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Forgiven But Not Forgotten: Covert Uncertainty in Overt Responses and the Paradox of Defection-Despite-Trust

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Despite the widespread belief that trust is a critical determinant of loyalty, empirical and anecdotal evidence calls into question the real-world robustness of the trust–loyalty link. An important reason for the fuzzy nature of the trust–loyalty link may be the fuzzy nature of trust itself. That is, stated trust judgments embody both a magnitude dimension (i.e., the position along a favorable-unfavorable continuum) and an uncertainty dimension (i.e., the lack of conviction with which the judgment is held). We investigated this possibility using data pertaining to consumers' reactions to a service failure and the provider's success in responding to their complaints. We found that the interplay between dissatisfaction with the complaint handling and past experience simultaneously influences trust magnitude and trust uncertainty. However, these two dimensions of trust are shaped by different underlying processes. Finally, uncertainty dampens the impact of stated trust on loyalty.

Consumer trust, defined as the consumer's expectations that a service provider can be relied on to deliver on its promises, is viewed as a critical antecedent of consumer loyalty (Dwyer, Shurr, & Oh, 1987; Moorman, Zaltman, & Deshpande, 1992; Morgan & Hunt, 1994). Dwyer et al. (p. 23) note that "it might be impossible to cover all contingencies in a formal contract for sustained cooperation, but if the parties have trust it may be unnecessary to cover all contingencies." Berry (1996, p. 42) concurs when he notes that "the inherent nature of services, coupled with abundant mistrust in America, positions trust as perhaps the single most powerful relationship marketing tool available to a company." Consider also the impact of the product and service failure that led to the termination of the relationship between Bridgestone/Firestone and Ford. As an executive of Gartner, Inc., observed, "In this divorce, customers won't trust either company and will simply find a new home for their automotive purchases" (Gartner, Inc., 2001).

In contrast to the widespread belief that trust invariably translates into positive relational outcomes, however, the association between trust and relational outcomes varies considerably. Several researchers have found direct effects of trust on various indexes of loyalty, including commitment and propensity to provide referrals (e.g., Anderson & Weitz, 1989; Ganesan, 1994; Verhoef, Franses, & Hoekstra 2002; Morgan & Hunt, 1994). In a recent meta-analysis, Geyskens, Steenkamp, and Kumar (1999) found that trust explained about 28% of the variance in commitment. Other studies, however, have shown only weak and nonsignificant effects of trust on relational outcomes, such as resource allocation, pur-

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chase choice, and increased levels of business (e.g., Anderson, Lodish, & Weitz, 1987; Doney & Cannon, 1997; Grayson & Ambler, 1999; Moorman et al., 1992). Likewise, consumers who state that they are satisfied or trust the organization frequently switch service providers (e.g., Jones & Sasser, 1995; Reichheld, 1996). For example, Reichheld (1996) notes that 65% to 85% of consumers who defect report prior to defection that they are satisfied or very satisfied. Similarly, a study for the U.S. Office of Consumer Affairs (Technical Assistance Research Program, 1986) found that in households with service problems, only 54% would maintain brand loyalty if their problems were satisfactorily resolved.

The mixed evidence for the role of trust in influencing loyalty raises an important question: What underlies the paradox of defection-despite-trust? To address this question, we study a frequently occurring situation in which trust assumes central importance: consumers' reactions to a failed service encounter. Many other possible antecedents of trust could of course be investigated (e.g., marketing communications, misleading ads, brand characteristics). However, we chose to study service failures because of the immediate impact that these failures can have on the foundations of trust. Service failures increase uncertainties that can destabilize the trust on which a relationship is built and, therefore, can increase vulnerability to defection. Thus, examining key consumer judgments following service failures provides an opportunity to examine how dissatisfaction with critical service encounters is reconciled with past experiences and how this reconciliation contributes to solidifying or eroding buyer–seller relationships (Maxham & Netemeyer, 2002; Smith, Bolton, & Wagner, 1999; Tax, Brown, & Chandrashekaran, 1998).

As we explain shortly, one answer to the trust–defection conundrum lies in the very nature of trust. We show that consumer trust embodies both a magnitude dimension (i.e., the position along a favorable-unfavorable continuum) and an uncertainty dimension (i.e., the lack of conviction with which the judgment is held). The possibility that individuals display heterogeneity in the uncertainty with which trust judgments are held has not generated much interest in the consumer behavior literature. Thus, the principal goals of this research are (a) to understand how trust magnitude and trust uncertainty are shaped by the interplay between the dissatisfaction with the complaint handling and past experiences and (b) to demonstrate that trust uncertainty dampens the impact of trust on loyalty.

To convey our research objectives, we first discuss why trust judgments are inevitably fraught with uncertainty and why this is particularly important in the service failure context that we study. To conceptualize trust uncertainty as a covert dimension of trust judgments, we employed the recently developed Judgment Uncertainty and Magnitude Parameters (JUMP) model (Chandrashekaran, McNeilly, Russ, & Marinova, 2000). This model allows trust uncertainty to be estimated from stated trust. We then report the results of an empirical investigation of consumer judgments following a service failure and a complaint resolution attempt by the service provider.

We demonstrate that although dissatisfaction with the complaint handling and past experiences interact to shape trust magnitude as well as trust uncertainty, the underlying processes that govern the two dimensions of trust are quite different. Specifically, an "accumulated goodwill" effect appears to govern trust magnitude, such that consumers with prior positive experiences forgive a service provider for a poorly handled complaint and exhibit a greater degree of trust than consumers with prior negative experiences. In contrast, a "double deviation" effect is evident in the formation of covert trust uncertainty. Consumers who have had favorable past experiences but are dissatisfied with their current complaint handling do not forget that both the initial event (that led to the complaint) and the poorly handled complaint are really service failures. Consequently, they are highly uncertain of their trust judgment. At the same time, consumers who have had unfavorable past experiences (and therefore have low expectations of a positive service encounter) have low uncertainty regardless of how the complaint was handled. We further demonstrate that estimates of trust uncertainty provided by the JUMP model significantly dampen the influence of stated trust on loyalty. An uncertainty-filled consumer, therefore, is more likely to switch service providers if the opportunity presents itself despite having professed high levels of trust. These findings illuminate post–service failure consumer judgments and contribute to a better understanding of the paradox of defection-despite-trust.

THEORETICAL BACKGROUND

The Importance of Uncertainty in Consumer Trust

At least three lines of reasoning highlight the importance of uncertainty in consumer trust. First, the literature recognizes the ubiquitous nature of uncertainty associated with all human judgments (e.g., Gigerenzer, Hoffrage, & Kleinbölting, 1991; Koehler, 1994; Rust, Inman, Jia, & Zahorik, 1999; Woodruff, 1972; Wyer, 1973). Woodruff, for instance, was one of the first to recognize that when consumers provide a scale rating of an attribute, they may be simultaneously forming a "probability distribution over all the scale gradations he considers possibly applicable…" (p. 260). Similarly, Wyer postulated that individuals' rating of a stimulus reflects the category that they consider to be most representative of the distribution of beliefs, that the stimulus belongs to the scale categories available, and that their uncertainty that this rating is correct reflects the variance of this belief distribution.

The simultaneity of trust magnitude and trust uncertainty is also quite consistent with the fundamental view of judgments espoused by Gigerenzer et al. (1991) that overt judg-

ment and covert uncertainty are simultaneously produced from one underlying process.[1] Recent research has shown that decomposing stated judgments into magnitude and uncertainty dimensions provides additional insight into how judgments are formed and utilized. For instance, Chandrashekaran et al. (2000) find that the impact of uncertainty about behavioral intentions on actual behavior is five times larger than that of the reported magnitude of these intentions. This raises the conjecture that individual behavior has at least as much to do with the lack of conviction (i.e., uncertainty) with which we hold key sentiments as it does with the substance (i.e., magnitude) of these sentiments.

Second, uncertainty in trust is also evident when we consider how trust has been defined in the literature and examine this definition against the backdrop of research on decision making. Trust has generally been defined in terms of the perception of confidence (or certainty) in an exchange partner's reliability and integrity (e.g., Moorman et al., 1992; Morgan & Hunt 1994). Although the trust judgment itself is eventually a probability estimate, the literature strongly supports the need to examine "uncertainty about certainty." For instance, Einhorn & Hogarth (1986; see also Hogarth & Einhorn, 1990) note that unlike gambling situations (where the nature of uncertainty is explicit), beliefs about events in the real world are typically loosely held and could include uncertainty about the process used to generate these beliefs. As Einhorn & Hogarth (p. S227–S228) succinctly note, "'uncertainty about uncertainties' is a pervasive element of much real world decision making … although it may seem strange and awkward to speak of uncertainty as being more or less certain itself, such a concept is crucial for understanding how people make judgments and decisions in their natural environment." The possibility that imprecision can underlie probabilities is also evident in Marschak (1975), the work on fuzzy sets (Zadeh, 1978), Shafer's (1976) theory of evidence, and the elicitation of probability ranges (Wallsten, Forsyth, & Budescu, 1983).

Third, uncertainty associated with trust is especially crucial following service failures. Ellsberg (1961) notes that uncertainty about uncertainty will be high when either (a) evidence is unreliable and conflicting or (b) the causal process generating outcomes is poorly understood. These conditions are apt descriptors of the service failure setting: Consumers with varying degrees of prior experience encounter a service failure, are unsure of the true locus and stability of the problem, make different attributions about which they may or may not be sure, and may need to reconcile past experiences with conflicting evidence. Once the service failure has occurred, the handling of the resulting complaint adds to the information the consumer can use to make evaluative judgments. The consumer therefore needs to synthesize his past experiences, if any, with the information that a service failure occurred and with how the complaint was handled. Such an updating process, evident in Rust et al. (1999; see also Bhattacharya, Devinney, & Pillutla, 1998), is likely to result in heterogeneity in the uncertainty surrounding expectations of future interactions.

Formation of Uncertain Consumer Trust

So far we have discussed the reasons why trust judgments are likely to be fraught with uncertainty. We now turn to the formation of uncertain consumer trust following a series of events: a service failure, a complaint by the consumer, and an attempt by the service provider to handle the complaint. We focus first on trust magnitude and then consider trust uncertainty.

Trust magnitude. Trust in a person or organization is acquired through observation or by learning about previous interactions involving the parties at hand (Holmes & Rempel, 1989). For consumers without any prior experience, trust is likely to be shaped by how the complaint was handled following the service failure. For consumers with prior experience, in addition to how a complaint is handled, the valence of prior experience will influence postcomplaint trust. All else being equal, consumers will profess greater levels of trust if their past experiences have been favorable rather than unfavorable.

Prior experiences may also moderate the impact of dissatisfaction with the complaint handling. The nature of this impact is unclear, however. From an accumulated goodwill perspective, one might expect that if consumers' prior experiences have been very positive, one poor experience should have little or no effect on trust. Positive experiences, however, may give rise to an expectation of continuing positive experiences (Maxham & Netemeyer, 2002). Thus, one negative experience may loom large and reduce trust despite the very positive prior experiences. These competing explanations were evaluated in the research to be reported.

Trust uncertainty. For consumers without any prior experience, one might expect that satisfaction with the handling of a complaint would reduce trust uncertainty, whereas dissatisfaction would increase it. This has been suggested by research on service quality (Rust, Zahorik, & Keiningham,

[1]In employing the term *covert* to describe uncertainty, Gigerenzer et al. (1991) imply that the uncertainty dimension of judgments is not observable to the researcher and perhaps unknown to even the respondent. These authors go on to note that measuring this uncertainty via a confidence scale may force an artificial temporal sequence to the measures that may not be responsive to the generative mechanism underlying the process. That is, the seemingly temporal sequence of judgment-then-confidence is enforced by researchers when they ask respondents to report their judgments on scales and follow this up with a confidence scale. Such an artificial temporal sequence may also explain why subjective uncertainty (captured via a confidence scale) often shows correlation with judgment extremity (see Bassili, 1996); extreme judgments are easy to retrieve, and the ease with which judgments are retrieved implies to the respondent that these judgments are held with a high degree of certainty (Schwarz, 2004). We return to this discussion in the conclusion section of this article.

1994) as well as by evidence that favorable information increases attitude certainty whereas unfavorable information decreases it (Chandrashekaran et al., 2000; Kardes, 1994).

For consumers with prior experience, we expect the interplay between the valence of prior experience and dissatisfaction with the complaint handling to influence trust uncertainty. Decision-making research notes that uncertainty in the probability of future events is likely to be high in the face of conflicting evidence (e.g., Darley & Gross, 1983; Ellsberg, 1961). In the context of this study, it is therefore important to consider the degree of consistency between prior experiences and complaint handling effectiveness. From this perspective, we would expect that dissatisfaction will increase trust uncertainty to a greater extent among individuals who have had positive experiences in the past and, therefore, have higher expectations of continuing favorable experiences. When such individuals are confronted with a dissatisfying experience following an initial service failure, the inconsistency of this failure with their prior experiences will promote greater uncertainty. In contrast, individuals with unfavorable past experiences do not have high expectations of favorable experiences. When these individuals are faced with a dissatisfying experience that follows the initial service failure, the continuing consistency with prior experiences will promote certainty.

METHOD

Data Collection

We employed data from Tax et al. (1998) to test our theorizing. This study differs from the Tax et al. study in two significant ways. First, Tax and colleagues focused on the antecedents of satisfaction with complaint handling and did not consider the impact of dissatisfaction on trust uncertainty. Second, they did not examine the impact of trust uncertainty on subsequent phenomena such as loyalty.

A cross-sectional survey design was used to assess respondents' evaluations of their most recent service-related complaint, with the stipulation that it was lodged within the past 6 months. This approach is consistent with that used in much of the service encounter and complaint research (e.g., Bitner, Booms, & Tetreault, 1990). Employees were sampled from the local or national office of four medium- to large-sized firms in a large western U.S. city. The firms included a telecommunications company, a health care insurer, a bank, and a provider of ambulatory and emergency services. Participation by the four firms was motivated by management's interest in the study and the promise of a report of the results.

The employees in the four firms participated as everyday consumers, rather than in their role as employees of their respective organizations. Consumers reported on their service failure experiences relating to a wide variety of organizations. Over 40 types of service businesses were identified, the most frequent of which were restaurants (37), auto repair (32), banks (26), doctors/dentists (18), airlines (15), and hotels (13). We distributed 1,167 questionnaires, and 257 were returned. Thirty-six individuals did not provide complete data and were excluded from the analyses, leaving a final sample of 221. Most complaints concerned problems that were judged by the complainant to be highly important: The mean response to the question "How important to you was the problem which led to your complaint?" was 1.57 on a scale from 1 (*very important*) to 7 (*not important at all*).

Measures

The survey instrument had two parts. In the first part, respondents described the details of a recent service experience that led them to lodge a complaint. Details included the type of service receiving the complaint, the persons to whom the complaint was made (e.g., waiter, service representative, manager), and the number of people involved in resolving the dispute. These questions helped the respondents to focus on the encounter and provided useful information that contributed to understanding of complaint-handling evaluations. To discover how respondents viewed fairness in complaint resolution situations, we asked them to respond to the question "How do you feel that the complaint was handled?" on a scale ranging from 1 (*fairly*) to 7 (*unfairly*). The following questions were placed immediately after this scaled item: "Why do you feel this way? That is, exactly what happened?" and "What, if anything, could the firm have done to handle the complaint more fairly?" These aspects were explored in Tax et al. (1998) and are not the focus of this research.

In the second part, structured questions measured the variables of interest in this research. Respondents were instructed to answer these questions "according to how you were thinking or feeling during or immediately following the complaining incident." This part was divided into four sections. Section 1 included questions about personal treatment (fairness, caring, etc.), procedures (how the complaint was handled), and the results of the complaint. In essence, the questions dealt with the interpersonal, procedural, and distributive justice constructs that were the focus of Tax et al. (1998).

In Section 2, participants answered questions about the thoughts they remembered having about the service organization "immediately after the resolution of the complaint." The questions dealt with dissatisfaction, trust, and loyalty. Dissatisfaction with the complaint handling was inferred from agreement with statements such as "I was not happy with how the organization handled my complaint," and trust was inferred from agreement with four items such as "I believed the organization could not be relied on to keep its promises." Loyalty was measured in terms of commitment (inferred from agreement with four statements such as "I wanted to continue dealing with this organization"), and the

propensity to provide word-of-mouth (inferred from agreement with three statements such as "My recommendations about this organization would have been positive"). All responses were made along scales from 1 (*strongly disagree*) to 5 (*strongly agree*). Consistent with prior research on customer loyalty (e.g., Zeithaml, Berry, & Parasuraman, 1996), the scores on the commitment and word-of-mouth scales were averaged to obtain a single measure of loyalty. (Supplementary analyses of commitment and word-of-mouth measures separately produced identical patterns of results.) Larger values on these scales, therefore, indicated greater dissatisfaction, greater trust, and greater loyalty.

The questions in Section 3 pertained to the dealings (if any) that participants had had before the incident that led to the complaint. Participants responded to three items (e.g., "How would you rate your experiences with this organization prior to the incident which led to the complaint?") along scales from 1 (*very negative*) to 7 (*very positive*). To facilitate testing, we coded this variable such that larger values indicate more negative prior experiences.

Model Specification

We draw on the recently developed JUMP model (Chandrashekaran et al., 2000) that takes an overtly stated measure and statistically estimates the impact of independent variables on the magnitude as well as the uncertainty inherent in the overt judgment. Letting TRUST denote the stated trust, we therefore adopt the following structure for the i^{th} customer:

$$(1) \qquad TRUST_i = \alpha + TM_i + \varepsilon_i;\ var(\varepsilon_i) = \sigma^2 + TU_i$$

where TM and TU denote trust magnitude and uncertainty, respectively. Based on the conceptual arguments, TM and TU are specified as follows:

$$(2) \qquad TM = \beta_1 D_P{*}DISSAT + \beta_2 D_P{*}PRIORJ + \beta_3 D_P{*}DISSAT{*}PRIORJ + \beta_4(1\text{-}D_P){*}DISSAT$$

$$(3) \qquad TU = \gamma_1 D_P{*}DISSAT + \gamma_2 D_P{*}PRIORJ + \gamma_3 D_P{*}DISSAT{*}PRIORJ + \gamma_4 (1\text{-}D_P){*}DISSAT$$

where DISSAT denotes the level of dissatisfaction with the complaint handling; $D_P = 1$ (0) for individuals with some prior experience (without any prior experience) with the service provider; PRIORJ denotes the summary judgment that captures the valence of the prior experience with the service provider; β_1 and β_4 capture the effect of dissatisfaction on trust magnitude among consumers with and without prior experience, respectively; β_2 captures the impact of prior experience valence on trust magnitude; and β_3 captures the interplay between prior experience valence and dissatisfaction among consumers with prior experience; γ_1 and γ_4 capture the effect of dissatisfaction on trust uncertainty among consumers with and without prior experience, respectively; and γ_3 captures the interplay between prior experience and dissatisfaction in shaping trust uncertainty among consumers with prior experience.

Note that we do not measure trust uncertainty using a confidence scale. Rather, the JUMP model decomposes the stated trust into magnitude (TM) and uncertainty (TU) components. This decomposition is made feasible by the recognition that trust uncertainty *manifests* itself in the potential variability in the overt response, but is *not equal to the variance*; model misspecification and measurement error that are traditionally captured by an error variance are very much part of the model (as σ^2). Consistent with Rust et al. (1999), highly uncertain judgments are associated with large variability about the mean, whereas judgments held with certainty are associated with low variability about the mean.

Model Estimation and Testing

Because each customer has a unique variance term, Equations (1) through (3) constitute a heteroscedastic regression model. The parameters of interest (β and γ) can be estimated in a straightforward manner using feasible generalized least squares. Following the estimation, the estimate of individual trust uncertainty is computed as the right-hand side of Equation (3). A step-by-step estimation for the model that can be performed with any standard statistical package such as SAS and SPSS, as well as details of the derivation and a discussion of the estimation and testing, is presented in the Appendix.

RESULTS

Formation of Uncertain Consumer Trust

Overall model testing. A likelihood-ratio test revealed that the hypothesized two-dimensional model of trust (magnitude–uncertainty) outperforms the null model that restricts all parameters to zero ($\chi^2(8) = 299.98$, $p < .0001$; see Equation A9 of the Appendix) as well as a one-dimensional model of trust that ignores uncertainty ($\chi^2(4) = 51.04$, $p < .0001$; see Equation A10 of the Appendix). A similar test indicated strong support for a significant contribution of the hypothesized drivers of trust magnitude (i.e., the interplay of dissatisfaction and prior experience captured in Equation 2; $\chi^2(4) = 281.24$, $p < .0001$; $R^2 = .72$, $F(4,217) = 184.05$, $p < .0001$; see Equation A11). Finally, a likelihood-ratio test supported a significant contribution of the hypothesized drivers of trust uncertainty (i.e., the interplay of dissatisfaction and prior experience captured in Equation 3; $\chi^2(4) = 34.99$, $p < .0001$; see Equation A12). The correlation between trust magnitude and uncertainty was –.40 ($p < .05$). The issue of whether the estimated dimensions are distinct from one another will be considered presently. Overall, however, these results reveal strong support for our theorizing regarding the structure of

trust (i.e., the two-dimensional magnitude–uncertainty model), as well as the composition of trust (i.e., the groups of variables influencing trust magnitude and uncertainty).

Antecedents of trust magnitude.

The results indicate that as dissatisfaction with the complaint handling increases, the magnitude of trust decreases for consumers with and without prior experience ($[\hat{\beta}_1] = -.61$, $t[221] = -12.41$, $p < .0001$, and $(\hat{\beta}_4) = -.73$, $t[221] = -20.86$, $p < .0001$). We did not find support, however, for the expectation that prior positive experiences alone will increase trust magnitude.

Next, as expected, for consumers with prior experience, dissatisfaction and prior experience interact significantly to shape the magnitude of trust ($\hat{\beta}_3 = -.023$, $t[221] = -2.5$, $p < 0.05$). The negative coefficient reveals that as prior experience becomes more unfavorable, the negative impact of dissatisfaction on trust magnitude becomes more negative. Computing the net effects of dissatisfaction reveals that when prior experience is most favorable (corresponding to a scale value of 1), the net impact of dissatisfaction on trust magnitude is estimated to be –.63 ($p < .0001$). In contrast, when past experience is most unfavorable (corresponding to a scale value of 7), the net impact of dissatisfaction on trust magnitude is estimated to be –.77 ($p < .0001$). The difference between these two estimates is also significant ($t[221] = 2.5$, $p < .05$).

In sum, the data indicate that trust magnitude is related negatively to dissatisfaction, but this is less true when past experiences were favorable than when they were not. This supports an accumulated goodwill perspective: Favorable past experiences mitigate to some extent the deleterious impact of dissatisfaction on trust magnitude.

Antecedents of trust uncertainty. As expected, trust uncertainty increased with dissatisfaction with the complaint handling. Specifically, dissatisfaction increases trust uncertainty among individuals with prior experience ($\hat{\gamma}_1 = .155$, $t[221] = 2.63$, $p < .05$) and those without experience ($\hat{\gamma}_4 = .075$, $t[221] = 1.98$, $p < .05$).

Analyses of data from consumers with prior experience yields a significant interaction of dissatisfaction and prior experience ($\hat{\gamma}_3 = -.023$, $t(221) = -2.88$, $p < .05$). This interaction indicates that as prior experience becomes more negative, the impact of dissatisfaction on trust uncertainty decreases. That is, uncertainty is greatest when consumers have had favorable past experiences but are dissatisfied with the complaint handling. When prior experience is most favorable (scale value of 1), the net impact of dissatisfaction is estimated to be .132 ($p < .01$)—Dissatisfaction increases uncertainty. However, the net impact of dissatisfaction steadily decreases to nonsignificance when prior experience was most unfavorable (scale value of 7).

The data, therefore, indicate that trust uncertainty is related positively to dissatisfaction, and this relationship is greater when past experiences are favorable than when they are not. These results support the view that consistency of experiences leads to lower uncertainty: Consumers who have who have had prior negative experiences and are dissatisfied with the current experience are likely to be certain in their trust. In contrast, individuals who have had prior positive experiences and are dissatisfied with the present experience are likely to be uncertain about their trust.

TABLE 1
Computed Trust Uncertainty Values for Selected Values of Past Experience and Satisfaction with Complaint Handling

	Satisfaction With Complaint Handling	
Past Experience	*Very Satisfied*	*Very Dissatisfied*
Favorable	.26	.79
Unfavorable	.13	.11
No past experience	.20	.50

Note. Uncertainty values are computed for the scale values of prior experience corresponding to *very positive* (1) and *very negative* (7) and for dissatisfaction corresponding to *very dissatisfied* (5) and *very satisfied* (1).

To shed more light on the pattern of the interaction, we computed the estimated uncertainty for extreme values of dissatisfaction and prior experience valence. The results are presented in Table 1 and reveal two important aspects of trust uncertainty formation. First, consumers who have had favorable past experiences but are dissatisfied with the current complaint handling exhibit more uncertainty than consumers with any of the other three combinations of past experience and satisfaction (i.e., favorable-satisfied, unfavorable-satisfied, and unfavorable-dissatisfied). Second, the effects of satisfaction on uncertainty when past experience is favorable (.79 vs. .26, when customers were satisfied vs. dissatisfied, respectively) did not differ appreciably from its effect when consumers had no past experience (.50 vs. .20, respectively). When past experience was unfavorable, however, uncertainty was low and independent of satisfaction with the complaint handling.

Predictive Validity of the Estimated Trust Uncertainty

The preceding analyses concerned the role of dissatisfaction and prior experience on the formation of trust magnitude. To assess the validity of the estimate of trust uncertainty, we considered whether our estimate of trust uncertainty behaves in a manner consistent with prior research and with psychological principles. For instance, Wyer (1973) maintains (and shows empirically) that extreme judgments are necessarily associated with low uncertainty. That is, there is typically a nonmonotonic relationship between the favorableness of a rating and the uncertainty that is associated with it. To address this issue, we estimated a regression model with trust uncertainty as the dependent variable and included linear and quadratic terms for trust magnitude as the independent vari-

ables. Both terms were significant: The beta was positive for the linear term ($p < .01$) and was negative for the quadratic term ($p < .05$). Whereas the pattern of these effects indicates an inverted U-type function and reveals support for Wyer (1973), the linear component ($r = –.40$, $p < .05$) offered more explanatory power; this indicates that the model-estimated uncertainty generally decreases as the favorableness of the trust increases. This is only to be expected because dissatisfaction with the complaint handling and prior experience have linear effects on both trust ratings and uncertainty.

However, the empirical relationship between trust magnitude and uncertainty begs the question as to the distinctiveness of the two dimensions of trust estimated by the model. First, recall that different generative processes are implicated in the formation of each dimension of trust: Trust magnitude appears to be governed by accumulated goodwill, whereas trust uncertainty appears to be shaped by deviation from expectations produced by past experiences. We would expect to find that whereas stated trust increases loyalty (Ganesan, 1994; Morgan & Hunt, 1994), uncertainty will reduce the impact of trust on loyalty. That is, weakly held judgments should be relatively less likely to guide subsequent behavior (e.g., Fazio, Powell, & Williams, 1989; Petty & Krosnick, 1995).

Accordingly, we estimated a regression with loyalty as the dependent variable and included trust, trust uncertainty, and their interaction as independent variables. The overall model for loyalty was significant, $F(3, 217) = 271.48$; $R^2 = .79$, $p < .0001$. We also examined the model performance against a restricted model that did not incorporate trust uncertainty. (Specifically, we tested the null hypothesis that the betas for trust uncertainty and its interaction with trust magnitude were zero.) Results indicated that the null hypothesis was rejected, $\chi^2(2) = 14.06$, $p < .0001$. Thus, including trust uncertainty in the analysis adds significant explanatory power.

The results reveal a significant positive main effect for trust (beta = 1.24, $t(221) = 11.51$, $p < .0001$) and a negative interaction between trust and trust uncertainty (beta = –.89, $t[221] = –3.15$, $p < .01$). The negative coefficient for the interaction indicates that the effect of stated trust on loyalty is reduced as trust uncertainty increases.[2]

We also computed the net impact of trust on loyalty (i.e., net beta) at different levels of trust uncertainty and found that when uncertainty was at its lowest, the net impact of trust on loyalty (net beta = 1.14) was not significantly different from 1.0. However, as trust uncertainty increased, the net effect of stated trust on loyalty steadily decreased, and at the highest value of uncertainty in the sample, the net beta was estimated to be .53 ($p < .0001$), which is significantly less than 1.0 ($p < .0001$). Thus, going from low to high trust uncertainty, the relationship between trust and loyalty evidenced a 54% reduction (computed as [1.14 – .53]/1.14 = 54%).

This decrease in the impact of trust on loyalty as a function of trust uncertainty sheds light on the paradox of defection-despite-trust. It reveals that consumers with high levels of trust uncertainty are more vulnerable than are those who hold their trust with greater certainty. In sum, the magnitude of trust does not appear to diminish substantially following one service failure, but one service failure surely increases uncertainty in that trust. In turn, the uncertainty adversely affects relationship variables such as loyalty.

GENERAL DISCUSSION

The results of this research offer strong support for the view that trust judgments embody a covert dimension of uncertainty that sheds light into the paradox of defection-despite-trust. Drawing from the judgment and decision-making literatures (e.g., Einhorn & Hogarth, 1986; Gigerenzer et al., 1991; Wyer, 1973) as well as from research on decomposing judgments into magnitude and uncertainty dimensions (Chandrashekaran et al., 2000), we presented a conceptual model that centered on the interplay of satisfaction with complaint handling and prior experience in shaping trust magnitude as well as trust uncertainty. To test our theorizing, we analyzed consumer judgments following a failed service encounter and an attempt to resolve the complaint. Dissatisfaction with how the complaint was handled interacted with prior experience to shape both trust magnitude and trust uncertainty.

The underlying processes that govern the two dimensions of trust, however, are quite different. Specifically, consumers with prior positive experiences may forgive a service provider for a poorly handled complaint and witness higher trust magnitude than consumers with prior negative experience. However, the service failure and the poorly handled complaint are not forgotten, as evidenced by the fact that these very same forgiving consumers hold their trust with high uncertainty. We further found that when uncertainty was high, the impact of trust on loyalty was significantly dampened.

Some qualifications on the generalizability of our findings should be considered. For example, we used data from a cross-sectional survey based on retrospective reports of service complaints. Thus, biases in recall may have contributed to our results. Capturing the dynamics of the association between complaint-handling efforts by the service provider and postcomplaint behaviors would be enhanced by tracing consumer judgments and the inherent uncertainty in those judgments over time.

Second, although the hypothesized antecedents of trust behaved in accordance with our theoretical conjectures and explained a significant amount of the variance in stated trust,

[2]In a regression of loyalty on trust uncertainty alone, we obtain a negative coefficient (beta = –3.76, $p < .0001$), indicating that increases in uncertainty reduce loyalty. Although this result is not surprising in light of other evidence that uncertainty reduces continued patronage (Kardes, 1994), the fact that trust uncertainty and trust magnitude have opposite effects on loyalty reveals that the two dimensions are distinct from one another.

the introduction of psychographic variables might yield further insights into segmentation possibilities. For instance, which specific consumers are more or less likely to evidence uncertainty in their judgments? Uncertainty may be shaped by need for cognitive closure (Kruglanski, Webster, & Klem, 1993), which is manifested in preferences for order, structure, and decisiveness. Likewise, Sorrentino and Short (1986) noted that individuals with a high uncertainty orientation are open to new information and actively seek to incorporate such information in decision-making. These individuals might also be likely to hold attitudes with greater certainty.

An additional consideration surrounds the estimation model that underlies the trust decomposition. In this research, we have centered on the uncertainty manifest in subjective judgments. There are more sources of error in going from these fuzzy judgments to the actual report of judgments, including scale reliability, the error in going from a continuous construct space to a discrete measure space (referred to as the metric quality of ordered-categorical data by Srinivasan & Basu, 1979), individual-level response styles, and, more broadly, common-method biases (see Podsakoff, MacKenzie, Lee, & Podsakoff, 2003 for a review of common-method biases). Although the measures employed demonstrate good psychometric properties (see Tax et al., 1998, for details), in the JUMP model these are subsumed under the term s^2, as in all regression models. Our model does not speak to this issue. The mapping process itself (i.e., going from fuzzy judgments to actual selection of scale point on a measurement instrument) is an interesting issue but one that we have not dealt with in this article.

Implications for Trust/Loyalty

In this study we focused on the formation and consequences of uncertain trust following a service failure and an attempt to resolve the complaint. We advanced and supported three key points: (a) trust judgments were fraught with covert uncertainty, (b) this uncertainty would be influenced by actions taken by the service provider following the service failure, and (c) this covert uncertainty contributes to consumer vulnerability. Particularly troubling from a practitioner's viewpoint are the dynamics among consumers who have had prior positive experiences. Such individuals may profess to trust a service provider following a service failure and a poorly handled complaint. However, unbeknownst to the service provider, and perhaps to themselves, they hold this trust with greater uncertainty. Thus, their trust is rather fragile. As a result, practitioners may not be able to depend on customers' statements of trust/satisfaction to gauge their future behavior.

Relationship marketing theory maintains that trust is a critical antecedent to consumer loyalty (Dwyer et al., 1987; Morgan & Hunt, 1994), and researchers have sought to validate the direct impact of trust on loyalty (see Geyskens et al., 1999). Such a "main-effects" perspective, however, ignores the potential moderating role of uncertainty surrounding trust judgments. This may also shed light on research that has attempted to offer explanations for why trust is often unrelated to relational outcomes, especially in longer term relationships. For instance, Moorman et al. (1992) suggested that clients in long-term marketing service relationships begin to have higher expectations for service providers, thus increasing the likelihood of dissatisfaction. This might explain why trust emerged as a nonsignificant antecedent of loyalty in their research. In their replication and extension of Moorman et al.'s research, Grayson and Ambler (1999) found that although expectations do rise with the duration of a relationship, these expectations do not suppress the relation between trust and relational constructs. Their focus, however, was only on the magnitude of trust and not on the uncertainty associated with trust judgments. Our results indicate that Moorman and colleagues were on the right track: The key is in violations of higher expectations. Our research adds conceptual richness to this line of thinking by showing how this may happen and implicates trust uncertainty in the process. That is, violations of the high expectations held by consumers with favorable past experience may increase trust uncertainty rather than decreasing trust magnitude. In turn, trust uncertainty dampens the impact of trust on loyalty, and makes consumers vulnerable to defection.

Implications for Consumer Research in General

Marketers and consumer behavior scholars have been slow to adopt the view that the variation in observed responses is an important behavioral phenomenon (see Louviere, 2001). In this study, we were able to decompose trust judgments into magnitude and uncertainty dimensions because we started out with the recognition that trust uncertainty resided in the variance surrounding stated trust.

Simply asking consumers to indicate their confidence in the stated trust may not be an adequate substitute for the procedure we employed. First, accumulating evidence documents the measurement-induced confounding that accompanies confidence-elicitation tasks (e.g., Bassili, 1996; see footnote 1). Second, asking consumers to report their confidence in a judgment requires them to assess their knowledge about the issue at hand. A vast body of research attests to the inability of individuals to know how much they know (e.g., Fischhoff, Slovic, & Lichtenstein, 1977; Park, Mothersbaugh, & Feick, 1994). Individuals are often prone to a "feeling of knowing" (Schacter, 1983), and those who rate high on self-confidence report greater levels of knowledge (see Park et al., 1994). Thus, self-reported uncertainty along confidence scales may not shed light on the true and covert uncertainty in consumer judgments.

Other areas of research might benefit from a similar decomposition of consumer judgments. For instance, why do stated intentions sometimes predict behavior and sometimes not (e.g., Albarracin, Johnson, Fishbein, & Muellerleile,

2001; Sheppard, Hartwick, & Warshaw, 1988)? Why does encouraging individuals to supplement goal intentions with detailed planning increase intention–behavior consistency (Gollwitzer & Brandstatter, 1997)? Based on the results of this investigation, we theorize that the cognitive elaboration underlying the formation of implementation intentions influences the conviction with which intentions are held, which then influences the intention–behavior link.

Brand evaluation research might also gain from a consideration of uncertainty inherent in judgments. Although many models of brand evaluation are built on the assumption that attribute information underlies the favorability of evaluations, uncertainty in brand evaluations remains a relatively unexplored issue. Because uncertainty in brand evaluations may have an impact on subsequent phenomena such as brand consideration and brand choice, it can be useful to study how attribute information simultaneously influences brand evaluation magnitude and uncertainty.

Conclusion

The principal goals of this research were achieved. We determined how trust magnitude and trust uncertainty are shaped by the interplay between the dissatisfaction with the complaint handling and past experiences and demonstrated that trust uncertainty dampens the impact of trust on loyalty. The evidence reported in this research qualifies the conventional wisdom that it pays to build a reservoir of positive consumer experiences in the anticipation that accumulated good will can overcome the occasional service failure. We find that when a complaint is poorly handled, consumers with prior positive experiences appear to forgive the service provider and state high levels of trust, but they hold this trust with high uncertainty: The service failure and the poorly handled complaint are certainly not forgotten. These customers are therefore vulnerable to defection.

In conclusion, this article contains two key messages for consumer behavior research. First, there is more information in what we are measuring than has been typically utilized. Second, although consumer judgments surely depend on beliefs, they also depend on the conviction with which these beliefs are held. Simultaneously investigating the magnitude and uncertainty of stated consumer judgments is likely to shed more light on the why of consumer behavior. We look forward to this development in the literature.

REFERENCES

Albarracin, D., Johnson, B. T., Fishbein, M., & Muellerleile, P. A. (2001). Theories of reasoned action and planned behavior as models of condom use: A meta-analysis. *Psychological Bulletin, 127,* 142–161.

Amemiya, T. (1977). A note on the heteroscedastic model. *Journal of Econometrics, 6,* 365–370.

Amemiya, T. (1985). *Advanced econometrics*. Cambridge, MA: Harvard University Press.

Anderson, E., Lodish, L. M., & Weitz, B. A. (1987). Resource allocation behavior in conventional channels. *Journal of Marketing Research, 24,* 85–97.

Anderson, E., & Weitz, B. A. (1989). Determinants of continuity in conventional industrial channels. *Marketing Science, 8,* 310–323.

Bassili, J. N. (1996). Meta-judgmental versus operative indexes of psychological attributes: The case of measures of attitude strength. *Journal of Personality and Social Psychology, 71,* 637–653.

Berry, L. L. (1996). Retailers with a future. *Marketing Management, 5,* 39–46.

Bhattacharya, R., Devinney, T., & Pillutla, M. (1998). A formal model of trust based on outcomes. *The Academy of Management Review, 23,* 459–472.

Bitner, M. J., Booms, B., & Tetreault, M. (1990). The service encounter: Diagnosing favorable and unfavorable incidents. *Journal of Marketing, 54,* 71–84.

Chandrashekaran, M., McNeilly, K., Russ, F. A., & Marinova, D. (2000). From uncertain intentions to actual behavior: A threshold model of whether and when salespeople quit. *Journal of Marketing Research, 37,* 463–479.

Darley, J. M., & Gross, P. H. (1983). A hypothesis-confirming bias in labeling effects. *Journal of Personality and Social Psychology, 44*(1), 20–33.

Doney, P. M., & Cannon, J. P. (1997). An examination on the nature of trust in buyer–seller relationships. *Journal of Marketing, 61,* 35–71.

Dwyer, R. F., Schurr, P. H., & Oh, S. (1987). Developing buyer–seller relationships. *Journal of Marketing Research, 51,* 11–27.

Einhorn, H. J., & Hogarth, R. M. (1986). Decision making under ambiguity. *Journal of Business, 59,* S229–250.

Ellsberg, D. (1961). Risk, ambiguity, & the savage axioms. *The Quarterly Journal of Economics, 75,* 643–669.

Fazio, R. H., Powell, M. C., & Williams, C. J. (1989). The role of attitude accessibility in the attitude-to-behavior process. *Journal of Consumer Research, 16,* 280–288.

Fischhoff, B., Slovic, P., & Lichtenstein, S. (1977). Knowing with certainty: The appropriateness of extreme confidence. *Journal of Experimental Social Psychology: Human Perception and Performance, 3,* 552–564.

Ganesan, S. (1994). Determinants of long-term orientation in buyer-seller relationship. *Journal of Marketing, 58,* 11–27

Gartner, Inc. (2001). Gartner says Bridgestone/Firestone and Ford legal agendas are jeopardizing customer relationship management. Press release, May 22.

Geyskens, I., Steenkamp, J. E. M., & Kumar, N. (1999). A meta-analysis of satisfaction in marketing channel relationships, *Journal of Marketing Research, 36,* 223–238.

Gigerenzer, G., Hoffrage, U., & Kleinbölting, H. (1991). Probabilistic mental models: A Brunswikian theory of confidence. *Psychological Review, 98,* 506–528.

Goldfeld, S. M., & Quandt, R. E. (1972). *Nonlinear methods in econometrics*. Amsterdam: North-Holland.

Gollwitzer, P. M., & Brandstatter, V. (1997). Implementation intentions and effective goal pursuit. *Journal of Personality and Social Psychology, 73,* 186–199.

Grayson, K., & Ambler, T. (1999). The dark side of long-term relationships in marketing services. *Journal of Marketing Research, 36,* 132–141.

Greene, W. H. (1997). *Econometric analysis*. New York: Macmillan.

Gross, S. R., Holtz, R., & Miller, N. (1995). Attitude certainty. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences*. CITY, NJ: Lawrence Erlbaum Associates, Inc.

Hogarth, R. M., & Einhorn, H. J. (1990). Venture theory: A model of decision weights. *Management Science, 36,* 780–803.

Holmes, J. G., & Rempel, J. K. (1989). Trust in close relationships. In C. Hendricks (Ed.), *Review of personality and social psychology: Close relationships, 10* (pp. 187–220). Beverly Hills, CA: Sage.

Jobson, J. D., & Fuller, W. A. (1980). Least squares estimation when the covariance matrix and parameter vector are functionally related. *Journal of the American Statistical Association, 75*, 176–181.

Jones, T., & Sasser, Jr., W.E. (1995). Why satisfied customers defect. *Harvard Business Review, 73,* 88–99

Kardes, F. R. (1994). Consumer judgment and decision processes. In R. S. Wyer & T. K. Srull (Eds.), *Handbook of social cognition* (pp. 163–191). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Koehler, D. J. (1994). Hypothesis generation and confidence in judgment. *Journal of Experimental Psychology*, *20*, 461–469.

Kruglanski, A. W., Webster, D. M., & Klem, A. (1993). Motivated resistance and openness to persuasion in the presence or absence of prior information. *Journal of Personality and Social Psychology, 65,* 861–876.

Louviere, J. (2001). What if consumer experiments impact variances as well as means? Response variability as a behavioral phenomenon? *Journal of Consumer Research, 28*, 506–511.

Marschak, J. (1975). Personal probabilities of probabilities. *Theory and Decision, 6,* 121–153.

Maxham, III, J. G., & Netemeyer, R. G. (2002). A longitudinal study of complaining customers' evaluations of multiple service failures and recovery efforts. *Journal of Marketing, 66,* 57–73.

Moorman, C., Zaltman, G., & Desphande, R. (1992). Relationships between providers and users of marketing research: The dynamics of trust within and between organizations. *Journal of Marketing Research, 29,* 314–329.

Morgan, R. M., & Hunt, S. D. (1994). The commitment–trust theory of marketing relationships. *Journal of Marketing, 58,* 20–38.

Park, W. C., Mothersbaugh, D. L., & Feick, L. (1994). Consumer knowledge assessment. *Journal of Consumer Research, 21,* 71–82.

Petty, R. E., & Krosnick, J. A. (1995). *Attitude strength: Antecedents and consequences*. NJ: Lawrence Erlbaum Associates, Inc.

Podsakoff, P. M., MacKenzie, S. B., Lee, J., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88,* 879–903.

Reichheld, F. F. (1996). *The loyalty effect*. Boston: Harvard Business School Press.

Rust, R. T., Inman, J. J., Jia, J., & Zahorik, A. J. (1999). What you don't know about customer-perceived quality: The role of customer expectation distributions. *Marketing Science, 18*(1), 77–92.

Rust, R. T., Zahorik, A. J., & Keiningham, T. L. (1994). *Return on quality: Measuring the financial impact of your company's quest for quality.* Chicago: Probus.

Schacter, D. L. (1983). Feeling of knowing in episodic memory. *Journal of Experimental Psychology: Learning, Memory and Cognition, 9,* 39–54.

Schwarz, N. (2004). Metacognitive experiences in consumer judgment and decision making. *Journal of Consumer Psychology, 14,* 332–348.

Shafer, G. A. (1976). *A mathematical theory of evidence*. Princeton, NJ: Princeton University Press.

Sheppard, B. H., Hartwick, J., & Warshaw, P. R. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research, 15*(3), 325–343.

Smith, A. K., Bolton, R. N., & Wagner, J. (1999). A model of customer satisfaction with service encounters involving failure and recovery. *Journal of Marketing Research, 36,* 356–372.

Sorrentino, R. M., & Short, J. C. (1986). Uncertainty orientation, motivation and cognition. In R. M. Sorrentino & E. T. Higgins (Eds.), *The handbook of motivation and cognition: Foundations of social behavior* (pp. 379–403). New York: Guilford.

Srinivasan, V., & Basu, A. K. (1989). The metric quality of ordered categorical data. *Marketing Science, 8,* 205–231.

Tax, S. S., Brown, S. W., & Chandrashekaran, M. (1998). Customer evaluations of service recovery experiences: Implications for relationship marketing. *Journal of Marketing, 66,* 60–76.

Technical Assistance Research Program (TARP; 1986). Consumer complaint handling in America: An update study. Washington, DC: Department of Consumer Affairs.

Verhoef, P. C., Franses, P. H., & Hoekstra, J. C. (2002). The effect of relational constructs on customer referrals and number of services purchased from a multiservice provider: Does age of relationship matter? *Journal of the Academy of Marketing Science, 20,* 202–217.

Wallsten, T. S., Forsyth, B. H., & Budescu, D. (1983). Stability and coherence of health experts' upper and lower subjective probabilities about dose response functions. *Organization Behavior and Human Performance, 31,* 277–302.

Woodruff, R. B. (1972). Measurement of consumers' prior brand information. *Journal of Marketing Research*, *9*, 258–263.

Wyer, R. S., Jr. (1973). Category rating as "subjective expected values": Implications for attitude formation and change. *Psychological Review*, *80*, 446–467.

Zadeh, L. A. (1978). Fuzzy sets as a basis for a theory of possibility. *Fuzzy Sets and Systems, 1,* 3–28.

Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing, 60,* 31–46.

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APPENDIX

Step-by-Step Model Estimation

The trust model in Equations (1) through (3) can be represented as

$$\text{(A1)} \qquad \text{TRUST}_i = \alpha + \mathbf{M}_i\boldsymbol{\beta} + \varepsilon_i \text{ and } \text{var}(\varepsilon_i) = \sigma^2 + \mathbf{U}_i\boldsymbol{\gamma}$$

where $\mathbf{M_i} = [m_{1i}, m_{2i}, \ldots, m_{pi}]$ and $\mathbf{U}_i = [u_{1i}, u_{2i}, \ldots, u_{ki}]$ denote row-vectors of variables hypothesized to impact trust magnitude and uncertainty, respectively; a denotes the intercept term; and $\boldsymbol{\beta} = [\beta_1, \beta_2, \ldots, \beta_p]$ and $\boldsymbol{\gamma} = [\gamma_1, \gamma_2, \ldots, \gamma_k]$ denote column-vectors of the impacts of $\mathbf{M}_i$ and $\mathbf{U}_i$, respectively. The estimation of $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ proceeds in the following process:

1. Estimate an ordinary least squares regression model with TRUST as the dependent variable and **M** as the vector of independent variables to obtain initial estimates of $\boldsymbol{\beta}$.

2. Obtain the squared residual, that is, $e_i^2 = (\text{TRUST-}\mathbf{M}\hat{\beta})^2$. This term is an estimate of the individual-level variance and has the same asymptotic properties as ε_i^2. *This recognition, combined with the view that uncertainty manifests itself in the variance, underpins the JUMP model and facilitates the estimation of the antecedents of uncertainty.*

3. Regress e^2 on **U**, to obtain estimates $\hat{\sigma}^2$ and $\hat{\gamma}$**.**

4. e^2 is regressed, via weighted least squares, on **U** with $2(\hat{\sigma}^2 + U\hat{\gamma})^2$ as the weight, and with the constraint that $\hat{\sigma}^2 + U\hat{\gamma} > 0$, where $\hat{\sigma}^2$ and $\hat{\gamma}$ are the weighted least squares estimates of σ^2 and γ.

5. TRUST is regressed, via weighted least squares with $\hat{\sigma}^2 + U\hat{\gamma}$ as the weight, to obtain unbiased and efficient (i.e., minimum variance) estimates of $\boldsymbol{\beta}$.

Once we obtain estimates of β and γ, the estimate of individual trust uncertainty is given by $U\hat{\gamma}$.

Discussion of the Estimation and Identification

Step 1. Estimate an OLS regression model with TRUST as the dependent variable and **M** as the vector of independent variables. Let *a* be the estimate of α, **b** be the estimate of $\boldsymbol{\beta}$ and s(**b**) be the standard error of **b**. Although **b** is an unbiased and consistent estimate of $\boldsymbol{\beta}$, it is inefficient, and s(**b**) is biased (Amemiya, 1985; Greene, 1997; Jobson & Fuller, 1980). The inefficiency stems from the fact that although the residuals, e = (TRUST-*a*- **Mb**), will have the same limiting distribution as that of ε, the estimation ignores the heteroscedasticity in ε (note that $E[\text{var}(\varepsilon_i)] = \mathbf{U_i}\boldsymbol{\gamma} + \boldsymbol{\sigma}^2 \neq$ constant $\forall i$).

Step 2.Compute $e_i^2 = (\text{TRUST}_i\text{-}a\text{-}\mathbf{M_i b})^2$. Note that

$$\text{(A2)}\quad e_i = \text{TRUST}_i\text{-}a\text{-}\mathbf{M_i b} = \text{TRUST}_i\text{-}\alpha\text{-}\mathbf{M_i}\boldsymbol{\beta}\text{-}(a\text{-}\alpha)\text{-}\mathbf{M_i}(\mathbf{b}\text{-}\boldsymbol{\beta}) = \boldsymbol{\epsilon}_i\text{-}(a\text{-}\alpha)\text{-}\mathbf{M_i}(\mathbf{b}\text{-}\boldsymbol{\beta}).$$

Therefore,

$$\text{(A3)}\quad e_i^2 = \varepsilon_i^2 + (a\text{-}\alpha)^2 + [\mathbf{M_i}(\mathbf{b}\text{-}\boldsymbol{\beta})]^2 - 2e_i(a\text{-}\alpha) - 2\boldsymbol{\epsilon}_i\mathbf{M_i}(\mathbf{b}\text{-}\boldsymbol{\beta}) - 2(a\text{-}\alpha)\mathbf{M_i}(\mathbf{b}\text{-}\boldsymbol{\beta})$$

Now, because $E(\varepsilon_i^2) = \text{var}(\varepsilon_i)$, we can write $\varepsilon_i^2 = \text{var}(\varepsilon_i) + \eta_i$, where η_i is the difference between ε_i^2 and its expectation. Further, because *a* and **b** are consistent estimates of α and $\boldsymbol{\beta}$, respectively (Greene 1997), the latter five terms in Equation (A3) will be asymptotically negligible (say κ_i), we can write substitute from A1 to express A3 as follows:

$$\text{(A4)}\quad e_i^2 = \mathbf{W_i}\boldsymbol{\delta} + \boldsymbol{\kappa}_i + \eta_i = \mathbf{W_i}\boldsymbol{\delta} + \xi_i$$

where $\mathbf{W_i} = [\mathbf{U_i}, 1]$ and $\boldsymbol{\delta} = [\boldsymbol{\gamma}, \boldsymbol{\sigma}^2]$.

Step 3. Estimate Equation A4 via OLS regression. Let $\mathbf{d_1}$ be the estimate of $\boldsymbol{\delta}$ and s($\mathbf{d_1}$) be the standard error of $\mathbf{d_1}$. Although Equation A4 resembles a classical regression model, three properties of ξ are relevant in small samples: (a) it has a nonzero mean, (b) it is correlated across observations because each ξ has been constructed from the same estimate of $\boldsymbol{\beta}$, and (c) it is heteroscedastic. Amemiya (1985), however, shows that the first and second issues are absent in large samples—ξ_i has a zero mean and is nonautocorrelated. We can therefore expect the $\mathbf{d_1} = [\hat{\gamma}, \hat{\sigma}^2]$ to be a consistent estimator of $\boldsymbol{\delta} = [\boldsymbol{\gamma}, \sigma^2]$. This estimation, therefore, allows us to quantify the extent to which **U** explains variance in the second moment of the TRUST distribution. In turn, we can correct for the heteroscedastic nature of ξ_i because we know that $E(\text{var}[e_i 2]) = 2(\mathbf{W_i}\boldsymbol{\delta})^2$ (see Amemiya, 1985).

Step 4. Compute $\omega_U = 0.5(\mathbf{W_i d})^{-2}$. Estimate Equation A4 using weighted least squares with w_U as the weight, given the condition that the predicted dependent variable from the regression is nonnegative. Specifying this condition is important to preserve the conceptual underpinnings of the model that predicted variances cannot be negative. Let $\mathbf{d_2}$ be the estimate of $\boldsymbol{\delta}$ and s($\mathbf{d_2}$) be the standard error of $\mathbf{d_2}$. It is important to note that $\mathbf{d}_2$ has the desirable property of asymptotic normality and consistency (see Amemiya, 1977). Parameter testing then proceeds as in any regression model.

Step 5. Compute $\omega_L = [E(\mathbf{W_i d_2} | \mathbf{W_i d_2} > 0)]^{-1}$ and estimate a weighted regression model with TRUST as the dependent variable, **M** as the vector of independent variables and w_L as the weight. Let $\mathbf{b_2}$ be the estimate of $\boldsymbol{\beta}$ and s($\mathbf{b_2}$) be the standard error of $\mathbf{b_2}$. These estimates possess the desirable properties of asymptotic normality, unbiasedness, consistency, and efficiency. Parameter testing then proceeds as in any regression model.

It is important to recognize that **M** and **U** influence different aspects of the latent distribution of TRUST. First, **M**, the vector of antecedents of trust magnitude, is influencing the mean (or the first moment) of the TRUST distribution (note from Equation 1 that $e[\text{TRUST}] = \alpha + \text{TM}$). In turn, **U**, the vector of antecedents of trust uncertainty, is affecting the variance (or the second moment) of that distribution (note from Equation 1 that $e[\text{var}(\text{TRUST})] = \text{TU} + \sigma^2$). Because the first and second moments of the normal distribution are uncorrelated (Greene, 1997), **M** and **U** vectors can witness overlap and will not affect parameter estimation. We can thus tease out the impact of variables on trust magnitude from that on trust uncertainty.

Greene (1997) also suggests that it is possible to iterate around the preceding steps. In this extension, following step 5, compute $\Delta_{\mathbf{b}} = |\text{s}(\mathbf{b}_2)\text{-s}(\mathbf{b})|$ and $\Delta_{\mathbf{d}} = |\text{s}(\mathbf{d}_2)\text{-s}(\mathbf{d}_1)|$ and let φ be a very small number (say 0.0001). If $\Delta_{\mathbf{b}} > \varphi$, replace **b** with $\mathbf{b_2}$, go back to step 2 and proceed and if $\Delta_{\mathbf{b}} \leq \varphi$, examine $\Delta_{\mathbf{d}}$. In turn, if $\Delta_{\mathbf{d}} > \varphi$, replace $\mathbf{d}_1$ with $\mathbf{d}_2$, go back to step 4 and proceed, and if $\Delta_{\mathbf{d}} \leq \varphi$, stop. The convergence estimates of $\mathbf{b}_2$ and $\mathbf{d_2} = [\hat{\gamma}, \hat{\sigma}^2]$ possess the desirable properties of asymptotic normality, unbiasedness, consistency, and efficiency.

Model Testing

Based on the model estimates, the likelihood function values for the trust uncertainty and magnitude dimensions are given by:

$$\text{(A5)}\quad L_{TU} = \prod_i s_\chi^{-1}\phi\left[(\hat{e}_i^2 - W_i d_2)/s_\chi \mid \hat{e}_i^2 > 0\right]$$

$$\text{(A6)}\quad L_{TM} = \prod_i (W_i d_2)^{-0.5}\phi\left[(\hat{e}_i)/(W_i d_2)^{0.5}\right]$$

where $\hat{e}_i = \text{TRUST}_i\text{-}a\text{-}\mathbf{M_i b}_2$ and $\phi[.]$ denotes the standard normal pdf. Model testing revolves around the contribution of hypothesized variables in our understanding of trust magnitude and uncertainty. To meaningfully address the issue of contribution, we first define ω_{TM} and ω_{TU} as effect sizes of **M** (the hypothesized drivers of trust magnitude) and **U** (the hypothesized drivers of trust uncertainty). Consistent with maximum-likelihood testing, these are computed, in log-likelihood units, as follows:

(A7) $\boldsymbol{\omega}\text{-}_{TM} = (ln\ L_{TM})\text{-}(ln\ L_{TM}|\boldsymbol{\beta}=0)$

(A8) $\boldsymbol{\omega}\text{-}_{TU} = (ln\ L_{TU})\text{-}(ln\ L_{TU}|\boldsymbol{\gamma}=0)$

where L_{TM} and L_{TU} are expressed in Equations A5 and A6, respectively. Three important questions can now be addressed in the JUMP model framework.

Question 1: Is the overall JUMP model significant? As in an overall model-fit test, we are interested in assessing the extent to which the variables included in the analysis explain judgment magnitude and judgment uncertainty. This is a test of the null hypothesis H_0: $\boldsymbol{\beta} = \boldsymbol{\gamma} = 0$, with $p + k$ degrees of freedom. Consistent with standard likelihood-ratio testing, we employ the following test statistic:

(A9) $$2[\ (ln\ L_{TU}\text{-}ln\ L_{TU}|\boldsymbol{\gamma}=0) + (ln\ L_{TM}\text{-}ln\ L_{TM}|\boldsymbol{\beta}=\boldsymbol{\gamma}=0)\ ] = 2[\boldsymbol{\omega}_{TU} + ln\ L_{TM}\text{-}ln\ L_{TM}|\boldsymbol{\beta}=\boldsymbol{\gamma}=0] \sim \chi^2_{p+k}$$

Question 2: Is the two-dimensional model better than the one-dimensional model? Here we are interested in whether the magnitude–uncertainty specification outperforms a model that ignores uncertainty. This is a test of the null hypothesis H_0: $\boldsymbol{\gamma} = 0$, with k degrees of freedom and the appropriate test statistic is given by:

(A10) $$2[\ (ln\ L_{TU}\text{-}ln\ L_{TU}|\boldsymbol{\gamma}=0) + (ln\ L_{TM}\text{-}ln\ L_{TM}|\boldsymbol{\gamma}=0)\ ] = 2[\boldsymbol{\omega}_{TU} + ln\ L_{TM}\text{-}ln\ L_{TM}|\boldsymbol{\gamma}=0] \sim \chi^2_k$$

*Question 3: Is there a significant contribution of **M** in explaining the mean of trust?* This is a test of the trust magnitude specification, that is, a test of the null hypothesis H_0: $\boldsymbol{\beta} = 0$. This test involves p degrees of freedom and employs the following test statistic:

(A11) $$2\omega_{TM} \sim \chi^2_p.$$

*Question 4: Is there a significant contribution of **U** in explaining the variance of trust?* This is a test of the trust uncertainty specification, that is, a test of the null hypothesis H_0: $\boldsymbol{\gamma} = 0$. This test involves k degrees of freedom and employs the following test statistic:

(A12) $$2\ \omega_{TU} \sim \chi^2_k.$$