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Best Value, Price-Seeking, and Price Aversion: The Impact of Information and Learning on Consumer Choices

When information on product quality is not perfect, theories in the areas of consumer rationality, inference, and risk-aversion suggest at least three consumer choice strategies: best value, price-seeking, and price aversion. The authors relate these choice strategies through a common utility model and show they are three types of response to price: rational, overweighting, and underweighting, respectively. Through a simulated shopping experiment, they show the factors that discriminate when consumers use these strategies. In particular, they find that price-seeking due to inference is not strictly rational and can lead to a positive response to price when information on quality is low but quality is important. Although information on quality generally promotes the rational choice of best value, experience neither promotes rationality nor mitigates inference. Ironically, subjects seem to react to but do not learn from experience.

CONSUMERS generally purchase products with incomplete information about the alternatives. Information may be imperfect because of the proliferation of competing brands, the difficulties of exhaustive search or sampling, biases in product evaluation, constant product innovation, or consumer mobility (Newman 1977; Thorelli and Thorelli 1977). Though price and quality are the most general attributes on which brands are chosen, information about quality is more problematic because quality is more difficult to assess before and even after purchase. Moreover, the impact of quality persists; inferior quality can be a source of long-lasting irritation and inconvenience. The effect of incomplete information on consumer choices is therefore important for analyzing consumer behavior, social welfare, and firm strategy.

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We define "quality" as a product's outcome or performance according to specifications and "information" as the consumer's knowledge of the product's outcome. Einhorn and Hogarth (1987) define three levels of information for choices: *certainty, uncertainty*, and *ambiguity*. Here, certainty is full knowledge of the product's outcome, uncertainty is knowledge only of the probability distribution of various outcomes, and ambiguity is unclear knowledge about the outcomes' probability distribution itself.

When price is better known than quality, we identify three choice strategies consumers may use under uncertainty: *best value, price-seeking*, and *price aversion*. Best value is choosing the brand with the least overall cost in terms of price and expected quality; price-seeking is choosing the highest priced brand to maximize expected quality; price aversion is choosing the lowest priced brand to minimize immediate costs. The three choice strategies arise from three different

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research paradigms: best value from the economic theory of *rationality*, price-seeking from research on *inference*, and price aversion from research on *risk aversion*. Rationality is a set of principles that describe the normatively best (or utility maximizing) choice. Inference is the estimation of a value of a missing attribute from available attributes. Risk aversion is a preference for a more certain prospect to a more uncertain one even when both have the same expected value. Typically these research traditions have not been related to each other formally, as shown in the next section.

Marketers have been especially interested in the second choice strategy—how consumers use price to infer quality when price is better known than quality. A review of the more than 40 studies conducted over three decades indicates that consumers frequently do infer quality from price. However, researchers point out that the underlying theory is weak, many exceptions to the phenomenon are found, and the underlying factors that motivate such behavior are not clear (Bowbrick 1982; Lambert 1982; Zeithaml 1988). Further, though inference often is proposed as an alternative to rationality, that difference has not been modeled before.

We posit that the three choice strategies (best value, price-seeking, and price aversion) are related to each other and are three different consumer responses to price when information about product quality is incomplete. In such conditions, we suggest that three variables, *information on quality, the importance of quality,* and *price-quality correlation,* influence which strategy consumers use. We relate these strategies through a common utility model and show the influence of the explanatory variables by a laboratory experiment.

In particular, we explore the impact of two components of information on these strategies, *objective information* and *personal experience*. These two components are especially important for evaluating the role of information in market behavior. For example, though conceding that consumers may have imperfect information about their alternatives, many economists assert that consumers' experience would compensate for the deficiency (or that experience eliminates inefficiency; Hogarth and Reder 1987). However, Tversky and Kahneman (1987) doubt that experience can be so effective because experience is generally not immediate, reliable, or complete for each alternative. We examine how objective information and experience influence consumers' use of various choice strategies.

We carried out a shopping experiment to test the effects of the explanatory factors on the choice strategies. The experiment clearly contrasted the three choice strategies and their dependence on the explanatory factors. In the following sections we model the choice strategies, describe the experiment, and discuss the implications of the study.

Models of Choice Under Uncertainty

In this section, we first present a simple problem that contrasts the three choice strategies. Next, we relate the strategies by a common utility model. We then discuss the factors that discriminate between the choice strategies and develop testable hypotheses.

The Problem

Suppose we ask a consumer to choose among three brands, A, B, and C, having clear prices and repair costs but some uncertainty about quality.

Brand	Price per Unit ($)	Quality (Probabilty of Breakdown)	Cost of Repair ($)
A	24	.4	7
B	20	.5	7
C	18	.9	7

The rational approach (as assumed in economics) is to choose the brand with the best value or lowest total expected cost. The brand preferences then would be ordered B ($23.5), C ($24.3), and A ($26.8). However, extensive empirical evidence indicates that consumers do not always make rational decisions (Kahneman and Tversky 1979; Monroe and Petroshius 1981). Research on inference suggests that under some conditions, buyers may associate higher prices with better quality to the extent that the highest priced brand, A, appears to be the best buy. In those conditions, buyers systematically ignore or misinterpret the uncertain information on quality and make a *price-seeking* choice. Under other conditions, consumers may be overpowered by the uncertainty and may decide to minimize immediate losses by choosing the cheapest brand, C, a *price-averse* choice (Tellis 1987). Our study seeks to relate these choice strategies through a common utility model and identify the conditions or factors that determine which choice strategy consumers would use.

Best-Value Strategy

The best value can be derived from the expected utility model, a normative model of how consumers should behave. The model is used widely in economics to describe consumer behavior. The basic model assumes that consumers choose from a set of fixed alternatives "rationally" to maximize utility. Two extensions of the basic model greatly increase its relevance. To account for uncertainty, von Neumann and Morgenstern (1944) proposed that consumers respond to the *expected utility* of the alternatives (i.e., the probability times the benefit of the alternative). Lancaster (1966) extended the model from maximizing the utility of individual objects to maximizing the utility of the *bundle of characteristics* that describe those objects. This extension does not restrict the model to particular choice sets, but allows generalization to any choice set that can be described by the same attributes and utility functions. By these two extensions, the expected utility model for brand choice is:

$$\text{Choose i that maximizes } V_i = \sum_i P_j \cdot U_j(X_{ij}) \quad (1)$$

where:

V_i is subjective value of brand i,

X_{ij} are attributes (j) that describe the brands (i),

U_j is a subject's utility for the attribute, and

P_j is the objective probability of the attribute's occurrence, $0 < P_j \leq 1$.

For simplicity, let X_1 and X_2 be the only attributes, such that X_1 is known with certainty ($P_1 = 1$) and X_2 with some uncertainty ($P_2 < 1$). Let the subject's utility for these attributes be linear and represented by W_1 and W_2, respectively. Then equation 1 reduces to:

$$\text{maximize } V_i = W_iX_{1i} + P_{2i}W_2X_{2i}. \quad (2)$$

Because the expected utility model describes how consumers should behave, and commonly is used in economics for descriptive and predictive models, it is a good null model against which to test rival hypotheses about consumer choices. We refer to weights W_1 and W_2 under expected utility theory as the consumer's optimal or ideal weights; we refer to the utility-maximizing alternative as the best value.

Price-Seeking Strategy

The price-seeking strategy is based on consumers' inference of quality from price. After an early article by Leavitt (1954), several researchers in marketing, psychology, and economics researched this phenomenon. Though the evidence suggests that consumers may infer quality from price, there is no unanimity about the conditions under which they may do so (Monroe and Petroshius 1981; Olson 1977; Zeithaml 1988). We analyze the process of quality inference, show how it leads to price-seeking choices, contrast such choices to those of best value, and discuss the conditions under which each would prevail.

Consumers may infer quality from price for several reasons. Their past experience may be consistent with a positive price-quality relationship, they might rationalize that the higher price results from firms spending more to supply quality, or they might trust the market and believe that the higher price is the result of other consumers' willingness to pay more for better quality. Basic to all of these explanations is an assumption by consumers about a *positive correlation* between price and quality, which they use to infer the value of quality.

The key question is: How do consumers trade off price, objective quality, and perceived quality based on price when choosing a brand? Dodds and Monroe (1985) suggest a simple model in which price affects perceived value through perceived sacrifice and perceived quality. Zeithaml (1988) extends that model to a range of stimuli and perceptions that affect perceived value. Huber and McCann (1982) present a formal model to capture the effect of inference and attribute information on consumer choice. We find that an extension of the latter model to accommodate uncertain and correlated attributes can show the tradeoff among attributes and contrast inference with rationality:

$$\text{maximize } V_i = W_1 \cdot X_{1i} + P_2 \cdot W_2 \cdot X_{2i} + (1 - P_2) \cdot W_2 \cdot G(B_{12}) \cdot X_{1i} \quad (3)$$

where $G(B_{12})$ is the perceived increase in quality that consumers expect from higher price when quality is uncertain ($P_2 < 1$) and B_{12}, the effect of quality on price, is one estimate of the ecological correlation between price and quality. Equation 3 can be simplified to:

$$\text{maximize } V_i = W_1^fX_{1i} + P_2 \cdot W_2 \cdot X_{2i} \quad (4)$$

where W_1^f is the new weight on the certain attribute X_1 due to inference,

$$W_1^f = W_1 + (1 - P_2) \cdot W_2 \cdot G(B_{12}). \quad (5)$$

Assume that the certain attribute, X_1, is price and the uncertain attribute, X_2, is quality. Then equations 3 through 5 indicate how consumers trade off price and quality when choosing brands under uncertainty: first, consumers discount the weight (W_2) of quality by its probability (P_2); second, they infer the value of quality from price and systematically under- or overweight price ($W_1^f - W_1$) depending on its perceived correlation with quality $G(B_{12})$ and the uncertainty ($1 - P_2$) and utility (W_2) of quality.

To obtain the direction of the weighting, note that W_1 is negative, W_2 is positive, and $G(B_{12})$ generally is assumed to be positive so that $W_1^f > W_1$. In other words, when price is known but quality is not, subjects tend to react *more positively* (or less negatively) to price as they infer the value of the uncertain attribute, quality, from price.

Price-Aversion Strategy

An alternative choice strategy under uncertainty is for consumers to discount the available (uncertain) information on quality and decide only on price. An extreme form of this behavior would be for consumers to choose the lowest priced brand. A rationale for this response is to minimize expenses or "losses" that are certain. Kahneman and Tversky (1979) refer to such response as risk aversion.[1] They marshal considerable evidence to show that in the context of gambles, risk aversion is a recognizable decision strategy. Work by Thaler (1980, 1985) and others has confirmed the basic finding and extended it to the context of nonprobabilistic outcomes and to mixed (loss and gain) outcomes. In the context of brand choice with price known better than quality, we refer to this decision strategy as price aversion.

More generally, under price aversion, equation 1 becomes:

$$\text{maximize } V_i = \sum_j H(P_j) \cdot U(X_{ij}) \qquad (6)$$

where $H(\cdot)$ is the *subjective* probability of the attributes under uncertainty. The purpose of the function $H(\cdot)$ is to capture the risk-averse consumer's tendency to overweight certain attributes ($P = 1$) and underweight uncertain ones ($P < 1$). If we assume only two attributes, the simplified version of equation 3 corresponding to equation 2 is:

$$\text{maximize } V_i = W_1^r \cdot X_{1i} + W_2^r \cdot X_{2i} \qquad (7)$$

where W_1^r and W_2^r are the hypothesized weights under price aversion. Equation 7 describes how consumers systematically alter their optimal weights (W_1 and W_2) so that the absolute values of $W_1^r > W_1$ and $W_2^r < W_2$, but the signs are unchanged. For example, when price is known but quality is not, consumers would overweight price and underweight quality, responding *more negatively* to price than they would under expected utility theory ($-W_1^r < -W_1$).

In summary, when price is known and quality is uncertain, theories of consumer choice suggest rival predictions about the consumers' response to price; these predictions reflect an overweighting (price aversion, equation 7) or an underweighting (price-seeking, equation 4) of price in relation to the rational choice (best value, equation 2).

[1]In the context of gambles, Tversky and Kahneman (1987) postulate that individuals are risk averse for gains (the "certainty effect"), but risk-seeking for losses (the "reflection effect"). Thaler (1980) claims that both effects reflect the same phenomenon, which he labels "consumers' underweighting of opportunity costs." In our context, the consumer who buys the low priced brand probably views the brand choice as maximizing certain gains from buying the lowest priced brand and is risk averse in Tversky and Kahneman's (1987) terminology. However, to avoid controversy, we refer to the phenomenon as price aversion.

Effect of the Explanatory Factors on the Choice Strategy

Which of these three strategies typifies consumer choice? Are there factors that favor one over the others? The preceding discussion suggests a parsimonious set of three mediating factors: the type of information, the utility or importance of quality, and the perceived correlation between price and quality. Recall that by the term "information" we mean knowledge on product quality. Information itself has two important components, objective information from some neutral expert and the consumer's personal experience gained from product usage.

Objective information has a critical role in choice and the anomalous responses to price arise only because quality is uncertain. Hence,

H_{1a}: Consumers tend to choose the best value as the objective information on quality increases.

H_{1b}: Conversely, consumers tend to use price-seeking or price aversion as the objective information on quality decreases.

When information on quality is not certain, consumers' need for quality prompts them to use whatever information is available, especially price, to infer the value of quality. Thus as the importance of quality increases, they are more likely to choose the higher priced brand and less likely to choose the lower priced brand.

H_{2a}: Consumers tend to use price-seeking as the importance of quality increases.

H_{2b}: Consumers tend to use price aversion as the importance of quality decreases.

In the absence of certain information on quality, consumers are likely to use price as a cue for quality, but only if they perceive a relationship between price and quality. We therefore expect that:

H_3: Consumers tend to use price-seeking as the perceived correlation between price and quality increases.

How would objective information and personal experience interact in influencing consumers' decisions? There are three possibilities. First, at one extreme, a positive interaction may favor rational choices: objective information would facilitate the proper interpretation of feedback from past experience whereas the absence of objective information may hinder meaningful interpretation of experience (e.g., Jenkins and Ward 1965). By this argument:

H_{4a}: As consumers gain experience, they are more likely to choose the best value rather than the price-seeking and price aversion strategies if they have objective information on quality.

Second, experience and objective information may be additive: to the extent that consumers lack objective information or misuse it, experience would gradually steer them to the rational choice. Economists commonly assume that consumers behave in this way so that experience ultimately eliminates market inefficiencies caused by uncertainty (Hogarth and Reder 1987). By this argument:

> H_{4b}: As consumers gain experience, they are more likely to choose the best value rather than the price-seeking and price aversion strategies independent of objective information.

Third, experience may not lead to any substantive learning (Einhorn and Hogarth 1978; Hammond et al. 1975). The reason is that consumers tend to overact to immediate experience, rather than put experiences in perspective and develop probabilistic models (Einhorn and Hogarth 1981; Tversky and Kahneman 1987). Hence:

> H_{4c}: Consumers' likelihood of choosing the best value is invariant with experience.

Effect of the Explanatory Factors on the Price Response Function

Consumers' response to price can be described algebraically as in equations 1 through 7 or graphically by plotting product choices against the corresponding prices. Equations 1 through 4 demonstrate how price enters the choice process in one or both roles: the brand's cost or an indicator of its quality. If consumers make decisions rationally and use price only as the product's cost (equations 1 and 2), they will respond negatively to price. As argued previously, rational decisions are most likely in high information conditions.

> H_{5a}: Rational decision-making suggests a negatively sloped price response curve, especially in high information conditions.

However, if consumers use price to infer quality, equations 3 and 4 show how their negative response to price is tempered or positively biased by their expectations of higher quality from the higher price. If such inference of quality is strong enough, it leads ultimately to a positive response to price. As argued before, inference is stronger as the importance of quality and price-quality correlation increase, especially in the absence of information. Therefore:

> H_{5b}: Inference is likely to lead to a positively sloped curve that rises with high prices. The importance of quality and the price-quality correlation accentuate the effects of inference, especially in low information conditions.

Method

We conducted a shopping experiment that explored the effects of the explanatory factors on the three choice strategies. The design allowed for an explicit test of the hypotheses.

Subjects

One hundred thirty-five undergraduate students majoring in marketing participated in a simulated shopping experiment. Participation was voluntary, though a subset of the students were given extra credit. Prizes of \$25, \$15, and \$10 were offered for subjects with the highest closing balance in each information condition.

Design

The shopping experiment was played over 20 periods. The students, all of whom began with a fixed budget of \$500, had to choose a "brand" of winter boots from one of seven available. To control the importance of quality precisely, we manipulated it as the probability of a brand not needing repairs costing a fixed dollar amount. All students were given brand names for the boots, their prices, and the cost of repairs and, after each play, were told whether the chosen brand needed repairs. Brand names were represented by randomly assigned single letters (A–G) and in any condition a brand's price, quality, and repair cost were held constant over 20 periods. To simulate the gains that normally would accrue from such shopping, we promised the subjects monetary awards for having the highest closing balances (net of prices and service costs) after the 20 plays. The design was a full factorial comprising three levels of objective information (on quality) by three levels of the importance of quality (cost of repair) by five levels of correlation (between price and quality) by 20 periods of experience (of quality) (see Table 1).[2] The first three factors were manipulated between subjects and the fourth within subjects.

Objective information on quality was varied over three levels. In the "low" condition, subjects did not have prior repair probabilities of any brand and had posterior performance of only the purchased brand after each period. In the "medium" condition, subjects had repair probabilities of all brands and posterior performance of only the purchased brand. In the "high" condition, subjects had repair probabilities of each brand and posterior performance of all the brands. Thus, in the framework of Einhorn and Hogarth (1987), the first condition reflects ambiguity and the latter two are conditions of uncertainty. The first two conditions also provide "partial experience," whereas the third provides "complete experience" (Tversky and Kahneman 1987).

[2]We also manipulated a fifth between-subject factor, information on market share of brands, at three levels: absent, consistent with quality, and inconsistent with quality. The manipulation was entirely orthogonal to the other four factors and, for simplicity of exposition, we do not discuss this factor.

TABLE 1
Levels and Operationalizations of Experimental Manipulations

Variable	Levels	Operationalization in Logit Model
Price ($)	20.36, 20.83, 21.12, 22.32, 23.16, 24.21, 25.11	As is
Quality (success probability)	.30, .35, .39, .51, .55, .68, .74	As is
Objective information (on quality)	Low = no prior repair probabilities Medium = prior repair probabilities High = prior repair probabilities plus (posterior) last period performance	0 1 2
Importance of quality (repair costs)	5, 10, 20	0, 1, 2
Correlation between price and quality	−.25, .21, .32, .61, .69	0, 1, 2, 3, 4, 5
Experience	Last period performance of chosen brand, repeated over 20 plays.	0 ... 20

The five levels of the correlation between price and quality were chosen to avoid unique price-quality pairs that could invalidate the whole design. These levels were obtained by computer iteration to satisfy two constraints: (1) the brand with the best expected value was never the lowest or highest priced or of the best or worst quality and (2) the average of the five correlations approximated .22, which is an estimate of the ecological value for running shoes (Archibald, Haulman, and Moody 1983). The correlation between price and quality was never told to subjects, but it could be estimated from the prices and the performance of the chosen brand. It also could be determined from a comparison of prices and quality levels in two of the information conditions.[3] The importance of quality was manipulated as the repair cost for a breakdown incurred during a "year" and was set at $5, $10, or $20, which reflected approximately 22%, 45%, and 89% of the average price, respectively. These costs are not unreasonably high because labor costs are generally high and sometimes a replacement is cheaper than a repair.

Procedure

The experiment was conducted with a BASIC program that ran on an IBM microcomputer. Subjects worked independently in a small room containing 12 PCs. They came to the room in varying numbers and were assigned randomly to the experimental conditions. A handout that described the experimental procedure was given to each subject prior to the beginning of the experiment and then summarized verbally. The experimenter briefly explained the working of the PC and carried out a two-period practice session. Because subject responses involved simply pressing a letter and the return key, no operational difficulties were encountered.

During the experiment, the subjects were encouraged to deliberate as much as they normally would for such purchases. After the brand selection was made, the program used a dynamic computer-based pseudo-random-number generator calibrated to the displayed probabilities to determine whether the product needed service or not. The service cost of the selected boot was assessed and deducted from subjects' previous balance, and their new balance was displayed. After the game, subjects filled out a postexperiment questionnaire addressing product knowledge, realism, and decision strategies. Then they were debriefed. The experimental session required about 40 minutes.

Analysis

We carried out a visual graphic analysis on three of the seven discrete choices and a rigorous logit analysis on all choices. The graphic analysis included only the three choices that could be classified unambiguously as representative of the three strategies. In each condition, we classified the brand with the lowest expected total cost as the best value, the highest priced brand as price-seeking, and the lowest priced brand as price aversion. We then analyzed the proportion of these three choices as functions of the design conditions. The logit analysis included all the data as described in the Appendix. It directly operationalized equations 2, 4, and 7 and estimated the price response function.

Results of Analysis of Discrete Choices

The experiment yielded a total of 2700 choices (135 subjects × 20 periods) and 18,900 datapoints (2700

[3]Objective information and the price-quality correlation are collinear. We preferred this design because it is more realistic and the alternative of explicitly providing the correlation coefficient would introduce serious, unrealistic framing effects, which we wanted to avoid. However, the presence of five levels of correlation reduces the collinearity. Moreover, we expect subjects to infer the price-quality correlation by experience rather than by objective information.

choices × 7 brands). Figures 1 and 2 show the relative proportions of the three choices that can be characterized unambiguously as best value, price-seeking, and price aversion. These three choices amount to about 50% of the total choices and are noted as N in the figures. For the levels of information, "low" means no prior information on quality, "medium" means only prior information on quality, and "high" means prior and posterior information on quality.

Figure 1 shows the effect of objective information, the importance of quality, and price-quality correlation on choice. Consistent with our prediction (H_{1a} and H_{1b}), an increase in information leads to a dramatic increase in best value and a corresponding decrease in price-seeking and price aversion (χ^2 significant at $p < .001$). The effect of information on best value is significantly different among all three levels, but the increase in best value is not as great between medium and high, indicating the lower marginal value of more detailed information. Similarly, as predicted (H_{2a} and H_{2b}), price-seeking goes up sharply and price aversion declines as the importance of quality increases (χ^2 significant at $p < .001$). However, contrary to expectations, we obtain a nonlinear effect for the importance of quality, possibly because a very high importance for quality motivates subjects to compute tradeoffs more carefully. Also, consistent with our prediction (H_3), with one exception, price-seeking increases steadily as the correlation becomes stronger (χ^2 is significant at $p < .001$).

For H_{4a} through H_{4c}, Figure 2A shows that experience has no significant effect on any of the choices, including best value ($\chi^2 = 35$, d.f. $= 38$, $p > .6$). Experience also has no significant effect on the choices in the two extreme information on quality conditions (Figure 2B, C), suggesting that it neither enhances nor negates the effect of objective information. The only difference is that information reduces indecision over time as evidenced by curves that fluctuate less in that condition.

FIGURE 1

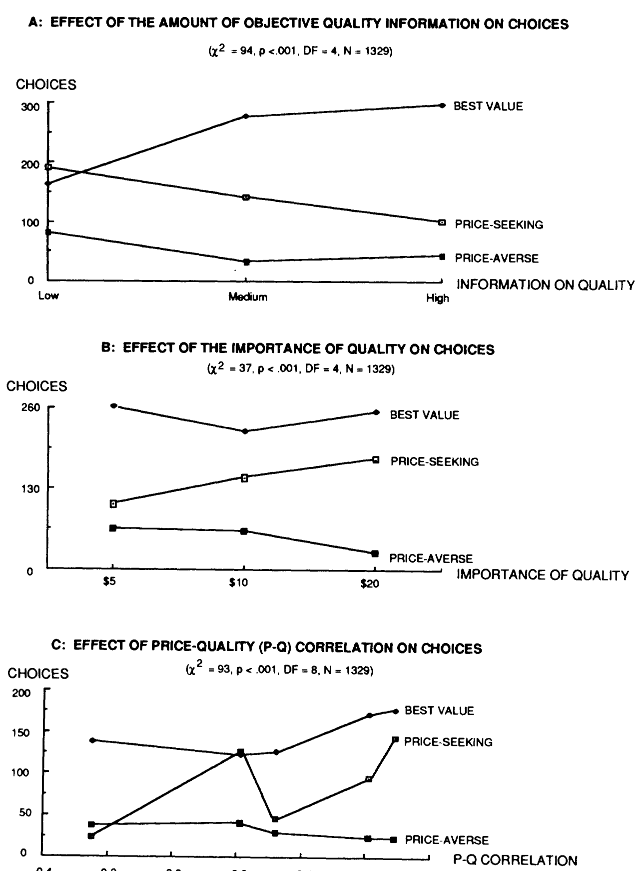
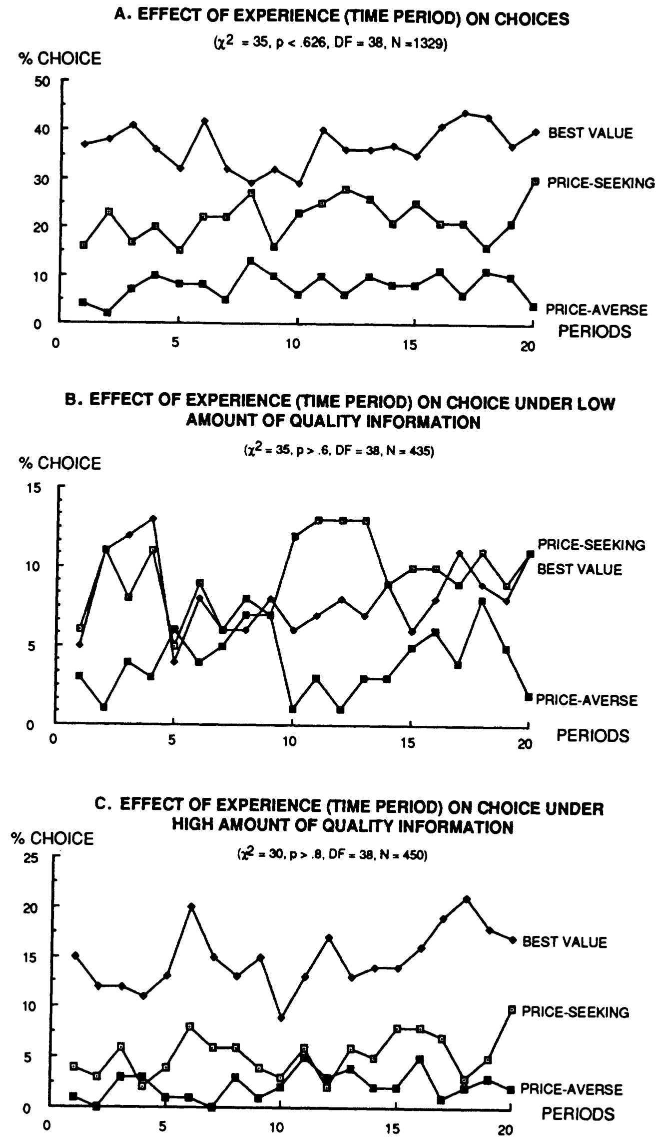


FIGURE 2



Logit Analysis and the Price Response Function

Formulation 1 (see Appendix) uses dummy variables for the three discrete choices as in the graphic analysis. In summary, most of the coefficients, and all but one of the strong effects, are consistent with the hypotheses and the graphic analysis. The model correctly predicts a total of 84% of subjects' brand choices (91% of the negative and 45% of the positive choices). Of the design factors, the strongest effects are associated with the provision of information. The importance of quality and the price-quality correlation have moderate explanatory power. Experience is only marginally significant.

Formulation 2 (Appendix and Table 2) tests the rival models described in equations 2, 4, and 7. In particular the signs and magnitudes of the price coefficients discriminate among the three competing choice models. The quadratic price terms capture potential inflections in response at the extreme values of price due to price-seeking or price aversion. Interactions of price and the design factors capture the mediating role of these factors.

An easy way to understand the results of formulation 2 is to plot the price response function it describes. Recall that the logit models the subjects' choices (dependent variable) as a probabilistic response to price and quality (independent variables) by various conditions (interaction variables). We can use the estimated coefficients to obtain estimated choice probabilities for various levels of the independent variables. If we plot these estimated choice probabilities by price levels, we get the estimated price response function. By using the coefficients of the interaction terms, we can obtain these plots by the design conditions to see how the latter affect the response function. Parts A and B of Figure 3 are plots of price response by the importance of quality and parts A and B of Figure 4 are plots of price response by price-quality correlation. In each graph, we plot a pair of curves, one for high information and one for low information. All curves are at the median level of quality and experience.

Consistent with expectations, the positive price response curve, suggestive of price-seeking, is evident in the low information condition, especially when the importance of quality is high (Figure 3B). The traditional negative price curve, suggestive of rationality, is evident in high information conditions. As in the graphic analyses, experience does not have any important effect. Similarly, there is no strong evidence of price aversion. We did not plot curves for the latter scenarios.

Discussion

A key benefit of our study is the formal comparison of three rival choice strategies, which affords a richer understanding of consumer decision-making under limited information. The success of the explanatory factors in discriminating among the choice strategies supports our basic approach. In particular, the explanatory power of objective information, the impor-

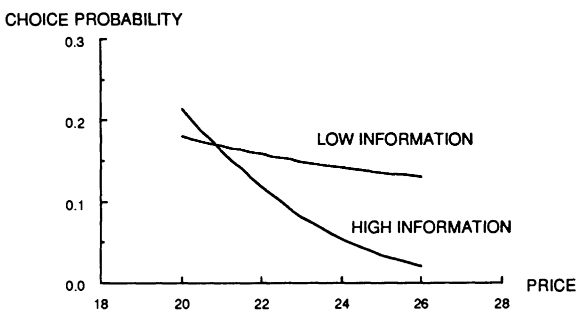
TABLE 2
Logit Estimates of Price Response

	Formulation 2			Formulation 3		
Independent Variable	**Beta**	χ^2	**R**	**Beta**	χ^2	**R**
Price × information	.21	19[a]	.033	.18	14[b]	.027
Price × importance	−.10	8[b]	−.019	−.06	4[c]	.010
Price × correlation	.02	1	.000	.02	1	.000
Price × experience	.006	4	.010	.004	2	.000
Price squared × information	−.008	17[a]	−.031	−.007	13[b]	−.026
Price squared × importance	.005	13[b]	.027	.004	7[c]	.017
Price squared × correlation	−.001	2	−.004	−.001	2	.000
Price squared × experience	.0002	3	.008	−.0002	2	.000
Price × importance × information	−.01	.1	.000	−.02	.6	.000
Price × information × correlation	.05	7[a]	.019	.04	4[a]	.012
Price squared × importance × information	.00009	.01	.000	.0006	.3	.000
Price squared × importance × correlation	−.001	4[c]	−.012	−.001	2	−.004
Price	−.34	.4	.000	−.31	.3	.000
Price squared	.008	.5	.000	.008	.4	.000
$Choice_{t-1}$				2.33[a]	1376	.298
$Choice_{t-1}$ × repair				1.53[a]	284	.135
Intercept	2.87	.2		1.79	0	
Hit rate (correct predictions, %)		79			84	

[a]<.0001,
[b]<.001.
[c]<.05.

FIGURE 3

A. PRICE RESPONSE FUNCTION BY AMOUNT OF INFORMATION ON QUALITY UNDER LOW IMPORTANCE ($5) OF QUALITY



B. PRICE RESPONSE FUNCTION BY AMOUNT OF INFORMATION ON QUALITY UNDER HIGH IMPORTANCE ($20) OF QUALITY

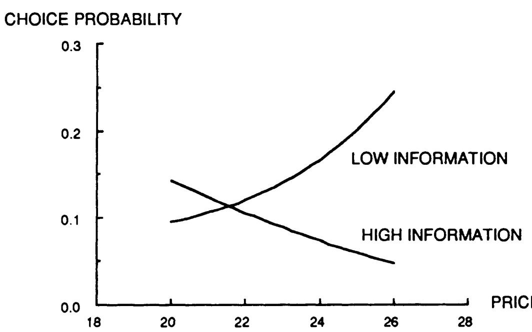
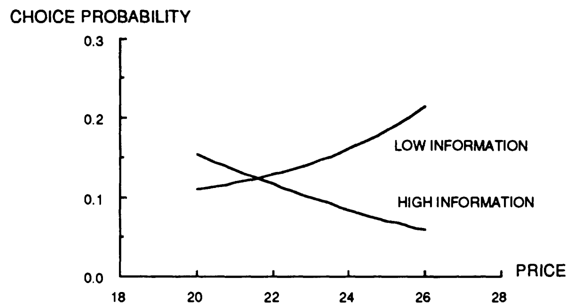
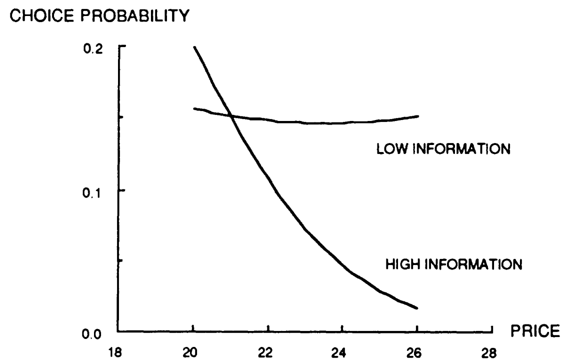


FIGURE 4

A. PRICE RESPONSE FUNCTION BY AMOUNT OF INFORMATION ON QUALITY UNDER LOW PRICE-QUALITY CORRELATION (-.25)



B. PRICE RESPONSE FUNCTION BY AMOUNT OF INFORMATION ON QUALITY UNDER HIGH PRICE-QUALITY CORRELATION (.69)



tance of quality, and the price-quality correlation is consistent with expectations, whereas the lack of impact of experience is unexpected and interesting. The results of the study throw some light on two specific issues: How effective is objective information in consumer choice? How does experience complement it?

The Value of Information and Experience

Though objective information strongly promotes rational choice, the study shows that, under uncertainty, objective information does not eliminate suboptimal choices. For example, in Figure 1A, even though the objective information in conditions 2 and 3 is adequate, only about 50% of the choices are best value. Because product quality in real markets is probabilistic, suboptimal decisions may not be rare. Hence, on aggregate, inferior brands could continue to be present in the market. In the past, the typical response of economists to such inefficiencies caused by uncertainty was to assume that consumers would learn from experience, which would eliminate market inefficiencies over time. The experiment supports the predictions of multicue learning theory: consumer experience is not very effective; indeed, experience did not greatly enhance subjects' ability to choose the best value.

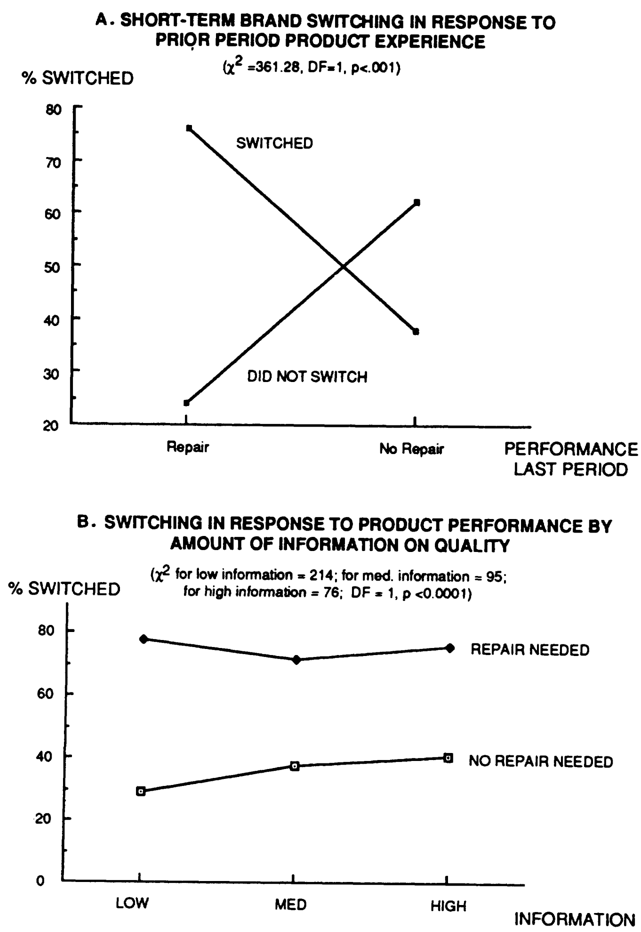
One explanation for low learning may be that subjects were not motivated. We tend to discount this hypothesis for several reasons. First, if subjects were not motivated to do well we would not observe many of the other strong effects consistent with our predictions. Second, informal discussions with subjects indicated that those who did not do well often were frustrated and perplexed at the outcome of their choices, but not bored. In contrast, the subjects who seemed to be bored were those who knew exactly how to respond! Third, exit interviews revealed that subjects generally were interested in the game, became more interested as the game progressed, believed they were learning which was the best brand, and were confident they had made the best choice on the last purchase. Fourth, Kahneman and Tversky's (1987) review indicates that deviations from rationality in laboratory studies are not due to lack of motivation and are robust to alternative rewards to subjects.

Another explanation for the lack of learning is that the choice task was too difficult. Indeed, Kahneman and Tversky (1979), Thaler (1980, 1985), and others show how even simpler experimental tasks involving probability reveal systematic suboptimality in decisions. In a pilot study with three brands and a simpler task, we found stronger experience effects in the predicted direction (Tellis, Gaeth, and Clark 1985). However, we believe that a seven-brand, two-attribute scenario is reasonably representative of brand choice in current markets, which have an average of 15 brands, are described by many more attributes, and involve repurchases over longer time intervals. Moreover, we believe that the quality of durable goods is inherently probabilistic. Hence even the best quality brands may break down, albeit with a low probability. We suspect that learning is low because consumers react more to their most recent experience than to long-term experience or reports of "experts" and rating agencies.

Consistent with this explanation is our finding that brand switching depends mostly on brand experience in the previous period as in a simple, first-order Markov process: switch if bad, repurchase if good. Figure 5A shows this behavior dramatically. Subjects whose brand needed repairs in the last period were twice as likely to switch as those whose brand did not need repairs; the pattern is just the opposite for repurchasers (subjects who did not switch). Would objective information correct this short-sightedness? Actually, subjects used the same heuristic even when information was available (Figure 5B). The logit analysis (Table 2) shows that the prior period's brand performance dominates every other explanatory factor including objective information. The three results show that short-term reaction to brand performance is strong, hinders long-term learning, and even dominates objective information.

Sales response models based on market data provide indirect external support for these results. The models indicate that consumers' purchases are much more dependent on the last period's purchase than on marketing activity (e.g., Guadagni and Little 1983). Can such behavior lead to efficient markets? Theoretical analyses indicate that complete efficiency rarely is achieved, whereas consumers' dependence on most recent experience could lead to perverse markets (e.g. Schmalensee 1978; Smallwood and Conlisk 1979). However, in markets with a few well-known brands, the loss in market share due to consumers' short-term reaction may be adequate to punish low-quality firms.

FIGURE 5



Relevance of the Design Factors

Quality is likely to vary in importance by consumers or product categories. For example, more wealthy or "sophisticated" consumers may value quality more. Similarly, consumers are likely to value quality more for high visibility items such as dress suits or a gift bottle of wine, or for durable goods for which its effects persist, than for nondurable goods (Tellis and Wernerfelt 1987). Though consumers may not think explicitly of the quality of boots in terms of service costs, we used service costs merely to measure explicitly the concept of *varying importance of quality*.

The manipulation of the correlation between price and quality was designed in the same spirit. In actual markets, consumers neither have access to nor compute correlations between price and quality. However, the assumption of a positive correlation is the basis for inferring quality from price. In the experiment, we allowed for different price-quality correlations, but consumers could infer them only from the explicit list of price and quality or from their experience of brand purchases with varying price-quality associations. The experimental results support the hypotheses.

In the experiment, we found that response to experience was immediate rather than cumulative. Though the experimental experience appears artificial, in actual markets experience may be even more inefficient because it occurs over longer intervals than in the experiment. However, manipulation checks on each factor would have strengthened our conclusions. The results should be replicated with other measures of each variable. In addition, allowing for price changes over time would enable one to test for dynamic effects of price, reference price, and information framing.

Specific Implications

We must draw implications cautiously because they derive from only one study. Firms will be rewarded for products with better quality as consumers' information on quality and the importance of quality increase (e.g., repair cost, risk), as for appliances or cars. However, the matching price for that quality is not obvious. If information on quality is high and the importance of quality is high (e.g., appliances), firms could effectively use a value strategy: high quality and low price. In such situations, informative advertising may be particularly suited. If information on quality is low and the importance of quality is high (e.g., expensive wines), consumers may infer quality from price and firms may profit from a signalling strategy: high quality and high price. Unfortunately for consumers and high-quality firms, an opportunistic strategy also may succeed; low quality and high price. In this case image advertising may be more effective.

If the product is a frequently purchased experience good (e.g., cereals), firms must have a minimum quality level that satisfies all consumers or else buyers may turn away after even one bad experience. However, if experience dominates, firms may not have to provide the highest quality because buyers might not switch away from slightly inferior brands with which they are satisfied.

For policy makers, the provision of information would be particularly helpful if quality is more important but information more scarce on all or some dimensions of quality. Examples of such items (and types of information) are wines (quality ratings), clothing (fabric content), cars (safety records), drugs (bio-availability).

Appendix
Logit Analysis

Description

The logit model is defined as:

$$Y_{ij} = \exp\left(\sum_k B_k X_{ijk}\right) \Big/ \left\{1 + \exp\left(\sum_k B_k X_{ijk}\right)\right\} \qquad \text{(A1)}$$

where i and j represent brands and subjects respectively; X is a set of k brand constants, brand characteristics, and the interactions of brand characteristics × design conditions; B is a set of corresponding coefficients to be estimated; and $Y_{ij} = 1$ if the j^{th} subject chooses the i^{th} brand and 0 otherwise, which is true if subject j finds the utility, V_{ij}, of purchasing brand i better than the utility of not purchasing it, where

$$V_{ij} = \sum_k B_k X_{ijk} + e_{ij} \qquad \text{(A2)}$$

and e_{ij} are disturbances assumed to be independently, identically, and Gumbel distributed. McFadden (1974) showed that this assumption of the error term yielded the relatively simple estimable function in equation A1.

Interpretation

The logit analysis incorporates all of the seven choices. It estimates the relative importance of each explanatory variable after controlling for the others and allows for a directional test of the hypotheses. We define the model as the interaction effects of brand characteristics (price, quality, etc.) × experimental factors (information, the importance of quality, price-quality correlation, experience) on choice. For simplicity, we assume there are no higher order interactions, the effects are linear, and the levels of the factors are interval-scaled with zero as lower bound (see Table 1.). We do not discuss the results for quality because we make no direct hypotheses about its effects.

We run three logit formulations: the first matches the graphic analysis; the second tests the alternative choice models (equations 2, 4, and 7); the third also tests the short-term reaction to product performance.

Results

Formulation 1. To test the graphic analysis rigorously, we include dummy variables in the logit model for each of best value, highest price, and lowest price. If consumers behave rationally, they should respond only to best value and the coefficients of all the other variables should not be different from zero. In the same way, the price dummies represent price-seeking and price aversion. These operationalizations introduce some collinearity among variables, but the problem is not serious and the results are consistent with those from the graphic analysis, which are free of multicollinearity. The results are summarized in the Results section.

Formulation 2. Following Thurstone's conception of random utility and McFadden's (1974) assumption of Gumbel-distributed random errors, we can formulate the logit model to test formally the rival choice models (equations 2, 4, 7). For this purpose we use continuous measures of price with a quadratic term, interacted with the design conditions (Table 2). The results are interpreted best as price response functions under various design conditions. They are presented graphically in Figures 3 and 4 and discussed in the text.

Formulation 3. Graphic analyses of the data (Figure 5) suggest the most recent experience has a strong effect on current purchase. To analyze this dimension, we include two new variables: prior period's purchase (choice_{t-1}) and prior period's purchase needing repairs ($\text{choice}_{t-1} \cdot \text{repairs}$; see Table 2). The negative sign of the coefficient of the latter variable suggests that subjects switch to a new brand if their choice failed in the last period. The positive sign of prior period's purchase suggests that subjects repurchase the same brand if it was repair-free. The partial correlations and chi square statistics of these two variables suggest that they are the most important explanatory variables in the model.

REFERENCES

Archibald, Robert B., Clyde H. Haulman, and Carlisle E. Moody, Jr. (1983), "Quality, Price, Advertising and Published Quality Ratings," *Journal of Consumer Research,* 9 (March), 347–56.

Bowbrick, Paul (1982), "Pseudoresearch in Marketing: The Case of the Price-Perceived Quality Relationship," *European Journal of Marketing,* 14 (8), 466–70.

Dodds, William B. and Kent B. Monroe (1985), "The Effect of Brand and Price Information on Subjective Product Evaluations," in *Advances in Consumer Research,* Vol. 12, Elizabeth C. Hirschman and Morris B. Holbrook, eds. Provo, UT: Association for Consumer Research, 85–90.

Einhorn, Hillel and Robin Hogarth (1978), "Confidence in Judgment: Persistence of the Illusion of Validity," *Psychological Review,* 85, 395–416.

——— and ——— (1981), "Behavioral Decision Theory: Process of Judgment and Choice," *Annual Review of Psychology,* 32, 52–8.

——— and ——— (1987), "Decision Making Under Ambiguity," in *Rational Choice: The Contrast Between Economics and Psychology,* Robin M. Hogarth and Melvin W. Reder, eds. Chicago: The University of Chicago Press, 41–66.

Guadagni, Peter M. and John Little (1983), "A Logit Model of Brand Choice Calibrated on Scanner Data," *Marketing Science,* 2 (Summer), 203–38.

Hammond, Kenneth R., T. R. Stewart, B. Brehmer, and D. O. Steinmann (1975), "Social Judgment Theory," in *Human Judgment and Decision Processes,* M. Kaplan and S. Schwartz, eds. New York: Academic Press, Inc., 271–312.

Hogarth, Robin M. and Melvin W. Reder (1987), "Introduction: Perspectives From Economics and Psychology," in *Rational Choice: The Contrast Between Economics and Psychology,* Robin M. Hogarth and Melvin W. Reder, eds. Chicago: The University of Chicago Press, 1–23.

Huber, Joel and John McCann (1982), "The Impact of Inferential Beliefs on Product Evaluations," *Journal of Marketing Research,* 19 (August), 324–33.

Jenkins, H. M. and W. C. Ward (1965), "Judgment of Contingency Between Responses and Outcomes," *Psychological Monographs: General and Applied,* 79, Whole No. 594.

Kahneman, Daniel and Amos Tversky (1979), "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica,* 47 (March), 263–91.

Lambert, David R. (1982), "Price as a Quality Signal: The Tip of the Iceberg," *Economic Inquiry,* 144–50.

Lancaster, K. (1966), "A New Approach to Consumer Theory," *Journal of Political Economy,* 74 (April), 132–57.

Leavitt, Harold L. (1954), "A Note on Some Experimental Findings About the Meanings of Price," *Journal of Business,* 27 (July), 205–10.

McFadden, Daniel (1974), "Conditional Logit Analysis of Qualitative Choice Behavior," in *Frontiers of Econometrics,* P. Zarembka, ed. New York: Academic Press, Inc., 105–42.

Monroe, Kent B. and Susan M. Petroshius (1981), "Buyers' Perceptions of Price: An Update of the Evidence," H. H. Kassarjian and T. S. Robertson, eds. Glenview, IL: Scott, Foresman and Co., 43–5.

Newman, Joseph W. (1977), "Consumer External Search: Amount and Determinants," in *Consumer and Industrial Buying Behavior,* A. G. Woodside, et al., eds. New York: North Holland Publishing Company, 79–94.

Olson, Jerry C. (1977), "Price as an Informational Cue: Effects on Product Evaluations," in *Consumer and Industrial Buying Behavior,* A. G. Woodside, et al., eds. New York: North Holland Publishing Company, 267–86.

Schmalensee, Richard (1978), "A Model of Advertising and Product Quality," *Journal of Political Economy,* 86 (3), 485–503.

Smallwood, Dennis E. and John Conlisk (1979), "Product Quality in Markets Where Consumers Are Imperfectly Informed," *Quarterly Journal of Economics,* 43 (February), 1–23.

Tellis, Gerard J. (1987), "Consumer Purchasing Strategies and the Information in Retail Prices," *Journal of Retailing,* 63 (Fall), 279–97.

———, Gary J. Gaeth, and Lynn Clark (1985), "The Impact of External Information and Experience on Consumer Inference and Choice," in *Marketing Communication: Theory and Research,* Michael J. Houston and Richard J. Lutz, eds. Chicago: American Marketing Association.

——— and Birger Wernerfelt (1987), "Competitive Price and Quality Under Asymmetric Information," *Marketing Science,* 6 (Summer), 240–53.

Thaler, Richard (1980), "Toward a Positive Theory of Consumer Choice," *Journal of Economic Behavior and Organization,* 1 (March), 39–60.

——— (1985), "Mental Accounting and Consumer Choice," *Marketing Science,* 4 (Summer), 199–214.

Thorelli, Hans B. and Sarah V. Thorelli (1977), *Consumer Information Systems and Consumer Policy.* Cambridge, MA: Ballinger Publishing Company.

Tversky, Amos and Daniel Kahneman (1987), "Rational Choice and the Framing of Decisions," in *Rational Choice: The Contrast Between Economics and Psychology,* Robin M. Hogarth and Melvin W. Reder, eds. Chicago: The University of Chicago Press, 67–94.

von Neumann, J. and O. Morgenstern (1944), *Theory of Games and Economic Behavior.* Princeton, NJ: Princeton University Press.

Zeithaml, Valarie A. (1988), "Consumer Perceptions of Price, Quality and Value: A Means-End Model and Synthesis of Evidence," *Journal of Marketing,* 52 (July), 2–22.

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