A PSYCHOLOGICAL APPROACH TO AVOIDANCE BEHAVIOR IN THE USE OF HIGH-EFFICIENCY LIGHTING

A Thesis

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by

Jeffrey Bryant Noethe, B.B.A.

George S. Howard, Director

Department of Psychology
Notre Dame, Indiana

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TABLE OF CONTENTS

INTRODUCTION

An exciting step in the evolution of high-efficiency lighting was expected to reach production during the Fall of 1995. Known as the E-lamp, this new concept in light generation employs electromagnetic waves similar to those used in radio broadcasting. A small transmitter within the bulb generates the waves which, in turn, excite a special coating on the inner surface of the bulb. This excited coating generates light with little energy loss in the form of heat. The E-lamp also uses a transparent coating on the exterior surface of the bulb to contain the electromagnetic waves which might otherwise cause interference with electronic devices.

Traditional incandescent bulbs produce light by super-heating a tungsten filament, which generates approximately twenty times more heat than light (Gore, 1992). By greatly reducing the ratio of heat output to light output, high-efficiency lighting technologies reduce electrical consumption significantly. In the case of E-lamps, the end result is a light bulb that lasts over 20,000 hours, more than twenty times as long as an incandescent bulb, and uses a fraction of the electricity to produce equivalent levels of light. Thus, lower electric bills are possible without actively cutting back on light consumption. E-lamps appear to be a major technological advance, with both ecological and economic benefits. However, there is great concern among bulb manufacturers and environmentalists alike that consumers will not respond positively to the new bulbs. This concern has delayed the release of a household E-lamp indefinitely. While such hesitation is frustrating from an ecological perspective, the bulb manufacturers cannot overlook their previous experience with a similar breakthrough, one that met with very limited acceptance.

A little over ten years ago, the compact fluorescent light bulb was introduced as an alternative to standard incandescent bulbs. These bulbs generate light by exciting a white phosphor coating on the inside surface, much like long-tube fluorescents. Like the E-lamps, compact fluorescent bulbs produce light far more efficiently than traditional incandescent bulbs, because most of the electric energy is used to generate light rather than heat. In fact, a 20-watt compact fluorescent bulb produces approximately the same amount of light as a 75-watt incandescent bulb. Unfortunately, public reaction to the bulbs has been quite disappointing. Despite the fact that each 20-watt compact fluorescent would save more than $40 in electricity over the course of its 10,000 hour life (see Figure 1), the bulbs were far from being a runaway commercial success, and bulb manufacturers were forced to learn an expensive lesson in consumer behavior.

Why did consumers react in such an irrational manner? The problems most commonly cited are the lack of fit, quality of light, and high initial cost of compact fluorescent bulbs. Due to the unusual shape of the bulbs, they do not fit in some fixtures. Similarly, the light produced by the bulbs is not the same warm yellow of incandescent bulbs. Although these are both valid concerns, they seem too minor to account for the very limited success of the bulbs, especially considering the savings involved. Thus, we are left with the issue of initial cost. Compact fluorescent bulbs have a modal cost of $20. General Electric claims that there is no market for $20 light bulbs, because equivalent light can be obtained from a 75¢ incandescent bulb

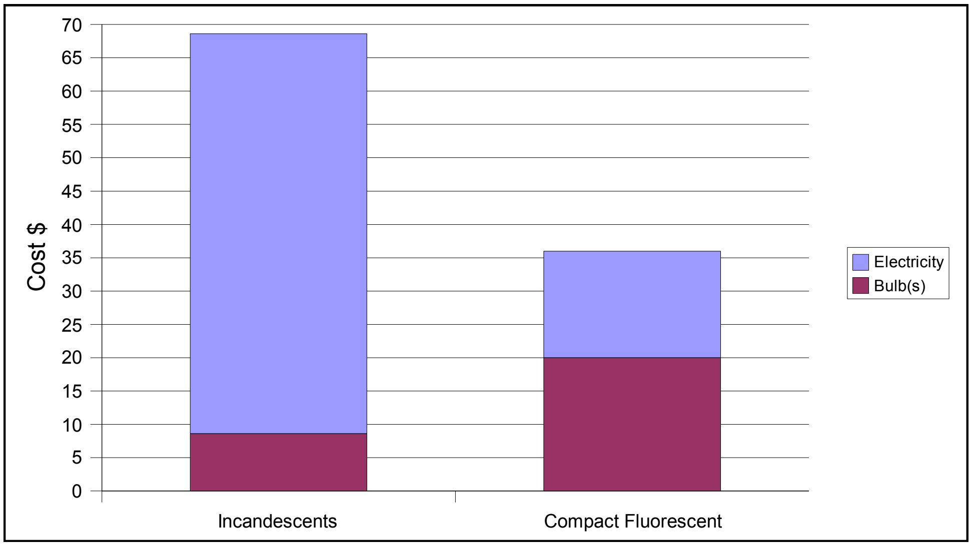

FIGURE 1. Cost of bulb(s) and electricity for 10,000 hours of use for 75-watt incandescent bulbs and a 20-watt compact fluorescent bulb (which gives equivalent light) at 8¢ per kilowatt-hour.

("Shine On," 1992). This claim suggests that people have an impulsive, consumer orientation and lack the investment perspective necessary for acting in their own long-term best interests. If this is the case, then new lighting technologies such as E-lamps, which also have high initial costs, may be doomed from the very start.

Although this perspective may seem overly pessimistic, examples can be found to support these conclusions. When steel-belted radials were introduced, people resisted them because they cost more than normal tires. Consumers failed to take into account the longer tire life and significant savings which would result over time. It took years for the new tires to find acceptance, despite their overwhelming total value (B. P. Keating, personal communication, September 17, 1993). A more current example of the impulsive consumer orientation can be seen in the success of credit card companies. Every month, millions of people choose to pay only the minimum balance on their credit card bills, thus accepting a loan at an exorbitant rate of interest. These examples demonstrate choices that are economically irrational but very prevalent. Consumers appear to be fixated on present costs and blind to future costs. As a result, people often desperately avoid paying any more than they have to immediately, and in the process, commit themselves to excessive future costs.

Behaviors such as these seem to contradict the widely-accepted theory of rational choice, which claims that organisms act as utility and reinforcement maximizers. Using utility maximization, people should always choose the alternatives with the highest total payoff. New lighting technologies, for example, should eclipse incandescent bulb sales due to their vast economic superiority. However, optimism in such predictions has faltered due to the limited success of compact fluorescent bulbs. As Herrnstein (1990) observes, "the economic theory of rational choice (also called optimal choice theory) accounts only poorly for actual behavior, yet it comes close to serving as the fundamental principle of the behavioral sciences" (p. 356). Perhaps the real problem is not in the bulbs but in our understanding of the decision-making process. Rational choice theory is very good at explaining how decisions should be made, but explaining actual decision-making requires several adjustments to the original theory.

The first adjustment necessary for improving the descriptive value of rational choice theory concerns the concept of utility. To accurately reflect human behavior, it is necessary to emphasize subjective utility over objective value. This change suggests that rationality be redefined as doing whatever is personally preferred rather than what is best overall (Herrnstein, 1990). Using this modification, a wide range of sub-optimal behaviors suddenly fall within the realm of "rational" choice: smoking, alcoholism, drug-abuse, over-eating, reckless driving, and impulsive use of money. Thus, it could be considered rational to forego the substantial savings of high-efficiency lighting if there is a simple preference for incandescent bulbs.

A second adjustment, which would make such choices even more likely, involves the use of subjective rather than objective weights. Not only are the utilities of different choices a personal matter, but also are the probabilities assigned to their outcomes (Herrnstein, 1990). In effect, people tend to inflate low probabilities such as insurance claims and winning the lottery, and dismiss high probabilities such as car fatalities and AIDS. In the case of high-efficiency lighting, people may overestimate the probability of bulb-related problems and underestimate the probability of long-term financial gain.

Other adjustments that must be considered arise from natural human limitations. People tend to have individual limits in knowledge, capacity for complexity, and perceived time horizon (Herrnstein, 1990), and any one of these may inhibit the utility maximization process. The time issue is especially relevant for explaining impulsive behavior, because it suggests that proximity in time acts as a magnifier of perceived consequences. Thus, $20 can seem huge right now while lower electric bills in the distant future seem insignificant. True maximization would only be expected when the different events and reinforcers occur at the same time.

Using this set of modifiers, the theory of rational choice is capable of explaining a broader array of actual behaviors, including the consumer behaviors addressed in this study. Unfortunately, these qualifications result in significant clutter and inconsistency, and they make prediction all but impossible. The theory of rational choice still suggests that organisms are utility maximizers; but the utilities are subjective, the weights are subjective, and the whole process is confined by individual limitations. Herrnstein

(1990) suggests that, if we really are utility maximizers at our core, then we should somehow be better at it. It may be that all these adjustments are only serving to patch a sub-optimal theory.

Alternative theories of decision-making have been proposed, but none of them have managed to overthrow the theory of rational choice. Herrnstein (1990) and his colleagues (Chung & Herrnstein, 1967; Herrnstein, 1982; Herrnstein & Prelac, 1989; Mazur & Herrnstein, 1988) have explored this area extensively, focusing on the description of human thought processes without the use of maximization. The result of their efforts is the matching law, which suggests a human tendency to balance the returns of various alternatives rather than to maximize total returns. While this theory more readily incorporates subjectivity and human limitations, as identified in the adjustments to rational choice theory, it also fails to simplify prediction. The subjective variables are still too numerous and complex to allow the creation of truly generalizable models. So, while theories such as the matching law paint a more realistic picture of human nature, they offer little insight into the practical problems of decision-making.

Regardless of which theory is ultimately preferred, it appears that pure utility maximization is more the exception than the rule. In accord with this realization, the terms "optimal" and "sub-optimal" will be used in the present study to represent the traditional notions of "rational" and "irrational," respectively. After all, labeling people as "irrational" simply because they lack a complete knowledge of economics and finance seems rather harsh. "Sub-optimal" provides a more accurate and socially-acceptable descriptor.

Unfortunately, the rejection of pure utility maximization and its terminology does little to simplify the task at hand. On the positive side, these insights clarify our understanding by allowing for the possibility that rational people will place a high value on the short-term convenience of having $20 and will avoid the worries of long-term returns. Similarly, rational people are no longer expected to act exclusively on the total long-term savings of compact fluorescent bulbs. On the negative side, these added dimensions of possibility open the door to a near infinite number of amorphous variables with no theory on which to build.

After all the years of assumed "rationality," it appears that decision-making must once again be explored with a trial-and-error methodology. We can start with general ideas about impulsive and consumer-driven behavior, but ultimately, our task is to isolate the most relevant variables and test their effects on the decision of interest, always keeping in mind that there may be inconsistencies across and within individuals. This exploratory process has the potential to build solid evidence against utility maximization and to inspire new models of decision-making, but the intuitive nature of rational choice theory has sparked little interest in such efforts.

Fortunately, the limited success of compact fluorescent bulbs was too great a violation of optimality to be overlooked, and one exploratory project was born. Howard, Delgado, Miller, and Gubbins (1993) started what was to become a series of studies intended to isolate and hopefully resolve the problems underlying the limited success of compact fluorescent bulbs. Throughout these studies, the research team has adopted a counseling approach to the situation, treating consumer reactions to the bulbs as avoidance behaviors. The outcome of interest is getting people to overcome their avoidant tendencies and move closer to the optimal choice, which is purchasing high-efficiency light bulbs. Confronting such complex choices and situations is a difficult task which people tend to put off for as long as possible. For example, alcoholics often choose to reduce current anxieties through drinking, despite the future suffering they inflict upon themselves in the process. Another relevant example is the manner in which many people deal with money. They avoid the anxiety of long-term financial considerations by drowning their current anxieties in impulsive spending. In both cases, the rationalizations that people erect can be a substantial barrier to change.

In modern psychotherapy, avoidance behaviors are typically resolved through a combination of insight and alternative behaviors, thus allowing both cognitive and behavioral elements to be addressed. First, the therapist acts as an educator, using information and logic to stimulate insight in the client. Then the therapist offers a program of actions, or homework, to gradually replace the avoidance behavior. The trial behavior serves to contradict the dysfunctional behavior and to stimulate the cognitive integration of insights. An incentive element can also be implemented to further influence change. This psychoeducational model reflects an approach that is common to cognitive therapy (Beck, Emery, & Greenberg, 1985), behavior therapy (Bandura, 1969), rational-emotive therapy (Ellis, 1977), and cognitive-behavior therapy (Meichenbaum, 1977). It also provides a potential intervention strategy for dealing with impulsive consumers.

In addressing consumer avoidance in the lighting research, a similar three-step intervention is used: (1) presentation of the economic and ecological benefits of high-efficiency lighting, (2) free trial use of the bulbs, and (3) an incentive to stimulate initial purchase. At first, the research team hypothesized that people were simply unaware of the benefits of compact fluorescent bulbs and that, once given the information, they would correct the error in their ways. The team tested this hypothesis with a door-to-door application of the three-step intervention. Participants were given a one-week free trial and offered a 20% discount, bringing the price down to $16 per bulb. The bulbs offered were 7, 11, 15, and 20-watt Osram Delux EL compact fluorescents. Disappointingly, the 120 households that agreed to participate purchased an average of 0.24 bulbs per household, far below the level of practical significance. A level of at least two bulbs per household would be necessary for the intervention to have commercial implications for bulb manufacturers.

Realizing that the door-to-door approach might lack credibility in the eyes of participants, the research team conducted a second study using campus-affiliated groups (i.e. faculty, office staff, etc.). They hypothesized that group interaction and discussion would help participants accept and integrate the information being presented. Using the same three-step intervention, this group approach produced a statistically significant, though unimpressive, increase in mean bulb purchases ($\underline{M}$ = 0.67), $\underline{F}_R(1, 210) = 7.51$, $\underline{p} < .01$. Thus, the group approach was more effective but still lacked any practical significance. Due to the non-normal distribution of bulb purchases, comparisons of mean bulb purchases across studies were made using a rank transformation approach. All F calculations using ranks are denoted F_R.

The third study (Howard, 1994) addressed the issue of initial cost by altering the incentive. Instead of offering a 20% discount, the research team offered participants a one-year delay in payment. This plan allowed the participants to experience electrical savings for a full year before paying for the bulbs. Under moderate to heavy use, each bulb should yield approximately $20 in savings, thus paying for itself (see Appendix A). Unfortunately, this study also failed to produce impressive results, essentially tying the purchase level of the second study ($\underline{M}$ = 0.66).

With three studies completed and little sign of improvement, the researchers were forced to reevaluate their approach. Increasing awareness had not worked under any conditions. Similarly, a delay of the initial cost had had no effect. This left several possibilities: perhaps a week is not enough time for participants to become accustomed to the bulbs and overcome their resistance to change, perhaps the compact fluorescent bulb is just an unappealing product with poor fit and quality of light, or perhaps people lack the ability to optimize in this specific situation.

The fourth study in the series was designed to address the issue of resistance-to-change by increasing the trial period to one month. The intervention was further enhanced by offering a choice between the two incentives offered in previous studies: a 20% discount or a one-year delay in payment. The result was a mean of 0.98 bulbs per household, which was not significantly higher than in the second and third studies, $\underline{F}_R(1, 192) = 1.05$, $\underline{p} > .25$. This left two hypotheses to be tested: either compact fluorescent bulbs are a bad product or people are not optimizing effectively. Fortunately, the recent introduction of a new compact fluorescent bulb provides a simple and efficient way of testing both hypotheses in one final study.

Unlike previous compact-fluorescent bulbs, General Electric's new 28-watt BIAX Electronic compact fluorescent bulbs do not suffer from the same unusual shape. They have a slimmer base and use a more compact set of tubes, which eliminate many problems of fit and aesthetics. The new bulbs also score big with their increased brightness. The 28-watt compact fluorescent bulb is slightly brighter than a 100-watt incandescent bulb. In short, the new G.E. compact fluorescent bulb solves most of the basic product issues surrounding previous compact fluorescents, leaving only one major cause for concern, the cost. These new bulbs are being introduced in the same price range as previous compact fluorescent bulbs, making direct comparisons possible.

By duplicating the fourth study with G.E. 28-watt compact fluorescent bulbs, only the product variable will have changed. If the new bulbs show a dramatic improvement in mean bulb purchases, then we can conclude that the old compact fluorescent bulbs were simply a lemon of the lighting industry. However, a failure by the new bulbs to produce a significant increase in purchases would suggest that people are unwilling to pay $20 for a light bulb, regardless of its benefits. This second conclusion would support the claim that people lack either the ability or the desire to optimize total returns. It would also provide a solid piece of evidence against the maximization principle and the theory of rational choice.

An additional test of optimizing ability, unrelated to light bulbs sales, will also be used to enhance the argument against maximization. This test is the Subjective Optimization Scale (SOS), which is intended to measure an underlying ability to make consistent decisions regarding financial and consumer situations. The logic behind the SOS starts with the assumption that each person makes financial and consumer decisions based on a subjective interest rate. For some people, this rate takes the form of an actual number. For others, it may simply exist as a gut feeling that mysteriously sways decisions one way or the other. Either way, the subjective interest rate is that aspect of people that determines how they perceive money in any given situation. When quantified, the subjective interest rate reveals two things: (1) the maximum rate of interest the participant would be willing to accept, and (2) the minimum rate of return the participant expects from investments. The return rate mirrors the interest rate, because it is not worthwhile to make an investment that returns less than the interest being paid to borrow that same amount of money. For example, a person who is willing to take a loan at 15% should not be willing to make an investment at less than 15%.

The theory of rational choice suggests that, all else being equal, people will make decisions in a consistent manner that corresponds to their subjective interest rate. Unfortunately, the "all else being equal" is extremely rare in the complex consumer environment. Aesthetics, brand names, convenience, personal values, and extenuating financial considerations all cloud the observation of pure financial decisions. By providing a set of hypothetical scenarios that are generally neutral except for fixed financial or consumer choices, it should be possible to evaluate the consistency in actual decision-making behavior. The resulting score is intended to serve as an indicator of each participant's relative ability to optimize financial and consumer decisions in accordance with their own subjective perceptions of the world.

A simple version of the SOS was used in the fourth study. A direct estimate of each participant's subjective interest rate was gathered with the Cost-of-Money Questionnaire (see Appendix B), which presented one question about the maximum interest rate that would be accepted on a personal loan. This rate was then compared with the participant's preference between the two incentives offered in the study. To maximize total utility, participants should prefer the incentive that best corresponds to their subjective interest rates. Specifically, participants with a subjective interest rate less than 25% should prefer the 20% discount, while participants with subjective rates in excess of 25% should select the one-year delay in payment. At a subjective interest rate of exactly 25%, the two incentives are financially equivalent. Using these guidelines, people can be classified dichotomously as either optimal or sub-optimal. Of the 55 participants in the fourth study, 71% selected the optimal incentive, leaving 29% who failed to maximize total utility. The fourth study also revealed a positive relationship between optimizing ability and income. Only 44% of lower income participants selected the optimal incentive, while 70% of middle-income and 80% of higher income participants made the optimal choice. Interestingly, these findings also demonstrated a predictable relationship with bulb purchases. Of the participants who were classified as optimal, 44% verified their optimizing ability by purchasing compact fluorescent bulbs. The participants classified as sub-optimal only purchased bulbs 19% of the time. This discrepancy in purchasing behavior supported the use of the SOS format as a measure of optimizing ability.

The Subjective Optimization Scale used in the present study provides a different operationalization of the financial consistency variable, one with superior psychometric properties. This new measure improves upon the SOS by incorporating a set of eight scenarios and a five-point Likert scale, thus replacing the dichotomous classification with a continuous score between zero and ten (see Appendix C). In addition, each item on the new measure incorporates a unique interest rate ranging from 1% to 25%. This increase in sensitivity allows the SOS to better reflect the subtle between-subject differences that are so essential for understanding the complexities of decision-making processes. The new measure of consistency is called the Optimization Score (OS). In addition, the five-point Likert scale allows for the level of decisiveness to be recorded for each choice and combined to yield a Confidence Score (CS), also ranging from zero to ten. Finally, the SOS will use the eight item responses to calculate an Estimated Subjective Interest Rate (ESIR).

Results from the fourth study indicate that the mean subjective interest rate for the population of interest is between 9% and 10%. This rough center point is used for two purposes. First, it serves as a marker around which the number of positive and negative items are balanced. Due to the variability in subjective interest rates, a perfect balance can never be achieved for all participants. Using the average rate as a guideline for item generation insures that the average participant will not encounter a heavy bias in either direction on the response scale. Second, the average rate serves to balance the interest rates used within the items. A mean interest rate of 9.2% for the eight items should assure sufficient response variance.

The primary advantage of the eight-item SOS is that it reduces the probability of achieving a perfect score through random responding to 0.19. With the dichotomous measure, the probability of guessing optimally was 0.50! The dichotomous measure also suffered from a restricted range problem, because a majority of participants preferred the 20% discount incentive. Thus, the eight-item SOS is capable of providing a more valuable piece of evidence against the maximization principle and the theory of rational choice. Because the Cost-of-Money Questionnaire has been eliminated, the eight-item SOS also has the advantage of using a single item format in calculating the Optimization Score. This change not only simplifies the scoring process but reduces the risk of comparing two different constructs. Eliminating the Cost-of-Money Questionnaire also avoids the problem of forcing participants to quantify their decision-making criteria, an ability that some people lack and which may not be required for optimization.

Twenty-nine participants from the first four studies were recruited to pilot the SOS. These participants were given a ten-item version of the SOS on two occasions, with a two week delay between administrations. The purpose of the pilot was to check the means, ranges, and reliabilities for the individual items and for the three scores drawn from those items.

Reliabilities were assessed using a test-retest format, because there is no reason to believe that the underlying ability to optimize is unstable in any way. Participants are not likely to seek out new information or to forget what little they may already know about financial decisions. In addition, it was hoped that the scenarios would not be interesting enough or vivid enough to create strong carry-over or practice effects. Any such effects that happen to arise should be easily eliminated during the two week delay between testings. Therefore, it is possible to assume trait stability and use the coefficient of stability as an indicator of item and test score reliability.

Of the ten items initially administered, two demonstrated extremely poor test-retest reliability, with coefficients less than 0.30, and were dropped. The remaining eight items were used to evaluate the reliabilities of the OS, CS, and ESIR. The OS had a mean score of 7.59, a range from 0.00 to 10.00, and a coefficient of stability of .461. The CS had a mean score of 7.57, a range from 3.75 to 10.00, and a coefficient of stability of .567. The ESIR had a mean value of 6.1%, a range from 1.5% to 26%, and a coefficient of stability of .531.

While these reliabilities may not be ideal, they are also not entirely unexpected. A high reliability presumes that participants are able and willing to work through and carefully consider each situation. As we have hypothesized, this ability and motivation may not be present in all people. Some people can do the math and respond in a manner that is consistent with a true subjective interest rate. Others cannot do the math but are still able to consider the situations and answer consistently. Still others are unwilling to put forth the effort and resort to random responding. It is this last group of participants that would drag down the reliability coefficients. The SOS remains useful, because we are interested in the inconsistencies of such unreliable people as measured by the OS. To have a perfectly reliable measure might preclude the ability of that measure to tap into the construct of interest. The reliability of the SOS might be improved by increasing the number of items and further reducing the effectiveness of random responding, but the measure becomes very tiring with as few as ten items. The eight-item SOS was adopted, because it is short enough to be incorporated into the existing research format and long enough to produce a substantial increase in sensitivity over the dichotomous measure.

Assessment of validity for the SOS is an even more difficult matter than reliability. Of greatest interest would be criterion validity, but observing participants' financial behavior in similar real-life situations is all but impossible. In fact, it is this difficulty that inspired the creation of the SOS. Fortunately, an appropriate decision is already under observation in the research on high efficiency lighting. Once the SOS is in use, the correlation between the Optimization Score and bulb purchases can be used as an estimate of concurrent validity. The only problem is that a low correlation could be caused by differential perceptions of compact fluorescent bulbs or their rates of return. This problem is unavoidable in any criterion that might be of interest for the SOS. As soon as we look at any real-life situation, the pure financial element will become obscured.

Two hypotheses are being tested in the current study. The first is that, using an identical intervention, the new 28-watt compact fluorescent bulbs will produce mean bulb purchases only slightly higher than the previous compact fluorescent bulbs, thus supporting the claim that people do not maximize total utility. Some increase is expected due to the superiority of the new bulbs over the old, but this increase is not expected to reach a level of practical significance ($\underline{M} \geq 2.00$). The second hypothesis is that, given a set of financial and consumer scenarios, participants will also fail to maximize with respect to their subjective interest rates. A positive relationship between purchases and subjective optimizing ability is expected.

METHOD

Participants

Seventy participants were recruited in eight preexisting groups of 5 to 20 people. Groups were selected from offices and departments on campus and included administrators, faculty, and staff personnel. The participant pool was composed of 30 men and 40 women with ages ranging from 23 to 58 years and a median age of 40 years. Family income was considered in group selection, with the intention of balancing the number of lower, middle, and higher income participants. These income classifications are defined as "less than $25,000", "$25,000 to $50,000", and "greater than $50,000" respectively. Of the 59 participants who reported family income, there were 17 lower income, 28 middle-income, and 14 higher income.

Design

Due to the limited commercial success of compact fluorescent bulbs, the control level of sales for previous studies was assumed to be zero. This assumption allowed for a nontraditional methodology using only one condition for all participants. Any practically significant deviation from zero would have led to further research using more traditional methods. However, no commercially important deviations have yet been found. The current study follows the same single-condition format, using the results of the fourth study as the baseline control. Although tests of statistical significance across studies are atypical, the similarity of these studies makes such comparisons possible.

Measures

Each item in the Subjective Optimization Scale describes a financial or consumer scenario which concludes in a decision that has been made between two alternatives. These alternatives involve the acceptance or rejection of an interest rate that is either stated directly or implied by dollar figures. While the interest rate is different for each item, the overall item difficulty is intended to remain fairly stable. The participant's task is to indicate how likely he or she would be to make the same choice in the given situation. Responses are recorded on a modified five-point Likert scale (see Appendix C). The middle point on the scale is identified as UNCERTAIN, which allows participants to exclude scenarios to which they are unable to relate. Items left blank would also be assigned to this midpoint.

Because each participant has a unique subjective interest rate, the calculations required for the OS, CS, and ESIR are quite tedious. Therefore, the scoring of the SOS is performed using a Microsoft Excel spreadsheet to avoid calculation errors. Figure 2 shows two sample templates. Data entry for each participant involves typing only an identification number and the eight numerical item responses. Since the items on the SOS are not in order according to interest rate, the spreadsheet template automatically rearranges them from lowest (1%) to highest (25%).

The first analytical task performed by the template is the determination of trend indicators for each item. Trend indicators show the implied direction of the subjective interest rate based on the direction of the response. For items one, two, three, and seven, a response of four or five implies a subjective interest rate greater than the rate of the item, while a response of one or two implies a subjective interest rate less than the rate of

I.D.	318			
Item	Answer	Trends		Best Rates
1	3	1.00%	▲	0.00% ✔
2	5	2.50%	▼	1.75%
3	5	3.50%	X	3.00% ✔
4	5	7.00%	▲	5.25% ✔
5	1	9.40%	▲	8.20%
6	3	10.80%	X	10.10%
7	1	14.00%	▲	12.40%
8	5	25.00%	▲	19.50%
				26.00%

Inconsistencies	1
Usable Responses	6
Optimization Score	**6.67**
Confidence Score	7.50
Estimated S.I.R.	3.00%

I.D.	319			
Item	Answer	Trends		Best Rates
1	4	1.00%	▼	0.00%
2	4	2.50%	▼	1.75%
3	5	3.50%	▼	3.00%
4	4	7.00%	▼	5.25%
5	2	9.40%	▲	8.20% ✔
6	5	10.80%	▲	10.10%
7	5	14.00%	▲	12.40%
8	2	25.00%	▲	19.50%
				26.00%

Inconsistencies	0
Usable Responses	8
Optimization Score	**10.00**
Confidence Score	6.88
Estimated S.I.R.	8.20%

FIGURE 2. Sample of SOS scoring template. Shaded areas indicate data entry cells.

the item. For the remaining four items, the opposite is true. The template checks the response direction for each item and creates a pointer (either ▲ or ▼) indicating the implied direction of the subjective interest rate. These pointers are the trend indicators. Items that have a response of three (UNCERTAIN) are marked with an X, because they do not provide information about the direction of the subjective interest rate.

Figure 3 shows an expanded SOS template for a single respondent, which reveals several hidden columns of information. In this figure, cells E3 to E10 contain the trend indicators, and cells D3 to D10 contain the numerical codes that correspond to the indicator symbols (115 = ▲, 116 = ▼, 53 = X). The determination of the appropriate code for each item is accomplished by a set of three IF statements related to response direction. The formula for cell

D3, which corresponds to item 7, is as follows:

IF (B9 > 3, 116) + IF (B9 = 3, 53) + IF (B9 < 3, 115).

The complete set of formulas for the entire template can be found in Appendix D. Once these calculations are complete, the set of eight trend indicators allow for trends in item responses to be identified.

	A	B	C	D	E	F	G	H	I	J
1	I.D.	318								
2	Item	Answer	Trends				Best Rates			
3	1	3	1.00%	115	▲		0.00%	52	0	✔
4	2	5	2.50%	116	▼		1.75%	32	FALSE	
5	3	5	3.50%	53	X		3.00%	52	0.03	✔
6	4	5	7.00%	115	▲		5.25%	52	0.0525	✔
7	5	1	9.40%	115	▲		8.20%	32	FALSE	
8	6	3	10.80%	53	X		10.10%	32	FALSE	
9	7	1	14.00%	115	▲		12.40%	32	FALSE	
10	8	5	25.00%	115	▲		19.50%	32	FALSE	
11							26.00%	32	FALSE	
12										
13		Inconsistencies					1			
14		Usable Responses					6			
15		**Optimization Score**					**6.67**			
16		Confidence Score					7.50			
17		Estimated S.I.R.					3.00%			
18										

FIGURE 3. Expanded SOS template. Shaded areas indicate hidden cells.

The template begins the scoring process by counting the number of usable responses, which include all responses not equal to three. This value is found in cell G14. The template then calculates the minimum number of inconsistencies among the usable items. For any position on the range of item interest rates, the number of inconsistencies is equal to the number of trend indicators that point away from that position. In Figure 3, the position between 2.50% and 3.50% has only one inconsistency, that being the trend indicator for the 1.00% item. The remaining five usable responses have trend indicators that are consistent with the interest rate suggested by this position (3%). This procedure for counting inconsistencies is repeated for every possible position on the range of item interest rates, including the positions before 1.00% and after 25.00%. Thus, there are nine positions being compared. The minimum number of inconsistencies is determined using the long formula found in cell G13, which counts inconsistencies for each position and retains the lowest value (see Appendix D).

Using the number of usable responses and the minimum number of inconsistencies, the Optimization Score is calculated according to the following formula: (((Usable Responses – Inconsistencies) / Usable Responses) x 20) - 10. This formula, found in cell G15, converts the input values into a consistency percentage and then rescales the percentage to fit on a zero to ten scale. The rescaling process uses "x 20 - 10" because the maximum number of inconsistencies is five, not ten. Therefore, the lowest possible percentage is 50%, which must correspond to zero on the final scale. Notice that participants are not penalized for a response of three. Rather, their OS is determined using only scenarios that they feel comfortable answering with some certainty.

Once the Optimization Score has been determined, the template calculates the Confidence Score, which shows the overall confidence level demonstrated within the eight responses. The CS is based on the extremity of item responses. A response of three (UNCERTAIN) is given a confidence value of zero, a response of two or four is given a value of one, and a response of one or five is given a value of two. The confidence values are summed, and the total is rescaled to fit on a zero to ten scale. Cell G16 contains the CS formula. Taking the OS and CS together provides a more detailed picture of the decision-making process for any one participant.

The final calculation made by the template is the determination of an Estimated Subjective Interest Rate. This rate is based on the positions of least inconsistency on the range of item interest rates. Cells G3 to G11 contain the approximate interest rates corresponding to each of the positions. For each position, a comparison is made between the number of inconsistencies for that position and the minimum number of inconsistencies overall. These calculations occur in cells H3 to H11 and yield one of two numerical codes for each position. These codes identify whether the number of inconsistencies for a position is equal to or greater than the minimum number of inconsistencies. Positions that have inconsistencies equal to the minimum receive a 52, which corresponds to a check mark character. Positions that have inconsistencies greater than the minimum receive a 32, which corresponds to a space character. The characters appear in cells J3 to J11 and identify the "best rates," rates that minimize inconsistency, for a respondent.

In order to calculate the ESIR, the best rates are identified numerically in cells I3 to I11, while the remaining rates are given a text string (FALSE). This labeling process is accomplished with IF statements that look at the values in cells H3 to H11. The ESIR, located in cell G17, is then calculated by taking the median of the numerical values in cells I3 to I11. Cells containing the text string are automatically excluded from the calculation.

Procedures

According to the business representative of the University Committee on the Protection of Human Subjects, informed consent does not apply to this study due to its classification as marketing research. Each group participated in a 10 to 20 minute presentation and discussion of the ecological and economic benefits of high-efficiency lighting. Part of the presentation included a full demonstration of the light output and energy consumption of a 28-watt compact fluorescent bulb and a 100-watt incandescent. The purpose of the study was explained carefully to minimize the effect of any sales pressure on the decision-making process. At the end of the discussion, participants were offered a one month free trial use of two compact fluorescent bulbs with no obligation or risk. A brief demographic questionnaire was completed by each participant (see Appendix E) and any questions about bulb use were addressed. Participants were given one 28-watt compact fluorescent bulb and one 7 or 11-watt compact fluorescent bulb from the previous studies. The lower wattage bulbs were offered to maintain a full range of products and to maximize the similarity between the fourth study and the present study.

After the one-month period, a second contact was made on an individual basis. Participants were asked where they used the bulbs and whether or not the bulbs had been effective in each of those locations. General impressions were recorded, and then participants were asked how many compact fluorescent bulbs they would like to purchase at $20 each (Measure 1). Once this number was recorded, a choice between two additional incentives was offered: (1) a 20% discount now or (2) a one-year delay in payment of the full price. Additional bulb purchases were recorded as Measure 2. Participants were also asked to identify the one reason that best explained their decision to purchase or not purchase compact fluorescent bulbs. At the end of the meeting, each participant was given an SOS questionnaire to fill out at their convenience. They were also given the old Cost-of-Money Questionnaire, in case this data should be needed. The entire research design is represented in Figure 4.

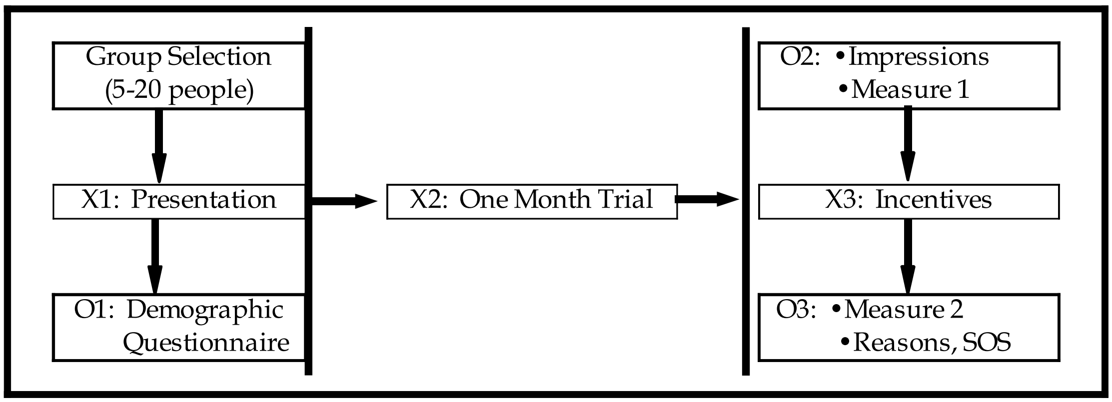

FIGURE 4. Research Design. X indicates an intervention, and O indicates an observation.

RESULTS

The mean level of bulb purchases for the present study is 0.94 bulbs per household, which is not significantly different than the level attained in the fourth study ($\underline{M}$ = 0.98), $\underline{F}_R(1, 123) = 0.07$, $\underline{p} > .25$. Thus, the introduction of the 28-watt compact fluorescent did not produce even the slight gains expected due to product improvements. In terms of practical significance, the mean level of bulb purchases for the present study also fails to reach the criteria of two bulbs per household.

In both the fourth study and the present (fifth) study, less than half of the participants purchased compact fluorescent bulbs. Of those who did make purchases, the mean number of bulbs purchased decreased from 2.70 bulbs per household in the fourth study to 2.28 bulbs per household in the present study, although this decline is not statistically significant, $\underline{F}_R(1, 47) = 1.22$, $\underline{p} > .25$. It is also interesting to note that the proportion of 28-watt bulbs purchased in the present study (65%) is not higher than the proportion of 15 or 20-watt bulbs purchased in the previous studies (approximately 70%). All of these clues seem to suggest that the product variable has little effect on purchases, which leaves us with the human variable. Regardless of the benefits involved, people seem to be largely unwilling to pay $20, or even $16, for a light bulb. People simply are not optimizing in their decisions related to high-efficiency lighting.

Looking at the purchase levels by income group reveals mean bulb purchases of 0.41, 1.14, and 1.50 bulbs per household for lower, middle, and higher income participants respectively. This relationship does reach a level of statistical significance, $\underline{F}_R(2, 56) = 3.71$, $\underline{p} < .05$, and provides one more piece in a recurring pattern across studies. The positive relationship between income and bulb purchases is even more compelling for its consistency than for its statistical significance. Unfortunately, even among higher income participants, a level of practical significance has yet to be obtained.

Sixty-one participants completed the Subjective Optimization Scale, producing a mean Optimization Score of 7.06, a mean Confidence Score of 7.53, and a mean Estimated Subjective Interest Rate of 6.09%. Despite a modal score of 10.00, 28% of the respondents scored worse than random responding, which seems to reveal a widespread deficit in optimizing ability. At the very least, it is clear that pure utility maximization is not being demonstrated, even when interest rates are allowed to be subjective.

Contrary to expectations, the OS did not demonstrate a significant relationship with income group, [$\underline{M}$low = 7.04; $\underline{M}$mid = 6.47; $\underline{M}$high = 7.40], $\underline{F}(2, 48) = 0.57$, $\underline{p} > .25$. The OS also failed to demonstrate a significant relationship with bulb purchase, [$\underline{M}$yes = 6.77; $\underline{M}$no = 7.26], $\underline{F}(1, 59) = 0.56$, $\underline{p} > .25$. These results prompted a reanalysis of the data using the original dichotomous SOS scoring procedure.

Using only the incentive preference and the subjective interest rate from the Cost-of-Money Questionnaire, 28% of the participants in the present study were classified as sub-optimal. This percent is almost identical to that found in the fourth study. Unfortunately, the similarities between the two studies end there. No longer is there a positive relationship between optimizing ability and income. Unlike the fourth study, 73% of lower income participants in the present study selected the optimal incentive, while 72% of middle-income and 63% of higher income participants made the optimal choice. There is also no longer a clear relationship between optimizing ability and bulb purchases. Of the participants classified as optimal, only 39% verified their optimizing ability by purchasing compact fluorescent bulbs, while the participants classified as sub-optimal purchased bulbs 53% of the time. These results are in the opposite direction of those found in the fourth study.

In the present study, the simple version of the SOS produced results similar to those of the eight-item SOS, but both of these scoring procedures produced results that failed to confirm the findings of the fourth study. This outcome suggests that the data yielded the opposite patterns and that the eight-item SOS is not implicated in the failure to confirm results.

Table 1 provides a clear summary of the five studies and their outcomes, while Table 2 summarizes the practical results of these studies in terms of environmental impact. The numbers used in Table 2 are derived from an algorithm provided by Osram Sylvania Incorporated.

TABLE 1

SUMMARY OF HIGH-EFFICIENCY LIGHTING STUDIES

	Study 1	**Study 2**	**Study 3**	**Study 4**	**Study 5**
Hypothesis:	People just lack awareness.	Group approach will improve credibility.	People avoid high initial costs.	People resist change.	(1) Bad product. (2) People do not optimize.
Product:	Osram Delux EL Comp. Fluorescent	Osram Delux EL Comp. Fluorescent	Osram Delux EL Comp. Fluorescent	Osram Delux EL Comp. Fluorescent	**GE 28-w Electronic Comp. Fluorescent**
Model:					
(1) Presentation	Individual	**Group**	Group	Group	Group
(2) Free Trial	1 week	1 week	1week	**1 month**	1 month
(3) Incentive	20% discount	20% discount	**1 year delay**	**Choice**	Choice
Results:					
Bulbs purchased	29	62	31	54	66
Households	120	92	47	55	70
Mean purchases	**0.24**	**0.67**	**0.66**	**0.98**	**0.94**
Significance (change)		FR(1,210) = 7.51 $p < .01$	FR(1,137) = 0.10 $p > .25$	FR(1,100) = 0.39 $p > .25$	FR(1,123) = 0.07 $p > .25$
Conclusion:	Awareness is insufficient.	Group is good, but not enough.	Delaying costs is not enough.	A long trial period is not enough.	The product is not the problem. A human factor is to blame.

TABLE 2

ENVIRONMENTAL IMPACT SUMMARY

Estimated Savings per Bulb

Compact Fluorescents	**7-watt**	**11-watt**	**15-watt**	**20-watt**	**28-watt**
Lumen	400	600	900	1200	1750
Incandescent Equivalents	**25-watt**	**40-watt**	**60-watt**	**75-watt**	**100-watt**
Lumen	230	455	830	1100	1630
Savings per bulb					
Electricity (watts)	18	29	45	55	72
Carbon Dioxide (lbs)	288	464	720	880	1152
Sulfur Dioxide (lbs)	2.1	3.4	5.3	6.4	8.4
Nitrous Oxide (lbs)	1.1	1.8	2.8	3.4	4.4

Estimated Savings Across Studies

	Studies 1-4	**Study 5**	**Total**
Total Purchases (bulbs)	176	66	242
Estimated Savings:			
Coal (tons)	176	66	242
Carbon Dioxide (lbs)	119824	58800	178624
Sulfur Dioxide (lbs)	876	429	1305
Nitrous Oxide (lbs)	464	225	689

DISCUSSION

The fact that the introduction of the new G.E. 28-watt compact fluorescent bulbs did not produce statistical or practical significance suggests that we are dealing with more than just a bad product. Regardless of product features or long-term benefits, people are having trouble making the optimal financial decision regarding compact fluorescent bulbs.

This conclusion is bad for manufacturers of high-efficiency lighting, because it suggests that technology will never be enough. Then again, the findings of these studies may stimulate useful insights into more appropriate tactics for addressing the relevant human variables. For psychologists, these findings encourage further research into the nature of human decision-making. Specifically, the results of these studies provide a solid piece of evidence against the maximization principle and the theory of rational choice, which have enjoyed unvalidated support among behavioral scientists. If people do not optimize in this lighting situation, then we must also question whether they are optimizing in other situations. If optimization proves to be a consistently unreliable predictor of human behavior, then we must use this information as an impetus for exploring new models of decision-making.

It is still unclear as to what variables are responsible for the limited acceptance of compact fluorescent bulbs. Before exploring the human variables any further, it is important to realize how uninfluential the product variable has demonstrated itself to be. Despite improved shape and brightness, the 28-watt compact fluorescent not only failed to reach a purchase level of practical significance, but also failed to stimulate even the slightest improvement over the technologically inferior bulbs offered in previous studies. Even the most pessimistic member of the research team expected some slight gains due to product improvement. It appears that the product variable is being completely eclipsed by some other variable.

Through these five studies, six variables have been addressed as possible explanations for the limited success of compact fluorescent bulbs. Lack of awareness, initial cost, resistance to change, and product issues have basically been ruled out. Presenter credibility, which was addressed by switching to a group intervention on campus, produced a significant increase in purchases, but this outcome may be nothing more than a testament to the complete failure of a door-to-door approach. Regardless, the increase was only significant in a statistical sense. With the present study, it also appears that optimizing ability cannot explain the difference between purchasing and not purchasing. Thus, we are left wondering about the variables we have missed.

In addition to optimizing ability, perhaps there is another human variable, one related to motivation level. It is possible that complex or long-term financial decisions are perceived as too great a hassle to even justify consideration. People may also feel overwhelmed by the barrage of marketing ploys, advertising messages, and consumer stimuli that confront them every moment of every day. What all of this boils down to is a lack of desire or motivation in pursuing optimal decisions.

One interesting observation that might support this motivation hypothesis was made during the individual follow-ups. In the first four studies, general issues of fit and brightness were usually mentioned as reasons for not purchasing, but during the present study, people seemed to be giving more specific and elaborate explanations. Instead of complaining that the compact fluorescent bulbs were not as bright as 100-watt incandescent bulbs, they complained that the bulbs were not as bright as 150-watt incandescent bulbs. As the bulbs got better, people just adopted more stringent criteria as reasons not to buy them. In other words, bulb purchases remained constant while the criteria for acceptance went up. One interpretation of this phenomena might be that participants are unmotivated to consider compact fluorescents, because lighting is one part of their lives that has always been a "no brainer." Therefore, they avoid adding complexity to their lives by creating rationalizations.

As a second piece of evidence against rational choice theory, the Subjective Optimization Scale served its purpose. Respondents did not demonstrate a uniform ability to maximize total returns, even in simplified financial and consumer scenarios. This statement is especially powerful, considering the forgiving nature of the measure. Respondents to the SOS are not required to demonstrate an awareness of current interest rates. In fact, they are not required to adhere to an external or objective interest rate of any kind. Respondents are not even required to quantify an internal or subjective rate. All the SOS requires is (that which it is intended to measure) consistency in decision-making in financial and consumer situations. The rate used and the strategy of decision-making are irrelevant, as long as the respondent is consistent.

Failure to optimize on the SOS does not bode well for more complex life situations, where additional factors and influences may obscure the financial element completely. Therefore, it seems reasonable to conclude that people are not true utility maximizers. People cannot even be classified as subjective optimizers according to the SOS, which leaves considerable room for new theories of decision-making.

Unfortunately, the SOS does not provide a clear explanation for sub-optimal behavior. It was hoped that the Optimization Score would demonstrate a significant relationship with bulb purchases, thereby implicating optimizing ability as the key culprit in sub-optimal decision-making, but this did not happen. Even respondents who scored perfectly on the SOS purchased at a mean level of only 0.94 bulbs per household. All of the evidence seems to point to an unidentified human variable.

In addition to the motivation hypothesis, a second possibility was generated concerning the clarity of interest rates. In the SOS scenarios, each interest rate is fixed and readily available. With compact fluorescent bulbs, the rate of return is not so clear, because it depends on the rate of use and the physical durability of the bulbs. Perhaps people are uncomfortable with this ambiguity and unwilling to make a substantial investment without more certainty. This hypothesis could easily account for the non-significant relationship between OS and bulb purchases. A person could simply be a subjective optimizer in stable or clearly-defined situations, which would eliminate any obligation to get involved with investments in high-efficiency lighting.

Both of these new hypotheses, low motivation and discomfort with ambiguity, would be troublesome if proven true, because neither reality would be easy to counteract. It is hardly feasible to guarantee a set rate of return for compact fluorescent bulbs, and even a labor-intensive intervention has failed to assure participants of their inherent value. In both cases, we still seem to be dealing with an avoidance behavior, but we have yet to identify the focus of that avoidance.

REFERENCES

Bandura, A. (1969). Principles of behavior modification. New York: Holt, Rinehart and Winston.

Beck, A. T., Emery, G., & Greenberg, R. L. (1985). Anxiety disorders and phobias. New York: Basic Books.

Chung, S. H., & Herrnstein, R. J. (1967). Choice and delay of reinforcement. Journal of the Experimental Analysis of Behavior, 10, 67-74.

Ellis, A., (1977). Rational-emotive therapy: Research data that supports the clinical and personality hypotheses of RET and other modes of cognitive-behavior therapy. The Counseling Psychologist, 7 (1), 2-42.

Gore, A. (1992). Earth in the balance: Ecology and the human spirit. Boston: Houghton-Mifflin.

Herrnstein, R. J. (1982). Melioration as behavioral dynamism. In M. L. Commons, R. J. Herrnstein, & H. Rachlin (Eds.), Quantitative Analysis of Behavior, Vol. 2: Matching and minimizing accounts (pp. 433-458). Cambridge, MA: Ballinger.

Herrnstein, R. J. (1990). Rational choice theory: Necessary but not sufficient. American Psychologist, 45, 356-367.

Herrnstein, R. J., & Prelac, D. (1989). Melioration: A theory of distributed choice (Harvard Business School Working Paper, 89-030). Cambridge, MA: Harvard Business School.

Howard, G. S. (1994). Against the myopia of our age: How short term thinking mortgages our future. Manuscript submitted for publication.

Howard, G. S., Delgado, E., Miller, D., Gubbins, S. (1993). Transforming values into actions: Ecological preservation through energy conservation. The Counseling Psychologist, 21, 581-595.

Mazur, J. E., & Herrnstein, R. J. (1988). On the functions relating delay, reinforcer value, and behavior. Behavioral and Brain Sciences, 11, 690-691.

Meichenbaum, D. (1977). Cognitive-Behavior Modification. New York: Plenum Press.

Shine On, and On... (1992, June 15). Time, p. 27.

APPENDIX A: EXAMPLE OF BULB SAVINGS CALCULATIONS

Replacing a 75-watt Incandescent

With a 20-watt Compact Fluorescent

(13 hrs/day at 8¢/KW-hr)

Savings:	55 W x 13 hrs/day x 30 days/mo = 21,450 W-hrs/mo
	21.45 KW-hr/mo savings x $.08/KW-hr = $1.72/mo
	$1.72/mo x 12 mo/yr = **<u>$20.64</u> savings per year in electricity**
Bulb Use:	13 hrs/day x 365 days/yr = 4745 hrs/yr
Bulb Life:	10,000 hrs ÷ 4745 hrs/yr = **2.11 years**

Note: This analysis only includes the economic benefits to you. It ignores the additional ecological benefits of compact fluorescent bulbs.

APPENDIX B: COST-OF-MONEY QUESTIONNAIRE

How much would you be willing to pay after one year for a $100 loan

today?

$98	108	118	128	138	148	158	168	178	188	198
$99	109	119	129	139	149	159	169	179	189	199
100	110	120	130	140	150	160	170	180	190	$200
101	111	121	131	141	151	161	171	181	191	
102	112	122	132	142	152	162	172	182	192	
103	113	123	133	143	153	163	173	183	193	
104	114	124	134	144	154	164	174	184	194	
105	115	125	135	145	155	165	175	185	195	
106	116	126	136	146	156	166	176	186	196	
107	117	127	137	147	157	167	177	187	197	

APPENDIX C: SUBJECTIVE OPTIMIZATION SCALE

The following scenarios describe a variety of financial and consumer decisions. Read each scenario carefully and circle the answer that indicates how likely you would be to make the same choice. **There are no right or wrong answers**, so please give your best guess as to how you would behave in each situation.

(1) A person is trying to choose between two new refrigerators, both of which are guaranteed to last ten years. The only difference is that one model will save $18 in electricity every year but costs $150 more. The person decides to buy the less expensive model.

In this situation, how likely would you be to make the same choice? (CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

(2) A person wants to buy a compact fluorescent bulb for a porch light. He has a choice of paying $16 right now or paying $20 after one year, so he decide to pay now.

In this situation, how likely would you be to make the same choice? (CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

(3) A person needs some money and decides to take a $1000 loan which requires her to pay back $1050 after two years.

In this situation, how likely would you be to take this same loan?

(CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

(4) A new kind of insulation comes out, which is guaranteed to reduce heat loss from the home. A person estimates that installing the new insulation would cost $275, but it would save $35 every year in gas bills. Since the person plans to live his house for another fifteen years, he decide to buy the insulation.

In this situation, how likely would you be to make the same decision?

(CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

(5) After Christmas, a person's credit card bill comes in the mail with a large balance. The interest rate on the card is 14%. The person decides to pay the minimum amount and worry about the rest later.

In this situation, how likely would you be to make the same decision?

(CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

(6) A person has a little money to save or invest and decides to buy a savings bond for $30 that will be worth $50 in five years.

In this situation, how likely would you be to make the same investment? (CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

(7) A person needs to buy a car. She has enough money to pay all at once, but the dealership is offering financing at 1% annual percentage rate. So, she decides to finance the car.

In this situation, how likely would you be to make the same choice? (CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

(8) A reliable acquaintance asks for a $500 loan, which will be paid back after one year at 7% interest. The person being asked has the money available, so she gives the loan.

In this situation, how likely would you be to make the same choice? (CIRCLE ONE)

1	2	3	4	5
NOT AT ALL LIKELY		UNCERTAIN		VERY LIKELY

APPENDIX D: FORMULAS FOR THE SOS SCORING TEMPLATE

(Cell names correspond to Figure 3)

D3 IF (B9 > 3, 116) + IF (B9 = 3, 53) + IF (B9 < 3, 115)

D4 IF (B5 > 3, 116) + IF (B5 = 3,53) + IF (B5 < 3, 115)

D5 IF (B3 > 3, 116) + IF (B3 = 3, 53) + IF (B3 < 3, 115)

D6 IF (B10 > 3, 115) + IF (B10 = 3, 53) + IF (B10 < 3, 116)

D7 IF (B6 > 3, 115) + IF (B6 = 3, 53) + IF (B6 < 3, 116)

D8 IF (B8 > 3, 115) + IF (B8 = 3, 53) + IF (B8 < 3, 116)

D9 IF (B7 > 3, 116) + IF (B7 = 3, 53) + IF (B7 < 3, 115)

D10 IF (B4 > 3, 115) + IF (B4 = 3, 53) + IF (B4 < 3, 116)

E3 CHAR (D3)

E4 CHAR (D4)

E5 CHAR (D5)

E6 CHAR (D6)

E7 CHAR (D7)

E8 CHAR (D8)

E9 CHAR (D9)

E10 CHAR (D10)

G13 MIN (COUNTIF (D3:D10, 116),
SUM (COUNTIF (D3, 115), COUNTIF (D4:D10, 116)),
SUM (COUNTIF (D3:D4, 115), COUNTIF (D5:D10, 116)),
SUM (COUNTIF (D3:D5, 115), COUNTIF (D6:D10, 116)),
SUM (COUNTIF (D3:D6, 115), COUNTIF (D7:D10, 116)),
SUM (COUNTIF (D3:D7, 115), COUNTIF (D8:D10, 116)),
SUM (COUNTIF (D3:D8, 115), COUNTIF (D9:D10, 116)),
SUM (COUNTIF (D3:D9, 115), COUNTIF (D10, 116)),
COUNTIF (D3:D10, 115))

G14 COUNTIF (B3:B10, "<> 3")

G15 20 * (G14 - G13) / G14 - 10

G16 (2 * (COUNTIF (B3:B10, 1) + COUNTIF (B3:B10, 5)) +
(COUNTIF (B3:B10, 2) + COUNTIF (B3:B10, 4))) * 5 / 8

G17 MEDIAN (I3:I11)

H3 IF (COUNTIF (D3:D10, 116) = G13, 52, 32)

H4 IF (SUM (COUNTIF (D3, 115), COUNTIF (D4:D10, 116)) = G13, 52, 32)

H5 IF (SUM (COUNTIF (D3:D4, 115), COUNTIF (D5:D10, 116)) =
G13, 52, 32)

H6 IF (SUM (COUNTIF (D3:D5, 115), COUNTIF (D6:D10, 116)) =
G13, 52, 32)

H7 IF (SUM (COUNTIF (D3:D6, 115), COUNTIF (D7:D10, 116)) =
G13, 52, 32)

H8 IF (SUM (COUNTIF (D3:D7, 115), COUNTIF (D8:D10, 116)) =
G13, 52, 32)

H9 IF (SUM (COUNTIF (D3:D8, 115), COUNTIF (D9:D10, 116)) =
G13, 52, 32)

H10 IF (SUM (COUNTIF (D3:D9, 115), COUNTIF (D10, 116)) = G13, 52, 32)

H11 IF (COUNTIF (D3:D10, 115) = G13, 52, 32)

I3 IF (H3 = 52, 0)

I4 IF (H4 = 52, 0.0175)

I5 IF (H5 = 52, 0.03)

I6 IF (H6 = 52, 0.0525)

I7 IF (H7 = 52, 0.082)

I8 IF (H8 = 52, 0.101)

I9 IF (H9 = 52, 0.124)

I10 IF (H10 = 52, 0.195)

I11 IF (H11 = 52, 0.26)

J3 CHAR (H3)

J4 CHAR (H4)

J5 CHAR (H5)

J6 CHAR (H6)

J7 CHAR (H7)

J8 CHAR (H8)

J9 CHAR (H9)

J10 CHAR (H10)

J11 CHAR (H11)

APPENDIX E: DEMOGRAPHIC QUESTIONNAIRE

Notre Dame Ecological Research Project

(All information will remain confidential)

Name:

Address:

Telephone Number:

Feel free to not answer any questions you wish:

Sex: ______Age: Education Level:_______________

Approximate Annual Family Income: ______less than $25,000

25,000 to 50,000

greater than 50,000

In general, to what extent do economic considerations (i.e. the price of goods and services) influence your choices?

1	2	3	4	5	6	7	8	9	10

Not at all Moderately A great deal

In general, to what extent do you allow your ecological values to influence your purchases?

1	2	3	4	5	6	7	8	9	10

Not at all Moderately A great deal

Do you wish to receive more information from the Indiana and Michigan Power company regarding other incentive programs they offer to make homes more energy efficient? Yes ______No___