Table S1

Glossary of network theoretic terms used here.

Term	**Definition**	**Purpose**
Betweenness centrality of an edge	The sum of weights of shortest paths between any two individuals that passes through a given edge.	A measure of how frequently a given edge in the network is on the shortest path between any two nodes.
Clustering coefficient of a network	The number of closed triplets divided by the total number of triplets.	A measure of the strength of cliquishness in a network.
Density of a network	The number of bonds divided by the total possible number of bonds.	A measure of how well connected a network is.
Diameter of a network	The longest of all shortest paths between any two individuals.	A measure of how tightly connected a network is.
Sparsity of a network fission	The sum of bond weights broken to the number of vertices in the smallest resulting post-fission group.	A measure of how evenly a fission occurred while minimizing broken bonds.

Table S2

Summary of ANOVA for pairwise comparisons between the algorithms for each metric we consider. Values in the table denote our measure of effect size (η^2) for the main effect of the algorithm with number in the parentheses the p-value associated with this main effect. As a general rule of thumb, η^2 of 0.01 is considered small, 0.07 medium, and 0.14 large[57].

	% broken	**mean broken**	**mean maintained**	**sparsity**	**broken bwness**	**maintained bwness**	**% correct**
Results figure for this metric	Fig. 3	Fig. 4	Fig. S8	Fig. S7	Fig. S9	Fig. S10	Fig. 5
Democracy vs Community	0.10 ($<<10^{-10}$)	0.12 ($<<10^{-10}$)	$<10^{-5}$ (0.69)	0.12 ($<<10^{-10}$)	$<10^{-2}$ ($<10^{-7}$)	$<10^{-3}$ ($<10^{-6}$)	$<10^{-2}$ ($<10^{-5}$)
Democracy vs Despotism	0.34 ($<<10^{-10}$)	0.04 ($<<10^{-10}$)	$<10^{-3}$ ($<10^{-7}$)	0.20 ($<<10^{-10}$)	0.01 ($<<10^{-10}$)	$<10^{-4}$ ($<10^{-3}$)	0.04 ($<<10^{-10}$)
Democracy vs Random	0.75 ($<<10^{-10}$)	0.14 ($<<10^{-10}$)	0.02 ($<<10^{-10}$)	0.42 ($<<10^{-10}$)	0.02 ($<<10^{-10}$)	$<10^{-3}$ ($<10^{-8}$)	0.18 ($<<10^{-10}$)
Community vs Despotism	0.50 ($<<10^{-10}$)	0.28 ($<<10^{-10}$)	$<10^{-3}$ ($<10^{-8}$)	0.49 ($<<10^{-10}$)	0.03 ($<<10^{-10}$)	$<10^{-3}$ ($<<10^{-10}$)	0.05 ($<<10^{-10}$)
Community vs Random	0.80 ($<<10^{-10}$)	0.41 ($<<10^{-10}$)	0.02 ($<<10^{-10}$)	0.64 ($<<10^{-10}$)	0.05 ($<<10^{-10}$)	$<10^{-2}$ ($<<10^{-10}$)	0.16 ($<<10^{-10}$)
Despotism vs Random	0.34 ($<<10^{-10}$)	0.04 ($<<10^{-10}$)	0.01 ($<<10^{-10}$)	0.13 ($<<10^{-10}$)	$<10^{-2}$ ($<<10^{-10}$)	$<10^{-3}$ ($<10^{-4}$)	0.08 ($<<10^{-10}$)

Table S3

Comparisons between the observed fissions and each of the stochastic algorithms presented as the percentile that the observed value falls on each algorithm. That is, a value of *x* in the table means that the observed fission had a higher value than *x*% of the data from the specified algorithm for each metric (averaged across all groups). More extreme values (those closer to 0 and 100) indicate a lower probability that the observed value would be produced by the stochastic algorithm being compared.

	% broken	**mean broken**	**mean maintained**	**sparsity**	**broken bwness**	**maintained bwness**
Figure	Fig. 3	Fig. 4	Fig. S8	Fig. S7	Fig. S9	Fig. S10
Democracy	95	87	41	85	33	50
Community	96	99	42	100	24	52
Despotism	49	57	48	59	49	49
Random	16	31	67	39	56	38

Table S4

Comparisons between the efficient non-behavioral network bisection (ENBNB) and each of the stochastic algorithms presented as the percentile that the ENBNB falls on each algorithm. That is, a value of *x* in the table means that the ENBNB had a higher value than *x*% of the data from the specified algorithm for each metric (averaged across all groups). More extreme values (those closer to 0 and 100) indicate a lower probability that the ENBNB's value would be produced by the stochastic algorithm being compared.

	% broken	**mean broken**	**mean maintained**	**sparsity**	**broken bwness**	**maintained bwness**	**% correct**
Figure	Fig. 3	Fig. 4	Fig. S8	Fig. S7	Fig. S9	Fig. S10	Fig. 5
Democracy	44	18	73	7.3	56	36	62
Community	69	75	69	34	38	46	58
Despotism	7.4	1.6	75	0	73	36	78
Random	0	0.14	88	0	83	32	82

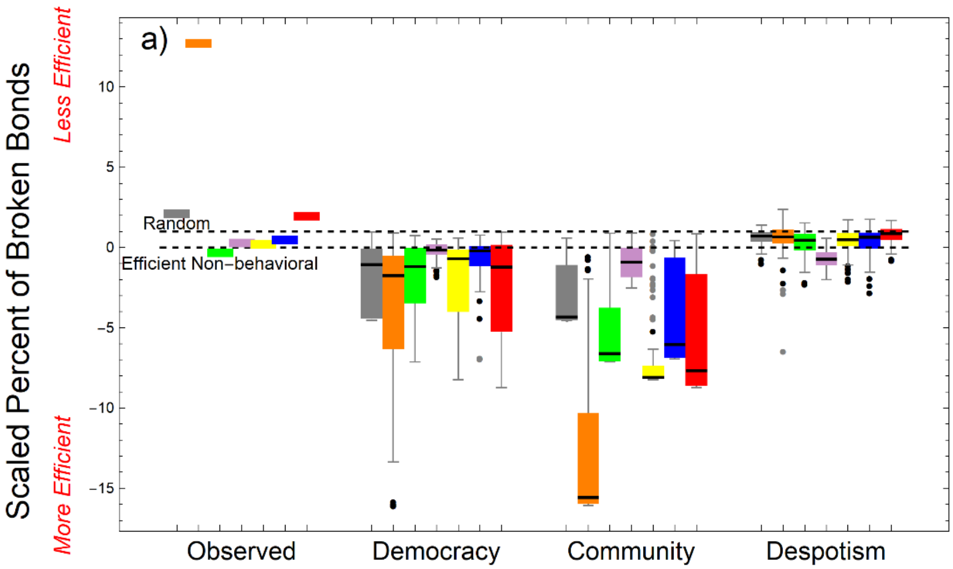
Table S5

Summary of efficiency metrics from the observed fissions and the algorithms for each group (specified by vertical text on left-most column). % broken: percentage of bonds broken during fission. Mean broken and maintained: average weight of broken and maintained bonds during fission. Broken and maintained bwness: average betweenness centrality of broken and maintained bonds during fission. Broken, maintained, total correct: percent of bonds correctly broken or maintained by the algorithms. Total correct represents a weighted average of broken and maintained correct (Total correct = (observed % broken) (broken correct) + (observed % maintained) (maintained correct))

		Efficiency metrics						Individual outcomes		
		% broken	mean broken	mean maintained	sparsity	broken bwness	maintained bwness	total % correct	broken % correct	maintained % correct
Dotty	Observed	44	0.11	0.20	0.44	0.30	0.19			
	Despotism	40	0.14	0.17	0.38	0.26	0.24	54	43	63
	Community	14	0.08	0.18	0.12	0.34	0.23	61	23	92
	Democracy	18	0.10	0.18	0.20	0.30	0.23	60	24	87
	Random	51	0.16	0.16	0.47	0.24	0.24	51	52	50
	ENBNB**	25	0.09	0.19	0.12	0.30	0.22	62	35	82
Hook	Observed	80	0.15	0.26	1.37	0.32	0.31			
	Despotism	42	0.15	0.19	0.46	0.34	0.31	49	44	65
	Community	14	0.12	0.18	0.28	0.43	0.31	32	17	94
	Democracy	29	0.13	0.19	0.36	0.37	0.30	38	29	72
	Random	50	0.24	0.17	0.62	0.32	0.79	50	50	52
	ENBNB	28	0.12	0.19	0.21	0.34	0.31	42	31	83
Linda	Observed	34	0.20	0.26	0.38	0.52	0.54			
	Despotism	33	0.22	0.26	0.52	0.61	0.51	56	32	66
	Community	7	0.12	0.25	0.18	0.90	0.53	67	11	95
	Democracy	24	0.20	0.26	0.38	0.60	0.53	62	27	78
	Random	51	0.24	0.24	0.77	0.55	0.53	50	50	49
	ENBNB	29	0.16	0.28	0.28	0.59	0.52	56	28	69
Lodge	Observed	25	0.26	0.23	0.41	2.61	1.04			
	Despotism	18	0.19	0.25	0.34	1.69	1.43	68	20	82
	Community	8	0.15	0.25	0.07	2.64	1.36	77	18	96
	Democracy	11	0.19	0.24	0.12	2.49	1.39	72	13	90
	Random	50	0.24	0.24	0.48	1.47	1.43	51	50	50
	ENBNB	9	0.16	0.25	0.05	2.55	1.35	79	24	96
Nyayo	Observed	34	0.12	0.11	0.40	0.24	0.33			
	Despotism	46	0.11	0.12	0.40	0.31	0.30	49	43	53
	Community	26	0.08	0.13	0.23	0.38	0.27	57	24	74
	Democracy	29	0.10	0.13	0.26	0.35	0.28	57	29	71
	Random	49	0.12	0.12	0.42	0.30	0.31	51	50	51
	ENBNB	28	0.08	0.13	0.15	0.41	0.26	56	27	71

*Note that table continues on next page
**Efficient-non-behavioral network bisection

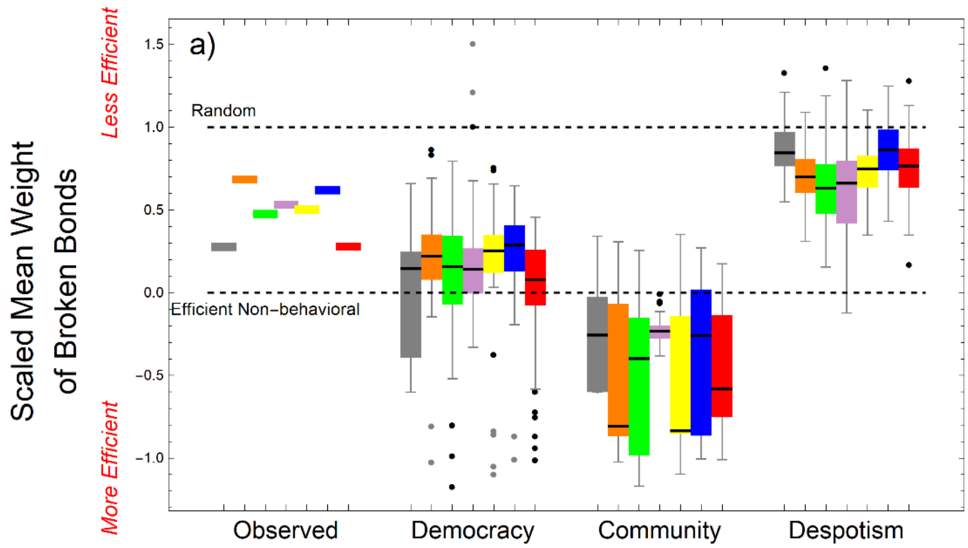
Viola	Observed	38	0.26	0.27	0.49	0.59	0.69			
	Despotism	41	0.26	0.28	0.71	0.70	0.62	51	60	52
	Community	25	0.18	0.30	0.34	0.85	0.69	25	76	57
	Democracy	26	0.22	0.29	0.45	0.77	0.62	28	75	58
	Random	50	0.27	0.27	0.83	0.65	0.66	49	50	49
	ENBNB	22	0.20	0.29	0.24	0.79	0.61	29	82	62
Vogue	Observed	34	0.16	0.17	0.70	0.37	0.28			
	Despotism	44	0.15	0.17	0.51	0.32	0.30	43	56	51
	Community	18	0.10	0.18	0.25	0.40	0.30	22	84	63
	Democracy	23	0.13	0.18	0.34	0.36	0.30	24	78	60
	Random	49	0.16	0.16	0.61	0.31	0.30	50	51	51
	ENBNB	32	0.11	0.18	0.17	0.30	0.31	28	80	63



b)

	Democracy	Community	Despotism	Random
Comm. η^2	0.24	–	–	–
Desp. η^2	0.18	0.77	–	–
Rand. η^2	0.39	0.71	0.17	–
ENBNB %	74	91	30	2.3
Obs. %	89	98	69	45

Figure S1. Scaled percent of broken bonds retaining all bonds (not just those of above-average strength; compare to figure 3). (a) Qualitative conclusions remain mostly intact. The democracy and community algorithms break the fewest bonds, followed by despotism and the observed fissions. The biggest difference is that now three of the seven observed fissions (Dotty, Hook, and Vogue) break more bonds than random fissions. One way to interpret this change in result is that the baboons did not attempt to maintain weak social bonds, consistent with our argument in favor of removing weak social bonds from the analysis. (b) Table shows that effect sizes are still large for differences between the algorithms.



b)

	Democracy	Community	Despotism	Random
Comm. η^2	0.14	–	–	–
Desp. η^2	0.18	0.46	–	–
Rand. η^2	0.28	0.53	0.03	–
ENBNB %	26	86	0.14	0
Obs. %	90	99	17	2.4

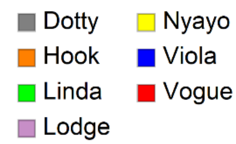
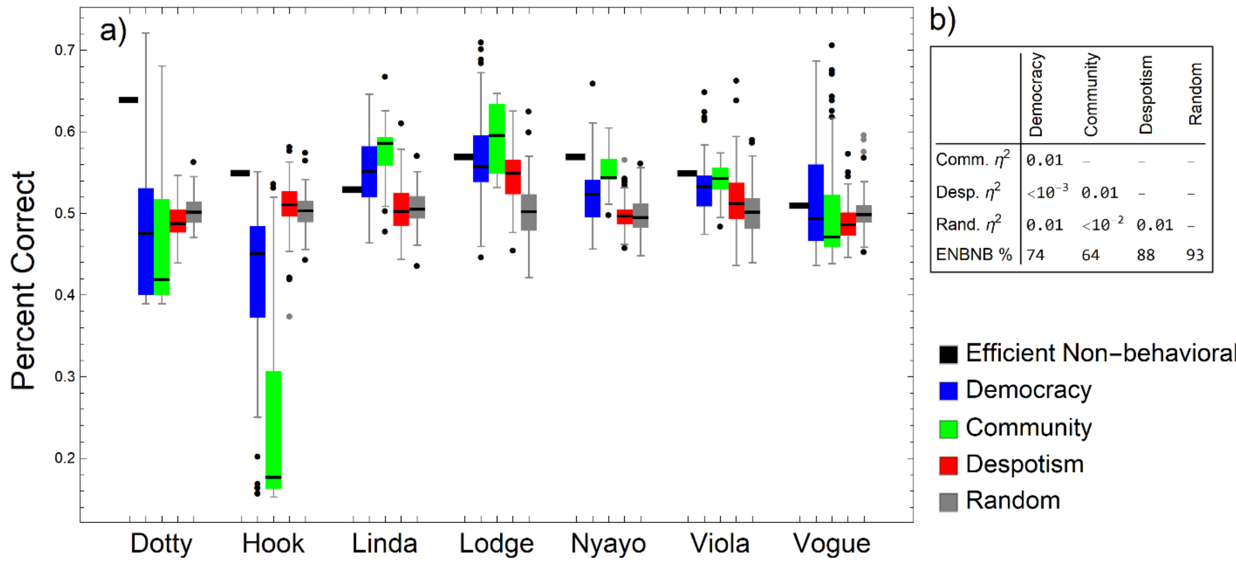


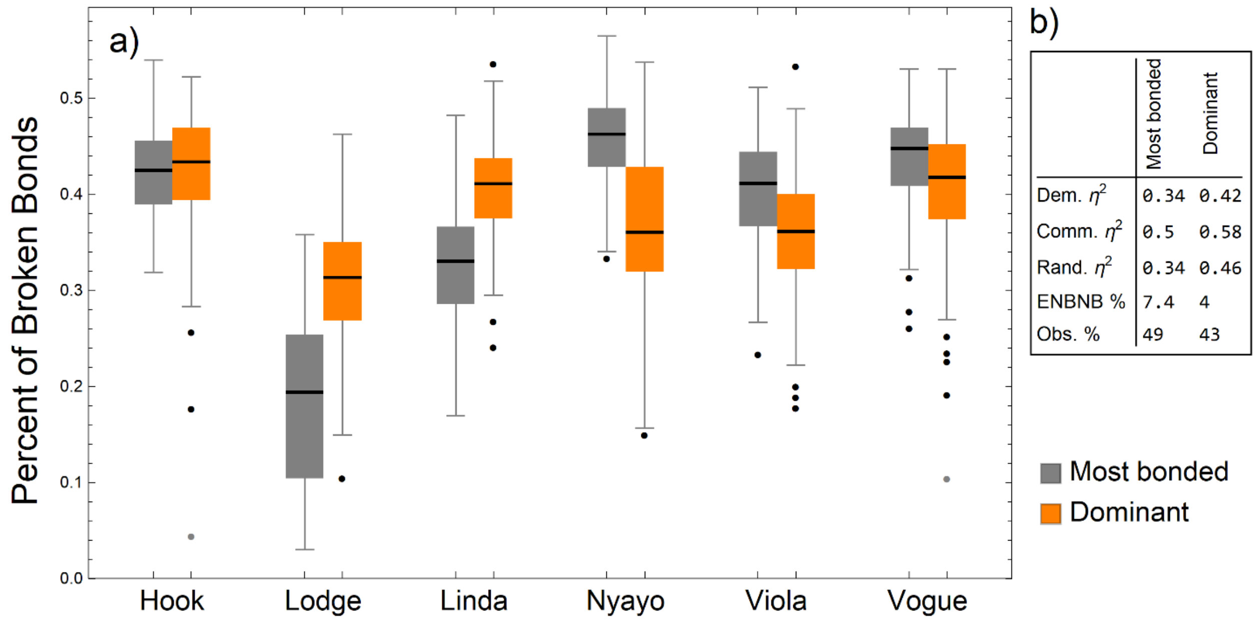
Figure S2. Scaled mean weight of broken bonds retaining all bonds (not just those of above-average strength; compare to figure 4). Qualitative conclusions remain intact. The community algorithm broke the weakest bonds, on average, followed by democracy, then the observed fissions and despotism. (b) Table shows that effect sizes are still large for differences between the algorithms.



b)

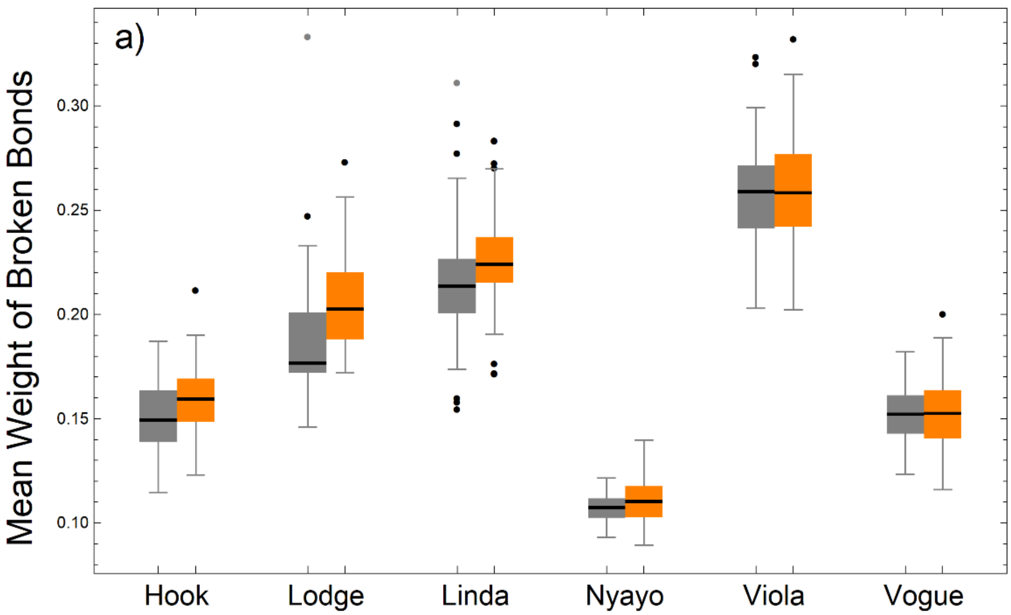
	Democracy	Community	Despotism	Random
Comm. η^2	0.01	–	–	–
Desp. η^2	$<10^{-3}$	0.01	–	–
Rand. η^2	0.01	$<10^{-2}$	0.01	–
ENBNB %	74	64	88	93

Figure S3. Percent of bonds correctly assigned as broken or maintained retaining all bonds (not just those of above-average strength; compare to figure 5). (a) All algorithms did generally worse at matching the data when including weak bonds as well. In most fissions, the democracy, community, and efficient non-behavioral algorithms perform the best, but the trend is weaker than with weak bonds removed, again indicating that baboons are not attempting to maintain weak bonds through a fission. (b) Table shows that, with all bonds included, effect sizes for differences between the algorithms are now small.



	Most bonded	Dominant
Dem. η^2	0.34	0.42
Comm. η^2	0.5	0.58
Rand. η^2	0.34	0.46
ENBNB %	7.4	4
Obs. %	49	43

Figure S4. (a) Percent of broken bonds from the despotism algorithm with either the most bonded individual (gray) or dominant individual (orange) as the despot. There is no clear trend towards one of these two variants of the despotism algorithm breaking fewer bonds on average. (b) Table showing measures of effect size for the two variants of despotism algorithm are each large in comparison with the other algorithms. All effects are in the same direction.



b)

	Most bonded	Dominant
Dem. η^2	0.04	0.06
Comm. η^2	0.28	0.08
Rand. η^2	0.04	0.02
ENBNB %	1.6	0
Obs. %	57	48

Figure S5. (a) Mean weight of broken bonds from the despotism algorithm with either the most bonded individual (gray) or dominant individual (orange) as the despot. In most cases, both variants of the despotism algorithm produce nearly identical distributions for mean weight of broken bonds. (b) Table showing measures of effect size for the two variants of despotism algorithm are qualitatively similar in comparison with the other algorithms (though the comparison with the community algorithm has considerably smaller effect). All effects are in the same direction.

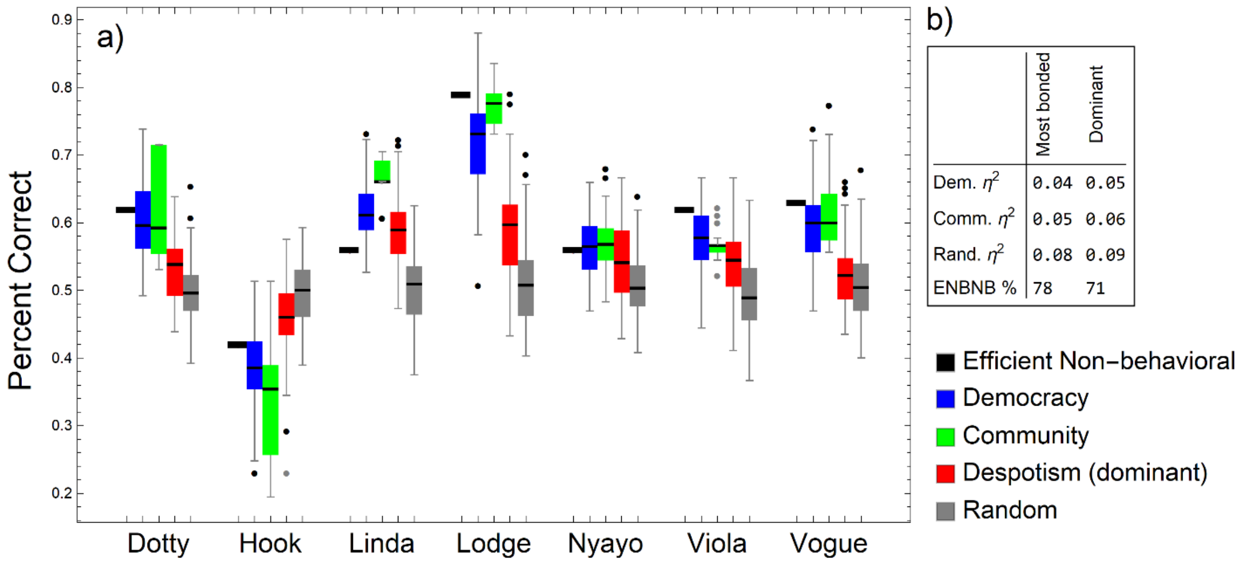
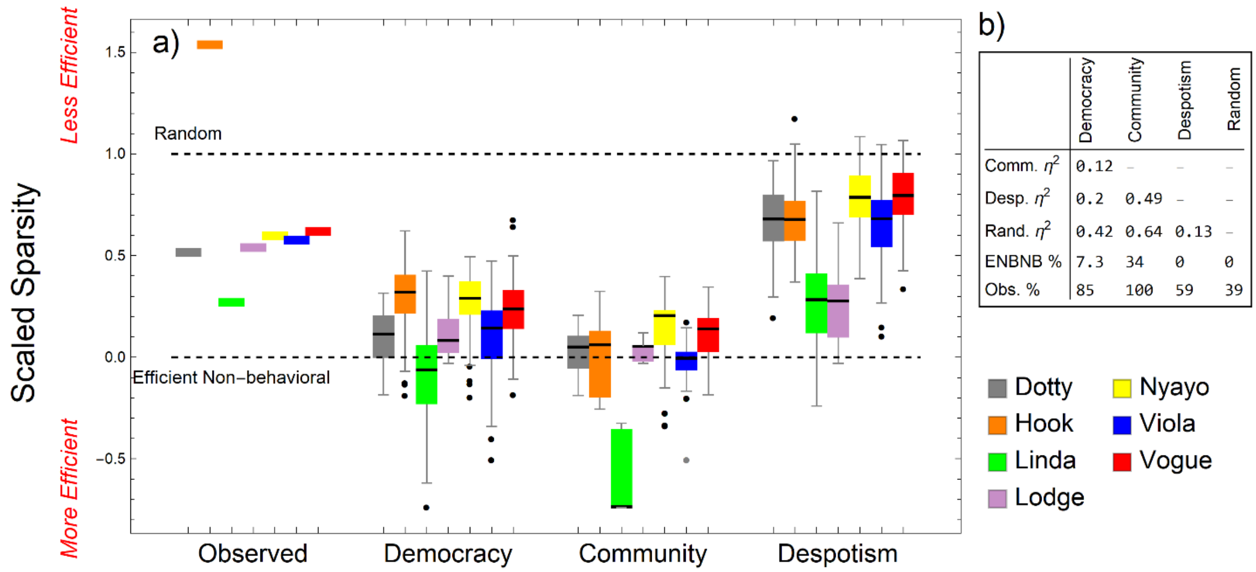
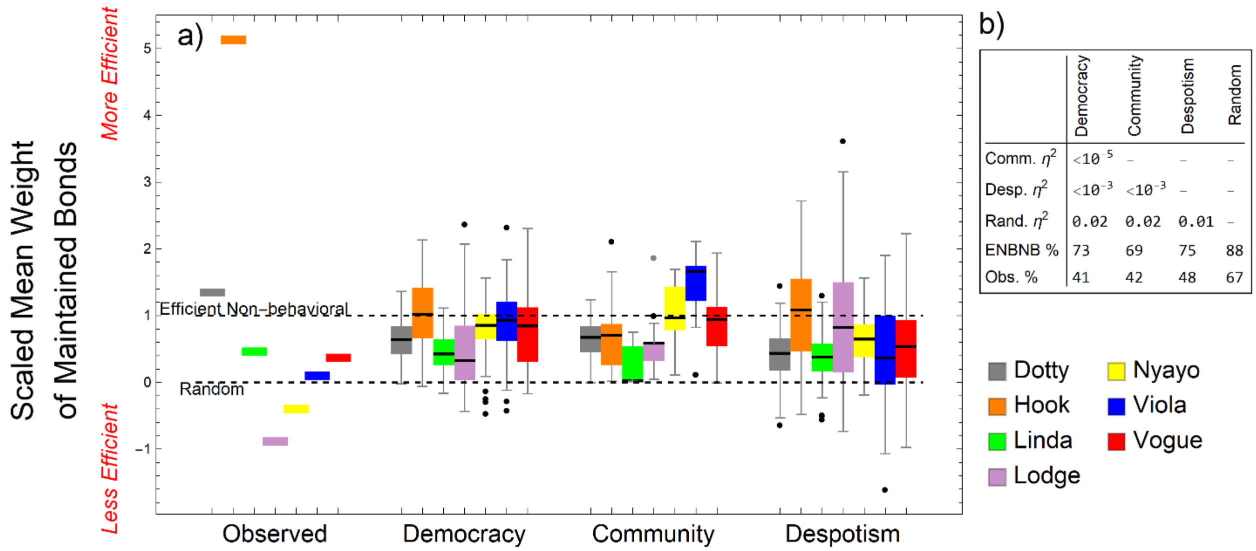


Figure S6. (a) Percentage of bonds correctly assigned as broken or maintained with the despotism algorithm (red) using the dominant individual as the despot. The despotism algorithm still consistently performs worse than other non-random algorithms and (b) has similar effect sizes that are in the same direction.



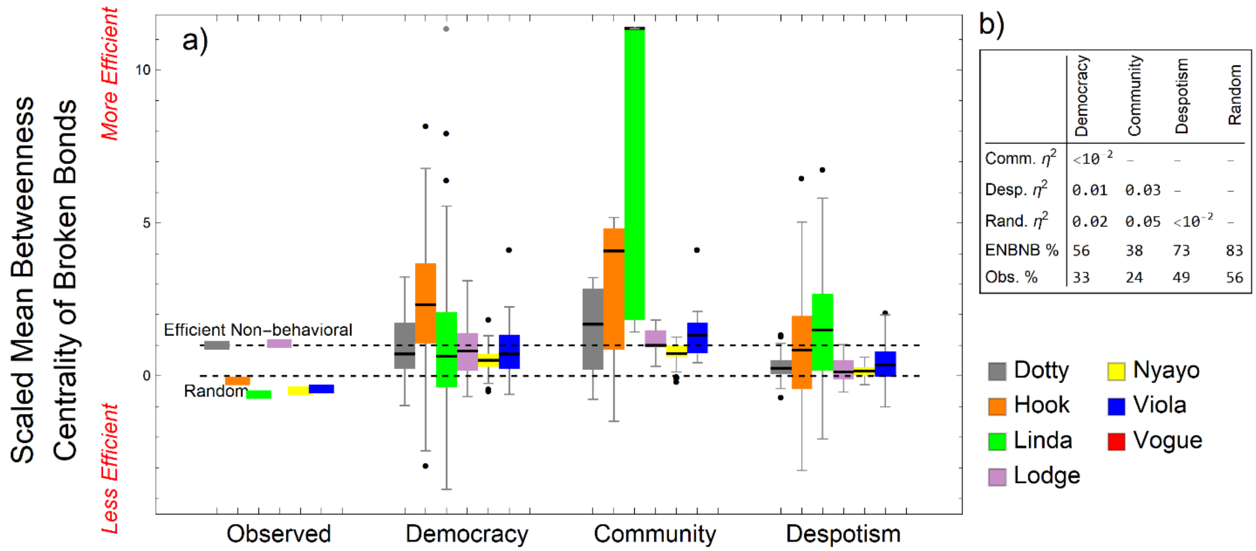
	Democracy	Community	Despotism	Random
Comm. η^2	0.12	–	–	–
Desp. η^2	0.2	0.49	–	–
Rand. η^2	0.42	0.64	0.13	–
ENBNB %	7.3	34	0	0
Obs. %	85	100	59	39

Figure S7. Sparsity of fissions from the fission algorithms and during the observed fissions of baboon social groups (sparsity is a measure of how little a fission disturbs the original network and is defined to be the sum of bond weights broken divided by the number of individuals in the smallest post-fission group). (a) The y-axis is scaled such that for each group a value of 0 is the sparsity of the fission produced by the efficient non-behavioral algorithm for that group, and a value of 1 is the mean sparsity of fissions produced by the random algorithm for that group (see dotted black lines). Values below 0 denote fissions with lower sparsity than the efficient non-behavioral network bisection for a given social network. Values above 1 denote fissions with higher sparsity than random (see 'How efficient were the five fission algorithms?'). The democracy and community algorithms produce the fissions of the lowest sparsity. The observed fissions tended to have sparsity which was intermediate to both the efficient non-behavioral and the random algorithms (see 'How efficient were the observed baboon fissions'). (b) Table of η^2 values for pairwise comparisons between the algorithms with the last two rows showing the efficient non-behavioral algorithm's and observed fission's percentile on the distribution of algorithms with a stochastic component.



	Democracy	Community	Despotism	Random
Comm. η^2	$<10^{-5}$	–	–	–
Desp. η^2	$<10^{-3}$	$<10^{-3}$	–	–
Rand. η^2	0.02	0.02	0.01	–
ENBNB %	73	69	75	88
Obs. %	41	42	48	67

Figure S8. Mean weight of maintained bonds from the fission algorithms and during the observed fissions of baboon social groups. (a) The y-axis is scaled such that for each group a value of 1 is the mean weight of bonds maintained by the efficient non-behavioral algorithm applied to that group, and a value of 0 is the mean weight of bonds maintained by the random algorithm applied to that group (see dotted black lines). Values below 0 denote fissions that maintained weaker bonds on average than the random algorithm for a given social network and values above 1 denote fission that maintained stronger bonds on average than the efficient non-behavioral network bisection (see ‘How efficient were the five fission algorithms?’). No algorithm performed markedly better than the others on this metric. The observed fissions most often maintained stronger bonds than random (see ‘How efficient were the observed baboon fissions’). (b) Table of η^2 values for pairwise comparisons between the algorithms with the last two rows showing the efficient non-behavioral algorithm’s and observed fission’s percentile on the distribution of algorithms with a stochastic component.



	Democracy	Community	Despotism	Random
Comm. η^2	$<10^{-2}$	–	–	–
Desp. η^2	0.01	0.03	–	–
Rand. η^2	0.02	0.05	$<10^{-2}$	–
ENBNB %	56	38	73	83
Obs. %	33	24	49	56

Figure S9. Mean betweenness centrality of broken bonds from the fission algorithms and the observed fissions of baboon social groups. (a) The y-axis is scaled such that for each group a value of 1 is the mean betweenness centrality of bonds broken by the efficient non-behavioral algorithm applied to that group and a value of 0 is the mean betweenness centrality of bonds broken by the random algorithm applied to that group (see dotted black lines). Note that Vogue's fission reversed these trends such that the random algorithm maintained bonds with higher betweenness centrality than the other algorithms. Therefore, we have not plotted Vogue's group here, though information regarding betweenness centrality metrics from its fission can be found in Table S2. Values below 0 denote fissions that broke bonds with lower betweenness centrality on average than the random algorithm for a given social network and values above 1 denote fission that maintained bonds with higher betweenness centrality on average than the efficient non-behavioral network bisection (see 'How efficient were the five fission algorithms?'). The community algorithm tended to break bonds with the highest betweenness centrality followed by efficient non-behavioral and despotism. The observed fissions tended to break bonds with lower betweenness centrality than random. (b) Table of η^2 values for pairwise comparisons between the algorithms with the last two rows showing the efficient non-behavioral algorithm's and observed fission's percentile on the distribution of algorithms with a stochastic component.

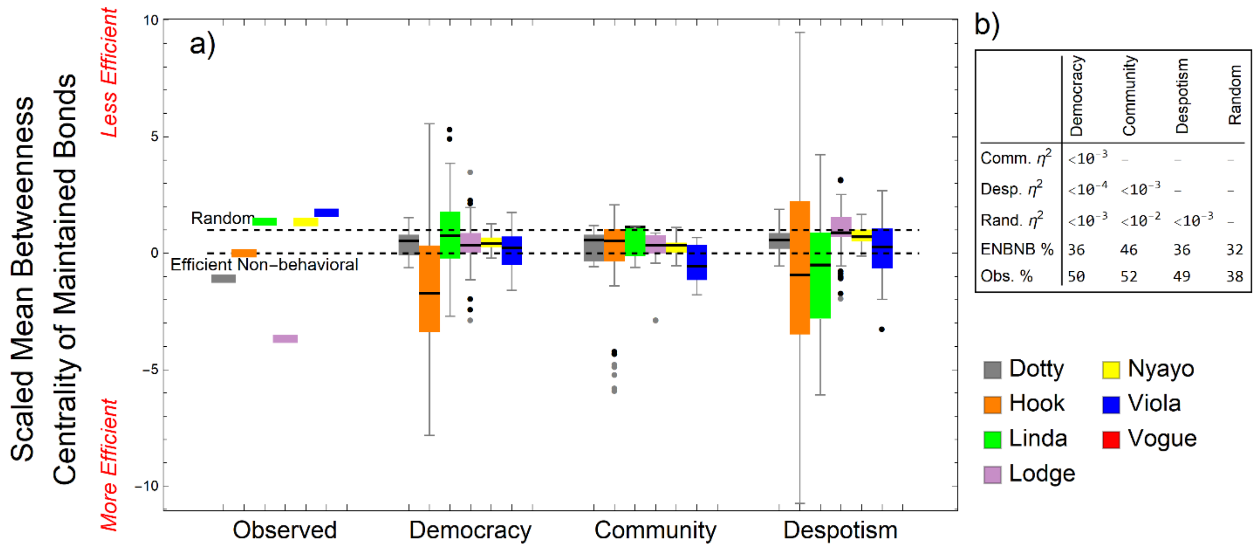


Figure S10. Mean betweenness centrality of maintained bonds from the fission algorithms and the observed fissions of baboon social groups. (a) The y-axis is scaled such that for each group a value of 1 is the mean betweenness centrality of bonds maintained by the random algorithm applied to that group and a value of 0 is the mean betweenness centrality of bonds maintained by the efficient non-behavioral algorithm applied to that group (see dotted black lines). Note that Vogue’s fission reversed these trends such that the random algorithm maintained bonds with weaker betweenness centrality than other algorithms. Therefore, we have not plotted Vogue’s group here, though information regarding betweenness centrality metrics from its fission can be found in Table S2. Values below 0 denote fissions that maintained bonds with lower betweenness centrality on average than the efficient non-behavioral network bisection for a given social network and values above 1 denote fission that maintained bonds with higher betweenness centrality on average than the random algorithm (see ‘How efficient were the five fission algorithms?’). No algorithm performed markedly better than the others on this metric nor was there a clear trend with the observed fissions. (b) Table of η^2 values for pairwise comparisons between the algorithms with the last two rows showing the efficient non-behavioral algorithm’s and observed fission’s percentile on the distribution of algorithms with a stochastic component.

Appendix S1: Change in bondedness as a result of fissions

We examined three measures of bondedness (i.e., how tightly bonded each social group was before and after each fission) using three different network measures: (i) clustering coefficient, (ii) network diameter, and (iii) network density (Table S1). Such measures of pre- and post-fission bondedness are of interest because of the possibility that individuals will benefit from maintaining close social bonds following a fission event.

All algorithms, except for random, tended to increase the groups' densities and clustering coefficients. Simulated post-fission groups tended to have approximately equal clustering coefficients for each algorithm, even despotism. The observed fissions increased the density of groups at a level comparable to the democracy and community algorithms. Observed fissions also increased the clustering coefficient of the groups at a level comparable to all of the algorithms except for random. A complete summary of these metrics can be found in Table S6. We do not see clear differences resulting in some algorithms repeatedly maximizing post-fission measures of bondedness.

Table S6*

Summary of bondedness metrics from the fissions. Bolded rows give pre-fission metrics. Each row of post-fission information shows two columns for each metric, one for each daughter group. Red "Observed" rows provide the metrics for the observed fissions.

		Group size		Bonds per individ**		Clustering Coeff		Diameter		Density		% Correct***
Dotty	**Pre-fission**	**50**		**0.84**		**0.30**		**1.10**		**0.11**		
	Observed	17	43	0.46	0.49	0.35	0.4	0.02	0.02	0.23	0.17	
	Despotism	21	29	0.81	0.32	0.37	0.2	0.02	∞	0.23	0.08	53
	Community	39	11	0.82	0.44	0.32	0.22	0.02	0.01	0.13	0.17	81
	Democracy	38	12	0.78	0.48	0.31	0.23	0.02	0.01	0.13	0.23	76
	Random	25	25	0.29	0.26	0.26	0.28	∞	∞	0.1	0.11	50
	ENBNB****	27	23	0.90	0.51	0.35	0.23	0.02	0.02	0.16	0.16	65
Hook	**Pre-fission**	**37**		**1.06**		**0.29**		**0.52**		**0.17**		
	Observed	17	22	0.42	0.12	0.28	0.52	1.66	∞	0.29	0.22	
	Despotism	20	17	0.87	0.42	0.30	0.28	0.68	∞	0.23	0.15	57
	Community	30	7	1.02	0.44	0.31	0.27	0.54	0.45	0.20	0.39	81
	Democracy	24	13	0.88	0.65	0.30	0.30	0.69	0.75	0.20	0.31	61
	Random	19	18	0.35	0.29	0.26	0.27	∞	∞	0.16	0.18	50
	ENBNB	19	18	0.90	0.80	0.26	0.40	0.78	0.46	0.22	0.29	67
Linda	**Pre-fission**	**40**		**1.36**		**0.28**		**1.33**		**0.14**		
	Observed	40	33	0.40	0.54	0.33	0.37	∞	∞	0.18	0.16	
	Despotism	24	16	1.34	0.35	0.32	0.17	1.05	∞	0.23	0.08	48
	Community	35	5	1.36	0.31	0.29	0.11	1.26	0.52	0.16	0.10	73
	Democracy	28	12	1.19	0.80	0.30	0.28	1.28	1.20	0.18	0.30	55
	Random	21	19	0.49	0.42	0.27	0.26	∞	∞	0.14	0.14	46
	ENBNB	19	18	1.40	0.68	0.27	0.00	0.07	∞	0.22	0.11	54
Lodge	**Pre-fission**	**38**		**0.84**		**0.24**		**2.44**		**0.10**		
	Observed	30	16	0.43	0.32	0.31	0.42	∞	1.11	0.11	0.36	
	Despotism	7	31	0.59	0.74	0.19	0.23	1.20	∞	0.42	0.10	80
	Community	26	12	0.81	0.74	0.27	0.27	1.94	1.66	0.14	0.31	69
	Democracy	26	12	0.79	0.69	0.26	0.25	1.99	1.85	0.14	0.28	63
	Random	18	18	0.25	0.21	0.23	0.20	∞	∞	0.09	0.10	50
	ENBNB	19	19	0.79	0.79	0.31	0.27	1.33	2.37	0.19	0.16	63
Nyayo	**Pre-fission**	**46**		**0.75**		**0.18**		**0.69**		**0.14**		
	Observed	51	25	0.23	0.23	0.19	0.28	0.68	0.37	0.18	0.28	
	Despotism	19	27	0.54	0.34	0.22	0.14	0.58	∞	0.22	0.11	49
	Community	32	14	0.66	0.43	0.22	0.21	0.69	0.69	0.17	0.28	61
	Democracy	29	17	0.62	0.46	0.21	0.20	0.64	0.70	0.18	0.24	55
	Random	23	23	0.26	0.22	0.18	0.18	∞	∞	0.14	0.15	49
	ENBNB	24	22	0.67	0.52	0.29	0.20	0.60	0.98	0.21	0.20	49

*Note that table continues on next page

**Bonds per individ: average weighted degree of each individual.

***% correct: percent of pairs correctly placed together by the algorithms

****Efficient-non-behavioral network bisection

Viola	**Pre-fission**	**34**		**1.38**		**0.24**		**1.08**		**0.16**		
	Observed	36	36	0.27	0.31	0.32	0.33	∞	1.48	0.17	0.18	
	Despotism	19	15	1.04	0.57	0.22	0.21	1.29	∞	0.21	0.15	50
	Community	22	12	1.24	0.99	0.29	0.33	1.35	1.30	0.21	0.33	51
	Democracy	22	12	1.19	0.89	0.27	0.31	1.22	1.19	0.20	0.34	54
	Random	18	17	0.46	0.37	0.23	0.19	∞	∞	0.16	0.16	47
	ENBNB	17	17	1.11	1.26	0.30	0.31	1.29	1.13	0.24	0.27	46
Vogue	**Pre-fission**	**36**		**1.05**		**0.36**		**0.98**		**0.18**		
	Observed	28	11	0.60	0.31	0.44	0.24	0.30	0.52	0.34	0.31	
	Despotism	16	20	0.81	0.44	0.43	0.28	0.52	∞	0.31	0.13	50
	Community	27	9	0.98	0.59	0.41	0.31	0.83	0.84	0.22	0.32	72
	Democracy	25	11	0.93	0.57	0.41	0.31	0.86	0.73	0.23	0.39	68
	Random	19	17	0.40	0.30	0.34	0.32	∞	∞	0.18	0.19	50
	ENBNB	19	17	0.89	0.87	0.44	0.53	0.90	0.57	0.28	0.30	67

Appendix S2: Fissions of hypothetical social networks

Network topology may interact with our algorithms in predictable ways, with the result that a given algorithm may produce markedly different outcomes for different pre-fission networks. Indeed, differences in network topology may explain some of the variation seen in the observed fissions. To assess the influence of network topology, we used the algorithms to break up hypothetical pre-fission networks that were designed as caricatures of network topologies that might be found in nature: complete, dumbbell, and linear (figure S11). We generated 100 networks of each type, each of which consisted of 30 individuals. In the complete networks, all individuals were bonded to all other individuals. In the dumbbell networks, one individual in a complete network of 15 individuals was bonded to one individual in a complete network of 14 individuals. In the linear networks, each individual was bonded to two others, except for the two individuals on the “end” of the network that only had a single bond each. To assign strengths to each bond in the hypothetical networks, we drew from an exponential distribution of observed bond strengths in the seven pre-fission baboon groups pooled together.

Unsurprisingly, all nonrandom algorithms were more most efficient at breaking up the linear network and least efficient at breaking up the complete network (figure S12). In the complete and dumbbell networks, the community algorithm resulted in the fewest broken bonds, although the democracy algorithm was almost as efficient at breaking up the network. Conversely, for the linear networks, the democracy and community algorithms could not be distinguished. The despotism algorithm was also almost as efficient as the other nonrandom algorithms on the linear network. Conversely, the despotism algorithm performed much worse, breaking far more bonds, and stronger bonds, than the other nonrandom algorithms on the dumbbell networks (figure S12). Results for other metrics are shown in Tables S7 and S8. We discuss these results further when interpreting some of the differences among observed fissions in the main text.

Table S7

Summary of efficiency metrics from the fissions on hypothetical networks and the algorithms for each group. % broken: percentage of bonds broken during fission. Mean broken and maintained: average weight of broken and maintained bonds during fission. Broken and maintained bwness: average centrality of broken and maintained bonds during fission. Broken, maintained, total correct: percent of bonds correctly broken or maintained by the algorithms.

		% broken	mean broken	mean maintained	sparsity	broken bwness	maintained bwness
Complete	Despotism	46	0.23	0.24	4.37	0.03	0.03
	Community	37	0.21	0.24	4.61	0.03	0.02
	Democracy	49	0.21	0.26	3.63	0.03	0.02
	Random	50	0.23	0.24	4.07	0.03	0.03
	ENBNB*	52	0.19	0.26	3.09	0.03	0.02
Dumbbell	Despotism	16	0.25	0.26	0.90	0.79	0.12
	Community	1	0.16	0.27	0.01	4.87	0.12
	Democracy	1	0.25	0.27	0.64	2.86	0.12
	Random	49	0.26	0.26	2.08	0.13	0.14
	ENBNB	1	0.17	0.26	0.01	4.64	0.11
Linear	Despotism	6	0.32	0.40	0.17	5.26	4.87
	Community	3	0.20	0.38	0.02	5.98	4.63
	Democracy	3	0.28	0.38	0.04	5.72	4.65
	Random	49	0.39	0.38	0.43	4.70	4.80
	ENBNB	3	0.26	0.37	0.02	6.64	4.51

*Efficient-non-behavioral network bisection

Table S8

Summary of bondedness metrics from the fissions on hypothetical networks. Bolded rows give pre-fission metrics, with post-fission information listed for the two daughter groups in the rows following.

		Group size		Bonds per individ*		Clustering Coeff		Diameter		Density	
Complete	**Pre-fission**	**30**		**6.73**		**1**		**0.29**		**1**	
	Despotism	12	18	2.87	3.88	1	1	36.91	36.62	1	1
	Community	22	8	5.07	1.76	1	0.94	0.00	0.00	1	0.99
	Democracy	18	12	4.23	3.01	1	1	0.00	0.00	1	1
	Random	16	14	2.47	1.78	1	1	0.00	0.00	1	1
	ENBNB**	16	14	3.91	3.42	1	1	0.00	0.00	1	1
Dumbbell	**Pre-fission**	**30**		**3.44**		**0.99**		**1.10**		**0.46**	
	Despotism	15	15	2.99	2.55	0.98	0.99	0.59	∞	0.87	0.72
	Community	15	15	3.59	3.63	0.99	1.00	0.01	0.00	0.93	0.95
	Democracy	18	12	3.27	2.83	0.99	0.99	0.01	0.00	0.75	0.98
	Random	15	15	1.14	0.84	0.99	0.99	∞	∞	0.46	0.45
	ENBNB	16	14	3.55	3.30	0.99	0.99	0.01	0.01	0.94	0.94
Linear	**Pre-fission**	**30**		**0.74**		**0**		**11.13**		**0.07**	
	Despotism	4	26	0.92	0.66	0	0	2	∞	0.55	0.08
	Community	19	11	0.76	0.72	0	0	0.10	0.01	0.11	0.21
	Democracy	20	10	0.70	0.63	0	0	0.11	0.05	0.10	0.23
	Random	16	14	0.25	0.21	0	0	∞	∞	0.07	0.07
	ENBNB	16	14	0.70	0.68	0	0	0.08	0.08	0.13	0.14

* Bonds per individ: average weighted degree of each individual.
**Efficient-non-behavioral network bisection

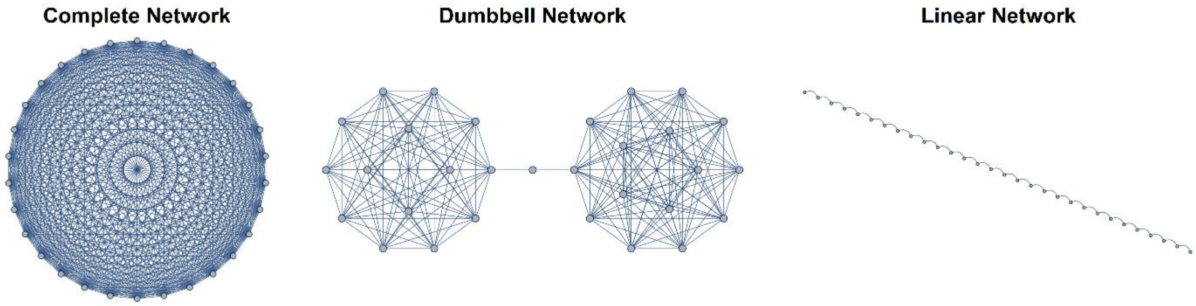


Figure S11. Hypothetical social networks analyzed in this study.

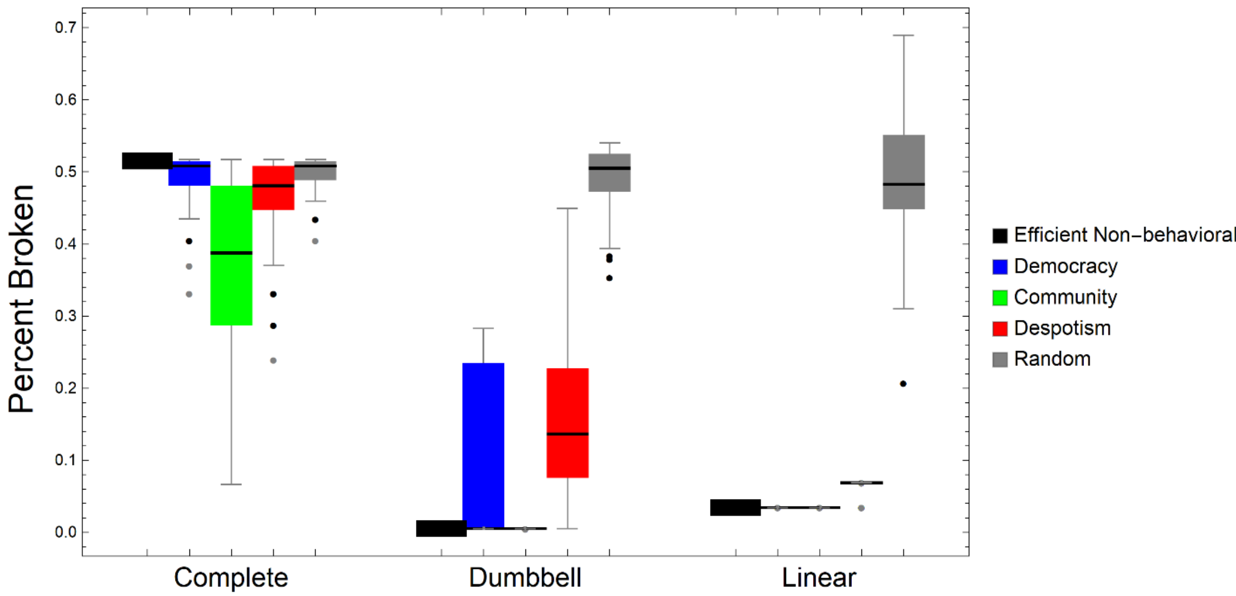


Figure S12. Box plots showing percent of bonds broken during fission for the various hypothetical network topologies across fission strategy. Clearly, the linear and dumbbell networks were much easier to split, while the complete network was challenging for all algorithms. The community algorithm breaks the fewest bonds on average with complete and dumbbell networks, although the democracy algorithm is close. The despotism algorithm breaks a large number of bonds for the dumbbell networks, but is comparable to the more democratic algorithms on linear networks. Note that some box plots are represented as only a line because the algorithm always broke the same percent of bonds during simulated fissions (e.g., the community algorithm on the dumbbell network).