Which Method is More Powerful in Testing the Relationship of Theoretical Constructs: A Meta Comparison of Structural Equation Modeling and Path Analysis with Weighted-composites

Lifang Deng and Ke-Hai Yuan

This file contains the parameter estimates, their standard errors, and the corresponding z-statistics for CB-SEM, corresponding to the 9 datasets and 11 models as described in Deng and Yuan 2021. These are presented in 11 tables and follow the same order as in Deng and Yuan 2021. All the parameter estimates are obtained using the normal-distribution based maximum likelihood, the standard errors are obtained using the inverse of the information matrix. Path diagrams for all the models are also included for easy reference.

λ represents factor loadings,

γ represents the path coefficients from exogenous variables to endogenous variables,

β represents the path coefficients between endogenous variables,

ψ_x represents the measurement error variances for indicators of exogenous latent variables;

ψ_y represents the measurement error variances for indicators of endogenous latent variables;

σ_ζ^2 represents the variances of prediction errors.

Figure 1. A model for stability of alienation (Bentler, 2006l; Jöreskog & Sörbom, 1993; Wheaton et al., 1977, $N = 932$).

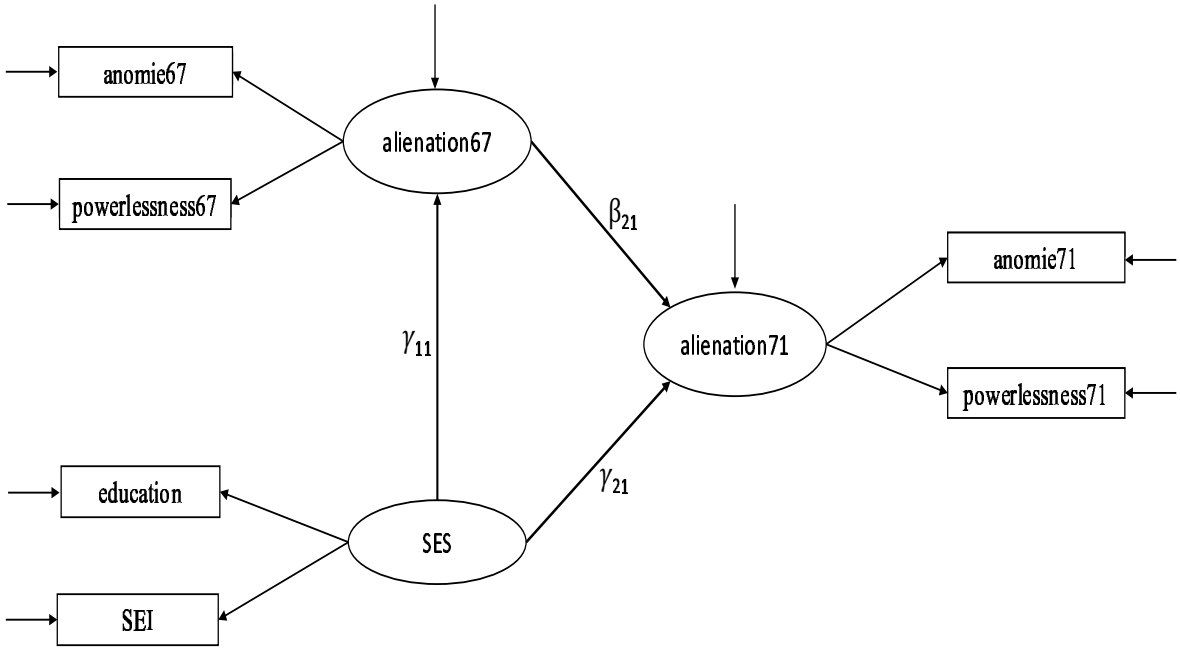

Table 1. Parameter estimates (est), their SEs (se) and z-statistics for the model in Figure 1 ($p = 6$, $N = 932$, $T_{ml} = 71.470$, $df = 6$, p-value=.000; RMSEA=.108, and CFI=.969).

θ	est	se	z	θ	est	se	z
$\lambda_{x1,1}$	2.582	0.124	20.796	ψ_{x1}	2.944	0.500	5.891
$\lambda_{x2,1}$	1.376	0.079	17.359	ψ_{x2}	2.610	0.182	14.307
$\lambda_{y1,1}$	1.000			ψ_{y1}	4.016	0.343	11.702
$\lambda_{y2,2}$	0.889	0.042	21.410	ψ_{y2}	3.191	0.271	11.757
$\lambda_{y3,2}$	1.000			ψ_{y3}	3.701	0.373	9.911
$\lambda_{y4,2}$	0.849	0.040	21.241	ψ_{y4}	3.625	0.292	12.410
γ_{11}	-1.585	0.120	-13.219	$\sigma^2_{\zeta_1}$	5.307	0.473	11.229
γ_{21}	-0.450	0.136	-3.303	$\sigma^2_{\zeta_2}$	3.741	0.388	9.653
β_{21}	0.705	0.054	13.163				

Figure 2. A longitudinal model for two versions of television possession and watching at three occasions (Jöreskog & Sörbom, 1993; Wiley & Hornik, 1973; $N = 189$).

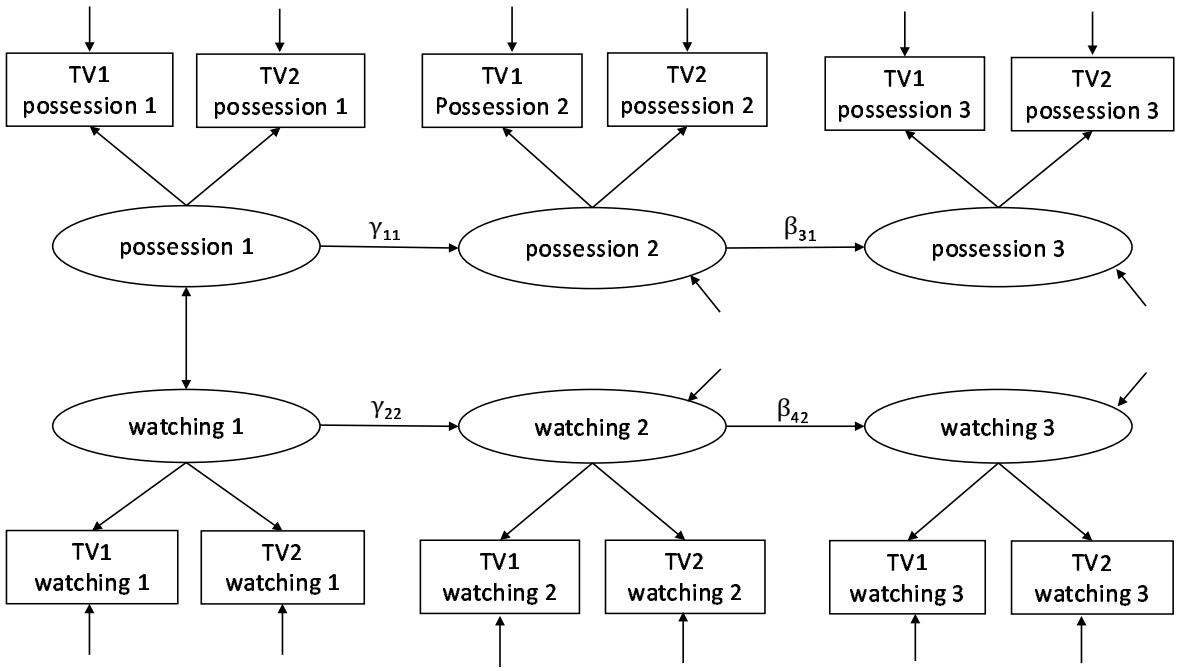

Table 2. Parameter estimates (est), their SEs (se) and z-statistics for the model in Figure 2 ($p = 12$, $N = 189$, $T_{ml} = 185.378$, $df = 49$, p-value=0; RMSEA=.122, and CFI=.938).

θ	est	se	z	θ	est	se	z
$\lambda_{x1,1}$	0.479	0.027	17.810	ψ_{x1}	0.018	0.004	4.047
$\lambda_{x2,1}$	0.473	0.027	17.362	ψ_{x2}	0.024	0.005	5.213
$\lambda_{x3,2}$	1.261	0.098	12.855	ψ_{x3}	0.722	0.124	5.805
$\lambda_{x4,2}$	1.008	0.104	9.699	ψ_{x4}	1.248	0.150	8.314
$\lambda_{y1,1}$	1.000			ψ_{y1}	0.021	0.004	5.615
$\lambda_{y2,1}$	1.014	0.032	31.728	ψ_{y2}	0.015	0.004	4.264
$\lambda_{y3,2}$	1.000			ψ_{y3}	0.918	0.136	6.751
$\lambda_{y4,2}$	0.700	0.080	8.755	ψ_{y4}	0.996	0.118	8.410
$\lambda_{y5,3}$	1.000			ψ_{y5}	0.011	0.004	2.486
$\lambda_{y6,3}$	0.976	0.032	30.363	ψ_{y6}	0.023	0.005	4.783
$\lambda_{y7,4}$	1.000			ψ_{y7}	0.809	0.167	4.830
$\lambda_{y8,4}$	0.795	0.092	8.655	ψ_{y8}	1.226	0.156	7.846
γ_{11}	0.421	0.029	14.282	$\sigma^2_{\zeta_1}$	0.051	0.007	7.077
γ_{22}	1.123	0.106	10.574	$\sigma^2_{\zeta_2}$	0.274	0.114	2.405
β_{31}	0.881	0.047	18.906	$\sigma^2_{\zeta_3}$	0.061	0.008	7.483
β_{42}	0.936	0.095	9.827	$\sigma^2_{\zeta_4}$	0.321	0.157	2.043
ϕ_{12}	0.723	0.044	16.270				

Figure 3. A model of home resources and educational achievement (Schumacker & Lomax, 2010, $N = 200$).

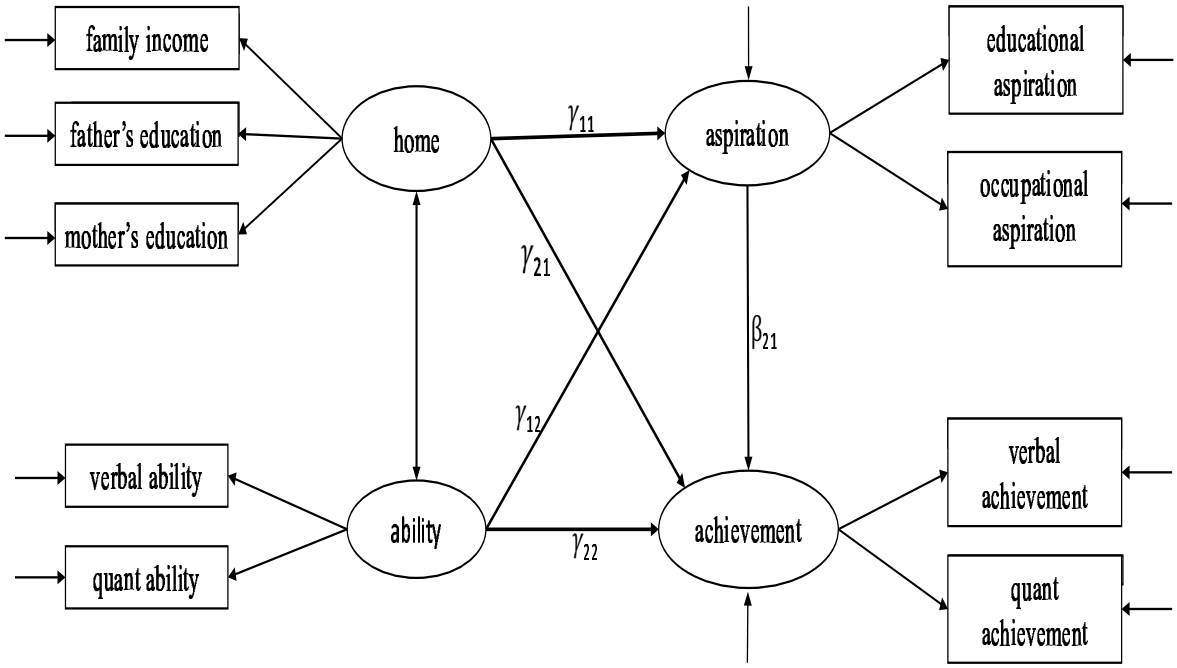

Table 3. Parameter estimates (est), their SEs (se) and z-statistics for the model in Figure 3 ($p = 9$, $N = 200$, $T_{ml} = 57.167$, $df = 21$, p-value$=3.39 \times 10^{-5}$; RMSEA=.093, and CFI=.974).

θ	est	se	z	θ	est	se	z
$\lambda_{x1,1}$	0.730	0.057	12.906	ψ_{x1}	0.320	0.040	8.086
$\lambda_{x2,1}$	0.735	0.047	15.630	ψ_{x2}	0.130	0.025	5.290
$\lambda_{x3,1}$	0.703	0.051	13.884	ψ_{x3}	0.222	0.030	7.375
$\lambda_{x4,2}$	0.814	0.054	14.998	ψ_{x4}	0.188	0.035	5.315
$\lambda_{x5,2}$	0.772	0.056	13.695	ψ_{x5}	0.274	0.038	7.128
$\lambda_{y1,1}$	1.000			ψ_{y1}	0.160	0.042	3.844
$\lambda_{y2,2}$	0.917	0.064	14.306	ψ_{y2}	0.351	0.048	7.351
$\lambda_{y3,2}$	1.000			ψ_{y3}	0.205	0.051	4.016
$\lambda_{y4,2}$	0.759	0.042	18.160	ψ_{y4}	0.342	0.044	7.846
γ_{11}	0.299	0.091	3.294	β_{21}	0.548	0.113	4.846
γ_{21}	0.177	0.093	1.900	ψ_{12}	0.726	0.046	15.938
γ_{12}	0.480	0.094	5.135	$\sigma^2_{\zeta_1}$	0.335	0.058	5.766
γ_{22}	0.611	0.113	5.414	$\sigma^2_{\zeta_2}$	0.225	0.058	3.901

Figure 4. A model of familial risk for psychopathology and child adjustment (Kline, 1998, Worland et al., 1984, $N = 158$).

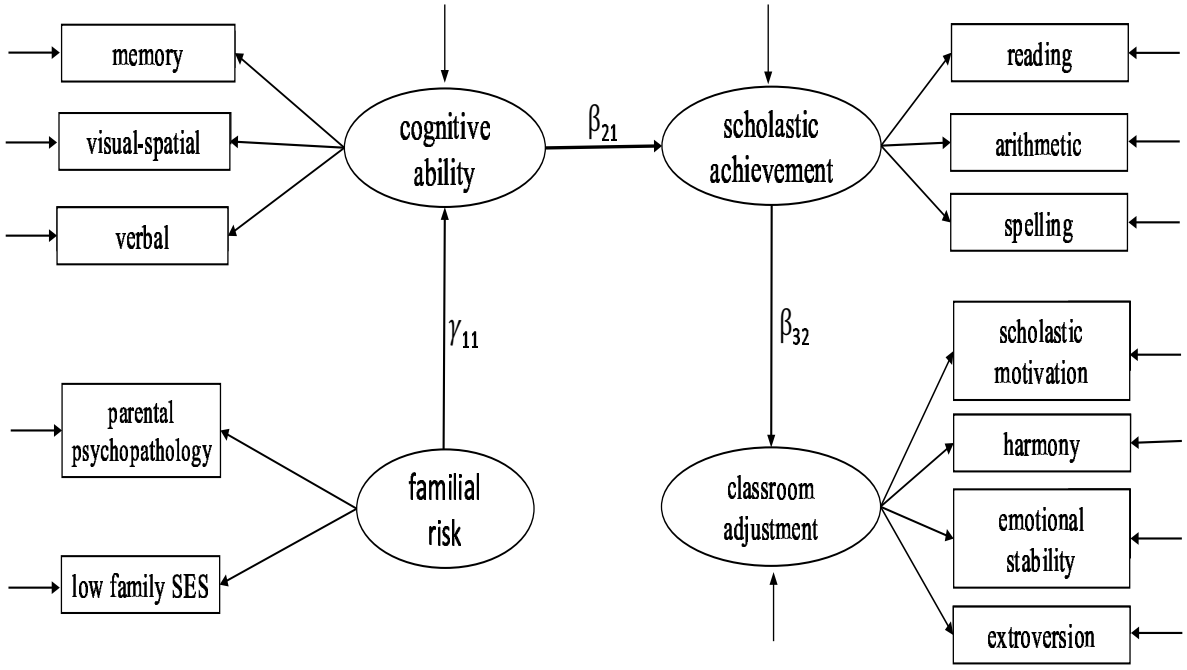

Table 4. Parameter estimates (est), their SEs (se) and z-statistics for the model in Figure 4 ($p = 12$, $N = 158$, $T_{ml} = 181.424$, p-value=.000; $df = 51$, RMSEA=.128, and CFI=.892).

θ	est	se	z	θ	est	se	z
$\lambda_{x1,1}$	0.614	0.089	6.895	ψ_{x1}	0.623	0.095	6.536
$\lambda_{x2,1}$	0.684	0.091	7.512	ψ_{x2}	0.532	0.100	5.314
$\lambda_{y1,1}$	1.000			ψ_{y1}	0.246	0.041	6.006
$\lambda_{y2,1}$	0.816	0.080	10.177	ψ_{y2}	0.498	0.063	7.961
$\lambda_{y3,1}$	0.950	0.074	12.831	ψ_{y3}	0.319	0.046	6.906
$\lambda_{y4,2}$	1.000			ψ_{y4}	0.104	0.024	4.320
$\lambda_{y5,2}$	0.845	0.058	14.447	ψ_{y5}	0.360	0.045	7.944
$\lambda_{y6,2}$	0.954	0.049	19.582	ψ_{y6}	0.185	0.029	6.380
$\lambda_{y7,3}$	1.000			ψ_{y7}	0.094	0.051	1.868
$\lambda_{y8,3}$	0.233	0.086	2.716	ψ_{y8}	0.951	0.108	8.824
$\lambda_{y9,3}$	0.854	0.070	12.260	ψ_{y9}	0.339	0.053	6.365
$\lambda_{y10,3}$	0.660	0.076	8.693	ψ_{y10}	0.606	0.073	8.277
γ_{11}	-0.650	0.088	-7.364	$\sigma^2_{\zeta_1}$	0.332	0.090	3.673
β_{21}	0.991	0.073	13.623	$\sigma^2_{\zeta_2}$	0.156	0.039	3.975
β_{32}	0.642	0.071	9.004	$\sigma^2_{\zeta_3}$	0.536	0.083	6.440

Figure 5. Two models of thought strategies and job satisfaction (Houghton & Jinkerson, 2007; Kline, 2016, $N = 263$).

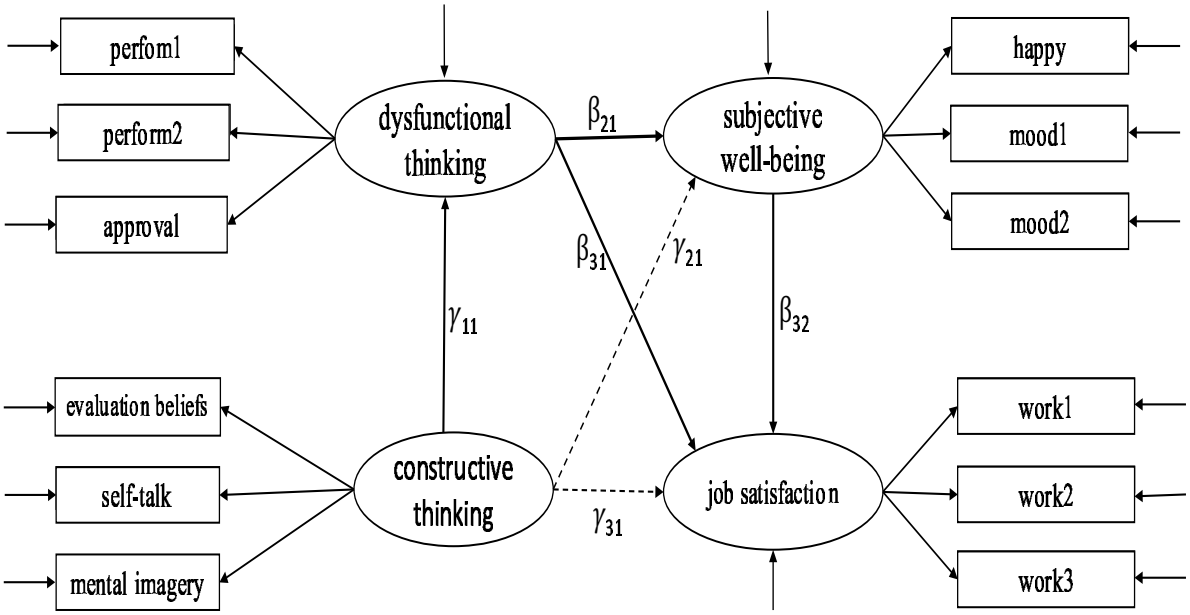

Table 5. Parameter estimates (est), their SEs (se) and z-statistics for the first model in Figure 5, excluding the two dashed arrows ($p = 12$, $N = 263$, $T_{ml} = 66.061$, $df = 50$, p-value=.064; RMSEA=.035, and CFI=.984).

θ	est	se	z	θ	est	se	z
$\lambda_{x1,1}$	0.464	0.055	8.509	ψ_{x1}	0.290	0.044	6.656
$\lambda_{x2,1}$	0.492	0.078	6.324	ψ_{x2}	1.021	0.098	10.421
$\lambda_{x3,1}$	0.864	0.086	10.020	ψ_{x3}	0.256	0.125	2.057
$\lambda_{y1,1}$	1.000			ψ_{y1}	0.105	0.016	6.689
$\lambda_{y2,1}$	1.126	0.080	14.081	ψ_{y2}	0.070	0.017	4.084
$\lambda_{y3,1}$	0.991	0.089	11.162	ψ_{y3}	0.301	0.030	10.157
$\lambda_{y4,2}$	1.000			ψ_{y4}	0.199	0.022	8.895
$\lambda_{y5,2}$	1.768	0.242	7.292	ψ_{y5}	0.213	0.045	4.755
$\lambda_{y6,2}$	0.812	0.125	6.472	ψ_{y6}	0.198	0.020	9.852
$\lambda_{y7,3}$	1.000			ψ_{y7}	0.260	0.042	6.168
$\lambda_{y8,3}$	1.031	0.081	12.705	ψ_{y8}	0.374	0.050	7.440
$\lambda_{y9,3}$	0.892	0.073	12.136	ψ_{y9}	0.383	0.044	8.630
γ_{11}	-0.065	0.036	-1.813				
β_{21}	-0.332	0.062	-5.371	$\sigma^2_{\zeta_1}$	0.233	0.031	7.585
β_{31}	-0.259	0.131	-1.980	$\sigma^2_{\zeta_2}$	0.091	0.020	4.450
β_{32}	0.907	0.220	4.116	$\sigma^2_{\zeta_3}$	0.473	0.067	7.022

Table 6. Parameter estimates (est), their SEs (se) and z-statistics for the second model in Figure 5, including the two dashed arrows ($p = 12$, $N = 263$, $T_{ml} = 62.231$, $df = 48$, p-value=.081; RMSEA=.034, and CFI=.986).

θ	est	se	z	θ	est	se	z
λ_{x1}	0.461	0.054	8.574	ψ_{x1}	0.293	0.043	6.858
λ_{x2}	0.486	0.077	6.271	ψ_{x2}	1.027	0.098	10.487
λ_{x3}	0.871	0.085	10.247	ψ_{x3}	0.243	0.123	1.968
λ_{y1}	1.000			ψ_{y1}	0.105	0.016	6.693
λ_{y2}	1.129	0.080	14.036	ψ_{y2}	0.069	0.017	4.005
λ_{y3}	0.992	0.089	11.156	ψ_{y3}	0.301	0.030	10.159
λ_{y4}	1.000			ψ_{y4}	0.201	0.022	8.976
λ_{y5}	1.792	0.246	7.283	ψ_{y5}	0.208	0.045	4.626
λ_{y6}	0.817	0.126	6.470	ψ_{y6}	0.198	0.020	9.870
λ_{y7}	1.000			ψ_{y7}	0.261	0.042	6.217
λ_{y8}	1.035	0.081	12.739	ψ_{y8}	0.370	0.050	7.385
λ_{y9}	0.891	0.074	12.123	ψ_{y9}	0.385	0.044	8.667
γ_{11}	-0.061	0.036	-1.690				
γ_{21}	0.036	0.026	1.387				
γ_{31}	0.066	0.056	1.194				
β_{21}	-0.317	0.061	-5.202	$\sigma^2_{\zeta_1}$	0.233	0.031	7.573
β_{31}	-0.251	0.130	-1.936	$\sigma^2_{\zeta_2}$	0.089	0.020	4.429
β_{32}	0.885	0.221	4.011	$\sigma^2_{\zeta_3}$	0.468	0.067	7.022

Figure 6. Two mediated models for self-efficacy belief on occupational considerations (Weston & Gore Jr 2006).

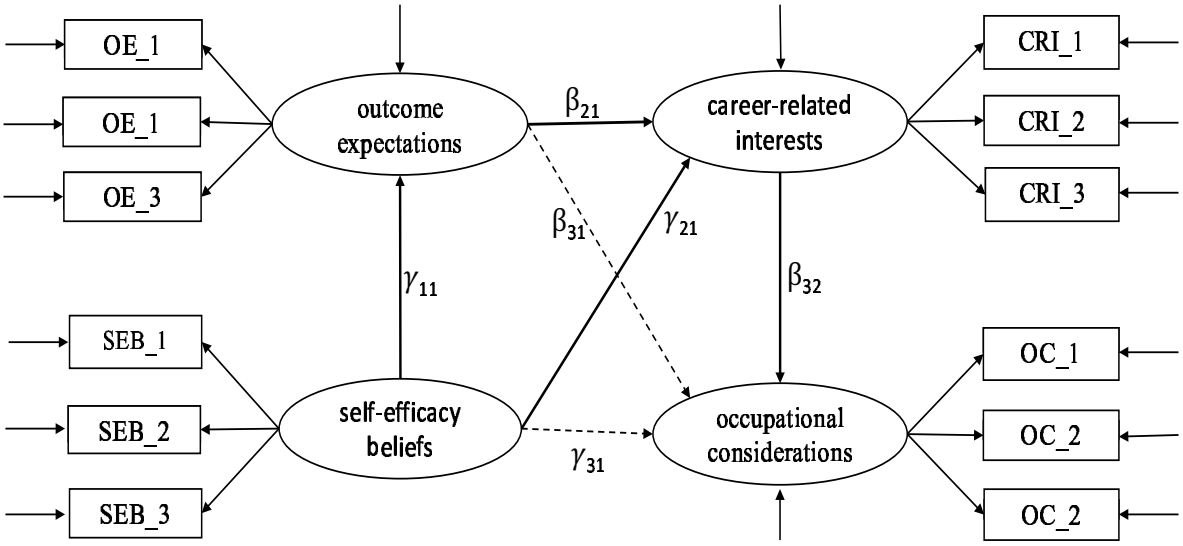

Table 7. Parameter estimates (est), their SEs (se) and z-statistics for the first model in Figure 6, excluding the two dashed arrows ($p = 12$, $N = 403$, $T_{ml} = 416.061$, $df = 50$, p-value=.000; RMSEA=.135, and CFI=.913).

θ	est	se	z	θ	est	se	z
$\lambda_{x1,1}$	2.381	0.111	21.467	ψ_{x1}	1.840	0.179	10.264
$\lambda_{x2,1}$	2.365	0.108	21.903	ψ_{x2}	1.628	0.167	9.768
$\lambda_{x3,1}$	2.402	0.104	23.145	ψ_{x3}	1.186	0.148	8.013
$\lambda_{y1,1}$	1.000			ψ_{y1}	0.882	0.078	11.318
$\lambda_{y2,1}$	0.976	0.030	32.930	ψ_{y2}	0.325	0.048	6.827
$\lambda_{y3,1}$	0.993	0.032	30.628	ψ_{y3}	0.580	0.060	9.621
$\lambda_{y4,2}$	1.000			ψ_{y4}	0.044	0.003	12.853
$\lambda_{y5,2}$	1.144	0.094	12.229	ψ_{y5}	0.027	0.002	11.300
$\lambda_{y6,2}$	1.011	0.098	10.326	ψ_{y6}	0.049	0.004	12.974
$\lambda_{y7,3}$	1.000			ψ_{y7}	0.795	0.100	7.918
$\lambda_{y8,3}$	0.963	0.040	24.212	ψ_{y8}	1.350	0.126	10.705
$\lambda_{y9,3}$	0.795	0.033	23.934	ψ_{y9}	0.962	0.089	10.867
γ_{11}	1.186	0.096	12.364				
γ_{21}	0.046	0.009	5.161	$\sigma^2_{\zeta_1}$	2.302	0.211	10.913
β_{21}	0.057	0.006	10.003	$\sigma^2_{\zeta_2}$	0.008	0.001	5.542
β_{32}	10.368	0.822	12.615	$\sigma^2_{\zeta_3}$	0.964	0.151	6.396

Table 8. Parameter estimates (est), their SEs (se) and z-statistics for the second model in Figure 6, including the two dashed arrows ($p = 12$, $N = 403$, $T_{ml} = 361.848$, $df = 48$, p-value=.000; RMSEA=.128, and CFI=.926).

θ	est	se	z	θ	est	se	z
λ_{x1}	2.387	0.111	21.551	ψ_{x1}	1.813	0.178	10.191
λ_{x2}	2.364	0.108	21.901	ψ_{x2}	1.630	0.166	9.791
λ_{x3}	2.398	0.104	23.074	ψ_{x3}	1.209	0.148	8.161
λ_{y1}	1.000			ψ_{y1}	0.881	0.078	11.335
λ_{y2}	0.978	0.030	33.086	ψ_{y2}	0.316	0.047	6.710
λ_{y3}	0.991	0.032	30.533	ψ_{y3}	0.592	0.061	9.773
λ_{y4}	1.000			ψ_{y4}	0.038	0.003	11.648
λ_{y5}	1.132	0.086	13.216	ψ_{y5}	0.021	0.003	8.126
λ_{y6}	1.020	0.089	11.511	ψ_{y6}	0.043	0.004	11.840
λ_{y7}	1.000			ψ_{y7}	0.858	0.101	8.498
λ_{y8}	0.979	0.040	24.399	ψ_{y8}	1.287	0.122	10.524
λ_{y9}	0.803	0.034	23.789	ψ_{y9}	0.956	0.088	10.892
γ_{11}	1.187	0.096	12.381				
γ_{21}	0.039	0.011	3.462				
γ_{31}	0.415	0.096	4.320				
β_{21}	0.055	0.006	8.510	$\sigma^2_{\zeta_1}$	2.299	0.211	10.916
β_{31}	0.390	0.061	6.347	$\sigma^2_{\zeta_2}$	0.016	0.002	6.393
β_{32}	3.968	0.715	5.550	$\sigma^2_{\zeta_3}$	1.188	0.135	8.781

Figure 7. A model of symptoms of alcoholism and psychopathology (Neumann, 1994, $N = 335$).

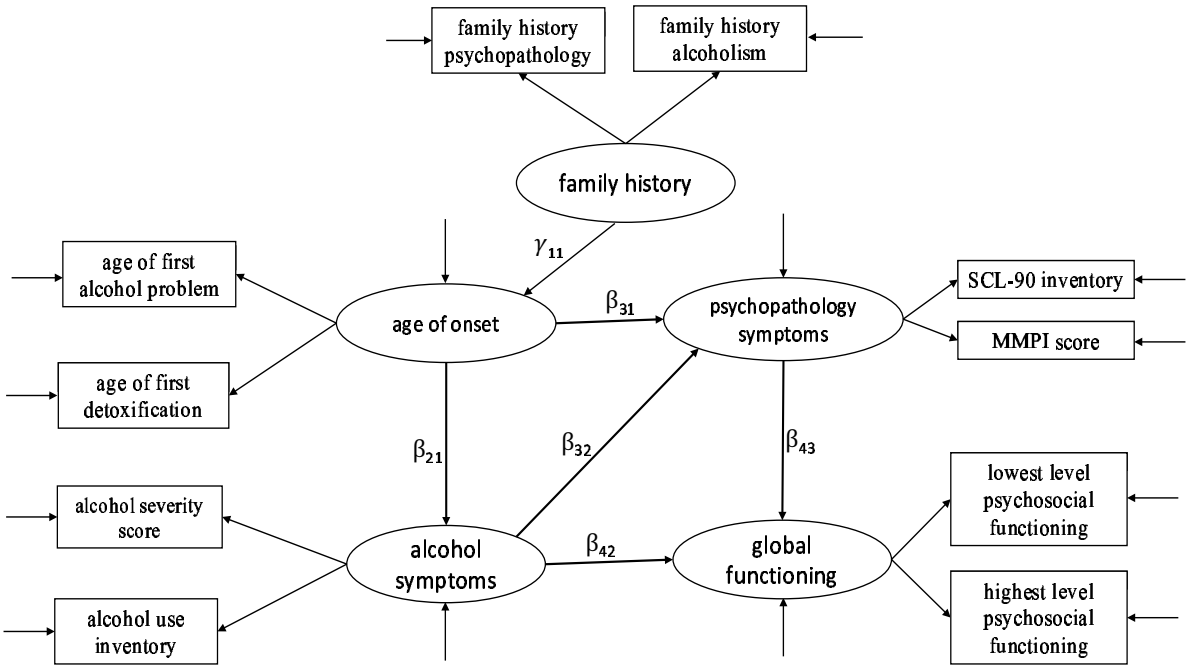

Table 9. Parameter estimates (est), their SEs (se) and z-statistics for the model in Figure 7 ($p = 10$, $N = 335$, $T_{ml} = 40.985$, $df = 29$, p-vale=.069; RMSEA=.035, and CFI=.987).

θ	est	se	z	θ	est	se	z
λ_{x1}	0.677	0.117	5.803	ψ_{x1}	1.325	0.164	8.079
λ_{x2}	0.698	0.105	6.622	ψ_{x2}	0.289	0.138	2.096
λ_{y1}	1.000			ψ_{y1}	0.233	0.068	3.412
λ_{y2}	0.940	0.090	10.422	ψ_{y2}	0.425	0.067	6.332
λ_{y3}	1.000			ψ_{y3}	0.418	0.054	7.772
λ_{y4}	1.096	0.087	12.563	ψ_{y4}	0.211	0.054	3.899
λ_{y5}	1.000			ψ_{y5}	0.262	0.076	3.471
λ_{y6}	0.805	0.093	8.634	ψ_{y6}	0.539	0.063	8.561
λ_{y7}	1.000			ψ_{y7}	0.479	0.142	3.381
λ_{y8}	0.594	0.121	4.923	ψ_{y8}	0.792	0.078	10.156
γ_{11}	-0.342	0.071	-4.819	σ_{ζ_1}	0.670	0.095	7.035
β_{21}	-0.483	0.067	-7.217	σ_{ζ_2}	0.482	0.067	7.215
β_{31}	0.087	0.074	1.182				
β_{32}	0.627	0.086	7.324	σ_{ζ_3}	0.497	0.086	5.771
β_{41}	-0.222	0.093	-2.381				
β_{42}	-0.418	0.101	-4.135	σ_{ζ_4}	0.488	0.141	3.456

Figure 8. A model of burnout and depression (Yuan & Deng, 2021, $N = 264$).

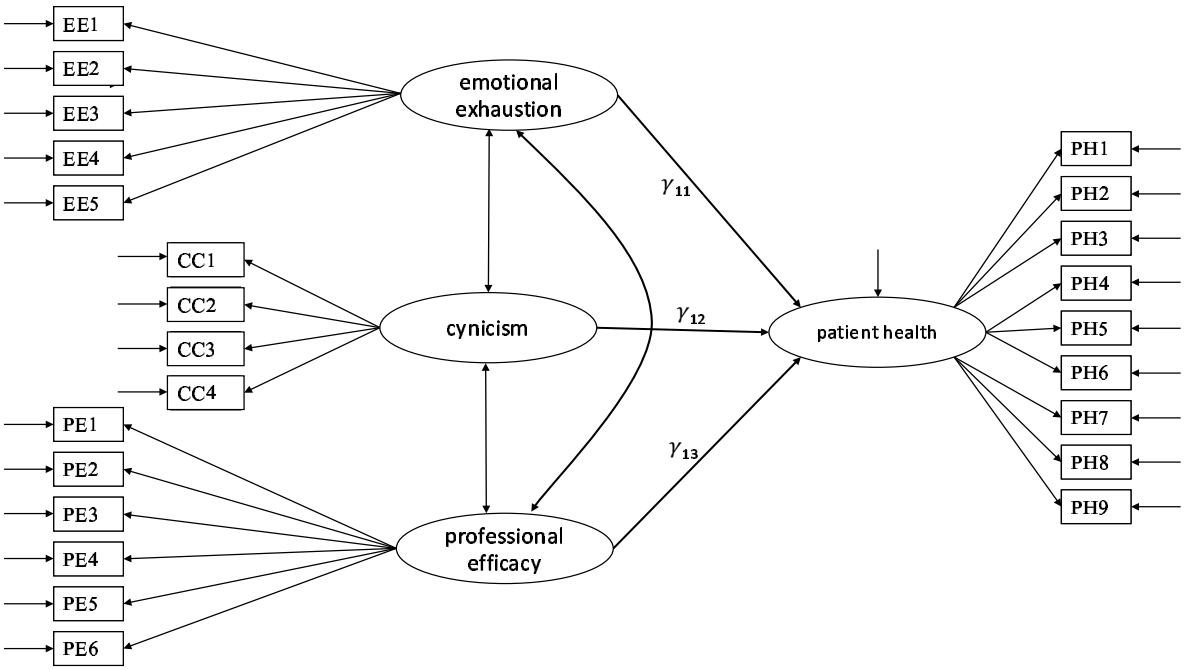

Table 10. Parameter estimates (est), their SEs (se) and z-statistics for the model in Figure 8 ($p = 24$, $N = 264$, $T_{ml} = 469.579$, $df = 246$, p-value=.000; RMSEA=.059, and CFI=.948).

θ	est	se	z	θ	est	se	z
λ_{x1}	1.006	0.060	16.820	ψ_{x1}	0.390	0.043	9.084
λ_{x2}	1.057	0.066	15.984	ψ_{x2}	0.535	0.056	9.558
λ_{x3}	1.202	0.072	16.621	ψ_{x3}	0.587	0.064	9.210
λ_{x4}	1.085	0.062	17.460	ψ_{x4}	0.379	0.044	8.612
λ_{x5}	1.110	0.068	16.365	ψ_{x5}	0.536	0.057	9.359
λ_{x6}	1.193	0.073	16.442	ψ_{x6}	0.588	0.067	8.814
λ_{x7}	1.288	0.071	18.155	ψ_{x7}	0.409	0.058	7.014
λ_{x8}	1.335	0.078	17.107	ψ_{x8}	0.612	0.074	8.235
λ_{x9}	1.071	0.081	13.157	ψ_{x9}	1.054	0.102	10.311
λ_{x10}	1.221	0.079	15.449	ψ_{x10}	0.823	0.083	9.935
λ_{x11}	1.399	0.080	17.445	ψ_{x11}	0.642	0.072	8.875
λ_{x12}	1.340	0.081	16.586	ψ_{x12}	0.744	0.079	9.421
λ_{x13}	1.234	0.084	14.738	ψ_{x13}	0.995	0.098	10.177
λ_{x14}	1.380	0.081	16.955	ψ_{x14}	0.715	0.078	9.207
λ_{x15}	1.304	0.080	16.337	ψ_{x15}	0.752	0.079	9.550
λ_{y1}	1.000			ψ_{y1}	0.174	0.018	9.667
λ_{y2}	1.034	0.072	14.441	ψ_{y2}	0.173	0.018	9.529
λ_{y3}	0.916	0.076	11.977	ψ_{y3}	0.270	0.026	10.497
λ_{y4}	0.918	0.065	14.032	ψ_{y4}	0.154	0.016	9.753
λ_{y5}	0.786	0.076	10.359	ψ_{y5}	0.305	0.028	10.835
λ_{y6}	0.999	0.076	13.200	ψ_{y6}	0.231	0.023	10.115
λ_{y7}	0.947	0.077	12.232	ψ_{y7}	0.270	0.026	10.428
λ_{y8}	0.921	0.074	12.440	ψ_{y8}	0.242	0.023	10.369
λ_{y9}	0.742	0.075	9.863	ψ_{y9}	0.310	0.028	10.914
γ_{11}	0.066	0.036	1.831	ϕ_{21}	0.451	0.055	8.260
γ_{12}	0.269	0.040	6.783	ϕ_{31}	-0.182	0.064	-2.832
γ_{13}	-0.044	0.032	-1.365	ϕ_{32}	-0.187	0.065	-2.887
σ_{ζ_1}	0.202	0.028	7.279				

Figure 9. A model of industrialization and democracy (Bollen, 1989, $N = 75$), each of the four factor loadings on democracy 1960 equals that on democracy 1965.

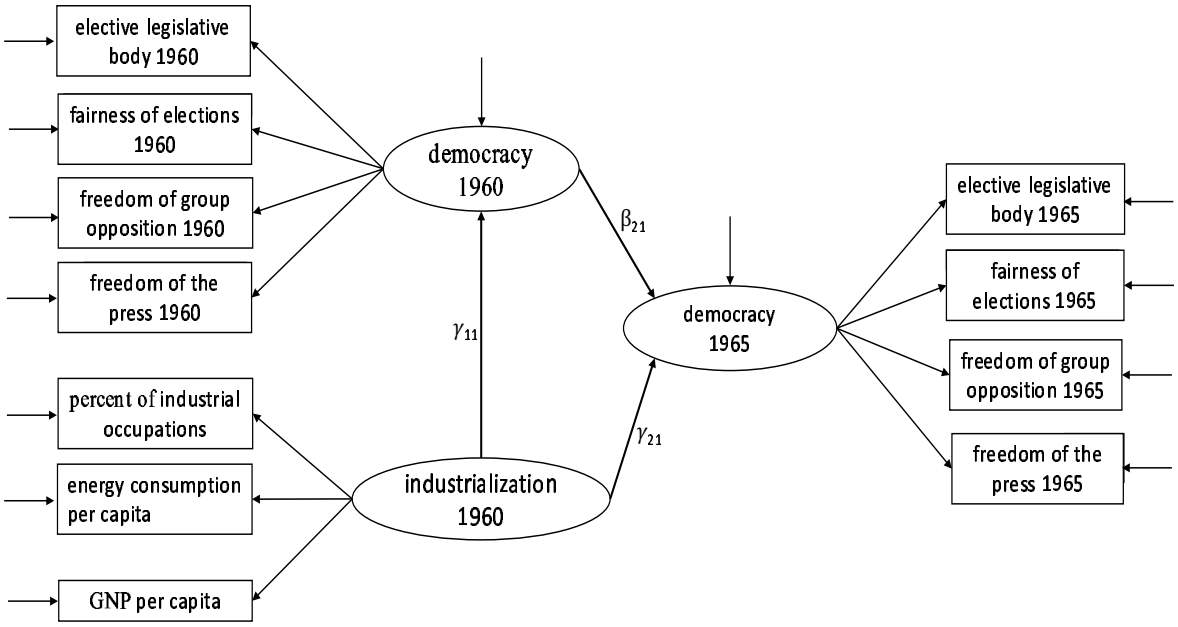

Table 11. Parameter estimates (est), their SEs (se) and z-statistics for the model in Figure 9 ($\lambda_{y2} = \lambda_{y6}$, $\lambda_{y3} = \lambda_{y7}$, $\lambda_{y4} = \lambda_{y8}$; $p = 11$, $N = 75$, $T_{ml} = 72.709$, $df = 44$, p-value=.004; RMSEA=.094 and CFI=.957).

θ	est	se	z	θ	est	se	z
λ_{x1}	0.672	0.066	10.167	ψ_{x1}	0.089	0.021	4.285
λ_{x2}	1.474	0.129	11.414	ψ_{x2}	0.106	0.072	1.475
λ_{x3}	1.225	0.130	9.392	ψ_{x3}	0.479	0.093	5.143
λ_{y1}	1.000			ψ_{y1}	1.959	0.398	4.918
λ_{y2}	1.289	0.119	10.794	ψ_{y2}	6.704	1.210	5.542
λ_{y3}	1.175	0.108	10.847	ψ_{y3}	5.388	0.976	5.523
λ_{y4}	1.300	0.103	12.625	ψ_{y4}	2.954	0.620	4.766
λ_{y5}	1.000			ψ_{y5}	2.422	0.457	5.302
λ_{y6}	1.289	0.119	10.794	ψ_{y6}	4.396	0.819	5.369
λ_{y7}	1.175	0.108	10.847	ψ_{y7}	3.648	0.680	5.367
λ_{y8}	1.300	0.103	12.625	ψ_{y8}	2.969	0.597	4.974
γ_{11}	0.981	0.267	3.670	$\sigma^2_{\zeta_1}$	3.852	0.830	4.643
γ_{21}	0.312	0.152	2.052	$\sigma^2_{\zeta_2}$	0.124	0.212	0.585
β_{21}	0.887	0.074	11.978				