Determine of Shared Trauma Posttraumatic Professional Growth Inventory-Modified Using Factor Procedure and Parallel Analysis

Abbas S. Tavakoli, DrPH, MPH, ME, April Hutto, , MSN, PMHNP-BC, FNP-BC, APRN, PhD ©, Phyllis Raynor, PhD, APRN, PMHNP-BC

University of South Carolina, College of Nursing, Biobehavioral Health & Nursing Science

Abstract

Shared Trauma Posttraumatic Professional Growth Inventory-Modified (STPPG) has been defined as a 17-item, Likert-type scale was developed to understand the nature of trauma exposure to the mental health professional. The original STPPG has 14-item, Likert-type scale composed of three subscales (Technique-Specific Shared Trauma, Personal Trauma, and Professional Posttraumatic Growth). The original STPPG acknowledges the mutual impact of shared trauma and aligns closely with established measures of posttraumatic stress, secondary trauma, shared trauma, and posttraumatic growth. This paper used parallel analysis to determine the dimensionality of Shared Trauma Posttraumatic Professional Growth Inventory-Modified (STPPG). Parallel analysis, using a SAS macro and option parallel in Proc Factor, was used to determine the dimensionality of the Perspectives of Faculty Caring. Exploratory factor analysis was conducted using maximum likelihood, squared multiple correlations, and Promax rotation. Parallel analysis, using a SAS macro and option parallel in Proc Factor, was used to determine the dimensionality of the Shared Trauma Posttraumatic Professional Growth Inventory-Modified. Internal consistency reliability was assessed using Cronbach's alpha. Pearson's correlation assessed the association between factors and subscale items. Parallel analysis showed there were two or three meaningful underlying factors. All loading from rotated factor pattern (standardized regression coefficient) were positive for 17 items, with factor loadings ranging from 0.33 to 0. 78. There was a positive correlation between three factors ranging from .58 to .77. Scale reliability in this study was examined by estimating the Cronbach's alpha. The reliability coefficient for total scale was 0.89. The Cronbach's alpha for the subscales ranged from 0.73 to 0.83. Parallel analysis was a valuable method for determining the dimensionality of the STPPG Scale.

Keywords: SAS, parallel analysis, exploratory factor analysis, shared trauma.

Background

Shared Trauma (ST) happens when a healthcare provider and a client experience the same collective traumatic event simultaneously. Collective Traumatic events (CT) involve a group, society, or community all undergoing the same trauma. While COVID-19 is like other CTs, its impact on nurses worldwide is unique. Research on clinicians during the COVID-19 pandemic has highlighted issues such as fatigue, burnout, PTSD symptoms, and moral distress. ST affects nurses across various aspects of their lives, including emotional, behavioral, cognitive, spiritual, and social domains. Evaluating the psychometric properties of the STPPG will enable a thorough examination of how ST has influenced psychiatric-mental health nurses during the COVID-19 pandemic[1,2].

Purpose

This study used parallel analysis to determine the dimensionality of the Shared Trauma Posttraumatic Professional Growth Inventory-Modified (STPPG).

Methodology

This study used the data from a sample of professional health (n=552) with self-reported Shared Trauma Posttraumatic Professional Growth Inventory-Modified (STPPG). The survey was set up in Research Electronic Data Capture (REDCap) software and was made available to eligible participants. Factor dimensionality was assessed through parallel analysis, which has been demonstrated to determine factor dimensionality more accurately than the traditional Kuder-Richardson. Parallel analysis produces correlation matrices from a randomly chosen simulated dataset that has a similar number of observations as the original dataset.[3] The observations in the simulated dataset have the same sampling error as observations in the original dataset.[3] Eigenvalues were computed for both the simulated and original data and compared to determine the point at which the eigenvalue in the simulated dataset was higher than in the original dataset. The number of factors before this transition point denoted the number of factors that were retained. A scree plot was also created to compare eigenvalues from simulated and original datasets to corroborate our determination of the number of factors to retain.

Data Analysis

Exploratory factor analysis was conducted using squared multiple correlations and prior communality estimates. Maximum likelihood (ML) estimation was used to extract factors followed by Promax (oblique) rotation. First, parallel analysis, using a SAS macro and option parallel in Proc Factor, was used to determine the dimensionality of the STPGG[4,5]. Second, the Scree plot, eigenvalues, and proportion of eigenvalues were examined. An eigenvalue greater than one determined if a factor was retained in the factor structure.

Third, a series of factor rotations were examined. Results of both varimax and promax rotation methods indicated an optimal factor structure of seven factors. When interpreting the rotated factor pattern, an item was determined to load on a given factor if the factor loading was 0.30 or greater for that factor and was less than 0.30 for other factors.[4] Internal consistency reliability was assessed using Cronbach's alpha for the total scale and each of the seven subscales. Pearson's correlation assessed the associations between factors and subscale items. PROC MEAN and PROC FREQ were used to conduct descriptive statistics. PROC CORR and PROC FACTOR were used to conduct exploratory factor analysis, compute Cronbach's alpha, and estimate correlations. We used the SAS® macro, %parallel, and parallel option in Proc Factor to determine the dimensionality of the STPGG. All data analyses were performed using SAS/STAT® statistical software, version 9.4.[6]

Results

Table1 displays the frequency distribution of item 1 for the STPGG, which indicates that about 16% of participants responses were true almost all the time. There were 13 missing values item1.

Table 1. Frequency distribution of item 1 of the SPTGG

My work with COVID-19 related clients opened the door for my grieving about the COVID-19 pandemic.				
q1	**Frequency**	**Percent**	**Cumulative Frequency**	**Cumulative Percent**
Not true at all	15	2.78	15	2.78
Rarely true	99	18.37	114	21.15
Sometimes true	181	33.58	295	54.73
Often true	156	28.94	451	83.67
True almost all the time	88	16.33	539	100.00
Frequency Missing = 13				

Table 2 reports Means, Standard deviation, and range of STPGG items. The mean ranged from 3.12 (q8) to 3.75 (q16). The frequency missing ranges from 0.01 (q140 to 3 percent (q15).

Table 2 N, Mean, Standard Deviation, Minimum, and Maximum of for the 17-item STPGG scale (n=552)

Item	Description	n	mean	std	min	max
q1	My work with COVID-19 related clients opened the door for my grieving about the COVID-19 pandemic.	539	3.38	1.048	1	5
q2	My work with COVID-19 pandemic related clients HINDERED my grieving about the COVID-19 pandemic.	542	3.16	1.120	1	5
q3	As a result of my personal experience with the COVID-19 pandemic, the PROFESSIONAL RELATIONSHIP BOUNDARIES with my clients changed after the onset of the pandemic.	546	3.35	1.070	1	5
q4	As a result of my personal experience with the COVID-19 pandemic, I can BETTER EMPATHIZE with my clients' traumatic experiences of the event.	547	3.62	0.992	1	5
q5	As a result of my personal experience with the COVID-19 pandemic, I can BETTER EMPATHIZE with my clients' traumatic experiences in general.	545	3.62	1.073	1	5
q6	As a result of my personal experience with the COVID-19 pandemic, my clients' traumatic reactions trigger my own trauma reactions to the COVID-19 pandemic.	544	3.30	1.047	1	5
q7	As a result of my personal experience with the COVID-19 pandemic, my clients' traumatic reactions trigger my own trauma reactions in general.	545	3.40	1.064	1	5
q8	As a result of my personal experience with the COVID-19 pandemic, I wish my clients WOULD NOT DISCUSS the COVID-19 Pandemic.	538	3.12	1.138	1	5
q9	As a result of my personal experience with the COVID-19 pandemic, I am more aware of my conscious and unconscious traumatic feelings and emotions being projected unintentionally onto the client.	547	3.31	1.096	1	5

Item	Description	n	mean	std	min	max
q10	As a result of my personal experience with the COVID-19 pandemic, I'm more willing to SELF-DISCLOSE my feelings to clients about the event.	544	3.51	1.069	1	5
q11	As a result of my personal experience with the COVID-19 pandemic, I'm more willing to SELF-DISCLOSE my feelings or life details to clients in general.	533	3.42	0.993	1	5
q12	As a result of my personal experience with the COVID-19 pandemic, I've sought PRACTICE KNOWLEDGE pertaining to disaster-related events.	545	3.49	0.983	1	5
q13	As a result of my personal experience with the COVID-19 pandemic, I've changed my PRACTICE POSITION (e.g., theoretical or technical approach).	544	3.42	1.081	1	5
q14	As a result of my personal experience with the COVID-19 pandemic, I've taken steps to make my PRACTICE MORE MANAGEABLE (e.g., reduce hours, limit number of difficult cases).	533	3.39	1.047	1	5
q15	As a result of my personal experience with the COVID-19 pandemic, I recognize the LIMITS of what my profession can accomplish.	547	3.53	0.982	1	5
q16	As a result of my personal experience with the COVID-19 pandemic, I have a RENEWED SENSE OF COMMITMENT to helping others.	545	3.75	0.939	1	5
q17	As a result of my personal experience with the COVID-19 pandemic, I am more aware of the need for additional support (support group, therapy, time/place to debrief).	543	3.67	0.958	1	5

Note. Items range from 1 to 5.

Figure 1 shows the plot of parallel analysis using macro which suggested two or three underlying dimensions.

Figure1. Parallel analysis plot of Eigenvalues using Macro.

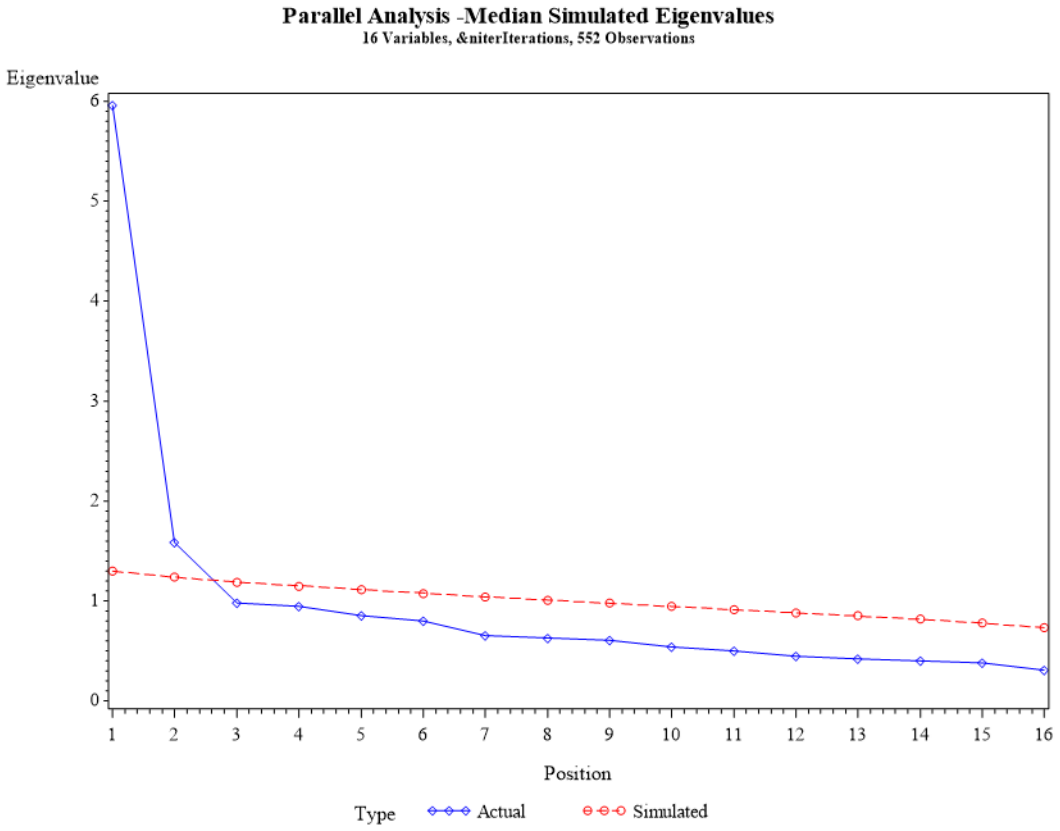


Figure 2 shows the plot of parallel analysis using parallel option in Proc Factor which suggested two or three underlying dimensions. The plot from Macro is a little different from Proc Factor.

Figure 2. Parallel analysis plot of Eigenvalues using parallel option in Proc Factor

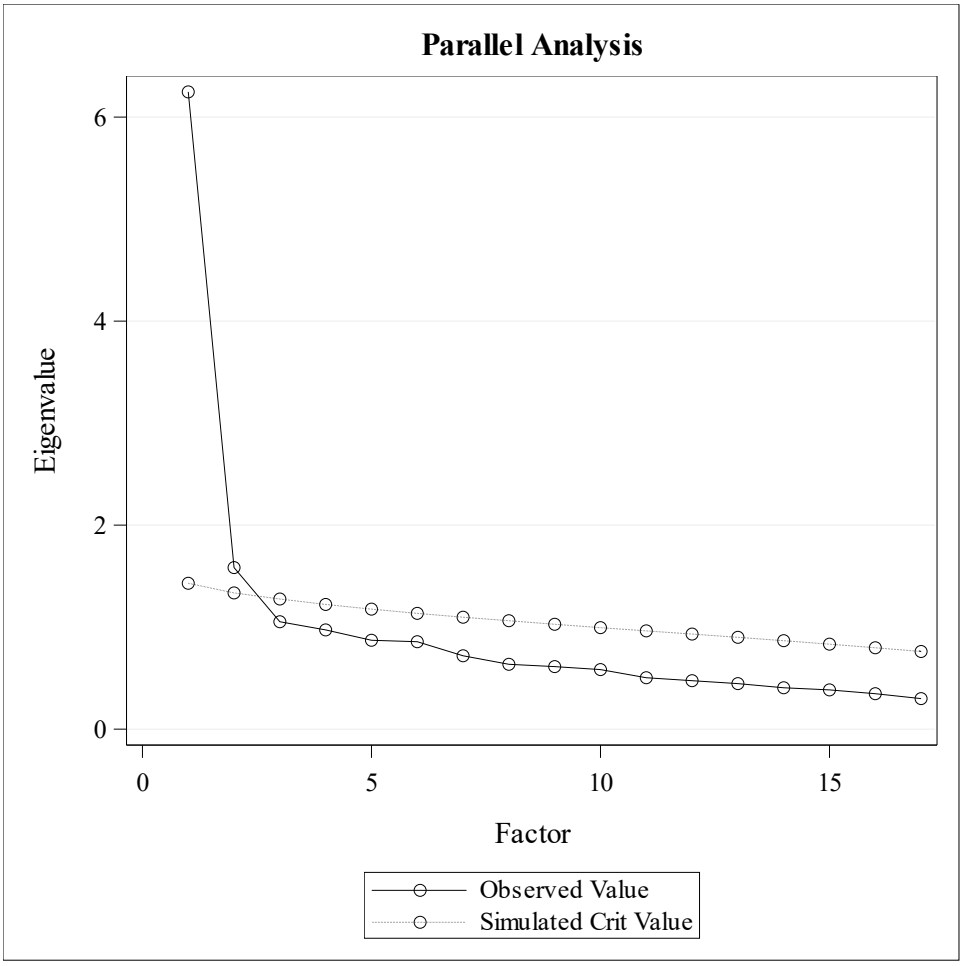


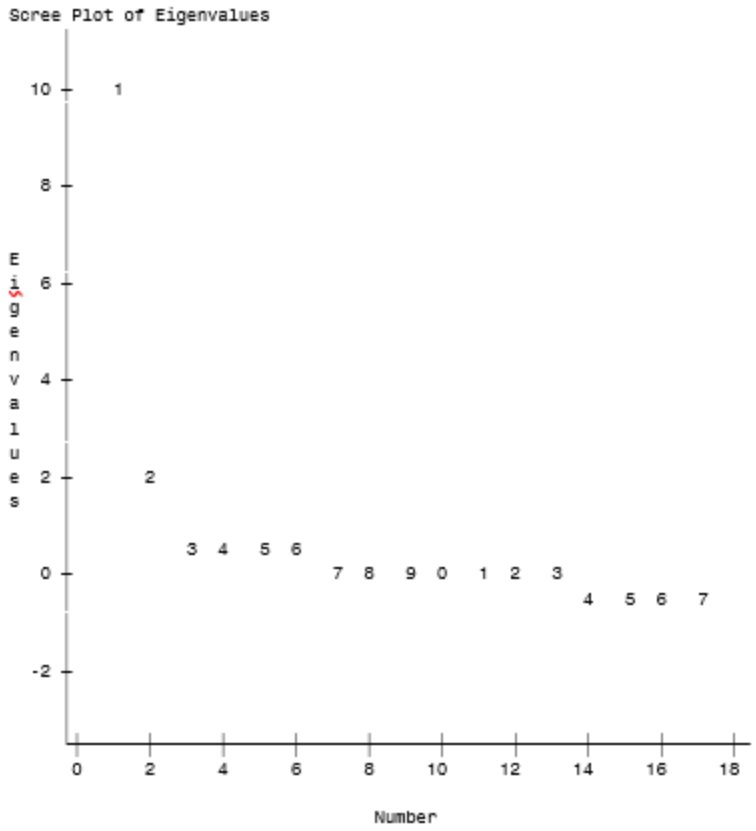
Table 3 reports eigenvalues for the STPGG scale. Eight eigenvalues are above 1. 46 and 52 percent of the variance were explained by two and three factors: respectively.

Table 3. Part of Eigenvalues for STPGG

Eigenvalues of the Correlation Matrix: Total = 17 Average = 1				
	Eigenvalue	**Difference**	**Proportion**	**Cumulative**
1	6.24705189	4.66339914	0.3675	0.3675
2	1.58365275	0.53071009	0.0932	0.4606
3	1.05294267	0.08010758	0.0619	0.5226
4	0.97283509	0.10137974	0.0572	0.5798

Figure 2 displays the scree plot of eigenvalues for the STPGG scale, which revealed that 2 factors are meaningful.

Figure 2: Scree Plot of Eigenvalues for STPGG Scale



Tables 4 and 5 report the Rotated Factor Pattern (Standardized Regression Coefficients) for the STPGG. Parallel analysis showed there were two or three meaningful underlying factors. Eigenvalues and the proportion of variance explained by each factor also suggested two or three meaningful factors for the 17-item scale. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is 0.90, which is acceptable. The residuals are all small and the overall RMSR is 0.05, indicating that the factor explains most of the correlations.[7] All 17 items loaded for two or three factors.

Table 4. Rotated Factor Pattern (Standardized Regression Coefficients) for the STPGG **Scale (Three factors)**

Item	Factor1	Factor2	Factor3
q5	74	-4	9
q4	71	7	-8
q17	66	0	14
q16	53	2	22
q15	52	24	-3
q10	37	14	26
q12	35	0	36
q8	-30	61	34
q9	16	57	3
q14	33	51	-15
q13	18	47	11
q3	17	38	10
q2	9	33	17
q7	-3	17	67
q6	9	7	52
q1	23	-5	43
q11	18	17	37

Table 5. Rotated Factor Pattern (Standardized Regression Coefficients) for the STPGG **Scale (Two factors)**

Item	Factor1	Factor2
q5	78	-4
q4	74	-8
q17	71	4
q16	57	14
q15	56	13
q10	41	31
q12	39	26
q14	36	28
q8	-25	86
q7	5	68
q9	20	49
q13	23	48
q6	15	48
q11	22	45
q2	12	43
q3	21	40
q1	27	29

Table 6 reports mean, standard deviations, minimums, and maximums of total scale and subscales of the STPGG for three and two factors. The results showed the average of the total scale, and each subscale were 57.89, 21.59, 19.54, and 16.76 or three factors respectively. The results indicated the average of each subscale were 26.96 and 30.93 for two factors.

Table 6: Frequency, Mean, and Standard Deviation for Total Scale and Subscales of the STPGG (3 and 2 factors)

Variable	N	Mean	Std Dev	Minimum	Maximum
tall	548	57.89	10.57	17.00	83.00
tf2f1	548	26.96	5.30	8.00	40.00
tf2f2	548	30.93	5.82	9.00	45.00
tf3f1	548	21.59	4.46	6.00	30.00
tf3f2	548	19.54	4.41	6.00	29.00
tf3f3	548	16.76	3.57	5.00	24.00

Table 7-8 reports Pearson correlations for the total scale and subscales of the STPGG (three factors). There was a positive correlation between the three factors range from .0.57 to 0.58 for three factors. A positive correlation was found between factor1 and factor 2 (0.80) for two factors. Scale reliability in this study was examined by estimating the Cronbach's alpha. The reliability coefficient for total scale was 0.89. The Cronbach's alpha for the subscales ranged from 0.73 to 0.83.

Table7: Pearson correlation and reliability coefficient for Total Scale and Subscales of the STPGG (3 factors)

Pearson Correlation Coefficients, N = 548 Prob > |r| under H0: Rho=0				
	tall	tf3f1	tf3f2	tf3f3
tall	0.89	0.85881 <.0001	0.85766 <.0001	0.82749 <.0001
tf3f1		0.83	0.57518 <.0001	0.58218 <.0001
tf3f2			0.77	0.58458 <.0001
tf3f3				0.73

Note: Cronbach's alphas are in the diagonal.

Table8: Pearson correlation and reliability coefficient for Total Scale and Subscales of the STPGG (2 factors)

Pearson Correlation Coefficients, N = 548 Prob > |r| under H0: Rho=0			
	tall	**tf2f1**	**tf2f2**
tall	0.89	0.94511 <.0001	0.95483 <.0001
tf2f1		0.84	0.80532 <.0001
tf2f2			0.82

Note: Cronbach's alphas are in the diagonal.

Conclusion

We used the SAS® macro, %parallel, and parallel option in Proc Factor to determine the dimensionality of the STPGG. Parallel analysis indicated two or three factors were the optimal solution for STPGG. All loading from rotated factor pattern (standardized regression coefficient) were positive for 17 items, with factor loadings ranging from 0.30 to 0. 86. There was a positive correlation between factors, with a range from 0.57 to 0.58 for three factors. A positive correlation was factor 1 and factor 2 for two factors (r=0.81). The reliability coefficient for total scale was 0.89. The Cronbach's alpha for the subscales ranged from 0.73 to 0.83. Parallel analysis was a valuable method for determining the dimensionality of the STPGG Scale.

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Contact Information

Abbas S. Tavakoli, DrPH, MPH, ME
Professor
College of Nursing
University of South Carolina
1601 Greene Street
Columbia, SC 29208-4001
Fax: (803) 777-5561
E-mail: abbas.tavakoli@sc.edu

SAS Syntax

Part of Data steps:

```
data two;
set one;

tall=sum(of q1-q17);

tf2f1= sum (of  q3 q4 q7 q8 q9 q10 q12 q14);
tf2f2= sum (of q1 q2 q5 q6 q11 q13 q15 q16 q17);

tf3f1= sum (of q4 q5 q10  q15 q16 q17);
tf3f2= sum (of q2 q3 q8 q9  q13 q14 );
tf3f3= sum (of  q1 q6 q7 q11 q12);

label
tall = "Shared Trauma Posttraumatic Professional Growth Inventory-Modified"
tf2f1 ="Two factor / factor 1"
tf2f2 ="two factor / factor 2"
tf3f1 ="three factor / factor 1"
tf3f2 ="three factor / factor 2"
tf3f3 ="Three factor / factor 3"
;
run;
```

Procedures:

Parallel analysis Macro[9]:

```
ods rtf;  ods listing close;

%macro parallel(data=_LAST_, var=_NUMERIC_,
niter=1000, statistic=Median);%macro parallel(data=_LAST_, var=_NUMERIC_,
niter=1000, statistic=Median);
data _temp;  set &data;  keep &var;  run;
/* obtain number of observations and variables in dataset */
ods output Attributes=Params;
ods listing close;
 proc contents data=_temp ;  run;
ods listing;

data _NULL_;  set Params;
 if Label2 eq 'Observations' then   call
symput('Nobs',Trim(Left(nValue2)));
 else if Label2 eq 'Variables' then  call
symput('NVar',Trim(Left(nValue2))); run;

/* obtain eigenvalues for actual data */
proc factor data=_temp nfact=&nvar noprint
 outstat=E1(where=(_TYPE_ = 'EIGENVAL'));
 var &var; run;  data E1;   set E1;  array A1{&nvar} &var;
 array A2{&nvar} X1-X&nvar;
 do J = 1 to &nvar;   A2{J} = A1{J};  end;
 keep X1-X&nvar; run;

/* generate simulated datasets and obtain eigenvalues */
%DO K = 1 %TO &niter;
 data raw;
 array X {&nvar} X1-X&nvar;  keep X1-X&nvar;
 do N = 1 to &nobs;  do I = 1 to &nvar;  X{I} = rannor(-1);  end;   output;   end;  run;
 proc factor data=raw nfact=&nvar noprint
 outstat=E(where=(_TYPE_ ='EIGENVAL'));  var X1-X&nvar;
 proc append base=Eigen
 data=E(keep=X1-X&nvar);  run; %END;

/* summarize eigenvalues for simulated datasets */
proc means data=Eigen noprint;
 var X1-X&nvar;  output out=Simulated(keep=X1-X&nvar) &statistic=;
proc datasets nolist;   delete Eigen;
```

```
proc transpose data=E1 out=E1; run;
proc transpose data=Simulated out=Simulated; run;

/* plot actual vs. simulated eigenvalues */
data plotdata;  length Type $ 9;  Position+1;
 if Position eq (&nvar + 1)  then Position = 1;
 set E1(IN=A)  Simulated(IN=B);
 if A then Type = 'Actual';  if B then Type = 'Simulated';
 rename Col1 = Eigenvalue; run;
title height=1.5 "Parallel Analysis - &statistic Simulated Eigenvalues";
title2 height=1 "&nvar Variables, &niter Iterations, &nobs Observations";
proc print data = plotdata ;  run;
symbol1  interpol = join  value=diamond  height=1  line=1  color=blue;
symbol2   interpol = join  value=circle  height=1  line=3  color=red ;
proc gplot data = plotdata;
 plot Eigenvalue * Position = Type; run;quit;
%mend parallel; run;
%parallel(data=two, var=q1-q17, niter=1000,statistic=Median); ods rtf close; ods listing; quit; run;
```

Other Procedures:

```
ods rtf; ods listing close;
option nolabel;
**** factor analysis   ****;
%macro factc (q,n,t);
proc factor data=two method=ml priors=smc scree rotate=promax reorder msa residual heywood
          flag=.35 nfact=&n msa ;
                                    var &q  ;
    title " factor analysis/not red cap (young)      &t";
%mend factc;
%factc (q1-q17,2,two factor score for perception  );
%factc (q1-q17,3,three factor score for perception  );
run;
ods rtf close; ods listing;quit;run;

ods rtf; ods listing close;

%macro fact (q,n,t);
proc factor data=two  rotate=promax  scree  reorder msa residual
parallel(alpha=0.01 nsims=10000 seed=20170229) map flag=.35 nfact=&n msa     plots=(parallel map);
var &q  ;
title " factor analysis/not red cap (young)      &t";
%mend fact;
%fact (q1-q17,2,two factor score for perception  );
%fact (q1-q17,3,three factor score for perception  );
ods rtf close; ods listing;quit;run;

ods rtf; ods listing close; Run;
%macro corrb (d,q,t);
proc corr  data=&d;
    var   &q;
    title " cotrrelation coeffcient  all sample/ &t";

%mend corrb;
%corrb(two, tall tf2f1 tf2f2 , two factor);
%corrb(two, tall tf3f1 tf3f2 tf3f3  , three factor);
ods rtf; ods listing close;run;
```