Writing Up A Factor Analysis

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CHECKLIST

About

This section provides a checklist of content to consider covering for factor analysis in your lab report. This is not an exhaustive-to-be-followed-to-the-letter list. Rather, you should take your own approach, whilst complying with APA style, in order to clearly demonstrate *your understanding* of factor analysis and the way in which you have applied the technique in your study.

Theoretical underpinning

A good report will also explain the theoretical underpinning of the structure of the constructs being measured in the introduction and discussion. The introduction might review and critique previous conceptualisations and measurements and could summarise previous factor analyses. The discussion might summarise and critique the present study's findings about the structure of the constructs of interest.

Results

Assumption testing

In the results, describe how you went about testing the assumptions for FA. Details regarding Measures of Sampling Adequacy should be reported. Strive to be thorough, but clear and succinct.

Type of FA

In the results, explain what FA extraction method (usually PC or PAF) was used and why.

Number of Factors & Items Removed

In the results, explain the criteria and process used for deciding how many factors and which items were selected. Clearly explain which items were removed and why, plus the number of factors extracted and the rationale for key decisions.

Rotation

In the results, explain what rotation methods were attempted, the reasons why, and the results.

Factor Loadings

Final (pattern matrix or rotated component matrix) factor loadings should be reported in the results, in a table. This table should also report the communality for each variable (in the final column). Factor loadings should be reported to two decimal places and use descriptive labels in addition to item numbers. Correlations between the factors

should also be included, either at the bottom of this table, in a separate table, or in an appendix. The correlation matrix should be included so that others people can re-conduct a factor analysis.

Label Factors

Meaningful names for the extracted factors should be provided. You may like to use previously selected factor names, but on examining the actual items and factors you may think a different name is more appropriate. One factor naming technique is to use the top one or two loading items for each factor. A well labeled factor provides an accurate, useful description of the underlying construct, and thus enhanced the clarity of the report.

Reliability Analyses

Following presentation of the factor analysis results, reliability analyses should be provided. Reporting of reliability analyses can be combined with a descriptives table which includes names of the factors, the number of items in each factor, descriptive statistics for the composite scores (e.g. mean, SD, Skewness and Kurtosis), and the Cronbach's alpha (α).

Discussion

Discussion of the factor analysis(es) might include:

- Was the choice of structure model clear-cut; or where there several alternatives?

- Were all factor well defined and internally consistent?

- Could the measurement of some factors be improved?

- Were some possibly relevant factors (or facets of factors) not measured? (e.g, perhaps as indicated by qualitative analysis)

- How would you recommend the validity of the measure be further tested?

- Was there evidence that the factor structure is invariant across sub-samples (e.g,. gender and age)

SAMPLE FACTOR ANALYSIS WRITE-UP

Exploratory Factor Analysis of the Short Version of the Adolescent Coping Scale

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Summarised extract from Neill (1994)

(Summary of the) Introduction (as related to the factor analysis)

Coping refers to the ways in which people deal with perceived stressors in their lives. A wide variety of different coping efforts are employed by people, such as ignoring problems, venting frustration, asking others what they what do, thinking positively, and working on solving the cause of the problem. Psychologists have proposed several different ways of categorising underlying coping responses. In empirical studies, there has been no clear consensus on the underlying factor structure of coping responses. Proposed factor structures have ranged from two factor (Lazarus & Folkman, 1984) to 18 factor models (Frydenberg & Lewis, 1993).

Adolescent coping is of particular interest, because adolescence is seen as a challenging period during which individuals are developing independent identities, experimenting with different ways of coping, and establishing coping patterns for adulthood. To date, only one instrument has been specifically developed for assessing the coping strategies used by adolescents, the Adolescent Coping Scale (ACS; Frydenberg & Lewis, 1993). For the long version of the ACS (79 items), the instruments' authors proposed an 18-factor structure, and also suggested the possibility of three higher order factors: (a) Problem-solving coping (e.g., focusing on solving the problem, working hard, focusing on the positive); (b) Reference to Others (e.g, asking friends what they would do, spending time with girlfriend/boyfriend, asking a professional person for help); and (c) Non-productive Coping (e.g., worrying, wishing the problem would go away).

A short version of the ACS, consisting of one item from each of the proposed 18 factors, has also been developed. Frydenberg and Lewis (1993) proposed that a three factor solution could summarise the underlying covariation between the 18 items, however only limited testing of this factor structure has been conducted to date (Frydenberg & Lewis, 1993).

<center>(Summary of the) Method</center>

Participants

Year 9 and 10 high-school participants in 9 day Outward Bound Australia programs reported on the frequency with which they used different types of coping strategies when dealing with their problems or concerns during their Outward Bound experience. In total data was collected from 255 participants (142 males; 113 females) with an average age of 14.4 years.

Materials

The 18 self-report items from the short version of the Adolescent Coping Scale (ACS) (Frydenberg & Lewis, 1993) were modified slightly (to past tense) so that participants rated the extent to which they used each of the coping responses during the Outward Bound program. An example item is "Worked at solving the problem to the best of my ability". Responses were on a Likert-type scale, ranging from 1 = "Didn't do it at all", 2 = "Used very little", 3 = "Used sometimes", 4 = "Used often", 5 = "Used a great deal". The 79-item version of the ACS was administered, however this analysis focused only on the 18 items from the proposed short form of the ACS (Frydenberg & Lewis, 1993).

Procedure

Participants completed a modified short version of the ACS towards the end of their 9 day Outward Bound program. The instrument was administered by the group instructors, along with a measure of self-concept and psychological well being, as part of a larger study. A standard protocol for administering the questionnaire was used (see Appendix # – not included in this example).

Results

Data Screening

The data was screened for univariate outliers. Three out-of-range values, due to administrative errors, were identified and recoded as missing data. The minimum amount of data for factor analysis was satisfied, with a final sample size of 218 (using listwise deletion), providing a ratio of over 12 cases per variable.

Factor Analysis

Initially, the factorability of the 18 ACS items was examined. Several well-recognised criteria for the factorability of a correlation were used. Firstly, it was observed that 16 of the 18 items correlated at least .3 with at least one other item, suggesting reasonable factorability (see Appendix A). Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was .73, above the commonly recommended value of .6, and Bartlett's test of sphericity was significant ($\chi^2 (153) = 840.26$, $p < .05$). The diagonals of the anti-image correlation matrix were also all over .5 Finally, the communalities were all above .3 (see Table 1), further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was deemed to be suitable with all 18 items.

Principal components analysis was used because the primary purpose was to identify and compute composite scores for the factors underlying the short version of the ACS. Initial eigen values indicated that the first three factors explained 19%, 16%, and 9% of the variance respectively. The fourth, fifth and sixth factors had eigen values just over one, and each explained 6% of the variance. Solutions for three, four, five and six factors were each examined using varimax and oblimin rotations of the factor loading matrix. The three factor solution, which explained 43% of the variance, was preferred because of: (a) its previous theoretical support; (b) the 'leveling off' of eigen values on the scree plot after three factors; and (c) the insufficient number of primary loadings and difficulty of interpreting the fourth factor and subsequent factors. There was little difference between the three factor varimax and oblimin solutions, thus both solutions were examined in subsequent analyses before deciding to use an oblimin rotation for the final solution.

A total of four items were eliminated because they did not contribute to a simple factor structure and failed to meet a minimum criteria of having a primary factor loading of .4 or above, and no cross-loading of .3 or above. The item "Spent more time with girlfriend/boyfriend" did not load above .3 on any factor. The item "Found a way to relax" had factor loadings between .3 and .4 on both Reference to Others and Problem-solving. "Improved my relationship with others" had similar factor loadings, between .4 and .5, on Reference to Others and Problem-solving. Finally, "Prayed for help and guidance" had a primary factor loading of .53 on the Non-productive factor (which was well defined by 7 other items) and a cross-loading of .37 on Problem-solving coping for the varimax solution. In addition, this item had a floor effect, with 42% of students reporting not using this strategy at all, resulting in positively skewed data.

For the final stage, a principal components factor analysis of the remaining 14 items, using varimax and oblimin rotations, was conducted, with three factors explaining

49% of the variance. An oblimin rotation provided the best defined factor structure. All items in this analysis had primary loadings over .5. Only one item had a cross-loading above .3 (Kept fit and healthy), however this item had a strong primary loading of .74. The factor loading matrix for this final solution is presented in Table 1.

The factor labels proposed by Frydenberg and Lewis (1993) suited the extracted factors and were retained. Internal consistency for each of the scales was examined using Cronbach's alpha. The alphas were moderate: .68 for Reference to Others (3 items), .72 for Non-Productive coping (7 items), and .63 for Problem Solving (4 items). No substantial increases in alpha for any of the scales could have been achieved by eliminating more items.

Composite scores were created for each of the three factors, based on the mean of the items which had their primary loadings on each factor. Higher scores indicated greater use of the coping strategy. Problem-solving was the coping factor that students reported using the most, with a negatively skewed distribution, whilst Reference to Others and Non-Productive Coping were used considerably less and had positively skewed distributions. Descriptive statistics are presented in Table 2. The skewness and kurtosis were well within a tolerable range for assuming a normal distribution and examination of the histograms suggested that the distributions looked approximately normal (see Appendix B). Although an oblimin rotation was used, only small correlations between each of the composite scores existed: .17 between Problem Solving and Reference to Others; -.07 between Problem Solving and Non-Productive coping; and .15 between Reference to Others and Non-Productive coping.

Overall, these analyses indicated that three distinct factors were underlying adolescent responses to the short version of the ACS items and that these factors were moderately internally consistent. Four of the eighteen items were eliminated, however the original factor structure proposed by Frydenberg and Lewis (1993) was retained. An approximately normal distribution was evident for the composite score data in the current study, thus the data were well suited for parametric statistical analyses.

Table 1

Factor loadings and communalities based on a principal components analysis with oblimin rotation for 14 items from the short version of the Adolescent Coping Scale (ACS) (N = 218)

	Non-productive	Problem-solving	Reference to others	Communality
Worry about what would happen next	.74			.55
Shut myself off from the problem so that I can avoid it	.69			.48
Saw myself as being at fault	.63			.39
Didn't let others know how I was feeling	.58		.27	.45
I had no way of dealing with the situation	.57			.33
Wished a miracle would happen	.54		-.28	.39
Found a way to let off steam, e.g., cry, scream, drink, take drugs	.53			.33
Worked at solving the problem to the best of my ability		.76		.62
Kept fit and healthy	.27	.74	.33	.62
Worked hard		.72		.59
Looked on the bright side of things and think of all that is good		.54		.34
Talked to other people about my concern to help me sort it out			-.80	.66
Joined with people who have the same concern			-.72	.55
Asked a professional person for help			-.72	.52

Note. Factor loadings < .2 are suppressed.

Table 2

Descriptive statistics for the three Adolescent Coping Scale factors (N = 218)

	No. of items	M (SD)	Skewness	Kurtosis	Cronbach's α
Non-Productive	7	2.29 (.68)	0.36	0.20	.72
Problem-Solving	4	3.78 (.72)	-0.54	0.43	.63
Reference to Others	3	2.35 (.88)	0.39	-0.24	.68

Discussion (key points)

- A three-factor structure for 14 out of the 18 items was evident, based on a principal components exploratory factor analysis with an oblimin rotation.

- The three factors fitted Frydenberg and Lewis' (1993) proposed three-factor structure, involving non-productive (7 items; 0.72), problem-solving (4 items; 0.63), and reference to others (3 items; 0.68) factors. This indicates moderate internal consistency.

- However, each of the factors could probably be strengthened through revision (rewriting) items with lower primary loadings and possibly adding new items. *Provide some specific examples/suggestions.*

References

Frydenberg, E., & Lewis, R. (1993). *Adolescent Coping Scale: Administrator's manual.* ACER: Hawthorn, Australia.

Lazarus, R. S., and Folkman, S. (1984). *Stress, appraisal and coping.* Springer: New York.

Neill, J. T. (1994). *The effect of Outward Bound high school programs on adolescents' self-concept, mental health, and coping strategies*. Unpublished honours thesis, Australian National University, Canberra, ACT, Australia. Retrieved 29 March, 2008, from http://wilderdom.com/abstracts/Neill1994OutwardBoundAdolescentSelfConceptMentalHealthCoping.htm

Neill, J. T., & Heubeck, B. (1997). Adolescent coping styles and outdoor education: Searching for the mechanisms of change. In *Proceedings of the 1st International Adventure Therapy Conference: Exploring the Boundaries, 1-5 July, 1997* (pp.227-243). Camping & Outdoor Education Association of Western 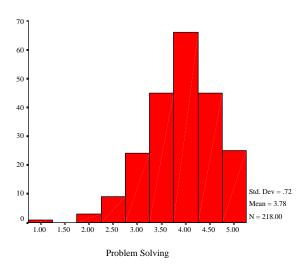Australia: Perth, Australia. Retrieved 29 March, 2008, from http://wilderdom.com/abstracts/NeillHeubeck1997AdolescentCopingStylesSearchingMechanismsChange.htm
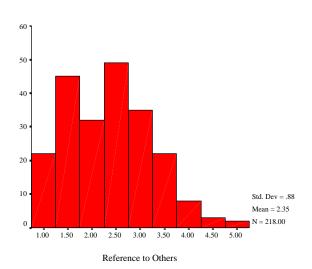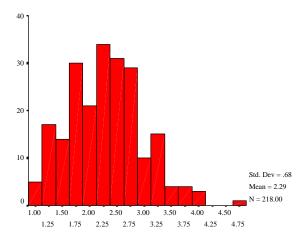
Appendix A: Correlation matrix for the 18 ACS items

	ACS2#18 Work at solving the problem to the best of my ability	ACS2#20 Keep fit and healthy	ACS2#22 Pray for help and guidance	ACS2#25 Work hard	ACS2#26 Find a way to relax; eg listen to music, read a book, etc	ACS2#29 Wish a miracle would happen	ACS2#35 Look on the bright side of things	ACS2#50 Improve my relationship with others	ACS2#55 I have no way of dealing with the situation	ACS2#57 Dont let others know how I am feeling	ACS2#59 Talk to other people about my concern	ACS2#61 Ask a professional person for help	ACS2#64 Worry about what will happen next	ACS2#67 Join with people who have the same concern	ACS2#70 See myself as being at fault	ACS2#76 Shut myself off from the problem so that I can avoid it	ACS2#77 Spend more time with boy/girl friend	ACS2#79 Find a way to let off steam, eg cry, scream, drink, take drugs
ACS2#18 Work at solving the problem to the best of my ability	1.000	.292	.161	.493	.257	-.029	.368	.169	-.119	-.103	.215	.156	.002	.119	-.021	-.127	-.085	-.021
ACS2#20 Keep fit and healthy	.292	1.000	.073	.330	.033	.067	.176	.205	.100	-.035	-.020	-.114	.110	.003	.066	.196	.072	.016
ACS2#22 Pray for help and guidance	.161	.073	1.000	.081	.143	.360	.294	.216	.179	.105	.027	.106	.375	.068	.140	.243	.176	.288
ACS2#25 Work hard	.493	.330	.081	1.000	.227	-.070	.202	.260	-.092	-.258	.187	.168	-.065	.058	-.096	-.170	-.007	-.073
ACS2#26 Find a way to relax; eg listen to music, read a book, etc	.257	.033	.143	.227	1.000	.038	.296	.289	-.149	-.127	.262	.203	-.036	.168	.073	-.076	.231	.037
ACS2#29 Wish a miracle would happen	-.029	.067	.360	-.070	.038	1.000	.126	.203	.230	.095	.149	.162	.441	.251	.197	.301	.132	.222
ACS2#35 Look on the bright side of things	.368	.176	.294	.202	.296	.126	1.000	.232	-.069	-.181	.152	.139	-.040	.090	-.013	.001	.022	-.051
ACS2#50 Improve my relationship with others	.169	.205	.216	.260	.289	.203	.232	1.000	.027	-.022	.326	.232	.130	.289	.120	.098	.203	.251
ACS2#55 I have no way of dealing with the situation	-.119	.100	.179	-.092	-.149	.230	-.069	.027	1.000	.238	-.052	.071	.279	.119	.204	.327	.066	.233
ACS2#57 Dont let others know how I am feeling	-.103	-.035	.105	-.258	-.127	.095	-.181	-.022	.238	1.000	-.202	-.021	.318	-.102	.300	.353	.045	.206

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	ACS2#18 Work at solving the problem to the best of my ability	ACS2#20 Keep fit and healthy	ACS2#22 Pray for help and guidance	ACS2#25 Work hard	ACS2#26 Find a way to relax; eg listen to music, read a book, etc	ACS2#29 Wish a miracle would happen	ACS2#35 Look on the bright side of things	ACS2#50 Improve my relationship with others	ACS2#55 I have no way of dealing with the situation	ACS2#57 Dont let others know how I am feeling	ACS2#59 Talk to other people about my concern	ACS2#61 Ask a professional person for help	ACS2#64 Worry about what will happen next	ACS2#67 Join with people who have the same concern	ACS2#70 See myself as being at fault	ACS2#76 Shut myself off from the problem so that I can avoid it	ACS2#77 Spend more time with boy/girl friend	ACS2#79 Find a way to let off steam, eg cry, scream, drink, take drugs
ACS2#59 Talk to other people about my concern	.215	-.020	.027	.187	.262	.149	.152	.326	-.052	-.202	1.000	.429	.061	.471	.069	.016	.045	.169
ACS2#61 Ask a professional person for help	.156	-.114	.106	.168	.203	.162	.139	.232	.071	-.021	.429	1.000	.054	.337	.004	.122	.049	.122
ACS2#64 Worry about what will happen next	.002	.110	.375	-.065	-.036	.441	-.040	.130	.279	.318	.061	.054	1.000	.086	.399	.362	.099	.328
ACS2#67 Join with people who have the same concern	.119	.003	.068	.058	.168	.251	.090	.289	.119	-.102	.471	.337	.086	1.000	.124	.138	.091	.103
ACS2#70 See myself as being at fault	-.021	.066	.140	-.096	.073	.197	-.013	.120	.204	.300	.069	.004	.399	.124	1.000	.293	.104	.327
ACS2#76 Shut myself off from the problem so that I can avoid it	-.127	.196	.243	-.170	-.076	.301	.001	.098	.327	.353	.016	.122	.362	.138	.293	1.000	.252	.220
ACS2#77 Spend more time with boy/girl friend	-.085	.072	.176	-.007	.231	.132	.022	.203	.066	.045	.045	.049	.099	.091	.104	.252	1.000	.127
ACS2#79 Find a way to let off steam, eg cry, scream, drink, take drugs	-.021	.016	.288	-.073	.037	.222	-.051	.251	.233	.206	.169	.122	.328	.103	.327	.220	.127	1.000

Appendix B: Histograms of the distribution of adolescents' responses to the composite ACS scales

Std. Dev = .72
Mean = 3.78
N = 218.00

Problem Solving

Std. Dev = .88
Mean = 2.35
N = 218.00

Reference to Others

Std. Dev = .68
Mean = 2.29
N = 218.00

Non-Productive Coping