

## **Toward a unified theory of social relationships and social networks**

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### **Abstract**

Navigating the social world requires representing how people relate to one another and how people are connected in a network. Though both are forms of relational knowledge, it is difficult to unify them in a single theoretical framework. I hypothesize that the statistics of observation may be sufficient to learn both network structure and an intuitive theory of relationships.

### **Main**

As the poet John Donne noted, “No [human] is an island, entire of itself; every [human] is a piece of the continent, a part of the main.” The great drama of human social life is staged not only in interactions between dyads but in the larger context of our social networks. A piece of gossip shared with the wrong person can quickly spread to far-flung corners of the community; the shockwaves generated by a romantic couple’s breakup might result in a cleaving of the network as people decide to take sides; an enterprising employee can try to climb the corporate ladder by strategically cultivating relationships with well-connected middle managers.

These examples illustrate that to adaptively navigate the social world, we must learn how people are connected to one another. Moreover, we must do so despite having imperfect memory and incomplete observations of others’ social relationships. How can this be accomplished? It is tempting to assume that the cognitive mechanisms underlying social network representation are essentially the same mechanisms underlying the representation of social relationships. After all, social networks are, by definition, composed of social relationships.

In the target article, Thomas proposes that having an intuitive theory about social relationships can help children understand other agents’ behaviors, much as intuitive theories can help us reason about the physics of an object or the psychology of an individual mind. I agree that the richness of an intuitive theory is useful for understanding how very young children and infants represent social relationships. However, it is unclear whether relational models (i.e., structured representations of different relationship “types”) provide the right cognitive foundation for representing complex social structures, like networks.

Due to limitations in both observation and memory of social relationships, learning a mental representation of a social network requires extrapolation from direct experience. Recent work has shown that adults are able to use the statistical structure of observation to make principled

inferences about the existence of unknown social relationships, including relationships they have never observed (Son, Bhandari, & FeldmanHall, 2021, 2023). The ability to make these inferences appears to enable adaptive social navigation (Son et al., 2024), including the ability to create a desirable social “niche” in real-world networks (Aslarus et al., 2025; Teoh et al., 2025). These capacities mirror at least two components of the intuitive theory outlined in Thomas’ proposal: inferring a relationship’s existence and changing relationships through one’s actions.

A simple learning mechanism, which does not necessitate any structured prior knowledge, is sufficient for explaining how adults jointly learn a probabilistic representation of both dyadic relationships and the larger-scale structure of a social network. Computationally, this mechanism works by chaining together direct observations of dyadic relationships. For example, imagine observing Abbie and Brooke eating lunch together. A week later, you observe Brooke and Charlotte going on a coffee run. By integrating over these observations, you can now infer a greater probability that Abbie and Charlotte will be observed together in the future, despite never having observed them together in the past. This co-occurrence probability acts as a useful signal for the existence of a relationship. If we think of these observations as “one-step” connections in a network graph, then the process of integrating over them produces a “multistep” representation in the mind. By integrating over many one-step observations, multistep inferences reveal the structure of an interconnected, relational system (Lynn & Bassett, 2020; Momennejad, 2020), including larger-scale social structures (e.g., communities, hubs, brokers, groups) reflecting the network’s topology (FeldmanHall, Son, & Bhandari, 2025).

If the statistics of observation are sufficient for learning about the structure of a social network, this suggests that core knowledge is not necessary for children to mentally represent social networks, particularly given infants’ aptitude for statistical learning. This is partly an empirical question to be tested, but it also raises an interesting theoretical quandary. Though mental representations of social relationships and social networks are both forms of relational knowledge, is it possible that they rely on different cognitive principles? Perhaps representing an intuitive theory of relationship categories is more akin to solving the problem of inferring mental states from behavior, whereas statistical learning about the existence and strength of a relationship is more akin to a structure-learning problem.

However, if we allow ourselves to be tempted by the possibility that the representation of social relationships and social networks is intertwined, then there are many interesting empirical questions and theoretical challenges for future work to address. In the spirit of “[intuitive] theories all the way down” (Gopnik & Wellman, 2012), I speculate that statistical learning could be used to discover distinct kinds of relationships: those that are mutually reciprocated, those that are sufficiently group-like that several individuals can be compressed into a single communal entity, and those that are asymmetric. Once a “proto-theory” is in place, this would provide the cognitive scaffolding needed to learn a richer intuitive theory specifying causal beliefs about (e.g.) social roles, obligations, affordances, etc.

How could the statistics of observation be used to learn such a theory? A fully-fledged proposal has yet to be developed; here, I sketch the outlines of what it might include. The cognitive foundation of equality-matching simply requires knowing that two people are related in some way, which is arguably present in the observation itself. If observations are sufficiently clustered

in time and space, this could be used to discover group-like structures from dyadic, pairwise relations, serving as the basis for communal sharing. Directed sequences of observation could facilitate the discovery of a treelike structure, which could then be used to represent asymmetric relations and authority-ranking.

Of course, there are many other possibilities for developing unified theories of social relationships and social networks and in characterizing how statistical learning interacts with intuitive theories and/or core knowledge to produce rich relational knowledge. It is also possible that the representation of relationships and networks relies on such different cognitive principles that a unified theory is unworkable. But if there are common principles, discovering them will answer foundational questions in social cognition about how we humans navigate our complex and interconnected social world.

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### **Competing interests**

The author declares none.

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