
Social Networks

SOC 6110

Th 2:40PM - 4:35PM

Instructor

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Office: Uris Hall 384
Office Hours: Wed. 14:30-16:00pm

COURSE DESCRIPTION

The purpose of this graduate-level seminar is to introduce students to the study of social networks. It will provide students with an overview of the basic concepts, their theoretical underpinnings, and applications in sociology. We will read through old and new literature that evolves around how individuals interact with one another. The course will not deal with data analysis; there will be no “lab session” and no coding assignments. That said, I would be happy to help students who want to work with the methods that appear in the reading materials. While this is not a “coding” or “methods” course, we will walk through a bit of mathematical formalization (at a quite rudimentary level), since, otherwise, we wouldn’t understand how necessary concepts are formalized and applied in empirical research. Also, while the course has no formal prerequisites, it is assumed that students have a basic understanding of how quantitative methods are used in the social sciences. Most materials should be accessible to students with an introductory background in graduate-level social statistics and a readiness to learn a bit of matrix algebra.

The roots of the study of social networks can be found in early sociological thoughts and structural anthropology. While the idea of social networks was around from early on, it was only with the development of computer algorithms that the field established itself. Nowadays, network approaches are used not only by sociologists but across all of the social sciences and beyond, which includes computer science, applied mathematics, and physics. The selection of the readings will not (and cannot) be representative of the cross-disciplinary field into which the study of networks has grown. I tried to focus on the sociology literature and chose readings that are important, not too difficult to understand, and, hopefully, inspiring.

ENROLLMENT, CLASS FORMAT, REQUIREMENTS, AND GRADES

This is a 4 unit course. All participants are expected to read the readings carefully in advance and actively participate in the class discussions. The quality of the discussion is a public good, the value of which exponentially decreases with each additional free-rider. I have tried to keep the reading under 200 pages per week (often much less).

You are required to submit 6 short memos throughout this course (a couple of paragraphs; should not exceed 2 pages). This means that you need to submit one memo, roughly, every two weeks. You can do quite anything with these two pages. A couple of examples are:

1. criticize a paper or raise questions
2. compare two or more of the readings and discuss how they are related or one improves on the other, or even offer a synthesis
3. write about how the readings contribute to an active research project of yours

The point is that you offer something that is not already in the materials and has the potential to be discussed in class or is helpful for your own research. All memos should be uploaded to Canvas two days before our meeting—i.e., on Tuesdays before 11:59pm—so that other students are able to read through them before coming to class. These memos do not have to be formal essays. Their main purpose is to share your thoughts and to facilitate discussions in class.

You are also required to submit a final paper, on which I'll provide detailed feedback. The final paper should be between 10 and 20 pages and can be either

1. a full research proposal
2. a proposal about how network concepts or models will be incorporated into an ongoing project of yours
3. a preliminary analysis of network data, accompanied with a short literature review
4. extension of a measure/model/method (although this course is not about methods, I'd be happy to give feedback on methodological papers)

You don't need to write this paper alone. Indeed, you are encouraged to collaborate with other classmates on this final paper, since this is how most research is done. The final paper is due on May 27th.

Grades will be distributed as follows:

- Attendance and participation in class discussions: 30%
- Short memos: 30%
- Final paper: 40%

NOTE TO STUDENTS WITH DISABILITIES

If you have a disability-related need for reasonable academic adjustments in this course, please request your accommodation letter from the [Office of Student Disability Services](#) as early as possible, so we have adequate time to arrange your approved academic accommodations. If

you need immediate accommodations, please arrange to meet with me within the first two class meetings.

A SHORT NOTE ABOUT CODING

This course will *not* deal with any coding material due to limited time. However, there are plenty of materials online that demonstrate how the concepts that we learn throughout the course can be applied to quantitative data. If you are interested in how to analyze network data, I would personally recommend [Mark Hoffman's course webpage](#), as it covers a similar set of topics as this course.

COURSE READING

The only required textbook for this course is

Wasserman, Stanley and Katherine Faust. 1994. *Social Network Analysis: Methods and Applications*. Cambridge University Press.

Although this book is dated, it contains *a lot* of useful material while still approachable for sociologists without any mathematical background. In the starting weeks I will assign to you some pages from this book which you should read carefully in order to follow this seminar even if they are not discussed in class, unless you already know basic graph theory and matrix algebra. Also, there will be many chapters in this textbook that correspond to the topics we will be discussing (even if there are no required readings from this book). Whenever you are confused by some of the readings, you can check the index of the textbook and find a clear introduction to the concepts in this book. So, it will be a handy reference throughout the course. If you have difficulties following this book, you can always reach out to me to ask questions.

Other useful textbook-like sources include

1. Carrington, Peter J., John Scott, and Stanley Wasserman, eds. 2005. *Models and methods in social network analysis*. Cambridge university press.
2. Jackson, Matthew O. 2010. *Social and economic networks*. Princeton university press.
3. Newman, Mark. 2018. *Networks: an introduction (2nd ed)*. Oxford university press.
4. Freeman, Linton. 2004. "The development of social network analysis: A Study in the Sociology of Science." Empirical Press. [Overview of how the field of social network has developed]
5. Easley, David, and Jon Kleinberg. 2010. *Networks, crowds, and markets*. Cambridge university press. [This is written for undergraduates, but still a great introduction]

COURSE SCHEDULE (SUBJECT TO REVISION)

Week 1: Introduction

1. Simmel, Georg. 1971[1908]. "Problem of Sociology" pp. 23-35 in Donald N. Levine (ed.) *Georg Simmel: On Individuality and Social Forms*. University of Chicago Press.
2. Granovetter, M., 1985. "Economic action and social structure: The problem of embeddedness." *American journal of sociology*, 91(3): 481-510.
3. Erikson, E., 2013. "Formalist and relationalist theory in social network analysis." *Sociological Theory*, 31(3), pp.219-242.
4. Borgatti, S.P., Mehra, A., Brass, D.J. and Labianca, G., 2009. "Network analysis in the social sciences." *Science*, 323(5916): 892-895.
5. Wasserman and Faust, pp. 69-84, 92-136.

Week 2: Dyads and Network Degree

1. Feld, Scott L. 1991. "Why your friends have more friends than you do." *American Journal of Sociology* 96(6): 1464-1477.
2. Christakis, N.A. and Fowler, J.H. 2010. "Social network sensors for early detection of contagious outbreaks." *PLoS ONE* 5(9):e12948.
3. Barabási, A.L. and Albert, R. 1999. "Emergence of scaling in random networks." *Science*, 286(5439), pp. 509-512.
4. Holme, P., 2019. "Rare and everywhere: Perspectives on scale-free networks," *Nature Communications*, 10(1), pp.1-3.
5. McPherson, Miller, Lynn Smith-Lovin, and Matthew E. Brashears. 2006. "Social isolation in America: Changes in core discussion networks over two decades." *American sociological review* 71(3): 353-375.
6. DiPrete, Thomas A., Andrew Gelman, Tyler McCormick, Julien Teitler, and Tian Zheng. 2011. "Segregation in social networks based on acquaintanceship and trust." *American journal of sociology* 116(4): 1234-83.
7. McFarland, Daniel, Dan Jurafsky and Craig Rawlings. 2013. "Making the Connections: Social Bonding in Courtship Situations." *American Journal of Sociology* 118: 1596-1649.
8. Wasserman and Faust, 148-165.

Week 3: Balance, Transitivity, Status Hierarchy

1. Cartwright, Dorwin and Frank Harary. 1956. "Structural Balance: A Generalization of Heider's Theory." *Psychological Review* 6(3): 277-93.
2. Davis, James A. 1967. "Clustering and Structural Balance in Graphs" *Human Relations* 20: 181-87
3. Ivan D. Chase. 1980. "Social Processes and Hierarchy Formation in Small Groups: A Comparative Perspective." *American Sociological Review* 45: 905-924.
4. Gould, Roger V. 2002. "The origins of status hierarchies: A formal theory and empirical test." *American journal of sociology* 107(5): 1143-1178.

5. Leifer, Eric M. 1988. "Interaction preludes to role setting: Exploratory local action." *American Sociological Review* 53(6): 865-878.
6. Martin, John Levi. 2009. "Formation and stabilization of vertical hierarchies among adolescents: Towards a quantitative ethology of dominance among humans." *Social Psychology Quarterly* 72(3): 241-264.

Week 4: Two-mode (Bipartite) Networks and More Matrix Algebra

During this week, I'll provide you with some notes on matrix algebra and their applications to networks that is necessary for the following materials. Topics we cover are

1. Eigenvectors and Eigenvalues
2. Markov Chains and Random Walks on Networks

We will also cover (at a very basic level) two-mode (sometimes called affiliation or bipartite) networks. The papers that we'll discuss are

1. Breiger, Ronald L. 1974. "The duality of persons and groups." *Social forces* 53(2): 181-190.
2. Weeden, Kim A., Benjamin Cornwell, and Barum Park. 2021. "Still a Small World? University Course Enrollment Networks before and during the COVID-19 Pandemic." *Sociological Science* 8: 73-82.

Week 5: Weak Ties and Small worlds

1. Granovetter, Mark S. 1973. "The strength of weak ties." *American journal of sociology*, 78(6): 1360-1380.
2. Aral, Sinan, and Marshall Van Alstyne. 2011. "The diversity-bandwidth trade-off." *American journal of sociology* 117(1): 90-171.
3. Park, Patrick S., Joshua E. Blumenstock, and Michael W. Macy. 2018. "The strength of long-range ties in population-scale social networks." *Science* 362(6421): 1410-1413.
4. Milgram, Stanley. 1967. "The small world problem." *Psychology today* 2(1): 60-67.
5. Watts, Duncan J. "Networks, dynamics, and the small-world phenomenon." *American Journal of sociology* 105(2): 493-527.
6. Watts, Duncan J., Peter Sheridan Dodds, and Mark EJ Newman. 2002. "Identity and search in social networks." *Science* 296(5571): 1302-1305.
7. Uzzi, Brian, and Jarrett Spiro. 2005. "Collaboration and creativity: The small world problem." *American journal of sociology* 111(2): 447-504.

Week 6, Groups and Categories: Homophily

1. Blau, Peter M. 1977. "A macrosociological theory of social structure." *American journal of sociology* 83(1): 26-54.
2. McPherson, M., Smith-Lovin, L. and Cook, J.M., 2001. "Birds of a feather: Homophily in social networks." *Annual review of sociology* 27(1): 415-444.

3. Feld, Scott, and Bernard Grofman. 2009. "Homophily and the focused organization of ties." pp 521-543 in Peter Hedström and Peter Bearman (ed.) *The Oxford handbook of analytical sociology*. Oxford University Press.
4. Centola, Damon. 2015. "The social origins of networks and diffusion." *American Journal of Sociology* 120(5): 1295-1338.
5. Currarini, S., Jackson, M.O. and Pin, P., 2010. "Identifying the roles of race-based choice and chance in high school friendship network formation." *Proceedings of the National Academy of Sciences*, 107(11): 4857-4861.
6. [†] Mummolo, Jonathan, and Clayton Nall. 2017. "Why partisans do not sort: The constraints on political segregation." *The Journal of Politics* 79(1): 45-59.
7. McFarland, Daniel A., James Moody, David Diehl, Jeffrey A. Smith, and Reuben J. Thomas. 2012. "Network ecology and adolescent social structure." *American sociological review* 79(6): 1088-1121.

Week 7: Multiplex Ties, Structural Equivalence, and Blockmodels

1. Wasserman and Faust, pp. 347-375.
2. Gluckman, Max. 1965. *Politics Law and Ritual in Tribal Society*. Blackwell. [read Chapter III]
3. Nadel, Siegfried F. 1957. *The Theory of Social Structure*. Free Press. [Read Chapters I and IV]
4. White, Harrison C., Scott A. Boorman, and Ronald L. Breiger. 1976. "Social structure from multiple networks. I. Blockmodels of roles and positions." *American journal of sociology* 81(4): 730-780.
5. Baldassarri, Delia and Mario Diani. 2007. "The Integrative Power of Civic Networks." *American Journal of Sociology* 113: 735-80.
6. Becker, Sascha O., Yuan Hsiao, Steven Pfaff, and Jared Rubin. 2020. "Multiplex Network Ties and the Spatial Diffusion of Radical Innovations: Martin Luther's Leadership in the Early Reformation." *American Sociological Review* 85(5): 857-894.
7. Yeung, King-To. 2005. "What does love mean? Exploring network culture in two network settings." *Social Forces* 84(1): 391-420.

Week 8: Centrality, Position, Brokerage

1. Freeman, Linton. 1979. "Centrality in Social Networks: Conceptual Clarification." *Social Networks* 1: 125-39.
2. Bonacich, P. 1987. "Power and Centrality: A Family of Measures." *American Journal of Sociology* 92:1170-82.
3. Borgatti, Stephen P. "Centrality and network flow." *Social networks* 27(1): 55-71.
4. Burt, Ronald S. 1992. "The social structure of competition" pp. 8-49 in *Structural Holes*. Harvard.
5. Fernandez, Roberto M., and Roger V. Gould. 1994, "A dilemma of state power: Brokerage and influence in the national health policy domain." *American journal of Sociology* 99(6): 1455-1491.

6. Padgett, John F., and Christopher K. Ansell. 1993. "Robust Action and the Rise of the Medici, 1400-1434." *American journal of sociology* 98(6): 1259-1319.
7. Goldberg, Amir, Sameer B. Srivastava, V. Govind Manian, William Monroe, and Christopher Potts. 2016. "Fitting in or standing out? The tradeoffs of structural and cultural embeddedness." *American Sociological Review* 81(6): 1190-1222.

Week 9: Cohesion, Subgroup Formation, and Community Detection

1. Moody, James, and Douglas R. White. 2003. "Structural cohesion and embeddedness: A hierarchical concept of social groups." *American sociological review* 68(1): 103-127.
2. Newman, Mark EJ and Michelle Girvan. 2004. "Finding and evaluating community structure in networks." *Physical review E* 69(2): 026113.
3. Blondel, Vincent D., Jean-Loup Guillaume, Renaud Lambiotte, and Etienne Lefebvre. 2008. "Fast unfolding of communities in large networks." *Journal of statistical mechanics: theory and experiment*: P10008. [Skim this paper]
4. Rosvall, Martin, Daniel Axelsson, and Carl T. Bergstrom. 2009. "The map equation." *The European Physical Journal Special Topics* 178(1): 13-23. [If you want a condensed version see Rosvall, Martin, and Carl T. Bergstrom. 2008. "Maps of random walks on complex networks reveal community structure." *Proceedings of the National Academy of Sciences* 105(4): 1118-1123.]
5. Rosvall, Martin, Alcides V. Esquivel, Andrea Lancichinetti, Jevin D. West, and Renaud Lambiotte. 2014. "Memory in network flows and its effects on spreading dynamics and community detection." *Nature communications* 5(1): 1-13. [Skim this paper as well]
6. Cheng, Siwei and Barum Park. 2021. "Flows and boundaries: a network approach to the study of mobility within the labor market" *American Journal of Sociology*

Week 10: Exchange and Cycles

1. Cook, Karen S., Richard M. Emerson, Mary R. Gillmore, and Toshio Yamagishi. 1983. "The distribution of power in exchange networks: Theory and experimental results." *American journal of sociology* 89(2): 275-305.
2. Ekeh, Peter. 1974. "Collectivist Orientations in Social Exchange Theory" pp. 37-78 in *Social Exchange Theory: The Two Traditions*. Heinemann Educational Books.
3. Bearman, Peter S. 1997. "Generalized Exchange" *American Journal of Sociology* 102(5): 1383-1415.
4. Molm, Linda D., Jessica L. Collett, and David R. Schaefer. 2007. "Building solidarity through generalized exchange: A theory of reciprocity." *American journal of sociology* 113(1): 205-242.
5. Bearman, Peter S., James Moody, and Katherine Stovel. 2004. "Chains of Affection: The Structure of Adolescent Romantic and Sexual Networks," *American Journal of Sociology* 110(1): 44-91

Week 11: Diffusion

1. Centola, Damon and Michael Macy. 2007. "Complex contagions and the weakness of long ties." *American journal of Sociology* 113(3): 702-734.
2. Centola, Damon. 2011 "An experimental study of homophily in the adoption of health behavior." *Science* 334(6060): 1269-1272.
3. Banerjee, Abhijit, Arun G. Chandrasekhar, Esther Duflo, and Matthew O. Jackson. 2013. "The diffusion of microfinance." *Science* 341(6144): 363-341.
4. Elizabeth Levy Paluck, Hana Shepherd, and Peter M. Aronow. 2016 "Changing Climates of Conflict: A Social Network Experiment in 56 Schools," *Proceedings of the National Academy of Sciences* 113(3): 566-571
5. Nickerson, David W. 2008. "Is voting contagious? Evidence from two field experiments." *American political Science review* 102(1): 49-57.
6. Goldberg, Amir and Sarah K. Stein. 2018. "Beyond Social Contagion: Associative Diffusion and the Emergence of Cultural Variation." *American Sociological Review* 83:897-932.

Week 12: Networks, Cooperation, and Collective Action

1. Granovetter, Mark. 1978. "Threshold models of collective behavior." *American journal of sociology* 83(6): 1420-1443.
2. Chwe, Michael Suk-Young. 1999. "Structure and strategy in collective action," *American journal of sociology* 105(1): 128-156.
3. Gould, Roger V. 1995. *Insurgent Identities*, University of Chicago Press. (Read chapters 1-2, 6-7).
4. Baldassarri, Delia. 2015. "Cooperative networks: altruism, group solidarity, reciprocity, and sanctioning in Ugandan producer organizations." *American journal of sociology* 121(2): 355-395.
5. Fowler, James H., and Nicholas A. Christakis. 2010. "Cooperative behavior cascades in human social networks." *Proceedings of the National Academy of Sciences* 107(12): 5334-5338.
6. Suri, Siddharth, and Duncan J. Watts. 2011. "Cooperation and contagion in web-based, networked public goods experiments." *PloS one* 6(3): e16836.
7. Larson, Jennifer M., Jonathan Nagler, Jonathan Ronen, and Joshua A. Tucker. 2019. "Social networks and protest participation: Evidence from 130 million Twitter users." *American Journal of Political Science* 63(3): 690-705.

Week 13: Other topics

1. Perceptions of networks:
 - (a) Freeman, L.C. and Webster, C.M., 1994. "Interpersonal proximity in social and cognitive space." *Social Cognition*, 12(3): 223-247.
 - (b) Goel, Sharad, Winter Mason, and Duncan J. Watts. 2010. "Real and perceived attitude agreement in social networks." *Journal of personality and social psychology* 99(4): 611.

2. Inequality:
 - (a) DiMaggio, Paul, and Filiz Garip. 2011. "How network externalities can exacerbate intergroup inequality." *American Journal of Sociology* 116(6): 1887-1933.
 - (b) Nishi, Akihiro, Hirokazu Shirado, David G. Rand, and Nicholas A. Christakis. 2015. "Inequality and visibility of wealth in experimental social networks." *Nature* 526(7573): 426-429.
3. Narratives
 - (a) Mohr, John W. 1994. "Soldiers, mothers, tramps and others: Discourse roles in the 1907 New York City charity directory." *Poetics* 22(4): 327-357.
 - (b) Bearman, Peter S., and Katherine Stovel. 2000. "Becoming a Nazi: A model for narrative networks." *Poetics* 27(2-3): 69-90.
4. Political Beliefs
 - (a) Baldassarri, Delia and Goldberg, Amir. 2014. "Neither ideologues nor agnostics: Alternative voters' belief system in an age of partisan politics." *American Journal of Sociology*, 120(1), 45-95.
 - (b) Boutyline, Andrei, and Stephen Vaisey. 2017. "Belief network analysis: A relational approach to understanding the structure of attitudes." *American Journal of Sociology* 112(5): 1371-1447.

FURTHER READINGS

Below is a short list supplementary readings. As most of you will not have the time and energy to read through them, I've added short comments to each of the items, in the hope that it'll help you select readings that are of interest to you.

Week 1: Introduction

Notice that all these chapters/articles (except the last) are written a long time ago, when many network scholars believed that "structure" can be analyzed separately from "culture."

1. Bott, Elizabeth. 1957. *Family and Social Network*. New York: Free Press. [Early study on social networks and family relations, linking the division of labor between couples to their networks outside of the family]
2. Homans, George C. 1992[1950]. *The Human Group*. Transaction. [Early studies on networks and small groups; includes many fascinating insights; datasets used throughout the book reappear in the social network literature over and over for illustrative purposes]
3. Wellman, Barry. 1988. "Structural analysis: from method and metaphor to theory and substance," pp. 19-61 in Barry Wellman and S.D. Berkowitz (eds.) *Social Structures: A Network Approach*. Cambridge University Press.
4. Emirbayer, Mustafa, and Jeff Goodwin. 1994. "Network analysis, culture, and the problem of agency." *American journal of sociology* 99(6): 1411-1454.
5. Emirbayer, Mustafa. 1997. "Manifesto for a Relational Sociology." *American Journal of Sociology* 103:281-317

6. McLean, Paul. 2017. "The Nuts and Bolts of Networks, through a Cultural Lens," pp. 15-33 in *Culture in Networks*. Polity.

Week 2: Dyads and Network Degree

1. Simmel, Georg. 1950[1908]. "The isolated individual and the dyad," pp. 118-144 in Kurt H. Wolf (ed.), *The Sociology of Georg Simmel*. Free Press.
2. Gouldner, Alvin W. 1960. "The Norm of Reciprocity: A Preliminary Statement." *American Sociological Review* 25:161-178. [Classical statement about the universality of reciprocity and some conceptual distinction between usages of the term]
3. Axelrod, Robert, and William Donald Hamilton. 1981. "The evolution of cooperation." *Science* 211(4489): 1390-1396. [Classic study on cooperation in repeated games. Documenting the success of TIT-FOR-TAT. There's also a book from Axelrod under the same title as the article. It's a very enjoyable and insightful read.]
4. Broido, Anna D., and Aaron Clauset. 2019. "Scale-free networks are rare." *Nature communications* 10(1): 1-10. [At that time, quite controversial paper on scale-free networks; gives you the context of Holme (2019)'s short comment]
5. Eom, Young-Ho, and Hang-Hyun Jo. 2014. "Generalized friendship paradox in complex networks: The case of scientific collaboration." *Scientific reports* 4(1): 1-6. [Shows that any characteristic that is correlated with node degrees will show a similar paradox: why your friend's have, on average, more of X than you do.]
6. Kim, D.A., Hwong, A.R., Stafford, D., Hughes, D.A., O'Malley, A.J., Fowler, J.H. and Christakis, N.A., 2015. "Social network targeting to maximise population behaviour change: a cluster randomised controlled trial." *The Lancet*, 386(9989), pp.145-153. [Field experiment that utilizes the friendship paradox. I hope you'll be able to have an informed guess about why the randomly chosen alter was more effective than the highest in-degree alter by the end of this course (although, we'll never be sure..)]
7. Zheng, T., Salganik, M.J. and Gelman, A. 2006. "How many people do you know in prison? Using overdispersion in count data to estimate social structure in networks." *Journal of the American Statistical Association*, 101(474): 409-423. [Provides details on the model used in the DiPrete et al. paper]
8. Wang, Jing, Siddharth Suri, and Duncan J. Watts. 2012. "Cooperation and assortativity with dynamic partner updating." *Proceedings of the National Academy of Sciences* 109(36): 14363-14368. [If actors have the ability to choose their partners, whom will they choose and how will it affect the amount of cooperation? An experimental study.]
9. Holland, Paul W., and Samuel Leinhardt. 1981. "An exponential family of probability distributions for directed graphs." *Journal of the American Statistical Association* 76(373): 33-50. [The introduction of the p_1 model, the precursor of now-widely used ERGMs (also called p^* models). Although ERGMs are quite general, the p_1 model is a dyadic model.]
10. Backstrom, Lars and Jon Kleinberg. 2014. "Romantic Partnerships and the Dispersion of Social Ties: A Network Analysis of Relationship Status on Facebook." pp. 831-841 in the Proceedings of the 17th ACM Conference on Computer-Supported Cooperative Work and Social Computing. [Can we identify romantic partners from network patterns (without

knowing in advance)?]

11. Jackson, M.O., 2010. *Social and economic networks*. Princeton university press. [Chapters 4 and 5; Provides some theoretical background about random graphs and their degree distribution]
12. Mark T. Rivera, Sara Soderstrom and Brian Uzzi. 2010. "Dynamics of Dyads in Social Networks: Assortative, Relational and Proximity Mechanisms." *Annual Review of Sociology* 3(6): 91-115. [Summary on dyadic relationships]
13. Zerubavel, Noam, Mark Anthony Hoffman, Adam Reich, Kevin Ochsner and Peter Bearman. 2018. "Neural Precursors of Future Liking and Affective Reciprocity." *Proceedings of the National Academy of Science* 115 (17): 4375-4380. [Interesting research on predicting liking relationships based on fMRI scans]

Readings pertaining to the GSS name-generator and tie measurement

1. Burt, Ronald S. 1984. "Network items and the general social survey." *Social Networks* 6(4): 293-339. [The proposal for the inclusion of a name generator into the GSS; explains what was the purpose of this now-widely used instrument.]
2. Fischer, Claude S. 2009. "Comment: The 2004 GSS Finding of Shrunk Social Networks: An Artifact?" *American Sociological Review* 74:657-669.
3. McPherson, Miller, Lynn Smith-Lovin, and Matthew E. Brashears. 2009. "Reply: Models and Marginals: Using Survey Evidence to Study Social Networks." *American Sociological Review* 74:670-681.
4. Paik, Anthony, and Kenneth Sanchagrin. 2013. "Social isolation in America: An artifact." *American Sociological Review* 78(3): 339-360.
5. Lee, Byungkyu, and Peter Bearman. 2017. "Important Matters in Political Context." *Sociological Science* 4: 1-30.
6. Bearman, Peter, and Paolo Parigi. 2004. "Cloning headless frogs and other important matters: Conversation topics and network structure." *Social Forces* 83(2): 535-557.[What do "important matters" actually mean to respondents?]

Week 3: Balance, Transitivity, Status Hierarchy

1. Simmel, George. 1950[1908]. "The Triad" pp. 145-169 in in Kurt Wolf (ed.), *The Sociology of Georg Simmel*, Free Press. [Some thoughts Simmel wanted to share about Triads (versus Dyads)]
2. Fritz Heider. 1946. "Attitudes and Cognitive Organization," *Psychological Review* 52:358-374 [Cognitive Balance; not particularly about networks, but the building block for structural balance theory] Festinger,
3. Festinger, Leon. 1957. *A Theory of Cognitive Dissonance*. Stanford University Press. [Classical account on cognitive dissonance; many scholars cite dissonance as the main driver for structural balance on the network level]
4. Newcomb, Theodore M. 1961. *The Acquaintance Process*. Holt, Rinehart and Winston. [Similar to Festinger, laying out classical social psychology study, cited often to explain why we observe structural balance]

5. Rawlings, Craig M., and Noah E. Friedkin. 2017. "The structural balance theory of sentiment networks: Elaboration and test." *American Journal of Sociology* 123(2): 510-548. [Empirical tests of underlying psychological mechanisms creating balance; observational study]
6. Van de Rijt, Arnout. 2011. "The micro-macro link for the theory of structural balance." *The Journal of Mathematical Sociology* 35(1-3): 94-113. [Best-response model showing that "jammed" states are overcome by a strictly improving path when actors are able to update more than one tie at the time to reduce balance.]
7. Marvel, Seth A., Jon Kleinberg, Robert D. Kleinberg, and Steven H. Strogatz. 2011. "Continuous-time model of structural balance." *Proceedings of the National Academy of Sciences* 108(5): 1771-1776. [As the title suggests: a continuous-time differential equation model of structural balance dynamics]
8. Holland, Paul and Samuel Leinhardt. 1971. "Transitivity in Structural Models of Small Groups," *Comparative Group Studies* 2:107-24 [Restrictions on triads and resulting macro structure]
9. Holland, Paul and Samuel Leinhardt. 1976. "Local Structure in Social Networks," *Sociological Methodology* 7: 1-45. [Summarizing the U|MAN and related distributions for the triad census]
10. Gould, Roger V. 2003. *Collision of wills: how ambiguity about social rank breeds conflict*. University of Chicago Press [Ambiguity in dominance hierarchies begets violence]
11. Papachristos, Andrew V. 2009. "Murder by Structure: Dominance Relations and the Social Structure of Gang Homicide." *American Journal of Sociology* 115:74-128.[Multi-method study on gang violence; relies heavily on Gould's (2003) theory on violence and status]
12. Chase, Ivan and W. Brent Lindquist. 2009. "Dominance Hierarchies," pp. 566-591 in Peter Hedström and Peter Bearman (eds.) *The Oxford Handbook of Analytical Sociology*. Oxford University Press.[Summary of models/experiments of Ivan Chase and others]
13. Zerubavel, Noam, Peter S. Bearman, Jochen Weber, and Kevin N. Ochsner. 2015. "Neural mechanisms tracking popularity in real-world social networks." *Proceedings of the National Academy of Sciences* 112(49): 15072-15077. [Again, as the title suggests: fMRI scans at time t used to predict popularity at time $t + 1$]

Week 4: Two-mode (Bipartite) Networks and a bit of More Matrix Algebra

1. Wasserman and Faust, Ch. 8.
2. Bonacich, Phillip. 1991. "Simultaneous group and individual centralities." *Social Networks* 13:155-168. [Centrality for two-mode networks]
3. Faust, Katherine. 1997. "Centrality in affiliation networks." *Social networks* 19(2): 157-191.[Another generalization of centrality measures]
4. Doreian, Patrick, Vladimir Batagelj, and Anuška Ferligoj. 2004. "Generalized blockmodelling of two-mode network data." *Social networks* 26(1): 29-53.[As the title suggests]
5. Wang, Peng, Ken Sharpe, Garry L. Robins, and Philippa E. Pattison. 2009. "Exponential random graph (p^*) models for affiliation networks." *Social Networks* 31(1): 12-25.[ERGMs for bipartite graphs]

6. Everett, Martin G., and Stephen P. Borgatti. 2013. "The dual-projection approach for two-mode networks." *Social networks* 35(2): 204-210.[Using *both* projection of an affiliation network remedies the information loss that occurs when using only one of them.]
7. Cornwell, Benjamin, and Jake Burchard. 2019. "Structural cohesion and embeddedness in two-mode networks." *The Journal of Mathematical Sociology* 43(4): 179-194.[Moody and White type of embeddedness measure for two-mode networks]
8. James Montgomery has very approachable lecture notes on topics in mathematical sociology freely available online [here](#), where you can also find how Markov Chains can be applied to various topics in sociology.

Week 5: Weak Ties and Small worlds

1. Marsden, Peter V., and Karen E. Campbell. 1984. "Measuring tie strength." *Social forces* 63(2): 482-501. [Problems with measures of tie strength]
2. Marsden, Peter V., and Karen E. Campbell. 2012. "Reflections on conceptualizing and measuring tie strength." *Social forces* 91(1): 17-23. [Short follow up on the original article]
3. Travers, Jeffrey, and Stanley Milgram. 1969. "An experimental study of the small world problem." *Sociometry* 34(4): 425-443. [Milgram's small world experiment, longer version]
4. Dodds, Peter Sheridan, Roby Muhamad, and Duncan J. Watts. 2003. "An experimental study of search in global social networks." *Science* 301(5634): 827-829. [Modern version of the small world experiment]
5. Newman, Mark EJ, Steven H. Strogatz, and Duncan J. Watts. 2001. "Random graphs with arbitrary degree distributions and their applications." *Physical review E* 64(2): 026118. [This paper introduces the approach to get network measures using probability generating functions used in Uzzi & Spiro's paper. Can be a bit technical if you are not familiar with formal power series or generating functions (such as characteristic or moment generating functions).]
6. Kleinberg, J.M. 2000. "Navigation in a small world". *Nature* 406(6798): 845. [Another view on how non-centralized search in small worlds is possible]
7. Martin, John L. 2009. *Social Structures*. Princeton University Press. pp. 26- 71. [This is chapter 2 of the book; contains insightful considerations on small worlds, transitivity, hierarchies, and long ranging ties.]

Week 6: Homophily

1. Simmel, Georg. 1955[1908], "The web of group-affiliations" pp. 125-195 in Kurt H. Wolff and Reinhard Bendix (trans.) *Conflict and the web of group-affiliations*. Free Press [This is the very origin of the term "crosscutting social circles" (*Kreuzung sozialer Kreise*), although Simmel was mainly interested in the question of individuality, rather than how social ties are formed.]
2. Lazarsfeld, Paul F and Robert Merton. 1954. "Friendship as Social Process: A Substantive and Methodological Analysis," pp. 18-66 in Morroe Berger, Theodore Abel, and Charles Page (eds.) *Freedom and Control in Modern Society*. D. Van Nostrand. [Paper in which the term "homophily" was coined. Notice that they pay more attention to "value homophily,"

rather than homophily based on socio-demographics]

3. Blau, Peter M. 1997. *Inequality and Heterogeneity: A Primitive Theory of Social Structure*, Free Press. [This is the long version of the required reading]
4. Blau, Peter M. and Joseph E. Schwartz. 1997[1984]. *Crosscutting Social Circles*. Transaction. [7 years after writing *Inequality and Heterogeneity*, Peter Blau tested his theory on empirical data; most of the predictions were confirmed]
5. Moody, James. 2001. “Race, School Integration, and Friendship Segregation in America.” *American Journal of Sociology* 107(3): 679-716 [Article analyzing the now-famous Add Health dataset.]
6. Newman, Mark EJ. 2003. “Mixing patterns in networks.” *Physical review E* 67(2): 026126. [Physicists use the term “assortativity” to describe homophily. This article introduces the concept and related methods.]
7. Wimmer, Andreas and Kevin Lewis 2010. “Beyond and Below Racial Homophily: ERG Models of a Friendship Network Documented on Facebook.” *American Journal of Sociology* 116(2): 583–642 [One of the early applications of Exponential Random Graph models to social network data. Differentiates between ethnicities not only broad racial categories]
8. Lewis, Kevin .2013. “The Limits of Racial Prejudice” *Proceedings of the National Academy of Sciences*, 110(47):18814–18819 [Homophily in online romantic relationships]

Week 7: Centrality, Position, and Brokerage

1. Freeman, Linton C., Stephen P. Borgatti, and Douglas R. White. 1991. “Centrality in valued graphs: A measure of betweenness based on network flow.” *Social networks* 13(2): 141-154. [Paper introducing the so-called “flow betweenness” measure]
2. Ballester, Coralio, Antoni Calvó-Armengol, and Yves Zenou. 2006. “Who’s who in networks. Wanted: The key player.” *Econometrica* 74(5): 1403-1417. [Shows that the Nash equilibrium of a non-corporative game where player’s have a certain utility functions is proportional to Bonacich’s centrality]
3. Everett, Martin G., and Stephen P. Borgatti. 2010. “Induced, endogenous and exogenous centrality.” *Social Networks* 32(4): 339-344. [A whole family of centrality measures by clever idea: take *any* centrality measure $C(G)$ on a graph G , select a node $i \in V$ and calculate the change $\Delta_i = C(G) - C(G_{-i})$, where G_{-i} is the subgraph of G with i removed. Then Δ_i is the induced centrality of i . Very simple to code but computationally prohibitive for large networks (unless you come up with an analytic updating equation).]
4. Gould, Roger V. 1989. “Power and social structure in community elites.” *Social Forces* 68(2): 531-552.[Interesting argument that brokerage position and “conventional” power resources interfere with one another when actors try to gain influence]
5. Gould, Roger V., and Roberto M. Fernandez. 1989. “Structures of Mediation: A Formal Approach to Brokerage in Transaction Networks.” *Sociological Methodology* 19:89-126. [Methods paper on various forms of brokerage]
6. Opsahl, Tore, Filip Agneessens, and John Skvoretz. 2010. “Node centrality in weighted networks: Generalizing degree and shortest paths.” *Social networks* 32(3): 245-251. [Straight-forward generalization of centrality measures to weighted networks]

Week 8: Multiplex Ties, Structural Equivalence, and Blockmodels

1. Lorrain, Francois, and Harrison C. White. 1971. "Structural equivalence of individuals in social networks." *The Journal of mathematical sociology* 1(1): 49-80. [The very article that introduced the concept of structural equivalence.]
2. Boorman, Scott A., and Harrison C. White. 1976. "Social structure from multiple networks. II. Role structures." *American journal of sociology* 81(6): 1384-1446. [Second part of the article in the main readings; deals with homomorphic reductions to role structures from multiplex networks]
3. DiMaggio, Paul. 1993. "Nadel's Paradox revisited: Relational and cultural aspects of organizational structures." In *Networks and organization*. Harvard Business School Press [How culture matters for network analysis, esp. blockmodeling. Notice that, at least during that time, many network scholars tried to differentiate their "structural" approach from "cultural" approaches.]
4. Breiger, Ronald L., and Philippa E. Pattison. 1986. "Cumulated social roles: The duality of persons and their algebras." *Social networks* 8(3): 215-256. [Beautiful article about social roles and networks]
5. Schwartz, Joseph E. 1977. "An examination of CONCOR and related methods for blocking sociometric data." *Sociological methodology* 8: 255-282. [Formal derivation of why the CONCOR algorithm works. These days, CONCOR is not often used; yet, the derivation will give you insights into the relationship between eigenvectors and blockmodels]
6. Holland, Paul W., Kathryn Blackmond Laskey, and Samuel Leinhardt. 1983. "Stochastic blockmodels: First steps." *Social networks* 5(2): 109-137. [First article introducing stochastic blockmodels; comparison with the usual blockmodel is included as well]
7. Nowicki, Krzysztof, and Tom A. B. Snijders. 2001. "Estimation and prediction for stochastic blockstructures." *Journal of the American statistical association* 96(455): 1077-1087. [Paper on stochastic blockmodeling; mainly cited by statisticians and physicists (or computer scientists); authors also introduce an EM algorithm and Gibbs sampler for estimation]
8. Mariadassou, Mahendra, Stéphane Robin, and Corinne Vacher. 2010. "Uncovering latent structure in valued graphs: a variational approach." *Annals of Applied Statistics* 4(2): 715-742. [Introduces a variational algorithm with fully factorized variational distribution for approximate MLE for stochastic blockmodels non-negative integer weights.]
9. Airoldi, Edoardo M., David M. Blei, Stephen E. Fienberg, and Eric P. Xing. 2008. "Mixed membership stochastic blockmodels." *Journal of machine learning research* 9: 1981-2014. [A generalization of the stochastic blockmodel using a mixed-membership approach. Introduces also a variational algorithm for estimation.]
10. Borgatti, Stephen P., and Martin G. Everett. 2000. "Models of core/periphery structures." *Social networks* 21(4): 375-395. [Formalizing core/periphery structures]
11. Zhang, Xiao, Travis Martin, and Mark EJ Newman. 2015. "Identification of core-periphery structure in networks." *Physical Review E* 91(3): 032803. [Probabilistic approach to the core/periphery problem using stochastic blockmodels (see further readings of the block-modeling section). Uses EM in conjunction with belief propagation for computational

efficiency in maximizing the likelihood function.]

Week 9: Interpersonal Influence and Diffusion

1. James Coleman, Elihu Katz, and Herbert Menzel. 1957. "The Diffusion of an Innovation Among Physicians." *Sociometry* 20:253-70 [Classic study on diffusion; followed by several famous critics as well]
2. Katz, Elihu and Paul Lazarsfeld .1955. *Personal Influence*. New York: Free Press. [Classic study on interpersonal influence and opinion leadership; together with *The People's Choice and Voting*, advances the two-step flow of communication argument]
3. Rogers, Everett M. 1962. *Diffusion of innovations*. Free Press of Glencoe [Probably the most cited work on diffusion]
4. Jackson, M.O., 2010. *Social and economic networks*. Princeton university press. [Chapter 7 is a good summary of what was going on outside of sociology with regard to diffusion on networks]
5. Friedkin, Noah E., and Eugene C. Johnsen. 2011. *Social influence network theory: A sociological examination of small group dynamics*. Cambridge University Press. [Friedkin and Johnsen have worked on the model in the main readings for a long time, starting with their 1990 paper in the Journal of Mathematical Sociology. This book summarizes its developments]
6. Young, Peyton H. 2009. "Innovation Diffusion in Heterogeneous Populations: Contagion, Social Influence, and Social Learning." *American Economic Review* 99:1899–1924. [Not necessarily about networks, but contains some interesting results on diffusion processes and population heterogeneity]
7. Banerjee, Abhijit V. 1992. "A simple model of herd behavior." *The quarterly journal of economics* 107(3): 797-817. [Not necessary network related, but classic model of cascades; inspired diffusion studies and explanations for phase transitions]
8. Duncan J. Watts, "A Simple Model of Global Cascades on Random Networks," *Proceedings of the National Academy of Sciences* 99(9): 5766–5771 [Simple formal model of cascading behavior through networks]
9. Aronow, Peter M. and Cyrus Samii. 2017. "Estimating average causal effects under general interference, with application to a social network experiment." *The Annals of Applied Statistics* 11(4): 1912-1947. [Paper on the methods used by Paluck et al.]

Week 10: Exchange and Cycles

1. Homans, George C. 1974. *Social behavior: Its elementary forms*. Harcourt, Brace, and World. [Probably the most prominent work of the most prominent person in the individualistic social exchange tradition]
2. Blau, Peter M. 1964. *Exchange and Power in Social Life*. Wiley [Dyadic exchange from a utility maximization point of view (no equations, though). Full of great insights.]
3. Malinowski, Bronislaw. 1922. *Argonauts of the Western Pacific*. Routledge & Kegan Paul. [Classical anthropological study; Kula ring]

4. Lévi-Strauss, Claude. 1969. *The elementary structures of kinship*. Beacon Press.[Must read if you are interested in generalized exchange]
5. Emerson, R. M. 1972. “Exchange Theory, Part II: Exchange Relations and Networks.” Pp. 58-87 in J. Berger, M. Zelditch, and B. Anderson (ed.) *Sociological Theories in Progress, Vol. 2*. Houghton Mifflin. [Second of a two-chapter contribution; introduction of network-exchange theory; foundation of paper by Cook et al. (1983)]
6. Yamagishi, Toshio and Karen S. Cook. 1993. “Generalized Exchange and Social Dilemmas.” *Social Psychology Quarterly* 56(4): 235-48. [Comparing group-generalized exchange and network-generalized exchange in promoting cooperation; it also suggests that longer exchange-rings do not reduce collaboration]
7. Simpson, Brent, Ashley Harrell, David Melamed, Nicholas Heiserman, and Daniela V. Negraia. 2018. “The roots of reciprocity: Gratitude and reputation in generalized exchange systems.” *American Sociological Review* 83(1): 88-110. [Experimental study on the emergence of generalized exchange systems]
8. Erikson, Emily, and Peter Bearman. 2006. “Malfeasance and the foundations for global trade: The structure of English trade in the East Indies, 1601–1833.” *American Journal of Sociology* 112(1): 195-230. [Unintended integration of the East Indies trade network due to long cycles created by self-interested sailors. Interesting read.]

Week 11: Cohesion, Subgroup Formation, and Modules

1. Wasserman and Faust, Ch. 7 [Summary of measures sociologists have used in the past; many of them are a bit out of fashion, but they are still relevant for developments of new measures; this might give you some inspiration]
2. Shannon, Claude E. 1948. “A mathematical theory of communication.” *The Bell system technical journal* 27(3): 379-423. [Introduction of the entropy measure and the Source Coding Theorem by Claude Shanon (basis of the map equation)]
3. Grünwald, Peter D., and Abhijit Grunwald. 2007. *The minimum description length principle*. MIT press. [Quite gentle introduction to the minimum description length principle and its relation to “conventional” statistical procedures, such as MLE.]
4. Fortunato, Santo, and Marc Barthelemy. 2007. “Resolution limit in community detection.” *Proceedings of the national academy of sciences* 104(1): 36-41. [Points out that modularity fails to detect small (relative to graph size) modules]
5. Leicht, Elizabeth A., and Mark EJ Newman. 2008. “Community structure in directed networks.” *Physical review letters* 100(11): 118703. [Attempt to generalize modularity to directed networks; it has been pointed out that this generalization has some problems]
6. Kim, Youngdo, Seung-Woo Son, and Hawoong Jeong. 2010. “Finding communities in directed networks.” *Physical Review E* 81(1): 016103. [The modularity measure was extended to directed and weighted networks by Leicht and Newman; this paper points out that the generalization given by Leicht & Newman doesn’t work; offers an alternative measure based on a similar idea as PageRank]
7. Fortunato, Santo. 2010. “Community detection in graphs.” *Physics reports* 486(3-5): 75-174. [probably one of the best summary of community detection methods up to 2010]

8. Handcock, Mark S., Adrian E. Raftery, and Jeremy M. Tantrum. 2007. "Model-based clustering for social networks." *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 170:301–354. [A Bayesian model for clustering network data; assumes latent euclidean space; the rest is similar to Gaussian Mixture Models; won't work on large datasets]
9. Schweinberger, Michael, and Tom AB Snijders. 2003. "Settings in social networks: A measurement model." *Sociological Methodology* 33(1): 307-341. [Interesting model to identify nested clusters; both MLE and Bayesian approaches are introduced]

Week 12: Networks, Cooperation, and Collective Action

1. Olson, Mancur. 1965. *The Logic of Collective Action*. Harvard University Press. [Classic statement on the problem of collective action and free-riding.]
2. Marwell, Gerald, and Ruth E. Ames. 1979. "Experiments on the provision of public goods. I. Resources, interest, group size, and the free-rider problem." *American Journal of sociology* 84(6): 1335-1360. [To the best of my knowledge, this was the first public goods game in the literature.]
3. Ostrom, Elinor. 1990. *Governing the Commons*. Cambridge University Press.
4. Marwell, Gerald, and Pamela Oliver. 1993. *The critical mass in collective action*. Cambridge University Press. [Summary of papers on collective action, networks, and critical masses]
5. Chwe, M.S.Y., 2000. "Communication and coordination in social networks," *The Review of Economic Studies*, 67(1): 1-16. [A formal version of the assigned readings]
6. Hedström, Peter, Rickard Sandell, and Charlotta Stern. 2000. "Mesolevel Networks and the Diffusion of Social Movements: The Case of the Swedish Social Democratic Party" *American Journal of Sociology*. 106(1):145-72. [Early attempt to model multiplex network ties in diffusion processes]
7. Raub, Werner and Jeroen Wessie. 1990. "Reputation and Efficiency in Social Interactions: An Example of Network Effects," *American Journal of Sociology*, 96(3): 626-654.[Formal paper on communication and norm enforcement/collective action]
8. Coren L. Apicella et al. 2012. "Social Networks and Cooperation in Hunter-Gatherers," *Nature* 481(7382): 497–501. [Network structure and rates of cooperation among the Hadza; shows assortativity (i.e., homophily) in public goods games contribution, which theoretical models predict to be an important property for cooperation on the large-scale to emerge]
9. Bisbee, James, and Jennifer M. Larson. 2017. "Testing social science network theories with online network data: An evaluation of external validity." *The American Political Science Review* 111(3): 502-521. [Can we draw conclusions regarding offline networks based on interactions on the web?]

Week 13: Other Topics (some statistical models that could not be included so far)

1. Robins, Garry, Pip Pattison, Yuval Kalish, and Dean Lusher. 2007. "An introduction to exponential random graph (p^*) models for social networks." *Social networks* 29(2): 173-

- 191.[Introduction to Exponential Random Graph Models (ERGMs or p^* models), which are widely used in the social sciences to model networks]
2. Hunter, David R., and Mark S. Handcock. 2006. "Inference in curved exponential family models for networks." *Journal of Computational and Graphical Statistics* 15(3): 565-583.[Most papers on ERGMs do not give a detailed explanation of the estimation algorithm (i.e, MCMCMLE); this paper is more detailed in this respect]
3. Hoff, Peter D., Adrian E. Raftery, and Mark S. Handcock. 2002. "Latent space approaches to social network analysis." *Journal of the American Statistical Association* 97(460): 1090-1098.[Quite simple(?) model based on a latent space approach; very similar to multidimensional scaling; notice that Euclidean spaces might explain transitivity and clustering, but that they have difficulties in modeling small-world kind of graphs (due to the assumed topology of the space)]
4. Snijders, Tom A. B. 2011. "Statistical Models for Social Networks." *Annual Review of Sociology* 37:131- 153. [Summary of statistical models up to 2011]
5. Snijders, Tom AB, Gerhard G. Van de Bunt, and Christian EG Steglich. 2010. "Introduction to stochastic actor-based models for network dynamics." *Social networks* 32(1): 44-60.[Introduction to a often-used (at least in sociology) dynamic network model]