The Effect of Gossip on Social Networks

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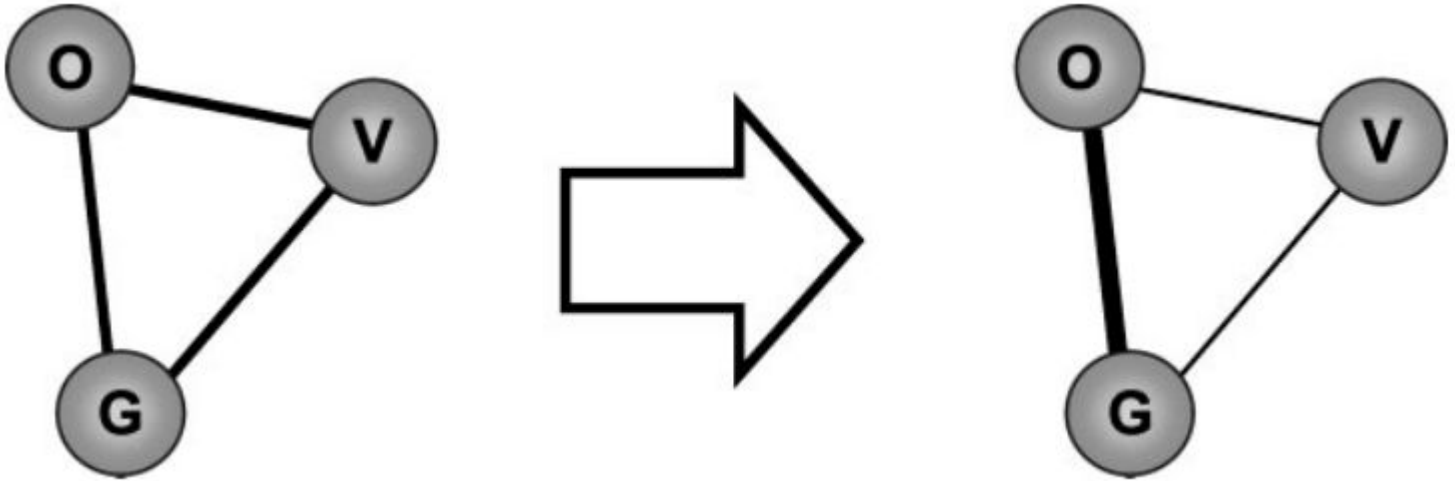
Background

- They developed a simple model for the effect of gossip spread on social network structure.
- Gossip is fundamental to human society and it usually has negative connotations.
- Rumours pertain to issues and events of public concern, gossip targets the behavior and private life of an individual.
- Gossip can be defined as information passed from one individual (originator) to another (gossiper) about an absent third individual (victim).

Assumption:

Gossip is negative and strengthens the relationship between gossipers while weakening the relationship between the victim and each gossiper.

Schematic of a triad before and after a gossip event



Analysis

For a fully connected node with m nodes (where m >= 3), there are:

→ **0.5 * m * (m -1)** links in the network

For a single gossip event;

→ **(m-1)** of these links will be weakened

→ **0.5 * (m-1) * (m-2)** will be strengthened

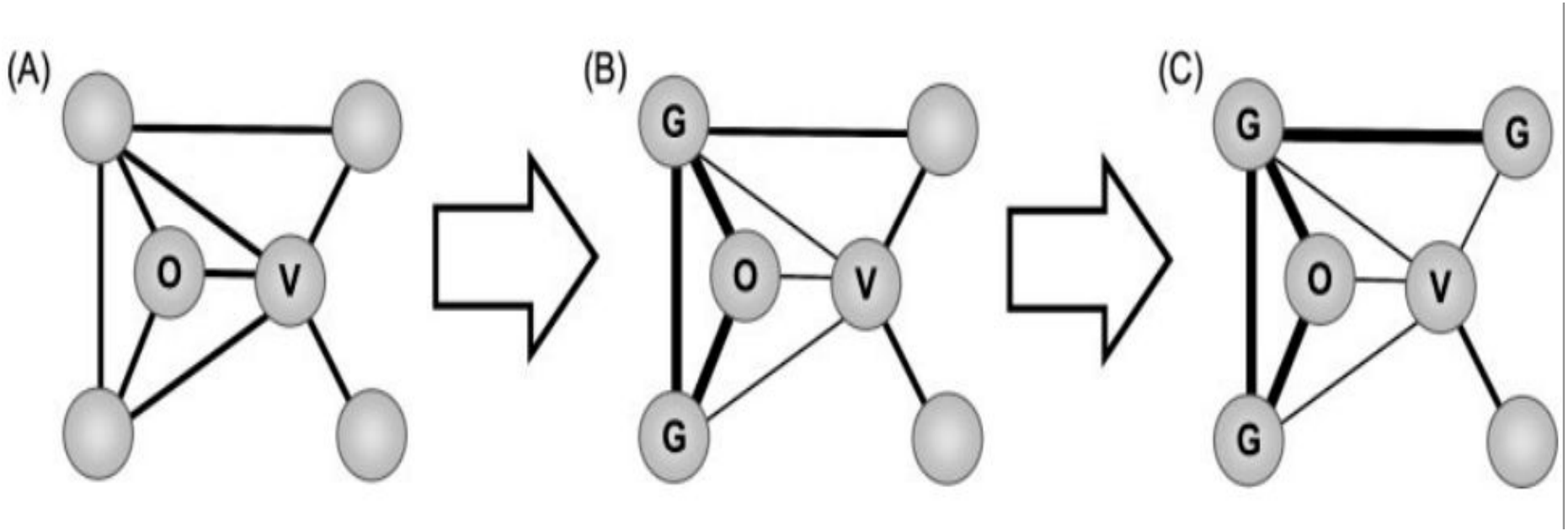
For n independent events, each link will weaken, on average (for very large n), 2n/m and strengthen n(1-2/m) times.

let $w_{n+1} \leftarrow w_n^{1/L}$ be the function to strengthen a link (defined as $0 < w < 1$)
$w_{n+1} \leftarrow w_n^{L}$ the function to weaken a link

on average, over several gossip events, the strength of each link in the network will go to

$$w^{(1/L)^{n(1-2/m)} * (L)^{2n/m}}$$

Schematic of how gossip spreads in a social network



Models

- They built a simple network model in Netlogo to simulate how the spread of gossip influences social network structure.

Algorithm 1 Basic Model

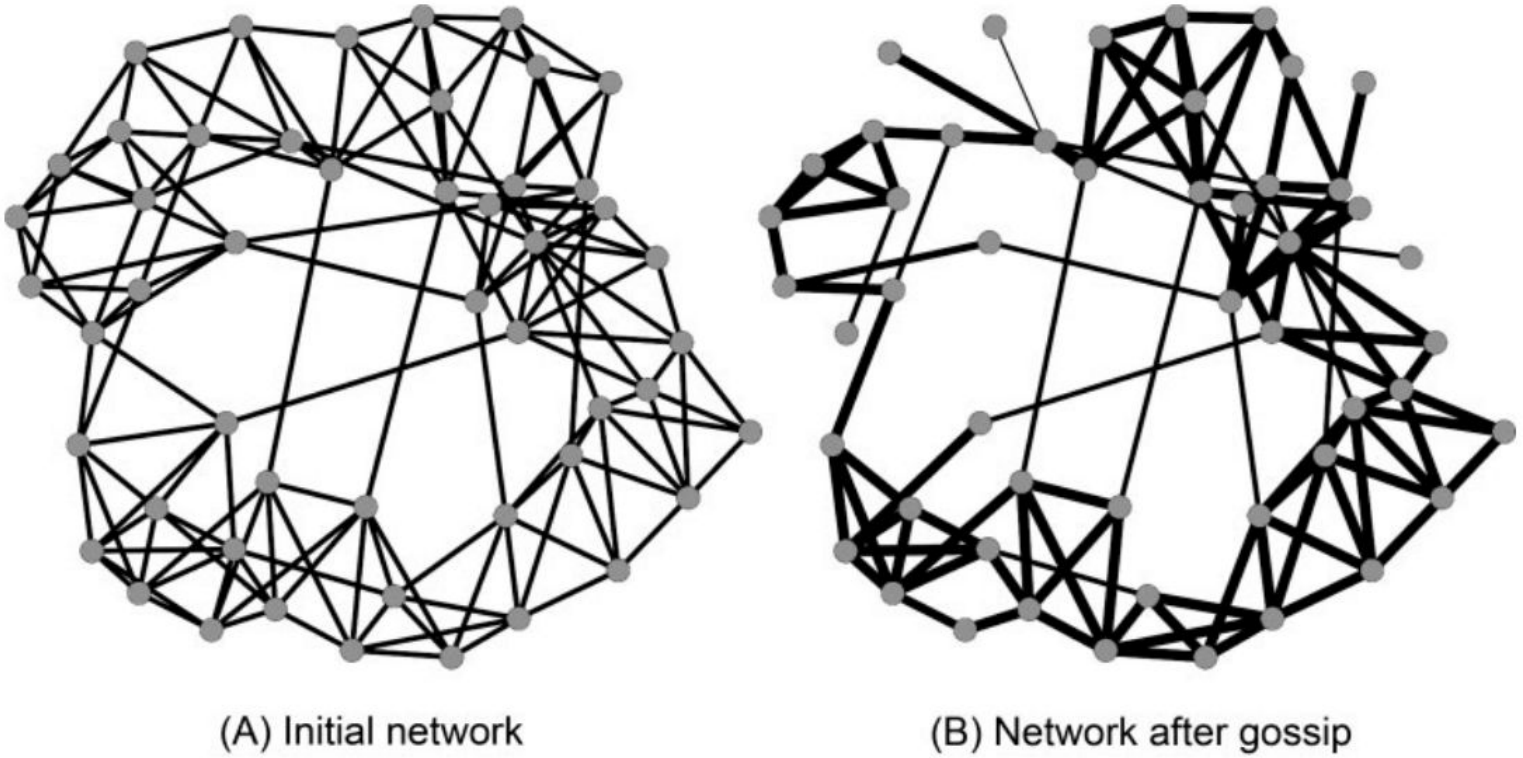
```
for each gossip event do
    set all individuals as non-gossipers
    choose victim: pick a random individual
    choose originator: pick a random neighbor of victim
    set originator as a gossiper
    while there exist mutual neighbors of the victim and a
    gossiper that are non-gossipers do
        set all mutual neighbors of the victim and each
        gossiper as gossipers
    end while
    decrease the links between the victim and each gossiper
    increase the links between all pairs of gossipers
end for
```

- They ran the simulation for 10,000 gossip events

Algorithm 2 Null Model

```
for each gossip event do
    set all individuals as non-gossipers
    choose victim: pick a random individual
    choose originator: pick a random neighbor of victim
    set originator as a gossiper
    choose one random mutual neighbor of the victim and
    gossiper, and set as gossiper
    decrease the links between the victim and each gossiper
    increase the link between the pair of gossipers
end for
```

Networks



View of a small-world network with 50 nodes, average-node-degree of 6 and rewiring probability of 0.1, (A) before and (B) after 10,000 gossip events. Thicker links show stronger relationships

Statistics

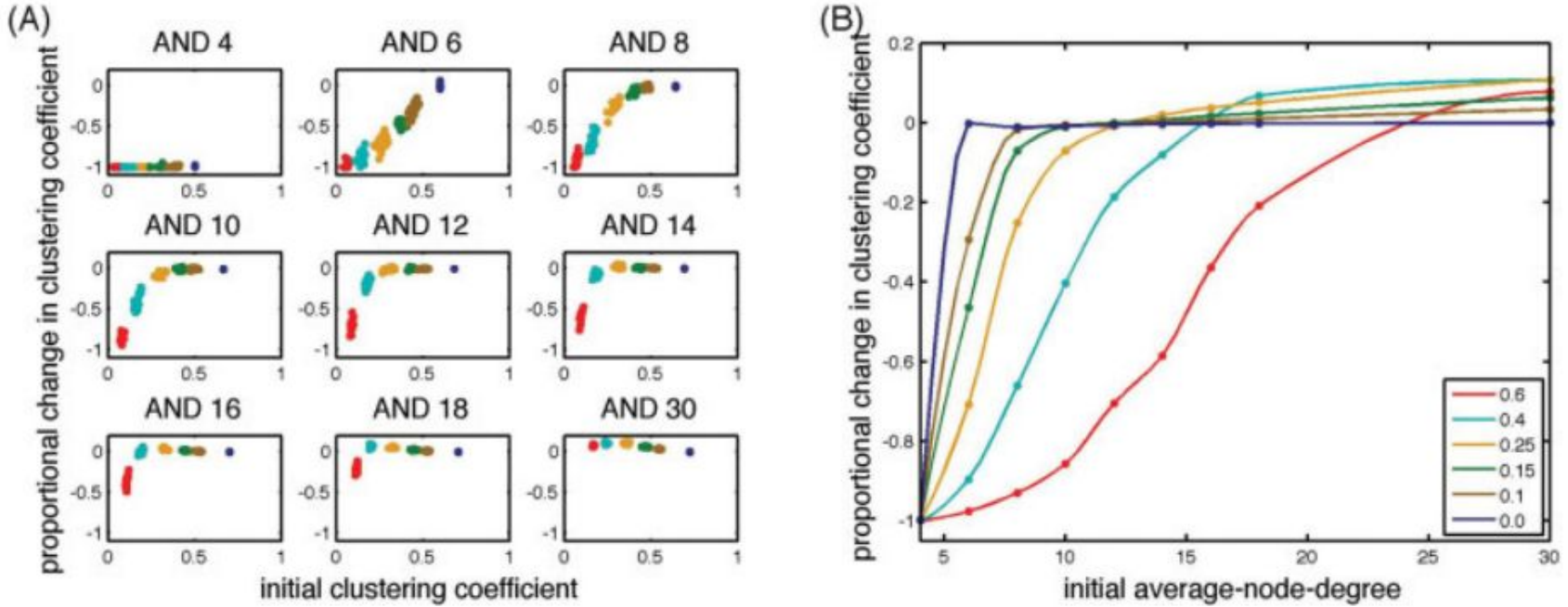
- They classified the effect of gossip on the networks using three characteristics:

→ **The average clustering coefficient** (used to measure the cliquishness of a typical neighborhood)

→ **Average path length** (the average separation between two nodes in a network)

→ **Sum of strength** (the sum of all link strength in the network)

Statistics



The effect of gossip on the clustering coefficient of a network: the proportional change in clustering coefficient (e.g., −1 means clustering coefficient decreased completely to zero) as a function of (A) initial clustering coefficient, where different panels correspond to different initial average-node-degree (AND) values, and (B) initial AND. Different colors correspond to different rewiring probabilities (0.0, 0.1, 0.15, 0.25, 0.4, 0.6) as shown in the legend in (B).

Findings

- Although gossip both weakens and strengthens links, weak links break but no new links are created.

- Although over the long run gossip destroys weakly triangulated links (i.e., “bridges”), it makes the links in dense clusters maximally strong

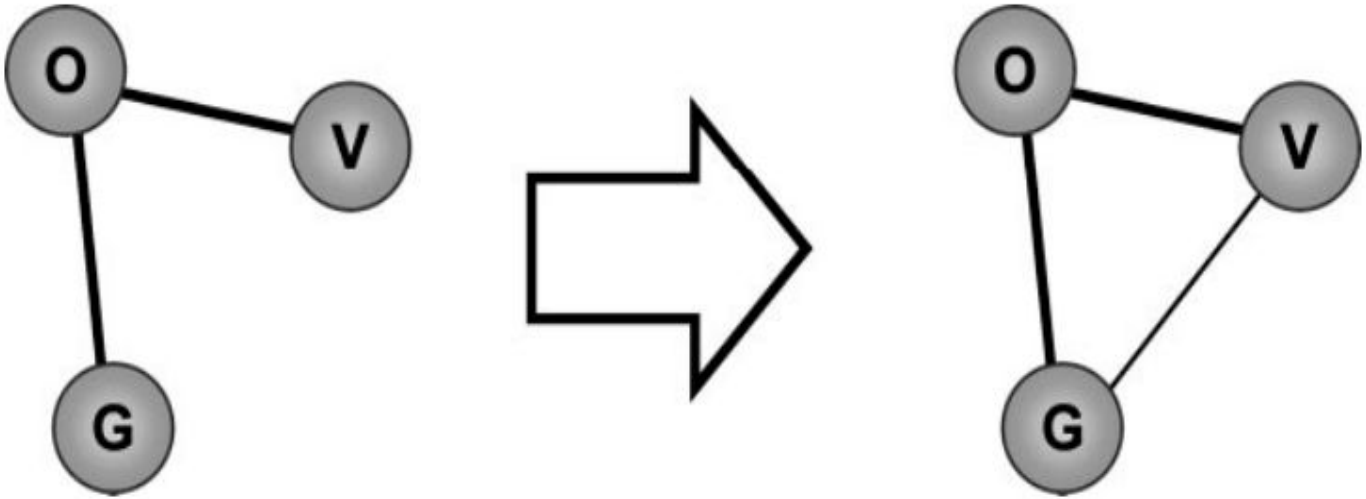
- The negative effect of gossip on clustering decreases with higher initial network average-node-degree

- Regarding average-path-length, gossip generally affected clustered networks strongly at low average-node-degree and weakly at high average-node-degree, but it affected more random-like networks weakly at low average-node-degree and strongly at high average-node-degree

Discussion and Future directions

- Gossip destroys clustering in weakly clustered networks and increases cliquishness in networks with already high clustering
- Negative gossip might help maintain relationships but only in groups that are already dense.
- They made many simplifying assumptions, several of which could be relaxed to make it more realistic.
- Gossip does not always have to be negative, and our model could be modified to allow positive gossip that is conductive to forming new relationships

Effect of positive gossip



Schematic for the effect of positive gossip (as opposed to negative gossip as depicted in Fig. 1). The originator (O) tells a gossiper (G) good things about a friend V who G does not know, resulting in G connecting to V.

THANKS
Q & A