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Similarity Structure Analysis and Structural Equation Modeling in Studying Latent Structures: An Application to the Attitudes towards Portuguese Language Questionnaire

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Abstract: Several international studies such as PISA and PILRS (Progress in International Reading Literacy Study), have stressed the importance of positive attitudes and behaviours as facilitators of individuals reading literacy during the school years and throughout their lives.

Considering that there are not available instruments for assessing attitudes Towards Portuguese Language, it was proposed the development of the Attitudes towards Portuguese Language Questionnaire – ATPLQ (*Questionário de Atitudes Face à Língua Portuguesa*: QAFLP, Neto et al., 2011; Rebelo, 2012). The questionnaire has 22 Likert-type items, with four levels of response (Strongly Disagree, Disagree, Agree, Strongly Agree), spread, through exploratory factor analysis (EFA), over three attitudinal dimensions: Behavioural, Affective, and Motivational.In this study we aimed to analyse the ATPLQ's latent structure with a pooled sample data of 1441 participants, applying similarity structure analysis (SSA) and confirmatory factor analysis of ordinal data (CFA). The SSA was carried out with Hudap in order to identify the structural properties of the questionnaire and to assess its adequacy in a Portuguese population. The CFA was carried out with LISREL in order to assure structural validity, i.e., accounting for factorial validity, but also for factors' convergent and discriminant validity, and composite reliability. These psychometric features allowed the comparison of both the EFA derived model and the SSA derived model.

We justify the selection of the SSA's model, and we discuss the similarities between the results generated by SSA and LISREL procedures, highlighting their use in modeling constructs with ordinal indicators.

1. Introduction

Several international studies such as PISA and PILRS (Progress in International Reading Literacy Study), have stressed the importance of positive attitudes and behaviours as facilitators of individuals reading literacy during the school years and throughout their lives. These studies are intended to point out a number of factors inherent in the student and the educational system that could explain the differences found between the various participating countries.

In Portugal, as in other countries, the use of PISA results in educational policies favouring the induction of which is essential in the education system and what values to promote, allowing an understanding of the results, the skills, the quality of what is taught and what is learned (Afonso & Costa, 2009). But learning does not depend only on how teachers teach, or on the cognitive abilities of each student. Learning is influenced by a number of factors such as psychological, social and content of the task. And, the affective characteristics of it may be an important explanatory element of quality-education and investment of individual actors in the different dimensions that make up the school (Santiago, 1994).

Attitudes are used by the subject to place the object in a class attitudinal favourable or unfavourable, helping to provide simple strategies to solve problems, organize memory of events and maintain self-esteem. Applying this information to the school field, we believe that knowledge of students' attitudes allow access to their evaluations about the school and the main school subjects, which will allow the development of curricular and extracurricular activities that take into account their attitudes, their interests and aspirations. The attitudes are still intrinsically linked to perception and interest of the student to learn, their competence (perceived and as a result of previous academic results) and motivation.

Regarding the Portuguese language (PL), little is known about the effect of students' attitudes on their performance and motivation to continue studying. But the results are not very encouraging reports of PISA for this discipline, according to which 22% of Portuguese students' performances are below level 1 (level featuring poor readers) in PISA 2003 compared with the reference value EU, which stood at 19.8 %, (Portal of the Ministry of Education, 06/01/2006), which compromises the academic success of both, students from regular and academic curriculum and students from professional curriculum. These data support the need to assess what other factors beyond the school curriculum may be interfering with the performance of students.

Considering that there are not available instruments for assessing attitudes towards PL, the development of the Attitudes towards Portuguese Language Questionnaire was proposed – ATPLQ (Questionário de Atitudes Face à Língua Portuguesa: QAFLP, Neto et al., 2011; Rebelo, 2012). As a result of this study,

the ATPLQ's model has 22 Likert-type items (4-points response format) spread over three attitudinal dimensions: behavioural, affective, and motivational.

However, this ATPLQ model was derived from exploratory factor analysis (EFA) through principal components' method based on a Pearson correlation matrix. Bollen (1989) has demonstrated that the use of Person correlations with simulated ordinal variables derived upon the discretization of continuous variables generally produced lower estimates than the ones produced by the continuous variables. Consequently, in EFA with ordinal variables, this attenuation effect can bias factor loadings and communalities' magnitudes, misleading the variables' aggregation to the factors.

The Babakus, Ferguson, and Jöreskog's (1987) simulation study pointed out the preference for the use of polychoric correlations instead of other measures of association (Pearson and Spearman correlation coefficients, or Kendall tau rank correlation coefficient). This was the type of correlations used in the current study to compare, through confirmatory factor analysis (CFA), with the ATPLQ's EFA derived model.

Finally, within this model comparison process, we intent to highlight the use of SSA based on monotonicity correlation and of CFA based on polychoric correlations in modeling constructs with ordinal indicators, and also to account for ATPLQ's structural validity, assessing its adequacy to the Portuguese youngsters population.

2. Method

2.1. Participants

Our work was developed with a convenience sample of 1441 Portuguese youngsters (28,8% in the first level, *Mdn*(age) = 9 years; 34,3% in the second level, *Mdn*(age) = 11 years; and, 6,9% in the third level, *Mdn*(age) = 14 years), of both gender (52,3% girls), from the main regions of Portugal (23,8% from North; 19,7% from Centre; 18,0% from Lisbon and Vale do Tejo; 17,4% from Alentejo; 13,6 from Algarve; and, 7,3% from Azores Islands).

2.2. Instrument

The ATPLQ (Neto et al., 2011; Rebelo, 2012) has 22 items, with a Likert-type response format (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree), spread over three attitudinal dimensions: behavioural, affective, and motivational (cf. Appendix).

2.3. Data collection

The ATPLQ's administration took place during the school year 2011/2012 in a single ninety-minute session during school hours. Responses to the questionnaire were voluntarily provided after the active informed consent of students' parents.

2.4. Data analyses

The IBM SPSS Statistics for Windows (version 19) was used for re-codification of Affective items, which are negatively connoted (cf. Appendix), and also for descriptive data analysis.

SSA. The 22 ATPLQ's items were analyzed with the help of a statistical analysis package, the HUDAP (Hebrew University Data Analysis Package), based on Louis Guttman's Facet Theory (Guttman, 1968; Guttman, 1982). One of the HUDAP program was used, the Smallest Space Analysis (SSA), that allows presenting the data graphically, portraying the structure of the data. First, a correlation matrix is calculated using the non-linear, regression-free Monotonicity Coefficient. SSA is a technique for structural analysis of similarity data providing a metric representation of non-metric information based on the relative distances within a set of points. Each variable is characterized by a point in a Euclidian space of one or more dimensions. The points are plotted in the space of smallest possible dimensionality which preserves the rank order of the relations. The distances among the points are inversely related to the observed relationship among the variables as defined by the correlations coefficients. When the correlation between two variables is high, the distance between them should be relatively small. On the other hand, when the correlation between two variables is low the distance between their geometric points should be somewhat large. In other words, in SSA distances between items are based on the inverse of a relational coefficient in such a way that the larger the coefficient the smaller the distance between the items. According to Guttman (1982), notwithstanding the fact that SSA and EFA share a common aim to reduce the number of variables by making parsimonious groupings, there are important differences that are critical in data analysis and building a theory. Besides the fact of SSA allows a greater flexibility of the allowable functions, it allows also representing domains in fewer dimensions, making the results more coherent, it is also less dependent on sample size as EFA that is highly dependent on large sample size. Furthermore, SSA is an extremely flexible technique, one that can model non-linear relationships and is not restricted by the various suppositions related with general linear models or even with factor analysis.

CFA. The ATPLQ's model derived from EFA (Neto et al., 2011; Rebelo; 2012) and the ATPLQ's model derived from SSA where compared, as oblique models, using confirmatory factor analysis (CFA) in LISREL 9.10 (Jöreskog & Sörbom, 2013).

The data collected for model testing are ordinal, requiring, in LISREL, a specific type of parameterization (Jöreskog, 2005). First, on PRELIS 2 (Jöreskog & Sörbom, 1996), the items' underlying latent continuous response, cut by m - 1 threshold parameters (m = number of response options), were used to produce the polychoric correlation (PC) matrix of those latent response variables, along with their asymptotic covariance matrix to aid estimation. These matrices were used as input in LISREL, knowing that polychoric correlations are robust estimates of bivariate associations among ordinal data (Flora & Curran, 2004).

In a second step, we tested a latent trait model, denoting the word "trait" an underlying latent variable and not an individual characteristic. Model estimation was done using the SIMPLIS command language (Jöreskog & Sörbom, 1993) with the Satorra-Bentler scaled correction of maximum likelihood (ML_{SB}; Satorra & Bentler, 1994), which adjusts standard errors and model fit statistics to non-normality. This robust technique has a good performance over a number of different sample sizes and degrees of non-normality with continuous (Curran, West, & Finch, 1996) and discrete (DiStefano, 2002) variables. To assign the units of measurement of each ATPLQ's factor, the path for one of its items was fixed to one.

The assessment of model fit is usually founded in goodness of fit (GOF) statistics, in addition to the χ^2 test. However, in large samples like our (N = 1441), the χ^2 test statistic would be very high and statistically significant because of its excessive sensitivity to sample size (Bentler & Bonett, 1980), wrongly leading to model rejection (Type I error). Thereby, although we present the ML_{SB}-χ^2 estimates and respective degrees of freedom, we only used to exam model fit to empirical data the following alternative practical (or heuristic) GOF indices, and respective cutoff values: The comparative fit index (CFI), needing values close or above .95 to denote a good fit; the root mean square error of approximation (RMSEA), needing values close or below .06 to denote a good fit; and, the standardized root mean square residual (SRMR), needing values close or below .08 to denote a good fit (Hu & Bentler, 1998). We also used the expected cross-validation index (ECVI) to compare the two alternative or competing models in appreciation (EFA and SSA models): The model presenting the lower ECVI value should be selected (Browne & Cudeck, 1993).

To assure model´s structural validity it is important that, besides factorial validity (i.e., model fit), the factors show acceptable convergent validity (CV), discriminant validity (DV), and reliability (Anderson & Gerbing, 1988). The obtained CFA's standardized estimates (MLSB-PC method) allowed the examination of factors' CV, DV, and composite reliability (CR) (Fornell & Larcker, 1981). The CV was assessed through the examination of items' average variance extracted, which should be at least .50, accordingly to the expression

$AVE = \Sigma\beta i^2/(\Sigma\beta i^2 + \Sigma\varepsilon i)$,

were β = standardized factor loading, and ε = standardized residual or error measurement variance. The DV was assessed by comparing the shared variance (φ^2 = squared de-attenuated correlation) between any two factors and the AVE of each one: DV's values should be lower than the AVE's values. Factor's reliability was calculated through the expression

$$CR = (\Sigma\beta i)^2/[(\Sigma\beta i)^2 + \Sigma\varepsilon i].$$

Factor's reliability is deemed acceptable for group comparisons when it reaches .80 (Nunnally & Bernstein, 1994). When these criteria were not achieved, the model was modified and tested again. Nevertheless, data-driven modifications of an initial model should be substantively justified to avoid capitalization based on chance (MacCallum, Roznowski, & Necowitz, 1992).

3. Results

3.1 Similarity Structure Analysis (SSA)

In order to better understand the structure of the intercorrelations among the 22 items of the ATPLQ the Similarity Structure Analysis or Smallest Space analysis was computed (Guttman, 1965). Table 1 presents the Monotonicity correlation coefficient matrix for twenty-two items of the *Attitudes towards Portuguese Language Questionnaire* (ATPLQ). We can observe that no negative correlations were found (with two exceptions which are very low). According to Guttman's first law of attitude, a positive or close to zero correlation between two items points out that these items are from the same conceptual universe of attitudes, from the moment it is established that the sample has not been artificially chosen (Guttman & Levy, 1982).

The results of the SSA that was based on the monotonicity correlations matrix revealed that it is possible to represent the matrix of the intercorrelations fairly well in two dimensions (coefficient of alienation?), but rather better in a three-dimensional space (1x2, coefficient of alienation .09; Figure 1). The same three factors found in the EFA can be easily observed in the SSA projection revealing an axial partitioning with the Behavioural items in the middle, thus sharing a similarity with the other two groups of items Affective (on the left) and Motivational (on the right).

It is also evident in the SSA map three deviating points in the Behavioural partition. Two of them are better located in the Motivational partition in the upper part of the map: item 10 "I can easily get good grades in PL", and item 8 "I can easily be a good student in PL". The third item - 15 "Portuguese Language (PL)

gives me skills", is located quite far away from the Behavioural items (at the very bottom of the plot in the lower-right hand region).

On the other hand, in the Affective partition located on the left side of the plot, two points are quite isolated from the rest of the items located in the center: Item 18 "I think it's more important to study other subjects than studying PL" located at the bottom and item 16 "I think PL has difficult subjects" located at the top.

Table 1. Monotonicity correlation coefficient matrix for twenty-two items of the Attitudes towards Portuguese Language Questionnaire – ATPLQ (decimal omitted)

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
B.01	-																				
A.02	24	-																			
M.03	69	20	-																		
B.04	77	24	74	-																	
M.05	62	15	90	71	-																
B.06	72	32	52	76	45	-															
A.07	40	67	35	45	21	56	-														
B.08	66	38	67	53	55	62	38	-													
A.09	38	59	29	40	18	47	71	46	-												
B.10	65	33	63	55	62	48	24	81	30	-											
B.11	65	21	55	71	51	75	47	59	45	34	-										
A.12	24	53	18	26	10	34	64	26	64	4	45	-									
M.13	60	22	83	65	81	56	36	71	40	56	65	36	-								
A.14	29	57	28	32	21	48	65	38	73	18	51	70	51	-							
B.15	49	-1	37	50	36	54	21	46	22	41	54	12	46	27	-						
A.16	27	40	25	18	20	24	37	33	47	26	13	37	30	55	7	-					
M.17	52	17	70	60	71	46	20	52	19	47	57	12	71	24	50	18	-				
A.18	27	36	15	37	4	37	46	13	45	7	33	48	12	45	6	39	10	-			
A.19	25	50	16	30	13	47	58	25	56	17	43	63	25	68	12	52	26	51	-		
M.20	55	27	61	49	56	46	23	70	26	62	53	16	60	27	42	20	59	5	23	-	
M.21	51	21	78	56	75	45	24	59	21	53	52	12	72	30	42	20	71	-2	24	63	-
A.22	32	49	18	30	9	46	56	29	64	20	44	62	30	71	13	52	20	52	74	25	15

Note: ATPLQ's Items aggregated by factors according to Neto et al. (2011) and Rebelo (2012): B = Behavioural, A = Affective; M = Motivational.

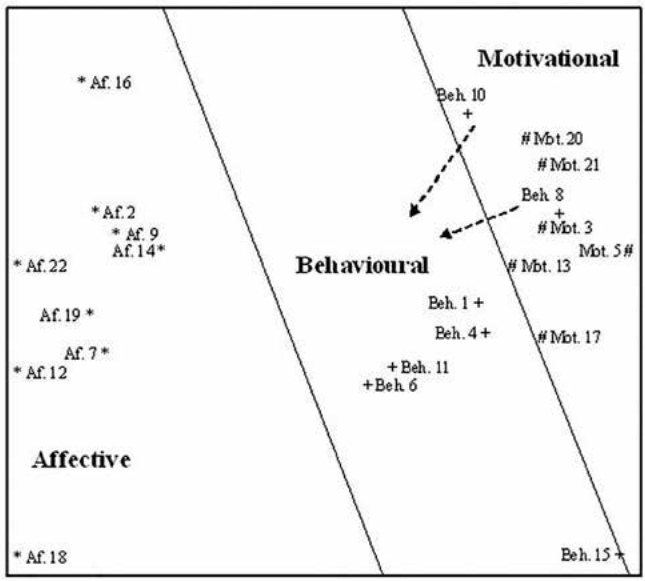

Fig. 1. SSA Map of the 22 items of the Attitudes towards Portuguese Language Questionnaire – ATPLQ (3-D, 1x2, coefficient of alienation .09).

These last two Affective items form the point of view of their location in the SSA space could be considered as belonging to the same dimension detected by EFA, despite their distance from the rest of the items matching the corresponding dimension. A similar observation can be made for two of the Behavioural items, item 10 and item 15 (especially the last one). Considering the logic underlying the CFA, it can be hypothesized that these items will show less accuracy to represent their specific dimensions or factor. On the other hand, the Behavioural item 8 could be better considered as a Motivational item, due to its location in SSA map. These observations will be verified in the next section.

3.2. Confirmatory Factor Analysis

The CFA of the ATPLQ model derived from AFE (Neto et al., 2011; Rebelo, 2012) revealed its acceptable fit to empirical data (M, Table 2), but its competing model, derived from SSA results, showed better fit results, namely a lower ECVI value (M1, Table 2). This result denoted that the shift of the items 8 and 10 from the Behavioral to the Motivational factor produced a more plausible model and, consequently, M1 should be the model selected for subsequent analyses (i.e., the VC, DV, and CR examination).

In Table 2 we can see that all M1 factors presented a good CR, however the Affective factor presented a VC's problem: Its VME was below the desirable cutoff value (.49/.50). Moreover, signalling a model DV's problem, the shared variance between Behavioral and Motivational factors was too high ($\varphi^2 = .56$; M1, Table 4), considering the AVE of each of them (M1, Table 3).

Table 2. Fit Indices of ATPLQ Models: Satorra-Bentler's Maximum Likelihood Estimation based on Polychoric Correlations

Model	ML_{SB}-x^2/df	CFI	RMSEA	SRMR	ECVI
M	1438.26/206	.938	.065	.065	1.064
M1 (SSA)	1420.88/206	.939	.064	.064	1.052
M1a (SSA)	863.42/132	.951	.062	.062	.654

Note: M = three oblique factors with 22 items (items 8 and 10 in the Behavioral factor) (Neto et al., 2011; Rebelo, 2012). SSA = model derived form similarity structure analysis. M1 = three oblique factors with 22 items (items 10 and 8 in the Motivational factor); M1a = M1 with 18 items. MLSB = Satorra-Bentler scaled correction of maximum likelihood; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean squared residual; ECVI = expected cross-validation index.

As expected, the exclusion of the items 16 and 18, the ones with less accuracy to represent the Affective factor, turned out its CV acceptable (M1a, Table 3).

Table 3. CFA of the ATPLQ Model Derived from SSA: Standardized Satorra-Bentler's Maximum Likelihood Estimates based on Polychoric Correlations, AVE and CR

	M1		M1a	
Item (Factor)	β	R^2	β	R^2
1 **(Behavioral)**	.74	.55	.74	.55
4	.81	.66	.81	.66
6	.76	.58	.76	.58
11	.76	.58	.75	.56
15	.52	.27	---	---
AVE	.53		.59	
CR	.85		.85	
2 **(Affective)**	.60	.36	.61	.37
7	.72	.52	.73	.53
9	.73	.53	.74	.55
12	.70	.49	.71	.50
14	.79	.62	.79	.62
16	.49	.24	---	---
18	.51	.26	---	---
19	.71	.50	.70	.49
22	.73	.53	.72	.52
AVE	.45		.51	
CR	.88		.88	
3 **(Motivational)**	.87	.76	.88	.77
5	.84	.71	.84	.71
8	.65	.42	.62	.38
10	.60	.36	---	---
13	.82	.67	.82	.67
17	.70	.49	.70	.49
20	.61	.37	.59	.35
21	.74	.55	.88	.77
AVE	.54		.56	
CR	.90		.90	

Note: β = standardized factor loading (with $p < .001$); R^2 (communality) = 1 - ε (standardized residual). AVE = average variance extracted; CR = composite reliability. See Table 1 for other abbreviations.

Also the previously identified DV's problem of M1 was solved with the exclusion of the items 10 and 15, respectively the ones with less accuracy to represent the Motivational and the Behavioral factors. The shared variance between the Motivational and the Behavioral factors ($\varphi^2 = .55$; M1a, Table 3) was now, as was desired, lower than the AVE of each one of them (M1a, Table 2).

Table 4. CFA of the ATPLQ Model Derived from SSA: De-attenuated Correlations between Factors with Maximum Likelihood Estimates based on Polychoric Correlations

	M1		
Factor	**Behavioral**	**Affective**	**Motivational**
Behavioral	1.00		
Affective	.55	1.00	
Motivational	.75	.33	1.00
	M1a		
Factor	**Behavioral**	**Affective**	Motivational
Behavioral	1.00		
Affective	.56	1.00	
Motivational	.74	.39	1.00

Note: All de-attenuated correlations (φ) with $p < .001$. See Table 1 for abbreviations.

Finally, it should be noted in Table 1 that the re-specification of M1 also has ameliorated model fit (M1a): The ATPLQ oblique model derived from SSA, with modifications to guarantee a good CV, CR and DV, showed a good fit to empirical data.

3.3. SSA (18 items)

Based on the SSA map presented in Figure 1 (confirmed also by the CFA - ameliorated model fit displayed in Table 1) a further SSA was computed with eighteen items (Figure 3; 3-D, 1x2, coefficient of alienation .07). In this new SSA again an axial partitioning can be observed with all items in their respective region, quite clustered together without any deviation. The Behavioural items located in the middle and the other two groups of items at the extremities: Affectivity items on the left side and Motivational on the right side. This structure is congruent with the results obtained in the CFA.

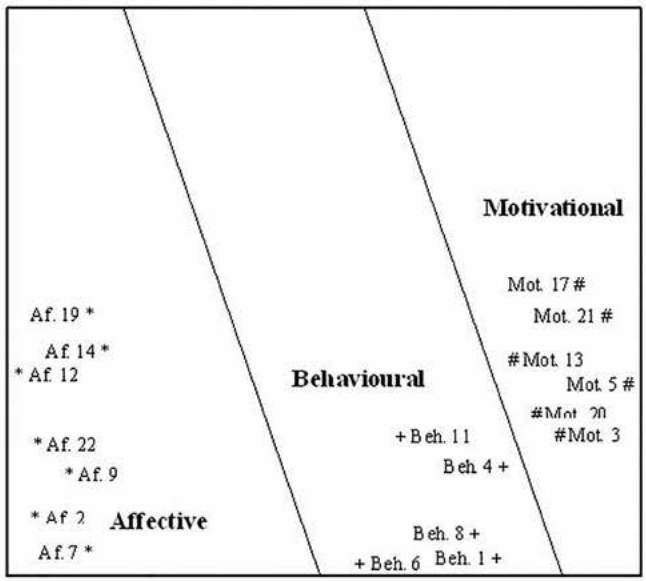

Fig. 2. SSA Map of the 18 items of the Attitudes towards Portuguese Language Questionnaire – ATPLQ (3-D, 1x2, coefficient of alienation .07).

4. Discussion

The aim of this paper was to compare, highlight and discuss the relevance and application two statistical techniques in research: SSA and Factor Analysis (EFA and CFA).

More specifically, in this study we examined the ATPLQ's structure, applying SSA's monotonicity coefficient solution, and compared that solution with the ATPLQ authors' proposed structure, derived through principal components' EFA (Neto et al., 2011; Rebelo, 2012). We aimed to see if the known limitation of the use of Pearson correlations to properly deal with ordinal variables (Babakus et al., 1987; Bollen,1989) generated a worse model than the one generated through SSA's method.

The CFA of the ATPLQ's structure, tested as a latent trait model or, in other words, modeling constructs with polychoric correlations between the underling latent continuous distributions of ordinal manifest variables, has shown differences between both methods. The structure generated through SSA was more plausible then the structure generated through EFA. The shift of the items 8 and 10 from the Behavioral to the Motivational factor in the SSA structure produced a better model fit to empirical data. This data-driven modification is also substantively justifiable taking into account the content of both items (cf. Appendix).

This model was selected to exam factors' CV, DV and CR (Fornell & Larcker, 1981), in order to complete the assessment of ATPLQ's adequacy to the younger Portuguese population. The CV of the Affective factor was only acceptable with the exclusion of the items 16 and 18, and the DV between the Motivational and the Behavioral factors was only achieved with the exclusion of the items 10 and 15. The decision to exclude these items was anchored not only on ATPLQ psychometric features' results, but also on their convergence with the SSA's results and, moreover, because it is also substantively justifiable through the examination of the items' content (cf. Appendix): Items 16 and 18 are not linked to emotional aspects of attitudes toward PL; and, item 10 is also related to behavioral and item 15 to motivational aspects of attitudes toward PL. It should be noted that, during data collection, most of the participants in the study showed difficulty in understand the item 15 word "*competência*" (competence).

The corollary of this assessment procedure was an ATPLQ model statistically significant and sufficiently parsimonious with four items in the Behavioural factor, and seven items in both the Affective and Motivational factors. However, an attentive look to the items of the Motivational factor leads us to rethink the denomination of that factor: The items point to students' perceptions of PL activities' usefulness to their future lives, as well as the worth of PL activities and learning. In future studies this factor should be named as instrumentality, a construct directly related to motivation and commitment to study (George, 2006; Simons, Dewitte & Lens, 2004).

Thus, CFA and especially SSA confirmed and improved the ATPLQ model identifying the subscales and dynamic relationships between them. In fact, SSA, a non-metric multidimensional analysis of items, presupposes less stringent assumptions regarding the distributional and metric properties of the data and enables a representation of complex relationship in a relatively intuitive manner. The loading of items on the main factors in the ATPLQ questionnaire was revealed through analysis of item clusters in the SSA map, which was further confirmed with CFA. The analyses lead to the revision of the questionnaire with final better reliability values, giving in such a way support to the use of SSA in item analysis, which should produce more reliable testing tools. Finally, both these statistical tools provide new heuristically important opportunities for research committed to better understanding the underlying structure of data.

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References

Afonso, N. & Costa, E. (2009). A influência do Programme for International Student Assessment (PISA) na decisão política em Portugal: O caso das políticas educativas do XVII Governo Constitucional Português. Sísifo Revista de Ciências da Educação, 10, 53-64.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two step approach. Psychologial Bulletin, 103, 411-423.

Babakus, E., Ferguson, C. E., & Jöreskog, K. G. (1987). The sensitivity of confirmatory maximum likelihood factor analysis to violations of measurement scale and distributional assumption. Journal of Marketing Research, 24, 222-228.

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. Psychological Bulletin, 88, 588-606.

Bollen, K. A. (1989). Structural equations with latent variables. New York: Wiley.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen, & J. S. Long (Eds.), Testing structural equation models (pp. 136-162). London: SAGE.

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. Psychological Methods, 1, 16-29.

DiStefano, C. (2002). The impact of categorization with confirmatory factor analysis. Structural Equation Modeling, 9, 327-346.

Flora, D. B., & Curran, P. J. (2004). An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. Psychological Methods, 9, 466-491.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18, 39-50.

George, R. (2006). A cross-domain analysis of change in students' attitudes toward science and attitudes about the utility of science. International Journal of Science Education, 28, 571-589.

Guttman, L (1968) A General nonmetric technique for finding the smallest co-ordinate space for a configuration of points. Psychometrika 33, 469-506.

Guttman, L. (1982) Facet Theory, Smallest Space Anlaysis and Factor Analysis, Perceptual and Motor Skills, 454, 491-493.

Guttman, L. & Levy, S. (1982). On the definition and varieties of attitude and wellbeing. Social Indicators Research, 10, 159-174.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparametrized model misspecification. Psychological Methods, 3, 424-453.

Jöreskog, K. G. (2005). Structural equation modeling with ordinal variables using LISREL. Retrieved from http://www.ssicentral.com/lisrel/techdocs/ordinal.pdf

Jöreskog, K. G., & Sörbom, D. (1993). LISREL 8: Structural equation modeling with the SIMPLIS command language. Chicago, IL: Scientific Software International.

Jöreskog, K. G., & Sörbom, D. (1996). PRELIS 2: User's reference guide. Chicago, IL: Scientific Software International.

Jöreskog, K. G., & Sörbom, D. (2013). LISREL 9.10 for Windows [Computer software]. Chicago, IL: Scientific Software International.

MacCallum, R. C., Roznowski, M., & Necowitz, L. B. (1992). Model modification in covariance structure analysis: The problem of capitalization on chance. Psychological Bulletin, 111, 490-504.

Neto, A., Candeias, A., Pomar, C., Costa, P., Oliveira, M., Silva, S., & Rebelo, N. (2011). Questionários de atitudes face à Língua Portuguesa (QAFLP), Matemática (QAFM), Ciências da Natureza (QAFCdN), Ciências Naturais (QAFCN) e Ciências Físico-Químicas (QAFCFQ) em alunos portugueses do Ensino Básico: Estudo psicométrico. Comunicação apresentada no XI Congreso Internacional Galego-Portugués de Psicopedagoxía. Universidade da Coruña, Coruña, España.

Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric theory (3ª ed.). New York, NY: McGraw-Hill.

Rebelo, N. (2012). Estudo dos perfis atitudinais e emocionais de alunos do ensino básico português: Caracterização em função do nível escolar e do sexo. Dissertação de Mestrado em Psicologia da Educação, Universidade de Évora, Évora.

Santiago, R. (1994). Representações da escola nos alunos. Comunicação apresentada no VI Seminário - A Componente de Psicologia na Formação de Professores: Ser Aluno, Universidade de Évora, Évora.

Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis. In A. von Eye, & C. C. Clogg (Eds.), Latent variable analysis (pp. 399-419). Thousand Oaks, CA: SAGE.

Simons, J., Dewitte, S., & Lens, W. (2004). The role of different types of instrumentality in motivation, study strategies, and performance: Know why you learn, so you'll know what you learn! British Journal of Educational Psychology, 74, 343-360.

Appendix

ATPLQ's Items Aggregated by Factors (Neto et al., 2011; Rebelo, 2012)

Behavioral	
1. Percebo a utilidade da língua portuguesa (LP).	I understand the usefulness of the Portuguese language (PL).
4. A LP é útil para a minha vida.	PL is useful for my life.
6. Penso que é importante ter bons resultados a LP.	I think it is important to get good results in PL.
8. Consigo ser bom/a aluno/a a LP facilmente.	I can easily be a good student in PL.
10. Tenho facilmente boas notas a LP.	I can easily get good grades in PL.
11. Considero a LP uma área importante no dia-a-dia.	I consider the PL an important subject in my day-to-day.
15. A LP dá-me competência.	PL gives me skills.
Affective	
2. As matérias de LP provocam-me insegurança.	The subjects of PL make me insecure.
7. A expressão "língua portuguesa" provoca-me uma sensação desagradável.	The expression "Portuguese language" gives me an unpleasant sensation.
9. A LP desorienta-me.	The PL confuses me.
12. Interpretar textos de LP desanima-me.	To interpret PL texts gets me down.
14. Estudar LP assusta-me.	Studying PL scares me.
16. Penso que a LP tem matérias difíceis.	I think PL has difficult subjects.
18. Penso que é mais importante estudar para outras disciplinas do que para LP.	I think it's more important to study other subjects than studying PL.
19. Quando aparece um texto de LP para interpretar tenho vontade de desistir.	When a PL text appears to interpret, I want to quit.
22. Quando interpreto textos de LP fico incomodado/a.	When I interpret PL texts, I get uneasy.
Motivational	
3. Para mim, estudar LP é divertido.	To me, studying PL is fun.
5. Estudar LP dá-me alegria.	To study PL makes me happy.
13. Gosto de estudar LP.	I enjoy studying PL
17. Sinto-me entusiasmado/a quando vou às aulas de LP.	I feel enthusiastic when I go to PL classes.
20. Compreendo facilmente o que é explicado em LP.	I easily understand what is explained in PL.
21. Estudar LP tranquiliza-me.	The study of PL calms me down.

Note: The items in English are a product of a thinking-aloud consensus method made by four judgs, based on the work of two bilinguals translators.

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Facet Theory (FT) is a meta-theory for designing structural and other theories in the behavioral sciences. Basic assumptions of FT are that social and behavioral concepts are complex constructs and that their study, therefore, requires a systematic design for defining observations and for examining the correspondence between the observations and the theory. Because such a definitional design should facilitate the evaluation of systematic relations between the data and the theory, it should lead to cumulative results. In the above sense, FT is a systematic approach for coordinating theory and research.

FT comprises the universe of observations, the population of respondents, and the range of observations. It stratifies these universes by facets and integrates the design by means of a mapping sentence which guides the construction of items and the formulation of hypotheses. Finally, particular multivariate data analysis methods (such as SSA, POSAC, MSA) have been developed to test these hypotheses.

Facet Theory has been successfully applied to a large number of research areas where it has significantly contributed to the discovery and refinement of empirical laws.

Our aims in this book are:

1) To review recent and innovative research results arising from the application of the Facet Theory approach to complex social and psychological issues;

2) To present methodological advances in comparative studies and applications of Similarity Structure Analysis (SSA), Multidimensional Scalogram Analysis (MSA), Factor Analysis (FA), Confirmatory Factor Analysis (CFA), Partial Order Scalogram Analysis (POSAC), and other multivariate procedures and techniques related to FT;

3) To present theoretical advances in Facet Theory and related approaches;

4) To present new reflections on the role of Facet Theory in modern science and in the emergence of new scientific paradigms.

Editors
Antonio Roazzi
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