The Higher-Order Model Imposes a Proportionality Constraint: That is Why the Bifactor Model Tends to Fit Better

*Supplementary Material*

Table S1

*Simulated Correlation Matrix: Proportionality Constraint Satisfied 1*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .524 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .475 | 1.000 |  |  |  |  |  |  |
| b1 | .342 | .325 | .310 | 1.000 |  |  |  |  |  |
| b2 | .342 | .325 | .310 | .500 | 1.000 |  |  |  |  |
| b3 | .342 | .325 | .310 | .500 | .500 | 1.000 |  |  |  |
| c1 | .342 | .325 | .310 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .342 | .325 | .310 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .342 | .325 | .310 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S2

*Simulated Correlation Matrix: Proportionality Constraint Violated 1*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .550 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .451 | 1.000 |  |  |  |  |  |  |
| b1 | .342 | .325 | .310 | 1.000 |  |  |  |  |  |
| b2 | .342 | .325 | .310 | .500 | 1.000 |  |  |  |  |
| b3 | .342 | .325 | .310 | .500 | .500 | 1.000 |  |  |  |
| c1 | .342 | .325 | .310 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .342 | .325 | .310 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .342 | .325 | .310 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S3

*Simulated Correlation Matrix: Proportionality Constraint Violated 2*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .550 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .451 | 1.000 |  |  |  |  |  |  |
| b1 | .324 | .325 | .325 | 1.000 |  |  |  |  |  |
| b2 | .324 | .325 | .325 | .500 | 1.000 |  |  |  |  |
| b3 | .324 | .325 | .325 | .500 | .500 | 1.000 |  |  |  |
| c1 | .324 | .325 | .325 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .324 | .325 | .325 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .324 | .325 | .325 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S4

*Simulated Correlation Matrix: Proportionality Constraint Violated 3*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .576 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .428 | 1.000 |  |  |  |  |  |  |
| b1 | .324 | .325 | .325 | 1.000 |  |  |  |  |  |
| b2 | .324 | .325 | .325 | .500 | 1.000 |  |  |  |  |
| b3 | .324 | .325 | .325 | .500 | .500 | 1.000 |  |  |  |
| c1 | .324 | .325 | .325 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .324 | .325 | .325 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .324 | .325 | .325 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S5

*Simulated Correlation Matrix: Proportionality Constraint Violated 4*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .576 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .428 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .500 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .500 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S6

*Simulated Correlation Matrix: Proportionality Constraint Violated 5*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .605 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .406 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .500 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .500 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S7

*Simulated Correlation Matrix: Proportionality Constraint Violated 6*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .605 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .406 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .550 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .451 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S8

*Simulated Correlation Matrix: Proportionality Constraint Violated 7*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .605 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .406 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .576 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .428 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S9

*Simulated Correlation Matrix: Proportionality Constraint Violated 8*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .605 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .406 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .605 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .406 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .500 | 1.000 |

Table S10

*Simulated Correlation Matrix: Proportionality Constraint Violated 9*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .605 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .406 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .605 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .406 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .550 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .451 | 1.000 |

Table S11

*Simulated Correlation Matrix: Proportionality Constraint Violated 10*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .605 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .406 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .605 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .406 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .576 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .428 | 1.000 |

Table S12

*Simulated Correlation Matrix: Proportionality Constraint Violated 11*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a1 | a2 | a3 | b1 | b2 | b3 | c1 | c2 | c3 |
| a1 | 1.000 |  |  |  |  |  |  |  |  |
| a2 | .605 | 1.000 |  |  |  |  |  |  |  |
| a3 | .500 | .406 | 1.000 |  |  |  |  |  |  |
| b1 | .308 | .325 | .341 | 1.000 |  |  |  |  |  |
| b2 | .308 | .325 | .341 | .605 | 1.000 |  |  |  |  |
| b3 | .308 | .325 | .341 | .500 | .406 | 1.000 |  |  |  |
| c1 | .308 | .325 | .341 | .350 | .350 | .350 | 1.000 |  |  |
| c2 | .308 | .325 | .341 | .350 | .350 | .350 | .605 | 1.000 |  |
| c3 | .308 | .325 | .341 | .350 | .350 | .350 | .500 | .406 | 1.000 |