Practical Guide to Confirmatory Factor Analysis using Mplus

Matthieu M. Boisvert

University of Windsor

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Mplus is a statistical modeling software that provides researchers with a flexible tool to analyze data. Mplus offers a wide choice of models, estimators, and algorithms with a user-friendly interface and graphical displays of data and analysis results (Muthén & Muthén, 1998–2017). The Mplus modeling framework draws on the unifying theme of latent variables. Various types of analyses can be conducted utilizing continuous latent variables, such as regression, path analysis, exploratory and confirmatory factor analysis, structural equation modeling, and item response theory modeling (Muthén & Muthén, 1998–2017).

This document details the steps to conduct a second-order confirmatory factor analysis of the Leadership Scale for Sports using Mplus 8.0.

Leadership Scale for Sports

The Leadership Scale for Sports (LSS; Chelladurai & Saleh, 1980) is the most widely utilized measure of leadership in sport. Although originally developed for coaches, Loughead and Hardy (2005) adapted the LSS to assess athlete leaders. The modifications made to the LSS concerned the stem that preceded the items. In the original LSS, the stem reads "My coach" whereas in the athlete leader version the stem reads "The athlete leader(s) on my team." Like the original coach version, the athlete version of the LSS includes 40-items assessing five dimensions of leadership behaviours: training and instruction (13 items), positive feedback (5 items), social support (8 items), democratic behaviour (9 items), and autocratic behaviour (5 items). All responses on the LSS are scored on a 5-point Likert scale ranging from (1) never to (5) always with higher scores reflecting higher occurrences of the leadership behaviours. Psychometric evaluations of the athlete leader version of the LSS revealed a reasonably good model fit: CFI = .99, TLI = .98, and RMSEA = .05 (Vincer & Loughead, 2010), along with acceptable internal consistency scores (Paradis & Loughead, 2012). To view the instrument, see Appendix A.

Section 1: Getting Started with Mplus

To purchase and install Mplus 8.0, visit http://www.statmodel.com/orderonline/

After Mplus has been installed, the program can be run from the Mplus Editor or Diagrammer. I conducted every analysis using the Diagrammer. The Mplus user language consists of a set of ten commands each of which has several options. For most analyses, even complex models, only a small subset of the Mplus commands is needed. The ten main commands are:

Command	Action
TITLE	Provides a title for the syntax
DATA*	Identifies the dataset for the analysis
VARIABLE*	Specify the names and variables for the analysis
DEFINE	Transforming factors or creating variables
ANALYSIS	Describes the type of analysis
MODEL	Specifies the model that will be tested
OUTPUT	Request output of the analysis

SAVEDATA	Save analysis data, auxiliary data, and analysis results.
PLOT	Request graphical displays of observed data and analysis results
MONTECARLO	Specify the details of a Monte Carlo simulation study

***** *Required for every analysis.*

The Mplus commands may come in any order. All commands must begin on a new line and must be followed by a colon. Semicolons separate command options.

The **TITLE** command assigns a name to the analysis:

```
TITLE:                    CFA;
```

The **DATA** and **VARIABLE** commands are required for all analyses. If the data file is located in the same folder as the syntax, you can simply identify the name of the file:

```
DATA:    FILE IS LSS.dat;
```

If your data is located in another folder, you need to specify the path:

```
DATA:    FILE IS c:\desktop\cfa\data\LSS.dat;
```

Important to note, **VARIABLE** names CANNOT be longer than 8 characters and lines of text CANNOT exceed 90 characters. There can be more than one option per line, which can contain upper and/or lower-case letters and tabs. Commands can be shortened to four or more letters for convenience. Mplus uses a hyphen (-) to indicate a list of variables or numbers.

For this analysis, under the **VARIABLE** command, there are 3 additional commands: NAMES ARE, USE VARIABLES ARE, and MISSING.

The NAMES ARE command is where you list all of the factors in the data set. Each variable name represents a column within the original Excel file. Before uploading the file to Mplus, it is important to remove column names from the Excel file because Mplus cannot read column names. Therefore, it is important to name ALL of the variables in the file, in their specific order, regardless of how many variables will be included in the analysis.

```
VARIABLE:

NAMES ARE
        TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13
        DBA15 DBA16 DBA17 DBA18 DBA19 DBA20 DBA21 DBA22
        ABA23 ABA24 ABA25 ABA26 ABA27
        SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35
        PFA36 PFA37 PFA38 PFA39 PFA40;
```

The MISSING command allows Mplus to know which variables within the original dataset were designated as missing. In this case, all missing data were given the label of “999”.

```
MISSING ARE ALL (999);
```

The USEVARIABLES ARE command is used to specify which items/factors are going to be utilized in the analysis.

```
USEVARIABLES ARE

!f1: training and instruction
TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13

!f2: demographic behaviour
DBA15 DBA16 DBA17 DBA18 DBA19 DBA20 DBA21 DBA22

!f3: autocratic behaviour
ABA23 ABA24 ABA25 ABA26 ABA27

!f4: social support
SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35

!f5: positive feedback
PFA36 PFA37 PFA38 PFA39 PFA40
```

Comments can be included anywhere in the input setup by adding an "!". Anything on a line following an exclamation point is treated as a user comment and is ignored by Mplus. Several lines can be commented out by starting the first line with "!*" and ending the last line with "*!".

The keywords "IS", "ARE", and "=" can be used interchangeably in all commands except DEFINE, MODEL CONSTRAINT, and MODEL TEST. Items in a list can be separated by blanks or commas. There is also a special keyword ALL which can be used to indicate all variables.

The **ANALYSIS** command is used to specify the type of analysis. Mplus has a wide range of available estimators:

ML: maximum likelihood
MLM–ML, robust standard errors, & mean adjusted chi-square
MLMV-ML, robust standard errors & mean and variance adjusted chi-square
MLR-maximum likelihood with robust standard errors
MLF–maximum likelihood with first order derivative standard errors
WLSMV-weighted least squares, robust standard errors, & mean and variance adjusted chi-square

The default estimator for Mplus is the maximum likelihood, which assumes that the data is normally distributed. For the current analysis, the default maximum likelihood was utilized.

```
ANALYSIS:

ESTIMATOR = ML;
```

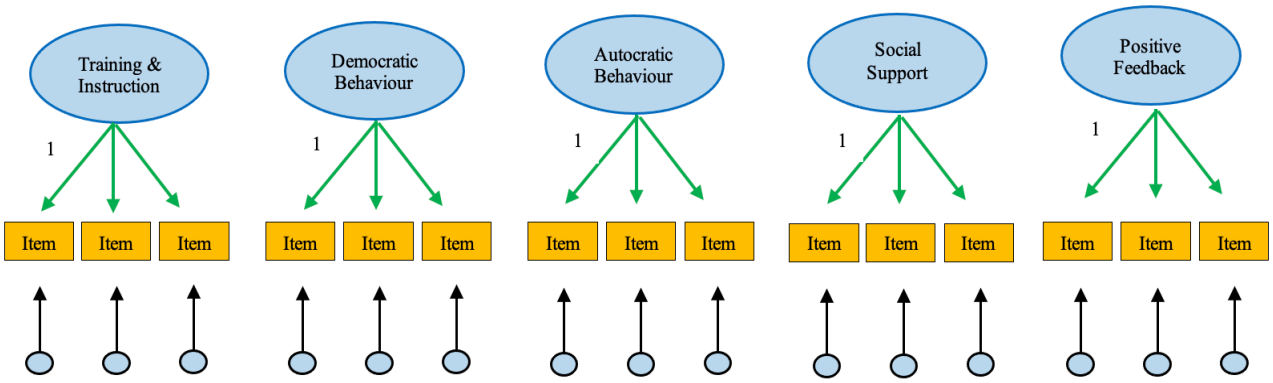
The **MODEL** command is used to specify the type of model that will be tested.

Command statements	Function	Syntax
BY	Factor loading. Means "measured BY" and is used to define factors associated with a latent variable.	F5 BY PFA36-40; OR F5 BY PFA36 PFA37 PFA38 PFA39 PFA40;
WITH	Correlation. Means "correlated WITH" and is used to specify covariance or correlational relationships	DBA21 WITH DBA19;
ON	Regression. Means "regressed ON" a linear relationship between exogenous and endogenous factors	GEQ ON LSS; This would be used in a structural model

```
MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA19 DBA20 DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA26 ABA27;
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;
```



The model above represents a first-order latent factor of the LSS. Here we can see that Training and Instruction (i.e., f1) is measured by 13 factors, Democratic Behaviour (i.e., f2) is measured by 8 factors, Autocratic Behaviour (i.e., f3) is measured by 5 factors, Social Support (i.e., f4) is measured by 8 factors, and Positive Feedback (i.e., f5) is measured by 5 factors.

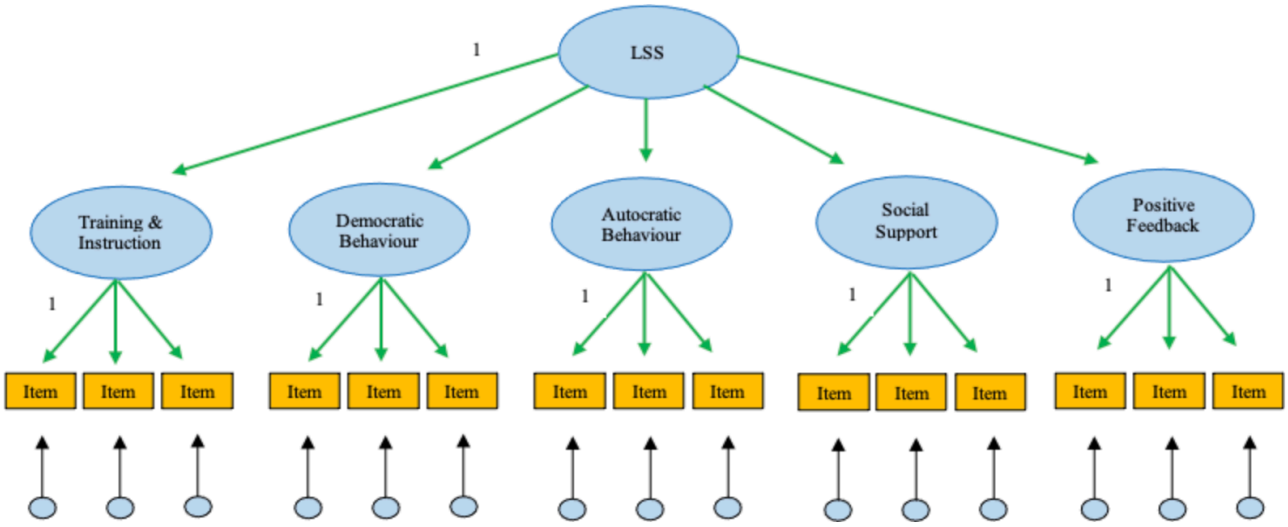
Additionally, each factor has an attached error variance. Although not shown in the above diagram, Mplus automatically calculates the covariances between each factor (see appendix B for the Mplus diagram). By default, Mplus constrains the first item of each latent variable to a factor loading of 1.

```
MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA19 DBA20 DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA26 ABA27;
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;

LSS BY f1 f2 f3 f4 f5;
```



The model above represents a second-order latent factor of the LSS. In this case, a new latent variable, named LSS, is measured by the five latent variables in the previous model.

The **OUTPUT** command allows you to request specific outputs for the analysis. The outputs requested included the standardized results, sample statistics to verify the distribution of the data (e.g., skewness and kurtosis), and modification indices to see how we can improve the model by correlating certain factors with one another. In this case, requesting modification indices of 10 will output relationships/modifications that will decrease the chi square by a minimum of 10.

```
OUTPUT:

stdyx;
sampstat;
modindices (10); ! reduces chi square by 10
```

Section 2: Second-Order CFA in Mplus

The following syntax was used to conduct the second-order CFA on the LSS. The following pages will detail the various relevant outputs.

```
TITLE:                    CFA;

DATA:                     FILE IS LSS.dat;

VARIABLE:

NAMES ARE
        TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13
        DBA15 DBA16 DBA17 DBA18 DBA19 DBA20 DBA21 DBA22
        ABA23 ABA24 ABA25 ABA26 ABA27
        SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35
        PFA36 PFA37 PFA38 PFA39 PFA40;

MISSING ARE ALL (999);


USEVARIABLES ARE

!f1: training and instruction
TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13

!f2: demographic behaviour
DBA15 DBA16 DBA17 DBA18 DBA19 DBA20 DBA21 DBA22

!f3: autocratic behaviour
ABA23 ABA24 ABA25 ABA26 ABA27

!f4: social support
SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35

!f5: positive feedback
PFA36 PFA37 PFA38 PFA39 PFA40

ANALYSIS:

ESTIMATOR = ML;

MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA19 DBA20 DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA26 ABA27;
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;

LSS BY f1 f2 f3 f4 f5;

OUTPUT:

stdyx;
sampstat;
modindices (10); ! reduces chi square by 10
```

Summary Statistics

The sample size for this CFA was 306. One negatively worded item "SPUR8" was removed, leaving a total of 39 continuous variables and 6 latent factors.

On the following page, the skewness and kurtosis scores show no value +/- 2. After insecting the skewness and kurtosis scores, I moved on to the model fit information (see page 9).

```
INPUT READING TERMINATED NORMALLY


CFA;

SUMMARY OF ANALYSIS

Number of groups                                                 1
Number of observations                                         306

Number of dependent variables                                   39
Number of independent variables                                  0
Number of continuous latent variables                            6

Observed dependent variables

  Continuous
   TIA1        TIA2        TIA3        TIA4        TIA5        TIA6
   TIA7        TIA8        TIA9        TIA10       TIA11       TIA12
   TIA13       DBA15       DBA16       DBA17       DBA18       DBA19
   DBA20       DBA21       DBA22       ABA23       ABA24       ABA25
   ABA26       ABA27       SSA28       SSA29       SSA30       SSA31
   SSA32       SSA33       SSA34       SSA35       PFA36       PFA37
   PFA38       PFA39       PFA40

Continuous latent variables
   F1          F2          F3          F4          F5          LSS


Estimator                                                       ML
Information matrix                                        OBSERVED
Maximum number of iterations                                  1000
Convergence criterion                                    0.500D-04
Maximum number of steepest descent iterations                   20
Maximum number of iterations for H1                           2000
Convergence criterion for H1                             0.100D-03
```

UNIVARIATE SAMPLE STATISTICS

UNIVARIATE HIGHER-ORDER MOMENT DESCRIPTIVE STATISTICS

Variable/ Sample Size	Mean/ Variance	Skewness/ Kurtosis	Minimum/ Maximum	% with Min/Max	Percentiles 20%/60%	40%/80%	Median
TIA1	3.613	-0.331	1.000	0.66%	3.000	3.000	4.000
305.000	0.657	0.009	5.000	11.48%	4.000	4.000	
TIA2	3.229	-0.200	1.000	4.58%	2.000	3.000	3.000
306.000	1.013	-0.488	5.000	9.15%	4.000	4.000	
TIA3	3.151	-0.121	1.000	5.25%	2.000	3.000	3.000
305.000	0.976	-0.324	5.000	8.20%	3.000	4.000	
TIA4	3.367	-0.242	1.000	4.90%	3.000	3.000	3.000
306.000	1.122	-0.467	5.000	15.36%	4.000	4.000	
TIA5	2.890	-0.016	1.000	9.87%	2.000	3.000	3.000
304.000	1.114	-0.701	5.000	5.26%	3.000	4.000	
TIA6	3.381	-0.521	1.000	3.29%	3.000	3.000	3.000
304.000	0.801	0.148	5.000	6.91%	4.000	4.000	
TIA7	3.085	-0.039	1.000	7.92%	2.000	3.000	3.000
303.000	1.246	-0.760	5.000	10.89%	3.000	4.000	
TIA8	3.918	-0.756	1.000	2.30%	3.000	4.000	4.000
304.000	1.075	-0.089	5.000	35.20%	4.000	5.000	
TIA9	2.988	0.039	1.000	8.17%	2.000	3.000	3.000
306.000	1.113	-0.472	5.000	8.50%	3.000	4.000	
TIA10	2.815	0.039	1.000	13.07%	2.000	3.000	3.000
306.000	1.205	-0.719	5.000	5.88%	3.000	4.000	
TIA11	3.596	-0.285	1.000	0.98%	3.000	3.000	4.000
306.000	0.841	-0.401	5.000	16.01%	4.000	4.000	
TIA12	3.220	-0.168	1.000	7.21%	2.000	3.000	3.000
305.000	1.280	-0.749	5.000	13.77%	4.000	4.000	
TIA13	3.018	-0.012	1.000	11.76%	2.000	3.000	3.000
306.000	1.431	-0.888	5.000	12.09%	3.000	4.000	
DBA15	3.723	-0.561	1.000	2.30%	3.000	4.000	4.000
305.000	0.967	-0.094	5.000	22.62%	4.000	5.000	
DBA16	3.969	-0.592	1.000	0.33%	3.000	4.000	4.000
306.000	0.735	-0.064	5.000	28.76%	4.000	5.000	
DBA17	2.739	0.135	1.000	20.59%	1.000	2.000	3.000
306.000	1.539	-0.987	5.000	8.82%	3.000	4.000	
DBA18	3.912	-0.740	1.000	2.29%	3.000	4.000	4.000
306.000	1.087	-0.143	5.000	35.29%	4.000	5.000	
DBA19	3.542	-0.421	1.000	3.27%	3.000	3.000	4.000
306.000	1.000	-0.214	5.000	16.99%	4.000	4.000	
DBA20	4.010	-0.740	1.000	0.65%	3.000	4.000	4.000
306.000	0.794	0.157	5.000	32.35%	4.000	5.000	
DBA21	3.444	-0.211	1.000	3.27%	3.000	3.000	3.000
306.000	1.116	-0.637	5.000	17.97%	4.000	4.000	
DBA22	3.304	-0.373	1.000	13.77%	2.000	3.000	3.000
305.000	1.727	-0.956	5.000	21.31%	4.000	5.000	
ABA23	2.919	0.013	1.000	8.91%	2.000	3.000	3.000
303.000	1.123	-0.723	5.000	5.94%	3.000	4.000	
ABA24	2.803	0.051	1.000	9.87%	2.000	3.000	3.000
304.000	1.007	-0.528	5.000	3.95%	3.000	4.000	
ABA25	2.426	0.487	1.000	25.41%	1.000	2.000	2.000
303.000	1.386	-0.724	5.000	5.28%	3.000	4.000	
ABA26	2.493	0.309	1.000	23.20%	1.000	2.000	2.000
306.000	1.296	-0.791	5.000	4.25%	3.000	4.000	
ABA27	2.484	0.489	1.000	21.57%	1.000	2.000	2.000
306.000	1.315	-0.536	5.000	6.21%	3.000	3.000	
SSA28	3.757	-0.469	1.000	1.31%	3.000	4.000	4.000
305.000	0.885	-0.223	5.000	22.95%	4.000	5.000	
SSA29	3.518	-0.352	1.000	1.96%	3.000	3.000	4.000
306.000	0.912	-0.348	5.000	14.05%	4.000	4.000	
SSA30	4.003	-0.832	1.000	1.32%	3.000	4.000	4.000
304.000	0.819	0.528	5.000	32.24%	4.000	5.000	
SSA31	3.990	-1.163	1.000	3.93%	3.000	4.000	4.000
305.000	1.011	1.211	5.000	33.77%	4.000	5.000	
SSA32	4.357	-1.357	1.000	0.66%	4.000	4.000	5.000
305.000	0.630	2.082	5.000	51.15%	5.000	5.000	
SSA33	3.857	-0.635	1.000	1.97%	3.000	4.000	4.000
305.000	0.942	0.018	5.000	28.85%	4.000	5.000	
SSA34	4.062	-0.742	1.000	0.99%	3.000	4.000	4.000
304.000	0.789	0.229	5.000	36.51%	4.000	5.000	
SSA35	3.642	-0.696	1.000	10.89%	3.000	4.000	4.000
303.000	1.721	-0.606	5.000	33.66%	4.000	5.000	
PFA36	4.390	-1.072	1.000	0.33%	4.000	4.000	5.000
304.000	0.513	1.228	5.000	50.99%	5.000	5.000	
PFA37	4.350	-0.832	2.000	1.32%	4.000	4.000	4.000
303.000	0.485	0.352	5.000	46.53%	5.000	5.000	
PFA38	3.668	-0.455	1.000	2.32%	3.000	3.000	4.000
302.000	1.009	-0.322	5.000	22.19%	4.000	5.000	
PFA39	4.281	-0.998	1.000	0.66%	4.000	4.000	4.000
303.000	0.532	1.745	5.000	41.91%	5.000	5.000	
PFA40	4.467	-1.334	1.000	0.33%	4.000	4.000	5.000
305.000	0.520	1.797	5.000	58.36%	5.000	5.000	

Model Fit

Chi Square is an indicator of model misfit. A Chi-Square value closer to zero indicates a better fitting model. Additionally, we are looking for a non-significant P-value. In this case, the p-value is significant, indicating a poor model fit. However, the Chi-Square is sensitive to sample size and model complexity. For this analysis, the model is simple, and the sample is small (i.e., 306). As such, other model fit indices will be investigated.

Root-Means-Square Error of Approximation (RMSEA) scores are deemed acceptable ≤ .08 (Marsh, 2007) and good ≤ .06 (Hu & Bentler, 1999). The results indicated a good model fit, RMSEA = .06.

Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values are deemed acceptable above 0.90 (Marsh, 2007) and excellent above 0.95 (Hu & Bentler, 1999). The results indicated a poor model fit, CFI = .79 and TLI = .78.

Standardized Root Mean Residual (SRMR) scores are deemed good ≤ .08. The results revealed an SRMR = .09.

```
MODEL FIT INFORMATION

Number of Free Parameters                       122

Loglikelihood

          H0 Value                       -15153.116
          H1 Value                       -14402.448

Information Criteria

          Akaike (AIC)                    30550.232
          Bayesian (BIC)                  31004.509
          Sample-Size Adjusted BIC        30617.581
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                            1501.336
          Degrees of Freedom                   697
          P-Value                           0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                          0.061
          90 Percent C.I.                   0.057  0.066
          Probability RMSEA <= .05          0.000

CFI/TLI

          CFI                               0.791
          TLI                               0.778

Chi-Square Test of Model Fit for the Baseline Model

          Value                            4593.932
          Degrees of Freedom                   741
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                             0.086
```

Standardized Model Results

This is where we look for measurement quality. Every item loading should be larger than .4 and significantly loaded. Although each item loads significantly, three Democratic Behaviour items (i.e., DBA 19, 21, 22) and one Autocratic Behaviour item (i.e., ABA 26) have low item loadings. Due to the poor fitting model, these items will be removed to improve model fit.

STDYX Standardization

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
F1	BY				
	TIA1	0.518	0.045	11.578	0.000
	TIA2	0.627	0.038	16.720	0.000
	TIA3	0.675	0.034	19.824	0.000
	TIA4	0.726	0.030	24.155	0.000
	TIA5	0.711	0.031	22.741	0.000
	TIA6	0.620	0.038	16.267	0.000
	TIA7	0.782	0.026	30.551	0.000
	TIA8	0.396	0.051	7.766	0.000
	TIA9	0.593	0.040	14.892	0.000
	TIA10	0.702	0.032	21.921	0.000
	TIA11	0.561	0.042	13.358	0.000
	TIA12	0.641	0.037	17.561	0.000
	TIA13	0.775	0.026	29.900	0.000
F2	BY				
	DBA15	0.564	0.048	11.679	0.000
	DBA16	0.552	0.049	11.243	0.000
	DBA17	0.444	0.056	7.882	0.000
	DBA18	0.609	0.045	13.466	0.000
	DBA19	0.352	0.059	5.963	0.000
	DBA20	0.622	0.045	13.814	0.000
	DBA21	0.288	0.061	4.701	0.000
	DBA22	0.304	0.060	5.077	0.000
F3	BY				
	ABA23	0.533	0.062	8.558	0.000
	ABA24	0.566	0.062	9.156	0.000
	ABA25	0.539	0.063	8.622	0.000
	ABA26	0.302	0.070	4.290	0.000
	ABA27	0.523	0.063	8.324	0.000
F4	BY				
	SSA28	0.665	0.039	17.093	0.000
	SSA29	0.676	0.038	17.752	0.000
	SSA30	0.615	0.042	14.537	0.000
	SSA31	0.470	0.051	9.259	0.000
	SSA32	0.556	0.046	12.028	0.000
	SSA33	0.597	0.043	13.740	0.000
	SSA34	0.640	0.041	15.639	0.000
	SSA35	0.416	0.054	7.762	0.000
F5	BY				
	PFA36	0.672	0.041	16.582	0.000
	PFA37	0.773	0.035	21.864	0.000
	PFA38	0.491	0.052	9.517	0.000
	PFA39	0.661	0.042	15.794	0.000
	PFA40	0.551	0.048	11.495	0.000
LSS	BY				
	F1	0.662	0.049	13.589	0.000
	F2	0.866	0.049	17.665	0.000
	F3	0.115	0.086	1.334	0.182
	F4	0.809	0.047	17.338	0.000
	F5	0.606	0.057	10.676	0.000

R-Square

R-Square indicates the specific variances for each individual item and each latent factor. Although significant, the three Democratic Behaviour items (i.e., DBA 19, 21, 22) and one Autocratic Behaviour item (i.e., ABA 26) do not appear to contribute much to the model. Similarly, Factor 3 (i.e., Autocratic Behaviour) does not significantly contribute to the model.

R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
TIA1	0.268	0.046	5.789	0.000
TIA2	0.393	0.047	8.360	0.000
TIA3	0.456	0.046	9.912	0.000
TIA4	0.528	0.044	12.078	0.000
TIA5	0.506	0.044	11.371	0.000
TIA6	0.385	0.047	8.134	0.000
TIA7	0.611	0.040	15.276	0.000
TIA8	0.157	0.040	3.883	0.000
TIA9	0.352	0.047	7.446	0.000
TIA10	0.492	0.045	10.960	0.000
TIA11	0.315	0.047	6.679	0.000
TIA12	0.411	0.047	8.781	0.000
TIA13	0.601	0.040	14.950	0.000
DBA15	0.318	0.054	5.840	0.000
DBA16	0.305	0.054	5.622	0.000
DBA17	0.197	0.050	3.941	0.000
DBA18	0.371	0.055	6.733	0.000
DBA19	0.124	0.042	2.981	0.003
DBA20	0.386	0.056	6.907	0.000
DBA21	0.083	0.035	2.351	0.019
DBA22	0.092	0.036	2.538	0.011
ABA23	0.285	0.066	4.279	0.000
ABA24	0.321	0.070	4.578	0.000
ABA25	0.291	0.067	4.311	0.000
ABA26	0.091	0.042	2.145	0.032
ABA27	0.274	0.066	4.162	0.000
SSA28	0.443	0.052	8.547	0.000
SSA29	0.457	0.052	8.876	0.000
SSA30	0.379	0.052	7.268	0.000
SSA31	0.220	0.048	4.630	0.000
SSA32	0.309	0.051	6.014	0.000
SSA33	0.356	0.052	6.870	0.000
SSA34	0.410	0.052	7.819	0.000
SSA35	0.173	0.045	3.881	0.000
PFA36	0.452	0.054	8.291	0.000
PFA37	0.597	0.055	10.932	0.000
PFA38	0.241	0.051	4.758	0.000
PFA39	0.437	0.055	7.897	0.000
PFA40	0.303	0.053	5.748	0.000

Latent Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
F1	0.438	0.064	6.795	0.000
F2	0.750	0.085	8.832	0.000
F3	0.013	0.020	0.667	0.505
F4	0.655	0.075	8.669	0.000
F5	0.368	0.069	5.338	0.000

Modification Indices

Modification Indices will help improve model fit. Importantly, items should be modified as little as possible. Additionally, error terms should only be correlated if there are theoretical justifications allowing it. That is, Democratic Behaviour items can only be correlated with other Democratic Behaviour items, and not with items from other latent factors.

Below, we can see that there are only 2 possible correlations between error terms: Training and Instruction item #10 **WITH** Training and Instruction item #7 and Democratic Behaviour item #21 **WITH** Democratic Behaviour item #19. However, as mentioned earlier Democratic Behaviour items 19 and 21 will be removed from the analysis.

Minimum M.I. value for printing the modification index 10.000

		M.I.	E.P.C.	Std E.P.C.	StdYX E.P.C.
WITH Statements					
TIA10	WITH TIA7	17.793	0.153	0.153	0.281
DBA21	WITH DBA19	45.324	0.377	0.377	0.398
ABA27	WITH TIA10	21.627	0.228	0.228	0.298
SSA29	WITH TIA3	16.354	0.132	0.132	0.258
SSA32	WITH TIA11	17.928	0.129	0.129	0.257
F3	WITH F1	23.924	0.075	0.424	0.424

Section 3: Improving Model Fit

Mplus Syntax

The first step was to remove the items that loaded poorly and run the analysis again. Error terms should only be correlated if necessary, therefore no correlations were added to the model at this stage.

The syntax below shows how items are excluded from the analysis. Adding a "!", followed by the items, turns these items into comments. Putting items into comments rather than simply deleting them helps keep track of the steps taken during the analysis.

```
USEVARIABLES ARE

!f1: training and instruction
TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13

!f2: demographic behaviour
DBA15 DBA16 DBA17 DBA18 DBA20 !Removed: DBA19  DBA21 DBA22

!f3: autocratic behaviour
ABA23 ABA24 ABA25 ABA27 !Removed: ABA26

!f4: social support
SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35

!f5: positive feedback
PFA36 PFA37 PFA38 PFA39 PFA40

ANALYSIS:

ESTIMATOR = ML;

MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA20; !Removed: DBA19  DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA27; !Removed: ABA26
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;

LSS BY f1 f2 f3 f4 f5;
```

Model Fit

Simply removing the items did not lead to any major improvement to model fit.

The RMSEA score was unchanged, RMSEA = .06.

Although the CFI increased from .79 to .82 and the TLI increased from .78 to .81, these still indicate a poor model fit.

The SRMR improved from .9 to .8.

```
MODEL FIT INFORMATION

Number of Free Parameters                      110

Loglikelihood

          H0 Value                       -13317.418
          H1 Value                       -12723.389

Information Criteria

          Akaike (AIC)                    26854.837
          Bayesian (BIC)                  27264.431
          Sample-Size Adjusted BIC        26915.562
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                            1188.059
          Degrees of Freedom                   555
          P-Value                           0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.061
          90 Percent C.I.                    0.056  0.066
          Probability RMSEA <= .05           0.000

CFI/TLI

          CFI                                0.824
          TLI                                0.812

Chi-Square Test of Model Fit for the Baseline Model

          Value                            4201.715
          Degrees of Freedom                   595
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                              0.081
```

Modification Indices

To further improve model fit, I started correlating error terms. Correlations were done individually starting with the largest sore. Correlations are run one at a time because the second largest score now may not be the largest score after the new analysis.

In this case, the Training and Instruction items 7 and 10 were correlated.

Minimum M.I. value for printing the modification index 10.000

		M.I.	E.P.C.	Std E.P.C.	StdYX E.P.C.
WITH Statements					
TIA10	WITH TIA7	18.239	0.155	0.155	0.284
TIA12	WITH TIA3	10.135	-0.125	-0.125	-0.198
DBA17	WITH TIA10	13.515	0.196	0.196	0.226
ABA27	WITH TIA9	10.655	0.171	0.171	0.207
ABA27	WITH TIA10	22.317	0.232	0.232	0.305
SSA28	WITH TIA8	13.390	-0.151	-0.151	-0.227
SSA29	WITH TIA3	16.341	0.132	0.132	0.259
SSA30	WITH TIA6	11.666	-0.107	-0.107	-0.212
SSA32	WITH TIA5	10.556	-0.100	-0.100	-0.202
SSA32	WITH TIA11	18.155	0.130	0.130	0.258
SSA32	WITH DBA17	13.037	-0.162	-0.162	-0.221
SSA34	WITH TIA8	12.022	0.139	0.139	0.213
SSA34	WITH TIA11	14.011	0.121	0.121	0.232
SSA34	WITH SSA29	11.290	-0.114	-0.114	-0.238
PFA37	WITH PFA36	10.678	0.079	0.079	0.338
F3	WITH F1	27.317	0.075	0.472	0.472

Mplus Syntax

To correlate error terms, a simple line of code is added to the **MODEL** command.

Simply add the command statement WITH in between the items.

It is important to add a ";" after the line of code, otherwise Mplus will not run the correlation.

```
MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA20; !Removed: DBA19  DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA27; !Removed: ABA26
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;

LSS BY f1 f2 f3 f4 f5;

TIA10 WITH TIA7;

OUTPUT:

stdyx;
sampstat;
modindices (10); ! reduces chi square by 10
```

Model Fit

The correlation of the two Training and Instruction items did not lead to any major improvement to model fit.

The Chi-Square, RMSEA, and SRMR were unchanged.

The CFI and TLI improved to .83 and .82, respectively.

```
MODEL FIT INFORMATION

Number of Free Parameters                      111

Loglikelihood

          H0 Value                       -13308.584
          H1 Value                       -12723.389

Information Criteria

          Akaike (AIC)                    26839.168
          Bayesian (BIC)                  27252.486
          Sample-Size Adjusted BIC        26900.445
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                            1170.390
          Degrees of Freedom                   554
          P-Value                           0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.060
          90 Percent C.I.                    0.055  0.065
          Probability RMSEA <= .05           0.000

CFI/TLI

          CFI                                0.829
          TLI                                0.816

Chi-Square Test of Model Fit for the Baseline Model

          Value                            4201.715
          Degrees of Freedom                   595
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                              0.080
```

Modification Indices

To further improve model fit, I correlated the largest error term, Social Support items 29 and 34.

Minimum M.I. value for printing the modification index 10.000

		M.I.	E.P.C.	Std E.P.C.	StdYX E.P.C.
WITH Statements					
TIA12	WITH TIA3	10.805	-0.130	-0.130	-0.206
DBA17	WITH TIA5	10.987	0.168	0.168	0.205
DBA17	WITH TIA10	11.733	0.177	0.177	0.198
ABA27	WITH TIA9	11.813	0.181	0.181	0.218
ABA27	WITH TIA10	17.075	0.198	0.198	0.251
SSA28	WITH TIA8	13.383	-0.151	-0.151	-0.227
SSA29	WITH TIA3	16.603	0.133	0.133	0.261
SSA30	WITH TIA6	11.487	-0.106	-0.106	-0.211
SSA32	WITH TIA5	11.700	-0.105	-0.105	-0.214
SSA32	WITH TIA11	17.556	0.127	0.127	0.254
SSA32	WITH DBA17	13.105	-0.162	-0.162	-0.222
SSA34	WITH TIA8	11.877	0.138	0.138	0.212
SSA34	WITH TIA11	13.822	0.120	0.120	0.231
SSA34	WITH SSA29	11.354	-0.114	-0.114	-0.239
PFA37	WITH PFA36	10.699	0.079	0.079	0.338
F3	WITH F1	26.067	0.075	0.468	0.468

Mplus Syntax

The second correlated error term is added a line below the other error term.

It is important to add a ";" after the line of code, otherwise Mplus will not run the correlation.

```
MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA20; !Removed: DBA19  DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA27; !Removed: ABA26
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;

LSS BY f1 f2 f3 f4 f5;

TIA10 WITH TIA7;
SSA34 WITH SSA29;

OUTPUT:

stdyx;
sampstat;
modindices (10); ! reduces chi square by 10
```

Model Fit

The correlation of the two Social Support items did not lead to any improvement to model fit.

The Chi-Square, RMSEA, SRMR, CFI, and TLI were unchanged.

I chose to correlate two more items to see if that would increase model fit.

```
MODEL FIT INFORMATION

Number of Free Parameters                       112

Loglikelihood

          H0 Value                       -13302.358
          H1 Value                       -12723.389

Information Criteria

          Akaike (AIC)                    26828.716
          Bayesian (BIC)                  27245.758
          Sample-Size Adjusted BIC        26890.545
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                            1157.939
          Degrees of Freedom                   553
          P-Value                           0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.060
          90 Percent C.I.                    0.055  0.065
          Probability RMSEA <= .05           0.001

CFI/TLI

          CFI                                0.832
          TLI                                0.820

Chi-Square Test of Model Fit for the Baseline Model

          Value                            4201.715
          Degrees of Freedom                   595
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                              0.080
```

Modification Indices

To further improve model fit, I correlated the largest error term, Positive Feedback items 36 and 37.

Minimum M.I. value for printing the modification index 10.000

		M.I.	E.P.C.	Std E.P.C.	StdYX E.P.C.
WITH Statements					
TIA12	WITH TIA3	10.837	-0.130	-0.130	-0.206
DBA17	WITH TIA5	10.959	0.168	0.168	0.205
DBA17	WITH TIA10	11.763	0.177	0.177	0.198
ABA27	WITH TIA9	11.852	0.181	0.181	0.218
ABA27	WITH TIA10	17.090	0.198	0.198	0.251
SSA28	WITH TIA8	13.655	-0.153	-0.153	-0.227
SSA29	WITH TIA3	16.139	0.129	0.129	0.265
SSA30	WITH TIA6	11.658	-0.107	-0.107	-0.211
SSA32	WITH TIA5	11.782	-0.106	-0.106	-0.213
SSA32	WITH TIA11	17.322	0.127	0.127	0.251
SSA32	WITH DBA17	13.221	-0.164	-0.164	-0.221
SSA34	WITH TIA8	11.491	0.133	0.133	0.214
SSA34	WITH TIA11	10.680	0.103	0.103	0.208
PFA37	WITH PFA36	10.953	0.080	0.080	0.341
F3	WITH F1	26.009	0.074	0.469	0.469

Mplus Syntax

The correlated error term is added a line below the other error terms.

It is important to add a ";" after the line of code, otherwise Mplus will not run the correlation.

```
MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA20; !Removed: DBA19  DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA27; !Removed: ABA26
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;

LSS BY f1 f2 f3 f4 f5;

TIA10 WITH TIA7;
SSA34 WITH SSA29;
PFA37 WITH PFA36;

OUTPUT:

stdyx;
sampstat;
modindices (10); ! reduces chi square by 10
```

Model Fit

The Chi-Square, RMSEA, SRMR, and TLI were unchanged. Only the CFI slightly improved from .83 to .84.

I chose to correlate two more items to see if that would increase model fit.

```
MODEL FIT INFORMATION

Number of Free Parameters                       113

Loglikelihood

          H0 Value                       -13297.283
          H1 Value                       -12723.389

Information Criteria

          Akaike (AIC)                    26820.565
          Bayesian (BIC)                  27241.330
          Sample-Size Adjusted BIC        26882.946
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                            1147.787
          Degrees of Freedom                   552
          P-Value                           0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                           0.059
          90 Percent C.I.                    0.055  0.064
          Probability RMSEA <= .05           0.001

CFI/TLI

          CFI                                0.835
          TLI                                0.822

Chi-Square Test of Model Fit for the Baseline Model

          Value                            4201.715
          Degrees of Freedom                   595
          P-Value                           0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                              0.079
```

Modification Indices

To further improve model fit, I correlated the largest error term, Training and Instruction items 3 and 12.

Minimum M.I. value for printing the modification index 10.000

		M.I.	E.P.C.	Std E.P.C.	StdYX E.P.C.
WITH Statements					
TIA12	WITH TIA3	10.879	-0.130	-0.130	-0.207
DBA17	WITH TIA5	10.960	0.168	0.168	0.205
DBA17	WITH TIA10	11.826	0.178	0.178	0.199
ABA27	WITH TIA9	11.853	0.181	0.181	0.218
ABA27	WITH TIA10	17.073	0.198	0.198	0.251
SSA28	WITH TIA8	13.618	-0.152	-0.152	-0.226
SSA29	WITH TIA3	15.952	0.128	0.128	0.264
SSA30	WITH TIA6	11.689	-0.107	-0.107	-0.211
SSA32	WITH TIA5	11.727	-0.106	-0.106	-0.212
SSA32	WITH TIA11	17.367	0.127	0.127	0.251
SSA32	WITH DBA17	13.074	-0.163	-0.163	-0.220
SSA34	WITH TIA8	11.478	0.133	0.133	0.214
SSA34	WITH TIA11	10.694	0.103	0.103	0.208
F3	WITH F1	26.984	0.076	0.476	0.476

Mplus Syntax

The correlated error term is added a line below the other error terms.

It is important to add a ";" after the line of code, otherwise Mplus will not run the correlation.

```
MODEL:

!Leadership Scale for Sports Fit

f1 BY TIA1 TIA2 TIA3 TIA4 TIA5 TIA6 TIA7 TIA8 TIA9 TIA10 TIA11 TIA12 TIA13;
f2 BY DBA15 DBA16 DBA17 DBA18 DBA20; !Removed: DBA19  DBA21 DBA22;
f3 BY ABA23 ABA24 ABA25 ABA27; !Removed: ABA26
f4 BY SSA28 SSA29 SSA30 SSA31 SSA32 SSA33 SSA34 SSA35;
f5 BY PFA36 PFA37 PFA38 PFA39 PFA40;

LSS BY f1 f2 f3 f4 f5;

TIA10 WITH TIA7;
SSA34 WITH SSA29;
PFA37 WITH PFA36;
TIA12 WITH TIA3;

OUTPUT:

stdyx;
sampstat;
modindices (10); ! reduces chi square by 10
```

Model Fit

There was only one more correlation between error terms that would decrease the chi square by a minimum of 10. However, the model fit information remained the same. Therefore, I chose to stop correlating error terms at this stage.

The final model fit statistics indicate a poor fitting model: RMSEA = .06, CFI = .84, TLI = .83, and SRMR = .08.

The following pages include the final standardized model results, r-square values, and the graphical output of the second-order CFA model of the LSS.

```
MODEL FIT INFORMATION

Number of Free Parameters                      114

Loglikelihood

          H0 Value                      -13291.533
          H1 Value                      -12723.389

Information Criteria

          Akaike (AIC)                   26811.067
          Bayesian (BIC)                 27235.556
          Sample-Size Adjusted BIC       26874.000
            (n* = (n + 2) / 24)

Chi-Square Test of Model Fit

          Value                           1136.289
          Degrees of Freedom                  551
          P-Value                          0.0000

RMSEA (Root Mean Square Error Of Approximation)

          Estimate                         0.059
          90 Percent C.I.                  0.054  0.064
          Probability RMSEA <= .05         0.001

CFI/TLI

          CFI                              0.838
          TLI                              0.825

Chi-Square Test of Model Fit for the Baseline Model

          Value                           4201.715
          Degrees of Freedom                  595
          P-Value                          0.0000

SRMR (Standardized Root Mean Square Residual)

          Value                            0.079
```

Standardized Model Results

STDYX Standardization

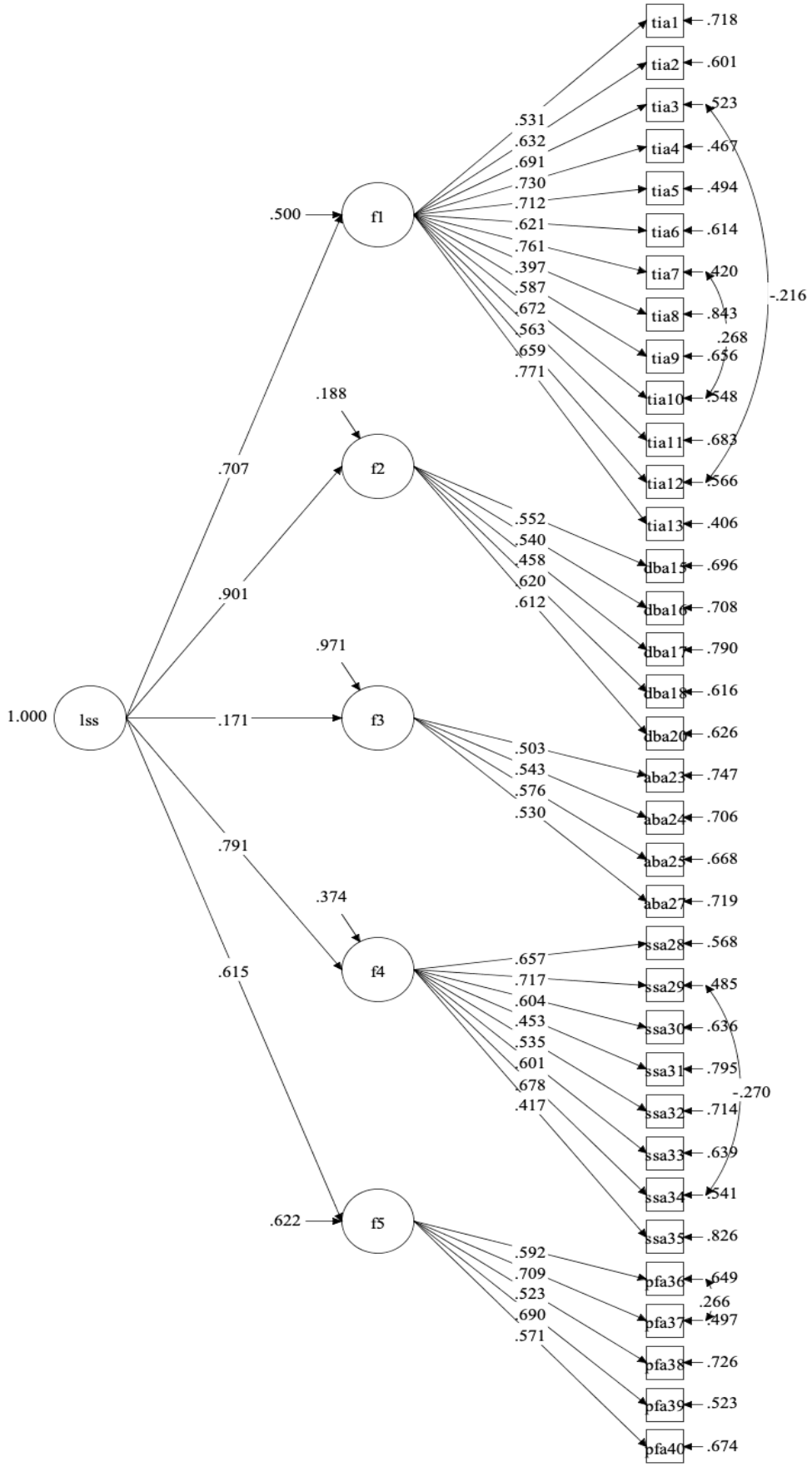
		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
F1	BY				
	TIA1	0.531	0.044	12.059	0.000
	TIA2	0.632	0.037	16.971	0.000
	TIA3	0.691	0.033	20.755	0.000
	TIA4	0.730	0.030	24.522	0.000
	TIA5	0.712	0.031	22.761	0.000
	TIA6	0.621	0.038	16.303	0.000
	TIA7	0.761	0.027	27.834	0.000
	TIA8	0.397	0.051	7.781	0.000
	TIA9	0.587	0.040	14.544	0.000
	TIA10	0.672	0.035	19.461	0.000
	TIA11	0.563	0.042	13.436	0.000
	TIA12	0.659	0.036	18.478	0.000
	TIA13	0.771	0.026	29.207	0.000
F2	BY				
	DBA15	0.552	0.050	11.072	0.000
	DBA16	0.540	0.052	10.452	0.000
	DBA17	0.458	0.058	7.969	0.000
	DBA18	0.620	0.045	13.733	0.000
	DBA20	0.612	0.047	13.035	0.000
F3	BY				
	ABA23	0.503	0.064	7.807	0.000
	ABA24	0.543	0.064	8.486	0.000
	ABA25	0.576	0.063	9.075	0.000
	ABA27	0.530	0.064	8.304	0.000
F4	BY				
	SSA28	0.657	0.038	17.117	0.000
	SSA29	0.717	0.036	19.781	0.000
	SSA30	0.604	0.042	14.342	0.000
	SSA31	0.453	0.051	8.891	0.000
	SSA32	0.535	0.047	11.402	0.000
	SSA33	0.601	0.042	14.315	0.000
	SSA34	0.678	0.040	17.064	0.000
	SSA35	0.417	0.053	7.915	0.000
F5	BY				
	PFA36	0.592	0.051	11.670	0.000
	PFA37	0.709	0.043	16.501	0.000
	PFA38	0.523	0.052	10.050	0.000
	PFA39	0.690	0.043	16.148	0.000
	PFA40	0.571	0.049	11.712	0.000
LSS	BY				
	F1	0.707	0.046	15.430	0.000
	F2	0.901	0.049	18.481	0.000
	F3	0.171	0.084	2.033	0.042
	F4	0.791	0.045	17.766	0.000
	F5	0.615	0.058	10.539	0.000

R-Square

R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
TIA1	0.282	0.047	6.030	0.000
TIA2	0.399	0.047	8.486	0.000
TIA3	0.477	0.046	10.377	0.000
TIA4	0.533	0.043	12.261	0.000
TIA5	0.506	0.044	11.380	0.000
TIA6	0.386	0.047	8.152	0.000
TIA7	0.580	0.042	13.917	0.000
TIA8	0.157	0.040	3.891	0.000
TIA9	0.344	0.047	7.272	0.000
TIA10	0.452	0.046	9.731	0.000
TIA11	0.317	0.047	6.718	0.000
TIA12	0.434	0.047	9.239	0.000
TIA13	0.594	0.041	14.604	0.000
DBA15	0.304	0.055	5.536	0.000
DBA16	0.292	0.056	5.226	0.000
DBA17	0.210	0.053	3.984	0.000
DBA18	0.384	0.056	6.867	0.000
DBA20	0.374	0.057	6.518	0.000
ABA23	0.253	0.065	3.904	0.000
ABA24	0.294	0.069	4.243	0.000
ABA25	0.332	0.073	4.538	0.000
ABA27	0.281	0.068	4.152	0.000
SSA28	0.432	0.050	8.559	0.000
SSA29	0.515	0.052	9.890	0.000
SSA30	0.364	0.051	7.171	0.000
SSA31	0.205	0.046	4.445	0.000
SSA32	0.286	0.050	5.701	0.000
SSA33	0.361	0.050	7.158	0.000
SSA34	0.459	0.054	8.532	0.000
SSA35	0.174	0.044	3.957	0.000
PFA36	0.351	0.060	5.835	0.000
PFA37	0.503	0.061	8.251	0.000
PFA38	0.274	0.054	5.025	0.000
PFA39	0.477	0.059	8.074	0.000
PFA40	0.326	0.056	5.856	0.000

Latent Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
F1	0.500	0.065	7.715	0.000
F2	0.812	0.088	9.241	0.000
F3	0.029	0.029	1.017	0.309
F4	0.626	0.071	8.883	0.000
F5	0.378	0.072	5.269	0.000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Appendix A

Leadership Scale for Sports (LSS; Chelladurai & Saleh, 1980)

Latent Factors:

- F1: Training and instruction (item #1 to #13)
- F2: Democratic behavior (item #14 to # 22)
- F3: Autocratic behavior (item #23 to #27)
- F4: Social support (item #28 to #35)
- F5: Positive feedback (item #36 to #40)

Using the following scale, please circle a number from 1 to 5 to indicate your level of agreement with each of the statements regarding ATHLETE LEADERS on your team.

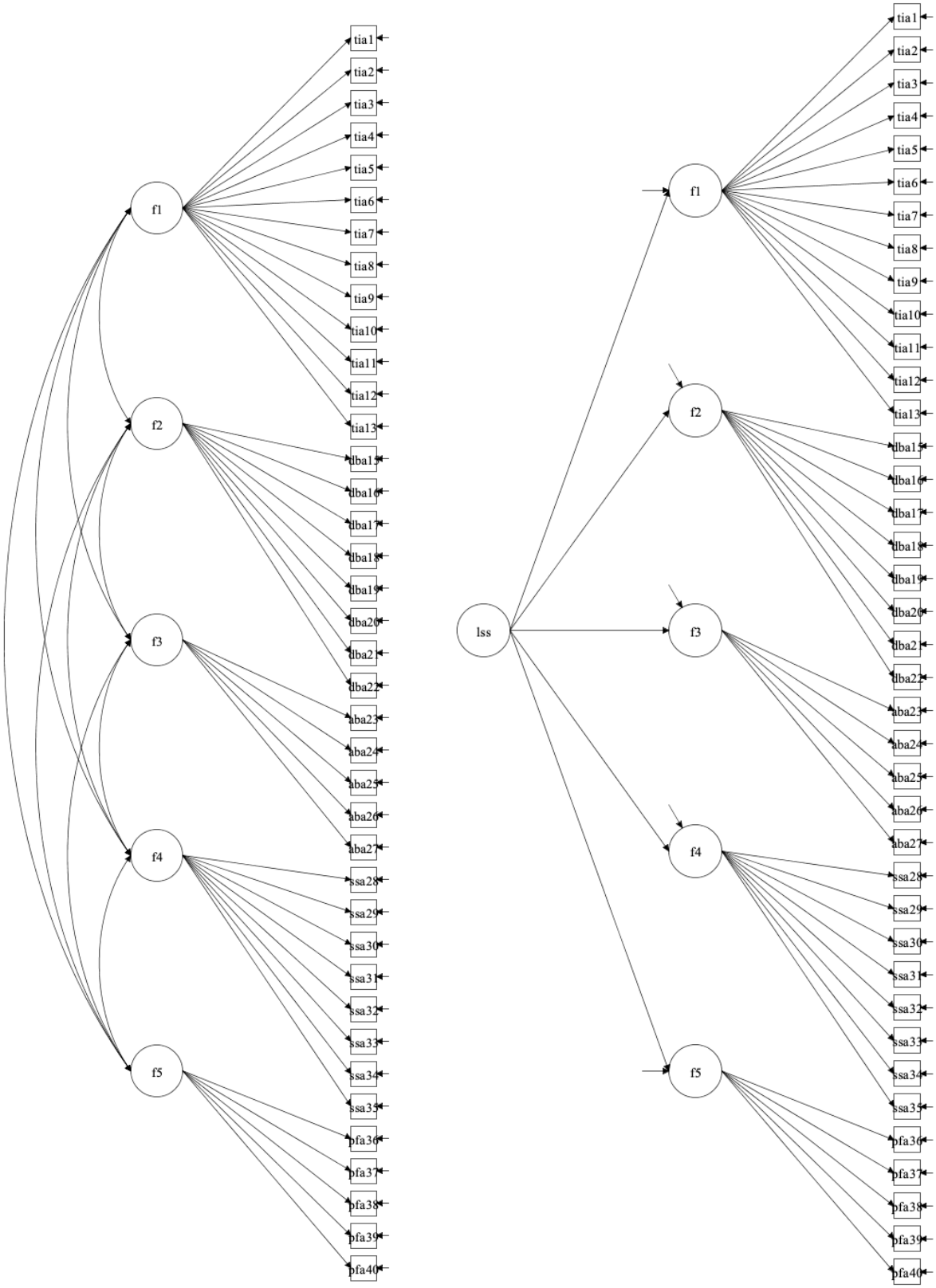
1 **Never**	2 **Seldom** 25% of the time	3 **Occasionally** 50% of the time	4 **Often** 75% of the time	5 **Always**

The athlete leader(s) on my team…

	Never				Always
1. See to it that every team member is working to his/her capacity.	1	2	3	4	5
2. Explain to team members the techniques and tactics of the sport.	1	2	3	4	5
3. Pay attention to correcting team members' mistakes.	1	2	3	4	5
4. Make sure that team members role on the team are understood.	1	2	3	4	5
5. Instruct team members individually in the skills of the sport.	1	2	3	4	5
6. Figure ahead on what should be done.	1	2	3	4	5
7. Explain to team members what they should and what they should not do.	1	2	3	4	5
8. Expect team members to carry out their assignment to the last detail.	1	2	3	4	5
9. Point out team members' strengths and weaknesses.	1	2	3	4	5
10. Give specific instructions to team members as to what they should do in every situation.	1	2	3	4	5
11. See to it that the efforts are coordinated.	1	2	3	4	5
12. Explain how team members contributions fits into the total picture.	1	2	3	4	5
13. Specify in detail what is expected of team members.	1	2	3	4	5

14. Ask for the opinion of team members on strategies for specific competitions.	1	2	3	4	5
15. Get team members approval on important matters before going ahead.	1	2	3	4	5
16. Let fellow team members share in decision making.	1	2	3	4	5
17. Encourage team members to make suggestions for ways of conducting practices.	1	2	3	4	5
18. Let team members share in discussion about goals for the team as a whole (e.g., the number of wins over the following month).	1	2	3	4	5
19. Let team members try their own way even if they make mistakes.	1	2	3	4	5
20. Ask for the opinion of team members on important team matters.	1	2	3	4	5
21. Let team members work at their own speed.	1	2	3	4	5
22. Let team members decide on the plays to be used in a game.	1	2	3	4	5
23. Work relatively independent of other team members.	1	2	3	4	5
24. Not explain his/her/their action(s).	1	2	3	4	5
25. Refuse to compromise a point.	1	2	3	4	5
26. Keep to himself/herself/themselves.	1	2	3	4	5
27. Speak in a manner not to be questioned.	1	2	3	4	5
28. Help team members with their personal problems.	1	2	3	4	5
29. Help team members settle their conflicts.	1	2	3	4	5
30. Look out for the personal welfare of team members.	1	2	3	4	5
31. Do favors for team members.	1	2	3	4	5
32. Express care for other team members.	1	2	3	4	5
33. Encourage team members to confide in him/her/them.	1	2	3	4	5
34. Encourage close and informal relations with team members.	1	2	3	4	5
35. Invite team members to his/her/their home(s).	1	2	3	4	5
36. Compliment a team member for his/her performance in front of others.	1	2	3	4	5
37. Tell a team member when he/she does a particularly good job.	1	2	3	4	5
38. See that a team member is rewarded for a good performance.	1	2	3	4	5
39. Express appreciation when a team member performs well.	1	2	3	4	5
40. Give credit when credit is due.	1	2	3	4	5

Appendix B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