

Supplementary Material for “Resting networks and personality predict attack speed in social spiders”

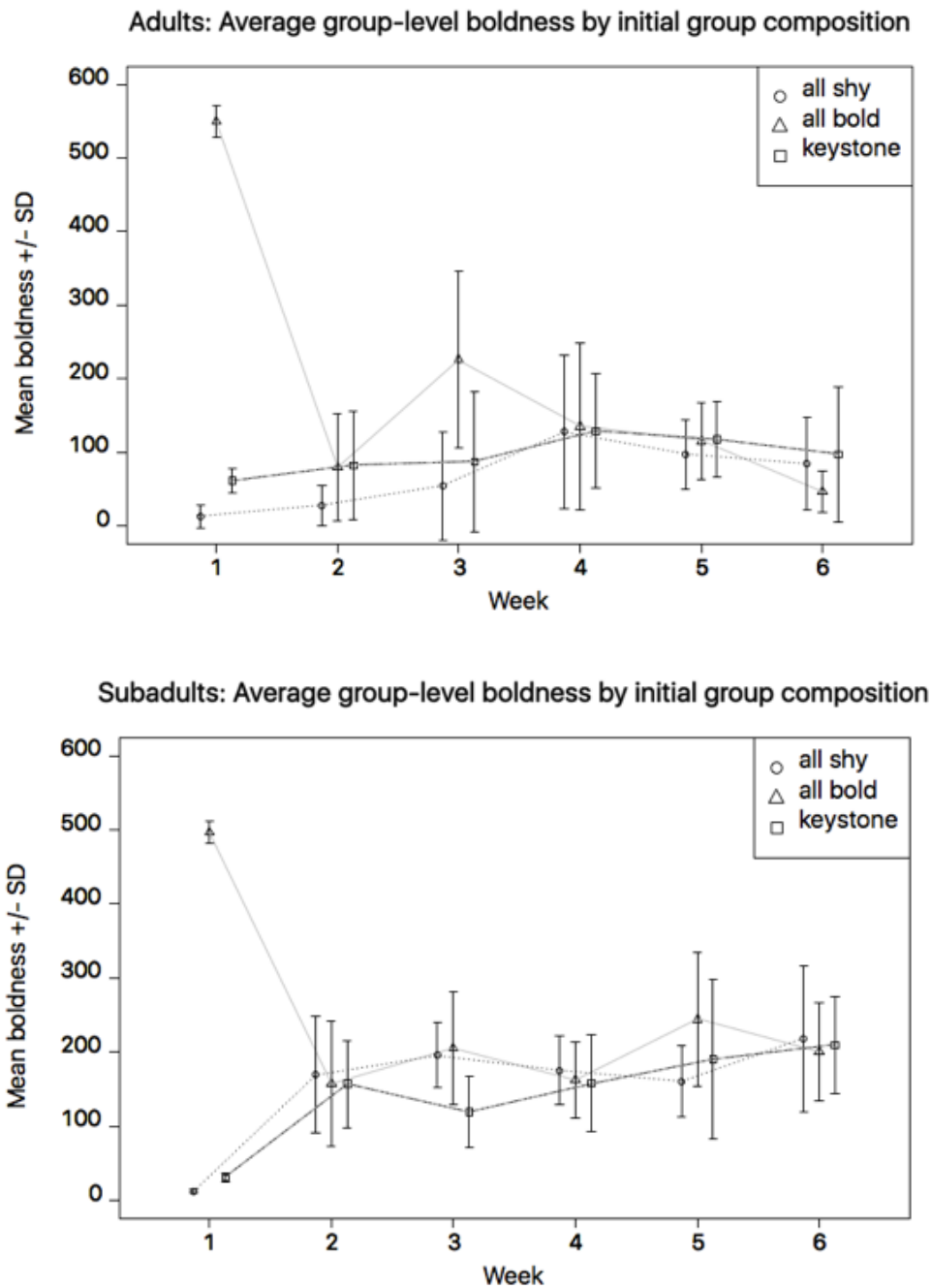


Figure S1-A. Mean group boldness by initial boldness composition. Top: adults and bottom: subadults. Error bars indicate standard deviation. For adults, N=9 groups of all shy, N=5 groups of all bold, and N=10 groups of keystone groups. For subadults, N=5 groups for each of the three compositions. For both adults and subadults, mean group boldness converged after the first week.

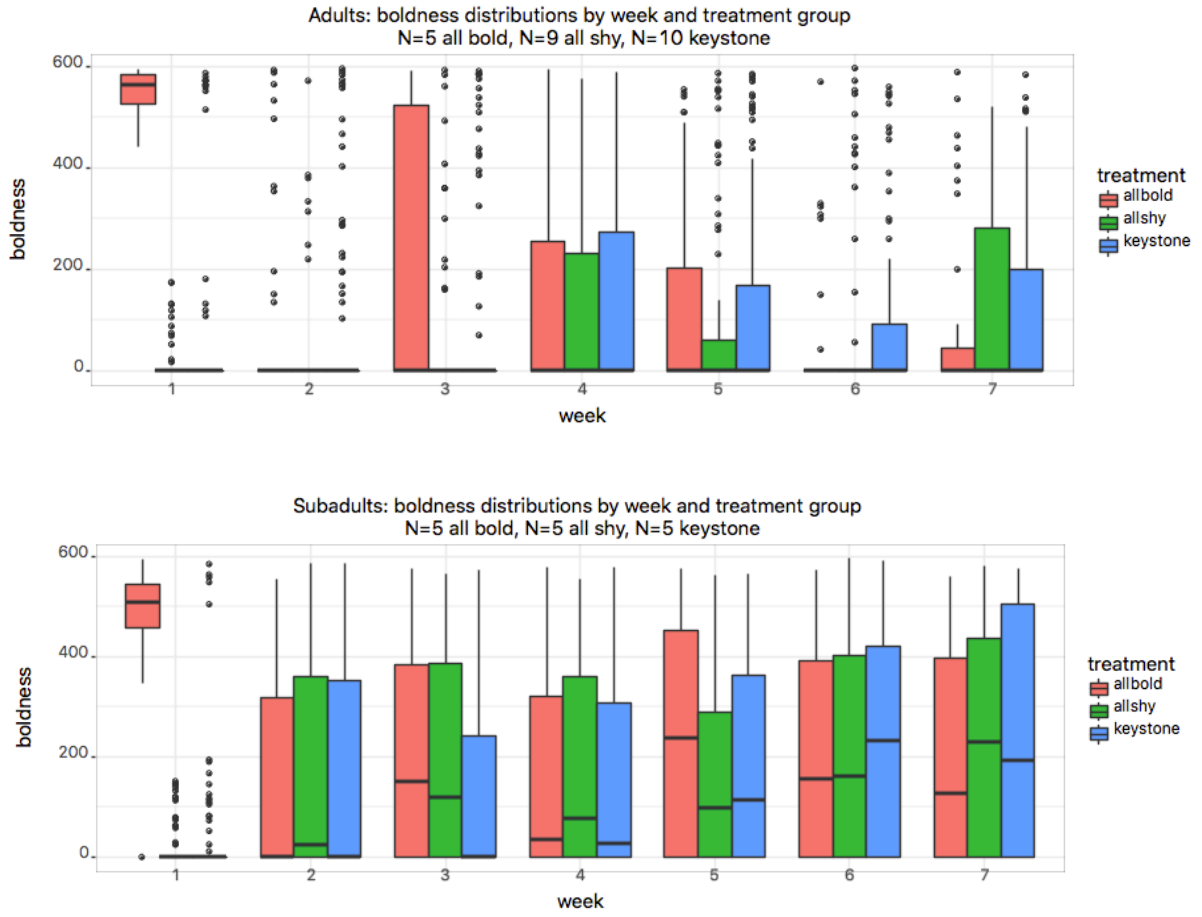


Figure S1-B. Boxplots of the adult and subadult spider boldness by week and treatment. The thick line is the median, the lower and upper hinges are the first and third quartiles, the whisker is $1.5 \times \text{IQR}$, and the single points are outliers beyond this. The boldness substantially converges in weeks 2-6, justifying the pooling of treatments.

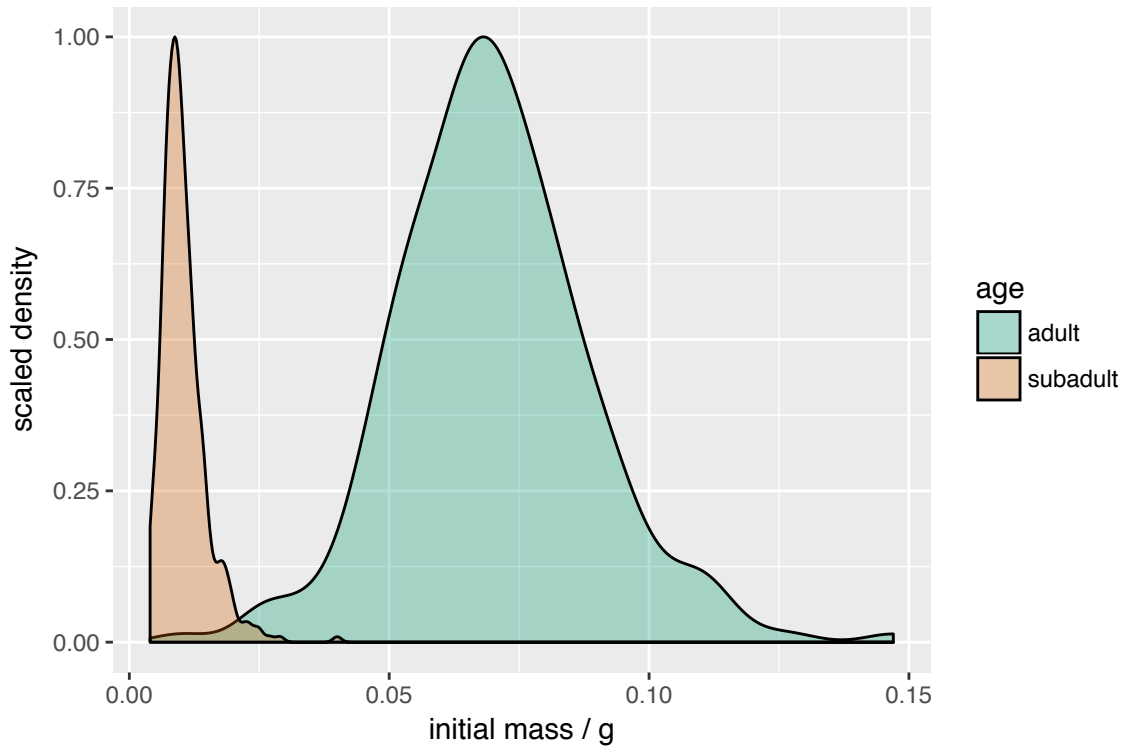


Figure S2. Distribution of initial spider mass for the two developmental stages (subadult or adult) scaled to 1 on the y-axis to allow comparison. Subadults have the physical features of adults but they are much smaller.

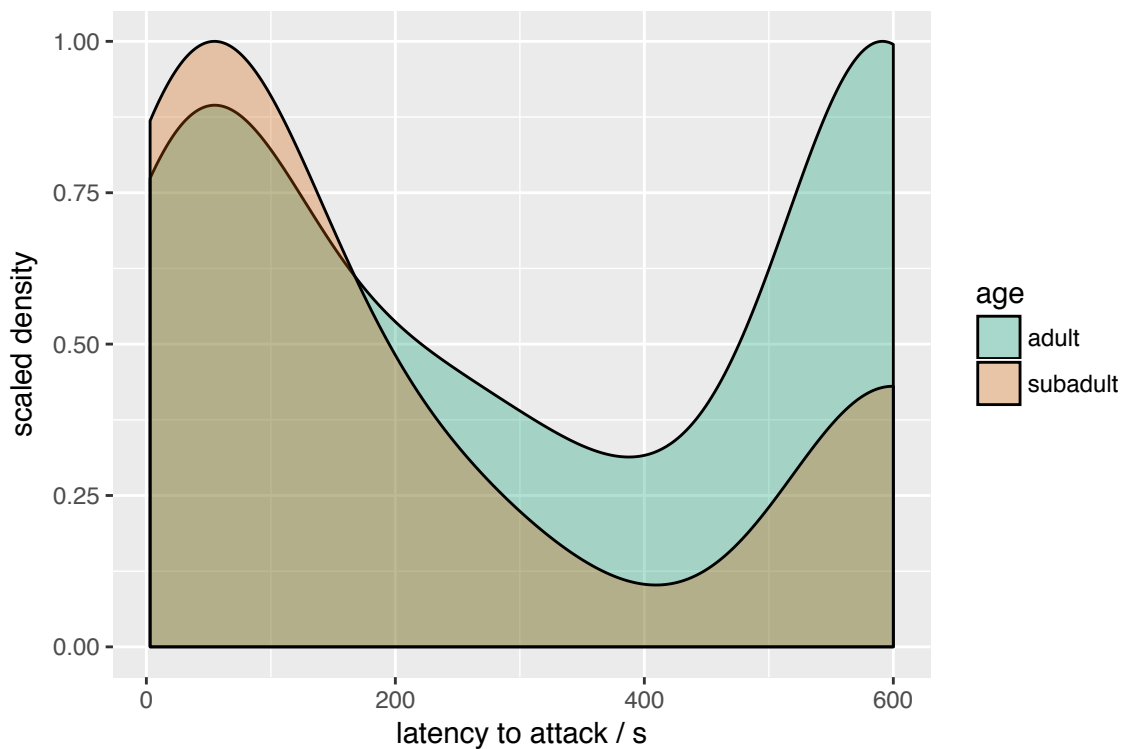


Figure S3. Distribution of latency to attack for the two developmental stages (subadult or adult). Scaled to 1 on the y-axis for comparability. There is right-censoring at $t=600$ s, which is the time given for no attack (i.e. > 600 s). The two distributions are broadly similar in actual attack speeds.

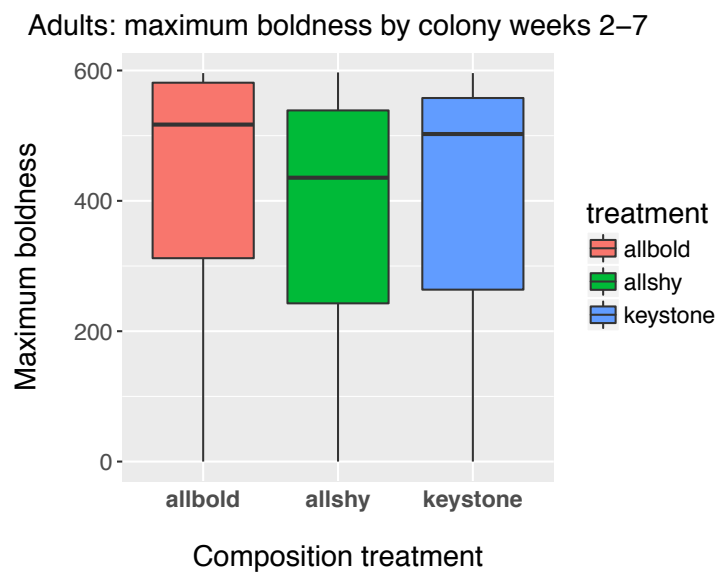


Figure S4. The distribution of maximum (keystone) boldness by initial composition treatment, excluding the first week when the artificial distributions were first created. The distributions are similar, indicating that keystone boldness became similar regardless of initial conditions.

Table S1. Convergence of boldness distributions after first week.

P values resulting from two-sample Kolmogorov-Smirnov test ('ks.test' in R 'stats' package), to compare the boldness distributions in the 3 different initial boldness treatments. $P < 0.05$ is evidence that the distributions are different.

In weeks 2-6 the distributions are substantially converged, except for 2 cases in both adults and subadults, though the p value remains relatively large for this test (> 0.001). It should also be noted that with multiple comparisons the expectation for a significant p value is raised.

Adult spiders

Week	allbold vs allshy	allbold vs keystone	allshy vs keystone
1	0.000	0.000	0.621
2	0.723	1.000	0.293
3	0.001	0.010	0.764
4	0.997	1.000	0.999
5	1.000	1.000	0.999
6	0.676	0.402	0.848

Subadult spiders

Week	allbold vs allshy	allbold vs keystone	allshy vs keystone
1	0.000	0.000	0.976
2	0.652	0.493	0.884
3	0.949	0.012	0.063
4	0.827	1.000	0.904
5	0.013	0.201	0.479
6	0.995	0.618	0.848

Results of the separate adult and subadult spider model selection procedures

Adult spiders

Table S2. Adults: Output of selected model for prey attack speed. In the fixed effect source colony, Col_num2, 3, measure the effect relative to baseline Col_num1. To measure the random effect of group and time, μ_i is the individual-specific time invariant random effect and v_{it} is the individual-specific time varying residual random effect. ‘Days before’ is before prey stimulus, and is a fixed effect interacting with the chosen predictor variables.

Adult spiders: selected model for latency to attack							
Level of Analysis	Coefficient	Days before	Estimate log(seconds)	Standard error	t value	p	Sig. at 5%
	(Intercept)		5.702	0.397	14.357	< 0.001	*
Individual	Closeness of keystone	4	10.715	6.682	1.604	0.109	
		2	12.766	6.269	2.036	0.042	*
		0	18.842	7.205	2.615	0.0089	*
Group	Average degree	4	-0.172	0.129	-1.334	0.182	
		2	-0.239	0.150	-1.596	0.111	
		0	-0.367	0.175	-2.101	0.036	*
Source colony (fixed effect)	Col_num2		0.951	0.509	1.870	0.061	
	Col_num3		-0.538	0.592	-0.909	0.363	
Group and time (random)	log(Sigma(μ_i))		0.0187	0.192	0.097	0.923	
	log(Sigma(v_{it}))		0.341	0.052	6.540	< 0.001	*

Table S3. Generalized Variance Inflation Factors (VIFs) for the adult model.

Calculated using the vif() function in the ‘car’ R package; the corrected GVIF takes into account categorical variables. The predictor variables maximum boldness and degree of keystone interact with measurement day (4, 2, or 0 days before prey attack assay).

Coefficient	Df	GVIF ^{1/(2*Df)}
Source colony (Col_num)	2	1.006
Closeness of keystone : day	3	1.717
Average degree : day	3	1.716

The corrected GVIFs for maximum boldness and degree of keystone are not of concern (squared corrected GVIF < 10, also see (O’Brien, 2007)).

Subadult spiders

Table S4. Subadults: Output of selected model for prey attack speed. Boldness is measured on a 0-600 scale. In the fixed effect source colony, Col_num2, 3, 4 measure the effect relative to baseline Col_num1. To measure the random effect of group and time, μ_i is the individual-specific time invariant random effect and v_{it} is the individual-specific time varying residual random effect.

Adult spiders: selected model for latency to attack							
Level of Analysis	Coefficient	Days before	Estimate log(seconds)	Standard error	t value	p	Sig. at 5%
	(Intercept)		7.262	0.965	7.523	< 0.001	*
Individual	Maximum boldness	4	-0.0053	0.0015	-3.548	< 0.001	*
		2	-0.0049	0.0016	-3.045	0.002	*
		0	-0.0051	0.0016	-3.210	0.001	*
Group	Average degree	4	0.0052	0.0247	0.211	0.833	
		2	-0.0410	0.0031	-1.304	0.192	
		0	-0.0245	0.0245	-1.000	0.317	
Source colony (fixed effect)	Col_num2		1.935	0.748	2.587	0.009	*
	Col_num3		-0.078	0.798	-0.097	0.923	
	Col_num4		-0.212	0.696	-0.305	0.761	
Group and time (random)	log(Sigma(μ_i))		-0.104	0.225	-0.462	0.644	
	log(Sigma(v_{it}))		0.149	0.059	2.529	0.011	*

Table S5. Generalized Variance Inflation Factors (VIFs) for subadult model.

Calculated using the vif() function in the 'car' R package; the corrected GVIF takes into account categorical variables. The predictor variables maximum boldness and degree of keystone interact with measurement day (4, 2, or 0 days before prey attack assay).

Coefficient	Df	GVIF ^{1/(2*Df)}
Source colony (Col_num)	3	1.012
Maximum boldness : day	3	1.565
Average degree : day	3	1.564

The corrected GVIFs for maximum boldness and degree of keystone are not of concern (squared corrected GVIF < 10, also see (O'Brien, 2007)).

Table S6. An alternative subadult model with degree of keystone as a second individual-level effect, instead of the group-level effect average degree (Table S4). Maximum boldness remains the only significant predictor.

Adult spiders: selected model for latency to attack							
Level of Analysis	Coefficient	Days before	Estimate log(seconds)	Standard error	t value	p	Sig. at 5%
	(Intercept)		6.858	1.0045	6.827	< 0.001	*
Individual	Degree of keystone	4	0.032	0.019	1.709	0.087	
		2	0.0029	0.022	0.131	0.896	
		0	0.023	0.020	1.180	0.238	
	Maximum boldness	4	-0.0050	0.0015	-3.378	< 0.001	*
		2	-0.0049	0.0016	-3.040	0.002	*
		0	-0.0053	0.0016	-3.374	< 0.001	*
Source colony (fixed effect)	Col_num2		2.093	0.834	2.511	0.012	*
	Col_num3		-0.018	0.807	-0.022	0.983	
	Col_num4		-0.322	0.763	-0.422	0.673	
Group and time (random)	log(Sigma(μ_i))		-0.040	0.212	-0.189	0.850	
	log(Sigma(v_{it}))		0.143	0.0587	2.440	0.015	*

Coefficient	Df	GVIF ^{1/(2*Df)}
Source colony (Col_num)	3	1.012
Degree of keystone : day	3	1.384
Maximum boldness : day	3	1.393

Table S7. Adult spiders – Full-model Averaging Results

Parameter and variance estimates are made according to

$$\tilde{\beta} = \sum_{i=1}^R w_i \hat{\beta}_i \quad \widehat{var}(\tilde{\beta}) = \sum w_i \left[\widehat{var}(\hat{\beta}_i) + (\beta_i - \tilde{\beta})^2 \right]$$

Where w_i is the Akaike model weight. See (Symonds and Moussalli, 2011) and (Lukacs et al. 2009).

For the adult spiders, none of the predictors are significant under full-model averaging, suggesting that excessive model selection uncertainty makes this approach uninformative. Instead, a parsimonious model selected using predictor ranking (Table S2) allows us to identify informative predictors.

Adult spiders: Full-model Averaging Results						
Level of Analysis	Coefficient	Days before	Estimate log(seconds)	Standard error	t value	Sig. at 5%
	(Intercept)		5.6852	0.6774	8.3925	*
Individual	Degree of keystone	4	-0.0147	0.0540	-0.2717	
		2	-0.0095	0.0520	-0.1830	
		0	-0.0147	0.0623	-0.2354	
	Keystone closeness	4	8.4980	6.9952	1.2148	
		2	8.3614	6.7450	1.2397	
		0	12.0574	8.8400	1.3640	
	Maximum boldness	4	0.0003	0.0006	0.5155	
		2	0.0004	0.0008	0.5032	
		0	0.0003	0.0007	0.4118	
Subgroup	Modularity	4	-0.5745	0.9094	-0.6317	
		2	-0.5248	0.8842	-0.5935	
		0	-0.4508	0.7923	-0.5690	
Group	Average degree	4	-0.0896	0.1386	-0.6463	
		2	-0.1302	0.1859	-0.7006	
		0	-0.1828	0.2450	-0.7464	
	Skewness of degree distribution	4	0.0011	0.0620	0.0171	
		2	-0.0011	0.0580	-0.0190	
		0	-0.0057	0.0773	-0.0744	
Source colony (fixed effect)	Col_num2		0.9687	0.5320	1.8208	
	Col_num3		-0.5438	0.6104	-0.8910	
Group and time (random)	log(Sigma(μ_i))		0.0437	0.1926	0.2267	
	log(Sigma(v_{it}))		0.3416	0.0533	6.4119	*

Table S8. Subadult spiders – Full-model Averaging Results

Calculated with the equations given at Table S7. The same qualitative result is found as in Table S4: maximum boldness is a significant predictor of attack speed.

Subadult spiders: Full-model Averaging Results						
Level of Analysis	Coefficient	Days before	Estimate log(seconds)	Standard error	t value	Sig. at 5%
	(Intercept)		7.0716	1.0905	6.4847	*
Individual	Degree of keystone	4	0.0281	0.0344	0.8158	
		2	0.0118	0.0231	0.5117	
		0	0.0247	0.0324	0.7643	
	Keystone closeness	4	0.8071	2.8725	0.2810	
		2	0.9217	3.1178	0.2956	
		0	0.2378	2.2045	0.1078	
	Maximum boldness	4	-0.0050	0.0017	-2.9086	*
		2	-0.0053	0.0019	-2.7946	*
		0	-0.0049	0.0018	-2.7588	*
Subgroup	Modularity	4	-0.1258	0.5981	-0.2103	
		2	0.7506	1.1170	0.6720	
		0	-0.5798	0.9804	-0.5914	
Group	Average degree	4	-0.0216	0.0404	-0.5347	
		2	-0.0304	0.0493	-0.6162	
		0	-0.0366	0.0477	-0.7661	
	Skewness of degree distribution	4	0.0056	0.0819	0.0681	
		2	-0.0493	0.1465	-0.3362	
		0	-0.0133	0.0727	-0.1835	
Source colony (fixed effect)	Col_num2		2.0068	0.7807	2.5704	*
	Col_num3		-0.0197	0.7960	-0.0247	
	Col_num4		-0.2374	0.7411	-0.3203	
Group and time (random)	log(Sigma(μ_i))		-0.0853	0.2191	-0.3894	
	log(Sigma(v_{it}))		0.1335	0.0612	2.1823	*

References

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