THE JOINT EFFECTS OF BRANDS AND WARRANTIES IN SIGNALING NEW PRODUCT QUALITY

by

L. J. PRICE*
and
N. DAWAR**

95/86/MKT

* Assistant Professor of Marketing, at Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong.

** Assistant Professor of Marketing, at INSEAD, Boulevard de Constance, 77305 Fontainebleau Cedex, France.

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Lydia J. Price*
and
Niraj Dawar**

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* Assistant professor of marketing at Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Tel. (852) 2358-7712, Fax (852) 2358-2429.

** Assistant professor of marketing at INSEAD, Boulevard de Constance, Fontainebleau, France, Tel. (331) 6072-4000, Fax (331) 6074-5565.

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Abstract

An integrative review of signaling theory literature pertaining to brand reputations and warranties serves as the basis for hypothesizing about the joint effects of the two quality signals on consumers' perceptions of product quality, as well as their intentions to purchase. Although prior research largely treats brands and warranties separately, tending to stress the superiority of brand signals over warranties, we identify conditions under which the two signals interact to determine consumer evaluations. In addition, we find evidence that the dimensions along which quality judgments are made by consumers in response to warranty signals may depend on the strength of a brand's reputation. The latter effect suggests that consumers do not always interpret the two signals independently. Findings are discussed in terms of their fit with signaling theory assumptions as well as their implications for product management.

The Joint Effects of Brands and Warranties in Signaling New Product Quality

Consumer reliance on signals for assessing unknown product quality is well documented in theoretical and empirical research. Brand reputations and warranties are among the signals recognized by researchers and consumers, although of the two, brand reputations are considered on theoretical grounds to be more efficient from the perspective of the firm (Shapiro 1983; Allen 1984). Empirical evidence also suggests that consumers often prefer brands to warranties as a means of lowering perceived risk (Perry and Perry 1976; Roselius 1971; but see Olson and Jacoby 1972 for a counterexample). Despite this apparent superiority of the brand, however, reputations take time and effort to build. Thus, new products often have to rely on other, more immediately available means of signaling quality to potential consumers. While this certainly is true for new brands which lack an established reputation, it also might hold when an established brand attempts to enter a new product category. For although consumers might recognize the quality of an original branded product, these associations may not always easily transfer to new products.

The propensity for transfer of quality associations to new products may depend on the similarity of an extension product to the brand's historical product line (Aaker and Keller 1990; Keller and Aaker 1992). For highly dissimilar extensions, the brand signal may be weak and other quality indicators such as warranties might play a larger signaling role. Whether warranties would dominate or enhance the brand signal in this case, however, is unclear. Numerous studies have demonstrated positive warranty effects for products that lack an established brand reputation (Bearden and Shimp 1982; Boulding and Kirmani 1993; Broniarczyk and Alba 1994; Innis and Unnava 1991, unknown brand case; Shimp and Bearden 1982; White and Truly 1989), and at least one study has demonstrated the opposite effect of a strong and well-known brand name dominating a warranty signal (Innis and Unnava 1991, known brand case). No evidence appears in the literature to date, however, to indicate how

brands and warranties might jointly determine consumers' quality perceptions for new products. Brand extension products provide an opportunity to explore this question.

This paper reports the results of three experiments designed to test the joint effects of brand and warranty signals on consumers' quality perceptions for new products. The specific case examined is that of consumer durable products that are brand extensions from other durable categories. Brand extensions provide a conducive setting for the research in that, *a priori*, 1) both brand and warranty signals may play an important role in the formation of consumer perceptions and preferences, and 2) the relative importance of the two signals in this process may vary with extension similarity. Theoretically, examination of this problem requires merging of two topics from the signaling theory literature which hitherto for the most part have been treated separately.

We begin with an integrative review of the signaling theory literature as it pertains to warranties and brands, particularly brand extension products. An important aspect of the literature is that quality is defined alternately in terms of product breakdown or functional performance. Synthesizing across the two quality dimensions leads to the conclusion that they may not always operate in parallel. Our review serves as a foundation for hypothesizing about the joint effects of brand and warranty signals on both dimensions of consumers' quality perceptions, as well as purchase intentions. Three experiments are then described in which brand names, warranties and extension product categories were manipulated in an attempt to determine whether the two signals affect the two quality dimensions as prescribed by signaling theory, and to identify conditions which moderate the level of signal interaction.

Traditionally, signaling theory research in economics has focused on identifying equilibrium behaviors of firms while assuming that consumers behave "rationally." Empirical tests of the theory have correspondingly sought to determine if aggregate firm behavior in the marketplace matches the equilibrium predictions. More recently, experimental tests of the implicit consumer behavior assumptions underlying signaling theory have expanded the scope of signaling theory research (Boulding and Kirmani 1993; Kirmani 1990; Kirmani and Wright

1989). Following this trend, we attempt in the present research to determine whether consumer behavior is indeed consistent with signaling theory propositions rather than to determine whether firms actually follow equilibrium predictions. Although experimental tests have the potential to validate signaling theory, or equally important, to indicate areas of needed modification, they are seldom seen in the literature.

BACKGROUND

Brand and Warranty Signals

The effectiveness of a quality signal hinges on consumer and firm perceptions that deception (i.e., claiming higher than actual quality) is economically unattractive to firms. This could be due to differential costs of sending the signal for low- and high-quality firms, or because deception evokes a financial penalty from the market. In either case, the perceived costs of false signaling must exceed the perceived benefits for the signal to be a reliable indicator of quality.

The signaling potential of brands rests on the loss of future profits due to a tarnished reputation in the event that quality is overstated (Allen 1984; Klein and Leffler 1981; Shapiro 1983). For example, the irrecoverable loss of market share suffered by the Perrier brand after consumers rejected its implied quality claim of being "naturally sparkling" is a type of penalty cost for false signaling. Such penalties for deception may be heightened when a brand extends its product scope since profit loss may then pertain to more than one product category. Wernerfelt (1988) has argued that firms use existing brand reputations to bond extension product quality, since a reputation and its attendant profit potential are forfeited in the event that extension quality is low.

The signaling potential of warranties stems from the cost of redemptions in the event that quality is overstated (Emons 1989; Spence 1977). Economists and marketing researchers cite two problems with warranty contracts which render brand signals more efficient from the firm's perspective: 1) consumer moral hazard, which is the propensity for consumers to be

careless or abusive of products in the event of full warranty coverage and 2) adverse selection, which is the potential for fully warranted products to attract predominantly those consumers who are most likely to be careless or abusive of the product (Padmanabhan and Rao 1993). These two problems increase the cost of signaling through warranties and may lead high quality manufacturers to offer less than full warranty coverage. For low quality firms, on the other hand, redemption costs present a disincentive for offering better coverage than actual product quality would allow (Lutz 1989, Padmanabhan and Rao 1993). Thus, while a limited warranty does not necessarily imply poor quality, an extensive warranty in principle is an indicator of high quality. The risks of moral hazard and adverse selection, however, combined with the ambiguous meaning of a limited warranty, reduce the efficiency of warranty signals from the perspective of the firm.

While the above considerations reduce the attractiveness of warranty signals from the firm's perspective, there also may be reasons for brand signals to be preferred to warranty signals from the consumer's perspective. Given that the number of warranty redemptions is limited by prior sales volume in the product category, while the loss of a brand's reputation jeopardizes potential profits from more than one product category, the penalty for deception with a brand signal may be markedly greater than the penalty for deception with a warranty signal. Consumers who recognize this disparity might consider the brand signal more credible than a warranty signal. A second reason centers on the ease of offering the two signals with deceptive intent. Whereas firms with a history of low quality products can easily offer extensive warranty coverage in an attempt to falsely convey high quality, it is impossible for such firms to attempt a high quality signal on the basis of firm or brand reputation. Although the costs of redemption reduce the attraction of false warranty signaling in the long-run, a fly-by-night firm may attempt such a move with short-run profits in mind. Recent empirical studies have demonstrated the ineffectiveness of warranty signals when consumers are given reason to doubt the long-run viability of the warranting firm (Boulding and Kirmani 1993; Broniarczyk and Alba 1994).

Consumer Response to Quality Signals

A key assumption underlying signaling theory propositions is that consumers act on the basis of knowledge about the firm's motives and constraints. Whether consumer behavior actually matches the theory, or more importantly perhaps, the conditions under which it does or does not do so, is not yet well documented. Empirical tests of signaling theory typically focus on firm actions rather than consumers, and use market level data to determine whether equilibrium solutions are apparent in actual firm behavior.

While empirical consumer research generally supports the superiority of brand reputations over warranty signals, the evidence is limited in scope. Some support is found in self-report measures of rank-order preference for various risk relievers, where brands generally rank higher than warranties (Perry and Perry 1976; Olson and Jacoby 1972; Roselius 1971). The import of these findings is limited, however, by the abstract nature of the rank-order task which discourages indications of multiple signal use. More direct evidence is found in experimental studies where both warranties and brand reputations have been manipulated. These studies show clear dominance of a brand signal over warranties under two conditions : 1) a strong and successful brand is applied to a new model of an historically successful product line (Innis and Unnava 1991), and 2) a brand with a described history of poor quality products is applied to a new model of the same product line (Boulding and Kirmani 1993; Broniarczyk and Alba 1994). As these represent the extremes of an unambiguously good or poor brand reputation being leveraged within a single product line, the finding of brand dominance over warranty signals is not surprising. Whether brand superiority holds in the case of an extension product where the brand signal may be more ambiguous, however, or whether the two signals jointly determine product quality, remains to be determined.

Dimensions of Quality

In the signaling theory literature, quality is defined along two dimensions: mechanical reliability and product performance. Mechanical reliability reflects the product's propensity to

function without breakdown; product performance reflects the product's effectiveness on pre-defined criteria. For example, the speed at which a computer performs calculations is a measure of product performance. Analytic signaling models typically address only one aspect of quality, most often mechanical reliability. Consumers, on the other hand, seek information about both aspects of quality when making purchase decisions. Hypothesizing about consumer reactions to joint brand and warranty signals requires a synthesis of insights across the two quality dimensions, which may not always operate in parallel.

Signaling mechanical reliability. Warranty policies on consumer durables generally are intended to allay consumer apprehension about product breakdown. The warranty is an effective quality signal because firms incur redemption costs in the event of deception. Although consumer moral hazard and adverse selection may lead high quality firms to offer limited warranty coverage (Lutz 1989), an extensive warranty theoretically is a credible signal of high mechanical reliability.

A brand with an established reputation also is a theoretically effective signal of mechanical reliability. Brand signaling is tantamount to posting an existing reputation as a bond against future product quality (Wernerfelt 1988), with the penalty for false signaling being the loss of future sales of all products carrying the brand name. Brand signals are more general than warranties in that they do not offer specific promises against breakdown, nor are they directly linked to the performance of any individual item. Nevertheless, they can be an effective signal of mechanical reliability, since the threat of consumer boycott in the event of product failure provides a disincentive for firms to apply a reputable brand to a low quality product.

Wernerfelt (1988) argues that firms are unlikely to use an established brand reputation to signal quality of a dissimilar new product extension. He formalizes this idea in a signaling model by incorporating a cost of brand dilution which increases with product dissimilarity. From the firm's perspective, this reduces the financial attractiveness and hence the likelihood of extension branding for a dissimilar new product. However, in the marketplace we observe

numerous instances of brand extension to dissimilar categories, for example, Panasonic bicycles, Adidas watches, and Bic surf boards. The signaling model is unclear about consumer response in the event a firm violates equilibrium behavior and applies an established brand to a dissimilar product. A consumer who recognizes the suboptimality of such action for the firm might doubt the reliability of the brand signal and hence reject it in favor of other quality indicators. Alternatively, the branding decision might be seen as an indicator of the firm's confidence in the extension product's quality, made stronger precisely because the firm is willing to risk brand dilution in order to make the claim.

Although signaling theory offers no clear guidance on which of these two consumer responses is more likely, research on consumer responses to brand extension products may provide a clue. Experimental evidence indicates that consumers generalize abstract brand associations, such as quality, to similar products carrying the same name (Keller and Aaker 1992), but that generalization typically diminishes as an extension becomes increasingly dissimilar from the brand's historical product category. Brand extension research thus suggests that consumers may reject a brand signal under conditions of high product dissimilarity. As empirical brand extension studies do not focus explicitly on measuring and testing quality signaling effects, however, this conclusion requires further investigation.

Signaling product performance. Although warranties sometimes cover product performance dimensions (e.g., total satisfaction guarantees on some food items), this is not typical of consumer durable products. Instead, warranties are a specific signal of a durable product's mechanical reliability which theoretically should not be taken by consumers as a signal of performance quality. Nevertheless, empirical evidence indicates that consumer evaluations of product performance are sometimes affected by warranty coverage (Boulding and Kirmani 1993; Innis and Unnava, unknown brand case, 1991), though the result is not uniformly found (Shimp and Bearden 1982). The question arises whether observed warranty effects on performance perceptions represent halo from theoretically prescribed warranty effects on mechanical reliability. The halo interpretation has been questioned on grounds of

imperfect replication across the two quality dimensions (Boulding and Kirmani 1993). However, this conclusion remains tentative and further investigation is necessary.

Brands cannot perfectly signal product performance since the features of extension products and historical products are never identical. Sappington and Wernerfelt (1985), however, have argued that brands can reduce uncertainty about the performance of similar extension products. The logic is that consumers attempt to interpret performance claims about a new product consistent with the performance of the historical product, assuming the same brand name is applied to both. When products are dissimilar, however, consumers' inability to find a link between historical and new product features may heighten performance uncertainty. The costs of consumer uncertainty should reduce the likelihood that a firm will apply an extension brand to a dissimilar new product. As with mechanical reliability, however, signaling theory offers little insight on consumer response in the event firms nevertheless apply an established brand to a dissimilar product. On the basis of brand extension research cited above, one would expect rejection of the brand signal under conditions of high product dissimilarity. Thus, brands can be expected to serve as a credible signal of the performance dimension of quality for similar, but not dissimilar, extension products.

Table 1 provides a summary of the arguments made from brand and warranty signaling theory and lists issues concerning signal interaction that have not as yet explicitly been addressed in the literature. Synthesizing across the two streams of literature we argue that brands and warranties both signal mechanical reliability, although differences in the penalty for, and ease of attempting deception should lead consumers to rely more on the brand if it has a strong reputation to protect. The value of a brand signal may decline with decreasing similarity of historical and extension product categories, however, potentially leaving room for a warranty to signal reliability of a dissimilar extension. Warranty signals remain effective in this case because contract terms apply to the extension product explicitly and specifically. Performance quality also can be signaled by a brand if the extension product is similar to historically produced products, but not if the products are dissimilar. In contrast to

mechanical reliability, however, warranties theoretically are not intended as a signal of performance quality.

Table 1 about here

Quality Signals and Purchase Likelihood

Under the signaling theory assumption that consumers value quality, it is argued that purchase intentions are higher when high quality has been signaled. Although no guidelines exist about how consumers might combine judgments across the two dimensions of quality, it seems reasonable to expect a cumulative effect. Accordingly, we hypothesize that purchase intentions will be greatest when both high mechanical reliability and high product performance have been signaled, weakest when neither quality dimension has been signaled, and intermediate when only one dimension of quality has been signaled. As consumers generally will not equally value the reliability and performance dimensions of quality, the ordering of effects when reliability alone versus performance alone has been signaled should depend on the relative weights consumers assign to the two dimensions.

Experiment 1

We initially tested the joint signaling effects of brands and warranties by having subjects evaluate potential extensions to a highly reputable brand of personal computers, where warranty coverage and extension similarity to personal computers were varied. On the basis of preceding arguments we hypothesized that the brand would signal high mechanical reliability of the similar extension, regardless of the proposed warranty coverage. In contrast, warranties were expected to signal reliability of the dissimilar extension product where brand effects were expected to be minimal. Thus, a similarity-by-warranty interaction was hypothesized for perceived mechanical reliability of the new product. A similarity main effect

also was expected, under the assumption that the brand signal would be quite strong for the similar product. Figure 1, panel A, shows this and subsequent research hypotheses in graphical form.

Figure 1 about here

We further hypothesized that the brand would signal product performance for only the similar extension, and without regard to warranty coverage. If consumers interpret claims about a similar extension's performance in accordance with historical product performance (Sappington and Wernerfelt 1985), and if historical product performance is high in quality, then the brand should signal high quality performance for the extension. As the signal should be effective only for a similar extension product, we expected a main effect of extension similarity on the performance dimension of quality, with the similar extension having higher perceived quality than the dissimilar extension. Since warranties theoretically do not signal performance quality for durable products, we hypothesized no warranty main effects or interactions. However, the mixed results of previous empirical studies suggest that warranty effects on performance quality could not be ruled out. With the objective of testing signaling theory propositions, however, we formulated our hypotheses in accordance with theoretical constraints. Figure 1 illustrates the difference in hypothesized effects for the mechanical reliability and performance dimensions of quality.

High purchase intentions were expected for the similar extension product on the basis of hypothesized brand signaling of both mechanical reliability and performance. Low intentions were expected for the dissimilar extension with low warranty coverage where neither the brand nor the warranty were expected to signal any aspect of quality. Finally, moderate purchase intentions were expected for the dissimilar extension with high warranty coverage where the expectation was that only mechanical reliability would be signaled.

Overall this argues for a main effect of similarity and a similarity-by-warranty interaction on purchase intentions.

Design and Stimulus Materials

The basis for our research design was an established and highly reputable brand in a product category that is familiar to student subjects. A pretest sample of 26 students in a major business school was asked to rate nine brands of personal computers on 7-point scales of brand familiarity ("not at all/very familiar"), brand attitude (3-item average of "negative/positive", "unfavorable/favorable", "bad/good"; Cronbach alpha 0.87) and product quality ("low/high"). As Compaq scored highest on all three measures ($\bar{x}$ =4.65, 5.99, and 6.08, respectively), it was selected as the brand name for experimental stimuli.

A 2 (extension similarity) x 2 (warranty coverage) between-subjects experiment was used to test hypotheses. Strong manipulations of the independent variables were realized by using fax machines and mountain bikes as the similar and dissimilar extension products for a personal computer maker, and offering either a good product warranty with 7 years unconditional coverage of parts and labor or a poor warranty with 3 months limited coverage of manufacturer defects only. Similar strong manipulations have been used in previous brand extension (e.g., Boush and Loken 1991) and consumer warranty studies (e.g., Boulding and Kirmani 1993)

Descriptions of the extension product were presented in the form of an independent laboratory test report (see Figures 2 and 3). An information table indicated the brand name, the historical and extension product categories, numerical ratings on four product attributes, warranty terms and purchase price. Although attribute labels varied for the two extension products, numerical ratings and the price did not. The listed price of $389 was determined on the basis of *Consumer Reports* to be moderate for both fax machines and mountain bikes (fax machine prices ranged from $300 to $600 in *Consumer Reports*; bike prices ranged from $265

to $535). Attributes were representative of those tested by *Consumer Reports*, and ratings were held constant across treatments at a favorable level.

Figures 2 and 3 about here

Subjects and Procedure

Seventy-two business school students participated in the study for partial course credit. Participants were asked to study the description of a potential brand extension product and then a) evaluate the product's mechanical reliability b) evaluate its performance on three functional attributes, and c) indicate their purchase intentions for the product. Question order was counterbalanced but, as no significant order effects were found (p-values >.25), this will not be discussed further. Finally, subjects responded to a number of manipulation and randomization checks before being debriefed and excused. All questions were measured on 7-point scales.

Results

Manipulation checks. Prior to testing the research hypotheses we verified that extension similarity and warranty coverage had been manipulated as intended. On a scale labeled "very dissimilar/very similar" at the endpoints, subjects rate fax machines to be significantly more similar to Compaq's current products than mountain bikes ($\bar{x}$ = 5.06 and 1.89, respectively, $F_{1,68}$ = 100.33, p<.01), confirming the similarity manipulation. As intended, similarity ratings do not vary with the warranty manipulation (p-values >.48) Subjects judged warranty length relative to the product category average ("much shorter/longer than average"), with the result that ratings in the good warranty condition are significantly higher than those in the poor warranty condition ($\bar{x}$ =6.00 and 3.31, respectively, $F_{1,68}$ = 63.40, p<.01). Similarly, ratings of the likelihood that the product would be fixed without cost in the event of a breakdown ("very unlikely/likely") are significantly higher in the good warranty

condition than the poor warranty condition ($\bar{x}$ =5.22 and 4.23, respectively, $F_{1,67} = 6.38$, $p<.02$). These tests confirm that subjects correctly perceived the good warranty to be longer and greater in scope than the poor warranty. As intended, warranty perceptions do not significantly differ across the similarity manipulation (p-values >.56).

As in the pretest sample, subjects were highly familiar with the Compaq brand ($\bar{x}$ =5.53) and held favorable brand attitudes ($\bar{x}$ =5.79, Cronbach alpha 0.97). There are no significant differences in these measures across treatments (p-values >.22), nor are groups different in product involvement (p-values >.18), as measured by Mittal's (1989) 4-item scale (grand mean 5.46; Cronbach alpha 0.83). Finally, there are no significant differences across cells in subjects' expressed confidence ("not at all/very sure") in their quality assessments (grand mean 4.19; p-values >.22).

Hypothesis Tests. Each dependent variable was tested in a separate between-subjects ANOVA with warranty (good/poor) and extension similarity (similar/dissimilar) at two levels. The first dependent variable, mechanical reliability, was measured as the average response to two questions asking "Compared to other fax machines/mountain bikes, how likely is..." a) the described product to break down within 7 years of purchase and b) the described product to have defective parts and/or workmanship ("much less/more likely"; Cronbach alpha 0.73). This scale is reversed in subsequent discussion so that bigger numbers reflect higher reliability. Product performance was similarly measured in comparison to other products in the same category. Ratings of three performance features were averaged for each product to obtain a single performance index: transmission speed, reception quality and printing quality for the fax machine (Cronbach alpha 0.57) and gearshift protection, off-road handling and shock absorption for the mountain bike (Cronbach alpha 0.73). Principle components analysis on the three performance- and two reliability-subscales concurrently yielded two distinct dimensions of quality for each product category, as expected, with questions loading on the appropriate sub-dimensions as just described. Finally, purchase intentions were measured with a single

question asking how likely subjects would be to purchase the described product ("very unlikely/very likely") if they were in the market for that particular category.

We predicted a similarity-by-warranty interaction and a similarity main effect on perceived mechanical reliability of the proposed product. ANOVA results show a significant interaction ($F_{1,68} = 3.92$, p=.05) along with significant main effects of both similarity ($F_{1,68} = 13.53$, p<.01) and warranty ($F_{1,68} = 8.99$, p<.01). Cell means in Table 2 indicate, as expected, that subjects judged the fax machine to be higher in reliability than the mountain bike ($\bar{x}$ =4.79 and 3.89, respectively), regardless of warranty coverage. Further, warranty contributes positively to perceived reliability of the mountain bike, as expected ($\bar{x}$ =3.28 and 4.50 in poor and good conditions, respectively), but also has a mildly favorable effect on fax machine perceptions ($\bar{x}$ =4.67 and 4.92 in poor and good conditions, respectively). Nevertheless, the main result on mechanical reliability is the significant interaction, which shows a much stronger effect of warranty for the mountain bike extension than the fax machine extension. Results thus support our hypothesis and are consistent with the argument that a strong brand reputation dominates warranty in signaling mechanical reliability of a similar, but not a dissimilar, extension. Warranty also contributes to quality perceptions of both products, but the effect is much stronger for the dissimilar extension where brand signaling is weak.

Table 2 about here

We also predicted a main effect of similarity on perceptions of product performance. ANOVA results confirm this prediction ($F_{1,68} = 4.47$, p<.05), with cell means showing higher performance perceptions for the fax machine than the mountain bike ($\bar{x}$ =4.98 and 4.59, respectively), regardless of warranty coverage. This follows the argument that product claims for the similar extension would be interpreted in accordance with the perceived high quality performance of the brand's historical products. Perceptions of the dissimilar extension appear

not to have been influenced by the historical product, and thus are less favorable. A main effect of warranty also is seen in performance quality ratings ($\bar{x}$ =4.56 and 5.02 in poor and good conditions; $F_{1,68} = 6.33$, $p<.02$). This is not predicted by signaling theory but confirms the findings of previous consumer studies (Boulding and Kirmani 1993; Innis and Unnava 1991). In sum, theoretical assumptions about brand signaling effects on performance quality are supported by Experiment 1, as seen in the effects of the similarity variable. In addition, significant warranty effects on performance quality emerge, confirming the results of previous experimental studies which showed a violation of signaling theory assumption in this respect (Boulding and Kirmani 1993; Innis and Unnava 1991).

Finally, we predicted a similarity main effect and a similarity-by-warranty interaction on purchase intentions. The interaction hypothesis was based on the assumption that warranty would contribute to perceived mechanical reliability, but not the perceived product performance, of the dissimilar extension. In light of the observed warranty effects on both quality dimensions for both extension products, however, purchase intentions for both products might also be expected to increase with warranty coverage. A revised hypothesis, taking into account these observed warranty effects thus would call for main effects of both the warranty and the similarity manipulation. ANOVA results support this modified hypothesis. As expected, purchase intentions are higher for the fax machine than the mountain bike, resulting in a significant effect of similarity ($\bar{x}$ =4.58 and 3.03, respectively; $F_{1,68} = 20.62$, $p<.01$). Furthermore, purchase intentions are higher in the good warranty condition than the poor warranty condition ($\bar{x}$ =4.28 and 3.33 respectively) resulting in a significant main effect of warranty ($F_{1,68}=7.60$, $p<.01$) rather than the initially hypothesized interaction ($p>.33$). Given the observed warranty effects on mechanical reliability and performance quality ratings, purchase intentions follow our predictions of being highest when both quality dimensions are signaled (as in the fax-with-high-warranty condition) and lowest when neither quality dimension is signaled (as in the bike-with-low-warranty condition), indicating a cumulative effect of the two quality dimensions in driving purchase intentions.

Discussion

The results of Experiment 1 are consistent with propositions deduced from the brand and warranty signaling literatures, and also illustrate some important deviations. Consistent with theory, it appears that the strong reputation of the Compaq brand serves as an effective signal of both the mechanical reliability and performance dimensions of quality for an extension product similar to computers. This complements arguments that firms find brand signals superior to warranties (Shapiro 1983; Allen 1984) with evidence that consumers sometimes demonstrate the same preference. When extension similarity is weak, on the other hand, reliance on the brand signal decreases and warranty has a stronger effect on consumer perceptions. Dependence of the brand signaling effect on similarity between the old and new branded products shows an important boundary condition for assumed signaling superiority of the brand.

In contrast to signaling theory arguments, on the other hand, effects of the warranty signal are not limited to mechanical reliability but include product performance. Although this might reflect halo, we concur with previous authors (Boulding and Kirmani 1993) that differences in the pattern of results across the dependent measures cannot be fully explained by the halo effect. Good warranties contributed equally to perceived performance quality of the two extension products, whereas the effects of warranties on perceived mechanical reliability were much stronger for the dissimilar extension. Pure halo would argue for more equivalent effects on the two measures.

One advantage of examining both the brand and warranty signals in conjunction is that it is possible to determine their relative influence on perceptions of quality. Whereas we hypothesized on the basis of independent signaling models of brands and warranties that consumers would rely completely on either the brand or the warranty as a function of extension similarity, mechanical reliability ratings and purchase intentions show a less extreme interactive effect. That is, subjects relied on the warranty signal for judging quality of both

extension products, but with greater intensity when extension similarity decreased. In no case was the warranty signal rendered ineffective by a stronger brand signal.

A limitation of this study is that brand signaling effects were inferred from observed differences across the two extension products. While results of the similarity manipulation confirmed our theoretical expectations in entirety, there might be inherent differences in the two extension products that could also explain the observed effects. To test this possibility we exactly replicated the first experiment except that an unfamiliar, less established brand replaced the Compaq name in all experimental stimuli. If similarity effects in the first experiment actually reflect brand signaling, these effects should be minimized in the replication study.

Experiment 2

Since an unknown brand has no reputation to post as bond, theoretically it cannot signal quality of an extension product, regardless of extension similarity to existing products. In contrast to Experiment 1, therefore, we hypothesized no effects of similarity on perceived product quality in Experiment 2. In keeping with our initial purpose of testing consumer behavior assumptions of signaling theory, we chose to ignore the observed warranty effects on product performance in Experiment 1 and revert to signaling theory predictions. Accordingly, warranty was expected to signal mechanical reliability of the extension products, regardless of similarity, but was not expected to signal performance quality. In sum, a main effect of warranty was hypothesized for mechanical reliability, and no effects of either warranty or similarity were hypothesized for product performance. Since the warranty signal was expected to influence only mechanical reliability and the brand signal was expected to be ineffective, purchase intentions were expected to follow warranty signaling of mechanical reliability, yielding a main effect of warranty on measured intentions. Figure 1, panel B, shows these hypotheses graphically.

Stimulus Materials and Subjects

Pretest materials for Experiment 1 were examined to identify an unfamiliar brand of personal computers to serve as the basis for stimulus materials. CompuAdd had been rated the least familiar brand among pretest subjects ($\bar{x}$ =1.85), and was therefore selected for our design. Average pretest attitudes and quality perceptions were near the scale midpoint for the CompuAdd brand ($\bar{x}$ =3.76 and 3.62, respectively), indicating that subjects held neither favorable nor unfavorable brand impressions which might influence results and mistakenly be interpreted as signaling effects.

Seventy-two business school students participated in the second experiment for partial course credit. Stimulus materials and procedures were identical to those in Experiment 1 with the exception that the CompuAdd brand name replaced the Compaq name in all stimuli. As with Experiment 1, counterbalancing of questions had no effect on dependent variable responses (p-values>.71) and will not be discussed further.

Results

Manipulation checks. Fax machines are judged to be more similar than mountain bikes to CompuAdd's current products ($\bar{x}$ =4.97 and 2.03, respectively, $F_{1,68}$ = 57.09, p<.01) in accordance with the intended similarity manipulation. As expected, similarity ratings do not vary with the warranty manipulation (p-values >.89). Furthermore, the good warranty is judged to be longer ($\bar{x}$ =5.76 and 3.01, respectively, $F_{1,66}$ = 63.94, p<.01) and broader in scope ($\bar{x}$ =4.44 and 3.43, respectively, $F_{1,67}$ = 6.00, p<.02) than the poor warranty, in accordance with the intended warranty manipulation. Perceived warranty length does not vary with the similarity manipulation (p-values >.27), although warranty scope is considered marginally greater in the mountain bike cells than the fax machine cells ($\bar{x}$ =4.31 and 3.57, respectively, $F_{1,67}$ = 3.19, p<.09). The realized warranty manipulation thus may have been slightly stronger in the former case than the latter. Since no interactions between warranty and

similarity were detected in the results reported below, however, this difference was not considered problematic *post hoc*.

As in pre-testing, subjects were unfamiliar with the CompuAdd brand ($\bar{x}$ =2.32), and their brand attitudes were neutral ($\bar{x}$ =4.10, Cronbach alpha 0.97). No significant differences are seen in these measures across treatments (*p*-values >.14). Experimental groups do not significantly differ in product involvement (grand mean 5.30, *p*-values >.63, Cronbach alpha 0.73) nor in the expressed confidence of their quality ratings (grand mean 3.82, *p*-values >.12).

Hypothesis Tests. Principle components analysis yields two distinct dimensions of product quality, thus subscales were again averaged to create separate indices of mechanical reliability (Cronbach alpha 0.84) and product performance (Cronbach alpha 0.77 and 0.88 for fax machines and mountain bikes, respectively). Hypotheses were tested as in Experiment 1 with a 2 (warranty) x 2 (similarity) between-subjects ANOVA.

The prediction of a main effect of warranty is supported by subjects' ratings of mechanical reliability ($F_{1,68}$ = 16.18, p<.01); no significant main effects or interactions of similarity are detected (*p*-values >.44). Cell means (see Table 2) show higher perceived mechanical reliability in the good warranty conditions than the poor warranty conditions ($\bar{x}$ =4.54 and 3.24, respectively), regardless of extension product similarity. Results are consistent with the reasoning that Compaq signaled fax machine reliability in Experiment 1 but the CompuAdd brand, with no reputation to bond extension product quality, was unable to do so in Experiment 2. This interpretation is strengthened by comparing reliability ratings for the Compaq fax machine under low warranty conditions in Experiment 1 with the corresponding ratings for CompuAdd in Experiment 2. Higher ratings of the Compaq machine (4.67 versus 3.00) are likely to reflect the Compaq brand signal in isolation from any additional warranty effects. Without a clear signal from the CompuAdd brand, mechanical reliability of the fax machine is perceived to be low in the absence of good warranty coverage.

We further predicted no significant warranty or similarity effects on subjects' perceptions of product performance. ANOVA results conform to hypothesis, with p-values exceeding 0.15 in all cases (grand mean 4.69). Warranty effects conform to signaling theory assumptions in Experiment 2 in being ineffective as a signal of product performance. Results contradict those from Experiment 1, however, where warranty did signal performance quality of the reputable brand.

Non-significance of the similarity effect fits the argument that the unfamiliar brand is unable to signal performance quality in Experiment 2. As for mechanical reliability, however, a stronger test of the brand signaling hypothesis would require higher performance perceptions for the Compaq fax machine under low warranty conditions in Experiment 1 than the CompuAdd fax machine under low warranty conditions in Experiment 2. The difference would reflect the brand effect in isolation from any warranty effects. Contrary to expectations, this comparison reveals no perceptual superiority of the Compaq brand; average Compaq performance ratings are no different from average CompuAdd ratings (4.78 versus 4.82). Since ratings were collected from different subjects who made no direct comparisons across brands, the results may reflect differences in scale usage rather than actual perceptual similarity for the two brands. This explanation lacks force, however, in light of the mechanical reliability results just discussed. The result argues for a stricter test of the brand signaling hypothesis before our interpretation of the results of Experiment 1 can be accepted.

Finally, we predicted a main effect of warranty on subjects' purchase intentions. Contrary to hypothesis, the warranty main effect is non-significant ($p>.90$) but the similarity main effect is significant ($F_{1,67} = 5.52$, $p<.03$). Table 2 shows higher purchase intentions for the fax machine than the mountain bike ($\bar{x}$ =3.99 and 3.14, respectively), regardless of warranty coverage. Thus, although warranty signals mechanical reliability of both extension products, the effect fails to impact subjects' purchase intentions. Even more problematic is the appearance of a similarity effect on intentions when no such effects are detected in mechanical reliability or performance quality perceptions.

Discussion

Experiment 2 supports the brand signaling hypotheses pertaining to the mechanical reliability dimension of quality. Given subjects' low familiarity with the CompuAdd brand, no brand signaling was expected. This argument was indirectly tested via the extension similarity manipulation under the assumption that the weak brand signal would be unable to create differences in quality perceptions across the different products. The observed similarity in perceived mechanical reliability of the two extensions supports our expectation of no CompuAdd brand signaling. Although this test is weak because of its indirect focus as well as the ambiguity of not rejecting a null hypothesis, the combined results of Experiment 1, where similarity effects are observed for a reputable brand, and Experiment 2 where they are not observed for a reputationless brand, together support the hypothesized brand signaling effects on mechanical reliability.

Experiment 2 also supports signaling theory arguments that warranties are an effective signal of mechanical reliability for an unfamiliar brand, regardless of extension similarity, but are not an effective signal of product performance. This latter finding is consistent with signaling theory but not consistent with the results of Experiment 1. One possible explanation for the inconsistency is that subjects unfamiliar with the CompuAdd brand focused heavily on attribute ratings to assess product quality whereas those familiar with the Compaq brand de-emphasized ratings and relied instead on prior brand knowledge. If so, numerical test ratings may have anchored performance judgments for the CompuAdd products more strongly than the Compaq products. Indeed, research on consumers' use of cues indicates that the brand name is relied on as a first source of information and that other information may be sought and examined if the brand fails to provide the necessary input (Dawar and Parker 1994; Jacoby, Szybillo and Busato-Schach 1977). In the CompuAdd case, failing to find sufficient evidence of quality in the brand name, subjects may have turned to attribute ratings. Perceptions of product performance would then be based directly on this evidence rather than on the

warranty signal. A cleaner test of the signaling hypotheses may be provided by using stimulus materials which do not include numerical attribute ratings.

Experiment 2 fails to support the hypothesized link between quality perceptions and purchase intentions for the unfamiliar brand. Higher perceived mechanical reliability does not translate into higher purchase intentions for either extension product. Furthermore, subjects' preference for the fax machine over the mountain bike does not follow from their quality perceptions, where no product differences are observed. While quality perceptions for the two CompuAdd products in Experiment 2 were expected to be equivalent, performance quality ratings for the CompuAdd and Compaq fax machines were not expected to be equivalent. The observed similarity in performance ratings for the two brands is not consistent with the hypothesized brand signaling effects in Experiment 1. These results question our initial interpretation of Experiment 1 where main effects of similarity on subjects' performance ratings and purchase intentions were seen as a result of brand signaling. Moreover, differences in purchase intention ratings for the two products in Experiment 2, where brand signaling was minimized, indicate that inherent product differences are at least partly responsible for observed similarity effects. In order to clarify this issue and address the performance anchoring concerns mentioned above, we conducted a third experiment in which brand effects were directly tested and no attribute ratings were included in the test stimuli.

Experiment 3

The third experiment replicated Experiments 1 and 2 with two important differences. First, brand signaling was directly tested by manipulating brand reputation at high and low - Compaq versus CompuAdd - levels, but holding product category constant with fax machine descriptions. This eliminates product differences as an alternative explanation for ostensible brand signaling effects. Second, extension product descriptions took the form of a press release rather than a laboratory test report. No attribute ratings were included in the product descriptions, eliminating potential anchoring effects on the performance dimension of quality.

Hypotheses are similar to those in Experiment 1 (see Figure 1, panel A), with the CompuAdd fax machine matching the Compaq mountain bike in expectations of warranty signaling effects but no brand signaling effects. Accordingly, brand was expected to signal mechanical reliability of the Compaq fax machine, reducing the effect of the warranty signal. In lieu of brand reputation, warranty should be a strong signal of mechanical reliability for the CompuAdd fax machine. Overall, a main effect of brand and a brand-by-warranty interaction were hypothesized for mechanical reliability. A main effect of warranty may result, as seen in Experiment 1, but this should be tempered by a significant interaction which reflects the relatively stronger warranty effects for the unfamiliar brand.

Only the reputable brand was expected to benefit from brand signaling of performance quality, suggesting a main effect of brand on performance expectations. Warranty effects on performance perceptions were difficult to predict in this case. In keeping with signaling theory predictions, we once again hypothesized no warranty main effects or interaction effects on performance quality perceptions. Results of the first two experiments cast doubt on this expectation, however. To be consistent with the first two studies, we might expect performance perceptions to increase with warranty coverage for the reputable brand but not for the unfamiliar brand. We opt for the theory-based hypothesis, but recognize that an alternative outcome is likely. Finally, signaling effects of the Compaq brand on both dimensions of quality were expected to carry through to purchase intentions, yielding a main effect of brand. If warranty effects conform to theoretical guidelines, this effect should be tempered by a brand-by-warranty interaction due to strong warranty signaling of mechanical reliability for the CompuAdd brand.

Stimulus Materials and Subjects

Descriptions of the extension products were presented in the form of a press release (see Figure 4). As in the first two experiments, the description mentioned the brand name, the historical and extension product categories, the price and warranty terms, and four product

attributes. In this case, however, the announcement claimed manufacturer confidence in the performance attributes rather than including explicit laboratory test ratings. Warranty manipulations and attribute labels were the same as in the first two experiments, and product price was again held constant in all cells.

Figure 4 about here

Sixty-three business school students participated in the experiment on a voluntary basis. Materials and procedures were identical to those in the first two studies with the exception of the brand name and format changes just described. As in Experiments 1 and 2 counterbalancing of questions had no effect on dependent variable responses ($p>.42$) and will not be further mentioned.

Results

Manipulation checks. The brand manipulation was verified on the basis of the attitude and familiarity scales described for pretest materials. Attitude (Cronbach alpha 0.97) and familiarity ratings are significantly higher for the Compaq brand than the CompuAdd brand (attitude $\bar{x}$ =5.74 and 4.10, respectively, $F_{1,58} = 81.05$, $p<.01$; familiarity $\bar{x}$ =5.26 and 1.84, respectively, $F_{1,59} = 90.72$, $p<.01$) in accordance with the intended manipulation. An unexpected main effect of warranty also emerges in subject's attitude ratings, however, with subjects in the good warranty condition indicating a more favorable attitude than those in the poor warranty condition ($\bar{x}$ = 5.23 and 4.62, respectively, $F_{1,58} = 9.62$, $p<.01$). The meaning of this latter effect initially was unclear. Since attitude was measured toward the end of the experimental procedure, it is possible that warranty terms contributed to subjects' attitudes as well as their product quality perceptions, making this an experimentally induced effect. Alternatively, it is possible that the initial brand manipulation was unequal in the two warranty conditions (i.e., subjects in the good warranty conditions initially had better brand attitudes

than those in the poor warranty conditions) indicating a potential failure of the randomization process.

Given the similarity of the warranty effect across the two brands (interaction $p>.92$) the first explanation seems more likely than the second, in that a duplicated failure of the randomization process for both brands seems unlikely. Nevertheless, to further rule out the latter explanation, hypothesis tests were run after eliminating subjects with outlying low attitudes from the two poor warranty conditions as well as those with outlying high attitudes from the two good warranty conditions so as to achieve rough equivalence of attitudes over the warranty factor (resulting mean attitude ratings were 3.97 versus 4.08 for the good and poor warranty CompuAdd conditions, and 5.58 versus 5.50 for the respective Compaq conditions). Results of the hypothesis tests do not differ from those reported below for the full data set except that the significance of both brand and warranty effects falls to marginal levels for the dependent purchase intention measure. Under the assumption that purchase intentions and brand attitudes were similarly altered by exposure to the stimulus materials, attempts to reduce group differences on the latter measure would also reduce differences on the former. Lowered significance in the purchase intention tests thus is consistent with our argument that attitude differences are an experimentally induced effect. Given the stability of results for measures of the two quality dimensions and the directional consistency of results for the purchase intention measure across the full and reduced data sets, it seems likely that differences in attitude across warranty conditions resulted from exposure to warranty information rather than being a randomization failure. Therefore, this effect is not thought to compromise interpretation of the full data set results reported below.

Subjects in the good warranty condition correctly perceived longer warranty coverage on the extension product than was described in the poor warranty condition ($\bar{x}$=6.19 and 2.72, respectively, $F_{1,56} = 115.98$, $p<.01$). As expected, perceived warranty length did not vary by brand (p-values >.20). Although mean ratings of warranty scope were greater in the good warranty conditions than the poor warranty conditions ($\bar{x}$=5.59 and 5.45, respectively),

the difference was not significant ($F_{1,59} = 0.18$, $p>.67$). This weakens the overall warranty manipulation but is not overly problematic in light of the strong warranty length manipulation. As intended, perceived warranty scope does not significantly differ across brands (*p*-values>.12). Treatment groups do not significantly differ in product involvement (grand mean 4.92, Cronbach alpha 0.84; *p*-values>.42), and subjects' confidence in their expressed quality judgments is similarly equivalent across cells (grand mean 3.38, *p*-values >.27).

Hypothesis Tests: Principle components analysis yields two distinct dimensions of product quality; therefore, items from the mechanical reliability and performance subscales were again averaged to form two separate quality indicators. Hypotheses were tested with a 2 (brand reputation) x 2 (warranty coverage) between-subjects ANOVA on the mechanical reliability (Cronbach alpha 0.69), product performance (Cronbach alpha 0.76) and purchase intention measures.

We predicted a main effect of brand and a brand-by-warranty interaction on the extension product's perceived mechanical reliability. As expected, subjects perceive the reliability of the Compaq fax machine to be significantly greater than that of the CompuAdd machine ($\bar{x}$ =4.85 and 4.33, respectively, see Table 3), yielding a significant main effect of brand ($F_{1,59} = 4.31$, $p<.05$). Perceived reliability also is significantly higher in the good warranty cells than the poor warranty cells ($\bar{x}$ =5.02 and 4.15, respectively, $F_{1,59} = 11.59$, $p<.01$), once again indicating warranty effects for both brands. As in the first experiment, however, the main effect of warranty is tempered by a marginal interaction of brand and warranty ($F_{1,59} = 3.81$, $p<.06$) which is directionally consistent with the hypothesis. Specifically, the strength of the warranty effect is greater for the CompuAdd brand where brand signaling is weak ($\bar{x}$ =3.66 and 5.00 in the poor and good conditions) as opposed to the Compaq brand, where brand signaling is strong ($\bar{x}$ =4.67 and 5.03 in the poor and good conditions). These results are consistent with signaling theory and with the first two experiments in finding a brand signaling effect on mechanical reliability for a reputable brand only. Moreover, they match the previous two studies that demonstrate strong effects of the

warranty signal when the brand signal is not strong, and moderate effects when the brand signal is strong.

Table 3 about here

We also predicted on the basis of theory a single main effect of brand reputation on perceptions of product performance quality, although evidence from the earlier studies argues against this hypothesis. Once again, performance ratings fail to conform to the theoretical hypothesis, in this case showing a significant interaction of brand reputation and warranty ($F_{1,59} = 8.57$, $p<.01$; main effect p-values>.16). Cell means indicate that warranty has a positive impact on performance perceptions for the Compaq brand ($\bar{x}$ =4.56 and 5.31 in the poor and good conditions), and a weak but negative effect on performance perceptions for the CompuAdd brand ($\bar{x}$ =5.08 and 4.83 in the poor and good conditions). These results replicate those of the first two experiments in showing a violation of signaling theory for the reputable brand but a fit with signaling theory for the reputationless brand regarding the (in)ability of warranty to signal performance quality. The replicated finding of no warranty effects for the unfamiliar brand indicates that attribute ratings in stimulus materials were not the underlying reason for the null effect observed in Experiment 2. With this possibility ruled out, we suggest an explanation for the observed differences across brands in warranty signaling of performance quality in the general discussion below.

Results also contradict our initial interpretation of Experiment 1 and the signaling theory hypothesis that brand would signal performance quality. Instead, the findings support the argument raised in our discussion of experiment 2 where we claimed that apparent brand effects on performance ratings in experiment 1 were actually product category effects. In line with this argument, performance ratings in experiment 3 are no higher for the Compaq brand than the CompuAdd brand, unless a strong warranty accompanies the Compaq label.

Finally, we predicted a main effect of brand on subjects' purchase intentions. In accordance with hypothesis, purchase intentions are significantly higher for the Compaq brand than the CompuAdd brand ($\bar{x}$ =4.58 and 3.84, respectively, $F_{1,59} = 4.39$, $p<.05$), matching the brand signaling effect on mechanical reliability perceptions. Our initial hypothesis also predicted an interaction of brand and warranty under the theory-motivated hypothesis that warranty would only signal mechanical reliability of the CompuAdd brand. In light of observed warranty effects on both quality dimensions of the Compaq brand, however, a significant warranty effect on purchase intentions toward the Compaq brand might have been expected. Observed purchase intentions support this expectation, with subjects in the good warranty conditions showing higher intentions than those in the poor warranty conditions ($\bar{x}$ =4.78 and 3.61, respectively, $F_{1,59} = 11.48$, $p<.01$), regardless of brand (interaction $p>.78$). Given the observed quality ratings, therefore, purchase intentions again conform to the hypothesis of being greatest when both reliability and product performance are signaled (Compaq, high warranty) and least when neither quality dimension is signaled (CompuAdd, low warranty), demonstrating a cumulative effect.

Discussion

Results of the third experiment alleviate concerns that observed similarity effects in the first two experiments reflect only product category differences rather than true brand signaling. The apparent brand signaling of mechanical reliability for the Compaq brand and the lack of signaling for the CompuAdd brand matches the pattern of results in Experiments 1 and 2. Moreover, the significant effect of the Compaq brand in raising fax machine purchase intentions over those of the CompuAdd brand reinforces the claim that quality signals affect more than simply perceptions. It is notable that the strength of the brand effect on purchase intentions in Experiment 3 is less than that of the corresponding similarity effect in Experiment 1. This suggests that the latter may reflect both a true brand signaling effect from the Compaq name and an unintended effect of extension product differences. The observed similarity effect

on purchase intentions in Experiment 2, in which no brand signaling effects are detected for the CompuAdd brand, most likely reflect only these unintended product differences. Experiment 3 is important, therefore, in demonstrating a clear brand signaling effect on mechanical reliability perceptions and purchase intentions when the extension product is held constant.

On the other hand, the third experiment fails to confirm brand signaling of performance quality as had been hypothesized from signaling theory and inferred from Experiment 1. Results in Experiment 1 most likely reflect unintended product differences, as just discussed. Warranty effects on performance perceptions also differ from signaling theory propositions, although empirical results are perfectly consistent across the three studies. Specifically, warranties signal higher performance quality of all products carrying the Compaq brand but no products carrying the CompuAdd brand. Warranty thus seems to be an effective performance signal only for a reputable brand. This interaction of the two quality signals is not currently accounted for by signaling theory and points to the importance of studying joint effects of quality signals.

Experiment 3 also matches Experiment 1 in showing significant but weak warranty signaling of mechanical reliability for the Compaq brand. Although brand reputation signals mechanical reliability as hypothesized, extensive warranty coverage adds further to reliability perceptions. This replicates the finding that subjects sometimes draw on both signals jointly to assess product quality.

Similar to brand signals, warranty signals are found in Experiment 3 to be linked with purchase intentions. Warranty signaling of mechanical reliability and performance quality of the reputable brand was always reflected in purchase intention ratings. Warranty signaling of mechanical reliability for the reputationless brand also sometimes carried over to purchase intentions. Comparing results across the three experiments, however, the link between the warranty signal and purchase intentions appears most reliable for the reputable brand. In all cases where warranty signals quality of a Compaq product, purchase intentions follow,

whereas warranty signaling of CompuAdd product quality is mirrored by purchase intentions in Experiment 3 but not in Experiment 2. This difference may be due to the signal's impact on both the performance and reliability dimensions of quality for the reputable brand while its effect is limited to mechanical reliability for the lesser known brand. The benefits of warranty signaling for an unknown brand thus are less certain than those for a well known brand.

General Discussion

An integrative review of signaling theory as it pertains to brand reputations and warranties provided the basis for our hypotheses about the joint effects of the two signals on consumers' quality perceptions and product preferences. Previous work tends to downplay the importance of warranty signals in light of the superior signaling efficiency of brands; that approach, however, overlooks important situations where a brand signal may be ineffective in isolation as an indicator of product quality. Synthesizing the two subtopics within the signaling literature, we predicted that consumer reliance on brand and warranty signals would vary as a function of similarity between previously branded products and new products carrying the same name. Although our initial views stressed dominance of one signal over another, results of our empirical tests provide evidence that consumers sometimes use the two quality signals jointly. In particular, it was observed that both brand reputation and warranty contributed to perceived mechanical reliability of a similar extension to a highly reputable brand. When extension similarity was low, on the other hand, and/or when the brand lacked an established reputation, warranties were the only effective signal of mechanical reliability.

Our results offer empirical support at the consumer level for Wernerfelt's (1988) analytic brand signaling model of extension product quality. Previous empirical investigations have explored firm behavior in comparison with model equilibria, with no direct consideration of consumer response. Evidence from our first and third experiments supports Wernerfelt's (1988) suggestion that brands can effectively signal mechanical reliability of similar, but not dissimilar, extension products. The product-similarity constraint demonstrates an interesting

parallel between firm behavior and consumer response; that is, when extension branding was suboptimal for the firm due to product dissimilarity, consumers were seen to reject the brand signal as a basis for forming perceptions. Overall, consumer responses to both brand and warranty signals of mechanical reliability were in accord with signaling theory's assumptions about consumer behavior.

Results pertaining to the performance dimension of quality, on the other hand, were mixed. First, our studies fail to confirm suggestions by Sappington and Wernerfelt (1985) that brands serve as an effective signal of performance quality. Although subjects sometimes expected better performance from a similar, as opposed to a dissimilar, extension product, this effect did not systematically vary with the strength of the brand reputation. Thus, it seems that the effect was due to inherent product differences rather than a brand signal of performance quality for the similar extension as originally hypothesized for our first two experiments. A second deviation from signaling theory assumptions was apparent in the consistent tendency for warranties to signal performance quality of a reputable brand. Despite theoretical arguments that warranties cannot signal performance quality in the absence of related redemption costs, the effect was observed in both experiments where the new product carried a reputable brand name. This violates the assumption that consumer responses to signals are formed on the basis of known manufacturer costs and constraints, but it fits with previous studies finding warranty effects on attribute perceptions (Boulding and Kirmani 1993; Innis and Unnava 1991). Although halo could explain why warranty effects carry over from mechanical reliability perceptions to performance perceptions, halo cannot explain why this effect was observed in our experiments only for a reputable brand.

This finding suggests that consumers might interpret warranty cues differently as a function of the warranting firm's reputation. In the event of an unknown firm, the warranty may be seen as simply a contract which insures the buyer against product failure. In such situations the warranty would add little to the product's inherent attractiveness, which could explain why generous warranties did not always raise purchase intentions for the CompuAdd

products in our experiments. When a reputable firm offers an attractive warranty, on the other hand, consumers may see this as a general sign of the firm's confidence in the product. That could explain why product performance perceptions increased along with perceived mechanical reliability as warranty coverage improved for a product bearing a reputable brand. Purchase intentions similarly should increase with warranty coverage under this scenario, as was observed for the Compaq products described in our test stimuli.

Overall, our results indicate a stronger relationship between brand names and warranties in jointly signaling product quality than has been previously recognized in the literature. Although generalization of our conclusions beyond the product categories, warranty terms and brand names studied here is not advisable at this time, it is safe to say that consumers do not always view the two quality signals independently. The finding may indicate a need for greater efforts by public policy makers to assure consumer understanding of warranty terms. On the other hand, consumers who understand the limits of warranty liability and nevertheless increase their performance expectations for a warranted product offered by a reputable, but not a reputationless, brand present challenges for both types of producers. For a reputable firm the challenge is to meet the consumer's raised expectations with respect to product performance, as failure to do so might result in subsequent consumer dissatisfaction. For reputationless firms the challenge is to find a signaling mechanism that does not depend on firm reputation for its effectiveness. These problems highlight the need for further investigations of how quality signals combine to influence consumer perceptions. Such combined effects allow insight into the boundary conditions for signaling theory by providing empirical evidence for or against the hitherto assumed behavior of consumers.

Table 1
Insights and Unaddressed Issues in Brand and Warranty Signaling Theory

Brand Signals	Warranty Signals
• Signaling potential due to loss of future sales and profits in the case of a tarnished reputation if quality is overstated	• Signaling potential due to warranty redemption costs if product is of low quality
• A general quality signal that may be interpreted by consumers to indicate both mechanical reliability and product performance (Sappington and Wernerfelt 1985; Wernerfelt 1988)	• Generally intended as a signal of mechanical reliability, but also empirically found to influence perceptions of product performance (Boulding and Kirmani 1993; Innis and Unnava 1991)
• Brand signals may be inefficient from the firm's perspective if the new product is dissimilar to the original product to which the brand applies (Wernerfelt 1988)	• Not affected by dissimilarity of product and can operate in the absence of a reputation (Bearden and Shimp 1982; Boulding and Kirmani 1993; Broniarczyk and Alba 1994; Innis and Unnava 1991; Shimp and Bearden 1982; White and Truly 1989)

Brand and Warranty Signals

- Brands are thought to be a superior signal to warranties in that,

  from the firm's perspective:
  (1) there is no consumer moral hazard as for warranties;
  (2) there is no adverse selection as for warranties; and

  from the consumers' perspective:
  (3) the adverse effect of overstated quality potentially impacts future sales of multiple products, thus making brand signals more credible; and
  (4) It takes time and effort to build a brand reputation on the basis of past quality. Warranties, on the other hand, can be offered immediately and by any firm.

Unaddressed Issues

- To what extent do brand and warranty signals interact to signal product quality?
  - When does one signal dominate?
  - When do both signals operate jointly?
- Is warranty effectiveness a function of the (dis)similarity between new products and existing products under the same brand?
- Do the two signals differ in ability to signal different dimensions of product quality (e.g. mechanical reliability versus product performance?)

Table 2
CELL MEANS (AND STANDARD DEVIATIONS): EXPERIMENTS 1 AND 2

Experiment 1: Reputable Brand

	Similar Extension (Fax)		Dissimilar Extension (Bike)	
Dependent Variable	Low Warranty	High Warranty	Low Warranty	High Warranty
Mechanical Reliability	4.67 (0.89)	4.92 (0.88)	3.28 (1.09)	4.50 (1.26)
Performance	4.78 (0.55)	5.19 (0.69)	4.33 (1.02)	4.85 (0.79)
Purchase Intentions	4.28 (1.49)	4.89 (1.49)	2.39 (1.24)	3.67 (1.57)
n	18	18	18	18

Experiment 2: Reputationless Brand

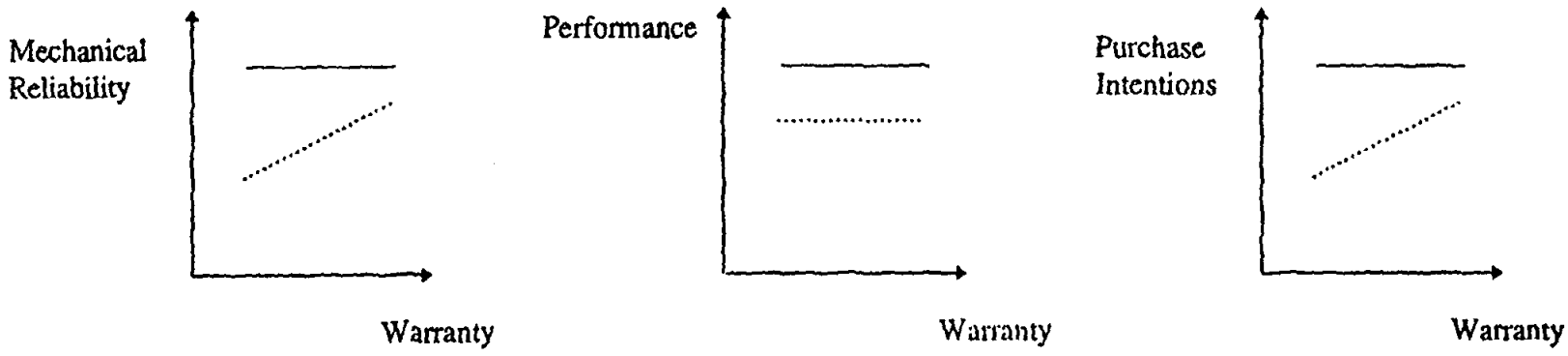
	Similar Extension (Fax)		Dissimilar Extension (Bike)	
Dependent Variable	Low Warranty	High Warranty	Low Warranty	High Warranty
Mechanical Reliability	3.00 (1.01)	4.53 (1.27)	3.47 (1.73)	4.56 (1.40)
Performance	4.82 (0.79)	4.85 (0.79)	4.19 (1.21)	4.89 (0.99)
Purchase Intentions	3.86 (1.41)	4.12 (1.05)	3.22 (1.83)	3.06 (1.66)
n	18	18	18	18

Table 3
CELL MEANS (AND STANDARD DEVIATIONS): EXPERIMENT 3

	Reputable Brand		Reputationless Brand	
Dependent Variable	Low Warranty	High Warranty	Low Warranty	High Warranty
Mechanical Reliability	4.67 (0.90)	5.03 (0.99)	3.66 (1.23)	5.00 (0.80)
Performance	4.56 (0.48)	5.31 (0.49)	5.08 (0.76)	4.83 (0.89)
Purchase Intentions	3.93 (1.39)	5.19 (1.28)	3.31 (1.62)	4.38 (1.09)
n	15	16	16	16

Figure 1
HYPOTHESIZED RELATIONSHIPS: EXPERIMENTS 1 AND 2

A. Experiment 1: Reputable Brand



B. Experiment 2: Reputationless Brand

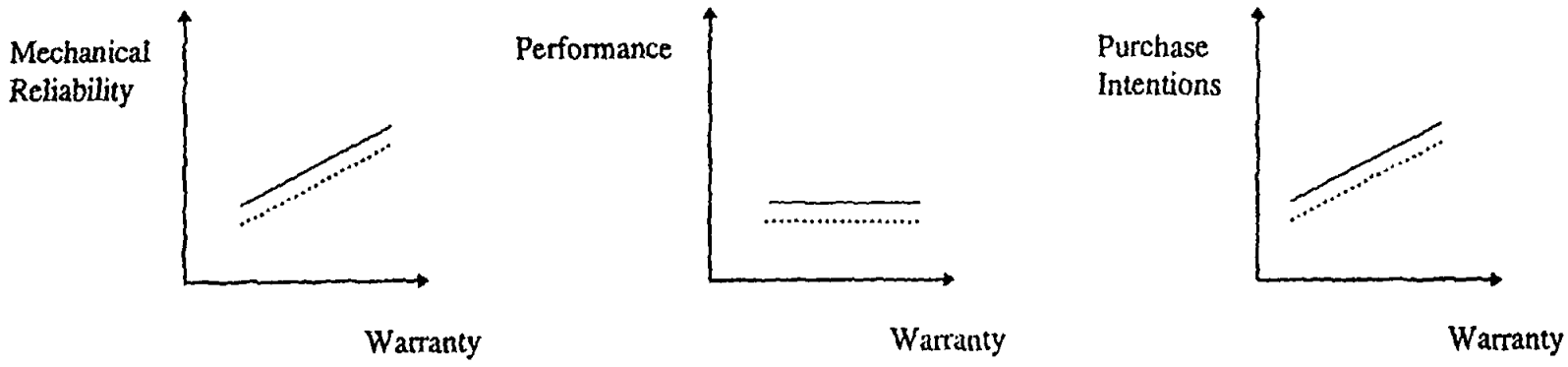


Figure 2
PRODUCT DESCRIPTION: EXPERIMENTS 1 AND 2

Brand Extension: Compaq Fax Machine

Note: Product features were rated by a panel of judges following independent laboratory testing. Ratings could range from 1 to 10 where 1 means extremely poor performance and 10 means extremely good performance.

About The Tests

Transmission speed: To gauge transmission speed we faxed 3 pages of single-spaced typed text in Fine (high resolution) mode over a phone line.

Reception: Tests centered on the machine's immunity to telephone-line noise, introduced gradually into a clear circuit.

Printing quality: We sent typed text and standard optical test charts to the fax machine, then checked printouts. Ratings reflect printing quality.

Brand Name	Compaq
Current Product Category	Personal computers and accessories
New Product Category	Fax machines
Transmission Speed	8
Reception	8
Printing Quality	7
Design	9
Warranty	7 years Unconditional coverage of parts and labor
Price	$389

Figure 3
PRODUCT DESCRIPTION: EXPERIMENTS 1 AND 2

Brand Extension: Compaq Mountain Bike

Note: Product features were rated by a panel of judges following independent laboratory testing. Ratings could range from 1 to 10 where 1 means extremely poor performance and 10 means extremely good performance.

About The Tests

Gearshift protection: Tests examined the extent of dirt buildup and corrosion on derailleur and cables during usage on various terrains.

Off-road handling: Tests were performed on a variety of off-road terrains, and covered climbing, descending and quick turning.

Shock absorption: Tests were performed in a variety of on- and off-road conditions, including rocky surfaces.

Brand Name	Compaq
Current Product Category	Personal computers and accessories
New Product Category	Mountain bikes
Gearshift Protection	8
Off-road Handling	8
Shock Absorption	7
Saddle Comfort	9
Warranty	3 months Limited coverage, manufacturer's defects only
Price	$389

Figure 4
PRODUCT DESCRIPTION: EXPERIMENT 3

Press Release:

Compaq has announced a move to expand its product range to include fax machines in addition to the current line of personal computers and accessories. Company sources expressed confidence that users would find the product superior to other available models in terms of transmission speed, signal reception and printing quality. They're also counting on the product's sleek design to attract consumer attention. Initial plans are to introduce a single model at a suggested retail price of $389 with a 7 year, unconditional warranty covering parts and labor.

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