Supplementary appendix: Bifactor analysis to partition the variance of the multidimensional scales

Analysis procedure

The 13 indicators of active leadership were further analysed and modelled as a bifactor model using Mplus 7.2 using maximum-likelihood estimation.[1-3] Bifactor models can be used to partition the variance of multidimensional scales, differentiating the variance of each indicator into a common and unique component. The unique component can then further differentiate an indicator-specific and random error component. The bifactor model was composed of one general active leadership factor (i.e., all 13 indicators loading on the same factor) and four factors signifying the implementation leadership-specific sub-factors (i.e., *exemplary behaviour, individualized consideration, intellectual stimulation,* and *contingent reward*). Thus, all items loaded on two separate factors: the general active leadership factor and one implementation leadership-specific sub-factor. These five factors were uncorrelated with each other.[1] Based on the standardized factor loadings, omega (ω), omega hierarchical (ωH), and omega subscale (ωS) were calculated. Omega (ω) estimates the amount of variance in the observed scores that is due to a common factor variance (i.e., all sources of common variance); it corresponds to coefficient alpha for the total score. Omega hierarchical (ωH) estimates the amount of total score variance that can be attributed to a single common factor (i.e., active implementation leadership), whereas omega subscale (ωS) indicates the proportion of the reliable score variance of indictors measuring a specific factor (i.e., exemplary behaviour, individualized consideration, intellectual stimulation and contingent reward) after the general active implementation leadership factor is controlled for.[1] Hence, the Omega subscale (ωS) is interpreted as the reliability of a specific sub-factor after the effect of other factors is controlled for. It is recommended that ωS be at least .50 so that the specific sub-factor is sufficiently systematic to be interpreted separately. [1]

Findings

Results from the bifactor model specifying the different variance components are presented in Table 1, where the standardized factor loadings (λ) for the common factor as well as the sub-factors are given.

The model fit (χ^2=25,922*, df=55, RMSEA=.102, CFI=.945, SRMR=.033) indicates mixed results, with some values above the recommended cut-off points. However, when fitting bifactor models the traditional fit indices may not be applicable, due to the use of polytomous items.[4] Table 1 also presents the three omega (ω) coefficients, which are based on the standardized factor loadings (λ) retrieved from the bifactor model (see formulas 3, 4, and 6 in Reise et al., 2010[1]). The general active implementation factor was reliable (ω estimate of .96), which indicates 96% of the variance in the observed scores was due to all sources of the common variance. Hence, there is a common factor showing systematic differences between individuals in active implementation leadership. The general active implementation leadership factor alone accounted for 92% of the variance (ωH=0.92), whereas the sub-dimensions of active implementation leadership show very low ωH coefficients. Hence, the sub-factors are systematic but account for very small parts of the total variance of active implementation leadership. This interpretation is also strengthened by ωS estimates, which indicate the proportion of reliable score variance of indictors measuring a specific sub-factor or perspective after the general active implementation leadership factor is controlled for. None of these ωS values is near the cut-off value of 0.50, recommended by Reise et al., 2010.[1]

Table 1. CFA bifactor model of active implementation leadership in the iLead scale.

	λ Active implementation leadership	**λ Exemplary behaviours**	**λ Individualized consideration**	**λ Intellectual stimulation**	**λ Contingent reward**
Item 1	.67*	.37*			
Item 2	.79*	.20*			
Item 3	.76*	.45*			
Item 4	.85*	.06			
Item 5	.84*	.27*			
Item 6	.70*	.46*			
Item 7	.80*		.26*		
Item 8	.74*		.26*		
Item 9	.83*			.14*	
Item 10	.76*			-.07	
Item 11	.78*			.62*	
Item 12	.75*				.39*
Item 13	.79*				.37*
ω	.96				
ωH	.92	.02	.002	.004	.005
ωS		.12	.08	.06	.16

Model fit: χ^2=25.922*; df=55; RMSEA=.102; CFI=.945; SRMR=.033

References

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