Network Psychometrics Based Validation of Volitional Component of Self Regulated Learning and Estimation of its Polychoric Ordinal Omega Reliability

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ABSTRACT

The present study validates the volitional component of self regulated learning to be made up of three variables, namely, academic delay of gratification, future time perspective and academic procrastination in the Indian context, further providing empirical support to the previous study in the German context [1]. A new technique of dimension extraction, called Exploratory Graph Analysis (EGA), the confirmation of its factor structure using the ordinal data based "WLSMV" estimator and its robust estimates, network inferential statistics under the state-of-the-art approach of Network Psychometrics, and polychoric ordinal omega reliability were calculated using R/RStudio Ver. 3.6.3. The tools used in the study were the Zimbardo Time Perspective Inventory Short Form [2], the Academic Procrastination Scale Short Form [3] and the Academic Delay of Gratification Scale [4].The sample of the study comprised of 187 students (159 boys and 28 girls) of second year computer science and engineering, Lovely Professional University, Punjab, India, selected using simple random sampling technique. The robust estimates of confirmatory factor analysis obtained were as desired in concurrence with their respectively benchmarks along with maximum likelihood ML based CFA estimates - TLI, CFI, RMR and RMSEA estimated using SPSS AMOS Ver. 23.0. The study also showed the limitations of the Cronbach alpha as a measure of internal consistency reliability, and the estimation and reporting of the alternative estimates of reliability like Raykov's Composite Reliability, McDonald's Omega and Guttman's Lambda**.** The polychoric ordinal omega reliability was also quite acceptable at 0.83. Implications of the study are discussed.

Keywords: Exploratory Graph Analysis (EGA), Guttman's Lambda, McDonald's Omega, Network Psychometrics, Polychoric Ordinal Omega Reliability, Raykov's Composite Reliability**,** Self-regulated Learning, Volition, WLSMV.

1. INTRODUCTION

The concept of volition had its deep roots in Western culture and its origin can be traced back to the times of Aquinas [5]. Its critical role in understanding voluntary human behavior was widely appreciated by psychologists until the beginning of the twentieth century [6]. However, there was a dip in the interest of this concept in the middle of the twentieth century, and it was not until 1970s, that volition as a concept became a subject of interest again [7] - [25]. In spite of its conceptual importance, psychologists could not come up with a unifying theory [26] and empirical studies on volition thus remained difficult to achieve.

According to [27], volition is a relatively stable individual difference in the personality that influences goal choices and working towards action control processes and is based on the action-control theory of [28]. [5] postulated volition to be an executive or higher order mental process that mediated a person's mental deliberation of a thought, decision-making and eventual execution through action, and stressed upon the need to conduct more empirical studies as a promising way to bring clarity about the concept.

As part of providing impetus to conducting of empirical studies on volition, many researchers of late have started to recognize volition as a component of self regulated learning and stressed on its inclusion in the integrative model of self regulated learning [29].

[30] contributed to the research of volition by proposed the variables academic delay of gratification, future time perspective and academic procrastination as the possible component candidates to empirically measure volition. However, the first empirical attempt to test and validate such a framework of volition was conducted by [1] on

German students. Its replication and further validation in other culturally diverse countries and on different sample subjects are important and it is the purpose of this study, to do the same in the Indian context.

The validation of the factor structure of volition also involved establishing a parsimonious model of this construct, substantiated by the works of [31] and [32]. The parsimonious model construction and its eventual validation are conducted through scale purification as the tools used in the study are primarily of foreign origin [33]. Scale purification is a less known but vital step to be taken while validating foreign tools involving reflexive constructs. In these tools, the items are mere reflections of the latent construct and identification of the minimum of the items explaining the maximum average variance explained is in keeping with the principal of parsimony [34] under structural equation modeling [35].

The present study applies the Network Psychometrics approach of dimensions exploration and confirmation of the same using the network inferential statistics. The details of the approach can be found in [36].

2. METHODOLOGY

Sample:

The subjects of the study comprised of 187 IInd year students (159 boys and 28 girls) from the "School of Computer Science and Engineering, of the Lovely Professional University", Phagwara, Punjab, India. The students were selected through simple random sampling technique in the study.

Instruments:

Measuring the Volitional Component of Self Regulated Learning:

i. Academic Delay of Gratification Scale:

This tool was constructed by [4] containing 10 items which measured academic delay of gratification in college students by providing them an academic event involving instant gratification and an alternative involving delayed gratification, of which the students had to select any one option and record their response in a four point likert scale, with the option "Definitely A = 1 to Definitely B =4". The tool was validated in the Indian context by the researcher on professional courses students [37]. The scale was found to be unidimensional. It had good psychometrics, involving Cronbach's Alpha of 0.715, and goodness of fit indices CMIN/Df = 1.097 (< 3), RMR = 0.069 (< 0.08), RMSEA = 0.028 (< 0.05), GFI = 0.944 (> 0.93), IFI = 0.981 (> 0.93), TLI = 0.974 (>0.93) and CFI= 0.979 (>0.93) respectively [38]. The greatest lower bound reliability of the scale was estimated to be between (0.75,1) [39].

ii. Academic Procrastination Scale – Short Form:

The academic procrastination scale is a five items short form version tool developed by [40], using the original 25 items tool developed by [41]. The tool was adapted and validated by the researcher in the Indian context on engineering students [42]. The scale was unidimensional. The Item 3, was deleted for its poor inter-item correlation. The tool with the four remaining items had greatest lower bound reliability between (0.622,1). Owing to the skewness of the data, violation of Tau-equivalence condition, the Cronbach alpha underestimated the reliability of the scale at 0.556. The construct validity of the scale was established through goodness of fit estimates CMIN/DF= 0.359(< 3), RMR = 0.039 (0.08), RMSEA = 0.000 (0.08), GFI = 0.96 (>0.93), IFI = 1. 043 (>0.93), TLI= 1.148 (>0.93) and CFI=1.000 (>0.93). The value of TLI can exceed 1 and need not be between 0 and 1 [43],[44],[45]. The responses are reverse coded since in a five point Likert scale 1=Disagree and 5=Agree.

iii. Future Time Perspective:

The future time perspective construct was measured using the shorter form of the original 56 item Zimbado Time Perspective Inventory developed by [46]. The shorter version has 17 items developed by [47] where the responses are recorded in five point Likert scale with 1=very uncharacteristic to 5=very characteristic. The tool

was validated in the Indian context by the researcher [48]. The study was conducted on 187 IInd year computer science engineering students (159 boys and 28 girls) of the "School of Computer Science and Engineering, Lovely Professional University", Phagwara, Punjab, India. During exploratory factor analysis, Principal component analysis, with Varimax rotation was used initially. While most the items displayed reasonable clustering with their respective factors, item 11 displayed considerable split loading. It was discarded and the exploratory factor analysis was rerun with Principal component analysis, but with Quartimax rotation, to bring the number of factors from six to the theoretically indicated five factors. This method is the opposite of varimax rotation. In varimax rotation, the number of variables having very high factor loading on every factor is kept at low, allowing simple interpretation of factors. In Quartimax rotation, the number of factor necessary to explain the reflecting variables are kept low, which allows easy interpretation of manifest variables. The determinant was 0.077. The KMO sampling adequacy was 0.658. The Barlett's test of sphericity was significant. Five factors were extracted which explained 51.313 percent of the variance in the measured construct. The existence of five factors was confirmed by Hong's parallel analysis, as the obtained eigen values were greater than the critical eigen values. The five factors are past positive, past negative, present hedonistic, present fatalistic and future time perspective. Items 11, from the future time perspective dimension was removed as it loaded poorly on to the construct. Under the violation of tau equivalence condition and non-normality of the data, the reliability of the entire 16 items scale was estimated using greatest lower bound reliability to be between (0.822,1). The Cronbach's alpha of underestimated the reliability of the scale to be 0.671. The goodness if fit estimates showed moderate proof of construct validity with CMIN/DF = 1.36 (< 3), IFI = 0.9 (> 0.9), TLI=0.86 (>0.9), CFI= 0.891 (> 0.9) and RMSEA = 0.044 (< 0.08).

Statistical Analysis:

Some of the best practices were observed while conducting exploratory factor analysis to extract the number of factors from the data. This included, using Hong's parallel analysis for figuring out the number of factors to extract instead of the routine and erroneous practices of Kieser Criterion and Scree plot [49] with the help of principal component analysis extraction method and Varimax rotation.

Based on the guidelines provided by [50], the item to factor loading was set at 0.32 and factor with minimum of three items and maximum of five or more items loading on it was retained or considered for confirmatory factor analysis.

During Confirmatory factor analysis, the goodness of fit estimates selected were CMIN/DF (to be below 3 for a good fit [51]), RMR, GFI, IFI, TLI, RMSEA and CFI. While the recommended value for RMR and RMSEA is below 0.08, the rest of the estimates are desired to have values are above 0.93 [52].

Using AIC and BIC estimates, the initial model containing all 10 items of academic delay of gratification model scale, all 5 items of academic procrastination scale and all 3 items of future time perspective scale, was compared with a parsimonious model. The better model has lower values of these estimates.

The conventional validation of the factor structure of volitional component was then confirmed using the network psychometrics approach. The details of the estimands and the way of their estimation can be found in another article by the researcher [36].

With respect to the reporting of reliability of the scales, the McDonald's reliability and Guttman lambda 2 estimators were used in this study. This exercise is owing to the fact that the Cronbach's alpha as a measure of internal consistency reliability can be reported only when the condition of Tau-equivalence is not violated [53]. Under this condition, Cronbach's alpha is the measure of internal consistency reliability of the items, only when these items not only load on a single construct but also with equal factor loading. Also, the data distribution should be normal [54].

In the case of violation of Tau-equivalence condition but existence of normality of the data, Raykov's composite reliability can be reported as the measure of reliability [55]. However, in all realistic conditions, neither the factor loadings of all the items are exactly equal nor the data is normal. In such a situation, the Cronbach's alpha should

be abandoned [56] - [58]. Usage of Cronbach's alpha even under the violation of Tau-equivalance leads to the underestimation of the actual reliability of the scale ranging from 0.6 to 11 percent on the basis of the gravity of the violation [55].

Procedure:

The researcher approached the head of the department of the "School of Computer Science and Engineering in Lovely Professional University" and asked for the permission to administer the tool on the subjects, when they had a free period. The purpose of the visit was explained to the students. The instructions on the filling of the responses were clearly provided to the subjects and their help in the gathering of the data was sought and well appreciated. The students took seven to ten minutes to fill the questionnaire and returned it to the researcher.

3. RESULTS AND DISCUSSION

187 students (159 boys and 28 girls) of IInd year from"School of Computer Science and Engineering, Lovely Professional University", Phagwara, Punjab, India were sample of this study. The tools administered when a regular class was in session, were the parsimonious versions of academic delay of gratification scale, academic procrastination scale and the Zimbardo time perspective scale. The results of the study were as follows:

Table 1: Descriptive Statistics:

	N	Mean		Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error	Statistic	Std. Error
ZTP12	187	3.2139	.08995	1.23010	-.223	.178	-.891	.354
ZTP13	187	3.4652	.07926	1.08391	-.499	.178	-.378	.354
ZTP14	187	3.4706	.07324	1.00158	-.600	.178	.061	.354
APS1	187	3.2032	.09715	1.32851	-.226	.178	-1.149	.354
APS2	187	2.9679	.09619	1.31535	.088	.178	-1.067	.354
APS3	187	3.2834	.09945	1.35991	-.358	.178	-1.088	.354
APS4	187	2.9091	.10445	1.42831	.038	.178	-1.387	.354
ADGS4	187	2.9519	.07781	1.06399	-.607	.178	-.908	.354
ADGS5	187	2.6043	.07820	1.06941	-.168	.178	-1.208	.354
ADGS8	187	3.0535	.07183	.98228	-.658	.178	-.702	.354
ADGS9	187	2.5241	.07633	1.04378	-.036	.178	-1.170	.354
ADGS10	187	2.8075	.07412	1.01354	-.388	.178	-.955	.354
Valid N (listwise)	187							

Table 2: Reliability Analysis:

S.No.	Name of the Variable	Item No	Cronbach's α	Guttman's λ 2	McDonald's ω	Raykov's Composite Reliability
1.	Future Time Perspective	12 13	0.565	0.585	0.6	0.589

		14				
2.	Academic Procrastination	1	0.669	0.672	0.7	0.684
		2				
		3				
		4				
3.	Academic Delay of Gratification	4	0.692	0.696	0.75	0.7
		5				
		8				
		9				
		10				

The Cronbach's alpha underestimation of reliability due to the violation of tau-equivalence and non-normality of data is known. Owing to this condition, alternative reliability estimates addressing this short coming, like the Guttmann lambda 2 and McDonald's Omega are reported. SPSS Statistics Ver.23.0 is used for the calculation of Cronbach's alpha and Guttman's Lambda 2. R/RStudio and Psych function are used for the estimation of McDonald's Omega and the online composite reliability calculator www.statisticalmind.com is used for the calculation of Raykov's composite reliability.

Though the reliability of the three items of future time perspective are very lowly estimated by Cronbach's alpha, Gutmman's lambda 2 and Raykov's composite, it is found to be acceptable in terms of McDonald's Omega at 0.6 [51]. This estimate for academic procrastination and academic delay of gratification is quite acceptable at 0.7 and 0.75 respectively. Post reliability analysis, the model of volition as proposed by [1] is validated through the statistical technique of confirmatory factor analysis, with the following results:

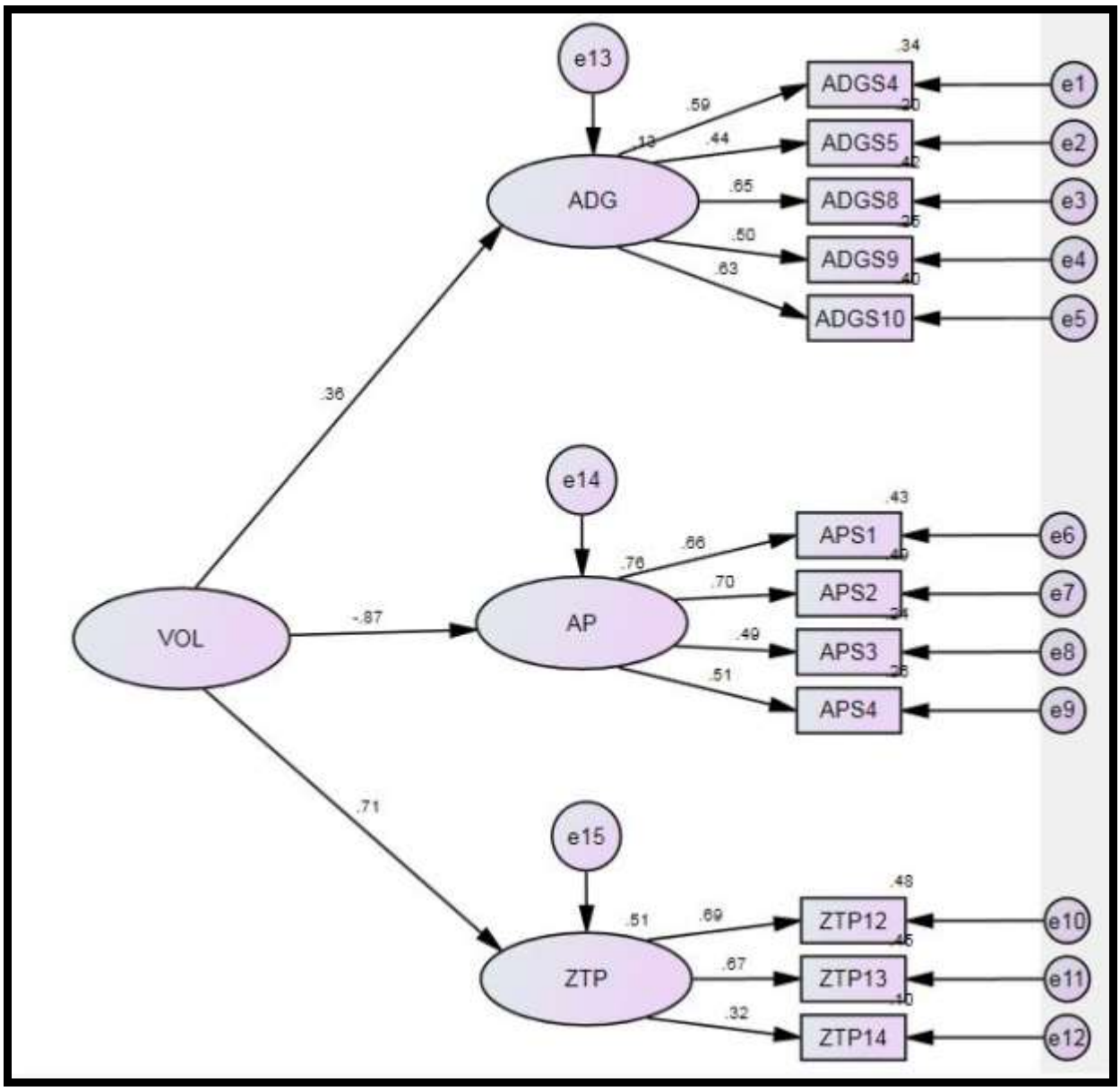

Figure 1. **Factor Loadings in the Path Diagram of the Factor Structure of Volition in Self Regulated Learning:**

Interpretation: Academic procrastination shares negative relationship with volition as its factor loading is -0.87. It is because the lack of this variable in a student represents the presence of volition in him or her. However, academic delay of gratification and future time perspective have positive relationship with volition as displayed by their positive factor loading of 0.36 and 0.71 respectively in concurrence with volition theory.

Table 3: Goodness of Fit Estimation:

Estimate	CMIN/DF	IFI	TLI	CFI	RMR	RMSEA
Benchmark	< 3.00	> 0.9	> 0.9	> 0.9	<0.08	< 0.08
Result	1.342	0.953	0.936	0.951	0.072	0.043

Interpretation: All the goodness of fit estimates display excellent estimates of their estimands, be it CMIN/DF, RMR, RMSEA or the absolute, comparative and parsimonious estimands of goodness of fit. CMIN/DF is 1.342 below the desired 3.00 value. The estimates of the estimands root mean residual and the root mean square error of approximation are 0.072 and 0.043 respectively, below the benchmark of 0.08. Incremental fit index (IFI), Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) estimates are 0.953, 0.936 and 0.951, which are well above the desired 0.9 benchmark, indicating the valid representation of volition in self regulated learning by the three variables academic delay of gratification, academic procrastination and future time perspective.

Validation of the Volitional Component of Self Regulated Learning Using Network Psychometrics in R along with the codes:

The best of the items from the respective scales are used in the validation of the factor structure using network psychometrics in R.

First the data file "VOL_DATA", containing the responses of the best of the items of the three variables, is imported into R interface.

```
> library(haven)
> VOL_DATA <- read_sav("D:/New Research/NP/VOL/VOL_DATA.sav")
> View(VOL_DATA)
```

Then the package in responsible for carrying out exploratory graph analysis, "EGAnet" is installed into R.

```
> install.packages("EGAnet")
```

The installed package is activated.

```
> library(EGAnet)
```

The data frame "ega.vol", which would store the results of the exploratory graph analysis conducted using the above package is defined.

```
> ega.vol<-EGA(VOL_DATA, plot.EGA = TRUE)
```

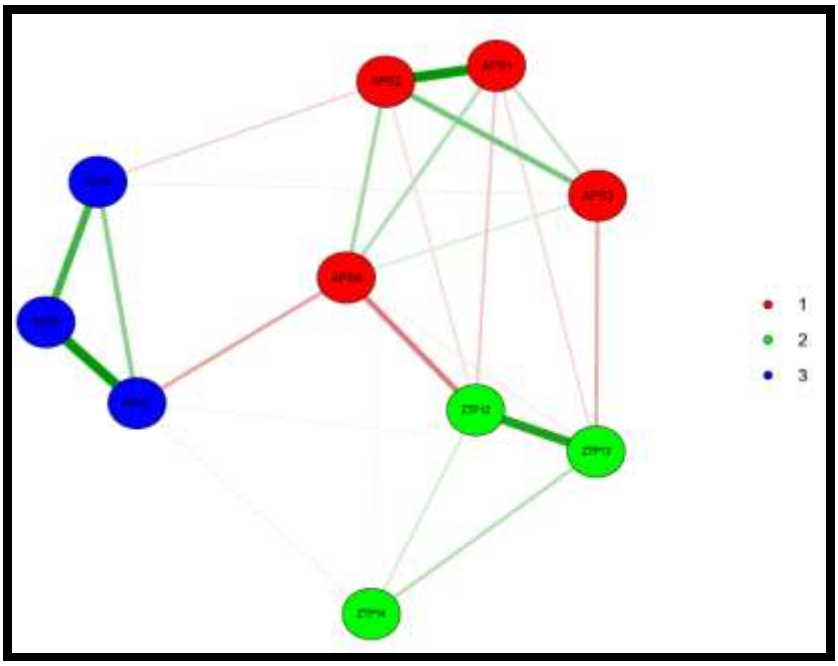

Figure 2. Network Structure of Volition – 1. Academic Procrastination; 2. Future Time Perspective; 3. Academic Delay of Gratification:

Interpretation: The obtained network clears shows that the items of the three variables represent their respective dimensions with consistency. While the variable academic procrastination is represented in red color along with its items (nodes), the variables future time perspective and academic delay of gratification are represented in green and blue colors along with their respective items. The interconnectivities between items and the dimensions are represented in deep green and red color lines called edges of varying thickness. The summary is displayed below:

```
> summary(ega.vol)
EGA Results:

Number of Dimensions:
[1] 3

Items per Dimension:
       items dimension
APS1    APS1         1
APS2    APS2         1
APS3    APS3         1
APS4    APS4         1
ZTP12  ZTP12         2
ZTP13  ZTP13         2
ZTP14  ZTP14         2
ADGS4  ADGS4         3
ADGS8  ADGS8         3
ADGS1 ADGS10         3
```

After the three dimensions of volition are extracted the factor structure is confirmed using confirmatory factor analysis (CFA) where the estimator used is meant for ordinal variables, which is WLSMV. The exercise of confirmatory factor analysis here is done by installing and activating the package lavaan.

```
> install.packages("lavaan")
> library(lavaan)
```

The code for conducting the confirmatory factor analysis is mentioned below along with the data frame cfa.vol, which would store the obtained results:

```
> cfa.vol <- CFA(ega.obj = ega.vol, estimator = 'WLSMV', plot.CFA = TRUE,
data = VOL_DATA)
```

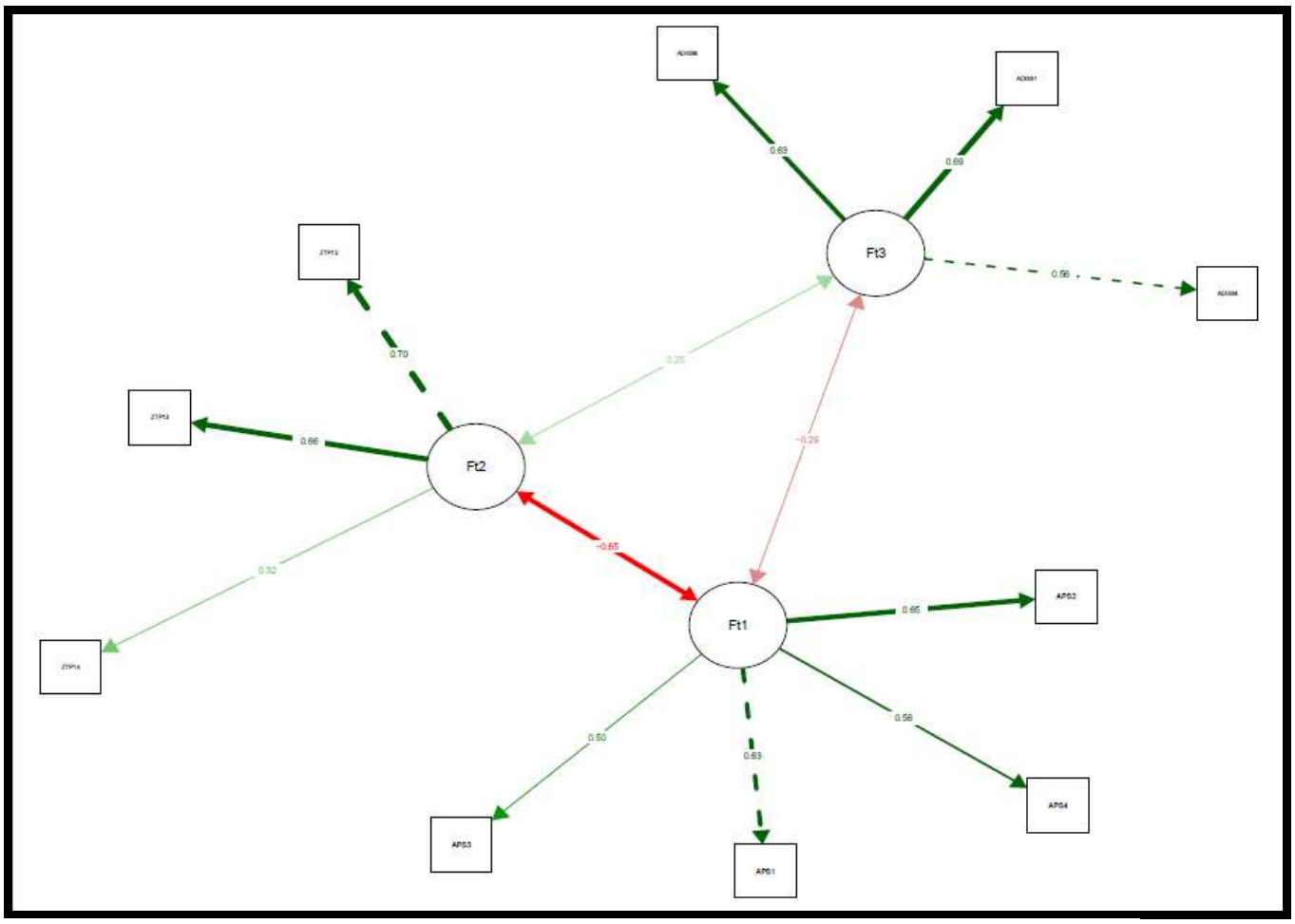

Figure 3. Factor Structure of Volition along with the factor loadings on its three dimensions and their respective items:

Interpretation: Theoretically, the variable academic procrastination Ft1 is related negatively with academic delay of gratification Ft3 and future time perspective Ft2. The same is obtained in the results in form of two red lines negatively relating academic procrastination with the other two variables, which are positively related with each other shown in the form of the green line between them. The estimates are obtained using the below code:

```
> lavaan::fitMeasures(cfa.vol$fit, fit.measures = "all")
                          npar                           fmin
                        23.000                          0.046
                         chisq                             df
                        17.122                         32.000
                        pvalue                   chisq.scaled
                         0.985                         26.410
                   df.scaled                   pvalue.scaled
                        32.000                          0.745
     chisq.scaling.factor                     baseline.chisq
                         0.648                        424.819
                baseline.df                  baseline.pvalue
                        45.000                          0.000
      baseline.chisq.scaled              baseline.df.scaled
                      424.819                         45.000
  baseline.pvalue.scaled     baseline.chisq.scaling.factor
                        0.000                          1.000
                          cfi                            tli
```

1.000	1.055
nnfi	rfi
1.055	0.943
nfi	pnfi
0.960	0.682
ifi	rni
1.038	1.039
cfi.scaled	tli.scaled
1.000	1.021
cfi.robust	**tli.robust**
1.000	**1.013**
nnfi.scaled	nnfi.robust
1.021	1.013
rfi.scaled	nfi.scaled
0.913	0.938
ifi.scaled	rni.scaled
1.014	1.015
rni.robust	rmsea
1.010	0.000
rmsea.ci.lower	rmsea.ci.upper
0.000	0.000
rmsea.pvalue	rmsea.scaled
1.000	0.000
rmsea.ci.lower.scaled	rmsea.ci.upper.scaled
0.000	0.050
rmsea.pvalue.scaled	rmsea.robust
0.952	**0.000**
rmsea.ci.lower.robust	rmsea.ci.upper.robust
0.000	0.032
rmsea.pvalue.robust	rmr
NA	0.060
rmr_nomean	srmr
0.060	**0.042**
srmr_bentler	srmr_bentler_nomean
0.042	0.042
crmr	crmr_nomean
0.046	0.046
srmr_mplus	srmr_mplus_nomean
0.042	0.042
cn_05	cn_01
502.828	582.039
gfi	agfi
0.992	0.987
pgfi	mfi
0.577	1.041
ecvi	
0.339	

Table 4: Robust Goodness of Fit Estimates

Estimate	Robust TLI	Robust CFI	SRMR	Robust RMSEA
Benchmark	> 0.9	> 0.9	<0.08	< 0.08
Result	1.013	1.000	0.042	0.000

Interpretation: The robust estimates are the quite desirable and satisfy their benchmarks values well, confirming the factor structure of volition and its representation by academic procrastination, academic delay

of gratification and future time perspective. The estimand TLI need not have its estimate always between 0 and 1 since it is non-normed (Cangur and Ercan, 2015). The factor loadings are obtained and displayed as below:

```
> View(ega.vol$dim.variables)
> net.loads(ega.vol$network, ega.vol$wc)$std
            1      2      3
ZTP12  -0.201  0.314  0.000
ZTP13  -0.131  0.346  0.019
ZTP14  -0.013  0.142  0.022
APS1    0.353 -0.113  0.000
APS2    0.425 -0.062 -0.049
APS3    0.219 -0.095 -0.019
APS4    0.193 -0.176 -0.095
ADGS4  -0.056  0.000  0.323
ADGS8   0.000  0.024  0.469
ADGS10 -0.079  0.020  0.389
```

The network inferential statistics is carried by installing and activating the R package “bootnet”.

```
> install.packages("bootnet")
> library(bootnet)
```

The regularized network consisting of the partial correlation based structure is estimated and graphically displayed using qgraph R package installation and activation:

```
> Network <- estimateNetwork(VOL_DATA,default = "EBICglasso")
> install.packages("qgraph")
> library(qgraph)
> plot(Network, layout = "spring",labels = TRUE)
```

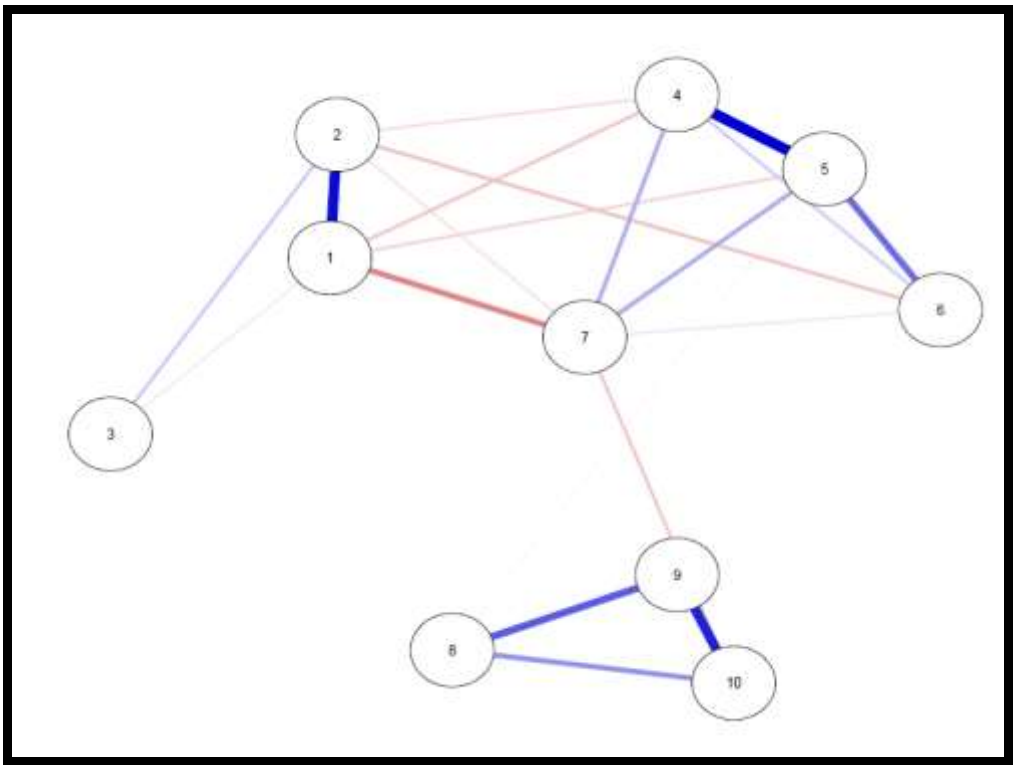

Figure 4. Partial Correlation Network of Volition

Interpretation: The thicker the blue lines (edges) between the items called nodes, the stronger the relationship positively. The red lines represent negative relationship with the width of the lines representing the magnitude of the negative relationship between the dimensions and items as well.

```
> centralityPlot(Network)
```

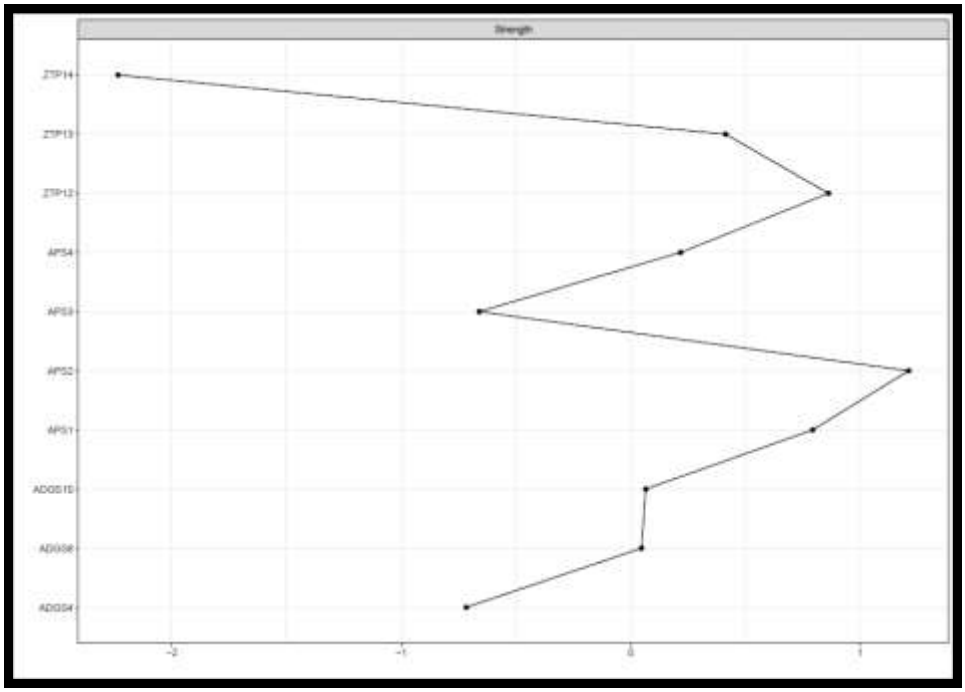

Figure 5. **Node Strength Centrality**

Interpretation: The items or nodes are arranged with respect to their strength.The item or node ZTP14 is the weakest node in the network shown in the extreme left of the graph. The node APS2 is the strongest node in the network shown in the extreme right of the graph.

```
> boot1 <- bootnet(Network, nBoots = 100,nCores = 8)
> plot(boot1, labels = FALSE, order = "sample")
```

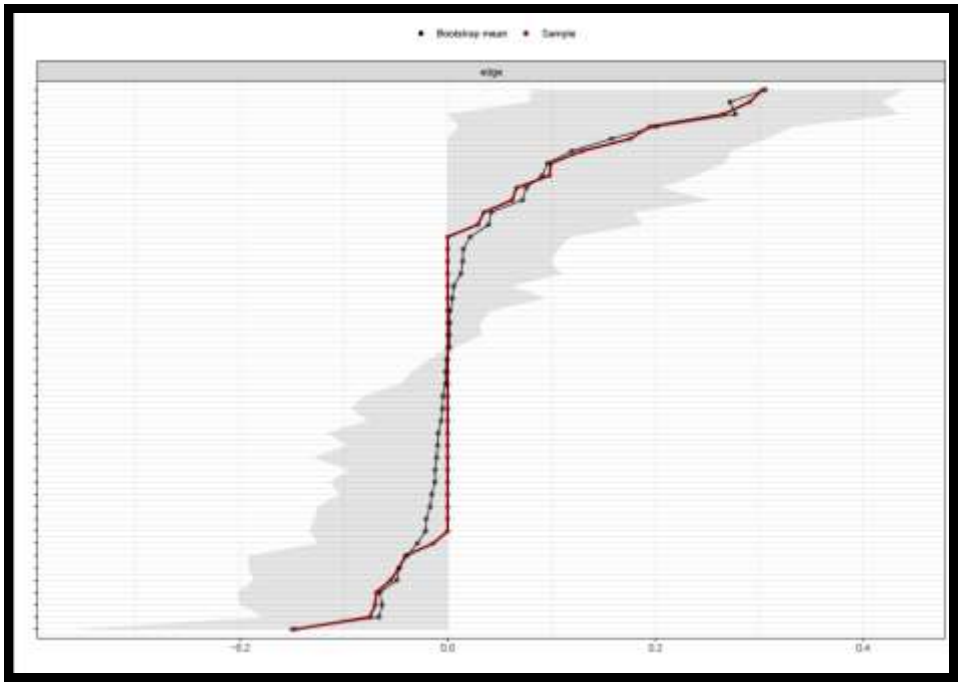

Figure 6. **Node Strength Confidence Interval**

Interpretation: The order of nodes arranged as per their strength cannot be trusted because the confidence interval of the node strength centrality contains zero in it (-0.2, 0.4). It means that the null hypothesis that the the nodes or items not differ from each other significantly is accepted.

```
> boot2 <- bootnet(Network, nBoots = 100,type = "case", nCores = 8)
> plot(boot2, labels = TRUE,order = "sample")
```

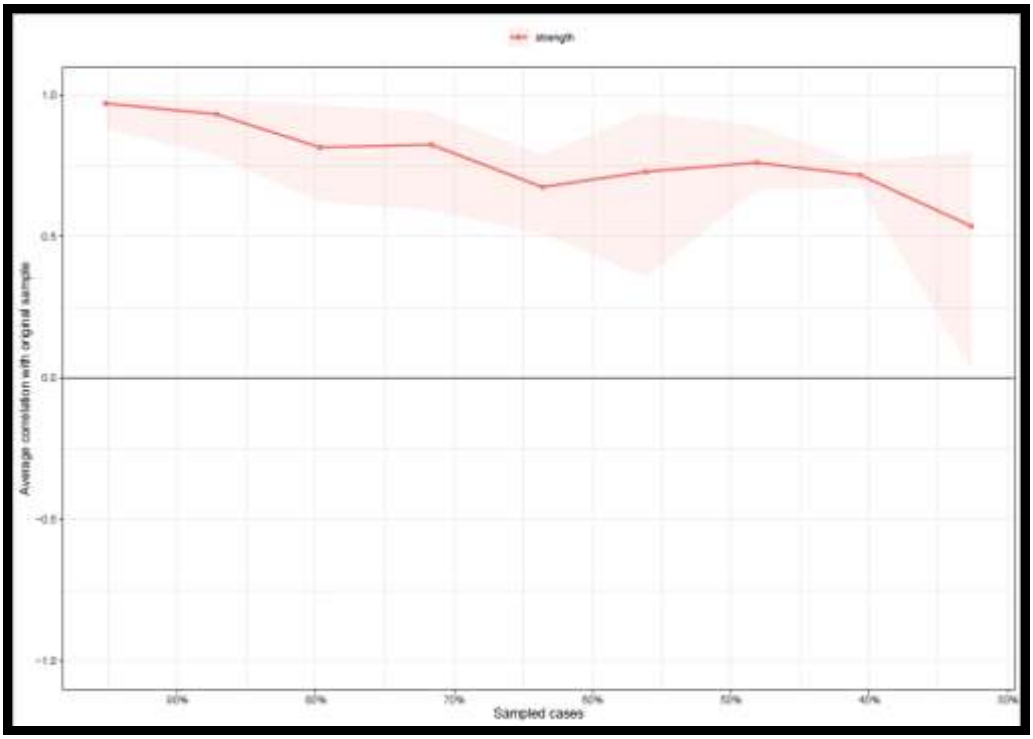

Figure 7. Node Strength CS Coefficient Stability

Interpretation: The order of nodes cannot be retained as the data rows are reduced. While correlation stability CS coefficient hovers around 0.9 when 90 percent of the complete data is considered, it reduces to around 0.55 by the time 30 percent of the total data is considered for evaluation. However, the CS coefficient is able to maintain its magnitude above the necessary thrush hold of 0.5.

```
> corStability(boot2)
=== Correlation Stability Analysis ===

Sampling levels tested:
   nPerson Drop%  n
1       47  74.9 12
2       61  67.4 10
3       76  59.4  7
4       90  51.9 10
5      105  43.9 11
6      119  36.4  9
7      134  28.3 10
8      149  20.3 13
9      163  12.8 10
10     178   4.8  8

Maximum drop proportions to retain correlation of 0.7 in at least 95% of
the samples:

edge: 0.203
  - For more accuracy, run bootnet(..., caseMin = 0.128, caseMax = 0.283)
```

```
strength: 0.128
  - For more accuracy, run bootnet(..., caseMin = 0.048, caseMax = 0.203)

Accuracy can also be increased by increasing both 'nBoots' and 'caseN'.
```

Interpretation: The correlation stability CS coefficient is very poor at 0.128, way below the desirable thrush hold of 0.5 value.

Estimation of Polychoric Ordinal Omega Reliability:

The data obtained from the responses of subjects from different psychological likert scales are ordinal and Likert scale based like 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly Disagree. This calls for the correlation matrix to be converted to polychoric correlation matrix instead of the pearson correlation matrix in order to obtain a true estimate of the reliability [59]. Polychoric correlation provides the measure of relationship through correlation coefficients between variables which are continuous in nature but are measured using ordinal responses of Likert scales. Such correlation matrices are then useful in the estimation of the ordinal versions of alpha [60] and omega [61] which are appropriate estimates of reliability using Likert scale based psychological tools.

R Codes for the estimation of polychoric ordinal omega:

1. Import the data file (VOL_DATA-AP3) in R.
2. Install the package *Psych*
3. Library (psych) activate it
4. polychoric(VOL_DATA-AP3) Calculate the polychoric correlation for ordinal variables.
5. examplename<-polychoric(VOL_DATA-AP3) Define the dataframe examplename to store the results of the polychoric correlation calculations
6. omega(examplename$rho) Estimate the polychoric ordinal omega reliability

Results as Obtained in R:

Alpha: 0.74
G.6: 0.83
Omega Hierarchical: 0.49
Omega H asymptotic: 0.59
Omega Total 0.83

Interpretation: The result shows that the polychoric ordinal omega reliability of the variable volition, consisting of three dimensions, future time perspective, academic delay of gratification and academic procrastination is 0.83, which is quite acceptable an estimate of reliability.

4.DISCUSSION

India as a developing nation requires large number of professional to join the work force to aid in the speedy building of the nation. Along with economic hurdles of paying high fees to pursue courses, the student community has to unfortunately deal with low spirit while pursuing tough and challenges professional courses, especially when proper counseling platforms are non-existent. This scenario leads to rise in the high drop-out rates of students from professional courses in particular. The issue of high drop-outs rate in professional courses can be addressed through proper diagnosis of the level of volition in the student and administering the interventions at the right time.

Presence of a parsimonious and valid factor structure along with its tool can aid in the profiling of the students based on the presence of volition in them. Such an exercise can lead to the development of intervention programs which are customized in nature and would improve the chances of success in academics for the students in the long run.

The validation of the parsimonious volition model of trait self regulation in the Indian context, after its first study in Germany in the year 2015, is a step forward in the right direction. A couple of limitations of the German study are addressed in the present study.

The study also serves as a tutorial for implementing the network psychometrics approach of tool validation since the R codes for the exercise are shared, along with the estimation of polychoric ordinal omega reliability.

Firstly, the former study used a scale to measure procrastination. In the present study, the used tool measured academic procrastination in particular. Secondly, the German study reported the Cronbach's alpha of the used tools without addressing the issue of violation of tau-equivalence. In the present study, this aspect was taken into account. Also, the underestimation of the true reliability of the scale by Cronbach's alpha was demonstrated by reporting Guttman's lambda 2, McDonals's Omega and Greatest Lower Bound reliability in parallel.

5.LIMITATIONS

The study sample size can be increased and students from disciplines other than engineering and locality other can urban areas can be included. One of the major limitations of this study was that was conducted with mostly boys as the sample subjects.

6. CONCLUSION

Empirical studies on volition are less in number owing to the lack of a valid model that can measure this vital aspect of human endeavor. In the context of academics, absence of such a model, can be frustrating and unproductive for both the teacher and the taught. Based on the proposal of [30] to include academic delay of gratification, procrastination and future time perspective, [1] validated a model of volition in the German context. Its cross validation in other culture was essential. The present study conducted to achieve the same intent in the Indian context. Further studies need to be conducted for the establishment of the validity of proposed parsimonious factor structure of volition in a land that is culturally diverse like India and in other abroad as well.

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