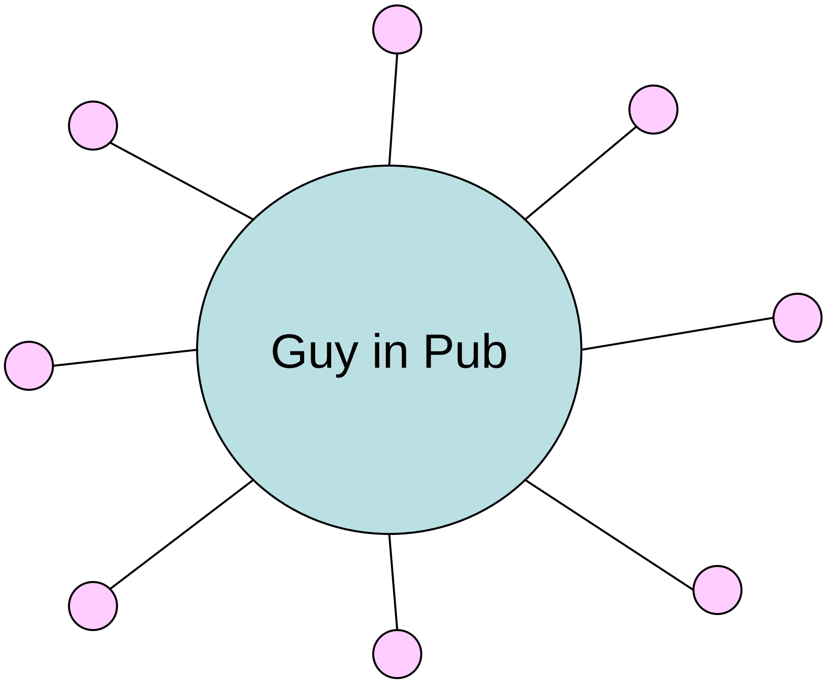
Brokerage

Steve Borgatti

Structural Holes

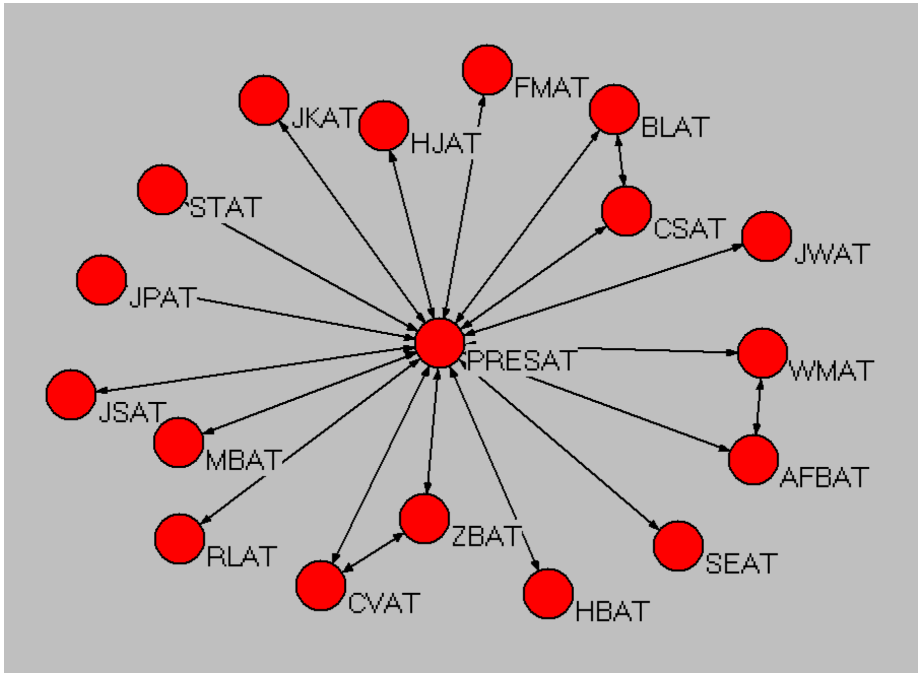
- Basic idea: Lack of ties among alters may benefit ego
- Benefits
  - Autonomy
  - Control
  - Information

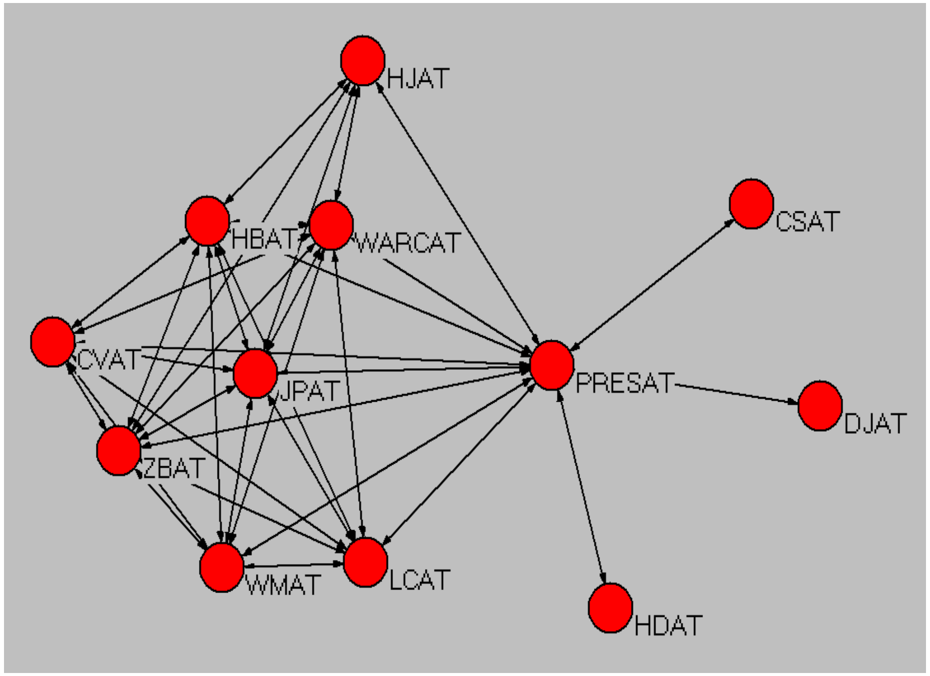
Autonomy



Control Benefits of Structural Holes

White House Diary Data, Carter Presidency



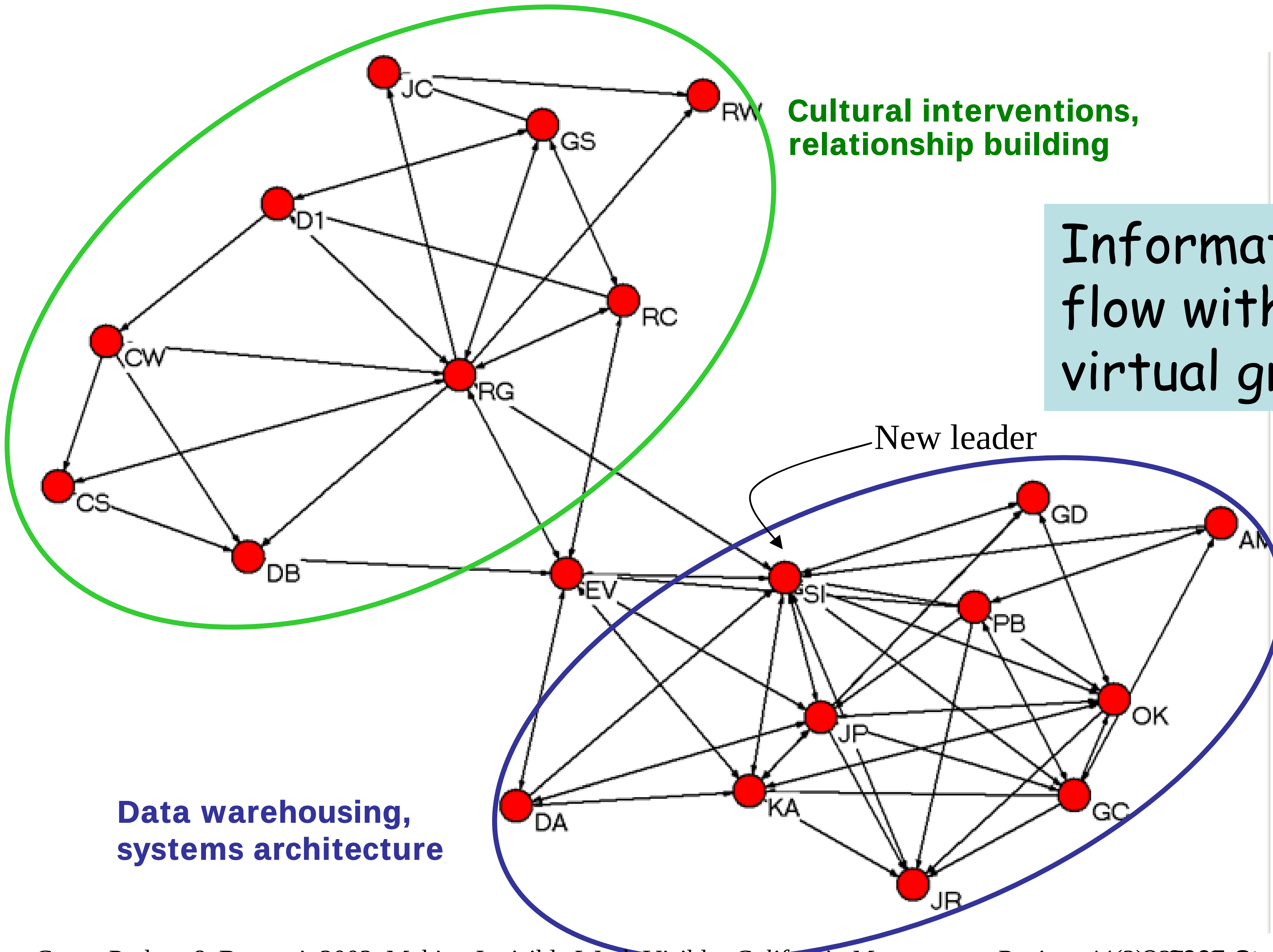


Year 1

Data courtesy of Michael Link

Year 4

Information & Success



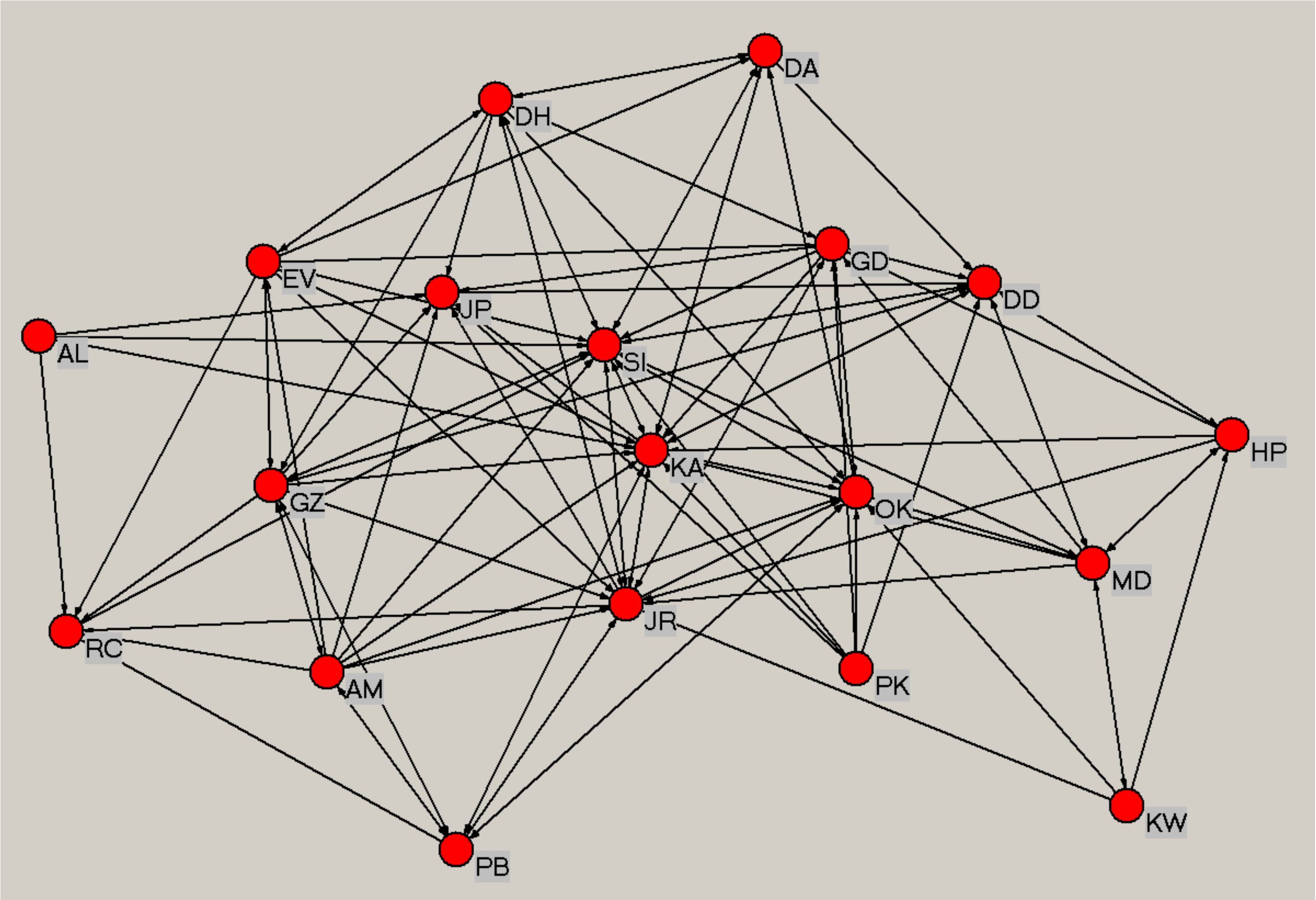
Information flow within virtual group

Cross, Parker, & Borgatti, 2002. Making Invisible Work Visible. *California Management Review*. 44(2): 25-46

Changes Made

- Cross-staffed new internal projects
  – white papers, database development
- Established cross-selling sales goals
  – managers accountable for selling projects with both kinds of expertise
- New communication vehicles
  – project tracking db; weekly email update
- Personnel changes

9 Months Later



Cross, Parker, & Borgatti, 2002. Making Invisible Work Visible. *California Management Review*. 44(2): 25-46

Burt’s Measures of Structural Holes

- Effective Size
- Constraint

Effective Size

m_{jq} = j's interaction with q divided by j's strongest relationship with anyone
p_{iq} = proportion of i's energy invested in relationship with q

$$ES_i = \sum_j \left[1 - \sum_q p_{iq} m_{jq} \right], \quad q \neq i, j$$
$$ES_i = \sum_j 1 - \sum_j \sum_q p_{iq} m_{jq}, \quad q \neq i, j$$

- Effective size is network size (N) minus redundancy in network

Effective Size in 1/0 Data

- M_{jq} = i's interaction with q divided by j's strongest tie with anyone
  - So this is always 1 if j has tie to q and 0 otherwise
- P_{iq} = proportion of i's energy invested in relationship with q
  - So this is a constant 1/N where N is ego's network size

$$ES_i = \sum_j \left[1 - \sum_q p_{iq} m_{jq}\right], \quad q \neq i, j$$

$$ES_i = \sum_j \left[1 - \frac{1}{n} \sum_q m_{jq}\right], \quad q \neq i, j$$

$$ES_i = \sum_j 1 - \sum_j \frac{1}{n} \sum_q m_{jq}, \quad q \neq i, j$$

$$ES_i = n - \frac{1}{n} \sum_j \sum_q m_{jq}, \quad q \neq i, j$$

Average degree

Constraint

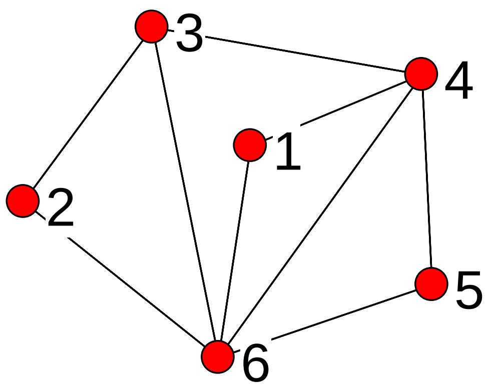
M_{jq} = i's interaction with q divided by j's strongest relationship with anyone
So this is always 1 if j has tie to q and 0 otherwise

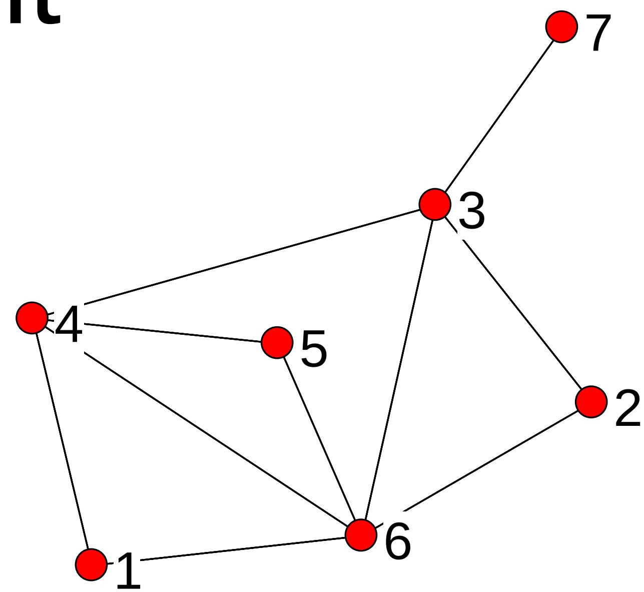
P_{iq} = proportion of i's energy invested in relationship with q
So this is a constant 1/N where N is network size

$$c_{ij} = p_{ij} - \sum_{q} p_{iq} m_{qj}, \quad q \neq i, j$$

- Alter j constrains i to the extent that
  - i has invested in j
  - i has invested in people (q) who have invested heavily in j. That is, i's investment in q leads back to j.
- Even if i withdraws from j, everyone else in i's network is still invested in j

Constraint



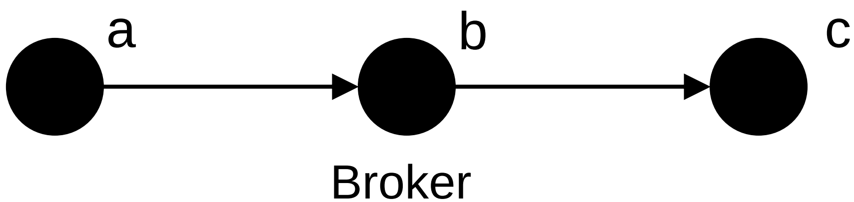


- On left, node 2 is more constrained than 1 and 5
- On right, node 2 is less constrained than 1 and 5

Approaches to Social Capital

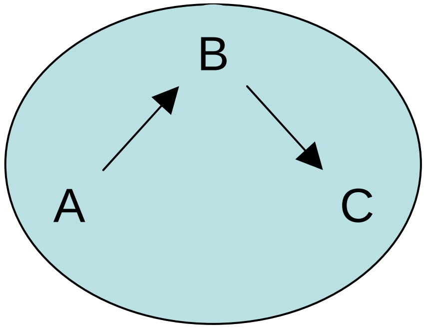
- Topological (shape-based)
  - Burt
  - Coleman
- Connectionist (attribute-based)
  - Lin

Brokerage Roles

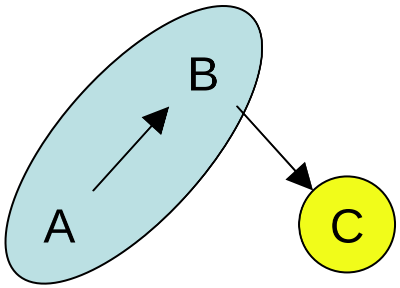


- Gould & Fernandez
- Broker is middle node of directed triad
- What if nodes belong to different organizations?

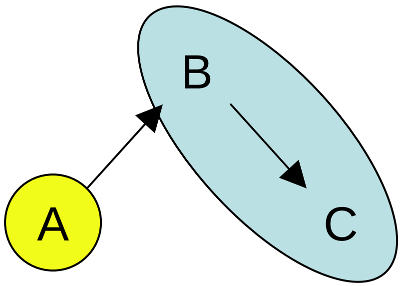
Brokerage Roles



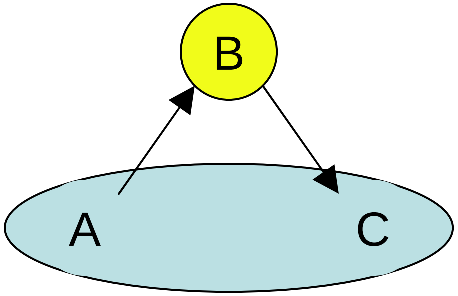
Coordinator



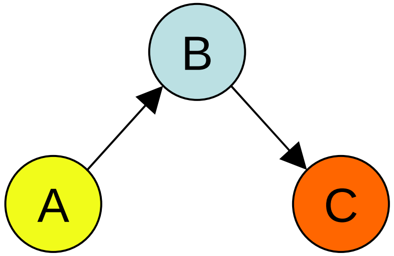
Representative



Gatekeeper



Consultant



Liaison

- We can count how often a node enacts each kind of brokerage role

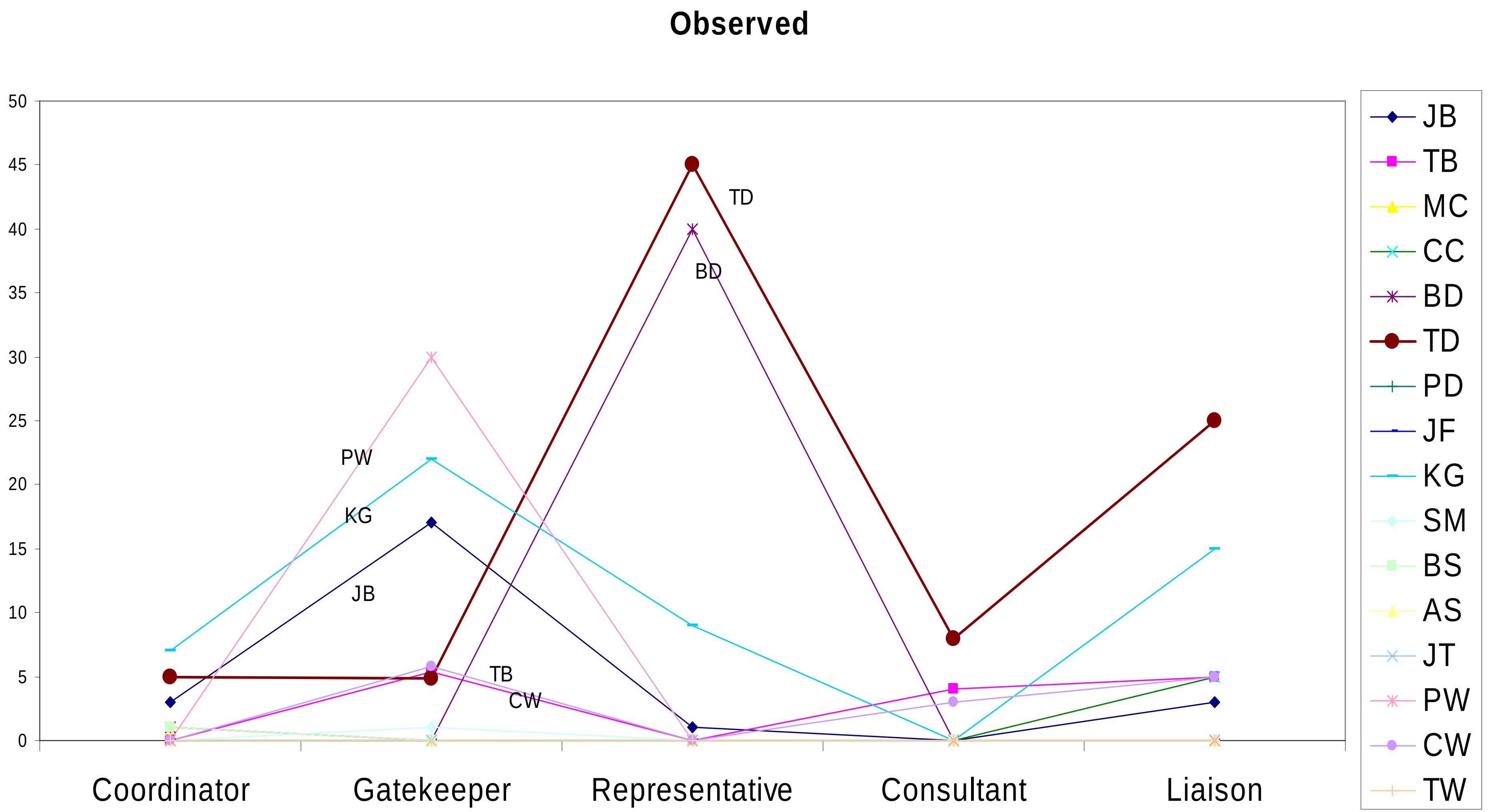
Counting of Role Structures

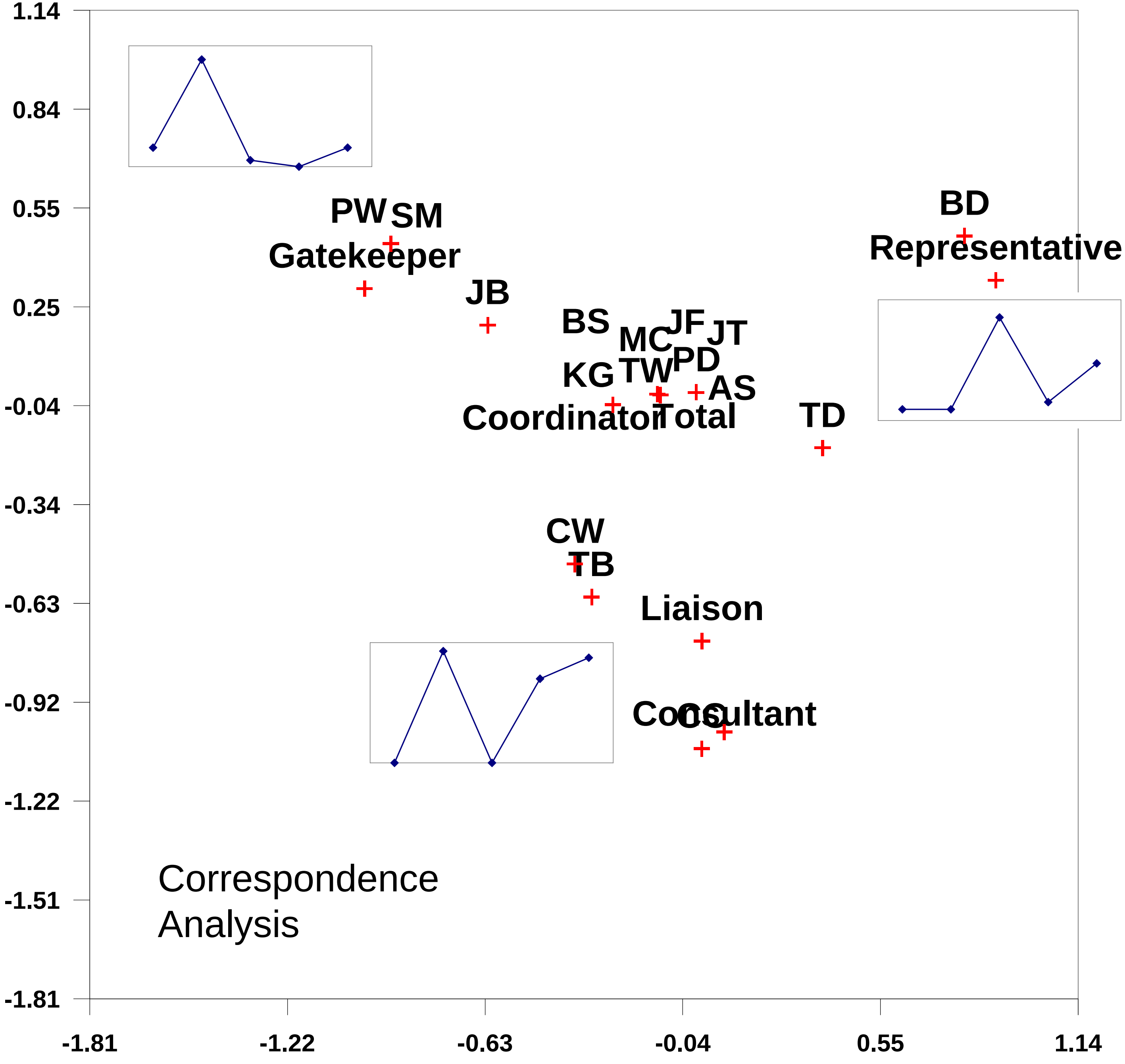
	Coordinator	Gatekeeper	Representative	Consultant	Liaison	Total
HOLLY	0	6	6	2	0	14
BRAZEY	0	0	0	0	0	0
CAROL	2	0	0	0	0	2
PAM	6	4	4	0	0	14
PAT	4	3	3	0	0	10
JENNIE	4	0	0	0	0	4
PAULINE	6	4	4	0	0	14
ANN	2	0	0	0	0	2
MICHAEL	2	4	4	0	0	10
BILL	0	0	0	0	0	0
LEE	0	0	0	0	0	0
DON	2	0	0	0	0	2
JOHN	0	2	2	0	0	4
HARRY	2	0	0	0	0	2
GERY	2	3	3	0	0	8
STEVE	10	0	0	0	0	10
BERT	4	0	0	0	0	4
RUSS	6	0	0	0	0	6

Another Example

	Coord	Gate	Rep	Cons	Liais	Total
JB	3	17	1	0	3	24
TB	0	5	0	4	5	14
MC	1	0	0	0	0	1
CC	0	0	0	0	5	5
BD	1	0	40	0	0	41
TD	5	5	45	8	25	88
PD	0	0	0	0	0	0
JF	0	0	0	0	0	0
KG	7	22	9	0	15	53
SM	0	1	0	0	0	1
BS	1	0	0	0	0	1
AS	0	0	0	0	0	0
JT	0	0	0	0	0	0
PW	0	30	0	0	0	30
CW	0	6	0	3	5	14
TW	0	0	0	0	0	0
Total	18	86	95	15	58	272

Role Profiles




1.14
0.84
0.55
0.25
-0.04
-0.34
-0.63
-0.92
-1.22
-1.51
-1.81
-1.81
-1.22
-0.63
-0.04
0.55
1.14
PW
SM
Gatekeeper
JB
BS
MC
JF
JT
KG
TW
PD
AS
Coordinator
Total
TD
BD
Representative
CW
TB
Liaison
Consultant
CS
Correspondence Analysis

E-I Index

- Krackhardt and Stern

$$\frac{E - I}{E + I}$$

- E is number of ties between groups, I is number of ties within groups
- Varies between -1 (homophily) and +1 (heterophily)

E-I Index

	Internal	External	Total	E-I
HOLLY	3	2	5	-0.20
BRAZEY	3	0	3	-1.00
CAROL	3	0	3	-1.00
PAM	4	1	5	-0.60
PAT	3	1	4	-0.50
JENNIE	3	0	3	-1.00
PAULINE	4	1	5	-0.60
ANN	3	0	3	-1.00
MICHAEL	4	1	5	-0.60
BILL	3	0	3	-1.00
LEE	3	0	3	-1.00
DON	4	0	4	-1.00
JOHN	2	1	3	-0.33
HARRY	4	0	4	-1.00
GERY	3	1	4	-0.50
STEVE	5	0	5	-1.00
BERT	4	0	4	-1.00
RUSS	4	0	4	-1.00

Density Tables

- Number of ties from one group to another, as a proportion of the number possible

	Division 1	Division 2	Division 3	Division 4	Division 5	Division 6	Division 7	Division 8
Division 1		5%	11%	2%	6%	7%	1%	10%
Division 2	5%		18%	11%	7%	2%	3%	2%
Division 3	11%	18%		21%	12%	13%	16%	9%
Division 4	2%	11%	21%		6%	7%	6%	6%
Division 5	6%	7%	12%	6%		2%	8%	3%
Division 6	7%	2%	13%	7%	2%		2%	10%
Division 7	1%	3%	16%	6%	8%	2%		0%
Division 8	10%	2%	9%	6%	3%	10%	0%	
Avg.	6.0%	6.8%	14.3%	8.4%	6.3%	6.1%	5.1%	5.7%