Supplementary Material for the paper: "Humans can learn bimodal priors in complex sensorimotor behaviour"

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Extended data

Table 1. Multilevel regression model of error estimation on day 1 in the fast condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(2673)	*p* two-sided
Intercept	–18.32	4.01	[–26.19, –10.46]	–4.57	< .001
Ball position	0.16	0.06	[0.03, 0.28]	2.45	.014
Segment (0 = left, 1 = right)	3.24	1.66	[–0.01, 6.49]	1.95	.153
Random effects					
Intercept variance (τ_{00})	280.98	–	–	–	–
Slope variance (τ_{11})	0.06	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.99	–	–	–	–
Level-1 residual (σ^2)	98.98	–	–	–	–
ICC	0.24	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .148. Model comparison in Table 2.

Table 2. Model comparison for multilevel regression model of error estimation on day 1 in the fast condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	21171.00	21182.80	–10583.50			
2 Base model	3	20755.30	20773.01	–10374.65	1 vs 2	417.697	< .001
3 Base model + RI	4	20631.67	20655.28	–10311.84	2 vs 3	125.632	< .001
4 Base model + RS	6	20211.17	20246.57	–10099.58	3 vs 4	424.502	< .001
5 Base model + RS + Bimodal segment factor	7	20209.35	20250.65	–10097.67	4 vs 5	3.820	.051

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 3. Multilevel regression model of error estimation on day 1 in the moderate condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(3096)	*p* two-sided
Intercept	–13.02	3.72	[–20.30, –5.73]	–3.50	< .001
Ball position	0.17	0.06	[0.06, 0.28]	3.04	.002
Segment (0 = left, 1 = right)	0.27	1.46	[–2.60, 3.15]	0.19	.852
Random effects					
Intercept variance (τ_{00})	251.55	–	–	–	–
Slope variance (τ_{11})	0.04	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.96	–	–	–	–
Level-1 residual (σ^2)	90.90	–	–	–	–
ICC	0.29	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .090. Model comparison in Table 4.

Table 4. Model comparison for multilevel regression model of error estimation on day 1 in the moderate condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	24246.25	24258.34	–12121.13			
2 Base model	3	23938.17	23956.31	–11966.09	1 vs 2	310.078	< .001
3 Base model + RI	4	23570.14	22594.32	–11781.07	2 vs 3	370.034	< .001
4 Base model + RS	6	23107.90	23144.18	–11547.95	3 vs 4	466.239	< .001
5 Base model + RS + Bimodal segment factor	7	23109.87	23152.19	–11547.93	4 vs 5	0.035	.852

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 5. Multilevel regression model of error estimation on day 1 in the slow condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(3049)	*p* two-sided
Intercept	1.53	3.25	[–4.84, 7.90]	0.47	.638
Ball position	0.08	0.05	[–0.02, 0.18]	1.62	.105
Segment (0 = left, 1 = right)	–2.24	1.39	[–4.97, 0.49]	–1.61	.216
Random effects					
Intercept variance (τ_{00})	181.19	–	–	–	–
Slope variance (τ_{11})	0.03	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.94	–	–	–	–
Level-1 residual (σ^2)	79.84	–	–	–	–
ICC	0.29	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .003. Model comparison in Table 6.

Table 6. Model comparison for multilevel regression model of error estimation on day 1 in the slow condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	23242.37	23254.44	–11619.19			
2 Base model	3	23229.23	23247.33	–11611.62	1 vs 2	15.141	< .001
3 Base model + RI	4	22743.84	22767.97	–11367.92	2 vs 3	487.399	< .001
4 Base model + RS	6	22366.15	22402.34	–11177.08	3 vs 4	381.693	< .001
5 Base model + RS + Bimodal segment factor	7	22365.56	22407.78	–11175.78	4 vs 5	2.595	.108

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 7. Multilevel regression model of error estimation on day 2+3 in the fast condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(5571)	*p* one-sided
Intercept	–27.10	3.09	[–33.16, –21.04]	–8.76	< .001
Ball position	0.36	0.05	[0.27, 0.45]	7.79	< .001
Segment (0 = left, 1 = right)	–2.36	1.04	[–4.39, –0.33]	–2.28	.023
Random effects					
Intercept variance (τ_{00})	190.39	–	–	–	–
Slope variance (τ_{11})	0.04	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.98	–	–	–	–
Level-1 residual (σ^2)	78.39	–	–	–	–
ICC	0.23	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .273. Model comparison in Table 8.

Table 8. Model comparison for multilevel regression model of error estimation on day 2+3 in the fast condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	43268.33	43281.59	–21632.17			
2 Base model	3	41641.60	41661.49	–20817.80	1 vs 2	1628.732	< .001
3 Base model + RI	4	41273.01	41273.53	–20619.51	2 vs 3	396.587	< .001
4 Base model + RS	6	40521.26	40521.04	–20234.63	3 vs 4	769.756	< .001
5 Base model + RS + Bimodal segment factor	7	40524.07	40524.48	–20232.04	4 vs 5	5.184	.023

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 9. Multilevel regression model of error estimation on day 2+3 in the moderate condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(6584)	*p* one-sided
Intercept	–18.20	2.90	[–24.08, –12.70]	–6.28	< .001
Ball position	0.29	0.04	[0.21, 0.37]	7.26	< .001
Segment (0 = left, 1 = right)	–2.64	0.91	[–4.36, –0.94]	–2.90	.006
Random effects					
Intercept variance (τ_{00})	171.07	–	–	–	–
Slope variance (τ_{11})	0.03	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.97	–	–	–	–
Level-1 residual (σ^2)	71.51	–	–	–	–
ICC	0.24	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .182. Model comparison in Table 10.

Table 10. Model comparison for multilevel regression model of error estimation on day 2+3 in the moderate condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	50105.85	50119.45	–25050.93			
2 Base model	3	48784.41	48804.80	–24389.21	1 vs 2	1323.442	< .001
3 Base model + RI	4	48022.77	48049.96	–24007.39	2 vs 3	763.638	< .001
4 Base model + RS	6	47179.99	47220.77	–23584.00	3 vs 4	846.782	< .001
5 Base model + RS + Bimodal segment factor	7	47173.56	47221.13	–23579.78	4 vs 5	8.435	.004

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 11. Multilevel regression model of error estimation on day 2+3 in the slow condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(6462)	*p* one-sided
Intercept	–0.95	2.34	[–5.53, 3.64]	–0.40	.686
Ball position	0.10	0.03	[0.03, 0.16]	2.79	.005
Segment (0 = left, 1 = right)	–0.81	0.80	[–2.38, 0.76]	–1.02	.154
Random effects					
Intercept variance (τ_{00})	107.93	–	–	–	–
Slope variance (τ_{11})	0.02	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.96	–	–	–	–
Level-1 residual (σ^2)	54.89	–	–	–	–
ICC	0.24	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .033. Model comparison in Table 12.

Table 12. Model comparison for multilevel regression model of error estimation on day 2+3 in the slow condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	46272.21	46285.77	–23134.11			
2 Base model	3	46045.41	46065.74	–23019.70	1 vs 2	228.806	< .001
3 Base model + RI	4	45356.42	45383.53	–22674.21	2 vs 3	690.987	< .001
4 Base model + RS	6	44591.78	44632.44	–22289.89	3 vs 4	768.645	< .001
5 Base model + RS + Bimodal segment factor	7	44592.74	44640.19	–22289.37	4 vs 5	1.034	.309

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 13. Multilevel regression model of error estimation for the control experiment in the fast condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(2738)	*p* two-sided
Intercept	–31.69	2.72	[–37.02, –26.35]	–11.65	< .001
Ball position	0.38	0.04	[0.31, 0.45]	10.80	< .001
Random effects					
Intercept variance (τ_{00})	156.34	–	–	–	–
Slope variance (τ_{11})	0.03	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.91	–	–	–	–
Level-1 residual (σ^2)	129.81	–	–	–	–
ICC	0.21	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .207. Model comparison in Table 14.

Table 14. Model comparison for multilevel regression model of error estimation for the control experiment in the fast condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	22636.72	22648.57	–11316.36			
2 Base model	4	21959.43	21977.20	–10976.71	1 vs 2	679.295	< .001
3 Base model + RI	5	21539.11	21562.80	–10765.55	2 vs 3	422.321	< .001
4 Base model + RS	7	21423.08	21458.62	–10705.54	3 vs 4	120.028	< .001

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 15. Multilevel regression model of error estimation for the control experiment in the moderate condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(3018)	*p* two-sided
Intercept	–13.13	2.40	[–17.83, –8.42]	–5.46	< .001
Ball position	0.15	0.03	[0.09, 0.21]	4.93	< .001
Random effects					
Intercept variance (τ_{00})	124.11	–	–	–	–
Slope variance (τ_{11})	0.02	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.88	–	–	–	–
Level-1 residual (σ^2)	100.02	–	–	–	–
ICC	0.25	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .050. Model comparison in Table 16.

Table 16. Model comparison for multilevel regression model of error estimation for the control experiment in the moderate condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	23660.52	23672.56	–11828.26			
2 Base model	4	23465.21	23483.28	–11729.61	1 vs 2	197.304	< .001
3 Base model + RI	5	22921.17	22945.26	–11456.59	2 vs 3	546.042	< .001
4 Base model + RS	7	22798.38	22834.51	–11393.19	3 vs 4	126.790	< .001

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.

Table 17. Multilevel regression model of error estimation for the control experiment in the slow condition.

Fixed effects	*B*	*SE B*	95% CI	*t*(2894)	*p* two-sided
Intercept	7.22	2.18	[2.96, 11.49]	3.32	.001
Ball position	–0.05	0.02	[–0.09, 0.00]	–1.96	.050
Random effects					
Intercept variance (τ_{00})	101.92	–	–	–	–
Slope variance (τ_{11})	0.01	–	–	–	–
Intercept-slope covariance (ρ_{01})	–0.88	–	–	–	–
Level-1 residual (σ^2)	81.31	–	–	–	–
ICC	0.26	–	–	–	–

Note. *B = unstandardized regression coefficients, SE* = standard error, CI = confidence intervals, *t*(degrees of freedom). ICC = Interclass correlation coefficient. Model statistics: $N_{participants}$ = 24, $R^2_{marginal}$ = .006. Model comparison in Table 18.

Table 18. Model comparison for multilevel regression model of error estimation for the control experiment in the slow condition.

Model	*df*	AIC	BIC	logLik	Comparison	χ^2	*p*
1 Intercept	2	21976.13	21988.09	–10986.07			
2 Base model	3	21963.32	21981.26	–10978.66	1 vs 2	14.810	< .001
3 Base model + RI	4	21364.30	21370.22	–10669.15	2 vs 3	619.024	< .001
4 Base model + RS	6	21263.17	21299.04	–10625.58	3 vs 4	87.130	< .001

Note. df = degrees of freedom, AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, logLik = log-likelihood, RI = random intercepts, RS = random intercept and slopes. The base model includes the predictor ball position.