words. The highest level was set based on pilot experiments to ensure the target was sufficiently challenging but still achievable for most subjects in order to enhance comparability. All subjects successfully reached the highest achievement level.

[5] Earnings were significantly lower in Complex compared with Simple, especially in the first three rounds ($p$-Values$<$0.001, Wilcoxon test). Earnings were significantly higher in the Earned versus Unearned treatments overall ($p = 0.05$) and in the last round ($p = 0.06$).

[6] Complexity in retirement choices comes from many sources. By focusing on complexity in fees only, we can isolate the effect of complexity from potential confounds such as risk preferences, while still creating a sufficiently complex choice environment for participants.

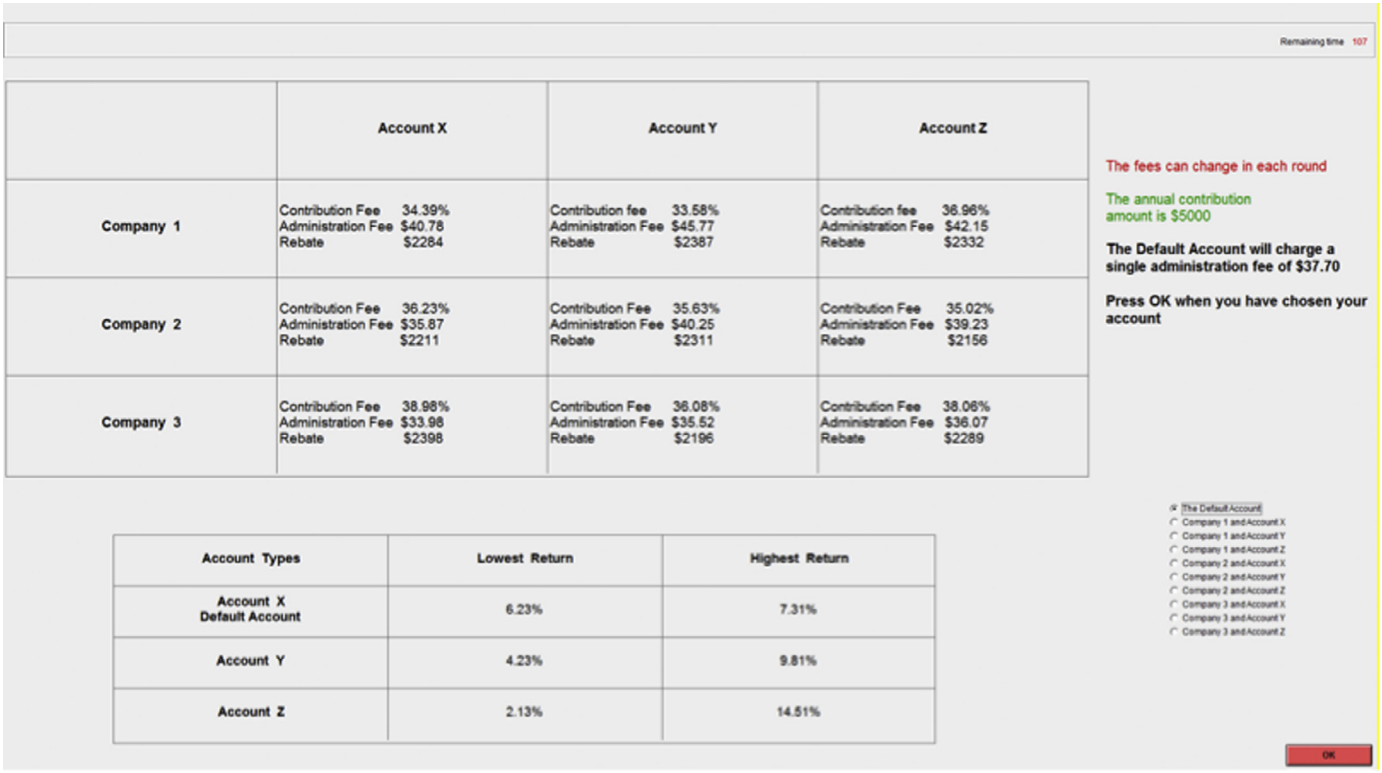


**Fig. 1.** Screenshot of the investment task – Complex treatment.

shows a screenshot of the information provided to subjects each round of the Complex treatment. In the Simple treatment each cell contained only the value of the weekly administration fee.

Our fee design in the Complex treatment is motivated by the observation that real world retirement products typically contain a myriad of complex and different fee types. Many do include fixed administrative type fees, as well as fees that are a percentage of the annual account balance. In the experiment, we chose to have a fee that is the percentage of the contribution (rather than the annual account balance) in order to have a fee that subjects could actually compute. A rebate was also included as this required subjects to perform a different mathematical operation, subtraction. While each fee is relatively simple, the combination of them makes the task more challenging.

Each company offers three account types, neutrally labeled as X, Y, and Z to avoid any potential confounds. Account X resembles a defensive option with an annual return spread of 6.23–7.31%, while Account Y resembles a balanced option with a spread of 4.23–9.81%, and Account Z resembles a high growth option with returns of 2.13–14.51%. These return spreads are loosely based on retirement fund returns in Australia before the financial crisis occurred in 2007. We deliberately chose to avoid accounts with potential losses to avoid any confounds with loss aversion. The return spreads are the same across companies, treatments and rounds.

In each round, the subject chooses a particular account to invest their funds in for the entire 30 years of the round. The annual percentage returns are drawn from a uniform distribution across the specified range, with a separate independent random draw conducted in each year and each round. The return balance evolves over the 30 years in each round. Each year, the annual contribution amount ($E5000) is added to the account balance, along with the return amount, while total fees are deducted. As the actual return rate differs in each year, it is not possible to use a simple future value formula.

An important feature of the design is the inclusion of an explicit Default Account, which has the same return spread as Account X, but a higher total fee value than any type of account. However, it is simple having only one (administration) fee. Therefore, choosing the default option reflects an erroneous choice rather than a particular risk preference. Subjects know that they are always in the Default Account (i.e. if they fail to actively choose a different company and account during the allowed time), but they can choose any other account.

The fee structure was designed so that total fees are lowest with a particular company regardless of the account chosen. Thus we can define an error independently of the risk preference of the participant, where an error is defined as not choosing the lowest fee option for the chosen account type. For example, subjects do not make an error by choosing Account X over the other accounts, but they do make an error when they do not choose the Account X with the lowest fee. In the experiment, minimizing total fees is equivalent to maximizing their payoff. Note that with our design (specifically the specification of the contribution fee) subjects can readily compute the actual fees for each account.

In each round, subjects have two and half minutes to make a decision, which is then repeated over six rounds. Subjects are provided with a basic calculator, as well as a pen and paper to assist with any calculations. They are provided with detailed instructions including specific numerical examples showing how each type of fee or rebate is computed and aggregated. Quiz questions also asked them to compute these fees. In all treatments subjects were asked to compute the annual administration fee and everyone could. In the Complex treatment subjects were also asked to compute the contribution fee, which everyone could, and define a rebate (only 7% got this wrong).

Payoffs do not accumulate over different rounds. Instead, to avoid any potential wealth effects there is only one randomly chosen payment round. Subjects receive feedback after each round

**Table 1**
Aggregate error rates.

| Type of error | All treatments | Complex | Simple | Unearned money | Earned money |
|---|---|---|---|---|---|
| No error (lowest fee) | 65% | 54% | 76% | 64% | 66% |
| Second lowest fee | 11% | 13% | 8% | 9% | 12% |
| Highest fee | 10% | 14% | 7% | 12% | 9% |
| Default error | 14% | 19% | 9% | 15% | 12% |

**Table 2**
Error rates by treatment.

| | Simple | | Complex | |
|---|---|---|---|---|
| Type of error | Unearned money | Earned money | Unearned money | Earned money |
| No error (lowest fee) | 72% | 81% | 56% | 52% |
| Second lowest fee | 6% | 10% | 12% | 14% |
| Highest fee | 11% | 3% | 12% | 15% |
| Default error | 12% | 6% | 19% | 18% |

regarding the realized (actual) returns over the 30 years for their chosen account, as well as summary statistics of the returns, total fee paid, and closing balance for their account.

Each round the fee values were changed, and thus potentially also the position of the lowest fee company. Any learning that occurs was therefore regarding the nature of the decision problem rather than the position of the best option. To enhance comparability across rounds, the fee changes occurred within certain bounds, with the fee-to-return ratio kept approximately constant across all rounds and accounts, as were the differences between the lowest fee, second lowest, and highest fee accounts. By not choosing the lowest fee account, subjects lost between $AUS 1.17 and 7.91. With the default, the comparison is to choosing Account X. The largest losses occurred when choosing the default option. Account return spreads were the same in all rounds. To enhance comparability across treatments and companies we pre-drew the realizations of the random returns for each round and used the same outcomes for all cases.[7]

## 3. Results

### 3.1. Summary statistics

In the investment task, each subject makes choices in six rounds. In the following summary statistics, we compute averages across rounds and subjects, unless otherwise stated. For our statistical tests of treatment differences, we use the non-parametric Wilcoxon (Mann-Whitney) ranksum test with the unit of analysis the relevant subject average, unless stated otherwise.[8]

Recall that subjects make an error by not choosing the lowest fee company for their chosen account type. Table 1 shows average error rates of different kinds, with information disaggregated by treatment in Table 2. Across all treatments, the lowest fee company was selected 65% of the time, the second lowest fee company 11% of the time, and the highest fee company 10% of the time. The default account was (erroneously) chosen 14% of the time. Recall that staying in the Default Account is an error because it has the same return spread as Account X, but higher fees.[9]

Average account choices (excluding defaults) are summarized in Tables 3 and 4. Account Z, the riskiest option, was the most commonly chosen option (41% of choices on average), followed by Account Y (33%), and Account X (25%). Account choice percentages are computed using active (i.e. not default) choices only.

For each person in each round we construct three indicator variables to summarize subject choices in the investment task. First, to measure the frequency of decision errors, we construct the variable Error, which equals zero if the lowest fee company was chosen and one otherwise. Second, we construct Default, which takes the value one if the default option was chosen, and zero if not. Finally, the variable ChoseZ takes on a value of one if Account Z, the riskiest option, was selected and zero otherwise.

For subjects in Simple-Earned and Complex-Earned, the average, minimum and maximum number of encoded words for the encryption task was 43, 31, and 60, respectively. Therefore, all subjects entered the investment task with the same amount to invest regardless of treatment. The quiz questions suggest that by round one, almost all subjects have a good understanding of the main experiment, with only five subjects (4%) making an error in these questions.

### 3.2. The effect of complexity

We combine Complex-Unearned and Complex-Earned to create an aggregate Complex treatment. Similarly, Simple-Unearned and Simple-Earned are combined to form the Simple treatment. We then compare error rates across the two combined treatments in order to test Hypothesis 1.

As shown in Table 1, on average, subjects make significantly more errors in Complex compared to Simple (46% versus 24%, $p$-Value $< 0.001$, Wilcoxon test). Fig. 2 shows the average error rate across rounds between Simple and Complex. The complexity effect clearly diminishes over time as subjects gain experience (and feedback) with the task. Not only so, subjects in all treatments make fewer errors over time with significantly fewer errors made in Round 6 compared to Round 1, both overall and in each of the

[7] The opportunity cost of not choosing the lowest fee company is calculated as the difference in final account balances between the chosen option and best option given their preferred account type. That is, the opportunity cost reflects the difference in fees compounded over the 30 years of returns, and as such, this cost is not apparent to subjects. As a result, minor difference in the opportunity cost across rounds are not salient for subjects and therefore seem unlikely to have affected choices.

[8] We also tested for differences in the means across treatments using $t$-tests. Since the results are virtually identical to those reported in the text we do not report them separately.

[9] Subjects can choose the default account either actively (with time remaining) or passively (by failing to make a choice within the allowed time), although this classification is imperfect as some apparently passive choices might reflect a deliberate choice on the part of the subject. Over all periods 21% of default choices were active. With experience, the proportion of default choices made passively decreases; in round 1, 36/39 default choices were passive, while in round 6, 6/9 were passive. In the analysis that follows, both types are included in "default errors" while passive choices are excluded from the analysis of account types.

**Table 3**
Average account choices.

| Account choice | All treatments | Complex | Simple | Unearned money | Earned money |
|---|---|---|---|---|---|
| Account X | 25% | 25% | 26% | 27% | 24% |
| Account Y | 33% | 36% | 31% | 37% | 30% |
| Account Z | 41% | 40% | 43% | 36% | 46% |

*Notes*: Active choices only (excludes default choice).

**Table 4**
Account choices by treatment.

| | Simple | | Complex | |
|---|---|---|---|---|
| Account choice | Unearned money | Earned money | Unearned money | Earned money |
| Account X | 29% | 24% | 25% | 24% |
| Account Y | 35% | 27% | 38% | 33% |
| Account Z | 36% | 49% | 37% | 42% |

*Notes:* Active choices only (excludes default choice).

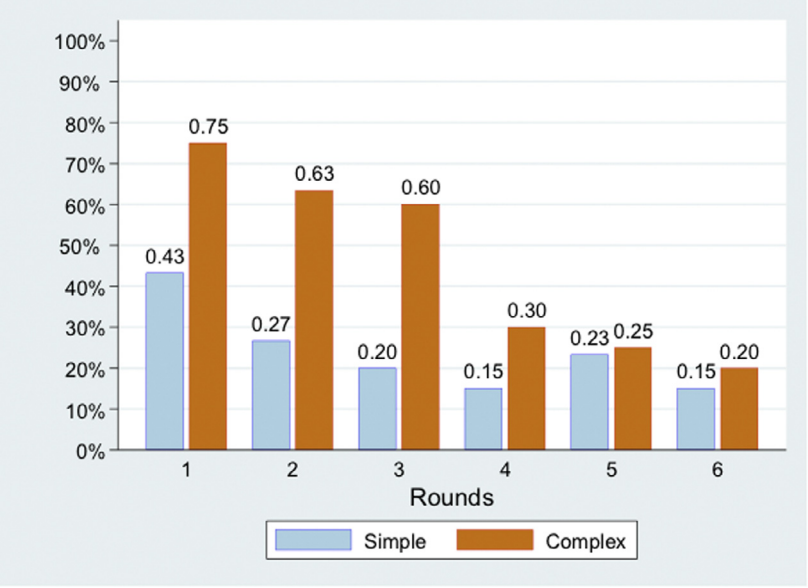


**Fig. 2.** Average error rate – Simple versus Complex treatments.

four treatments ($p$-Values $< 0.01$, Wilcoxon matched pairs signed ranks test) Subjects make significantly more errors in Complex in the first four rounds ($p$-Values $< 0.05$), but by rounds 5 and 6, the difference is no longer significant. The diminishing effect of complexity indicates that subjects overcome the complexity effect with experience. This provides support for Hypothesis 1 only in settings where consumers are inexperienced.

Default option choices are also more frequent in Complex compared to Simple (19% versus 9%, $p = 0.001$). However, as with errors, experience tends to lessen both the effect of complexity and the number of default choices in general. Fig. 3 shows the average default choices across rounds in Simple and Complex. There is a significant difference in the default option choices between Simple and Complex in each of the first three rounds ($p < 0.03$) but not in later rounds. Complexity does increase the likelihood of default option choices in the early rounds, supporting Hypothesis 2, but the complexity effect diminishes with experience. Experience therefore encourages informed and active decisions particularly in complex decision environments. Fewer default choices occur in Round 6 compared to Round 1 ($p < 0.01$, Wilcoxon matched pairs signed ranks test). Disaggregating by treatment this difference over time is only significant in the two complex treatments ($p$-Values $< 0.004$, Wilcoxon matched pairs signed ranks test) and not in the simple treatments.

Finally, complexity appears to have little effect on the account chosen by subjects. While Account Z was chosen less in the Complex settings, the difference is not significant on average (40% of active choices versus 43%, $p = 0.73$) or in any particular round.

### 3.3. The effect of unearned money

To test Hypothesis 3 and 4 we combine Simple-Unearned and Complex-Unearned to create Unearned, and Simple-Earned and Complex-Earned to create Earned. Summary statistics are provided in Tables 1–4. There is no difference in the average error rate between Unearned and Earned either overall (36% versus 34%, $p = 0.57$) or in any particular round. Fig. 4 shows the average error rate across rounds in Unearned and Earned. While the average error rate diminishes with experience, there is no evidence to support Hypothesis 3. There is no statistical difference even if we separate by complexity level. The average error rate in Simple-Unearned is 28% compared to 19% in Simple-Earned ($p = 0.22$). Similarly, the average error rate in Complex-Unearned is 43% compared to 48% in Complex-Earned ($p = 0.56$). The source of money appears to have no impact on default choices either (12% earned versus 15% unearned, $p = 0.21$) overall or in any particular round. Separating by complexity, there is a marginally significant effect in the Simple treatments overall ($p = 0.10$).

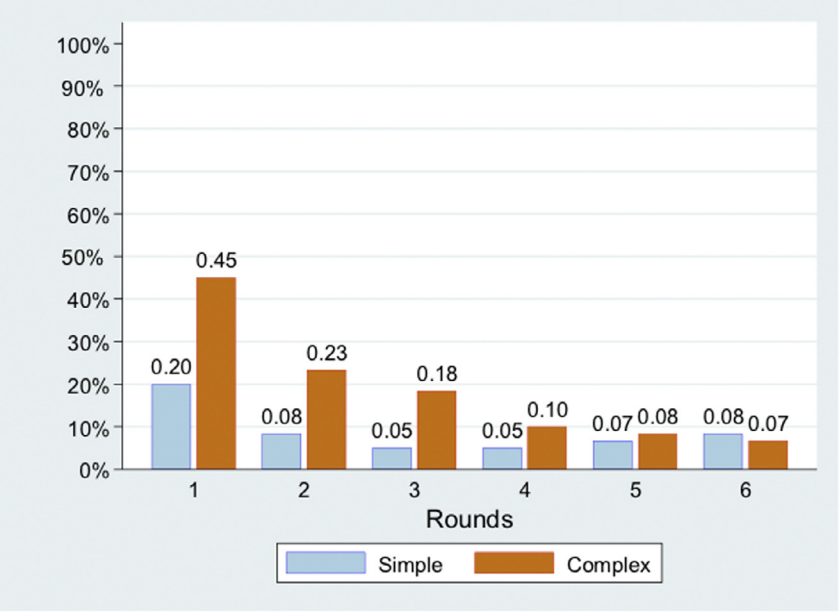


**Fig. 3.** Average default option choices – Simple versus Complex treatments.


**Fig. 4.** Average error rates – Unearned money versus Earned money treatment.

A subject's account choice reflects their risk preference, with Account Z having the widest spread and largest expected value, followed by Account Y, and X the least risky with the lowest expected value. Therefore, those choosing X were the most risk averse, followed by Y, and Z. When analyzing account choices we exclude those who remained in the default (99 observations over the 6 rounds) even though the default has the same return range as Account X as it is unclear whether they actively chose that option. There is a significant difference in account choices between Earned and Unearned on average, with Account Z more likely to be chosen in Earned (46% versus 36%, $p$-Value $= 0.09$). The increase in Account Z choices comes from a decrease in Account Y choices on average in Earned compared with Unearned (30% versus 37%, $p = 0.08$) with no significant difference in Account X choices.

Fig. 5 shows the average choice of Account Z over the rounds disaggregated by Earned versus Unearned treatments.[10] Thus, risk aversion appears to diminish with experience and when investing earned money rather than unearned money. Across all treatments, the proportion of Account Z choices significantly increases from Round 1 to Round 6 ($p < 0.001$, Wilcoxon matched pairs signed ranks test). Separating by treatment this effect only occurs in Complex-Earned ($p = 0.06$) and Simple-Earned ($p = 0.01$), and does not occur in Unearned.

[10] While there is a significant difference in account choices in aggregate, disaggregating by round reveals a significant difference in choices ($p$-Value$= 0.08$) only in round 4.


**Fig. 5.** Average account Z choices – Unearned versus Earned money treatments.

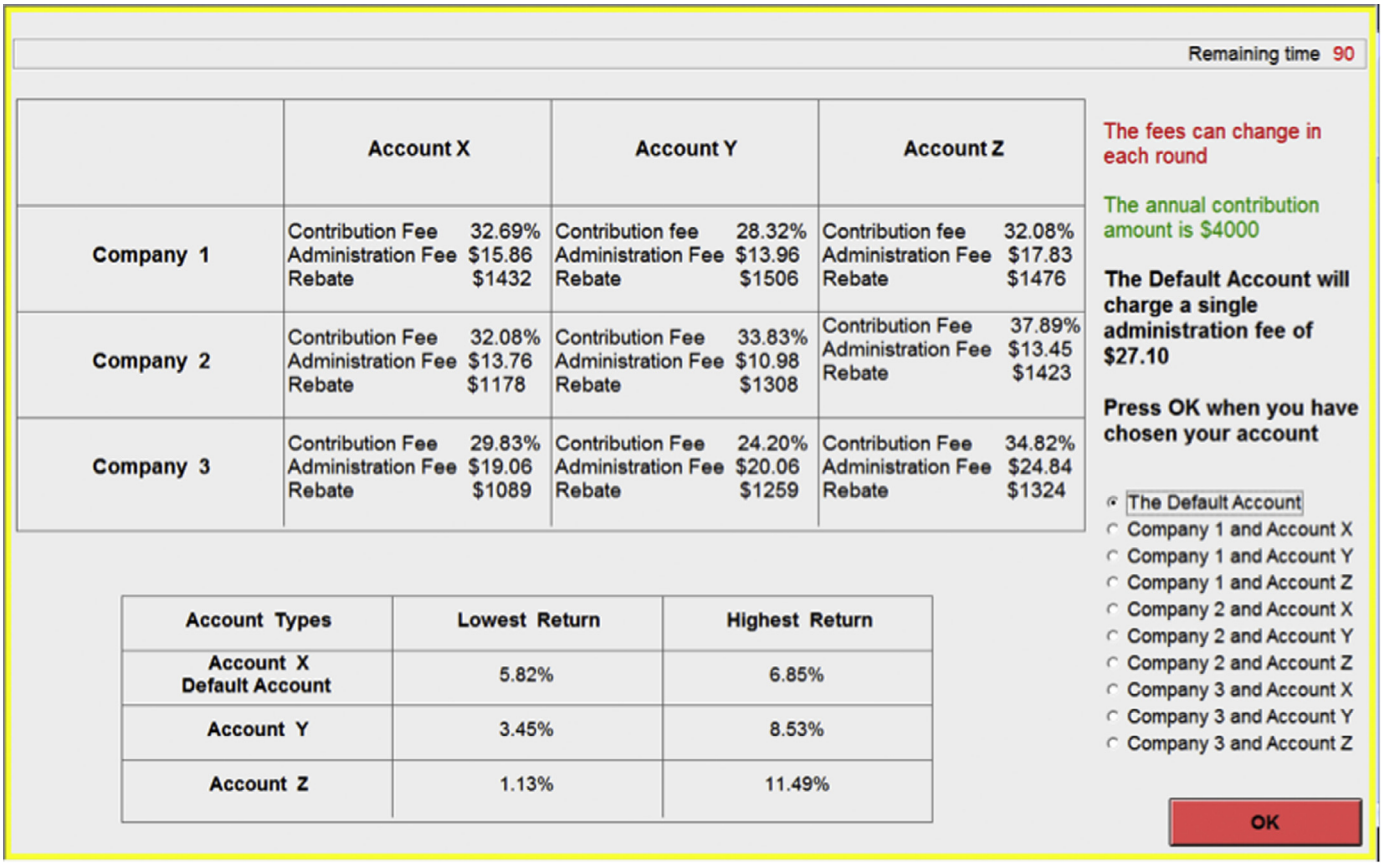


**Fig. 6.** Investment choice in Complex.

Further analysis reveals that the effect of earned money on risk preferences arises only in Simple and not in Complex. Fig. 6 shows Account Z choices in Simple only, and reveals a similar pattern to Fig. 5. The average choice for Account Z is 49% in Simple-Earned compared to 36% in Simple-Unearned ($p = 0.07$). The only significant difference in a particular round is in Round 6, when 71% of subjects in Simple-Earned choose Account Z compared to 44% of subjects in Simple-Unearned Money ($p = 0.04$). In contrast, the source of money does not affect risk preferences in Complex. There is no difference in choices of Account Z either on average (42% earned versus 37% unearned, $p$-Value $= 0.5$) or in any round.

Thus, we find no support for Hypothesis 3 and contrary evidence for Hypothesis 4 (in aggregate, and in the Simple case). On the surface, the results for Hypothesis 4 are surprising when compared with literature reviewed earlier where subjects take greater risks with unearned (or house) money than earned money

(Thaler and Johnson, 1990). However, in this experiment, the differences in risk across the accounts are diminished by the repeated nature of the returns (over 30 rounds) and thus choosing Account Z is the better option unless one is extremely risk averse. In some sense, not choosing Account Z is evidence of narrow bracketing and acting as if there is only one lottery (Barberis, Huang and Thaler, 2006). One interpretation of our finding is that Earned money induces subjects to learn this more quickly, particularly in the Simple setting. We discuss this interpretation further in the final section of the paper.

### 3.4. Regression Results

The nonparametric statistics provide support for Hypotheses 1 and 2, in the initial rounds, no support for Hypothesis 3, and contrary evidence for Hypothesis 4. In this section, we check the robustness of these conclusions after controlling for demographic differences. We also seek to understand which types of individuals are most error-prone. Because we have six investment decisions for each subject, we can also control for learning effects.

We estimate separate models for Error and ChoseZ (defined in Section 3.1) using a random effects Probit model, accounting for individual specific heterogeneity by clustering standard errors at the subject level. Explanatory variables include experimental variables, standard demographics, and financial knowledge variables. The experimental variables include a non-linear time trend (1/Round), which allows learning to be greatest in the earlier rounds, and indicator variables for the main treatments (Simple, Unearned). Standard demographics include gender, age, education (an indicator of having completed a tertiary qualification), and whether the participant is an Economics or Business major. To measure financial knowledge we include measures of whether a subject was Australian born, is currently employed, and whether or not a student is renting their accommodation (as compared to living at home) as these may be proxies for knowledge and experience about financial matters. Finally, we include an indicator of whether or not the subject made an error in answering our three financial literacy questions.

Our results are reported in Table 5, with two separate models estimated for both Error and ChoseZ. The results show that the probability of an error decreases as subjects gain experience and being in the Simple treatments, consistent with our earlier results. Likewise, the source of the investment money does not affect errors. Of the demographic variables, only education significantly affects errors, with those who have completed a tertiary qualification less error prone. In addition, employed students made fewer errors, possibly reflecting greater experience with financial matters.[11] We also estimated models of Default choices but as the results are very similar to Error, we do not report these to conserve space. The only difference is that older subjects were significantly more likely to choose the default option, while employment status has no significant impact on default choices.

Results for ChoseZ, reported in columns 3 and 4 of Table 5, also support our earlier conclusions, with Account Z chosen less frequently with Unearned money and more frequently over time, while complexity has no effect. Men are more likely to choose Account Z compared to female subjects, as are those studying business or economics. These regression results therefore concur with the earlier univariate tests in supporting Hypothesis 1 and Hypothesis 2, no evidence for Hypothesis 3, and contrary evidence for Hypothesis 4.

Including additional explanatory variables, none of which were significant, does not alter any of these conclusions. Finally, we also ran regressions excluding decisions from Round 1 in order to exclude learning about the interface as a confounding factor. As the results are very similar to those reported in Table 5 we do not report them here.

[11] At the very least, employed students would have some exposure to retirement decisions as Australia has compulsory employer contributions to retirement savings.

## 4. External validity

### 4.1. Motivation and overview

It is common to use student subjects in experiments nevertheless a common criticism is that students are not representative of the general population limiting the external validity of laboratory findings (Harrison and List, 2004). While most studies involving non-student subjects find little difference (see Frechette, 2011 for a review), in the area of retirement savings such differences might matter. Student subjects may not only have given little thought to retirement decisions, they will also have limited experience in making serious financial decisions in general (e.g. mortgage financing to purchase property).

To test the external validity of (some of) our results we ran additional sessions with worker subjects, i.e. we conduct an artefactual field experiment according to Harrison and List's (2004) classification. Using personal contacts, followed up by emails, we recruited 71 worker subjects from a range of industries with the most common being research and scientific services (30%), education and training (21%), and government agencies (13%). The majority of the participants were in either professional or management occupations (63%) or administration and clerical positions (20%).

Because of the logistics involved, we focused our efforts on the two Complex treatments and studied whether workers make as many errors (and default choices) in complex environments as students do, and on the distribution of account choices. Thirty-five worker subjects participated in Complex-Unearned, while 36 worker subjects participated in Complex-Earned, with two sessions held for each treatment.[12] The experiments are identical to those involving students, except for using a higher take-home money conversion rate for workers, to account for greater opportunity costs and enhance the saliency of the payoffs for workers. Specifically, workers receive A$1 for every $E7000 they earn in the experiment, compared to students who had a rate of $E10,000 per A$1. Earnings were $50.22 on average, and ranged from $30.55 to $61.77.[13]

The characteristics of our two subject pools, students and workers, are compared in Table 6, with the final column reporting the *p*-Value from a Wilcoxon test of differences. Unsurprisingly, students are younger, exhibited less variation in age, and were less likely to have completed an advanced qualification, than workers were. Students are also less experienced with financial matters, with none having a mortgage compared to one-third of workers (indeed nearly one-half of students were living at home rent-free), and only one-third of students currently have a retirement savings account compared to nearly all workers. The two subject pools thus exhibit significant differences in financial experience. More than one-half of student subjects were male (60%) compared with

[12] All sessions were held at the University of Queensland's Experimental Economics Laboratory. Workers participated in different sessions than students. To encourage participation and reduce issues with randomization of subjects, we held two sessions for each worker treatment compared with only one for each treatment for student subjects. It is easier to randomize students from different disciplines, but more difficult to randomize workers as they may participate with colleagues from the same occupation and industry.

[13] Unlike the student subject pool, two of the 36 worker subjects in Complex-Earned failed to reach the target of 30 words in the encryption task and therefore only received $E3500 each period to invest rather than $E5000. The average, minimum and maximum number of encoded words for the encryption task was 40, 27, and 62, respectively.

**Table 5**
Probit regressions.

| | Error rate | | Account Z choice[d] | |
|---|---|---|---|---|
| | Model 1 | Model 2 | Model 1 | Model 2 |
| 1/Round | 1.67 (0.21)[c] | 1.68 (0.21)[c] | −0.84 (0.23)[c] | −0.85 (0.23)[c] |
| Simple | −0.85 (0.19)[c] | −0.84 (0.19)[c] | 0.11 (0.21) | 0.14 (0.20) |
| Unearned | 0.10 (0.18) | 0.07 (0.19) | −0.34 (0.21) | −0.42 (0.20)[b] |
| Male | | 0.01 (0.19) | | 0.64 (0.21)[c] |
| Age | | 0.03 (0.03) | | 0.06 (0.05) |
| Australian born | | −0.01 (0.20) | | 0.30 (0.22) |
| Higher ed. (completed) | | −0.71 (0.22)[c] | | −0.01 (0.26) |
| Renting accommodation | | − 0.34 (0.21) | | 0.32 (0.24) |
| Economics or business | | 0.18 (0.18) | | 0.45 (0.20)[b] |
| Employed | | −0.47 (0.19)[b] | | 0.07 (0.21) |
| Error in fin. literacy | | 0.31 (0.24) | | −0.10 (0.24) |
| Constant | −0.85 (0.17)[c] | −1.07 (0.62)[a] | 0.10 (0.21) | −1.84 (0.94)[b] |
| Number of observations | 720 | 720 | 621 | 621 |

*Notes:* Probit model with random effects and standard errors clustered at the individual level. Standard errors in parentheses.
[a] Indicates statistical significance at 10%.
[b] Indicates statistical significance at 5%.
[c] Indicates statistical significance at 1%.
[d] Active choices only (excludes default choice).

**Table 6**
Characteristics of students versusworkers.

| Variable | Description | Students | Workers |
|---|---|---|---|
| Male | Indicator | 0.60 (0.49) | 0.37 (0.49) [a] |
| Age | Years | 19.30 (2.59) | 29.92 (7.10) [a] |
| Australian | Born in Australia | 0.45 (0.50) | 0.49 (0.50) |
| Asian | Born in Asia | 0.40 (0.49) | 0.23 (0.42) [a] |
| Live long | Expat for 10+ years | 0.12 (0.33) | 0.28 (0.45) |
| Live short | Expat for <1 year | 0.33 (0.48) | 0.19 (0.40) |
| Renting | Renting accommodation | 0.53 (0.50) | 0.63 (0.49) |
| Property owner | Have mortgage or own outright | 0 | 0.32 (0.47)[a] |
| Undergraduate | Completed undergraduate degree | 0.10 (0.30) | 0.30 (0.46)[a] |
| Postgraduate | Completed postgraduate degree | 0.03 (0.18) | 0.49 (0.50)[a] |
| Retirement account | Has a retirement savings account | 0.38 (0.49) | 0.89 (0.32)[a] |
| Quiz error | Indicator | 0.08 (0.28) | 0.14 (0.35) |
| Financial literacy error | Indicator | 0.17 (0.38) | 0.44 (0.50)[a] |

*Notes:* Students only include subjects in complex treatments. Standard errors in parentheses. ∗ Indicates statistical significance at 10%.
[a] indicates statistical significance at 5% using a Wilcoxon (Mann–Whitney) test of difference.

only one-third of workers (37%). While around half of participants were locally born in both subject pools, worker subjects were more ethnically diverse.

### 4.2. Comparing student and worker choices

Table 7 summarizes worker errors in the two treatments, with the final column showing student errors in the complex treatments for ease of comparison. Across both treatments, worker subjects correctly chose the lowest fee company 49% of the time, the second highest fee company 19% of the time and the highest fee company 17% of the time. They remained in the default account 15% of the time. While workers make more errors than students do in all except one round, the difference is only significant in round 6 (20% students versus 34% workers, $p = 0.08$). On the other hand, workers tend to make fewer default choices, but not significantly so. Workers also exhibit the same learning pattern, making significantly fewer errors in the last round (34%) than the first (82%, $p < 0.01$, Wilcoxon matched pairs signed ranks test) as well as fewer default choices (1% versus 47%; $p < 0.01$, Wilcoxon matched pairs signed ranks test).

Average account choices of workers are summarized in Table 8, again with the comparison with students in the final column. As with students, Account Z was the most popular choice, 37% of the time, followed by Account Y, 35% of the time and Account X, 29%. The choices of workers and students are very similar, and indeed, there is no significant difference either in aggregate or in any period. In addition, as with students, the proportion of Account Z choices significantly increased over the six rounds only in Complex-Earned ($p = 0.01$, Wilcoxon matched pairs signed ranks test) and not in Complex-Unearned ($p = 0.16$, Wilcoxon matched pairs signed ranks test)

Only Hypotheses 3 and 4 can be tested for workers, and the results for workers concur with those for students. The source of the money does not significantly affect either worker error rates (48% versus 54%, $p$-Value= 0.18) or default choices (14% versus 16%, $p$-Value= 0.58).[14] Similarly, the source of the money has no impact on worker account choices with Account Z chosen 35% of the time in Complex-Earned compared to 38% in Complex-Unearned ($p = 0.49$). There is also no difference in any round. This is consistent with student results in the Complex treatments.

Thus, despite differences in characteristics, and in particular, student inexperience with serious financial issues in general and specifically with retirement savings, our main conclusions are robust to the choice of subject pool. Life experience alone is

[14] There is a single exception: in round 3 errors were significantly higher ($p$-Value= 0.03) with Earned money (67%) than with Unearned money (40%). Default choices however were not different (8% versus 20%, $p$-Value= 0.16) in this round.

**Table 7**
Aggregate error rates of workers.

| Type of error | All Complex | Complex Unearned | Complex Earned | Complex Unearned | Complex Earned |
|---|---|---|---|---|---|
| | Workers | Workers | Workers | Students | Students |
| No error (lowest fee) | 49% | 52% | 46% | 56% | 52% |
| Second lowest fee | 19% | 16% | 22% | 12% | 14% |
| Highest fee | 17% | 17% | 16% | 12% | 15% |
| Default error | 15% | 14% | 16% | 19% | 18% |

**Table 8**
Average account choices of workers.

| Account choice | All Complex Workers | Complex Unearned Workers | Complex Earned Workers | Complex Students |
|---|---|---|---|---|
| Account X | 29% | 24% | 34% | 25% |
| Account Y | 35% | 38% | 31% | 36% |
| Account Z | 37% | 38% | 35% | 40% |

*Notes:* Active choices only (excludes default choice).

insufficient to improve complex financial decisions. Simply having a retirement savings account, typically a passive choice because of compulsory employer contributions in Australia, or experience with mortgages does not improve decision making in this complex environment.

## 5. Discussion

The main result in our paper is that complexity leads to errors in retirement investment decisions. Importantly, these errors are biased towards the default option. It is important to note that the degree of complexity in the experiment is much less than in the real world, nevertheless errors occurred despite training and detailed instructions. While participants did learn over time, there are two points to make. First, not everyone learns, and even in the final round, a reasonable number of people are still making mistakes. Second, learning from repeated experience (at least, not over long periods of time) is not readily available in the retirement context in reality, although retirement funds often make available different simulators/calculators for different accounts. Our results suggest that this type of learning/training is more important than improving general financial literacy or experience with other financial matters.

The most obvious policy implication of our results is for regulators to encourage simplifying retirement investment decisions - especially the fee structure as this can significantly help investors. Additionally the default options are especially important in complex environments hence design of the defaults might require special attention. Indeed there is growing policy moves toward nudges via default choice architecture (Thaler and Sunstein, 2009). However, these moves should be treated with caution, as they may further encourage passive management of funds (see Caplin and Martin, 2012; Carlin, Gervais and Manso, 2013).

Our results have important implications for economic theory as well as policy. Most economic models disregard complexity as a variable that might affect decisions. A model that incorporates our insights would for example have a complexity parameter that increases random errors as well as creating a bias towards the more salient default option.

We are aware of the limitations of our experiment when it comes to generalizing the results to real markets although we take a step in this direction by showing that the subject pool did not matter. An interesting extension to address this limitation would be conducting a similar experiment in the field for example collaborating with a private retirement fund.

## Appendix. Experimental instructions

*Instructions*

[These instructions are for the Complex-Earned treatment, with appropriate adjustments necessary for the other treatments. The instructions are identical for Workers except a higher exchange rate was used: $E7000 = $A1.]

*Welcome instructions*. Welcome to our experimental session on decision-making. The experiment will take about 1 h 30 min. Follow the instructions carefully and you can earn a considerable amount of money for your time and participation. All the money you earn is yours to keep and will be paid to you in private and in cash immediately after the experiment. If you decide to leave early, you will forgo your earnings, except for a $5 participation fee.

You will earn experimental dollars ($E) during today's experiment, which at the end of the experiment will be converted to Australian dollars ($A). For every $E10,000 you earn during the experiment, you will be paid $A1. You will participate in a number of tasks and they will be explained to you before you begin each task. Your actions will not be observed by other participants and decisions made by others will not affect your earnings in any way.

If you have any questions during the experiment, please raise your hand. Please do not consult with other participants in this room. All decisions that you make today are recorded only by an anonymous subject number and will only be used for research purposes. Your decisions will remain completely anonymous.

You are allowed to use a calculator and the blank paper to assist you during the experiment. Please turn your phone off or to silent mode now. Do not touch or read any material unless directed. Are there any questions before we begin?

You will need to answer some questions before we begin Task 1. You have five minutes and you can use a calculator.

*Task 1 Instructions [Earned money treatments only]*

You are required to complete an encryption task. Your success at this task will determine the amount of money you will have for the next task. You will be presented with a number of words and your task will be to encode these words by substituting the letters of the alphabet with numbers using an encryption table. The table will be displayed on the screen and is shown in Table 9 on the next page.

Example 1: You are given the word PLANT. The letters in Table 9 show that P = 16, L = 3, A = 8, N = 1 and T = 19 .

The amount of money you have available for the next task will depend on your achievement level in this task. There are

**Table 9**

| Letters | Numbers |
|---|---|
| **A** | **8** |
| **B** | **12** |
| **C** | **14** |
| **D** | **10** |
| **E** | **9** |
| **F** | **6** |
| **G** | **24** |
| **H** | **22** |
| **I** | **7** |
| **J** | **5** |
| **K** | **11** |
| **L** | **3** |
| **M** | **18** |
| **N** | **1** |
| **O** | **21** |
| **P** | **16** |
| **Q** | **23** |
| **R** | **2** |
| **S** | **13** |
| **T** | **19** |
| **U** | **25** |
| **V** | **4** |
| **W** | **26** |
| **X** | **17** |
| **Y** | **20** |
| **Z** | **15** |

three achievement levels. If you encode 0–15 words, you will earn $E2000 per year for 30 years for the next task (more details are given in the next task). If you encode 16–29 words, you will earn $E3500 per year for 30 years for the next task. If you encode 30 or more words, you will earn $E5000 per year for 30 years for the next task. Once you encode a word correctly, you will be given another word to encode. You will have 10 minutes (600 s) for this task.

All participants will encode the words in the same order. The more words you can encode, the more money you will earn for the next task and the more money you will take away from this experiment.

Please turn your attention to the screen now. Some tips are displayed to help you with this task. You can use the TAB key on the keyboard to switch to the next box quickly. After completing the encoded word, press "OK" button to verify the code. When you insert an incorrect code, you will be asked to correct your mistake before you move on. Please raise your hand if there are any questions. We will now begin Task 1.

*Task 2 Instructions [Complex treatments]*

Based on your achievement in the previous task, you have received $E5000, which will be placed into a financial account for each year of the 30 years in Task 2. During Task 2 you will be making one financial decision in each round. There are six rounds in Task 2. No-one else will make further contributions. There are no taxes and all earnings are reinvested into your account.

Your earnings in each round will depend on your decision and on chance. Each round is independent. This means that what you earn in one round is NOT affected by what you chose or earned in any previous rounds. Your earnings will NOT accumulate over the six rounds. Instead, at the end of the entire experiment, one of these six rounds will be randomly chosen and you will be paid your earnings from that round only. To choose the round for your payment, we will roll a (six-sided) dice, making each round equally likely to be chosen.

The amount you contribute is fixed (and equal to what you earned in the previous task) but you can decide which account to place the money in. There are 3 companies and each company offers 3 different accounts – X, Y and Z. Each account provides an annual return (more details in the next section). You will choose one account in each round and your money will accumulate in that chosen account over 30 years. You can imagine this is like choosing an account today and not changing it for the next 30 years.

**Please note that ALL the values in these instructions are ONLY examples and are NOT the same in the actual task.**

The first screen you see displays the fees and return intervals for each available account offered by the companies. You are initially assigned to the Default Account. A sample screen is given in Fig. 6. You have 2 min and 30 s in each round to select one account. You must press OK when you have made your choice.

You will remain in the Default Account when no choices are made after 2 min and 30 s. Alternatively, you can press OK if you choose to remain in the Default Account. In Fig. 1, the Default Account offers the same return interval as Account X and charges a single weekly administration fee of $27.10. You still have to wait for other participants to make a decision before the next screen appears.

*Returns.* The annual return for each account will vary each year, but will never be higher or lower than the indicated intervals. There is an equal chance of any return within the interval occurring. In Fig. 7, for example, the return for Account X and the Default Account will range from 5.82% to 6.85% in each year.

*Fee structure.* The companies charge different fees and the fees can vary in each round. The amount of fee you pay will play a role in determining your earnings over the 30 years. All the numerical examples in this section are shown in Fig. 8. There are two types of fee and one rebate for each account:

The first fee is an annual contribution fee. This charges a percentage of the amount that is contributed into your account each year. For example, if your contribution amount is $4000 and company 1 charges a contribution fee of 32.69% for Account X, then the annual contribution fee is $4000 $\times$ 0.3269 = $1307.60. Choosing company 1 means you will pay an annual contribution fee of $1307.60 each year.

The second fee is a weekly administration fee. You can assume there are exactly 52 weeks in each year. For example, if company 1 charges a weekly administration fee of $15.86 for Account X, then the annual administration fee is $15.86$*$52 = $824.72 each year.

Lastly, each account will include a rebate. This reduces the total fee you pay. For example, if company 1 offers an annual rebate of $1432 for Account X and when the contribution and administration fee costs $2132.32 ($1307.60+$824.72), then you will only pay $2132.32−$1432 = $700.32 in total fees each year.

*Breakdown of the returns.* Once all participants have chosen an account, the second screen will show the breakdown of your actual returns in each year over the 30 years for your chosen account. Fig. 9 shows that Account X was chosen. You will notice that the annual return varies, but only within the specified intervals in Fig. 4. You have 45 s to observe the values on this screen.

*Summary.* The third (final) screen shows your earnings for each round as illustrated in Fig 10. The second column shows which account you have chosen and the third column shows the total fees over 30 years. Columns 4–6 show the lowest, highest and average returns respectively. The last column shows your total earnings over the 30 years after accounting for fees. You have 45 s to observe the values on this screen.

You will make these decisions for six rounds. The fees and returns for each account can change in each round.

ALL the values shown in these instructions are different in the actual experiment.

| Account Types | Lowest Return | Highest Return |
|---|---|---|
| Account X<br>Default Account | 5.82% | 6.85% |
| Account Y | 3.45% | 8.53% |
| Account Z | 1.13% | 11.49% |

**Fig. 7.** Returns.

| | Account X | Account Y | Account Z |
|---|---|---|---|
| Company 1 | Contribution Fee 32.69%<br>Administration Fee $15.86<br>Rebate $1432 | Contribution fee 28.32%<br>Administration Fee $13.96<br>Rebate $1506 | Contribution fee 32.08%<br>Administration Fee $17.83<br>Rebate $1476 |
| Company 2 | Contribution Fee 32.08%<br>Administration Fee $13.76<br>Rebate $1178 | Contribution Fee 33.83%<br>Administration Fee $10.98<br>Rebate $1308 | Contribution Fee 37.89%<br>Administration Fee $13.45<br>Rebate $1423 |
| Company 3 | Contribution Fee 29.83%<br>Administration Fee $19.06<br>Rebate $1089 | Contribution Fee 24.20%<br>Administration Fee $20.06<br>Rebate $1259 | Contribution Fee 34.82%<br>Administration Fee $24.84<br>Rebate $1324 |

**Fig. 8.** Fees.

You have selected Account X
This table shows you the returns that actually occurred in each year

| Year | Return | Year | Return | Year | Return |
|---|---|---|---|---|---|
| 1 | 5.99% | 11 | 6.22% | 21 | 6.49% |
| 2 | 6.07% | 12 | 6.26% | 22 | 6.21% |
| 3 | 6.29% | 13 | 5.97% | 23 | 6.54% |
| 4 | 6.85% | 14 | 5.96% | 24 | 6.03% |
| 5 | 6.06% | 15 | 6.04% | 25 | 5.95% |
| 6 | 6.65% | 16 | 6.35% | 26 | 6.40% |
| 7 | 6.54% | 17 | 5.99% | 27 | 6.75% |
| 8 | 6.84% | 18 | 6.53% | 28 | 6.80% |
| 9 | 5.85% | 19 | 6.00% | 29 | 6.64% |
| 10 | 6.12% | 20 | 6.56% | 30 | 6.66% |

**Fig. 9.** Feedback.

| Round | Your Account | Total Fee over 30 years | Lowest Return | Highest Return | Average Return | Your Earnings |
|---|---|---|---|---|---|---|
| 1 | X | $21,010 | 5.85% | 6.85% | 6.32% | $295,431 |

**Fig. 10.** Feedback.

Note that you have earned the contribution amount from completing the encryption task. Remember, there are no taxes involved and all returns are reinvested into your financial account. For every $E10,000 earned during this experiment, you will take away $A1. Lastly, you will only be paid for one round which will be randomly chosen at the end of the experiment. Are there any questions before we begin Task 2?

Before we begin, you will need to answer some questions to check your understanding of these instructions.

*Financial literacy questionnaire*

1. Suppose there is a 15% probability of catching the flu in any given year. Out of the group of 1500 people, how many would you expect to catch the flu in each year?
   (a) 144
   (b) 150
   (c) 15
   (d) 225
   (e) Don't know
2. Suppose you have $1200 in a savings account that offers 13% interest per year. How much will you have in your account at the end of the 1 year, assuming interest is paid annually (assume there are no taxes or other costs).
   (a) $1254
   (b) $1224
   (c) $1356
   (d) $1452
   (e) Don't know
3. Suppose the Reserve Bank of Australia (central bank of Australia) increased the interest rate by 0.25 basis points today. Suppose you have a mortgage with a fixed interest rate. What is the most likely scenario?
   (a) Nothing changes. My mortgage is not with the central bank.
   (b) Nothing changes. My mortgage is with a different bank and they are not changing interest rates.
   (c) I will be paying higher mortgage repayment because my bank will increase the interest rate.
   (d) My mortgage repayments do not change because I have fixed interest rate.
   (e) I will be paying lower mortgage repayment because my bank will decrease the interest rate.

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