M A R K E T I N G S C I E N C E I N S T I T U T E

Customer Expectations Management and Optimal Firm Behavior for New Products

Praveen K. Kopalle and Donald R. Lehmann

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When launching a new product in an existing market, a firm needs to achieve initial acceptance and create long-term profitability. Initial sales depend heavily on customer expectations about quality which are based in part on the level of quality represented in advertising. Continued sales depend largely on actual quality (to the extent customers can evaluate it) and satisfaction—which depends on the gap between expectations and actual quality.

In other words, a firm must, on the one hand, keep expectations *up* to increase initial acceptance/trial and, on the other hand, keep expectations *down* to increase satisfaction and hence future sales.

In this study, authors Kopalle and Lehmann focus on determining the "just right" level of advertised quality to maximize current and future profits.

Study and Findings

Drawing on the established literature, the researchers develop a model in which first-period sales are driven by price and quality expectations. Subsequent-period sales depend on price and revised expectations as well as first-period satisfaction. Several propositions emerge:

- ❒ optimal "puffery" (advertised minus average actual quality) is lower when customers are more sensitive to differences in actual and advertised quality;
- ❒ optimal puffery is lower when future periods provide more potential vis-à-vis initial sales;
- ❒ optimal puffery increases as the base satisfaction level (i.e., the value of the product category per se) increases, price increases, and quality decreases.

They extend the model to allow for the non-linear relation between the gap between actual and advertised quality and satisfaction, and to allow for customers' tendency to "strategically" lower their expectations when evaluating satisfaction in order to be more satisfied. They also assess decisions concerning price and average actual and advertised quality.

A study of 200 consumers concerning tires (where length of usable wear serves as the measure of quality) confirms the model propositions. The empirical results also show that consumers indeed lower expectations as part of the satisfaction evaluation process and that the gap between actual and expected quality has a diminishing impact as it grows.

Overall, the results suggest that one would expect more overstatement of quality, or puffery, when:

- ❒ customers are generally satisfied with the product category (e.g., vacations);
- ❒ customers are slow to update expectations based on personal experience (e.g., long-term medical care);
- ❒ initial sales are critical (e.g., movies);
- ❒ customers "discount" advertised claims heavily (e.g., for an unknown company);
- ❒ customers use a second, lower set of expectations in evaluating satisfaction.

Another interesting implication of their study is that decisions about price, quality, and advertising should be integrated. In practice, such decisions are often made by different organizational units and individuals. These results clearly imply that making decisions separately for the various elements of the marketing mix is likely to be less than optimal.

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Contents

Introduction

Consider the problem of a firm about to launch a new product in an existing market. The firm needs to balance two important goals: achieving initial acceptance and creating long-term profitability. Initial acceptance depends heavily on customer expectations about quality which are partly based on the level of quality represented in ads and other promotional communication (Goering 1985). By contrast, continued (long-run) sales depend largely on actual quality (to the extent customers can evaluate it) and satisfaction (Cronin and Taylor 1992), which depends on the gap between quality and expectations (Yi 1990). In other words, a firm must, on the one hand, keep expectations *up* to increase initial acceptance/trial and, on the other hand, keep expectations *down* to increase satisfaction and hence future sales. In this paper, we explore the optimal level for advertised quality as well as optimal average actual quality and price.

Our results suggest that although overstating quality is generally desirable, understating quality may be optimal under certain conditions—for example, when customers are more sensitive to the difference between actual and expected quality, and when they do not "discount" advertised quality. This is especially true when future sales are the major source of profits.

The paper proceeds as follows. In the next section, we provide a brief background and develop a simple model of consumer and firm behavior that focuses on advertised quality as a decision variable, assuming average actual quality and price are fixed. The optimal closed-form solution (from a firm's perspective) is then derived, as well as model propositions. In addition to the simple model, we present a richer, more general model that considers advertised quality, average actual quality, and price as decision variables, and that includes a comprehensive satisfaction model. We estimate most of the model parameters using data from a field study. We then determine the optimal levels of advertised quality, average actual quality, and price from a firm's perspective via numerical simulations, and test the propositions derived from the simple model. We find that the main results of the simple model hold in the more general case as well. Finally, we provide a discussion of our results and suggestions for future research.

Background

Advertising plays multiple roles in marketing strategy (signalling quality, providing information, acting as a barrier to entry, etc.). A key aspect of these roles is setting quality expectations. Quality expectations influence initial purchase and, through their role in determining satisfaction, repeat/subsequent purchases. While high expectations may generate initial purchase, inflated expectations may lead to dissatisfaction and decreased future purchases. Consequently, management of expectations both pre- and post-purchase is a key component of marketing strategy. In this paper, we focus on the use of advertising to set optimal customer quality expectations.

Of course, advertising does not always accurately convey product quality (Kopalle and Assunção 2000). Nagler (1993) suggests that companies will advertise deceptively when consumers are boundedly rational, i.e., when full rationality entails a cost to the consumers. One might expect the largest gap between average advertised and actual quality when quality is difficult to observe and/or measure (Darby and Karni 1973), as is the case for the health and nutritional benefits of certain foods (Greenberg 1996; Pappalardo 1996). Typical analysis assumes that all companies have an incentive to stretch unverifiable claims within the boundaries of the law (Crawford and Sobel 1982; Farrell and Gibbons 1989). However, even advertisements for products whose quality can be observed and measured tend to exaggerate claims. For example, ski resorts routinely overstate the quality of their skiable terrain (*Wall Street Journal,* December 22, 1992). Similarly, Nestle S.A.'s Contadina Fresh refrigerated pasta sauce and Procter & Gamble Co.'s Citrus Hill Fresh Choice orange juice embellished claims of "freshness" in their packaging. (The word "fresh" was later removed from these products' labels [*Wall Street Journal*, May 8, 1991]).

Other companies—albeit not many—deliberately under-represent the quality of their products or services. One example is Boeing, whose "sales force . . . tend to understate rather than overstate product benefits" (Kotler and Armstrong 1987). Another is Ben & Jerry's, which has gained consumers' trust and respect with their modest claims (*Advertising Age*, December 5, 1994). Similarly, some restaurants exaggerate the amount of time patrons must wait for a table, and other companies overstate their advertised delivery time. Presumably, the objective of underplaying quality is to lead consumers to expect less and to be pleasantly surprised when their expectations are exceeded.

In this study, we examine the conditions under which a firm may find it optimal to overstate or understate quality. We do so by examining the effects of actual and advertised quality on consumer expectations and satisfaction, and the ensuing impact on demand and profit. Similar to Bloomfield and Kadiyali (2000) and Kopalle and Assunção (2000), in our model advertised claims of quality (unlike advertised prices) do not have to be accurate and do not result in additional out-of-pocket costs (as long as the mis-statement is not so large as to incur legal liability).

This paper focuses on three marketing-mix variables: the advertised level of product quality, average actual quality, and price.

A Simple Model of Consumer and Firm Behavior

This section develops an analytical model for the impact of advertised quality on profits, relying on results established in the choice modeling, advertising, and satisfaction literatures. Our model applies to experience goods (Darby and Karni 1973), products that must be used in order to observe their quality. Typically, realized (or actual) quality of such products varies across customers and over time due to chance variation in quality (see Wadsworth, Stephens, and Godfrey 1986) as well as customer and other environmental characteristics. For example, durability of car tires depends on tire type, driving conditions, driving habits etc. (*Consumers' Research* 1991). Similarly, customer service time varies randomly around its mean across customers and over time (Kumar, Kalwani, and Dada 1997).

Thus, we conceptualize actual quality, Q, as following a distribution, $f(Q)$ with mean, μ, and variance σ^2. In other words, the actual quality realized by a given customer in a given period is a random draw from this distribution. Here, we consider a two-period model. When consumers purchase the product in Period 1, they do so based on the information provided by the firm and on general information sources that suggest the average actual quality of the product. Realized (or actual) quality of a product, Q, varies randomly around this average value, μ, and differs across consumers and time. Customers then individually update their expectations about the product's quality based upon their respective experiences with the product.

Customer Behavior

Expectations in Period 1. In Period 1, when consumers have not experienced the product, information provided by advertisements partially determines expectations (Boulding, Kalra, Staelin, and Zeithaml 1993; Kopalle and Lehmann 1995; Oliver and Winer 1987; van Raaij 1991). In addition, we assume that information about the firm's average actual quality is available through websites, testing firms, firm reputation, etc. Thus, following Boulding et al. (1993) and Boulding, Kalra, and Staelin (1999), consumer "will" expectations about the quality of a product ($\hat{Q}_1$) (that is, "how long customers expect a product to last") at the beginning of Period 1 are

$$\hat{Q}_1 = \alpha_1 I + (1-\alpha_1)\mu \qquad (1)$$

where I is the information provided by the firm about the quality of the product, i.e., the advertised level of quality; μ is the average actual product quality which is often reported by testing services, etc. $0 \le \alpha_1 < 1$ is the weighting parameter. Note that $Q \sim f(\mu, \sigma^2)$.

Demand in Period 1. We assume an individual's purchase probability is a function of customer expectations (Krishna 1992), i.e., expected quality ($\hat{Q}_1$) and price (*P*).

Following other demand models in marketing (Lilien, Kotler, and Moorthy 1992; Monroe and Della Bitta 1978) and for ease of analysis, we consider a linear model.[1] Accordingly, in Period 1, probability of purchase for a customer is given by

$$D_1 = b_0 + b_1\hat{Q}_1 + b_2 P \quad (2)$$

where b_0 is the intercept, and $b_1 > 0$ and $b_2 < 0$ are the quality and price coefficients respectively. Note that b_0, b_1, and b_2 may be scaled so that D_1 lies between 0 and 1. In Period 1, since expectations, $\hat{Q}_1$, and price, P, are constant across individuals, the purchase probability is the same across individuals, i.e., $\overline{D}_1 = D_1$, where $\overline{D}_1$ denotes average purchase probability across customers in Period 1, i.e., represents the percent who buy the new product.

Satisfaction. As various models of consumer satisfaction have shown, disconfirmation (i.e., performance minus expectations) significantly affects satisfaction (Boulding et al. 1993; Oliver 1997; Bolton and Drew 1991a, b; Bolton and Lemon 1999; Brown and Swartz 1989; Spreng, MacKenzie, and Olshavsky 1996). Although there is some debate about the exact impact of disconfirmation on service quality (Cronin and Taylor 1992, 1994; Parasuraman, Zeithaml, and Berry 1994; Teas 1993, 1994), disconfirmation clearly has a significant effect on customer satisfaction (Bolton and Drew 1991a, b; Bolton and Lemon 1999; Brown and Swartz 1989; Spreng, MacKenzie, and Olshavsky 1996). According to the disconfirmation or "gap" model, satisfaction at time t is a function of the disconfirmation at time t, that is, the difference between actual product quality at time t, and prior expectations about the product's quality (expectations at t-1).

Kopalle and Lehmann (2001) define disconfirmation-sensitive consumers as those who are more satisfied (dissatisfied) when products perform better (worse) than expected. They show that for those consumers whose self-rated disconfirmation sensitivity was higher, the impact of disconfirmation on satisfaction was in fact greater. Thus, we incorporate an interaction effect of self-rated disconfirmation sensitivity and disconfirmation on satisfaction. Initially we focus on a model of satisfaction that is based on disconfirmation alone.[2] For those customers who bought the product in Period 1, satisfaction (S_1) is[3]

$$S_1 = d_0 + [d_1 + d_2 DS](Q_1 - \hat{Q}_1) \quad (3)$$

where

Q_1 = realized product quality in Period 1,

DS = disconfirmation sensitivity,

d_1, $d_2 > 0$.

Expectations in Period 2. Customers update expectations based on past expectations and the actual quality realized in Period 1. Actual experience, as incorporated in models of adaptive expectations, is an important and well-established basis for expectations (Johnson, Anderson, and Fornell 1995; Winer 1985). Thus, following Boulding, Kalra, and Staelin (1999) and Rust, Inman, Jia, and Zahorik (1999), for those customers who bought the product in Period 1, expectations in Period 2 are given by

$$\hat{Q}_2 = \alpha_2 \hat{Q}_1 + (1-\alpha_2)Q_1 \quad (4)$$

where $0 \leq \alpha_2 < 1$ determines the weight given to prior expectations in the updating process. We assume $\hat{Q}_2 = \hat{Q}_1$ if a customer does not buy the product in Period 1, i.e., expectations are unchanged.

Demand in Period 2. In Period 2, the probability of purchase consists of two components. Akin to the probability of purchase in Period 1, the first component is due to price and expected quality, which we term the "normal effect". The second component is the satisfaction component, i.e., the probability of purchase in Period 2 increases with the amount of satisfaction derived in Period 1 (Shiv and Huber 2000). This is consistent with Mittal and Kamakura (2001) who find a significant link between satisfaction and repurchase intent, and between repurchase intent and repurchase behavior. Hence, we incorporate the satisfaction effect given in Equation 3 in determining the probability of purchase in Period 2. If a customer buys the product in Period 1, $D_{2|buy}$, the purchase probability in Period 2 conditional on Period 1's purchase is

$$D_{2|buy} = \overbrace{b_0 + b_1\hat{Q}_2 + b_2 P}^{\text{normal effect}} + \overbrace{[d_0 + (d_1 + d_2 DS)(Q_1 - \hat{Q}_1)]}^{\text{satisfaction effect}} . \quad (5)$$

If the customer has not bought the product in Period 1, the corresponding purchase probability in Period 2 is the same as in Period 1,

$$D_{2|no\ buy} = b_0 + b_1\hat{Q}_1 + b_2 P . \quad (6)$$

Hence, ex-ante (i.e., at the beginning of Period 1), the probability of purchase in Period 2 for a customer is

$$D_2 = D_1 D_{2|buy} + (1 - D_1) D_{2|no\ buy} \quad (7a)$$

where D_1 is the purchase probability in Period 1. Upon simplifying Equation 7a we get

$$D_2 = D_1[1 + b_1(1-\alpha_2)(Q_1 - \hat{Q}_1) + d_0 + (d_1 + d_2 DS)(Q_1 - \hat{Q}_1)] . \quad (7b)$$

We incorporate individual heterogeneity in D_2 in two ways. First, we allow the actual quality of the product in Period 1, Q_1, to vary according to a probability distribution f with mean, μ, and variance, σ^2. We also assume disconfirmation sensitivity, DS, is distributed g (independent of f) with mean, $\overline{DS}$, and variance, ρ^2. Since actual quality, Q_1, is a random variable for any customer, we integrate the purchase probability over the distribution of actual quality to arrive at the expected purchase probability in Period 2, E[D_2], for a customer. Combining equations 2, 5, and 6 to obtain E[D_2], we have

$$E[D_2] = \int_{Q_1} D_2 f(Q_1) dQ_1$$

$$= \int_{Q_1} [\overline{D}_1 \{b_0 + b_1\{\alpha_2 \hat{Q}_1 + (1-\alpha_2)Q_1\} + b_2 P + d_0 + (d_1 + d_2 DS)(Q_1 - \hat{Q}_1)\}] f(Q_1) dQ_1 + (1-\overline{D}_1)\overline{D}_1$$

$$= \overline{D}_1 [\{b_0 + b_1 \alpha_2 \hat{Q}_1 + b_2 P + d_0 - \hat{Q}_1 (d_1 + d_2 DS)\} \int_{Q_1} f(Q_1) dQ_1 +$$

$$\{(d_1 + d_2 DS) + b_1(1-\alpha_2)\} \int_{Q_1} Q_1 f(Q_1) dQ_1 + (1-\overline{D}_1)]$$

Given that $\int_{Q_1} f(Q_1) dQ_1 = 1$, and $\int_{Q_1} Q_1 f(Q_1) dQ_1 = \mu$, we have

$$E[D_2] = \overline{D}_1 [b_0 + b_1 \alpha_2 \hat{Q}_1 + b_2 P + d_0 - \hat{Q}_1 (d_1 + d_2 DS) + \{(d_1 + d_2 DS) + b_1(1-\alpha_2)\}\mu + 1 - \overline{D}_1] \quad (8)$$

where $\hat{Q}_1$ and D_1 are given by equations 1 and 2 respectively.

The average purchase probability across all customers in Period 2, $\overline{D}_2$, is given by

$\overline{D}_2 = \int_{DS} E[D_2] \bullet g(DS) \bullet d(DS)$. Since

$\int_{Q_1} g(DS) \bullet d(DS) = 1$, and $\int_{DS} DS \bullet g(DS) \bullet d(DS) = \overline{DS}$,

$$\overline{D}_2 = \overline{D}_1 [b_0 + b_1 \alpha_2 \hat{Q}_1 + b_2 P + d_0 - \hat{Q}_1 (d_1 + d_2 \overline{DS}) + \{(d_1 + d_2 \overline{DS}) + b_1(1-\alpha_2)\}\mu + 1 - \overline{D}_1] \quad (9)$$

Firm Behavior

Consider a firm (such as a new entrant) whose objective is to maximize net discounted profit, and the decision variable is advertised quality, I (in the more general model, we allow average actual quality and price to vary as well). We take the demand function for that firm as given. This is a reasonable assumption for a follower in a multiple-firm industry (such as car tires) where the other firms have already chosen their respective marketing-mix strategies. Such behavior is similar to a monopolistic competition framework analyzed in marketing (Feichtinger, Hartl, and Sethi 1994) and economics (Shleifer 1986; Shleifer and Vishny 1988). Any strategic thinking by the other firms leads to choices of their own optimal quality, advertised quality, and price levels whose effects are contained in the parameters of the demand equation. In effect this is a Stackelberg game where the firm under consideration is the follower and initial positions are "sticky", i.e., unlikely to be altered.

In this two-period model, we incorporate the tradeoff between the benefits of immediate sales, which suggest setting the advertised quality, I, to maximize expectations, and future (repeat) sales, which are greater among first-period purchasers who are more satisfied when they have lower initial expectations. This model is more tractable than an n-period or an infinite horizon model. Further, by allowing the impact of second-period sales to be greater through the use of a multiple (m), we can capture the relatively greater importance of subsequent-period sales. For example, since initial sales are often at a trial level, subsequent per-period purchases are often greater in magnitude than initial ones.

The multiplier m represents the discounted value of future earnings from a customer due to repeat purchases from Period 2 forward.[4] Thus, the objective function for the firm is

$$\max_{I}[\pi - F] = \max_{I}[(P-v)Ny(\overline{D}_1 + m\overline{D}_2) - F] \tag{10}$$

where the purchase probabilities in periods 1 and 2, $\overline{D}_1$ and $\overline{D}_2$, are given by equations 2 and 9 respectively, and

π = total profit,

v = unit variable cost,

F = fixed cost,

y = average purchase quantity per customer, and

N = number of customers.

For expositional purposes, we do not include the impact of average actual quality on cost here but do so in the more general model in the next section.

Optimal Advertised Quality

Since advertised quality, I, is the decision variable, substituting equations 1, 2, 4, and 9 in Equation 10, taking the derivative with respect to the advertised quality, I, rearranging the terms, and simplifying, we get

$$b_1(1+m(1+d_0)) - m[(1-\alpha_2)b_1 + d_1 + d_2\overline{DS})][b_0 + b_1\mu + b_2P + 2\alpha_1 b_1(I-\mu)] = 0. \tag{11}$$

Solving Equation 11, the optimal advertised quality (I^*) is given by

$$I^* = \frac{\mu}{2} + \frac{1+m(1+d_0)}{2\alpha_1 m(b_1(1-\alpha_2) + d_1 + d_2\overline{DS})} - \frac{b_0 + \mu b_1(1-\alpha_1) + b_2P}{2\alpha_1 b_1}$$

$$= \underbrace{\mu(1-\frac{1}{2\alpha_1})}_{\text{Quality Effect}} - \underbrace{\frac{b_0 + b_2P}{2\alpha_1 b_1}}_{\text{Price Effect}} + \underbrace{\frac{1+m(1+d_0)}{2\alpha_1 m(b_1(1-\alpha_2) + d_1 + d_2\overline{DS})}}_{\text{Disconfirmation Sensitivity Effect}} \tag{12}$$

Model Propositions

We focus on comparative statics, i.e., how do optimal levels of the variables of interest change when the parameters of the model, especially those related to customer characteristics, change. In the context of this study, one interesting variable is "puffery" (Kopalle and Assunção 2000), the difference between advertised and average actual quality (when puffery is positive it indicates overstatement of quality and when it is negative, it suggests understatement of quality). Based on Equation 12, the following propositions hold:

> P_1: The optimal level of puffery decreases with average disconfirmation sensitivity, $\overline{DS}$.

Proof:

Using Equation 12, the optimal level of puffery is given by

$$I^* - \mu = \frac{1 + m(1 + d_0)}{2\alpha_1 m(b_1(1 - \alpha_2) + d_1 + d_2 \overline{DS})} - \frac{b_0 + \mu b_1 + b_2 P}{2\alpha_1 b_1}. \qquad (13)$$

Taking the partial derivative of Equation 13 with respect to average disconfirmation sensitivity, $\overline{DS}$, and simplifying, we obtain

$$\frac{\partial(I^* - \mu)}{\partial(\overline{DS})} = \frac{-d_2(1 + m(1 + d_0))}{2\alpha_1 m(b_1(1 - \alpha_2) + d_1 + d_2 \overline{DS})^2}$$, which will be negative if $d_0 > 0$.

Since $d_2 > 0, m > 0, \alpha_1$ and $\alpha_2 > 0$, $\frac{\partial(I^* - \mu)}{\partial(\overline{DS})} < 0$.

As disconfirmation sensitivity increases, customers will be more satisfied for a given level of actual quality. Firms can enhance satisfaction, and therefore increase sales in Period 2, by lowering puffery and thereby lowering expectations. Hence, puffery decreases as disconfirmation sensitivity increases.

> P_2: The optimal level of puffery decreases with the potential future earnings from a customer, i.e., the multiplier, *m*.

Proof:

Taking the partial derivative of Equation 13 with respect to the multiplier, *m*, and simplifying, we have

$$\frac{\partial(I^* - \mu)}{\partial m} = \frac{-1}{2\alpha_1 m^2 (b_1(1 - \alpha_2) + d_1 + d_2 \overline{DS})} < 0.$$

Since α_1, m, d_1, d_2, and $\overline{DS}$ are greater than zero, and $\alpha_2 < 1$, the derivative is negative.

Note that the multiplier, *m*, represents the relative size of future income from a customer. As the multiplier increases, it becomes more important for the firm to increase the likelihood that a customer will buy its product in Period 2. For a given level of quality, one way to increase this likelihood is to increase satisfaction in Period 1 by lowering the optimal level of puffery.

> P_3: The optimal level of puffery decreases with α_1 (the weight customers place on advertised quality in forming their will expectations) if $b_1(\frac{1}{m} + d_0 + \alpha_2) > d_1 + d_2 \overline{DS}$.

Proof:

Taking the partial derivative of Equation 13 with respect to α_1, the weight placed on advertised quality, and simplifying the terms, we have

$$\frac{\partial(I^* - \mu)}{\partial \alpha_1} = \frac{1}{2\alpha_1^2}\left[\frac{-(1 + m(1 + d_0))}{m(b_1(1 - \alpha_2) + d_1 + d_2 \overline{DS})} + \frac{(b_0 + b_1\mu + b_2 P)}{b_1}\right].$$

Since $b_0 + b_1\mu + b_2P$ is a special case of purchase probability in Period 1, D_1, we have

$0 \le b_0 + b_1\mu + b_2P \le 1$. But $(1+m(1+d_0)) > 1$ for $d_0 > 0$. Therefore, $\frac{\partial(I^* - \mu)}{\partial \alpha_1}$ will be < 0 if $\frac{1 + m(1 + d_0)}{m(b_1(1-\alpha_2) + d_1 + d_2\overline{DS})} > \frac{1}{b_1}$, i.e., cross-multiplying, rearranging the terms, and simplifying we get $b_1(\frac{1}{m} + d_0 + \alpha_2) > d_1 + d_2\overline{DS}$.

Following Equation 1, as customers place more weight on the advertised information provided by the firm (as is the case for firms with good reputations), customer expectations increase more with advertised quality. Ceteris paribus, higher expectations lead to lower satisfaction levels in Period 1, thus lowering purchase likelihood in Period 2. It is in the best interest for a firm to enhance Period 2's purchase probability without sacrificing Period 1's likelihood of purchase (because Period 2's probability is conditioned on purchase in Period 1). When customers do not discount the advertised quality, a firm has less incentive to indulge in puffery. This way, the firm is able to manage customer expectations in such a way that future purchase probability is enhanced without overly reducing sales in the first period.

P_4: As the base level of satisfaction increases (d_0), the optimal level of puffery also increases.

Proof:

Taking the partial derivative of Equation 13 with respect to d_0, the base level of satisfaction as given in Equation 3, and simplifying the terms, we have

$$\frac{\partial(I^* - \mu)}{\partial d_0} = \frac{1}{2\alpha_1(b_1(1-\alpha_2) + d_1 + d_2\overline{DS})} > 0.$$

Since, α_1, d_1, d_2, $\overline{DS} > 0$, and $\alpha_2 < 1$, the derivative is positive.

As the base level of satisfaction increases, customers are more satisfied regardless of quality and therefore the impact of disconfirmation sensitivity on satisfaction in Period 1 (and therefore on Period 2's purchase probability) decreases. Hence, the firm will be more concerned about managing future sales by increasing sales in Period 1, which can be achieved by increasing advertised quality, i.e., increasing puffery. Thus, optimal puffery increases as the base satisfaction level increases.

P_5: As average actual quality (μ) increases, puffery decreases.

Proof:

Taking the partial derivative of Equation 13 w.r.t. μ, the average actual quality, we get $\frac{\partial(I^* - \mu)}{\partial \mu} = -\frac{1}{2\alpha_1} < 0$.

Since $\alpha_1 > 0$, the derivative is negative.

When the average actual quality is higher, it has multiple effects. It increases Period 1's sales, increases satisfaction in Period 1, and has a direct effect on Period 2's sales by increasing expectations in Period 2. Because of these positive effects, a firm has less incentive to indulge in puffery. By lowering advertised quality, the firm increases the satisfaction in Period 1, thus increasing total sales and therefore total profit. Hence, it is not a surprise that lower quality-tier firms indulge in greater puffery.

P_6: As price increases, puffery also increases.

Proof:

Taking the partial derivative of Equation 13 with respect to price, *P*, we get

$$\frac{\partial (I^* - \mu)}{\partial P} = -\frac{b_2}{2\alpha_1 b_1} > 0.$$

Since, α_1, $b_1 > 0$, and $b_2 < 0$, the derivative is positive. In other words, the absolute level of puffery can be expected to be greater for high-priced products.

P_7: The optimal level of puffery increases with α_2, the weight customers place on prior expectations in forming their updated expectations.

Proof:

Taking the partial derivative of Equation 13 with respect to price, α_2, and simplifying, we get

$$\frac{\partial (I^* - \mu)}{\partial \alpha_2} = \frac{b_1(1 + m(1 + d_0))}{2\alpha_1 m(b_1(\alpha_2 - 1) - d_1 - d_2 DS)^2} > 0.$$

Since α_1, b_1, and m > 0, and when $d_0 > 0$, the above derivative is positive. Thus, if customers are slow to update expectations, there is incentive to create (false) positive initial expectations. The negative effect of disconfirmed expectations on Period 2's purchase probability is offset by the positive effect of the still-high expectations on the corresponding purchase probability.

A General Model

The simple model provides some analytical conclusions. While some are obvious (propositions 1 and 2), others are less so. The question, therefore, is whether these results generalize to more realistic models. The general model discussed in this section extends the simple model in five important ways. First, the purchase probability in both periods is bounded between 0 and 1 via a logit specification. Second, we allow the firm to also set both average actual quality and price. Third, we consider a more general customer satisfaction process. Specifically, we allow for the direct impact of actual quality on satisfaction (Yi 1990) and incorporate the diminishing-returns effect of disconfirmation on satisfaction. Fourth, we consider the possibility that the standard used to determine disconfirmation in the customer satisfaction equation may be a more general function of "will" expectations. Finally, we incorporate the cost implications of increasing the level of average actual quality (Lehmann-Grube 1997).

Following Boulding et al. (1993), Boulding, Kalra, and Staelin (1999), Bolton and Drew (1991 a, b), Bolton and Lemon (1999), Oliver (1997), Spreng, MacKenzie, and Olshavsky (1996), and Yi (1990), we incorporate the direct effect of actual quality on customer satisfaction. Further, we allow for a non-linear (decreasing) impact of the gap between actual quality and expectations on satisfaction (Anderson and Sullivan 1993; Kopalle and Lehmann 2001; Mittal, Ross, and Baldasare 1998). Thus, realized satisfaction at the end of Period 1 (S_1) is now given by

$$S_1 = d_0 + [d_1 + d_2 DS](Q_1 - E_1) + d_3 Q_1 + d_4 (Q_1 - E_1)^2 \tag{14}$$

where

Q_1 = actual quality in Period 1,

E_1 = comparison standard used to determine disconfirmation in Period 1,

d_1, d_2, $d_3 > 0$, and $d_4 < 0$.

Expectations and Satisfaction. "Will" expectation is the standard that is typically used in the satisfaction literature (Boulding et al. 1993). Here we allow for a more general standard (E_1) to determine the disconfirmation component of satisfaction. There is some empirical evidence that the level of product performance at which consumers are neither satisfied nor dissatisfied seems to be significantly lower than consumers' will expectations (Kopalle and Lehmann 2001). This notion stems from the self-enhancing and cognitive dissonance literature which suggests that individuals may try to reduce dissonance to attain self-enhancement by reducing the expectations they use for valuing a product experience.

Considerable research (e.g., Harmon-Jones and Mills 1999) has examined consumers' tendency to justify decisions post hoc in order to reduce cognitive dissonance. Steele (1988) and Steele and Liu (1983) contend that individuals may try to reduce dissonance in order to achieve self-enhancement (Fiske and Taylor 1991). One way consumers justify purchase decisions (Bagozzi 1991) is by evaluating the experience afterward in a positive light. Following the gap model of satisfaction (Yi

1990; Zeithaml, Berry, and Parasuraman 1988), both increasing perceived product performance and lowering consumers' expectations can increase consumer satisfaction. The former option—increasing (inflating) perceptions of performance—is difficult when performance is objective, such as the amount of time a product lasts. When this is the case, it may be sensible to decrease expectations. A strategic (forward-thinking) decision maker will try to maximize anticipated satisfaction by considering both "will" expectations—that is, what the product will do (Boulding et al. 1993)—and the other determinants of their satisfaction. Lowering expectations is more effective for, and therefore more likely to be employed by, individuals who are more sensitive to the gap between performance and expectations, that is, people who are disconfirmation sensitive.

Building on evidence that customers manage their purchase decisions strategically (Wertenbroch 1998; Kopalle and Lehmann 2001), Kopalle and Lehmann (2001) conceptualize that a different type of expectations, "as-if" expectations, may be used as a standard to evaluate satisfaction post-purchase. As-if expectations, defined as the point where consumers are neither satisfied nor dissatisfied with the quality of a product, were found to be (a) distinct from will and "should" expectations (i.e., "how long should a product last?" [Boulding et al. 1993]) and (b) lower than will expectations. Since will expectations are formed earlier in Period 1, we assume, consistent with Kopalle and Lehmann (2001), that as-if expectations are a function of will expectations. Further, as consumers who are more disconfirmation sensitive stand to gain more by lowering expectations, we expect those consumers who are more disconfirmation sensitive to have lower as-if expectations than those who are less disconfirmation sensitive. Accordingly, we have

$$E_1 = a_0 + a_1\hat{Q}_1 + a_2(DS) \tag{15}$$

where $a_1 > 0$, $a_2 < 0$,

E_1 = as-if expectations in Period 1,

DS = disconfirmation sensitivity.

Note that Equation 15 may be rewritten as the sum of will expectations and a "bias" term,

$$\text{i.e., } E_1 = \hat{Q}_1 + \overbrace{(a_1 - 1)\hat{Q}_1 + a_0 - a_2(DS)}^{\text{"bias" term}}$$

When $a_0 = a_2 = 0$ and $a_1 = 1$, as-if expectations (E_1) converge to will expectations ($\hat{Q}_1$), and the disconfirmation term in the satisfaction equations 3 and 14 would be the same.[5]

Demand in Period 1. As in the "simple" model discussed earlier, expectations in Period 1 are given by Equation 1. However, for the probability of purchase for a customer (D_1), we use a binary logit specification so that the purchase probability is naturally bounded between 0 and 1. Thus, we have

$$D_1 = \frac{e^{b_0 + b_1\hat{Q}_1 + b_2 P}}{1 + e^{b_0 + b_1\hat{Q}_1 + b_2 P}} \tag{16}$$

Since expectations and price are constant across individuals in Period 1, the purchase probability is the same across customers, i.e., the average purchase probability across customers, $\overline{D}_1 = D_1$.

Demand in Period 2. For those customers who bought the product in Period 1, updated expectations in Period 2 are given by Equation 4. Further, $\hat{Q}_2 = \hat{Q}_1$ if a customer does not buy the product in Period 1. The probability of purchase in Period 2 conditional on Period 1's purchase consists of two components, the normal price/expected quality component and the satisfaction component. Thus, incorporating customer satisfaction given in Equation 14 in the purchase probability in Period 2 conditional on Period 1's purchase, $D_{2|buy}$, is given by,

$$D_{2|buy} = \frac{e^{\overbrace{b_0+b_1\hat{Q}_2+b_2P}^{\text{normal effect}} + \overbrace{d_S S_1}^{\text{satisfaction effect}}}}{1+e^{b_0+b_1\hat{Q}_2+b_2P+d_S S_1}} \tag{17}$$

where satisfaction in Period 1, S_1, is given by Equation 14, and the parameter, d_S, captures the impact of satisfaction on purchase probability.

If the customer has not bought the product in Period 1, the corresponding purchase probability in Period 2 remains unchanged from Period 1, i.e., $D_{2|no\ buy} = D_1$ (i.e., Equation 16). As in the simple model, ex-ante (i.e., at the beginning of Period 1), the probability of purchase in Period 2 for a customer (D_2) is given by Equation 7a. Thus, substituting Equation 16 and Equation 17 in the equation for D_2 (Equation 7a) and simplifying, we get

$$D_2 = \frac{e^{b_0+b_1\hat{Q}_1+b_2P}}{1+e^{b_0+b_1\hat{Q}_1+b_2P}}\left[\frac{e^{b_0+b_1\hat{Q}_2+b_2P+d_sS_1}}{1+e^{b_0+b_1\hat{Q}_2+b_2P+d_sS_1}} + \frac{1}{1+e^{b_0+b_1\hat{Q}_1+b_2P}}\right] \tag{18}$$

where S_1 is given by Equation 14.

Note that Equation 18 (D_2) always lies between ∅ and 1 since it is derived from Equation 7a, which is bounded between ∅ and 1. The expected probability of purchase in Period 2, $E[D_2]$, is derived by integrating Equation 18 over actual quality, Q_1. That is

$$E[D_2] = \int_{Q_1} [D_2] f(Q_1) dQ_1 \tag{19}$$

The average purchase probability across all customers in period 2, $\overline{D}_2$, is given by

$$\overline{D}_2 = \int_{DS} E[D_2] dDS \tag{20}$$

where DS follows a distribution with mean, $\overline{DS}$, and variance, ρ^2.

Firm Behavior

The objective function for the firm is given by

$$\max_{I,\mu,P}[\pi - F] = \max_{I,\mu,P}[(P-v)Ny(\overline{D}_1 + m\overline{D}_2) - F(\mu)] \tag{21}$$

where the purchase probabilities in periods 1 and 2, $\overline{D}_1$ and $\overline{D}_2$, are given by equations 16 and 20 respectively. Based on Kopalle and Winer (1996), Lehmann-Grube (1997), and Rosenkranz (1997), we assume that changes in quality levels impact the fixed cost, *F*. This is relevant in cases where investments in new machinery or facilities or R&D are required for quality improvements. The tire industry is a good example where R&D investments are necessary for quality enhancements (for example, see Quelch and Isaacson 1994). We consider the following convex relationship between fixed cost, *F*, and the average actual quality:

$$F(\mu) = \mu^2 / 2 \tag{22}$$

Equation 22 suggests increasing marginal cost of quality, similar to the functional form used by Schmalensee (1978). Equation 22 also fulfills the criteria for a cost function in Rogerson (1988).

To determine optimal advertised quality, average quality, and price, we substitute equations 1, 4, 16, 20, and 22 into the profit Equation 21, and take the partial derivative with respect to the advertised quality, *I*, average quality, μ, and price, *P*. Given the complexity of the general model, there is no closed form solution for I^*, μ^*, and P^* (the optimal advertised quality, average actual quality, and price respectively). In the next section, we describe an empirical application of the general model and develop the model propositions.

An Application of the General Model

In order to check whether the model propositions derived in the simple case would hold in the general model, we use numerical simulation. We do so by first estimating most of the model parameters using data from a mall intercept study at a major northeastern city in the United States, and then determining the optimal solution numerically. Based on the parameters obtained in the base case, we conducted a simulation to test whether the propositions derived from the simple model hold in the general case as well.

Data

Data were obtained via mall intercepts of 200 respondents conducted by a professional market research agency in a large northeastern city. We used car tires for this study because they are a relatively high involvement durable good for consumers in a mall intercept study. Tread life was used to represent the quality of the product (*Consumers' Research* 1991). Actual quality was manipulated between subjects and we measured both prior and updated (after subjects observed the quality of the product) as-if and will expectations. A 10-minute distractor task was introduced before subjects learned the quality (life in miles) of the tire; the distractor task consisted of a survey on retail stores' sales in a small city. An overview of the study is shown in Appendix 1. Expectations were measured in miles. Disconfirmation sensitivity was measured as the average of six items, all on a 7-point scale (coefficient alpha = .64). All other measures used 7-point scales (see Appendix 2). Five levels were used for actual quality (tire mileage) in a between-subjects design: 20,000, 30,000, 40,000, 50,000, and 60,000 miles.

Respondents drive, on average, 19,076 miles each year and 99 percent own a car (as expected for mall shoppers). Forty-three percent of respondents were male, median education was a college degree, and median annual household income was between $45,000 and $60,000. About 78 percent had purchased car tires in the past two years, indicating a reasonable degree of relevance and expertise. The average level of disconfirmation sensitivity, $\overline{DS}$, was 5.5 and the variance, ρ^2, was .53.

Results

Table 1 shows how will and as-if expectations were updated with quality experiences, and indicates the corresponding satisfaction and future (next period) purchase intention levels.

In this data, expectations of actual performance (will expectations) are updated to be more closely in line with quality experience. Unsurprisingly, both satisfaction and repeat purchase go up as experienced quality rises. The results suggest that will expectations were updated when quality fell both above and below initial expectations. By contrast, as-if expectations exhibited less variation than will

Table 1. Impact of Quality Experiences on Will Expectations, Satisfaction, and Future Purchase Intention

Quality Experience ('000 miles)	Sample Size	Will Expectations ('000 miles)		As-if Expectations ('000 miles)		Satisfaction (7-point Scale)	Purchase Intention (7-point Scale)
		Prior	*Updated*	*Prior*	*Updated*		
20	36	42.03	30.15	37.78	36.06	1.84	1.78
30	41	38.41	34.51	30.05	28.85	3.80	3.36
40	42	39.32	42.14	35.19	36.96	4.71	4.38
50	38	45.13	52.50	37.29	41.45	5.38	4.93
60	39	42.41	55.00	38.67	48.10	6.27	6.05

expectations. Further, there appears to be a floor effect for as-if expectations, i.e., as-if expectations changed less when quality fell below expectations compared to when quality was above expectations. As expected, both satisfaction and future (next-period) purchase intention increase with actual quality.

Table 2 provides the results for updated expectations (Equation 4). Note that Equation 4 may be rewritten as

$$\hat{Q}_2 - \hat{Q}_1 = (1 - \alpha_2)(Q_1 - \hat{Q}_1) \tag{23}$$

Table 2. Dependent Variable: Change in Will Expectations, $\hat{Q}_2 - \hat{Q}_1$

Independent Variable	Unstandardized Coefficient (*t*-value)	Standardized Coefficient (*t*-value)
Quality differential, $(Q - \hat{Q}_1)$	.70 (19.8)	.82 (19.8)
R^2	.67	
Sample Size	197	

Comparing Equation 23 with the estimate in Table 2, we obtain α_2 = .3.

Table 3 examines the determinants of as-if expectations and the ensuing satisfaction via two-stage least squares.[6]

The coefficients for as-if expectations (a_0 = 1.249, a_1 = .573, and a_2 = −.211) are all significantly different from zero.[7] As expected, as-if expectations increase with will expectations and decrease with disconfirmation sensitivity as measured on a 7-point scale.

Using Equation 14, we find that satisfaction in Period 1 is determined by actual quality in Period 1, disconfirmation, disconfirmation squared, and disconfirmation sensitivity[8] (Table 3). Here disconfirmation sensitivity, as expected, has no significant

Table 3. As-if Expectations, E_1, and Satisfaction: Two-Stage Least Squares Results
(t-values in parentheses)

Independent Variables	FULL MODEL				REDUCED MODEL			
	Unstandardized Estimates Dependent Variables		Standardized Estimates Dependent Variables		Unstandardized Estimates Dependent Variables		Standardized Estimates Dependent Variables	
	E_1	S_1	E_1	S_1	E_1	S_1	E_1	S_1
Intercept	1.249 (4.93)	3.459 (8.24)	—	—	1.249 (4.93)	3.402 (8.57)	—	—
Will Expectations, $\hat{Q}_1$	.573 (9.71)	—	.566 (9.71)	—	.573 (9.71)	—	.566 (9.71)	—
Actual Quality, Q_1	—	.241 (2.14)	—	.174 (2.14)	—	.256 (2.39)	—	.184 (2.39)
Disconfirmation Sensitivity, $(DS - \overline{DS})$	– .211 (–2.1)	–.045 (–.43)	– .123 (– 2.1)	– .017 (– .43)	– .211 (– 2.1)	—	– .123 (– 2.1)	—
Gap, $(Q_1\text{-}E_1)$	—	.971 (9.44)	—	.774 (9.44)	—	.957 (9.88)	—	.762 (9.88)
Gap-squared, $(Q_1\text{-}E_1)^2$	—	– .154 (– 4.88)	—	– .204 (– 4.88)	—	– .152 (– 4.87)	—	– .202 (– 4.87)
Interaction, $(DS - \overline{DS})(Q_1\text{-}E_1)$	—	.274 (4.57)	—	.182 (4.57)	—	.272 (4.56)	—	.180 (4.56)
R^2	.36	.73	.36	.73	.36	.73	.36	
Sample Size	196							

E_1 = As-if expectations in Period 1
S_1 = Realized satisfaction in Period 1
$\overline{DS}$ = Mean disconfirmation sensitivity = 5.5 (of a possible 7.0)

direct effect on satisfaction. Therefore, we drop it from the satisfaction equation and Table 3 reports the parameter estimates for the full and reduced models. Note that disconfirmation sensitivity does have a significant impact on satisfaction through an interaction with disconfirmation. The quadratic disconfirmation term is negative and significant, thus suggesting the diminishing returns effect of disconfirmation on satisfaction. Combining the Table 3 results of the reduced model with Equation 14, we get, d_0 = 3.402, d_1 = .957 − .272($\overline{DS}$), d_2 = .272, d_3 = .256, and d_4 = −.152.

Finally, we examine the impact of satisfaction on purchase behavior in Period 2. Since our data capture only stated purchase intentions in Period 2 and not actual buying behavior, we first converted the stated purchase intentions (on a 7-point scale) to actual purchase probabilities in Period 2, $D_{2|buy}$,[9] using the table presented in

Lehmann, Gupta, and Steckel (1998, p. 253) based on Haley and Case (1979). Following Pindyck and Rubinfeld (1998, p. 309), Equation 17 may be rewritten as

$$\log[\frac{D_{2|buy}}{1-D_{2|buy}}] = b_0 + b_1\hat{Q}_2 + b_2 P + d_S S_1 \tag{24}$$

Thus, we regressed $\log[\frac{D_{2|buy}}{1-D_{2|buy}}]$ on updated expectations and satisfaction. The results (Table 4) suggest that while both updated expectations and satisfaction determine purchase probability, the impact of satisfaction is much stronger (d_S = .66 versus b_1 = .10). In other words, the subjective reaction to past purchase (a "sunk cost") dominates the impact of updated expectations.

Table 4. Logit Regression Dependent Variable: $\log[\frac{D_{2|buy}}{1-D_{2|buy}}]$

	Unstandardized Coefficients (*t*-value)	Standardized Coefficients (*t*-value)
Intercept	– 5.86 (– 36.0)	.00
Updated Will Expectations, $\hat{Q}_2$	.10 (2.1)	.12 (2.1)
Satisfaction, S_1	.66 (25.5)	.80 (25.5)
R^2	.81	
Sample Size	196	

Optimal Advertised Quality, Average Actual Quality, Puffery, and Price

We now use parameters obtained in our empirical analysis in determining optimal advertised quality in relation to average actual product quality. We begin with an analysis of a base-case scenario and then develop some comparative statics (i.e., how the optimal solution changes when a parameter changes). From Table 5, we cannot infer the intercept, b_0, and price sensitivity, b_2, because price was not manipulated in the study. In the numerical analysis, we set b_0 = 1 and b_2 = –1, and we find that at the optimal levels of advertised and average actual quality and price, the price elasticity of demand obtained from the general model is around –1.35, well within the range reported in Tellis (1988). Although it is slightly less than the average price elasticity of about –1.7 (Tellis 1988), it is not surprising that customers are less price sensitive for car tires, which are typically considered a necessity to keep vehicle in driving condition and which most consumers purchase on the same day they become aware of their need (Quelch and Isaacson 1994). Further, varying b_0 and b_2 did not change the qualitative nature of our results, i.e, the model propositions still hold.

Finally, we assume equal weight for advertised quality (I) and average actual quality (μ), i.e., in Equation 1, $\alpha_1 = .5$. Without loss of generality, we consider one customer (i.e., a single customer segment) buying four tires on average ($y = 4$), with a multiplier effect of $m = 5$. The average variable cost, v, was set at 1.0. Using these values, the optimal levels of average actual quality, advertised quality, and price are given by 2 units, 5 units, and 2 units respectively. Since tables 2-4 use data for quality in tens of thousands of miles, optimal average actual and advertised quality are 20,000 miles and 50,000 miles respectively. In this case, the firm has an incentive to overstate quality partly because the firm knows that customers use a lower standard (as-if rather than will expectations) in determining satisfaction. For example, for average disconfirmation sensitivity ($DS = 5.5$), an average actual quality of 2 and an advertised quality of 5 translates to will expectations of 3.5 and as-if expectations of 2.08. On the other hand, we find that it is optimal for the firm to understate quality if customers use will expectations as the standard to determine satisfaction instead of as-if expectations. Table 5 describes the effect of the multiplier, m, and the advertised quality, I, on purchase probabilities in periods 1 and 2 and the total profit in both periods (the average quality and price were set at their respective optimal levels).

Table 5. Impact of Advertised Quality on Demand and Profit

Adv. Quality, I	Average Purchase Probability, Period 1, $\overline{D}_1$	Average Purchase Probability, Period 2, $\overline{D}_2$	Total Profit $m = 1$	Total Profit $m = 5$
4 (40,000)	.33	.530	1.47	10.05
5	.34	.537	1.52	10.14
6	.35	.536	1.56	10.12
7	.437	.532	1.59	10.10

We find that sales increase as advertised quality increases. Further, when the second-period sales "count" the same as first-period sales, profits are also greater when advertised quality exceeds average actual quality. However, when future-period sales are more important ($m = 5$), profit begins to decrease when advertised quality exceeds its optimal level.

Numerical Results

In order to test the propositions from the simple model, we varied the following five model parameters: disconfirmation sensitivity (DS), the weight consumers place on advertised quality (α_1), the value of future purchases (m), the base level of satisfaction derived by customers (d_0), and the weight customers place on prior expectations in updating their expectations (α_2). In order to test Proposition 5 (Proposition 6), average quality (price) was varied from 1 to 4 (1 to 4). We find that in the general model, propositions 2-4 and 6-7 derived in the simple case hold unconditionally, and an interesting interaction emerges with respect to Proposition 1. Proposition 5 holds on a percent basis. The results are as follows:

Result 1. As disconfirmation sensitivity, *DS*, increases from 1 to 7, optimal advertised quality decreases to the extent customer satisfaction depends on "true" (will) expectations. Further, we find that as disconfirmation sensitivity increases, puffery decreases. However, when customers discount will expectations in evaluating how satisfied they are (i.e., use as-if expectations), optimal advertised quality and puffery can increase with disconfirmation sensitivity.

Result 2. As the multiplier, *m*, increases from 1 to 5, i.e., when potential future sales from a customer increases, optimal puffery (optimal advertised quality minus optimal actual quality) decreases. It is optimal for the firm to understate quality when future potential is high because the benefits of future sales resulting from satisfied customers outweigh the advantage of higher initial-period sales. In fact, if they use will expectations to determine satisfaction, it can be optimal to understate quality.

Result 3. As the weight customers place on advertised quality (α_1) increases from .1 to .9, the optimal level of puffery decreases. As discussed earlier in Proposition 3, when customers discount the advertised quality of a product, the firm should, in an effort to increase customer expectations (and therefore sales in Period 1), advertise a higher quality and thus increase puffery. Interestingly, when customers pay attention to what firms say about the quality of their products and use them more literally in evaluating the products for future purchase decisions, firms have less incentive to indulge in puffery.

This suggests there is some impetus toward truth telling since it saves consumers the effort of discounting advertised quality and the firm the effort (and possible legal repercussions) of overstating quality.

Result 4. As the base level of satisfaction that customers derive from experiencing a product (d_0) increases (from 1 to 5), optimal puffery increases.

Result 5. Assuming quality is set exogenously, as average actual quality increases, absolute puffery increases although it decreases as a percent of average actual quality.

Note this is why although simple models provide results which often (as in our case) generalize, the results do not always recur when a more complex (and hopefully realistic) model is employed.

Result 6. Assuming price is set exogenously, as price increases, optimal puffery also increases.

Result 7. As the weight customers place on prior expectations (α_2) increases, optimal puffery increases.

Conclusions

Firm decisions in terms of product quality, price, and, in particular, advertised quality (which may differ from average actual quality in terms of what we call puffery) are critical for the long-run success of a new product. Here we have modeled the impact of advertised quality on initial and subsequent sales incorporating consumer expectations and satisfaction. A simple model was developed and solved analytically. A more complex (and hopefully realistic) model was also developed, its parameters estimated based on a field study, and its propositions examined via numerical methods. For both simple and more complex models, several results emerge. In the "obvious" category, puffery (the difference between advertised quality and average actual quality) decreases when the potential future earnings from a customer increases. Somewhat less obviously, optimal puffery decreases when

- the weight customers place on advertising in developing quality expectations increases,
- customers' base level of satisfaction decreases,
- the weight customers place on prior expectations decreases.

Interestingly, the relation of puffery to disconfirmation sensitivity and average actual quality differed between the two models, reinforcing the potential importance of not relying solely on simple tractable models.

Empirically we report a study of 200 consumers concerning tires where length of usable wear serves as the measure of quality. Unsurprisingly, will expectations depend more on actual quality than prior expectations. More interestingly, as-if expectations depend on both will expectations and disconfirmation sensitivity (i.e., those who are more disconfirmation sensitive have lower as-if expectations). Further, as-if expectations are resistant to reduction when quality is low but are adjusted upward when it is high. Finally, in terms of purchase intentions, satisfaction with the last purchase has a much stronger impact on future intentions than updated (will) expectations. Most importantly, based on our results, failure to consider the customer expectations-setting process may lead to non-optimal firm decisions.

Of course, the results reported here depend on both the model form and the data. Generalization to other datasets and product categories is clearly desirable. One may also investigate other model forms, in particular a dynamic infinite horizon model as well as equilibrium properties in a competitive market. Further, while we include some form of heterogeneity in terms of variation in actual quality and disconfirmation sensitivity, it would be helpful to also study other forms of customer heterogeneity. Still, the results here are encouraging. As an example of the implications, the following summary of the more comprehensive model results suggests which categories will be more prone to puffery.

Six Questions to Help Determine When Puffery Will Be Greater			
	When Should Puffery Be Greater?		Examples Where More Puffery Is Expected
1. What is the inherent level of *satisfaction* in the product?	Low	High ✓	Vacations, beer
2. How rapidly do customers *update expectations* based on personal experience?	Slow ✓	Fast	If quality is hard to observe, e.g., long-term medical care
3. How important are *future versus initial sales*?	Initial ✓	Future	Movies
4. To what extent will customers *accept the company's "word"* at face value versus discount it?	Accept	Discount ✓	Unknown company
5. What is the *standard of comparison* for satisfaction, i.e., will or discounted (as-if) expectations	Will	As-if ✓	Most experience goods
How *disconfirmation sensitive* are the customers?	Not	Very	
Rely on as-if expectations for satisfaction		✓	
Rely on will expectations for satisfaction	✓		

For example, when customers accept a company's "word" (i.e., believe its claims), puffery should be reduced. This suggests that well-established, high-quality companies have less incentive to indulge in puffery. Similarly, when customers are generally satisfied with a product (i.e., the category itself is positive such as a vacation or beer), there is more reason to "puff". On the other hand, when future sales are more critical (i.e., when firms want to build a long-term customer relationship), less puffery is better. Hopefully future work can examine the extent to which this occurs, as well as explore potential public policy implications.

One other interesting implication also emerges. The results suggest that decisions about price, quality, and advertising need to be integrated. Yet in practice these decisions are often made by different organizational units and individuals. These results clearly imply that making decisions separately for the various elements of the marketing mix is likely to be noticeably less than optimal.

Notes

1. We relax this assumption in the general model where we consider a logit formulation.

2. A more complete model that includes a direct effect of quality and the diminishing impact of disconfirmation on satisfaction (Mittal, Ross, and Baldasare 1998) is $S_1 = d_0 + (d_1 + d_2 DS)(Q_1 - \hat{Q}_1) + d_3 Q_1 + d_4 (Q_1 - \hat{Q}_1)^2$, where $d_3 > 0$ and $d_4 < 0$. We examine the more general model in the next section.

3. The satisfaction level for those customers who have not bought the product is assumed to be zero.

4. Notice that if the average demand stabilizes in periods 2 through k (and then drops to zero), the average profit across customers from periods 2 through k becomes $\sum_{t=2}^{k} (\frac{1}{1+r})^t (P - v)\overline{D}_2 = \frac{1}{r}[1 - (\frac{1}{1+r})^{k-1}](P - v)\overline{D}_2$. Therefore m would be $\frac{1}{r}[1 - (\frac{1}{1+r})^{k-1}]$. To the extent demand varies after Period 2, m provides an approximation of discounted future profits with the accuracy of the approximation dependent on how the average demand changes.

5. We also consider the case where consumers are more strategic and set as-if expectations to maximize expected satisfaction. In other words, before experiencing actual quality, expected satisfaction (S_E) is given by,

$$S_E = d_0 + [d_1 + d_2 DS](\hat{Q}_1 - E_1) + d_3 \hat{Q}_1 + d_4 (\hat{Q}_1 - E_1)^2$$

$\hat{Q}_1$ = Expected quality in Period 1, i.e., will expectations in Period 1
E_1 = As-if expectations in Period 1
d_1, d_2, $d_3 > 0$, and $d_4 < 0$.

Maximizing expected satisfaction, S_E, to determine optimal as-if expectations in Period 1, we obtain:

$$\frac{\partial S_E}{\partial E_1} = 0 \Rightarrow E_1^* = \alpha_1 I + (1 - \alpha_1)\mu + (d_1 + d_2 DS)/(2d_3)$$

$$= \frac{d_1}{2d_4} + \hat{Q}_1 + \frac{d_2}{2d_4} DS$$

Note that as disconfirmation sensitivity increases, as-if expectations decrease. More importantly, as-if expectations are linear in will expectations. Thus, this is a special case of the as-if expectations shown in Equation 15, where $a_0 = d_1/(2d_4)$, $a_1 = 1$, $a_2 = d_2/(2d_4)$. We make two observations in this regard. First, our results suggest that when consumers set their as-if expectations strategically, it seems optimal for the firm to always overstate its quality. Second, based on the experimental data (discussed in the next section) we find that customers do not seem to set as-if expectations optimally in a strategic fashion. Therefore, to conserve space, we discuss the more general setting in this paper.

6. We obtain similar results using ordinary least squares, seemingly-unrelated regression, and three-stage least squares.

7. The impact of optimism, involvement, and expertise on as-if expectations was not significant ($p > .2$). So we dropped them from the specification and re-estimated the model.

8. The disconfirmation sensitivity variable is mean-centered to reduce collinearity between the gap, $Q\text{-}E_1$, and the interaction $(DS)(Q\text{-}E_1)$.

9. In the study, note that all subjects buy the product in Period 1.

Appendix 1. Overview of Empirical Study

Sight-screen for persons of age 18 and older, offer brief introduction, and ask whether they own a car, how many miles they drive in a year, whether they purchased car tires in the past three years, and how long a typical set of car tires last an average driver. Then present the following situation:

> *Imagine you are on a long trip in your car. Inadvertently you drive over a road hazard that slashes two of your all-season steel-belted radial tires. You realize that the tires need to be replaced and so you get the attention of a highway patrolman who calls for a tow truck.*
>
> *The tow truck takes you to the nearest gas station, which also happens to be the only gas station in the area. You notice that the dealer is an American Automobile Association (AAA) recommended dealer. In the gas station you notice a prominently displayed brand of all-season steel-belted radial tires–CAMAC, made by the CAMAC Tire Company, manufacturer of all types of radial tires. The display also indicates that the CAMAC Tire Company has been in the tire business for over 50 years in the United States.*
>
> *As you are considering which brand of tires to buy, the dealer inquires about the tire size you need. You find out that the only brand of tires available in the correct size is CAMAC's all-season steel-belted radial tires and so you decide to buy them and continue on your trip.*

Measure *prior* will and as-if expectations

Respondents complete a 10-minute distractor task. Upon completion, they see the following:

> *Upon buying the CAMAC tires, you have the mechanic put them on the car and continue on your journey. You return home after a refreshing trip.*
>
> *You have been driving the same car since the trip. Some time later, you notice that the CAMAC all-season steel-belted radial tires need replacement. You observe that the CAMAC tires lasted _____ miles.*

Measure satisfaction and updated will and as-if expectations

Measure disconfirmation sensitivity, expertise, involvement, and optimism (items were presented in random order).

Measure demographics, realism of the scenario presented in the study, and how interesting they found the study.

Appendix 2. Measures

Disconfirmation Sensitivity (DS, Coefficient α = .64)

I notice when product performance does not match the quality I expect from the product.

Customers should be delighted when products perform better than expected.

I am not at all satisfied when products perform worse than I expect.

I am very satisfied when products perform better than I expect.

Customers are legitimately irritated when products perform worse than expected.

I typically compare a product's performance to my expectations for that product.

Optimism (Correlation, r = .52)

I expect to be better off in the future than I am now.

I consider myself more of an optimist than a pessimist.

Involvement (Correlation, r = .58)

The performance of car tires is very important to me.

The product category, car tires, is very relevant to me.

Expertise (Correlation, r = .45)

Compared to others, I consider myself more knowledgeable about car tires.

I drive a car more than most people do.

Will Expectations

Approximately how long (in miles) would you expect the set of CAMAC tires to last you?

As-if Expectations

I would be neither satisfied nor dissatisfied if the set of CAMAC tires last ____ miles.

Satisfaction

How satisfied would you be with the performance of the CAMAC tires?

Purchase Intention

Would you buy CAMAC tires again?

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