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DINA **TASNEEM**
AUDREY **AZEROT**
MARINE **DE MONTAIGNAC**
JIM **ENGLE-WARNICK**

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Nudge vs. Financial Literacy in a Retirement Savings Laboratory Experiment[*]

Dina Tasneem[†], *Audrey Azerot*[‡], *Marine de Montaignac*[§], *Jim Engle-Warnick*[**]

Résumé/Abstract

We report results from an economics experiment that examines the role of financial literacy in retirement savings. In the experiments, participants make decisions in a retirement savings game, in which income during working years is uncertain. Participants are nudged to varying degrees with automatic savings in each period of the game. Some participants receive financial literacy training in the form of training to compute the expected savings needed at retirement to smooth consumption over the entire life cycle. We find evidence that literacy increases savings and improves efficiency. Our finding has implications for choice architecture for retirement savings.

Mots clés/Keywords: Precautionary Savings; Retirement Savings; Life-cycle Model; Dynamic Optimization; Nudge; Financial Literacy; Decision Heuristics

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[†] American University of Sharjah.
[‡] McGill University.
[§] CIRANO.
[**] McGill University and CIRANO.

1 Introduction

The increased access to financial markets and conversion to defined contribution pension plans have put more responsibility for decision-making into the hands of savers. This responsibility can be addressed in at least three ways: getting advice, being nudged, or getting more financially literate.

The financial advice industry has grown substantially since 1980, with questions surrounding the performance of advice (Malkiel, 2013) and the extent to which advice is consistent with client heterogeneity (Foerster, Linnainmaa, Melzer, and Previtero, 2017). Nudge (Thaler), or the attention to Òchoice architectureÓ, is a method for policy makers to structure the decision-making environment so that increasing savings is made easy, given known and predictable biases of decision-makers. Financial literacy, on the other hand, is more related to autonomous or informed decision-making. Financial literacy is important not just for independent decision-making, but also for evaluating advice and being aware of and responding to nudges, thus in a sense it encompasses issues surrounding savings and investment decisions.

In this paper we address the effect of literacy training on savings decisions in a laboratory experiment. Studying the path from literacy training to decision-making in real life is difficult in the field for several reasons (Lusardi and Mitchell, 2014). For one, literacy is an investment in human capital, which means that not everyone should invest, and that not everyone who should invest should ultimately take an action based on the training. For another, it is unclear how financial literacy is developed. The quality of training can be difficult to assess, short term interventions must be targeted to specific needs, and it seems unlikely that short-term training would have identifiable long-term benefits.

We overcome several of these problems with a laboratory experiment, in which we present a game with only precautionary and retirement savings motives. We identify a salient need for literacy: the computation of the expected amount of money needed at retirement age to smooth consumption over the life cycle. Our participants are heads of households likely to be in the savings accumulation stage in real life. We nudge them with and without financial literacy, and we test the effect of literacy training on their behavioural responses to the nudge.

Our experiment consists of two basic games. In the first game, participants make decisions in a twenty-period game. In each period there is a constant and independent 50/50 chance of earning either a high or a low income. Participants choose how much to consume and how much to spend. The consumption is turned into points through a CRRA utility function inducing the motive to smooth. Thus, the savings motive in this game is precautionary.

In the second game we add five periods at the end of the game with no income and call this the retirement period. Everything else is the same in this twenty-five period game. Thus, the savings motive in this game is both precautionary and retirement. The difference between the two games is retirement savings.

For the nudge treatments, we automatically place 0

For the literacy treatments, we run both the nudges and a financial literacy training module before the savings game. The training module explains how to compute, in expectation, the amount of funds needed for retirement to smooth consumption across all twenty-five periods of the retirement savings game. The module takes the participant step-by-step through the process of computation, and requires correct answers from multiple choice questions before continuing to the next step.

Our precautionary savings game is similar to Ballinger, Palumbo and Wilcox (2003) and Ballinger, Hudson, Karkovlata and Wilcox (2011) who reported results from social learning and cognitive ability on the precautionary game respectively. More broadly, Hey and Dardanoni (1988), Carbone and Hey (2004) and Carbone (2006) document heterogeneity in behavior in savings games. Taking a step back from the precautionary model, Carbone and Duffy (2014) report results from a deterministic life-cycle consumption optimization problem, and Zhikang, Chua and Camerer (2009) test for explanations for under-saving in life-cycle models. Our experiment adds the retirement savings motive to the precautionary game. We are not aware of an experiment that tests Nudge in this environment, nor of one that tests the effect of literacy training.

We find thatÉ

2 Experimental Design

2.1 The Model

The model, similar to the model in the experimental study of Ballinger et al. (2003), presents to the subjects a finite time forward looking intertemporal consumption problem with an uncertain income in each period and an incentive to smooth consumption. There are no bequests, there is no investment motive, and the agents face a strict borrowing constraint (Browning and Lusardi (1996)). We induce preferences with a CRRA utility function, and assume that preferences are additively separable over time. Agents discount the future at a constant rate. We present two different decision problems: a precautionary savings problem and a retirement savings problem.

In the 20-period precautionary savings problem, let the income stream be given by $y = (y_1, y_2, ...y_{20})$, where each y_t = \$3 or \$9 with equal probability. The decision in each period is simply how much money to save and how much to use for consumption, where the precautionary savings motive is induced by an incentive to smooth consumption over the lifespan. For simplicity the agent cannot borrow and does not earn interest on savings. In the retirement savings problem, all parameters are identical and an additional five periods corresponding to retirement are added such that $y_{21} = y_{22} = ... = y_{25} = \$0$.

Following Ballinger et al. (2003) notation let us denote the instantaneous utility of consumption in period t by $u(c_t)$, the accumulated asset at the beginning of period t by

A_t and the uncertain labour income realized at the beginning of each period by y_t. Utility is discounted at a constant rate β. During the T period life cycle the agent's objective is to choose c_s at each period $s = 1, 2, 3, ..., T$ to maximize the expected sum of discounted utility :

$$E_s \sum_{t=s}^{T} \beta^{(t-s)} u(c_t)$$

subject to the intertemporal budget constraint

$$A_{t+1} = A_t + y_t - c_t$$

where

$$A_t \geq 0 \; \forall t.$$

Utility in period t is given by a CRRA utility function, where the convex marginal utility along with a strict borrowing constraint, creates a precautionary savings motive:

$$u(c_t) = k + \theta \frac{(c_t + \epsilon)^{(1-\sigma)}}{1 - \sigma}.$$

As in Ballinger et al. (2003) the utility function has several parameters: ϵ is a flow of consumption that is independent of c_t, σ is the coefficient of relative risk aversion, and k and θ are scaling parameters. Note also that we multiplied the entire utility function by an exchange rate of 0.16 to scale the experimental cash earnings in currency.

In our finite horizon model, the optimal consumption rule is a function of "cash-in-hand", $X_t = A_t + y_t$, and time, which can be denoted by $c^*(X_t, t, T)$.[1] In fact, the relationship between consumption and cash-in-hand is not a constant fraction in any certain period. Roughly speaking, if the amount of cash-in-hand goes below a critical value the consumer should spend everything, and the marginal propensity to save is increasing in cash in-hand (Deaton (1992)). We cannot solve the model analytically. Therefore we derive the optimal policy by solving the problem numerically using the backward recursion method that starts

[1] When the horizon is infinite the optimal consumption rule is a function of cash-in-hand (Deaton (1992)).

with finding c_T^*, given the terminal value function. Following that step, c_t^* for t = T-1: -1 :1 are derived successively in backward recursive steps (Miranda and Fackler (2002)).

2.2 Behavioral Hypotheses

3 Experimental Procedures

In the experiments, at the beginning of each period, subjects earned either a high income of \$9 or a low income of \$3 with equal probability, constant and independent of the previous period.[2] In the implementation of the decision problem called "precautionary treatment", an agent earns an income for exactly 20 periods. The income, which is realized at the beginning of each period, is either high or low with equal probability. Subjects earn "experimental dollars" in income, which they either spend or save. The experimental dollars they spend are transformed into consumption by the utility function, which determines their cash payment at the end of the session. We chose the same relative risk aversion parameter as in Ballinger et al. (2003), $\sigma = 3$. Thus there exists a precautionary savings motive. Also we assume no discounting of utility over time and set $\beta = 1$.

In the extension of the decision problem called "retirement treatment", after 20 periods of the same uncertain income distribution, the agent then experiences exactly 5 periods with no income. These final 5 periods create a retirement savings motive. Table 1 summarizes the experimental treatments.

Each period of the decision task, subjects realized their period income, which was immediately added to their cash-in-hand, and then decided how much money to spend on consumption. Any cash left became cash-in-hand and was carried over to the next period. Subjects spent "experimental cash", but were rewarded with real cash for their consumption after transforming their spending into a reward through the CRRA utility function. This

[2] By $\$X$ we mean X experimental dollar.

Table 1: Experimental Parameters

Treatment	k	θ	ϵ	σ	Income	Pr of low Income	Starting C-In-H	Retirement Period	T
Precautionary	10.105	476.19	2.7	3	3 or 9	0.5	6	0	20
Retirement	10.105	476.19	2.7	3	3 or 9	0.5	6	5	25

transformation from spending to consumption induces the motive for consumption smoothing.[3]

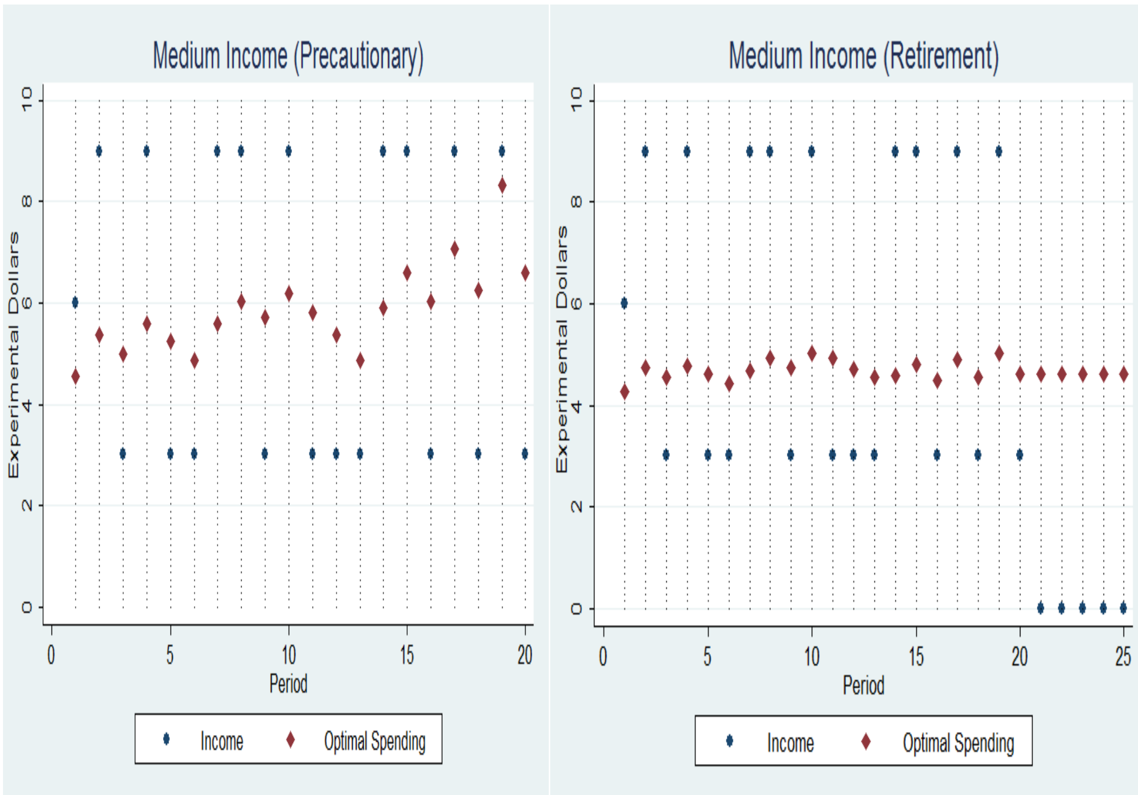
We drew the income streams before the experiment and presented identical draws to all subjects. Since it is well known that subjects form non-standard beliefs about random process (Kahneman and Tversky (1974)), the particular draws we presented to the subjects could influence decision-making in their own unique ways, thus we describe them here. One income sequence resulted in a majority of high income draws in the first ten periods, one resulted in a majority of low income draws in the first ten periods, and one resulted in a representative number of high and low draws in the first ten periods.

Figure 1 shows the income stream. The left-hand panel of the figure shows the precautionary savings treatment and the right-hand panel displays the retirement savings treatment. The circles represent the actual income draws in experimental dollars (either \$9 or \$3) and the diamonds in the middle show the optimal spending choice. Notice that the initial endowment is the average of the income draws, \$6, and that six of the first seven income draws were high. The figure shows both the draws and the degree to which optimal decision-making smooths consumption.

The two panels of Figure 1 demonstrate that the income histories are identical across the two experimental treatments. Spending is lower in retirement treatment as agents are forced to save for retirement. Notice that when retirement savings is an issue spending is

[3] A binary lottery mechanism exists to reward subjects to control for risk preferences, see Ballinger et al. (2003) for an example. For simplicity of understanding the experiment we did not employ this mechanism.

Figure 1: Income and Optimal Choice History for Medium Income Draw



actually smoother across the total lifetime. Also notice that optimal retirement spending is mechanical at the end of a finite life, spending one-fifth of the cash-in-hand available at period 21 across the final five periods.

We used a savings game to analyse the effect of financial literacy on savings decisions. The experiment took place in our laboratory, located in Montreal, QC. Among the 160 players, 51.2% were male and 48.8% were female. Their age ranged from 19 to 66, with an average of 33. In this game, 160 participants were asked to save and smooth their consumption over multiple rounds to maximize a score representing their utility. The final score determined the monetary compensation of each participant. Thus, there was a clear

incentive for players to play in the most effective way possible. Participants made savings decisions with a slider: more was saved if the slider was moved to the left; more was consumed if it was moved to the right. The utility from consuming was represented by a score that appeared on the screen of all participants. It adjusted as the player moved the slider and increased along with the consumption level. The income received by players was fixed at
6*inthefirstperiodofthegame.Inthesubsequentperiods, itcouldbe*\$3*or*\$9*withequalprobability.Assuch, aplay*
periodpracticeroundwasplayedbyparticipants.W ithaninitialincomeof \$12, *theyhadtochoosehowmuchtosa*
*maximizingchoiceswererevealed.Itconsistedofsaving*6 and consuming 6*inthefirstround, andconsuming*
in the second round. The remaining 93 subjects were used as a control group to assess the role played by the treatment.

The nudges To evaluate the result of the literacy treatment, we nudged participants into saving too much or too little relative to the optimal savings rate. Nudging consists in encouraging certain behaviours in an individual through implicit suggestion. In our case, we encouraged subjects to save a certain amount of their wealth using the initial position of the slider. The players were confronted to a single nudge throughout the whole experiment. We used four nudges: 0% (a neutral nudge), 10%, 20% and 30%.

4 Experimental Results

5 Conclusion

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