*Journal of Behavioral Decision Making*
*J. Behav. Dec. Making*, **14**: 169–185 (2001)
**DOI**: 10.1002/bdm.370

# The Mental Accounting of Sunk Time Costs: Why Time is not Like Money

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ABSTRACT

The sunk-cost effect, an irrational attention to non-recoverable past costs while making current decisions, has been documented widely in the domain of monetary costs. In this paper, I study the effect of past **time** investments on current decisions. In three experiments using choice situations, I demonstrate that the sunk-cost effect is not observed for past investments of time, but the effect reappears when the investments are expressed as monetary quantities. I further propose that this 'pseudo-rationality' is due to the fact that individuals lack the ability to account for time in the same way as they account for money. In two additional experiments, I facilitate the accounting of time and show that the irrational sunk-cost effect reappears. In a final experiment, I test my propositions in a setting where subjects make real investments of time and subsequently make real choices. Copyright © 2001 John Wiley & Sons, Ltd.

KEY WORDS sunk-cost effect; time; mental accounting; past investments

Research in individual decision making has shown that people often fall prey to the sunk-cost effect (Arkes and Blumer, 1985; Garland, 1990; Garland and Newport, 1991; Thaler, 1980). Specifically, this line of research has shown that individuals will respond to previous investments by becoming increasingly willing to invest additional resources, a tendency also referred to as the escalation of commitment in response to sunk costs (Staw, 1981).

As an example of the sunk-cost effect, consider a situation adapted from Thaler (1980), in which Mr A has advance purchased a $40 ticket to a basketball game while Mr B is given an identical (free) ticket to the same game. There is a major snowstorm on the day of the game and the roads are very bad. Thaler (1980, 1999) proposes that Mr A would be more likely to brave the snowstorm and go to the game as compared Mr B. Similarly, other researchers show that the act of prepayment increases the commitment to consume the associated benefit (e.g. Arkes and Blumer, 1985; Gourville and Soman, 1998; Staw, 1981). This tendency contradicts a basic principle in economics that past costs and benefits should be irrelevant to current decisions (Frank, 1994). Both individuals in this example should make decisions based on the marginal costs (e.g. transportation cost and risks associated with traveling through bad weather) and marginal benefits (the expected enjoyment from the game; Frank, 1994). However, Thaler (1980, 1999) argues that individuals

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set up mental accounts to keep track of their transactions and are driven to consume the benefits in order to balance the negative value of their prior costs. Since Mr A needs $40 'worth' of benefit to satisfactorily close his mental account, he is more driven to attend the game than Mr B who has no monetary investments to recover.

Arkes and Blumer (1985, p.124) define the sunk-cost effect as the 'greater tendency to continue an endeavor once an investment in money, effort, or time has been made'. However, a review of past research shows that this effect has primarily been documented when past investments of money (rather than effort or time) have been made. The goal of the present research is to answer the question: Does the sunk-cost effect persist when past investments are temporal rather than monetary in nature?

The rest of this paper is divided into three sections. First, I review literature on the sunk-cost effect and mental accounting, analyze differences between time and money and offer a hypothesis about the strength of the sunk-cost effect for time. I test this hypothesis in three experiments. Second, I discuss two competing explanations for these results and describe three additional experiments to test between these explanations. Third, I conclude with a general discussion and offer directions for future research.

## EXPLANATIONS FOR THE SUNK-COST EFFECT AND THEIR IMPLICATIONS FOR SUNK TIME COSTS

A number of researchers have proposed a variety of explanations for the sunk-cost effect. These include the commitment to, and the need to justify prior choices (Brockner, 1992; Staw, 1981); the tendency to be risk seeking in the light of previous losses (Garland and Newport, 1991; Whyte, 1986) and the desire to avoid waste (Arkes and Blumer, 1985). Although each of these explanations is driven by different underlying motivations and psychological processes, they all share an important characteristic relevant to the present research—that past costs and benefits have been properly accounted for. Specifically, they require that the decision maker track and evaluate the disutility associated with the cost, and link it to the benefit (Thaler, 1980).

In his seminal work on mental accounting, Thaler (1980, 1985, 1999) provides a compelling framework for the tracking and evaluation of costs and benefits associated with a routine transaction. He proposes that individuals open a transaction-specific mental account on incurring a payment, and close that account on the accrual of benefits. For instance, consider Mr A from the introductory example. On purchasing the $40 basketball ticket, this individual might open a mental account called 'Basketball Game' containing the psychological value (or disutility, $v[-40]$) of the payment. The psychological value is related to the actual dollar cost by Prospect Theory's value function (Kahneman and Tversky, 1979). Mr A can complete the transaction and recover his investment only by attending the game,[1] but if he is unable to go, he will be forced to close the mental account with a perceived loss of $v[-40]$, i.e. 'in the red' (Prelec and Loewenstein, 1998). It is this motivation to avoid the loss and associated pain that may drive Mr A through the bad weather to see the game.

A notable exception to this tendency of attending to sunk costs was demonstrated by Heath (1995). In his research on the role of budgeting, Heath proposes that individuals set mental budgets for expenditures in various categories. As the cumulative expenditure on a project approaches the budgeted limit, individuals reduce their commitment to the project and show a reverse sunk-cost effect. Heath's experiments suggest that individuals are only likely to fall prey to the sunk-cost effect when they fail to set a budget, or when expenses are difficult to track.

[1]Assuming that the ticket cannot be refunded or resold.

 

Will an individual exhibit a sunk-cost effect if he or she had invested time (rather than money) in a given endeavor? Do individuals mentally account for time investments using the same principles as monetary investments? Do they set budgets? To answer these questions, I first analyze differences between time and money as resources.

## Time versus money

How is time different from money? I list below three differentiating features of time that would make it difficult to be accounted for along the same lines as money.

(1) *Time cannot be inventoried or replaced*: The principles of mental accounting call for past expenses to be 'held on the books' until the commensurate benefit has been consumed and the account can be closed. By its very nature of being perceived as a flow variable rather than a stock variable, humans find it difficult to inventory past time investments and hold them 'on the books' (Gross, 1987). Similarly, outcomes of time cannot be easily transferred and time is not fungible (LeClerc *et al.*, 1995). While an individual can make up for lost money (e.g. make up for an unexpected expenses by cutting down on another), lost time can never be recovered.

(2) *Time is not as easily aggregated as money*: The (negative) utility that individuals derive from a quantity of monetary investment is a monotonic function of the amount of money. The aggregation of the disutilities of money expenses is guided by relatively straightforward and intuitive rules (e.g. the prospect theory value function). On the other hand, recent research in psychology shows that the disutility associated with an investment of time might not be directly related to the amount of the time investment (Fredrickson and Kahneman, 1993) and may not even be monotonically related (Elster and Loewenstein 1992). As the time investment in an endeavor commences, people might experience positive thoughts and feelings due to anticipation and learning. However, after an initial increase in the positive evaluation, further investments may be accompanied by negative evaluations due to boredom, frustration, and feelings of futility (Elster and Loewenstein, 1992).

(3) *Accounting for money is a routine activity, but accounting for time is not*: Accounting for money is a routine activity to most individuals. At a formal level, businesses are mandated to keep accounts of monetary expenses but not of time investments. In economics, money is treated as a factor of production while time is not. At a more intuitive level, humans are trained to think of transactions in monetary terms. Children are provided monetary allowances with the intent of developing budgeting and money-management habits. In everyday transactions, consumer economists advise people to make sure to get their 'money's worth' (Zelenak, 1999). And research has documented numerous instances in which consumers invest considerable time in order to avail themselves of monetary savings (e.g. Dhar and Hoch, 1996).

Based on the above discussion, it appears that people have neither the necessary economic sophistication nor the perceptual apparatus to effectively be able to account for time in the same way as they account for money. It seems unlikely that Thaler's (1980, 1999) model of mental accounting applies to time costs. While people might be able to assign their time investment to a particular mental account, it seems less clear whether they can actually assign a disutility to a 'stock' of invested time.

## The mental accounting of time costs

The following elements and assumptions are the key components of the mental accounting model (Heath and Soll, 1996). First, individuals track costs that are relevant to a particular expense and 'assign' these costs to the relevant mental account. Second, the Prospect Theory value function dictates that the negative value of

 

the cost displays diminishing marginal sensitivity. Third, expenses and funds are grouped into categories and spending is constrained by implicit and explicit budgets.

To examine whether time investments follow these principles, I generated eight statements that described features of the mental accounting model. Two versions of these statements were created, one describing costs as monetary and the other describing costs in terms of time, resulting in a total of 16 statements. These were embedded in a number of other filler statements and were presented to 26 individuals intercepted at a Boulder, Colorado, shopping mall. These individuals reported their extent of agreement with each statement on a 9-point scale (1 = Strongly Disagree, 5 = Neither Agree Nor Disagree, 9 = Strongly Agree). Exhibit 1 lists the statements and the mean extent of agreement with each.

Note that each statement was phrased such that high levels of agreement reflected a greater degree of validity of the mental accounting model. As Exhibit 1 shows, the responses suggested that the principles of the mental accounting model were highly valid for monetary expenses but did not do a very good job of describing expenditures of time.

## Hypothesis development

The previous discussion suggests that the mental accounting for time costs will be different from the mental accounting of monetary costs. However, it does not provide an understanding of the direction and implication of these differences. Two streams of literature on (a) time perception and (b) the evaluation of experiences offer some insights.

### *Time perception*

Research shows that time intervals perceived by individuals who have gone through a time investment may not necessary correspond to the actual time intervals (cf. Osuna, 1985). Specifically, retrospective evaluations may depend on the extent to which the time interval was 'filled' with activities and enjoyable events (Kellaris and Kent, 1992), or the extent to which individuals felt that the duration was being efficiently utilized (Soman and Shi, 2000).

Exhibit 1. Mean agreement with phrases representing the elements of the mental accounting process for time and money

| Statements | Mean agreement | |
|---|---|---|
| | Money | Time |
| (1) If I have wasted (money / time) on a particular activity or item, I try to save it on another activity or item. | 6.69 | 4.11[a] |
| (2) If I spend (money / time) on an activity or item but cannot avail its benefits, I feel a sense of loss. | 6.42 | 4.27[a] |
| (3) I try to keep track of past expanses of (money / time). | 7.04 | 4.23[a] |
| (4) The more (money / time) I invest in a venture, the more anxious I am to complete it. | 6.69 | 4.04[a] |
| (5) I regularly budget my (money / time) by specifying upper limits on how much I will devote to any given item or activity. | 6.27 | 4.27[b] |
| (6) Every time I invest (money / time) in an endeavor or product, I try to ensure that I get benefits commensurate with my investment. | 7.12 | 4.34[a] |
| (7) The more (money / time) I have spent on a lost cause, the more I will regret having incurred the expense. | 6.65 | 4.19[a] |
| (8) I feel like I must make sure that past expenses of (money / time) are not wasted. | 7.15 | 4.04[a] |

[a]Money versus time significant at $p < 0.01$
[b]Money versus time significant at $p < 0.05$

 

*Duration neglect in the evaluation of experiences*

A recent stream of research shows that the evaluation of an experience spanning an interval of time may not be monotonically related to the amount of time invested. Instead, other 'global evaluation' variables like the peak intensity, rate of change of the experience, and the final state of the decision maker at the conclusion of the experience (Ariely, 1998; Varey and Kahneman, 1992) drive the evaluation. Fredrickson and Kahneman (1993) show that retrospective evaluations of an experience are determined by a weighted average of 'snapshots' of the experience and that the actual duration does not matter, a phenomenon they label as 'duration neglect'.

Thus, while there has been no formal investigation of the mental accounting of time costs, the broad consensus emerging from the above literature is that individuals might be insensitive to the size of the time investment in its retrospective evaluation. In the context of the effect of past time investments on future choices, this leads me to propose:

> **Hypothesis 1**: Since duration does not seem to be an important predictor of the evaluation of sunk **time** costs, the sunk-cost effect will not vary greatly as a function of the size of the sunk-cost. More generally, the sunk-cost effect will be weaker in the domain of temporal costs than in the domain of monetary costs.

I next describe three experiments designed to investigate Hypothesis 1.

## TESTING FOR THE SUNK TIME COST EFFECT

In order to investigate the presence of the sunk-cost effect for investments of time, I adapted some of the classic demonstrations of the parallel effect for monetary investments from the past literature. The objective of the first three experiments was to detect the sunk-cost effect for investments of time rather than investments of money. To eliminate the possibility that the outcome of the experiment was attributable to the peculiarities of the scenario used, each experiment was done in the domain of time costs as well as monetary costs. Subjects received a questionnaire with a sunk-cost scenario adapted from prior research (e.g. Arkes and Blumer, 1985; Thaler 1980). The percentage of subjects choosing each option is shown under each of the following scenarios.

### Experiment 1 (Theater and concert tickets)

Subjects were 122 undergraduate students at the Hong Kong University of Science and Technology who participated in a series of unrelated studies in exchange for course credit. They were randomly assigned to either the sunk time version or the sunk money version of the problem.

> (*Sunk time version*, $n=62$): Imagine that you recently saw an advertisement on the bulletin board. A literature professor was looking for a research assistant to work for about 15 hours. The payment was in the form of a front row seat to a professional theater performance. On the same bulletin board, a music professor was also looking for a research assistant to work for about 5 hours and this assistant would be paid with a ticket (in a good section) to a rock concert by a band that you like. You had recently seen posters for both the theater performance and the rock concert. You think you will like to see both these events, although you expect to like the rock concert more. You work for both the professors (15 hours for literature and 5 hours for music) and get paid with the two tickets (theater and rock concert respectively).
>
> As you are putting the tickets away in your wallet, you notice that both events are scheduled for the same evening and are both at good locations on campus. The tickets are non-transferable, nor can they be exchanged. You can use only one of the tickets and not the other. Which ticket will you use?

 

(a) Theater performance [4.8%]
(b) Rock concert [95.2%]

(*Sunk money version*, $n=60$): Subjects in a second version of the scenario were told that they had purchased the theater ticket for HK$450 and the rock concert ticket for HK$150.[2] The rest of the scenario was unchanged.

(a) Theater performance [61.7%]
(b) Rock concert [38.3%]

Respondents in this scenario (adapted from Arkes and Blumer, 1985, Experiment 1) were faced with the choice between a preferred rock concert for which they had incurred a smaller expense, and a less-preferred theater performance for which they had incurred a larger expense. In both versions of the scenario, the larger expense was three times the smaller expense. If individuals ignored the sunk-cost, they should have chosen to attend the rock concert. However, if the larger sunk-cost of the theater performance influences decisions, choice should shift towards the theater.

In the first version of the scenario in which the sunk costs were temporal, 95.2% of the respondents made a choice consistent with their original preferences. A large majority of the respondents made a choice that was consistent with the rational prediction favoring the option with the greater anticipated enjoyment. However, in the second version in which the sunk costs were monetary in nature, a significantly lower fraction of the respondents (38.3%, $p<0.001$) made a choice consistent with their anticipated enjoyment and a majority of the respondents fell prey to the sunk-cost effect. The results from this scenario show that the sunk-cost effect was observed when the costs are monetary, but the effect disappeared when the costs are temporal in nature.

**Experiment 2 (Choosing a project)**

This experiment differed from the previous one in two ways. First, a pair of scenarios (rather than a single scenario) was used in each domain, i.e. time and money. Except for the fact that one member of the pair involved a sunk-cost, the two members of a pair were identical in all other aspects. Second, unlike the first experiment in which both options involved different *quantities* of sunk time cost, the present experiment compared a no-sunk-cost option with a sunk-cost option. Subjects were students of engineering at the University of Colorado who were intercepted outside the school building and requested to participate.

*Time—A* (*Sunk-cost*, $n=49$): You are planning to submit an entry to the 'new invention' competition organized by the students' club. You have spent 30 hours preparing a design for an innovative rocket engine and estimate that it will take you an additional 10 hours to finish it. You just learn that the winner of the previous year's competition was also working on a rocket engine design similar to yours. You had also thought about working on a (equally innovative and good) design for a solar powered pump that would take about 10 hours to complete. You can submit only one entry, and since the deadline is very close, you must choose now. The question is: Should you spend 10 hours trying to finish your rocket engine design or would you rather work on the solar-powered pump?

(a) Rocket engine (20.4%)
(b) Solar-powered pump (79.6%)

[2] 1 US$ = 7.78 HK$.

 

*Time—B* (*No sunk-cost*, $n=58$): You are planning to submit an entry to the 'new invention' competition organized by the students' club. You thought about preparing a design for an innovative rocket engine, and you estimate that it will take you 10 hours to finish it. You just learnt that the winner of the previous year's competition was also working on a rocket engine design similar to yours. You had also thought about working on a (equally innovative and good) design for a solar-powered pump that would take about 10 hours to complete. You can submit only one entry, and since the deadline is very close, you must choose now. The question is: Should you spend 10 hours trying to work on the rocket engine design or would you rather work on the solar-powered pump?

(a) Rocket engine (19.0%)
(b) Solar-powered pump (81.0%)

In the sunk money version of the problem, subjects read the same basic scenario. However, instead of time investments, subjects were told about monetary investments they had made (or would need to incur) to purchase relevant books and materials. The summary of the questions and the responses are as follows:

*Money—A* (*Sunk-cost*, $n=49$). You had already spent \$90 on the rocket engine design. You expect that it will cost you an additional \$30 to finish. The solar-powered pump would cost approximately \$30.

(c) Rocket engine (55.1%)
(d) Solar-powered pump (44.9%)

*Money—B* (*No sunk-cost*, $n=50$). Both designs will cost approximately \$30.

(c) Rocket engine (24.0%)
(d) Solar-powered pump (76.0%)

The difference between Scenarios A and B is that in A, some time (or money) has already been invested while in B, nothing has been invested yet. The future costs in both cases are identical (as are, presumably, expectations of future benefits). When the sunk investment was temporal in nature, there was no significant difference in the fraction of respondents who chose the rocket engine in the sunk-cost Scenario A (20.4%) and the no sunk-cost Scenario B (19.0%, $\chi^2(1)=0.04$, $p=0.85$). Subjects' choice against the rocket engine design in both cases seemed to be guided by the expectations of a smaller chance of its winning the competition (since a former winner was preparing a similar design), notwithstanding the fact that some time may have already been sunk into it. On the other hand, when the sunk investment was monetary in nature, we see a different pattern of results. In the no sunk-cost scenario (B), we again see that only a minority of the subjects (24%) chose the rocket engine design. However, in the sunk-cost scenario (A), the preference for the rocket engine design was significantly greater (55.1%, $\chi^2(1)=9.59$, $p < 0.005$). There is no obvious economic reason to complete the rocket engine project, yet a majority of the subjects seemed to be motivated by the money that had already been invested. I again find no sunk-cost effects in the domain of temporal investments, but find these effects using the same scenario with monetary investments.

**Experiment 3 (Free tickets)**

In this task, subjects were asked for their willingness to forgo a cruise in the face of a conflict with a rescheduled exam. Subjects were Hong Kong University of Science and Technology students participating in a series of unrelated studies in exchange for course credit. A sunk time cost was either absent, or if present, was manipulated to have two different levels in either the money or time domain. This experiment thus differed from the previous scenarios in that subjects did not have to choose between a sunk-cost and no-sunk-cost option, rather the sunk-cost manipulation was between subjects. The basic scenario that subjects in the control (no sunk-cost) condition read was:

 

> Imagine that you are a member of a store loyalty program where you get points for making purchases. Because you had a lot of points, the store selected you to receive a free gift—two tickets to a one-day cruise to Macau on a luxury ship. *All you had to do to claim your free gift was to call an URBTIX telephone number and provide your promotion code and address*. The tickets had arrived in the mail last week, and you were all set to go on the cruise with a special friend tomorrow.
>
> However, you went to college today and received some bad news. An exam had been rescheduled and it will now be held tomorrow, the same day as your free cruise. The instructor will not allow you take a make-up examination, so if you miss the exam your grade will come down from A− (which you had been expecting and working hard for) to a B+ (which would still keep you in the first class, but would leave feeling a little disappointed). On the other hand, if you attend the exam, you would be not able to go to the cruise that you had been so eagerly anticipating.
>
> The question is: Will you go on the cruise or will you attend the exam?

In the low sunk time (*high sunk time*) version of this scenario, the sentence in italics was replaced by:

> In order to receive your free gift, however, you had to participate in a marketing research program for the store. Specifically, you needed to attend four focus group interviews about grocery shopping, and also fill in a lengthy survey. In all, these activities took a total of 8 hours (*24 hours*) of your time and were spread over one week (*three weeks*). After participating in this, all you had to do was to call an URBTIX telephone number and provide your promotion code and address.

Another version of the scenario was based on low sunk money (*high sunk money*) costs. The first paragraph in this version read:

> Imagine that you are a member of a store loyalty program where you get points for making purchases. Because you had a lot of points, the store chose you to receive a gift at a special discount offer—two tickets to a one-day cruise to Macau on a luxury ship. Two tickets were regularly priced at HK$ 1000, but because of the offer you got a 70% (*10%*) discount and would have to pay HK$ 300 (*HK$ 900*). All you had to do was to call an URBTIX telephone number and provide your promotion code and address.

All subjects responded on a 7-point scale (1 = Definitely Attend Exam, 7 = Definitely Go on Cruise). Note that higher responses implied a greater attention to the sunk-cost. The mean responses ($n = 40$ in each condition) for willingness to go on the cruise (GO) were:

| | |
|---|---|
| (a) No sunk-cost (control) | 2.65 |
| (b) 8 hours sunk time | 2.86 |
| (c) 24 hours sunk time | 2.78 |
| (d) HK$ 300 sunk money | 3.15 |
| (e) HK$ 900 sunk money | 3.85 |

First, we consider GO scores in the control condition and the two sunk-time conditions. These three GO scores were not significantly different from one another ($p$'s $> 0.30$), indicating that the presence and the magnitude of a sunk time cost did not prod subjects into trying to recover their time investment. However, a comparison of the control group with the low and high sunk money groups revealed a different pattern of results. Specifically, the GO score in the control condition was significantly lower than in the low sunk money condition ($t_{39} = 1.74$, $p < 0.05$), which in turn was significantly lower than the GO score in the high sunk money condition ($t_{39} = 1.76$, $p < 0.05$). When the sunk-cost was monetary, it played an increasingly larger role in decision making as the size of the sunk-cost increased. However, there was no evidence for this effect when the sunk-cost was temporal.

The first three experiments showed support for Hypothesis 1. Specifically, I found that subjects seemed to ignore both the presence (Experiments 2 and 3) and the magnitude (Experiments 1 and 3) of sunk time costs

 

in choosing pending alternatives. However, when I ran parallel scenarios in the domain of monetary costs, I found support for the sunk-cost effect suggesting that the null results in the domain of time were not an artifact of any peculiarity associated with the vignettes.

## CREATING A SUNK TIME COST EFFECT

The theoretical rationale behind the absence of the sunk-cost effect for time was the expectation that people have difficulty in accounting for time costs in the same manner as they account for money (the *difficulty* hypothesis). However, an alternative explanation for the null results is the hypothesis that in the domain of sunk time, individuals recognize that previous investments can never truly be recovered and hence are willing to ignore these sunk costs in making current decisions (the *rational* hypothesis).

If the null effect is caused by difficulty in mental accounting, then any experimental manipulation that facilitates the mental accounting of time should cause the sunk-cost effect to strengthen and reappear. If the absence of the sunk-cost effect is due to rationality, it should be an enduring phenomenon and the facilitation of mental accounting should not change the null result obtained in the domain of temporal costs. The following pair of competing hypotheses captures this reasoning:

**Hypothesis 2a** (*Difficulty*): If the absence of a sunk time cost effect is due to difficulties associated with the accounting of time, then the facilitation of accounting should cause the effect to reappear.

**Hypothesis 2b** (*Rational*): If the absence of a sunk time cost effect is due to the fact that individuals behave rationally when evaluating past time investments, then the facilitation of accounting should not cause the effect to reappear.

In Experiments 4 and 5, I test Hypothesis 2 by using three different experimental manipulations that facilitated mental accounting. These manipulations are (a) the provision of a wage rate which facilitated the conversion of time into a monetary equivalent, (b) education about the economic approach to time (cf. Becker, 1965), and (c) highlighting the opportunity cost of the invested time.

### Experiment 4 (Providing a measuring rod)

Subjects in this experiment (students at the University of Colorado) faced a situation in which they had to decide whether to forgo a sporting event they had paid for because of bad weather. They were told that they had worked for a certain amount of time in exchange for a ticket to an important football game. Specifically, they were told:

> One of your professors had offered a ticket to a second level seat for the Denver Broncos vs. Kansas City Chiefs game at the Mile High Stadium[3] absolutely free in exchange for some research assistance. Specifically, you needed to spend a number of hours entering data from a stack of questionnaires into a computer.

Within this basic scenario, the experiment employed a 2(*Size of Sunk Cost*) × 2(*Availability of Wage Rate*) design resulting in a total of four experimental conditions to which 80 subjects were randomly assigned ($n = 20$ in each condition). The *Size of Sunk Cost* was either 5 hours of work or 10 hours of work. There were two levels of *Availability of Wage Rate*—subjects were either told that the standard wage rate for research assistants was $7 per hour, or they were not provided with this information.

[3]This was an eagerly anticipated regular season football game at the time this study was conducted. The stadium is approximately 21 miles from where most of the respondents lived. The exact location of the seat (level and section) was specified using an accompanying map of the stadium and was constant across all experimental conditions.

 

All subjects were then asked to imagine that due to a blizzard on the day before the game, it was bitterly cold on the day of the game and road and traffic conditions were very poor. They were told that most roads were icy, driving was hazardous, and driving times were at least four to five times the normal.[4] They were then asked to 'indicate your strength of preference for braving the poor traffic and cold conditions to attend the game rather than sitting at home and watching it on television' (1 = Definitely Stay At Home, 9 = Definitely Attend Game). Their response is referred to as the ATTEND score.

Note that from a rational perspective, all subjects were in an identical position. They had made a past investment by working for a professor in exchange for the ticket. In all cases, the marginal decision involved a tradeoff between the benefit from attending the game and the cost of negotiating the bad traffic and weather. And finally, the alternative to the event was identical in all conditions.

The mean ATTEND scores are plotted in Exhibit 2 and were analyzed using an ANOVA with *Size of Sunk Cost* and *Wage Rate* as the independent variables. ANOVA results indicate significant main effects of *Size of Sunk Cost* ($F_{1,76} = 4.12$, $p < 0.05$) and the *Wage Rate* ($F_{1,76} = 6.27$, $p < 0.02$). As Exhibit 2 shows, however, these main effects were qualified by a significant interaction between the two independent variables ($F_{1,76} = 4.52$, $p < 0.05$). When subjects were not provided with a wage rate, there was no evidence of the sunk-cost effect and the ATTEND ratings were identical irrespective of the time investment. However, when subjects were explicitly made aware of the wage rate, they seemed to respond to a greater investment in sunk-cost by reporting higher ATTEND scores.

These data suggest that the provision of a measuring rod for the time investment facilitates the conversion of time into an equivalent monetary amount, which in turn is accounted by the principles of mental accounting.

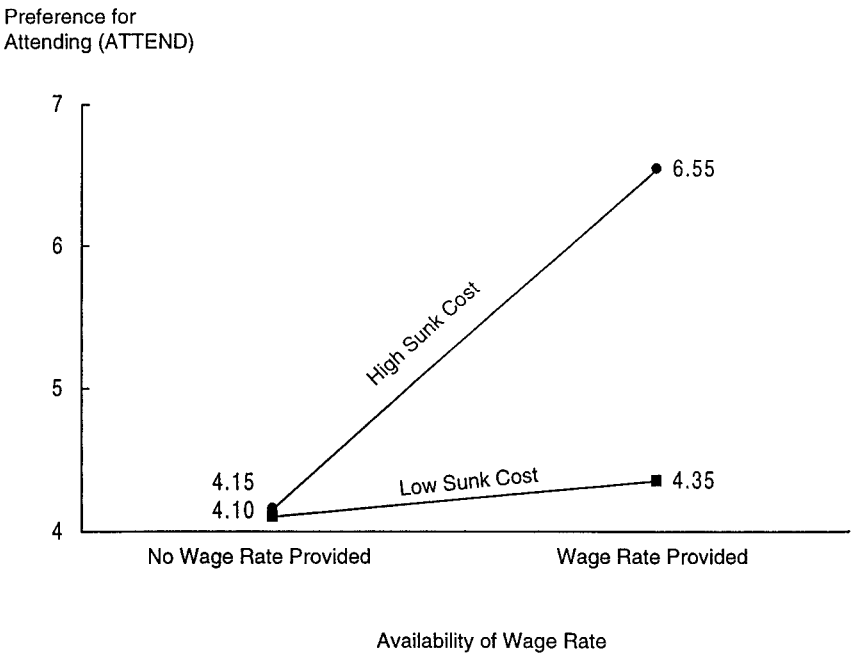


Exhibit 2.

[4]This scenario was very vivid to respondents—a severe snowstorm and blizzard-like conditions had just hit the area when this study was conducted, and hence subjects could very easily empathize with the scenario.

 

**Experiment 5 (Education and opportunity costs)**

Seventy-two students enrolled in a marketing analysis class at the University of Colorado served as subjects in this experiment. All subjects read a basic scenario similar to the one used in Experiment 1 in which they had worked as research assistants for two professors and were compensated with

(a) A theater ticket in exchange for 15 hours of work; and
(b) A rock concert ticket in exchange for 5 hours of work

They then realized that both events were scheduled for the same evening. They were asked to indicate on a 9-point scale their relative preference (PREF) for choosing to go to either of these two events (1 = Definitely Rock Concert, 5 = Indifferent, 9 = Definitely Theater). Note that high values of PREF indicate greater attention to sunk costs.

Within this basic scenario, the experiment employed a 2 (*Opportunity Cost*) × 2(*Education*) between-subjects, full factorial design. Subjects who were in the 'Low Opportunity Cost' conditions were told that the above scenario had occurred 'during the summer' when they had a summer scholarship due to which they 'did not have to take any classes, nor work to support themselves'. Subjects in the 'High Opportunity Cost' conditions were told that the scenario occurred 'during the Fall semester' when 'they were taking five classes and working three part-time jobs to support themselves' and consequently were 'badly pressed for time'.

Further, the *Education* factor manipulated the timing of data collection relative to a classroom discussion about economic approaches to time (cf. Becker, 1965) and the possibility of segmenting markets based on the consumers' scarcity and cost of time. Subjects who were run prior to this classroom discussion were labeled the 'No Education' group, while subjects who were run after were labeled the 'Educated' group.

The mean PREF scores in each of the four experimental conditions are plotted in Exhibit 3. These data were analyzed using an ANOVA model with PREF as the dependent variable, and *Education and Opportunity Cost* as the independent variables. ANOVA results indicate significant main effects of *Education* ($F_{1,68} = 13.65$, $p < 0.001$) and *Opportunity Cost* ($F_{1,68} = 6.63$, $p < 0.02$), while the interaction effect between these variables was not significant ($p > 0.95$). The main effect of *Education* arose because the facilitation of mental accounting of time by educating subjects about the cost of time strengthened the sunk-cost effect.

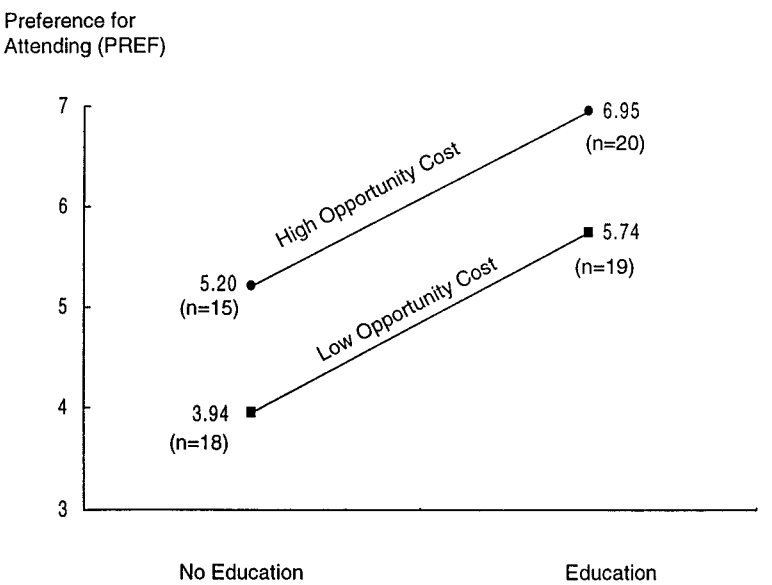


Exhibit 3.

 

Specifically, subjects in the 'Educated' conditions displayed a greater attention to sunk costs (PREF = 6.36) than did subjects in the 'No Education' conditions (PREF = 4.52). The main effect of *Opportunity Cost* was also consistent with my expectations. Subjects who were in the high opportunity cost conditions displayed a greater attention to sunk costs (PREF = 6.20) than subjects in the low opportunity cost conditions (PREF = 4.86).

The fact that there is a sunk-cost effect for time if the opportunity cost of time is high suggests that the presence or absence of the effect in the domain of time could be situational, and that the effect could be stronger in situations of time stress. To test for this possibility, I posed the following question (based on the scenario in Experiment 3) to 38 adults in Hong Kong who were working either full time or part time or were first-year MBA students:

> Imagine that your credit card company selects you to win a free weekend cruise to Macau in exchange for some market research that you must participate in. The research involves participation in focus groups and questionnaires—it takes a total of about 12 hours spread over two weeks. You participated in the research and collected your free ticket to the cruise. However, a couple of days before the cruise you get invited to an all-expenses paid weekend trip to Bangkok for the same weekend as the cruise. You would love to visit Bangkok, but have also really been looking forward to this cruise. What will you do?

Subjects responded on a 9-point scale with higher numbers reflecting a greater preference for going on the cruise (referred to as the GO score). Earlier, subjects had also been asked to indicate their agreement with the following statements—(a) My time is valuable, (b) 'I do not find much time to relax and unwind,' and (c) 'If I could put a price on my time, I would say that it is presently a very high price'.[5] The correlations among these three items were high ($\alpha = 0.81$) and hence their average is taken as the self-reported opportunity cost of time (TIMECOST). Results show that the correlation between TIMECOST and GO was relatively high and significant ($\gamma = +0.76$, $p < 0.001$) suggesting that the greater the opportunity cost of one's time, the higher is the attention to the sunk time cost. Specifically, the sunk-cost effect was the highest for the full time working adults (GO = 6.36, TIMECOST = 7.50), second higher for the part-time working adults (GO = 5.58, TIMECOST = 5.75), and lowest for the students (GO = 3.58, TIMECOST = 4.23).

Collectively, the results from Experiments 4 and 5 provide support for the difficulty hypothesis (Hypothesis 2a) but not for the rational hypothesis (Hypothesis 2b). Specifically, experimental manipulations that facilitated the accounting of time costs (provision of a wage rate, increasing the salience of opportunity costs, and education about economic approaches to time) increased attention to sunk costs. This result is inconsistent with a rational explanation for the absence of the sunk time cost effect, which would predict that the absence of the effect would be enduring and will not be changed by the provision of additional information.

**Experiment 6 (Real time investments)**

While the first five experiments repeatedly demonstrated the absence of a sunk-cost effect for temporal costs, they all used hypothetical stimuli in which subjects were asked to imagine previous investments of time. In the present experiment, I tested for the effect by asking subjects to actually invest different quantities of time in a particular endeavor.

Fifty undergraduate students at the University of Colorado were intercepted at the student center and asked for their willingness to participate in an experiment comprising of two separate research studies. They were told that they would be given a gift as compensation for each of the studies, and that they could keep one of

[5]My goal in this study was to test for the correlation between the sunk-cost effect and the perceived cost of time. I wanted to ensure that I would get the effect and hence I asked people to respond to the 'cost of time' questions before they looked at the decision problem.

 

these gifts. Those who agreed to participate were given a questionnaire titled 'Marketing Survey'. On completion, they were told about the corresponding gift (Gift A) and then given a second questionnaire titled 'Consumer Survey'. On completion, they were told about a second gift (Gift B), and were then shown both gifts.[6] Two gift items were used—a souvenir shot-glass and a paperweight, both bearing the logo of a professional sports team. The assignment of these two gifts as either Gift A or B was counterbalanced across subjects (e.g. approximately half the subjects saw the shot-glass as Gift A while the other half saw the paperweight as Gift A). Also counterbalanced across subjects was the length of the two surveys. Both surveys had a number of questions asking subjects to rate a number of brands on a number of attributes. However, one of the surveys was long (6 pages) and took approximately 25 minutes to complete, while the other one was short (2 pages) and took approximately 8 minutes to complete.[7] Approximately half the subjects saw a long 'marketing survey' and a short 'consumer survey' while the other half saw the reverse assignment. Each subject in the experiment therefore performed two tasks (one long and one short) and was shown a separate gift that originated from each task.

Within this basic experimental procedure, subjects were randomly assigned to one of two experimental conditions. In the *Pure Gift* condition, subjects were merely given the gifts without any reference to their monetary value. In the *Gift for Cash* condition, subjects were told that 'we had initially hoped to compensate you with cash at the rate of approximately $10 per hour for your participation. However, certain regulations prevented us from giving cash as compensation. Therefore, we will give you a gift item instead of cash.' These subjects were therefore provided with some external wage rate information that they could use to generate the monetary equivalent of the gift.

After completing the two tasks and examining the gifts, subjects were asked two questions. First, they were asked for their CHOICE: 'Which of these two gifts would you like to keep?' Second, they were asked to indicate their relative preference (PREF) for keeping one of the two items (1 = Definitely Keep Gift A, 5 = Indifferent, 9 = Definitely Keep Gift B).

*Results and discussion*

For the purpose of analysis, the data were recoded in two ways. First, I coded the two tasks as the S (short) task or the L (long) task. Second, I recoded the gifts as $G_S$ (gift originating from short task) and $G_L$ (gift originating from the long task). Hence, the CHOICE data were coded as a choice for $G_S$ or $G_L$, while the PREF data were coded as 1 = Definitely Keep $G_S$, 5 = Indifferent, 9 = Definitely Keep $G_L$.

In the pure gift condition, 11 out of the 25 respondents (44%) chose to keep $G_L$, a fraction that was not significantly different from 50%. However, in the gift for cash condition, a significantly greater fraction of subjects; as many as 20 out of 25 (80%, $\chi^2(1) = 6.42$, $p < 0.02$) chose to keep $G_L$ instead of $G_S$. The results from the PREF variable mirror the CHOICE data. Specifically, the mean PREF score in the Pure Gift condition was 4.88, which is not significantly different from the indifference score of 5. However, in the Gift for Cash condition, the mean PREF score was significantly higher ($\chi = 6.24$, $t_{48} = 2.49$, $p < 0.02$). Consistent with the earlier results from paper and pencil studies, I found that subjects ignored their sunk time costs in choosing between the two gifts. However, when the conversion of their time investment into an equivalent monetary amount was facilitated, the sunk-cost effect reappeared.

[6]The ultimate variable of interest was the relative value that subjects would place on these two gifts. In order to control for possible differences arising from other sources (e.g. the endowment effect causing the earlier gift to be valued more) I presented both gifts at the conclusion of the experiment. However, subjects were clearly told that Gift A was compensation for the first task and Gift B for the second task.

[7]These time estimates were based on a pretest. There might have been individual differences in the time taken to complete the task, but every subject took a longer time to complete the long task as compared to the short task. Note that since the nature of questions was identical across both tasks, the quality of the investment was identical for both surveys, but the quantity (time) was different.

 

One caveat is in order here. The reasoning behind the present experiment assumes that the quality of the final outcome was not directly linked to the size of the time investment. For instance, there was no reason to believe that the quality of the shot-glass or the paperweight would have been any different whether the subject worked 8 minutes or 25 minutes to earn it. However, there are other classes of everyday decisions in which the time invested in an endeavor might be used as a credible signal of the quality. For instance, in the absence of any external feedback about the quality of his research papers, a student may choose to submit for a research and one that he has worked on for a longer time. In such a situation, people's choices may appear to be consistent with a sunk-cost effect, but in reality may be driven by a rational inference about the quality of the final outcome.

Experiment 6 involved real choices made by individuals who had made real investments of time. The results validated Hypotheses 1 and 2a, namely that the sunk-cost effect was not detected in the domain of temporal investments, but it reappeared when the accounting of time was facilitated.

## GENERAL DISCUSSION AND CONCLUSIONS

### Summary of research

My objective in this paper was to investigate the sunk-cost effect in situations where the past investment was temporal rather than monetary in nature. Using a survey, I provided empirical evidence to support my contention that people may not mentally account for time in the same manner as they account for money. In three experiments, I found support for the hypothesis that the sunk-cost effect would be weak for temporal investments. Two further experiments helped to establish that this lack of attention to sunk costs was not due to increased rationality but rather to difficulties in mentally accounting for time. When this accounting was facilitated by an experimental manipulation, the sunk-cost effect reappeared.

This research joins prior work by Heath (1995; Heath and Soll, 1996) in identifying situations where the sunk-cost fallacy does **not** occur. Like Heath, the present research argues that the absence of the sunk-cost effect occurs due to a constraint in the mental accounting process. However, unlike Heath, who argued that the constraint is in the form of an endogenously set budget, the present research shows that the constraint is in the form of an inability or unwillingness to account for time using the same principles as those used with money.

### Contributions

The present research extends the literature in mental accounting and the sunk-cost effect in two specific ways. First, this paper is the first systematic investigation of time as an investment. Prior experiments on the sunk-cost effect have always used monetary investments and no attempt has been made to catalog similarities and differences between monetary and temporal investments. By taking a first step in this direction, the present research makes a start at understanding how individuals account for time investments. Second, these results provide further support for the importance of studying mental accounting processes. It seems that people are compulsive mental accountants of money—whenever the conversion of a non-monetary resource to a monetary equivalent is facilitated, people naturally seem to start setting up mental accounts and to want to close these accounts 'in the black'.

### Limitations

The present research was not without limitations. First, I was able to show that the sunk-cost effect is not observed when sunk costs are temporal in nature. I was also able to show that the effect reappears when the value of time is made salient. However, my investigations did not allow me to determine the single under-

 

lying explanation for these effects. For instance, it is possible that individuals do not follow conventional 'red and black' accounting systems with time because it is cognitively more difficult. Alternately, it is equally likely that accounting for time is a more 'unnatural' activity and hence it is routinely not done unless prompted by the external manipulations. Further research could investigate which of these two (or more) explanations drive the observed effects.

Second, as in the real world, the time manipulation in the experiments was also confounded in many instances with the total effort expended. For instance, working as a research assistant for 15 hours presumably involved more effort than working for 5 hours. In other experiments not reported here, there was little or no confound. For instance, a 15-minute bus ride needed to get a sports ticket probably involves the same effort on the individual's part as a 60-minute bus ride. In my experiments, I found similar results both for situations in which a confound existed and for one in which it did not. However, this confound raises a broader issue in research on time and effort investments since, ecologically, time and effort are almost always deeply confounded. A more complete treatment of the sunk-cost effect should involve an orthogonal manipulation of time, effort, and monetary investments in order to isolate the effects of each on current decisions.

## Discussion and directions for future research

Three points of discussion are in order. First, in my experiments, changing the size of the sunk-time investment did not impact current decision making. In all experiments, I tried to control for the quality of the experience and only changed its quantity. However, research on time perception suggests that it is possible that the same quantity of time investment may have a different sunk-cost impact in different settings, i.e. when the *quality* of the experience was different. For instance, individuals might be more determined to recover their 5-hour investment of working as a research assistant if the work was tedious (e.g. data coding) rather than something enjoyable (e.g. viewing advertisements or feature films). The effect of time quality on its sunk-cost impact is an interesting avenue for future research to pursue.

Second, what implications might my results have for educating individuals to avoid the sunk-cost pitfall? If people do not naturally think of time investments in accounting terms, it may be possible to express past monetary expenses in terms of time equivalents in an effort to reduce attention to sunk costs. For instance, I surveyed employees of an investment bank in India who earned approximately the same monthly salary[8], and who had rated 'watching a one-day cricket match' as a more enjoyable activity than 'taking a weekend trip'. I asked some of them ($n=22$) the following question: 'Imagine that you had purchased a ticket to a one-day cricket match for Rs. 450 and spent Rs. 1350 on a weekend trip. Both expenses are non-refundable and not transferable. Due to bad weather, the match gets rescheduled and now coincides with your weekend trip. You can only go to one of the two, which one will you go to?' Contrary to their prior preferences, as many as 13 (59.1%) said they would take the weekend trip. I asked a second group of 19 employees a similar question, but framed the expenses as time. Specifically, I asked: 'Imagine that you had purchased a ticket to a one-day cricket match and prepaid for a weekend trip. The ticket cost the equivalent of one day's work at office, while the trip was the equivalent of 3 days' work'. In this frame, only 6 (31.6%) respondents opted for the trip. While the difference barely approached significance ($p=0.08$), these data are provocative enough to warrant a more detailed investigation.

Finally, I find that people appear rational in their approach to sunk time costs, but educating them about the economic value of time actually makes them irrationally pay attention to sunk costs. This finding is similar to the economic theory of second best (Layard and Walters, 1978; Lipsey and Lancaster, 1956), which refers to

[8]All the employees surveyed earned approximately Rs. 12,000 ($\sim$ \$300) per month and were made aware that their daily wage was approximately Rs. 460 ($\sim$ \$11.54).

 

situations in which a friction or constraint of some kind prevents market efficiency.[9] The theory postulates that in such conditions, it may be better to have another friction to counteract the existing friction and restore a degree of market efficiency. In other words, if two conditions of market efficiency are violated, you may make things worse by only fixing one of them. Consistent with this theory, my subjects displayed 'pseudo-rationality' because they had two frictions—they had the tendency to attend to sunk money costs, and they were unaware or uneducated about the time value of money. Fixing the second problem removed the pseudo-rationality and made them behave irrationally.

## ACKNOWLEDGMENTS

I thank Julien Cayla, Amar Cheema, Kareen Kinzli and Vivian Man Wai Lam for research assistance, and Donnie Lichtenstein, J. Frank Yates and three anonymous reviewers for comments and suggestions on previous drafts. I also acknowledge the support of the College of Business at the University of Colorado at Boulder.

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[9]I thank an anonymous reviewer and Uday Rajan for discussions on the theory of second best.

 

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