

Item analysis of selected variables
(Abstract)

In Individual In-depth Scanning

Group of authors

1. Purpose of the document

The document aims at exploring statistically selected variables of Individual In-depth Scans and demonstrating their reliability.

We selected variables to which standard statistical methods used for item analysis of questionnaire survey can be applied.

As a result there are extracted factors of variables and their reliability is measured.

2. Methodological introduction

We work based on the fact that item analysis that is generally used for development of classic and other tests may be an appropriate tool for variable analysis of an Individual In-depth Scan, too. The cornerstone of classic tests is a battery of related items (questions) that concerns a single psychological, pedagogical or other construct. This requirement is verified by multiple correlations. The items (characters, variables) are to be placed into factor analysis, which statistically significantly correlate with each other - they are closely linked, which is a prerequisite for the battery of items to measure the same that is the same construct. Through the use of factor analysis, factors and sub-factors are extracted enabling us to identify the latent variables. Subsequently, the reliability of factors and sub-factors is analysed. The battery of items is optimized so that the items with weaker correlation, with a scale of factors, are discarded and new items with better parameters are submitted.

Item analysis includes the following methods:

1. multiple correlation
2. reliability analysis
3. factor analysis.

Battery of stimuli questions in classic tests usually have Likert's scale of sum estimates, that is a sequential scale with different number of levels, most often with 5 levels.

Responds to stimuli words in case of color verbal association method have a similar sequential scale, too - it regards a sequence of 8 colours and a combination of colors.

For our purposes, Item analysis of 110 variables of Individual In-depth Scan helps us to find out whether it is possible to extract latent variable constructs (factors), which measure the same at a higher level. If it is possible to extract these constructs also by factor analysis then we describe their parameters.

Requirements

- The variables in batteries of variables have to be statistically significantly correlated, at least at the level of $r > 0.3$.

- Reliability of the battery of items (variables) must not fall below the level of 0.6 measured by reliability coefficients Cronbach alfa, Guttman lambda, glb a omega_total
- Extracted factor has to be one-dimensional, it has to measure one construct
- Extracted factor shall be named and defined meaningful
- Share of explained variability of factors should not be lower than 50%.

Except for the second requirement relating to reliability, the others are unambiguously measurable and the results can be clearly interpreted. The most common measure of reliability is Cronbach Alfa. At the same time, however, there are several alternative measures of reliability, Guttman lambda 1 to 6, glm, and omega_hierarchical omega_total, Rewell's beta, and other less well-known measure. In the professional journals there is a discussion on whether Cronbach Alpha is a good reliability measure. Therefore, we present other alternative reliability measure besides Cronbach Alpha, calculated in statistical system R. For evaluation of the results of reliability analysis, we used the following table:

Evaluation of reliability coefficients

More than 0.9	Excellent	Excellent
More than 0.8	Good	Good
More than 0.7	Acceptable	Acceptable
More than 0.6	Questionable	Questionable
More than 0.5	Poor	Poor
Less than 0.5	Unacceptable	Unacceptable

Preconditions for the application of factor analysis have been tested using Kaiser - Mayer - Olkin measure (KMO) and Bartlett's spherical test.

KMO is according to Meloun et al. (2005) an index, which compares the size of experimental correlative coefficients in relation to the size of partial correlative coefficients. We used the the following table to evaluate the test:

KMO index evaluation

0.9	Excellent correlation
0.8.	Good correlation
0.7.	Average correlation
0.6.	Medium correlation
0.5.	Weak correlation
Less than 0.5	Unacceptably weak correlation

Bartlett's test is according to Meloun et al. (2005) a statistical test of correlations between the initial characters, variables, in item analysis terminology "items". It tests

statistical zero hypothesis, which claims that "there is no correlation between the items". An alternative hypothesis H_a claims otherwise that "there is a correlation between the items". We tested at the level of significance $\alpha = 0.05$. If the p value in Bartlett's test is lower than the set significance level of the test then we do not have tolerable reasons to accept the zero-hypothesis. In practice, this means we can accept alternative statistical hypothesis, which claims that there is a correlation between the items.

Terminological notes

We used two types of factor analysis. Firstly, we extracted the components by virtue of factor analysis and the main components method, and then verified the one-dimensionality and other parameters of the resulting model by virtue of factor analysis and the correlation method. That is why we generally use the term "factor". When interpreting the tables resulting from the analysis of main components, we shall use the term component. The variables used in the process of item analysis, we shall call items.

3. Data collection

Number of respondents.	3000
Period of data collection	1st January, 2008 to 9th April, 2013
Age range	6 - 15 years
Average age	9.607
Number of boys	1581
Number girls	1419

The data were collected while using Internal School Evaluation tool in primary schools in the Czech Republic and had to comprise of reactions to 57 stimuli words needed for the Individual In-depth Scan diagnostic profile for age 6-15 years.

4. Method used and the diagnostic profile

Color verbal association method (www.camethod.com) was used for the diagnostics. A group of 57 words was chosen for the survey. Group of words are stimuli words and the respondents respond to them when using Individual In-depth Scan diagnostic profile for age 6 - 15 years.

List of surveyed variables and code names assigned:

The list of variables can be found in the complete document on item analysis. 110 variables have been analysed, definition of the various variables are available in the framework of Basic training methods of Colors of Life method and in DAP Services e-learning system - <http://lms.dap-services.com> (only in Czech).

5. Extracted factors

In this chapter the extracted factors of variables are listed as is the summary of their naming. Items of individual factors can be found in the complete document on item analysis.

1. Factor of **external aggression**
2. Factor of **energetic determination and investment**
3. Factor of **internal anxiety and concerns**
4. Factor of **stamina**
5. Factor of **internal stability of consciousness**
6. Factor of **internal aggression**
7. Factor of **anxiety in interaction with people**
8. Factor of **existential self-endangering**
9. Factor of **mental sensitivity**
10. Factor of **common goals in the group**
11. Factor of **the need to control**
12. Factor of **the need for positive cooperation**
13. Factor of **physical predisposition**
14. Factor of **variability of external expression**
15. Factor of **target-aiming (ambition)**
16. Factor of **active self-assertion**
17. Factor of **active defence against external influences**
18. Factor of **self-preservation**

6. Conclusion

We can conclude that all extracted factors have achieved from good to excellent reliability values in different coefficients.

All 18 extracted factors have created units, which have been re-named so as to correspond to the original significance of the variables. The naming was achieved using a combination of standard interpretation of individual variables into a whole and selecting one short snappy name.

Summary of named extracted factors and their values

	Name	Cronbach alpha – Raw ratio	Cronbach alpha – Std. ratio	Guttman lambda 3 (alpha)	Guttman lambda 4 max	Guttman lambda 6 (smc)	glb	omega total	Share of explained variability
Factor 1	External aggression	0.83	0.94	0.94	0.97	0.96	0.97	0.96	98.88%
Factor 2	Energetic determinations and investments	0.924	0.93	0.92	0.95	0.95	0.95	0.95	99.74%
Factor 3	Internal anxiety and concerns	0.776	0.89	0.89	0.89	0.92	0.94	0.9	66.31%
Factor 4	Stamina	0.74	0.86	0.86	0.67	0.77	0.83	0.9	99.96%
Factor 5	Internal stability of consciousness	0.891	0.94	0.94	0.93	0.95	0.96	0.95	86.05%
Factor 6	Internal aggression	0.869	0.93	0.93	0.99	0.98	0.98	0.93	99.99%
Factor 7	Anxiety in interaction	0.768	0.89	0.89	0.94	0.94	0.94	0.9	70.64%

	with people								
Factor 8	Existential self-endangering	0.742	0.81	0.81	0.87	0.84	0.84	0.84	64.64%
Factor 9	Mental sensitivity	0.685	0.91	0.91	0.86	0.88	0.91	0.91	84.23%
Factor 10	Common goals in the group	0.857	0.87	0.87	0.96	0.92	0.87	0.87	72.49%
Factor 11	The need to control	0.923	0.93	0.93	0.90	0.95	0.94	0.94	87.41%
Factor 12	The need for positive cooperation	0.861	0.87	0.87	0.86	0.87	0.89	0.89	80.16%
Factor 13	Physical predispositions	0.677	0.83	0.83	0.81	0.78	0.84	0.84	74.43%
Factor 14	Variability of external expression	0.755	0.75	0.75	0.78	0.71	0.79	0.79	67.45%
Factor 15	Target-aiming (Ambition)	0.832	0.88	0.88	0.94	0.93	0.95	0.88	62.53%
Factor 16	Active self-assertion	0.793	0.86	0.86	0.9	0.83	0.9	0.86	70.36%
Factor 17	Active defence against external influences	0.588	0.81	0.81	0.81	0.79	0.84	0.84	72.76%
Factor 18	Self-preservation	0.622	0.78	0.78	0.82	0.79	0.83	0.83	71.04%

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