**Network Science and the Study of Politics: Interdependence, Density Dependence, and Individual Actors**

1. Some preliminaries:
   1. The enduring dominance of the very powerful individualistic model of political behavior, in both theory and practice.
   2. Thinking about networks and socially contingent behavior as more than graphs of nodes and edges.
   3. The confessions of an unabashed methodological individualist, in the context of Boudon’s (agnostic) sociological micro-theories.
   4. The crucial stochastic component.

2. In the beginning …
   1. Birth of modern statistics: Francis Galton, Karl Pearson, Ronald Fisher in late 19\textsuperscript{th} and early 20\textsuperscript{th} centuries
   2. The rise of social and political statistics: Emile Durkheim (1897), Herbert Tingsten (1937)
   3. Aggregate analyses of politics: Heberle and Nazi Voting (1945); Key and Southern Politics (1949)
   4. Election studies (Elmira, NY in 1940 and Erie County, OH in 1948) based on surveys within communities (Lazarsfeld and colleagues)
   5. Election studies based on national samples are begun at the University of Michigan in 1948
3. The ecological fallacy and its revolutionary implications (W.S. Robinson. 1950. ASR)

1. Aggregate data and the roots of empirical research on electorates
2. The danger of ecological fallacies
3. Goodman’s model: $B_j = P_1(S_j) + P_2(1-S_j)$, or $B_j = P_2 + (P_1-P_2)S_j$
4. Goodman’s insight: if the $P_i$ are constant, the model can be estimated without concern regarding an ecological fallacy
5. The density dependence insight: if the $P_i$ are not constant, we need to be concerned about individualistic fallacies as well as ecological fallacies.
6. The unfortunate result: a widespread suspicion of anything other than individual level observation.

4. Evidence that the $P_i$ vary based on group specific rates

1. Tingsten’s Stockholm precincts in the 1930s
2. Matthews and Prothro and black registration rates in southern counties in the 1960s
3. Warren Miller and one-party politics in the 1950s
5. Why might the $P_i$ vary? That is, why might individual rates of behavior be context dependent?

1. Crude forms of self-selection
2. Complex, subtle processes of sorting and mixing
3. Individual behavior that is density dependent within a diffusion/influence model
4. Individual behavior that is density dependent within a competition/conflict model

6. If individual behavior is density dependent, not only are individualistic models improperly specified, but we may be ignoring a profound source of complexity in political dynamics. See:


7. May and complex dynamics: $\Delta X_t = aX_t(1 - X_t)$

A more satisfying political version: $\Delta X_t = aX_t(1 - X_t) - b(1 - X_t)X_t$

Compare to Goodman’s static model: $B_j = P_1(S_j) + P_2(1 - S_j)$

In short, the study of dynamically complex social systems is intimately related to the study of social contingencies operating on individual behavior. (structural indeterminacy, thresholds, path dependence, multiple equilibria, etc)
8. We still have the observational problem – how to observe behavior as socially contingent – and one response to the problem is to “contextualize” individual behavior in order to consider the context specific contingencies operating on group-specific rates of behavior by implementing multi-level models. \(Y_{ij} = a + bX_{ij} + cX_i + dX_{ij}X_i\)

In terms of Tingsten’s results, individual support for socialist parties depends not only on individual class membership, but also on the class composition of the precinct in which the individual lives. And the contextual and individual effects are likely to be conditional on each other.

9. Multi-level contextual models of political behavior have been widely employed and are still in use.

Warren Miller. 1956. One party politics and the voter. APSR

10. The compelling urge to be explicit – to move beyond a random mixing assumption – in the movement toward networks and social contingencies, inspired by revolutionary understandings of individuals, aggregates, and interdependence.

-Harrison White (with Boorman and Breiger) → 2 papers on Blockmodels in the 1976 volume of AJS
-Mark Granovetter’s three papers: “The Strength of Weak Ties” (1973); “Threshold Models of Collective Behavior” (1978); “Economic Action and Social Structure” (1985).”
-Thomas Schelling (1978) Micromotives and Macrobehavior (and the papers on which it is based)
-And we must not forget John Conway’s Game of Life
11. Moving Beyond “Random Mixing”: Connecting Networks and Contexts in Surveys

- Edward Laumann invents the survey name generator for the 1966 Detroit Area Study (Bonds of Pluralism 1973)

- Huckfeldt (AJS, 1983) employs DAS and a reworked Coleman model (1964: chap. 16) to address the relationships among (1) the contextually defined supply of interaction opportunities, (2) selectivity in network construction, and (3) the composition of the resulting social networks

- The parable of fishing for bass in a lake full of blue gill (Cachuma Lake, 1959).

- Moral #1: choice is often circumscribed by supply, even among very resolute minorities
- Moral #2: Networks are doubly endogenous → the intersection between choice and supply
- the outstanding McPherson and Smith-Lovin (1987 ASR) paper identifies this problem as the difference between choice homophily and structural homophily (ASR) – a distinction lost in many political science treatments

Working class densities in neighborhoods and networks, Detroit Area Study 1966.
12. Surveys and Egocentric Networks → Data sets, all available through national data archives

Huckfeldt and Sprague. South Bend 1984
Beck, Dalton, Huckfeldt. CNEP (USA) 1992
Kaase, Klingemann, Pappi. CNEP (Germany). 1990.
Huckfeldt, Sprague. Indianapolis-St. Louis, 1996

13. Snowball surveys extend our ability to understand density dependence: tying together individuals and aggregates via networks, based on independent observation of the nodes.

i. Contexts as density dependent constraints on network formation.
ii. Message recognition and opinion densities within networks.
iii. Dyadic influence and opinion density within networks.
iv. Density dependence and the survival of disagreement (see next).
Autoregressive Influence and Patterns of Social Connection and Implications for Electoral Change: Socially Heroic Holdouts, Socially Sustained Disagreement, and Indeterminate Outcomes.

A. Conformity and the socially heroic holdout.

B. Socially sustained disagreement.

C. Social connections giving rise to political change.
14. Strategies regarding endogeneity and self-selection

i. Instruments
ii. Studying the movers: Thad Brown
iii. Field studies and natural experiments: Levitan and Visser; Lazer et al.; Klofstad
iv. Field experiments: David Nickerson
v. Causal inference: Betsy Sinclair
vi. The advantages studying networks within the context of large scale aggregates: Huckfeldt, Ikeda, and Pappi (AJPS 2005)
15. Social dilemma experiments using incentives: an opportunity waiting to be embraced

i. Ahn’s revisitation of Fehr and Gächter’s altruistic punishment: the “punishment” of being an outcast

ii. Huckfeldt, Pietryka, and Reilly (Social Networks, forthcoming): experts, activists, and opinion leaders: high out-degree plus sticky priors
   - seven subjects with varying levels of privately acquired information
   - three opportunities to communicate
   - the experts have strong and durable (sticky) priors
   - at the same time they are attractive informants

iii. Moral: Nodes matter too!
Experts, Activists, and Opinion Leadership

A. Communication requests go to experts

B. Expert priors decay more slowly

C. Experts become Opinion Leaders
In conclusion, I have managed to cover both too much and not enough. I have ignored massive amounts of material, mostly related to exciting work in international relations, international communications, and other efforts that study large (approximately) complete networks. I leave these topics in the capable hands of my colleagues.

And I leave you with several concluding thoughts.

1. Political interdependence lies close to the core of a series of observational challenges related to political analysis: ecological fallacies, individualistic fallacies, and the remarkably complex dynamics that are produced by human interaction.

2. Social networks are endogeneous to an interplay between contexts and the individuals that reside within these contexts.

3. Hence, network analysis provides the means and mechanisms for moving back and forth between aggregates and individuals.

4. While social networks tend toward homophily, both as a consequence of choice and structure, they can also be configured to sustain opinion diversity within networks.

5. Rejecting individualistic models of human behavior does not require that we reject methodological individualism. Re-read Schelling whenever you feel the need to be persuaded.

6. Network analysts who care about data continue to confront observational challenges that require fresh and innovative approaches to these problems.

7. The best way to move the study of politics is to shed new light on important venerable problems, building on the past efforts without discarding them.