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Original Article

Rasch Analysis of the Power as Knowing Participation in Change Tool – the Brazilian version

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Objectives: the objective of this study was to evaluate the items contained in the Brazilian version of the Power as Knowing Participation in Change Tool (PKPCT). Method: investigation of the psychometric properties of the mentioned questionnaire through Rasch analysis. Results: the data from 952 nursing assistants and 627 baccalaureate nurses were analyzed (average age 44.1 (SD=9.5); 13.0% men). The subscales Choices, Awareness, Freedom and Involvement were tested separately and presented unidimensionality; the categories of the responses given to the items were compiled from 7 to 3 levels and the items fit the model well, except for the following/leading item, in which the infit and outfit values were above 1.4; this item has also presented Differential Item Functioning (DIF) according to the participant's role. The reliability of the items was of 0.99 and the reliability of the participants ranged from 0.80 to 0.84 in the subscales. Items with extremely high levels of difficulty were not identified. Conclusions: the PKPCT should not be viewed as unidimensional, items with extremely high levels of difficulty in the scale need to be created and the differential functioning of some items has to be further investigated.

Descriptors: Rasch; Questionnaires; PKPCT.

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Análise *Rasch do Power as Knowing Participation in Change Tool* - Versão Brasileira

Objetivos: o objetivo do estudo foi avaliar os itens da versão brasileira do Power as Knowing Participation in Change Tool (PKPCT). Método: investigação das propriedades psicométricas do instrumento por meio da análise Rasch. Resultados: foram analisados dados de 952 auxiliares de enfermagem e 627 enfermeiros (idade média 44,1 (DP=9,5) anos; 13,0% homens). As subescalas escolhas, consciência, liberdade e envolvimento foram testadas separadamente e apresentaram unidimensionalidade; as categorias de resposta dos itens foram colapsadas de 7 para 3 níveis, os itens se ajustaram bem ao modelo, com exceção do item de liderado/de líder, cujos valores de infit e outfit ficaram acima de 1,4; esse item também apresentou DIF (differential item functioning) para função do respondente. A confiabilidade dos itens foi de 0,99 e a confiabilidade das pessoas variou de 0,80 a 0,84 nas subescalas. Não foram identificados itens nos extremos de dificuldade. Conclusões: o PKPCT não deve ser tratado como unidimensional, é necessário que sejam criados itens nos extremos de dificuldade da escala e investigado o funcionamento diferencial de alguns itens.

Descritores: Rasch; Questionários; PKPCT.

Rasch análisis del *Power as Knowing Participation in Change Tool* - Versión Brasileña

Objetivos: Los objetivos del estudio fueron validar la versión brasileña del Power as Knowing Participation in Change Tool. Método: evaluación del elementos del instrumento a través del análisis Rasch. Resultados: Se analizaron datos de 952 auxiliares de enfermería y 627 enfermeras (edad promedia 44,1 años, DE = 9,5, hombres 13,0%). Cada una de las 4 subescalas (Elección, Conciencia, Libertad y Compromiso) mostraron unidimensionalidad. Las 7 categorías iniciales de respuesta debieron colapsarse a 3. Todos los ítems de las sub-escalas mostraron buen ajuste, exceptuando el ítem liderado/líder cuyos valores infit y oufit fueron mayores de 1,4. Este ítem también mostró el DIF para rol del respondiente. La fiabilidad de los ítems fue de 0,99 para las cuatro escalas y para las personas osciló entre 0.80 y 0.84. No fueron identificados ítems en los extremos de dificultad. Conclusión: El PKPCT no debe ser tratado como un instrumento unidimensional. Se deberían crear ítems en los extremos de dificultad de la escala, además de investigar el funcionamiento diferencial de algunos ítems.

Descriptores: Rasch; Cuestionarios; PKPCT.

Introduction

In the literature, there is an awareness that deepening and integrating the knowledge about the power in nursing is essential for the effectiveness of health care practices[1-4]. In order for knowledge to advance, the concepts of interest need to be operationalized. The *Power as Knowing Participation in Change Tool* (PKPCT), which operationalizes the concept of power as an intentional participation in changes[5], is vastly used in studies about the power in nursing; however, the construct validity estimates of the PKPCT through analysis based on the *Classical Test Theory* are controversial[6]. The Rasch models, which are based on the *Item Response Theory*, overcome the limitations found in traditional analysis[7] that can be involved in the observed controversies about the PKPCT structure. In this article, we report the procedures and results of the PKPCT's Rasch analysis – Brazilian version.

Power as Knowing Participation in Change Tool (PKPCT)

The concept of power the PKPCT is based on results from Martha Rogers' conceptual model[8]. Power is the capacity to intentionally participate in the nature of changes[5]. It involves the awareness that people have of the context they are in (Awareness), the way in which people make their own choices (Choices), the freedom they have to act intentionally (Freedom) and their involvement in creating changes (Involvement)[5]. Power as intentional participation means people's awareness of what they choose to do, the feeling of freedom to do

what they choose to do, to intentionally do what they choose and to be involved in creating changes[5-6,9].

The author of the PKPCT used the semantic differential technique in order to develop the items that measure the meaning of the operational indicators of power: awareness, choices, freedom to act intentionally and involvement in creating change[5]. The current version of the PKPCT has 12 pairs of adjectives applied to the four operational indicators, totaling 48 items, which can range from 1 to 7 points. The total score of the PKPCT can range from 48 to 336[5] and, although accepted as an ordinal measure, it is often treated as a continuous measure. The PKPCT was developed in 1983[5] and, since then, its validity and reliability have been checked through the Classical Test Theory.

The PKPCT has been used in a number of studies involving American[6,9] and Brazilian[10-11] patients, baccalaureate nurses and nursing students. In a study undertaken in Brazil[11], the results of the Factor Analysis (FA) were also different from those observed in other studies[6,9].

In view of conflicting results regarding the PKPCT construct, the objective of the study reported on in this paper was to assess the items of the PKPCT-Brazilian version using Rasch analysis.

Rasch Analysis

The statistical techniques of the Item Response Theory (IRT) have been acknowledged as stronger strategies for the construction and validation of psychometric instruments because they permit checking the measure invariance and the error in the measure by item, besides informing the position of each item in the *continuum* of the latent trait being studied[12]. The Rasch Model, in particular, converts ordinal to interval measures[13-14] and is a mathematic model that deals with the likelihood of success to an item based only on the difficulty of the item and the person's skills[12,15-16]. The assumptions of the Rasch Model are: unidimensionality and local independence. The unidimensionality principle shows that the variable deals with only one attribute[7,13]. According to the local independence principle, the likelihood of success or failure to a certain item should not be conditioned to the success or failure to another item[14]. Other important aspects of the Rasch Model are presented:

The Fit to the Rasch Model

The fit statistics shows whether or not the data deviated from the model[14] and presents the comparison between what is expected in the model and what was actually observed[7,17]. The Infit and the Outfit can be analyzed with the results presented in MnSq (mean-square) format, in which appropriate scores, according to some authors, range from 0.60 to 1.4 for polytomous items, with associated scores of t = ± 2.0[17-18]. Too high MnSq scores may indicate errors in item scores. A score of MnSq < 0.7 indicates little variance in item scores or a very predictable standard of response[18].

Categorical Response Threshold

The Rasch Model allows to identify whether there was good discrimination of response categories on the part of the participants[14]. The transition point between two response categories is called threshold. Each threshold represents the point where there is a 50% probability that the participant with an abitily level of X answers the categories A or B[19].

Difficulty and abitily level

According to the Rasch Model, the participants' abilities are estimated without the interference of the items, as well as the difficulty of the items is established regardless of the sample used[7]. The calibration of abilities and the difficulty result in a map in which these two elements are put into the same metric unit[12]. This map allows the researcher to identify which abilities magnitude the item measures, whether the items are homogeneously distributed and whether there are floor or ceiling effects[12]. The empirical map resulting from the Rasch analysis can be used as evidence for the construct validity of the instrument[12].

The metric unit in the Rasch Model can be the *logit (log-odds)*, which is a linear function of the probability of obtaining a particular score by a person with a certain set of abilities[13]. In relation to the Rasch analysis, zero in the *logits* scale arbitrarily represents the average; the easiest items present negative scores and the most difficult ones present positive scores in the scale[7].

Differential item functioning

The behavior of an item is only a result of the ability level of the respondent. This means that it is not affected by any other characteristic presented by the respondent. When groups with the same ability level respond to the same item in a different way, however, it shows a differential item functioning – DIF[16].

Separation index of persons and items

The separation index of persons indicates how many groups with different ability can be identified[12]. The separation index of items indicates the number of ability groups the items are capable of identifying[12].

Reliability

The reliability of items deals with the replicability of item allocation in the *continuum* of the latent trait if these same items are applied to another group of people with comparable ability levels[13].

Method

The study was an analysis of the partial data of an ongoing project carried out in hospitals and outpatient care centers of the Sao Paulo State Health Secretary (SES/SP). In total, 1606 nursing professionals from 35 of the 43 institutions under the direct management of SES/SP participated in the study. The recruitment and selection procedures in relation to the institutions and participants, as well as the calculation of the sample size are listed in another source[11]. Sampling was done through convenience and the data were collected between January and October 2011, through a self-report which involved responding to the PKPCT- Brazilian Version and a form containing the professional, social and demographic information.

The PKPCT – Brazilian Version was an adapted version of the original carried out in another study[10]. In the application of the PKPCT questionnaire, the respondents are asked to score the way they feel in relation to their awareness, choices, freedom to act intentionally and involvement in creating change. For each subscale, 12 pairs of adjectives with opposite meanings are presented: one of the adjectives of each pair expresses a position of higher power and the other expresses lower power. Each pair is separated by seven equidistant points and the respondents have to choose one of the seven points, based on the further or closer proximity of their position with one of the adjectives of each pair[10]. Each subscale has a pair of repeated adjectives, thus forming a thirteenth item in each subscale. This repeated pair is used to test the reliability of the responses and is not added to the total score. Six items of each subscale are presented in an inverted format.

Duly trained research assistants carried out data collection; the participants responded to the questionnaire in the presence of the research assistants, who were available to clarify eventual doubts.

The project received approval from the Research Ethics Committee (Registration number 856/2009). The participants were informed about the study objectives and, upon their agreement to participate, they signed the Informed Consent Form as per Resolution 196/96 and the complementary resolutions from the National Research Council.

Data analysis was undertaken with the use of the software Winsteps 3.7[20]. A polytomous items analysis was used and the following aspects were evaluated: dimensionality, *infit, outfit*, threshold of response categories, calibration of items and people, separation index of people and items and reliability.

The items with no responses, according to the Rasch analysis, are appropriately dealt with and there is no need for data imputation, so the number of responses can vary according to the items.

Results

From the 1606 participants, 27 did not respond to the gender variable question and were excluded from the study. Data from 1579 participants were analyzed (952/60.3% nursing assistants and 627/39.7% baccalaureate nurses). About 13.0% of the total were male; the average age was 44.1 (SD=9.5); the average weekly work hours was of 44.5 (SD=17.4); the majority worked in general hospitals and on day shifts; 42.0% had two or more jobs and 8.6% performed a supervisory role.

Rasch Analysis

During the analysis of the 48 pairs of items contained in the PKPCT – Brazilian Version, it was identified more than one factor through the FA Principal Component. The items did not appropriately fit the Rasch model and presented *infit* and *outfit* values over 1.4[17]. Taking into consideration the theoretical basis that guided the development of the PKPCT with four components (awareness, choices, freedom to act intentionally and involvement in creating change) [5], an analysis was carried out separately for each subscale.

Many items presented disordered categorical response thresholds, with overlapping categories, which suggested that the scale of responses (7 points) was not appropriate and contributed to the inadequate fit of the items. As a consequence, a new scale was

given to the responses. At each attempt of scoring the response categories, the fit measures of the items were observed, until values closer to the reference ones were achieved. The coding of responses changed from 1234567 (7 points) to 0000012 (3 points), which was the coding that showed the best fit for the items and people.

Table 1 – PKPCT Items grouped by subscales and ordered according to degrees of difficulty. São Paulo, SP, Brazil, 2011

Item – Subscale	N	Measure	Infit MnSq	Outfit MnSq
Awareness				
6. following – leading*	1524	1.42	1.73	1.73
5. timid – assertive	1518	0.89	1.10	1.06
8. shrinking – expanding	1525	0.51	0.99	0.97
4. unintentional – intentional	1499	0.34	1.21	1.26
1. superficial – profound	1526	-0.10	1.03	1.11
9. unpleasant – pleasant	1525	-0.16	0.86	0.84
11. constrained – free	1528	-0.25	0.98	1.00
10. uninformed – informed	1527	-0.26	0.80	0.81
2. avoiding – seeking	1508	-0.31	0.96	0.99
7. chaotic – ordely	1529	-0.32	0.93	1.03
12. unimportant – important	1528	-0.87	0.76	0.76
3. worthless – valuable	1525	-0.87	0.77	0.72
Choices				
23. following – leading*	1518	1.44	1.81	1.80
16. timid – assertive	1521	0.65	1.01	0.99
14. shrinking – expanding	1521	0.37	1.01	1.02
24. superficial – profound	1524	0.36	0.95	0.96
21. constrained – free	1527	0.15	1.11	1.16
19. unintentional – intentional	1522	0.00	1.12	1.29
20. unpleasant – pleasant	1524	-0.21	0.88	0.97
25. uninformed – informed	1528	-0.22	0.86	0.84
15. avoiding – seeking	1524	-0.47	0.88	0.98
18. chaotic – ordely	1526	-0.52	0.95	0.99
22. worthless – valuable	1528	-0.66	0.76	0.73
17. unimportant – important	1529	-0.89	0.73	0.64
Freedom to act intentionally				
29. following – leading*	1510	1.57	1.83	1.85
31. shrinking – expanding	1508	0.70	0.94	0.90
30. superficial – profound	1506	0.69	1.03	0.95
27. timid – assertive	1514	0.64	1.14	1.22
37. unintentional – intentional	1498	0.01	1.04	1.14
36. constrained – free	1507	-0.18	0.96	1.04
28. uninformed – informed	1513	-0.29	0.88	0.90
38. unpleasant – pleasant	1512	-0.33	0.90	1.00
35. avoiding – seeking	1502	-0.59	0.94	1.09
34. chaotic – ordely	1514	-0.65	0.90	0.99
32. unimportant – important	1508	-0.77	0.79	0.72
33. worthless – valuable	1512	-0.81	0.79	0.91
Involvement in creating change				
48. following – leading*	1509	1.51	1.88	1.89
50. timid – assertive	1508	0.64	1.08	1.02
42. superficial – profound	1515	0.61	0.97	0.91
41. shrinking – expanding	1509	0.30	0.94	0.92
44. constrained – free	1508	-0.11	0.94	0.95
40. unintentional – intentional	1508	-0.13	1.24	1.51

(continue...)

Table 1 - (continuation)

Item – Subscale	N	Measure	Infit MnSq	Outfit MnSq
51. unpleasant – pleasant	1514	-0.27	0.89	0.98
46. uninformed – informed	1510	-0.39	0.78	0.79
43. chaotic – ordely	1512	-0.44	0.89	0.95
47. avoiding – seeking	1507	-0.47	0.97	1.19
45. worthless – valuable	1514	-0.50	0.80	0.72
49. unimportant – important	1507	-0.75	0.78	0.78

*Item with DIF

Table 2 - Rasch analysis of the PKPCT subscales. São Paulo, SP, Brazil, 2011

Statistics	Awareness	Choices	Freedom	Involvement
Number of factors by FA	1	1	1	1
Explained variance (total)	45.8%	48.0%	52.5%	53.2%
Variance explained by persons	24.2%	27.0%	29.9%	31.0%
Variance explained by items	21.6%	21.0%	22.6%	22.2%
Number of self-values in the first contrast	< 2	< 2	< 2	< 2
Number of persons with maximum score	162	201	162	198
Number of persons with minimum score	42	63	91	123
Separation index of persons*	1.98	2.12	2.27	2.28
Separation index of items	13.28	11.87	13.38	11.32
Average Infit	1.01	1.01	1.01	1.01
Average Outfit	1.02	1.03	1.06	1.05
Item with fit statistic > 1.4	Lead...	Lead...	Lead...	Lead... Intentional...
Reliability of items	0.99	0.99	0.99	0.99
Reliability of persons*	0.80	0.82	0.84	0.84
Average skills of participants (logits / SD)*	0.46 (1.36)	0.46 (1.51)	0.22 (1.65)	0.23 (1.67)
Average degree of difficulty of items (logits / SD)	0.00 (0.65)	0.00 (0.62)	0.00 (0.71)	0.00 (0.62)
Most difficult item	Lead...	Lead...	Lead...	Lead...
Easiest item	Valuable Important…	Important...	Valuable...	Important...
DIF for gender	No	No	No	Lead...
DIF for role†	Lead...	Lead...	Lead...	Lead...

* Not taking into consideration the extremes
† The item works differently among baccalaureate nurses and nursing assistants

Figure 1 shows the relationship between the perception of power (left side) and the difficulty of the items (right side) for the subscale Awareness. The other maps are not shown herein due to limitation of space. The linear measurement in *logits* is shown on the central axis. The distribution of estimates of the perceived power/difficulty of the items is concentrated close to the area of average value. There are also a considerable number of people with a high-level perception of power. There are no items that show too high or too low perceptions of power. The participants' skills, which averaged 0.46 *logits* (SD=1.36), were close to the difficulty of items, with an average of 0.00 *logits* (SD=0.62).

The four subscales shared the lack of items showing high and low-level perceptions of power. That is, the items were located close to the average and there were no items at the extremes of the scale.

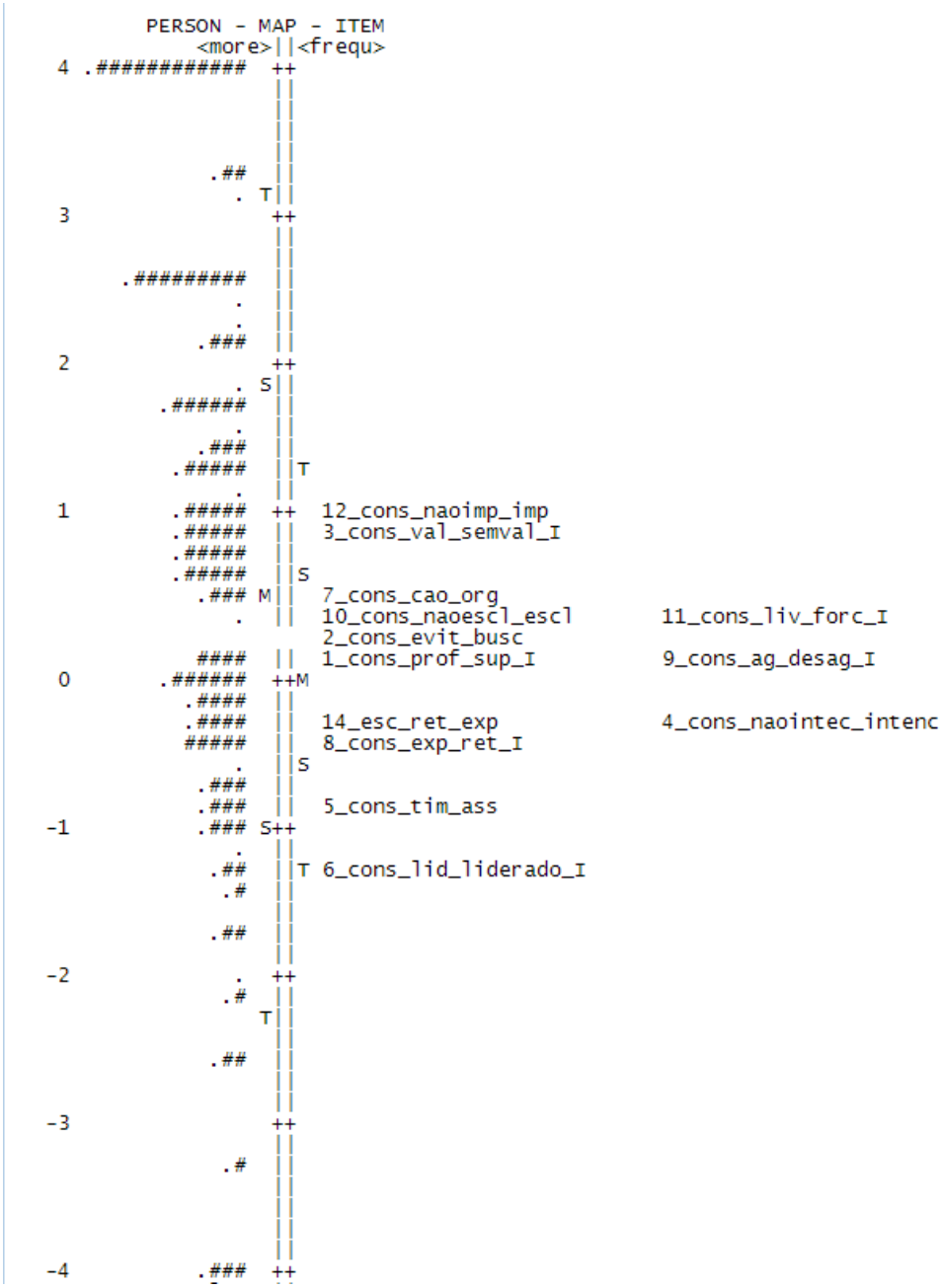

Figure 1 - Map of abilities and difficulty of items in relation to the subscale Awareness. São Paulo, SP, Brazil, 2012

Discussion

The Rasch analysis permitted the investigation of the following provisions of the PKPCT – Brazilian Version: dimensionality, *infit*, *outfit*, categorical response threshold, calibration of items and persons, separation index of persons and items and reliability.

In the study undertaken to develop the scale, the author identified through the FA that the contribution of each subscale to the concept of power was different[5]. But the understanding that the "involvement in creating change" requires a sense of "freedom to act intentionally", which is related to the type of "choices" that are made, and these connections are maintained even when there is "awareness", led the author to opt for the unidimensionality of the instrument with its 48 items[5]. In the present study, the FA did not confirm the unidimensionality of the total instrument with its 48 items, but confirmed the unidimensionality of each subscale. The analyses were performed separately in the

four subscales in order to ensure the unidimensionality required for the Rasch analysis. Each subscale possibly represents a construct that contributes to the perception of power, as planned by the instrument's author[5].

The seven response categories for the PKPCT items did not present adequate discrimination and the threshold overlapped in various items. It is admitted that the use of many response categories may hinder the understanding of subtle mutual differences[21]. The frequency of responses in each category was analyzed and those with low frequency were compiled. In principle, there is no ideal number of response categories for the items, and researchers need to identify the appropriate number for their instrument, as well as investigate its suitability whenever the questionnaire is applied to a new group[19].

With the exception of the following/leading item in all subscales and the un intentional/intentional item for the Involvement subscale, the others showed adequate fit values (Table 1). The choice of fit parameters was very conservative, since values between 1.5 and 2.0 indicate less useful items, but which do not negatively affect the measurement[17-18].

It is important to note that the following/leading item, which presented fit values above the values set in the present study and which would indicate erratic scores in the item or greater variability than that showed in the model, also presented DIF for the roles in all subscales and for gender in the subscale *Involvement*. One option is to perform a separate analysis according to the professional category in order to better fit the item to the model. Perhaps from the perspective of power understood as hierarchy, the leading position is not seen as a component of the nursing assistant's professional role. "Leading/following" translated into Portuguese as "de liderado/ de líder" that could be back translated as "leading/ led". It is possible to consider the trial of another adaptation, such as "de seguidor/ de líder". Although it would sound strange in Portuguese "de líder/ de seguidor" is a more literal version. In any event, this is a finding that should be investigated in depth in other studies and that alerts to the use of this item.

The Rasch Model's concept of skill applied to the PKPCT relates to the frequency at which individuals consider a particular aspect by individuals as part of their *Awareness, Choices, Freedom and Involvement*. The perspective of power was concentrated around the average values for all subscales and presented a considerably high number of individuals with a high level perception of power. Note that between 150 and 200 people reached maximum scores in the subscales (Table 2), which indicates the importance of considering the social desirability in these results in further studies.

The most difficult items in the Rasch Model refer to those more difficult to be chosen. The item following/ leading was the most difficult in the four subscales. The easiest items referred to matters involving the allocation of value (important, valuable). There were no items that discriminated perceptions of power at extreme points in the scale and there was a ceiling effect in the four subscales. This indicates the need to develop items able to discriminate people at extreme points of the *continuum* of the scale.

The participants were separated into two levels of power perception and, from the maps of ability/ difficulty, it can be inferred that these were high and moderate level perceptions of power. The items from the four subscales were able to separate between 11 and 13 levels of power perception. The reliability of the four subscales of the PKPCT was 0.99 for the items and ranged between 0.80 and 0.84 for the people, therefore indicating very good reliability.

Conclusion

The PKPCT – Brazilian Version is an instrument composed of four unidimensional subscales. The items in each subscale fit the Rasch Model and presented good reliability and good ability' separation index.

The results show that the scores given to the subscales should not be added, but dealt with separately, and that the response categories can be compiled from 7 to 3 levels. The meaning of the four unidimensional scales for the theoretical concept the PKPCT is based on will deserve further discussion. Other studies are needed, especially to understand the differential functioning of the item "leading/following" amongst baccalaureate nurses and nursing assistants, in order to explore the weight of social desirability at extreme scores, as well as to test new items that are able to discriminate extreme perceptions of power.

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