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# An exploration of the structure of mentors' behavior in nursing education using exploratory factor analysis and Mokken scale analysis

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ABSTRACT

*Background:* To understand nursing students' expectation from their mentors and assess mentors' performance, a scale of mentors' behavior was developed based on literature review and focus group in China.
*Objectives:* This study aims to explore the structure of mentors' behavior.
*Design:* A cross-sectional survey.
*Setting:* Data were collected from nursing students in three hospitals in southwest China in 2014.
*Participant:* A total of 669 pre-registered nursing students in their final year clinical learning participated in this study.
*Methods:* Exploratory factor analysis and Mokken scale analysis was employed to explore the structure and hierarchical property of mentors' behavior.
*Results:* Three dimensions (professional development, facilitating learning and psychosocial support) were identified by factor analysis and confirmed by Mokken scaling analysis. The three sub-scales showed internal consistency reliability from 87% to 91%, and moderate to strong precision in ordering students' expectation about mentors' behavior and a small Mokken scale showing hierarchy was identified.
*Conclusion:* Some insight into the structure of mentoring in nursing education has been obtained and a scale which could be used in the study of mentoring and in the preparation of mentors has been developed.


## 1. Introduction

Mentorship can provide better adaptability, role conception, nursing performance and role socialization (Frazer et al., 2014; Webb and Shakespeare, 2008) for nursing students than teaching by traditional school nurse teachers on a ward. It is also beneficial to mentors as they may experience more job satisfaction and self-esteem by sharing knowledge with young nurses and nursing students and they have the opportunity to learn from mentees (Usher et al., 1999; Hyrkäs and Shoemaker, 2007). Therefore, it is widely applied in clinical nursing education throughout the world.

## 2. Background

In China, nearly all nursing students go to hospital in the final year for approximately 10–12 months of consecutive clinical practice, which is different from the parallel arrangement in other countries whereby, in each term, there is theoretical learning and clinical placement learning. The situation in China is said to be hospital and school-centered, rather than student-centered. Due to nurse shortages in hospitals, mentors simultaneously act as staff nurses and face a dilemma between providing care to the patients and training the students.

Furthermore, there are no national guidelines about mentorship applied to nursing student learning and teaching. Mentors lack adequate training to perform properly as educators to support and assess nursing students (Eddins et al., 2011). Under this condition, mentors are neither confident nor competent to fulfill their roles, which bring little benefit to nursing students' clinical learning (Eddins et al., 2011).

When nursing students in China study in clinical placements, there are no strict rules to guarantee their supernumerary status, but in terms of nursing human resource management they are not accounted for as staff. In reality, due to severe nurse shortages in hospitals, students are prone to be treated as human resource rather than learners and, commonly, the placement learning is work-led rather than education-driven; in particular, a large proportion of basic nursing procedures are done by them (Eddins et al., 2011). In turn, students' professional identity acquisition, interest in nursing and professional competency development are impaired; their enthusiasm for being a nurse is undermined. To improve this situation, mentors' behavior and

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responsibility should be better understood; these should also be incorporated into mentor training programs and they should be assessed regularly to ensure high clinical learning quality and a positive experience for students.

This research project was conducted to develop and validate a scale to measure mentors' behavior in China. A literature review identified 20 mentoring measurement scales in business, education nursing field, but none of them was considered suitable to guide and assess mentors behavior in clinical nursing education for a variety of reasons; for instance, these scales showed different conceptualization from nursing students' mentoring and did not providing enough psychometric evidence to support their use (Chen et al., 2016). This paper, a part of the research project, aims to describe the exploration of the structure of mentors' behavior in an empirical study.

## 3. Methods

### 3.1. Design

A cross-sectional design was used.

### 3.2. Participants and Data Collection

Convenient sampling was applied in one university and three hospitals in China in 2014. Students in their final year of clinical study from degree, associate degree, 3-year diploma and 5-year diploma programs participated in this survey. The sample size estimation (>470) was mainly based on the requirements for the exploratory factor analysis (Ferguson and Cox, 1993).

The Bristol online survey tool was used in one medical university in southwest China. In addition, hard copy surveys were conducted in three hospitals (Hospital 1 has approximately 3000 beds; hospitals 2 and 3 hold more than 1000 beds.) in one city in southwest China with convenient samples, by inviting students to complete the questionnaire at the end of a lecture. Students were asked to rate the importance of each behavior of mentors in contributing towards their successful learning, using five options from 'not important at all' to 'quite important' (scoring 1–5).

Response rate ranged from 83% to 86% in the three hospitals, while the online survey had 69 responses. Cases with missing data were excluded after checking the missing pattern and randomized missing data was assumed. Cases with low engagement (0 variance or low variance in response) were also excluded, as the response of these cases may not reflect true reliability and validity of the instrument but respondents' characteristics, such as conscientiousness, idiosyncratic response behavior, understanding problems and response motivation (Meijer et al., 2015). Finally 669 cases without missing data were entered in the data analysis as the Mokken scale analysis does not allow missing data, more theory regarding Mokken scale analysis is presented in data analysis section.

### 3.3. Measurement Tool Development and Validation

The process of scale development and validation is shown in Fig. 1. The item pool was developed through a literature review where 49 items were selected or adapted following a three dimensional theoretical framework of mentorship (professional development, psychosocial support and facilitating learning) generated from 43 studies (to be reported elsewhere), then this item pool was enlarged to 84 through six online nursing student and mentor focus groups in China (to be reported elsewhere). The pool was reduced to 52 items after rewording and duplication reduction in research group discussion.

Thereafter, the scale with 52 items was sent to 12 mentoring experts (nine responded) in the UK for content validity review, the items with content validity index over 0.78 were retained ($n = 47$) and the scale level content validity index (S-CVI) was 0.95, (data reported in the unpublished thesis). Discriminant validity ($t = -3.26$, $p < 0.05$) and test–retest reliability (Intra-class Correlation Coefficient, $ICC = 0.92$) are reported in the unpublished thesis.

### 3.4. Data Analysis

Exploratory factor analysis (EFA) was used to explore the common factors in the latent variable (here, mentoring behavior) using SPSS 22.0. Principal axis factoring (PAF) was selected for this study, which aimed to explore the theory of mentorship rather than data reduction. Based on eigenvalues > 1, there were 9 factors, explaining 56.59% of the variance, which probably overestimated the number of factors, as the number of items is greater than 30 and some communalities are below 0.4 in this study (Field, 2009). The scree plot suggested that there might be two or six factors. Therefore, Monte Carlo parallel analysis for Principal Components Analysis was used to decide the number of factors to extract. Both orthogonal rotation and oblique rotation were tried and the results suggested that oblique rotation gave a simpler solution. The criterion for loading and cross loading was set at 0.4, and based on this, items with loading below 0.4 and cross loading over 0.4 were deleted. This process was repeated until a simple structure was achieved where loadings were maximized on putative factors and minimized on the others.

Mokken scale analysis (MSA) can be used to analyze dichotomous items and polytomous items. It has two models: first, the monotone homogeneity model, which means an item's score increases as the trait increases and this is described by the item response curve (IRC). This can order respondents according to their raw accumulated scores. The other model, invariant item ordering (IIO), assumes that all IRCs do not intersect, which means items can be ordered according to their difficulties and this item ordering is the same for all respondents (Sijtsma and Junker, 1996; Ligtoet et al., 2010). Scalability strength can be judged by the scalability coefficients (Ligtoet et al., 2010), such as $H_{ij}$ (item-pair), measuring inter-item correlation; $H_i$ (item), measuring precision of item discrimination: showing the strength of the correlation between an item and the latent trait under investigation; $H_s$ (scale), measuring the quality of total scale, a weighted mean of item coefficients, an index for the precision of ordering person; $H^T$, assessing precision of invariant item ordering. According to Ligtoet et al. (2010), the rule of thumb cut-off points are presented below: if the monotone homogeneity model holds, $Hij > 0$; Hi, Hs, $HT < 0.3$, means unscalable; $0.3 < Hi, Hs, HT < 0.4$, implies poor scalability; $0.4 < H_i, H_s, H^T < 0.5$, shows moderate scalability; $H_i, H_s, H^T > 0.5$, displays strong scalability. The package 'mokken' in the software R (R is a free software environment for statistical calculation and graphics) was used to conduct the Mokken scaling.

A Mokken scale analysis was carried out to explore whether there were hierarchical properties in mentors' behavior and the dimensions of this new scale. Mokken scale analysis proceeded as described below. The items identified in factor analysis were checked first for scalability coefficients. Any item with $H_i$ under 0.3 or the 95% CI (confidence interval) around $H_i$ covering lower limit below 0.3 were excluded. Then scale partitioning was carried out to explore the dimensions of mentors' behavior through increasing c (Lower bound c defines the minimum value of coefficients $H_i$ in the Mokken scale (Molenaar and Sijtsma 2000)) by 0.05 increments. Monotone homogeneity model and invariant item ordering were investigated at sub-scale level and at whole scale level.

### 3.5. Ethics

Ethical approval was granted by the research ethics committee of the Faculty of Health and Social care, University of Hull, UK and permission was obtained from one university and three hospitals in China. If participants completed the questionnaires, informed consent to participate in the study was assumed. It was explained to participants before