Motivation and Emotion, Vol. 19, No. 3, 1995

Physicians' Reactions to Uncertainty: Refining the Constructs and Scales[1]

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The Physicians' Reactions to Uncertainty (PRU) scales were developed to measure physicians' affective reactions to uncertainty. However, the structural (factor) model for the two PRU scales has not been cross validated on an independent sample of physicians. We surveyed 337 physicians in internal medicine at Indiana University to test the structural model for the PRU scales using confirmatory factor analysis and, if necessary, to refine the constructs and scales. The structural model of the original PRU scales did not fit the data (χ^2 = 559.26, p < .001) provided by the 265 (79%) respondents. Based on models suggested by 15 volunteers, we refined the constructs and scales. The four new scales are Anxiety Due to Uncertainty (five items, α = .85), Concern about Bad Outcomes (three items, α = .74), Reluctance to Disclose Uncertainty to Patients (five items, α = .76), and Reluctance to Disclose Mistakes to Physicians (two items, α = .75). The revised structural models have greater conceptual clarity, better fit to the data, and shorter scale measures than the original PRU model.

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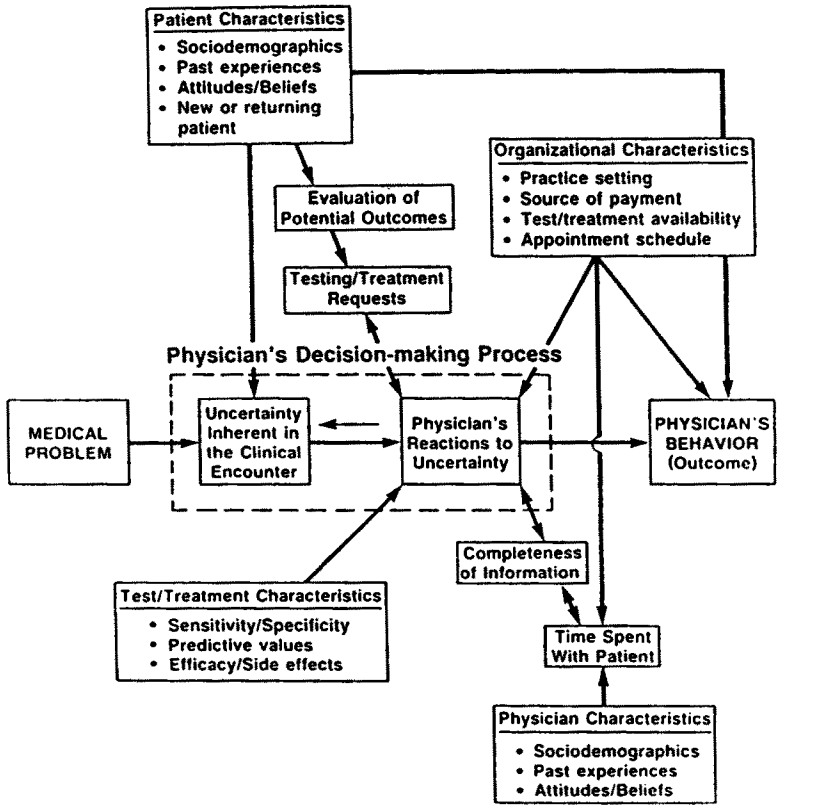

Fig. 1. Conceptual model of the factors influencing physicians reactions to uncertainty.

Physicians vary significantly in their use of tests and treatments (Brook, et al., 1984; Roos & Roos, 1981; Wennberg, 1986). This variation occurs without demonstrated variability in the epidemiology of the diseases or illnesses for which these tests and treatments would be relevant (Connell, Day, & LoGerfo, 1981; Roos & Roos, 1981). One explanation is that clinical uncertainty leads physicians to adopt local customs as the standard of care when there is little empirical evidence providing "certainty" (Eddy, 1984; Eddy & Billings, 1988; Goyert, Bottoms, Treadwell, & Nehr, 1989; Katz, 1984; Light, 1979; Wennberg, Barnes, & Zubkoff, 1982). In spite of this explanation, physicians' attitudes toward uncertainty have received little systematic attention (Katz, 1984; Lusted, 1984).

We developed the Physicians' Reactions to Uncertainty (PRU) scales to measure physicians' affective reactions to uncertainty and coping behaviors (Gerrity, DeVellis, & Earp, 1990). Our first step was to develop a con-

ceptual model (Fig. 1) to guide our investigations of physicians' reactions to uncertainty (Gerrity, Earp, DeVellis, & Light, 1992). This model attempts to integrate internal processes, cognitive and affective, with external influences, sociological and cultural. It focuses on five major elements: the patient, the medical problem or illness, the physician, test and treatment characteristics, and the organizational environment.

Next, we defined the construct "physicians' reactions to uncertainty" as "(a) the emotional reactions and concerns engendered in physicians who face clinical situations that are unfamiliar or not easily resolved and (b) the behaviors used by physicians to cope with those emotions and concerns" and wrote items consistent with this definition. Although this definition highlighted emotions, concerns, and behaviors, its boundaries were broad. This was intentional for two reasons. First, a wide variety of issues were raised by physicians in discussing their reactions to uncertainty during informal interviews (Gerrity et al., 1990). Second, prior theory and research did not provide a clear direction for defining specific, focused constructs. It was not clear, at the start of the scale development study, exactly what constructs would emerge as physicians' reactions to uncertainty.

Exploratory factor analysis of physicians' responses to 61 items in the original scale development survey identified two constructs that we named "stress from uncertainty" and "reluctance to disclose uncertainty to others." These constructs were measured by a 13-item and 9-item scale, respectively. However, independent reviewers identified additional themes running through the items in these scales (Gerrity et al., 1990). This suggested that the constructs, stress from uncertainty and reluctance to disclose uncertainty to others, might be multidimensional. We, therefore, began the current study with the following objectives: (1) to cross validate the structural (factor) model underlying the PRU scales using confirmatory factor analysis (Bollen, 1989; Bollen & Lennox, 1991), and (2) if the original model was not validated, to refine the PRU constructs and scales.

METHODS

Sample and Data Collection

In October 1989, all residents (n = 119) and fellows and faculty (n = 218) in the Department of Medicine at Indiana University received a self-administered questionnaire containing the 22 items from the PRU scales and five new items concerning disclosing uncertainty. We asked the physicians to respond to the 27 items using a 6-point Likert scale ranging from (1) *strongly disagree* to (6) *strongly agree.* One week after the initial mailing,

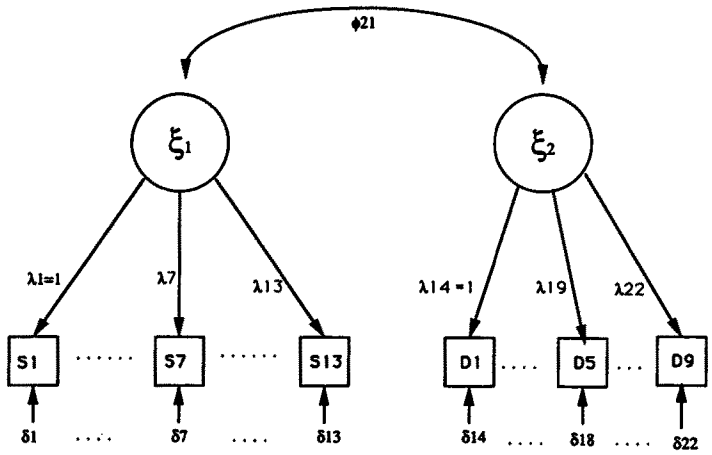

Fig. 2. Confirmatory factor analysis model of the original physicians' reactions to uncertainty scales with 22 items.

all physicians received a postcard reminding them to return the questionnaire. Three weeks and 7 weeks after the initial mailing, nonresponders were sent a letter and replacement questionnaire. The study was approved by the Institutional Review Boards at Indiana University and the University of North Carolina at Chapel Hill.

Data Analysis

Testing the Original PRU Model. We used confirmatory factor analysis (CFA) to test a two-factor model of the original PRU scales. CFA was used because we could specify a model, a priori, for the constructs stress from uncertainty and reluctance to disclose uncertainty to others (Gerrity et al., 1990). CFA tests the hypothesis that a specific model fits the data by analyzing the covariance among the observed variables in the model (Baldwin, 1989). The model we tested appears in Fig. 2. The notation for this model follows standard path diagram and LISREL notation (Bollen, 1989; Jöreskog & Sörbom, 1986). The ξ_1 and ξ_2 represent the latent or unobserved variables (factors) stress from uncertainty and reluctance to disclose uncertainty to others. The curved arrow between ξ_1 and ξ_2 stands for the covariance or correlation between the latent variables, ϕ_{12}. The latent variables, ξ_1 and ξ_2, influence physicians' responses to the 13 items in the Stress scale and the nine items in the Disclosure scale, respectively. These 22 items are called the observed variables or indicators. The λ (lambda)

coefficients, the influence of the latent variables on the indicators, are interpreted in a manner similar to factor loadings or regression coefficients. The deltas (δ) are the variability in the items that are due to measurement error.

We used the maximum-likelihood fitting function to estimate the measurement model in Fig. 2 and evaluate the correspondence or "fit" of the model to the data (SAS Institute, 1991; Tanaka 1987; Bollen, 1989). A chi-square test was used to assess model fit. Chi-square should *not* be statistically significant when a model fits the data. The chi-square test assumes that the distribution of the observed variables has no excessive kurtosis (Browne, 1974). Since some of our observed variables did not fully satisfy this assumption, we also estimated our model using the weighted least-squares (WLS) fitting function, a distribution-free estimator (Browne, 1984; SAS Institute, 1991), to investigate the robustness of the maximum-likelihood-based tests.

Because the chi-square test is sensitive to minor deviations from perfect model fit (Bollen, 1989, p. 268), we also used six other measures of overall model fit: Δ_1 and ρ_2 (Bentler & Bonett, 1980), Δ_2 and ρ_1 (Bollen, 1988), and the Goodness of Fit Index (GFI) and Adjusted GFI (AGFI) (Jöreskog & Sörbom, 1986). Higher values of these measures indicate a better model fit. All have a maximum value of 1.0 except Δ_2 and ρ_2, which can exceed 1.0. Because consensus has not emerged as to the best overall fit measure, we used all six with the criterion for adequate model fit being all six fit indices ≥ 0.9. Finally, we assessed model fit by examining the fit of components of the model, particularly the influence of the latent variables on the items as represented by the λ coefficients and the squared multiple correlations (R^2) for each item.

Refining the PRU Constructs and Model. We asked 15 volunteers (six physicians and nine graduate students) to sort the 22 original PRU items plus five new items into groups of related items. Restrictions were not placed on the number of groups or items in a group. We then asked the volunteers to describe or name each group of items. This "name" was regarded as the construct or latent variable uniting the group of items. Each latent variable (construct) and its respective indicators (items) were considered a single-factor model. Confirmatory factor analysis was again used to evaluate the goodness of fit for the single-factor models.

We then selected the single-factor models with the best fit indices (all six indices ≥ 0.90). Four models met our criteria. Because two of the four models were related to stress from uncertainty and two were related to disclosing uncertainty and mistakes, we tested a two-factor (two-dimensional) model of stress from uncertainty and a two-factor model of reluctance to disclose uncertainty and mistakes. We made revisions in these

Table I. Overall Fit Measures for the Original Model of Physicians' Reactions to Uncertainty (PRU), a Two-Factor Model of Stress from Uncertainty, and a Two-Factor Model of Reluctance to Disclose Uncertainty and Mistakes[a]

Overall fit measures	Original PRU model[b] (22 items, N = 227)	Stress from Uncertainty[c] (eight items, N = 252)	Reluctance to Disclose Uncertainty and Mistakes[c] (seven items, N = 253)
χ^2	559.26	37.08	13.43
(df)	(208)	(19)	(10)
p value	<.001	<.008	<.201
Δ_1	0.72	0.96	0.97
Δ_2	0.80	0.98	0.99
ρ_1	0.68	0.94	0.94
ρ_2	0.78	0.97	0.98
GFI	0.81	0.96	0.98
AGFI	0.77	0.93	0.96

[a]See text for descriptions of Δ_1, Δ_2, ρ_1, ρ_2, GFI, and AGFI. GFI = Goodness of Fit Index; AGFI = Adjusted GFI.
[b]The weighted least-square estimator could not be used because the weight matrix was singular for this model. The reported chi-square and fit indices are based on the maximum-likelihood estimator.
[c]The chi-square and fit indices based on the weighted least-square estimator were similar to those based on the maximum-likelihood estimator; therefore, they are not reported.

models based on the parameter estimates and modification indices (Bollen, 1989; SAS Institute, 1991). Items that were significantly influenced by more than one latent variable (double loaded) were removed from the model, and the model was reevaluated.

Our last step was to analyze physicians' scores on the new scales. We calculated a score for each physician by summing the responses to the items in the scale. If a response was missing, the scale was not scored. We described the distribution of the scores and calculated Cronbach's alpha for each scale (SAS Institute, 1989). The t-test and analysis of variance (ANOVA) were used to determine to what extent physicians' scores differed based on gender, training status, and subspecialty status (general internist vs. subspecialist).

RESULTS

Characteristics of the Physicians

Two hundred sixty-five (79%) physicians responded to the questionnaire. The mean age of the physicians was 35.3 years (SD = 9.3 years), 51 (19%) were female, and a mean of 10.2 years (SD = 9.6 years; median =

Table II. The Revised Physicians' Reactions to Uncertainty Scales[a]

	Stress from Uncertainty
Anxiety due to Uncertainty (five items)	
S3	I usually feel anxious when I am not sure of a diagnosis.
S5	I find the uncertainty involved in patient care disconcerting.
S9	Uncertainty in patient care makes me uneasy.
S11	I am quite comfortable with the uncertainty in patient care.[b]
S13	The uncertainty of patient care often troubles me.
Concern About Bad Outcomes (three items)	
S6	When I am uncertain of a diagnosis, I imagine all sorts of bad scenarios—patient dies, patient sues, etc. . . .
S8	I fear being held accountable for the limits of my knowledge.
S10	I worry about malpractice when I do not know a patient's diagnosis.
	Reluctance to Disclose Uncertainty and Mistakes
Reluctance to Disclose Uncertainty to Patients (five items)	
D2	When physicians are uncertain of a diagnosis, they should share this information with their patients.[b]
D8	I always share my uncertainty with my patients.[b]
D9	If I shared all of my uncertainties with my patients, they would lose confidence in me.
N2	Sharing my uncertainty improves my relationship with my patients.[b]
N5	I prefer patients not know when I am uncertain of what treatments to use.
Reluctance to Disclose Mistakes to Physicians (two items)	
D4	I almost never tell other physicians about diagnoses I have missed.
D6	I never tell other physicians about patient care mistakes I have made.

[a]Items are rated on a 6-point Likert scale: 1 = *strongly disagree*, 2 = *moderately disagree*, 3 = *slightly disagree*, 4 = *slightly agree*, 5 = *moderately agree*, 6 = *strongly agree*. Scales are scored by summing physicians' response to each item in the scale (note reverse-scored items). A scale should not be scored if a response is missing.

S3, D2, N2, etc., represent the number of the item from the original scales. This notation corresponds to the notation used in other figures and tables in this paper. S = original Stress scale; D = original Disclosure scale; N = new item written for the Disclosure scale.

[b]Items that are reverse scored.

6 years) had passed since medical school graduation. Ninety-nine (38%) physicians were residents, 35 (14%) were fellows, and 114 (44%) were full-time internal medicine faculty. Out of the 154 fellows and faculty, 32 (21%) were general internists and 122 (79%) were subspecialists (e.g., cardiologists).

Testing the Original PRU Model

Table I presents a summary of the overall fit indices for the two-factor model of the original PRU constructs and scales (Fig. 2). The large number of variables in this model made calculation of the weight matrix for weighted least-squares estimation impossible. Therefore, only the maximum-likelihood estimator was used. The analysis reported in Table I reveals

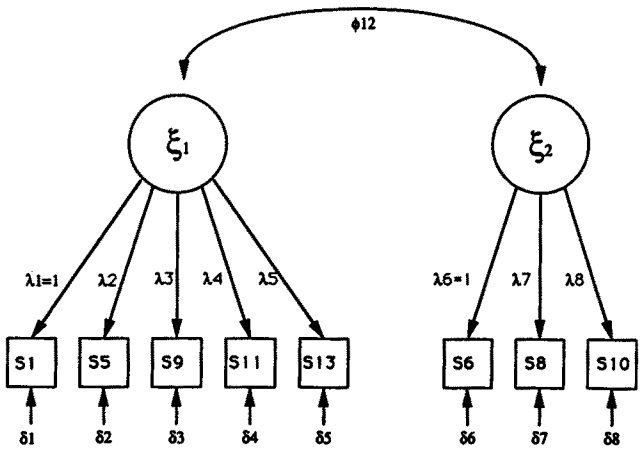

Fig. 3. Confirmatory factor analysis model of stress from uncertainty with eight items.

that the original PRU model does not fit the data. The chi-square of 559.26 is significant, and the various fit indices are well below 0.90.

Refining the Original Model

Fifteen volunteers identified and named over 50 different groups of items representing unidimensional constructs (single-factor models). Confirmatory factor analysis identified four models having all six fit indices $\geq$ 0.90. We named the four constructs Anxiety due to Uncertainty, Concern About Bad Outcomes, Reluctance to Disclose Uncertainty to Patients, and Reluctance to Disclose Mistakes to Physicians based on the names given to us by the volunteers. Table II lists the 15 items included in the four new scales. Two items in the new Reluctance to Disclose Uncertainty to Patients scale are new items (N2 and N5). The remaining items are from the original Stress and Disclosure scales.

New Stress Model. Figure 3 displays the hypothesized two-factor (two-dimensional) model of stress from uncertainty. The ξ_1 and ξ_2 represent the latent or unobserved variables (factors) Anxiety due to Uncertainty and Concern About Bad Outcomes. ξ_1 and ξ_2 influenced physicians' responses to the items in the Anxiety and Outcomes scales, respectively. A summary of the overall fit measures for this model appears in Table I. Although the chi-square of 37.08 is significant ($p < .008$), all six fit indices are > 0.90, indicating a good overall fit.

Table III. Maximum-Likelihood Parameter Estimates and Squared Multiple Correlations for the Two-Factor Model of Stress from Uncertainty with Eight Items (N = 252)

Parameter	Unstandardized estimate (standard error)[a]	Standardized estimate	R^2
	Anxiety due to Uncertainty		
λ_1 (S3)	1.00[b] (—)	0.66	.43
λ_2 (S5)	1.30 (0.12)	0.77	.60
λ_3 (S9)	1.32 (0.12)	0.83	.70
λ_4 (S11)	1.04 (0.12)	0.64	.41
λ_5 (S13)	1.38 (0.13)	0.80	.64
	Concern About Bad Outcomes		
λ_6 (S6)	1.00[b] (—)	0.71	.51
λ_7 (S8)	1.01 (0.11)	0.72	.52
λ_8 (S10)	0.89 (0.10)	0.68	.47
ϕ_{11}[c] (ξ_1)	0.54 (0.10)	—	—
ϕ_{22} (ξ_2)	0.87 (0.15)	—	—
ϕ_{12} (ξ_1, ξ_2)	0.54 (0.08)	0.79	-

[a]All parameter estimates are significant at $p < .05$.
[b]Parameters constrained to 1.0 in order to scale the latent variables.
[c]ξ_1 is the latent variable anxiety due to uncertainty and ξ_2 concern about bad outcomes. ϕ_{11} is the variance of ξ_1, ϕ_{11} is the variance of ξ_2, and ϕ_{12} is the covariance.

In addition, the parameter estimates supported the fit of the model (Table III). The estimates for the λs are in the predicted direction and statistically significant ($p < .05$). The standardized estimates can be interpreted as factor loadings. The magnitude of the loadings ranged from .64 to .83, indicating a strong influence of the latent variables, Anxiety due to Uncertainty and Concern About Bad Outcomes, on their respective items. Furthermore, a substantial portion of the variability in each item was accounted for by the latent variables (R^2 ranged from .41 to .70).

Finally, Anxiety due to Uncertainty and Concern About Bad Outcomes were highly correlated (r = .79) according to the sample estimate for ϕ_{12}. Because of the strong correlation, a reasonable question is whether anxiety due to uncertainty (ξ_1) and Concern About Bad Outcomes (ξ_2) were per-

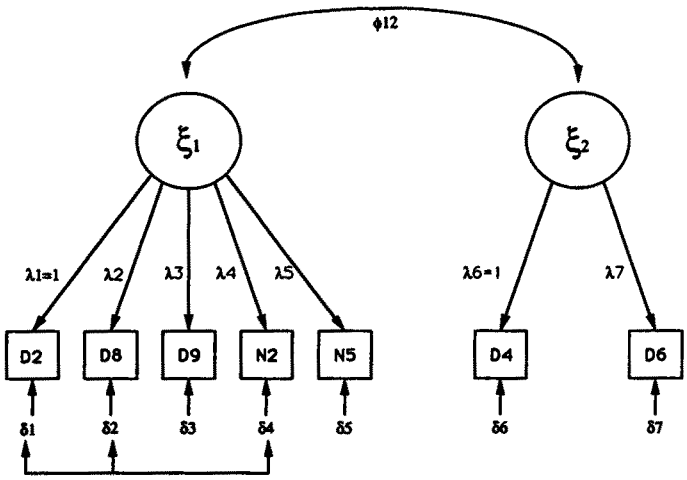

Fig. 4. Confirmatory factor analysis model of Reluctance to Disclose Uncertainty and Mistakes with seven items.

fectly correlated. We tested this hypothesis by constraining the correlation between ξ_1 and ξ_2 to equal 1.0 for the model in Fig. 3. The test of the constrained model produced an error message ("the central parameter matrix Φ has probably 1 zero eigenvalue"), indicating a significant problem with the model. Under these conditions, the chi-square (65.17, $p < .0001$) and fit indices should not be interpreted. Since the model constraining the correlation between ξ_1 and ξ_2 to equal 1.0 had significant problems, we concluded that Anxiety due to Uncertainty and Concern About Bad Outcomes were not perfectly correlated and represented distinct constructs.

New Disclosure Model. We also tested a two-factor (two-dimensional) model of Reluctance to Disclose Uncertainty and Mistakes to others (Fig. 4). The ξ_1 and ξ_2 represent Reluctance to Disclose Uncertainty to Patients and Reluctance to Disclose Mistakes to Physicians, respectively. ξ_1 and ξ_2, influenced physicians' responses to the five items in the Disclosing Uncertainty to Patients scale and the two items in the Disclosing to Mistakes to Physicians scale, respectively. In addition, the measurement errors for the positively worded Items (D2, D8, and N2) were correlated, as represented by the joined arrows below δ_1, δ_2, and δ_4. The two-factor model of Reluctance to Disclose Uncertainty and Mistakes has an excellent fit (Table I). The chi-square estimate of 13.43 ($p < .201$) and accompanying fit indices (e.g., $\Delta_1 = .97$, $\Delta_2 = .99$, $\rho_1 = .94$, and $\rho_2 = .98$) all indicate an excellent fit.

Table IV permits a closer examination of the adequacy of the hypothesized model. The estimates for the λs are in the predicted direction and

Table IV. Maximum-Likelihood Parameter Estimates and Squared Multiple Correlations for the Two-Factor Model of Reluctance to Disclose Uncertainty and Mistakes with Seven Items (N = 253)

Parameter	Unstandardized estimate (standard error)[a]	Standardized estimate	R^2
Reluctance to Disclose Uncertainty to Patients			
λ_1	1.00[b]	0.57	.32
(D2)	(—)		
λ_2	1.17	0.52	.28
(D8)	(0.16)		
λ_3	1.53	0.66	.43
(D9)	(0.22)		
λ_4	1.02	0.59	.35
(N2)	(0.14)		
λ_5	1.50	0.80	.63
(N5)	(0.21)		
Reluctance to Disclose Mistakes to Physicians			
λ_6	1.00[b]	0.86	.75
(D4)	(—)		
λ_7	1.01	0.65	.42
(D6)	(0.11)		
ϕ_{11}[c]	0.32	—	—
(ξ_1)	(0.08)		
ϕ_{22}	0.95	—	—
(ξ_2)	(0.22)		
ϕ_{12}	0.25	0.45	—
(ξ_1, ξ_2)	(0.06)		

[a]All parameter estimates are significant at $p < .05$.
[b]Parameters constrained to 1.0 in order to scale the latent variables.
[c]ξ_1 is the latent variable reluctance to disclose uncertainty to patients and ξ_2 reluctance to disclose mistakes to physicians. ϕ_{11} is the variance of ξ_1, ϕ_{22} is the variance of ξ_2, and ϕ_{12} is the covariance.

statistically significant. The magnitude of the factor loadings ranged from .52 to .86. Except for item D8, "I always share my uncertainty with my patients," a moderate to substantial portion of the variability in each item was accounted for by the latent variables (R^2 ranged from .32 to .75). Finally, Reluctance to Disclose Uncertainty to Patients and Reluctance to Disclose Mistakes to Physicians were moderately correlated (r = .45).

Physicians' Scores on the New Scales

Table V displays the descriptive statistics for the four new PRU scales. For each scale, the greater the score the greater the reaction (i.e., Anxiety due to Uncertainty, Concern About Bad Outcomes, or Reluctance to Dis-

Table V. Descriptive Statistics and Cronbach's Alpha for Physicians' Scores on the Revised Physicians' Reactions to Uncertainty Scales[a]

Scale	Number of items	Mean (*SD*)	Median	Range[b]	Cronbach's alpha
Anxiety	5	18.8 (4.7)	19	5 to 30	.86
Bad Outcomes	3	9.5 (3.1)	10	3 to 18	.73
Disclosing Uncertainty to Patients	5	13.6 (4.2)	14	5 to 24	.79
Disclosing Mistakes to Physicians	2	4.4 (1.9)	4	2 to 10	.72

[a]The scales were scored by summing the response to the items in the scale. If a response was missing, the scale was not scored. Because of missing values for scale scores, the number of physicians in each analysis varied from 257 to 262.

[b]The greater the score for a scale the greater the anxiety, concern about bad outcomes, reluctance to disclose uncertainty to patients, and reluctance to disclose mistakes to physicians, respectively. The maximum ranges that can be measured by the scales are 5 to 30 for the Anxiety and Disclosing Uncertainty to Patients scales, 3 to 18 for the Bad Outcomes scale, and 2 to 12 for the Disclosing Mistakes to Physicians scale.

close Uncertainty). The average scores were 18.8 (SD = 4.7), 9.5 (SD = 3.1), 13.6 (SD = 4.2), and 4.4 (SD = 1.9) for the Anxiety, Bad Outcomes, Disclosing Uncertainty to Patients, and Disclosing Mistakes to Physicians scales, respectively. Cronbach's alpha ranged from .72 to .86, demonstrating good internal consistency for the scores derived from each scale.

Finally, physicians' scores were compared across gender and training status for the entire sample. Female physicians reported greater anxiety due to uncertainty than male physicians (mean scores ± standard deviations, 19.2 ±+ 4.8 vs. 17.8 ± 4.5, respectively, $t = -2.02, p < .05$). However, there were no significant differences in their scores on the other three scales. Trainees (residents and fellows) reported greater anxiety due to uncertainty than full-time faculty (19.4 ± 3.7 vs. 16.7 ± 4.8, respectively, $t = 4.89, p < .001$), greater concern about bad outcomes (10.3 ± 2.8 vs. 8.6 ± 3.1, respectively, $t = 4.42, p < .001$), greater reluctance to disclose uncertainty to patients (14.1 ± 3.8 vs. 13.0 ± 4.5, respectively, $t = 2.01, p < .05$), and a trend toward greater reluctance to disclose mistakes to other physicians (4.7 ± 1.8 vs. 4.2 ± 1.8, respectively, $t = 1.87, p < .064$).

Because a greater proportion of the trainees (vs. faculty) were women (22% vs. 12%, $\chi^2 = 4.41, p < .04$), we explored the possibility that gender

might account for the differences between trainees and faculty on the Anxiety scale. A factorial ANOVA with two levels for gender and two for practice category (trainee vs. faculty) was significant ($F = 10.08$, $p < .001$). Pairwise comparisons of the four means scores indicated that male faculty reported significantly less anxiety due to uncertainty (mean score, 16.3) than female faculty (19.1), male trainees (19.3), and female trainees (19.8) ($t = 3.87$, $p < .001$, $t = 4.92$, $p < .001$, $t = 2.24$, $p < .026$, respectively). Female faculty and male and female trainees were not significantly different from each other.

For the fellows and faculty, we also compared general internists to subspecialists. General internists and subspecialists were similar in their anxiety due to uncertainty, concern about bad outcomes, and reluctance to disclose uncertainty to patients ($t = 0.17$, 0.68, and 1.03, respectively). However, subspecialists reported greater reluctance to disclose mistakes to other physicians (mean score ± standard deviation, 4.5 ± 2.0) than did general internists (3.6 ± 1.2) ($t = -3.02$, $p = .004$).

DISCUSSION

The Constructs

We originally conceptualized physicians' reactions to uncertainty as two correlated unidimensional constructs, Stress from Uncertainty and Reluctance to Disclose Uncertainty to Others (Fig. 2). This conceptualization was based on an exploratory factor analysis of physicians' responses to 61 items in our scale development study (Gerrity et al., 1990). We found this conceptualization of physicians' reactions to uncertainty to be invalid. The goodness of fit measures for the structural model indicated that it did not fit the data.

However, we identified four meaningful constructs based on the 22 items in the original PRU scales and five new items written for the Disclosure scale. We named these constructs Anxiety due to Uncertainty, Concern About Bad Outcomes, Reluctance to Disclose Uncertainty to Patients, and Reluctance to Disclose Mistakes to Physicians. These constructs and the items representing these constructs have greater clarity than the original constructs and scales. For example, the Anxiety Due to Uncertainty scale consists of five items all containing terms related to anxiety (Lazarus, 1991). In addition, the two-factor models of Stress from Uncertainty and Reluctance to Disclose Uncertainty and Mistakes have good to excellent fits to the data.

The emotional reactions (anxiety and concern) and coping mechanisms (reluctance to disclose uncertainty or mistakes) we identified are consistent with our original definition of physicians' reactions to uncertainty and are clearly described in other studies of physicians. Fox (1957) was the first to identify anxiety, concern about bad outcomes, and mistakes as important issues for medical students as they encounter uncertainty in medical school. Bosk (1979, 1980, 1986) and Mizrahi (1984) expanded Fox's description of the how trainees cope with uncertainty and mistakes in their studies of trainees in internal medicine and surgery. Davis (1960), Light (1979), and Katz (1984) described physicians' reluctance to disclose uncertainty to patients.

A consistent or unifying theme also emerged from these studies and our earlier work (Gerrity et al., 1992)—concern about being inadequate as a physician. The four new PRU constructs relate to issues of personal adequacy as a physician. According to Lazarus (1991, p. 235), "the core relational theme of *anxiety* is *uncertain, existential threat.*" Anxious people are threatened by personal inadequacy, and threats to self-esteem can result in anxiety (Lazarus, 1991). This may be the case when physicians are confronted with uncertainty in their clinical practices.

However, the relationships among the four PRU constructs and feelings of failure or personal inadequacy are not clear. In our models, we hypothesized that the PRU constructs would covary. We did not explore causal relationships. For example, feelings of inadequacy (not measured in this study) might cause concern about bad outcomes and anxiety due to uncertainty. Concern about bad outcomes might, in turn, cause reluctance to disclose uncertainty to patients and mistakes to physicians. These relationships should be explored in future research as a means of furthering our understanding of physicians emotional reactions and coping mechanisms when confronted with clinical uncertainty.

Nonetheless, the most important result of this study is evidence for the structural validity of the individual constructs Anxiety due to Uncertainty, Concern About Bad Outcomes, Disclosing Uncertainty to Patients, and Disclosing Mistakes to Physicians. Further research is needed to cross validate the structural models for the new PRU constructs and to explore the relationship between physicians' emotional reactions to uncertainty and their decision making (cognitive processes), coping strategies (e.g., test ordering), and performance. For example, to what extent does anxiety due to uncertainty and concern about bad outcomes influence physicians' problem-solving abilities under conditions of uncertainty?

The Scales

This study produced four measures having good psychometric properties. First and most importantly, the factor loadings and squared multiple correlations (R^2) indicated that the latent variables had a moderate to strong influence on the items. Second, estimates of the reliability of the four PRU scales were encouraging. Cronbach's alpha ranged from .74 to .85, indicating that the items in each scale, as a group, consistently measured the same construct. Finally, comparisons of physicians' scores on the four new scales across gender and training status were consistent with those from the original scales (Gerrity et al., 1990). For example female faculty reported a greater anxiety due to uncertainty than male faculty, and trainees reported greater anxiety and concern about bad outcomes than faculty physicians. This was expected since the new scales and constructs were derived from the old scales and constructs.

However, physicians in the earlier study were community practitioners, not faculty and trainees at an academic medical center. This may account for some of the differences between the previous study and this study. For example, female and male trainees were similar in their anxiety due to uncertainty, suggesting that being a trainee might overpower the effect of gender. Trainees also reported greater reluctance to disclose uncertainty to patients and mistakes to physicians than did faculty. These findings were new but not surprising. The difference between trainees and faculty seems logical since trainees have less experience and are in educational programs where they are being evaluated; therefore, trainees might be less likely to show that they are uncertain or do not have the "right answers" (Bowers, 1987, pp. 49-72). Finally, subspecialists reported greater reluctance to disclose mistakes to other physicians than general internists. This finding was new but surprising. It may be related to the consultative role the subspecialists play and/or to cultural differences between general internists and subspecialists. Further research is needed to better understand these issues. In the meantime, practice setting should be viewed as a factor that may influence physicians' reactions to uncertainty (see Fig. 1) and care should be taken in interpreting and generalizing the results of studies done at a single site.

In summary, this study makes several important contributions to understanding physicians' reactions to uncertainty. First, the original PRU constructs stress from uncertainty and reluctance to disclose uncertainty to others have been refined. The four new constructs are consistent with the findings from qualitative sociological studies of physicians and psychological research on anxiety and adaptation. Furthermore, the analyses of the Anxiety Due to Uncertainty, Concern about Bad Outcomes, Disclosing Uncer-

tainty to Patients, and Disclosing Mistakes to Physicians scales support the reliability and structural (factorial) validity of these measures. Further research is needed to cross validate the new models, to establish "external evidence" of the validity of these scales (e.g., the ability to use physicians' scores on the scales to predict their test-ordering behavior), and to establish the generalizability of the results of this study. Although further research is needed, the revised PRU scales provide short, conceptually clear, psychometrically sound measures of physicians' emotional reactions to uncertainty that can be used to study the relationship between physicians' emotions, their cognitive processes, and their coping behaviors under conditions of uncertainty.

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