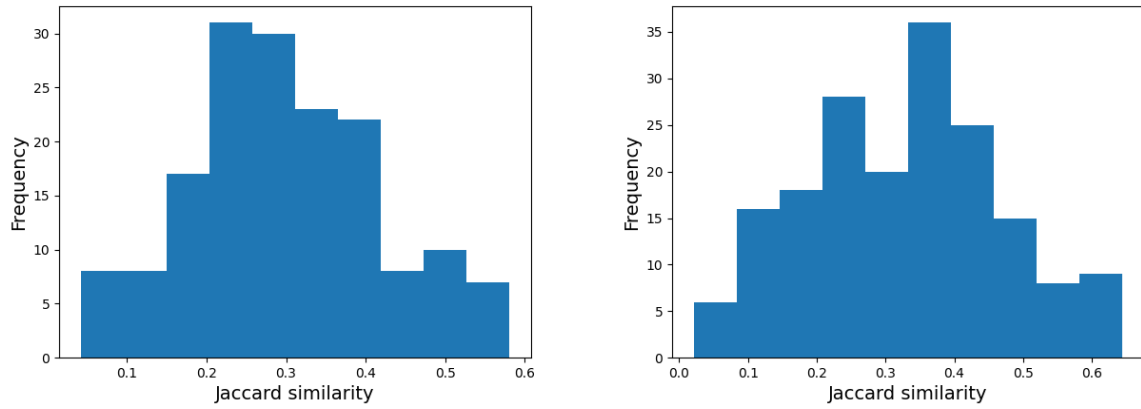


The core might change anyhow we define it: the instability of key actors in longitudinal social network data

Supplementary material

1 Jaccard similarity of networks: figures and tables



S1: The histograms of the Jaccard similarity values. The left side shows the histogram of the advice-seeking networks and the right side shows the histogram of the friendship networks.

S2: Wave-to-wave statistic of the Jaccard similarity values for the advice-seeking networks

Wave	Mean	Variance	Min	Max
1 to 2	0.2855	0.0108	0.0799	0.523
2 to 3	0.319	0.0129	0.0827	0.5608
3 to 4	0.3151	0.0144	0.0417	0.581
4 to 5	0.2677	0.019	0.0455	0.5496

S3: Wave-to-wave statistic of the Jaccard similarity values for the friendship networks

Wave	Mean	Variance	Min	Max
1 to 2	0.3658	0.011	0.1786	0.6146
2 to 3	0.3766	0.0135	0.161	0.6448
3 to 4	0.3829	0.0121	0.1854	0.5953
4 to 5	0.1384	0.0038	0.0208	0.2767

2 Centrality measures computed on the advice-seeking networks: figures and tables

S4: Monotonicity statistics for the centrality measures computed on the advice-seeking networks

Centrality	Mean	Variance
In-Degree	0.7166	0.0078
PageRank	0.9385	0.0053
Two-Hop Neighbourhood	0.7663	0.0099
Coreness	0.2616	0.0247
Eigenvector	0.9841	0.0013
Borda count aggregation	0.9515	0.0013



S5: The empirical mean of the Kendall tau correlation values computed on the advice-seeking networks. The variance is between 0.0086 and 0.0554. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, bca: Borda count aggregation

S6: The mean and variance of the sequence instability values with $k = 1$ and using the Jaccard-distance, restricted to the classes for which we have observation data for 4 waves. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation

/	advice-seeking	friendship
iDg	0.6315 (0.0317)	0.7554 (0.0203)
pg	0.6667 (0.0885)	0.7727 (0.0329)
2Nbh	0.7948 (0.0147)	0.8670 (0.0172)
core	0.4899 (0.0085)	0.4266 (0.0060)
eign	0.6701 (0.0512)	0.5530 (0.0458)
cl	-	0.7741 (0.0824)
btw	-	0.7273 (0.0961)
Bca	0.6128 (0.1175)	0.5227 (0.1062)

S7: The mean and variance of the sequence instability values with $k = 1$ and using the Jaccard-distance, restricted to the classes for which we have observation data for 5 waves. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign : eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation

/	advice-seeking	friendship
iDg	0.6528(0.0386)	0.7702(0.0275)
pg	0.5891(0.0641)	0.7790(0.0318)
2Nbh	0.6910(0.0476)	0.8149(0.0135)
core	0.4799(0.0206)	0.4642(0.0092)
eign	0.7152(0.0221)	0.7878(0.0411)
cl	-	0.8096(0.0204)
btw	-	0.7513(0.0333)
Bca	0.6304(0.0565)	0.7484(0.0358)

S8: The mean and variance of the sequence instability values with $k > 1$ and using the Jaccard-distance, restricted to the classes for which we have observation data for 4 waves. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation. The number after the hyphen represents the k value.

/	advice-seeking	friendship
iDg-3	0.6250 (0.0064)	0.5592 (0.0056)
pg-5	0.6511 (0.0111)	0.6547 (0.0194)
2Nbh-3	0.6265 (0.0214)	0.6205 (0.0177)
eign-5	0.6463 (0.0153)	0.6511 (0.0323)
cl-5	-	0.5700 (0.0085)
btw-5	-	0.7548 (0.0098)
Bca-5	0.6395 (0.0055)	0.6482 (0.0137)

S9: The mean and variance of the sequence instability values with $k > 1$ and using the Jaccard-distance, restricted to the classes for which we have observation data for 5 waves. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation. The number after the hyphen represents the k value.

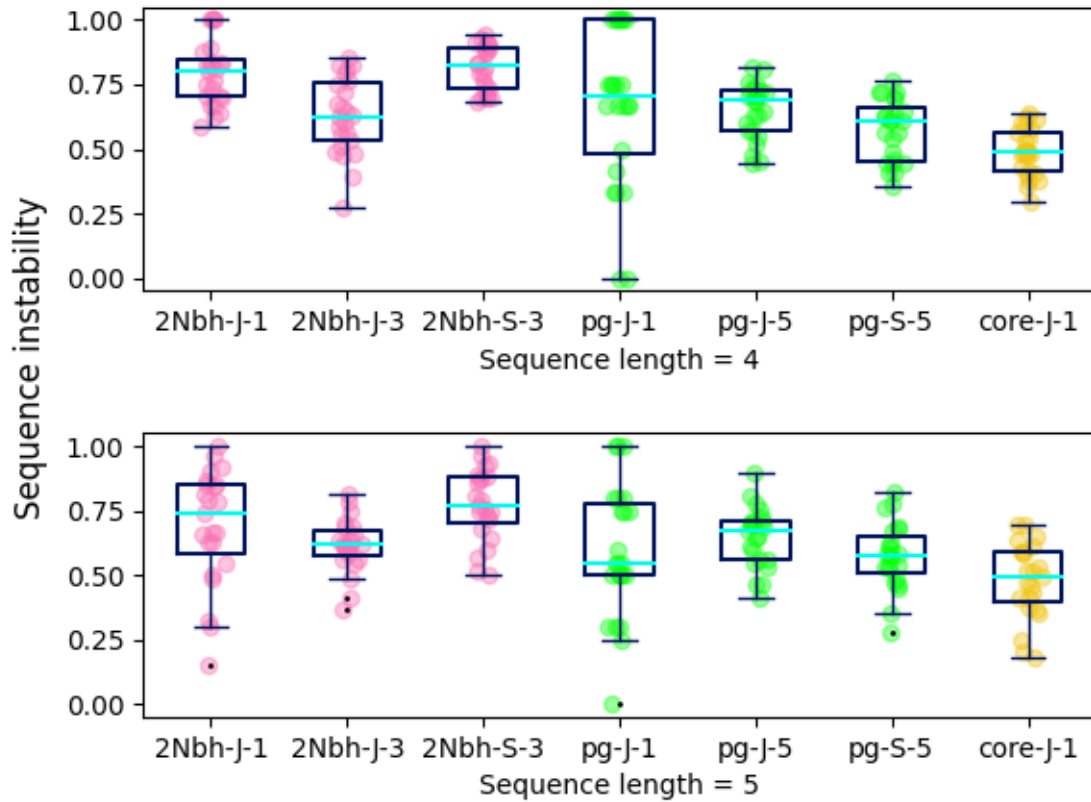
/	advice-seeking	friendship
iDg-3	0.5317 (0.0093)	0.6358 (0.0119)
pg-5	0.6481 (0.0135)	0.7249 (0.0128)
2Nbh-3	0.6159 (0.0104)	0.6054 (0.0167)
eign-5	0.6476 (0.0111)	0.7073 (0.0074)
cl-5	-	0.6417 (0.0095)
btw-5	-	0.7431 (0.0045)
Bca-5	0.5952 (0.0184)	0.6712 (0.0084)

S10: The mean and variance of the sequence instability values with $k > 1$ and using the d_{SFH} distance, restricted to the classes for which we have observation data for 4 waves. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation. The number after the hyphen represents the k value.

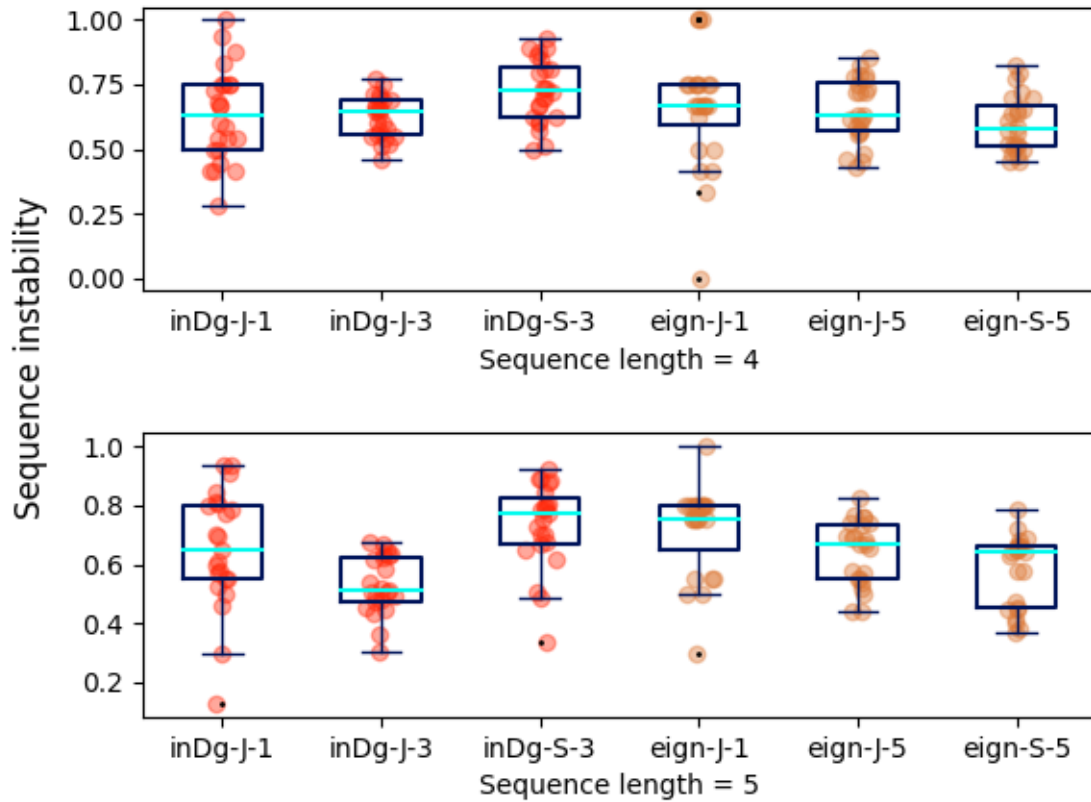
/	advice-seeking	friendship
iDg-3	0.7245 (0.0145)	0.8018 (0.0078)
pg-5	0.5748(0.0136)	0.6348(0.0150)
2Nbh-3	0.8148 (0.0075)	0.8984 (0.0015)
eign-5	0.5921 (0.0116)	0.6040 (0.0202)
cl-5	-	0.7712 (0.0119)
btw-5	-	0.6854 (0.0158)
Bca-5	0.5938 (0.0110)	0.6126 (0.0098)

S11: The mean and variance of the sequence instability values with $k > 1$ and using the d_{SFH} distance, restricted to the classes for which we have observation data for 5 waves. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation. The number after the hyphen represents the k value.

/	advice-seeking	friendship
iDg-3	0.7333(0.0203)	0.8223(0.0066)
pg-5	0.5730(0.0160)	0.7014(0.0100)
2Nbh-3	0.7735(0.0190)	0.8635(0.0074)
eign-5	0.5796(0.0143)	0.6677(0.0084)
cl-5	-	0.7752(0.0031)
btw-5	-	0.6783(0.0059)
Bca-5	0.6251(0.0157)	0.6931(0.0083)



S12: Box plot of sequence instability values computed on the advice-seeking networks for the two-hop neighbourhood (2Nbh), PageRank (pg) and coreness (core) centrality measures. We separated the school classes into two groups: on the top plot we have observation data for 4 waves, on the bottom for 5 waves. The number after the hyphen represents the parameters of the sequence instability algorithm in the form : d-k, where d denotes the rank distance measure and k is the top-k parameter of the method. The d parameter can be "J" or "S", where "J" denotes the d_J Jaccard-distance and "S" stands for the d_{SFH} distance.

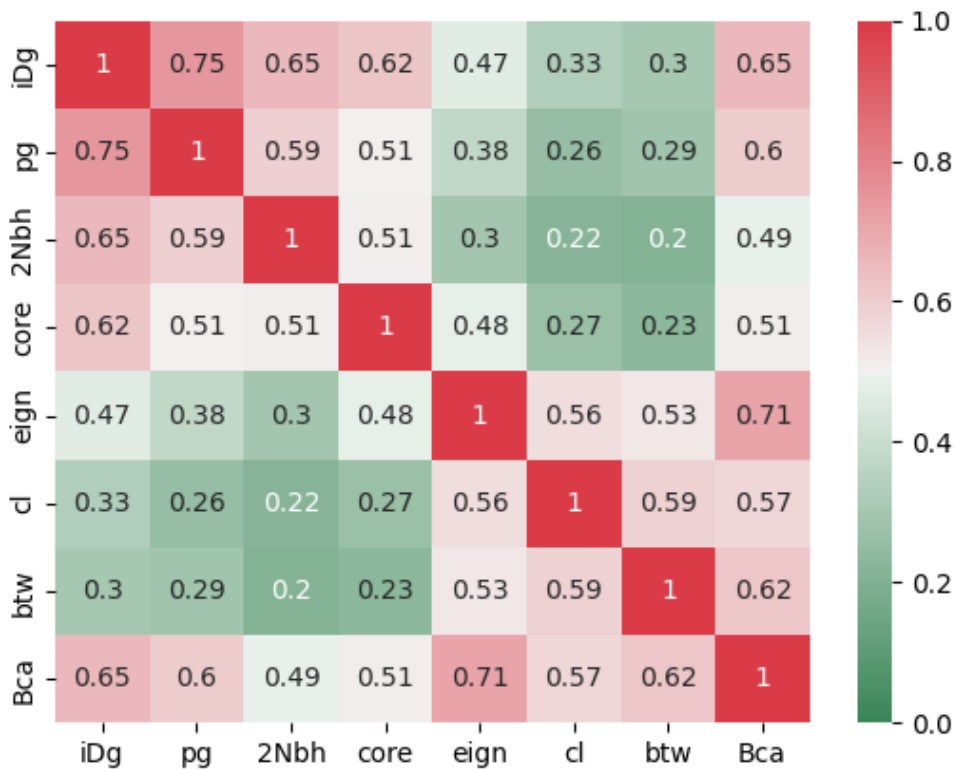


S13: Box plot of sequence instability values computed on the advice-seeking networks for the in-degree (iDg) and eigenvector (eign) centrality measures. We separated the school classes into two groups: on the top plot we have observation data for 4 waves, on the bottom for 5 waves. The number after the hyphen represents the parameters of the sequence instability algorithm in the form : d-k, where d denotes the rank distance measure and k is the top- k parameter of the method. The d parameter can be "J" or "S", where "J" denotes the d_J Jaccard-distance and "S" stands for the d_{SFH} distance.

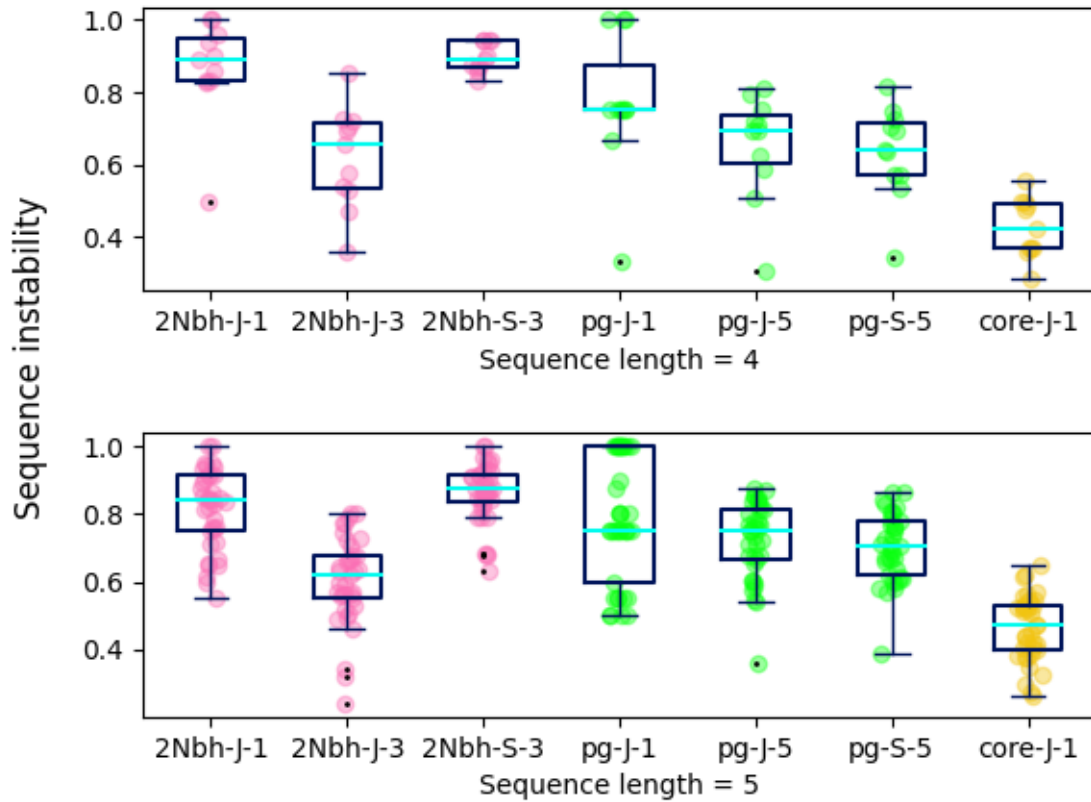
3 Centrality measures computed on friendship networks: figures and tables

S14: Monotonicity statistics for the centrality measures computed on the friendship networks

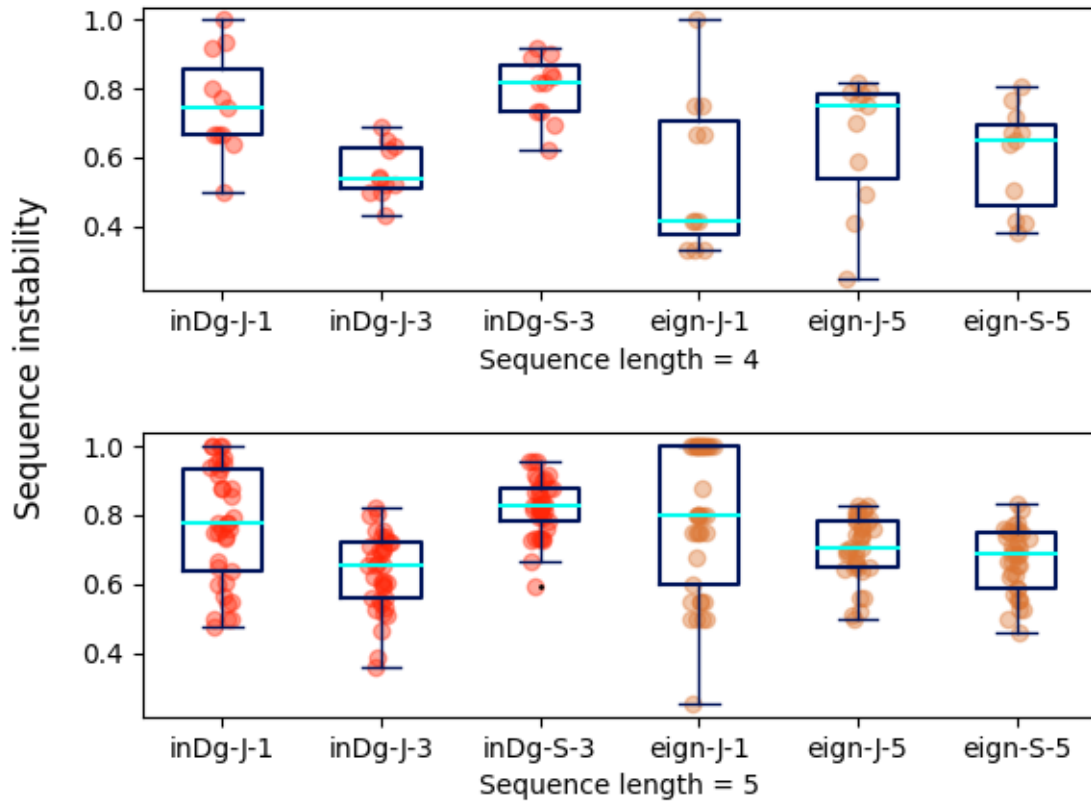
Centrality	Mean	Variance
In-Degree	0.7589	0.0088
PageRank	0.9862	0.001
Two-Hop Neighbourhood	0.6885	0.0296
Coreness	0.2433	0.0277
Eigenvector	0.9957	0.0007
Closeness	0.8603	0.005
Betweenness	0.9206	0.0126
Borda count aggregation	0.9711	0.0003



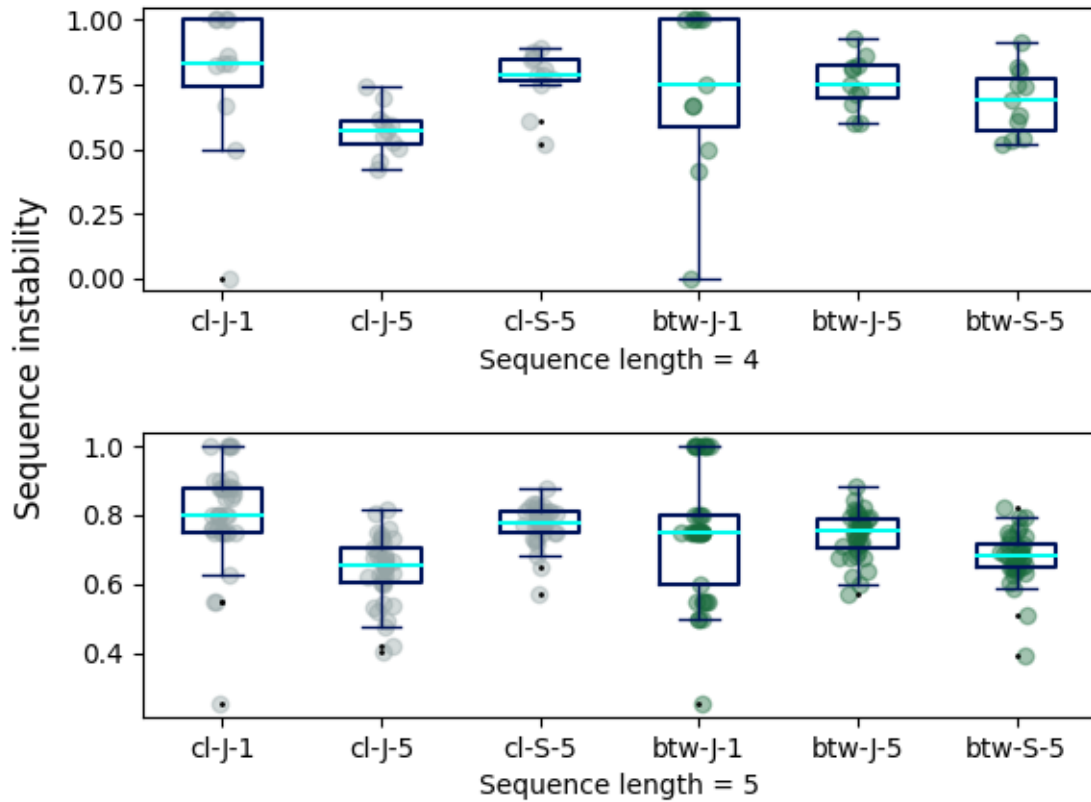
S15: The empirical mean of the Kendall tau correlation values computed on the friendship networks. The variance is between 0.0177 and 0.1064. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, bca: Borda count aggregation



S16: Box plot of sequence instability values computed on the friendship networks for the two-hop neighbourhood (2Nbh), PageRank (pg) and coreness (core) centrality measures. We separated the school classes into two groups: on the top plot we have observation data for 4 waves, on the bottom for 5 waves. The number after the hyphen represents the parameters of the sequence instability algorithm in the form : d-k, where d denotes the rank distance measure and k is the top-k parameter of the method. The d parameter can be "J" or "S", where "J" denotes the d_J Jaccard-distance and "S" stands for the d_{SFH} distance.

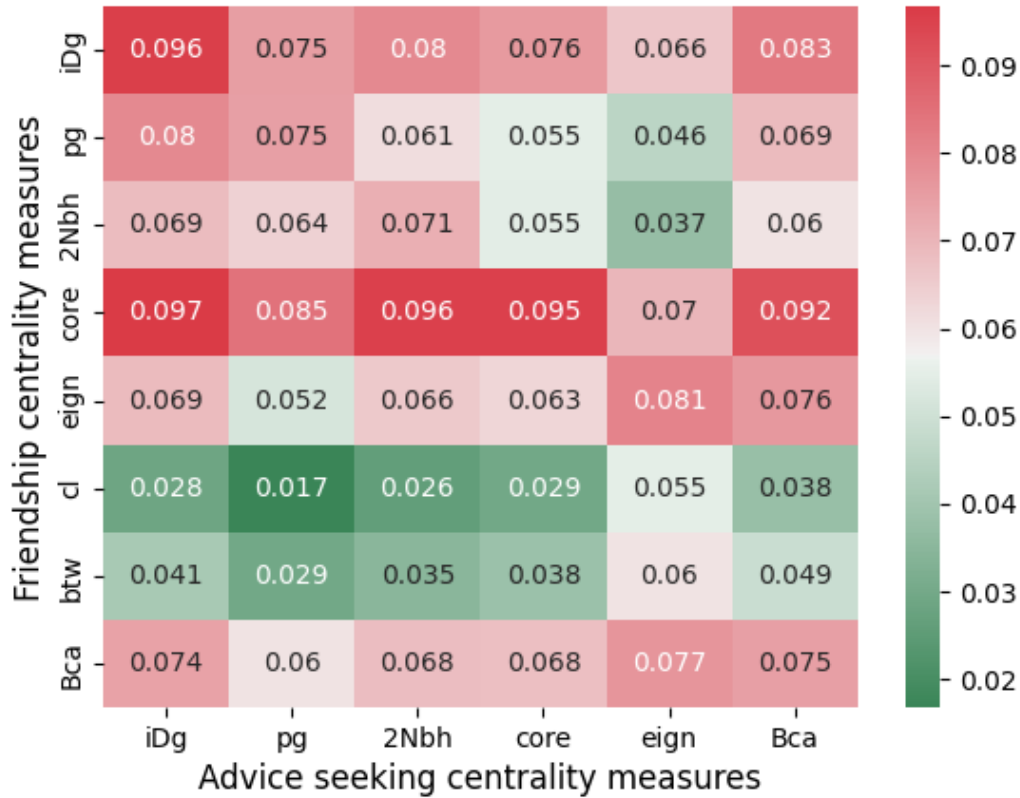


S17: Box plot of sequence instability values computed on the friendship networks for the in-degree (iDg) and eigenvector (eign) centrality measures. We separated the school classes into two groups: on the top plot we have observation data for 4 waves, on the bottom for 5 waves. The number after the hyphen represents the parameters of the sequence instability algorithm in the form : d-k, where d denotes the rank distance measure and k is the top-k parameter of the method. The d parameter can be "J" or "S", where "J" denotes the d_J Jaccard-distance and "S" stands for the d_{SFH} distance.



S18: Box plot of sequence instability values computed on the friendship networks for the closeness (cl) and betweenness (btw) centrality measures. We separated the school classes into two groups: on the top plot we have observation data for 4 waves, on the bottom for 5 waves. The number after the hyphen represents the parameters of the sequence instability algorithm in the form : d-k, where d denotes the rank distance measure and k is the top-k parameter of the method. The d parameter can be "J" or "S", where "J" denotes the d_J Jaccard-distance and "S" stands for the d_{SFH} distance.

4 Aggregation of advice-seeking and friendship networks: figures and tables

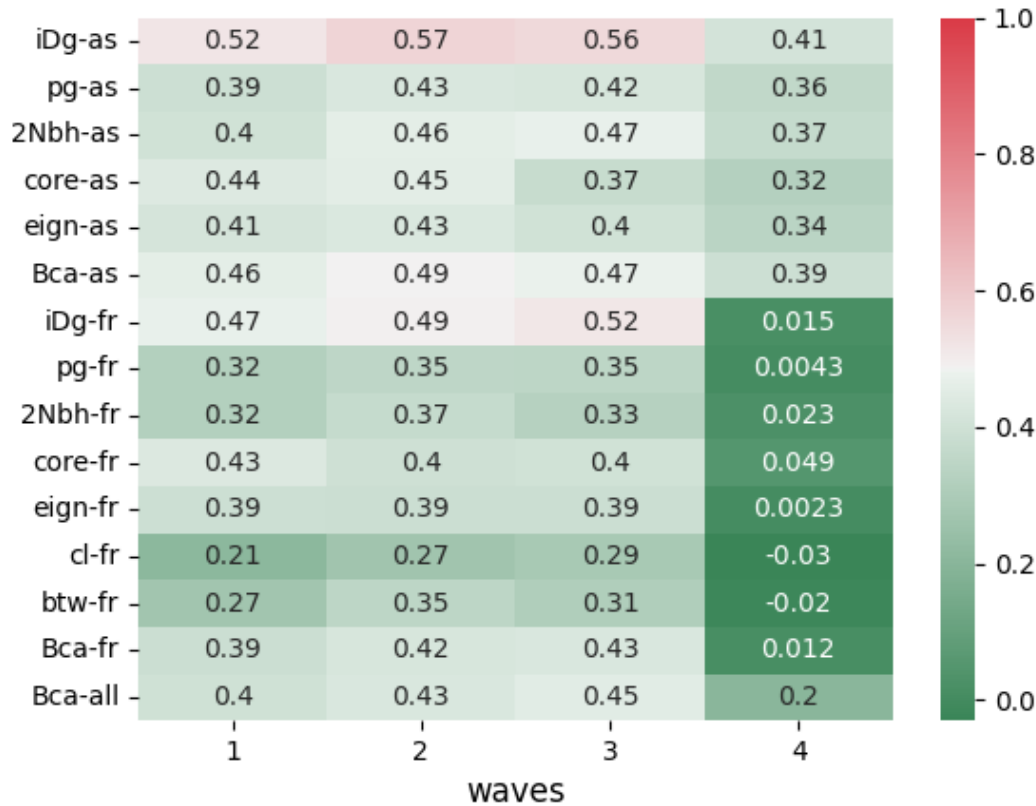


S19: The empirical mean of the Kendall tau correlation values between the centrality measures computed on the advice-seeking and the friendship networks. The variance is between 0.03 and 0.0809. Abbreviations: iDg: in-Degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation

S20: The empirical mean of the Kendall tau correlation values computed between the aggregated measure over both advice-seeking and friendship networks and the other centrality measures. The variance is between 0.0129 and 0.0622. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign : eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation

Network type	iDg	pg	2Nbh	core	eign	cl	btw	bca
advice-seeking	0.43	0.39	0.38	0.36	0.37	-	-	0.44
friendship	0.53	0.48	0.41	0.45	0.55	0.43	0.48	0.65

5 Wave to wave correlation of the centrality measures



S21: The wave-to-wave empirical mean of the Kendall tau correlation values. The variance values are between 0.018 and 0.106 in all cases. Abbreviations: iDg: in-degree, pg: PageRank, 2Nbh: two-hop neighbourhood, core: coreness, eign: eigenvector centrality, cl: closeness, btw: betweenness, Bca: Borda count aggregation. Where the meaning of the suffixes as and fr are advice-seeking network and friendship network. The Bca-all centrality measure is the aggregation of all the centrality measures over both network types.

6 Analysis of the core: figures and tables

S22: The mean and the variance of the core size and the relative core size of the advice-seeking (as) and friendship (fr) networks

Description	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5
Core size (as)	11.87 (25.59)	10.53 (24.78)	12.55 (39.95)	11.96 (27.82)	11.08 (23.23)
Relative core size (as)	0.59 (0.06)	0.55 (0.05)	0.6 (0.06)	0.6 (0.06)	0.6 (0.05)
Core size (fr)	12.52 (15.21)	12.68 (23.15)	12.31 (20.05)	11.5 (18.25)	12.5 (17.51)
Relative core size (fr)	0.68 (0.04)	0.68 (0.04)	0.66 (0.04)	0.63 (0.05)	0.67 (0.04)

S23: The mean and the variance of the number of common items and the relative number of common items of the core grouped by network type (advice-seeking or friendship) and number of available waves (4 or 5)

Description	Network type	Waves	Mean	Variance
Number of common items	advice-seeking	4	4.92	7.16
Relative number of common items	advice-seeking	4	0.24	0.01
Number of common items	advice-seeking	5	3.43	9.2
Relative number of common items	advice-seeking	5	0.18	0.03
Number of common items	friendship	4	4.91	3.17
Relative number of common items	friendship	4	0.3	0.01
Number of common items	friendship	5	3.7	4.75
Relative number of common items	friendship	5	0.2	0.01

S24: The number of cases when the opinion leaders induced by the other centrality measures are in the core of the advice-seeking networks.

Centrality	Network type	Nr. of cases in the core	Total number of cases	Rate
In-degree	advice-seeking	317	333	0.95
PageRank	advice-seeking	195	212	0.92
Two-Hop neighbourhood	advice-seeking	373	409	0.91
Eigenvector centrality	advice-seeking	195	211	0.92
Borda-count	advice-seeking	233	239	0.97
In-degree	friendship	196	322	0.61
PageRank	friendship	120	202	0.59
Two-Hop neighbourhood	friendship	322	516	0.62
Coreness	friendship	1506	2433	0.62
Eigenvector centrality	friendship	125	200	0.62
Closeness	friendship	158	260	0.61
Betweenness	friendship	133	201	0.66
Borda-count	friendship	154	229	0.67
Borda-count	both	198	222	0.9

S25: The number of cases when the opinion leaders induced by the other centrality measures are in the core of the friendship networks.

Centrality	Network type	Nr. of cases in the core	Total number of cases	Rate
In-degree	advice-seeking	201	312	0.64
PageRank	advice-seeking	129	200	0.65
Two-Hop neighbourhood	advice-seeking	248	386	0.64
Coreness	advice-seeking	1506	2303	0.65
Eigenvector centrality	advice-seeking	122	200	0.61
Borda-count	advice-seeking	140	226	0.62
In-degree	friendship	383	393	0.97
PageRank	friendship	213	232	0.92
Two-Hop neighbourhood	friendship	535	590	0.91
Eigenvector centrality	friendship	221	230	0.96
Closeness	friendship	213	299	0.71
Betweenness	friendship	166	231	0.72
Borda-count	friendship	251	259	0.97
Borda-count	both	204	222	0.92