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### Synonyms

Opinion dynamics, clustering, polarization

### Definition

It is a truism that everyday social interaction leads to interpersonal influence. We often see that influence leads interaction partners to grow more similar in opinions, values, and behaviors. This pattern may be because interaction partners exchange arguments and persuade each other directly, it may be due to imitation or social learning among peers, or it may also be because interaction partners are exposed to common external influences, such as groups that pressure members to conform to shared norms. Cognitive consistency theories provide one account for this increasing similarity among friends, by assuming that people have a motivational drive to be similar to people that they like or respect. In order to resolve the dissonance caused by disagreeing with friends, actors may try to convince friends to adopt similar opinions or may change their own opinions to conform to their friends.

Social influence can lead to complex dynamics in groups where several individuals influence each other repeatedly. Researchers have developed formal models to investigate these dynamics in social networks, and applied them to theoretical problems like the emergence of shared cultural norms, the persistence of cultural diversity, the development of organizational culture, conflicts in work teams, and clustering and polarization of political opinions.

### Theoretical Background

When two individuals influence each other they typically become more similar. In social groups, this influence can lead to self-reinforcing dynamics that drive the group toward homogeneity. To illustrate this, Figure 1 shows a typical linear influence process in a group of 10 individuals, labeled 1 to 10. At the outset of the influence process, each individual holds a numerical opinion corresponding to its label. Furthermore, the group has a very simple influence network, a line. That is, actor 1 is only influenced by actor 2. Actor 2 is only influenced by actors 1 and 3. Actor 3 is only influenced by actors 2 and 4 and so on. At the beginning of the process, actors in the interior of the line do not change their opinions because the influences by their two neighbors balance each other out. However, actors 1 and 10 are each influenced in only one direction by a

single neighbor – who has a less extreme opinion – so they develop more moderate opinions. This compromise by actors 1 and 10 causes the opinions of actors 2 and 9 to become less extreme, triggering opinion adjustments of actors 3 and 8, and so on.

As Figure 1 illustrates, the opinions of the actors converge toward a common value (a shared norm) in the long run. In fact, as long as the influence network is strongly connected (i.e. there exists a directed path connecting each pair in the influence network), the linear influence model *always* generates convergence to global uniformity. According to these classical influence models, the group will converge toward a uniform opinion unless the network is broken into subsets that have no influence on one another.

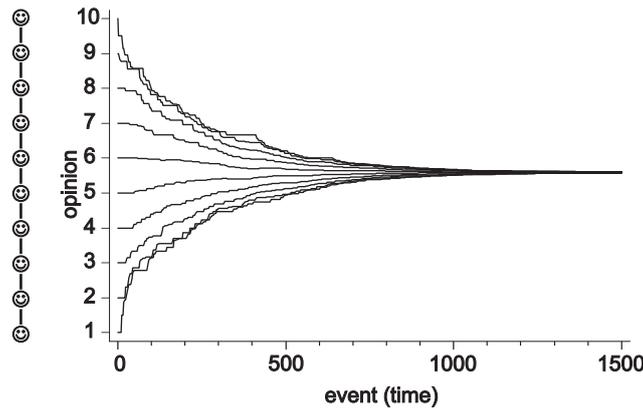


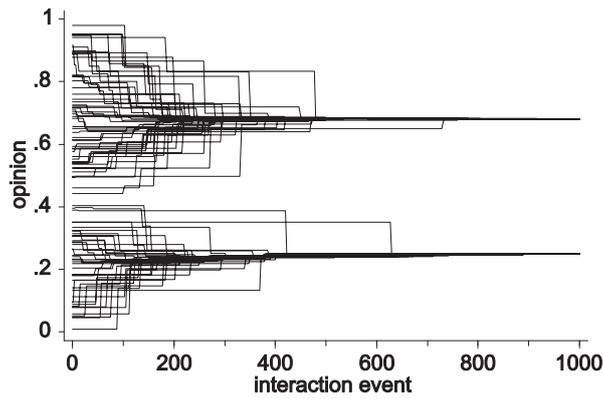
Figure 1. Classical social influence model

## Important Scientific Research and Open Questions

The pervasive drive toward uniformity is puzzling because it seems to contradict the high diversity of opinions and behavior that we observe empirically, even in small groups where the network is strongly connected. In these cases, social separation cannot explain the diversity of opinions, if influence operates as described in the classical model.

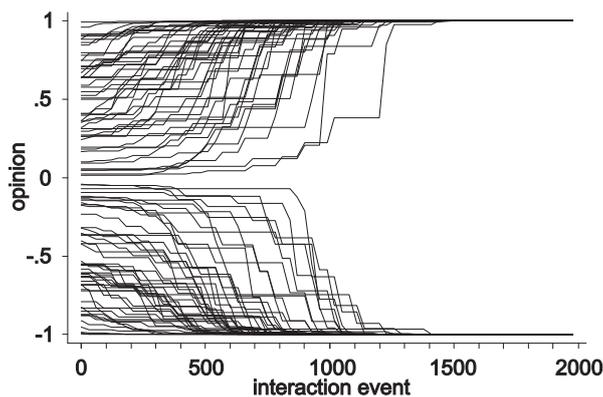
A common extension of the basic influence model is the assumption of homophily, represented by the adage “birds of a feather flock together.” This principle of social network formation – that individuals develop and maintain social ties to others who are sufficiently similar to themselves – is analogous to Hebbian Learning in neural networks. In tandem with the classical influence model, homophily implies a positive feedback loop: If relatively similar actors interact and influence each other, they become even more similar, which increases interaction and thus greater similarity. However, a second set of actors that is sufficiently dissimilar from the first set (but similar to each other) may converge toward their own norm, while ignoring or forgetting the first set. In this way, distinct clusters of similar actors can emerge and persist over time.

To illustrate how the interplay of selection and influence triggers cluster formation, Figure 2 shows a scenario with 100 individuals having random opinions at the outset. Individuals have social ties to (and are influenced by) others that are relatively similar but ignore others that are very different. In contrast to the classical social influence models (see Figure 1), distinct clusters form in these conditions. Dynamics settle when the clusters are internally homogeneous.



**Figure 2. Social influence model with homophily**

Thus, the interplay of homophily and social influence offers an explanation for the emergence and persistence of subgroups with distinct opinions or behaviors. However, this theory fails to explain polarization, the development of increasingly different subgroups. Trying to explain polarization, researchers have gone beyond the homophily assumption and assumed that actors actually differentiate themselves from others who are very different. Figure 3 illustrates the implications of such negative influence tendencies. In this model, individuals are positively influenced by similar others (“friends”) as before, but form negative ties to very dissimilar others (“enemies”), which convey negative influence. At the outset, opinions are uniformly distributed. Individuals with moderate opinions do not change their opinions much at the beginning of the influence process because they receive balancing forces of influence in both directions. However, individuals who hold relatively extreme opinions are driven to differentiate themselves from enemies at the opposite extreme. As more individuals adopt very extreme opinions, the influence of the extremists on the moderate individuals increases in strength. As a consequence, moderate individuals gradually turn more extreme. Opinion dynamics settle when all individuals hold an opinion on one of the two poles of the scale. Of course, uniformity remains an equilibrium under this model, but this tendency to differentiate from enemies creates a powerful force toward polarization that in most conditions will prevent convergence toward uniformity in heterogeneous groups.



**Figure 3. Social influence model with differentiation**

Formal models of social influence in networks are highly abstract, as they are based on strong simplifying assumptions about individual behavior. Some researchers are validating these models by bringing them into dialog with empirical data. For example, social psychologists have studied social influence through networks implemented in experimental laboratories, and have also explored the conditions under which pressures to uniformity will be realized in small groups. Field researchers study influence networks through e-mail

communication or contacts on social networking web sites, and have recently begun to use wearable sensors to monitor communication and influence through face-to-face conversations.

## Cross-References

- Agent Based Modeling
- Emergence of Norms Through Learning
- Learning (and Evolution) of Social Norms
- Modeling and Simulation

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