Exploring How People Experience Life – Part 1

Notes on Social Complexity - a Still Emerging Scientific Research Discipline
Ver. 1 – 5 May 2025

Contact: William.reed@nxtlight.com

Overview

There is an interesting and maturing class of social problems where individuals dynamically interact with others and make local choices consistent with the principles of behavioral economics. That is to say that people are emotional creatures that compete, cooperate, negotiate, and learn from their experiences as they seek to achieve their goals. They also, form and disband groups, value their cultural heritages, participate in larger social groups and evolve with social and technological advancements. And people age, mature, and reflect on moral sentiments, structural norms, and historical traditions.

Seldom do traditional research studies capture this richness of the human experience with enough precision and detail to adequately address rapid dynamical and progressive change. Practical constraints limit the breadth and depth of qualitative methods while quantitative research often captures only a snapshot in time, while mostly focusing on population level statistics. Longitudinal studies that track results over time are often resource-bound and face declining participation.

There are no perfect and overarching research methods for discovery and prediction. The Complex Adaptive Systems approach described here is an emerging research method tailored for the specific class of problems described below. It finds value in giving primacy to individual cognition within the context of larger groups while exploring the dynamical processes that occur over time. These temporal trajectories account for individual agency along with the structural forces that constrain action. This approach recognizes and accounts for idiosyncratic behavior of individuals as they interact with others, learn and grow from the experiences, respect their cultures and traditions, and co-evolve with their environments.

Historically, large populations have been broadly studied with statistical tools that focus attention on certain quantitative questions such as range of ages, average income, or percentage of college graduates. Comparisons between groups have used pair-wise correlations and similar statistics, while multivariate analysis and measures such as cluster analysis can be applied to capture multiple factors associated with one or more independent variables.

While there has been a growing "replicability crisis" [(1)] in establishing the reliability of prior statistical studies, my more prescient interest is about research that incorporates more realistic conditions and predicts human behavioral trajectories over time. These are questions addressed by "complexity theory" which has rapidly matured over the last two decades.

[(1)] (https://en.wikipedia.org/wiki/Replication_crisis)

Complexity theory is typically an agent-centric, network analysis where multiple agents are connected to others in a network of associations that exist in a broader ecosystem. Certain characteristics are typical:

- The network is the unit of analysis and has "initial conditions" that govern its early performance
- Agents are knowledgeable (but not necessarily) experts in their local environments (and less aware of information further away)
- Agents can act independently but are also constrained by the social and physical structures that exist
- Agents have bounded rationality, make mistakes, and can learn from their experiences
- In some studies, the "wiring" of the network is permitted to change, reflecting actual conditions (sometimes this is self-organization)

This approach overcomes many limitations of research in the human-social domain by being dynamical, responsive to individual conditions and changing with the surroundings. Essentially, it reflects the real world as a continually evolving complex system, where individuals have unique characteristics and interactions with others that involving non-linearity, iteration, feedback, and randomness. In sum, this approach describes a system that is "far from equilibrium" and co-evolving with its surroundings.

Applications

While complexity analytics are applicable to physical systems such as forest fires, fluid flows, and avalanches, the focus here is on the social behavior of individuals within a network and the consequences of their decisions and behaviors. Some examples follow:

Topic	**Research Reference**
Traffic Jams	
Pandemics	
Riots - Insurrections	
Climate Change	
Voting Patterns	
Supply Chain Issues	
Emergency Response	
Public Space Utilization	
Social Movements	
Overcrowding	

Rather than describing each of these in detail, it is more helpful to discuss what each topic has in common. They are all adaptive to their participants and environments. In addition they typically share:

- Local control and a lack of central management
- Simple rules and self-organization
- Iteration of process
- Non-linear characteristics

- Black swan behavior
- Initial conditions
- Non-linear regions
- Random elements

Graph Theory & Computation

Graph theory is the mathematical name for the study of networks, especially the relationships between nodes (people) and edges (the elements that connect people). Numerous mathematical relationships are well established and utilized for assessing network performance. More recently, the study of “hypergraphs” have found utility in modeling higher-order interactions where 3 or more simultaneous influences exist. This can be particularly useful in looking at how interaction between two people can be influenced by a third person or factor, such as the environment or legal boundaries.

In my work, I largely use graphing add-ins to Python to generate networks that can be randomized or seeded with specific data.

End of Part 1