STUDY OF THE PSYCHOMETRIC PROPERTIES OF THE DENTAL FEAR SURVEY USING ITEM RESPONSE THEORY

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ABSTRACT

The study of psychometric properties of Likert-type scales traditionally relies on several techniques such as exploratory and confirmatory factor analysis, which don't account for what psychometricians refer to as an unobservable, or latent, trait. One purpose of Item Response Theory (IRT) is the determination of how much of such a latent trait exists. This study presents the analysis of the Dental Fear Survey (DFS) using IRT. 377 university students were surveyed regarding dental anxiety with DFS, consisting of 20 Likert-type items. Evidence of good psychometric properties was found, namely regarding individual performances and items consistency.
Keywords: dental anxiety, psychometrics, item response theory

RESUMO

No estudo das propriedades psicométricas de escalas tipo Likert, muitas vezes são utilizadas técnicas como análise factorial exploratória ou confirmatória, que não tomam em consideração o que alguns estatistas denominam de característica não observável, ou latente. Uma das finalidades da Teoria de Item-Resposta (IRT) é a quantificação desta característica latente. Este trabalho apresenta a análise do Dental Fear Survey (DFS) utilizando o IRT. O DFS, constituído por 20 itens, e que mede a ansiedade

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dentária, foi aplicado a 377 estudantes do ensino universitário. Encontraram-se boas propriedades psicométricas, nomeadamente no que diz respeito à consistência dos itens.

Palavras-Chave: ansiedade dentária, psicometria, teoria item resposta

INTRODUCTION

In many educational and psychological measurement situations there is an underlying variable of interest. This variable is often something that is intuitively understood but difficult to be computed. Psychometricians refer to them as an unobservable, or latent, trait. Although such a variable is easily described, and knowledgeable persons can list its attributes, it cannot be measured directly since the variable is a concept rather than a physical dimension. One purpose of Item Response Theory (IRT) is the determination of how much of such a latent trait an individual possesses (Baker, 2001).

IRT models are mathematical equations describing the association between a respondent's underlying level on a latent trait and the probability of a particular item response using a nonlinear monotonic function. The correspondence between the predicted responses to an item and the latent trait is known as the item-characteristic curve. Most applications of IRT assume unidimensionality, and all IRT models assume local independence.

The use of the Rasch model entails a different perspective, or paradigm, from IRT approaches in general (Andrich, 2004). Where data do not conform to the expectations of the Rasch model, the main challenge is not to find a model that better accounts for the data, but to understand statistical misfit as substantive anomalies that need to be understood, and by being understood, to lead to the construction of more valid and reliable tests (Bhakta, Tennant, Horton, Lawton, & Andrich, 2005).

The Rasch model specifies a 1-parameter logistic (1-PL) function. The 1-PL model allows items to vary in their difficulty level (probability of endorsement or scoring high on the item), but it assumes that all items are equally discriminating (the item discrimination parameter, α, is fixed at the same value for all items). Observed dichotomous item responses are a function of the latent trait (θ) and the difficulty of the item (β):

$$P(\theta) = e^{D\alpha(\theta - \beta)} / [1 + e^{D\alpha(\theta - \beta)}] = 1 / [1 + e^{-D\alpha(\theta - \beta)}],$$ where D is a scaling factor. Generalizations are possible to accommodate a discriminating factor and polytomous IRT models for ordered categorical responses (Hays, Morales, & Reise, 2000).

The aim of this paper is to explore the use of Rasch analysis to determine the validity of the Dental Fear Survey.

METHODS

Sample

A convenience sample of 377 students (28,1% M) was gathered from different Faculties of the University of Coimbra. The mean age of the sample was 21,3 yrs (SD=3,49)

Instrument

Kleinknecht's Dental Fear Survey (DFS) is a paper and pencil instrument used in the assessment of dental anxiety. It is a 20-item 5 point Likert-type scale, measuring dental anxiety in 3 different factors: avoidance of dental treatment (items 1 and 2), somatic symptoms of anxiety (items 3 to 7) and anxiety caused by dental stimuli (items 9 to 20). Its scores range from 20 (low anxiety) to 100 (high anxiety) (Kleinknecht, Klepac, & Alexander, 1973).

Procedure

A Portuguese version of DFS (Lopes, Ponciano, Pereira, Medeiros, & Kleinknecht, 2004) was applied in a single session, in the classroom, prior to class. All tests were all answered voluntarily and under anonymity.

The data set consisted of 20 items and 377 individuals and was analyzed using the TestGraf98 software (Ramsey, 2000).

Results

We can see how the probabilities of choosing the four options are estimated to vary with score on the entire scale. As one would hope, only those with the smallest scale scores are choosing option 1; that is, a low fear scale score is associated with choosing the option claimed to go with the least level of fear. As the total fear score increases, respondents are estimated to be more likely to choose the next level option.

For items 1, 2, 5, 6, 8, 9, 10, 12, 13, 19 most respondents choose option 1.

In the other items the 5 options succeed each other (with no predominance). As we would expect respondents with low scores choose low options and the ones with high scores are consistent with higher categories (Figure 1).

Figure 1 – Item 11 - Respondents with low scores chose low options while the ones with high scores chose high options
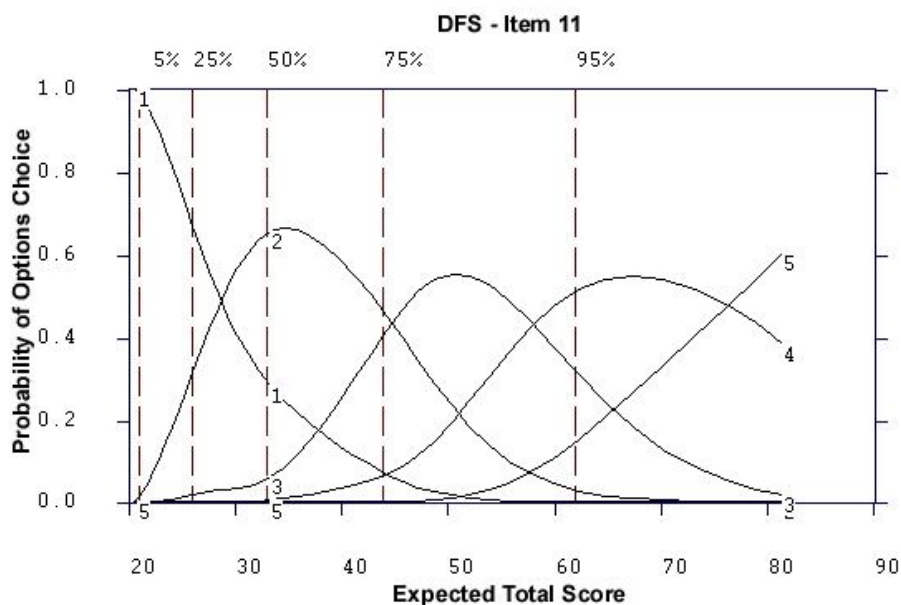
The average item information function, $I(\theta)/n$, for the DFS as a function of expected number correct. For this test we see that it is most informative for least anxious subjects performing at around 30. This is primarily due to the fact that no variation for low scores, which tend to convey information only for low proficiency levels.

Classical test theory offers no way of measuring test quality as a function of latent trait. We can compute the reliability coefficient as a function of θ. We see that reliability for this test is seemingly excellent, being around 0.95, for students scoring at around 30, where the test is the most powerful.

CONCLUSION

The DFS does reveal excellent scale properties when data from a more clinical population is analysed. This illustrates the point that the quality of the scale is partly a question of the scale being used on a population with an appropriate range of trait values.

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