The Absentminded Consumer

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March 2003 (Preliminary)

Abstract

We present a model of an absentminded consumer who does not keep constant track of his spending. The model generates a form of precautionary consumption, in which absentminded agents tend to consume more than attentive agents. We show that wealthy agents are more likely to be absentminded, whereas young and retired agents are more likely to pay attenition. The model presents new explanations for a relationship between spending and credit card use and for the decline in consumption at retirement.

Key Words:
JEL Classification:

1 Introduction

Do you know how much you spent last month, and what you spent it on? It is only if you answer this question in the affirmative that the classical life-cycle model of consumption applies to you. Otherwise, you are to some extent an absent-minded consumer. In this paper we develop a theory that applies to those of us who fall into this category.

The concept of absentmindedness that we employ in our analysis was introduced by Rubinstein and Piccione [1997]. They define absentmindedness as the inability to distinguish between decision nodes that lie along the same branch of a decision tree. By identifying these distinct nodes with different

*We would like to thank Mark Gertler, Per Krusell, and Ricardo Lagos for helpful comments.

levels of spending, we are able to model consumers who are uncertain as to how much they spend in any given period. The effect of this change in model structure is to make it difficult for consumers to equate the marginal utility of consumption with the marginal utility of wealth. We show that this innocent twist in a standard consumption model may not only provide insight into some existing puzzles in the consumption literature, but also shed light on otherwise puzzling results concerning linkages between financial planning and wealth accumulation (Ameriks, Caplin, and Leahy [2003]).

Section 2 presents a static model that provides intuition. In a one period model of labor and consumption choice, absentmindedness induces a form of "precautionary consumption". In precautionary savings models, the convexity of marginal utility implies that future uncertainty raises the expected marginal utility of future consumption and hence the desire to save. In our formulation of absentmindedness a similar phenomenon occurs, only it is current rather than future utility that is uncertain. Agents may be willing to consume more on average in order to ensure that their absentmindedness does not produce damaging under-consumption. In our model, a coefficient of relative risk aversion greater than unity is sufficient for the consumption of the absentminded consumer to exceed on average the consumption of an attentive consumer. Since almost all estimates of the coefficient of relative risk aversion are greater than one, absentmindedness may be associated with increased consumption.

While the static model provides intuition, our chief interest is to study the interaction between absentmindedness and life-cycle consumption. We develop a framework in which the degree of absentmindedness is a choice variable, and show that it varies systematically over the life-cycle. We find that wealthy individuals are more likely to be absentminded, while those who are at the end of their lives or who face liquidity constraints are more likely to monitor. The retired have a particular incentive to monitor, since labor income can no longer be used to insure against the wealth effects of absentmindedness. This gives rise to a U-shaped pattern of attention over the life-cycle. The young attend to consumption because they are relatively poor and face liquidity constraints. The middle aged are absentminded because they are relatively wealthy and can use their labor income to insure against over consumption. The old pay attention because they are retired and face the prospect dwindling funds. This patter of attention gives rise to an inverted U-shaped pattern of consumption relative to permanent income.

Using evidence from a survey of TIAA-CREF participants, we are able to present some preliminary evidence on these comparative statics. We have data on the extent to which these agents set budgets for their spending. As the theory would predict, we find that wealthy households and working household are less likely to budget, whereas young households are more likely to budget.

Beyond these implications for life-cycle consumption, our model relates to several other recent strands of the consumption literature.

- *The decline in consumption at retirement.* It has been noted that many households spend a great deal less after they retire than they did before retirement (Mariger [1987], Banks, Blundel and Tanner [1998], and Bernheim, Skinner and Weinberg [2001]). Our framework predicts just such a decline in consumption. Retirement increases the incentives for careful monitoring of spending and also reduces the costs in terms of time and forgone earnings. The result is greater attention and reduced consumption.

- *The desire to commit resources to future consumption.* The desire to constrain ones actions is the defining characteristic of many self-control problems (e.g. Laibson [1997] or Gul and Pesendorfer [2001]). By assumption, our absentminded consumers do not have a problem of self control. They have, however, problems of control. For this reason, it may be a good idea for them to move resources into illiquid form to prevent themselves from dipping into them by mistake.

- *Credit cards as a source of over-spending.* Our theory opens the door for differences in the form in which one spends to impact the level of spending. In particular, it provides a novel explanation for the association between credit cards and overspending. The amount of cash in one's wallet provides a measure of past spending, as well as a limit on current spending. Credit cards remove this crutch and promote absentmindedness.

- *The link between financial planning and wealth accumulation.* In earlier work (Ameriks, Caplin and Leahy [2003]) we studied the relationship between planning and wealth accumulation. We collected measures of financial planning from a sample of TIAA-CREF participants and used these to establish a causal relationship between planning and net worth. Planners tended to monitor their spending more closely, save more and accumulate greater wealth. Our model provides one framework that may explain these findings.

The paper proceeds as follows. In the next section, we introduce a static model of an absentminded consumer. In section 3, we add dynamics and analyze the incentive to pay attention. In Section 4, we discuss our evidence on budgeting. Section 5 concludes.

2 Modelling Absentmindedness

Our goal is to model the behavior of consumers who do not always keep track of their spending. We follow Rubenstein and Piccione [1997] and link absentmindedness to an agent's confusion over which decision node he is current at. Their prototypical example is a drive who must turn right after six blocks. If the driver is not paying attention he may lose track as to how many blocks he has driven.

To place the idea in the context of consumption, suppose that consumption opportunities arrive in sequence and are indexed, in order of arrival, by points along the real line. An agent who is absentminded is an agent who may lose track of his exact position along this line. He may have some vague idea of where he currently is, but his current information set includes several or possibly many points.

We can imagine many complex information structures that may capture how the agent's beliefs evolve as he consumes through time. In order to begin to understand the implications of inattention and absentmindedness for consumption, we begin with a particularly simple information structure. We assume in what follows that all of the consumption levels lie in the same information set. We now present the details of the model and describe how an agent makes choices in this environment.

2.1 A One-Period Model

There are two states $\{H, S\}$. H refers to home, and S refers to a street with shops that contain goods for the consumer to purchase. The shopping street S is comprised of a continuum of locations. These locations, which may be called "stores", are indexed by $i \in [0, \infty)$.

The timing of events is as follows. The consumer begins the day at home. He then visits the stores in S sequentially. Upon arriving at a store, he purchases one unit of the product that the store offers for sale then decides whether to proceed to the next store or to return home. Upon arriving at home, the agent receives delivery of all of his purchases and consumes.[1]

We consider two information structures. The first is the standard assumption in economic models. The agent knows where he is and where he has been. Each element $i \in S$ is a separate information set. The agent can therefore condition his shopping strategy on the location i. In the second information structure, all of the locations in S are elements of the same information set. The agent cannot remember any of the stores that he has visited. He immediately forgets each purchase. Only when he returns home does he discover how much he has actually purchased. The important implication of this assumption is that, since the agent cannot differentiate between locations, he cannot condition his strategy on his position on the street. He must follow the same (possibly random) strategy at each location. This makes it impossible to control consumption precisely.

The payoffs are as follows. The price of each goods is λ units of utility. At this point, one should think of this cost as the labor effort that the agent must expend at the end of the day in order to pay for his consumption. We will consider other ways of endogizing λ below, including multi-period settings. The utility from consumption depends on the number of stores that the consumer has visited. Suppose that he visits stores with index $i < c$, then his utility from consumption is $u(c)$, where the function u is weakly increasing and concave. In much of the paper we will consider the special case of constant relative risk aversion

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}.$$

Here σ is the coefficient of relative risk aversion.

2.2 The Optimal Policy with Full Information

If the consumer has full information, then he will continue to shop so long as the marginal benefit of consumption exceeds the marginal cost. He visits all stores with index $i < c^*$ where c^* satisfies:

$$u'(c^*) > \lambda.$$

[1]This timing assumption circumvents the difficult issue of how to determine utility when an agent forgets.

This is basically, the standard model of consumption.

In the case of constant relative risk aversion:

$$(c^*)^{-\sigma} > \lambda$$

or

$$c^* = \lambda^{-\frac{1}{\sigma}}.$$

The level of consumer surplus associated with this policy is:

$$\begin{aligned} U^* &= \frac{c^{*1-\sigma} - 1}{1-\sigma} - \lambda c^* \\ &= \frac{\sigma}{1-\sigma}\lambda^{\frac{\sigma-1}{\sigma}} - \frac{1}{1-\sigma} \end{aligned}$$

2.3 The Optimal Absentminded Policy

What is the optimal policy in the case that the consumer does not keep track of purchases? Rubinstein and Piccione (1997) point out that this is a delicate question with more than one potential answer. For now, we follow a reasonable approach: before the agent leaves home, he chooses a shopping strategy that maximizes expected utility.

Recall that when the consumer is absentminded, he does not know his position in S. Therefore his strategy cannot depend on his location. Clearly, no pure strategy can be optimal: if he chooses always to continue shopping, he will never stop, and, if he chooses always to stop, he will never buy anything. The optimal strategy must therefore be random. Let p denote the rate at which the consumer chooses to quit shopping and return home. This quit rate defines an exponential density of stopping times: pe^{-pc}. Expected utility is simply the average taken with respect to this density.

The quit rate is chosen to the maximize expected surplus:

$$\max_p p \int_0^\infty [u(c) - \lambda c] \, e^{-pc} dc$$

With the assumption of constant relative risk aversion this problem takes a particularly simple form. With constant relative risk aversion we have:

$$\max_p p \int_0^\infty \left[\frac{c^{1-\sigma} - 1}{1-\sigma} - \lambda c \right] e^{-pc} dc$$

We can simplify this integral in two ways. First, note that associated with a policy p is an expected level of consumption $\bar{c}$:

$$\bar{c} = p \int_0^\infty c e^{-pc} dc = \frac{1}{p}$$

Second, we apply a change of variable: $z = pc$. With these two amendments, the maximization problem becomes

$$\max_{\bar{c}} \frac{A\bar{c}^{1-\sigma} - 1}{1-\sigma} - \lambda \bar{c}$$

where $A = \int_0^\infty z^{1-\sigma} e^{-z} dc$.[2] The first order condition for optimal consumption is to set p such that expected consumption $\bar{c}$ satisfies

$$A\bar{c}^{-\sigma} > \lambda.$$

Whether the absentminded consumer consumes more or less than a consumer who keeps track of his consumption depends on the value of A. We can learn something about the value of A by comparing the expected surplus of the absentminded consumer to the surplus of an attentive consumer. An attentive consumer could choose to randomize consumption in a way similar to the absentminded consumer, but because of the strict concavity of utility, he would choose not to. It follows from Jensens inequality that

$$\frac{\bar{c}^{1-\sigma} - 1}{1-\sigma} = u(Ec) > Eu(c) = \frac{A\bar{c}^{1-\sigma} - 1}{1-\sigma}$$

for all $c > 0$. We conclude that

$$A \lesseqgtr 1 \qquad \text{as} \qquad \sigma \lesseqgtr 1.$$

We therefore have the following result

Lemma 1 *There is the following relationship between σ and A:*

[2] For some values of σ, A may equal infinity. This is a technical problem that arrises because there is a chance that the agent will stop immediately and receive almost zero consumption. This is unlikely to happen in practice for several reasons. First, the agent is unlikely to become absent minded immediately upon leaving home. Second, the agent will generally have access to some minimal level of consumption available from family, friends, storage, public welfare, etc.

1. *If* $\sigma \in [0, 1)$ *then* $A < 1$.

2. *If* $\sigma = 1$, *then* $A = 1$.

3. *If* $\sigma > 1$, *then* $A > 1$.

It follows immediately from the lemma that the absentminded consumer consumes more than the knowledgeable consumer if and only if their utility is more risk averse than log utility.

Proposition 2 *There is the following relationship between* c^* *and* $\bar{c}$*:*

Lemma 3 1. *If* $\sigma \in [0, 1)$ *then* $\bar{c} < c^*$.

2. *If* $\sigma = 1$, *then* $\bar{c} = c^*$.

3. *If* $\sigma > 1$, *then* $\bar{c} > c^*$.

There is a simple intuition for this result. An increase in risk aversion σ tends to raise the marginal utility of early consumption units relative to later. The greater the consumer's level of risk aversion, the more the consumer wants to avoid quitting too early. The optimal policy is therefore to reduce the quit rate, which raises the expected level of consumption.

2.4 Discussion

2.4.1 Spending limits

Suppose that the absentminded consumer had access to a technology that would force him to stop spending when consumption reached some level $\hat{c}$. Suppose further that invoking this constraint would cost ϕ units of utility. The maximization problem becomes

$$\max_{p,\hat{c}} p \int_0^{\hat{c}} e^{-pc}[u(c) - \lambda c]dc + e^{-p\hat{c}} [u(\hat{c}) + \lambda \hat{c} - \phi]$$

Our first observation is that the consumer would like to us this technology. The first order condition for $\hat{c}$ sets

$$u'(\hat{c}) = \lambda - p\phi.$$

The agent sets the constraint where the loss in utility from consumption equals the cost of invoking the constraint.

Our second observation is that the presence of a constraint on spending might actually increase average consumption. The reason is that the constraint protects the consumer against overconsumption.

Our third observation is that we normally we associate the desire for constraints with self-control problems. Our absentminded consumer does not have a self control problem, but his inability to precisely control spending makes an external constraint valuable to him.

2.4.2 Credit Cards

Our theory implies a novel explanation for the popular notion that credit cards increase spending. The use of cash is potentially very informative about spending. The amount of cash in one's wallet or purse is a signal as to how much has been spent, and trips to the bank provide an opportunity to check one's account balance. Moreover, an agent will tend to run out of cash before spending excessive amounts. In all of these ways the use of cash promotes attentiveness. Credit cards, on the other hand, remove this crutch. They promote absentmindedness, and thereby increase spending.[3]

3 Adding Dynamics

To this point we have compared absentminded and attentive agents with the same marginal utility of wealth. We have also assumed that the marginal utility of wealth is constant. Clearly, the marginal utility of wealth should not be exogenous to absentmindedness. An absentminded consumer will tend to spend his wealth inefficiently, so that the marginal utility of wealth may fall. Excessive consumption, on the other hand, may reduce wealth and thereby increase the marginal utility.

In this section we build a series of models that illustrate the interactions between absentmindedness and the marginal utility of wealth. Along the way we analyze the incentive to pay attention. This will lead us to a characterization of the life-cycle of absentmindedness.

[3] The role of cash as a substitute for memory is reminiscant of Kocherlakota [1998] analysis of money in a search model.

3.1 The Wealth Effect

In this section we embed our consumer in a continuous time setting and analyze the effect of wealth on the incentive to pay attention.

A consumer is endowed with a given amount of wealth W, which he must allocate toward consumption over $t \in [0, \infty)$. At each instant t, the consumer visits the shopping street S and consumes an (infinitessimal) amount c_t according to the static model of the last section. The agent has a constant relative risk aversion utility function. He discounts future utility at rate ρ. Wealth accumulates at rate r.

The agent chooses a consumption strategy at discrete points in time. At dates $\{0, \Delta, 2\Delta, 3\Delta \ldots\}$, the agent chooses whether or not to pay attention. If he chooses to pay attention then he also chooses a target level of consumption c. If he chooses to be absentminded, then he chooses a quit rate p. These decisions remain fixed until the next decision date Δ moments later. We assume that attention is costly. There is a flow cost of m units of utility to being attentive.

Given a date $t \in \{0, \Delta, 2\Delta, 3\Delta \ldots\}$, the Bellman equation for this problem is

$$\begin{aligned} V(W_t) &= \max \left\{ \max_p \int_0^\Delta e^{-\rho t} E_p u(c(p)) dt + e^{-\rho\Delta} V(W'), \right. \\ &\qquad \left. \max_c E \int_0^\Delta e^{-\rho t} \left[u(c) - m \right] dt + e^{-\rho\Delta} V(W') \right\} \end{aligned}$$

where

$$\begin{aligned} W' &= e^{r\Delta} \left(W - \bar{c}\Delta \right) \\ E_p u(\bar{c}(p)) &= \frac{A\bar{c}^{1-\sigma} - 1}{1-\sigma} \\ u(c) &= \frac{c^{1-\sigma} - 1}{1-\sigma} \end{aligned}$$

A look at the instantaneous utility functions shows that if $\sigma > 1$, then $\frac{c^{1-\sigma}-1}{1-\sigma} - m > \frac{Ac^{1-\sigma}-1}{1-\sigma}$ at low levels of c while the opposite is true at high levels of c. It is easy to show that this implies that the agent will be attentive at low levels of wealth and absentminded at high levels of wealth. Let $\bar{W}$ denote the cutoff point.

We now take the limit as Δ approaches zero. This formulation simplifies the analysis. It retains the effect that absentmindedness has on the efficiency of consumption, while removing the effect on future resources. We return to the effect of overconsumption on resources below.

For $W < \bar{W}$, the agent is attentive. The Bellman equation is:

$$\rho V(W) = \max_{c} u(c) - m + V'(W)(rW - c)$$

The first order condition for the optimal choice of c is

$$u'(c) = V'(W)$$

Similarly, For $W > \bar{W}$, the agent is absentminded and we have

$$\rho V(W) = \max_{\bar{c}} Au(\bar{c}) + V'(W)(rW - \bar{c})$$

and the first order condition is

$$Au'(\bar{c}) = V'(W)$$

We now characterize the optimal consumption policy. Suppose that $r > \rho$. In this case, consumption will be increasing along the optimal. The case with $r < \rho$ is analogous. Initially, consumption is low and the agent will be attentive. At some date T, wealth will reach $\bar{W}$ and the agent will switch to being absentminded. We characterize first the path of consumption before and after T. For $t \neq T$, the Euler equation implies that

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}(r - \rho)$$

both before and after the switch at date T. We now characterize the level of consumption at date T, and the level of wealth $\bar{W}$. To determine c_T, consider the optimal allocation of consumption given T. The optimal allocation of consumption over time implies that marginal utility is continuous (recall that the monitoring cost is sunk for this decision). This implies

$$c_T^{-\sigma} = A\bar{c}_T^{-\sigma}.$$

To determine $\bar{W}$, consider that the agent cannot not gain or lose by delaying the witch to absentmindedness.. This means that the payoff from attention is the same as the payoff from absentmindedness at date T. The payoff from remaining attentive is

$$\frac{c_T^{1-\sigma} - 1}{1-\sigma} - m - V'(M)c_T$$

The first term is the utility from consumption, the second is the cost of attention, and the third is the cost of consumption valued at the marginal utility of wealth. Similarly the payoff to absentmindedness is:

$$\frac{A\bar{c}_{TA}^{1-\sigma} - 1}{1-\sigma} - V'(M)\bar{c}_{TA}$$

We now have two equations in c_T and $A\bar{c}_T$. Solving for c_T

$$c_T = \left(\frac{M(\sigma - 1)}{\sigma \left(A - A^{\frac{\sigma-1}{\sigma}} \right)} \right)^{\frac{1}{1-\sigma}}$$

We can solve for $\bar{W}$ and c_0 using the budget constraint.

We draw two conclusions from this section. First, in the current formulation absentmindedness only matters if the agent at some point switches between absentmindedness and attention. If an agent is always absentminded, then the agent's utility is re-scaled by A in every period. This has no effect on the intertemporal allocation of resources.

Our second conclusion is that less wealthy agents have an incentive to pay attention. The benefits of attention are declining in wealth. Intuitively, what is costly about absentmindedness is the possibility of disastrously low consumption. As wealth increases this is less likely. The conclusion that attention declines with wealth is reinforced if attention involves some labor effort so that the cost of attention is increasing in wealth as well.

3.1.1 Aside: Absentmindedness and Precautionary Saving

The results of this section parallel the literature on precautionary saving. In that literature, uncertainty concerning future consumption raises saving if marginal utility is convex. Here absentmindedness induces uncertainty about consumption. If this absentmindedness is in the future and not in the present, then it increases saving if $\sigma > 1$.

It turns out that these results are related. Consider the Euler equation between two periods when the agent is attentive in the first period and absentminded in the second (we need $\Delta > 0$ for this thought experiment):

$$u'(c_1) = \frac{1+r}{1+\rho}\frac{d}{dc_2}\left[\frac{1}{c_2}\int_0^\infty u(c)e^{-c/c_2}dc\right].$$

The only nonstandard feature of this Euler equation is the derivative on the right-hand side that appears in the usual place of the marginal utility of consumption in period two. The term in brackets is the average utility that results from an exit strategy $p = 1/c_2$ consistent with average consumption c_2. When an agent shifts resources to the future, he alters this target level of consumption by altering the realized distribution of future consumption.

We can take a closer look at the derivative. With a change of variables:

$$\frac{d}{d\bar{c}}\left[\frac{1}{\bar{c}}\int_0^\infty u(c)e^{-c/\bar{c}}dc\right] = \frac{d}{d\bar{c}}\int_0^\infty u(\bar{c}z)e^{-z}dz$$

We then differentiate under the integral and change variables again:

$$\frac{d}{d\bar{c}}\int_0^\infty u(\bar{c}z)e^{-z}dz = \int_0^\infty u'(\bar{c}z)ze^{-z}dz = \frac{Eu'(c)c}{Ec}$$

There are three differences between absentmindedness and prudence. First, they depend on the convexity of different functions. Prudence depends on the convexity of marginal utility, whereas the saving associated with absentmindedness depends on the convexity of $c \cdot u'(c)$. It is possible for an agent to be prudent ($u''' > 0$) but not sufficiently prudent that condition (1) holds. $u'(c)c$ is convex if and only if the coefficient of relative prudence (Kimball [1990]) is sufficiently high, specifically:

$$-\frac{cu'''(c)}{u''(c)} > 2 \tag{1}$$

A sufficient condition for absentmindedness to reduce saving would be for condition (1) to hold everywhere.

The second difference is that where prudence is a local property of a utility function, absentmindedness is global. A prudent individual will increase saving in response to small risks. In the case of absentmindedness, however, the expectation is taken with respect to the exponential distribution. Absentminded saving is therefore a global property of the utility function.

Finally, whereas prudence always affects the marginal utility of future consumption, absentmindedness may affect the marginal utility of consumption in any period. It is possible that the agent is absentminded today and attentive tomorrow. In this case, we will see precautionary spending rather than precautionary saving.

3.2 The Effect of Horizon

Let's move away from the continuous time setting and consider a discrete time setting in which the errors induced by absentminded consumption decisions affect the marginal utility of wealth.

Consider an agent who has a horizon of n periods. He is endowed with wealth W and earns no labor income. As above, $u(c)$ denotes the utility from consumption in each period. For simplicity we assume that the interest rate and the discount rate are both equal to zero.

We want to analyze how the incentive to pay attention varies with the horizon n. We therefore begin with the assumption that the agent pays attention over the last $n-1$ periods and compare utility if the agent is attentive in period n to utility if the agent is absentminded.

Given that both the interest rate and the discount rate are zero, the optimal policy of an attentive agent is particularly simple. The agent will choose to perfectly smooth consumption over the n periods. Let $V_{M,n}(W)$ denote the value of attention when the horizon is n and wealth is W.

$$V_{M,n}(W) = nu\left(\frac{W}{n}\right)$$

The value of absentmindedness is slightly more complex. Given that the agent may in some states of the world inadvertently consume more than the resources at his disposal, we need to specify what happens when $c > W$. We make the assumption that the consumer is cut off by the stores when he can no longer pay, that he pays a fixed penalty ϕ, and that he receives utility $\bar{u}$ in all future periods. The latter assumption is necessary if $u(0) = -\infty$ as is the case if the coefficient of relative risk aversion is greater than or equal to one. We can think of $\bar{u}$ the utility of an agent receiving welfare payments. Let $V_{A,n}(W)$ denote the value of absentmindedness when the horizon is n and wealth is W. Recall that the agent is absentminded only in the first period and attentive thereafter:

$$V_{A,n}(W) = \max_p p \int_0^W \left[u(c) + V\left(\frac{W-c}{n}\right) \right] e^{-pc} dc + e^{-pW} \left[u(W) + (n-1)\bar{u} - \phi \right]$$

We are interested in how the incentive to pay attention varies as we change n (while varying wealth to maintain average consumption per period when the agent chooses to remain attentive). There are three effects. First, a longer horizon allows the agent to spread the cost of over- or under-consumption in the first period across more future periods. This effect reduces the cost of inattention as n increases. Second, when the agent overconsumes the worst that can happen is that he receives $\bar{u}$ over the final $n-1$ periods. If the horizon is longer, the damage from overconsumption may be felt for a longer time. This effect increases the cost of inattention as n increases. Finally, the longer the horizon, all else equal, the larger is wealth. This tends to reduce the probability that $c > W$ and that the agent incurs the cost ϕ. This effect reduces the cost of inattention as n increases.

Given that the three effects work in opposite directions, we have not been able to prove a general monotonicity result. In numerical simulations, however, the second effect appears quite weak. It appears that the cost of inattention falls with n. Table 1 presents the results of simulations for which $u(c) = \ln(c)$, $\bar{u} = \ln(.01)$, $\phi = 0$, and $W = 5n$. The second column shows that the cost of inattention declines monotonically with the horizon n. The fourth column shows the average consumption that would result in the first period if the agent choose to be absentminded. This average consumption rises with n. When the horizon is short, the agent does not risk overconsumption. As the horizon lengthens, the cost of overconsumption may be spread over more and more periods. By the time the horizon reaches 100, $\bar{c}$ is just short of 5, which is the value it would take if the marginal utility of wealth were linear. The last column shows the average consumption per period over the last $n-1$ periods. This amount is declining in $\bar{c}$ and n.

Table 1
The effect of horizon n

n	$V_{M,n}(W) - V_{A,n}(W)$	p^*	$\bar{c}$	$\frac{W-\bar{c}}{n}$
2	1.0195	.3638	2.749	7.251
3	.8760	.3386	2.995	6.022
5	.7312	.2798	3.574	5.356
10	.6345	.2271	4.404	5.066
100	.5802	.2026	4.935	5.001

3.3 The Effect of Labor Choice

Consider the following thought experiment. Two agents must choose a strategy for how much to consume and how much to work. The only difference between the agents is the order in which they must work and consume in the current period. One must work first and then consume. The other must consume first and then work. The agents begin with identical wealth. Beyond the current period they face identical futures. Which agent has the greater incentive to attend to consumption?

Note first, that if the agents choose to pay attention, the value of an optimal policy does not depend on the order of work and consumption. So long as we assume that there is a zero intra-period interest rate and that the agents can borrow and lend freely, the order of the activities does not matter. The incentive to pay attention, therefore, depends solely on the value if absentminded. In this case, however, there is a clear advantage to working later. The agent who works later, can adjust his labor effort to his level of consumption. If he inadvertently overconsumes, he can work harder and replenish his resources. If he inadvertently underconsumes, he can take advantage of his unspent wealth by working less. The agent who works later therefore has less incentive to pay attention.

As above, $u(c)$ denotes the utility from consumption in the current period. Since the two workers have identical futures (given their resulting wealth), let $V(W)$ denote the value of an optimal consumption/employment policy give wealth W. As above we need to make some assumption on $V(0)$. Since utility from consumption is concave, it is natural to assume that V is concave as well. Let $v(l)$ denote the marginal disutility of labor effort. We assume that v is convex.

Let l^* and p^* denote the optimal policy in the case that labor effort proceeds consumption. Since labor proceed consumption l^* is constant. Now l^* and p^* are feasible choices for the agent when labor follows consumption. The agent, however, can do better. The first order condition for the optimal choice of labor effort is

$$v'(l) = wV'(W_0 - c + wl)$$

This choice of labor effort varies with c. When the realization of c is high, the agent works more. When the realization is low the agent works less. In this case labor effort provides some insurance against absentmindedness. We conclude that agents who work are more likely to be absentminded.

Do working agents consume more? Yes. First they are more likely to be absentminded. Second, conditional on being absentminded they face less risk. [add proof]

3.3.1 Retirement Consumption

Many studies have found that consumption falls at retirement. This decline has not been explained.[4]

One possibility is that upon retirement, people lose the ability to use labor effort of the date of retirement to insure against fluctuations in consumption. They lose the option to work harder if they overconsume. The loss of this option increases the cost of absentmindedness. As they begin to monitor their consumption, their consumption falls.

4 Some Empirical Evidence

The discussion of the previous sections suggests that agents who are older, wealthier and working will tend to be more absentminded. In this section we present evidence in favor of all of these hypotheses.

We take as our measure of absentmindedness a measure of the extent to which an household sets a budget. Setting a budget is certainly on aspect of monitoring ones spending. In prior work (Ameriks, Caplin and Leahy [2003]), we surveyed a sample of TIAA-CREF participants regarding their and budgeting behavior. In particular, we asked respondents to respond to the following statement:

[4] See Bernheim, Skinner and Weinberg [2001] or Blundell, Banks and Tanner. Ameriks, Caplin and Leahy [2002] find evidence that the decline in consumption is anticipated.

- My household regularly sets a detailed budget for our overall spending.

Answers were coded on a scale of 1 to 6 with 1 indicating strong disagreement and 6 indicating strong agreement. We also collected detailed data on household demographics, wealth and employment.

Table 1 shows the result of a regression of the answer to the budgeting question on household net worth, the age of the respondent, the employment status, and number of children. The coefficient on new worth is negative and significant. This is consistent with the conclusion of section 3.1 that wealth promotes absentmindedness. The retirement dummy is positive and significant. This is consistent with the conclusion of sections 3.2 and 3.3 that end of life effects and the lack of labor flexibility promote attention to consumption. The coefficient on age is negative and significant. This is consistent with the hypothesis that the young, who are more likely to be liquidity constrained, have a greater incentive to pay attention

Table 1
Regression of Budgeting Question

variable	coef.	s.e.	p
net worth (x10)	$-.969$	.443	.029
age (x10)	$-.156$	.060	.010
employment status			
full time		*omitted*	
part time	.377	.187	.044
retired	.424	.154	.006
number children	$-.168$	.117	.153
constant	4.40	.283	.000
n			802

These results are consistent with the predictions of the model, but they should not be taken too far. We have not controlled for any reverse causation, nor can we at this point attest to their quantitative importance. They are merely suggestive that the channels explored above may be present in the data.

5 Discussion

5.1 The Information Structure

Our assumption that the agent cannot recall any purchase while in S is stark. While this makes the model simple, it is not necessary for our main results. In order to for the relationships in this paper to hold we need that the agent cannot perfectly control marginal utility. Fluctuations in marginal utility will then interact with the curvature of the utility function to generate the effect of precautionary consumption. The results should survive extensions to more general information structures.

It might also be possible to generate similar results with other mechanisms. For example, suppose that instead of being absentminded, agents merely make mistakes. When they spend x dollars they get $u(x+\varepsilon)$ units of utility. Suppose further that the variance of ε is declining in the amount of attention that they pay to their purchases. This formulation will also have random marginal utility. It should also generate precautionary spending.

5.2 The Solution Method

Rubinstein and Piccione (1997) point out that the solution to models with absentmindedness is a delicate question with more than one potential answer. We consider only one solution concept, which Rubinstein and Piccione refer to as the *ex ante* optimal strategy. This solution concept is supported by the experimental results of Huck and Müller (2001). It is also generally equivalent to what Rubinstein and Piccione call the modified multi-self equilibrium, which involves identifying each visit to an information set with a different self and analyzing the resulting intrapersonal game.

It differs, however, from the solution that results if the agent were to solve the optimization problem while in S using the beliefs generated by the optimal strategy. This solution involves a fixed point: strategies induce beliefs and beliefs give rise to optimal strategies. This solution also involves randomization and therefore yields qualitatively similar results. It is difficult, however, to interpret this solution, since it is pinned down by a time consistency condition rather than as the solution to an optimization problem.

5.3 Relation to Models of Memory

Absentmindedness is a form of imperfect memory. There are obvious connections to other models of imperfect memory, including Dow [1991], Mullianathan [1998], Bernheim and Thomadsen [2002], and Wilson [2002]. Sims [2002] considers the implications of information processing constraints, which may also be related.

6 Conclusion

We have presented a model of an absentminded consumer. The model can explain a positive effect of planning on saving. It also explains the correlations that we observe between age, wealth, and employment status on the one hand, and budgeting behavior, on the other. The model presents new explanations for a relationship between spending and credit card use and for the decline in consumption at retirement.

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