The Determinants of Sunk Cost Sensitivity In Students*

Jeffrey P. Carpenter† Peter Hans Matthews‡ Ashley D. Brown§

September 14, 2005

Abstract

We conduct a vignette study of the propensity to commit the sunk cost fallacy with 106 undergraduates. Our contribution is to examine the socio-demographic determinants of "sunk cost sensitivity." The likelihood of commitment is found to be positively correlated with some ethnicities, negatively correlated with both family income and high personal income, negatively correlated with intermediate levels of schooling, and more or less uncorrelated with standard measures of educational ability and performance like GPAs and SAT scores.

1 Introduction

Despite the positivist aspirations of mainstream economic theory, the principle that individual decisions are based on opportunity costs, not historical costs, is often presented in normative terms. Mankiw's (1998, 291) popular introductory text, for example, describes it as a "deep truth about rational decision-making" but, as the context makes clear, this "truth" is more assertion than empirical law. To some, if not most, economists, then, statistical evidence that individuals often commit "sunk cost fallacies" comes as a surprise.

An example may help to clarify why real decision makers are so susceptible. Imagine that you are on vacation and running short of the local currency. To avoid carrying much cash, you purchased travelers checks before you left, at a cost of, say, 2%. You have discovered, however, that your ATM card also works there. You now find yourself standing in front of a bank, torn between cashing some of the checks and using the ATM card. Suppose, too, that because there are neither queues nor language barriers, it is not more costly to use the bank. What factors will, or should, determine the choice you make? Whatever other factors influence the decision, most economists believe that the sunk cost of the travelers checks should *not* be one of them: cashed or not, the commission has been paid and cannot be recovered. This is not, however, how many real people think about the problem.

In one of the most comprehensive studies of the sunk cost fallacy, Arkes and Blumer (1985) corroborated a number of earlier findings, and showed that much of the bias could be attributed to the desire not to

*We thank Carolyn Craven and Corinna Noelke for their comments. We also thank Middlebury College and the National Science Foundation (SES-CAREER 0092953) for financial support.

†Department of Economics, Middlebury College and IZA; jpc@middlebury.edu.

‡Department of Economics, Middlebury College; pmatthew@middlebury.edu.

§Department of Economics, Middlebury College; abrown@lucasware.com

seem "wasteful." Since then, much of the literature has focused on the escalation of "throwing good money after bad." Karlsson *et al* (2002) and Zikmund-Fisher (2004), for example, examine continued investment in losing ventures. Indeed, the scope of such behavior could be much broader than first believed: there is some evidence that digger wasps (Dawkins and Jane, 1980) and pigeons (Navarro and Fantino, 2005) are sensitive to historical, and not opportunity, costs.

There is no evidence, however, that sensitivity is even approximately uniform across human populations, and the contribution of this paper is to examine *who*, in a sample of undergraduate students, is most likely to commit the sunk cost fallacy. We employ a vignette experiment in which participants respond to 13 scenarios, 10 of which involve sunk cost fallacies. In addition to the 10 observations per participant, we collect a number of demographics, as well as measures of school experience, work experience and academic ability. As it turns out, many of these correlate with sunk cost sensitivity.

2 Vignette Design and Participant Summary Statistics

A hard copy of a survey was mailed to 360 Middlebury College students chosen through a randomized list of the total student population. No special skill or experience was required for participation. There were 106 responses, for a response rate of 29.4%. The first section consisted of ten sunk cost vignettes and three control vignettes designed to obscure the intent of the survey. While many of the vignettes were based on examples from the existing literature, all of them were modified to engage Middlebury students. We also created a small number of vignettes specifically for our purposes. The value of the historical costs in the different scenarios ranged \$5 to \$499 to capture possible "size effects." The exact vignettes appear in Table 1. The second section of the survey contained questions about sex, class (senior, junior, etc), ethnicity, nationality, annual personal and family income, work status, academic major, GPA and SAT scores.

An examination of the left side of Table 2, which summarizes almost all of the data collected in the demographic section of the survey, reveals the broad characteristics of our subject pool. We first observe that the respondent population was more female (65%) than male, that it contained students from all four classes (seniors, juniors, et cetera) and that 73% classified themselves as Caucasian. Further, the mean math and verbal SAT scores were 686 and 676, respectively. The proportion of respondents with high GPAs ($3.50 - 4.00$) was 25%. International students comprised 8% of the sample population. The sample also includes equal proportions (7%) of economics and psychology majors, isolated here because of their prior exposure to sunk cost fallacies in class, an experience that could have influenced responses.

More students (41% vs. 22%) counted themselves members of high annual income families ($\$150,000-200,000+$) than low income families ($\$0 - 49,999$). Most (87%) were employed during the summer, but tended to report low annual personal income: 80% earned between \$0 and $\$3,499$. A smaller proportion, 51%, was employed during the academic year.

While there are some differences between the respondent and overall student populations - Middlebury, for example, has more female students than male, but the ratio is not quite so lopsided, and more than 7% major in economics - the sample is more or less representative, so that response bias does not seem to be much of an issue.

3 Violations of the Sunk Cost Principle

An initial review of the survey responses reveals that, contrary to standard economic theory, sunk costs often do matter, at least for subjects' predictions about their own behavior. Almost all (98%) of our participants committed the sunk cost fallacy at least once, 93% committed it at least twice, and 61% committed it at least five times. No one, however, committed it all ten times: the most sunk cost sensitive respondent committed eight fallacies, and the mean (see Table 2) was 4.74.

Figure 1 depicts the cumulative distribution of the number of fallacies committed by our respondents. From the differences in slopes of sections, one sees that 5 violations is the mode - 28% committed 5 fallacies - and that the distribution is relatively symmetric. However, the Kolmogorov-Smironv test indicates that the number of fallacies is committed was not normally distributed ($p < 0.1$).

Returning to Table 1, one also sees that the number of fallacies committed varies by vignette. At one extreme, 87% were sensitive to historical costs in the fifth vignette, in which the value of historical costs was largest, while at the other extreme, none were sensitive in the seventh, in which the stakes were relatively small. The results of (unreported here) regressions in which we stacked the data confirm that historical costs are a positive and statistically significant ($p < 0.01$) predictor of the propensity to commit sunk cost fallacies. If the fallacy was in fact a simple test of logical reasoning, one would expect sunk cost sensitivity to diminish as the stakes increased. We do not report these, or otherwise work with pooled models, however, because the coefficients were not significant in a behavioral sense: the practical effects of even substantial variations in costs are too small to matter.

4 The Determinants of Sunk Cost Sensitivity

Our approach in this paper is instead to collect individual responses and measure the propensity to commit the sunk cost fallacy by the number of fallacies that respondent i commits, denoted N_i. Given our count data, we use a Poisson regression model of the form:

$$\Pr(N_i \mid X_{1,i}, ..., X_{k,i}) = \frac{\exp -(\sum_{j=1}^{k} X_{j,i}\beta_j) \left(\sum_{j=1}^{k} X_{j,i}\beta_j\right)^{N_i}}{N_i!}$$

where $X_{1,i}, ..., X_{k,i}$ are (some of) the characteristics of i. To account for possible heteroscedasticity, robust standard errors are calculated.

We report the results in Table 2, which lists incidence rate rations, or IRRs, rather than coefficients, for each regressor. Recall that the IRR for an indicator variable is an estimate of the increase or decrease in the number of fallacies committed relative to the counterfactual. For example, from the second row, we see that, other things being equal, women are estimated to commit 93% the number of fallacies (or 7% less than) that men do, but that this difference is not significant at the 10% level.

Continuing with demographic factors, we find that self-reported Caucasians committed 27% more fallacies; Latinos, 116% more; and African-Americans 41% more than the omitted category, a catch-all for all those who did report themselves one of these three. A closer examination of the point estimates reveals, however, that the only statistically significant intergroup differences are those involving Latinos.

Interestingly, international students - about 10% of the students at Middlebury are international - committed approximately half as many fallacies as American-born students, and this difference is highly significant ($p < 0.01$).

As for family income, respondents from families with between $\$150,000$ and $\$200,000$ in annual income were the least likely to commit sunk cost fallacies: on average, they committed 38% fewer ($p < 0.01$) than those from families with \$0 and $\$50,000$, the omitted category. In fact, with the exception of those from the very richest families ($\$200,000+$ in annual income), all respondents committed significantly fewer fallacies than those from the poorest.

If, as mainstream economists believe, those who commit sunk cost fallacies have made some sort of decision error, it should be the case that with the increase in opportunities to learn from past mistakes, an increase in own work experience should be associated with a decrease in the number of such errors. Only one of the relevant variables seems important, however. While we collected data on annual personal income, summer work experience and work-study status, the only variable that mattered is whether the respondent earned a lot from work, and this was associated with reduced sunk cost sensitivity. Those who earned between $\$5,000$ and $\$6,500$ over the summer committed fewer fallacies (38%, to be precise) than those in the omitted category, who earned less than \$500 and did not work over either the summer or school year.

We did find that experience in school had some traction, however. Sophomores committed 16% fewer fallacies ($p = 0.08$), and juniors 27% ($p = 0.01$) fewer, than first year students. But if these are indeed decision errors, then what is learned in the second and third years of college is somehow "unlearned" in the fourth: the IRR for seniors is close to 1 in both the absolute and statistical senses.

Middlebury admits two classes each year, one in September and the other in February, and our analysis suggests that, after controlling for years of school experience, "Febs" commit 17% more fallacies ($p = 0.05$).

As economists, we were surprised to find that, *ceteris paribus*, economics majors committed only 3% fewer fallacies, and psychology majors only 2% fewer, and that even these small differences were not statistically significant ($p = 0.79$ and 0.90, respectively). Further, one does *not* need to believe that that those who commit such fallacies are "mistaken" to share our surprise: even if the sunk cost sensitive somehow benefited from this characteristic, about which more below, it seems reasonable to suppose that students who discuss it in economics or psychology courses would be more reluctant to reveal their "natural responsiveness" to historical costs.

Finally, we find that GPA and verbal SAT score do not predict sunk cost sensitivity, but that as math SAT scores rise, so, too, does the number of sunk cost fallacies committed. To the extent that math scores and logical ability are correlated, this, too, comes as a surprise if the predisposition to commit such fallacies is interpreted as a "miscalculation." This said, the effect, although significant ($p = 0.06$) is quite modest: someone who scores 100 points better on the math SAT, for example, will commit 10% more fallacies.

5 Conclusion and Implications

In this note, we contribute to the literature on sunk cost fallacies by examining who is more likely to commit them. In addition to having our participants respond to ten different vignettes, we collected data on a

number of socio-demographic variables, several of which appear to predict differences in the number of fallacies committed. Briefly, this number correlated positively in our student sample with some but not all ethnicities, negatively with family and high personal income, negatively with intermediate school experience, but was not correlated with standard measures of educational ability or performance, like GPAs and SAT scores.

It seems reasonable to conclude, then, that many individuals are sunk cost sensitive *and* that this sensitivity is not distributed uniformly across the population. The implications of this observation are much less clearcut, however. In particular, it is difficult to reconcile some of our results with standard economic treatments of sunk costs. And if no reconciliation is possible, what are the alternatives?

Consider the simplest representation of the "hold up problem" (Williamson, 1975): individual A must decide whether or not to invest some fixed amount in her "relationship" with individual B, after which B proposes some allocation of the resultant surplus, which A must either accept or reject. The conventional wisdom (in economics, at least) is that because B will never offer A much - B predicts that A will accept even a little, since this is better than the alternative - A will never invest because the costs of investment can never be recouped. As a result, both A and B will be worse off than if A had invested and B had proposed some equitable division of the surplus.

If B is *inequity averse* (Fehr and Schmidt, 1999) and A knows this, however, A will expect a better offer and, for investment costs below some threshold, will choose to invest. If, in addition, B is sunk cost sensitive, A can expect an even better offfer - a proposal to split the net (of historical costs) surplus is better for A than one to split the gross - and the threshold falls. *When individual preferences are "prosocial,"* in other words, *sunk cost sensitivity may facilitate investment in social and economic relationships.*

This is no more than a suggestive example, of course, but it nevertheless motivated us to invite the same subjects to participate in a lab experiment several months later, the results of which we plan to share in future work.

6 Bibliography

Arkes, H. & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Processes, 35*, 124-140.

Dawkins, R. & Jane, B.H. (1980). Do digger wasps commit the Concorde fallacy? *Animal Behavior, 28*, 892-896.

Kahneman, D., Knetsch, J. & Thaler, R. (1986). Fairness as a constraint on profit seeking: Entitlements in the market. *American Economic Review, 76,* 728-741.

Kahneman, D. & Tversky, A. (1984). Choices, values, and frames. *American Psychologist, 39*, 341-350.

Karlsson, N., Ásgeir, J., Grankvist, G. & Gärling, T. (2002). Impact of decision goal on escalation. *Acta Psychologica, 111*, 309-322.

Navarro, A.D. & Fantino, E. (2005). The sunk cost effect in pigeons and humans. *Journal of the Experimental Analysis of Behavior, 83*, 1-13.

Sutton, J. (1981). *Sunk costs and market structure: Price competition, advertising, and the evolution of concentration.* Cambridge: MIT Press.

Thaler, R. (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior and Organization, 39*, 36-90.

Thaler, R. (1999). Mental accounting matters. *Journal of Behavioral Decision Making, 12*, 183-206.

Zikmund-Fisher, B.J. (2004). De-escalation after repeated negative feedback: Emergent expectations of failure. *Journal of Behavioral Decision Making, 17*, 365-379.

TABLE 1: SUNK COST VIGNETTES

Fallacy	Percent Committing the Fallacy	Phrasing
1	55%	You recently bought a new pair of non-returnable running shoes for $75. They were comfortable in the store, but after a long run, you discover a painful defect in the arch support. Do you ever run in the shoes again?
2	57%	You regularly purchase 2 slices of pizza and a Coke for $5 at the Grille. You arrive for lunch one day and discover that the Grille is offering a special: all-you-can-eat pizza and soda for $5. You are not hungrier than normal. Do you eat more than 2 slices?
3	35%	You have decided to go see a movie in town and paid the admission price of $10. As you are waiting outside with your friends, you discover that you have lost the ticket. The seat was not marked and the ticket cannot be recovered (the employee does not remember you). Would you pay $10 for another ticket ?
4	52%	You and your friends pay $25 for non-refundable tickets to a concert in Burlington. On the day of the concert, there is a huge snowstorm, and the roads are still covered with snow. Do you go to Burlington ?
5	87%	Although it is still November, you and a friend have purchased a limited time offer, all-inclusive $499 "spring break package" for Jamaica. You soon discover, however, that your other friends were too late to act on the offer; rather than purchase the Jamaican vacation at full-price, they have decided to drive to Florida, where one of them lives and all of you could stay for free. You would both prefer to be with all of your friends, but you also know that the $499 is non-refundable. Do you both go to Jamaica?
6	16%	You pay $110 for a yearly membership to the Middlebury Golf Course. After two weeks of playing, you sprain your wrist. Does your decision of whether or not to keep playing depend on how many rounds you have played thus far ?
7	0%	You have decided to go see a movie in town with your friends. When you go to pay the $10 admission fee, you realize that you lost a $10 bill from your wallet. You still have more than enough cash to pay for the ticket. Do you?
8	73%	You are in Boston for the weekend, and as you're walking around a torrential downpour begins. You have ten more blocks till your destination when you pass someone selling $7 umbrellas for $15 on the street corner. Do you buy one?
9	73%	It is fall break, and you and your friend planned to spend the weekend in Montreal. You made a $100 non-refundable deposit for the hotel room. However, your enthusiasm wanes as you start to pack, and you discover that neither of you is in the mood for the long trip. But, if you don't go, you lose the $100 deposit. Do you cancel the trip?
10	26%	You don't feel like eating in the dining hall so you buy a frozen dinner at Shaw's for $3 using a discount coupon. As you prepare to cook it, you get the idea of inviting a friend over. Your friend accepts. When you go back to the grocery store, you have to pay the regular price of $5 for the identical dinner. You go back to your dorm and cook both dinners, but then your friend cancels. Unfortunately, both dinners are already cooked, and you are not hungry enough to eat both and can't freeze it. You must eat one and throw away the other. Assuming you know which dinner is which, do you eat the more expensive one?

TABLE 2: SUMMARY STATISTICS AND POISSON REGRESSION ESTIMATES
(dependent variable is the number of fallacies committed)

	Attribute	Mean	Standard Deviation	Estimated Incidence Rate Ratio	Robust Standard Error of Estimate	P>|z|
Number of Fallacies Committed		4.74	1.83			
Demographics:	Female	0.65	0.48	0.928	0.08	0.36
	Caucasian	0.73	0.45	1.273	0.15	0.05
	Latino	0.02	0.14	2.156	0.60	0.01
	Asian	0.11	0.32	1.120	0.17	0.47
	African American	0.02	0.14	1.411	0.24	0.04
	International Student	0.08	0.26	0.544	0.09	0.00
	50,000 < Family Income < 99,999	0.22	0.42	0.779	0.07	0.01
	100,000 < Family Income < 149,999	0.15	0.36	0.840	0.08	0.07
	150,000 < Family Income < 199,999	0.13	0.33	0.622	0.09	0.00
	Family Income > 200,000	0.28	0.45	0.853	0.10	0.17
Work Experience:	500 < Personal Work Income < 1999	0.38	0.48	0.993	0.10	0.94
	2000 < Personal Work Income < 3499	0.29	0.46	1.109	0.14	0.41
	3500 < Personal Work Income < 4999	0.11	0.32	0.951	0.13	0.70
	5000 < Personal Work Income < 6499	0.05	0.21	0.623	0.09	0.00
	Personal Work Income > 6500	0.04	0.19	0.932	0.21	0.76
	Work During the Summer (part time)	0.25	0.44	0.912	0.14	0.54
	Work During the Summer (full time)	0.49	0.50	1.122	0.12	0.27
	Work During the Summer (unpaid internship)	0.13	0.34	1.008	0.12	0.95
	Work During the School Year	0.51	0.50	0.919	0.08	0.30
School Experience:	Senior	0.23	0.43	0.966	0.09	0.72
	Junior	0.11	0.32	0.731	0.11	0.03
	Sophmore	0.29	0.45	0.836	0.09	0.08
	Entered School in February	0.18	0.38	1.175	0.10	0.05
	Economics Major	0.07	0.25	0.965	0.13	0.79
	Psychology Major	0.07	0.25	0.979	0.17	0.90
Ability:	4.00 < GPA < 3.50	0.25	0.44	0.936	0.09	0.49
	3.49 < GPA < 3.00	0.40	0.49	0.986	0.09	0.88
	SAT score (math)	685.8	65.60	1.001	0.00	0.06
	SAT score (verbal)	676	75.82	1.001	0.00	0.17
Trust Measures:	Believe others have good intentions	0.96	0.68	0.816	0.05	0.00
	Distrust people	0.69	0.81	1.041	0.05	0.36
	Believe others are moral	0.79	0.64	0.889	0.06	0.07
	Suspect others of hidden motives	0.16	0.98	1.068	0.05	0.14
	Believe in human goodness	1.21	0.69	1.086	0.05	0.07
	Am cautious of others	0.17	1.06	1.060	0.03	0.08

Note: The incidence rate ratio describes (in this case) the relative change in the number of fallacies committed compared to a counter-factual. The counter-factual for an indicator variable is the person without the trait (or in the omitted category). For continuous variables the counter factual is a person with a unit difference in the score.

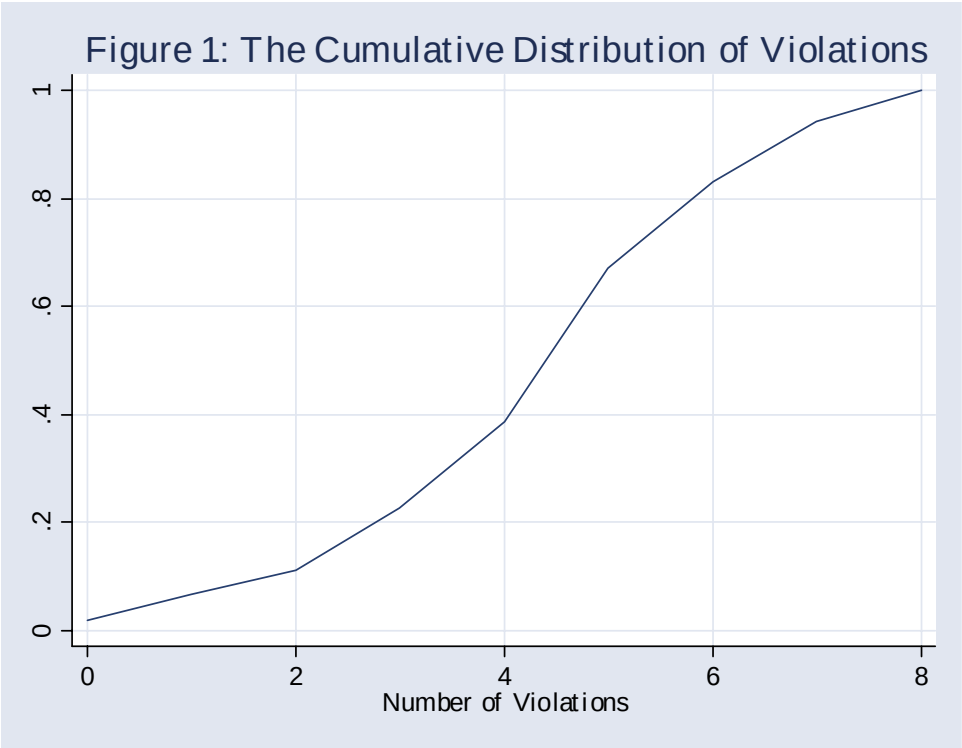
Figure 1: The Cumulative Distribution of Violations
0
.2
.4
.6
.8
1
0
2
4
6
8
Number of Violations