

### SEM Assignment # 3: Structural Model and Research Report (Due November 14)

1. Describe whether the research questions/findings involve with **mediators** or **moderators** and why (5 points each).

(a) Researchers would like to investigate whether the effect of self-stigma on the attitude toward counseling is different between heterosexual men and gay men.

#### MODERATION

(b) Researchers would like to check whether the effect from depression toward attitudes is fully explained by self-stigma.

#### MEDIATION

(c) Research studies showed that the treatment effect (the difference between averaged depression score between the treatment group and control group) increases when family support increases.

#### MODERATION

(d) Research studies showed that the reason why mindfulness-based cognitive therapy (MBCT) decreases depression is that MBCT increases self-awareness and self-awareness decreases depression.

#### MEDIATION

(e) Job performance depends on both ability and motivation. When workers have high ability and high motivation, the job performance is very high. If workers have only high ability or only high motivation, the job performance is not good.

#### MODERATION

2. Researchers would like to test whether collective efficacy (a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainments) mediates the effect of group potency (a group's enduring ability to perform a wide range of tasks across different activities) and group performance. The researchers collect data based on self-reports from 200 task groups in a company. Collective efficacy and group potency are measured by 9 questions which are grouped into 3 parcels (only parcel data are provided). Group performance is a single indicator with the range of 0 to 100.

The researchers provide a data set (hw3i2.csv) for you which have eight variables:

ID, POTENCY1, POTENCY2, POTENCY3, COLLECT1, COLLECT2, COLLECT3, PERFORM

Please answer the following questions:

(a) Draw a path diagram of a **measurement model** with appropriate boxes and squares to represent factors and indicators in this model (10 points). Note that group performance should be included in the model.

- (b) Run a confirmatory factor analysis model with marker-variable approach for scale identification (using POTENCY1 and COLLECT1 as marker variables). Report the model fit indices in the following table (5 points):

$\chi^2$	<i>df</i>	<i>p</i>	RMSEA	SRMR	TLI	CFI
7.057	12	.854	.000	.022	1.018	1.000

- (c) Does the model fit well? Justify your answer. (5 points)
- (d) Fill the results of the parameter estimates in the following table (5 points). If any standard errors, *z*, and *p* values are not available, please answer NA.

	Value	<i>SE</i>	<i>z</i>	<i>p</i>	Std Value
Factor Loadings					
COLLECT → COLLECT1	1	NA	NA	NA	.704
COLLECT → COLLECT2	1.111	0.121	9.217	.000	.750
COLLECT → COLLECT3	1.172	0.126	9.284	.000	.757
POTENCY → POTENCY1	1	NA	NA	NA	.799
POTENCY → POTENCY2	0.723	0.093	7.751	.000	.632
POTENCY → POTENCY3	0.795	0.097	8.157	.000	.676
Correlations					
COLLECT and POTENCY	0.384	0.066	5.794	.000	.688
COLLECT and PERFORM	0.385	0.056	6.911	.000	.758
POTENCY and PERFORM	0.343	0.059	5.830	.000	.544

\*Std = Standardized

- (e) Draw a path diagram of a **partial mediation model** with appropriate boxes and squares to represent factors and indicators in this model (10 points)
- (f) Run a partial mediation model. Are the model fit from this model different from the model fit from the confirmatory factor analysis model? Why? (5 points)  
**Yes, exactly the same model.**
- (g) Make an additional parameter to represent the **indirect effect** from group potency to group performance via collective efficacy in your SEM analysis. Investigate the **Wald** statistic of the additional parameter. Then, fill the following table about the direct and indirect effects (5 points):

	Value	<i>SE</i>	<i>z</i>	<i>p</i>	Std Value
Direct Effect					
POTENCY → COLLECT	0.554	0.084	6.623	.000	.688
COLLECT → PERFORM	20.873	3.338	6.253	.000	.730
POTENCY → PERFORM	0.956	2.368	0.404	.686	.042
Indirect Effect					
POTENCY → COLLECT → PERFORM	11.553	2.307	5.008	.000	.502

- (h) Run the SEM analysis with the additional parameter again using bootstrap approach. I recommend the bias-corrected confidence interval; however, if you use other bootstrap

approach, please report your option here. Using 95% confidence interval, fill the following table (10 points):

	Value	Lower Bound	Upper Bound
Direct Effect			
POTENCY → COLLECT	0.554	0.401	0.760
COLLECT → PERFORM	20.873	14.999	27.951
POTENCY → PERFORM	0.956	-3.707	5.644
Indirect Effect			
POTENCY → COLLECT → PERFORM	11.553	8.182	16.448

- (i) Based on the bootstrap procedure, are the direct and indirect effects from group potency to group performance significant? How do you know whether those effects are significant? (5 points)

The direct effect is not significant whereas the indirect effect is significant.

- (j) Run a **full** mediation model (no direct effect from group potency to group performance). Report the model fit indices in the following table (5 points):

$\chi^2$	<i>df</i>	<i>p</i>	RMSEA	SRMR	TLI	CFI
7.215	13	.891	.000	.022	1.019	1.000

- (k) Compare the difference in model fits between the full mediation model and partial mediation model. Fill the following table (5 points)

$\Delta\chi^2$ ( $\chi^2$ [Full] - $\chi^2$ [Partial])	$\Delta df$	<i>p</i>
0.158	1	.691

Note that the *p* value can be calculated by looking up tables in a statistic book, using online calculator, using Excel function, *chisq.dist*, or using R function, *pchisq*.

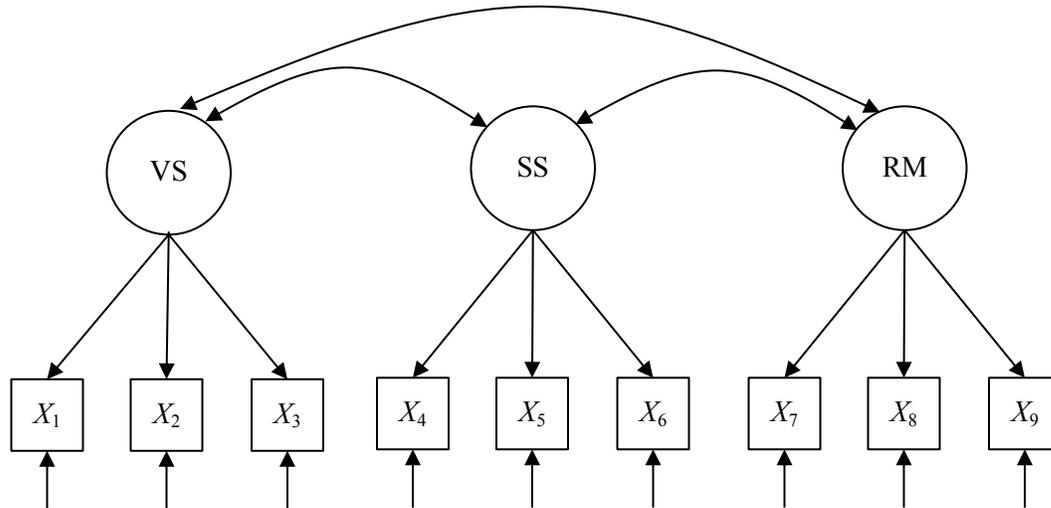
- (l) What is the effect that the chi-square difference test represents? Is it significant? What does the significance testing mean in this research context? (5 points)

Test of the direct effect. It is not significant.

### Comprehensive Homework

Please answer **only one** question from Question 3 or 4. Question 3 is about measurement invariance across two countries. Question 4 is about mediation analysis at the latent-variable level. Please write a **result section** to test the research hypotheses mentioned in each question. In the result section, students should provide a table of descriptive statistics and useful tables mentioned in each question. The figure of the analysis model is provided in each question. Please improve the figure so that it is ready for a publication. The results should provide the details of how do you analyze the data. The details should be brief but enough so that your classmate can replicate your analysis. The APA writing style is highly recommended. If you use other writing style in your field, please note in your answer and send me an example article using SEM that endorses the writing style you use. Note that each question is created based on real research articles. The format, writing style, tables, or figures in the research articles are not necessary the best practice.

3. The data are simulated based on Hu, Pellegrini, and Scanduran (2011) result (see hw3i3.pdf). Researchers would like to investigate whether the factor structures of Mentoring Functions Questionnaire are different across two countries (A and B). The scale contains 9 items which can be equally separated into three subscales. See the figure below:



where VS = Vocational Support, PS = Psychological Support, and RM = Role Modeling

Researchers would like to test the following hypotheses or explore the following research questions:

- (a) The factor structures across countries are invariance in both weak (metric) and strong (scalar) invariance

Model	$\chi^2$	$df$	$p$	RMSEA	SRMR	TLI	CFI
Configural	45.95	48	.557	0	.028	1.003	1
Weak	49.84	54	.635	0	.033	1.005	1
Strong	53.07	60	.725	0	.034	1.007	1

Model	$\Delta\chi^2$ ( $\chi^2$ [Full] - $\chi^2$ [Partial])	$\Delta df$	$p$	$\Delta CFI$
Configural vs Weak	3.886	6	.692	0
Weak vs Strong	3.231	6	.779	0

- (b) Investigate the factor correlations within each group

Correlation	Country 1	Country 2
VS & PS	0.679	0.685
VS & RM	0.772	0.783

PS & RM	0.587	0.489
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(c) (Extra Credit) Explore whether factor correlations are different across groups (phantom variable approach or nonlinear constraint approach)

Difference in Correlation	Value	Lower Bound	Upper Bound
VS & PS	-0.005	-0.173	0.201
VS & RM	-0.011	-0.208	0.196
PS & RM	0.098	-0.094	0.327

(d) Investigate the factor means within each group

Means	Country 1					Country 2				
	Value	SE	z	p	Std Value	Value	SE	z	p	Std Value
VS	0	NA	NA	NA	0	0.411	0.077	5.360	.000	.638
PS	0	NA	NA	NA	0	0.027	0.081	0.336	.737	.035
RM	0	NA	NA	NA	0	0.597	0.095	6.285	.000	.805

(e) Explore whether the factor means are different across groups

Means	Country 2 – Country 1				
	Value	SE	z	p	Std Value
VS	0.411	0.077	5.360	.000	.638
PS	0.027	0.081	0.336	.737	.035
RM	0.597	0.095	6.285	.000	.805

(f) Find the effect size of the factor mean differences between groups

$$ES_{VS} = \frac{0.411 - 0}{\sqrt{\frac{300 \times 0.361 + 150 \times 0.415}{300 + 150}}} = 0.668$$

$$ES_{PS} = \frac{0.027 - 0}{\sqrt{\frac{300 \times 0.359 + 150 \times 0.601}{300 + 150}}} = 0.041$$

$$ES_{RM} = \frac{0.597 - 0}{\sqrt{\frac{300 \times 0.622 + 150 \times 0.551}{300 + 150}}} = 0.772$$

The complete report must contain

(a) The table of descriptive statistics across items which contains item means, standard deviations, and correlations within each group

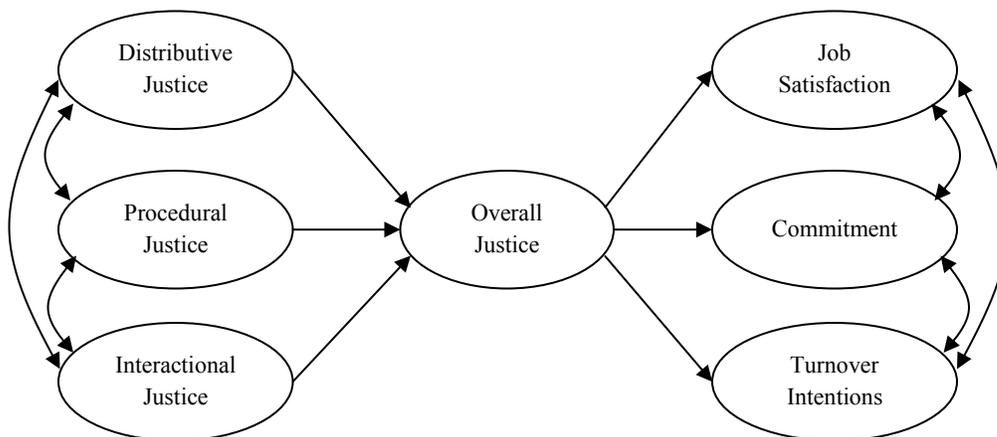
- (b) The table of model fits of the analyzed models ( $\chi^2$ ,  $df$ ,  $p$ , CFI, TLI, RMSEA, SRMR) and the model fit comparison between nested models ( $\Delta\chi^2$ ,  $\Delta df$ ,  $p$ ,  $\Delta CFI$ )
- (c) The table of factor means, standard deviations, and correlations within each group
- (d) The figure of the factor structure with appropriate values (factor loadings, measurement error variances, factor variances, factor covariances and correlations) of each group (if they are different)

The dataset (hw3i3.csv) contains 11 variables: ID, 9 scale items, and countries (1 = Country A and 2 = Country B). The sample sizes from Countries A and B are 300 and 150, respectively.

#### Grading Rubrics

- Accuracy of the research questions (a), (b), (d), (e), and (f) (10 points each)
- The figure of factor structure (10 points)
- Table of descriptive statistics of items (5 points)
- Table of model fit statistics (20 points)
- Table of descriptive statistics of factors (5 points)
- Clarity of writing including the description of analysis procedures (10 points)
- APA style (10 points)
- Extra Credit (20 points)

4. The data are simulated from the Ambrose and Schminke (2009) result (see hw3i4.pdf). Researchers would like to investigate whether the overall justice judgment mediates the relationship between specific justice facets and three outcomes: job satisfaction, organizational commitment, and turnover intentions. All variables of interest are measured within three parcels. See the figure below:



Note that the measurement model is omitted. The measurement model is that each parcel is loaded on only one construct (no cross loading).

Researchers would like to test the following hypotheses or explore the following research questions:

- (a) Compare the factor structure of justice items with four-factor structure (distributive, procedural, interactional, and overall), two-factor structure (specific and overall), and one-factor structure. Only justice items are used.
  - i. Compare the absolute model fit of each model
  - ii. If those models are nested, use the chi-square difference test to compare hypothesized models.

Model	$\chi^2$	<i>df</i>	<i>p</i>	RMSEA	SRMR	TLI	CFI
Four	38.928	48	.82	.000	.024	1.008	1.000
Two	576.04	53	.000	.181	.147	.565	.651
One	671.46	54	.000	.195	.122	.496	.588

Model	$\Delta\chi^2$ ( $\chi^2$ [Full] - $\chi^2$ [Partial])	$\Delta df$	<i>p</i>
Four vs Two	537.11	5	.000
Two vs One	95.424	1	.000

- (b) The factor structure of all seven factors should fit the data well (check model fit and factor loadings)

All standardized factor loadings were greater than .65 except one that was .515. The factor solution looked great.

Model	$\chi^2$	<i>df</i>	<i>p</i>	RMSEA	SRMR	TLI	CFI
Seven	129.29	168	.99	.000	.031	1.018	1.000

- (c) Overall perceived justice should fully mediate the relation between component justices and three outcomes
  - i. Nested model comparison between full and partial mediation models
  - ii. All nine indirect effects should be significant by bootstrap approach.

Model	$\chi^2$	<i>df</i>	<i>p</i>	RMSEA	SRMR	TLI	CFI
Partial	129.29	168	.99	.000	.031	1.018	1
Full	137.14	177	.99	.000	.035	1.017	1

Model	$\Delta\chi^2$ ( $\chi^2$ [Full] - $\chi^2$ [Partial])	$\Delta df$	<i>p</i>
Partial vs Full	7.855	9	.549

Indirect Effects

Difference in Correlation	Value	Lower Bound	Upper Bound
Dis → Overall → JS	0.106	0.034	0.225
Dis → Overall → OC	0.140	0.041	0.280
Dis → Overall → TI	-0.064	-0.15	-0.015
Proc → Overall → JS	0.298	0.155	0.492
Proc → Overall → OC	0.394	0.235	0.599
Proc → Overall → TI	-0.179	-0.302	-0.063
Inter → Overall → JS	0.209	0.076	0.405
Inter → Overall → OC	0.277	0.100	0.526
Inter → Overall → TI	-0.126	-0.306	-0.038

- (d) Explore the proportion of factor variances explained by independent variables. Please indicate which model you use to find the proportions.

	Partial	Full
Overall	.531	.522
JS	.343	.337
OC	.395	.349
TI	.192	.190

- (e) (Extra Credit) Test which specific justices contribute to the overall justice the most. That is, test the differences between regression coefficients of distributive justice, procedural justice, or interactional justice contribute to overall justice.

Difference in Correlation	Value	Lower Bound	Upper Bound
Dis - Proc	-0.289	-0.472	-0.133
Dis - Inter	-0.156	-0.429	0.102
Proc - Inter	0.133	-0.133	0.424

The complete report must contains

- The table of all factor means, standard deviations, and correlations. Note that if factor means or factor standard deviations have the same value, the values are not necessary individually listed in the table. You may put them in a table note only.
- The table of factor loadings of all seven factors
- The tables of model fits of the analyzed models ( $\chi^2$ ,  $df$ ,  $p$ , CFI, TLI, RMSEA, SRMR) and the model fit comparison between nested models ( $\Delta\chi^2$ ,  $\Delta df$ ,  $p$ ,  $\Delta CFI$ )
- The table of the significance of indirect effects
- The figure of the factor structure with appropriate values (factor covariances/correlations, regression coefficients)

The dataset (hw3i4.csv) contains 22 variables: ID, 3 parcels of distributive justice, 3 parcels on procedural justices, 3 parcels on interactional justices, 3 parcels on overall justice, 3 parcels on job satisfaction, 3 parcels on organizational commitment, and 3 parcels on turnover intentions. The sample size is 300.

### Grading Rubrics

- Accuracy of the research questions (a) (15 points), (b) (10 points), (c) (15 points), and (d) (5 points)
- The figure of factor structure (10 points)
- Table of descriptive statistics of factors (5 points)
- Table of model fit statistics (10 points)
- Table of indirect effects (10 points)
- Clarity of writing including the description of analysis procedures (10 points)
- APA style (10 points)
- Extra Credit (10 points)

### Total Score

Items	Full Credit	Scores
Item 1	25	
Item 2	75	
Item 3 / 4	100	
Total	200	