Photo: V. Batagelj

Balance Theoretic Ideas

Patrick Doreian

University of Pittsburgh

Ljubljana, FDV Social Networks Class, 19 Novemeber, 2007

version: November 17, 2007 / 16 : 34

Outline

Structural Balance Theory

One variant of 'consistency' theories for idividuals that;

- Features signed relations
  - Like and dislike
  - Respect and disrespect
  - Admire and despize
- And assumes people prefer consistent belief systems as well as
- Prefering consistent relationships with others.
- As a result people are 'uncomfortable' with inconsistent belief systems and inconsistent systems of social relationships.

Four Common Sayings (Folk Proverbs)

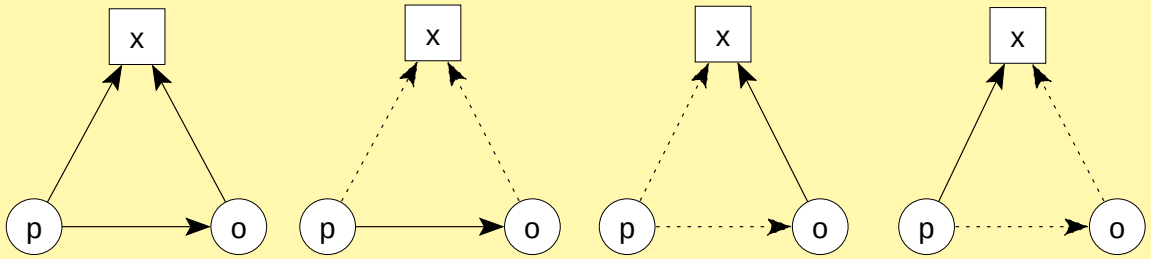
- The statements
  - A friend of a friend is a friend.
  - An enemy of an enemy is a friend.
  - A friend of an enemy is an enemy.
  - An enemy of a friend is an enemy.
- Questions we could have:
  - Are any of these true?
  - Are some of them true?
  - Under what conditions are they true?

Some Notation

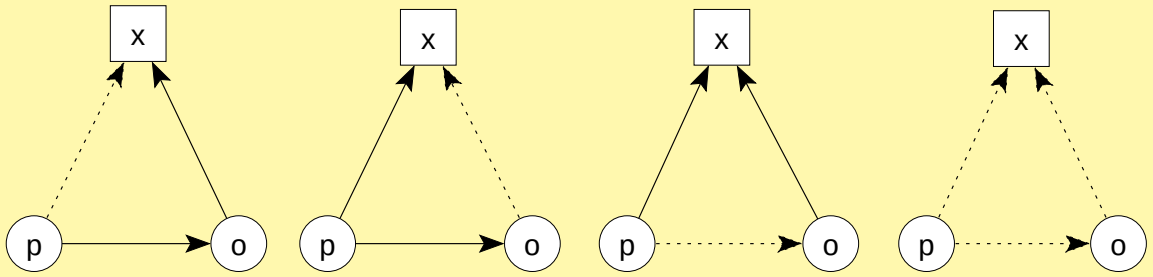
- Social entities
  - People, representad by p, o, q
  - Social Objects, represented by x
- Relations
  - Positive ties, represented by +1 and solid lines
  - Negative ties, represented by -1 and dashed lines
  - Ties between p, o and q are **social relations**
  - Ties between $\{p, o, q\}$ and x are **unit relations**

Two people and one social object: pox-triples

Four Balanced Triples

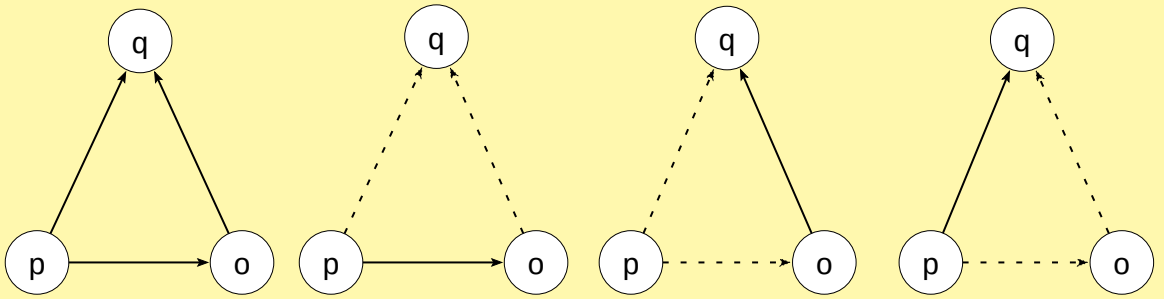


Four Imbalanced Triples

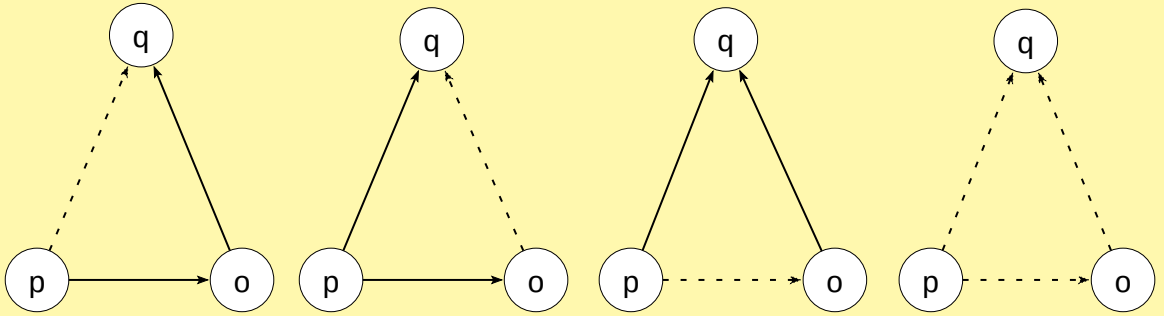


Three people: poq-triples

Four Balanced Triples



Four Imbalanced Triples



Assumptions about Humans

- There is a preference for ‘balance’ (consistency).
- States of imbalance create ‘tension’.
- People act (think, emote) so as to reduce this tension.
  - Works in dyads
  - Works in triples
- Works in a similar way for social relations and unit formation relations.

Balanced and Imbalanced Triples

- The sign of a triple is the product of the signs of the relations.
  - Positive
  - Negative
- Balance and imbalance
  - A triple is balanced if its sign is positive
  - A triple is imbalanced if its sign is negative

Heider's Key Ideas

- The 'mechanisms' are located in the minds of actors
- Efforts to reduce tension move imbalanced states towards balance
- Imbalanced states are unstable:
  - Imbalanced dyads move towards balance
  - Imbalanced triples move towards balance
- All dyads and triples tend to move towards balanced over time.

The Cartwright and Harary Generalization of Heider I

- Start by considering signed triples
- In effect, forget the distinction between social relations and unit formation relations.
- In practice, this meant forgetting about unit formation relations
- Units are only social actors $\{p, o, q\}$.
- Start thinking of *group structures* (beyond triples).
- Extend balance theoretic ideas to *networks of any size*.

The Cartwright and Harary Generalization of Heider II

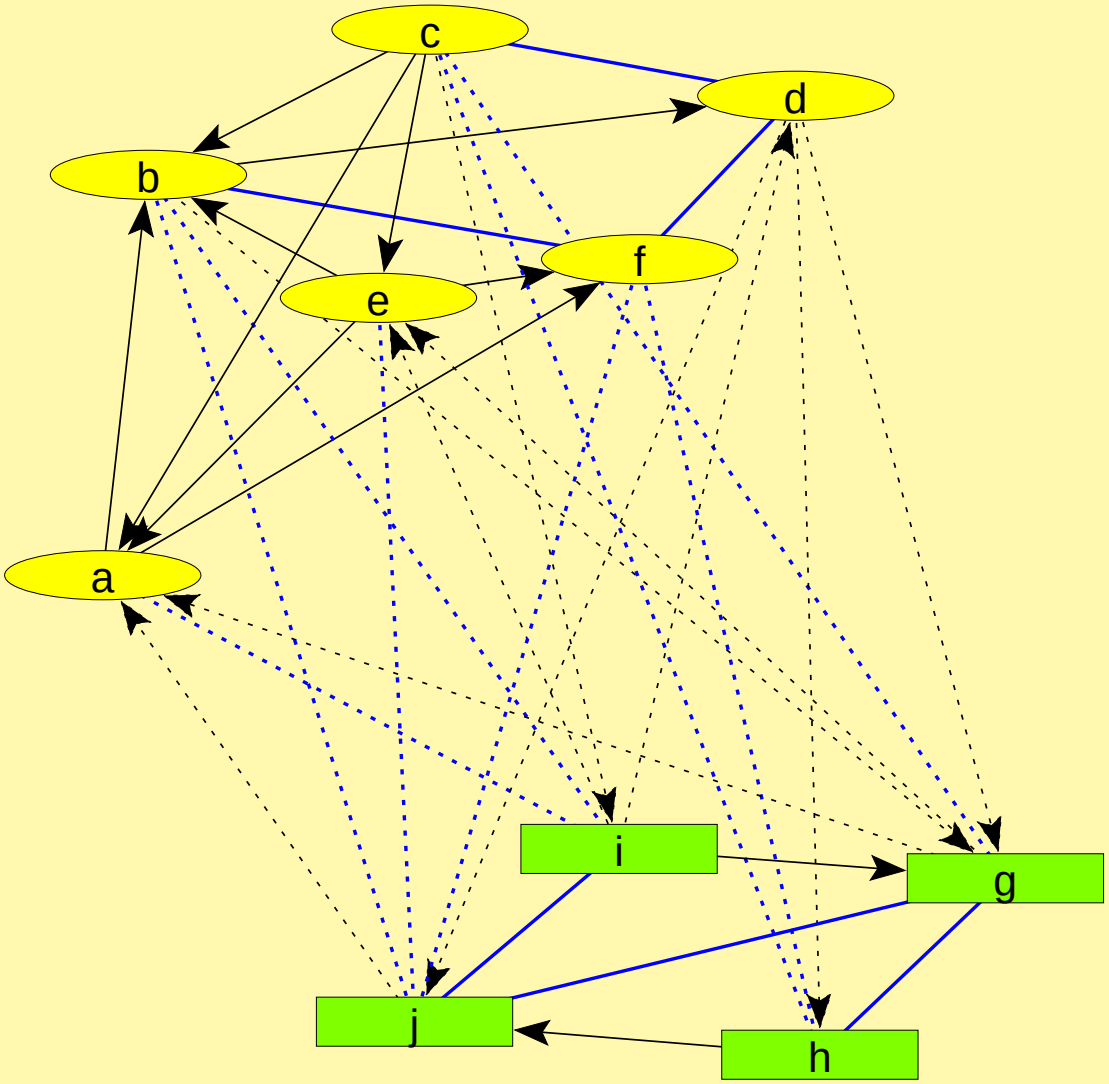
- We already have the idea of the sign of a triple.
- Extend this to longer sequences of relations, i.e. to walks
- The sign of a walk is the product of the signs of all the ties (arcs).
- A walk is positive if is sign is positive and negative if the the sign is negative.
- A network (graph) is balanced if all of its walks are positive.

The First Structure Theorem

This is due to Cartwright and Harary:

Theorem 1 *For a balanced signed network, the set of units, units (usually people) can be partitioned into two subsets (clusters) so that every positive arc joins units of the same subset and every negative arc joins units of different subsets.*

An Example of a Balanced Signed Network



The Davis Generalization of the First Structure Theorem

- Davis observed that human groups often break up into more the two mutually hostile subgroups.
- He suggested that we treat the all negative triple as balanced.
- This leads to the **Second Structure Theorem** where:
- A network is balanced if it there are no walks with exactly one negative arc.

Theorem 2 *For a balanced signed network (in the sense of Davis), the set of units (usually people) can be partitioned into* **two or more** *subsets (clusters) so that every positive arc joins units of the same subset and every negative arc joins units of different subsets.*

Some Implications of the Structure Theorems

- If correct, it suggests a remarkable 'macro-micro link' between actor level processes and group structure.
- If this is true, then how do we find the partition structure of balanced networks?
- A better question, given that most signed networks are not exactly balanced, how do we find partition structures of empirical groups when they are not perfectly balanced?
- Actually we can do this with the approach of Doreian and Mrvar (1996) and this leads us into 'generalized blockmodeling' (which comes later in the course).
- Heider's theory is genuinely dynamic because is predicts changes over time. It follows that over time data are needed to test his theoretical ideas.

- If a group is imbalanced, then it will be handy to measure the amount of imbalance and we can do this. (In fact it is essential the the blockmodeling methods.)
- The theory is quite simple - even simplistic - so we need to think about whether it works, how it works, and when it works. This is a theoretical effort that can lead to a more realistic version of structural balance. Put a little differently: what are the mechanisms driving group changes when structural balance is involved?
- Can we model structural balance mechanisms as well as other mechanisms for change?