

NUMERICAL SOLUTIONS FOR CATTELL'S SCREE TEST:

APPLICATION TO THE ADOLESCENT SMOKING CONSEQUENCES QUESTIONNAIRE (ASCQ)

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INTRODUCTION

- Principal components analysis (PCA) is a dimension reduction technique that is frequently used as an exploratory data analytic tool (Pearson, 1901). Cattell's scree test is a simple graphical solution to determine the number of components to retain, following a PCA.
- Raïche, Walls, Riopel, and Blais (under review) introduce some numerical approaches to Cattell's scree test: 1) the scree test optimal coordinates (OC) and 2) scree test acceleration factor (AC).
- As a demonstration of these new approaches, we consider data from 51 sibling pairs and two singletons ($n=104$, mean age = 18 years) from each of the second and third waves of a three wave study of adolescents smoking behavior.
- Number of components retained were compared between: Kaiser's Rule (KA), Parallel Analysis (PA), Scree Test Optimal Coordinates (OC), and Scree Test Acceleration Factor (AF).

BACKGROUND INFORMATION

- Kaiser's Rule (KA)** $n_k = \sum_i (\lambda_i \geq 1)$

Kaiser's rule retains components that have eigenvalues greater than 1.

- Parallel Analysis (KA)** $n_{parallel} = \sum_i (\lambda_i \geq LS_i)$

Parallel analysis is intended to use the average, or a specified percentile of the eigenvalues as a criterion, instead of the value 1.

- Scree Test Optimal Coordinates (SOC)**

In the Scree Test Optimal Coordinates, eigenvalues are predicted by preceding points, and if the observed eigenvalue is greater or equal to the predicted eigenvalue, it is retained.

$$n_{OC} = \sum_i [(\lambda_i \geq 1) \text{ and } (\lambda_i \geq \text{predicted } \lambda_i)]$$

$$n_{OC} = \sum_i [(\lambda_i \geq LS_i) \text{ and } (\lambda_i \geq \text{predicted } \lambda_i)]$$

- Scree Test Acceleration Factor (SAF)**

The number of components retained is determined by the maximum acceleration factor.

$$n_{af} = \text{If } [(\lambda_i \geq 1) \text{ and } (i = \max(af))]$$

$$n_{af} = \text{If } [(\lambda_i \geq LS_i) \text{ and } (i = \max(af))]$$

METHOD

Measures

- The Adolescent Smoking Consequences Questionnaire (ASCQ; Lewis-Esquerre, Rodrigue, & Kahler, 2005) is a modified version of the Smoking Consequences Questionnaire (SCQ; Brandon, Baker, 1991). SCQ is an 80 item measure to assess the subjective expected utility (SEU) of smoking. ASCQ is consisted of 31 items that were adopted from SCQ.
- Number of different factor structures were reported from different versions of SCQs; Brandon and Baker (1991) reported four components ($n=382$, mean age=18.7), and Copeland et al. reported eight components ($n=407$, mean age=43.2) by PCA.
- Lewis-Esquerre and colleagues conducted confirmatory factor analysis (CFA) instead of PCA. Lewis-Esquerre tested 3, 5, and 8 factor models based on previous findings, and concluded best fit for the seven factor model. CFA revealed moderate fit for seven factors (CFI=.92, TLI=.97, and RMSEA=.07), in a normative sample of adolescents ($n=396$). The seven factors identified by the authors were: 1) Negative affect reduction, 2) Taste/sensorimotor manipulation, 3) Social facilitation, 4) Weight control, 5) Negative physical feelings, 6) Boredom reduction, and 7) Negative social impression.

Analysis

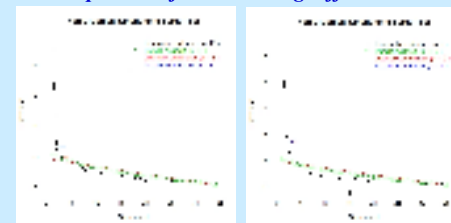
- Principal component analysis was conducted for wave 2 and wave 3 using nFACTORS package in statistical software R.
- Also, for comparison, a CFA for the seven factors proposed by Lewis-Esquerre et al. (2005) were examined with MPLUS (using weighted least squares).

RESULTS

Results

- In PCA using R, the number of components retained was 10, 3, 3, 1 and 8, 2, 2, 1 for KA, PA, OC and AF, respectively, for waves 2 and 3.
- In CFA using MPlus, the convergence criteria was not met for both of the waves 2 and 3, in this sample of adolescents.

Table 1. Comparison of Results using different solutions



CONCLUSIONS

- Initial intention of this study was to compare the PCA results of ASCQ in adolescent sample to the earlier studies on SCQ. Solutions with PA and OC indicated 3 components to retain for waves 2 and 3, showing similarity to the Brandon and colleagues (1991) report of 4 components.
- Second purpose of this study was to apply new solutions for PCA, as proposed by Raïche and colleagues. In this application, compared to KA, 1) PA, SOC and SAF reduced the number of components to retain, and 2) remained steady across the waves. This result is in line with Raïche and colleagues' data simulation.
- Direct comparison with the Lewis-Esquerre and colleagues' (2005) study is inappropriate since the sample characteristics are different: the participants of this study were sampled from 1) high risk group of smoking behavior and were conveniently sampled from a pool of ongoing study, and 2) the unit of sampling was dyads, thus individuals' behaviors may not be independent from each other.

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