Predicting Consumer Response to Gasoline Shortage

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Traditionally, much of psychology has been concerned with the manner in which humans respond to their environment when many features are unchanged or changed in a manner related to previous experience. The response of humans to radically altered situations or those with minimal information related to rational selection of alternatives has previously been of less interest. The problem of minimizing the cost of disaster and understanding the mechanisms by which people assess risky situations has led to the development of a considerable body of literature related to the study of human response under conditions of minimal information, low certainty about outcomes, minimal control over outcomes, or time pressures. A sudden gasoline shortage possesses many of the characteristics of these situations, and a review of this literature appears to be useful in explaining previous behavior and developing rules for limiting or guiding future response choices.

RISK ESTIMATION

The need for studying decision-making behavior has become most apparent during the past 25 years. During this period, increasing societal and personal costs associated with less-than-optimum decisions have indicated that improvements in decision making may be profitably exploited. It is during this period that problems with the application of utility theory and its presumption of objective rationality on the part of the consumer have shown the need for a better tool for predicting market behavior. The claim has been made that utility theory "permits strong predictions to be made about behavior without the painful necessity of observing people" (1). This may be so; however, some significant sacrifices in accuracy and reliability appear to accompany this approach. As more research on consumer behavior has been performed and as human cognitive limitations have been more clearly defined, it has been shown that expectations, perceptions, motives, and intentions often deviate significantly from values that would be predicted if human beings always optimized their choices. There are severe limitations on a person's ability to process sensory signals and to store and use the information available (2-4). Human failures to always elect the most-efficient alternatives or payoffs are, at least in part, attributable to the necessity of adopting certain simplification strategies when handling large amounts of conceptual information.

A number of attempts have been made to provide alternatives to use maximization by accounting for the limited capacity of humans for information storage and handling. For example, a theory of bounded rationality has been devised that states that cognitive limitations force people to construct simplified models of the world in order to cope with it. Many a person is content to know that his or her car will probably run if gasoline is put in it, without wanting to spend time considering any of the technical details or the theory of transportation system operation. By understanding the way in which this simplified model is constructed and by defining the limits of its performance, a better approximation to the prediction of human behavior can be obtained (5).

The validity of the above assertions is at least partially supported by the results of survey techniques that have been found to predict economic behavior in many situations where more traditional tools have produced either less accurate or even erroneous predictions. Our particular concern is with predicting behavior relative to transportation choices under conditions of high uncertainty or where information about the probability of selecting the best choice is meager and suspect. For example, it has been found that subjective decisions in favor of a particular mode of transport are only partially based on a rational evaluation of objective, or economic, parameters (6). The biases affecting choice are asserted to be directly attributable to the personality structure of individuals (psychology), and objective facts can modify the ultimate choice only to a limited extent (6).

The problem is approached from a slightly different perspective when human protective actions in the face of risk are examined. For example, the option of obtaining insurance against disasters, such as floods, does not correspond at all well to the actual probability of loss (7). Although utility theory assumes that risk-averse individuals should desire a mechanism to protect them from rare catastrophic losses that they could not bear themselves, in actual practice people prefer to insure against relatively high-probability, low-loss hazards and tend to reject insurance in situations where the probability of loss is low and the potential losses are high (7,8). As borne out repeatedly in laboratory and survey studies, people show a definite disinclination to worry about low-probability hazards. Given limitations on time and energy and the limited cognitive capacity referred to previously, there are finite limits to the amount of concern that can be expended on a given threat. Therefore, it appears more useful to ignore low-probability threats and attend to those everyday matters that repeatedly claim significant expenditures of effort. There may be some rational understanding that the probability of efficiently obtaining adequate information about low-probability events is itself very limited and will not provide an adequate payoff for the investment.

There is an additional factor in this assessment. Frequent high-probability threats apparently come to be considered as a normal and continuing cost of doing business. Therefore, making claims and receiving payments by insuring against high-probability losses are viewed as returns on the premium. In other words, the insurer believes that he or she will obtain a sufficient return on the investment, thus making the overall expenditure profitable or, at the very least, not involving a significant loss. On the other hand, insurance against a low-probability risk is viewed as having no possibility of receiving a positive return and, hence, is a needless expenditure of money. People attempting to solve their personal gasoline-shortage problems may apply a substantially similar risk-probability model to their evaluation of the situation at hand and decide that, because the gasoline-availability scenario is becoming increasingly unstable, it is worthwhile to top off the tank as routine insurance.

BIASES IN HUMAN JUDGMENT

There are several principles enunciated that describe in general terms the sources of bias that lead to errors of probability assessment or prediction (9). In addition to being generally incapable of satisfactorily estimating the error and unreliability of small samples of data, people consistently rely almost exclusively on specific information and neglect prior probabilities. Similarly, rarely is adequate allowance made for the validity of information. Neither can people adequately discount information from correlated sources. These problems are related to the normative aspects of statistical prediction and only represent the beginning of prediction problems.

In addition to the above basic problems of data-base comprehension, a number of biases consistently affect performance. The estimated probability of an event increases dramatically with the ease with which relevant instances can be imagined and by the number of such instances that are readily retrieved from memory. If a stalled automobile or a man with a gasoline can is observed,

the probability of such an event happening to the subject will be overestimated and overprotected against, despite the actual probability of such an occurrence. Secondary to these factors are the influences of recency and emotional saliency that have significant effects on perceived probability. An appreciation of the importance of these availability biases is demonstrated by the fact that the frequency of accidents, cancer, botulism, and tornados as causes of death are all greatly overestimated, while the frequencies of asthma and diabetes are greatly underestimated (10).

Another source of bias, and one that every experimental psychology student should be familiar with, is anchoring bias. The strain of processing information can be considerably eased by using a natural starting point or anchor as a first approximation to the judgment. Anchor points are frequently no more valid than random numbers, yet they exert a considerable influence on judgment. Whether a high or low anchor point is available for use in making a best estimate affects significantly human judgments in the absence of additional information (11).

The last of the most significant biases is hindsight bias, a subject with considerable relevance to the overall topic of contingency planning. Being told that some events have happened invariably increases our feeling that it was, in fact, inevitable. Studies of predictions, foresight, and preparations made for events indicate that people have a much better idea of what was going to happen after it has occurred than they had before the event (12).

When the capabilities of humans to estimate probabilities are examined, it is surprising that utility theory predicts human behavior as well as it does. In fact, cognitive limitations are pervasive in decision making and exert their greatest effects under conditions where motivation and involvement are greatest. Not only do we have a considerable inability to conceptualize events that have never occurred, but events in recent memory or those that are readily envisioned exert an effect out of all proportion to their statistical probability.

Similarly, it is a comparatively simple matter to limit the cognitive capacity available to a person making a particular decision and even further limit his or her ability to process the relevant information. This is achieved by complicating the task through the deliberate introduction of irrelevant, erroneous, or conflicting data. The possibility of the decision maker coming to anything approaching a rational decision then becomes vanishingly small. Practically speaking, probably the best that can be said for decision making under these conditions is that (a) there are usually opportunities for correcting decisions on the basis of subsequent information and (b) the bulk of the population is likely to make the same or similar decisions when given the same information. As a consequence, there need not be a winning decision, but it is likely that everyone will bear some loss, thus making the situation tolerable for everyone. In fact, if all group members believe that losses are apportioned equally, significant inequities in distribution will be tolerated. If members suspect inequity, individual or separate plans to maximize individual shares will proliferate. Even though gasoline rationing during World War II was significantly inequitable, the belief in equity played a significant role in maintaining the program's success.

BEHAVIORAL THEORIES

With this brief overview of the human ability to select appropriate protective strategies, it may be useful to recognize that considerable work has been done in the development of helpful theories describing responses to uncontrollable outcomes. Having assumed that some estimate of the degree of control over a particular event is obtained from the preceding information, some feelings are likely to control response or the selection of a strategy. In point of fact, feelings of lack of control have been viewed as a cause of many types of antisocial behaviors. Instances in which people have been provoked to apparently senseless violent acts, such as assault, murder, and vandalism, have been subsequently associated by the perpetrator with a feeling of helplessness or powerlessness in a given situation. In at least one instance, a group of children was attacked by a night worker who became enraged because their noise prevented him from sleeping. Similarly, recent reports of violence directed toward service stations or displaced toward groups or individuals have been traced to feelings of sudden powerlessness over a gasoline-shortage situation that had previously been well under the control of the individuals. The felt control is related to the amount and certainty of available knowledge.

The various states of knowledge under which decisions can be made are divided into three categories: certainty, risk, and ignorance. These represent the full range of degrees of control over outcomes that are possible. Decision theory is generally concerned with the risk category and rarely with those instances in which occurrence is an absolute certainty or in which there is complete ignorance of possible outcome. The very recognition that a possible outcome exists, by establishing anchoring biases and through other psychological factors, will have some value for decision making. Risk assessment has been briefly addressed.

The psychological theories that handle the two remaining no-decision categories (certainty and ignorance) are the reactance theory and the learned-helplessness theory. Reactance theory is concerned with the responses of individuals whose reinforcement is eliminated or threatened with elimination, unless responses are altered. Learned-helplessness theories are concerned with individuals who are exposed to unavoidable aversive events regardless of any response they may make.

REACTANCE THEORY

Reactance theory predicts that, whenever an individual's freedom is eliminated or threatened with elimination, the individual will be motivationally aroused to reestablish that freedom (13). According to reactance theory, a person will only respond when he or she feels that control over a behavioral option has been eliminated or threatened. Thus, response to the availability of gasoline is vitally affected by the following variables: the expectation that the individual possessed control over the gasoline source to begin with, the strength of the threat to the individual's access to gasoline, the importance of the access to gasoline, and the implications of this threat for the individual's other freedoms.

Reactance theory provides a number of predictions related to gasoline shortages. If the individual is subjected to an uncontrollable outcome (gasoline shortage) and is unable to engage in a behavior that the individual originally felt free to pursue (e.g., drive to work), or is faced with an undesirable option that would ordinarily be avoided (e.g., ride the bus), several changes in behavior and mood are predictable. The attractiveness of the threatened behavior will be increased and the motivation to continue with this behavior will increase. If the threatened behavior cannot be engaged in, alternative or related behaviors may be adopted to provide restoration even though they are not optimum or efficient, thus demonstrating by implication that the person could engage in the established behavior if desired. Resorting to gasohol or buying one's own service station may represent this type of response. Finally, hostile and aggressive feelings will be experienced. Aggression may be directed toward the responsible agent, although it is far more likely to be displaced to another agent or object.

LEARNED HELPLESSNESS

The learned-helplessness theory of response is concerned with individuals exposed to unavoidable aversive events. The theory predicts that exposure to unavoidable aversive events impairs an individual's ability to subsequently learn

responses to avoidable aversive events. Theorists explain that this phenomenon represents learning by the subjects that their behavior and the outcomes of specific events are independent of each other. The lack of a relation between response and outcome is then generalized to new situations. In other words, when there is absolute certainty that one has no control over a situation, there is little motivation to exert effort or to try to demonstrate control.

The learned-helplessness theory probably has greatest application to the description of behavior of hostages or others whose environment is totally beyond their control. Emulation of the behavior of those in control becomes a common response mode, even though the responses have no effect on the situation. For the general population experiencing a gasoline shortage, there are likely to be a sufficient number of alternatives so that little of this behavior will be observed.

One of the principal derivations from helplessness theory as applied to the possibility of a gasoline shortage is the effect of an individual's perception of who does have control over the situation. In experiments where the locus of control was with either a special authority or an anonymous super authority, significant differences in perception and response occurred. A test was devised so that frustration was attributable to either bureaucratic operation or to the personal behavior of the bureaucrat (14). In the initial condition, when the individual was led to expect to not have control over the situation (i.e., bureaucratic bungling was a constant for everyone exposed to the problem), performance was worse than when the individual controlled outcomes under unrestricted conditions. Behavior, however, was at least consistent and productive. Where the frustrating experience was arranged to be attributable to personal characteristics of the bureaucrat, response was uniformly negative, with test subjects cheating on the task and adopting a variety of obstructive and aggressive tactics. The conclusion, related to response to gasoline shortages, is congruent with real-world experience in that people will accept an imposed limitation on behavior if they have no expectation that they should be able to control the situation to a significant degree and if an expectation of evenly distributed limitations is reinforced. Contrarily, if an expectation is built that some people could control the situation differently—that is, helplessness is not universal—generally disruptive and nonresponsive behaviors will follow.

IMPLICATIONS OF THEORIES

The brief summary of the reactance and learned-helplessness theories presents us with two different conclusions that are related to two possible outcomes—experienced or anticipated. Reactance theory predicts that loss of control over a situation will result in renewed attempts at mastery, while the learned-helplessness model suggests that experience with loss of control will impair subsequent problem solving. Individuals will react to loss of control by becoming hostile and aggressive according to reactance theory, while the learned-helplessness theory predicts passivity. A combined model of reactance and helplessness theories has been proposed in which the expectations of control, learning that one has no control, and the importance of the outcome to be controlled are combined to determine an organism's response (15). An expectation of control leads to reactance, and an expectation of no control produces helplessness and impaired learning and performance.

Important for our purposes is the fact that uncontrollable aversive outcomes that affect a large number of people (a gasoline shortage) may have different psychological aftereffects than outcomes of other shortages of equal magnitude that are perceived as unique or rare. This effect relates to some of the earlier discussion of estimation of risk and overemphasis of frequently or recently occurring events. In addition, the relative deprivation of other individuals will affect response in a manner similar to the behaviors of subjects exposed to either uniform bureaucratic or personal frustration. Where the frustration is perceived to be uniform (i.e., bureaucratic frustration), there was some moderate decline in performance. Where there are large perceived discrepancies (i.e., personal frustration), the subject will resort to a variety of obstructive and negative tactics. Similar behavior is to be anticipated under gasoline-shortage conditions.

Individuals are motivated to perceive the world as a predictable, orderly place where people get what they deserve, derogate the victim of uncontrollable outcomes, or blame a person associated in some way with an outcome rather than attributing it to chance (16). Unfortunately, people are not capable of accurately assessing probabilities or risks. As a consequence of biases in decision making, people have definite and predictable ideas about whether a gasoline shortage is predictable or deserved. As a consequence, their response will be to some extent predictable. Most important, the continuum from certainty or uncertainty reflects a considerable diversity of decision-making strategies. To the extent that there is certainty about the outcome and to the extent that the individual does not have prior expectations about a different outcome, there will be acceptance of the conditions as stated or delivered. If it is perceived that these conditions are uniform for all other individuals, acceptance of them will be even further enhanced.

COPING WITH FIRST-TIME EVENTS

The theoretical constructs described above and the conclusions drawn apply to a number of situations that correspond to potential shortage conditions. One area that has been well studied is human response to disaster. Several valuable generalizations have been drawn from the disaster literature that are useful when trying to derive some hypotheses for application to shortage models. Parameters may include a population, the physical characteristics of the environment, a requirement for substantial change in behavior on the part of individuals and groups, and both short- and long-term significant changes in the goals and objectives of the affected population. The generalizations that have been drawn from the disaster literature are presented here (17).

1. A constellation of behaviors occurs in response to disasters or extreme situations (18). The symptomatology is characterized by three phases. The first phase occurs immediately after the disaster incident and behavior tends to conform to a kind of emotional shock. Dazed, stereotyped behaviors are most commonly observed. The second phase is characterized by docility, coupled with high suggestibility. The third phase consists of an initial depression, followed by a coping recovery process.
2. Nonrational or uncontrolled forms of behavior are very much rarer than popular accounts indicate. Compelling pressure to act and a compressed time perspective, coupled with a perception that escape will soon be impossible, are the conditions that most frequently lead to either flight or freezing (panic) behavior.
3. Individuals tend to perceive and interpret disaster cues and causal agents with reference to those features of the environment with which they are most familiar. Periodically, different information will be interpreted in the most parsimonious manner (i.e., a manner congruent with known previous conditions).
4. Considerable variability in the perception of the causal agent exists. Correct identification of operative parameters under changed conditions requires considerable analysis and comparison.
5. Previous experience or practice in coping with a set of changed conditions provides significant assistance in the quality and quantity of response.

The characteristics of response to a new situation

represent all human behavior in a new situation to some degree. Where possible, behaviors within the repertoire are usually adapted or modified as an economic means of providing response. Or, where competition exists, the most efficient or conserving frame of reference will be selected for use as a model in the interpretation and evaluation of the threatening condition. As emphasized previously, the cognitive structure of human beings and their experiences tend to distort or bias evaluations in a consistent manner so that a logically consistent evaluation of any changed conditions is not known to the individual. Instead, the individual operates within a system that incorporates trade-offs between time and energy available, perceived use of attending to low-probability events, and a number of social or psychological values that significantly bias an ultimate choice.

The problem of anyone confronted with a prospective gasoline shortage—and a large population unprepared to respond to the shortage—must include an appreciation of the most economic and effective method of ensuring that all members of the group respond in a manner that is acceptable and does not tend to exacerbate conditions. To this end, the objective must be to provide information that will be reliably and rapidly interpreted and used as a basis for making consistent decisions about courses of action. To this end, there are several general rules related to the type and method of information presentation that will significantly improve its acceptance and use. With the aim of giving knowledge, changing attitudes, and ensuring that the behavior takes place, the most effective findings include the following (19):

1. Specificity of information to the situation,
2. Positive unambiguous instruction,
3. Information close in time and place to where the desired behavior is to take place,
4. Relation of information to existing attitudes and knowledge,
5. Existence of elaborative or in-depth descriptions and accessibility of substantiating material, and
6. Emphasis on reasons for adopting the behavior other than that it is required or constrained by conditions.

The information preparation and presentation (a) must not imply that the situation in which the individuals are involved is catastrophic or of an enduring nature, (b) must not dwell on the undesired alternative behaviors, and (c) must not allow the formulation of independent courses of action. All information must be prepared so that it can be interpreted as a planned and comprehensive effort directed specifically toward solution of the problem within a finite and acceptable time-and-space framework. The authority for courses of action must be clear and unambiguous, with the sanctions for failure to respond in the desired manner presented clearly and defined so that the individuals perceive a high probability of some low or intermediate penalty for their failure to comply.

IMPLICATIONS FOR GASOLINE-SHORTAGE SITUATIONS

The response of consumers to initial energy shortages has been congruent with the predictions drawn from the disaster models and the decision-theory models described previously (20). Many of the behaviors, including riots, gasoline lines, and innovative strategies (e.g., adopting alternative fuels and extra fuel tanks) correspond to the predictions. With additional information and experience with the new conditions, consumers will develop a revised and more-sophisticated set of behaviors and beliefs. These are likely to continue to overestimate the probabilities and costs of well-known problems and significantly underestimate the lesser, well-visualized aspects of the shortage scenarios.

Attribution of blame is currently displaced to oil companies and the government as the primary culprits. Initially, however, displacement was to those individuals (service station personnel) immediately available in time and space. A lack of information, planning, and rules of behavior for response to a gasoline shortage reinforces pessimism about whether other individuals will engage in energy conservation efforts and, hence, individual disposition to conserve. As a response to this condition, consumers are in favor of government intervention and controls over energy. Recognition of the personalized nature and readily visualized inequities of rationing and tax increases psychologically reinforces any existing opposition to these methods as solutions. At least one highly visible measure, perceived as enforceable, is the 55-mph speed limit, which most consumers endorse (21). The acceptability of this alternative and the rejection of rationing and taxes correspond to some aspects of the learned-helplessness model. In this model the inevitability of the costs plays a considerable role in the ultimate acceptance and response to the plan's penalties. It can be conjectured that, because there is very little experience with catastrophic system failures comparable to the loss (shortage) of a primary source of energy, consumers appear to believe that there is a vanishingly small probability that this can, in fact, be a possible outcome.

A cheering note for utility theorists is that middle-income groups in particular are more likely to reduce energy consumption if prices continue to rise. These results are not explicable from a psychological point of view; rather, these results are attributable to the fact that lower-income groups have either fewer alternative responses or have implemented all available energy-conserving responses at their disposal. The upper-income groups are unaffected to any significant economic extent by any realistic increase in energy costs. The sole group with significant energy use and without a compelling and continuous need to monitor expenditure is, therefore, the middle-income group. Survey results support this view.

Beyond this finding, few demographic and socioeconomic factors appear useful in explaining energy attitudes and behaviors. This brief outline of applicable models is presented as a suggestion that a social psychological approach may be of some assistance in preparing communication and organizational programs for use in responding to anticipated gasoline shortages.

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Short-Run Traveler Responses to Alternative Gasoline-Allocation Plans: Some Modeling Results

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The possibility that serious gasoline shortages may occur in the United States is prompting government agencies to give increased attention to the development of ways to allocate scarce gasoline supplies among travelers. A large number of allocation procedures are potentially available, including allocation by allowing the retail price of gasoline to rise to a market-clearing level, by means of queues at service stations (i.e., persons with the greatest desire or ability to spend time waiting in queues tend to receive the greatest allocations of gasoline), and by various rationing systems.

Quantitative estimates of the likely impacts on travel of gasoline shortages when different gasoline allocation procedures are in effect presumably could help government agencies and others to determine how the adverse effects of shortages can best be mitigated or equitably distributed. However, the development of such estimates has been impeded by a lack of satisfactory data and estimation methods. Virtually all of the data that are currently available for transportation forecasting studies in the United States were acquired before the 1973-1974 gasoline shortage and, hence, do not reflect any changes in travelers' tastes (e.g., changes in the value of travel time or in the extent to which the schedule inflexibility of carpooling is disvalued) that may have occurred as a result of or since this shortage. Nor do currently available data reflect transportation system changes (e.g., new transit systems) or changes in urban demographic and land use patterns that may have occurred since the large transportation studies of the 1960s and early 1970s. Moreover, transportation data sets typically pertain to urban weekday travel and, hence, do not include much of the recreational travel that may be most severely affected by gasoline shortages. Even if more recent and comprehensive data were available, their relevance for forecasting the effects of severe gasoline shortages could be questioned, as the forecasts almost certainly would require extrapolations to shortage conditions or allocation procedures that were not represented in the data.

The methodological difficulties of forecasting travelers' responses to gasoline shortages are also severe, although they may be more tractable than those resulting from data deficiencies. Past efforts to estimate the effects of gasoline shortages on travel and travelers have been based on surveys of travelers' responses to the 1973-1974 gasoline shortage (1-4) and on travel demand forecasting studies that have been predicated on disaggregate travel demand models (5-6). However, despite substantial differences in data and methodology, these survey and modeling studies have consistently indicated that, in the short run, most households tend to adjust to gasoline shortages or price increases by decreasing nonwork travel frequencies and nonwork trip lengths, whereas relatively few households change their modes of travel for either work or nonwork purposes. Although this consistency of results is encouraging, the survey and demand-modeling methods on which the results are based have important limitations. By themselves, the survey results cannot be used for forecasting, except in a very loose and qualitative way, and they are not suitable for comparing the impacts of various alternative gasoline-allocation procedures. The disaggregate demand models are, of course, designed for use in forecasting. These models permit treatment of a broader range of travel and policy options than can be dealt with by alternative modeling approaches. However, past disaggregate demand-modeling studies of the effects of gasoline shortages or price increases have not included certain potentially important short-run traveler responses (e.g., notably increased use of multidestination travel). The only gasoline-allocation method that has been treated in these studies is that of allowing the retail price of gasoline to rise to the market-clearing level. Thus, much of the potential value of the disaggregate demand-modeling approach to forecasting short-run effects of gasoline shortages remains unrealized.

The purpose of this paper is to present the results of applying an improved version of the disaggregate demand-modeling method in connection with a currently available data set to develop some exploratory estimates of the travel impacts of a gasoline shortage. The methodological improvements consist of including increases in multidestination travel among the modeled responses of travelers to gasoline shortages and of including several