

Mental Budgeting Versus Marginal Decision Making: Training, Experience and Justification Effects on Decisions Involving Sunk Costs

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ABSTRACT

Many studies have shown that individuals make economically irrational decisions by using, rather than ignoring, sunk cost information. In this study, the effects of relevant academic training, financial experience and decision justification on investment decisions involving sunk costs were examined. Data on both the process (strategy) and outcome of the decisions were collected. The results indicate that practicing Certified Public Accountants (CPAs), Masters of Business Administration students (MBAs) and undergraduate accounting students perform better than undergraduate psychology students. The level of training, as measured by the number of college courses in managerial accounting, was found to be positively correlated with performance, while the level of experience, as measured by years of financially-related work, was not. Justification was found to improve decisions only for those participants with significant work experience (MBAs and CPAs). Strategies used in this type of decision were examined with the surprising finding that economically rational decisions can be made even if sunk costs are not ignored. Copyright © 2007 John Wiley & Sons, Ltd.

KEY WORDS sunk costs; mental budgeting; justification

INTRODUCTION

Many decision making studies have examined the effect of sunk costs, or costs that result from expenditures made in the past and that present or future decisions cannot change. The typical decision involves a situation in which significant sums of money have already been invested in a project and the decision maker must decide whether or not to invest more money to complete the project. All but a few of the studies have concluded that individuals are significantly influenced by sunk costs and this leads them to make poor decisions.

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Most studies in this area have documented escalation behaviour, in which individuals tend to 'throw good money after bad' (e.g. Arkes & Blumer, 1985; Garland, 1990; Staw, 1976; Thaler, 1980). People continue to invest because of the sunk costs that they have already incurred. Heath (1995), however, found that individuals (undergraduate students in that study) are sometimes more likely to *de-escalate* commitment by halting investment even when future benefits exceed future costs. He proposed that individuals use a type of 'mental accounting' called 'mental budgeting'. In general, mental accounting is a cognitive process of coding, categorizing and evaluating events (e.g. Thaler, 1980, 1985). Specifically, mental budgeting involves the comparison of total expenditures (including sunk costs and proposed future expenditures) to total expected benefits in order to make investment decisions. De-escalation then occurs because sunk costs cause decision makers to believe that they have spent too much already. They do not wish to continue investing even though the future benefit of a project exceeds its future costs.

Mental budgeting violates the training received by students in economics and managerial accounting courses. Such students are taught to make marginal decisions by ignoring sunk costs and therefore only considering future costs and benefits. Business decision makers such as practicing accountants are often involved in investment decisions that contain significant sunk costs such as product line additions or deletions, special order pricing and plant capacity changes. Since clients rely on the advice of such professionals, it is important to determine whether the training and experience that they receive can overcome the frequently documented bias toward misusing sunk cost information.

One purpose of the current study is to examine how individuals with different training and experience deal with sunk costs that are high enough to cause those who use a mental budgeting strategy to reject profitable investments. We are specifically interested in whether training and/or experience can overcome the mental budgeting strategy documented in Heath's (1995) undergraduate students. Another purpose is to examine the strategies that individuals use to make these types of decisions and to determine whether justifying those decisions can alter strategy selection so as to improve decision making. In most investment decision contexts, decision makers must justify or explain their decision to continue to invest in a project. Since the act of explanation can change decision processes (e.g. Koonce, 1992), it would be useful to know how it affects decision making in this context. By employing written protocol methods to identify decision processes, we hope to identify not only performance differences between students and experienced decision makers but also the strategies responsible for those differences. This should provide a better understanding of the process of how individuals deal with sunk costs and aid in the determination of whether decisions involving them pose a serious concern for professional decision makers.

The next section outlines the concept of mental budgeting and reviews previous studies of sunk costs and the effects of training and experience. An experiment is then conducted to examine the effects of training and experience on performance in an investment task involving sunk costs.

MENTAL BUDGETING, TRAINING AND EXPERIENCE

The investment task chosen for the current study is based on Heath (1995). In an experiment, he provided undergraduate student participants with six real estate projects (see the Appendix). Each project had clearly identified previous costs, future investment and future return (i.e. a sales forecast). Participants in that experiment were given either the high sunk cost versions (i.e. the 'a' versions in the Appendix) or the low sunk cost versions (i.e. the 'b' versions) to evaluate. The task was simply to identify which projects to continue. Although the returns of the projects varied from 356 to 512 per cent (and the alternative investment was given as 15 per cent), participants largely refused to continue projects when sunk costs were high. For example, in Project 1 where the future investment was \$1.55 million and the sales forecast was \$6.66 million, 58 per cent of the participants refused to invest when the previous costs were \$6.58 million. No one refused to invest when there were zero previous costs. Results for the other projects were similar, with a substantial

percentage of participants refusing to invest when sunk costs were high and nearly zero doing so when they were low.

The above behaviour is an example of de-escalation. Individuals refuse to invest when sunk costs are high. It is a clear violation of marginal decision making, and it occurred even though the experimental stimuli were simple and well labelled. Even when the returns were huge, participants chose to forgo them when they felt that too much had been spent in the past.

Heath (1995) proposed that individuals engage in a process of mental budgeting in which they (1) set a budget for an investment, (2) track ongoing investments against that budget and (3) cease investing when the investments exceed the budget. For example, in Project 1 in the Appendix, participants in his experiment refused to invest an additional \$1.55 million to earn \$6.66 million because the total spent (\$8.13 million, including the \$6.58 million sunk cost) exceeded the budget of \$6.66 million. For Heath's undergraduate students, this strategy of mental budgeting was apparently widely used. Unfortunately, that strategy led them to make poor investment decisions.

The participants in Heath's (1995) study were generally not trained to deal with sunk costs nor were they experienced in financial decision making. A general finding in the expertise literature is that relative to novices, experts utilize richer decision making and problem-solving strategies and they are better able to evaluate the appropriateness of those strategies (Johnson, 1988). In the case of sunk costs, novice decision makers may follow the strategy of mental budgeting while experts may employ the principles of marginal decision making. According to Anderson's model of skill acquisition, three key elements of expertise development are (1) acquisition of declarative knowledge, (2) application of such knowledge to tasks and (3) acquisition of immediate feedback regarding the appropriateness of the application of the knowledge to tasks (Anderson, 1982, 1987, 1995). We propose that training, in the form of relevant college coursework, would provide the declarative knowledge and perhaps some of its application and that financially related experience would provide repeated application and feedback.

In the next two sections, we examine the possibility that economic training and/or professional financially related experience might overcome the tendency of untrained and inexperienced individuals to engage in mental budgeting in the face of significant sunk costs. An experiment follows to test that possibility.

Training

Although most studies of sunk cost effects have generally examined the behaviour of economically untrained participants (such as undergraduate psychology students), some have examined the behaviour of participants that had been specifically trained to ignore sunk costs in making investment decisions. Conlon and Parks (1987) allowed Masters of Business Administration (MBA) students access to both retrospective (i.e. sunk cost) and prospective information. These participants generally violated marginal decision making by requesting information concerning past costs instead of future costs. Garland and Newport (1991) found that both undergraduate business students' and MBAs' willingness to commit funds to complete a project were in direct proportion to the amount of sunk cost involved. Shanteau and Harrison (1991) examined the behaviour of accounting undergraduate and MBA students, concluding that a large proportion of their decisions violated their training. Overall, the results of these and other studies have generally not found economically normative behaviour in a business student population that should be well trained to make these types of decisions.

In a study comparing accounting and non-accounting undergraduate students, Tan and Yates (1995) attempted to show differences in behaviour between the two groups. They replicated simple tasks used in the psychology literature, adding critical information concerning the future benefits to be received from a project. Their experimental project had either zero or \$7 million of sunk cost, expected future costs of \$3 million and expected sales of \$8 million. Their findings indicate that when future benefit information was provided, there was no difference in investment behaviour due to the presence or absence of sunk costs. There was also no difference in behaviour between the accounting students and non-accounting students. However, even though

this project's return was over 250 per cent, 44 per cent of the accounting students and 26 per cent of the non-accounting students refused to invest. The reasons for this troubling level of non-marginal decision making by accounting majors could not be determined with the methodology used in the study. Therefore, it is unclear what factors might account for marginal and non-marginal decision making.

In one of the few studies that has documented a reduction in the sunk cost effect in economically trained individuals, Larrick, Morgan, and Nisbett (1990) found that economics professors make more economically normative decisions than those in biology, art history and romance languages. They also found that brief training of undergraduate students in economic principles caused them to make more marginal decisions. The conclusion of their study was that although individuals are not normally rational by economists' standards, they are capable of making more economically rational decisions through training.

Two studies have attempted to find a correlation between specific training and performance in these types of economic decisions. First, Arkes and Blumer (1985) collected information concerning the number of economics classes completed by their undergraduate participants. They found that the sunk cost effect was not mitigated by such education. Larrick, Nisbett, and Morgan (1993) examined the behaviour of two groups of participants, college seniors and college faculty. For the student group, the number of college economics courses did not lead to better performance in a group of questions designed to measure whether the individuals ignored sunk costs in their decisions. For the faculty group, however, the number of economics courses was correlated with higher performance. This is consistent with the finding of Larrick et al. (1990) that economics professors made more economically rational decisions than other professors. It should be noted, however, that the performance increases for the economics professors might be the result of having repeatedly taught the concepts of marginal decision making.

Taken together, these studies provide an unclear picture of what type of training leads to more marginal decision behaviour. In the current study, economic training is measured by the number of college managerial accounting courses taken. This measure was chosen due to the emphasis on marginal decision making in these classes. Sunk costs are also explicitly discussed in managerial accounting courses and they are included in virtually every managerial accounting text (e.g. see Horngren, Datar, & Foster, 2003). Therefore, it seems likely that individuals with that type of training will overcome the tendency to engage in mental budgeting in the face of significant sunk costs. We also collected information on the number of economics courses so we could compare our results to those of previous studies and the number of financial accounting courses to determine what impact they might have on the type of decision studied here.

Experience

There have been few studies of the effect of sunk costs on the decisions of experienced individuals. In a study of oil exploration investment behaviour, Garland, Sandefur, and Rogers (1990) asked expert geologists to make investment decisions in their domain. This context was very familiar to the geologists and it clearly involved sunk costs (i.e. dry holes). The results indicate that as the number of dry holes increased, the geologists were less willing to authorize funds. This appropriate de-escalation behaviour was not observed in undergraduate business students who also completed the experiment. In this context, experience did improve decision making.

Two field studies have examined behaviour in real world contexts involving sunk costs. Staw and Hoang (1995) showed that National Basketball Association teams granted more playing time to their most highly drafted players and retained them longer, even after controlling for performance, injuries, trade status and position played. Similar results were identified by McCarthy, Schoorman, and Cooper (1993), who examined the investment behaviour of entrepreneurs. Their results indicate that entrepreneurs who had started their firms (as opposed to purchasing them) were more likely to make expansion (i.e. escalation) decisions. Thus, in these two studies, experience did not lead to improved decision making.

As with economic training, past studies of decision making experience provide mixed results as to the effect of experience on the quality of decisions involving sunk costs. In the current study, we measure experience in two ways, one general and one specific. The general measure involves the use of different groups of participants, including undergraduate psychology students, undergraduate accounting students, MBA students and practicing Certified Public Accountants (CPAs). The more specific measure is the participants' number of years of financially related work experience. Based on Anderson's (1982, 1987, 1995) model of skill acquisition and Johnson's (1988) discussion of expertise and problem-solving strategies discussed previously, we predict that individuals with higher levels of declarative knowledge (i.e. individuals with more managerial accounting coursework) and more work experience will perform better in the type of sunk cost problem examined here than those individuals with less knowledge or experience.

EXPERIMENT 1

This experiment utilizes Heath's (1995) task because it led to obvious and serious departure from economically rational decision making. Northcraft and Wolf (1984) and Bowen (1987) have argued that many studies of the sunk cost effect did not show that participants were clearly economically irrational in their behaviour since the data they were given did not include information concerning future revenues and costs. The task studied here involves an unequivocal decision context containing clear information about the future. The decision structure leaves little room for doubt as to which action is economically rational. As in Heath, data were collected for both high and low sunk cost projects. However, the primary interest in the current study is the examination of behaviour concerning those project choices having high sunk costs since the choices with low sunk costs leave little opportunity for economically irrational behaviour.

Method

Participants

Eighty CPAs, 61 MBA students, 105 undergraduate accounting (UGA) students and 57 students enrolled in an introductory psychology class (PSY) participated in the experiment. The CPAs had an average of 14 years of work experience and were presented the exercise during a continuing professional education course. The MBA students had an average of 2 years of work experience and were enrolled in a managerial accounting class. The UGA students were in their junior or senior year and enrolled in a managerial accounting class. For the MBA and UGA students, the exercise was completed after the point in time where sunk costs and their irrelevance to current decisions were discussed. The PSY students were largely freshmen and sophomores fulfilling their commitment to participate in research studies as part of their introductory psychology class.

Design and procedure

Participants were asked to make six independent investment decisions of whether or not to continue real estate projects. The Appendix shows two alternative presentations for each of six possible projects, one with a high sunk cost and one with low. The only difference between the two alternative presentations is the amount of sunk cost involved. Each participant was shown three high sunk cost projects (i.e. version 'a' in the Appendix) and three low sunk cost projects (i.e. version 'b'). All six projects represent good marginal investments, so the correct decision in each case would be to continue the project. One possible exception is Project 6, which has a probabilistic return. Although the expected value of the return is significantly higher than the 15 per cent alternative return, the lowest possible return (\$2.23 million) is not. In addition to selecting whether they would continue the project, participants were also asked to report their number of managerial

Table 1. Experiment 1 results

Panel A—mean (standard deviation) number of correct responses^a

	PSY	UGA	MBA	CPA
High sunk cost projects	0.56 (0.91)	1.15 (1.22)	1.52 (1.30)	1.39 (1.33)
Low sunk cost projects	2.77 (0.50)	2.78 (0.52)	2.77 (0.42)	2.66 (0.57)

Panel B—mean (standard deviation) number of courses and years of experience

	PSY	UGA	MBA	CPA
Economics	0.21 (0.59)	3.67 (1.27)	2.97 (2.81)	2.73 (1.65)
Finance	0.04 (0.19)	1.45 (1.62)	2.59 (2.34)	2.75 (1.78)
Managerial accounting	0.04 (0.19)	1.56 (0.76)	1.43 (0.90)	2.08 (0.91)
Financial accounting	0.04 (0.19)	2.90 (1.42)	1.95 (1.49)	6.58 (3.27)
Years of experience	0.00 (0.00)	0.30 (0.67)	1.59 (2.81)	13.88 (9.31)

Panel C—correlation coefficients for number of courses, years of experience, and number of correct responses for high sunk cost projects

	Economics	Finance	Managerial	Accounting	Years	Correct responses
Economics	—	0.324 ($p < .01$)	0.407 ($p < .01$)	0.236 ($p < .01$)	0.106 ($p = .06$)	0.139 ($p = .02$)
Finance		—	0.484 ($p < .01$)	0.402 ($p < .01$)	0.221 ($p < .01$)	0.066 ($p = .25$)
Managerial			—	0.612 ($p < .01$)	0.307 ($p < .01$)	0.172 ($p < .01$)
Accounting				—	0.590 ($p < .01$)	0.084 ($p = .14$)
Years					—	0.022 ($p = .71$)
Correct responses						—

^aOf three correct responses possible.

accounting, economics and financial accounting college courses taken and their number of years of experience in financially related work.

Results

Although it is only the high sunk cost condition that is of interest here, for completeness analyses were performed on both the high sunk cost and low sunk cost projects. Panel A of Table 1 shows a summary of the mean number of correct responses by group. An ANOVA indicated that the difference in the number of correct responses between participant groups for the high sunk cost projects is significant [$F(3, 299) = 7.35, p < .01$]¹. For those projects involving low sunk costs there was no significant difference across groups as all four groups selected near the maximum number of three correct responses. For the high sunk cost condition, Tukey's HSD test showed that PSY students performed at a lower level than the MBA and CPA groups ($p < .01$), and also at a lower level than the UGA group ($p < .05$). There were no other significant pairwise differences.

Panel B of Table 1 shows the descriptive statistics for college coursework and years of experience and Panel C shows the correlation coefficients for the college coursework, years of experience and correct

¹Due to the non-normality of the number of correct responses data, non-parametric analyses (Wilcoxon Two-Sample Tests) were conducted. The results were consistent with the parametric tests reported.

Table 2. Analysis of effect of coursework and work experience on performance for high sunk cost projects (Experiment 1)

Source	df	SS	MS	F-value	p-value (one-tailed)
Model	5	17.6438	3.5287	2.29	.046
Error	297	456.7324	1.5378		
Total	302	474.3762			

Variable	df	Parameter estimate	Standardized estimate	t-value	p-value (one-tailed)
Intercept	1	0.8292	0	6.22	<.0001
Economics	1	0.0515	0.08628	1.37	.087
Finance	1	-0.0210	-0.03272	-.49	.312
Managerial	1	0.2032	0.16727	2.10	.018
Accounting	1	-0.0043	-0.01038	-.12	.452
Years	1	-0.0042	-0.02545	-.36	.360

Adjusted $R^2 = 0.0210$.

responses. The effect of training (number of college courses) and experience (the years of financial experience) on the number of correct responses was analysed using multiple regression (see Table 2). The number of managerial accounting courses was positively related to performance ($t = 2.10$, $p = .02$), but the number of economics courses was not ($t = 1.37$, $p = .09$). There was no relationship between the number of correct responses and the number of years of work experience ($t = -.36$, $p = .36$).

Discussion

This study showed that individuals trained in sunk costs in managerial accounting courses performed better at this task than untrained students like those studied by Heath (1995). Economics coursework was not so correlated, consistent with Arkes and Blumer (1985) and with the student participants in Larrick et al. (1993). As discussed earlier, sunk costs are specifically discussed in managerial accounting courses. However, it is likely that only certain economics courses address the topic of sunk costs. Courses concerning macro-economic policy or topics such as money and banking would likely not deal with the issue of marginal decision making. Therefore, managerial accounting classes would better provide the training needed to make good decisions in this context.

The results for the effect of experience are not as obvious, as one of our measures of experience (years of financially related experience) was not correlated with performance but the other (groups with significant work experience, i.e. CPAs and MBAs) was. As previously noted, two elements of expertise development are knowledge application and feedback acquisition. It may be possible that many types of 'financially related' decisions do not involve sunk costs and, therefore, individuals with this type of work experience had neither sufficient application of their knowledge nor adequate feedback on their decision making models. Therefore, our specific measure of years of financially related experience was not adequate to capture the type of experience needed to fulfil Anderson's (1982, 1987, 1995) application of knowledge and feedback elements of expertise development.

Another possible mechanism for improving performance in sunk cost decision making situations is for individuals to justify their decisions. As discussed earlier, such justification is routinely required in many business decision contexts. The next section outlines the concept of justification and presents an experiment designed to examine its effect on performance in an investment task involving sunk costs as well as to gather data on the strategies individuals use to make decisions in these situations.

DECISION JUSTIFICATION AND STRATEGY SELECTION

Johnson and Kaplan (1991) define justification as the actual physical and/or mental process of explaining a judgment. In the investment decision examined in the current study, justification is the process of explaining the decision by calculating and documenting the support for the choice to continue the investment or not. For this task, we expect that the justification process will cause decision makers to become more self-critical of their judgment process. This prediction comes from the study of the related construct of accountability (see Peecher & Kleinmuntz, 1991 for a discussion of the relationship between justification and accountability). Johnson and Kaplan define accountability as the pre-existing expectation that justification might be called for. Tetlock (1983) also discusses accountability in terms of justification, defining it as the social pressure to justify one's decisions to others. Although participants in the current study are not directly accountable for their decisions (i.e. the responses are all anonymous), the request for their justification would likely cause them to follow the same processes as they would if they were made accountable.

One of the overall conclusions of many studies of decision justification and accountability is that their effects are highly variable across tasks and individuals (see Lerner & Tetlock, 1999 for a review of accountability studies). Depending upon the decision context, accountability has been found to improve, degrade, or not change performance (e.g. Simonson & Nye, 1992). Improvement has generally been documented when (1) poor performance resulted from a lack of self-critical attention to the judgment process and (2) improvement required no special training in formal decision rules, only greater attention to the information provided. In the investment decision context studied here, the effect of justification would likely depend upon whether individuals had the marginal decision making strategy in their repertoire. We expect that likelihood to depend on the training and/or experience that the individual had received.

For Heath's (1995) undergraduate students, mental budgeting was the predominant strategy. It is likely that without training and/or experience, most undergraduate students have no knowledge of a marginal decision strategy. Their mental budgeting approach would persist even if they engage in more self-critical attention to their decision processes because they have no other strategy to utilize. With training or experience, individuals are likely to learn better strategies, such as that of marginal decision making. If this is the case, justification may lead some of those who might otherwise engage in mental budgeting to adopt a better strategy that will result in better decisions. This leads us to predict that the act of decision justification will lead to increased performance for highly trained and experienced individuals but not for inexperienced, untrained ones.

A second experiment was conducted to test this hypothesis and to gather more direct data on the strategies used to approach the type of decision problem studied here. In previous studies, such as Heath (1995), the decision strategies used by the individuals were inferred from the outcome of the decision. While it is reasonable to infer that the better decision makers were using the marginal strategy of ignoring sunk costs while the poorer ones were using mental budgeting or some other strategy, a more direct examination of the process would provide stronger evidence of the strategies used.

EXPERIMENT 2

This experiment is essentially the same as the first, except that participants were required to justify each of their six decisions with written calculations and narrative explanations. The purpose of the experiment was (1) to determine what strategies individuals used to make these investment choices and (2) to determine the effect of justification on this type of decision. The participants included 58 undergraduate PSY students, 38 UGA students, 58 MBA students and 71 practicing CPAs. For all the student participants, data were collected in a subsequent semester to that of the first experiment. The students were recruited from the same courses as the first experiment, and the UGA and MBA students again completed the exercise at a point in time in the

course following discussions of sunk costs. The PSY students were from the same pool of undergraduate psychology students. The CPAs were attending continuing professional education courses in different cities than those who completed the exercise for the first experiment. The results of the first experiment were not published or communicated to any of the participants in the second experiment in order to assure that the only difference between the first and second experiments was the request that the decisions be justified.

Results

Strategy selection

From the written explanations, it was determined that all but 14 of the participants used one of four distinct strategies to make their decisions (see Table 3). The strategy of mental budgeting, documented by Heath (1995), was the modal strategy for the psychology (74 per cent) and undergraduate accounting (47 per cent) students. Those participants added the 'Previous Costs' to the 'Future Investment' and compared that total to the 'Sales Forecast'. If the former exceeded the latter, they did not continue to invest in what would have been a profitable project.

A strategy of marginal decision making was characterized by not using the 'Previous Costs' in any calculations and/or identifying such costs as 'sunk' or otherwise irrelevant to the decision. It was expected that training and/or experience would lead to this type of strategy. It was the most used strategy for the MBA participants (33 per cent), and 23 per cent of the CPAs used that strategy.

In a third widely used strategy, participants compared the loss of the sunk cost if the investment was not made with the loss that would occur if the investment was made. The latter calculation involves adding the costs as in mental budgeting and then subtracting the amount to be received. For example, in Project 1 for the high fixed cost condition, participants added \$6.58 million to the \$1.55 million to get \$8.13 million. They then subtracted \$6.66 million to get a loss of \$1.47 million and compared this loss of making the investment to the loss of the sunk cost if the investment were not made (i.e. \$6.58 million). Their conclusion was to make the investment due to the lower loss. A typical explanation was 'Spending \$8.13 million and getting \$6.66 million back is better than spending \$6.58 million and getting nothing back'. This 'loss comparison' strategy was the overwhelming choice (48 per cent) of the CPAs and the second most used strategy of the MBAs (26 per cent).

Only a total of 11 participants used a clear escalation strategy, making statements like 'since a large amount has already been invested, I would proceed with the investment'. This strategy led to the correct decision, but for the wrong reason.

Justification effects

As with the first experiment, the decisions of interest are the three high sunk cost scenarios. Overall, justification improved the decision making for the investment task studied here [$F(1, 520) = 13.50, p < .01$,

Table 3. Analysis of strategy selection

Strategy	Per cent (number) of strategies used			
	PSY	UGA	MBA	CPA
Mental budgeting	74 (43)	47 (18)	22 (13)	25 (18)
Marginal decision-making	2 (1)	13 (5)	33 (19)	23 (16)
Loss comparison	9 (5)	34 (13)	26 (15)	48 (34)
Sunk cost (escalation)	5 (3)	0 (0)	9 (5)	4 (3)
Undeterminable	10 (6)	5 (2)	10 (6)	0 (0)

Table 4. Analysis of justification effects for high sunk cost projects

	Mean (standard deviation) number of correct responses ^a			
	PSY	UGA	MBA	CPA
Justification (Experiment 2)	0.55 (0.92)	1.37 (1.36)	2.12 (1.19)	2.06 (1.17)
No justification (Experiment 1)	0.56 (0.91)	1.15 (1.22)	1.52 (1.30)	1.39 (1.33)

^aOf three correct responses possible.

by ANOVA]². Pairwise comparisons were made in order to determine the effect of justification for each group of participants (see Table 4). For the PSY group, performance was nearly exactly the same for those who were asked to justify their decisions as for those who were not ($t = .04$, two-tailed $p = .96$). UGA participants improved from 1.15 to 1.37, but that improvement was not statistically significant ($t = .96$, two-tailed $p = .34$). For MBAs and CPAs, justification resulted in significant improvement in their decisions. Those MBAs who were asked to justify their decisions made 2.12 correct choices compared to 1.52 for those who did not ($t = 2.73$, one-tailed $p < .01$). For the CPA group the improvement was from 1.39 to 2.06 ($t = 3.45$, one-tailed $p < .01$). The interaction between justification and the type of participant was significant [$F(3, 520) = 2.27$, $p = .04$, by ANOVA].

Discussion

This experiment provides significant insight into what strategies individuals use when faced with an investment decision. One surprising finding is that 30 per cent of the participants in this study used a strategy that does not ignore sunk costs, but yields the same decision as with marginal decision making. The loss comparison strategy was favoured by those participants with significant financially related experience (i.e. MBAs and CPAs). It is interesting to note that these two groups had no more training (in the form of managerial accounting courses) than the undergraduate accounting students who favoured the mental budgeting strategy and, therefore, did not perform as well.

The effect of justification in this context was generally as predicted. The performance of the undergraduate students (psychology and undergraduate accounting) who did not justify their decisions was the same as those who did. The MBA students and practicing CPAs who justified their decisions did perform better than those who did not. We posit that this improvement is the result of more self-critical attention to the judgment process, which led those individuals to adopt better strategies. The undergraduate students, having an average of less than 1 year of financially related experience, generally knew no strategy other than mental budgeting, so more self-critical attention to the judgment process could not lead to a change in strategies. The more financially experienced MBAs (average 2 years) and CPAs (average 14 years) had developed better strategies such as marginal decision making and loss comparison so they were able to change from mental budgeting when asked to justify.

The most interesting result in this study is the finding of *how* performance improved for the MBA and CPA participants. In Experiment 1, where there was no justification, both groups performed at the same level (1.52 correct for the MBAs, 1.39 for the CPAs). Although strategy data was not collected in that experiment, it can be assumed that both groups use the mental budgeting strategy at about the same level since that is the only documented strategy which leads to incorrect decisions in this context. Both groups improved when asked to

²As with Experiment 1, non-parametric analyses were conducted. The results were consistent with the parametric tests reported.

justify, with a level of 2.12 correct for the MBAs and 2.06 for the CPAs. Further analysis of the data in Table 4 reveals that those two groups used different strategies to achieve their improvement ($\chi^2 = 4.75, p = .03$). The MBAs switched from mental budgeting to a strategy of marginal decision making while the CPAs switched to the loss comparison strategy. A comparison of the number of financial accounting courses completed shows that CPAs, with an average of six courses, have more training of this type than the MBAs who have an average of slightly fewer than two courses ($t = 7.40, p < .01$). It is interesting to note that managerial accounting and financial accounting treat sunk costs in opposite ways. As discussed previously, managerial accounting emphasizes marginal decision making, advising decision makers to ignore sunk costs and only consider future costs and benefits. Financial accounting *requires* that sunk costs be measured and reported. Indeed, financial reports such as income statements and balance sheets involve the categorization and compilation of sunk costs. Therefore, it makes sense that CPAs would adopt a strategy that is most closely aligned with their training and experience.

CONCLUSIONS

The first goal of this study was to examine the effect of sunk costs on individuals who had a wide range of training and experience. The results of the current study generally do show improvement in decision making in trained and experienced individuals. Undergraduate accounting students, MBA students and practicing CPAs all made better decisions than undergraduate psychology students, the population that Heath (1995) found to largely use a mental budgeting strategy.

An alternative explanation for the finding that business school students and professional accountants perform better than undergraduate psychology students is one of self-selection. It is possible that those who pursue a profession of financial decision making may systematically approach financial problems in a different way from those who do not. For example, in Larrick et al. (1990) study, economics professors may have outperformed those in other liberal arts fields because the former group tends to be more economically rational and that is why they chose to pursue a career in economics. If this is the case, the undergraduate psychology students, only a small percentage of which will choose a business education and profession, might never acquire the declarative knowledge or the experience to overcome their tendency to mentally budget.

Another goal of this study was to examine the strategies used to approach this type of decision problem. Based on the results of Heath (1995) and the current study, mental budgeting seems to be the predominant strategy of untrained and inexperienced individuals (i.e. the undergraduate psychology students and the undergraduate accounting majors). The most interesting strategy documented in this study is that of loss comparison, where individuals compared the losses under both the invest and do not invest scenarios. This was the second most used strategy for the MBAs and the most used for the CPAs. Although the process is different, the outcome is the same as that of the marginal decision strategy of ignoring sunk costs. This leads to the subtle point that sunk costs need not be ignored in making good decisions. With this strategy, correct decisions are made not by ignoring sunk costs but by attending to them consistently.

There are at least two reasons why CPAs and other financially trained individuals might tend to adopt the loss comparison strategy. First, in real world settings, managers are probably evaluated on a *portfolio* of investments over some period of time (Johnstone, 2003). Since performance is assessed over a period of time and over a number of projects, it would seem reasonable that individuals would calculate how individual projects would affect their portfolio of investments. Smaller losses would aid overall portfolio performance more than large losses, even if those losses include sunk costs in their calculation.

Another reason that trained accountants might utilize a strategy that compares losses is the training that they receive in financial (as opposed to managerial) accounting. Such training *requires* the utilization of

sunk costs to determine the profit or loss for a project or entity over a period of time. Although the task required in the current experiment was set up as a one-time decision, accountants might naturally calculate the profit or loss from each investment since that is the way they prepare performance reports. These reports, such as income statements and balance sheets, require that sunk costs be explicitly considered and accounted for.

The final goal of this study was to examine the effect of justification on decisions involving sunk costs. The finding that MBAs' and CPAs' performance improved when they were asked to justify their choices supports the notion that justification alters decision making processes in this context. Specifically, justification caused more attention to the judgment process, leading some of those MBAs and CPAs who would otherwise have used a mental budgeting strategy to use a better one. MBA students improved their performance by switching to a marginal decision making strategy while the CPAs switched to one of loss comparison. For the psychology students there was no effect of justification, probably because they had no other strategy to use. The implication of this finding for CPAs and other financial decision makers is that reporting relationships should be structured such that decisions are justified in order to assure as much self-critical attention to the decision process as possible.

Although this training and experience allowed MBA students and CPAs to perform better than the undergraduate psychology students in the current study, the absolute level (22 per cent for MBA students and 25 per cent for CPAs) of mental budgeting on the part of these well-trained decision makers has implications for those who educate business students. Given the pervasive findings of so many studies that the presence of sunk costs leads to poor decision making, maybe accounting texts and professors should do more to alert students about the psychology of decisions made in the presence of sunk costs.

Another implication of the current study involves the relatively poor performance of undergraduate psychology students in the current study. Such performance calls into question the use of such individuals as surrogates for real world decision makers. This concern is echoed in a study by Chang and Ho (2004) in which the behaviour of experienced managers was found to be significantly different than that of undergraduate business students in a project continuation task. If the goal of future research in this area is to understand the behaviour of real world decision makers, student surrogates should be used with caution.

Such future studies of sunk cost effects might examine more detail about individuals' training and experience. First, more information about the timing and content of college courses taken might be helpful. For example, it is probably the case that many economics courses do not address the subject of sunk costs and would therefore be of little use as training for the types of decisions studied here. Second, future studies might specifically examine those professional decision makers who routinely make decisions involving sunk costs. The point of the current study was to examine the behaviour of individuals who *should be* expected to make good decisions. Individuals who rely on the advice of their accountants would undoubtedly expect them to give high-quality investment decision information. If future studies examine only those individuals who actually make investment decisions as part of their current activities, the effect of that specific experience could be determined.

Finally, future studies could examine procedures that, like justification, might improve performance in the type of decisions studied here. There have been some efforts made in this direction. Northcraft and Neale (1986) found that investment decisions could be improved if opportunity costs (i.e. the return received if the investment is not continued) were made more explicit. Ghosh (1997) found that investment decisions improved when individuals were provided with unambiguous feedback of previous expenditures and about future benefits of additional expenditures. Improvement was also documented when the decision makers were required to prepare progress reports on their investment projects. This is supported by Shanteau and Harrison (1991) who found that decision quality improved when their participants were required to prepare financial statements before making investment decisions. Continued efforts in this direction should help develop the understandings required to aid individuals in their role as reliable decision makers.

APPENDIX

Experimental stimuli (from Heath, 1995)^a

The following data is from commercial real estate projects that were undertaken by your company on your advice. You have already invested the amount listed in the 'Previous Costs' column. You must now decide whether to complete the project by investing the amount of money listed in the 'Future Investment' column. Assume that this amount will allow you to complete the project with certainty. If the project is not completed your company will receive nothing. The 'Sales Forecast' column lists the value of the project when it is completed. Sometimes this value is known for sure. Sometimes the value depends on factors that are unknown right now, and this column lists the probabilities of various outcomes. If you choose not to invest in the real estate project, money can always be invested in other areas, yielding about 15% a year (Amounts listed are in millions of dollars.).

Project	Previous costs	Future investment	Sales forecast	Would you proceed with this investment?
1a.	\$6.58	\$1.55	\$6.66	Yes, No
1b.	None	\$1.55	\$6.66	Yes, No
2a.	\$9.07	\$2.57	\$9.16	Yes, No
2b.	\$6.33	\$2.57	\$9.16	Yes, No
3a.	\$8.70	\$2.16	\$9.45	Yes, No
3b.	\$1.50	\$2.16	\$9.45	Yes, No
4a.	\$9.72	\$1.97	\$10.09	Yes, No
4b.	None	\$1.97	\$10.09	Yes, No
5a.	\$9.72	\$1.97	20% chance of \$12.10 30% chance of \$10.00 50% chance of \$9.34	Yes, No
5b.	None	\$1.97	20% chance of \$12.10 30% chance of \$10.00 50% chance of \$9.34	Yes, No
6a.	\$9.72	\$1.97	20% chance of \$15.20 30% chance of \$10.17 50% chance of \$2.23	Yes, No
6b.	None	\$1.97	20% chance of \$15.20 30% chance of \$10.17 50% chance of \$2.23	Yes, No

^aParticipants were given three of the 'a' and three of the 'b' versions of the six projects.

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