1   Two Stage Path Analysis with Corrected Standard Error (Updated lavaan)

2   Jimmy[1]

3   [1] University of Southern California

4   Author Note

5   Add Note

6   Two Stage Path Analysis with Corrected Standard Error (Updated lavaan)

7   **Results**

Table 1

Standardized Bias and Raw Bias of Path Coefficient Estimates (γ) Across 2,000 Replications.

		Joint SEM		Global SAM		Local SAM		2S-PA		2S-PA Rel	
p	N/p	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
						$\gamma = 0$					
5	6	-0.00 (-0.00)	0.03 (0.01)	-0.00 (-0.00)	0.03 (0.01)	-0.00 (-0.00)	0.03 (0.01)	-0.00 (-0.00)	0.02 (0.01)	-0.00 (-0.00)	0.02 (0.01)
	25	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)
	100	-0.02 (-0.00)	0.04 (0.00)	-0.02 (-0.00)	0.04 (0.00)	-0.02 (-0.00)	0.04 (0.00)	-0.02 (-0.00)	0.04 (0.00)	-0.02 (-0.00)	0.04 (0.00)
10	6	-0.02 (-0.00)	-0.00 (-0.00)	-0.02 (-0.00)	-0.00 (-0.00)	-0.02 (-0.00)	-0.00 (-0.00)	-0.02 (-0.00)	-0.00 (-0.00)	-0.02 (-0.00)	-0.00 (-0.00)
	25	0.03 (0.00)	-0.01 (-0.00)	0.03 (0.00)	-0.01 (-0.00)	0.03 (0.00)	-0.01 (-0.00)	0.03 (0.00)	-0.01 (-0.00)	0.03 (0.00)	-0.01 (-0.00)
	100	0.05 (0.00)	0.02 (0.00)	0.05 (0.00)	0.02 (0.00)	0.05 (0.00)	0.02 (0.00)	0.05 (0.00)	0.02 (0.00)	0.05 (0.00)	0.02 (0.00)
20	6	0.01 (0.00)	-0.01 (-0.00)	0.01 (0.00)	-0.01 (-0.00)	0.01 (0.00)	-0.01 (-0.00)	0.00 (0.00)	-0.01 (-0.00)	0.00 (0.00)	-0.01 (-0.00)
	25	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)	-0.02 (-0.00)
	100	-0.00 (-0.00)	0.00 (0.00)	-0.00 (-0.00)	0.00 (0.00)	-0.00 (-0.00)	0.00 (0.00)	-0.00 (-0.00)	0.00 (0.00)	-0.00 (-0.00)	0.00 (0.00)
						$\gamma = 0.3$					
5	6	-0.10 (-0.03)	0.01 (0.00)	-0.30 (-0.08)	-0.04 (-0.01)	-0.30 (-0.08)	-0.04 (-0.01)	-0.15 (-0.05)	0.01 (0.00)	-0.15 (-0.05)	0.01 (0.00)
	25	-0.00 (-0.00)	-0.05 (-0.00)	-0.10 (-0.01)	-0.07 (-0.01)	-0.10 (-0.01)	-0.07 (-0.01)	-0.01 (-0.00)	-0.05 (-0.00)	-0.01 (-0.00)	-0.05 (-0.00)
	100	0.04 (0.00)	-0.00 (-0.00)	-0.01 (-0.00)	-0.01 (-0.00)	-0.01 (-0.00)	-0.01 (-0.00)	0.04 (0.00)	-0.00 (-0.00)	0.04 (0.00)	-0.00 (-0.00)
10	6	-0.18 (-0.04)	-0.01 (-0.00)	-0.29 (-0.06)	-0.04 (-0.00)	-0.29 (-0.06)	-0.04 (-0.00)	-0.26 (-0.06)	-0.01 (-0.00)	-0.26 (-0.06)	-0.01 (-0.00)
	25	0.01 (0.00)	0.00 (0.00)	-0.05 (-0.00)	-0.01 (-0.00)	-0.05 (-0.00)	-0.01 (-0.00)	0.01 (0.00)	0.00 (0.00)	0.01 (0.00)	0.00 (0.00)
	100	-0.05 (-0.00)	-0.05 (-0.00)	-0.08 (-0.00)	-0.05 (-0.00)	-0.08 (-0.00)	-0.05 (-0.00)	-0.05 (-0.00)	-0.05 (-0.00)	-0.05 (-0.00)	-0.05 (-0.00)
20	6	-0.30 (-0.06)	-0.01 (-0.00)	-0.35 (-0.07)	-0.02 (-0.00)	-0.35 (-0.07)	-0.02 (-0.00)	-0.36 (-0.08)	-0.01 (-0.00)	-0.36 (-0.08)	-0.01 (-0.00)
	25	-0.07 (-0.00)	0.00 (0.00)	-0.10 (-0.01)	-0.01 (-0.00)	-0.10 (-0.01)	-0.01 (-0.00)	-0.07 (-0.00)	0.00 (0.00)	-0.07 (-0.00)	0.00 (0.00)
	100	0.01 (0.00)	-0.00 (-0.00)	-0.00 (-0.00)	-0.01 (-0.00)	-0.00 (-0.00)	-0.01 (-0.00)	0.01 (0.00)	-0.00 (-0.00)	0.01 (0.00)	-0.00 (-0.00)
						$\gamma = 0.6$					
5	6	-0.15 (-0.05)	-0.01 (-0.00)	**-0.54 (-0.15)**	-0.15 (-0.02)	**-0.54 (-0.15)**	-0.15 (-0.02)	-0.24 (-0.09)	-0.02 (-0.00)	-0.24 (-0.09)	-0.02 (-0.00)
	25	-0.02 (-0.00)	-0.06 (-0.00)	-0.27 (-0.03)	-0.12 (-0.01)	-0.27 (-0.03)	-0.12 (-0.01)	-0.02 (-0.00)	-0.06 (-0.00)	-0.02 (-0.00)	-0.06 (-0.00)
	100	-0.02 (-0.00)	-0.01 (-0.00)	-0.14 (-0.01)	-0.04 (-0.00)	-0.14 (-0.01)	-0.04 (-0.00)	-0.02 (-0.00)	-0.01 (-0.00)	-0.02 (-0.00)	-0.01 (-0.00)
10	6	-0.25 (-0.08)	0.01 (0.00)	**-0.41 (-0.13)**	-0.05 (-0.01)	**-0.41 (-0.13)**	-0.05 (-0.01)	-0.32 (-0.12)	0.00 (0.00)	-0.32 (-0.12)	0.00 (0.00)
	25	0.01 (0.00)	-0.02 (-0.00)	-0.12 (-0.01)	-0.05 (-0.00)	-0.12 (-0.01)	-0.05 (-0.00)	0.02 (0.00)	-0.02 (-0.00)	0.02 (0.00)	-0.02 (-0.00)
	100	-0.04 (-0.00)	-0.02 (-0.00)	-0.11 (-0.00)	-0.04 (-0.00)	-0.11 (-0.00)	-0.04 (-0.00)	-0.04 (-0.00)	-0.02 (-0.00)	-0.04 (-0.00)	-0.02 (-0.00)
20	6	-0.33 (-0.12)	-0.03 (-0.00)	-0.39 (-0.15)	-0.06 (-0.00)	-0.39 (-0.15)	-0.06 (-0.00)	-0.38 (-0.16)	-0.03 (-0.00)	-0.38 (-0.16)	-0.03 (-0.00)
	25	-0.06 (-0.00)	0.01 (0.00)	-0.13 (-0.01)	-0.01 (-0.00)	-0.13 (-0.01)	-0.01 (-0.00)	-0.07 (-0.00)	0.01 (0.00)	-0.07 (-0.00)	0.01 (0.00)
	100	0.01 (0.00)	-0.02 (-0.00)	-0.03 (-0.00)	-0.03 (-0.00)	-0.03 (-0.00)	-0.03 (-0.00)	0.01 (0.00)	-0.02 (-0.00)	0.01 (0.00)	-0.02 (-0.00)

Table 2

Raw Relative Standard Error (SE) Bias Ratio and Outlier Proportion of SE (%) of Path Coefficient Estimates (γ) Across 2,000 Replications.

		Joint SEM		Global SAM		Local SAM	
p	N/p	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
				$\gamma = 0$			
5	6	**-26.33 (2.80)**	-9.57 (5.40)	-7.38 (1.95)	-5.86 (5.85)	-7.38 (1.95)	-5.86 (5.85)
	25	-5.65 (2.45)	1.21 (3.95)	-1.54 (1.95)	1.88 (4.05)	-1.54 (1.95)	1.88 (4.05)
	100	-2.99 (1.10)	-1.58 (2.00)	-2.10 (1.05)	-1.43 (2.00)	-2.10 (1.05)	-1.43 (2.00)
10	6	-9.76 (2.65)	-0.32 (6.10)	-1.54 (2.15)	0.80 (5.95)	-1.54 (2.15)	0.80 (5.95)
	25	-2.24 (1.45)	-2.18 (3.00)	-0.49 (1.45)	-1.95 (3.00)	-0.49 (1.45)	-1.95 (3.00)
	100	-2.40 (0.80)	2.90 (1.70)	-2.07 (0.85)	2.97 (1.70)	-2.07 (0.85)	2.97 (1.70)
20	6	-3.76 (1.95)	-1.32 (6.00)	-1.15 (1.90)	-0.98 (5.95)	-1.15 (1.90)	-0.98 (5.95)
	25	-1.97 (0.90)	1.85 (3.25)	-1.25 (0.80)	1.94 (3.25)	-1.25 (0.80)	1.94 (3.25)
	100	-2.83 (1.10)	-2.88 (1.35)	-2.68 (1.05)	-2.85 (1.35)	-2.68 (1.05)	-2.85 (1.35)
				$\gamma = 0.3$			
5	6	**-33.11 (1.95)**	-7.48 (1.70)	**-15.67 (1.95)**	-3.64 (1.95)	**-15.67 (1.95)**	-3.64 (1.95)
	25	-6.50 (1.20)	-2.30 (0.95)	-2.76 (1.25)	-1.62 (0.95)	-2.76 (1.25)	-1.62 (0.95)
	100	2.00 (0.95)	0.61 (0.70)	2.95 (0.90)	0.76 (0.75)	2.95 (0.90)	0.76 (0.75)
10	6	**-30.70 (1.30)**	-3.67 (1.95)	**-24.93 (1.40)**	-2.58 (2.00)	**-24.93 (1.40)**	-2.58 (2.00)
	25	-4.70 (1.00)	0.87 (0.45)	-3.01 (1.00)	1.13 (0.45)	-3.01 (1.00)	1.13 (0.45)
	100	0.22 (0.55)	-0.94 (1.25)	0.66 (0.55)	-0.87 (1.25)	0.66 (0.55)	-0.87 (1.25)
20	6	**-50.89 (0.95)**	-7.03 (1.20)	**-49.89 (0.90)**	-6.65 (1.20)	**-49.89 (0.90)**	-6.65 (1.20)
	25	**-13.09 (0.50)**	1.58 (0.90)	**-12.55 (0.40)**	1.66 (0.95)	**-12.55 (0.40)**	1.66 (0.95)
	100	0.07 (0.55)	-2.21 (0.80)	0.07 (0.65)	-2.20 (0.80)	0.07 (0.65)	-2.20 (0.80)
				$\gamma = 0.6$			
5	6	**-45.21 (0.60)**	-7.96 (0.00)	**-33.50 (1.40)**	-3.71 (0.10)	**-33.46 (1.40)**	-3.71 (0.10)
	25	-6.10 (0.55)	-2.72 (0.65)	-1.89 (0.80)	-1.87 (0.65)	-1.89 (0.80)	-1.87 (0.65)
	100	-0.85 (0.75)	0.38 (0.50)	0.07 (0.90)	0.54 (0.50)	0.07 (0.90)	0.54 (0.50)
10	6	**-60.39 (0.45)**	-6.25 (0.45)	**-58.18 (0.60)**	-4.85 (0.45)	**-58.18 (0.60)**	-4.85 (0.45)
	25	**-14.31 (0.45)**	-0.45 (0.50)	**-12.47 (0.50)**	-0.16 (0.55)	**-12.47 (0.50)**	-0.16 (0.55)
	100	-2.07 (0.90)	0.51 (0.90)	-1.54 (0.95)	0.63 (0.85)	-1.54 (0.95)	0.63 (0.85)
20	6	**-78.74 (1.00)**	**-18.14 (0.60)**	**-78.66 (0.95)**	**-17.66 (0.65)**	**-78.66 (0.95)**	**-17.66 (0.65)**
	25	**-19.72 (0.55)**	-3.48 (0.95)	**-35.41 (0.70)**	-3.35 (0.95)	**-35.41 (0.70)**	-3.35 (0.95)
	100	1.48 (0.90)	1.22 (0.90)	1.63 (1.05)	1.25 (0.85)	1.63 (1.05)	1.25 (0.85)

Table 3

Raw Relative Standard Error (SE) Bias Ratio and Outlier Proportion of SE (%) of Path Coefficient Estimates (γ) Across 2,000 Replications (for 2S-PA Methods).

		2S-PA		2S-PA-Rel		2S-PA Corrected		2S-PA-Rel Corrected	
p	N/p	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
					$\gamma = 0$				
5	6	**13.99 (10.00)**	-8.81 (6.05)	**-16.76 (9.60)**	-8.52 (6.20)	**97.57 (10.10)**	-8.76 (6.10)	**-11.92 (9.40)**	-8.48 (6.10)
	25	-5.48 (2.50)	1.21 (3.90)	-5.25 (2.55)	1.28 (3.65)	-5.29 (2.55)	1.22 (3.95)	-5.15 (2.65)	1.28 (3.55)
	100	-2.99 (1.10)	-1.58 (2.00)	-2.93 (1.05)	-1.57 (1.95)	-2.95 (1.05)	-1.58 (2.00)	-2.91 (1.05)	-1.56 (1.95)
10	6	-9.72 (2.75)	-0.32 (6.10)	-9.28 (2.30)	-0.19 (5.75)	-9.46 (2.25)	-0.31 (6.00)	-9.15 (2.15)	-0.18 (5.80)
	25	-2.25 (1.45)	-2.18 (3.00)	-2.14 (1.35)	-2.15 (2.95)	-2.20 (1.45)	-2.18 (3.00)	-2.11 (1.35)	-2.15 (2.95)
	100	-2.40 (0.80)	2.90 (1.70)	-2.37 (0.80)	2.91 (1.45)	-2.39 (0.80)	2.91 (1.70)	-2.36 (0.80)	2.91 (1.45)
20	6	-3.76 (1.95)	-1.32 (6.00)	-3.60 (1.70)	-1.28 (5.95)	-3.73 (1.95)	-1.32 (6.00)	-3.58 (1.60)	-1.27 (5.95)
	25	-1.97 (0.90)	1.85 (3.25)	-1.93 (1.00)	1.86 (3.00)	-1.96 (1.00)	1.85 (3.25)	-1.92 (0.95)	1.86 (3.00)
	100	-2.83 (1.10)	-2.88 (1.35)	-2.82 (1.10)	-2.88 (1.35)	-2.83 (1.10)	-2.88 (1.35)	-2.82 (1.10)	-2.88 (1.35)
					$\gamma = 0.3$				
5	6	**-30.55 (8.25)**	-7.03 (1.75)	**-29.44 (8.10)**	-6.17 (1.95)	**-24.38 (8.75)**	-6.87 (1.70)	**-27.83 (8.10)**	-6.01 (1.85)
	25	-7.63 (1.25)	-2.32 (0.95)	-6.05 (1.20)	-1.57 (1.00)	-6.26 (1.05)	-2.23 (0.95)	-5.34 (1.40)	-1.50 (0.95)
	100	1.80 (0.95)	0.59 (0.70)	3.42 (1.05)	1.36 (0.70)	2.99 (0.80)	0.67 (0.75)	4.04 (0.85)	1.42 (0.70)
10	6	**-37.52 (1.40)**	-3.67 (1.95)	**-36.39 (1.35)**	-2.94 (1.90)	**-36.88 (1.15)**	-3.61 (1.95)	**-36.04 (1.35)**	-2.89 (1.80)
	25	-4.76 (1.00)	0.86 (0.45)	-3.26 (1.10)	1.57 (0.45)	-4.03 (0.95)	0.91 (0.45)	-2.85 (1.15)	1.61 (0.45)
	100	0.16 (0.50)	-0.94 (1.25)	1.64 (0.55)	-0.27 (1.20)	0.86 (0.55)	-0.90 (1.25)	2.03 (0.55)	-0.23 (1.25)
20	6	**-54.89 (0.95)**	-8.08 (1.20)	**-54.27 (1.05)**	-7.59 (1.20)	**-54.73 (0.90)**	-8.05 (1.20)	**-54.17 (1.10)**	-7.56 (1.20)
	25	**-15.02 (0.50)**	1.58 (0.90)	**-13.92 (0.35)**	2.09 (0.95)	**-14.75 (0.40)**	1.60 (0.90)	**-13.74 (0.35)**	2.12 (0.95)
	100	0.05 (0.50)	-2.22 (0.80)	1.35 (0.55)	-1.72 (0.80)	0.38 (0.55)	-2.19 (0.80)	1.56 (0.55)	-1.70 (0.80)
					$\gamma = 0.6$				
5	6	**-53.53 (3.70)**	-9.30 (0.05)	**-52.26 (4.05)**	-5.94 (0.15)	**-23.70 (5.60)**	-8.44 (0.10)	**-48.18 (4.80)**	-5.28 (0.15)
	25	-7.41 (0.60)	-2.87 (0.65)	-0.92 (1.10)	0.89 (0.70)	-0.03 (0.95)	-2.22 (0.65)	2.76 (1.00)	1.40 (0.70)
	100	-1.91 (0.90)	0.23 (0.50)	5.00 (0.95)	4.22 (0.55)	5.05 (1.00)	0.89 (0.50)	8.50 (0.95)	4.74 (0.55)
10	6	**-67.29 (0.40)**	-9.28 (0.45)	**-65.10 (0.60)**	-6.02 (0.45)	**-65.57 (0.75)**	-8.84 (0.45)	**-64.18 (0.65)**	-5.67 (0.45)
	25	**-12.27 (0.45)**	-0.50 (0.50)	-6.10 (0.50)	3.10 (0.55)	-7.89 (0.50)	-0.06 (0.50)	-3.76 (0.50)	3.46 (0.55)
	100	-2.44 (0.90)	0.46 (0.90)	4.35 (0.90)	4.12 (0.75)	2.24 (0.95)	0.91 (0.90)	6.85 (1.05)	4.48 (0.70)
20	6	**-80.80 (0.95)**	**-18.15 (0.60)**	**-79.61 (1.00)**	**-15.93 (0.60)**	**-80.34 (0.85)**	**-17.98 (0.65)**	**-79.32 (0.85)**	**-15.78 (0.60)**
	25	**-36.20 (0.55)**	-3.49 (0.95)	**-32.18 (0.70)**	-0.84 (0.90)	**-34.66 (0.65)**	-3.29 (0.95)	**-31.21 (0.65)**	-0.66 (0.90)
	100	1.34 (0.90)	1.21 (0.90)	7.83 (0.85)	3.99 (0.65)	3.83 (0.95)	1.42 (0.85)	9.39 (0.90)	4.17 (0.65)

Table 4

Robust Relative Standard Error (SE) Bias Ratio and Outlier Proportion of SE (%) of Path Coefficient Estimates (γ) Across 2,000 Replications.

p	N/p	Joint SEM		Global SAM		Local SAM	
		$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
				$\gamma = 0$			
5	6	**-26.87 (2.80)**	**-10.15 (5.40)**	-8.63 (1.95)	-7.36 (5.85)	-8.63 (1.95)	-7.36 (5.85)
	25	-8.08 (2.45)	-1.70 (3.95)	-4.11 (1.95)	-1.23 (4.05)	-4.11 (1.95)	-1.23 (4.05)
	100	-6.05 (1.10)	-3.51 (2.00)	-5.39 (1.05)	-3.35 (2.00)	-5.39 (1.05)	-3.35 (2.00)
10	6	**-10.49 (2.65)**	1.95 (6.10)	-3.45 (2.15)	3.71 (5.95)	-3.44 (2.15)	3.71 (5.95)
	25	-3.09 (1.45)	-4.17 (3.00)	-1.91 (1.45)	-3.97 (3.00)	-1.91 (1.45)	-3.97 (3.00)
	100	-4.20 (0.80)	3.45 (1.70)	-4.13 (0.85)	3.51 (1.70)	-4.13 (0.85)	3.51 (1.70)
20	6	-1.21 (1.95)	-4.60 (6.00)	0.58 (1.90)	-4.40 (5.95)	0.58 (1.90)	-4.40 (5.95)
	25	0.58 (0.90)	1.87 (3.25)	0.97 (0.80)	1.71 (3.25)	0.97 (0.80)	1.71 (3.25)
	100	-2.99 (1.10)	-1.40 (1.35)	-4.00 (1.05)	-1.29 (1.35)	-4.00 (1.05)	-1.30 (1.35)
				$\gamma = 0.3$			
5	6	**-27.70 (1.95)**	-8.28 (1.70)	**-12.00 (1.95)**	-3.96 (1.95)	**-12.00 (1.95)**	-3.96 (1.95)
	25	-5.65 (1.20)	0.96 (0.95)	-1.96 (1.25)	1.66 (0.95)	-1.96 (1.25)	1.66 (0.95)
	100	6.26 (0.95)	-2.60 (0.70)	7.46 (0.90)	-2.19 (0.75)	7.46 (0.90)	-2.19 (0.75)
10	6	**-16.59 (1.30)**	1.96 (1.95)	**-10.59 (1.40)**	3.53 (2.00)	**-10.59 (1.40)**	3.54 (2.00)
	25	-3.99 (1.00)	1.01 (0.45)	-1.37 (1.00)	1.24 (0.45)	-1.37 (1.00)	1.24 (0.45)
	100	-4.36 (0.55)	0.40 (1.25)	-4.44 (0.55)	0.39 (1.25)	-4.44 (0.55)	0.39 (1.25)
20	6	**-16.73 (0.95)**	-3.38 (1.20)	**-14.43 (0.90)**	-3.03 (1.20)	**-14.42 (0.90)**	-3.03 (1.20)
	25	-0.27 (0.50)	6.80 (0.90)	1.53 (0.40)	6.90 (0.95)	1.53 (0.40)	6.90 (0.95)
	100	0.52 (0.55)	0.66 (0.80)	0.70 (0.65)	0.53 (0.80)	0.70 (0.65)	0.53 (0.80)
				$\gamma = 0.6$			
5	6	**-26.49 (0.60)**	-5.66 (0.00)	**-11.20 (1.40)**	-3.39 (0.10)	**-11.20 (1.40)**	-3.39 (0.10)
	25	-6.03 (0.55)	-0.03 (0.65)	-2.89 (0.80)	1.05 (0.65)	-2.89 (0.80)	1.05 (0.65)
	100	-3.40 (0.75)	-2.57 (0.50)	0.13 (0.90)	-2.13 (0.50)	0.13 (0.90)	-2.13 (0.50)
10	6	**-18.13 (0.45)**	-4.69 (0.45)	**-11.88 (0.60)**	-2.56 (0.45)	**-11.88 (0.60)**	-2.56 (0.45)
	25	-4.45 (0.45)	-2.27 (0.50)	-2.94 (0.50)	-1.55 (0.55)	-2.94 (0.50)	-1.55 (0.55)
	100	-0.76 (0.90)	2.30 (0.90)	-1.85 (0.95)	2.26 (0.85)	-1.85 (0.95)	2.26 (0.85)
20	6	**-17.80 (1.00)**	2.99 (0.60)	**-16.33 (0.95)**	2.57 (0.65)	**-16.33 (0.95)**	2.57 (0.65)
	25	-3.40 (0.55)	-0.37 (0.95)	-2.61 (0.70)	0.05 (0.95)	-2.61 (0.70)	0.05 (0.95)
	100	3.11 (0.90)	1.09 (0.90)	2.98 (1.05)	1.12 (0.85)	2.98 (1.05)	1.12 (0.85)

Table 5

Robust Relative Standard Error (SE) Bias Ratio and Outlier Proportion of SE (%) of Path Coefficient Estimates (γ) Across 2,000 Replications (for 2S-PA Methods).

		2S-PA		2S-PA-Rel		2S-PA Corrected		2S-PA-Rel Corrected	
p	N/p	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
					$\gamma = 0$				
5	6	**-20.83 (10.00)**	-9.81 (6.05)	**-19.74 (9.60)**	-9.71 (6.20)	**-20.08 (10.10)**	-9.80 (6.10)	**-19.30 (9.40)**	-9.69 (6.10)
	25	-7.98 (2.50)	-1.70 (3.90)	-7.74 (2.55)	-1.66 (3.65)	-7.83 (2.55)	-1.70 (3.95)	-7.65 (2.65)	-1.66 (3.55)
	100	-6.06 (1.10)	-3.52 (2.00)	-6.00 (1.05)	-3.50 (1.95)	-6.02 (1.05)	-3.51 (2.00)	-5.99 (1.05)	-3.50 (1.95)
10	6	**-10.66 (2.75)**	1.95 (6.10)	**-10.38 (2.30)**	2.00 (5.75)	**-10.54 (2.25)**	1.95 (6.00)	**-10.29 (2.15)**	2.01 (5.80)
	25	-3.30 (1.45)	-4.17 (3.00)	-3.21 (1.35)	-4.15 (2.95)	-3.26 (1.45)	-4.17 (3.00)	-3.19 (1.35)	-4.14 (2.95)
	100	-4.20 (0.80)	3.45 (1.70)	-4.17 (0.80)	3.46 (1.45)	-4.18 (0.80)	3.45 (1.70)	-4.16 (0.80)	3.46 (1.45)
20	6	-2.01 (1.95)	-4.55 (6.00)	-1.89 (1.70)	-4.52 (5.95)	-1.98 (1.95)	-4.54 (6.00)	-1.86 (1.60)	-4.52 (5.95)
	25	0.58 (0.90)	1.87 (3.25)	0.62 (1.00)	1.88 (3.00)	0.58 (1.00)	1.87 (3.25)	0.63 (0.95)	1.88 (3.00)
	100	-2.99 (1.10)	-1.40 (1.35)	-2.98 (1.10)	-1.40 (1.35)	-2.99 (1.10)	-1.40 (1.35)	-2.98 (1.10)	-1.40 (1.35)
					$\gamma = 0.3$				
5	6	**-25.46 (8.25)**	-7.69 (1.75)	**-24.41 (8.10)**	-7.04 (1.95)	**-23.82 (8.75)**	-7.59 (1.70)	**-23.47 (8.10)**	-6.97 (1.85)
	25	-6.00 (1.25)	0.93 (0.95)	-4.56 (1.20)	1.71 (1.00)	-4.75 (1.05)	1.03 (0.95)	-3.90 (1.40)	1.79 (0.95)
	100	6.05 (0.95)	-2.62 (0.70)	7.67 (1.05)	-1.92 (0.70)	7.22 (0.80)	-2.55 (0.75)	8.28 (0.85)	-1.85 (0.70)
10	6	**-21.67 (1.40)**	1.95 (1.95)	**-20.61 (1.35)**	2.64 (1.90)	**-21.15 (1.15)**	2.03 (1.95)	**-20.30 (1.35)**	2.69 (1.80)
	25	-4.08 (1.00)	1.01 (0.45)	-2.64 (1.10)	1.70 (0.45)	-3.37 (0.95)	1.07 (0.45)	-2.27 (1.15)	1.74 (0.45)
	100	-4.43 (0.50)	0.39 (1.25)	-3.00 (0.55)	1.07 (1.20)	-3.75 (0.55)	0.44 (1.25)	-2.61 (0.55)	1.12 (1.25)
20	6	**-20.63 (0.95)**	-3.64 (1.20)	**-19.66 (1.05)**	-3.14 (1.20)	**-20.35 (0.90)**	-3.62 (1.20)	**-19.48 (1.10)**	-3.11 (1.20)
	25	-0.37 (0.50)	6.80 (0.90)	0.90 (0.35)	7.35 (0.95)	-0.05 (0.40)	6.83 (0.90)	1.12 (0.35)	7.37 (0.95)
	100	0.50 (0.50)	0.66 (0.80)	1.82 (0.55)	1.17 (0.80)	0.84 (0.55)	0.68 (0.80)	2.04 (0.55)	1.19 (0.80)
					$\gamma = 0.6$				
5	6	**-31.91 (3.70)**	-5.45 (0.05)	**-26.88 (4.05)**	-1.81 (0.15)	**-23.71 (5.60)**	-4.38 (0.10)	**-22.46 (4.80)**	-1.04 (0.15)
	25	-7.33 (0.60)	-0.17 (0.65)	-0.64 (1.10)	3.67 (0.70)	-0.19 (0.95)	0.49 (0.65)	2.62 (1.00)	4.17 (0.70)
	100	-4.39 (0.90)	-2.71 (0.50)	2.28 (0.95)	1.12 (0.55)	2.39 (1.00)	-2.13 (0.50)	5.78 (0.95)	1.61 (0.55)
10	6	**-22.02 (0.40)**	-4.74 (0.45)	**-16.69 (0.60)**	-1.20 (0.45)	**-18.06 (0.75)**	-4.27 (0.45)	**-14.51 (0.65)**	-0.86 (0.45)
	25	-4.87 (0.45)	-2.31 (0.50)	1.82 (0.50)	1.25 (0.55)	-0.20 (0.50)	-1.89 (0.50)	4.40 (0.50)	1.60 (0.55)
	100	-1.11 (0.90)	2.26 (0.90)	5.80 (0.90)	5.92 (0.75)	3.64 (0.95)	2.68 (0.90)	8.36 (1.05)	6.29 (0.70)
20	6	**-21.09 (0.95)**	2.98 (0.60)	**-16.24 (1.00)**	5.69 (0.60)	**-19.29 (0.85)**	3.17 (0.65)	**-15.05 (0.85)**	5.85 (0.60)
	25	-3.57 (0.55)	-0.38 (0.95)	2.59 (0.70)	2.37 (0.90)	-1.20 (0.65)	-0.18 (0.95)	4.03 (0.65)	2.55 (0.90)
	100	2.98 (0.90)	1.07 (0.90)	9.54 (0.85)	3.85 (0.65)	5.47 (0.95)	1.29 (0.85)	**11.12 (0.90)**	4.03 (0.65)

Table 6

Coverage Rate of 95 % Confidence Interval (CI) of Path Coefficient Estimates (γ) Across 2,000 Replications.

		Joint SEM		Global SAM		Local SAM		2S-PA		2S-PA-Rel		2S-PA Corrected		2S-PA-Rel Corrected	
p	N/p	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
								$\gamma = 0$							
5	6	**82.85**	**89.65**	91.45	91.40	91.45	91.40	**85.45**	**90**	**86.15**	**90.35**	**86.65**	**90.1**	**86.95**	**90.35**
	25	93.2	94.8	93.90	95.00	93.90	95.00	93.2	94.8	93.45	94.9	93.45	94.8	93.5	94.9
	100	94.25	94.4	94.60	94.45	94.60	94.45	94.25	94.4	94.35	94.4	94.3	94.4	94.35	94.45
10	6	91.2	93.5	93.50	93.95	93.50	93.95	91.2	93.5	91.65	93.75	91.35	93.5	91.65	93.75
	25	93.85	93.9	94.45	94.00	94.45	94.00	93.85	93.9	94	93.95	94	93.9	94.05	93.95
	100	94.85	95.8	95.05	95.85	95.05	95.85	94.85	95.8	94.9	95.85	94.9	95.8	94.9	95.85
20	6	93.2	95.15	94.15	95.30	94.15	95.30	93.2	95.15	93.4	95.2	93.25	95.15	93.45	95.2
	25	94.35	94.85	94.50	94.85	94.50	94.85	94.35	94.85	94.35	94.85	94.35	94.85	94.35	94.85
	100	94.05	93.75	94.00	93.75	94.00	93.75	94.05	93.75	94.05	93.75	94.05	93.75	94.05	93.75
								$\gamma = 0.3$							
5	6	**79.75**	**90.8**	**88.35**	92.30	**88.35**	92.30	**81.3**	**90.9**	**82.65**	91.60	**83.95**	**90.95**	**84.05**	91.65
	25	92.65	94.35	94.15	94.45	94.15	94.45	92.45	94.35	93.45	94.55	93.5	94.35	93.8	94.55
	100	95.7	95.15	95.9	95.20	95.9	95.20	95.7	95.15	95.95	95.25	95.9	95.15	96	95.25
10	6	**86.35**	93	**88.45**	93.25	**88.45**	93.25	**83.65**	93	**84.4**	93.15	**84.2**	93	**84.5**	93.20
	25	93.25	94.7	94.5	94.90	94.5	94.90	93.25	94.7	94.1	94.90	93.55	94.75	94.4	94.95
	100	95.5	94.6	95.7	94.60	95.7	94.60	95.45	94.6	95.75	94.75	95.5	94.6	95.95	94.75
20	6	**83.8**	93.7	**84.4**	93.65	**84.4**	93.65	**81.25**	93.65	**81.6**	93.70	**81.35**	93.65	**81.6**	93.70
	25	95.3	94.85	95.25	94.90	95.25	94.90	95.25	94.85	95.45	95.15	95.3	94.85	95.45	95.15
	100	94.85	94.8	94.9	94.80	94.9	94.80	94.85	94.8	95.15	94.85	94.85	94.8	95.25	94.90
								$\gamma = 0.6$							
5	6	**80.3**	**90.05**	**87.25**	92.55	**87.25**	92.55	**76.95**	89.95	**79.95**	91.05	**83.55**	**90.4**	**83.1**	91.25
	25	93.2	94.3	94.3	94.95	94.3	94.95	92.7	94.25	94.3	95.40	94.7	94.45	95.3	95.55
	100	94.85	95.15	95.1	95.10	95.1	95.10	94.6	95.15	95.9	95.70	95.95	95.2	96.65	95.80
10	6	**85.05**	91.85	**87**	93.00	**87**	93.00	**81.55**	91.75	**83.5**	93.15	**83.4**	92.1	**84.55**	93.40
	25	94.2	95	94.6	95.00	94.6	95.00	94.05	95	95.3	95.95	95.25	95.1	95.7	96.10
	100	94.15	94.6	94.4	94.65	94.4	94.65	94.15	94.6	96.1	95.65	95.6	94.65	96.65	95.75
20	6	**81.6**	94.35	**82.7**	94.60	**82.7**	94.60	**78.8**	94.3	**80.95**	94.85	**80**	94.4	**81.35**	94.90
	25	94.75	93.75	95.05	93.75	95.05	93.75	94.65	93.75	95.8	94.35	94.95	93.75	96.15	94.40
	100	95.2	95.25	95.1	95.25	95.1	95.25	95.2	95.25	96.45	96.10	95.7	95.25	96.6	96.15

Table 7

Root Mean Square Error (RMSE) of Latent Interaction Estimates (γ) Across 2,000 Replications.

		Joint SEM		Global SAM		Local SAM		2S-PA		2S-PA-Rel		2S-PA Corrected		2S-PA-Rel Corrected	
p	N/p	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
							$\gamma = 0$								
5	6	0.29	0.21	0.24	0.20	0.24	0.20	0.29	0.21	0.28	0.21	0.29	0.21	0.28	0.21
	25	0.13	0.10	0.12	0.10	0.12	0.10	0.13	0.10	0.13	0.10	0.13	0.10	0.13	0.10
	100	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05
10	6	0.18	0.14	0.17	0.14	0.17	0.14	0.18	0.14	0.18	0.14	0.18	0.14	0.18	0.14
	25	0.09	0.07	0.08	0.07	0.08	0.07	0.09	0.07	0.09	0.07	0.09	0.07	0.09	0.07
	100	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03
20	6	0.11	0.10	0.11	0.10	0.11	0.10	0.11	0.10	0.11	0.10	0.11	0.10	0.11	0.10
	25	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05
	100	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02
							$\gamma = 0.3$								
5	6	0.30	0.19	0.26	0.18	0.26	0.18	0.32	0.19	0.32	0.19	0.32	0.19	0.32	0.19
	25	0.12	0.09	0.12	0.09	0.12	0.09	0.12	0.09	0.12	0.09	0.12	0.09	0.12	0.09
	100	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04
10	6	0.22	0.13	0.21	0.13	0.21	0.13	0.25	0.13	0.25	0.13	0.25	0.13	0.25	0.13
	25	0.08	0.06	0.08	0.06	0.08	0.06	0.08	0.06	0.08	0.06	0.08	0.06	0.08	0.06
	100	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03
20	6	0.22	0.09	0.22	0.09	0.22	0.09	0.24	0.10	0.24	0.10	0.24	0.10	0.24	0.10
	25	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04
	100	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02
							$\gamma = 0.6$								
5	6	0.32	0.14	0.32	0.14	0.32	0.14	0.40	0.14	0.40	0.14	0.40	0.14	0.40	0.14
	25	0.10	0.07	0.10	0.07	0.10	0.07	0.10	0.07	0.10	0.07	0.10	0.07	0.10	0.07
	100	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03
10	6	0.32	0.10	0.33	0.10	0.33	0.10	0.39	0.10	0.39	0.10	0.39	0.10	0.39	0.10
	25	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05
	100	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02
20	6	0.39	0.08	0.40	0.08	0.40	0.08	0.44	0.08	0.44	0.08	0.44	0.08	0.44	0.08
	25	0.05	0.03	0.06	0.03	0.06	0.03	0.06	0.03	0.06	0.03	0.06	0.03	0.06	0.03
	100	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Table 8

Empirical Type I Error Rate and Statistical Power Across 2,000 Replications.

p	N/p	Joint SEM		Global SAM		Local SAM		2S-PA		2S-PA-Rel		2S-PA Corrected		2S-PA-Rel Corrected	
		$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$	$\rho = .70$	$\rho = .90$
						Empirical Type I Error Rate ($\gamma = 0$)									
5	6	0.17	0.10	0.09	0.09	0.09	0.09	0.15	0.10	0.14	0.10	0.13	0.10	0.13	0.10
	25	0.07	0.05	0.06	0.05	0.06	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05
	100	0.06	0.06	0.05	0.06	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
10	6	0.09	0.07	0.07	0.06	0.07	0.06	0.09	0.07	0.08	0.06	0.09	0.07	0.08	0.07
	25	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	100	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04
20	6	0.07	0.05	0.06	0.05	0.06	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05
	25	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05
	100	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
						Statistical Power ($\gamma = 0.3$)									
5	6	0.39	0.43	0.27	0.41	0.27	0.41	0.36	0.43	0.35	0.42	0.34	0.42	0.34	0.42
	25	0.73	0.88	0.70	0.87	0.70	0.87	0.73	0.88	0.72	0.88	0.72	0.88	0.72	0.88
	100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	6	0.50	0.65	0.44	0.64	0.44	0.64	0.50	0.65	0.49	0.64	0.50	0.65	0.49	0.64
	25	0.96	0.99	0.95	0.99	0.95	0.99	0.96	0.99	0.95	0.99	0.96	0.99	0.95	0.99
	100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	6	0.79	0.90	0.78	0.90	0.78	0.90	0.79	0.90	0.79	0.90	0.79	0.90	0.79	0.90
	25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
						Statistical Power ($\gamma = 0.6$)									
5	6	0.81	0.95	0.69	0.94	0.69	0.94	0.80	0.95	0.79	0.95	0.78	0.95	0.78	0.95
	25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	6	0.97	1.00	0.95	1.00	0.95	1.00	0.97	1.00	0.97	1.00	0.97	1.00	0.97	1.00
	25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	100	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00