HomeWork 4

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Use the covariance matrix in Weston & Gore (2006)

In the present model, self-efficacy beliefs (SEB), positive outcome expectations (POE), interests in career-related activities and occupations (ICO), and intention to engage in a particular career direction (IEC) are four latent variables and are shown by the circles. Observed variables were represented by rectangles. All latent variables are reflected by their own observed variables. Direct effects are also specified in this model. All latent variables are scaled by fixing a loading from the latent variable to an observed variable (e.g., SEB to SEB_1). The specified model is shown in Figure 1.

We have analyzed the data by using the `lavaan` package in `R`. The `lavaan` package is a free open source package that provide `R` users a good platform to perform latent variable related analysis, such as structural equation modeling (SEM). In the present work, we have analyzed the data in Weston & Gore (2006) and replicate the results in the paper.

The specified model is an over-identified model. There are 28 parameters to be estimated and a total number of 50 degree of freedom. The sample size is 403. The maximum likelihood estimator, which assumes multivariate normality is used in the present work. The optimization procedure used here is the PORT routines in the `nlminb` package. To be more specific, Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm is adopted. It belongs to quasi-Newton methods with Hessian approximation (for details).

Figure 2 shows the standardized results for the specified model. Results and fit indexes are shown as follow. Fit of the model: $\chi^2(50, N = 403) = 417.096$, $p < .05$; comparative fit index (CFI) = .913; root mean square error of approximation (RMSEA, 90% confidence interval) = .135 (.123 – .147); standardized root mean square residual (SRMR) = .052. Although no other model are presented here to perform the comparison, akaike information criterion (AIC), bayesian information criterion (BIC), and sample-size adjusted BIC (SABIC) are listed. AIC: 12614.681; BIC: 12726.651; SABIC: 12637.804. In addition to the standardized results in Figure 2, all estimates are shown in Table 1. Note that the results is really similar to the Figure 4 in Weston & Gore (2006). The only difference is that they show the disturbances but the present work shows the variance of the disturbances (e.g., disturbance of POE: $.788^2 = .621$).

We conclude that the results of `lavaan` and `EQS` are roughly the same. It is reasonable since the estimators used are the same (i.e., ML). Also, it somehow echoes the stability of the model and the sample data.

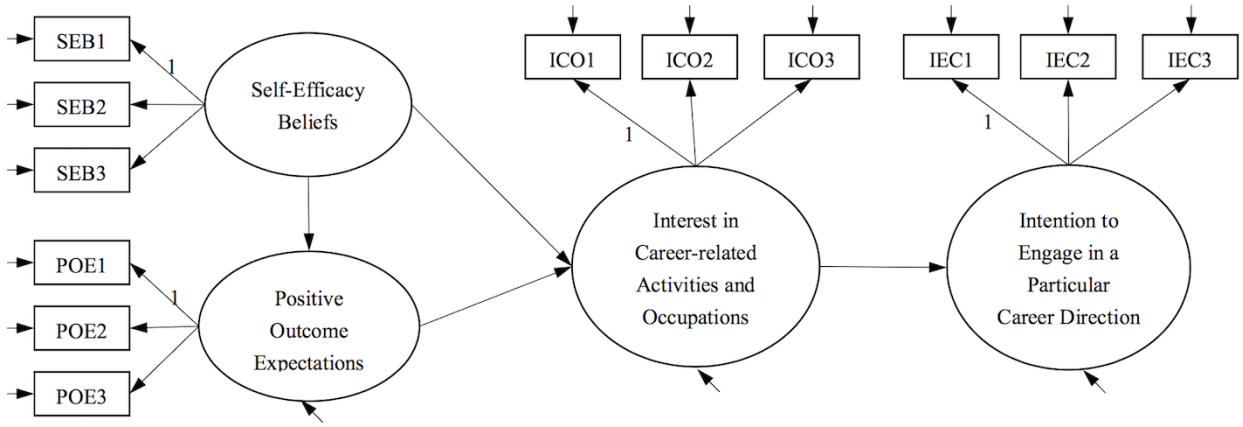

Figure 1: The specified model in the present work

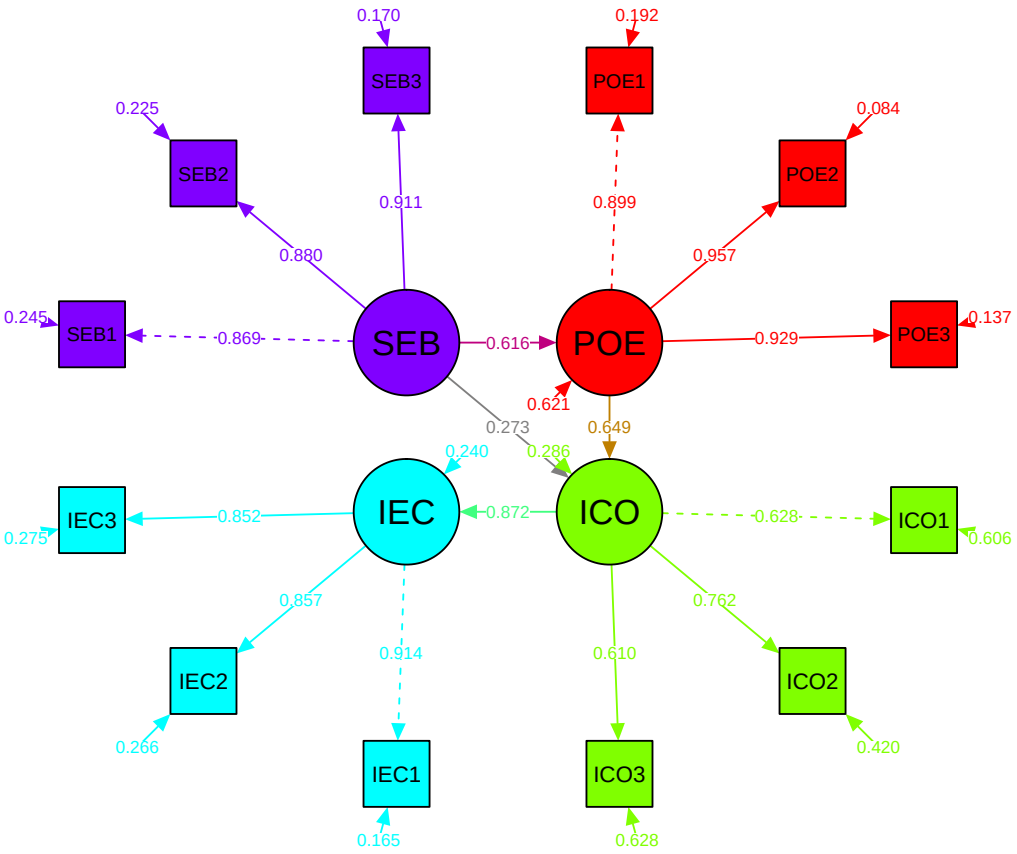

Figure 2: Standardized parameter estimates for the specified Model

Table 1. Details of Parameter Estimates

Latent Variable					
	Estimate	SE	*Z*	*P*	Std
POE					
POE1	1				0.899
POE2	0.976	0.03	32.971	0	0.957
POE3	0.993	0.032	30.666	0	0.929
ICO					
ICO1	1				0.628
ICO2	1.144	0.093	12.244	0	0.762
ICO3	1.011	0.098	10.339	0	0.61
IEC					
IEC1	1				0.914
IEC2	0.963	0.04	24.242	0	0.857
IEC3	0.795	0.033	23.964	0	0.852
SEB					
SEB1	1				0.869
SEB2	0.993	0.042	23.574	0	0.88
SEB3	1.009	0.041	24.795	0	0.911
Regressions					
	Estimate	SE	*Z*	*P*	Std
POE ~ SEB	0.498	0.039	12.673	0	0.616
ICO ~ SEB	0.019	0.004	5.187	0	0.273
ICO ~ POE	0.057	0.006	10.016	0	0.649
IEC ~ ICO	10.368	0.821	12.631	0	0.872
Variances					
	Estimate	SE	*Z*	*P*	Std
.POE1	0.88	0.078	11.333	0	0.192
.POE2	0.324	0.047	6.835	0	0.084
.POE3	0.579	0.06	9.633	0	0.137
.ICO1	0.043	0.003	12.869	0	0.606
.ICO2	0.027	0.002	11.314	0	0.42
.ICO3	0.049	0.004	12.99	0	0.628
.IEC1	0.793	0.1	7.928	0	0.165
.IEC2	1.346	0.126	10.718	0	0.266
.IEC3	0.96	0.088	10.881	0	0.275
.SEB1	1.836	0.179	10.277	0	0.245
.SEB2	1.624	0.166	9.78	0	0.225
.SEB3	1.183	0.147	8.023	0	0.17
.POE	2.296	0.21	10.927	0	0.621
.ICO	0.008	0.001	5.549	0	0.286
.IEC	0.961	0.15	6.404	0	0.24
SEB	5.657	0.526	10.747	0	1

Note. SE: standard error of estimates; Z: Z value; P: P value; Std: standrardized results.

Figure 3: Details of the parameter estimates