

# New Product Announcement Signals and Incumbent Reactions

The authors focus on NPA signals, which they define as new product announcements in advance of market introduction. They develop a set of hypotheses regarding incumbent reactions to NPA signals and test them in a field study among managers in the United States and the United Kingdom. The authors' findings provide a characterization of the factors affecting the likelihood of competitive response to NPA signals and suggest a set of managerial implications.

**W**e study how incumbent firms within a product category react to NPA signals from competitors. We define an NPA signal as an announcement or move that precedes an actual new product introduction. Additionally, although signals may be intentional or unintentional, our concern is with intentional NPA signals, that is, a competitor within the product category deliberately making an NPA. A deliberate NPA signal could be directed to various or multiple audiences, such as the trade, consumers, or competitors. We focus on announcements directed to competitors as one of the audiences.

We believe that an NPA signal directed at competitors is sent with the intent to influence competitive behavior. One dominant motivation for NPA signals is *preemption*. For example: Boeing's preannouncement of the 787 was interpreted by industry analysts as a preemption of a product/market position, namely, the 650 passenger aircraft market (*Business Week* 1993). Similarly, Microsoft's preannouncements of software could be considered as preemptive, and competitors have claimed that Microsoft's NPA signals are unfair, because it sometimes has not developed the software at the time the preannouncement occurs (Clark 1995). Similarly, Schmalensee (1978) found that preemption using multiple brands in product space was instrumental in blocking the entry of new cereal products to the United States cereal market. Alternatively, the intent of an NPA signal could be to encourage competitors to react, thus, "revealing their hand," that is, the results of the competitor's new product development efforts. The signal initiator may then be able to use this information to advantage in market entry decisions.

An NPA signal could also be sent for *cooperative* purposes. For example, an NPA signal could be sent as a means of seeking alliances or encouraging complementary product design, such as in the computer industry, in which it is nec-

essary to encourage software development to accompany the introduction of new hardware (Rabino and Moore 1989). NPA signals may also encourage competitors to follow a particular product standard. Compatible designs are particularly desirable in industries, such as telecommunications and information systems, that are subject to network externalities, that is, in industries in which there are scale economies that arise from the demand side of the market (Farrell and Saloner 1986; Gilbert 1992). Compatible designs increase the potential value that consumers can derive from the product category. Competitive signaling battles over dominant designs are not uncommon, including the current conflict between Sony and Toshiba and their partners over the next generation of multimedia disks (Nakamoto 1995). Earlier battles included Sony's Betamax versus Matsushita's VHS and audio cassettes versus 8-track tapes.

Whereas a rich stream of theory and research exists on signaling (mostly in economics and using a game-theory paradigm), little research and theory is performed related to competitive NPA signaling. The seminal work of Spence (1974), for example, concerns educational signals in the employment market. Other important foundations of signaling theory include Milgrom and Roberts' (1982a) model of limit pricing, in which firms adopt predatory pricing behavior to signal a reaction to a future potential entry, that is, to deter entry. Moore (1992) has shown that price signals and moves influence competitive behavior in an experimental prisoner's dilemma research framework. Other signaling work examines both advertising and price as product quality signals (Bagwell and Riordan 1991; Cooper and Ross 1984; Dawar and Parker 1994; Kihlstrom and Riordan 1984; Milgrom & Roberts 1986; Nelson 1974) and the effects of new product and technology signals on stock prices (Chaney, Devinney, and Winer 1991; Wittink, Ryans, and Burrus 1982; Woolridge and Snow 1990). Research on signaling has also examined buyer-seller relationships (Banks and Sobel 1987; Cho and Kreps 1987; Engers 1987; Farrell and Saloner 1986) and distribution channel interactions (Davis 1990; Desai and Srinivasan 1995; Seshadri 1990). Although this literature constitutes a valuable source of ideas for research, it is not explicitly related to competitive behavior nor to NPA signaling.

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Similarly, whereas extensive literature exists on innovation in economics, strategy, and marketing, only recently has research focused on competitive reactions to innovation. This research has been stimulated partly by the analytical work of Hauser and Shugan (1983), which specifies profit maximizing defensive strategies to new product entry. Much of this research base utilizes PIMS (Profit Impact of Market Strategies) or other existing data bases or secondary sources (Chen and MacMillan 1992; Gatignon, Anderson, and Helsen 1989; Ramaswamy, Gatignon, and Reibstein 1994; Robinson 1988). Eliashberg and Robertson's (1988) and Heil and Walters's (1993) studies focus explicitly on NPA signaling, utilizing surveys with managers.

An alternative audience for signals is consumers, though here it is not our concern. The topic of NPA signaling to consumers has been discussed in the literature, usually under the heading of product preannouncements. Arguments have been made that preannouncements may be important to the success of new products. For example, Wind and Mahajan (1987) argue for the use of "marketing hype" in the new product introduction process to improve the chances of a successful launch. They suggest creating a favorable marketing environment for the introduction of the product by using a set of prelaunch activities (including preannouncing). Favorable commentaries in publications, such as the *Wall Street Journal* and trade journals, generate awareness and credibility that can be used later as a promotional tool (Rabino and Moore 1989). Farrell and Saloner (1986) show that for markets with significant network externalities, a preannouncement can secure the success of a new technology that might not otherwise be adopted if the new product signal were not sent. Eliashberg and Robertson (1988) take the viewpoint of the signal sender to examine the rationale for preannouncing new product introductions to consumers and identify conditions that favor such strategic behavior.

## The Research Problem

Our purposes are (1) to provide empirical data to explain and predict competitive reaction to NPA signals and (2) to specify an initial set of variables affecting signal reaction propensity. Advancing the knowledge base regarding competitive signal reaction has managerial significance for new product launch strategies. In particular, firms introducing new products may gain direction as to whether NPA signals to competitors are advisable in terms of the expected competitive response and depending on such factors as industry characteristics and the type of signal envisioned.

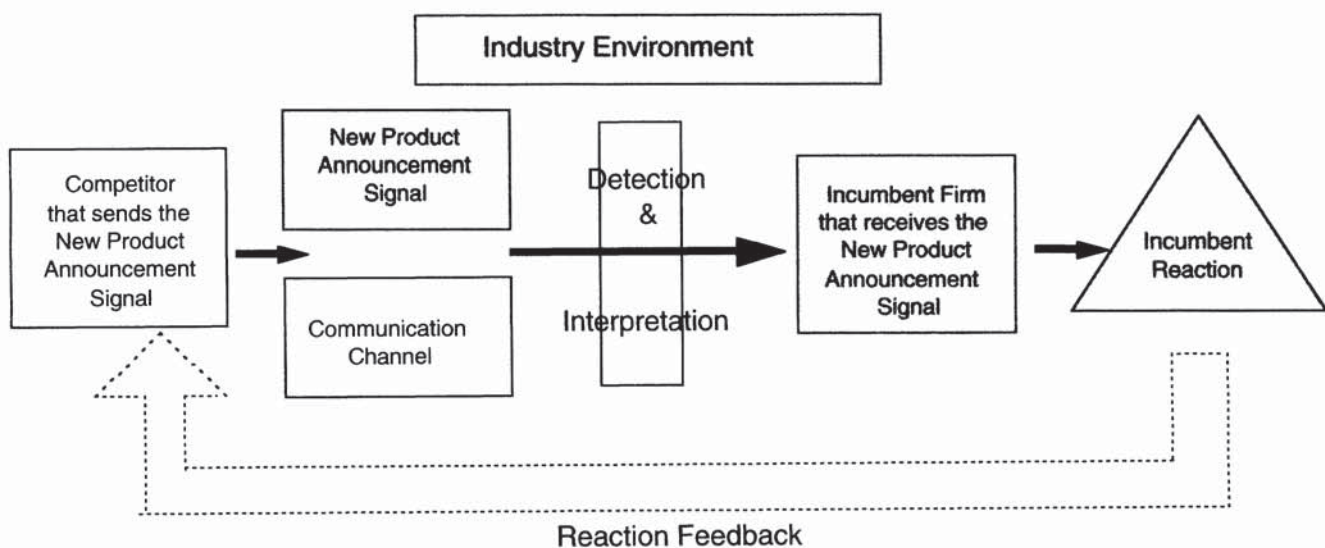
Figure 1 illustrates our approach. Our data are derived from the vantage point of the signal receiver, who acknowledges receiving an NPA signal. We study the receiver's reaction to the NPA signal as a function of the signal's characteristics, the receiver's characteristics, and the characteristics of the industry environment (see the shaded boxes in Figure 1). We do not study the signal sender's characteristics or the characteristics of the communication channel. Furthermore, we do not study the process of detection and interpretation or the feedback loop to the sender.

Thus, the dependent variable of interest is the receiving firm's reaction. After the reception of an NPA signal, there are four major potential outcomes. The receiver can:

1. Decide not to react.
2. Decide to wait and see what happens before reacting.
3. Send a counter signal.
4. Take an action.

If the firm decides to *send a counter signal*, it can issue a signal regarding the pending introduction of its own new product, or signal back another potential action. If the firm decides to *take an action*, it can introduce its own new product, or take another marketing action. Taking or signaling

FIGURE 1  
New Product Announcement Signaling Paradigm



Shading indicates the foci of our attention in this study.

other actions could involve moves in terms of advertising, channels of distribution, salesforce, new market entry, modification of the existing product, and/or pricing. Reactions can also be characterized in terms of their aggressiveness and speed.

To explain these patterns of signaling reaction, we posit a limited set of variables derived from the signaling literature. We first examine characteristics of the signal: How hostile is the signal? How credible is it? Next, we examine the receiving firm's level of fixed commitments in the product category. Then, we consider the level of patent protection within the industry. The combination of these variables with the dependent variables leads to a number of hypotheses as specified subsequently. We recognize that other potentially relevant variables are not included, but have relied on the extant literature and pilot research to specify what we consider to be the most justifiable variables for study.

### **Signal Hostility**

NPA signals vary in terms of their hostility. Heil and Robertson (1991, p. 410) suggest a positive relationship between signal aggressiveness ("threatening the receiving firm's livelihood") and speed and magnitude of reaction. In an empirical test of this proposition, Heil and Walters (1993, p. 57) have confirmed that "hostile" signals ("overly self serving") engender stronger competitive reactions.

The relationship between perceived signal hostility and level of reaction can be seen in two industry examples. In the first example, Mansfield (1990) provides the following illustration of a non-hostile, competitive signal. When Timex announced its impending entry into the watch industry, its strategy was (1) to produce a watch that was so cheap that customers likely would not have it repaired and (2) to sell it in drug stores rather than jewellery stores. The Swiss watch makers, who dominated the industry at that time, did not view this strategy as hostile because it did not affect their position as the leading producers of high-quality watches that were sold through traditional jewelery store channels. No particular competitive reaction occurred in this context. The Swiss watch industry did not react until many years later when it introduced Swatch after watches from Japan and Hong Kong had captured the dominant share of world demand, and, even then, the innovator was a non-Swiss executive.

In contrast, IBM's advance announcement of its enhanced OS/2.2 operating system for personal computers was read by Microsoft as a major and hostile challenge to its dominance in PC (Personal Computer) operating systems. Microsoft responded by preannouncing Windows NT (New Technology), which limited IBM's sales of OS/2.2 after its market introduction. Interestingly, Windows NT was then late to enter the market and underwent various transformations and name changes. The current product is Windows 95. The software industry's habit of preannouncing "vaporware," namely, software products that do not yet exist and are unlikely to be launched soon, is a significant issue of contention and a possible antitrust problem (Clark 1995).

It has been generally acknowledged that hostile signals encourage aggressive responses (Jervis 1976). MacMillan,

McCaffery, and Van Wijk (1985), for example, found that the more a competitor's actions attacked a firm's existing position, the quicker the firm responded. Smith and colleagues (1989) document a similar finding among high technology electronics firms: The greater the perceived threat, the shorter the response time. Chen, Smith, and Grimm (1992) confirm a comparable finding in the airline industry—the attack intensity is a salient predictor of response.

Reaction to a competitive signal also seems to depend on the receiver's attribution of whether harm was intended. The signal receiver will be more likely to react if it believes that the sender intends harm, regardless of how much harm actually occurs. Thus, reaction may derive more from an attribution of hostility than from the likely consequences (Dyck and Rule 1978; Jervis 1976; Taylor, Shuntich, and Greenberg 1979). Also, if the signal receiver believes the aggression to be under the sending firm's control, rather than beyond its control, a more forceful reaction is likely (Baron and Byrne 1984).

Research also suggests that cooperative signals elicit cooperative responses and that competitive signals elicit competitive responses. Experimental results by Axelrod (1984) have been particularly supportive of this view of cooperation, or "tit-for-tat" strategy. In a simulation involving diverse strategies, tit-for-tat emerged as the preferred strategy. The expectation is that competitors will react in kind; for example, an aggressive pricing move will encourage a matching move; an aggressive NPA signal will encourage a matching announcement. In particular, tit-for-tat suggests that complying with a cooperative move on the same dimension at the beginning of an interaction with a competitor can sustain cooperation throughout and benefit all participants. Recently, Moore and Moore (1990) have shown in experimental game-theoretic research that cooperation rates increase as the probability of continued play increases. Moore (1992), in a game-theory experiment on pricing, has shown that cooperative moves increase cooperation later in the interaction. This suggests, perhaps, that cooperation is most likely to be successful in mature industries or industries in which the competitive set is reasonably constant.

H<sub>1</sub>: The higher the perceived hostility of an NPA signal, (1) the more likely there will be a competitive reaction, (2) the more aggressive the reaction, and (3) the more likely the reaction will be on the product dimension.

### **Signal Credibility**

The perceived credibility of a signal seems to be a significant factor affecting whether competitors who receive the signal are likely to react, because not every announcement is executed (e.g., Chen and Miller 1994). And, of course, the credibility of a signal is subject to interpretation. For example, when Boeing signaled that it was considering building a 650 passenger aircraft, the question was whether Airbus should react. Was Boeing's signal credible or, as *Business Week* (1993, p. 32) mused, "a bluff to preempt Airbus from forging ahead with a similar plane. After all, why would Boeing want to launch a competitor to its own 400-seat 747?" The potential credibility of the NPA signal subsequently increased when Boeing created a partnership with

Deutsche Aerospace to conduct a feasibility study, and Airbus did eventually react by announcing plans for a similar plane, the 3XX.

Credibility is a two-dimensional construct. The receiver's assessment of signal credibility is a function of (1) the sender's reputation and (2) the potential reversibility of the signal. Reputation, as noted by Weigelt and Camerer (1988), becomes important in an incomplete information environment when the signal receiver is not certain of the sender's pay-off. The attribution of reputation by the receiver is based on the consistency of the other firm's actions over time and the fulfillment history of its prior signals (Heil and Robertson 1991). Signals from a firm that has fulfilled its prior signals in a consistent manner are more likely to be judged as credible. Fombrun and Shanley (1990) advance the proposition that reputational status within an industry influence rivalry and that, if firms value their reputations, they are less likely to engage in unacceptable activities. In an example of reputation effects, Milgrom and Roberts (1982b) have shown that developing a reputation for aggressive responses (consistent fulfillment over time) will deter further new entrants.

The second dimension of credibility—the irreversibility of the commitments that the signal sender has made—may have multiple indicators for an NPA signal, including tangible investments in plant and equipment, contracts with suppliers or customers, and agreements with the trade (Mansfield 1990; Porter 1980; Staw 1981). In international relationships, Schelling (1960) notes that irreversible commitments constitute signals of impending actions that are unlikely to be revoked. Research by Chen and MacMillan (1992) has demonstrated that in cases of high irreversibility, the propensity to respond increases.

It is our expectation that the perceived credibility of an NPA signal will affect the likelihood of reaction. Credible signals are more likely to be considered seriously and, hence, generate competitive reactions. Additionally, though NPA signals are not always threatening, they often are, particularly within our focus on the receipt of a signal from a competitor involving a "substantial" innovation. We recognize that some NPA signals could be oriented toward establishing industry standards or inviting new competitors to help build primary demand. However, in most cases, the signal of a new competitive product, if credible, is threatening to an incumbent firm in and of itself. Whether the incumbent firm also perceives it to be aggressive is a separate issue. Thus, we further anticipate that credible NPA signals will generate aggressive reactions.

H<sub>2</sub>: As the perceived credibility of an NPA signal increases, (1) the more likely there will be a competitive reaction and (2) the more aggressive the reaction.

Our discussion of the predictor variables has, to this point, focused on the characteristics of the NPA signal. The signal, however, is inextricably bound to the sender, and the receiver's evaluation of aggressiveness and credibility is based not only on the discrete signal, but also on an implicit consideration of the signal sender and its history of prior signals.

## **Receiver's Fixed Commitments**

We now turn to the receiver's characteristics and, particularly, to the receiver's fixed commitments in the product category. We first anticipate that a high level of fixed commitments will be associated with a greater propensity to react to competitive signals. As Porter (1980, p. 100) notes, "Commitment can guarantee the likelihood, speed, and vigor of retaliation to offensive moves...." Research by Chen, Smith, and Grimm (1992), based on airline industry secondary data, supports this view. They find that market dependence is pervasively and significantly associated with competitive response.

The logic of fixed commitments is that they will engender a defensive posture. This is shown in the Dixit (1980) model of credible entry deterrence; investment in sunk capital raises the incentive for an incumbent to take a more competitive posture towards potential rivals. Thus, we expect that NPA signals, with high fixed commitments, will be associated with competitive retaliation. Some indirect empirical support for our hypothesis can be found in the PIMS-based research of Robinson (1988), which found that reactions are more likely when the incumbent is dependent on sales from that market.

Market dependence seems to be associated with the firm's investments and commitments in that product category. Chen, Smith, and Grimm (1992) confirm market dependence to be a significant predictor of reaction in the airline industry. However, they add an interesting subtlety (p. 450): If competitors' key markets are "strongly threatened," the speed of response is slower. "This result suggests that competitors who have a large stake tend to signal their displeasure by offering responses, yet they do so by taking slow and cautious counteractions, presumably to avoid escalating retaliation" (Chen, Smith, and Grimm 1992, p. 452). In a more recent study, Chen and Miller (1994, p. 89) provide empirical support to the related claim that "the greater the centrality of the markets attacked, the greater the number of retaliatory responses" when the centrality of the attack is viewed as "the extent to which it pertains to markets that are especially large, valued by, or vital to potential responders."

Thus, we anticipate a greater proclivity to react to an NPA signal under conditions of high fixed commitments in the product category. Additionally, we expect that high fixed commitments will bias firms toward reacting using alternative marketing mix instruments. The structure of commitments may limit the firm's ability to make product changes and will mitigate its desire to make product changes that would raise costs and potentially disrupt the product line and the product migration strategies being pursued. Of course, the tendency not to react on the product dimension, or the inability to do so, may eventually destroy competitive advantage (Cooper and Schendel 1976; Ghemawat 1991), but that scenario is beyond the bounds of our present research design.

The relationship between fixed commitments and aggressiveness of reaction is less clear. In fact, whereas Porter (1980) advocates a positive relationship, Chen, Smith, and Grimm (1992) suggest a negative relationship because reaction will be slower. Thus, although we will examine the re-

relationship between fixed commitments and aggressiveness of reaction in our analysis, we will not offer a directional hypothesis.

H<sub>3</sub>: The higher the level of fixed commitments that the receiver has made in the product category, (1) the more likely there will be a competitive reaction to an NPA signal and (2) the more likely it will involve a marketing mix instrument other than product

## Patent Protection

The role of patents is a generally neglected focus in the research literature within marketing. Yet, the existence and relevance of patents within an industry may constitute a potentially interesting variable affecting the likelihood of competitive reaction to NPA signals.

Patents are generally thought of as a barrier to entry (Porter 1980) and their very purpose is to create a temporary monopoly for the patent holder as a reward for the time and money invested in the technological invention and innovation (Tirole 1988). If a patent holder can achieve a broad patent (i.e., a wide scope of coverage that increases how different a competitor's product must be) with long life (i.e., an extended period of protection), then the high imitation costs might be expected to discourage competitive entry (Comanor 1964; Gallini 1992; Gilbert and Newberry 1982). However, as Scherer and Ross (1990, p. 624) conclude, "The protection provided is often weak because there can be many viable solutions to a technical problem, so other firms can 'invent around' a given patented solution. Individual patents that solidly protect a ... technology are rare...." Empirical data also suggest that executives and research and development (R&D) directors do not necessarily regard patents as an effective blocking mechanism. Research by Levin and colleagues (1987), among a range of executives, indicates that patents are less important than prime mover advantage, experience curve effects, or sales/service infrastructure in appropriating new product benefits. Mansfield (1986) found that only about 14% of inventions would not have been developed in the absence of patents.

It is our contention that in industries characterized by high patent protection, there will be a sensitivity to NPA signals from competitors. This sensitivity is enhanced by the public nature of patents and the oligopolistic character of those industries which tend to be most characterized by patents. Competitive signaling seems to be more relevant in concentrated (oligopolistic) industries in which firms feel a strong sense of interdependence, and when gains for one firm injure its competitors (Moore and Urbany 1994). Scherer and Ross (1990) have shown that industries characterized by high R&D (e.g., drugs, electronics, aircraft, semiconductors) and, by implication, high patents, are highly concentrated.

We hypothesize that in industries characterized by high patent protection, reactions to NPA signals will not only be more likely but will also be more aggressive. Companies that are sensitive to each other's moves are unlikely to allow any advantage for a competitor. Furthermore, these reactions are more likely to be on a marketing mix instrument *other*

*than the product* (e.g., pricing, salesforce allocation, distribution channel initiatives), which are likely to have higher elasticities (Gatignon, Anderson, and Helsen 1989). Game theoretic-based modeling by Rasmusen (1989) suggests that product responses may not always be optimal because the revenues expected from the old technology may exceed the net gain expected from the new technology. If patent protection is high in an industry, the net gains received from implementing additional new patents (i.e., introducing new products) are likely to decrease. Hence, incumbent firms may choose not to implement their product discoveries ("sleeping patents").

The industrial organization and management literature has been successful in identifying reasons why incumbents often fail to enter early into new technical fields (e.g., Arrow 1962; Cooper and Schendel 1976; Hannan and Freeman 1984; Reinganum 1983; Tushman and Anderson 1986). Ghemawat (1991), for example, describes a case in which market incumbency led to technological inertia: AT&T in the private branch exchange (PBX) industry lost its market to new entrants that developed an unprecedented innovation. AT&T, a well established and strong competitor, and two other existing companies, Rolm and Northern Telecom, were surpassed by new players who innovated into the new technological subfield of voice-and-data PBXs in the early 1980s. The lack of AT&T's competitive response was explained by Ghemawat (1991) as being due to a fear of cutting into the sales of existing products, also termed self-cannibalization. Reinganum (1983) provides the theoretical support for this phenomenon by showing that an established competitor, who may have been protected by a patent for a certain period of time, invests less than a new entrant, if the entrant develops a sufficiently revolutionary innovation (and the process of invention is stochastic).

Thus, when threatened by a competitor in an industry characterized by high patent protection, we hypothesize that the incumbent will protect the revenue base for the existing technology by reacting aggressively on alternative marketing mix instruments.

H<sub>4</sub>: As the level of patent protection in the industry increases, (1) the more likely there will be a competitive reaction to an NPA signal, (2) the more aggressive the reaction, and (3) the more likely the reaction will be on a marketing mix instrument other than product.

Our hypotheses are summarized in Table 1.

## Methodology

Our research methodology seeks to explain competitive reaction to NPA signals and test the relationships that have been hypothesized. Our study is based on a field investigation. This primary data collection method—survey methodology—complements analytical models, as well as secondary data sources (e.g., PIMS), which have been the dominant research paradigms in the literature on competitive reaction until now.

The questionnaire employed in our study was developed over an extensive time period on the basis of two pilot studies and a mail pre-test. We conducted the pilot studies with

**TABLE 1**  
**Hypotheses Regarding Reaction to NPA Signals**

Variables	Hypothesis	Relationship to Whether a Reaction Occurs	Relationship to Level of Reaction Aggressiveness	Likelihood of Reacting Along The Product Dimension Versus Using Other Marketing Instruments
Signal Hostility	1	+	+	+
Signal Credibility	2	+	+	**
Receiving firm's fixed commitments in product category	3	+	*	-
Industry patent protection	4	+	+	-

+A positive relationship is hypothesized.

-A negative relationship is hypothesized.

\*A formal hypothesis is not offered because of conflicting arguments.

\*\*No relationship is hypothesized.

executives in management development programs. With the first group, we lectured on signaling and then set forth our hypotheses for discussion and modification. With the second group, we pretested our preliminary measures and sought feedback on questionnaire wording. The result of these pilots helped to introduce a sense of reality in guiding the research process. The mail pretest allowed us to refine measures and develop methods for improved response rates—especially because of the sensitive nature of the questions being asked.

### Sampling

The sample was drawn from a commercially purchased mailing list of directors of marketing within the United States and the United Kingdom. The choice of the two countries was based on the locations of the authors. The available list encompassed over 10,000 names from which we randomly drew 2010 names (1310 in the United States and 700 in the United Kingdom). After deleting inaccurate addresses and titles, the realized sampling frame was 1554 (1034 in the United States and 520 in the United Kingdom). We excluded wholesale and retail services and small firms (less than \$50 million in sales). We eliminated small firms to limit the range of data for analysis purposes. We excluded wholesale and retail services to avoid the need for separate questionnaire versions for these types of services. Nevertheless, a reasonably broad range of consumer and industrial product industries was surveyed.

The sampling procedure was to mail an advance letter that informed managers about the forthcoming survey and asked for cooperation. The mail questionnaire followed one week later. The incentives for completion were to “further knowledge” and receive a copy of the tabulated (and anonymous) results. The resulting sample size was 346 usable questionnaires (241 from the United States and 105 from the United Kingdom). The United States response rate was 23.3% and the United Kingdom’s was 20.2%. Although the rates of response are not high, they are well within the range of typical rates for industrial marketing research field studies reported in the literature (Achrol and Stern 1988; Anderson, Chu, and Weitz 1987; Gatignon and Robertson 1989; Heil and Walters 1993; Puto, Patton, and King 1985; Sujan

1986). It is possible that the competitive context of the study mitigated achieving higher response rates.

An examination of the industries represented by respondent firms aligned closely with the sample composition and included business equipment, business supplies, chemicals, consumer products, electrical products, financial services, pharmaceuticals, textile and paper, and telecommunications. A test of early versus late respondents failed to reveal any major differences by industry. Thus, there does not seem to be evidence of a non-response bias.

To ascertain that the respondents were indeed legitimate key informants, that is, informants qualified to provide valid information, we limited the list to marketing directors for both the United States and United Kingdom industries. We also asked each respondent for an evaluation of how much responsibility he or she has for reacting to signals. Most respondents indicated “major responsibility” (62%). The remainder included in the analysis answered “some responsibility” (33%). Those who indicated “no responsibility” (5%) were eliminated from the analysis. Thus, we have reasonable confidence that the respondents were indeed key informants (Campbell 1955).

### Measurement

We asked respondents to consider the last NPA signal that the firm received, which was defined as “a deliberate competitive preannouncement in advance of market introduction.” We also asked respondents to limit consideration to new products that were “significantly different from existing products in the category.” This restriction was to heighten the significance of the competitive threat. We believed that respondent recall problems would be severe for incremental innovations from competitors.

The questionnaire incorporated items to measure the perceived hostility and credibility of the signal that was received, the level of the receiving firm’s fixed commitments in the product category, and the level of industry patent protection. Items also assessed whether and how the respondent’s firm reacted to the signal. These data allowed us to test the hypotheses regarding reaction propensity. The questionnaire items also measured other aspects of the reaction in terms of its aggressiveness and the marketing mix instru-

ment utilized, that is, it measured a like response on the same variable (i.e., new product) or on a different variable (e.g., increased advertising).

To test the hypotheses, a set of multiple-item measures was developed for each construct. These measures were refined at the pilot and pre-test phase and then again on the basis of the final data. The pilot phase encompassed two sequential initiatives with executives participating in management development programs, one of which involved completing an early version of the questionnaire. We used these initial data (and an oral debriefing of respondents) to help finalize the list of variables of interest, the length of the questionnaire, question wording, and question flow. To arrive at the composition of the specific constructs, the final variables employed were based on a procedure that involves Varimax-rotated principal component factor analysis in conjunction with Cronbach's coefficient alpha (Lord and Novick 1968). A comparison of the United States and United Kingdom factor analysis results showed parallel profiles and loadings of items.

We provide the final constructs, together with the number of items (6-point scales) measuring each construct, the coefficient alphas, and the questionnaire items in the Appendix. (The actual questionnaire is available from the authors upon request.) These reliability measures generally compare favorably with the .70 or higher desired value in exploratory research (Nunnally 1978). An analysis of the correlation matrices showed generally low correlations among the independent variables, reaching as high as .22 in only one instance.

We conducted Chow tests (Chow 1960) for poolability of the United States and United Kingdom samples on each of the dependent variables (regressed on the independent variables). The Chow test is an Analysis of Variance test to determine the stability of the parameters between the two populations that generated the two data sets. In all cases (three dependent variables), the null hypothesis that there were no differences in the parameters and that the two data sets were poolable was accepted. The subsequent analysis, therefore, is based on the pooled United States and United Kingdom data.

We note that, though the study was conducted in two countries, we did not postulate intercountry differences. We assume Farley and Lehmann's (1994) viewpoint that the ability to generalize internationally about the factors affecting market response could be of substantial value for designing marketing programs. In their meta-analysis, they find that, whereas there are international differences, they are "not systematically larger than differences due to market environments studied or due to technical characteristics of the models" (p. 120). Similarly, Kumar, Scheer, and Steenkamp (1995), in their research on supplier relations in the United States and Holland, test for generalizable results across countries rather than positing intercountry differences.

### **Analyses**

We test the hypotheses using discriminant and regression analyses. Two-group discriminant analysis is used to sepa-

rate reactors from non-reactors and reactors in the same domain from reactors in different ones. We use regression analysis to establish a relationship between the aggressiveness of the signal reaction and the corresponding set of predictor variables.

## **Results**

To provide some background for the context of our research, we begin by exploring some baseline descriptive data about the phenomenon of NPA signaling and comparing the United States and United Kingdom response patterns. Table 2 addresses the following questions:

- How often were NPA signals received by the firms in our sample?
- From where did these signals emanate—and by what medium of communication?
- What percentage of firms reacted to the signals they received?
- What marketing mix instrument was used to react—a product reaction or another instrument, such as advertising?
- How aggressively did firms react to NPA signals?

Approximately 40% of the firms in our sample acknowledged that they had recently recognized an NPA signal from a competitor. An interesting question is whether other firms that did not report signal reception actually failed to receive signals because none were transmitted by competitors or they were less sensitive to transmitted signals and, therefore, failed to receive them. We have no way of ascertaining the "truth" utilizing the present data set. The United Kingdom managers were more likely to receive NPA signals than the United States managers (46.7% versus 36.5%). However, the pattern of how signals were received is remarkably similar between the two countries. The dominant communication sources were press announcements and trade journals; trade shows, speeches, and word-of-mouth were of much less importance. Alternatively, approximately one-third of the signals were in media reaching broader audiences (including, perhaps, customers, distributors, and shareholders), whereas approximately one-half of the NPA signals were in more specialized media, perhaps aimed more directly at competitors.

Of the firms that acknowledged receiving an NPA signal, one-half responded. Again, there is variation by country: 46.6% of United States firms reacted versus 57.1% of United Kingdom firms. The nature of the reaction is documented in Table 2. The most prevalent response was to introduce a new product (42% of the pooled sample). The second most common response was to take an alternative marketing action (33.3% of the pooled sample), such as lowering price or increasing advertising. The less frequently employed responses were signaling a new product by issuing an announcement (21.7%) and signaling an alternative marketing action (2.9%), such as lowering price or increasing advertising.

Thus, most responses (75.3%) involve taking some sort of a competitive reaction, whereas a minority (24.6%) involve reacting by signaling. Also, most responses (63.7%) involve a new product-based move (retaliation), though 36.2% of respondents did respond by utilizing an alternative

marketing mix instrument. Previous research by Robinson (1988) on entry by start-up firms in established product categories found reaction on another element of the marketing mix to substantially outweigh reactions on product, but the context of Robinson's research (new *firm* entry) is different from new *product* entry. Robinson also found that firms were unlikely to react to new entrants (start-ups), whereas we find that 50.4% of firms receiving NPA signals react in some manner, either with an action or a signal. Thus, it may be that although incumbents are not likely to react to new start-ups, perhaps because of the inherent uncertainty and lack of resources of such businesses, they are likely to react to NPA signals, which usually come from established firms.

As to the aggressiveness of reaction, managers responded to a five-item measure characterizing their firm's reaction (e.g., "It was a reaction to try and take advantage of our competitor" and "It was a reaction designed to indicate our dissatisfaction with the competitor's announcement"). The mean level of aggressiveness was 14.9 (range from 5 to 30) and this was somewhat similar between the two countries (14.2 in the United States and 16.1 in the United Kingdom).

### Predicting Reaction

Our analyses now focus on the specified variables that account for whether a reaction occurs to an NPA signal and what the pattern of the reaction is. We present group means for the independent variables in Table 3. Table 4 provides discriminant analyses results, and Tables 5 and 6 show clas-

sification results for the two dichotomous dependent variables: reaction versus non-reaction and reaction with a product versus reaction with an alternative marketing mix instrument, respectively. To assess the "goodness" of the classification, we compare the classification results against two criteria, as discussed by Morrison (1969):

1. The maximum chance criterion: The group with the greatest probability of occurrence.
2. The proportional chance criterion:  $C_{pro} = p^2 + (1 - p)^2$ ,

where  $p$  = proportion of individuals in Group 1, and  $1 - p$  = proportion of individuals in Group 2. The proportional chance criterion is more conservative than the maximum one, and Morrison recommends that in most situations  $C_{pro}$  should be used.

*Whether reaction occurs.* First, we sought to classify those firms that would react to an NPA signal from those that would not. We posited that four variables would be positively related to a reaction response: (1) the perceived hostility of the signal received, (2) the perceived credibility of that signal, (3) the receiving firm's level of fixed commitments in the product category, and (4) the level of patent protection in the industry.

Results (see Table 4) lend empirical support to three of the four hypothesized relationships. Based on the significance levels of the explanatory variables, competitors are most likely to react when the NPA signal received is per-

**TABLE 2**  
Baseline 'Descriptive' Results

	United States Sample	United Kingdom Sample	Pooled Sample
<b>Total Respondents</b>	241	105	346
<b>Reception of an NPA Signal</b>			
• Signal Receivers	88 (36.5%)	49 (46.7%)	137 (39.6%)
• Where did the signal appear:			
Press announcements	31.0%	34.0%	32.1%
Trade journals	29.9	19.1	26.1
Trade shows and conferences	10.3	12.8	11.2
Speeches	9.2	8.5	9.0
Word-of-mouth	5.7	4.2	5.2
Other	13.9	21.4	16.4
Total	100%	100%	100%
<b>Reaction to an NPA Signal</b>			
• Signal Reactors	41 (46.6%)	28 (57.1%)	69 (50.4%)
• Type of reaction:			
Introduced a new product	43.9%	39.3%	42.0%
Took another marketing action (e.g., lowered price or increased advertising)	34.1	32.1	33.3
Signaled a counter-NPA signal	17.1	28.6	21.7
Signaled an impending action on another marketing instrument (e.g., lower price)	4.9	0.0	2.9
Total Reactors	100%	100%	100%
• Aggressiveness of reaction	14.2 (range = 5 to 30)	16.1 (range = 5 to 30)	14.9 (range = 5 to 30)



**TABLE 3**  
**Group Means**

Variables	Signal Reaction		Marketing Mix Instrument Used to React	
	React	Did Not React	New Product	Another Marketing Mix Instrument
• Signal Hostility	11.43	10.21	11.31	11.64
• Signal Credibility	13.10	13.70	*	*
• Receiving Firm's Fixed Commitments in Product Category	16.34	15.39	15.97	16.88
• Industry Patent Protection <sup>a</sup>	10.43	11.98	11.31	8.92

<sup>a</sup>Note that the patent variable is reversed, that is, low values indicate high patent protection.  
\*No hypothesis specified.

**TABLE 4**  
**Discriminant Analysis Results**

Variables	Signal Reaction			Marketing Mix Instrument Other Than Product Used to React		
	Wilks's Lambda	F	Significance Level	Wilks's Lambda	F	Significance Level
• Signal Hostility	.9399	5.378	.02	.9974	.166	.69
• Signal Credibility	.9964	.472	.49	*	*	
• Receiving Firm's Fixed Commitments in Product Category	.9616	4.148	.02	.9571	2.87	.10
• Industry Patent Protection	.9718	3.749	.05	.9304	4.788	.03

\*No hypothesis specified.

**TABLE 5**  
**New Product Reaction: Classification Table**

Actual	Predicted		
	Reactors	Non-Reactors	Total
Reactors	43 64.2%	24 35.8%	67 (100%)
Non-Reactors	24 37.5%	40 62.5%	64 (100%)
Total	67	64	131 (100%)

Overall Correct Classification = 63.36% compared with  $C_{pro} = 50.01\%$  and  $C_{max} = 50.75\%$ .

ceived to be hostile (.02 significance level), the receiving firm has high commitments in the product category (.02 level), and the industry is characterized by the relevance of patents (.05 level). The classification matrix (see Table 5) shows evidence of reasonable predictive ability. The equation correctly classifies 63.36% of the sample compared to 50.01% using the proportional chance criterion and 50.75% using the maximum chance criterion.

Thus, we empirically confirm a prevalent finding and conventional wisdom that hostile signals trigger reactions. We also confirm that reaction is more likely if the competitor receiving the NPA signal has a high level of commitment to the product category. In addition, we provide empirical evidence (perhaps somewhat counterintuitive) that in indus-

tries characterized by the relevance of patents, competitive reaction to NPA signals is more likely.

*Marketing mix instrument.* Three variables were posited to account for whether reaction would occur on the product dimension or with another marketing mix instrument. It was expected that the perception of high signal hostility would be associated with a product reaction, but that high patent protection and high product category fixed commitments would be associated with a proclivity to react with an alternative marketing mix instrument.

Results (see Table 4) lend empirical support to the proposition that firms in industries characterized by high patent protection were indeed more likely to react with a marketing mix variable rather than with a product (.03 level). This is logically consistent with the short-term im-

pediments that patents erect against product initiatives. The posited relationship between the level of a firm's fixed commitments and its reaction with an alternative marketing mix instrument is marginally significant (.10 level). The posited positive relationship between signal hostility and reaction in the product dimension, however, is not confirmed. The correct classification using these three variables (see Table 6) is 63.64% versus 52.9% (proportional chance) and 62.2% (maximum chance).

*Reaction aggressiveness.* Finally, we use a regression analysis (see Table 7) to relate the firm's aggressiveness in responding to an NPA signal to the predictive variables. We posited that response aggressiveness would be positively associated with perceived signal hostility, signal credibility, and high patent protection in the industry.

These expected relationships are confirmed for both signal credibility and patent protection, but not for signal hostility. Thus, although hostile signals are likely to encourage reactions, they do not necessarily encourage aggressive reactions. The adjusted R<sup>2</sup> is .396, which suggests a moderate specification of variables affecting reaction aggressiveness. Additionally, although we did not specify a directional hypothesis, we tested the relationship of the firm's fixed commitments in the product category to reaction aggressiveness. The literature suggests contrary expectations, and our results suggest a lack of a significant relationship.

## Discussion

We have sought to add to the conceptual and analytical research base of competitive behavior and reaction to NPA signals by providing evidence from a survey of marketing directors. We also have provided some descriptive data on the incidence of NPA signal reception and reaction. We found that 39.6% of the firms in our sample acknowledged receiving an NPA signal from competitors. Of those who received a signal, 50.4% reacted. And of those reacting, 63.7% reacted with a product, whereas 36.2% reacted with an alternative marketing mix instrument.

How, then, do we interpret these levels of reaction? Our results can be contrasted with previous research on reaction frequency when an incumbent is faced with an actual new product entry. For example, Biggadike (1979), Yip (1982), and Robinson (1988) found that a lack of reaction is the norm. Robinson (1988) reports that 91% and 82% of incumbents from the PIMS's Start-Up Business database did not react in the first and second year, respectively, following new business entry. However, Bowman and Gatignon (1995) found that 60% of competitors in the total PIMS' data base did react when faced with a new product introduction, as opposed to a new firm entering the market. They suggest that reactions to new product entries are more common than reactions to start-up businesses because of the inherent uncertainty associated with start-up businesses, which reduces the incumbent's propensity to react. In a different domain, Heil, Morrison, and Walters (1994) documented that 95% of firms

**TABLE 6**  
**Marketing Mix Instrument Used To React: Classification Table**

Actual Reaction	Predicted Reaction		Total
	With Product	With Another Marketing Mix Instrument	
With product	25 61.0%	16 39.0%	41 (100%)
With another marketing mix instrument	8 32.0%	17 68.0%	25 (100%)
Total	33	33	66

Overall Correct Classification = 63.64% compared with  $C_{pro}$  = 52.9% and  $C_{max}$  = 62.2%.

**TABLE 7**  
**Regression Results on Aggressiveness of Reaction\***

Variable	Coefficient	Significance Level
Signal Hostility	.019	.869
Signal Credibility	.337	.004
Receiving Firm's Fixed Commitments in Product Category**	-.054	.649
Industry Patent Protection	.528	.000

R<sup>2</sup> = .666.

R<sup>2</sup><sub>adj</sub> = .396.

F = 9.39 (.000 level).

\*Note that reaction aggressiveness and patent protection are reversed; that is, low values indicate high reaction aggressiveness and high patent protection.

\*\*A directional hypothesis was not specified.

responded in some way when confronted with price reductions.

Thus, we tentatively conclude that competitive reaction propensity varies depending on the type of signal or competitive initiative. Incumbents are unlikely to react to new firms entering a market (Biggadike 1979; Robinson 1988; Yip 1982), but are as likely to react as not to a new product entry announcement (e.g., Bowman and Gatignon 1995) and are highly likely to react to a price reduction (Heil, Morrison, and Walters 1994).

We have sought to shed some light on three questions. When an incumbent is confronted by an NPA signal from a competitor, (1) what determines whether a reaction will occur? (2) what variables affect the aggressiveness of the reaction? and (3) what influences whether the reaction will be on the product dimension or with another marketing instrument?

First, we show a reasonable ability to discriminate between signal reactors and non-reactors. Our data support the posited relationship between high signal hostility and the occurrence of a reaction. Additionally, we found that reaction is more likely when the incumbent firm has high fixed commitments in the product category. The pattern that emerges is that firms with more "at stake" are more likely to react. We also found reactions to be more likely in industries characterized by higher levels of patent protection.

Second, we address the variables affecting aggressiveness of reaction. We found that aggressive reactions are more likely under conditions of high signal credibility. Credible signals seem to reduce uncertainty and lower the probability of signal misinterpretation. Thus, there is less risk of inappropriate reaction and more latitude for aggressiveness in response to what would usually be viewed as a threatening signal, namely, the introduction of a new product into the category, whether or not the signal sender issued the signal in a deliberately hostile manner. We also found that aggressive reactions are more likely in industries that have high patent protection than those with low patent protection, because competitors are more sensitive to each other's moves in patent rich industries, which are often oligopolistic, and less willing to allow momentum to shift to a competitor.

Interestingly, however, hostile signals, though encouraging reaction, are not likely to trigger aggressive reactions—possibly to limit escalation. This is consistent with the results of Chen, Smith, and Grimm (1992), who found a similar phenomenon in the airline industry. Finally, fixed commitments in the product category do not seem to be associated with less aggressive reactions as we had proposed.

Our results partially illuminate the issue of whether reaction will occur on the product dimension or with another marketing mix instrument. As hypothesized, firms in industries in which patents are highly relevant are less likely to react on the product dimension, perhaps because such firms are precluded by patents in the short-term and are more likely to react with alternative marketing mix instruments. Firms with high fixed commitments in the product category show a slight tendency to react with alternative marketing mix instruments, perhaps because these commitments favor product constancy in the short-term. However, hostile sig-

nals do not engender reactions on the product dimension, as might have been expected with a tit-for-tat logic. Perhaps, firms are more likely to react with marketing mix instruments with the highest elasticity (Gatignon, Anderson, and Helsen 1989), whether product or a non-product.

## Limitations

Before positing the managerial implications of our research and suggesting an agenda for further research, we set forth the limitations of our research. Although we deliberately selected a survey methodology to emphasize external validity, there are inherent limitations to the survey design. One possible shortcoming is its focus on only the signal receiver. Because we assess new product signaling behavior from the vantage point of the receiver, our research is potentially biased because we rely on the receiver's perception only. Two types of error are possible: (1) The receiving firm may perceive signals that do not exist or (2) it may fail to perceive actual signals (Coombs, Dawes, and Tversky 1970; Srinath and Rajasekaran 1979). It would be desirable to measure NPA signal incidence from the vantage point of the sender issuing signals and to determine whether they were received by the intended receiver. However, a research design to assess both vantage points has its own problems—it would likely be limited to a single cooperating industry, and there would be an issue of missing data when trying to match competitive dyads.

Another issue is that of sampling and non-response and the resulting existence or non-existence of bias. We did restrict the sample to exclude small firms (below \$50 million in sales) and wholesale and retail services. Thus, the sample is not fully representative of all business enterprises. It may also be that those managers most likely to respond are more sensitized to competitive signals and interplay. We also recognize that managers chose both whether to respond to the survey and for which competitive new product signal to provide data. Response rates can be increased, but at a cost in money and resources, and, therefore, a tradeoff is generally made. Here, our response rate is within the domain of other surveys with managers, but we recognize the inherent potential for non-response bias.

We also rely on a key informant data source. Multiple respondents within the firm might have more fully represented the decision process. Although we assessed the respondent's self-reported responsibility for reacting to signals, it is questionable whether the 33% of respondents who indicated "some responsibility" were adequately informed versus the 62% with "major responsibility." As noted previously, we eliminated those with "no responsibility." Results did not change with the more constrained respondent set so we chose to include the 95% indicating some or major responsibility. We also relied on managers' perceptions of signals rather than the incidence of actual signals. However, it is perception that drives behavior (or reaction) and, therefore, the vantage point of the signal receiver (or perceiver) seems to be the more salient perspective.

Another question, which poses possible problems of reliability, is whether respondents were able to accurately recall events. Additionally, the measures achieved reasonable,

but not very high, Cronbach alphas: Two of the measures fell below the desired .70 level. Finally, our results are limited to reactions to significant innovations and may not be generalizable to the range of possible new products varying from continuous to discontinuous innovations (Robertson 1971).

We acknowledge these limitations, yet believe that survey methodology is a useful component of the research methods arsenal. A further goal would be to test for a sense of convergence in findings among multiple methodologies or conduct a meta-analysis to more fully explain patterns of competitive signal reaction across different research settings.

## Managerial Implications

We characterize competitive NPA signals to be sent by a firm with the intent to convey or gain information from competitors on the basis of how they react. As such, the initiating firm makes announcements or moves before taking actual actions in the marketplace. In essence, NPA signals are an attempt to influence the competitive interplay.

The purposes of signals vary. For example, we might surmise that price increase signals are sent with the intent to encourage cooperative behavior. So too are signals regarding industry lobbying positions, such as the auto industry's signals regarding import restrictions or mileage-per-gallon guidelines. However, other signals may be sent with the intent to discourage competitors from following specific behaviors, such as capacity increase announcements.

NPA signals most often seem to be sent for preemptive purposes and with the intent to discourage competitors from following market behavior. However, there may be cases, such as the search for industry standards, the need to encourage complementary products, or the desire to affect primary demand using multiple players, in which the firm sends the signal for cooperative purposes.

Here, if we assume that NPA signals seek preemption, then the initiating firm may not be achieving its primary objective in the 50.4% of the cases in which a competitive reaction occurs. Thus, we could suggest that NPA signaling is inadvisable and might even be disadvantageous if it provided competitors with more time to react. Alternatively, value might have been gained by observing the incumbent's reaction, and the initiating signal may have caused the receiving firm to reveal its hand. The sender, then, could adjust its product and marketing strategy.

Another interpretation of the data, from a managerial perspective, is that NPA signals seem to generate competitive reactions disproportionately to competitive counter-signals; in other words, in 75.3% of the cases incumbents responded by taking an action rather than signaling a possible action. This could suggest that managers react with too much commitment to an NPA signal and miss the opportunity to exchange information using counter signals. Whereas an NPA signal is quick, "cheap," and reasonably flexible, actual moves may be slower, more expensive, and irreversible. We suggest that counter signals may be underutilized as a form of competitive reaction.

We now offer two suggestions to managers considering sending NPA signals. First, calculate the trade-off between the values of signaling and secrecy. Second, minimize competitive reaction, assuming that this is the objective. Secrecy presumes a different path to competitive new product preemption. Competitive secrecy has the intent of surprising competitors. Instead of signaling a future action, a firm preempts competitors by actually taking the action, thus, leaving competitors in disarray and unable to respond quickly.

There are a number of key assumptions that must be met if competitive secrecy is to be successful. First, it must be possible to keep the secret. This may be difficult and the difficulties increase as more parties are involved, such as suppliers and customers. For example, one manufacturer was secretly pursuing new product entry into the snack market, but its pending entry became known when competitors became aware from suppliers that the company had ordered specialized baking ovens. Second, pent-up demand is available. However, take-off in the diffusion process may not be rapid and it may be necessary to educate the market before new product introduction. If there are issues of product standards, this may also delay the realization of demand and negate the value of entering the market without advance warning. Third, competitors will not be able to react immediately. If they can, advantage is dissipated and there may be considerable risk in moving directly to an action rather than testing the potential action using signaling.

If the firm is committed to preemptive NPA signals, then it may be able to limit reaction by controlling the aggressiveness of its signals. Hostile signals seem to encourage reactions, though not necessarily aggressive reactions. There may be a prevailing logic in many product categories to limit escalation. Managers sending an NPA signal may want to adhere to the industry norm or level of signal aggressiveness.

The firm sending an NPA signal may also be able to limit reaction by limiting the credibility of the signal. Highly credible signals may be easily read by competitors, and, if a reaction occurs, it is likely to be more aggressive. Reducing the clarity and credibility of a signal might make interpretation more difficult and reaction alternatives less clear. This can be inferred from game theory research by Benabou and Laroque (1992), who showed that "noisy" (ambiguous) signals increase the receiver's learning requirements. Also, in international affairs, Jervis (1976) suggests that noisy signals increase the difficulty in signal interpretation, thus providing flexibility to the sender.

Finally, the sender should recognize that, under certain industry conditions, reaction is more likely, particularly if the receiving firm has high fixed commitments in the product category or if the industry patent protection is high. The role of patents is surprising, but seems to suggest that managers contemplating new product entry into such industries are likely to encounter a high likelihood of reaction. If the firm signals under these conditions, it should assume that a reaction will be forthcoming and only signal for the purpose of gaining necessary information from the type of response the incumbent firm makes.

## Future Research Directions

Our exploratory study on NPA signaling, we believe, had some success in classifying firms likely to react to NPA signals. Thus, we have identified a set of relevant independent variables and postulated their likely relationship to the signal reaction, aggressiveness of reaction, and type of marketing instrument used. However, the results are suggestive, rather than conclusive, and there are missing variables whose inclusion would have increased the ability to classify the behavior of firms regarding NPA signals.

A potentially interesting conceptual distinction regarding new product signaling could be pursued in further research. New product signals could be classified as *announcement* signals versus *introduction* signals. An NPA signal could be considered as an impending new product entry, whereas a new product introduction signal could be limited to an announced date of market entry. This would then lead to different expectations. For example, NPA signals might be more frequent and are more easily updated, more likely to encourage competitive counter signaling, and more subject to bluffing. New product introduction signals, in contrast, are more concrete, less reversible, and less subject to bluffing. Research utilizing this distinction might refine our understanding of new product signaling behavior.

Additional research could usefully consider reactions to other signals, such as price increases or decreases, new market entry, new distribution systems, and the likelihood of signal reception and reaction. Each type of signal is likely to engender a different pattern of behavior. Further conceptualization might also modify the set of relevant variables to enhance the predictive power of how firms react to competitive signals, perhaps by specifying unique variables likely to affect behavior for different types of signals.

Further research could also study additional dimensions of the signaling paradigm (Figure 1). The present data have been collected from the vantage point of the signal receiver and have studied reaction assuming receipt of a signal. It would be a further contribution to study factors affecting detection and receipt of signals in a competitive environment. It would also be interesting to study reaction as a function of the perceived characteristics of the sender. Finally, the research data could be collected from the signal sender's point of view (the opposite of our research perspective) and could study the motivations for NPA signaling and the perception of what constitutes successful signaling endeavors.

## Appendix

### Dependent Variables

*Reaction Propensity*—Key informant's report of whether a response was made to the competitor's signal.

*Reaction Aggressiveness*—5 items,  $\alpha = .69$

Please tell us how you would characterize your company's response.

1. A cooperative reaction toward our competitor.
2. A reaction to try and take advantage of our competitor.
3. An aggressive reaction.

4. An accommodative reaction.
5. A matching reaction.

*Reaction instrument*—Key informant's report of whether reaction took place:

1. By signaling a new product.
2. By actually introducing a new product.
3. By signaling a reaction on an alternative marketing mix instrument.
4. By taking an action on an alternative marketing mix instrument.

### Independent Variables

*Signal Hostility*—3 items,  $\alpha = .63$

Please describe for us the new product preannouncement signal that your firm received from its competitor.

1. It would have resulted in a harmful outcome for my firm.
2. My company perceived it as a threat.
3. It was an aggressive signal.

*Signal Credibility*—5 items,  $\alpha = .83$

Please describe for us the new product preannouncement signal that your firm received from its competitor.

1. The competitor's product preannouncement signal was very informative.
2. It was not very believable.
3. It was very unclear.
4. It was somehow deceptive.
5. It was a credible signal.

*Fixed Commitments*—3 items,  $\alpha = .76$

Please tell us about your firm's position in this product category.

1. My firm has significant plant and equipment dedicated to this product category.
2. My firm has a major investment in this product category.
3. My firm has a major commitment to this product category.

*Patent Protection*—3 items,  $\alpha = .85$

Please tell us about this product category by indicating how much you agree or disagree with the following statements:

1. There is opportunity for patent advantage in this product category.
2. Patents are irrelevant in this product category.
3. Very few patents exist in this product category.

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