

验证性因子分析多组比较 在语言测试构念效度检验中的运用

许宏晨

外交学院

xuhongchen@cfau.edu.cn

发言提纲

1. 验证性因子分析与测评
2. 一则实例
3. 验证性因子分析多组比较思路
4. 验证性因子分析多组比较操作
5. 验证性因子分析多组比较结果解读

1. 验证性因子分析与测评

- 构念效度
 - 事先预设?
 - 后来归纳?
- 验证性因子分析 (confirmatory factor analysis, CFA)
- 探索性因子分析 (exploratory factor analysis, EFA)

2. 一则实例

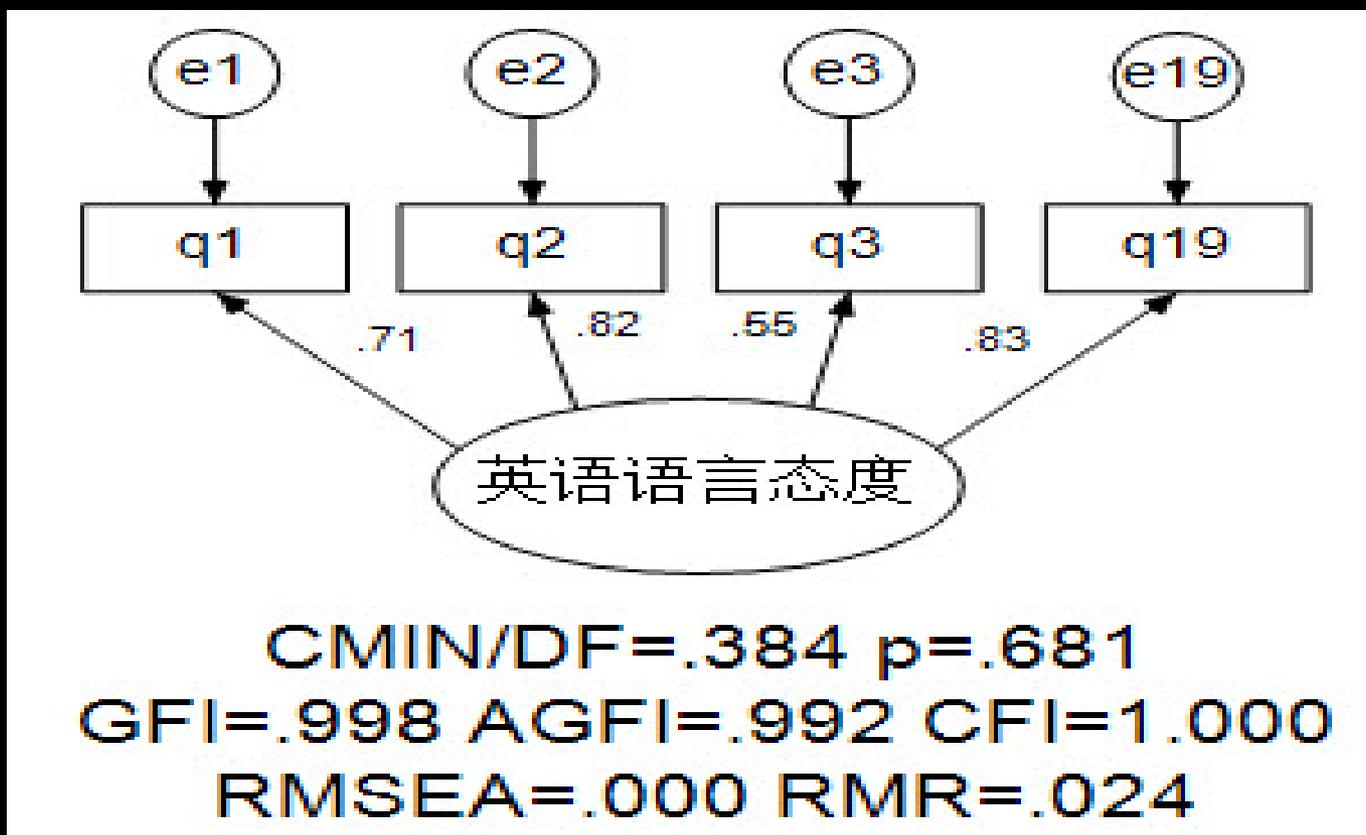
- 背景：
 - “英语语言态度”由q1, q2, q3和q19四个题目测得。“英语教学态度”由q6, q8, q9, q21, q22, q38, q39和q49八个题目测得。
- 问题：
 - 1) 以上两个维度构成的量表是否可以反映“英语态度”这个构念？
 - 2) 如果可以反映这个构念，那么它在“性别”这个调节变量上是否有差异？

3. 验证性因子分析多组比较思路

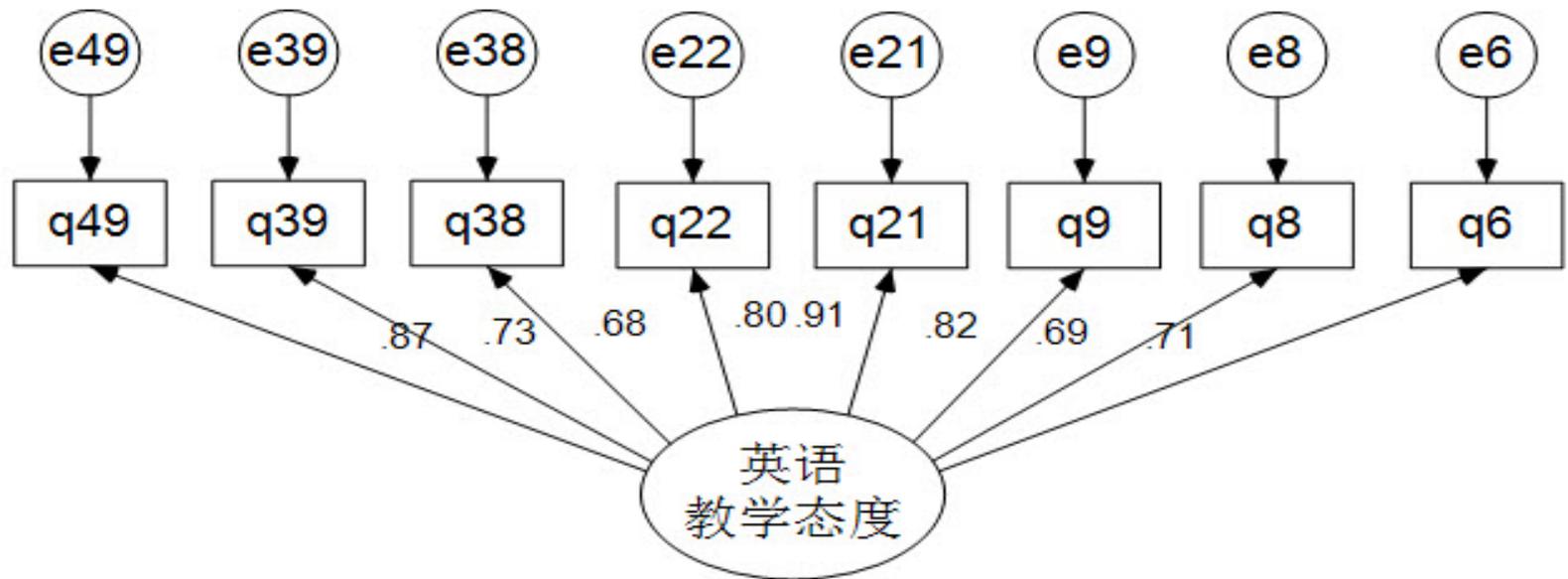
- 本质：
 - 测量模型与数据的拟合程度及跨组比较
- 步骤：
 - 1) 分别考察构念组成部分与数据的拟合程度
 - 2) 整体考察构念与数据的拟合程度
 - 3) 以“性别”为分组变量考察构念与男生组和女生组数据的拟合程度
- 预期结果：
 - 以上三步模型均与数据拟合

4. 验证性因子分析多组比较操作

- “英语语言态度” CFA

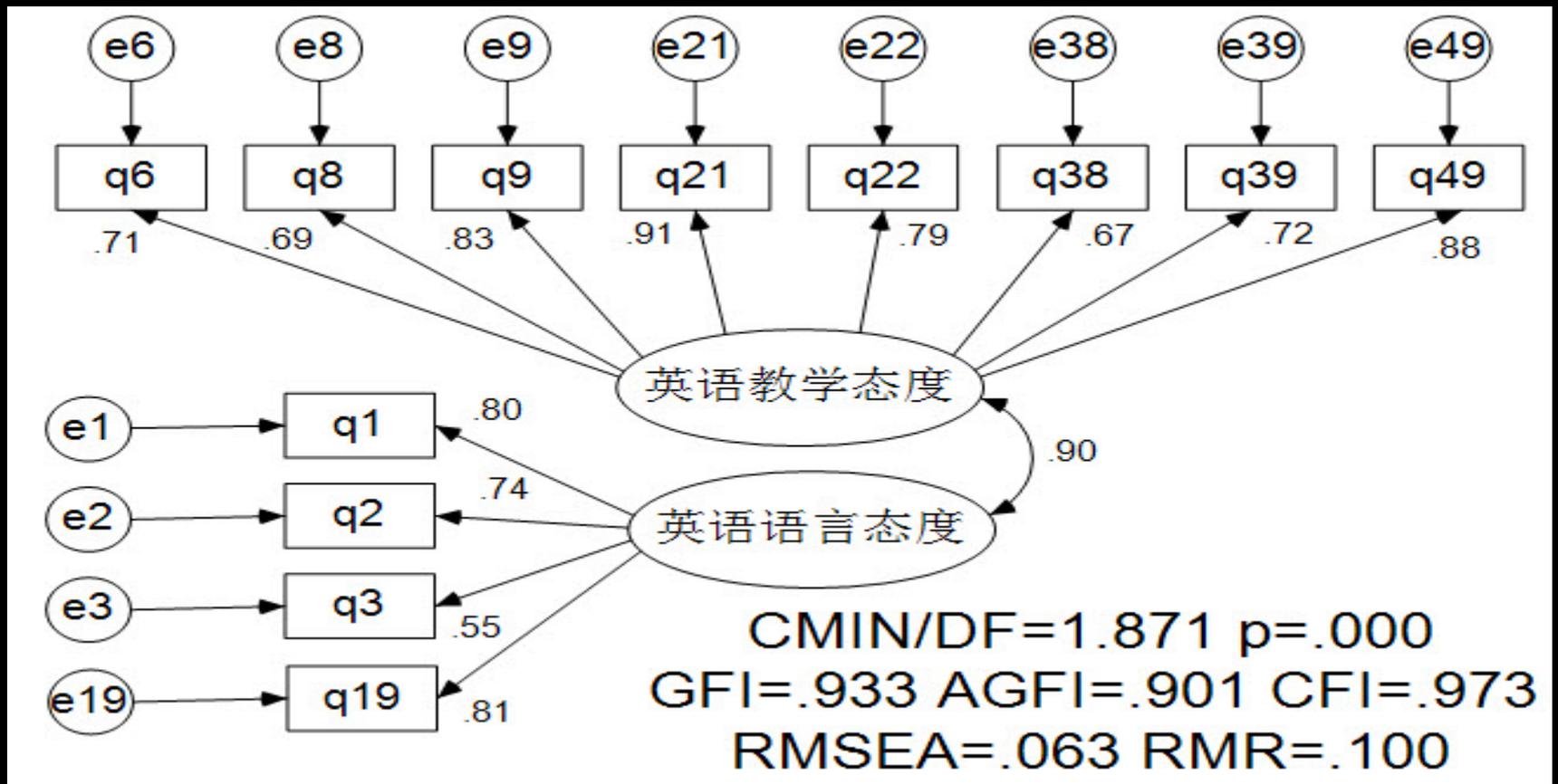


- “英语教学态度” CFA



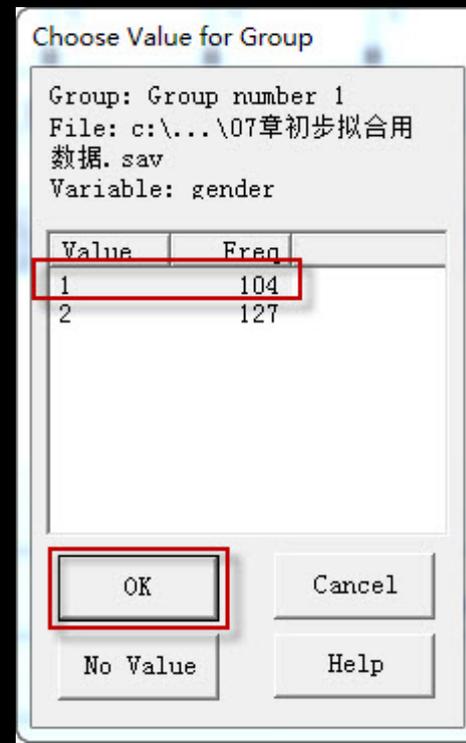
CMIN/DF=1.325 p=.150
GFI=.972 AGFI=.949 CFI=.994
RMSEA=.038 RMR=.061

- “英语语言态度”与“英语教学态度” CFA

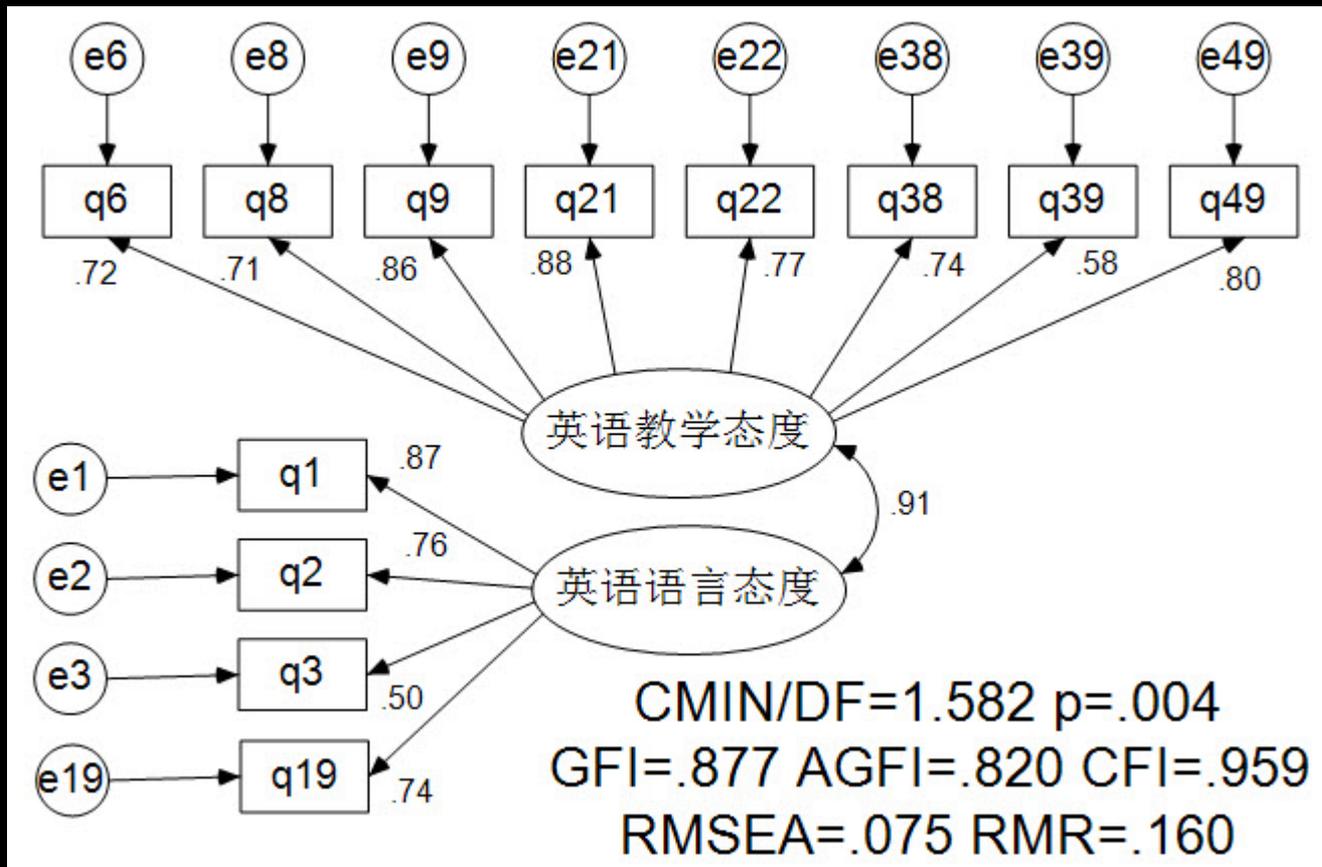


- 以“性别”为分组变量考察模型与数据拟合
 - 考察上图中由潜在变量指向观测变量的12条单箭头指标（测量权重）和
 - 潜在变量之间的1个双箭头指标（结构协方差）。
- 需要注意的是，在多组分析检验中，研究者关注
 - 模型与数据的拟合指标，
 - 不同组别的回归系数和相关系数的差异。

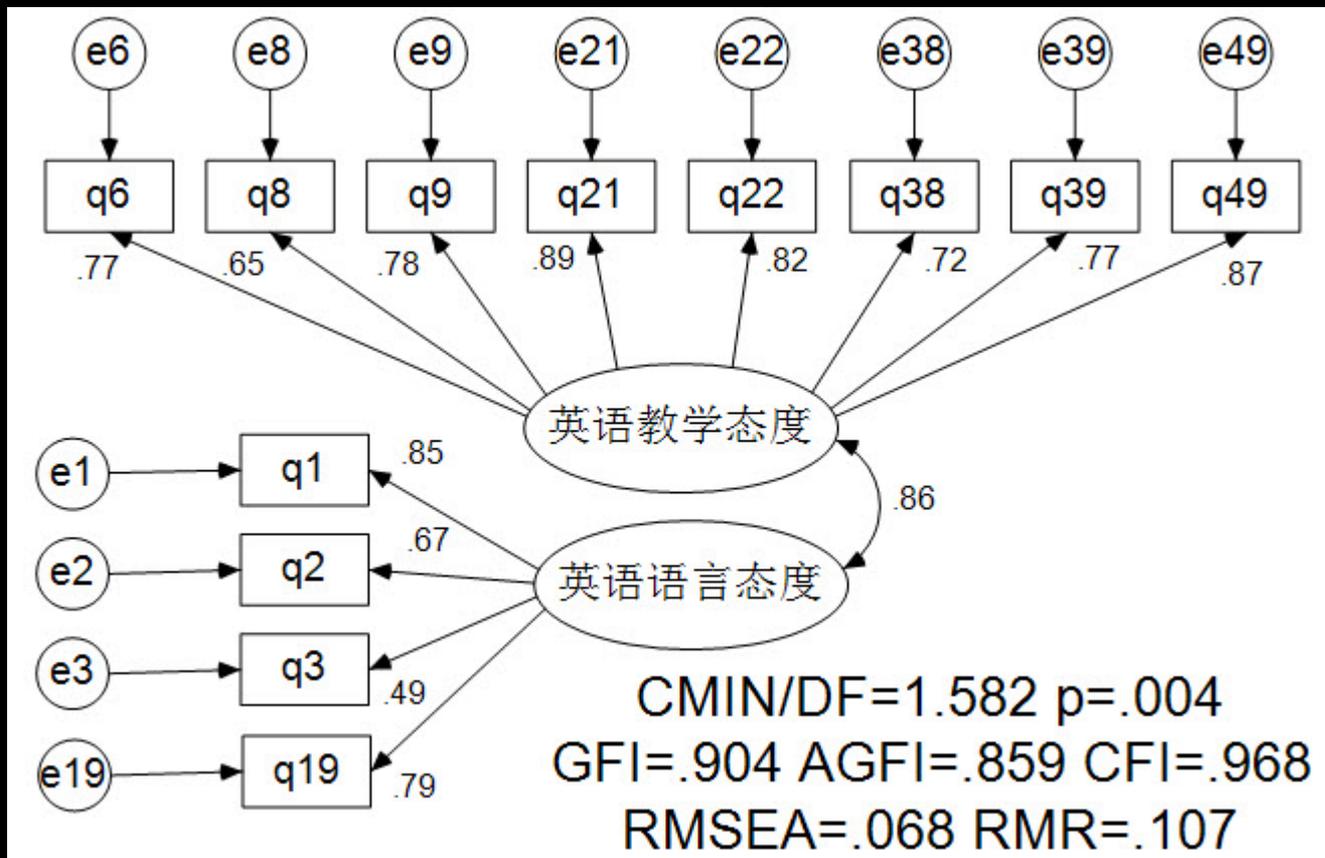
- 用男、女生数据分别与模型拟合，调入数据。



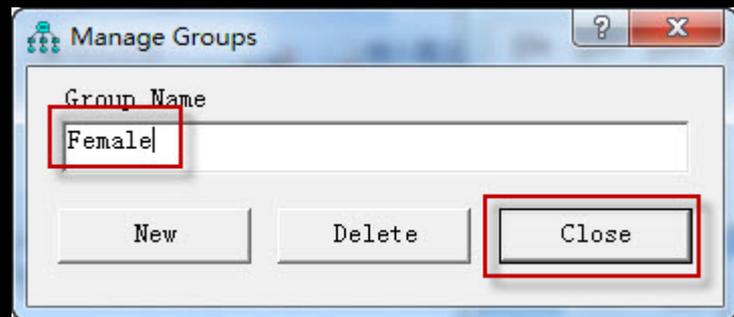
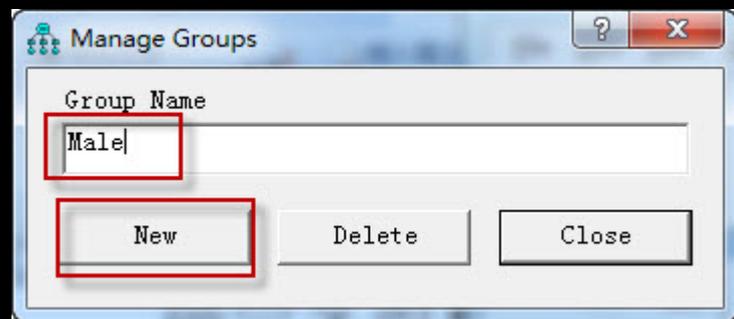
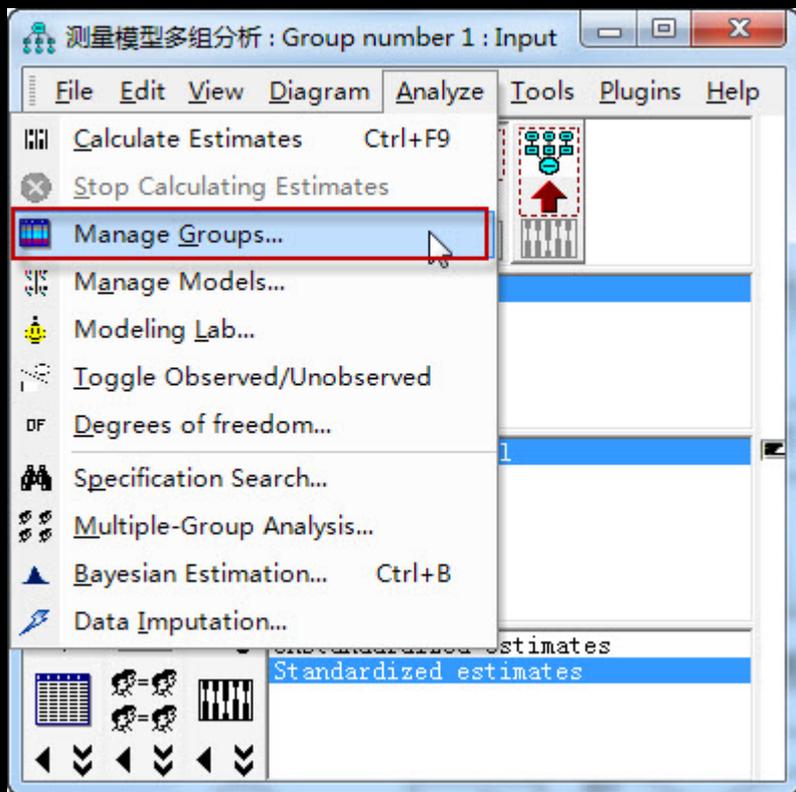
- 男生组数据与模型拟合结果



- 女生组数据与模型拟合结果



• 设定组别 (1)



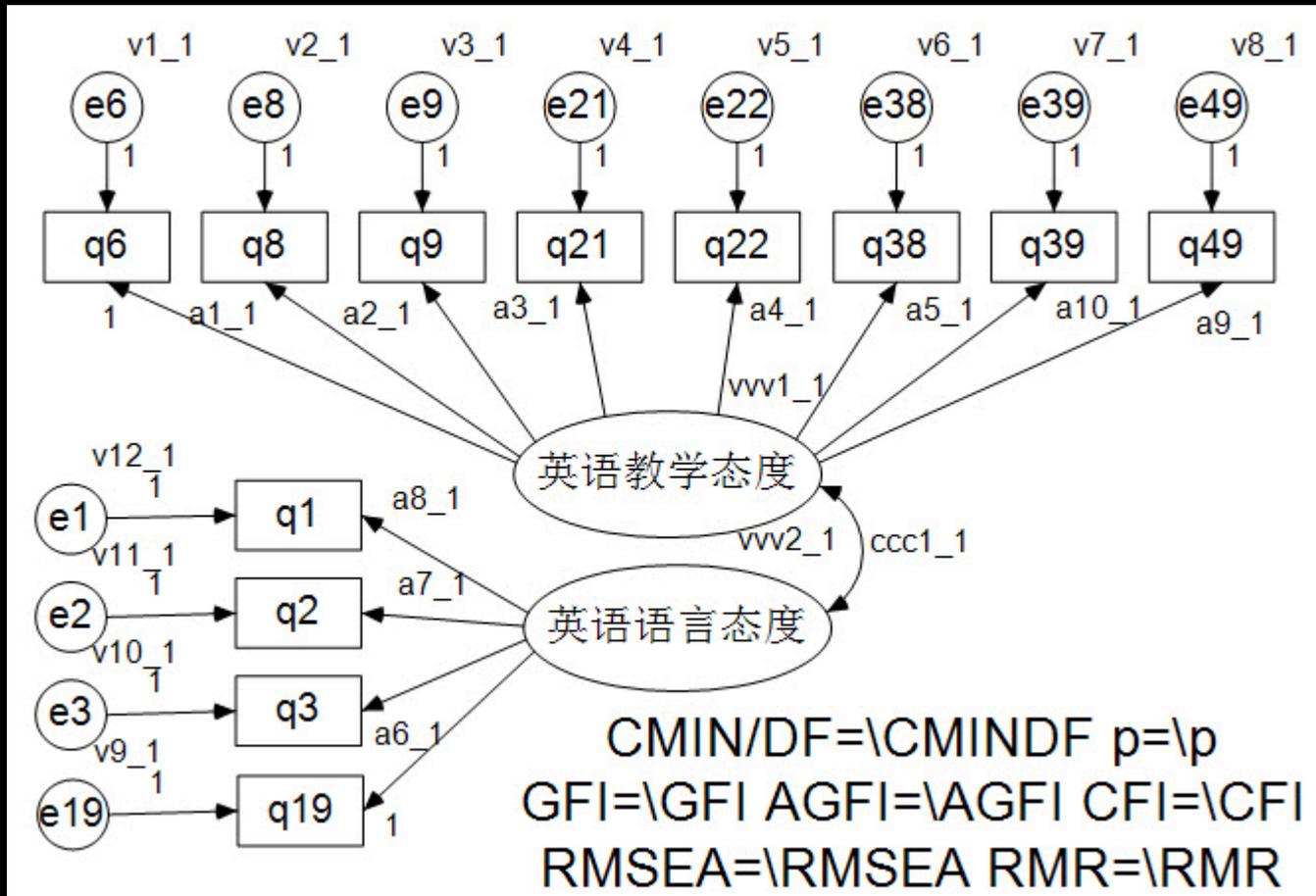
- 设定组别 (2)

Multiple-Group Analysis

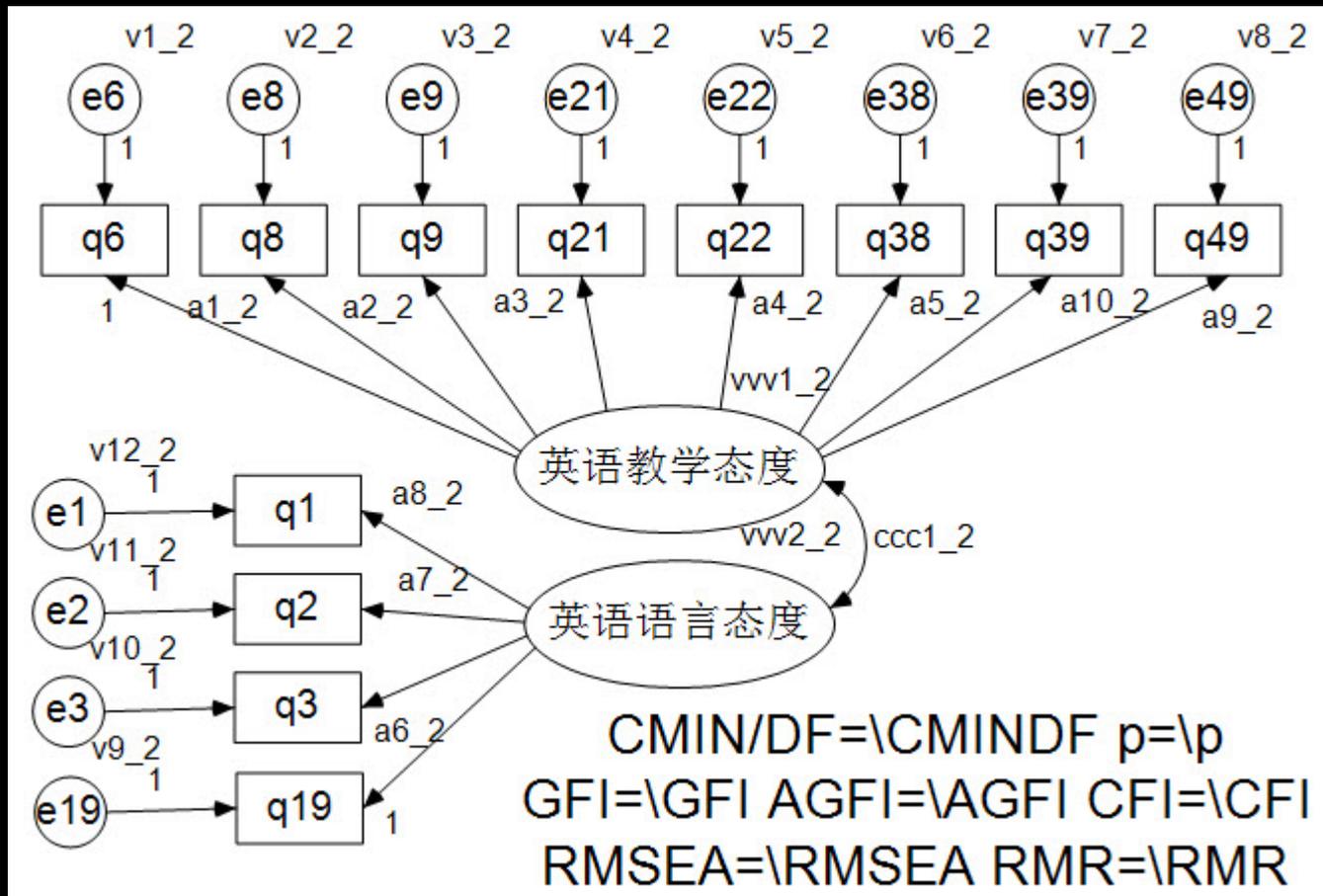
Parameter Subsets	Models							
	1	2	3	4	5	6	7	8
Measurement weight	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
Measurement interce	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Structural weights	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Structural interce	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Structural means	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Structural covaria	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>				
Structural residua	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Measurement residu	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>				

Help Default **OK** Cancel

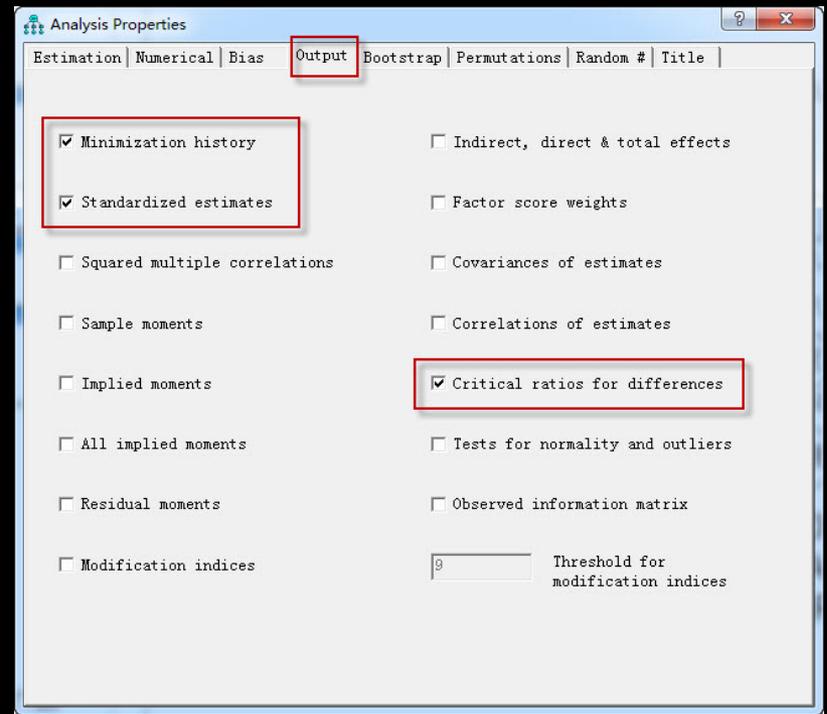
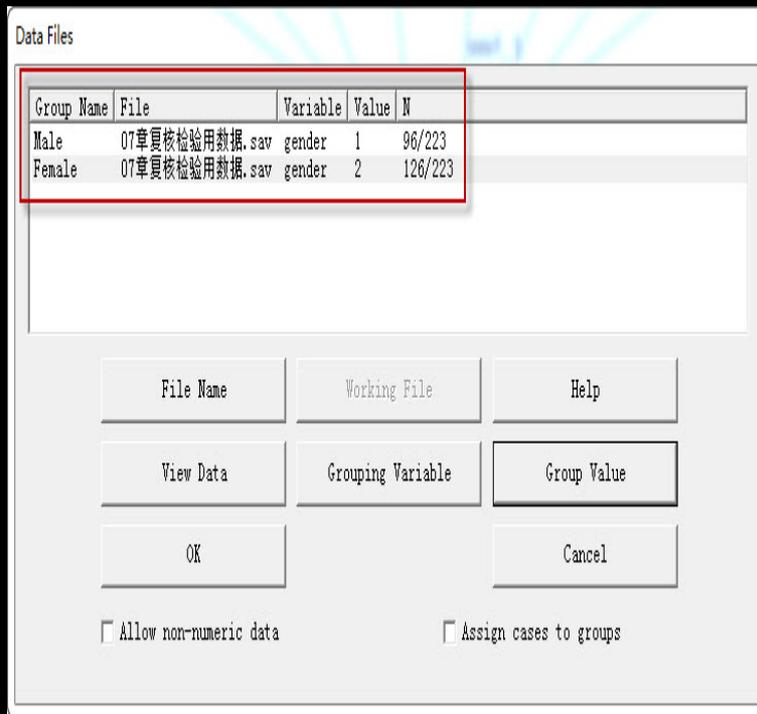
- 设定组别后男生组模型状态



- 设定组别后女生组模型状态



• 分别调入男、女生组数据进行拟合运算



5. 验证性因子分析多组比较结果

- 拟合指标

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Unconstrained	50	175.988	106	.000	1.660
Measurement weights	40	199.962	116	.000	1.724
Structural covariances	37	205.622	119	.000	1.728
Measurement residuals	25	236.402	131	.000	1.805
Saturated model	156	.000	0		
Independence model	24	1887.448	132	.000	14.299

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Unconstrained	.133	.885	.830	.601
Measurement weights	.229	.870	.825	.647
Structural covariances	.289	.867	.826	.661
Measurement residuals	.293	.846	.817	.711
Saturated model	.000	1.000		
Independence model	1.430	.227	.086	.192

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Unconstrained	.907	.884	.961	.950	.960
Measurement weights	.894	.879	.953	.946	.952
Structural covariances	.891	.879	.951	.945	.951
Measurement residuals	.875	.874	.940	.939	.940
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Unconstrained	.055	.040	.069	.280
Measurement weights	.057	.044	.071	.179
Structural covariances	.058	.044	.071	.170
Measurement residuals	.060	.048	.073	.082
Independence model	.246	.236	.256	.000

- 模型比较指标 (1)

Nested Model Comparisons

Assuming model Unconstrained to be correct:

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
Measurement weights	10	23.974	.008	.013	.013	.004	.005
Structural covariances	13	29.634	.005	.016	.017	.005	.005
Measurement residuals	25	60.414	.000	.032	.034	.010	.011

Assuming model Measurement weights to be correct:

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
Structural covariances	3	5.659	.129	.003	.003	.000	.000
Measurement residuals	15	36.439	.002	.019	.021	.006	.006

Assuming model Structural covariances to be correct:

Model	DF	CMIN	P	NFI Delta-1	IFI Delta-2	RFI rho-1	TLI rho2
Measurement residuals	12	30.780	.002	.016	.017	.005	.006

● 模型比较指标 (2)

新建 Microsoft Office Excel 2007 工作表 (2).xlsx - Microsoft Excel

开始 插入 页面布局 公式 数据 审阅 视图 开发工具 ABBYY FineReader 12 Acrobat

粘贴 剪贴板 字体 对齐方式 数字 样式 单元格 编辑

K38 fx -0.141

	A	B	C	D	E	F	G	H	I	J	K	L
28	v12_1	-1.741	-2.709	-3.412	-1.406	-1.378	0.776	-1.25	-1.599	-2.51	-1.521	-2.307
29	a1_2	-0.167	-1.146	-1.902	0.228	0.233	2.632	0.517	0.105	-0.927	0.153	-1.272
30	a2_2	0.256	-0.78	-1.585	0.691	0.689	3.353	1.045	0.622	-0.544	0.625	-1.035
31	a3_2	0.9	-0.127	-0.947	1.356	1.344	4.071	1.765	1.373	0.114	1.309	-0.633
32	a4_2	0.942	-0.067	-0.874	1.39	1.378	4.035	1.79	1.407	0.171	1.344	-0.592
33	a5_2	-0.289	-1.295	-2.064	0.112	0.119	2.593	0.402	-0.028	-1.072	0.032	-1.359
34	a6_2	-2.224	-3.344	-4.111	-1.865	-1.82	0.717	-1.757	-2.363	-3.128	-2.027	-2.512
35	a7_2	-1.75	-2.901	-3.701	-1.36	-1.322	1.417	-1.191	-1.797	-2.674	-1.509	-2.232
36	a8_2	-2.601	-3.785	-4.565	-2.247	-2.187	0.477	-2.199	-2.897	-3.567	-2.441	-2.693
37	a9_2	0.849	-0.191	-1.018	1.31	1.298	4.07	1.724	1.324	0.053	1.262	-0.674
38	a10_2	-0.461	-1.496	-2.278	-0.053	-0.044	2.511	0.233	-0.221	-1.27	-0.141	-1.474
39	ccc1_2	0.671	-0.106	-0.737	0.998	0.996	2.828	1.249	0.952	0.076	0.95	-0.566
40	vvv1_2	0.218	-0.497	-1.074	0.508	0.511	2.134	0.714	0.435	-0.332	0.458	-0.84
41	v1_2	0.009	-0.967	-1.725	0.409	0.411	2.822	0.711	0.307	-0.747	0.338	-1.159

就绪 平均值: -0.3844 计数: 10 求和: -3.844 100%

- CFA多组比较分析结果汇总表

“英语态度”构念的性别多组分析

Model	χ^2	df	χ^2/df	GFI	AGFI	CFI	RMR	RMSEA	$\Delta\chi^2(\Delta df)$
男生	83.84*	53	1.582	0.877	0.820	0.959	0.160	0.075	---
女生	83.82*	53	1.582	0.904	0.859	0.968	0.107	0.068	---
M ₁	175.99*	106	1.660	0.885	0.830	0.960	0.133	0.055	---
M ₂	199.96*	116	1.724	0.870	0.825	0.952	0.189	0.057	23.97*(10)
M ₃	205.62*	119	1.728	0.867	0.826	0.951	0.229	0.058	5.66(3)

* $p < 0.05$