Social networks are a longstanding field of inquiry, yet interest in them has arguably never been higher. For present purposes, we will define a *social network* as a network of individual people, while a *societal network* can represent larger entities – organizations or collections of people connected by shared interests, function, decision making, etc., especially relating to functions essential to the survival and general well-being of the community.

Within this broad area, I am studying multilayer networks – networks where a given node may be connected to other nodes in different ways. We will consider networks to have two types of layers: awareness layers and active layers. Awareness layers represent avenues by which information is made available to nodes, such as social media links. Active layers represent more concrete bonds that satisfy higher goals, such as buyer-seller relationships. Rather than merely looking at static relationships or centrally designed and coordinated structures, we will consider an agent-based framework. Nodes themselves seek to build (or weight) links in active layers that maximize an objective function representing their perceived utility (subject to constraints). They do so based on information available through their connections in awareness layers.

My research is divided into two stages. During the first stage, we are studying various agent-based models – investigating various classes of optimizations (choice of objective functions, information models, etc.) and looking at characteristics of the resulting networks – convergence, degree distribution, distance properties, sensitivity to initial inputs, etc. The second stage seeks to apply the findings of the first to datasets from the NSF FEWSION (Food, Energy, and Water Systems) project. We will look at the relationships between individual counties, and focus on issues of resource security and supply resilience – in the event of a disruption, which counties are best positioned to reorient themselves to find alternate suppliers? We will seek to identify structural properties of the underlying networks that give rise to that security (on either a node or network level), and match these with behaviors used to form networks (or neighborhoods) with those characteristics. Ultimately, we hope to address the following questions:

- Why do social or societal networks form the way they do?
- If networks are formed by nodes (be they individuals or entities) trying to make connections according to what they perceive to be best for themselves (based on available information and a particular perspective), what are the ramifications for the network as a whole?
- In resource networks, what structural characteristics allow nodes (or networks) to be resilient to supply disruptions?
- Putting all this together, what kinds of behaviors at a node level lead to robustness at the network level?

While this work is still in an early state, we will present some examples and illustrations drawn from the work to date, providing a flavor of the results to come.