

Table S1. Output from CircMLE v0.2.0. The output from the ‘circ_mle’ function for all 10 models of orientation using default parameters. The input data consisted of 100 angles simulated from a bimodal distribution with a $\varphi_1 = 0^\circ$ (0 rad), $\varphi_2 = 90^\circ$ (1.57 rad), concentration parameters $\kappa_1 = \kappa_2 = 5$, and $\lambda = 0.5$.

Model	M5B	M5A	M2A	M4B	M2B	M2C	M3B	M4A	M1	M3A
Params ¹	5	4	2	4	2	3	3	3	0	2
φ_1	1.57	1.53	0.83	4.01	0.83	0.83	3.97	1.31	NA	0.82
κ_1	4.63	6.01	1.82	0.00	2.33	3.82	0.00	1.05	0.00	0.87
λ	0.48	0.49	1.00	0.25	0.50	0.75	0.50	0.75	1.00	0.50
φ_2	6.28	6.28	NA	7.16	NA	NA	7.11	4.46	NA	3.97
κ_2	4.94	6.01	0	2.05	0	0	2.18	1.05	0	0.87
Likelihood ²	123.9	125.0	132.7	140.6	150.4	150.2	150.5	163.3	183.8	183.1
Convergence ³	0	0	0	0	0	0	0	0	0	0
AIC	257.8	258.1	269.5	289.1	304.9	306.4	307.0	332.6	367.6	370.3
AICc	258.5	258.5	269.6	289.5	305.0	306.6	307.3	332.8	367.6	370.4
BIC	270.9	268.5	274.7	299.5	310.1	314.2	314.8	340.4	367.6	375.5
Δ AIC	0	0.23	11.63	31.27	47.02	48.55	49.19	74.73	109.74	112.45
Δ AICc	0	0.01	11.12	31.05	46.51	48.17	48.80	74.35	109.10	111.94
Δ BIC	2.38	0	6.20	31.04	41.59	45.72	46.36	71.90	99.09	107.02
Relative likelihoods	1	0.89	0.003	0	0	0	0	0	0	0
AIC weights	0.53	0.47	0	0	0	0	0	0	0	0
Evidence Ratio	NA	1.12	3.36e ⁻²	6.16e ⁶	1.62e ¹⁰	3.50e ¹⁰	4.80e ¹⁰	1.69e ¹⁶	6.74e ⁻²³	2.62e ²⁴

¹Number of free parameters in the model

²Negative log likelihood

³Whether or not the maximum likelihood search converged, 0 = convergence.

Figure S1. Power analysis of CircMLE. The power of the maximum likelihood procedure in CircMLE v0.2.0 to correctly identify uniform (M1) and unimodal (M2A) models across various sample sizes (colored lines). Power is calculated as the proportion of 1000 simulated datasets that correctly returned the M1 (concentration parameter $K = 0$) or M2A ($K > 0$) models as best fit ($\Delta AIC < 2$). The recommended minimum power of 80% is shown (dotted black line).

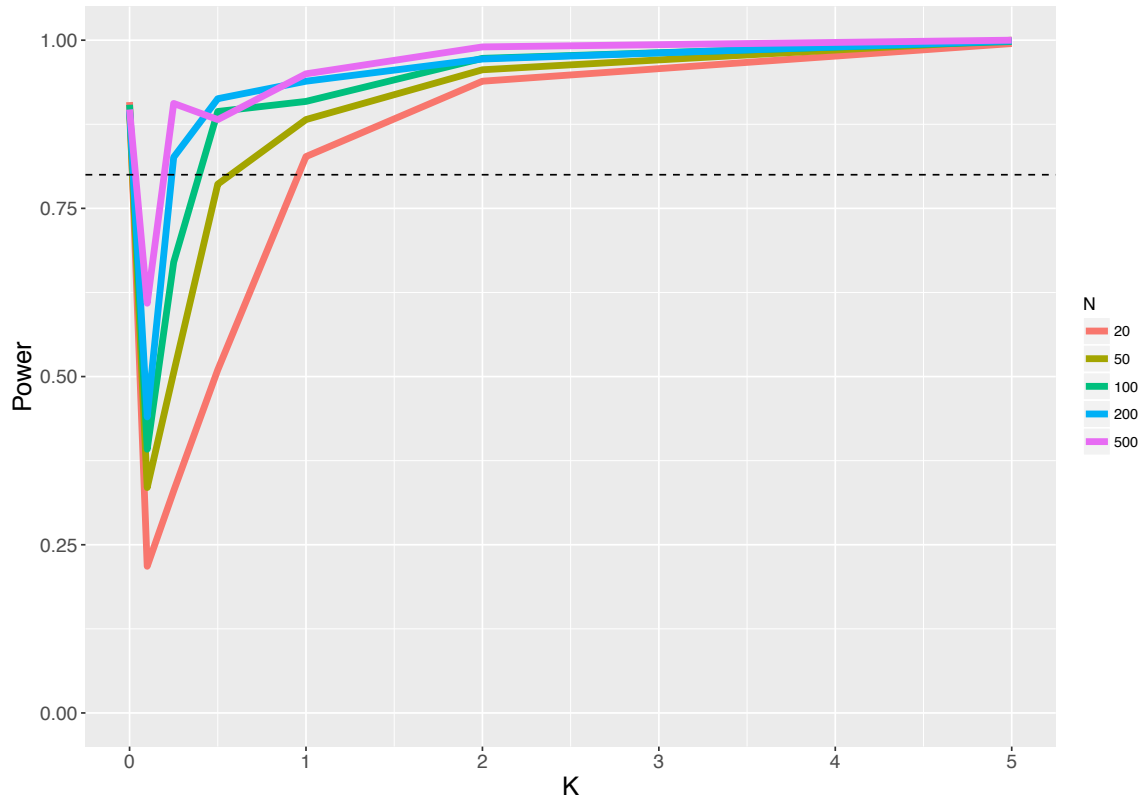


Figure S2. Best fit model for the simulated bimodal dataset. Circular histogram (gray bars) and mean vector (red arrow) of the simulated bimodal dataset. The density (dotted line) and mean angles (dotted arrows) for the best fit model, model M5B, are shown. The plot was produced using the 'plot_circMLE' function in the CircMLE v0.2.0 package in R.

