SPSS SERIES 6: EXPLORATORY FACTOR ANALYSIS

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What is factor analysis

- Structure analyzing procedures
- Identify the interrelationships among a large set of observed variables.
- Use data reduction to group a smaller number of variables into factors that have common characteristics.
Two types of factor analysis

- **Exploratory factor analysis (EFA)**
  - Researchers do not know how many factors explain the interrelationships among a set of items.
  - Using EFA to explore the underlying dimensions of the construct of interest.

- **Confirmatory factor analysis (CFA)**
  - Researchers do know how many factors explain the interrelationships among a set of items.
  - Using CFA to determine how well the hypothesized theoretical structure fits the data.
Assumptions of EFA

- Factor analysis uses Person product moment correlations.
- The data should have a bivariate normal distribution for each pair of variables.
- Observations should be independent.
When use EFA

- Factor Analysis is primarily used for data reduction or structure detection.
  - The purpose of data reduction is to remove redundant (highly correlated) variables from the data file, perhaps replacing the entire data file with a smaller number of uncorrelated variables.
  - The purpose of structure detection is to examine the underlying (or latent) relationships between the variables.
Sample size

- No golden rules
- 10-15 subjects/variable
- At least 300 cases
- 500 (very good) - 1000 or more (excellent)
Data required

- The variables should be quantitative at the interval or ratio level.
- Categorical data are not suitable for factor analysis.
- Data for which Pearson correlation coefficients can sensibly be calculated should be suitable for factor analysis.
- If you think the relationships between your variables are nonlinear, the bivariate correlations procedure offers correlation coefficients that are more appropriate for nonlinear associations.
- If your analysis variables are not scale variables, you can try hierarchical cluster analysis on the variables as an alternative to factor analysis for structure detection.
Decision-making process in EFA

- Step 1: Specifying problem
- Step 2: Generating items, initially testing the instrument
- Step 3: Assessing the adequacy of the correlation matrix
- Step 4: Extracting the initial factors
- Step 5: Rotating the factors
- Step 6: Refining the solution
- Step 7: Interpreting findings
- Step 8: Reporting and replicating the results

Factor extractions

- **Principal component analysis (PCA) for data reduction**
  - It begins by finding a linear combination of variables (a component) that accounts for as much variation in the original variables as possible.
  - then finds another component that accounts for as much of the remaining variation as possible and is uncorrelated with the previous component, continuing in this way until there are as many components as original variables.
  - A few components will account for most of the variation, and these components can be used to replace the original variables. This method is most often used to reduce the number of variables in the data file.
  - Hypothetical factors are generated from total variance (the sum of the variances for the original variables).
Factor extractions

- **Principal axis factoring (PAF) for structure detection**
  - With the assumption that some of the variability in the data cannot be explained by the components (usually called factors in other extraction methods).
  - The hypothetical factors are generated from **common variance** (variance that one item shares with other items), not total variance.
  - The total variance explained by the solution is smaller; But it is ideal for examining relationships between the variables.
Extractions

- Start with a PCA solution
- Compare results with a PAF solution
- Pick the one that best fits and makes sense
- With any extraction method, the two questions that a good solution should try to answer are "How many components (factors) are needed to represent the variables?" and "What do these components represent?"
Terms

- **Communalities**: total amount of variance in each item that is explained by the factors.
- **Eigenvalues**: amount of variance in all of the items that can be explained by a given principal component or factor.
Terms

- Scree plot

Three principal components

Draw a straight line through smaller eigenvalues
Rotation methods

- **Orthogonal rotations**
  - Assumption: the factors are independent of each other or uncorrelated.
  - Three major approaches to orthogonal rotation: \textit{Varimax, Quartimax, Equamax}

- **Oblique rotations**
  - Assumption: the factors are correlated.
  - Types of oblique rotations: \textit{Direct Oblimin} and \textit{Promax}
Guidelines for selecting the number of factors

- Eigenvalue > 1
- Percent of variance extracted: cumulative percentage of variance
- Scree plot
- Factor interpretability and usefulness
EFA using SPSS

- Example: use EFA to determine the underlying structure in self-image.
  - 30 items for self-image scale
  - Q59_1 to Q59_30
EFA using SPSS

- Analyze > Dimension Reduction > Factor...
- Enter all self-image items into Variables
- Click Descriptive
EFA using SPSS

- Descriptives
  - Check KMO... and Anti-image
- Extraction
EFA using SPSS

- Rotation
  - Check Varimax
  - Click Continue
KMO and Bartlett’s test: indicate the suitability of your data for structure detection.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy indicates the proportion of variance in your variables that might be caused by underlying factors.

High values (close to 1.0) generally indicate that a factor analysis may be useful with your data. If the value is less than 0.50, the results of the factor analysis probably won't be very useful.

Size of KMO
Above .90 is “marvelous”
In the .80s is “meritorious”
In the .70s is just “middling”
Less than .60s is “unacceptable”
Bartlett's test of sphericity tests the hypothesis that your correlation matrix is an identity matrix (there is no relationship among the item), which would indicate that your variables are unrelated and therefore unsuitable for structure detection.

Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with your data.
SPSS output

- Measures of sampling adequacy (MSA)
  - Anti-image correlation matrix: indicates how strongly one item is correlated with other items in the matrix. Cut-off is >.70.
Summary of tests of matrices

- According to Bartlett’s test ($p < .05$), the correlation matrix is not an identity matrix.
- KMO statistic suggests that we have a sufficient sample size relative to the number of items in our scale.
- The MSA statistics indicate that the correlations among the individual items are strong enough to suggest that the correlation matrix is factorable.
Communalities indicate the amount of variance in each item that is accounted for by components (8 components).

High communality indicates that the extracted components represent the variables well. If any communalities are very low in a principal components extraction, you may need to extract another component.
Eigenvalue

1. Total
The Total column gives the eigenvalue, or amount of variance in the original variables accounted for by each component.

2. The % of Variance column gives the ratio, expressed as a percentage, of the variance accounted for by each component to the total variance in all of the variables.

3. The Cumulative % column gives the percentage of variance accounted for by the first n components. For example, the cumulative percentage for the second component is the sum of the percentage of variance for the first and second components.

For the initial solution, there are as many components as variables, and in a correlations analysis, the sum of the eigenvalues equals the number of components. You have requested that eigenvalues greater than 1 be extracted, so the first 8 principal components form the extracted solution.
Eight extracted components explain nearly 66% of the variability in the original 30 variables. The variation is now spread more evenly over the components. The large changes in the individual totals suggest that the rotated component matrix will be easier to interpret than the unrotated matrix.
The scree plot helps you to determine the optimal number of components. The eigenvalue of each component in the initial solution is plotted. Generally, you want to extract the components on the steep slope. But for this scree plot, I want to extract 3 factors.
EFA using SPSS

- Rerun factor analysis using 3-factor solution
- Analyze > Dimension Reduction > Factor...
- Click Extraction

Under Extract
Check Fixed number of factors and type 3
SPSS output

- 42.49% of the variance in the 30 items is explained by 3 components.

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial Eigenvalues</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>6.883</td>
</tr>
<tr>
<td>2</td>
<td>3.448</td>
</tr>
<tr>
<td>3</td>
<td>2.415</td>
</tr>
</tbody>
</table>
SPSS output

- Rotated component matrix
  - The rotated component matrix helps you to determine what the components represent.

<table>
<thead>
<tr>
<th>Rotated Component Matrix</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>a59_1 Responsible</td>
<td>0.216</td>
</tr>
<tr>
<td>a59_2 Motivated</td>
<td>0.409</td>
</tr>
<tr>
<td>a59_3 A hard worker</td>
<td>0.365</td>
</tr>
<tr>
<td>a59_4 Mature</td>
<td>0.166</td>
</tr>
<tr>
<td>a59_5 Independent</td>
<td>0.231</td>
</tr>
<tr>
<td>a59_6 Successful</td>
<td>0.450</td>
</tr>
<tr>
<td>a59_7 Honest/Truthful</td>
<td>0.068</td>
</tr>
<tr>
<td>a59_8 Disciplined</td>
<td>0.184</td>
</tr>
<tr>
<td>a59_9 Fit/In shape</td>
<td>0.637</td>
</tr>
<tr>
<td>a59_10 Healthy</td>
<td>0.539</td>
</tr>
<tr>
<td>a59_11 Having a nice bodyfigure</td>
<td>0.706</td>
</tr>
<tr>
<td>a59_12 Athletic</td>
<td>0.679</td>
</tr>
<tr>
<td>a59_13 In style/ fashionable</td>
<td>0.703</td>
</tr>
<tr>
<td>a59_14 Cool</td>
<td>0.656</td>
</tr>
<tr>
<td>a59_15 Good looking/ Attractive</td>
<td>0.656</td>
</tr>
<tr>
<td>a59_16 Popular</td>
<td>0.734</td>
</tr>
<tr>
<td>a59_17 Rich/Wealthy</td>
<td>0.482</td>
</tr>
<tr>
<td>a59_18 A pot user</td>
<td>-0.047</td>
</tr>
<tr>
<td>a59_19 Taking drugs</td>
<td>-0.050</td>
</tr>
<tr>
<td>a59_20 A cigarettes smoker</td>
<td>-0.121</td>
</tr>
<tr>
<td>a59_21 A partier</td>
<td>0.160</td>
</tr>
<tr>
<td>a59_22 Wild</td>
<td>0.116</td>
</tr>
<tr>
<td>a59_23 An alcohol drinker</td>
<td>-0.088</td>
</tr>
<tr>
<td>a59_24 Nice/Friendly</td>
<td>-0.046</td>
</tr>
<tr>
<td>a59_25 Kind/Good</td>
<td>0.028</td>
</tr>
<tr>
<td>a59_26 Considerate</td>
<td>-0.003</td>
</tr>
<tr>
<td>a59_27 Worried</td>
<td>-0.319</td>
</tr>
<tr>
<td>a59_28 Depressed/Unhappy</td>
<td>-0.316</td>
</tr>
<tr>
<td>a59_29 Tough</td>
<td>0.364</td>
</tr>
<tr>
<td>a59_30 Strong</td>
<td>0.445</td>
</tr>
</tbody>
</table>
Evaluate factor loadings

- In an orthogonal rotation: such as Varimax
  - .45: fair
  - .55: good
  - .63: very good
  - .71: excellent
Evaluate factor loadings

- Examine rotated factor matrices for high or low loadings
  - In an orthogonal rotation, factor pattern and factor structure matrix are identical.
  - In an oblique rotation, those matrices are different.
    - First focus on structure matrix for factor interpretability and then compare your decisions with loadings in the factor pattern matrix
### Table 1. Factor Loadings from Varimax Rotation for Self-Image Scale of High School Sample

<table>
<thead>
<tr>
<th>Self-Image Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. External appearance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fit/in shape</td>
<td>.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Having a nice body/figure</td>
<td>.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Athletic</td>
<td>.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In style</td>
<td>.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cool</td>
<td>.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good looking/attractive</td>
<td>.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Popular</td>
<td>.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strong</td>
<td>.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. Internal characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsible</td>
<td></td>
<td>.59</td>
<td></td>
</tr>
<tr>
<td>Motivated</td>
<td>.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A hard worker</td>
<td>.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature</td>
<td>.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successful</td>
<td>.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honest/truthful</td>
<td>.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disciplined</td>
<td>.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nice/friendly</td>
<td>.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kind/good</td>
<td>.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Considerate</td>
<td>.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3. Drug using</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A pot user</td>
<td></td>
<td></td>
<td>.74</td>
</tr>
<tr>
<td>Taking drugs</td>
<td></td>
<td>.80</td>
<td></td>
</tr>
<tr>
<td>A cigarettes smoker</td>
<td></td>
<td>.65</td>
<td></td>
</tr>
<tr>
<td>A partier</td>
<td></td>
<td>.69</td>
<td></td>
</tr>
<tr>
<td>Wild</td>
<td></td>
<td>.65</td>
<td></td>
</tr>
<tr>
<td>An alcohol drinker</td>
<td></td>
<td>.78</td>
<td></td>
</tr>
</tbody>
</table>
EFA using SPSS

- The same example but using oblique rotation
- Analyze > Dimension Reduction > Factor...
- Enter all self-image items into Variables
- Click Rotation
- Choose Direct Oblimin
SPSS output

- Factor structure matrix: simple zero-order correlations of the items with the factors.
- Factor pattern matrix: contains the loadings that represent unique relationship of each item to a factor while controlling the correlations among the factors.
### Factor structure matrix

<table>
<thead>
<tr>
<th>Structure Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>a59_1 Responsible</td>
</tr>
<tr>
<td>a59_2 Motivated</td>
</tr>
<tr>
<td>a59_3 A hard worker</td>
</tr>
<tr>
<td>a59_4 Mature</td>
</tr>
<tr>
<td>a59_5 Independent</td>
</tr>
<tr>
<td>a59_6 Successful</td>
</tr>
<tr>
<td>a59_7 Honest/Truthful</td>
</tr>
<tr>
<td>a59_8 Disciplined</td>
</tr>
<tr>
<td>a59_9 Fit/In shape</td>
</tr>
<tr>
<td>a59_10 Healthy</td>
</tr>
<tr>
<td>a59_11 Having a nice body figure</td>
</tr>
<tr>
<td>a59_12 Athletic</td>
</tr>
<tr>
<td>a59_13 In style/Fashionable</td>
</tr>
<tr>
<td>a59_14 Cool</td>
</tr>
<tr>
<td>a59_15 Good Inkin/Attractive</td>
</tr>
</tbody>
</table>

**Extraction Method:** Principal Component Analysis.
**Rotation Method:** Oblimin with Kaiser Normalization.
### Factor pattern matrix

<table>
<thead>
<tr>
<th>Pattern Matrixa</th>
<th>Component</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>a59_1 Responsible</td>
<td>.119</td>
<td>-.133</td>
<td>.577</td>
<td></td>
</tr>
<tr>
<td>a59_2 Motivated</td>
<td>.337</td>
<td>-.117</td>
<td>.449</td>
<td></td>
</tr>
<tr>
<td>a59_3 A hard worker</td>
<td>.291</td>
<td>-.067</td>
<td>.469</td>
<td></td>
</tr>
<tr>
<td>a59_4 Mature</td>
<td>.079</td>
<td>-.028</td>
<td>.535</td>
<td></td>
</tr>
<tr>
<td>a59_5 Independent</td>
<td>.181</td>
<td>.046</td>
<td>.341</td>
<td></td>
</tr>
<tr>
<td>a59_6 Successful</td>
<td>.388</td>
<td>-.125</td>
<td>.389</td>
<td></td>
</tr>
<tr>
<td>a59_7 Honest/Truthful</td>
<td>-.029</td>
<td>-.066</td>
<td>.585</td>
<td></td>
</tr>
<tr>
<td>a59_8 Disciplined</td>
<td>.093</td>
<td>-.199</td>
<td>.520</td>
<td></td>
</tr>
<tr>
<td>a59_9 Fit/In shape</td>
<td>.650</td>
<td>-.124</td>
<td>-.047</td>
<td></td>
</tr>
<tr>
<td>a59_10 Healthy</td>
<td>.521</td>
<td>-.165</td>
<td>.127</td>
<td></td>
</tr>
<tr>
<td>a59_11 Having a nice body/figure</td>
<td>.725</td>
<td>-.060</td>
<td>-.063</td>
<td></td>
</tr>
<tr>
<td>a59_12 Athletic</td>
<td>.694</td>
<td>-.015</td>
<td>-.024</td>
<td></td>
</tr>
<tr>
<td>a59_13 In style/Fashionable</td>
<td>.713</td>
<td>.142</td>
<td>.046</td>
<td></td>
</tr>
<tr>
<td>a59_14 Cool</td>
<td>.642</td>
<td>.133</td>
<td>.185</td>
<td></td>
</tr>
<tr>
<td>a59_15 Good looking/Attractive</td>
<td>.649</td>
<td>.091</td>
<td>.130</td>
<td></td>
</tr>
</tbody>
</table>

### Factor loadings

<table>
<thead>
<tr>
<th>Item</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>a59_16 Popular</td>
<td>.740</td>
<td>.148</td>
<td>.073</td>
</tr>
<tr>
<td>a59_17 Rich/Wealthy</td>
<td>.501</td>
<td>.070</td>
<td>-.050</td>
</tr>
<tr>
<td>a59_18 A pot user</td>
<td>-.016</td>
<td>.742</td>
<td>-.012</td>
</tr>
<tr>
<td>a59_19 Taking drugs</td>
<td>-.014</td>
<td>.795</td>
<td>-.032</td>
</tr>
<tr>
<td>a59_20 A cigarettes smoker</td>
<td>-.090</td>
<td>.640</td>
<td>-.050</td>
</tr>
<tr>
<td>a59_21 A partier</td>
<td>.196</td>
<td>.700</td>
<td>-.031</td>
</tr>
<tr>
<td>a59_22 Wild</td>
<td>.153</td>
<td>.657</td>
<td>-.048</td>
</tr>
<tr>
<td>a59_23 An alcohol drinker</td>
<td>-.051</td>
<td>.774</td>
<td>-.047</td>
</tr>
<tr>
<td>a59_24 Nice/Friendly</td>
<td>-.165</td>
<td>.058</td>
<td>.733</td>
</tr>
<tr>
<td>a59_25 Kind/Good</td>
<td>-.100</td>
<td>.042</td>
<td>.789</td>
</tr>
<tr>
<td>a59_26 Considerate</td>
<td>-.123</td>
<td>.026</td>
<td>.736</td>
</tr>
<tr>
<td>a59_27 Worried</td>
<td>-.351</td>
<td>.175</td>
<td>.205</td>
</tr>
<tr>
<td>a59_28 Depressed/Unhappy</td>
<td>-.308</td>
<td>.289</td>
<td>-.012</td>
</tr>
<tr>
<td>a59_29 Tough</td>
<td>.336</td>
<td>.185</td>
<td>.254</td>
</tr>
<tr>
<td>a59_30 Strong</td>
<td>.411</td>
<td>.174</td>
<td>.298</td>
</tr>
</tbody>
</table>

**Extraction Method:** Principal Component Analysis.  
**Rotation Method:** Oblimin with Kaiser Normalization.
SPSS output

- Correlations among factors

<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.000</td>
<td>-0.099</td>
<td>0.325</td>
</tr>
<tr>
<td>2</td>
<td>-0.099</td>
<td>1.000</td>
<td>-0.003</td>
</tr>
<tr>
<td>3</td>
<td>0.325</td>
<td>-0.003</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.
Evaluating factor loadings

- Items with weak loadings
  - Are those loadings <.30
  - Drop items that do not load reasonably on any factor
  - Evaluate the weak loading item’s communality and its unique contribution to the instrument
    - Low communality and little importance to the instrument, the item should be removed.
    - Important contributor to the instrument, the item should not be eliminated.
Evaluating factor loadings

- Items with double loadings
  - Placing item with the factor that it is most closely related to conceptually.
  - Based on factor’s internal consistency.
Principal axis factoring

- We use the same example
- 30-item self-image scale (Q59)
- We want to know the underlying structure of self-image scale
PAF using SPSS

- The same procedure
- Analyze > Dimension Reduction > Factor...
- Enter all self-image items into Variables
- Click Extraction
- Choose PAF
SPSS output

- Sampling adequacy
SPSS output

- **Communalities**

PCA assumes that all of the variance in an item can be explained by the extracted factors. PCA’s initial estimate of the communality is 1.00. PAF’s initial communalities are the amount of variance in one item that is explained by the remaining items and not equal to 1.

### PAF

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>a59_1 Responsible</td>
<td>.418</td>
<td>.455</td>
</tr>
<tr>
<td>a59_2 Motivated</td>
<td>.471</td>
<td>.470</td>
</tr>
<tr>
<td>a59_3 A hard worker</td>
<td>.451</td>
<td>.473</td>
</tr>
<tr>
<td>a59_4 Mature</td>
<td>.334</td>
<td>.356</td>
</tr>
<tr>
<td>a59_5 Independent</td>
<td>.276</td>
<td>.291</td>
</tr>
<tr>
<td>a59_6 Successful</td>
<td>.452</td>
<td>.498</td>
</tr>
<tr>
<td>a59_7 Honest/Truthful</td>
<td>.310</td>
<td>.311</td>
</tr>
<tr>
<td>a59_8 Disciplined</td>
<td>.353</td>
<td>.332</td>
</tr>
<tr>
<td>a59_9 Fit/In shape</td>
<td>.624</td>
<td>.861</td>
</tr>
<tr>
<td>a59_10 Healthy</td>
<td>.442</td>
<td>.464</td>
</tr>
<tr>
<td>a59_11 Having a nice body/figure</td>
<td>.548</td>
<td>.529</td>
</tr>
<tr>
<td>a59_12 Athletic</td>
<td>.508</td>
<td>.537</td>
</tr>
<tr>
<td>a59_13 In style/Fashionable</td>
<td>.590</td>
<td>.656</td>
</tr>
<tr>
<td>a59_14 Cool</td>
<td>.592</td>
<td>.616</td>
</tr>
<tr>
<td>a59_15 Good looking/Attractive</td>
<td>.584</td>
<td>.666</td>
</tr>
</tbody>
</table>

### PCA

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>a59_1 Responsible</td>
<td>1.000</td>
<td>.548</td>
</tr>
<tr>
<td>a59_2 Motivated</td>
<td>1.000</td>
<td>.529</td>
</tr>
<tr>
<td>a59_3 A hard worker</td>
<td>1.000</td>
<td>.558</td>
</tr>
<tr>
<td>a59_4 Mature</td>
<td>1.000</td>
<td>.483</td>
</tr>
<tr>
<td>a59_5 Independent</td>
<td>1.000</td>
<td>.530</td>
</tr>
<tr>
<td>a59_6 Successful</td>
<td>1.000</td>
<td>.590</td>
</tr>
<tr>
<td>a59_7 Honest/Truthful</td>
<td>1.000</td>
<td>.470</td>
</tr>
<tr>
<td>a59_8 Disciplined</td>
<td>1.000</td>
<td>.447</td>
</tr>
<tr>
<td>a59_9 Fit/In shape</td>
<td>1.000</td>
<td>.817</td>
</tr>
<tr>
<td>a59_10 Healthy</td>
<td>1.000</td>
<td>.623</td>
</tr>
<tr>
<td>a59_11 Having a nice body/figure</td>
<td>1.000</td>
<td>.637</td>
</tr>
<tr>
<td>a59_12 Athletic</td>
<td>1.000</td>
<td>.664</td>
</tr>
<tr>
<td>a59_13 In style/Fashionable</td>
<td>1.000</td>
<td>.727</td>
</tr>
<tr>
<td>a59_14 Cool</td>
<td>1.000</td>
<td>.690</td>
</tr>
<tr>
<td>a59_15 Good looking/Attractive</td>
<td>1.000</td>
<td>.742</td>
</tr>
</tbody>
</table>
After extraction, the amount of explained variance is lower in PAF (55.24%) than in PCA (65.80%), reflecting PAF’s emphasis on shared variance rather than total variance.
From 65.80% of initial solution to 55.24% of extracted solution, about 10% of the variation explained by the initial solution is lost due to latent factors unique to the original variables and variability that simply cannot be explained by the factor model.
SPSS output

- Scree plot

Supports 3-factor solution
SPSS output

- Rerun principal axis factoring with Varimax rotation.

36.68% of total variance in items is explained by 3 factors after rotation.
Rotated factor matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>a59_1 Responsible</td>
<td>.249</td>
<td>.512</td>
<td>-.129</td>
</tr>
<tr>
<td>a59_2 Motivated</td>
<td>.418</td>
<td>.445</td>
<td>-.131</td>
</tr>
<tr>
<td>a59_3 A hard worker</td>
<td>.377</td>
<td>.451</td>
<td>-.081</td>
</tr>
<tr>
<td>a59_4 Mature</td>
<td>.206</td>
<td>.448</td>
<td>-.034</td>
</tr>
<tr>
<td>a59_5 Independent</td>
<td>.243</td>
<td>.300</td>
<td>.023</td>
</tr>
<tr>
<td>a59_6 Successful</td>
<td>.448</td>
<td>.403</td>
<td>-.139</td>
</tr>
<tr>
<td>a59_7 Honesty/Truthful</td>
<td>.123</td>
<td>.472</td>
<td>-.059</td>
</tr>
<tr>
<td>a59_8 Disciplined</td>
<td>.211</td>
<td>.457</td>
<td>-.184</td>
</tr>
<tr>
<td>a59_9 Fit/In shape</td>
<td>.586</td>
<td>.071</td>
<td>-.151</td>
</tr>
<tr>
<td>a59_10 Healthy</td>
<td>.497</td>
<td>.076</td>
<td>-.122</td>
</tr>
<tr>
<td>a59_11 Having a nice body figure</td>
<td>.660</td>
<td>.067</td>
<td>-.102</td>
</tr>
<tr>
<td>a59_12 Athletic</td>
<td>.631</td>
<td>.098</td>
<td>-.059</td>
</tr>
<tr>
<td>a59_13 In style/Fashionable</td>
<td>.671</td>
<td>.162</td>
<td>.084</td>
</tr>
<tr>
<td>a59_14 Cool</td>
<td>.635</td>
<td>.276</td>
<td>.081</td>
</tr>
<tr>
<td>a59_15 Good looking/Attractive</td>
<td>.627</td>
<td>.225</td>
<td>.039</td>
</tr>
<tr>
<td>a59_16 Popular</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a59_17 Rich/Wealthy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a59_18 A pot user</td>
<td>-.048</td>
<td>-.013</td>
<td>.694</td>
</tr>
<tr>
<td>a59_19 Taking drugs</td>
<td>-.049</td>
<td>-.033</td>
<td>.769</td>
</tr>
<tr>
<td>a59_20 A cigarettes smoker</td>
<td>-.115</td>
<td>-.065</td>
<td>.574</td>
</tr>
<tr>
<td>a59_21 A partier</td>
<td>.138</td>
<td>.013</td>
<td>.620</td>
</tr>
<tr>
<td>a59_22 Wild</td>
<td>.098</td>
<td>-.016</td>
<td>.566</td>
</tr>
<tr>
<td>a59_23 An alcohol drinker</td>
<td>-.089</td>
<td>-.051</td>
<td>.740</td>
</tr>
<tr>
<td>a59_24 Nice/Friendly</td>
<td>-.019</td>
<td>.663</td>
<td>.062</td>
</tr>
<tr>
<td>a59_25 Kind/Good</td>
<td>.040</td>
<td>.760</td>
<td>.046</td>
</tr>
<tr>
<td>a59_26 Considerate</td>
<td>.029</td>
<td>.665</td>
<td>.027</td>
</tr>
<tr>
<td>a59_27 Worried</td>
<td>-.238</td>
<td>.072</td>
<td>.153</td>
</tr>
<tr>
<td>a59_28 Depressed/Unhappy</td>
<td>-.259</td>
<td>-.097</td>
<td>.252</td>
</tr>
<tr>
<td>a59_29 Tough</td>
<td>.348</td>
<td>.268</td>
<td>.127</td>
</tr>
<tr>
<td>a59_30 Strong</td>
<td>.429</td>
<td>.323</td>
<td>.118</td>
</tr>
</tbody>
</table>

a. Rotation converged in 4 iterations.
Other related procedures

- Factor scores: Click Scores
- Internal consistency of factors
Reporting a factor analysis study

Table 8.1  Suggested Items to Be Included in a Report of a Factor Analysis Study

A REPORT OF A FACTOR ANALYSIS SHOULD INCLUDE

- The theoretical rationale for the use of factor analysis
- Detailed descriptions of the sampling methods and participants
- Descriptions of the items, including means and standard deviations
- An evaluation of the assumptions of factor analysis
- A justification for the choice of factor extraction and rotation methods
- Evaluation of the correlation matrix: Bartlett’s test of sphericity, Kaiser-Meyer-Olkin test
- Criteria for extracting the factors: the scree test, eigenvalues, percent of variance extracted
- Cutoffs for meaningful factor loadings
- The structure matrix for orthogonally rotated solutions; the structure and pattern matrices and interfactor correlations for obliquely rotated solutions
- Descriptions and interpretation of the factors
- Internal consistency of the identified factors (e.g., Cronbach’s alpha)
- Approach to calculation of factor-based scores
- Assessment of the study limitations and suggestions for future research directions

### Reporting a factor analysis study

#### Table 8.6: Rotated Factor Pattern Matrix for the 20-Item CGTS: Principal Axis Factoring With Oblimin Rotation

<table>
<thead>
<tr>
<th>CGTS Items</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor 1</td>
</tr>
<tr>
<td><strong>1. Information seeking</strong></td>
<td></td>
</tr>
<tr>
<td>What to do to manage risk</td>
<td>.77</td>
</tr>
<tr>
<td>Need information about future screening activities</td>
<td>.77</td>
</tr>
<tr>
<td>Hope to make better lifestyle choices</td>
<td>.78</td>
</tr>
<tr>
<td>Need information about types of cancer at risk for</td>
<td>.70</td>
</tr>
<tr>
<td>Want to know survival prospects</td>
<td>.60</td>
</tr>
<tr>
<td>Want information about the difference between diagnosis and getting cancer</td>
<td>.63</td>
</tr>
<tr>
<td>Might be helped to make future life decisions</td>
<td>.62</td>
</tr>
<tr>
<td>Increase of personal control</td>
<td>.52</td>
</tr>
<tr>
<td><strong>2. Uncertainty</strong></td>
<td></td>
</tr>
<tr>
<td>Worry about uncertain diagnosis</td>
<td>.06</td>
</tr>
<tr>
<td>Worried about my future life</td>
<td>.17</td>
</tr>
<tr>
<td>Fear ambiguity of results</td>
<td>-.18</td>
</tr>
<tr>
<td>Help reduce uncertainty about future diagnosis</td>
<td>.22</td>
</tr>
<tr>
<td>Worry about a diagnosis</td>
<td>.27</td>
</tr>
<tr>
<td>I cannot do anything about</td>
<td></td>
</tr>
<tr>
<td><strong>3. Financial, social stigma</strong></td>
<td></td>
</tr>
<tr>
<td>Being targeted as a carrier</td>
<td>.04</td>
</tr>
<tr>
<td>Financial and social implications of being identified</td>
<td>.08</td>
</tr>
<tr>
<td>Loss of health and life insurance coverage</td>
<td>-.12</td>
</tr>
<tr>
<td>Financial concerns related to the screening</td>
<td>.29</td>
</tr>
<tr>
<td><strong>4. Family relationships</strong></td>
<td></td>
</tr>
<tr>
<td>How will family react</td>
<td>-.06</td>
</tr>
<tr>
<td>How will a positive test affect</td>
<td>.25</td>
</tr>
<tr>
<td>children and other family members</td>
<td></td>
</tr>
<tr>
<td>Worried about marital and family problems that might occur</td>
<td>-.08</td>
</tr>
</tbody>
</table>

Note: Underlined values indicate a double loading on two factors. Loadings highlighted in bold indicate the factor on which the item was placed.
References


THANK YOU