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Does Sample Size Influence the Factor Structure of A Construct: A Validation Study on Academic Delay of Gratification Scale

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Abstract:
In this study, the researchers investigated the association between sample size and factor structure of aconstruct, by using the"Academic delay of gratification scale prepared by Bembenutty and Karabenick (1996)". 488 students (277 boys and 211 girls) pursing professional courses like pharmacy, law, education and engineering from the Muslim community were the sample subject. CFAwas applied with the help of SPSS Amos Ver.23 to get the factor loadings and goodness of fit measures for item to sample size ratios of 1:10, 1:20, 1:30, 1:40 and 1:50. The study reports an improvement in the measures of the factor structure up to the item to sample size ratio of 1:30. The measures show no appreciable improvement for higher item to sample size ratio.

Keywords: *Academic delay of gratification, Academic delay of gratification scale, Confirmatory factor analysis, Sample size.*

I. INTRODUCTION

There are several recommendations on the number of sample subjects to be considered while conducting exploratory factor analysis to extract the possible number of factors explaining the variance in a construct. But, these recommendations can be broadly classified into two categories namely, the number of subjects (N) or the ratio between the subjects to item ratio (p).

Gorsuch (1974) and Arrindell and van der Ende,(1985) recommended that the sample size should be greater than 100 even though the variables under study are less than 20. Hatcher (1994) recommends that the number of subjects be five times more than the variables for conducting factor analysis. It is recommended to be 20 times more by Costello and Osberne (2005).

Many such best practices to follow during exploratory factor analysis (Chakraborty, 2017), are meant to conduct confirmatory factor analysis for establishing the validity of a factor structure. The present study tried to find the effects of increasing the sample size on the measures of goodness of fit of a factor structure formed by a fixed number of items loaded on a construct.

In the study, the items belonging to the construct of academic delay of gratification of the scale on the same name, prepared by Bembenutty and Karabenick (1996) were considered. The factor loading of these items on the construct and the factor structure measures were compared for varying item to subjects ratios.

II. METHOD

Sample

The present study was conducted by administering the Academic delay of gratification scale on 488

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professional courses students, comprising of 277 boys and 211 girls from different professional courses faculties like engineering, law, pharmacy and education of the Sultan Ul Uloom Education Society, a muslim minority educational society located at Banjara Hills, Hyderabad, India.

Measures

Academic Delay of Gratification Scale: The scale consists of 10 items based on immediate or delayed academic experiences. Some sample items of the tool are:

Item 1	"A. Go to a favorite concert, play, or sporting event and study less for this course even though it may mean getting a lower grade on an exam you will take tomorrow, or, B. Stay home and study to increase your chances of getting a higher grade."
Item 2	"A. Study a little every day for an exam in this course and spend less time with your friends, or, B. Spend more time with your friends and cram just before the test."
Item 3	"A. Miss several classes to accept an invitation for a very interesting trip, or, B. Delay going on the trip until this course is over."

The responses of the students to the ten items are recorded using a Likert scale of four points, comprising of options like "Definitely choose A=1, Probably choose A=2, Probably choose B=3, Definitely choose B=4".

The individual responses of all the ten items are added and divided by 10 to get the total score of the construct between 1 and 4.

The more the students score a mean value between 1 and 4, the higher is the existence of the psychological variable in them.

The researchers in their previous study (Chakraborty and Chechi, 2018) found that the psychometric properties of the scale improved on deleting the item 4. Hence the present study considered the left over nine items of the scale for conducting confirmatory factor analysis.

The instructions were presented in details to the subjects. The faculty help in distributing the questionnaire to the students, who ended filling the tool and returned it back within 10 to15 minutes to the researcher.

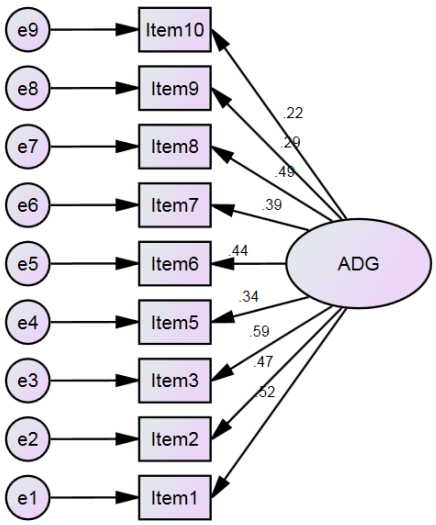
The statistical technique of CFA was applied on the collected test data to estimate the "goodness of fit" of the one factor global model for 1:10, 1:20, 1:30, 1:40 and 1:50 item to subjects ratio. Measures like

"p-value, CMIN/DF, RMR, RMSEA, GFI, IFI, TLI and CFI" applied in the study to find the goodness of fit measure of the one-factor model of academic delay of gratification scale for multiple item-subjects ratio.

To assess the strength of the factor structure, the factor loadings of the 9 items on the construct are also found out.

Results:

Table 1: Goodness of Fit Measures for n=90 and 1:10 ratio



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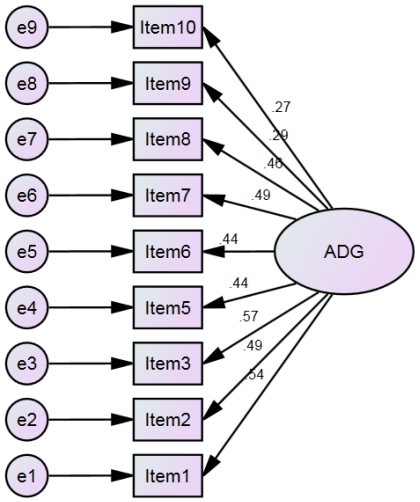
Estimates	"p-value"	"CMIN/DF"	"RMR"	"RMSEA"	"GFI"	"IFI"	"TLI"	"CFI"
Standards	**">0.05"**	**"<3"**	**"<0.08"**	**"<0.08"**	**">0.93"**	**">0.93"**	**">0.93"**	**">0.93"**
Result	0.018	1.650	0.104	0.085	0.904	0.791	0.688	0.766

Interpretation: The factor structure ofthe scale for item to sample ratio of 1:10 is poor only one (CMIN/DF) out of the eight fitness measures is consistent with the accepted benchmark. The factor loadings of item 9 and item 10 on the construct are also low, below (0.3).

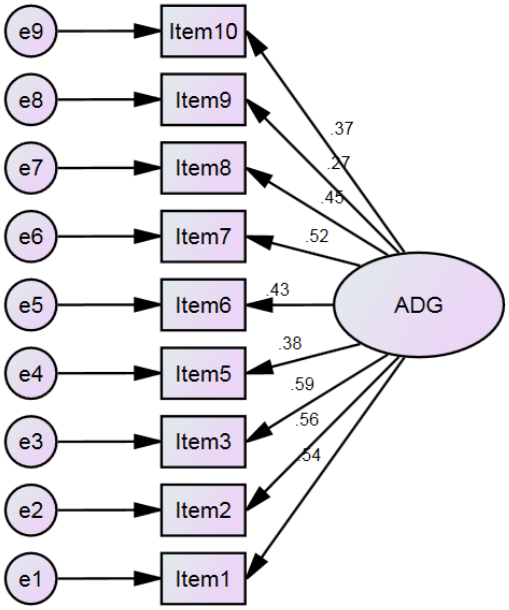
Table 2: Goodness of Fit Measures for n=180 and 1:20 ratio



Estimates	"p-value"	"CMIN/DF"	"RMR"	"RMSEA"	"GFI"	"IFI"	"TLI"	"CFI"
Standards	**">0.05"**	**"<3"**	**"<0.08"**	**"<0.08"**	**">0.93"**	**">0.93"**	**">0.93"**	**">0.93"**
Result	0.021	1.628	0.070	0.059	0.949	0.904	0.864	0.898

Interpretation: The factor structure of the scale for item to sample ratio of 1:20 is poor as three (CMIN/DF, RMR and GFI) out of the eight fitness measures are consistent with the accepted benchmark. The factor loadings of item 9 and item 10 on the construct are still also low (below 0.3).

Table 3: Goodness of Fit Measures for n=270 and 1:30 ratio



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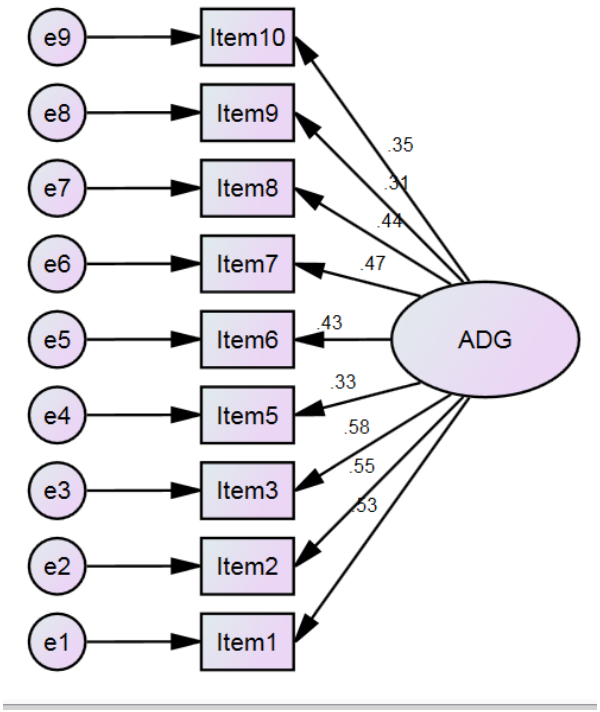
Estimates	"p-value"	"CMIN/DF"	"RMR"	"RMSEA"	"GFI"	"IFI"	"TLI"	"CFI"
Standards	**">0.05"**	**"<3"**	**"<0.08"**	**"<0.08"**	**">0.93"**	**">0.93"**	**">0.93"**	**">0.93"**
Result	0.082	1.397	0.053	0.038	0.970	0.961	0.946	0.960

Interpretation: The factor structure of the scale for item to sample ratio of 1:30 is excellent because except p-value, seven out of the eight fitness measures are consistent with the accepted benchmark. The factor loading of item 9 on the construct is low (below 0.3).

The p-value has a tendency to display non-significant results when the sample size is either too small or too large. Hence, in this case, it as a measure can be ignored. This implies that all the fitness measure are consistent with the accepted benchmark for the sample size n=270.

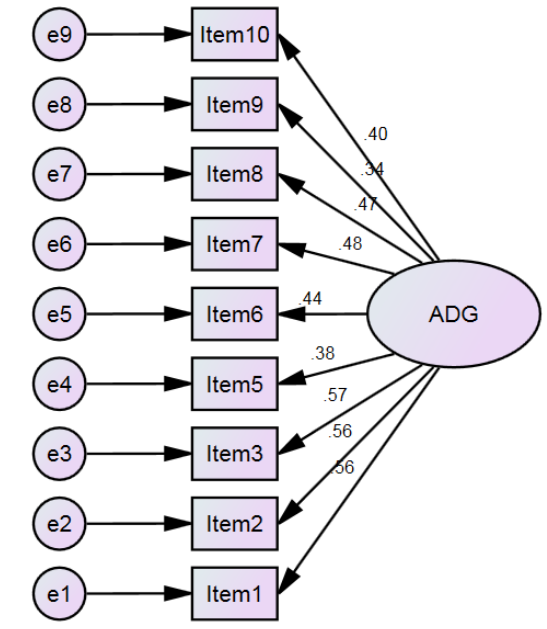
Table 4: Goodness of Fit Measures for n=360 and 1:40 ratio



Estimates	"p-value"	"CMIN/DF"	"RMR"	"RMSEA"	"GFI"	"IFI"	"TLI"	"CFI"
Standards	**">0.05"**	**"<3"**	**"<0.08"**	**"<0.08"**	**">0.93"**	**">0.93"**	**">0.93"**	**">0.93"**
Result	0.003	1.899	0.054	0.050	0.969	0.929	0.902	0.927

Interpretation: The factor structure of the scale for item to sample ratio of 1:40 is moderate as four (CMIN/DF, RMR, RMSEA and GFI) out of the eight fitness measures are consistent with the accepted benchmark. All the items load on the construct with acceptable factor loadings (above 0.3).

Table 5: Goodness of Fit Measures for n=450 and 1:50 ratio



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Estimates	"p-value"	"CMIN/DF"	"RMR"	"RMSEA"	"GFI"	"IFI"	"TLI"	"CFI"
Standards	**">0.05"**	**"<3"**	**"<0.08"**	**"<0.08"**	**">0.93"**	**">0.93"**	**">0.93"**	**">0.93"**
Result	0.001	2.111	0.049	0.048	0.975	0.943	0.922	0.942

Interpretation: The factor structure of the scale for item to sample ratio of 1:50 is good as six ("CMIN/DF, RMR, RMSEA, GFI, IFI and CFI") out of the eight fitness measures are consistent with the accepted benchmark. All the items load on the construct with acceptable factor loadings (above 0.3). The p-value has a tendency to display non-significant results when the sample size is either too small or too large. Hence, in this case, it as a measure can be ignored.

Table 6: Comparison of the Factor Loadings of the Items with Sample Size

	N=90	N=180	N=270	N=360	N=450
Item1	0.52	0.54	**0.54**	0.53	0.56
Item2	0.47	0.49	**0.56**	0.55	0.56
Item3	0.59	0.57	**0.59**	0.58	0.57
Item5	0.34	0.44	**0.38**	0.33	0.38
Item6	0.44	0.44	**0.43**	0.43	0.44
Item7	0.39	0.49	**0.52**	0.47	0.48
Item8	0.49	0.46	**0.45**	0.44	0.47
Item9	0.29	0.29	**0.27**	0.31	0.34
Item10	0.22	0.27	**0.37**	0.35	0.40

III. Discussion

The rules for determining sample size for obtaining desirable outcomes of confirmatory factor analysis like model convergence and high statistical power are of limited use as reported in literature (Marsh, Hau, Balla, and Grayson, 1998). Factors like distribution of the variables, size of the model, reliability of indicators, misspecifications in the modelvary in any two studies, making the determination of a sample size for CFA a difficult task (Myers, Ahn, and Jin, 2011). Sample size along with other model characteristics like communality of the indicators and degree of factor determinacy are known to affect the model fit statistics (MacCallum et.al, 1999). However, a common belief is that higher the sample size, better would be the goodness of fit measures of the factor structure. Some of the most common goodness-of-fit indices are chi square, goodness of fit index and root mean square error of approximation (Schumacker and Lomax, 2004). These indices are used along with other goodness of fit indices like "RMR, IFI, TLI and CFI" in this study along with p-value. These eight measures are used to find the goodness of fit the factor structure of "academic delay of gratification" construct on its nine items for increasing sample sizes for the fixed number of nine items.

The study found that the fit indices did not improve unilaterally on increasing the sample size of the study along with factor loading. For a specific item to sample subject ratio of 1:30, the measures showed excellent fit with decent factor loadings of the items on the construct. Sample subjects belong to the Muslim minority community and are pursuing courses like education, law, engineering and pharmacy. The study reveals that a higher sample size need not always ensure obtaining of good fitness measures for a proposed factor structure.

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Whether the findings of the study are applicable to this specific sample or holds good on subjects of other cultures from different parts of a culturally diverse nation like India remains to be seen through replication of the study in multiple contexts.

IV. References

1. Arrindell, W. A., & van der Ende. J. (1985). An empirical test of the utility of the observations-to-variables ratio in factor and components analysis. Applied Psychological Measurement, 9, 165 - 178.
2. Bembenutty H, Karabenick SA (1996) Academic Delay of Gratification Scale: A new of measurement of delay of gratification. Paper presented at the Eastern Psychological Association, USA, pp. 1-11.
3. Costelo, A.B, & Osborne, J.W. (2005), "Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most from your Analysis", Practical Assessment, Research and Evaluation, 10(7).
4. Chakraborty, .R. (2017) Validation of Academic Delay of Gratification Scale among Indian Professional Courses Students, International Journal of Indian Psychology, Volume 4, Issue 2, No. 92, ISSN:2348-5396 (e), ISSN:2349-3429 (p), DIP:18.01.117/20170402, ISBN:978-1-365-78192-6.
5. Chakraborty,.R., and Chechi,.Dr.V.K., (2018), Analysis of the Psychometrics of Academic Delay of Gratification Scale without Item 4, Issues in Educational Research, In Review.
6. Gorsuch, R. L. (1983), Factor Analysis, 2nd Edn. Hillsdale, NJ: Erlbaum.
7. Hatcher, L. (1994). A Step-by-Step Approach to Using the SAS® System for Factor Analysis and Structural Equation Modeling. Cary, NC: SAS Institute, Inc.
8. MacCallum RC, Widaman KF, Zhang S, Hong S., (1999), Sample size in factor analysis,Psychological Methods, 4:84–99.
9. Myers,N.D., Shn,.S., Jin,.Y, (2011),Sample Size and Power Estimates for a Confirmatory Factor Analytic Model in Exercise and Sport: A Monte
10. Carlo Approach, Research Quarterly for Exercise and Sport, American Alliance for Health, Physical Education, Recreation and Dance Vol. 82, No. 3, pp. 412–423
11. Marsh, H. W., Hau, K.-T., Balla, J. R., & Grayson, D. (1998). Is more ever too much? The number of indicators per factor in confirmatory factor analysis. Multivariate Behavioral Research, 33, 181–220.