

# Cross-Culture Adaptation and Validation of the Indonesian Version of the Feeding Cues Follow-up Form (FCF-UF) on NICU Nurses

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Dewi Irianti<sup>1\*</sup>, Dessie Wanda<sup>1</sup>, Fajar Tri Waluyanti<sup>1</sup>, Mega Hasanul Huda<sup>1</sup>

<sup>1\*</sup>Faculty of Nursing, Universitas Indonesia, Depok, Indonesia

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## Correspondence Author:

Dewi Irianti, Pascasarjana  
Fakultas Ilmu Keperawatan  
Univ.Indonesia, Prof Dr  
Bahder Djohan Road,  
Depok.16424

Email:

[dewiiriantii@gmail.com](mailto:dewiiriantii@gmail.com)

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## Abstract

**Background:** Premature infants often experience difficulties in oral feeding due to neurological immaturity and poor coordination of sucking, swallowing, and breathing. These challenges may delay the transition to full oral feeding and prolong hospitalization in neonatal intensive care units (NICUs). The Feeding Cues Follow-Up Form (FCF-UF) is designed to objectively assess feeding cues in premature infants; however, it has not been adapted for use in the Indonesian context.

**Methods:** This cross-sectional study aimed to adapt and evaluate the psychometric properties of the Indonesian version of the FCF-UF. Data were collected from 266 NICU nurses working in several hospitals in Indonesia between June and August 2025. The cross-cultural adaptation process followed seven stages. Internal consistency was assessed using Cronbach's alpha, and test-retest reliability was evaluated using the Intraclass Correlation Coefficient (ICC). Construct validity was examined through Confirmatory Factor Analysis (CFA), and known-group comparisons were conducted to explore differences in instrument scores across respondent characteristics.

**Result:** The Indonesian version of the FCF-UF demonstrated excellent internal consistency (Cronbach's alpha = 0.922) and high test-retest reliability (ICC = 0.99). CFA supported a one-factor structure with very good model fit ( $\chi^2/df = 0.87$ ; RMSEA = 0.000; CFI = 1.000; TLI = 1.001), with strong factor loadings across all items. Known-group comparison showed that pediatric nurse specialists scored significantly higher than nurses with a bachelor's degree ( $p = 0.001$ ).

**Conclusion:** The findings indicate that the Indonesian version of the FCF-UF is a reliable and valid instrument for assessing feeding cues in premature infants. This tool may assist NICU nurses in implementing cue-based care and supporting the transition to oral feeding.

**Keywords:** Premature Infants, Feeding Cues, Psychometric

## BACKGROUND

Premature infants often encounter challenges in transitioning to oral feeding. These difficulties are mainly caused by the immaturity of the central nervous system and the underdeveloped coordination of sucking, swallowing, and breathing (1, 2). As a result, premature infants often require a longer transition period to achieve independent oral feeding, which extends their length of hospitalization in neonatal intensive care units (NICUs) (3, 4). These challenges have significant clinical implications, as feeding difficulties not only prolong the use of orogastric tubes (OGT), but also increase hospitalization duration, healthcare costs, and family stress (5). Research has shown that approximately 80% of premature infants experience oral feeding difficulties during NICU care, and delayed readiness for oral feeding is a major factor contributing to prolonged hospitalization and delayed discharge (4).

Oral feeding is a complex physiological process that involves the coordinated functioning of neurological, oromotor, cardiorespiratory, and gastrointestinal systems. Impairment in any of these systems may reduce feeding effectiveness and delay the transition to full oral feeding (5). Several interventions have been developed to address these challenges, including oromotor stimulation and sucking-swallowing exercises, which have been shown to improve feeding skills and accelerate the achievement of independent oral feeding (6, 7).

Because of this complexity, the role of healthcare providers becomes essential in ensuring safe and effective feeding. In particular, successful oral feeding depends on the ability of healthcare providers to recognize infants' feeding cues, which include behavioral and physiological signals such as changes in motor activity, head and mouth movements, and alertness levels. Cue-based feeding approaches that focus on infant behavioral signals have been reported to support physiological stability, promote feeding readiness, and shorten hospitalization in premature infants (8, 9).

To objectively assess feeding cues in premature infants, reliable and valid measurement instruments are required. The methodological quality of health-related measurement instruments should follow internationally recognized standards, such as the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN). The COSMIN framework provides comprehensive guidelines for evaluating the reliability, validity, and responsiveness of measurement tools used in healthcare research and practice (10).

In addition, when instruments are used in different linguistic and cultural settings, cross-cultural adaptation is necessary to ensure conceptual equivalence between the original and translated versions. The widely accepted guideline proposed by Beaton et al. outlines a systematic process for cross-cultural adaptation, including translation, synthesis, back-translation, expert committee review, and pretesting to ensure semantic, experiential, and conceptual equivalence across cultures (11).

Despite the increasing attention to feeding assessment in neonatal care, psychometrically validated instruments for assessing feeding cues in premature infants remain limited in Southeast Asia. Most existing instruments have been developed and validated in Western or Middle Eastern contexts, which may not fully reflect differences in language, clinical practice, and cultural context in Southeast Asian healthcare settings. Therefore, the availability of culturally adapted and psychometrically validated instruments is essential to support evidence-based neonatal nursing practice in this region. One instrument designed to assess feeding cues in premature infants is the Feeding Cues Follow-Up Form (FCF-UF), originally developed in Turkey (12). However, this instrument has not yet undergone cross-cultural adaptation or psychometric validation in other countries, including Indonesia. Without proper adaptation and validation, the use of the instrument may introduce measurement bias due to differences in language, terminology, and clinical practice. Therefore, it is necessary to translate, culturally adapt, and evaluate the psychometric properties of the FCF-UF for use in the Indonesian context.

## METHODS

### *Variables*

This cross-sectional psychometric validation study was conducted in NICUs across several referral hospitals in Indonesia. These hospitals were selected because they represent tertiary-level neonatal intensive care units with high patient loads, diverse case complexity, and experienced NICU nurses, thus providing a representative setting for evaluating the psychometric properties of the instrument. Data were collected between June and August 2025. The study was reported in accordance with the STROBE guidelines

### *Population and Sample*

Participants were recruited using convenience sampling from nurses working in NICUs of various hospitals in Indonesia. Inclusion criteria were nurses who held at least a bachelor's degree in nursing (13), had a minimum of two years of work experience in the NICU, and were willing to complete the online questionnaire. The requirement of a bachelor's degree was applied to ensure that participants had a standardized level of professional nursing education and theoretical knowledge relevant to neonatal care. In addition, at least two years of NICU experience was required to ensure that participants had sufficient clinical exposure to recognize and interpret feeding cues in premature infants. Exclusion criteria included incomplete questionnaire responses.

The sample size was determined based on the recommendation that the number of participants in psychometric studies should be 5-10 times the number of items in the instrument (14). An additional 20% was added to account for potential missing data, resulting in a minimum target sample of 200-250 participants. A total of 266 NICU nurses from various hospitals in Indonesia participated in this study.

### *Cross-Cultural Adaptation Procedure*

Cross-cultural adaptation of the FCF-UF was carried out in six steps as recommended (15). **First**, in the forward translation stage, two independent bilingual translators fluent in both English and Indonesian produced two Indonesian versions of the instrument. One translator had a background in health sciences and was familiar with neonatal care terminology, while the other had expertise in language translation and colloquial language use. **Second**, in the synthesis stage, the two translated versions were compared and merged into a single preliminary version by the research team and a third translator. **Third**, the back-translation stage involved two native English speakers who independently translated the preliminary Indonesian version back into English, without prior knowledge of the original instrument, to check the accuracy of the translation and ensure consistency with the original instrument. **Fourth**, during expert panel review, a multidisciplinary team consisting of pediatricians and pediatric nursing experts examined the pre-final version for content, clarity, and cultural appropriateness, and evaluated semantic, conceptual, and experiential equivalence to ensure that the translated items were appropriate for the Indonesian NICU context. **Fifth** in the cognitive debriefing stage, the pre-final version was pilot-tested among 11 NICU nurses to evaluate clarity, relevance, and cultural appropriateness of the items. Participant feedback was used to refine the wording of the instrument where necessary. During this stage, one item (item 9) showed a low I-CVI value (0.57). The item was subsequently reviewed and discussed by the expert panel, and it was removed due to limited applicability in the Indonesian NICU context. **Finally**, in the complete testing stage, the revised instrument with eight items was administered to 266 NICU nurses across hospitals in Indonesia to evaluate its reliability and validity. Test-retest reliability was further assessed by re-administering the questionnaire to a subset of 52 participants within two weeks after the first completion to evaluate the stability of the instrument over time.

### *Data Analysis*

Data analysis was performed using SPSS version 23 and R (packages lavaan and semTools). Prior to analysis, the dataset was screened for missing values and data quality. Cases with incomplete questionnaire responses were excluded from the analysis. Descriptive statistics were calculated to

summarize participant characteristics. The distribution of data was examined using skewness and kurtosis statistics as well as the Shapiro-Wilk test to assess normality.

Internal reliability was assessed using Cronbach’s alpha (16) and ordinal alpha (17). Test–retest reliability was evaluated using the Intraclass Correlation Coefficient (ICC) (18). Test–retest reliability was assessed by re-administering the questionnaire to a subset of 52 participants within two weeks after the first completion.

Construct validity was examined through Confirmatory Factor Analysis (CFA) using the WLSMV estimator, which is appropriate for dichotomous data. Prior to CFA, multicollinearity among items was examined using correlation matrices to ensure that item correlations were within acceptable limits. Model fit was evaluated using several fit indices, including  $\chi^2/df$ , Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Factor loadings and Average Variance Extracted (AVE) were also calculated as indicators of convergent validity.

Known-group comparison was conducted to evaluate differences in instrument scores across relevant demographic groups. Data were collected using the Indonesian version of the Feeding Cues Follow-Up Form (FCF-UF), consisting of eight items after cross-cultural adaptation. The reporting of this cross-sectional study followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.

### ***Ethical Considerations***

This study was approved by the Research Ethics Committee of the Faculty of Nursing, Universitas Indonesia (KET-007/UN2.F12.D1.2.1/PPM.00.02/2025) and the Medical and Health Research Ethics Committee (MHREC), Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada Dr. Sardjito General Hospital (Ref. No.: KE/FK/0979/EC/2025).

## **RESULT AND DISCUSSION**

### ***Demographic Characteristics***

A total of 266 NICU nurses participated, with a mean age of 36 years (SD = 7.09) and mean NICU work experience of 8.66 years (SD = 6.06). Most respondents held a Ners degree (96.6%), 54% had received training on feeding cues, and all had cared for infants with gestational age over 32 weeks

**Table 1.** Demographic Characteristics of Respondents (N = 266)

Variabel	n (%)
Age, Mean (SD)	36,07 (7,091)
< 41 years	185 (69,5)
> 41 years	81 (30,5)
Years of NICU Experience, Mean (SD)	8,66 (6,058)
≤ 17 years	240 (90,2)
> 17 years	26 (9,8)
Educational Background	
Bachelor of Nursing, Registered Nurse	263 (98,9)
Pediatric Nurse Spesialist	3 (1,1)
Training History	
Yes	58 (21,8)
No	208 (78,2)
Experience Caring for Infants ≥ 32 weeks GA	
Yes	266 (100)
No	0 (0)

Note. n: total number of participants; %: percentage; SD: Standard Deviation

### **Internal Consistency and Test–Retest Reliability of the Feeding Cues Follow-Up Form**

Internal consistency and test–retest reliability of the Feeding Cues Follow-Up Form (FCF-UF) were confirmed through multiple indices. The mean score of each item ranged from 0.93 to 0.95 (SD: 0.216–0.258). All corrected item–total correlations were high (0.611–0.850), exceeding the recommended threshold of 0.30. Cronbach’s alpha ranged from 0.903 to 0.922 if item deleted, with an overall alpha of 0.922, indicating excellent reliability. Ordinal alpha was 0.982, while McDonald’s Omega ranged between 0.931 and 0.946, and Composite Reliability (CR) was 0.946, all of which surpassed the recommended cut-off of 0.70. The Average Variance Extracted (AVE) was 0.887, supporting convergent validity. Test–retest reliability was further confirmed with an Intraclass Correlation Coefficient (ICC) of 0.99 (n = 52; two-week interval), demonstrating strong stability of the instrument over time. The ICC value of 0.99 indicates excellent test–retest reliability. However, such a high value should be interpreted cautiously, as very high ICC estimates may occur in relatively homogeneous samples (Table 2).

**Table 2.** Descriptive Statistics and Internal Consistency of the Feeding Cues Follow-Up Form

No	Item	Mean	SD	Skewness	Kurtosis	Item-total correlation	Alpa if item deleted
1	Vital sign are within the normal range	0.94	0.245	-3.586	10.942	0.836	0.904
2	Opening the mouth	0.93	0.252	-3.462	10.061	0.810	0.906
3	Opening the eyes	0.93	0.258	-3.347	9.273	0.850	0.903
4	Bringing hands to face and/or mouth	0.95	0.224	-4.030	14.346	0.719	0.914
5	Sticking out the tongue	0.95	0.216	-4.209	15.831	0.611	0.922
6	Moving arms and/or legs	0.93	0.252	-3.462	10.061	0.747	0.912
7	Moving head to the right/left	0.94	0.231	-3.868	13.060	0.691	0.916
8	Responds to gentle touch around the mouth or lips	0.94	0.245	-3.586	10.942	0.644	0.920

### **Construct Validity**

Confirmatory Factor Analysis (CFA) was conducted to evaluate the unidimensional structure of the Feeding Cues Follow-Up Form (FCFUF). The CFA results indicated that the one-factor model with eight items demonstrated an excellent model fit. The goodness-of-fit indices supported the unidimensionality of the instrument ( $\chi^2 = 17.40$ ;  $df = 20$ ;  $\chi^2/df = 0.87$ ;  $p = 0.627$ ; SRMR = 0.032; RMSEA = 0.000, 90% CI [0.000–0.045]; CFI = 1.000; TLI = 1.001) (Table 3). These values fell within the recommended thresholds, indicating that no additional model modifications were necessary. All items showed high and significant standardized factor loadings, ranging from 0.887 to 0.990, with  $R^2$  values between 0.787 and 0.980 (Table 4). This finding suggests that each item contributed strongly to the underlying latent construct, with relatively low error variances (0.020–0.213).

Furthermore, the reliability and convergent validity analyses confirmed the consistency of the instrument. Cronbach’s alpha (0.922) and ordinal alpha (0.982) indicated excellent internal consistency. Model-based reliability indices were also high (McDonald’s Omega = 0.931–0.946; Composite Reliability = 0.946). The Average Variance Extracted (AVE = 0.887) exceeded the recommended minimum threshold of 0.50, further confirming the convergent validity of the instrument (Table 5).

**Table 3.** Goodness-of-fit statistics from confirmatory factor analysis of the Feeding Cues Follow-Up Form

Model	$\chi^2$	df	$\chi^2/df$	p	SRMR	RMSEA (90% CI)	CFI	TLI
1 factor, 8 items	17.401	20	0.87	0.627	0.032	0.000 (0.000–0.045)	1.000	1.001

$\chi^2$ , Chi-squared test; df, degree of freedom; p, significant level;  $\chi^2/df$ , Chi-squared test/ degree of freedom; CFI, Comparative fit index; RMSEA, root mean square error of approximation; TLI, Tucker-Lewis index;

**Table 4.** Standardized Factor Loadings of the Feeding Cues Follow-Up Form (FCF-UF)

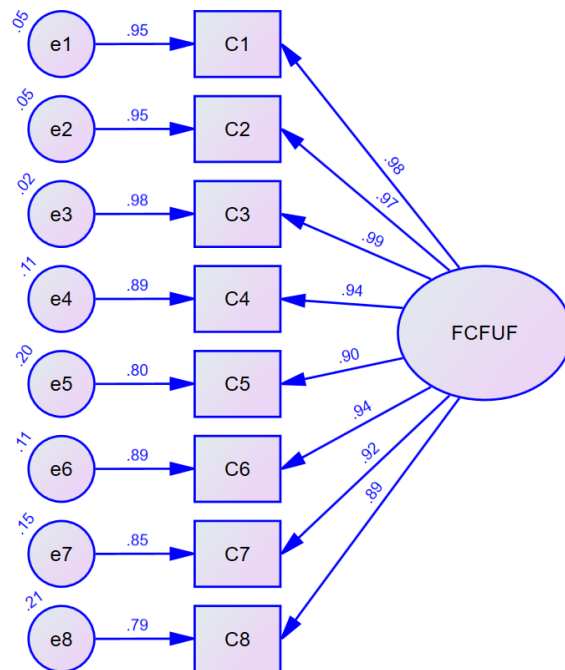
No	Item	Factor Loading ( $\lambda$ )	R <sup>2</sup>	Error Variance (1-R <sup>2</sup> )
1	Vital sign are within the normal range	0.98	0.95	0.05
2	Opening the mouth	0.97	0.95	0.05
3	Opening the eyes	0.99	0.98	0.02
4	Bringing hands to face and/or mouth	0.94	0.89	0.11
5	Sticking out the tongue	0.89	0.80	0.20
6	Moving arms and/or legs	0.94	0.89	0.11
7	Moving head to the right/left	0.92	0.85	0.15
8	Responds to gentle touch around the mouth or lips	0.89	0.79	0.21

**Table 5.** Reliability and convergent validity indices of the Feeding Cues Follow-Up Form (FCF-UF, N = 266)

Indeks	Value	Criteria (cut-off)	Interpretation
Cronbach's alpha	0.922	$\geq 0.70$	Very good
Ordinal alpha	0.982	$\geq 0.70$	Very good
McDonald's Omega ( $\omega$ )	0.931–0.946	$\geq 0.70$	Very good
Composite Reliability (CR)	0.946	$\geq 0.70$	Very good
Average Variance Extracted (AVE)	0.887	$\geq 0.50$	Very good

**Table 6.** Demographic Characteristics and Feeding Cues Follow-Up Form (FCF-UF) Scores (N = 266)

Variables	FCF-UF Mean (SD)	t	p
Age			
$\leq 41$ years	7,62 (1,367)	-1.53	0.128
$> 41$ years	7,26 (1,889)		
Years of NICU Experience			
$\leq 17$ years	7,51 (1,544)	0,159	0.874
$> 17$ years	7,46 (1,630)		
Educational Background			
Bachelor of Nursing, Registered Nurse	7,50 (1.56)	-5,186	0.001
Pediatric Nurse Spesialist	8,00 (0,00)		
Training on Feeding Cues			
Yes	7,53 (1,536)	-0,150	0,881
No	7,50 (1,557)		



**Figure 1.** Confirmatory factor analysis of the Feeding Cues Follow-Up Form (FCF-UF)

## DISCUSSION

This study represents the first psychometric validation of the Indonesian version of the Feeding Cues Follow-Up Form (FCF-UF) among NICU nurses across multiple hospitals in Indonesia. The findings demonstrate that the instrument has strong reliability and validity for assessing feeding cues in premature infants in clinical settings.

The internal consistency of the FCF-UF was excellent, with a Cronbach's alpha of 0.922 and high corrected item-total correlations across all items. These findings indicate that all items consistently measure the same underlying construct. Additional reliability indices, including ordinal alpha, McDonald's Omega, and Composite Reliability, also exceeded recommended thresholds, further supporting the internal consistency of the instrument (16, 17). Test-retest reliability was also very high (ICC = 0.99), indicating strong temporal stability of the instrument (18). However, such a high ICC value should be interpreted cautiously, as very high reliability estimates may occur in relatively homogeneous samples. This may reflect the relatively similar clinical backgrounds of the participating nurses, which could reduce variability in responses

Construct validity was supported by confirmatory factor analysis, which confirmed the unidimensional structure of the FCF-UF. The model demonstrated excellent fit indices ( $\chi^2/df = 0.87$ ; RMSEA = 0.000; CFI = 1.000; TLI = 1.001; SRMR = 0.032), and all items showed strong standardized factor loadings. These results indicate that the eight items adequately represent the latent construct of feeding cues. Although the fit indices were exceptionally high, such results may occur when the model structure is relatively simple and the items are highly correlated (16, 17).

The known-group comparison analysis further supported the discriminative ability of the instrument. Nurses with a pediatric nurse specialist background obtained significantly higher scores than those with only a bachelor's degree, suggesting that advanced professional education may enhance the ability to recognize subtle feeding cues in premature infants. Previous studies have reported that nurses' clinical competence in recognizing infant behavioral cues may be influenced by educational level, professional training, and clinical specialization (5, 8, 9). However, the number of participants in

the pediatric nurse specialist group was small ( $n = 3$ ), and therefore these findings should be interpreted cautiously.

The clinical relevance of assessing feeding cues in premature infants has been widely reported. Premature infants often demonstrate immature oral feeding skills, which may delay the transition to full oral feeding and prolong hospitalization (1, 2). Early identification of feeding readiness and behavioral cues is therefore essential to support safe and individualized feeding practices in neonatal intensive care units (3, 4).

Several interventions have been developed to improve feeding readiness and oral feeding skills in premature infants. For example, oromotor stimulation has been shown to improve feeding performance and accelerate the transition to oral feeding (19). Cue-based feeding approaches have also been associated with earlier attainment of full oral feeding and improved physiological stability in preterm infants (20-22).

In addition to behavioral approaches, sensory-based interventions have also been explored to support feeding readiness. Studies have reported that exposure to the smell of breast milk may improve physiological stability and feeding responses in preterm infants (23-25). A recent meta-analysis further demonstrated that human milk odor stimulation may shorten the time to oral feeding and reduce the duration of parenteral nutrition (26). Other studies have also suggested that olfactory stimulation may support digestive function and nutritional adequacy in premature infants (27).

This study has several strengths. It represents the first cross-cultural adaptation and psychometric evaluation of the FCF-UF in Indonesia and included a relatively large sample of NICU nurses from multiple hospitals. Despite these strengths, several limitations should be acknowledged. The use of convenience sampling may introduce a risk of selection bias and may limit the generalizability of the findings to all NICU nurses in Indonesia. Although this approach is commonly used in psychometric validation studies to recruit participants with relevant clinical experience, future studies using probability sampling and more diverse samples across different healthcare settings are recommended. In addition, the small number of pediatric nurse specialists in the known-group analysis restricts the strength of statistical inference for this subgroup. The use of binary response options may also increase the possibility of a ceiling effect, as participants may tend to select affirmative responses when identifying observable feeding cues. Furthermore, differences in NICU clinical practices and feeding protocols across healthcare settings may influence how nurses interpret and respond to feeding cues, which should be considered when applying the instrument in different contexts.

Overall, the Indonesian version of the FCF-UF demonstrated strong reliability and construct validity. The instrument may provide a standardized approach for assessing feeding cues in premature infants and support the implementation of cue-based feeding practices in NICU settings.

## CONCLUSION

This study established the Indonesian version of the Feeding Cues Follow-Up Form (FCF-UF) as a reliable and valid instrument for assessing feeding cues in premature infants. The instrument demonstrated strong internal consistency, excellent construct validity through confirmatory factor analysis, and satisfactory known-group validity, particularly in differentiating scores based on educational background. These findings confirm that the FCF-UF can be applied by NICU nurses as a rapid and systematic evaluation tool to identify premature infants' readiness for oral feeding. The systematic use of the FCF-UF in NICU settings may guide individualized, cue-based care pathways and facilitate timely interventions, including oromotor and sensory-based strategies such as breast milk aroma stimulation. Ultimately, the implementation of this instrument has the potential to accelerate the transition to oral feeding, reduce length of hospitalization, and support improved developmental outcomes for premature infants in Indonesia.

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## AUTHOR'S CONTRIBUTION STATEMENT

Writing – original draft: DI; Methodology: MHH; Investigation: FTH; Data Curation: MHH; Visualization: DW; Writing-review & editing: DI; Validation: MHH; Resource: DI; Supervision: DW; Formal analysis: DI

## CONFLICTS OF INTEREST

The authors declare no conflict of interest

## DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

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