Jesse Lecy

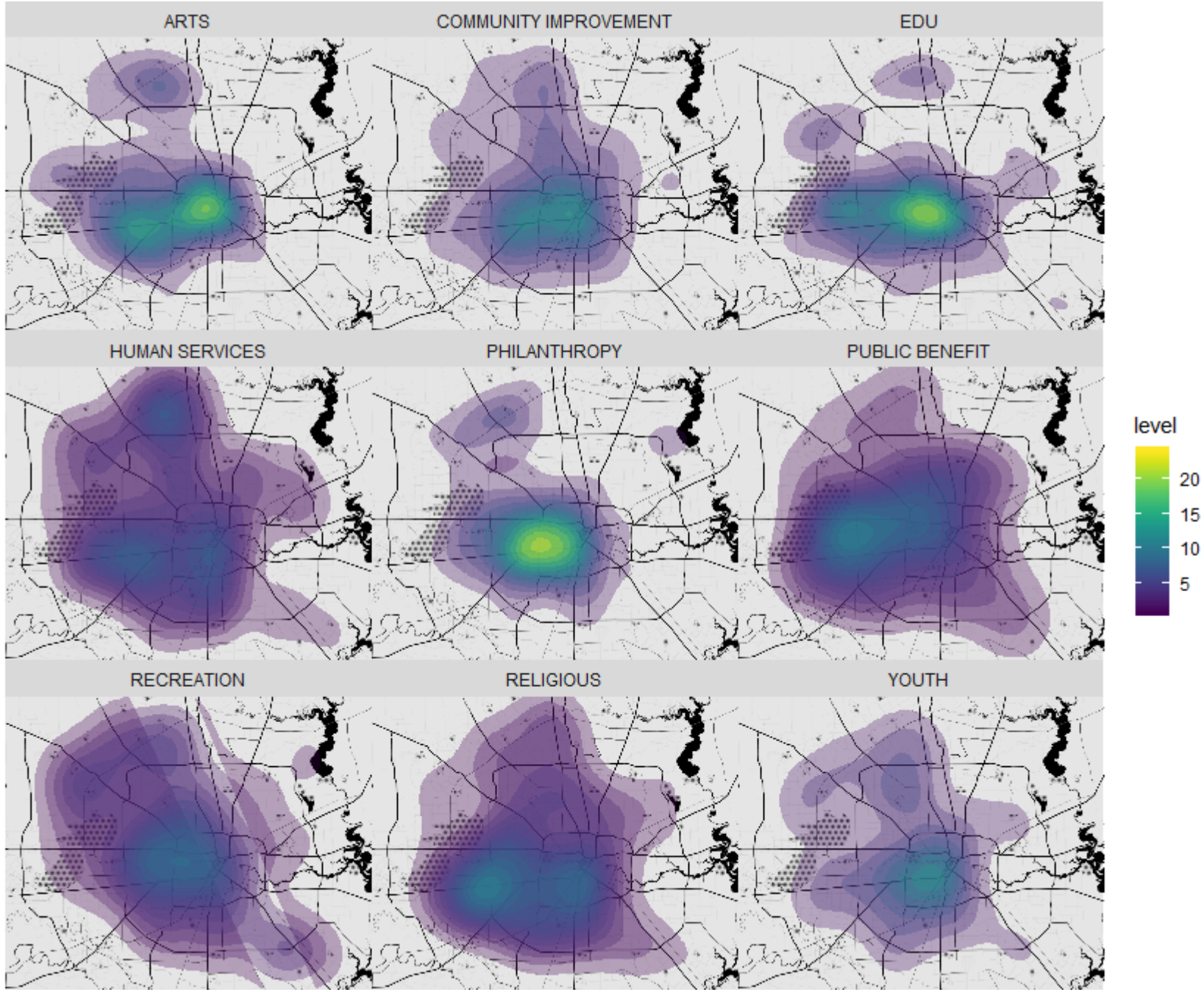
Arizona State University

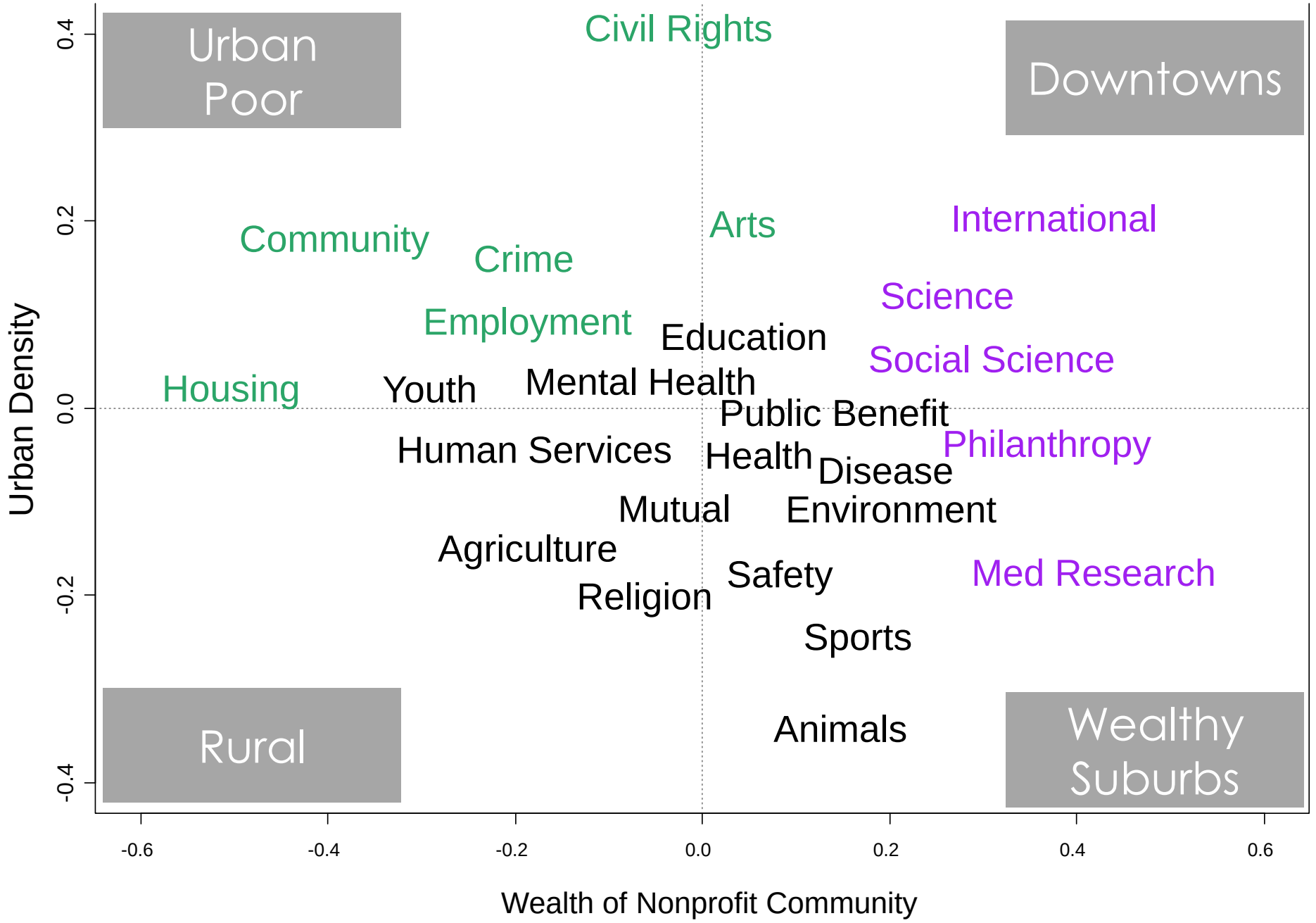
INFERENTIAL STATISTICS WITH SEMANTIC NETWORKS

ASU Virtual Symposium

February 18th, 2021

THE GEOGRAPHY OF NONPROFIT SERVICES


ARTS
COMMUNITY IMPROVEMENT
EDU
HUMAN SERVICES
PHILANTHROPY
PUBLIC BENEFIT
RECREATION
RELIGIOUS
YOUTH
level
20
15
10
5


Urban Poor
Civil Rights
Downtowns
Community
Crime
Arts
International
Science
Employment
Education
Social Science
Housing
Youth
Mental Health
Public Benefit
Philanthropy
Human Services
Health
Disease
Mutual
Environment
Agriculture
Safety
Med Research
Religion
Sports
Animals
Rural
Wealthy Suburbs
Urban Density
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
Wealth of Nonprofit Community

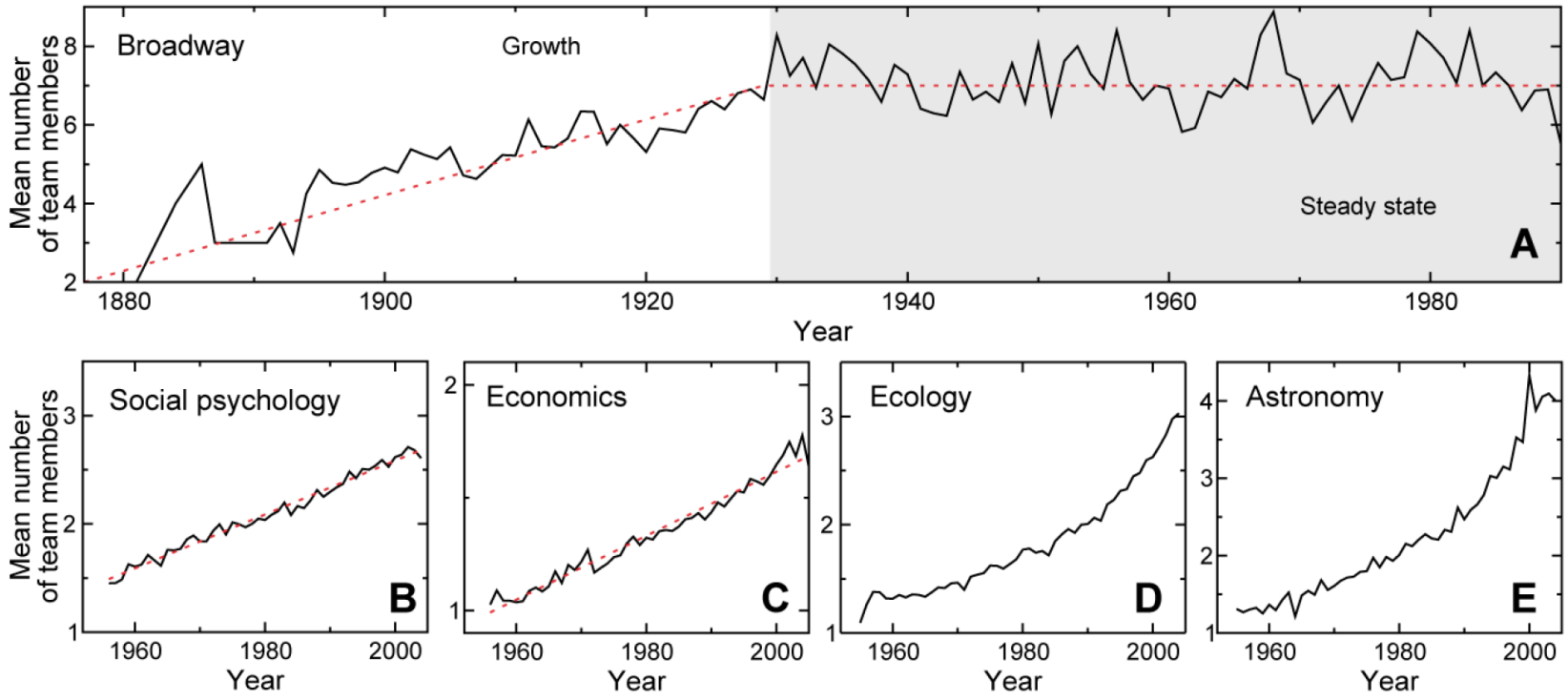
MOTIVATING THE TOPIC: HOW DO BOARDS SHAPE THE MIX OF SERVICES?

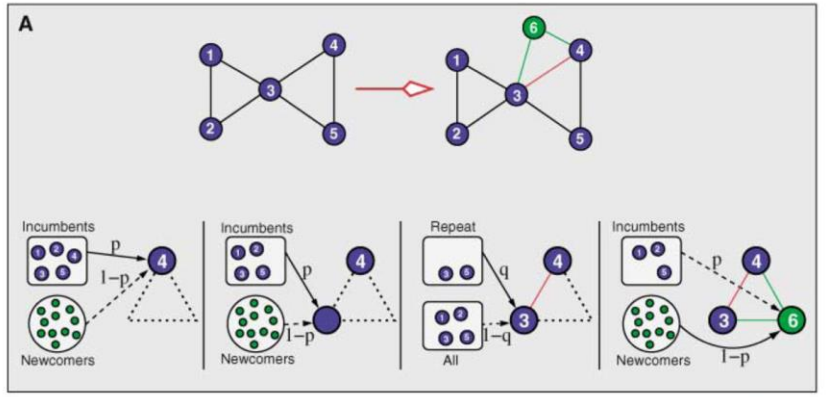
TEAM ASSEMBLY MECHANISMS

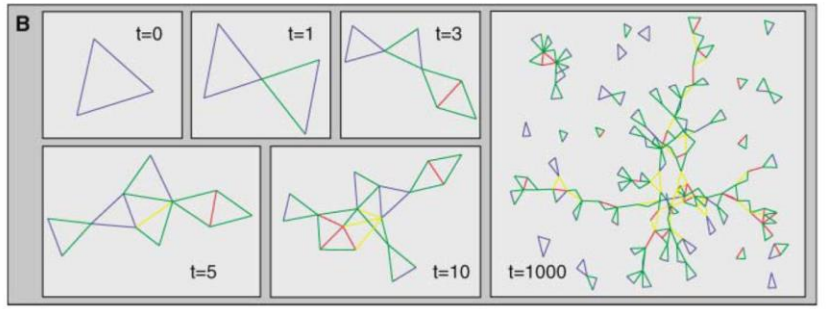
Guimera, R., Uzzi, B., Spiro, J., & Amaral, L. A. N. (2005).

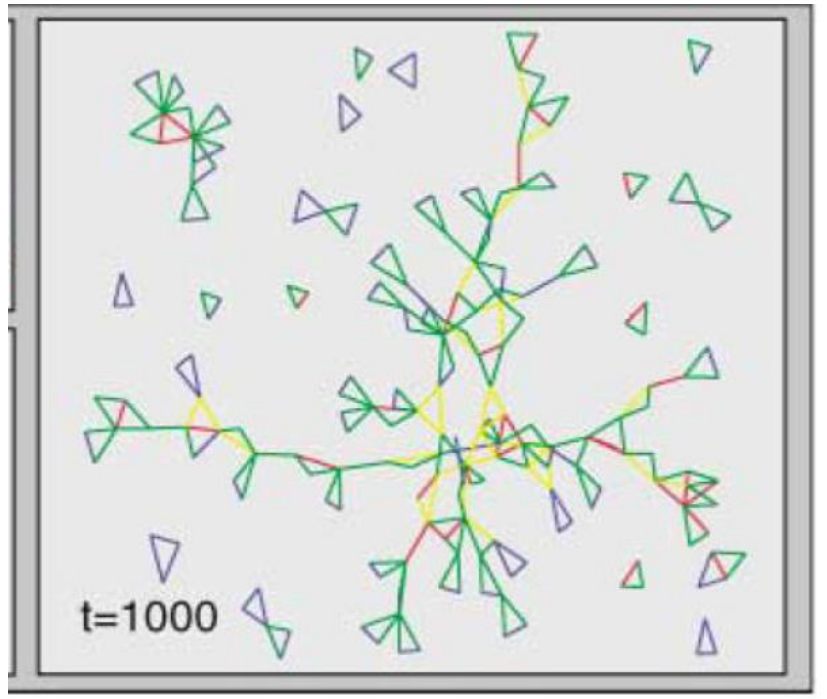
Team assembly mechanisms determine collaboration network structure and team performance.

Science, *308* (5722), 697-702.









Financial Success

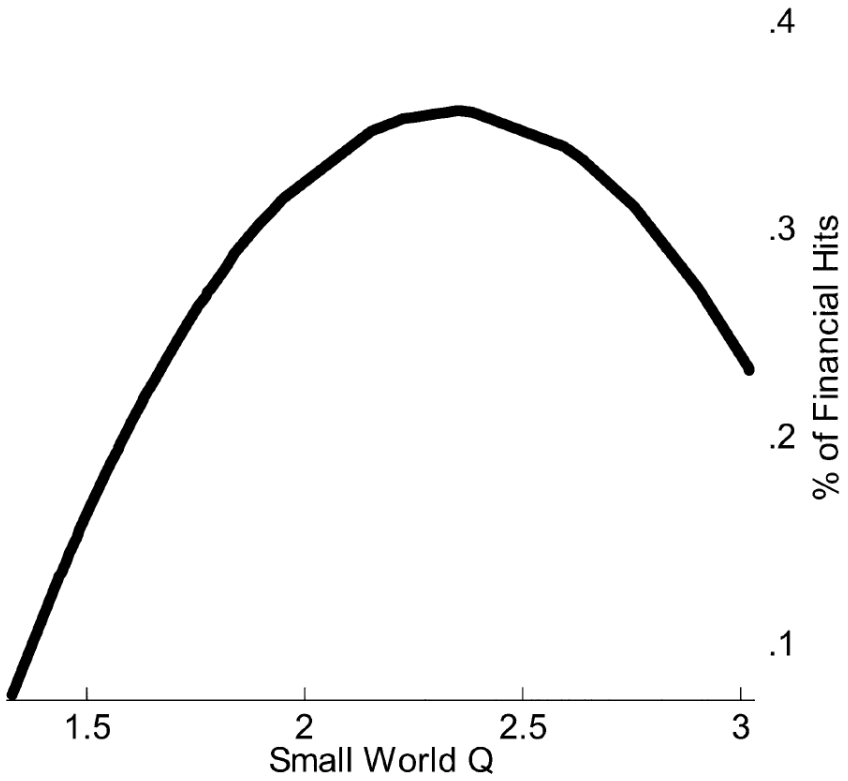


FIG. 6.—Financial success of a season

Artistic Success

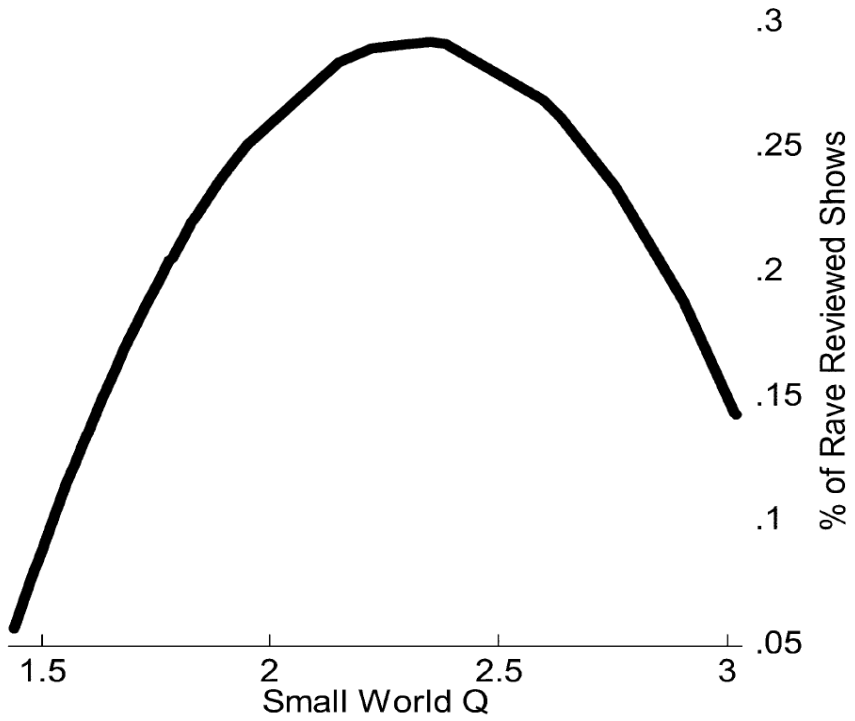
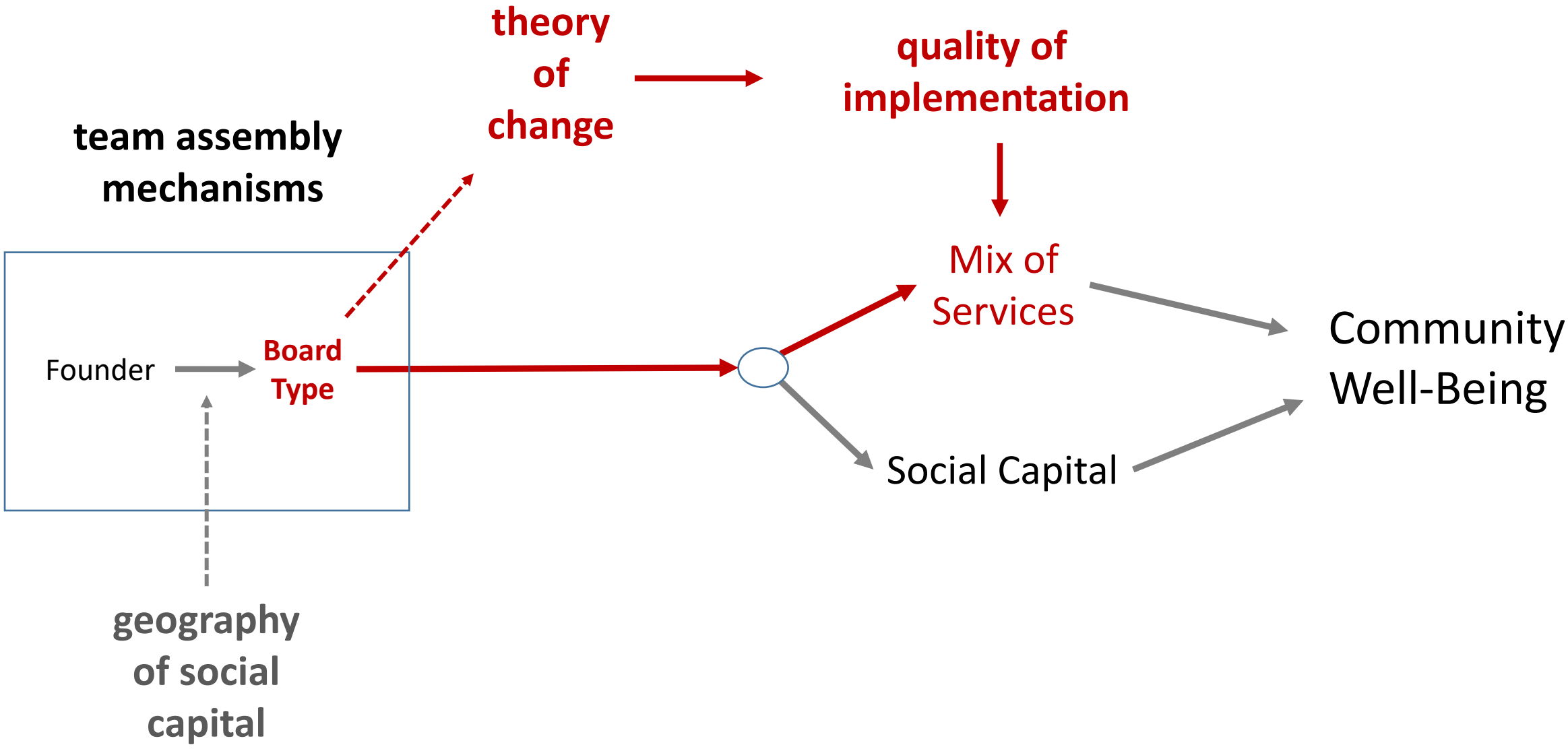


FIG. 7.—Artistic success of a season


theory of change
quality of implementation
team assembly mechanisms
Mix of Services
Founder
Board Type
Community Well-Being
Social Capital
geography of social capital

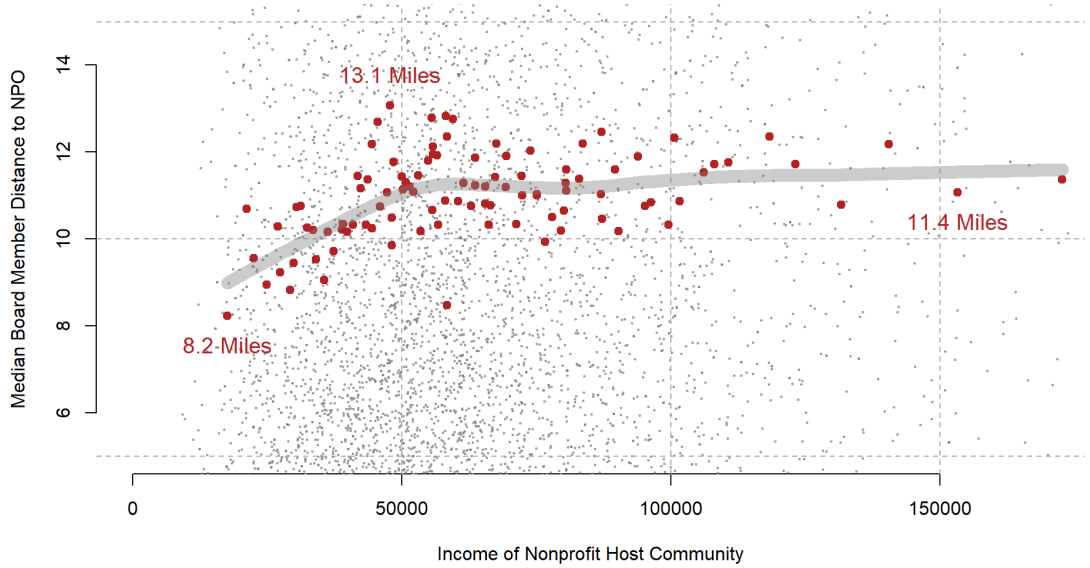
wealth of founder
(income is highly correlated in social and professional networks)

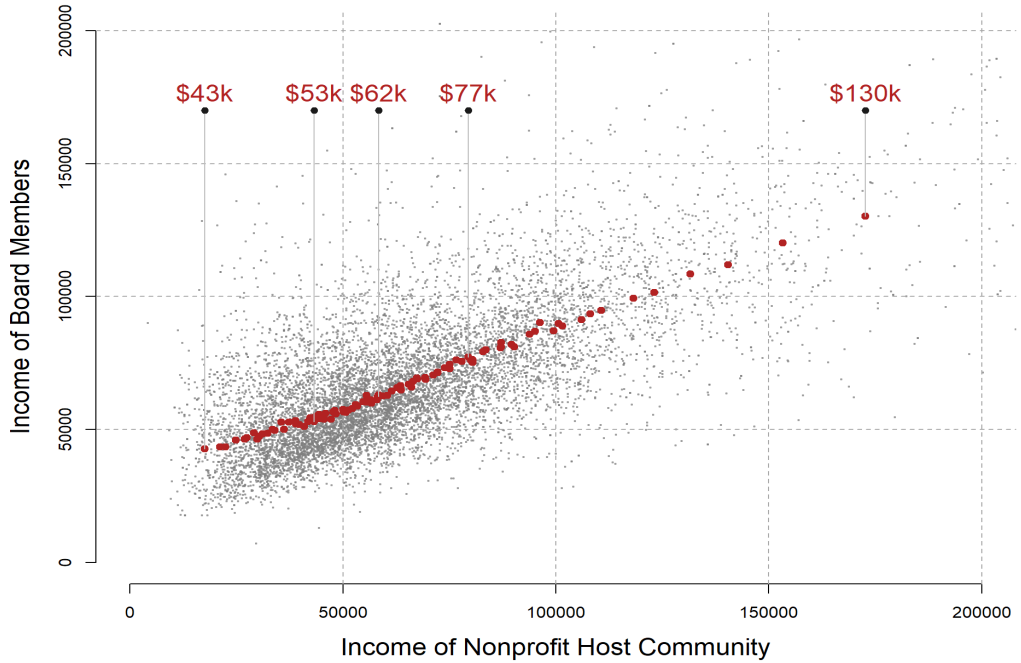
NPO traits
- Founder
- Community
- Mission

→ Board Type

social capital
bridging/bonding

geography
proximity of potential members





Board Influence on Mission:

HOLD CONSTANT
nonprofit subsector and community income status

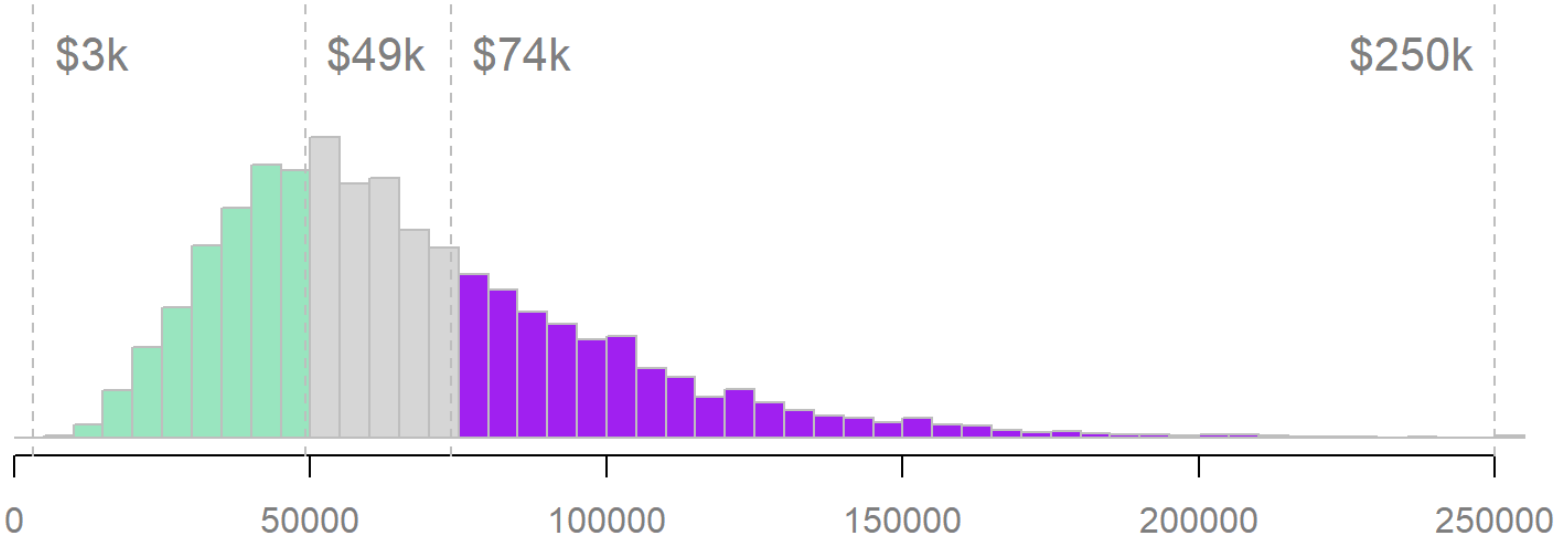
VARY the board traits of the nonprofit

LOW AVERAGE BOARD INCOME

HIGH AVERAGE BOARD INCOME

tracts ⟷ tracts

ARTS nonprofits located in low-income communities



Mission sample size by subsector

BM INC:	HIGH	LOW
A	**552**	**721**
B	732	1012
C	96	116
D	253	315
E	147	198
F	172	185
G	58	86
H	25	32
I	68	99
J	48	69
K	101	151
L	76	130
M	93	110

BM INC:	HIGH	LOW
N	600	668
O	400	498
P	819	1128
Q	59	53
R	76	84
S	260	397
T	210	271
U	38	28
V	8	14
W	204	260
X	369	449
Y	31	31
Z	61	87

Unit of Analysis: Nonprofit Mission Statements

The corporation's specific purpose is to supports affordable housing, community development and economic development of the city and county of San Francisco's economically disadvantaged individuals and communities, by lending to, investing in, and directly acquiring such affordable housing and related community development real estate assets.

Text as Data

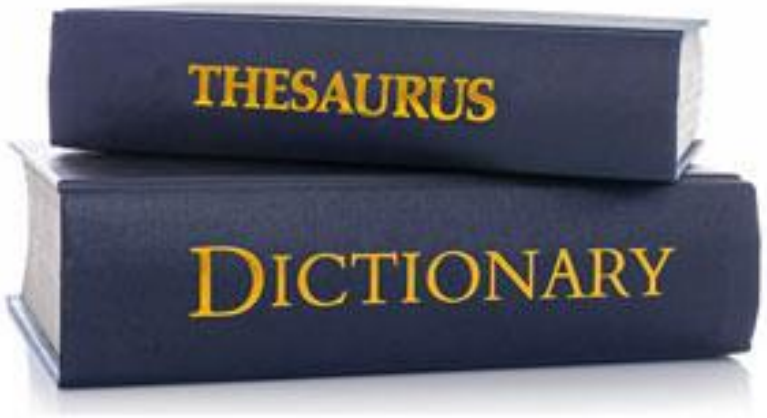
1. pre-processing
2. tokenization
3. feature selection
4. modeling

~~the~~ corporation specific purpose ~~is to~~ support AFFORDABLE_HOUSING, community development ~~and~~ ECONOMIC_DEVELOPMENT ~~of the~~ city and county of SAN_FRANCISCO economically disadvantaged individuals and communities by lending ~~to~~ investing ~~in and~~ directly acquiring ~~such~~ AFFORDABLE_HOUSING ~~and~~ related community development REAL_ESTATE assets

1. Remove punctuation
2. Delete words with little information value
3. Identify compound constructs

STEMMING

LEND	RELATE
LEND~~ing~~	RELATE~~d~~



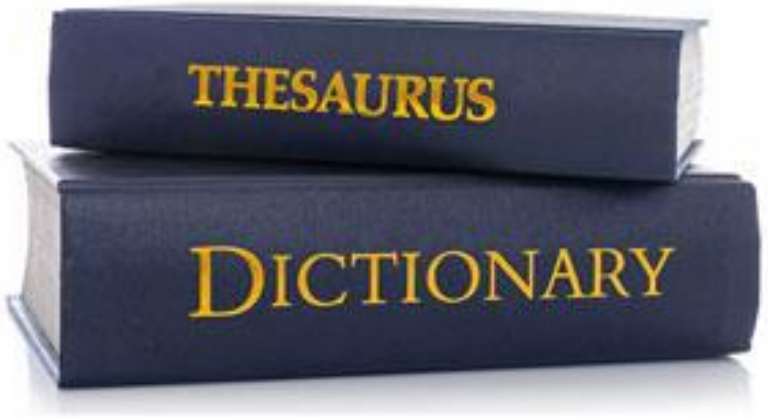
DISAMBIGUATION

George W. Bush

George Bush Jr.

President Bush

→ GW_BUSH



DISAMBIGUATION

New York City → PLACE

THING ← New York University

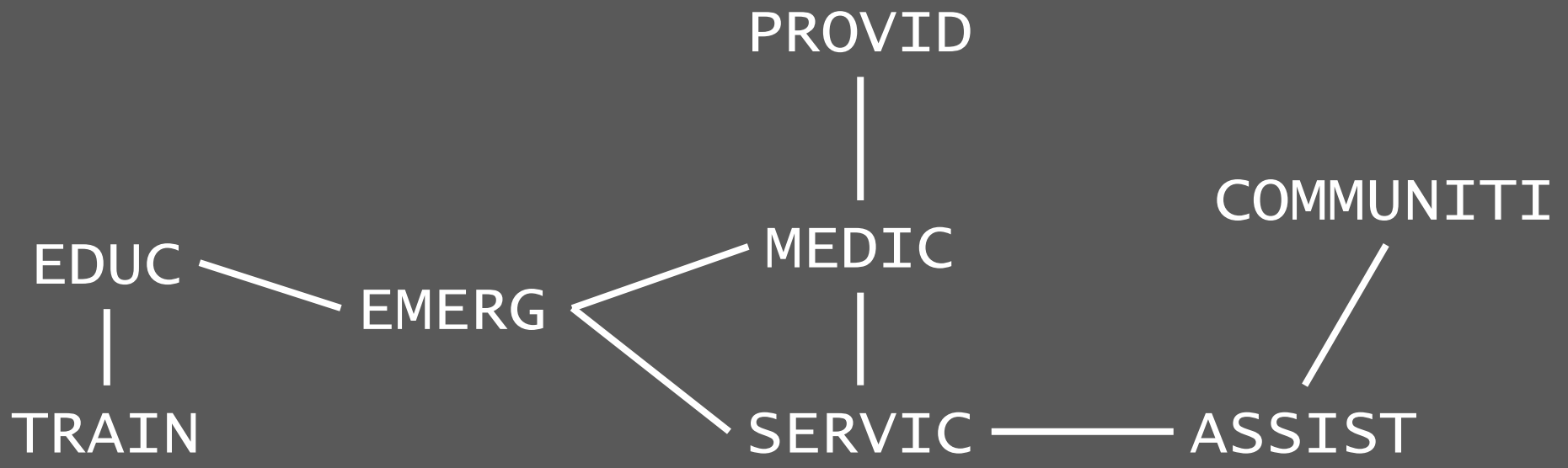
New Yorker → STATE OF MIND

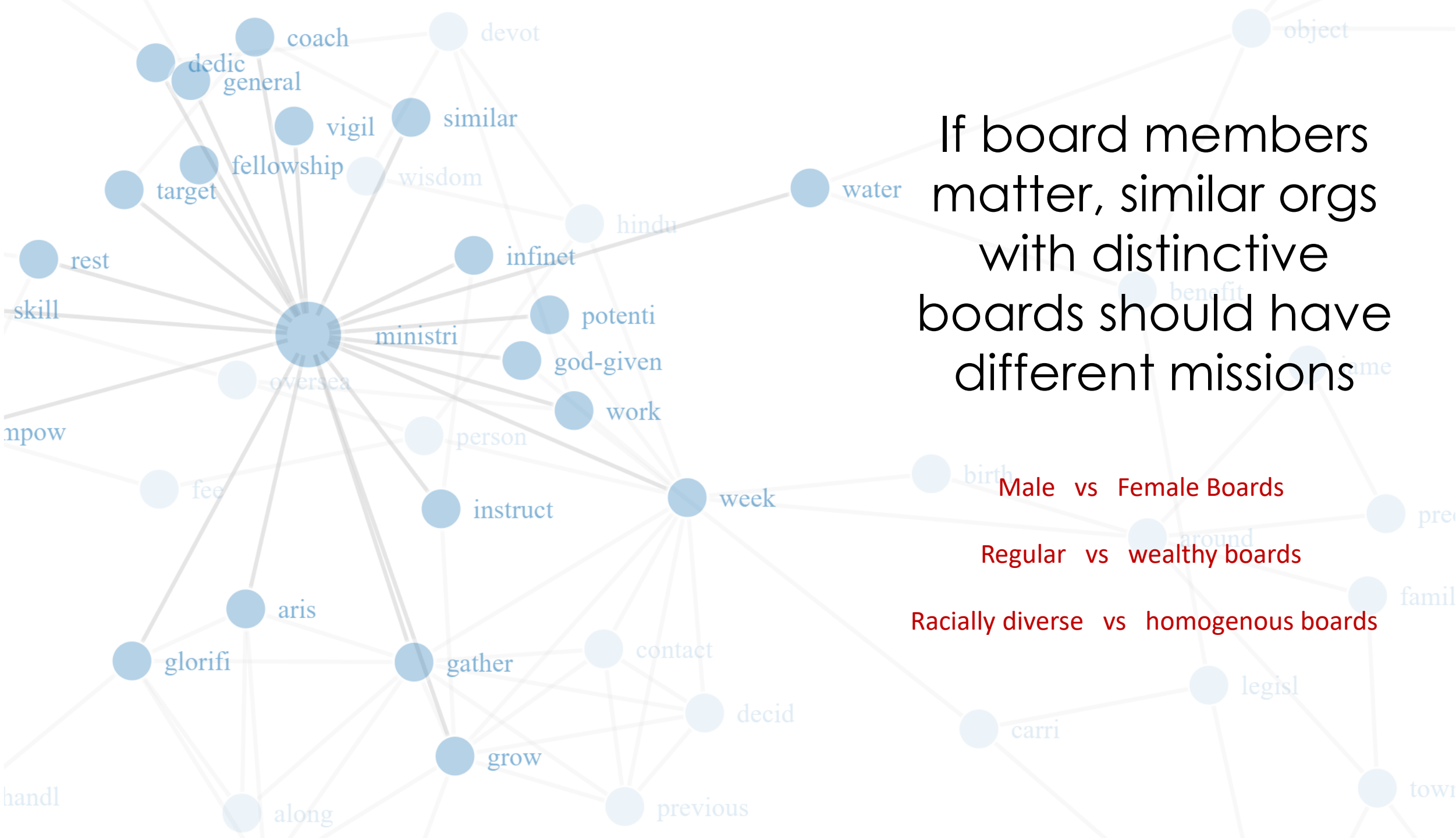
STATE ← New York

To educate, train and assist in providing emergency medical service for the community.

```
"EDUC" "TRAIN" "ASSIST"
"PROVID" "EMERG" "MEDIC"
"SERVIC" "COMMUNITI"
```

Semantic Networks





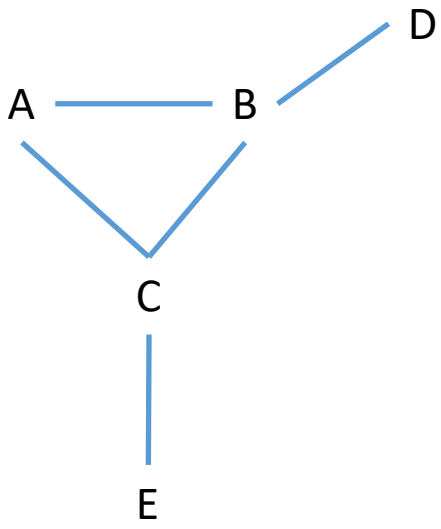
If board members matter, similar orgs with distinctive boards should have different missions

Male vs Female Boards

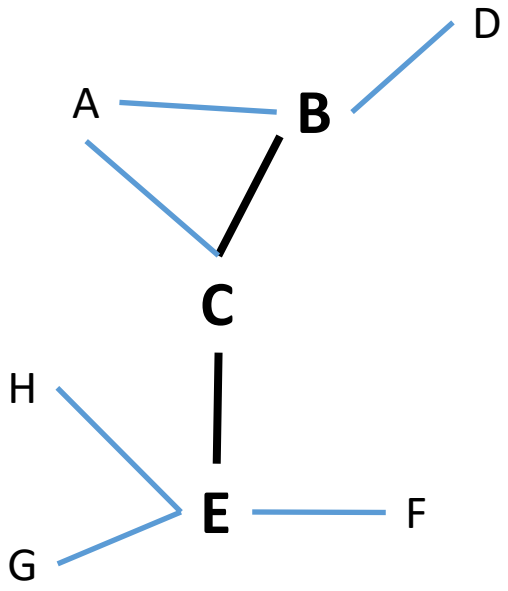
Regular vs wealthy boards

Racially diverse vs homogenous boards

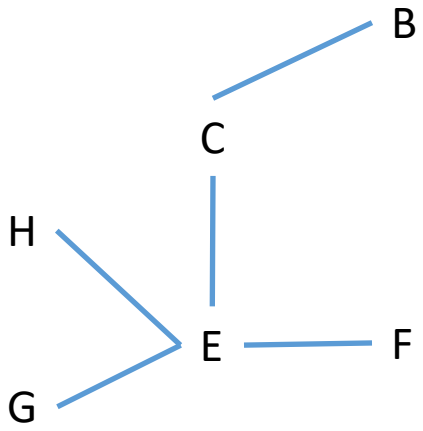
Mission Statement 1



Union (all statements) and **Intersection**



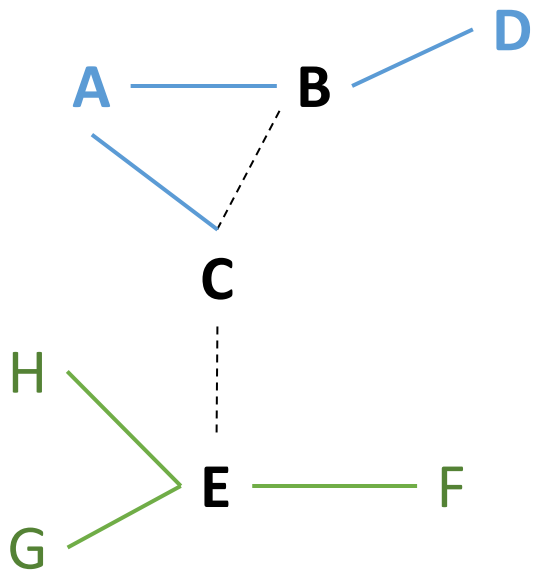
Mission Statement 2



Analyzing Missions by Types of Nonprofits

Mission Statement Components Unique to Org 1:

A-B
A-C
B-D



H-E
G-E
E-F

Mission Statement Components Unique to Org 2

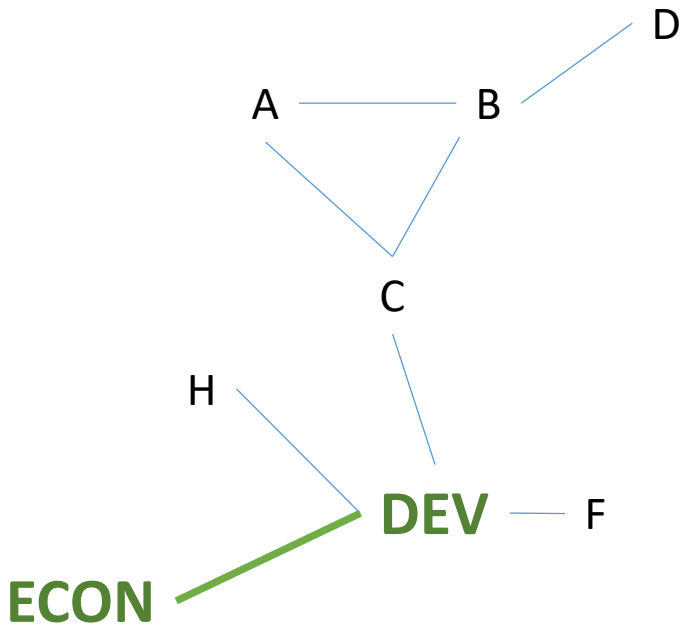
Doesn't work well with dense weighted graphs!

Data structure of a weighted network:

Freq ALL	Freq GROUP	Term 1	Term 2
10	**7**	**econ**	**dev**
7	4	self	reliance
5	3	dev	con
5	2	globla	econ
4	2	local	econ
4	1	soc	econ
3	2	econ	socialism
3	3	finance	global
3	2	global	finance
3	2	global	impsm
3	1	impsm	global
3	1	impsm	invasion

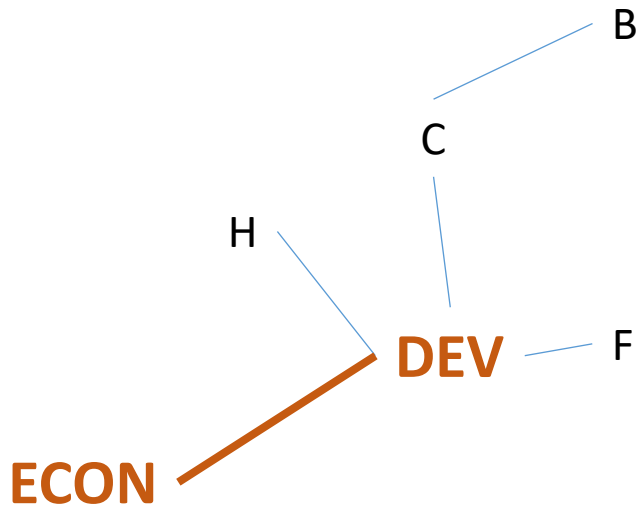
Is it significant that **economic development** was mentioned **7 times** by a specific type of organization?

ALL MISSION STATEMENTS



N=10

SUB-GROUP

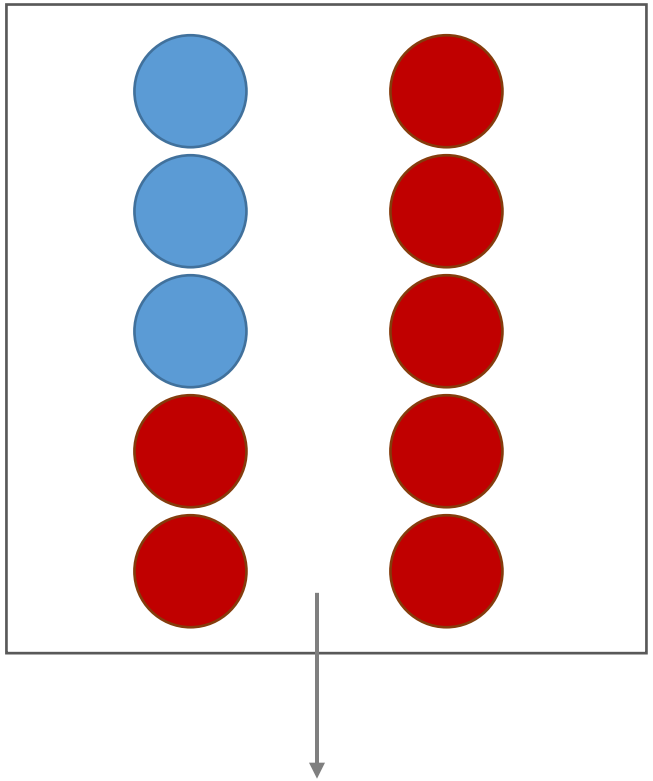


n=7

How often will a **random sample** of dyads from the **full weighted network** produce the **observed number** of "statements" (semantic network ties) in a group?

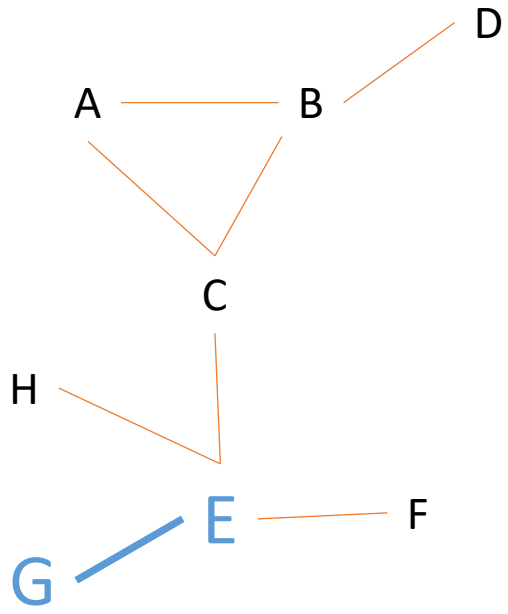
Is it significant that **Org Statement** significant?

What is the probability of selecting **2 blue balls** from a **sample of 5 balls**?

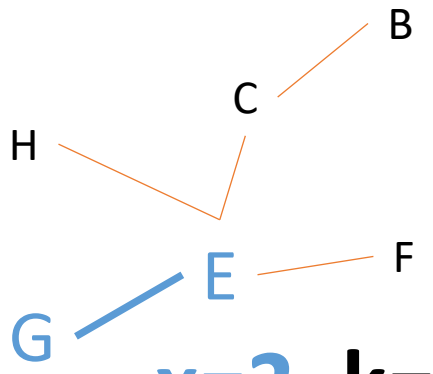


$$\Pr(\,blue = 2 \mid n = 5\,) = \frac{\binom{3}{2}\binom{7}{3}}{\binom{10}{5}}$$

$$= 0.42$$



X=3, N=10



x=2, k=5

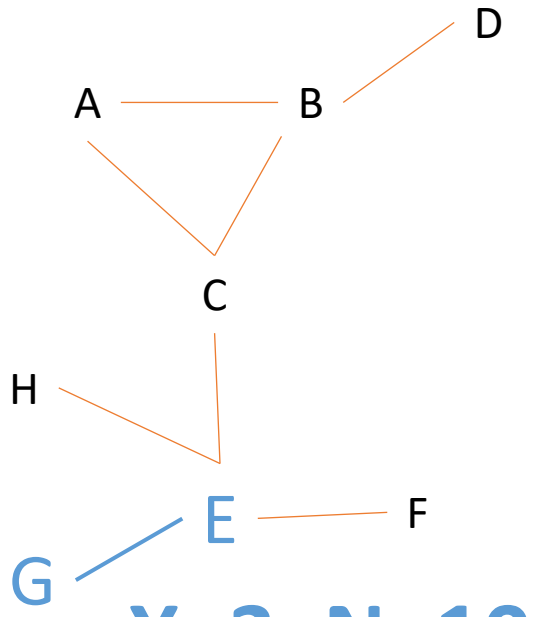
Generalized:

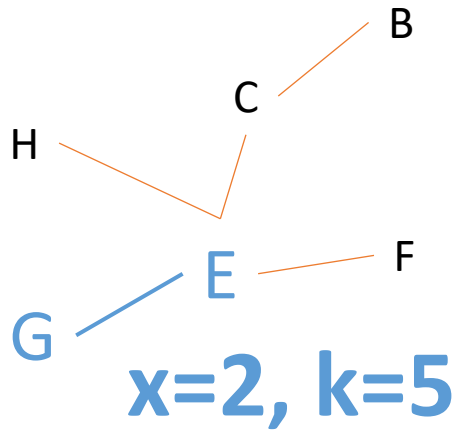
$$\Pr(\mathit{StatementCount} = x \mid \mathit{sample} = k) = \frac{\binom{X}{x}\binom{N-X}{k-x}}{\binom{N}{k}}$$

$Where\ X = the\ number\ of\ time\ a\ statement\ appears$

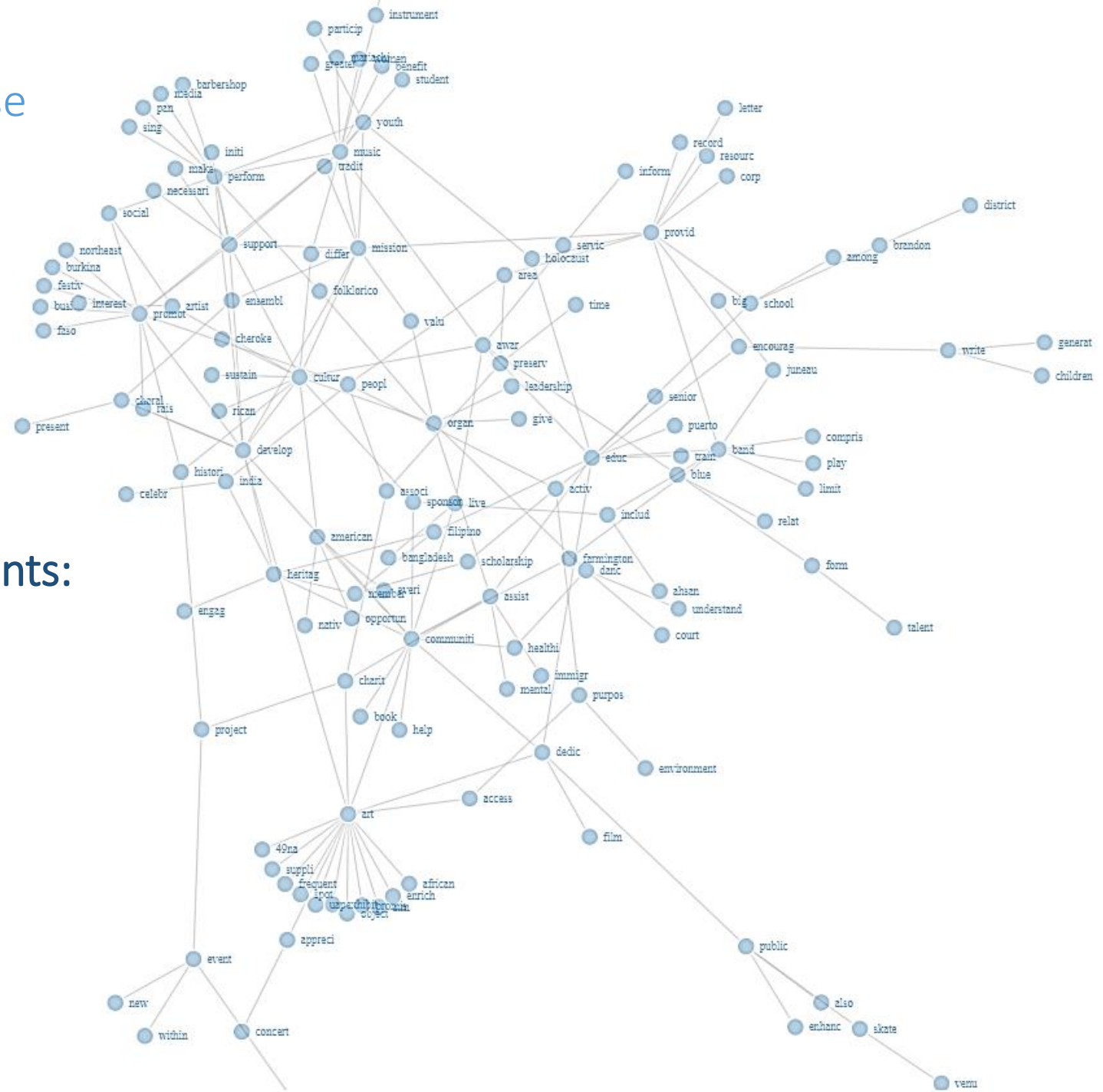
$N = total\ number\ of\ statements$

$k = number\ of\ statements\ in\ a\ specific\ period\ or\ group$





Only distinct edges retained those with observed frequencies that would occur less than 5% of the time by chance



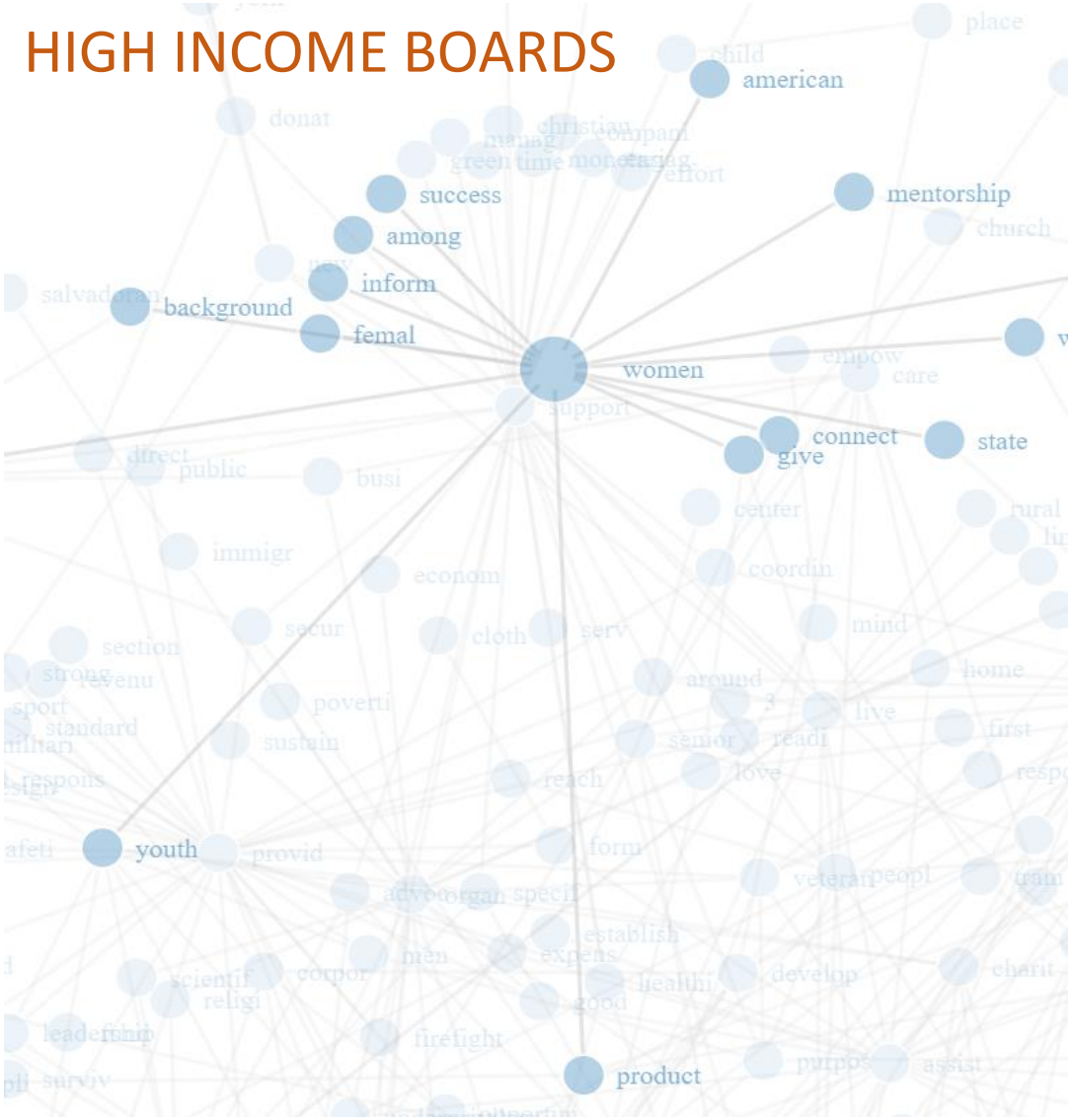
Each Semantic Network Represents:

COMMUNITY: LOW INCOME

SUBSECTOR: HEALTHCARE

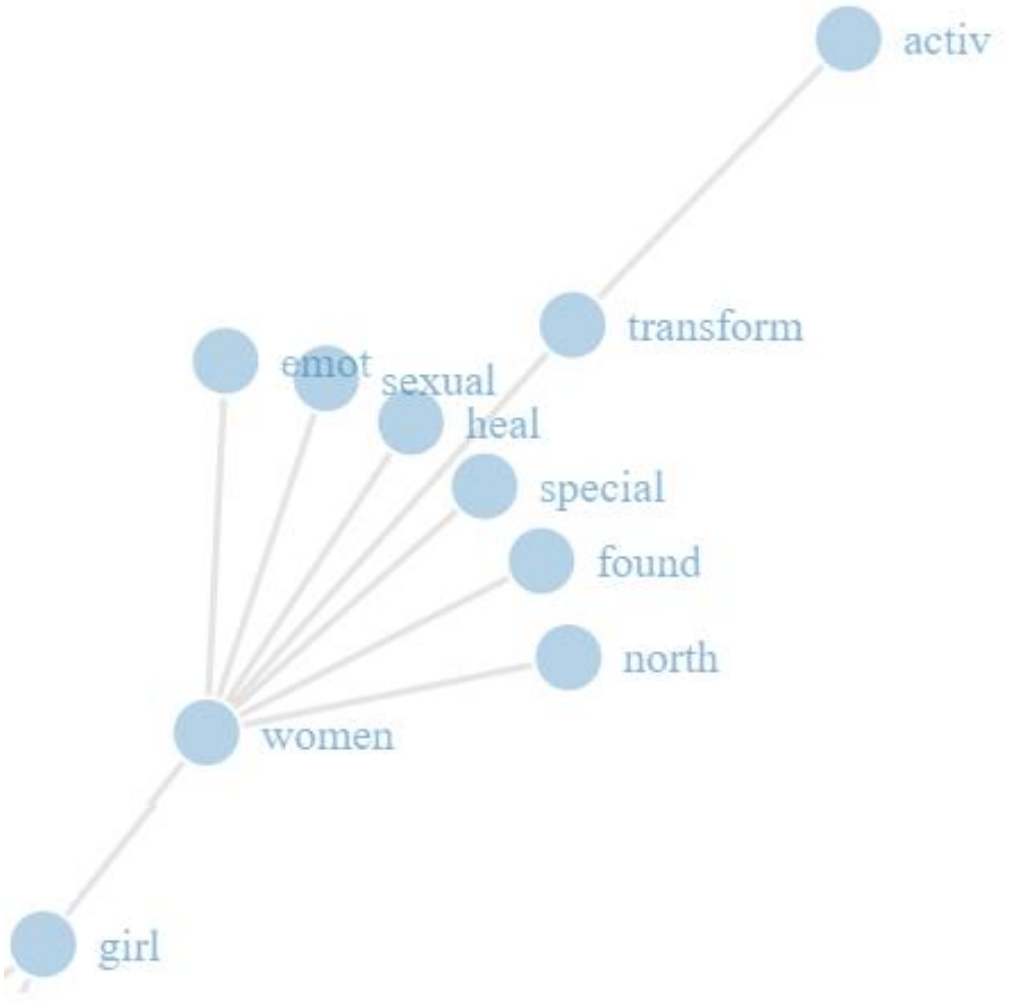
BOARD STATUS: LOW INCOME

HIGH INCOME BOARDS



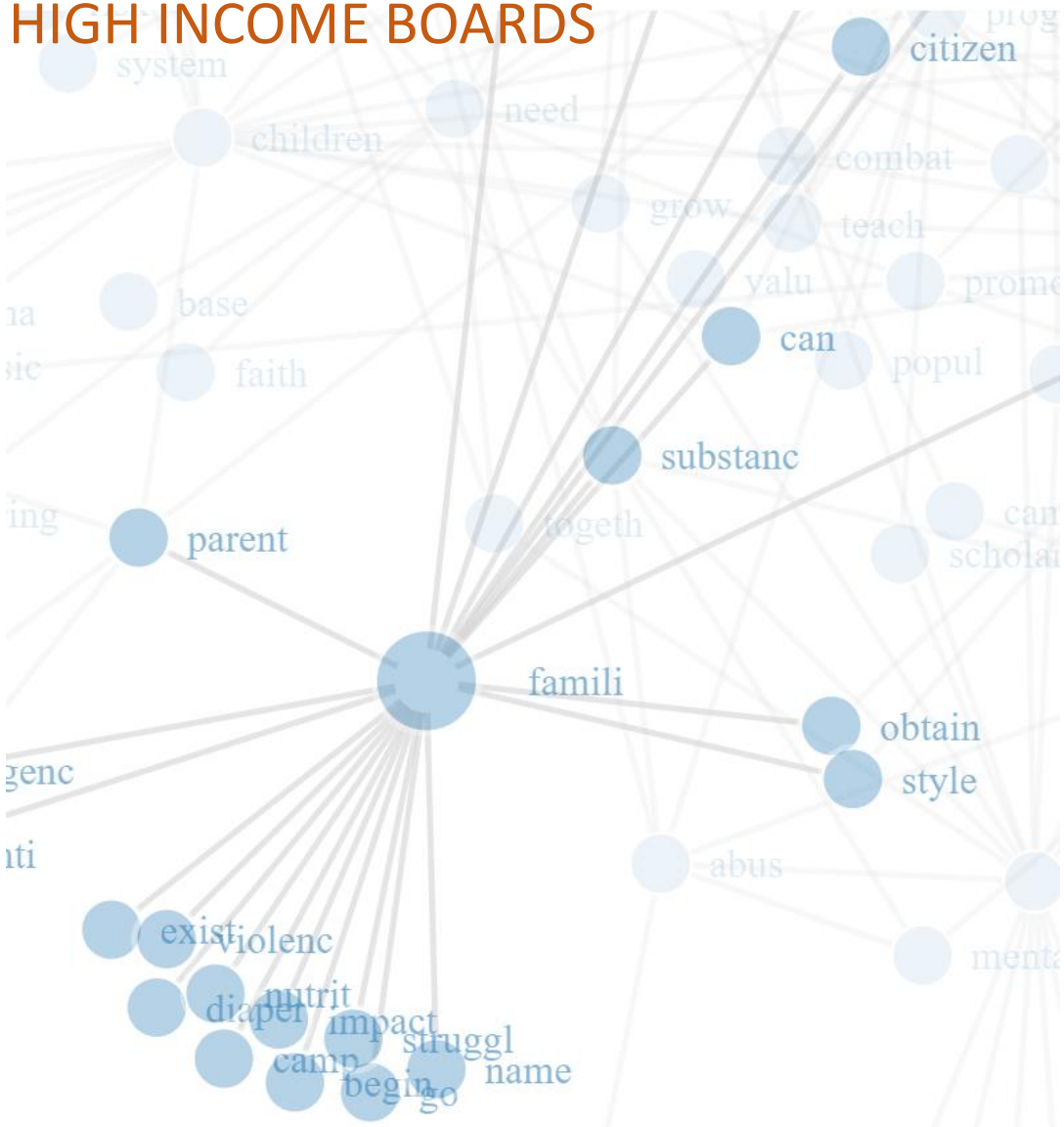
HUMAN SERVICES: LOW INCOME NHOODS

LOW INCOME BOARDS



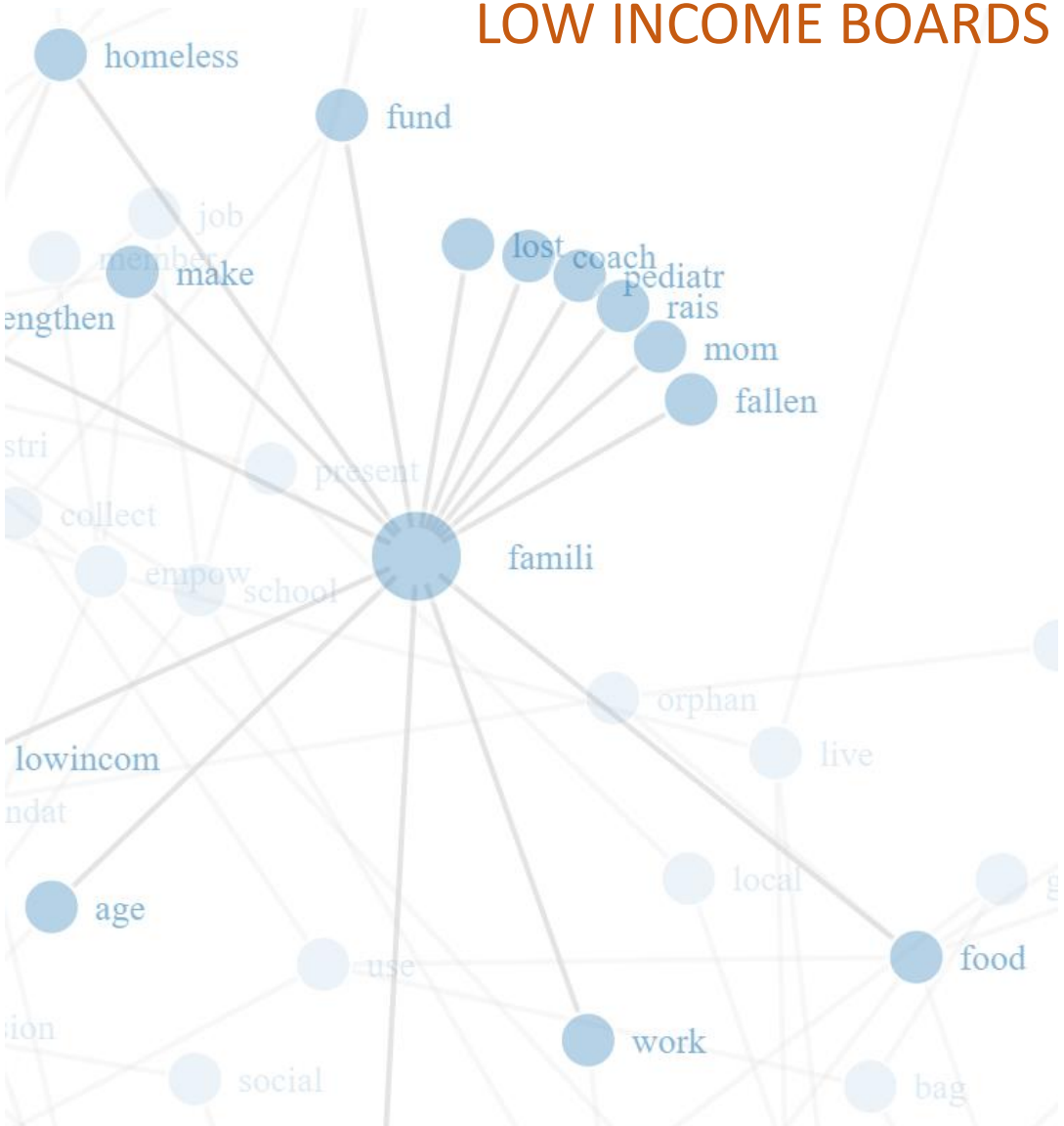
HUMAN SERVICES: LOW INCOME NHOODS

HIGH INCOME BOARDS



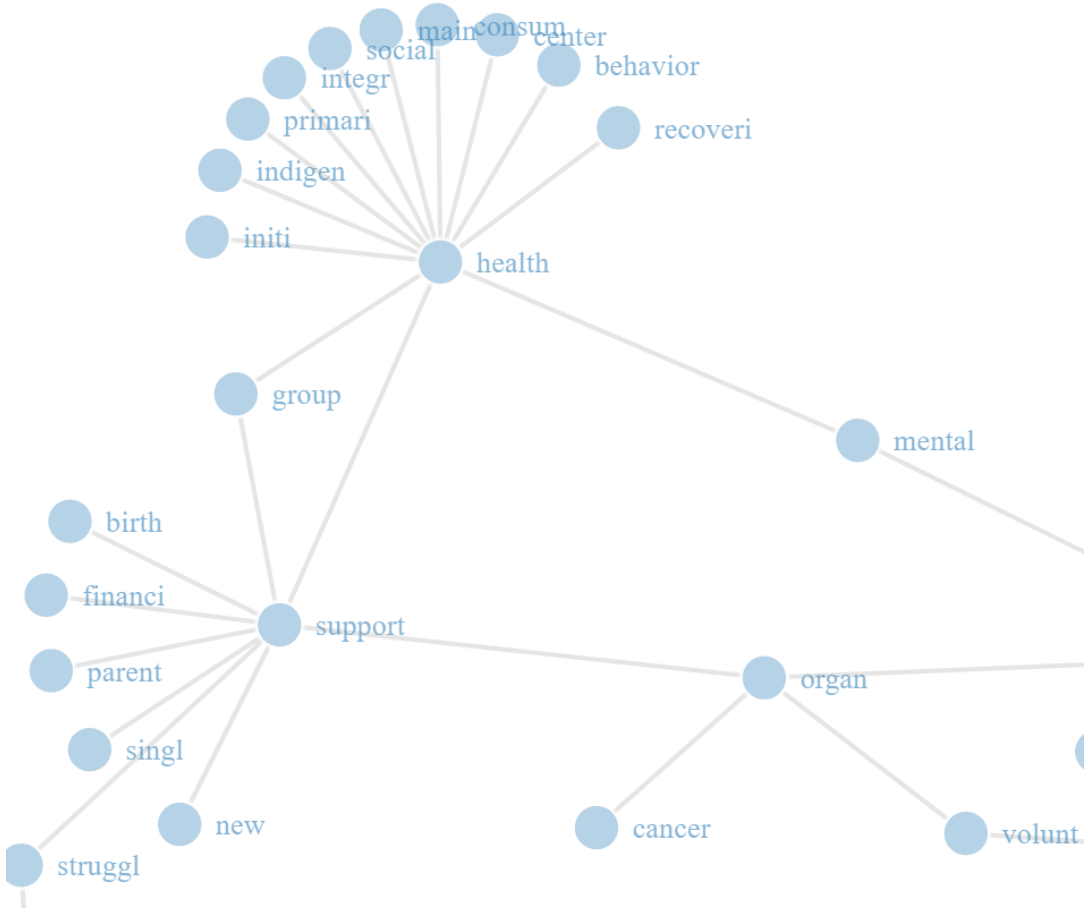
HUMAN SERVICES: LOW INCOME NHOODS

LOW INCOME BOARDS



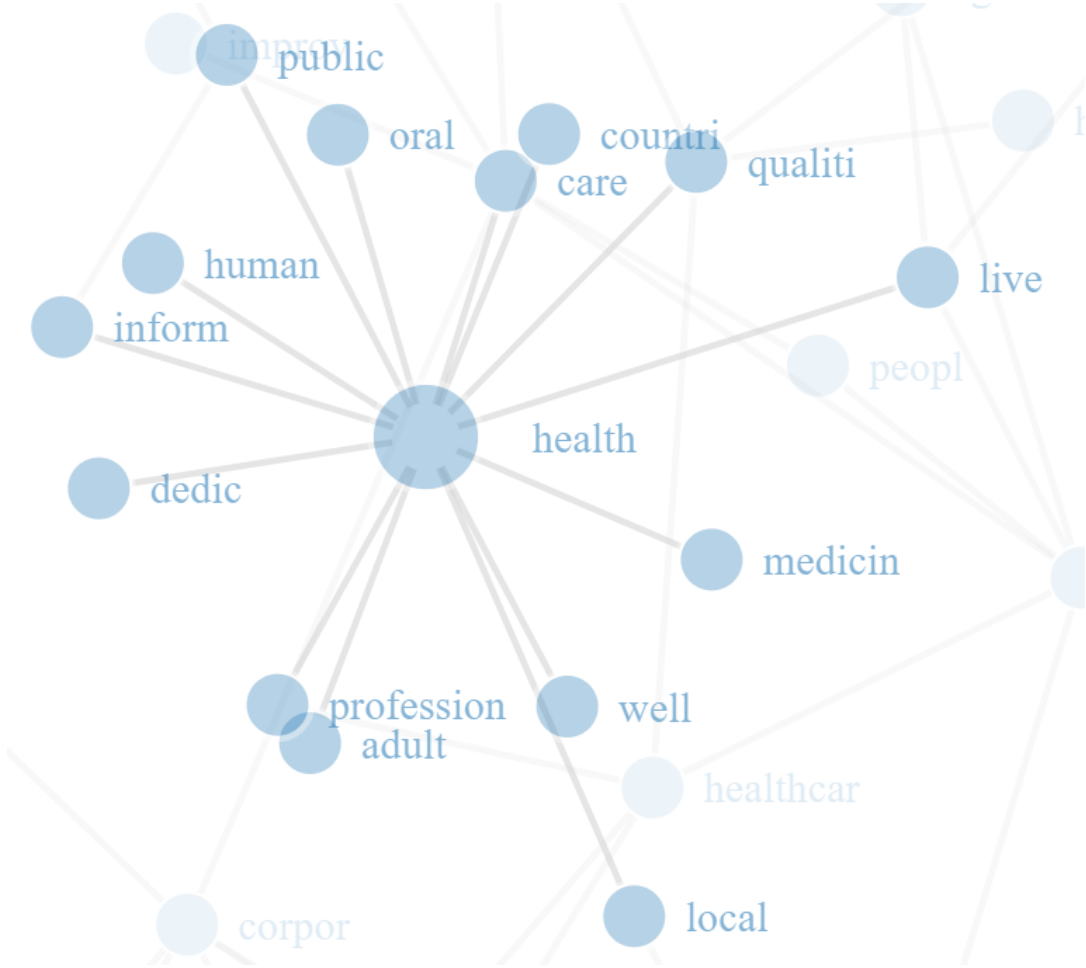
HUMAN SERVICES: LOW INCOME NHOODS

HIGH INCOME BOARDS



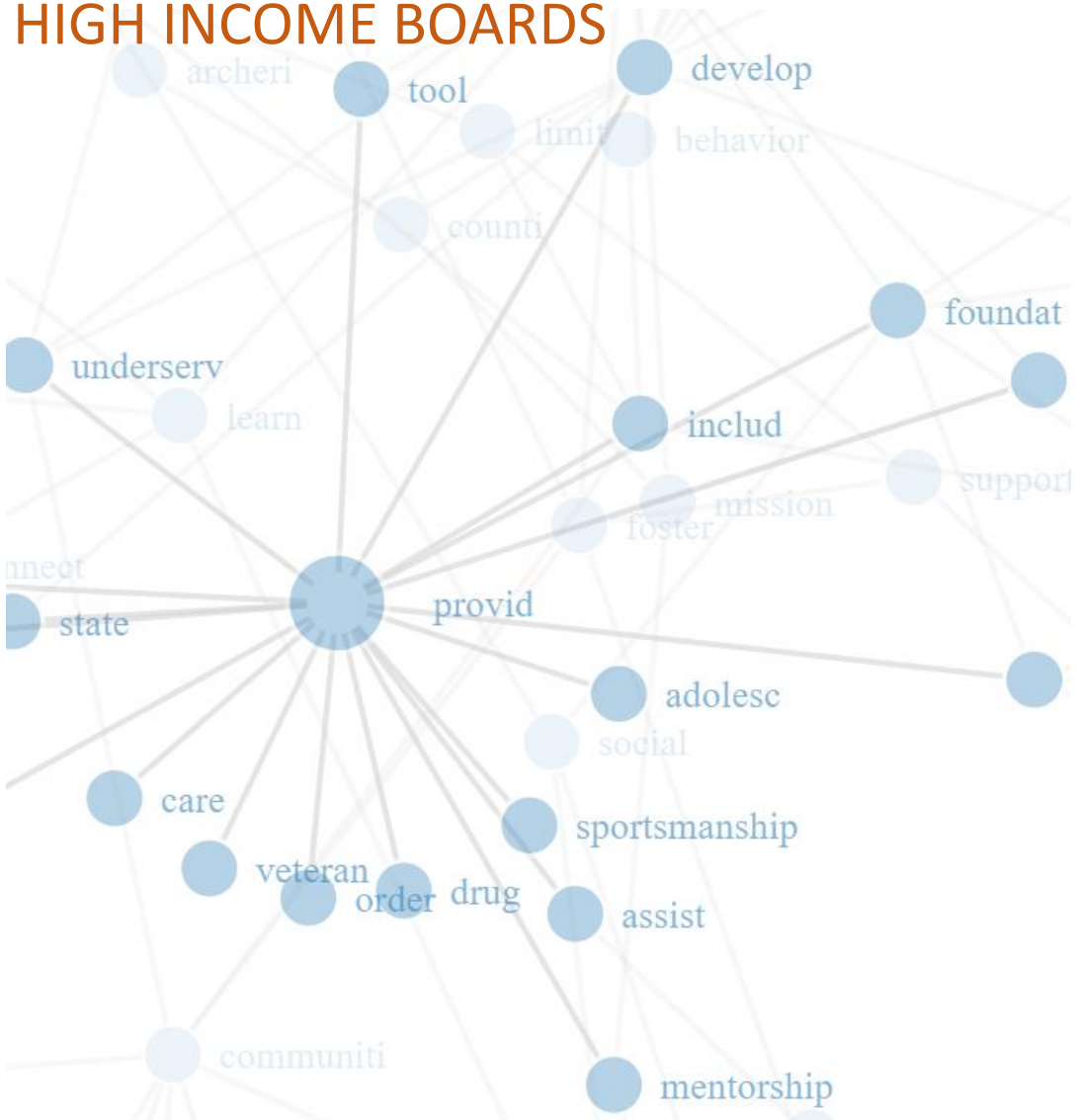
HEALTHCARE: LOW INCOME NHOODS

LOW INCOME BOARDS



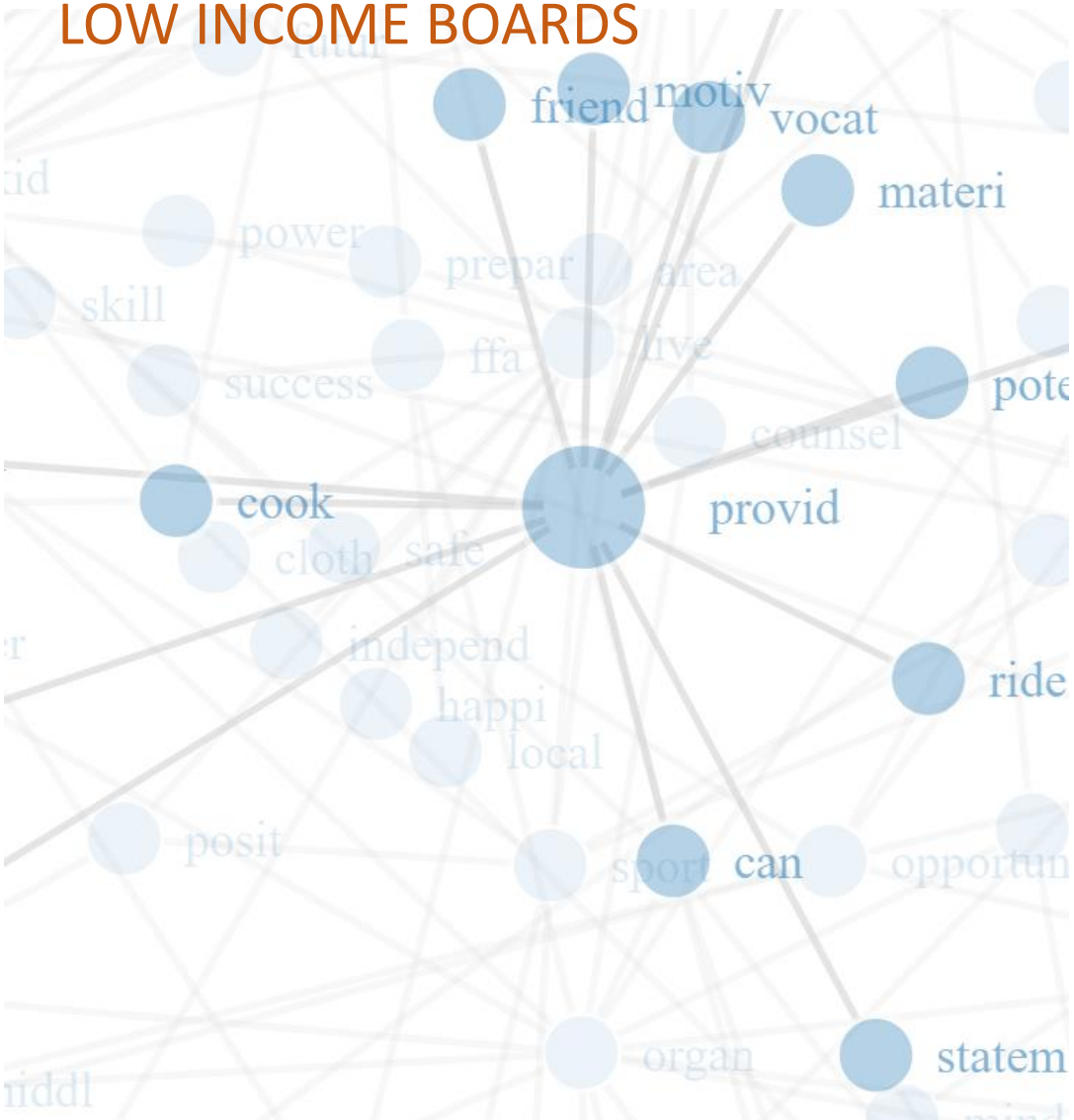
HEALTHCARE: LOW INCOME NHOODS

HIGH INCOME BOARDS



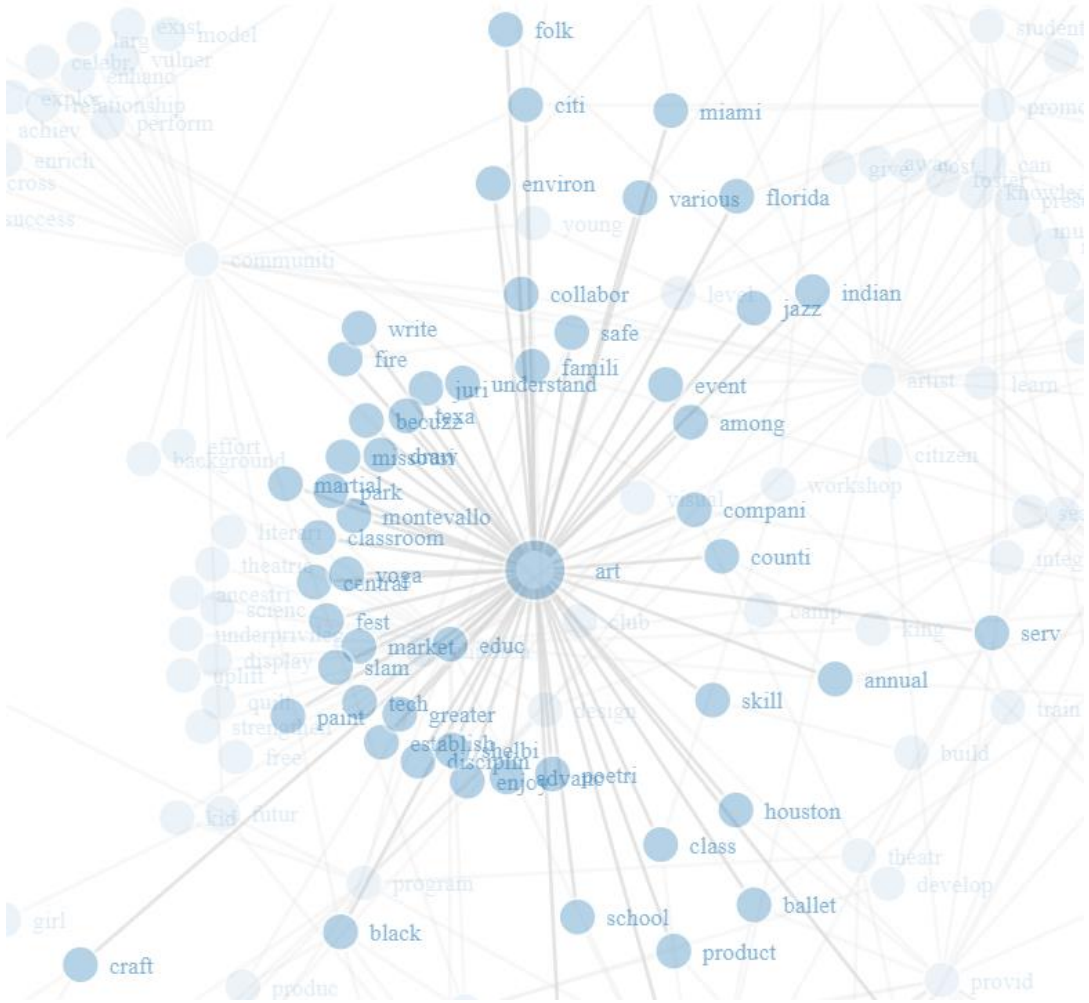
YOUTH: LOW INCOME NHOOD

LOW INCOME BOARDS



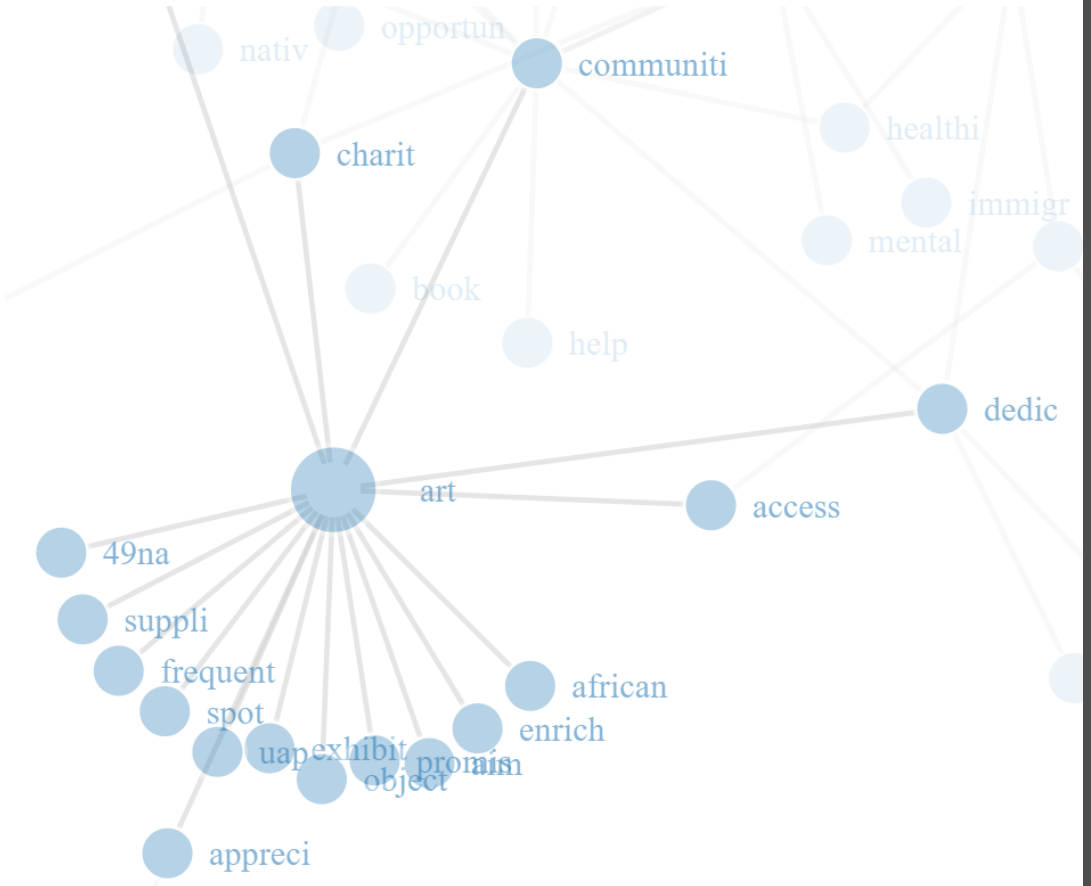
YOUTH: LOW INCOME NHOOD

HIGH INCOME BOARDS



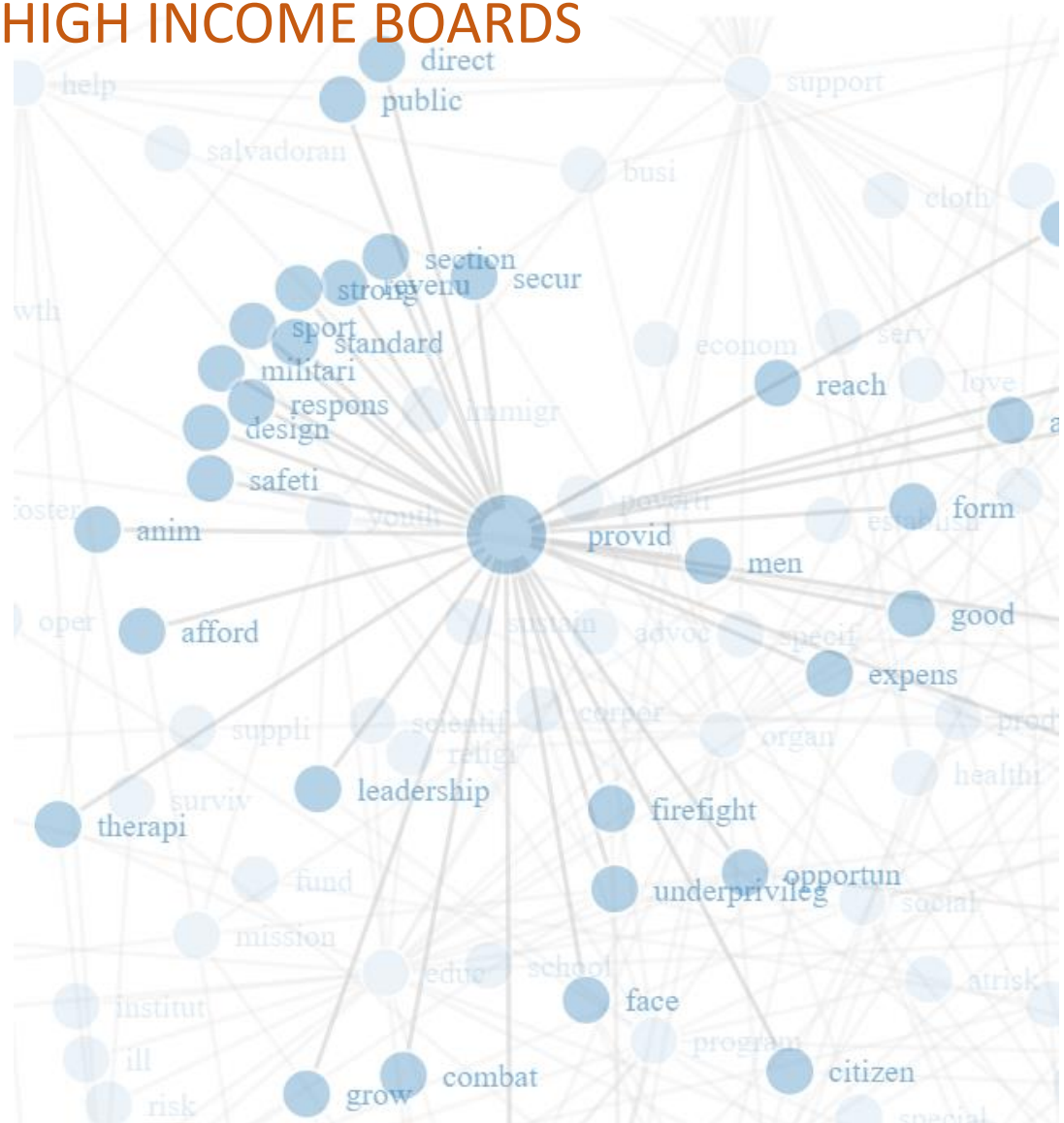
ARTS: LOW INCOME NHOOD

LOW INCOME BOARDS



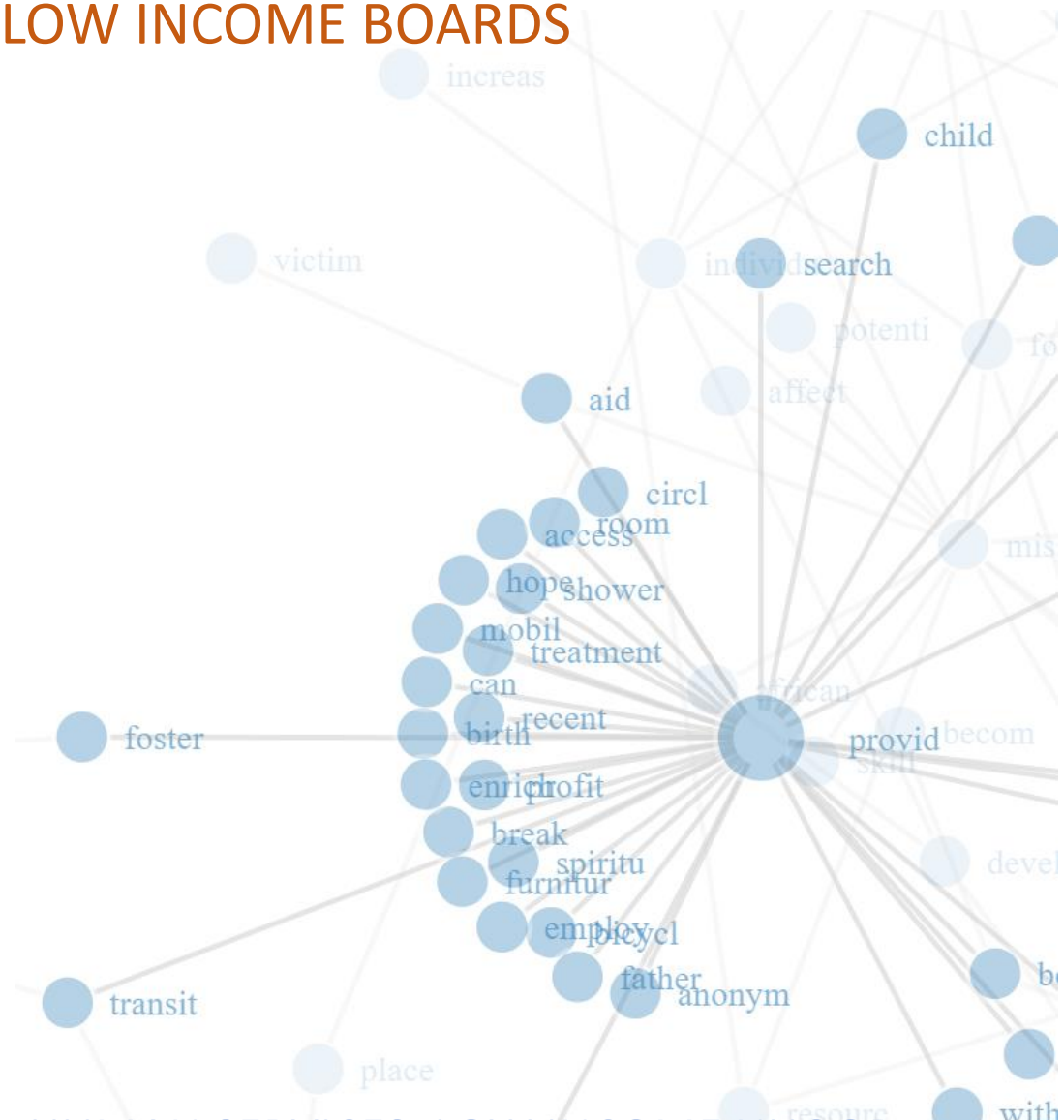
ARTS: LOW INCOME NHOOD

HIGH INCOME BOARDS



HUMAN SERVICES: LOW INCOME NHOOD

LOW INCOME BOARDS



HUMAN SERVICES: LOW INCOME NHOOD

THANK YOU