

Analysis of The Psychometrics of Academic Delay of Gratification Scale Without Item 4

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Abstract

The present study examines the grounds on which deletion of item 4 out of the 10 items of the “academic delay of gratification scale (ADGS)” constructed by Bembenutty & Karabenick (1996) can improve its psychometric properties. The subjects as the sample consisted of 488 students (277 boys and 211 girls) pursuing professional courses at undergraduate level from law, engineering, education and pharmacy departments. Statistics like mean, standard deviation, inter-item correlation, inter-item covariance, item-total statistics and partial correlation coefficient of item 4 are found to be markedly different from the rest of the items from the scale. Cross-sectional measurement invariance with respect to gender using confirmatory factor analysis reveals the scale to be metric invariant without item 4, proving its construct validity found, using SPSS Statistics Ver. 23. There is improvement in the greatest lower bound reliability of the scale without item 4, found using FACTOR software. Hence there is an overall improvement in the psychometrics of the scale without this specific item. The main ramifications of the findings are presented.

Keywords: Academic delay of gratification, Academic delay of gratification scale, ADGS, Gender, Item 4 of ADGS, Muslim minority community.

Introduction

The academic delay of gratification scale is an instrument constructed by Bembenutty, and Karabenick (1996), to measure the trait academic delay of gratification, defined as “willingness to forgo an immediately available option, in favor of a delayed alternative, in order to secure temporarily distant academic rewards, goals, and intentions” (Bembenutty, and Karabenick, 1998). The tool is the academic equivalent of delay of gratification construct (Bembenutty, and Karabenick, 1996) defined by Mischel as “people's attempts to delay immediate smaller gratification for the sake of more desirable but distant goals” (Mischel, 1981, p. 244).

The researchers prepared the initial version of the tool with 16 items, by adapting the questionnaire to measure delay of gratification by Ward et.al, (1989). The items consisted of two choices or alternatives based on the three criteria, one immediately available alternative and one delayed alternative, an academic outcome associated with each selected alternative and the delayed academic outcome being more valuable than the immediately available outcome.

The responses were provided in the form of “Definitely choose A=1, Probably choose A=2, Probably choose B=3, and Definitely choose B=4”. The scores of all the 10 items are added and divided 10 to get the mean score of academic delay of gratification. The higher is this score obtained between 1 and 4, the greater is the presence of the characteristic in the subject.

In the initial study, the tool had the measure of internal consistency Cronbach’s alpha at 0.72. But, six items belonged to an unrelated dimension of employment and were deleted. This resulted in the improvement of the tool’s internal consistency measure Cronbach’s alpha at 0.76 with 10 items. Finally, the revised tool was found to possess acceptable internal consistency measure at 0.77. The scale showed construct validity by correlating academic delay of gratification with related constructs like academic motivation and learning strategies. However, during this study of validation, the tool showed internal consistency reliability at 0.7.

The 10 items of the tool are:

Item Number	Item Statement
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.”
Item 4	“A. Go to a party the night before a test in this course and study only if you have time, or, B. Study first and party only if you have time.”
Item 5	“A. Spend most of your time studying just the interesting material in this course even though it may mean not doing so well, or, B. Study all the material that is assigned to increase your chances of doing well in the course.”
Item 6	“A. Skip this class when the weather is nice and try to get the notes from somebody later, or, B. Attend class to make certain that you do not miss something even though the weather is nice outside.”
Item 7	“A. Stay in the library to make certain that you finish an assignment in this course that is due the next day, or, B. Leave to have fun with your friends and try to complete it when you get home later that night.”
Item 8	“A. Study for this course in a place with a lot of pleasant distractions even

	though it may mean not learning the material, or, B. Study in a place where there are no distractions to increase the likelihood that you will learn the material.”
Item 9	“A. Leave right after this class to do something you like even though it means possibly not understanding that material for the exam, or, B. Stay after class to ask your instructor to clarify some material for an exam that you do not understand.”
Item 10	“A. Select now an instructor for this course who is fun even though he/she does not do a good job covering the course material, or B. Wait for an instructor for this course who is not much fun but who does a good job covering the course material.”
“Definitely Choose A Probably Choose A Probably Choose B Definitely Choose B”	

The researcher in his previous study (Chakraborty, 2017a) estimated the reliability of the tool with these 10 items using the “Greatest lower bound (GLB) reliability” statistics (Woodhouse and Jackson, 1977), owing to the limitations of Cronbach’s alpha as an estimate of reliability (Cronbach, 1951, Green, & Yang, 2009) in spite of its popularity (Sijtsma, 2009). The study found that the tool possessed reliability between the confidence interval of (GLB,1) that is (0.75,1) and abandoned reporting of the point estimation of reliability of the tool using Cronbach’s alpha (Peters, 2014). The study was conducted using R Studio / R software (2016, 2017).

The original study by Bembenutty and Karabenick found the construct to be multi dimensional but settled for unidimensionality for parsimony purposes (Abd-El-Fattah, and Salman, 2017). Also, the tool was of foreign origin and required a separate validation study before being administered on Indian students (Markus and Kitaynama, 1991, King and Du, 2011) and hence the researcher conducted such a study (Chakraborty, 2017 b). The study found sufficient evidence for the tool with 10 items of being unidimensional and possessing construct validity (between-network and within-network, Marsh, 1997). In a follow up study (Chakraborty, 2017 c), the researcher investigated the measurement invariance of the scale with respect gender and found it to be scalar non invariant, using SPSS ver. 23. The items responsible for it were identified as item 1, item 8, item 9 and item 10 (Chakraborty and Chechi, 2018).

While conducting these studies, the researcher found the statistics associated with item 4 indicate it as a weak link in the instrument. Its meaning is such that most of the subjects would respond on the higher side of the scale. It implies that the response of this item would be more skewed than the responses of the rest of the items in the scale, affecting the results of any study based on it. The present study is taken up to confirm this observation and establish an improvement in the psychometrics of the tool academic delay of gratification scale ADGS without item 4.

Method

Sample

488 undergraduate students (211 girls and 277 boys) studying professional courses from the disciplines of like law, engineering, pharmacy and education were randomly selected as the participants of this study who belonged to the minority

community of Muslims. The scale was administered in the class room during regular classes and the subject took 15 minutes to finish the test.

Measure

The tool's description and psychometric properties are already discussed above.

Procedure

Formal permission was sought and obtained from the Principals of the participant faculty colleges to administer the tool on the students while the classes were in session.

The instructions were explained in details and cooperation was sought from the subjects. The faculty members supported in the administration of the test and the students took 10 to 15 minutes to complete and handover the tool to the researchers.

Statistical Techniques

Statistics like mean, standard deviation, skewness, kurtosis, inter-item correlation, inter-item covariance, item-total statistics and partial correlation coefficient of item 4 are used and compared with the rest of the items and academic delay of gratification score of the tool. Goodness of fit of the hypothesized models is calculated using measures like "p-value, CMIN/DF, RMR, RMSEA, GFI, IFI, TLI and CFI" (Hu and Bentler, 1995; Thompson, 2000). Cross-sectional measurement invariance with respect to gender using confirmatory factor analysis of the scale is carried out without item 4, for proving the tool's construct validity, using SPSS Statistics Ver. 23. Chi-square difference test is used to find the extent of invariance between the hypothesized model of a level with its previous level (Bollen, 1989b; Cheung and Rensvold, 2002). Here, non-significant result means the existence of measurement invariance at the present level (Bialosiewicz, Murphy and Berry, 2013). The tool's greatest lower bound reliability without item 4 is found using FACTOR software (Lorenzo-Seva and Ferrando, 2006, 2013), to finally establish its present state of psychometrics.

Results

Table 1: "Mean, Standard Deviation, Skewness and Kurtosis of 10 items"

Item	"Mean"	"Standard Deviation"	"Skewness"	"Kurtosis"
1	2.5738	1.17934	-0.045	-1.499
2	2.4037	1.10392	0.181	-1.293
3	2.8238	1.08834	-0.413	-1.149
5	2.4078	1.11537	0.162	-1.294
6	2.6107	1.07999	-0.091	-1.271
7	2.6352	1.05795	-0.139	-1.204
8	2.9344	1.11909	-0.577	-1.092
9	2.3402	1.16020	0.253	-1.392

10	2.7746	1.13485	-0.319	-1.330
4	3.3811	1.01640	-1.407	0.521

N=488(Boys = 277, Girls=211)

Interpretation: Most of the students would prepare for an exam the next day, rather than attending a party. This is the reason why, the mean of item 4 is more than the mean score of the rest of the items. Its standard deviation is also less proving that the subjects form a homogenous group in responding to this item when compared to the rest of the items in the scale. The skewness and kurtosis values of this item further substantiate the point that item 4 should be a non-member of ADGS.

Table 2: “Inter-Item Correlation Matrix”

	“Item 1”	“Item 2”	“Item 3”	“Item 5”	“Item 6”	“Item 7”	“Item 8”	“Item 9”	“Item 10”	“Item 4”
“Item 1”	1.000									
“Item 2”	0.289	1.000								
“Item 3”	0.349	0.355	1.000							
“Item 5”	0.242	0.171	0.220	1.000						
“Item 6”	0.195	0.242	0.183	0.161	1.000					
“Item 7”	0.254	0.265	0.265	0.151	0.296	1.000				
“Item 8”	0.301	0.289	0.216	0.216	0.280	0.176	1.000			
“Item 9”	0.189	0.172	0.230	0.104	0.194	0.075	0.215	1.000		
“Item 10”	0.213	0.219	0.259	0.168	0.185	0.287	0.085	0.108	1.000	
“Item 4”	0.052	0.079	0.048	0.089	0.169	0.118	0.103	0.095	0.085	1.000

N=488(Boys = 277, Girls=211)

Interpretation:Item 4’s strength of correlation coefficient with most of the items in the scale, except item 7 and item 8, is very less. It shows that item4 should not belong to this scale.

Table 3: “Inter-Item Covariance Matrix”

	“Item	“Item	“Item	“Item	“Item	“Item	“Item	“Item	“Item	“Item
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	1"	2"	3"	5"	6"	7"	8"	9"	10"	4"
"Item 1"	1.391									
"Item 2"	0.376	1.219								
"Item 3"	0.448	0.427	1.184							
"Item 5"	0.318	0.211	0.267	1.244						
"Item 6"	0.248	0.289	0.215	0.194	1.166					
"Item 7"	0.316	0.310	0.305	0.178	0.338	1.119				
"Item 8"	0.397	0.357	0.264	0.269	0.338	0.208	1.252			
"Item 9"	0.258	0.220	0.290	0.134	0.244	0.091	0.279	1.346		
"Item 10"	0.286	0.274	0.320	0.213	0.226	0.345	0.108	0.143	1.288	
"Item 4"	0.062	0.088	0.053	0.101	0.186	0.127	0.117	0.112	0.098	1.033

N=488(Boys = 277, Girls=211)

Interpretation: Item 4's though belonging to a scale measuring academic delay of gratification does not change simultaneously with the rest of the items of the same scale. This shows its non-membership in the scale.

Table 4: "Inter-Total Statistics"

	Scale Mean if item is deleted	Scale Variance if item is deleted	Corrected item-total correlation	Squared Multiple Correlation	Cronbach's alpha if item deleted
Item 1	24.3115	26.728	0.444	0.228	0.668
Item 2	24.4816	27.219	0.443	0.223	0.669
Item 3	24.0615	27.179	0.456	0.249	0.667
Item 5	24.4775	28.525	0.316	0.112	0.691
Item 6	24.2746	27.818	0.400	0.186	0.677
Item 7	24.2500	27.983	0.396	0.200	0.678
Item 8	23.9508	27.612	0.398	0.198	0.677
Item 9	24.5451	28.651	0.285	0.107	0.697
Item 10	24.1107	28.226	0.334	0.147	0.688
Item 4	23.5041	30.616	0.168	0.043	0.713

Interpretation: There is a significant change in the mean and standard deviation statistics of the scale when item 4 is deleted. Its item –total correlation is least among other scale items. It explains only 4% of the construct it measures while the other items

explain academic delay of gratification at least 10% of more. There is a significant jump in the internal consistency reliability, Cronbach's alpha of the scale on its deletion.

Table 5: "Pearson's Correlation Coefficients and Partial Correlations Coefficients of Rest of the Items with ADGS Score Blocking Item 4's Influence"

	Academic Delay of Gratification (Total)	
	Pearson's Correlation Coefficient	Partial Correlation Coefficient Blocking Item 4
Item 1	0.600**	0.620**
Item 2	0.590**	0.600**
Item 3	0.599**	0.619**
Item 5	0.484**	0.484**
Item 6	0.551**	0.532**
Item 7	0.545**	0.540**
Item 8	0.554**	0.554**
Item 9	0.464**	0.461**
Item 10	0.502**	0.505**

** Correlation is significant at 0.01 level (2-tailed).

Interpretation: There is a moderate in strength and highly significant (at $\alpha=0.01$) rise in the strength of the relationship (using partial correlation coefficients) between items 1,2,3, and 10 individually with the construct academic delay of gratification when the influence of item 4 on the scale is held constant. The items 5 and 8 do not show any change in the strength of the relationship they share with the construct on blocking item 4 influence, while items 6, 7 and 9 do show fall in the strength of the relationship they have with the construct when item 4 is blocked from influencing the scale. In this way, 6 out of 9 items show betterment or no change in their relationship with the construct without item 4's presence in the scale.

Table 6: "Goodness of Fit Measures for Unconstrained Factor Structure"

Measure	"p-value"	"CMIN/DF"	"RMR"	"RMSEA"	"GFI"	"IFI"	"TLI"	"CFI"
Benchmark	">0.05"	"<3"	"<0.08"	"<0.08"	">0.93"	">0.93"	">0.93"	">0.93"
Result with Item 4	0.001	1.905	0.048	0.043	0.973	0.941	0.923	0.94
Result without Item 4	0.001	2.111	0.049	0.048	0.975	0.943	0.922	0.942

Interpretation: The hypothesized unconstrained factor structure of this scale without item 4 fits well with obtained data, as except for p-value and TLI measure, the obtained result crossed the benchmark for the rest of the goodness of fit measures, as was the case in the previous study with all the 10 items too (Chakraborty c, 2017). It means that the factor structure is unchanged even when item 4 is deleted from the scale. It also proves the within-network construct validity of the scale.

Table 7: "Goodness of Fit Measures for Configural Factor Structure – Boys/Girls"

Measure	"p-value"	"CMIN/DF"	"RMR"	"RMSEA"	"GFI"	"IFI"	"TLI"	"CFI"
Benchmark	">0.05"	"<3"	"<0.08"	"<0.08"	">0.93"	">0.93"	">0.93"	">0.93"
Result with	0.003	1.539	0.06	0.033	0.956	0.934	0.912	0.932

Item 4								
Result without Item 4	0.001	1.684	0.061	0.038	0.959	0.934	0.909	0.931

Interpretation: The hypothesized configural factor structure of boys and girls, of academic delay of gratification scale without item 4, fits well with obtained data, as except for p-value and TLI measure, the obtained result crossed the benchmark for the rest of the goodness of fit measures, as was the case in the previous study with all the 10 items too. It means that the factor structure is unchanged with respect to gender, when item 4 is deleted from the scale.

Table 8: “Goodness of Fit Measures for Metric Factor Structure – Boys / Girls”

Measure	“p-value”	“CMIN/DF”	“RMR”	“RMSEA”	“GFI”	“IFI”	“TLI”	“CFI”
Benchmark	“>0.05”	“<3”	“<0.08”	“<0.08”	“>0.93”	“>0.93”	“>0.93”	“>0.93”
Result with Item 4	0.002	1.531	0.091	0.033	0.951	0.924	0.913	0.923
Result without Item 4	0.001	1.646	0.094	0.036	0.954	0.926	0.914	0.924

Interpretation: The hypothesized metric factor structure of boys and girls, of academic delay of gratification scale without item 4, fits fairly well with obtained data, as except for p-value, IFI, TLI and CFI measures, the obtained result crossed the benchmark for the rest of the goodness of fit measures, as was the case in the previous study with all the 10 items too. It means the scale in the absence of item 4 is metric invariant and boys and girls understand the same meaning of the rest of the 9 items.

Table 9: “Goodness of Fit Measures for Scalar Factor Structure – Boys / Girls”

Measure	“p-value”	“CMIN/DF”	“RMR”	“RMSEA”	“GFI”	“IFI”	“TLI”	“CFI”
Benchmark	“>0.05”	“<3”	“<0.08”	“<0.08”	“>0.93”	“>0.93”	“>0.93”	“>0.93”
Result with Item 4	0.000	2.019	-	0.046	-	0.834	0.834	0.834
Result without Item 4	0.000	2.247	-	0.051	-	0.833	0.833	0.833

Interpretation: The hypothesized scalar factor structure of boys and girls, of academic delay of gratification scale without item 4, fits poorly well with obtained data. It is because except for the CMIN/DF and RMSEA, the obtained result did not cross the benchmark for the rest of the goodness of fit measures, as was the case in the previous study with all the 10 items too. As the scale is scalar variant, it means boys and girls responds differently to all the items though they understand them same.

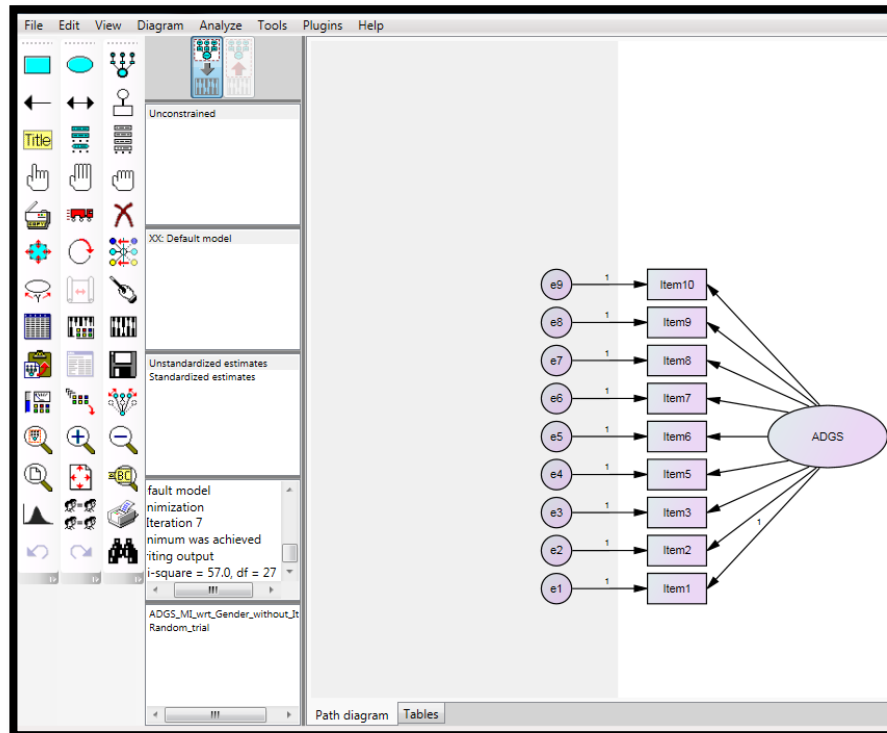


Figure 1: Unconstrained Factor Structure of ADGS without Item 4

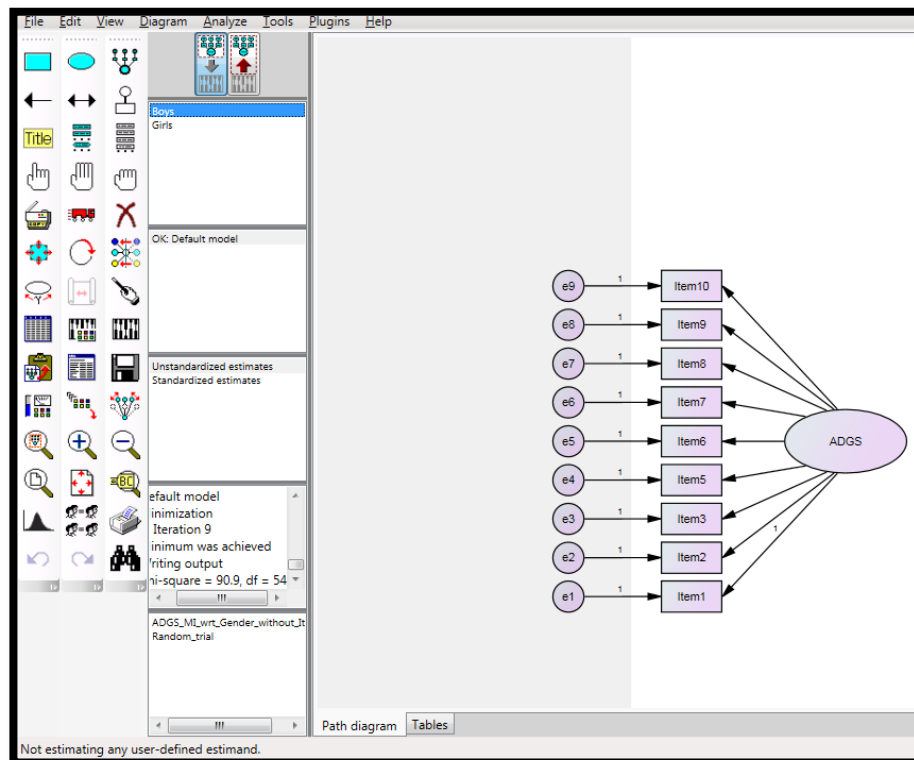


Figure 2: Constrained / Configural Invariance of ADGS without Item 4

Table 10: Chi-Square Difference Test for Configural Invariance

Model/Structure	Chi-square	df	p-value	Invariant
With Item 4				
Unconstrained	66.7	35	0.224	YES
Configural	107.7	70		
Difference	41	35		

Without Item 4				
Unconstrained	57	27	0.169	YES
Configural	90.9	54		
Difference	33.9	27		

Interpretation: The Chi-square test to find the difference between the unconstrained structure and the configural structure with respect to gender provided a p-value 0.169 which is greater than 0.05. It implies that the result is non-significant and means that there is no difference in the factor structure of the construct in boys and girls group simultaneously, even when item 4 is deleted from the ADGS, as was the case earlier with 10 items (p=0.224).

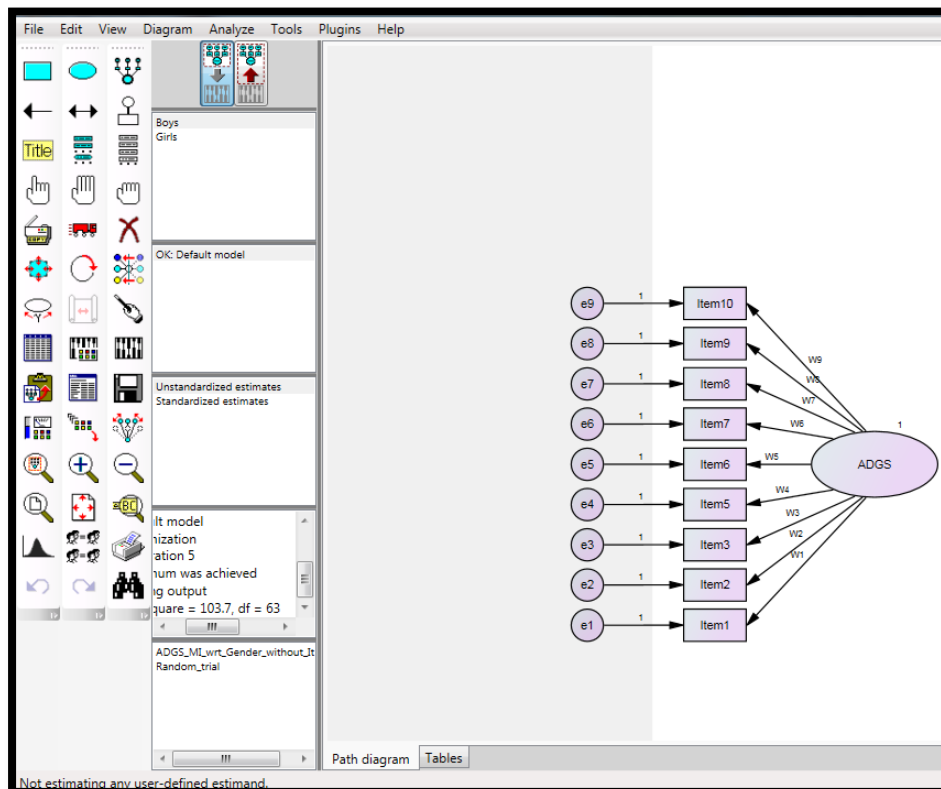


Figure 3: Constrained / Metric Invariance of ADGS without Item 4

Table 11: Chi-Square Difference Test for Metric Invariance

Model/Structure	Chi-square	df	p-value	Invariant
With Item 4				
Configural	107.7	70	0.143	YES
Metric	122.4	80		
Difference	14.7	10		
Without Item 4				
Configural	90.9	54	0.172	YES
Metric	103.7	63		
Difference	12.8	9		

Number of groups: 2

Interpretation: The Chi-square test to find the difference between the configural structure and the metric constrained structure with respect to gender provided a p-value 0.172 which is greater than 0.05. It implies that the result is non-significant and means that there is no difference in the way boys and girls understood the meaning of the rest of items in the scale when item 4 is deleted, as was the case earlier with 10 items

($p=0.143$). The ADGS remains metric invariant without item 4 in it.

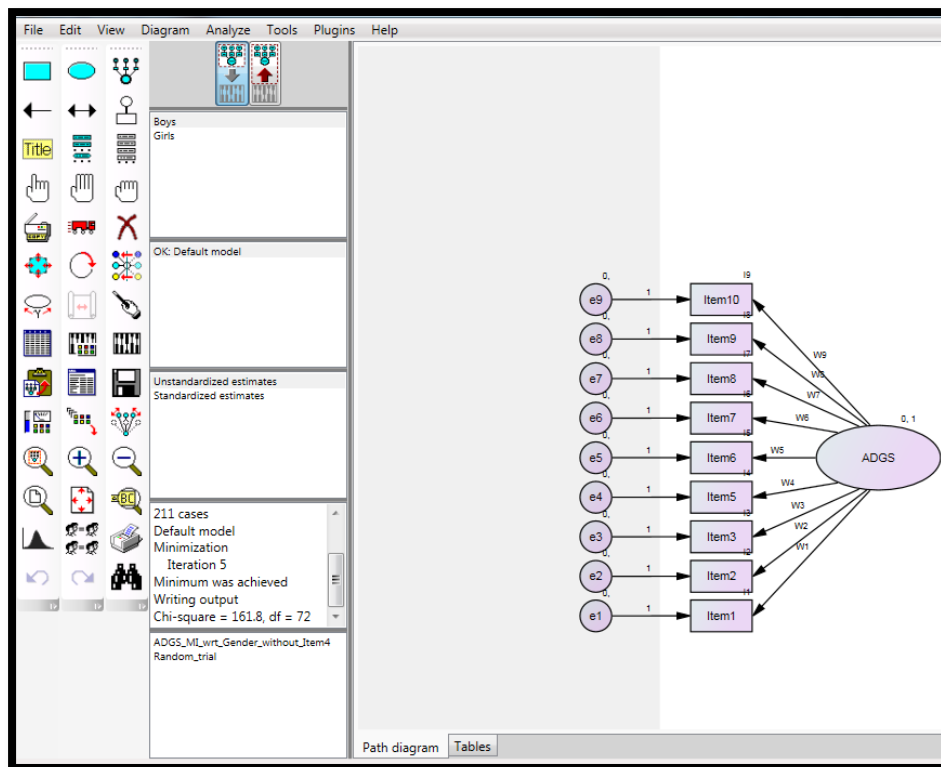


Figure 4: Constrained / Scalar Invariance of ADGS without Item 4

Table 12: Chi-Square Difference Test for Scalar Invariance

Model/Structure	Chi-square	df	p-value	Invariant
With Item 4				
Metric	122.4	80	0.000	NO
Scalar	181.7	90		
Difference	59.3	10		
Without Item 4				
Metric	103.7	63	0.000	NO
Scalar	161.8	72		
Difference	58.1	9		

Number of groups: 2

Interpretation: The Chi-square test to find the difference between the metric structure and the scalar constrained structure with respect to gender provided a p-value 0.000 which is lesser than 0.05. It implies that the result is significant and means that the origin or the starting value of the measurement scale of the ADG construct is different in boys and girls groups, when item 4 is deleted from the scale. Boys and girls respond differently to the 9 items of the scale though they understand them with same meaning. The scale is **scalar variant**, as was the case with 10 items earlier.

Table 13: Reliability Estimates

S.No.	Type of Reliability	Software used for Calculation	Reliability
With Item 4			
1.	Cronbach's Alpha	R Studio / R	0.7
2.	McDonald's Omega		0.7
3.	Greatest Lower Bound		0.75
Without Item 4			
1.	Cronbach's Alpha	FACTOR	0.713974
2.	McDonald's Omega		0.716618
3.	Greatest Lower Bound		0.772528

Interpretation: While in the previous study (Chakraborty, 2017 a), the researcher found the greatest lower bound reliability of the scale to be 0.75, removing item4 in this study raised the scale's GLB (true) reliability to 0.772528. Going by the definition of GLB, the ADGS true reliability lies within the confidence interval (0.772,1), which is acceptable.

Table 14: Violation of Tau-equivalence

Item	Factor Loading with item 4	Factor Loading without item 4
1	0.50	0.54
2	0.69	0.54
3	0.54	0.58
4	0.17	Deleted
5	0.38	0.37
6	0.57	0.44
7	0.44	0.47
8	0.61	0.44
9	0.39	0.33
10	0.40	0.45

Interpretation: In the previous study (Chakraborty, 2017b), the researcher found that the Cronbach's alpha (0.715) underestimated the true (GLB = 0.75) reliability of the scale with 10 items by 4.66 % due to the violation of tau –equivalence (Raykov, 1997;Graham,2006;Green & Yang, 2009). The factor loading of different items on the construct academic delay of gratification was not same (Teo & Fan, 2013). This study also found that Cronbach's alpha (0.713974) underestimated the true reliability of the scale without item 4 (GLB = 0.772528) by 7.58% in keeping with its limitation, the violation of tau-equivalence and the range of violation 0.6 % to 11 %. The factor loading of the 9 items on the construct academic delay of gratification is not same. There is an improvement of 2.916% of greatest lower bound reliability when item 4 is removed from the scale.

Discussion:

Item 4 of academic delay of gratification scale is:

- “A. Go to a party the night before a test in this course and study only if you have time, or,
B. Study first and party only if you have time.”

Response:

“Definitely Choose A=1 Probably Choose A=2 Probably Choose B=3
Definitely B=4”

There is a high probability that students with or without academic delay of gratification would choose the response “Definitely B” for this item. In this way, an element of bias originates in the ADGS scale. It calls for deletion of this item from the scale.

Moreover, all the descriptive statistics of this item were found to be markedly different from the statistics of rest of the items in this scale. Its correlation with the construct and covariance with the rest of the 9 items are also very less further indicating that it should be a non-member of the scale.

To establish its deletion on a firm psychometric basis, the present study checked the factor structure of the construct academic delay of gratification scale without item 4 and found it to be stable. This proved the construct validity of the scale. Also, for reliability estimation, Cronbach’s alpha was abandoned as limitation of violation of Tau-equivalence and underestimation of true reliability of the scale both under 10 items and 9 items scenario, were proved. Greatest lower bound reliability was adopted as the measure of reliability and an improvement in this measure by 2.916% without item 4 in the scale was found.

With validity and reliability of the scale intact, its measurement invariance across gender was taken up. The scale in its revised form with 9 items is found to be metric invariant in keeping with the results of the scale with 10 items. Items 1, 2, 3 and 10 are such scalar variant items. The responses of these items are gender biased, with the first three items biased towards girls and the item 10 has its responses biased towards boys (Chakraborty & Chechi, 2018). The size of the scale is also reduced.

The tool comprises of items with two alternatives, one associated with instant gratification and the other associated with delayed gratification. But, with the deep intrusion of information and communication technology in the lives of students of all ages in present times, the notion of instant gratification has also changed, to the extent that instant gratification is the new normalcy now.

In light of these findings, it is suggested that a new tool measuring academic delay of gratification for students belonging from a culturally diverse nation be undertaken. Apart from cultural diversity, the new tool must also include items which consider the psychological makeup of the present day college going students in order to come up with a valid means to measure this vital construct without any gender bias.

Conclusion:

It is shown in this study that “academic delay of gratification scale” prepared by

“Bembenutty and Karabenick” is metric invariant and has acceptable reliability under realistic conditions for non-homogeneous items and skewed data, without item 4. But, the study needs to be replicated as the sample of the study, though large for getting correct factor structure (20:1, as suggested by Costello & Osberne), is a minority community in India. The scalar variance of the tool even without item 4, has its own significance. Girls from this community are found to be more sincere than boys in studies and research indicates these girls to possess higher academic delay of gratification owing to the sociological conditions of this community (Chakraborty & Chechi, 2018). Even this latest finding is to be verified by replication of this study on students from other community.

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