Supplement

1. Simulation I: bivariate (RI-)CLPM

1.1. The number of times the RI-CLPM did not have positive random-intercept variances in a simulation

Table 1. The number of times the RI-CLPM did not have positive random-intercept variances for a combination of simulation conditions (regarding the number of waves, the number of participants, and the cross-lagged effects).

Number of waves	Number of participants	Cross-lagged effects β	Cross-lagged effects γ	Number of times the RI-CLPM did not have positive random-intercept variances
3	25	-0.07	-0.07	5
		0.1	0.2	3
		0.1	0.4	6
	50	0.1	0.2	1
		0.1	0.4	6
	75	0.1	0.4	4
4	25	0.1	0.2	1
		0.1	0.4	2

Note that, only 0.02% of the simulations in the bivariate RI-CLPM resulted in non-positive variance cases, which accounts for 28 times out of a total of 144,000 iterations.

1.2. *The performance of the AIC in a bivariate RI-CLPM (absolute values of the standardized cross-lagged effects)*

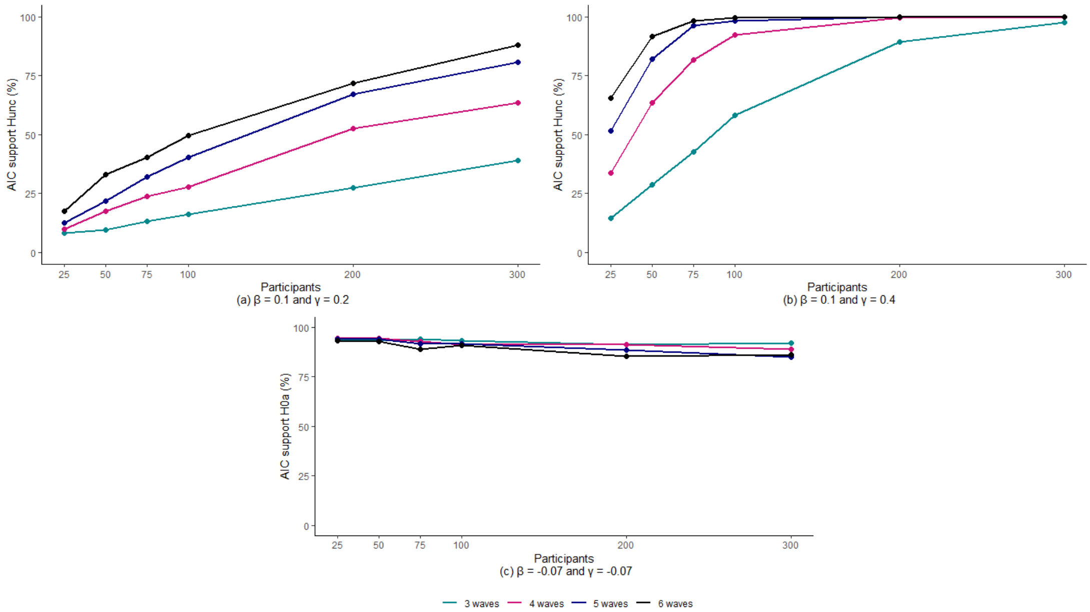


Figure 1. The (true) hypothesis rates when using the AIC in a bivariate RI-CLPM for all simulation conditions, namely the number of participants (x-axis), the number of waves (different colored lines), and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both $H_{0a} : \beta = \gamma$ and the unconstrained hypothesis are true but H_{0a} is the most parsimonious one.

1.3. The performance of the AIC in a bivariate RI-CLPM (non-absolute values of the standardized cross-lagged effects)

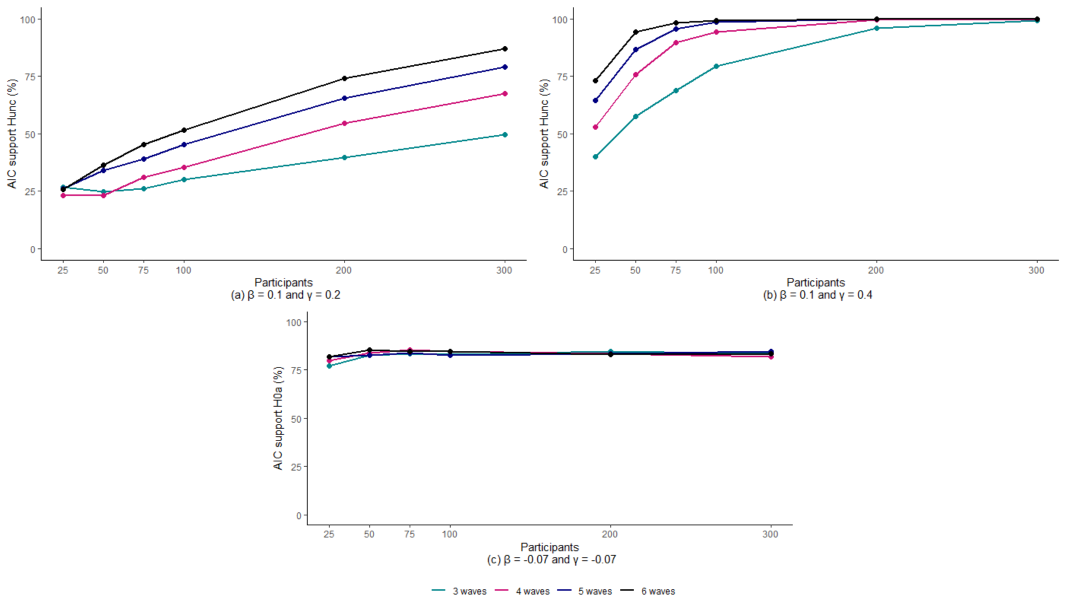


Figure 2. The (true) hypothesis rates of the AIC when using the AIC in a bivariate RI-CLPM for all simulation conditions, namely number of participants (x-axis), number of waves (different colored lines), and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both H_{0a} and the unconstrained hypothesis are true but H_{0a} is the most parsimonious one.

1.4. *The performance of the AIC in a bivariate CLPM (absolute values of the standardized cross-lagged effects)*

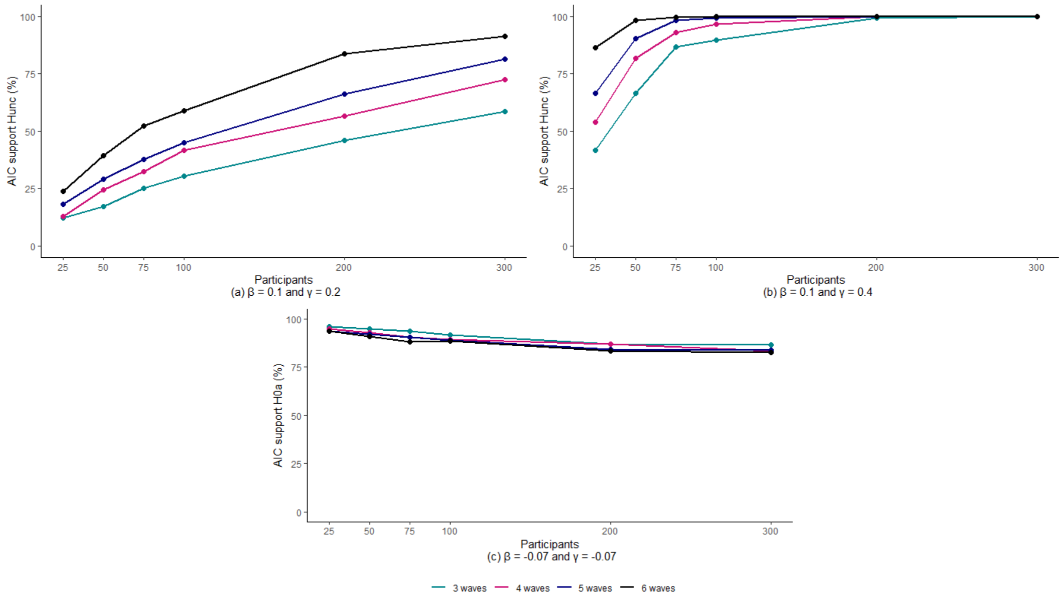


Figure 3. The (true) hypothesis rates of the AIC when using the AIC in a bivariate CLPM for all simulation conditions, namely number of participants (x-axis), number of waves (different colored lines), and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both H_{0a} and the unconstrained hypothesis are true but H_{0a} is the most parsimonious one.

1.5. *The performance of the AIC in a bivariate CLPM (non-absolute values of the standardized cross-lagged effects)*

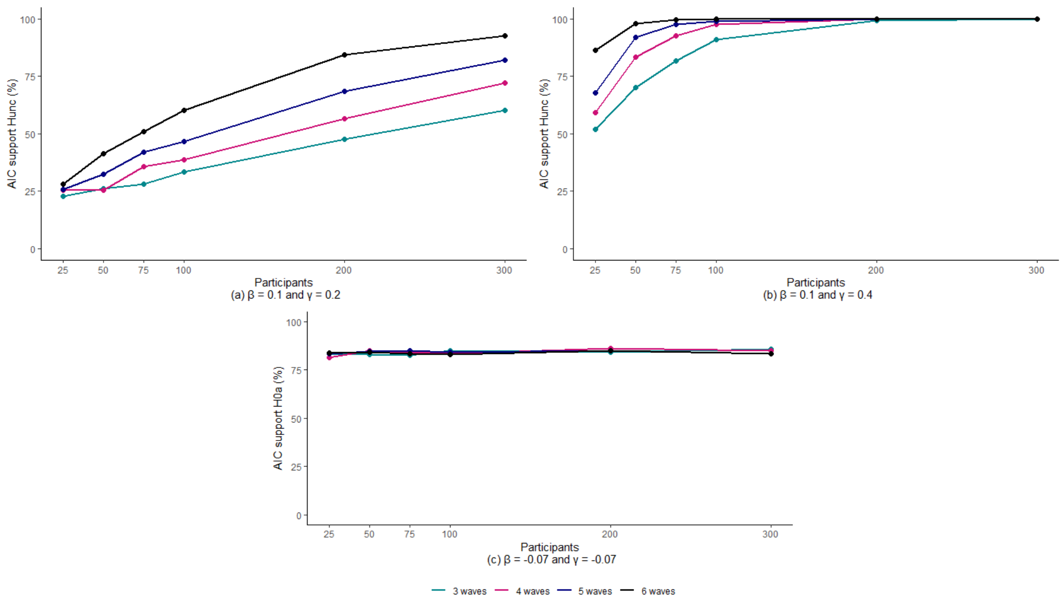


Figure 4. The (true) hypothesis rates of the AIC when using the AIC in a bivariate CLPM for all simulation conditions, namely number of participants (x-axis), number of waves (different colored lines), and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both H_{0a} and the unconstrained hypothesis are true but H_{0a} is the most parsimonious one.

1.6. The performance of the GORICA in a bivariate RI-CLPM (non-absolute values of the standardized cross-lagged effects)

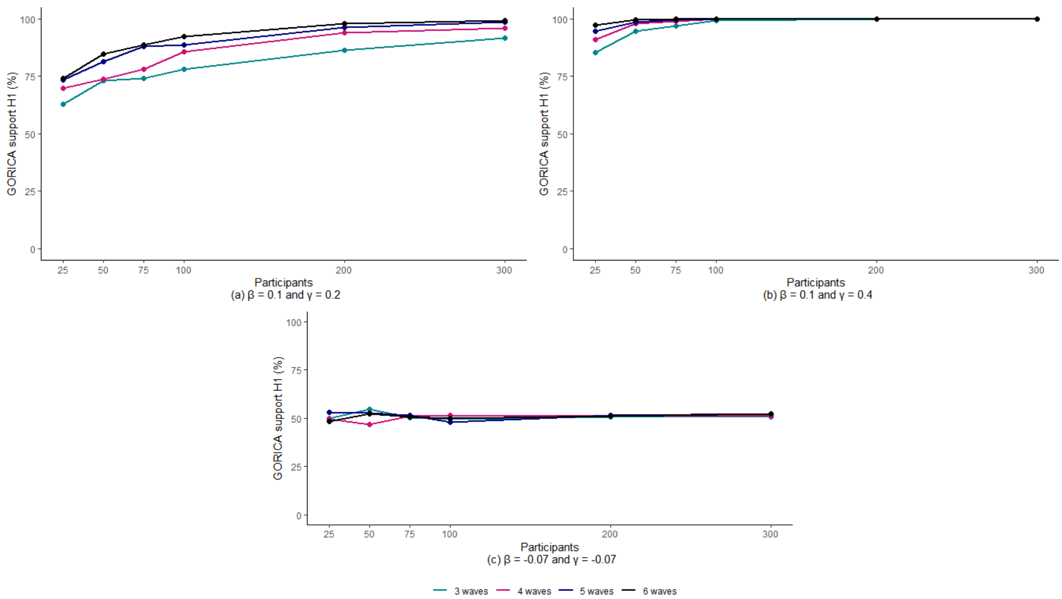


Figure 5. The (true) hypothesis rates of the GORICA when using the GORICA in a bivariate RI-CLPM for all simulation conditions, namely number of participants (x-axis), number of waves (different colored lines), and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07). Note that in Plots (a) and (b), H_1 is the true hypothesis, while in Plot (c) both $H_1 : \beta < \gamma$ and $H_2 : \beta > \gamma$ are true.

1.7. *The performance of the GORICA in a bivariate CLPM (absolute values of the standardized cross-lagged effects)*

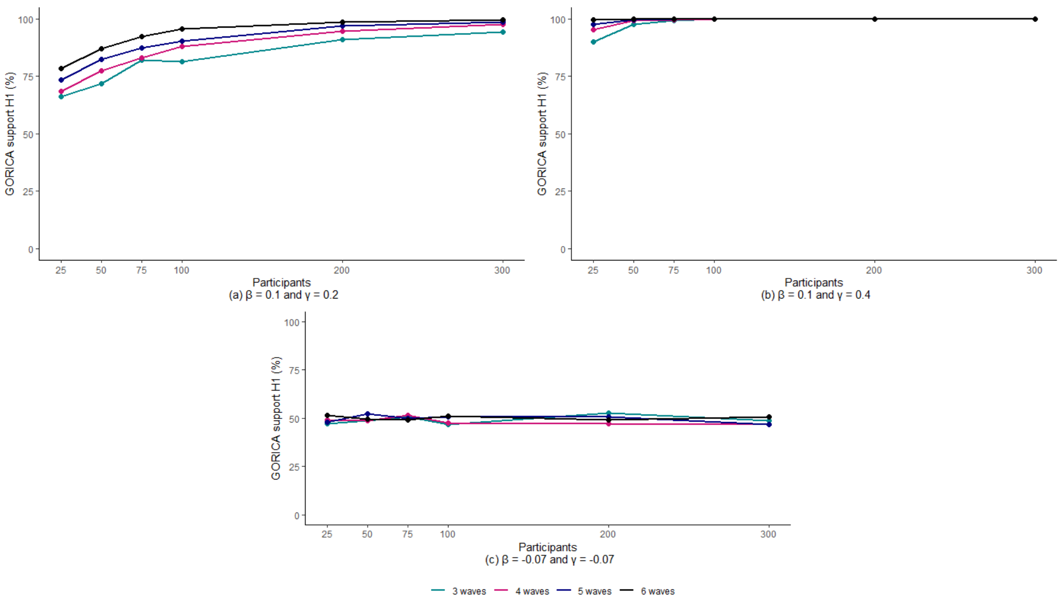


Figure 6. The (true) hypothesis rates of the GORICA when using the GORICA in a bivariate CLPM for all simulation conditions, namely number of participants (x-axis), number of waves (different colored lines), and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07). Note that in Plots (a) and (b), H_1 is the true hypothesis, while in Plot (c) both $H_1 : |\beta| < |\gamma|$ and $H_2 : |\beta| > |\gamma|$ are true.

1.8. *The performance of the GORICA in a bivariate CLPM (non-absolute values of the standardized cross-lagged effects)*

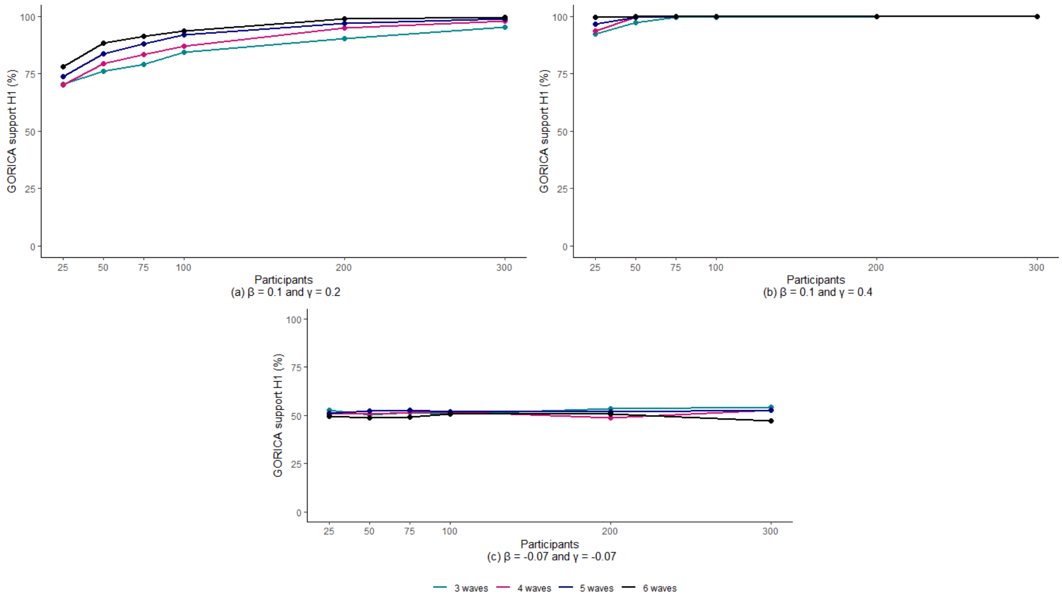


Figure 7. The (true) hypothesis rates of the GORICA when using the GORICA in a bivariate CLPM for all simulation conditions, namely number of participants (x-axis), number of waves (different colored lines), and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07). Note that in Plots (a) and (b), H_1 is the true hypothesis, while in Plot (c) both $H_1 : \beta < \gamma$ and $H_2 : \beta > \gamma$ are true.

2. Simulation II: Tri-variate (RI-)CLPM

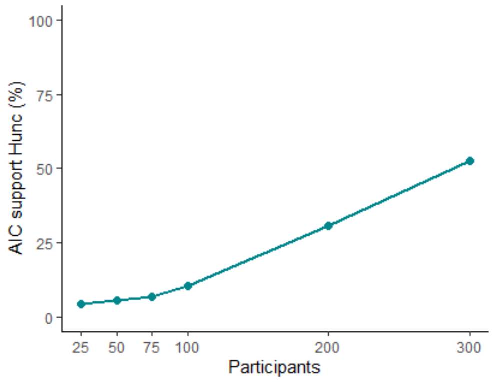
2.1. The number of times the RI-CLPM did not have positive random-intercept variances in a simulation

Table 2. The number of times the RI-CLPM did not have positive random-intercept variances for a combination of simulation conditions (regarding the number of waves, the number of participants, and the cross-lagged effects).

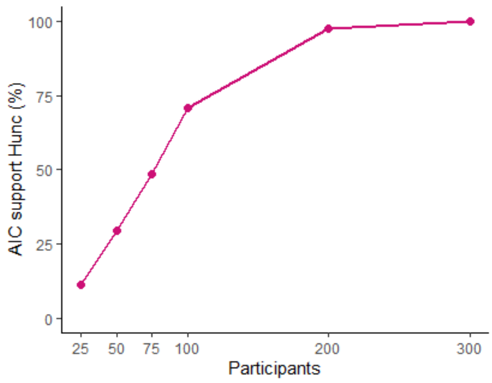
Number of waves	Number of participants	Cross-lagged effects β	Cross-lagged effects γ	Number of times the RI-CLPM did not have positive random-intercept variances
3	25	-0.07	-0.07	2
		0.1	0.2	2
		0.1	0.4	5
	50	0.1	0.4	5
	75	0.1	0.4	10
	100	0.1	0.4	7
	200	0.1	0.4	3

Note that, only 0.09% of the simulations in the tri-variate RI-CLPM resulted in non-positive variance cases, which accounts for 34 times out of a total of 36,000 iterations.

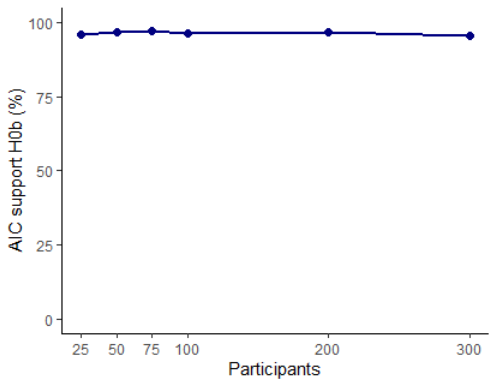
2.2. *The performance of the AIC in a tri-ivariate RI-CLPM (absolute values of the standardized cross-lagged effects)*



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



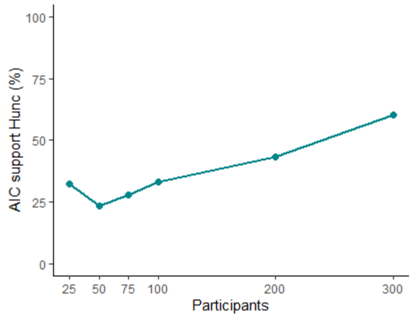
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)



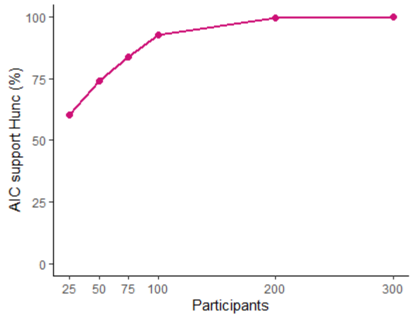
(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

Figure 8. The (true) hypothesis rates when using the AIC in a tri-variate RI-CLPM for all simulation conditions, namely the number of participants (x-axis) and the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both H_{0b} and the unconstrained hypothesis are true but H_{0b} is the most parsimonious one.

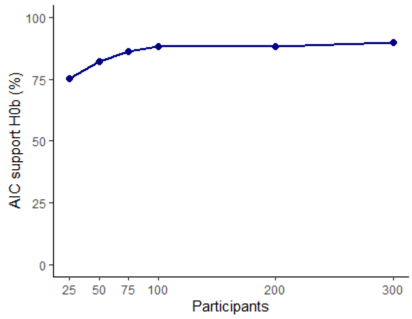
2.3. *The performance of the AIC in a tri-ivariate RI-CLPM (non-absolute values of the standardized cross-lagged effects)*



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



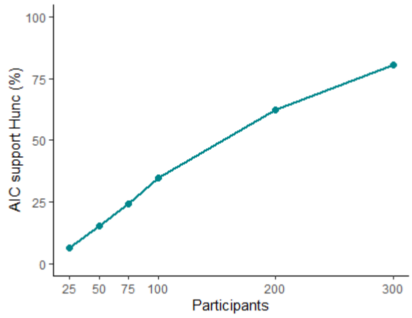
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)



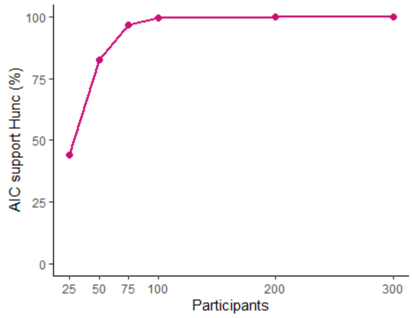
(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

Figure 9. The (true) hypothesis rates of the AIC when using the AIC in a tri-variate RI-CLPM for all simulation conditions, namely number of participants (x-axis) and the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both H_{0b} and the unconstrained hypothesis are true but H_{0b} is the most parsimonious one.

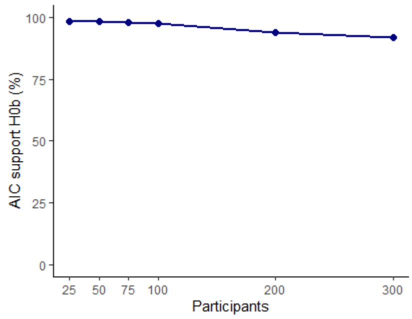
2.4. The performance of the AIC in a tri-ivariate CLPM (absolute values of the standardized cross-lagged effects)



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



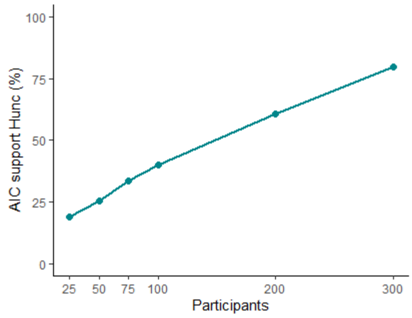
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)



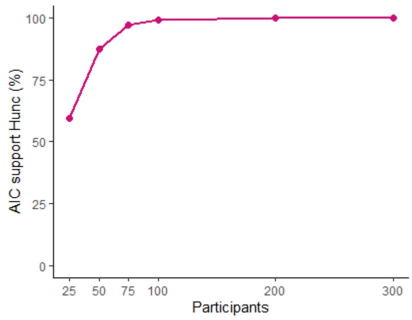
(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

Figure 10. The (true) hypothesis rates of the AIC when using the AIC in a tri-variate CLPM for all simulation conditions, namely number of participants (x-axis) and the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both H_{0b} and the unconstrained hypothesis are true but H_{0b} is the most parsimonious one.

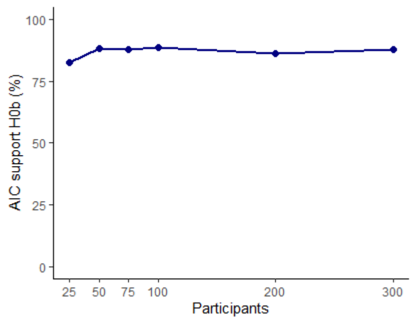
2.5. *The performance of the AIC in a tri-ivariate CLPM (non-absolute values of the standardized cross-lagged effects)*



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



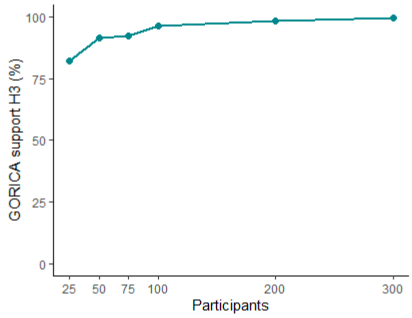
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)



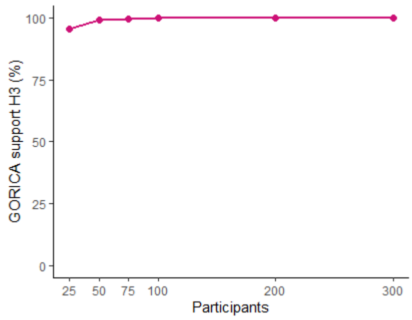
(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

Figure 11. The (true) hypothesis rates of the AIC when using the AIC in a tri-variate CLPM for all simulation conditions, namely number of participants (x-axis) and the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07). Note that in Plots (a) and (b), the unconstrained hypothesis is the true hypothesis, while in Plot (c) both H_{0b} and the unconstrained hypothesis are true but H_{0b} is the most parsimonious one.

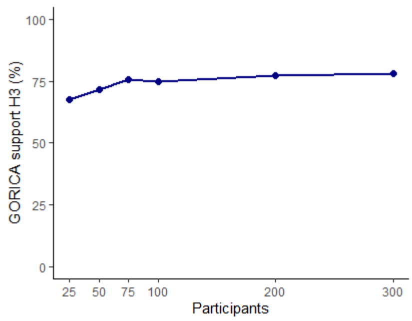
2.6. The performance of the GORICA in a tri-variate RI-CLPM (non-absolute values of the standardized cross-lagged effects)



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



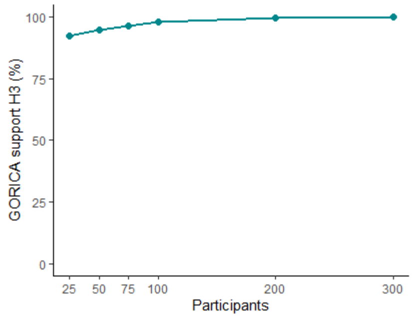
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)



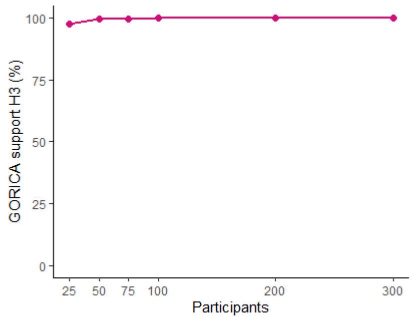
(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

Figure 12. The (true) hypothesis rates of the GORICA when using the GORICA in a tri-variate RI-CLPM for all simulation conditions, namely number of participants (x-axis) and the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07). Note that in Plots (a) and (b), H_3 is the true hypothesis, while in Plot (c) both H_3 and its complement are true but H_3 is the most parsimonious one.

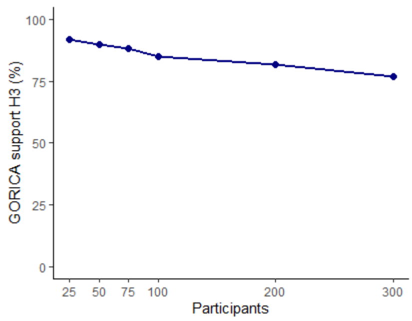
2.7. The performance of the GORICA in a tri-variate CLPM (absolute values of the standardized cross-lagged effects)



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



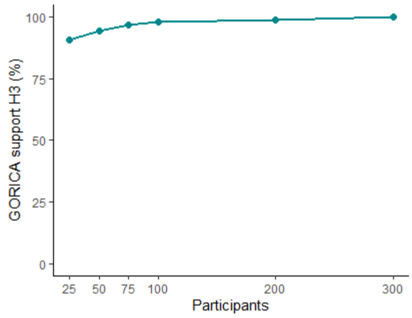
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)



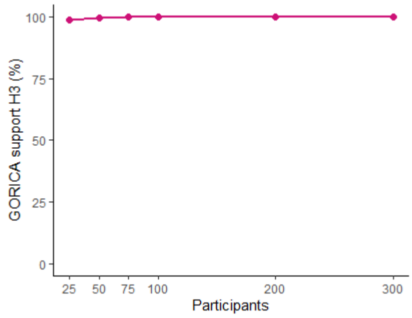
(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

Figure 13. The (true) hypothesis rates of the GORICA when using the GORICA in a tri-variate CLPM for all simulation conditions, namely number of participants (x-axis) and the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07). Note that in Plots (a) and (b), H_3 is the true hypothesis, while in Plot (c) both H_3 and its complement are true but H_3 is the most parsimonious one.

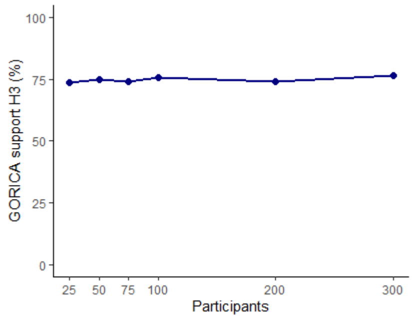
2.8. *The performance of the GORICA in a tri-variate CLPM (non-absolute values of the standardized cross-lagged effects)*



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)

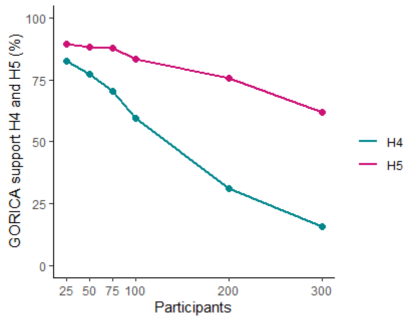


(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

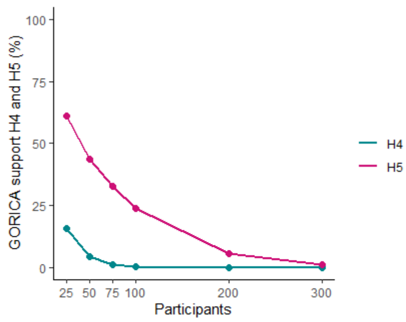
Figure 14. The (true) hypothesis rates of the GORICA when using the GORICA in a tri-variate CLPM for all simulation conditions, namely number of participants (x-axis) and the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07). Note that in Plots (a) and (b), H_3 is the true hypothesis, while in Plot (c) both H_3 and its complement are true but H_3 is the most parsimonious one.

3. What if the hypothesis of interest is not true and thus its complement is?

3.1. The performance of GORICA in a tri-variate RI-CLPM (non-absolute values of the standardized cross-lagged effects)



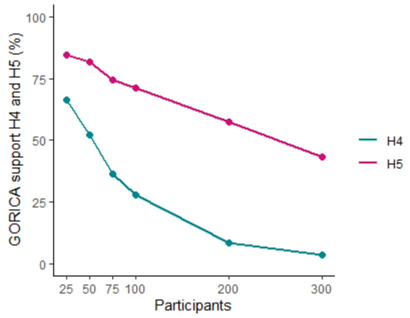
(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



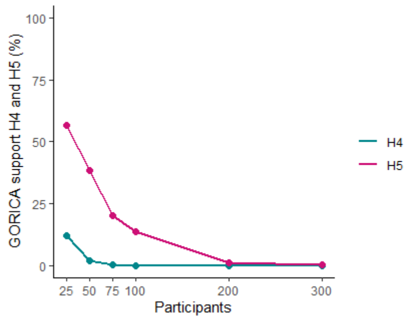
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)

Figure 15. The number of times the incorrect hypotheses H_4 (green) and H_5 (pink) are chosen in a RI-CLPM, for various participant numbers (x-axis) and two cross-lagged parameter specifications: (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), and (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4).

3.2. The performance of GORICA in a tri-variate CLPM (absolute values of the standardized cross-lagged effects)



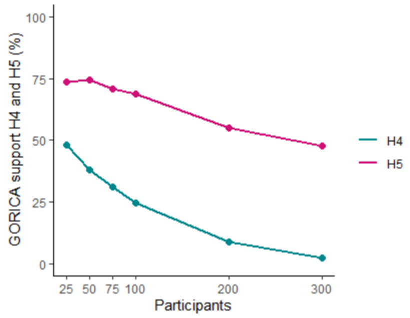
(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



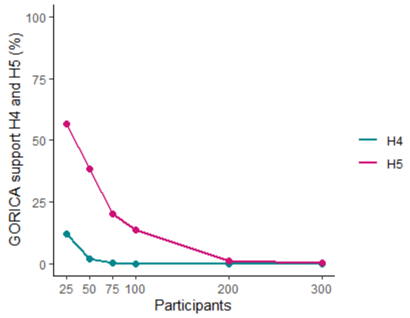
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)

Figure 16. The number of times the incorrect hypotheses H_4 (green) and H_5 (pink) are chosen in a CLPM, for various participant numbers (x-axis) and two cross-lagged parameter specifications: (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), and (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4).

3.3. *The performance of GORICA in a tri-variate CLPM (non-absolute values of the standardized cross-lagged effects)*



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)

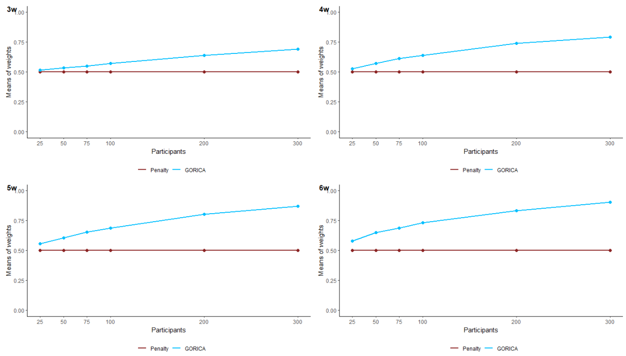


(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)

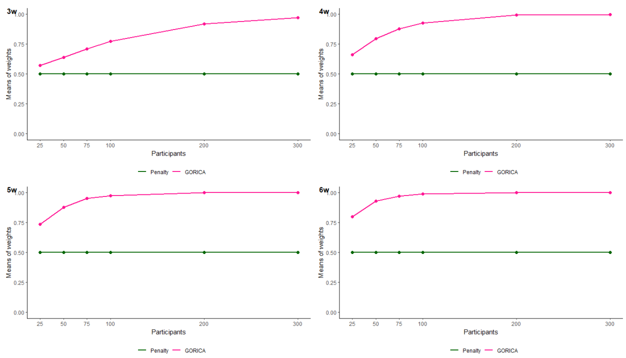
Figure 17. The number of times the incorrect hypotheses H_4 (green) and H_5 (pink) are chosen in a CLPM, for various participant numbers (x-axis) and two cross-lagged parameter specifications: (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), and (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4).

4. Mean of the penalty weights and mean of the GORICA weights

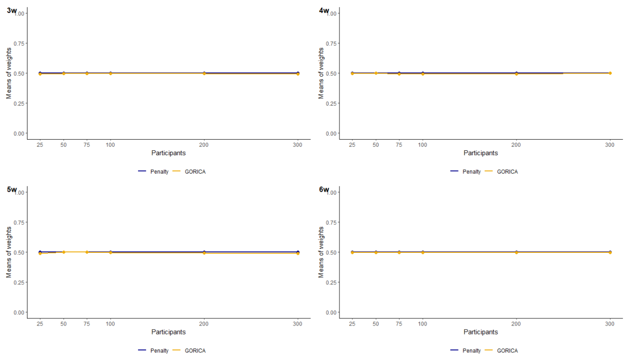
4.1. A bivariate RI-CLPM



(a) β = 0.1, γ = 0.2



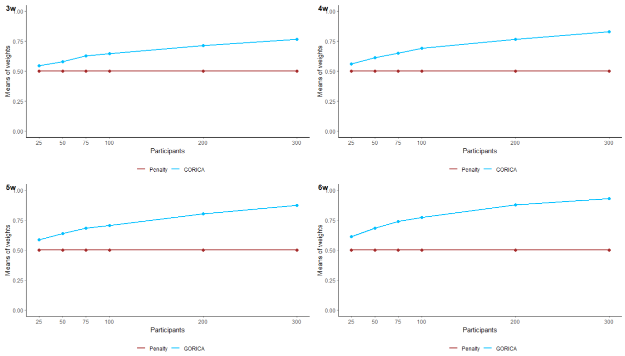
(b) β = 0.1, γ = 0.4



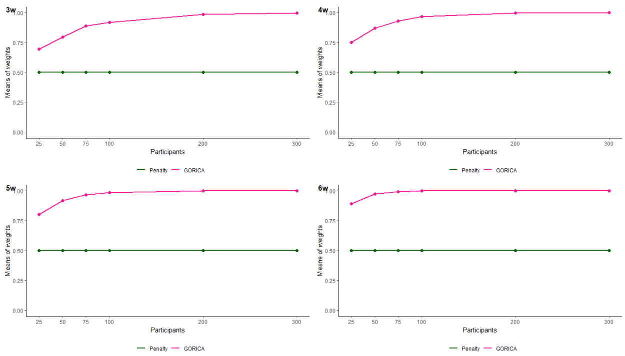
(c) β = -0.07, γ = -0.07

Figure 18. The illustration of the mean of penalty weights and the mean of GORICA weights in a bivariate RI-CLPM regarding different number of waves (w = 3, 4, 5, and 6) and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07).

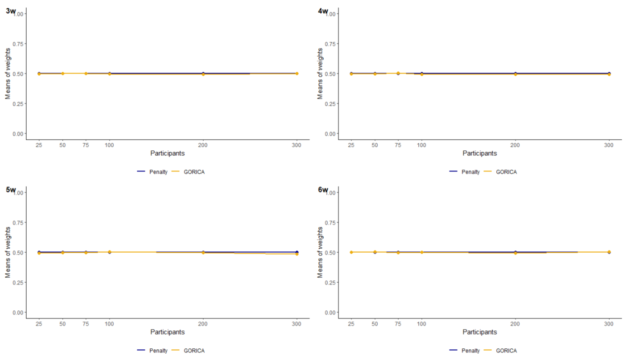
4.2. A bivariate CLPM



(a) β = 0.1, γ = 0.2



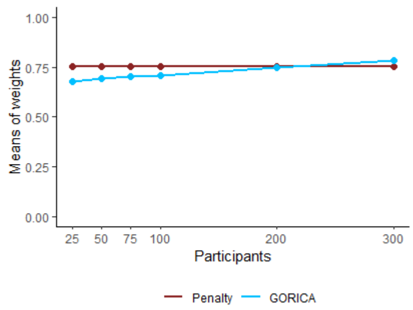
(b) β = 0.1, γ = 0.4



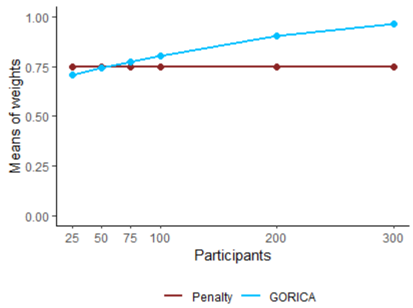
(c) β = -0.07, γ = -0.07

Figure 19. The illustration of the mean of penalty weights and the mean of GORICA weights in a bivariate CLPM regarding different number of waves (w = 3, 4, 5, and 6) and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07).

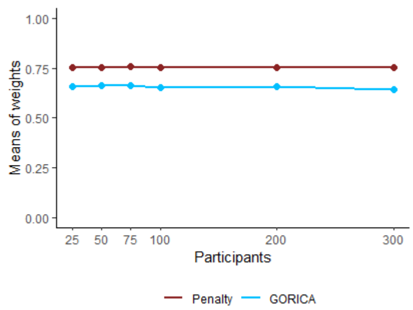
4.3. A tri-variate RI-CLPM



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



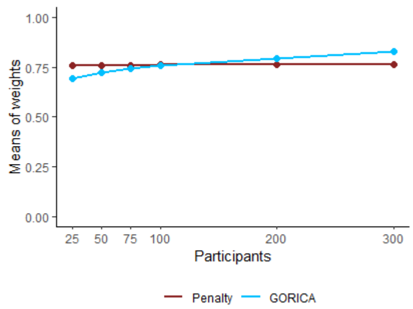
(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)



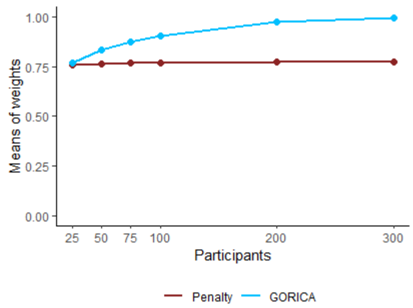
(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

Figure 20. The illustration of the mean of penalty weights and the mean of GORICA weights in a tri-variate RI-CLPM regarding the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07).

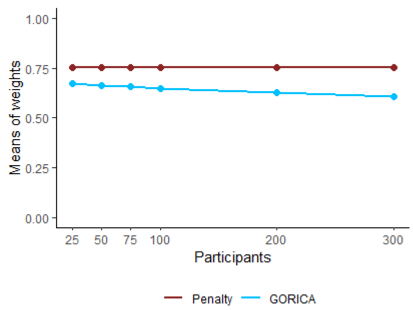
4.4. A tri-variate CLPM



(a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2)



(b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4)

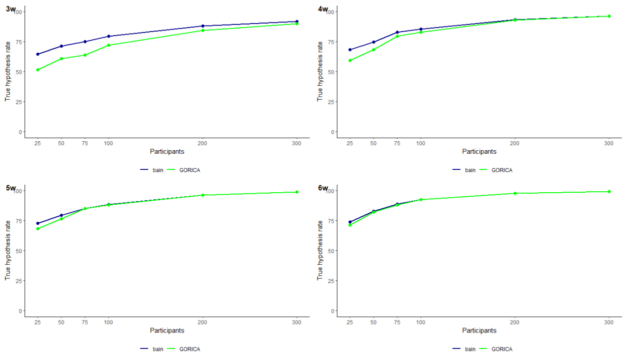


(c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07)

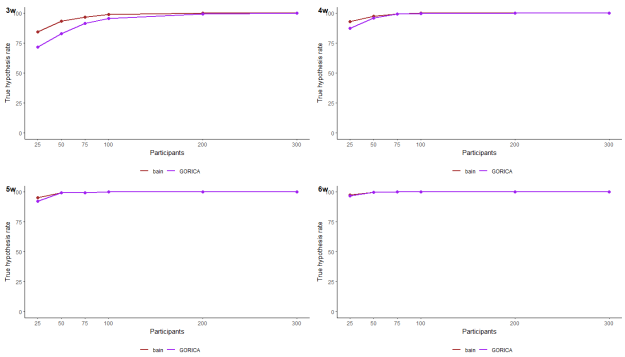
Figure 21. The illustration of the mean of penalty weights and the mean of GORICA weights in a tri-variate CLPM regarding the three different pairs of cross-lagged parameters (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32}): (a) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.2, 0.1, 0.2, 0.1, 0.2), (b) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (0.1, 0.4, 0.1, 0.4, 0.1, 0.4), and (c) (ϕ_{12}, ϕ_{21}, ϕ_{13}, ϕ_{31}, ϕ_{23}, ϕ_{32})= (-0.07, -0.07, -0.07, -0.07, -0.07, -0.07).

5. The performance of the GORICA and the Bayes Factors (BFs)

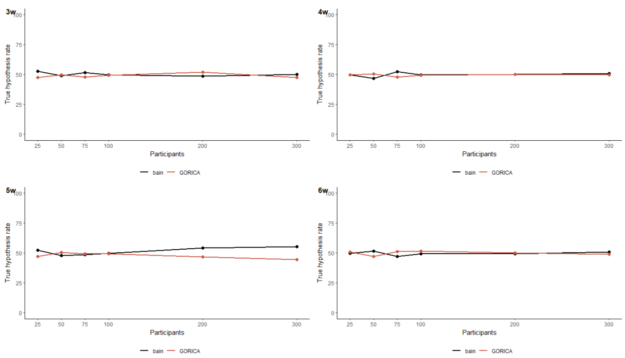
5.1. A bivariate RI-CLPM



(a) β = 0.1, γ = 0.2



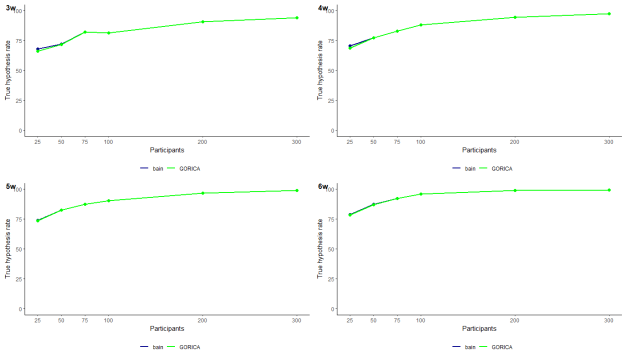
(b) β = 0.1, γ = 0.4



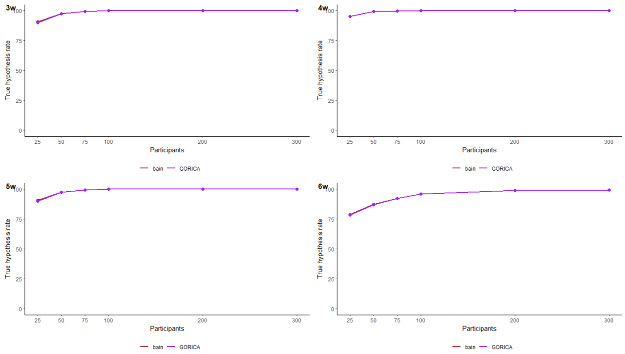
(c) β = -0.07, γ = -0.07

Figure 22. The performance of the GORICA and BFs in a bivariate RI-CLPM regarding different number of waves (w = 3, 4, 5, and 6) and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07).

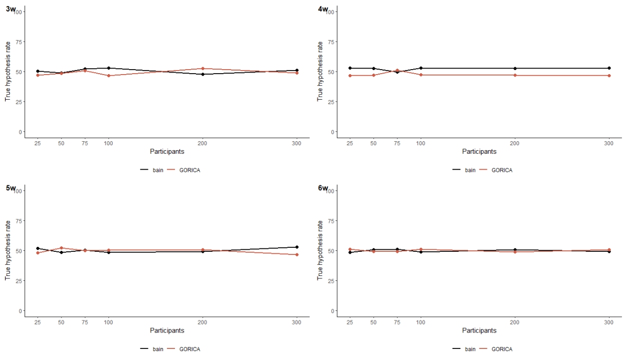
5.2. A bivariate CLPM



(a) β = 0.1, γ = 0.2



(b) β = 0.1, γ = 0.4



(c) β = -0.07, γ = -0.07

Figure 23. The performance of the GORICA and BFs in a bivariate CLPM regarding different number of waves (w = 3, 4, 5, and 6) and the three different pairs of cross-lagged parameters (β and γ): (a) (β, γ) = (0.1, 0.2), (b) (β, γ) = (0.1, 0.4), and (c) (β, γ) = (-0.07, -0.07).