

Original Article

# Adaptation and validation of a Danish version of the Physicians' Reactions to Uncertainty Scales

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## ABSTRACT

**INTRODUCTION.** Uncertainty in medical practice affects physicians' well-being and decision-making. The Physicians' Reactions to Uncertainty (PRU) scale measures affective and behavioural reactions to uncertainty, but no Danish version exists. This study aimed to translate, culturally adapt and validate the PRU.

**METHODS.** The PRU was translated and culturally adapted in accordance with international guidelines. A pilot test assessed face validity. Reliability and validity were examined in a cross-sectional study with 116 physicians using Cronbach's alpha, the intraclass correlation coefficient (ICC) and confirmatory factor analysis (CFA).

**RESULTS.** A Danish version (PRU-DK) was developed with minor linguistic adjustments. It showed strong internal consistency (Cronbach's  $\alpha \geq 0.75$  across subscales) and high item correlations (Spearman's  $\rho = 0.68-0.93$ ). Test-retest reliability was high (ICC  $> 0.80$  for all subscales except *Reluctance to disclose mistakes to physicians*, ICC = 0.56). CFA supported the four-factor model ( $\chi^2/df = 1.66$ , Comparative Fit Index = 0.923, Tucker-Lewis Index = 0.901, Root Mean Square Error of Approximation = 0.076, Standardised Root Mean Square Residual = 0.073). Inter-subscale correlations ranged from 0.16 to 0.62.

**CONCLUSIONS.** The PRU-DK is a validated and reliable tool for assessing Danish physicians' reactions to uncertainty, demonstrating solid psychometric properties and acceptable model fit. The original structure was preserved to enable comparison, but periodic revision is warranted to address cultural shifts and refine behavioural components.

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Uncertainty is an intrinsic part of medical practice [1]. Physicians routinely face complex and unpredictable situations that challenge their clinical judgement [2]. Poor management of such uncertainty is associated with physician well-being [3]. Furthermore, it impairs decision-making, resulting in over-investigation and over-treatment, thereby heightening patient concern [4-6]. These maladaptive responses emphasise the importance of providing better support for physicians in managing uncertainty [7] and cultivating greater comfort in facing it [8].

The Physicians' Reactions to Uncertainty (PRU) scale, developed by Gerrity et al. [9, 10], is the most widely cited and validated instrument for assessing clinicians' responses to uncertainty [2]. The PRU questionnaire supports research on uncertainty among physicians. To the best of our knowledge, the PRU has not been translated or culturally adapted for use in Denmark. A Danish version (PRU-DK) enables comparison of physicians' reactions

to clinical uncertainty across contexts, while also raising awareness of the pervasive role of ambiguity in medicine and the potential consequences of physicians' responses to it. Thus, this study aimed to conduct a translation and cultural adaptation of the PRU for use in Denmark and to investigate the validity and reliability of the PRU-DK.

## Methods

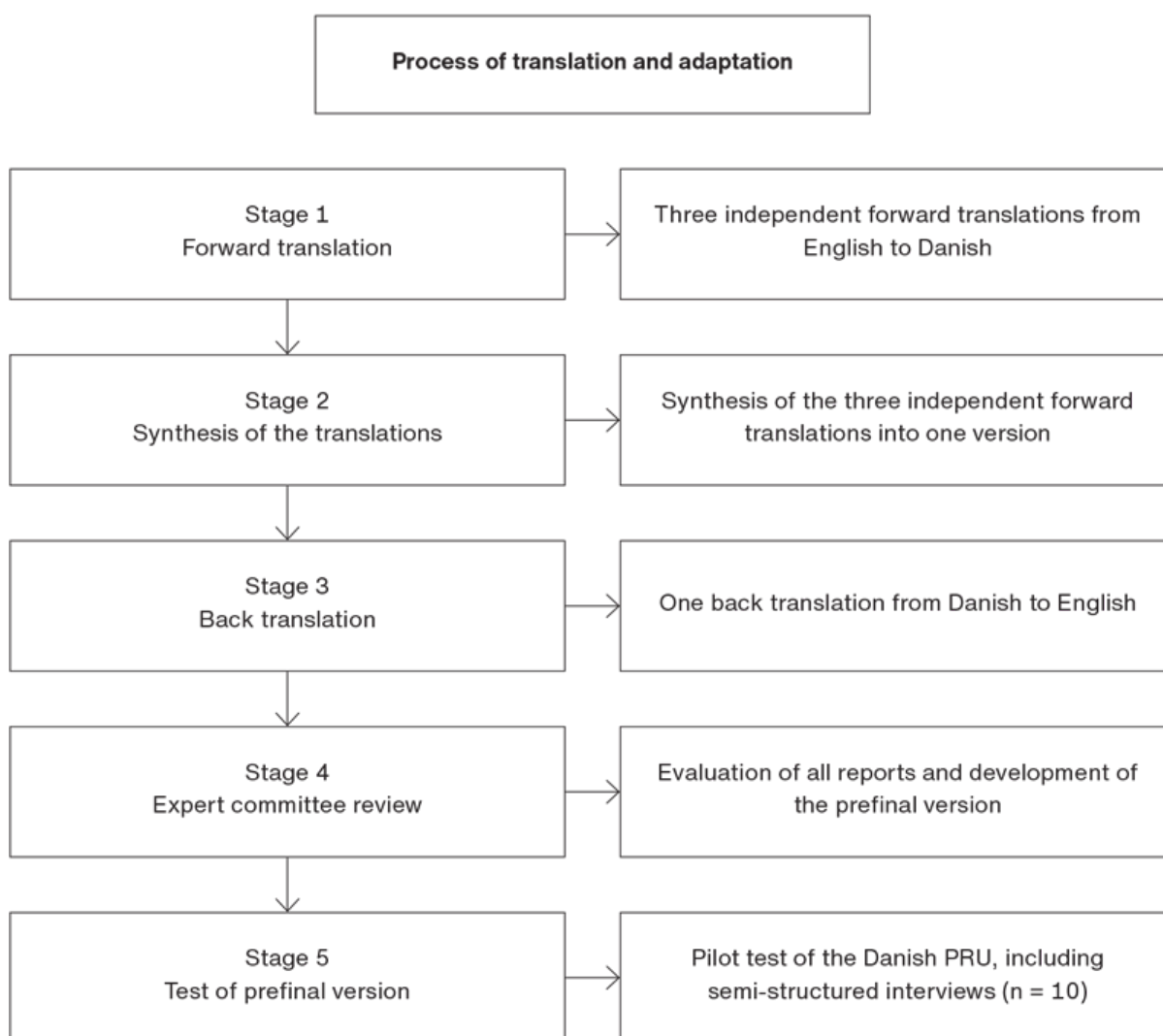
### The Physicians' Reactions to Uncertainty

The PRU was initially developed in 1990 and subsequently refined in 1995, as the two-factor structure of the initial version demonstrated inadequate model fit. The revision brought four new subscales with fewer items and improved psychometric properties [9, 10]. The current version of the instrument comprises four subscales: *Anxiety due to uncertainty* (five items), *Concern about bad outcomes* (three items), *Reluctance to disclose uncertainty to patients* (five items) and *Reluctance to disclose mistakes to physicians* (two items). Responses are given on a six-point Likert scale from 1 (strongly disagree) to 6 (strongly agree), with items 4, 9, 10 and 12 reversely scored. Subscale scores are summed, with higher scores indicating stronger reactions.

### Translation and cultural adaptation

The cross-cultural adaptation followed the guidelines of Beaton et al. [11] (Figure 1). The PRU was independently translated into Danish by three native speakers, one blinded to the study's purpose. Translations were compared, discrepancies resolved and a consensus version synthesised. A native English-speaker, bilingual in Danish, and blinded to the original PRU, back-translated the consensus version. The back translation was compared to the original. An expert committee, comprising a specialist doctor responsible for educational activities in their department, an educational psychologist with a PhD in medical education and expertise in workplace learning and the translation team ensured semantic, idiomatic, experiential and conceptual equivalence. After consensus and revision, the prefinal version was tested on ten physicians with diverse clinical experience, specialities and gender, selected through professional networks to accurately reflect the characteristics of the target study population. The participants completed the questionnaire and engaged in interviews to detect potential misunderstandings and deviations, thereby underpinning face validity and ensuring cultural adaptation. The authors of the original tool [9] were contacted for feedback on the back translation; however, no response was received.

**FIGURE 1** Flow chart illustrating the translation and cultural adaptation process of the Physicians' Reactions to Uncertainty (PRU) into Danish, following the guidelines proposed by Beaton et al. [11].



## Study setting and data collection

Following the pilot study, a cross-sectional survey was conducted among physicians in the Central Denmark Region (from December 2023 to January 2024). Participants varied in specialisations and experience. The questionnaire and study details were emailed to all participants; participation was voluntary and confidential. After three weeks, the same questionnaire was re-sent to all participants to assess test-retest reliability, with instructions not to recall previous responses.

## Statistical analysis

Data were collected in Research Electronic Data Capture (REDCap) [12] and analysed in STATA/SE 18 [13]. Mean subscale scores and standard deviation (SD) were calculated. Floor/ceiling effects were examined. Normality was assessed visually (histograms, Q-Q plots) and statistically (Shapiro-Wilk test). Non-normal distributions ( $p < 0.05$ ) led to the use of non-parametric tests for correlation analyses [14].

To assess internal consistency, Cronbach's alpha was calculated for each subscale, with  $\alpha > 0.70$  indicating acceptable reliability [15]. Item-subscale correlations were examined. Spearman's rank correlation was assessed and regarded as acceptable if the correlation coefficient was  $\geq 0.30$  [14]. The intraclass correlation coefficient (ICC) was used to estimate test-retest reliability, and values of 0.75-0.90 indicated good reliability.

Face and content validity were evaluated by the expert committee and the pilot test participants during the translation and adaptation process. Furthermore, the COSMIN checklist was used to quantify content validity [16]. To explore the construct validity of the proposed four-factor model, a confirmatory factor analysis (CFA) was conducted [17]. Modification indices  $> 10$  refined the model by allowing covariances between items 7 and 8 in the subscale *Concerns about bad outcomes* and items 9 and 10 in the subscale *Reluctance to disclose uncertainty to patients*. Model fit was evaluated using goodness-of-fit indices, including the  $\chi^2/\text{df}$  test, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) and Standardised Root Mean Square Residual (SRMR). Item-factor loadings exceeding 0.30 were regarded as acceptable [14]. Construct validity was further examined via Spearman's correlation between subscales [14].

## Ethics

According to the Danish Consolidation Act on Research Ethics Review of Health Research Projects, Consolidation Act number 38 of 1 September 2020, section 14 (1) [18], only health research studies must be notified to the Committees. The Committees do not consider educational studies to be health research studies (section 2 (1)) [19]. Thus, the study was exempted from ethical approval (case no. 1-10-72-6-23). Furthermore, the study was registered with the Danish Data Protection Agency (record no. 2022-0367531). Participants were informed that by completing the questionnaire, they consented to the use of their responses for research purposes.

*Trial registration:* not relevant.

## Results

### Adaptation

During adaptation, two subscales required changes. In *Anxiety due to uncertainty*, the term "patient care" (item 2-5) was unclear in Danish, as it refers to tasks typically handled by nurses in Denmark. To improve clarity, it was replaced by "diagnosing and treatment of patients" (Danish: "diagnosticering og behandling af patienter"). In item 6 ("...- patient dies, patient sues, etc."), "sues" was replaced by the Danish translation of "to lodge a complaint" (Danish: "at klage") to reflect Danish medico-legal practice.

### Participants

A total of 116 doctors participated, with 92 completing both test-retest questionnaires. Due to missing test-retest matches, 86 were included in the test-retest analysis. Respondent characteristics are presented in **Table 1**. Participants' mean age was 37.5 years (SD = 8.8, range: 27-66 years) and represented 27 of 39 medical specialities. Mean scale scores (SD) ranged from 12.5 (5.2) for *Anxiety due to uncertainty* to 3.7 (1.9) for *Reluctance to disclose mistakes to physicians* (**Table 2**). A notable floor effect (38%) was observed in the subscale *Reluctance to disclose mistakes to physicians* (**Table 2**).

**TABLE 1** Demographic characteristics of 116 physicians, including gender, age, time in profession and professional title. Values are presented as n (%).

<i>Gender</i>	
Male	53 (45.7)
Female	62 (53.4)
Missing	1 (0.9)
<i>Age groups</i>	
< 30 yrs	23 (19.8)
30-40 yrs	42 (36.2)
41-50 yrs	25 (21.6)
≥ 51 yrs	6 (5.2)
Missing	20 (17.2)
<i>Time in profession</i>	
0-4 yrs	43 (37.1)
5-9 yrs	23 (19.8)
10-14 yrs	16 (13.8)
≥ 15 yrs	29 (25)
Missing	5 (4.3)
<i>Title</i>	
Junior doctor: foundation year doctor	17 (14.7)
Introduction doctor: junior resident	15 (12.9)
Resident doctor	14 (12.1)
Specialist training doctor: registrar	27 (23.3)
Senior registrar: staff specialist	11 (9.5)
Private consultant: practising specialist	2 (1.7)
Consultant doctor	23 (19.8)
Chief medical officer: head of department	2 (1.7)
Other	5 (4.3)
Missing	0

**TABLE 2** Descriptive statistics, reliability estimates and inter-scale correlations of the subscales from Physicians' Reactions to Uncertainty for use in Denmark.

Scale	Score				Floor effect, %	Ceiling effect, %	Item-scale-correlation	Reliability: Cronbach's alpha	Test-retest correlation: ICC	Inter-scale correlations <sup>a</sup>			
	min.	max	mean	SD						1	2	3	4
Anxiety due to uncertainty	5	27	12.5	5.2	8.6	0.9	0.7-0.87	0.84	0.83	1			
Concern about bad outcomes	3	18	8.8	3.8	5.2	0.9	0.76-0.88	0.78	0.84	0.62	1		
Reluctance to disclose uncertainty to patients	5	24	12.3	4.6	7.8	0.9	0.68-0.79	0.76	0.85	0.45	0.30	1	
Reluctance to disclose mistakes to physicians	2	10	3.7	1.9	38.0	1.7	0.88-0.93	0.75	0.56	0.35	0.29	0.16	1

ICC = intraclass correlation coefficient; SD = standard deviation.

a) 1 = anxiety due to uncertainty, 2 = concern about bad outcomes, 3 = reluctance to disclose uncertainty to patients, 4 = reluctance to disclose mistakes to physicians. Calculations are based on 116 respondents, except for ICC, which is based on the 86 respondents who completed both questionnaires. Correlations were calculated using Spearman's correlation coefficient.

## Scale reliability and correlations

Internal consistency was high (Cronbach's  $\alpha = 0.87$ ) for the total PRU-DK, with subscales exceeding the 0.7 threshold (0.75-0.84), indicating good reliability. Test-retest reliability was based on a total of 86 questionnaires (74% of 116), with all subscales scoring above 0.8, except *Reluctance to disclose mistakes to physicians* (ICC = 0.56). Normality testing (Shapiro-Wilk, QQ-plots) showed non-normal distributions within all subscales ( $p = 0.001-0.008$ ); hence, Spearman's rank correlation was used. Item-subscale correlations were strong (0.68-0.88), supporting construct validity. Inter-subscale correlations revealed a strong association between *Anxiety due to uncertainty* and *Concern about bad outcomes* ( $\rho = 0.62$ ), while the subscale *Reluctance to disclose mistakes to physicians* in general showed a weaker correlation with the other subscales, especially *Reluctance to disclose uncertainty to patients* ( $\rho = 0.16$ ).

## Factor structure of the Physicians' Reactions to Uncertainty scale

The goodness-of-fit indices indicated an acceptable model fit ( $\chi^2/df = 1.66$ ). CFI (0.923) exceeded the 0.90 threshold, whereas TLI (0.901) was at the lower bound of acceptability. RMSEA (0.076) and SRMR (0.073) fell within acceptable limits, supporting that the overall classification of the model fit as acceptable. All standardised item-factor loadings were above 0.30, reinforcing the robustness of the factor structure and overall model fit (Table 3).

**TABLE 3** Confirmatory factor analysis of the Physicians' Reactions to Uncertainty for use in Denmark, showing standardised factor loadings and goodness-of-fit indices (N = 116).

Item	Factor no.				Values	Cut-off value <sup>a</sup>	
	1	2	3	4		for good fit	for acceptable fit
No. 1: I usually feel anxious when I am not sure of a diagnosis	0.80						
No. 2: I find the uncertainty involved in patient care disconcerting	0.74						
No. 3: Uncertainty in patient care makes me uneasy	0.85						
No. 4: I am quite comfortable with the uncertainty in patient care	0.51						
No. 5: The uncertainty of patient care often troubles me	0.71						
No. 6: When I am uncertain of a diagnosis, I imagine all sorts of bad scenarios - patient dies, patient sues, etc.		0.79					
No. 7: I fear being held accountable for the limits of my knowledge		0.63					
No. 8: I worry about malpractice when I do not know a patient's diagnosis		0.65					
No. 9: When physicians are uncertain of a diagnosis, they should share this information with their patients			0.55				
No. 10: I always share my uncertainty with my patients			0.61				
No. 11: If I shared all of my uncertainties with my patients, they would lose confidence in me			0.69				
No. 12: Sharing my uncertainty improves my relationship with my patients			0.64				
No. 13: I prefer patients not know when I am uncertain of what treatments to use			0.55				
No. 14: I almost never tell other physicians about diagnoses I have missed				0.77			
No. 15: I never tell other physicians about patient care mistakes I have made				0.77			
<b>Model fit indices</b>							
$\chi^2$ test of the model fit					$\chi^2/df = 1.66$ $\chi^2 = 135.986$ $df = 82$ $p < 0.001$	$\leq 2.0$	$\leq 5.0$
Comparative fit index					0.923	$\geq 0.95$	0.90-0.94
Tucker-Lewis Index					0.901	$\geq 0.95$	0.90-0.94
Root mean square error of approximation (95% CI)					0.076 (0.052-0.098)	$\leq 0.06$	0.07-0.08
Standardised root mean square residual					0.073	$\leq 0.08$	$\leq 0.10$

df = degrees of freedom.

a) Included as reference guideline.

## Discussion

This study translated the original PRU into Danish following Beaton et al. [11] and evaluated its psychometric properties among 116 physicians. Face and content validity, assessed through pilot testing and expert review, confirmed clarity and relevance, with minor rewording being introduced to improve understanding without

compromising comparability. The PRU-DK showed good validity and reliability, acceptable model fit and item–subscale correlations exceeding 0.3. These results are consistent with the revised original [10] and German versions [20], preserving the instrument’s conceptual structure and contextual relevance.

Our findings suggest that periodic adaptation of the PRU is needed to strengthen construct and content validity. While recent literature describes reactions to uncertainty among physicians as involving cognitive, affective and behavioral dimensions [2], the PRU mainly captures affective and behavioural aspects. Emotional subscales showed the strongest associations with the underlying construct. The behavioural subscales, especially *Reluctance to disclose mistakes to physicians*, contributed less and were affected by floor effects, likely reflecting Danish cultural shifts towards greater openness about medical errors. Minor linguistic adjustments, such as replacing “to sue” with “to lodge a complaint,” improved cultural relevance without compromising cross-national comparability.

These results may reflect broader changes in medical culture over the past three decades, including less hierarchical physician–patient relationships, better-informed patients and digital access to health records. Such changes may have influenced how uncertainty is perceived and managed. As ambiguity remains inherent to clinical practice [1], the ability to tolerate and manage it is a key professional competency linked to increased well-being [3] and fewer defensive medical practices [4–6] among doctors. Making uncertainty explicit and measurable is therefore essential, not to eliminate it, but to normalise it as part of the profession and to support adaptive coping strategies. The PRU-DK provides a structured framework for this purpose, with applications in research, education and quality improvement.

## Limitations

This study has several limitations. The absence of a reference scale limited the assessment of criterion validity. Validation ideally requires a sufficiently large and representative sample, often achieved through stratification by key background variables. According to the COSMIN checklist [16], structural validity requires at least seven respondents per item, requiring 105 participants for 15 items. In our study, participants were recruited through professional networks. This approach ensured diversity in gender, speciality and clinical experience, but full representativeness cannot be confirmed, and selection bias cannot be excluded. Only 86 of 116 physicians completed the retest. Since the survey was anonymous, non-respondents could not be identified, limiting the assessment of potential response bias.

The four reverse-scored items, designed to minimise acquiescence bias, may increase the risk of misinterpretation and reduce measurement precision, as they demand greater cognitive effort. No such issues emerged during face-validity testing or construct analysis, but a potential for inaccuracy remains. A tendency towards floor effects, particularly in the subscale *Reluctance to disclose mistakes to physicians*, may reflect cultural shifts toward openness, but also indicate limited item sensitivity. Retaining original content ensured comparability but may have restricted responsiveness to observed deviations.

Although the CFA model fit was acceptable, structural refinements could improve the PRU’s relevance in a Danish context. Future studies should revisit the factor structure, adjust subscale composition and reduce item overlap. As also noted by Gerrity and colleagues [10], the need for model revisions underscores that reactions to uncertainty are dynamic, shaped by the socio-cultural environment and require ongoing investigation to ensure accurate assessment.

## Conclusions

This study provides a validated PRU-DK, ensuring a reliable assessment of physicians' affective and behavioural



reactions to uncertainty. The scales demonstrated strong psychometric properties, with good internal consistency and an acceptable model fit. Our adaptation sought to preserve the original structure for cross-national comparability. Nevertheless, periodic revision of items and subscales is warranted to strengthen validity, and future studies should address cultural and linguistic shifts, refine underperforming behavioural components and better capture the cognitive dimension.

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