© Academy of Management Journal
1993, Vol. 36, No. 2, 402–413.

THE ROLE OF PROJECT COMPLETION INFORMATION IN RESOURCE ALLOCATION DECISIONS

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Prior studies have suggested that "sunk costs," the amount of money already invested in a project, influence resource allocation decisions but have often confounded sunk costs with the degree to which a project is completed. To address this issue, we varied information about both sunk costs and project completion in two experiments. Our results suggest that degree of project completion may dominate any sunk cost effects that are present in resource allocation decisions.

An expanding literature from a variety of theoretical paradigms suggests that, contrary to normative models of decision making, consideration of sunk costs—the amount of a budget invested in a project—may enter into resource allocation decisions. In the reported study, we focused on situations in which a decision maker faces a choice between continued investment in a project or withdrawal with certain loss of some or all prior investments.

According to traditional economic theory, a rational decision maker in the situation just described would consider only incremental costs and benefits. However, a growing body of research suggests that sunk costs may influence the decision to continue investment in an ongoing project. For example, Arkes and Blumer (1985) found that subjects faced with a decision to invest more funds in an ongoing research and development project were more willing to make the investment than those asked if they would invest the same amount of funds to start up the same R&D project. In a replication study using five levels of prior investment, Garland (1990) found a linear relationship between the amount of sunk costs and willingness to continue investment in the project.

Faced with mounting evidence for the existence of irrational sunk cost effects on resource allocation decisions, we examined the studies in which such effects have been observed. Such an examination revealed that at least two variables are in need of closer scrutiny. First, a number of studies have used decision scenarios in which sunk costs have been confounded with the degree of project completion. Second, most studies have included negative information about project success as a constant condition.

THEORETICAL BACKGROUND

Degree of Project Completion

In a number of previous studies (i.e., Arkes & Blumer, 1981; Garland, 1990; Garland & Newport, 1991) sunk costs are completely confounded with project completion. For example, Arkes and Blumer told some subjects that they had invested 9 out of 10 million dollars in a project that was 90 percent complete and compared the willingness of those subjects to invest the last million of their budget with the willingness of other subjects to invest the first million, clearly confounding project completion with sunk cost. In later replications using the same scenario, Garland (1990) and Garland and Newport (1991) continued to confound sunk costs and project completion.

We recognize that there may be a strong positive correlation between sunk costs and project completion in many instances. However, they do represent theoretically different concepts that may contribute separately to continuing investment behavior. For example, consider an R&D manager who is charged with allocating surplus year-end funds to one of two different R&D projects. Project A, estimated to last five years, is now into its third year and is about 50 percent completed. The project has cost $12 million to date, and seven engineers have devoted about 40 percent of their time to it since its inception. Project B, estimated to last nine months, is one month from completion (90 percent complete). The project has cost $200,000 to date and has involved 25 percent of the effort of two engineers. In this example, it is clear that the time, money, and effort sunk in project A are far greater than those associated with project B, but project B is considerably closer to completion than project A. Which piece or pieces of information in the above scenario will the R&D manager focus on in deciding which project to allocate resources to?

In their work on entrapment, Brockner, Shaw, and Rubin argued that individual motivation for an investment may shift, changing from an economic one at the outset to some other motive later, as additional resources are invested. They saw this phenomenon as "due in part to the presumed increased proximity to the goal" (1979: 194). But to what goal are these authors referring? Although the original goal may have been profit maximization, the new goal may be nothing more than completing whatever project has been started. If that is the case, and if the correlation between prior expenditures and the likelihood of project completion is positive, then so-called sunk cost effects can be explained by goal substitution—task completion substituted for making money—in combination with well-known psychological processes whereby motivation to achieve a goal increases as an individual gets closer to that goal (Katz & Kahn, 1966: 434; Miller, 1944; Ryan, 1970: 98). Of course, this explanation does not suggest that project completion effects are any more rational than sunk cost effects.

In a recent review article on escalation effects, Brockner argued that "when a given phenomenon can be explained by a variety of theories, it is

useful to conduct critical studies in which the competing theories make different predictions about the results" (1992: 58). The primary aim in the present research was to separate sunk costs and project completion within an R&D decision scenario in order to examine their individual and combined effects on a decision maker's willingness to invest additional resources in an ongoing project.

Negative Information

In research studies on escalation (e.g., Conlon & Wolf, 1980; Staw & Ross, 1978) and sunk costs (e.g., Garland & Newport, 1991; Northcraft & Neale, 1986), decision makers have often received negative information about project outcomes. In the escalation paradigm (e.g., Staw & Ross, 1987), where there has been no systematic variation of sunk costs, questionable or negative outcomes are proposed to be the primary exogenous condition for escalation effects. Researchers have seen those outcomes as both a stimulus for project reexamination and an underlying cause of decision makers' heightened concern with self-justification. In other words, the same information that triggers consideration of project withdrawal can also increase persistence.

However, several studies have discovered that negative information can be associated with a more "rational" withdrawal of investment in a project. These responses to negative information are particularly likely to occur when that information is endogenous to the project (Staw & Ross, 1978), when outcomes fall far short of goals (Kernan & Lord, 1989), or when the information is highly diagnostic of poor future returns (Garland, Sandefur, & Rogers, 1990).

Investment in a losing project—for example, continued investment when a competitor is producing a superior product—provides dramatic evidence for the negative consequences of escalation effects; thus, it is not surprising that most studies of sunk cost effects have focused on projects that are not going well. However, left unaddressed is the equally important, though less dramatic, exploratory question of to what degree sunk cost effects, project completion effects, or both occur when a project is doing well, as in the case of continued investment when a competitor is producing an inferior product. We would expect resource allocation to be more likely under conditions of product superiority; however, if positive information makes for lower self-justification pressures than negative information, there may be no sunk cost or project completion effects when information is positive. Thus, we recognized the importance of comparing the impacts of negative and positive information but made no prediction regarding their consequences for resource allocation.

Research Overview

Two experiments were conducted. In the first experiment, we varied sunk costs, project completion, and information about a competitor's product. This manipulation of information was designed to determine whether

sunk cost or project completion effects would occur under experimental "conditions" of both negative and positive information. Control conditions, in which subjects had information only about sunk costs or only about project completion, as well as a condition with no information of either sort, were included in the design. Two primary research questions were addressed: (1) When sunk costs and the degree of project completion are separated, what are the independent and combined effects of each on decisions to continue investment in an ongoing project? and (2) How, if at all, does the presence of negative or positive information about a competitor's product influence sunk cost and project completion effects?

EXPERIMENT ONE

Methods

Subjects and research design. Business administration students (N = 582) from three universities in the northeastern and midwestern United States participated in the study. There were 32 experimental conditions in the study, reflecting four levels each of the sunk cost and project completion variables, and two levels of competitor information. Cell frequencies for the experimental conditions ranged from 15 to 20.

At the beginning of a scheduled class, the instructor informed the students that they would be "role-playing" a business decision and gave them a written decision scenario modified from previous research on sunk costs (e.g., Arkes & Blumer, 1985; Garland & Newport, 1991). In the scenario, the president of Polymer Corporation has 10 million dollars budgeted for a sonar scrambling material for submarines.

Independent variables. When subjects had specific information about *sunk costs*, they were told that either 1 million, 5 million, or 9 million dollars of the 10 million dollars budgeted for the project had been spent. The remaining subjects were simply told that they had 10 million dollars budgeted for the project, but no reference was made to how much money had been spent.

The *project completion* manipulation immediately followed the sunk cost manipulation. Subjects receiving specific information regarding project completion were told that the engineering department had informed the president that the project was 10, 50, or 90 percent complete. The remaining scenarios contained no information about project completion.

The manipulation of *competitor's performance* immediately followed the project completion manipulation. Subjects in the superior competitor condition were told that they had just discovered that a competitor was producing a product that was less expensive and easier to bond underwater than their product. Subjects in the inferior competitor condition were told that they had just discovered that a competitor was producing a product that was more expensive and more difficult to bond underwater than their product.

Dependent variables. Upon receiving the information about sunk costs,

project completion, and competing products, subjects answered three questions. They indicated the probability (from 0 to 100 percent) that they would authorize the expenditure of the next million dollars remaining in the budget toward completion of the project ($\bar{x}$ = 65.37, s.d. = 25.74). Next, subjects indicated the probability (from 0 to 100 percent) that they would allocate all the money remaining in the budget to complete the project, a measure that was, of course, confounded with sunk costs ($\bar{x}$ = 49.25, s.d. = 28.17). Finally, subjects were asked to indicate the extent to which they believed that their competitor represented a threat to the success of the company's project on a scale ranging from 0 to 100, with 0 representing "no threat at all" and 100 representing "a very big threat" ($\bar{x}$ = 61.66, s.d. = 24.32).

Results

Because all three dependent measures were correlated ($p < .01$), we performed a four-by-four-by-two multivariate analysis of variance (MANOVA) before examining any of the univariate effects described below. This analysis revealed multivariate main effects, all at $p < .001$, for sunk costs ($F = 11.13$), project completion ($F = 3.43$), and competitor performance ($F = 93.15$). There were no significant interactions.

Sunk costs and project completion effects. Table 1 shows the mean reported likelihood of allocating the next 1 million dollars, our primary dependent variable, for all combinations of sunk costs and project completion, with results collapsed across competitor's performance, which did not interact with either of the other manipulations. The univariate *F*-tests on this measure revealed that project completion had a significant effect ($F_{3, 550} = 7.35$, $p < .001$) but that sunk costs did not ($F_{3, 550} = 1.58$, $p < .19$). As the table shows, subjects' willingness to allocate the next million dollars to the project increased as project completion increased. Newman-Keuls comparisons of means revealed that subjects with the information that the project was 90 percent complete were significantly more likely than all others to allocate the next million dollars.

Both sunk costs ($F_{3, 550} = 20.48$, $p < .001$) and project completion ($F_{3, 550} = 3.94$, $p < .01$) had significant main effects on subjects' willingness

TABLE 1
Mean Reported Likelihood of Allocating the Next Million Dollars, Experiment One

	Degree of Project Completion				
Sunk Costs	**No Information**	**10 Percent**	**50 Percent**	**90 Percent**	**Marginal Means**
No information	59.77	63.33	65.78	73.00	65.54
1 million dollars	64.32	56.97	59.84	66.11	61.92
5 million dollars	69.11	58.16	70.62	76.00	68.45
9 million dollars	66.49	60.69	59.82	74.57	65.40
Marginal means	65.05	59.77	64.21	72.39	

to allocate all the money remaining in the budget to complete the project. Newman-Keuls comparisons indicated that subjects who had spent $9 million, and thus had the least money left, were more willing to allocate all their remaining money ($\bar{x}$ = 60.14) than those with no information about sunk costs ($\bar{x}$ = 51.89) or those who had spent $5 million ($\bar{x}$ = 47.49). Subjects who had only spent $1 million were the least likely to allocate all the money remaining in the budget ($\bar{x}$ = 36.94). Newman-Keuls comparisons across project completion conditions indicated that subjects whose projects were 90 percent complete were more willing to allocate all remaining funds ($\bar{x}$ = 54.62) than those whose projects were 10 percent complete ($\bar{x}$ = 44.58). Subjects whose projects were 50 percent complete ($\bar{x}$ = 49.54) and those who had no information about project completion ($\bar{x}$ = 48.22) were not significantly different from one another or from either of the more extreme conditions.

Finally, although sunk costs had no significant effect on beliefs that the competitor's product was a threat ($F_{3, 550} = 1.13$, $p < .34$), project completion affected that variable ($F_{3, 550} = 5.06$, $p < .002$). Subjects whose projects were only 10 percent complete were the most likely to report that the competitor's product was threatening ($\bar{x}$ = 67.43) ($\bar{x}$'s = 60.55, 57.60, and 61.08 for the 50 percent, 90 percent, and no information conditions, respectively).

Competitor's performance effects. As mentioned above, there were no significant multivariate interactions between information about a competitor's product and either sunk costs or project completion. Univariate *F*-tests for the multivariate main effect of competitor's performance indicated that subjects told that the competitor's product was inferior were more willing to allocate the next million dollars in their budgets ($\bar{x}$ = 77.13 vs. 53.71, $F_{1, 550} = 156.11$, $p < .001$), more willing to allocate all the remaining money ($\bar{x}$ = 60.10 vs. 38.53, $F_{1, 550} = 107.36$, $p < .001$), and believed the competitor was less of a threat ($\bar{x}$ = 49.35 vs. 73.79, $F_{1, 550} = 193.86$, $p < .001$).

EXPERIMENT TWO

Overview

We designed the second experiment with two purposes in mind. First, we attempted to replicate the findings of experiment one. In designing this replication, we returned to the original scenario developed by Arkes and Blumer (1985) and modified by Garland and Newport (1991) to rule out the possibility that our nominal changes in this scenario might have been responsible for our inability to discover a sunk cost effect in experiment one. Following those and other previous studies, all scenarios for this experiment contained negative information about a competitor's marketing a superior product.

In addition to manipulating both sunk cost and project completion in-

formation, we manipulated two other variables.[1] One variable concerns an additional confound from our sunk cost manipulation in experiment one. Because all subjects were told that they had a 10 million dollar budget, sunk costs was confounded with the amount of money remaining in the budget. For example, subjects who were told they had spent 5 million dollars had only 5 million dollars remaining, and those who were told they had spent 1 million dollars had 9 million dollars. Thus, we cannot rule out the possibility that either the amount of money they had expended or the amount of money that remained influenced subjects' responses in experiment one. To address this concern, we manipulated whether or not scenarios mentioned a budget. When a budget was mentioned, its size was varied so that an identical amount of money remained in both sunk costs conditions.

Our final manipulation involved responsibility for the initial investment. Previous studies that have examined the impact of sunk costs have all attributed a high degree of personal responsibility to subjects. Thus, we varied whether or not subjects were responsible for the initial investment of money in the project.

Methods

Subjects and research design. Business administration students (N = 226) from a northeastern university participated in the study. The experiment had a two-by-two-by-two-by-two between-subjects factorial design reflecting two levels of each of the following: sunk costs (1 million or 9 million dollars), project completion (10 percent or 90 percent), knowledge regarding the budget (known or unknown), and responsibility for the initial investment decision (low or high). Cell frequencies ranged from 10 to 17.

As in experiment one, at the beginning of a scheduled class, the instructor informed the students that they would be role-playing a business decision. They were asked to read their scenarios carefully and respond to the questions as if they were really experiencing the decision situation.

Independent variables. Subjects in the high *responsibility* condition were told that they had made the initial decision to invest the 1 or 9 million dollars in the project. Subjects in the low responsibility condition were told that they had just been hired as a consultant by the company and that the company president had already invested the initial funds.

Sunk costs and *knowledge of the budget* were manipulated as follows: When the total budget was unknown, subjects in the low-sunk-costs condition were simply told that they had spent 1 million dollars, and those in the high-sunk-costs condition were told they had spent 9 million; the scenario made no mention of budgets. When the total budget was known, subjects in the low- and high-sunk-costs conditions were respectively told that they had

[1] Our thanks to the anonymous reviewers for this journal who suggested the two additional variables.

spent 1 million of a 10 million dollar budget and 9 million of an 18 million dollar budget. This manipulation allowed the amount of money remaining in the budget to be constant—9 million always remained—when subjects knew their budgets.

Project completion was varied as follows: subjects were told that the engineering department had informed them that the project was either 10 percent or 90 percent complete.

Dependent variables. Following each scenario, subjects were asked to indicate, on a scale from 1 to 100 percent, (1) the likelihood of their authorizing the next $1 million to continue with the project ($\bar{x}$ = 49.35, s.d. = 26.10), (2) the likelihood of their authorizing all remaining funds to continue with the project ($\bar{x}$ = 35.47, s.d. = 24.31), and (3) their rating of how much of a threat the competitor was to the success of their project ($\bar{x}$ = 72.00, s.d. = 18.37).

Results

Once again, all three dependent measures were correlated ($p < .01$). Thus, we performed a two-by-two-by-two-by-two MANOVA before examining any univariate effects. Data from one subject who neglected to answer one question were not included in the MANOVA or the follow-up tests. Only the main effect for project completion was significant ($F = 10.16$, $p < .001$); there were no other significant multivariate main effects or interactions.

Table 2 presents the means for the variable representing allocation of the next 1 million dollars for all combinations of sunk costs and project completion, collapsed across the other two manipulations. As in experiment one, there is no evidence for sunk costs affecting this measure, but there is a project completion effect ($F_{1, 209} = 30.29$, $p < .001$): Subjects whose projects were 90 percent complete were more likely to allocate the next 1 million dollars ($\bar{x}$ = 58.42) than were subjects whose projects were 10 percent complete ($\bar{x}$ = 39.53).

As in experiment one, a high degree of project completion led to greater willingness to allocate all remaining funds than did low project completion ($\bar{x}$'s = 41.15 and 29.56, $F_{1, 209} = 13.38$, $p < .001$). The project completion effect on perceptions of the competitor found in experiment one, in which high project completion lowered belief that the competition was threatening, was not as strong in experiment two. Although the pattern of means for this

TABLE 2
Mean Reported Likelihood of Allocating the Next Million Dollars, Experiment Two

	Degree of Project Completion	
Sunk Costs	**10 Percent**	**90 Percent**
1 million dollars	40.36	58.83
9 million dollars	38.73	58.03

measure was consistent with the results of our first study, the difference was not significant ($\bar{x}$'s = 70.55 and 73.64, $F_{1, 209} = 1.34$, $p < .25$).

DISCUSSION

Our two primary questions concerned (1) the implications of separating sunk cost and project completion information, and (2) the effects of positive and negative information about a competitor's product on sunk cost and project completion behavior. Only experiment one addressed the latter question, but the results were quite clear: Although there was a main effect—a greater likelihood of resource allocation when the competitor's product was inferior—the competitor performance variable did not interact with either the sunk costs or project completion variable. Thus, it seems that knowledge of negative outcomes, in the form of information about a competitor, at least, is not an important prerequisite for escalation effects.

The answer to the first question we posed in the introduction required a second study. Previous research has frequently confounded sunk costs with project completion. Our studies sought to separate those variables. The results are very consistent, suggesting that information about project completion influences resource allocation intentions to a far greater extent than does information about sunk costs. In both of our studies, subjects with larger sunk costs did not report a higher likelihood of allocating the next million dollars of the budget to the previously chosen course of action. In fact, when we held the amount of money remaining in the budget constant across conditions in experiment two, we no longer found a sunk cost effect on any of our dependent measures.

Certainly, a stronger case can be made for the influence of project completion information on subsequent resource allocation. Regardless of sunk costs, subjects whose projects were 90 percent complete were the most likely to allocate both fixed sums and all remaining budget money for a project. Moreover, this pattern emerged whether personal responsibility for the initial investment decision was low or high and whether competing products were superior or inferior. This finding is entirely consistent with psychological research suggesting that closure, or task completion, is in and of itself a potent influence on behavior (e.g., Katz & Kahn, 1966).

It is tempting to speculate that what has often been labeled a sunk cost effect might actually be a goal substitution effect, whereby project completion becomes a new goal, replacing profit maximization, and the desire to complete a project increases as its completion nears. However, we would certainly not argue that there are never sunk cost effects. Compelling anecdotal and case study evidence from everyday life quite reasonably demonstrate the effect of such costs (cf. Ross & Staw, 1986). However, we can interpret some of the findings from past studies (e.g., Garland, 1990) as indicating project completion effects. In addition, it may be that decision makers' beliefs that as they allocate more resources, they are getting closer to the goal mediate sunk cost effects. For example, in their discussion of esca-

lation of commitment at the Vancouver Exposition in 1986, Ross and Staw (1986) mentioned that some of the construction projects for which ground had not yet been broken were scuttled because it was clear that they could not be completed in time for the opening. Such behavior is consistent with what we would expect under conditions of low project completion.

In experiment one, subjects whose projects were 90 percent complete saw their competitors as less of a threat than did subjects whose projects were 10 percent complete. This effect was not significant in experiment two. Thus, further research appears to be needed to discover whether degree of project completion influences perceptions of competitive threat. Consistent replication of the finding from our first study would suggest that decision makers' enthusiasm about their own progress may blur or interfere with a critical analysis of the competition. In such a case, we might want to extend Staw and Ross's (1987) call for a bifurcated decision process, in which the decision makers at the time of the second resource allocation would not be the same individuals who made the initial investment decision. Those who are most affected by the excitement of project completion should not have undue influence or control over either subsequent resource allocation decisions or subsequent production and marketing decisions.

In light of the consistency of the results, further exploration of the consequences of project completion information on decisions in organizations seems warranted. For example, researchers might investigate how project completion information affects the degree to which decision makers consider alternative uses of funds (so-called "opportunity costs") that might lead to more economically sound decisions. For example, it may be that decision makers consider opportunity costs more carefully and are more likely to shift funds to a new project when project completion is low. When project completion is high, however, opportunity costs may receive less consideration.

Finally, we wish to stress that our studies were designed as part of an initial investigation to determine whether the separation of sunk costs and project completion enhanced understanding of resource allocation behavior. To maintain comparability with previous experiments that have claimed to demonstrate strong sunk cost effects (Arkes & Blumer, 1985; Garland, 1990; Garland & Newport, 1991), we chose to duplicate the very simple and rather sterile procedures used in those studies. As Brockner (1992) noted, such a method may not be a good context in which to study resource allocation, as the level of subjects' ego involvement is likely to be low. The method used may explain why our manipulation of responsibility for the initial investment had no effect in experiment two. Our experimental scenario probably did not produce a strong level of involvement or responsibility in either case. To argue that our manipulation produced strongly different needs for self-justification would be inappropriate, as low needs for self-justification probably existed in both conditions. It seems apparent that the next step in this research paradigm needs to be the replication of these studies and findings with practicing managers.

It is also important to point out that some of our combinations of sunk costs and project completion could be seen as quite extreme. A project that had used 10 percent of its budget yet was 90 percent complete might suggest that the company's budget forecasting department was producing inaccurate information. Similarly, a project that had consumed 90 percent of its budget yet was only 10 percent complete might suggest woeful mismanagement. Wouldn't such a project have been investigated or terminated long ago? We included those comparisons to allow a strong test of the independent and joint effects of high and low sunk costs and high and low project completion. Future studies might minimize the discrepancies between these two sources of information in order to examine resource allocation behavior under less exaggerated circumstances.

We close by reiterating some practical advice for managerial decision makers offered by Staw and Ross (1987). The institutionalization of specific policies requiring an exploration of alternate uses of funds, a process similar to the assignment of a devil's advocate in a decision-making group, may minimize project completion effects. Alternatively, making decision makers aware of phaseout or withdrawal costs, including the salvage value of previously purchased assets, at various stages of project completion might reduce the tendency toward reallocation. If a firm could force its managers to be vigilant and ignore the temptations inherent in project completion and sunk costs information during the reevaluation of projects, higher quality decisions might be made.

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