The Structure of Reasoning:

Measuring Justification and Preferences in Text

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Research Agenda

How do people **talk** and **reason** about political preferences?

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Today's Talk:

The Structure of Reasoning

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~OR~

Can we measure individual variation in how people structure their political expressions, and do we really care anyway? 🤔

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The Structure of Reasoning

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Spoiler Alert:

Today's Talk:

The Structure of Reasoning

~OR~

Can we measure individual variation in how people structure their political expressions, and do we really care anyway? 🤔

Spoiler Alert: Yes.

Today's Talk:

Can we measure:

- Individual variation in how
- People structure their political expressions
- And do we really care anyway?

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Today's Talk:

Can we measure:

- Individual variation in how
- People structure their political expressions
- **Potential for behavioral insights**

New Tools for a Classic Problem

This idea is not new

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- A classic element of public opinion scholarship
- Efforts used interviews or hand-coding of text
- Largely abandoned as too difficult / time consuming

Lane, 1962; Axelrod, 1976; Campbell, 1960

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- A classic element of public opinion scholarship
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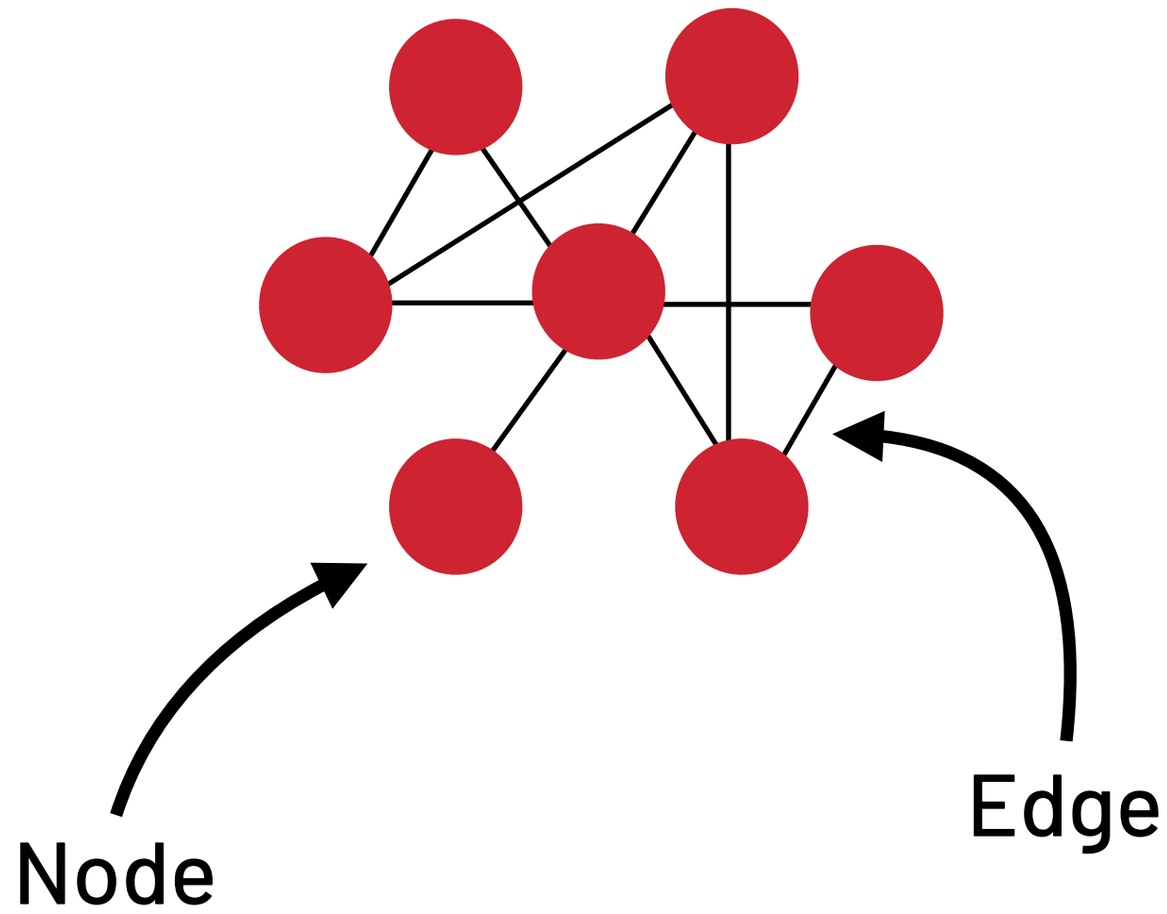
Lane, 1962; Axelrod, 1976; Campbell, 1960

➡ Modern computational tools make this task tractable

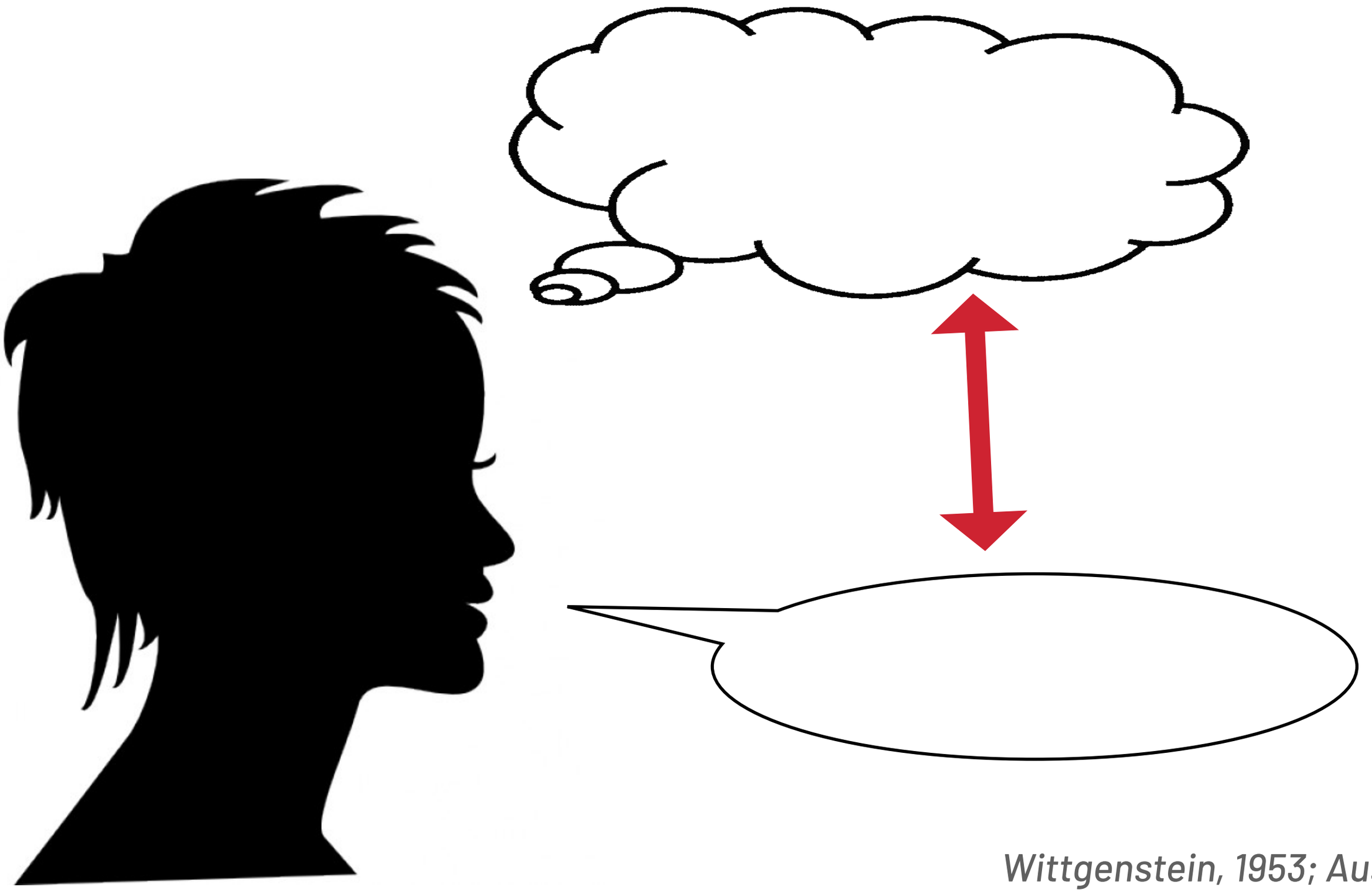
Today's Talk: Roadmap

1. Elaborate on "structure" of political reasoning
2. Define approach for inferring and measuring structure
3. Demonstrate potential for behavioral insights
   — using two distinct datasets

1. Political Reasoning is Structured



1. Political Reasoning is Structured



Wittgenstein, 1953; Austin, 1962

1. Political Reasoning is Structured

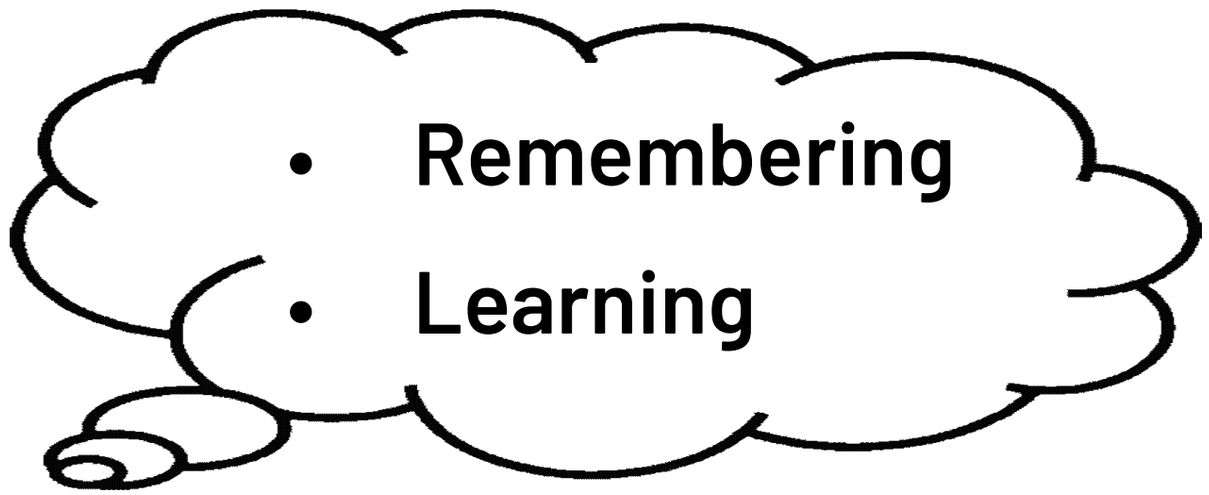
- Remembering
- Learning

Both have

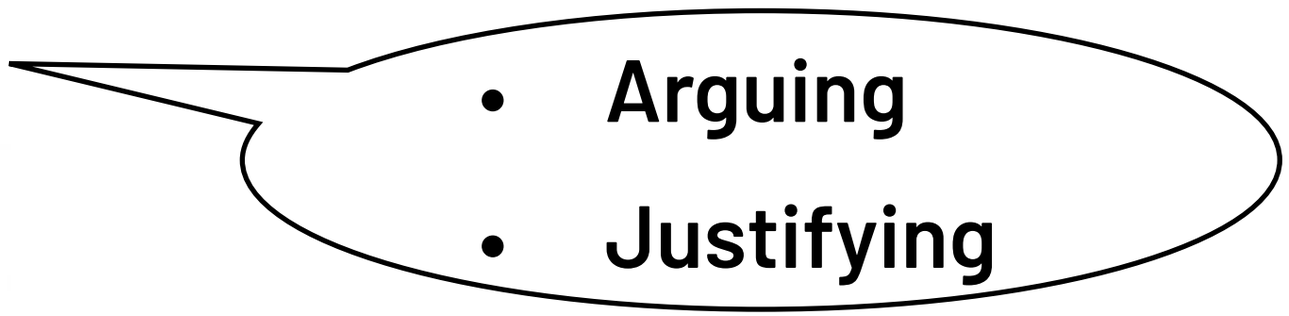
network structure

- Arguing
- Justifying

1. Political Reasoning is Structured



Collins & Loftus, 1975; Quillian, 1967
Shaffer et al., 2009; Shavelson, 1974



Toulmin, 1958; Walton, 1996

Axelrod, 1976; Danowski, 1982; Carley, 1993

1. Political Reasoning is Structured

Important interlude:

Should we even care about political talk?

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- ➡ "Political talk" reflects dominant messages

1. Political Reasoning is Structured

Important interlude:

Should we even care about political talk?

- ➡ Democratic ideal imagines citizens reasoning together
- ➡ Democracy demands citizens talk together
- ➡ "Political talk" reflects dominant messages
  - ➡ Receive - Accept - Sample

Zaller, 1992

1. Political Reasoning is Structured

Structure **and** ***content*** **both influence the quality of political talk**

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Structure:

- Sends a signal to interlocutor
- Influences receptivity to new messages
- Represents different philosophical approaches

1. Political Reasoning is Structured

Multiple moral philosophies claim:

Good* reasoning
must be coherent*

Sidgwick, 1907; Dancy, 1993
McNaughton & Rawling, 2000; Rawls, 1993
Thagard, 1998; Dorsey, 2006; Berker, 2015

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** For some definitions of "good" and "coherent"*

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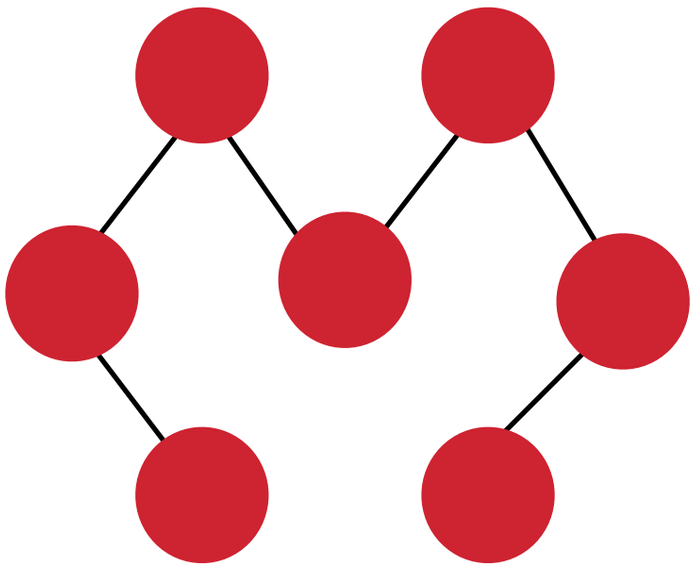
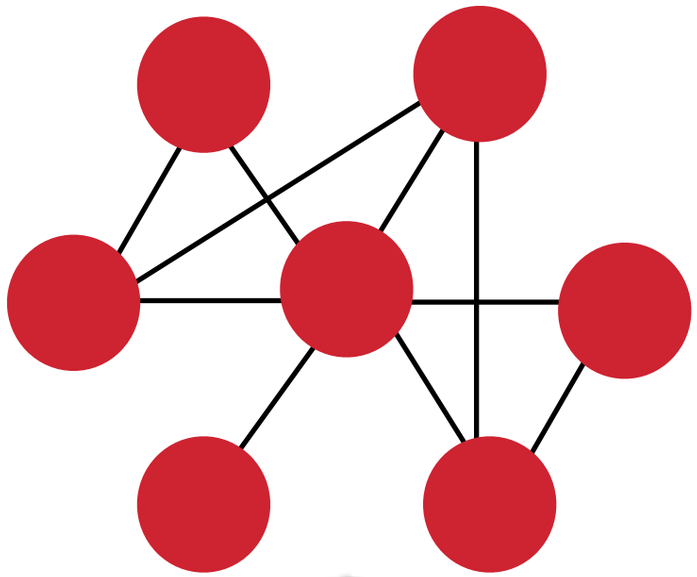
1. Political Reasoning is Structured

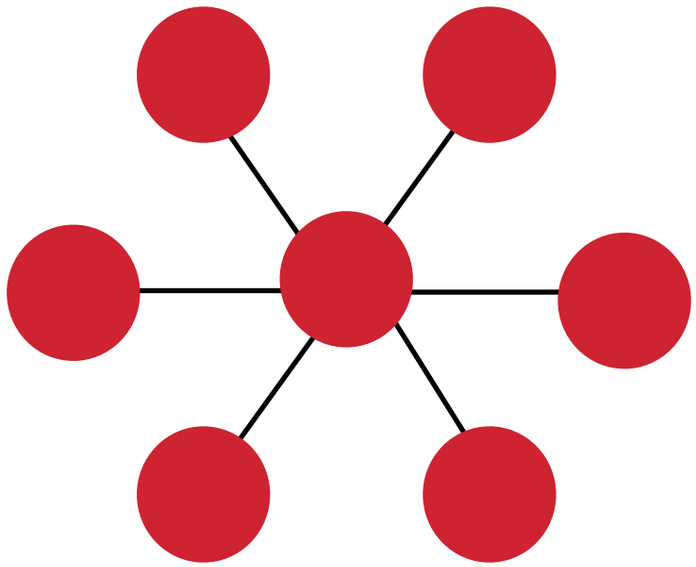
Connectivity
Baseline



Complexity
Dancy, 1993



Hierarchy
Sidgwick, 1907



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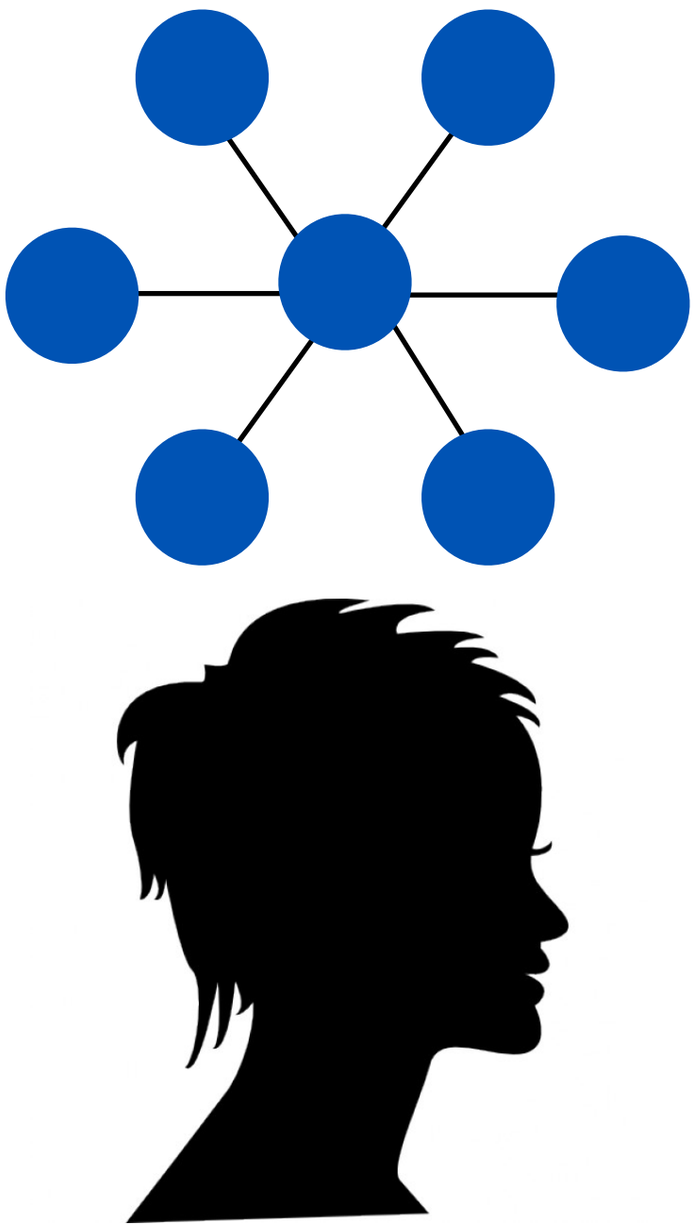

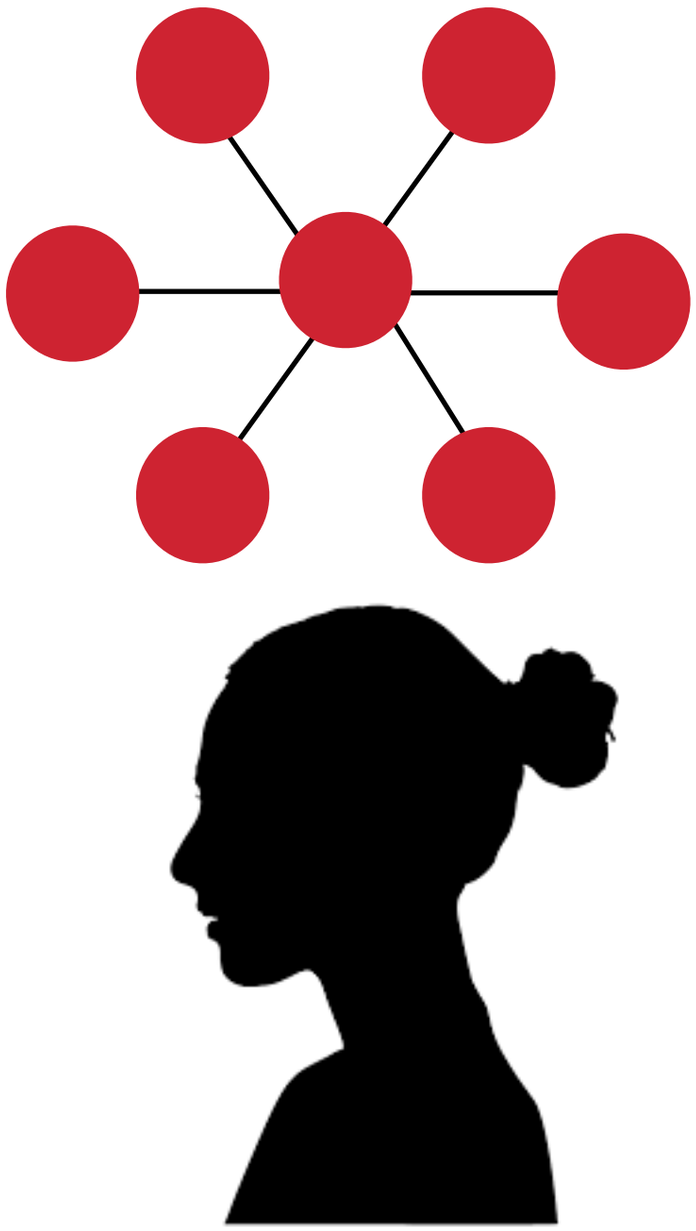

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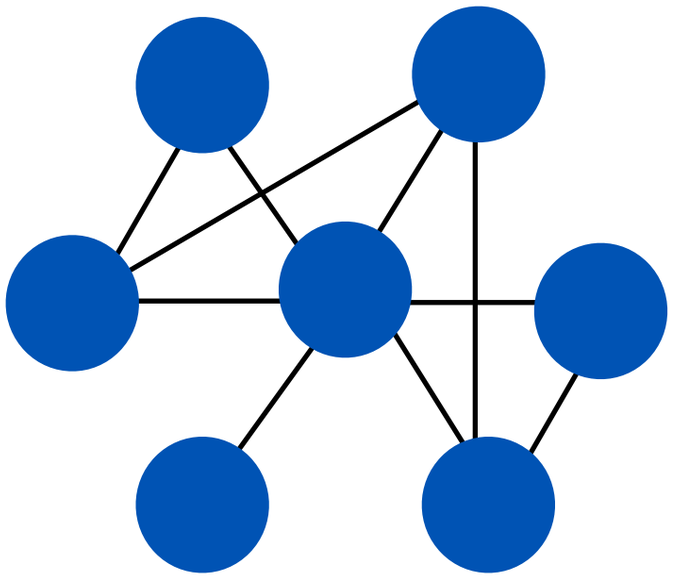

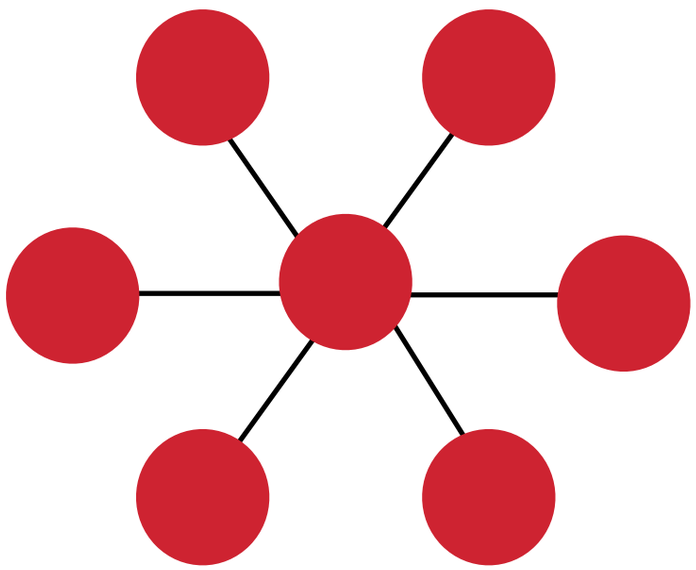

The Structure of Reasoning

Roadmap:

1. Elaborate on “structure”
2. **Define approach for inferring and measuring structure**
3. Demonstrate potential for behavioral insights
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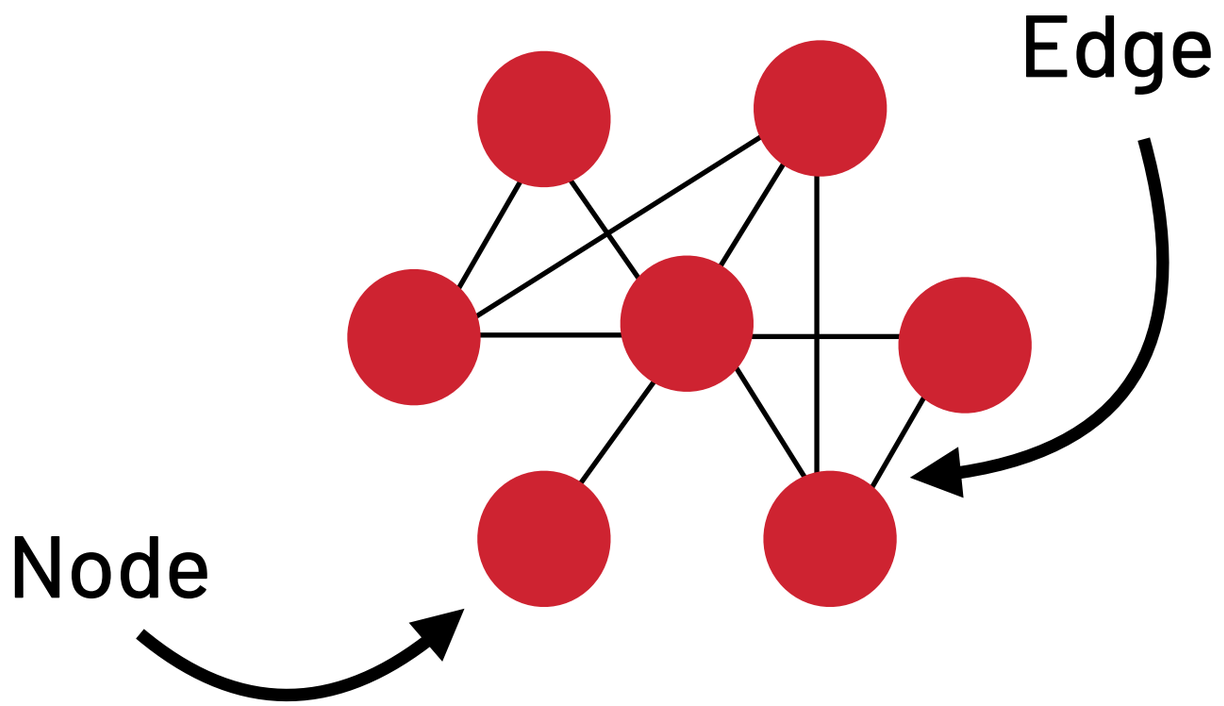
2. Inferring Network Structure

What are the nodes?

What are the edges?



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What are the nodes?

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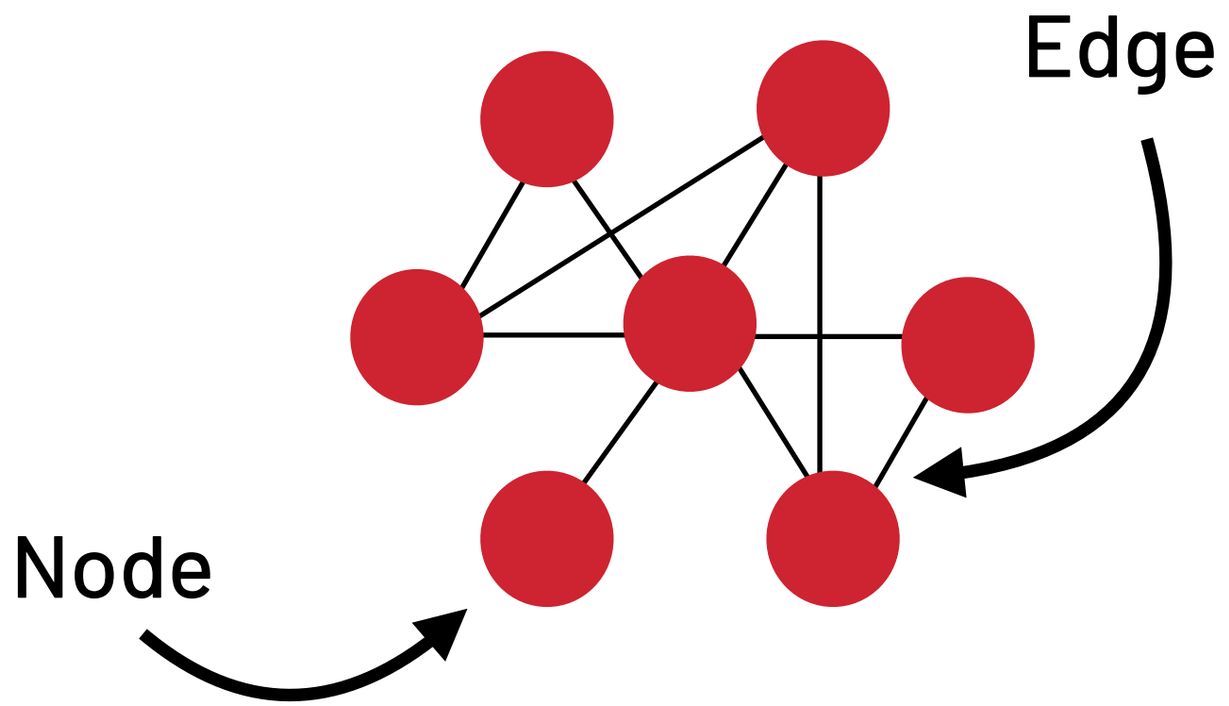
What are the edges?

- Connections between concepts (??)



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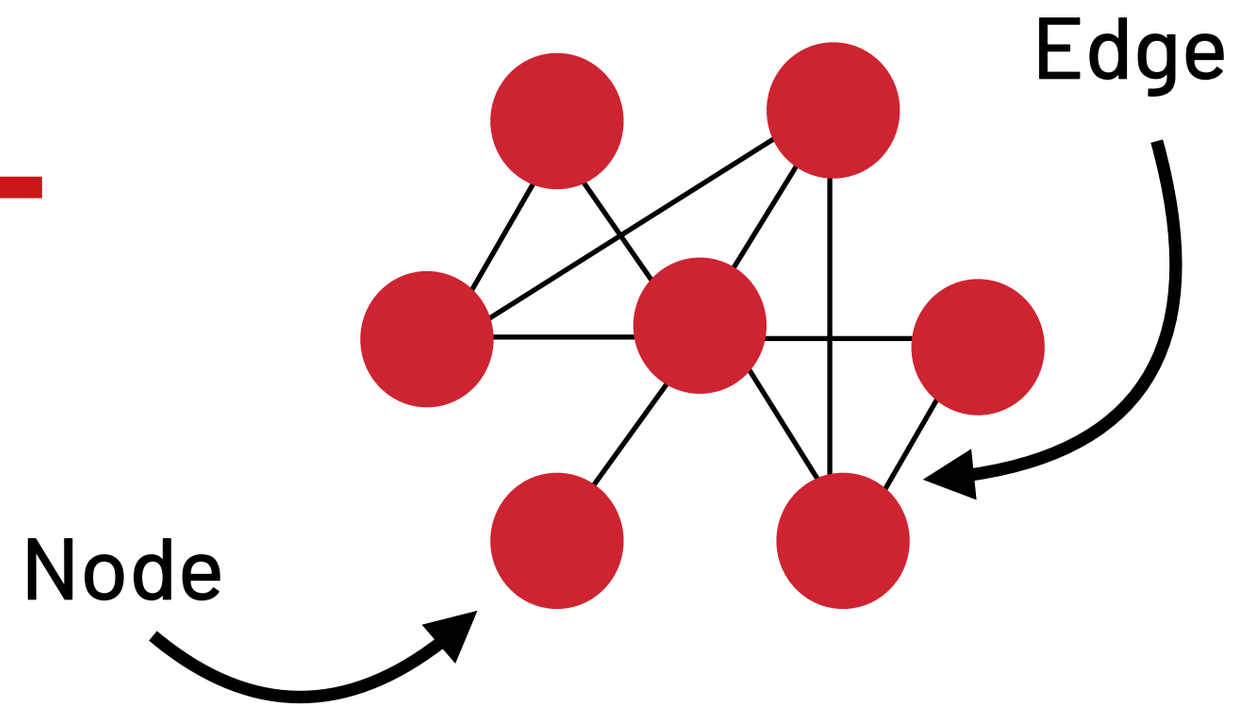
What is a "concept"??



2. Inferring Network Structure

What is a “concept” ?

- Compressed representation of information
- Collection of related “things”
- Represented by words

➡ Operationally, a collection of similar words

Collins & Loftus, 1975; Quillian, 1967

2. Inferring Network Structure

Identifying similar words through embeddings:

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Identifying similar words through embeddings:

- Words are high dimensional objects and can be embedded in high dimensional space

- Do this in such a way that words which appear in similar contexts are geometrically close

$$\frac{1}{T}\sum_{t=1}^{T}\sum_{-c\leq j\leq c, j\neq 0}\log p\left(w_{t+j}|w_t\right)$$

Mikolov et al, 2013
Spirling and Rodriguez, 2019

2. Inferring Network Structure

Identifying similar words through embeddings:

I took my **dog** to the vet.

I took my **cat** to the vet.

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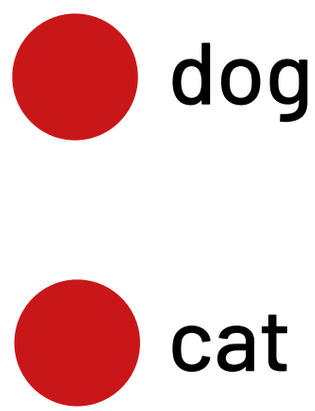

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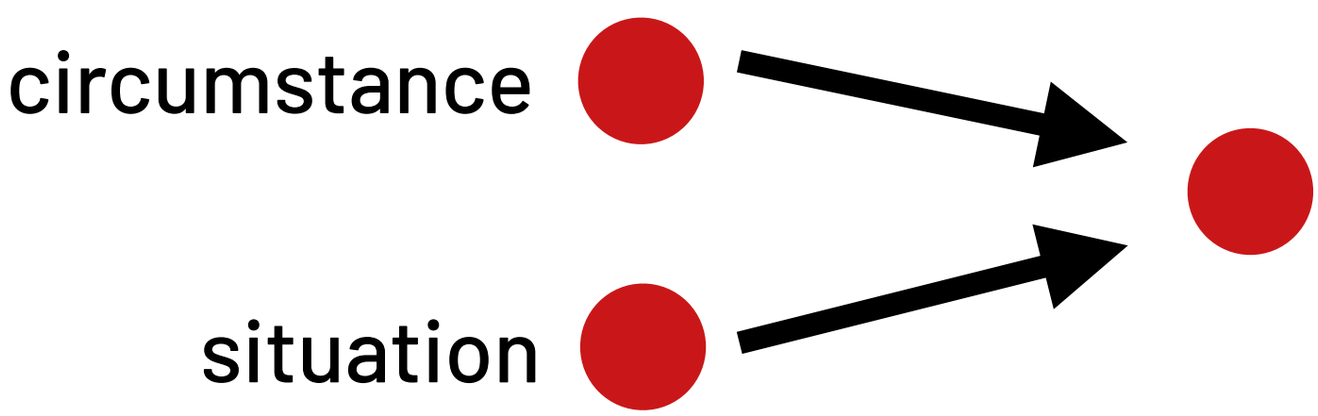

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What are the nodes?

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- ➡ Connections between concepts (??)

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Example:

Bodily autonomy is a basic human right.

2. Inferring Network Structure

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Word co-occurance

Bodily autonomy is a basic human right.

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Word co-occurance:

Bodily autonomy ~~is a~~ basic human right.

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Word co-occurance:
Assumes connected concepts are syntactic close

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Example:

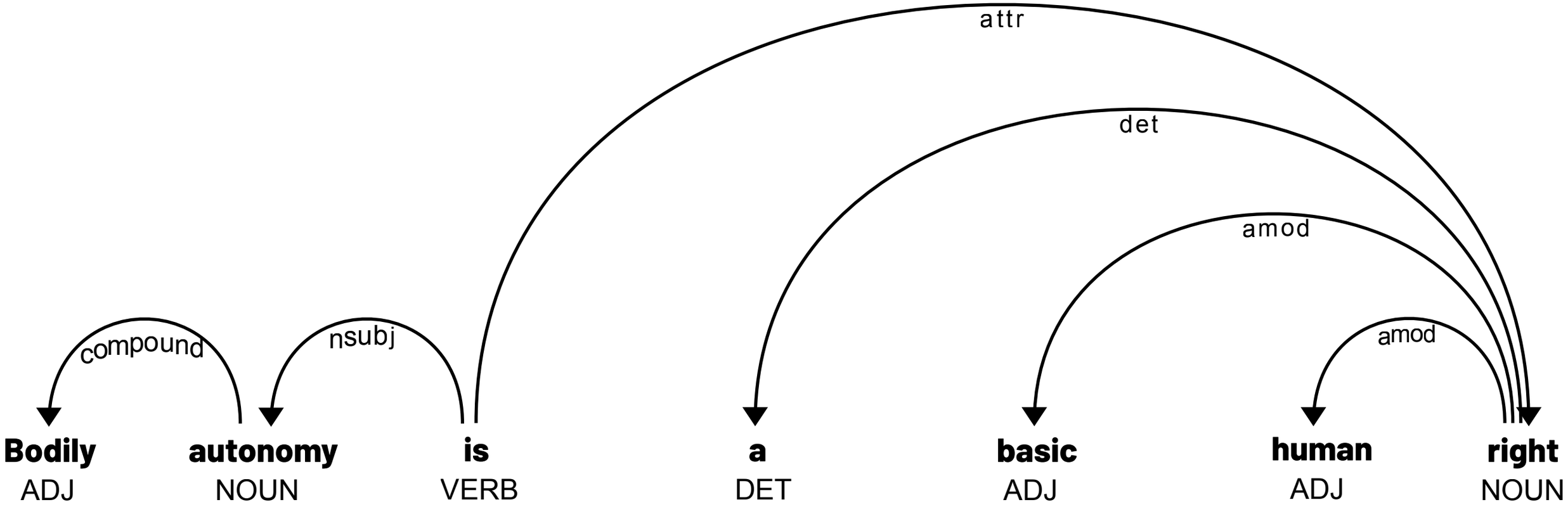
Grammatical structure:

Bodily autonomy is a basic human right.

2. Inferring Network Structure

Example:

Grammatical structure:
Designed to encode implicit connections



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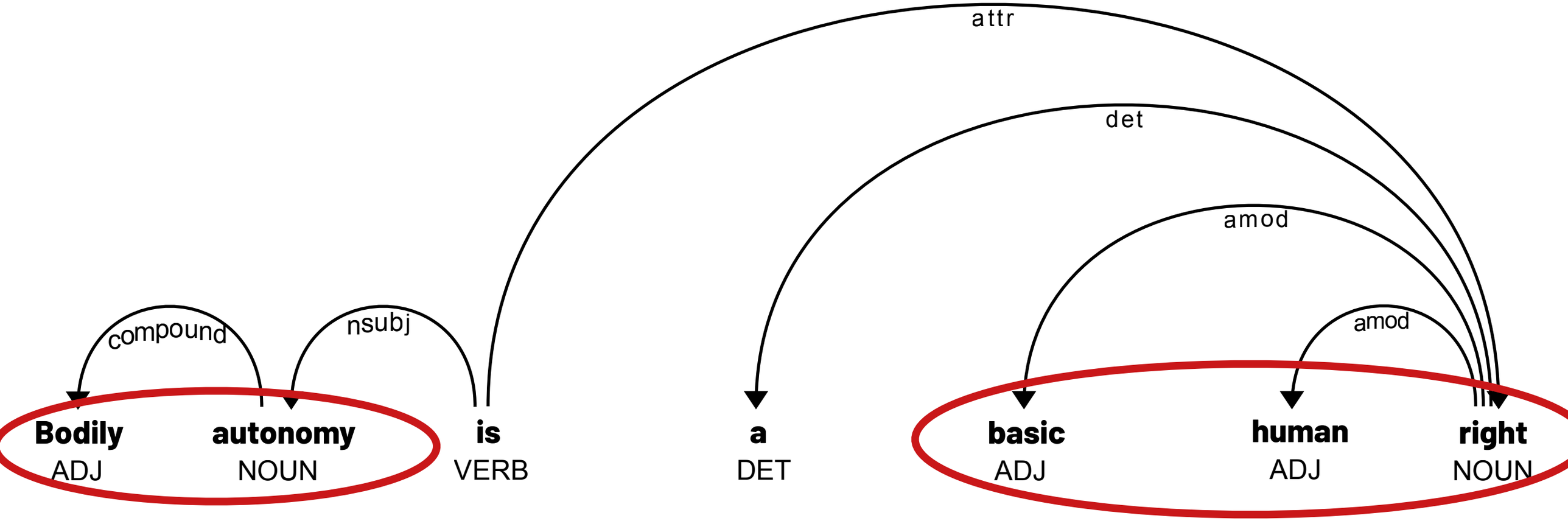

2. Inferring Network Structure

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Grammatical structure:
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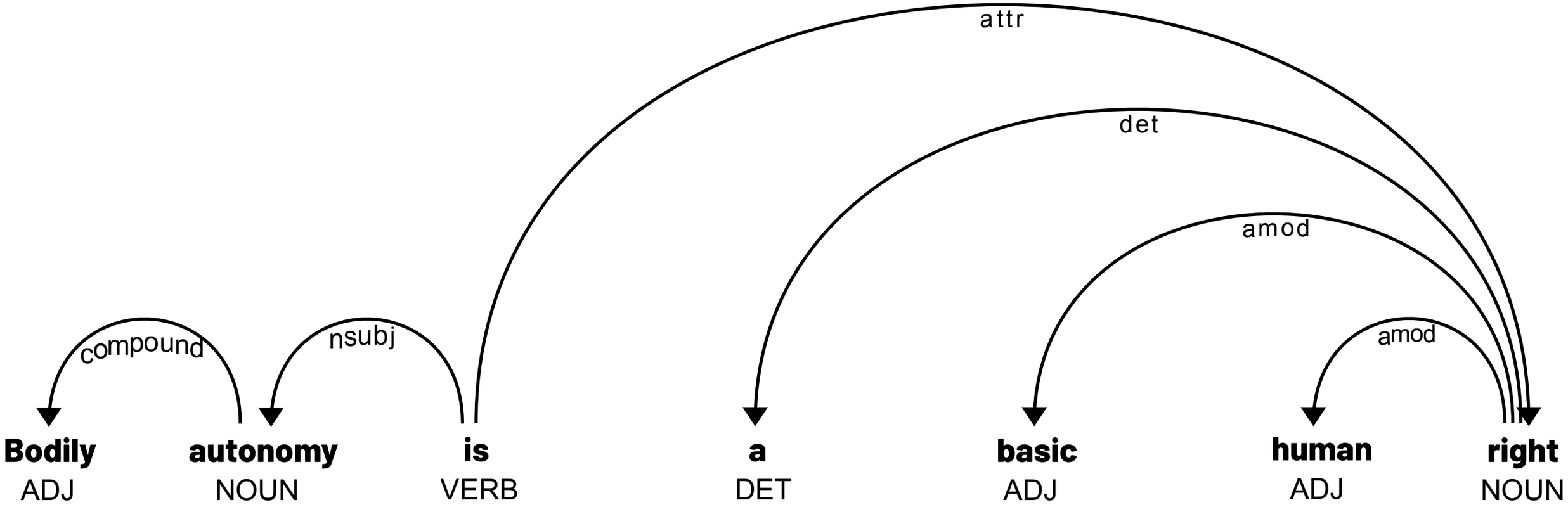
2. Inferring Network Structure

Model steps

1. Infer Part of Speech tags and grammatical structure



2. Inferring Network Structure

Model steps

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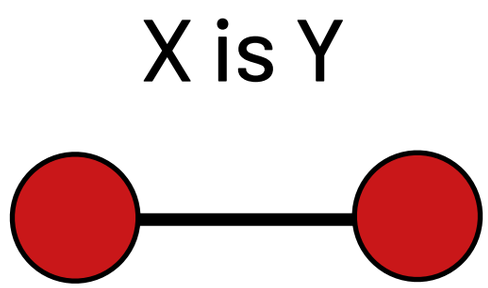

2. Inferring Network Structure

Model steps

1. Infer Part of Speech tags and grammatical structure
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X is **not** Y

2. Inferring Network Structure

Model steps

1. Infer Part of Speech tags and grammatical structure
2. Turn negative words into negative ties
3. Remove stopwords, maintaining network structure

The X is a Y

2. Inferring Network Structure

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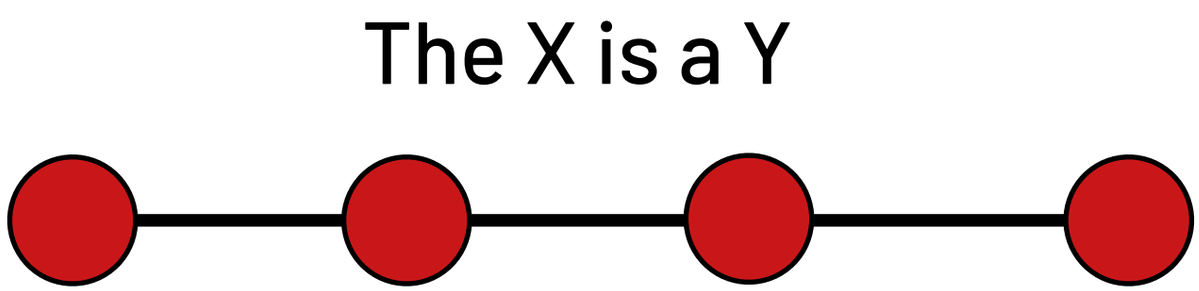

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~~The~~ X is ~~a~~ Y

2. Inferring Network Structure

Model steps

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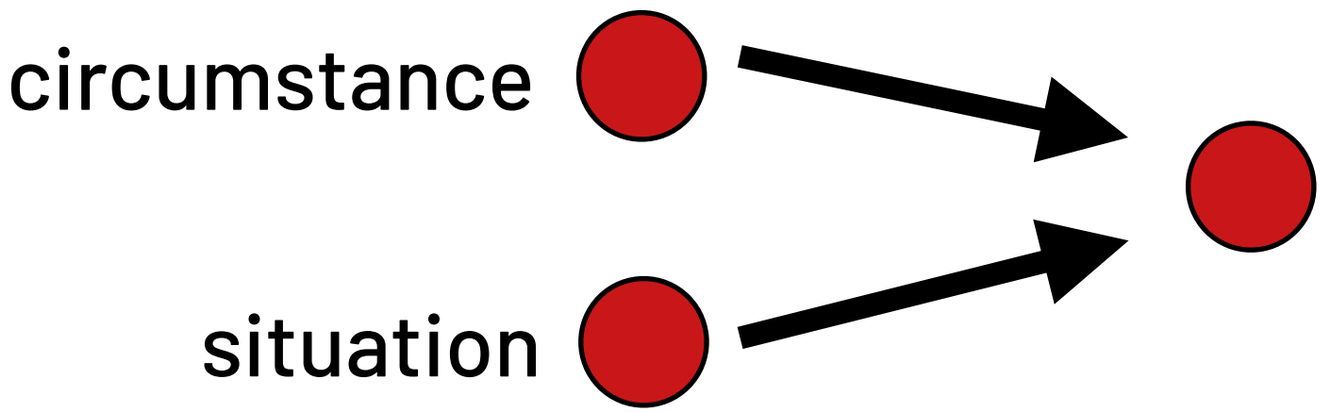
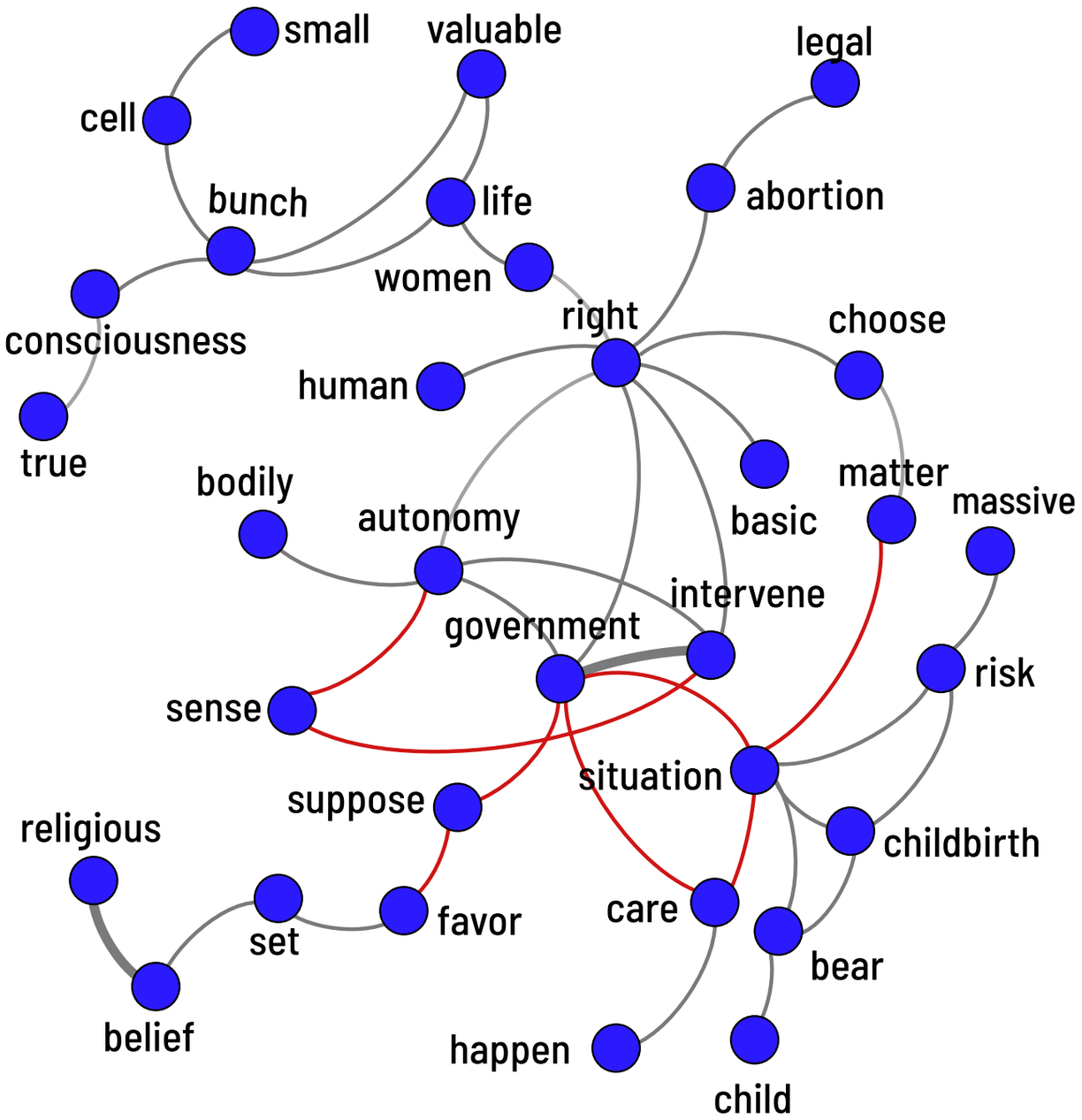
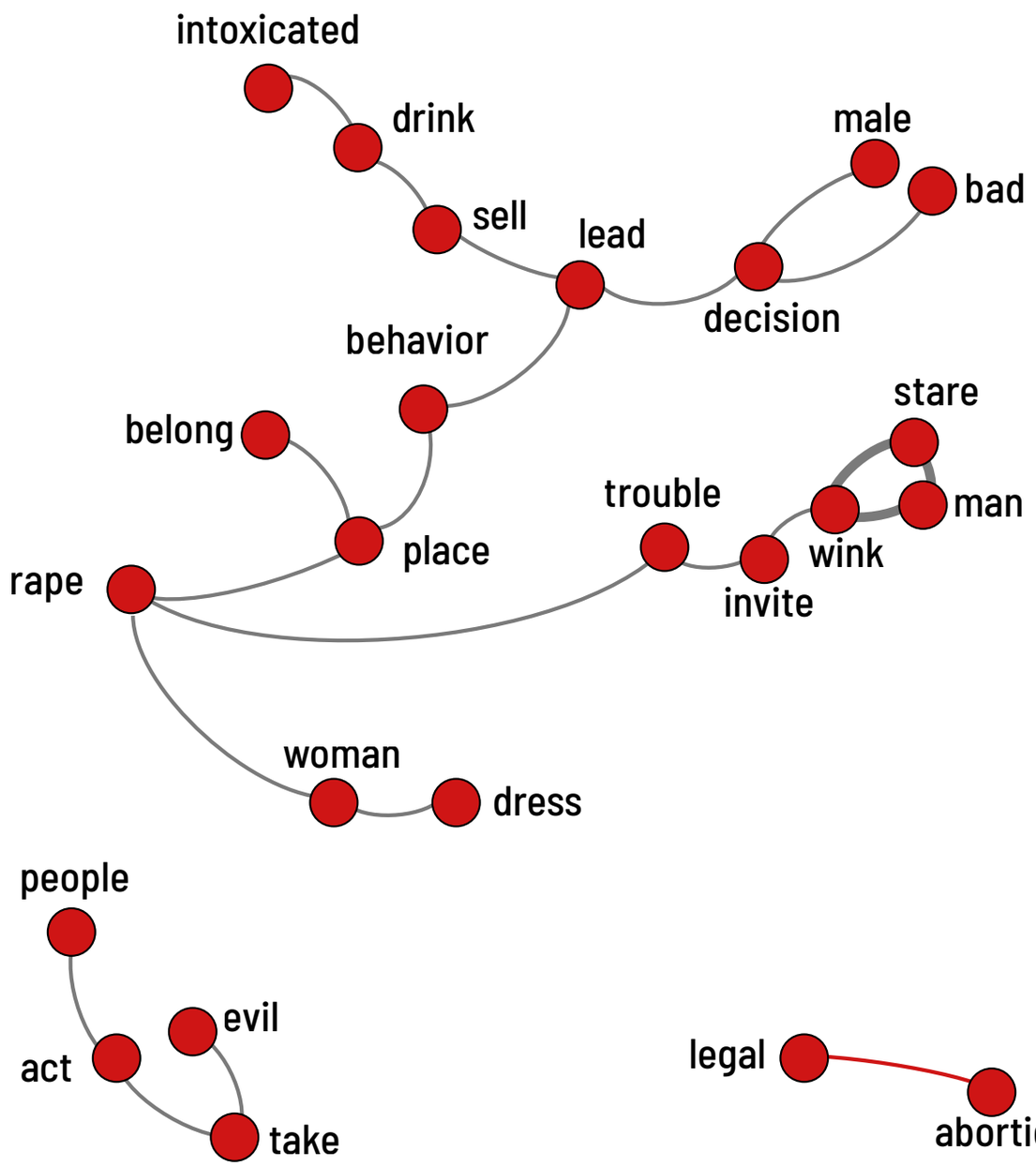
3. Remove stopwords, maintaining network structure
4. Merge similar words using embeddings



Sample Inferred Networks

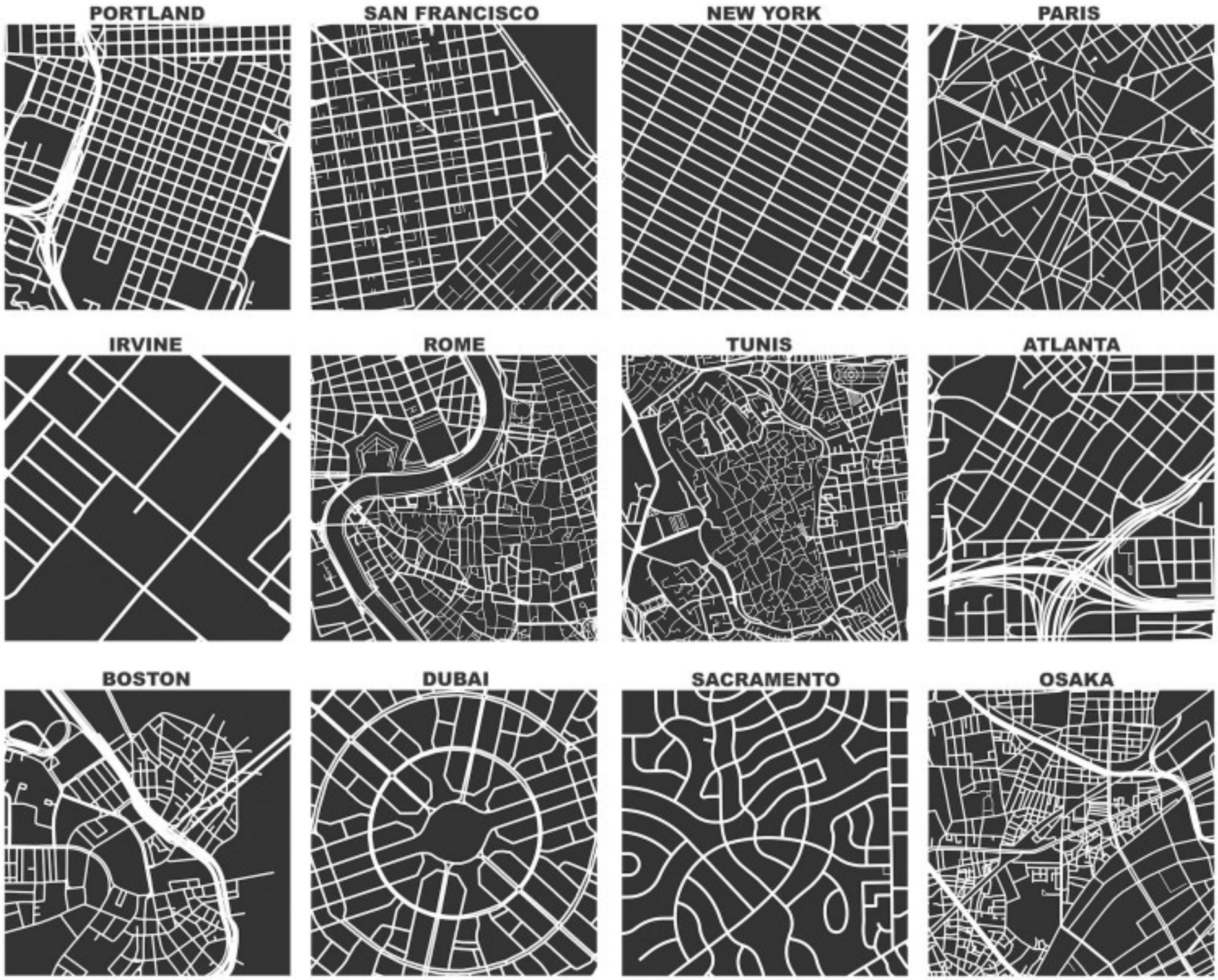




Positive weight Negative weight

Measuring Network Similarity

Measuring Network Similarity

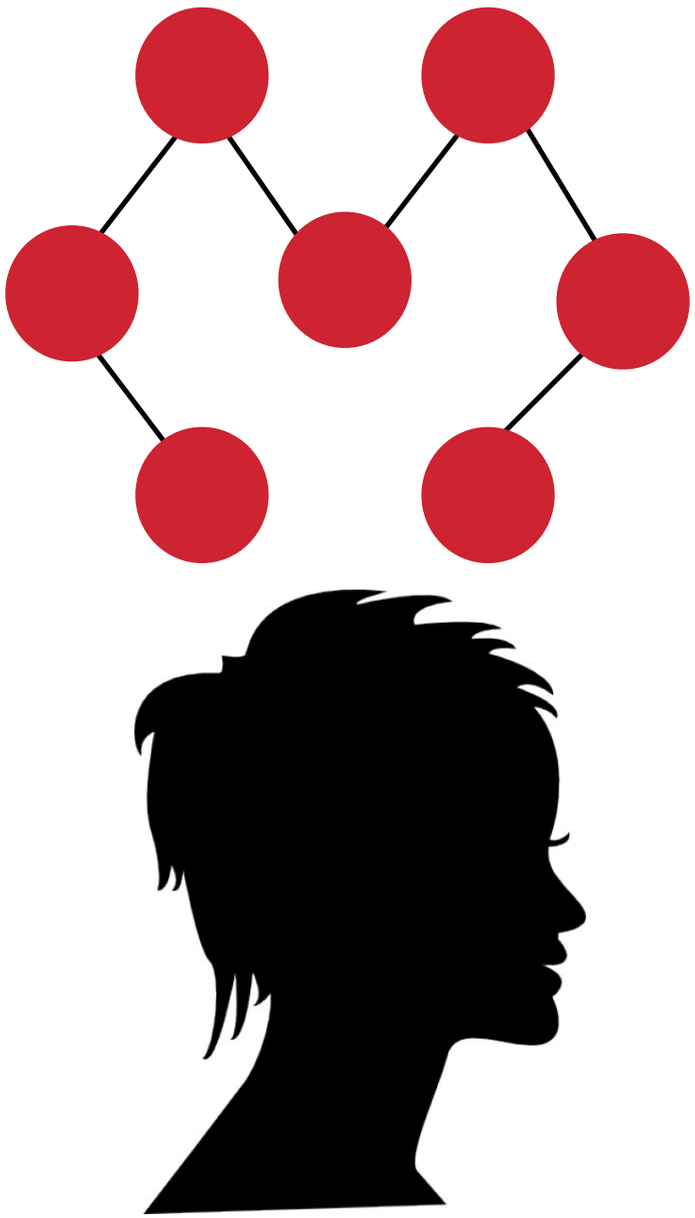


Boeing, 2017

Political Reasoning is Structured

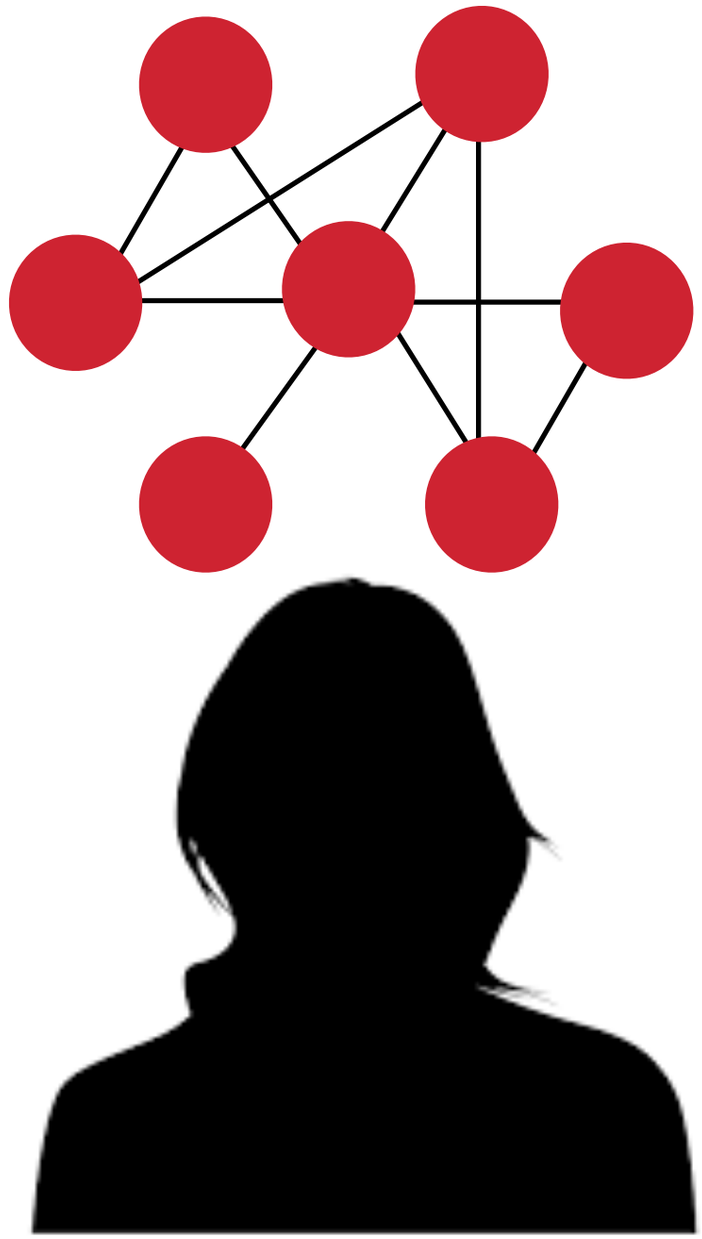
Connectivity

Baseline



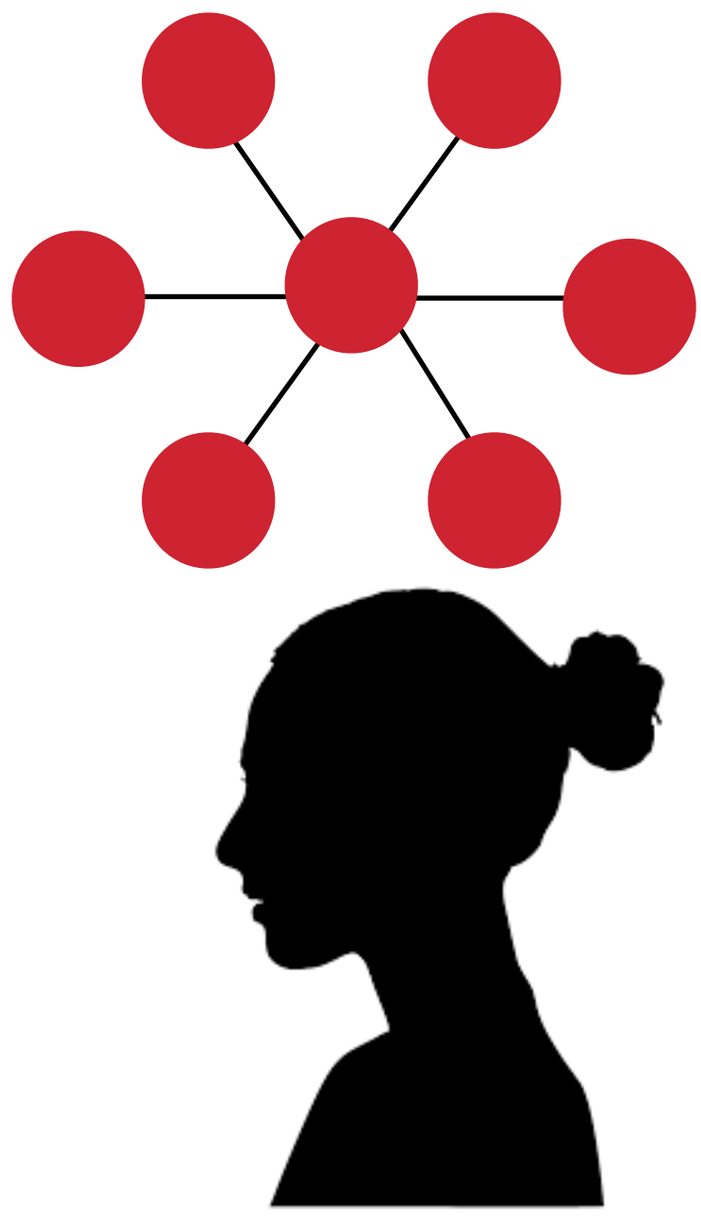
Complexity

Dancy, 1993



Hierarchy

Sidgwick, 1907



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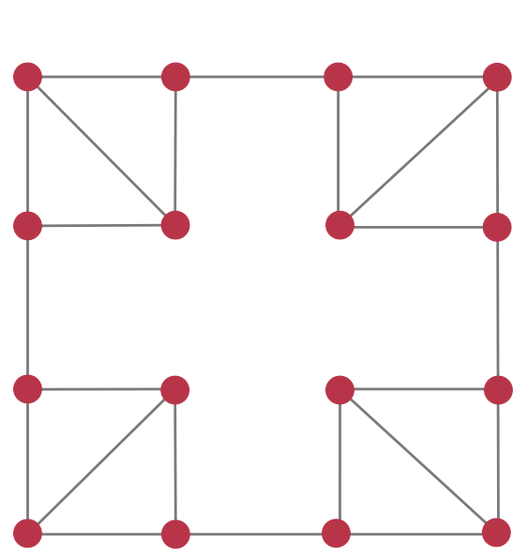

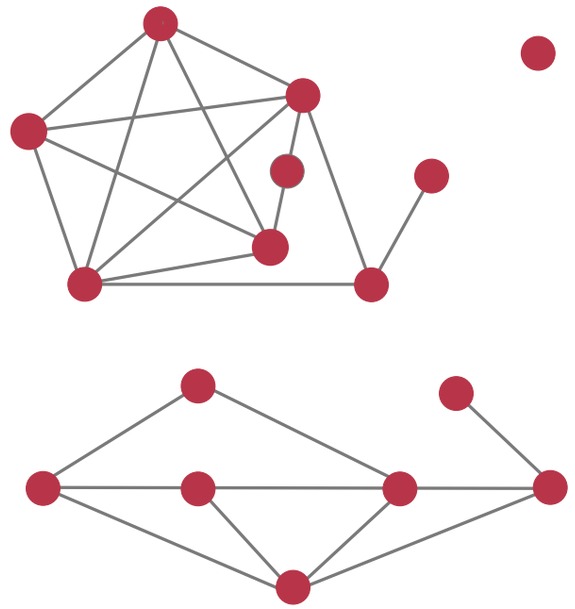

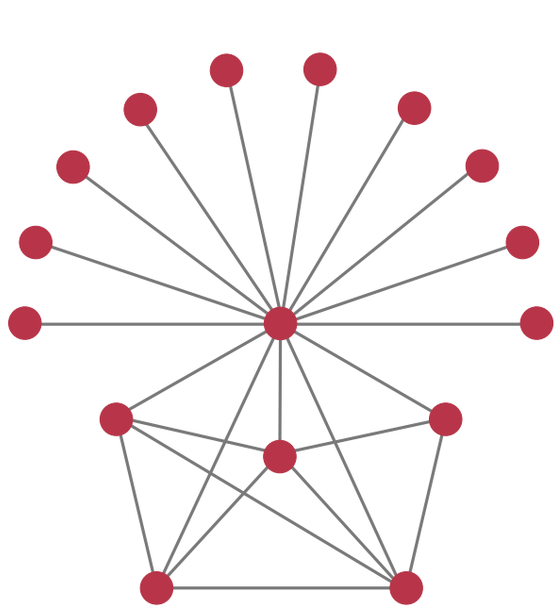

Homogeneous → **Heterogenous**

density	0.2	0.2	0.2
k avg	3.0	3.0	3.0
clustering	0.2	0.4	0.3
giant component	1.0	0.4	1.0
entropy	0.0	1.5	1.0
disassortativity	-1.0	-0.1	0.7
k std	0.0	3.0	3.5

The Structure of Reasoning

Roadmap:

1. Elaborate on “structure”
2. Define approach for inferring and measuring structure
3. **Demonstrate potential for behavioral insights — using two distinct datasets**

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Does the structure of expressed reasons convey useful information?

Data

Data

1. Experiment and survey
    - 100 subjects, recruited through MTurk
    - Three methods of inferring networks, for two of three topics: (1) abortion (2) healthcare (3) childrearing
    - Extensive demographic and personality survey

Shugars, Beauchamp, and Levine; 2019

Data

1. Experiment and survey
    - 100 subjects, recruited through MTurk
    - Three methods of inferring networks, for two of three topics: (1) abortion (2) healthcare (3) childrearing
    - Extensive demographic and personality survey

2. Ideological “Turing test"
    - 1000 subjects, recruited by YouGov
    - Asked to provide “liberal” and “conservative” positions on one of three topics
      (1) abortion (2) minimum wage (3) national defense

Hopkins and Noel, 2016

Data

1. Experiment and survey
    - 100 subjects, recruited through MTurk
    - Three methods of inferring networks, for two of three topics: (1) abortion (2) healthcare (3) childrearing
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Research Questions

- Does structure meaningfully correlate to known personality traits?

Shugars, Beauchamp, and Levine; 2019

3. Potential for Behavioral Insights

Research Questions

- Does structure meaningfully correlate to known personality traits?

  - Purity (Moral Foundations)
  - Authority (Moral Foundations)
  - Ingroup (Moral Foundations)
  - Harm (Moral Foundations)
  - Fairness (Moral Foundations)
  - Progressivism (Moral Foundations)

  - Extroversion (Big 5)
  - Agreeableness (Big 5)
  - Neuroticism (Big 5)
  - Conscientiousness (Big 5)
  - Openness (Big 5)

  - Ideology: Conservative
  - Political Knowledge
  - Deliberativeness

Haidt & Joseph, 2008; John & Srivastava, 1999

Gastil et al., 2012; Carpini & Keeter, 1993 ; Pew, 2017

3. Potential for Behavioral Insights

Research Questions

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$$s = \beta p + \alpha_t + \epsilon$$

3. Potential for Behavioral Insights

Research Questions

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$$s = \beta p + \alpha_t + \epsilon$$

Network statistic

Personality measure

Topic fixed effect

3. Potential for Behavioral Insights

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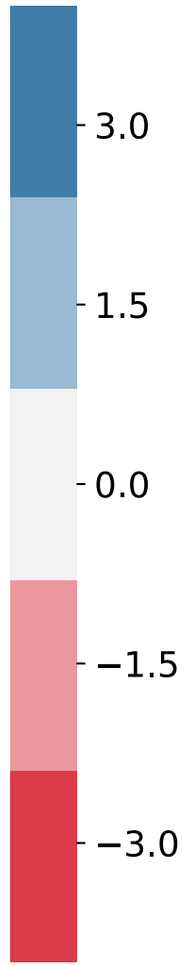
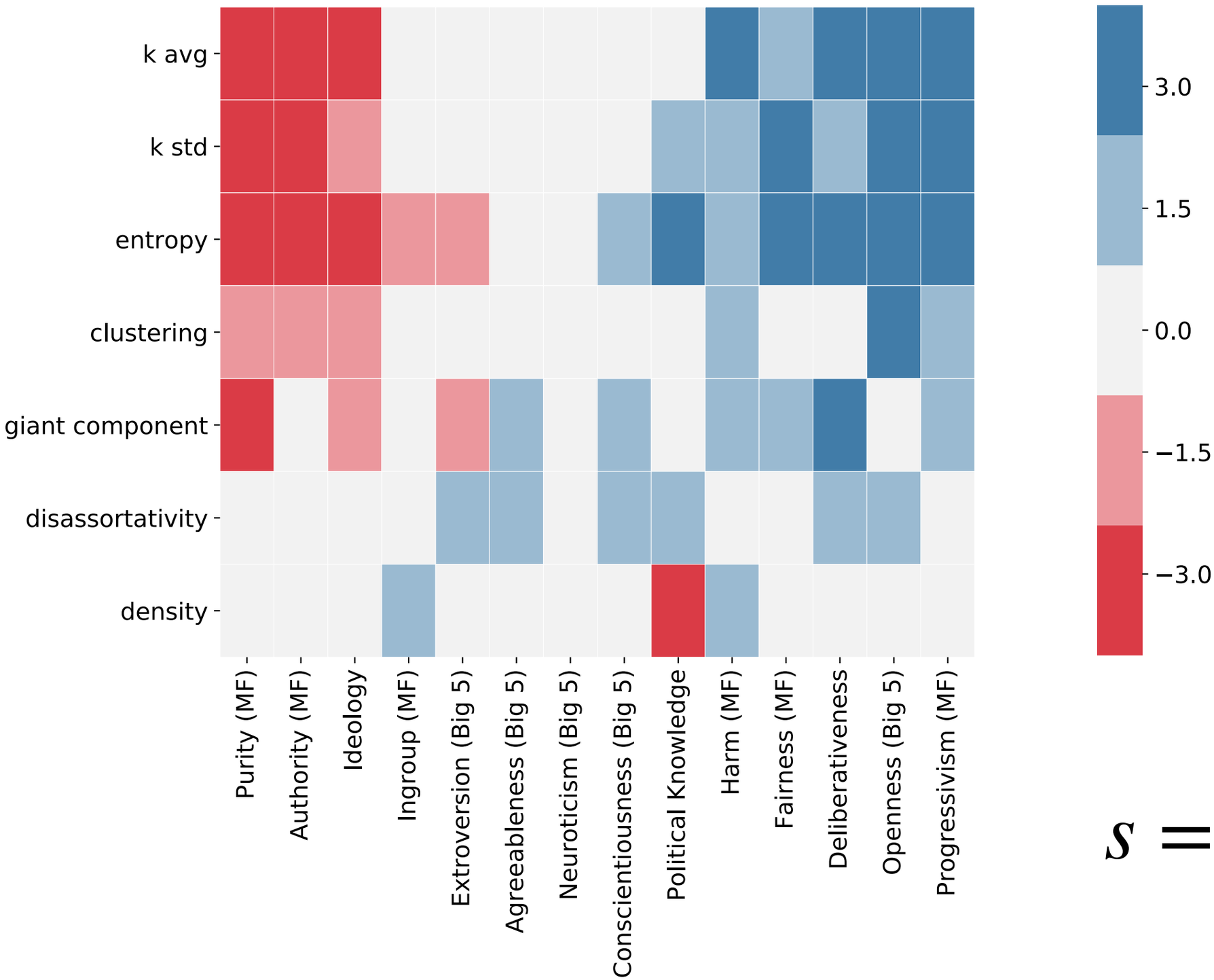
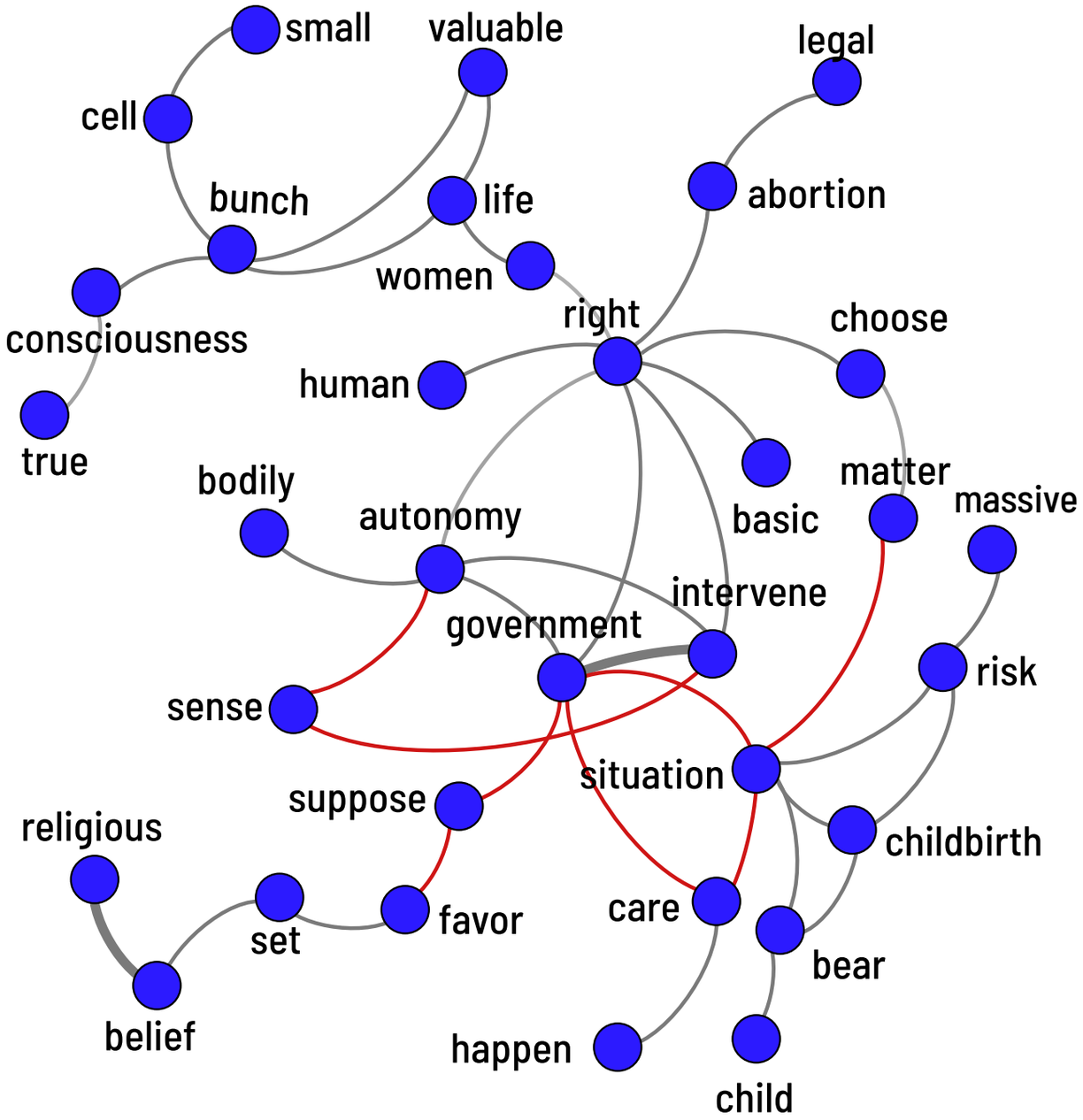


3. Potential for Behavioral Insights

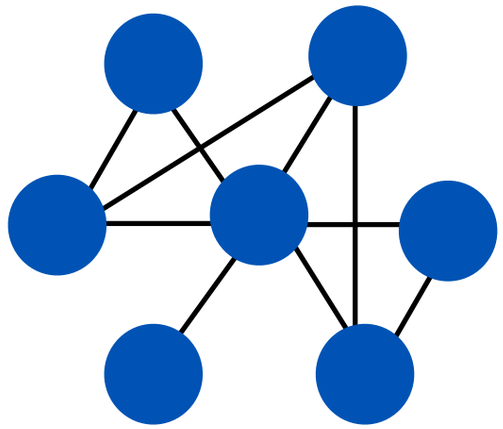


$$s = \beta p + \alpha_t + \epsilon$$

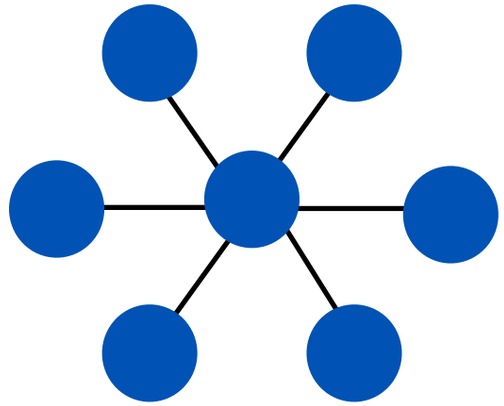
3. Potential for Behavioral Insights



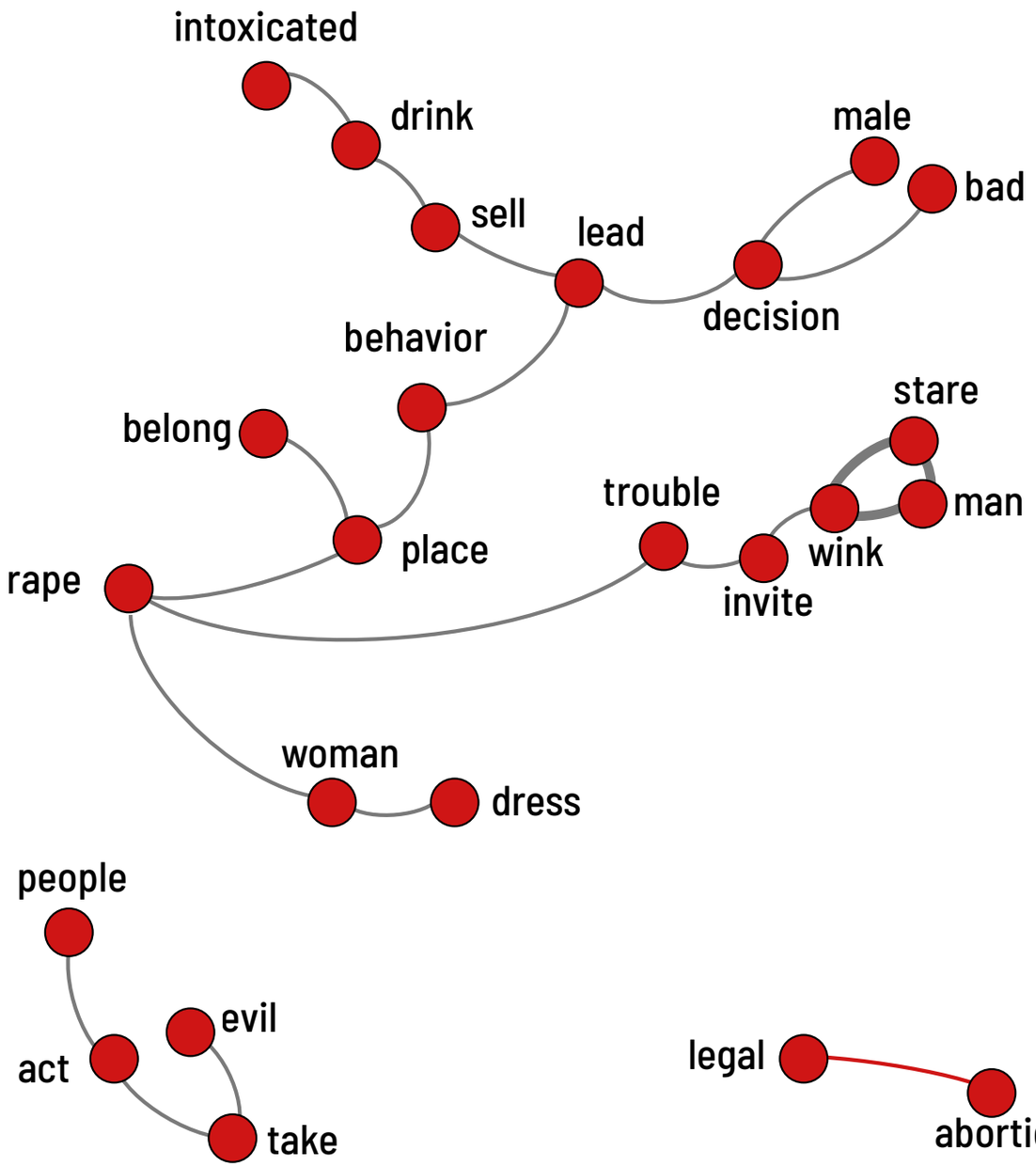
Complexity



Hierarchy

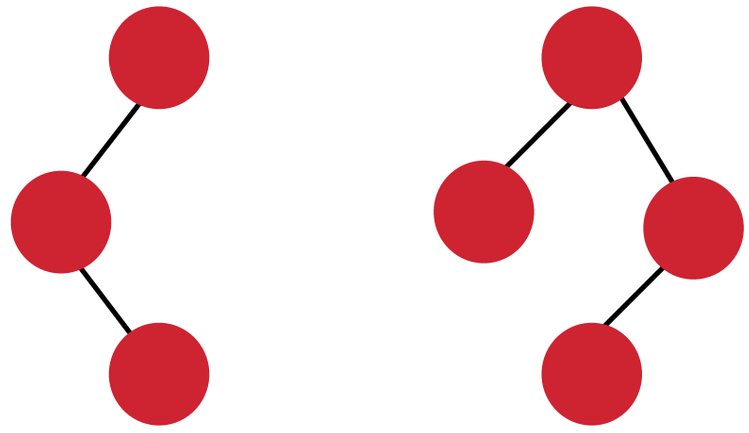


3. Potential for Behavioral Insights



(lack of)

Connectivity



Data

1. Experiment and survey
    - 100 subjects, recruited through MTurk
    - Three methods of inferring networks, for two of three topics: (1) abortion (2) healthcare (3) childrearing
    - Extensive demographic and personality survey

Research Questions

- Does structure meaningfully correlate to known personality traits? **Yes.**

Shugars, Beauchamp, and Levine; 2019

Data

2. Ideological “Turing test"
    - 1000 subjects, recruited by YouGov
    - Asked to provide “liberal” and “conservative” positions on one of three topics
      (1) abortion (2) minimum wage (3) national defense

Hopkins and Noel, 2016

Data

2. Ideological “Turing test"
    - 1000 subjects, recruited by YouGov
    - Asked to provide “liberal” and “conservative” positions on one of three topics
      (1) abortion (2) minimum wage (3) national defense

Research Questions

- Is structure driven by ideology or by individual traits
- Does structure suggest argument quality?

Hopkins and Noel, 2016

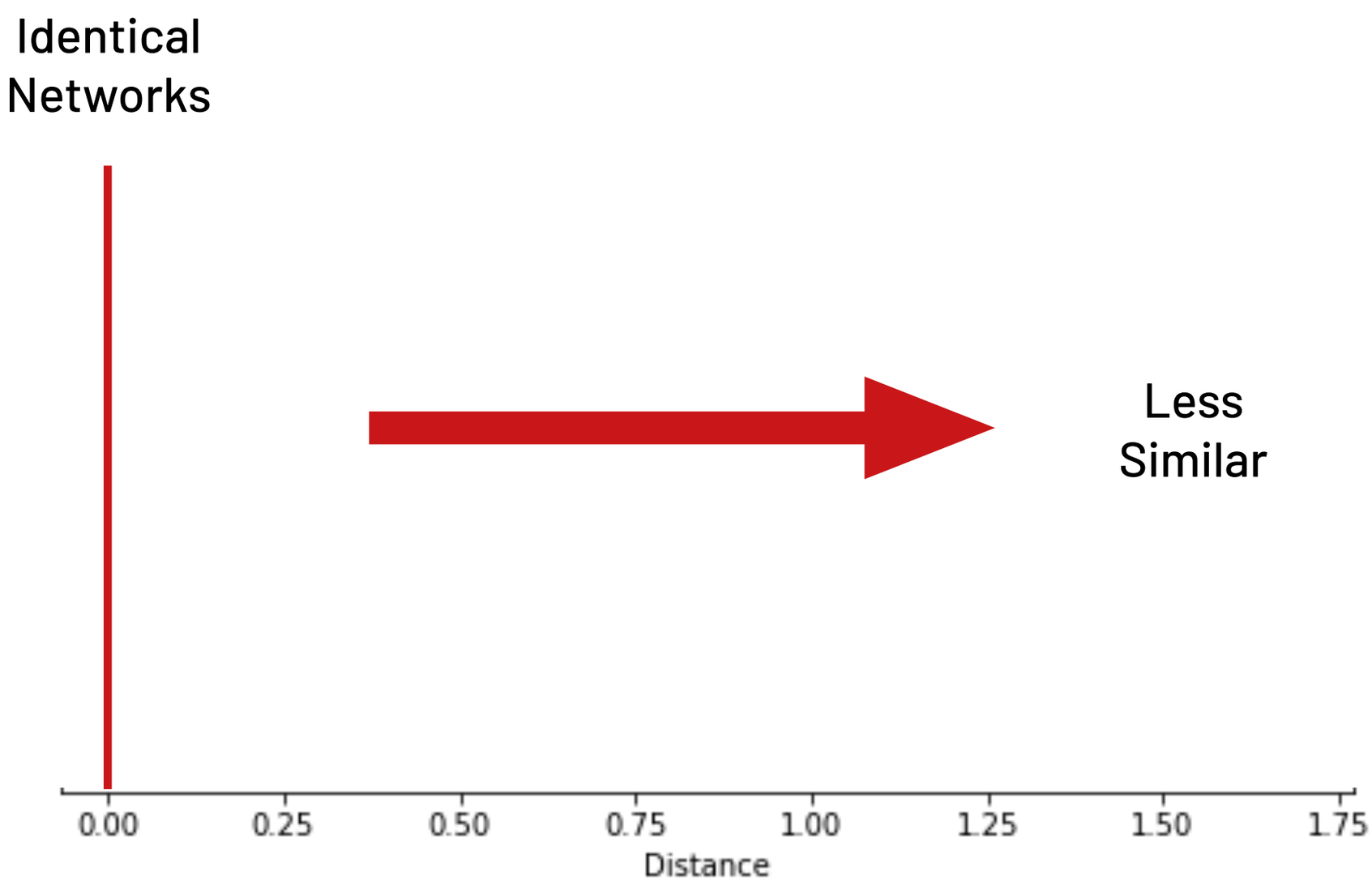
3. Potential for Behavioral Insights

My liberal essay v.
My conservative essay

My liberal essay v.
Your liberal essay

Which are more similar?

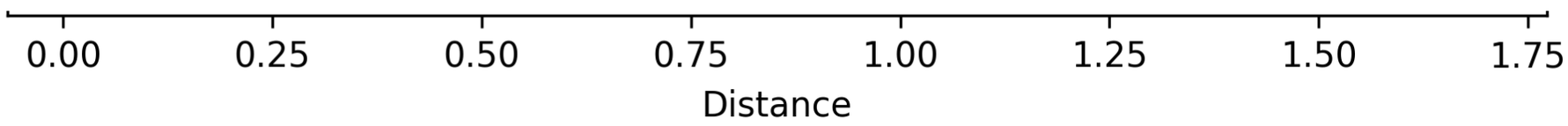
3. Potential for Behavioral Insights



3. Potential for Behavioral Insights

My liberal essay v.
My conservative essay

My liberal essay v.
Your liberal essay

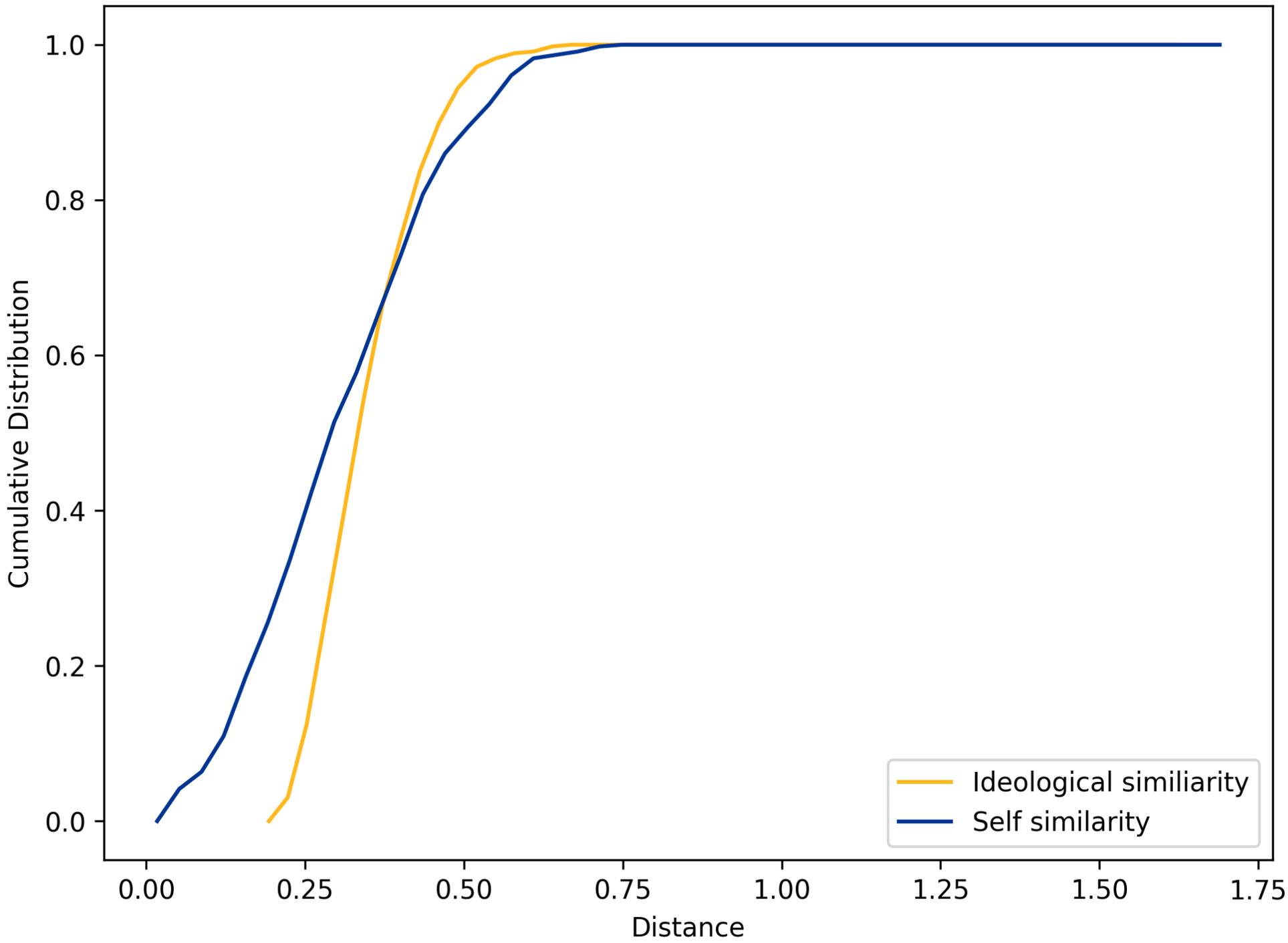


3. Potential for Behavioral Insights

My liberal essay v.
Your liberal essay

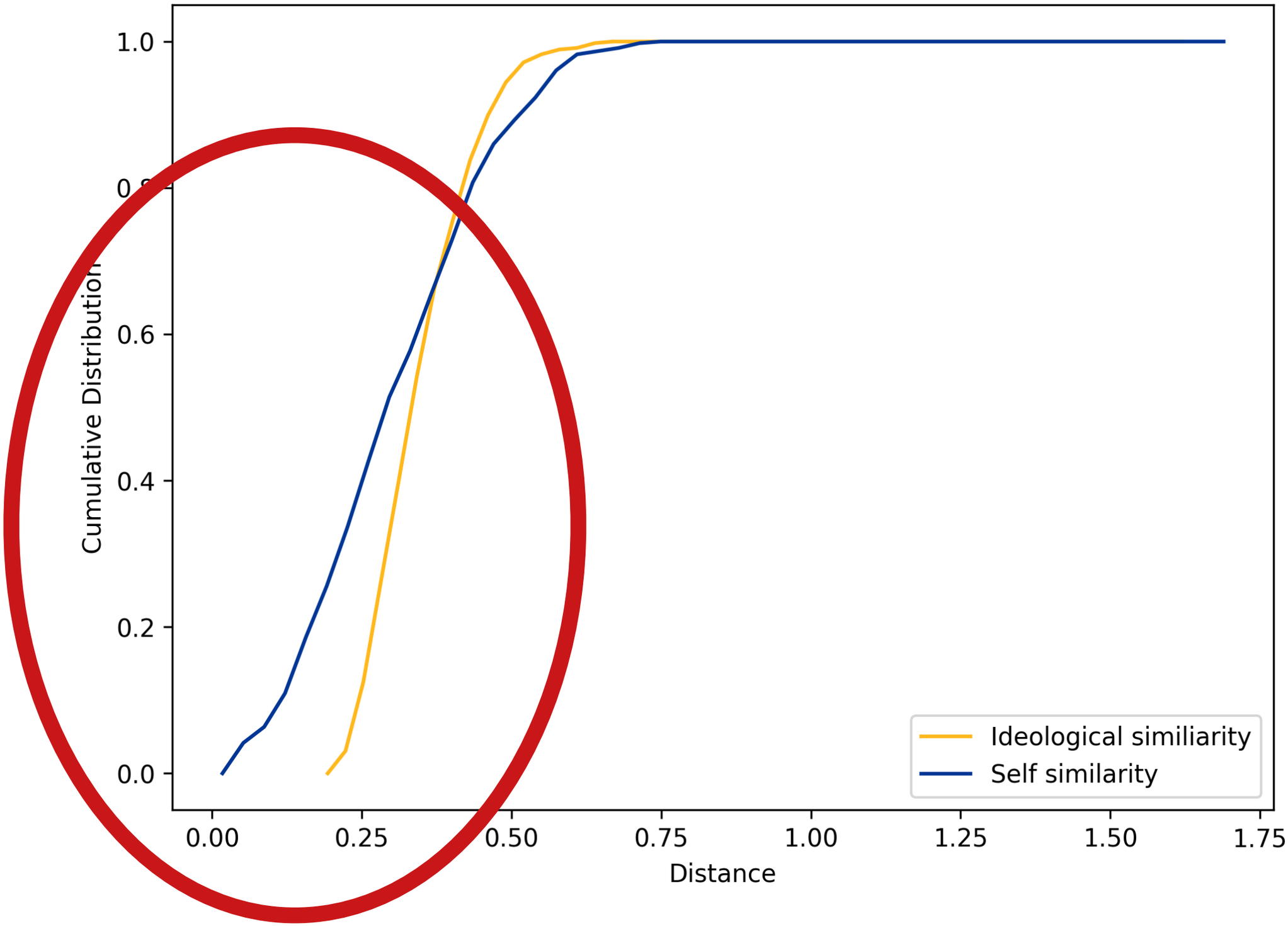
My liberal essay v.
My conservative essay

3. Potential for Behavioral Insights



$p << 0.05$

3. Potential for Behavioral Insights



$p << 0.05$

Data

2. Ideological “Turing test"
    - 1000 subjects, recruited by YouGov
    - Asked to provide “liberal” and “conservative” positions on one of three topics
      (1) abortion (2) minimum wage (3) national defense

Research Questions

- Is structure driven by ideology or by individual traits?
  Individual traits.
- Does structure suggest argument quality?

Hopkins and Noel, 2016

3. Potential for Behavioral Insights

Does structure suggest argument quality?

- ➡ Can we tell “authentic” from “ironic” responses?

Data — Guess That Ideology!

The conservative / liberal position on abortion is:

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The liberal position on abortion is:

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The liberal position on abortion is:

> A woman has the right to determine what happens to her body

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The liberal position on abortion is:

> A woman has the right to determine what happens to her body
>
> **Coding = 1**
> **Authentic**

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The liberal position on abortion is:

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The liberal position on abortion is:

> It is okay to murder

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The liberal position on abortion is:

It is okay to murder

Coding = 0
Ironic

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The conservative position on abortion is:

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The conservative position on abortion is:

> Women need guidance from more superior men!

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The conservative position on abortion is:

> Women need guidance from more superior men!
>
> **Coding = 0**
> **Ironic**

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The conservative position on abortion is:

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The conservative position on abortion is:

> All life is sacred.

This text was written by a:

conservative

liberal

Data — Guess That Ideology!

The conservative position on abortion is:

All life is sacred.

Coding = 1
Authentic

This text was written by a:

conservative

liberal

3. Potential for Behavioral Insights

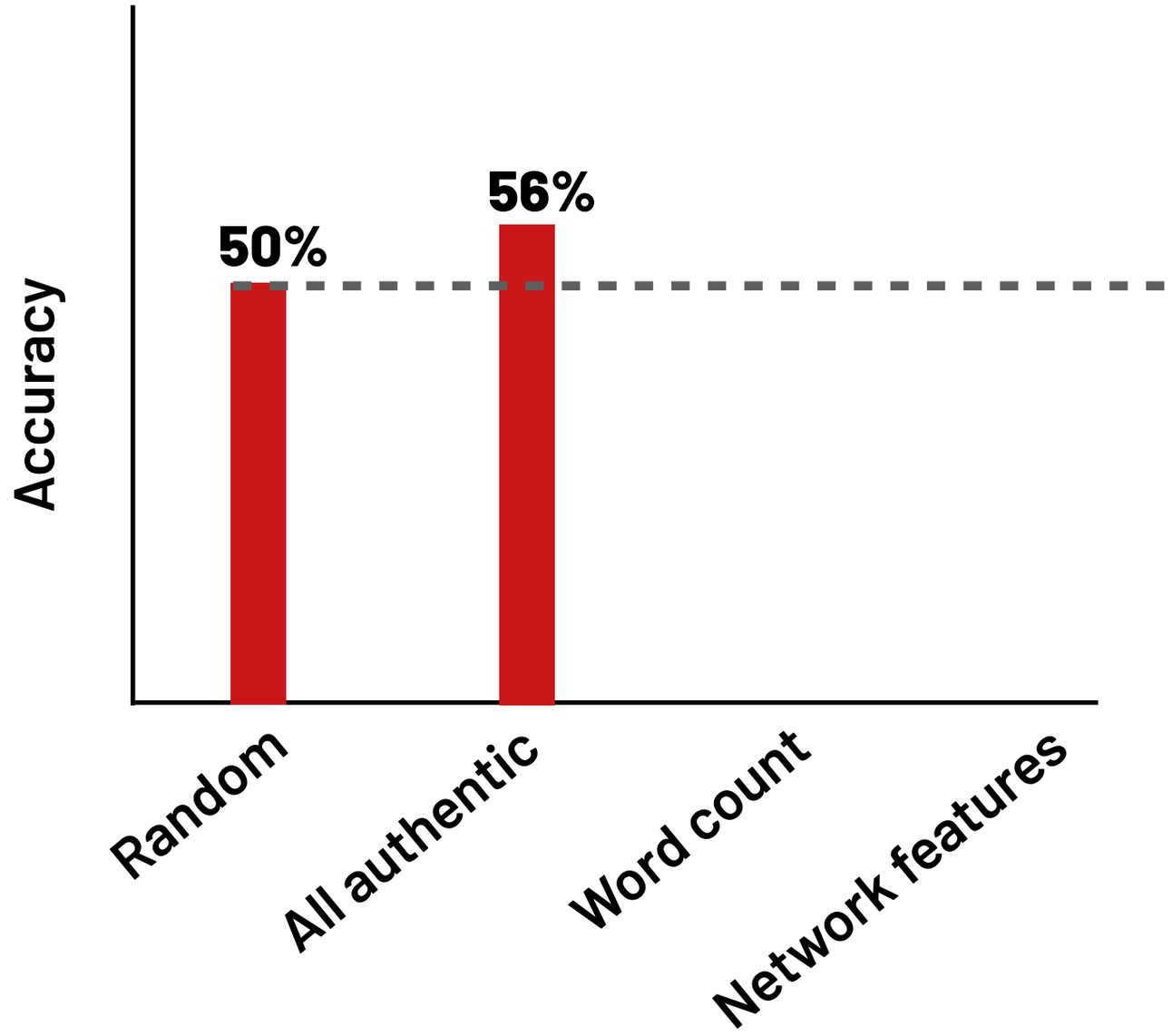
Does structure suggest argument quality?

- ➡ Can we tell “authentic” from “ironic” responses?

3. Potential for Behavioral Insights

Does structure suggest argument quality?

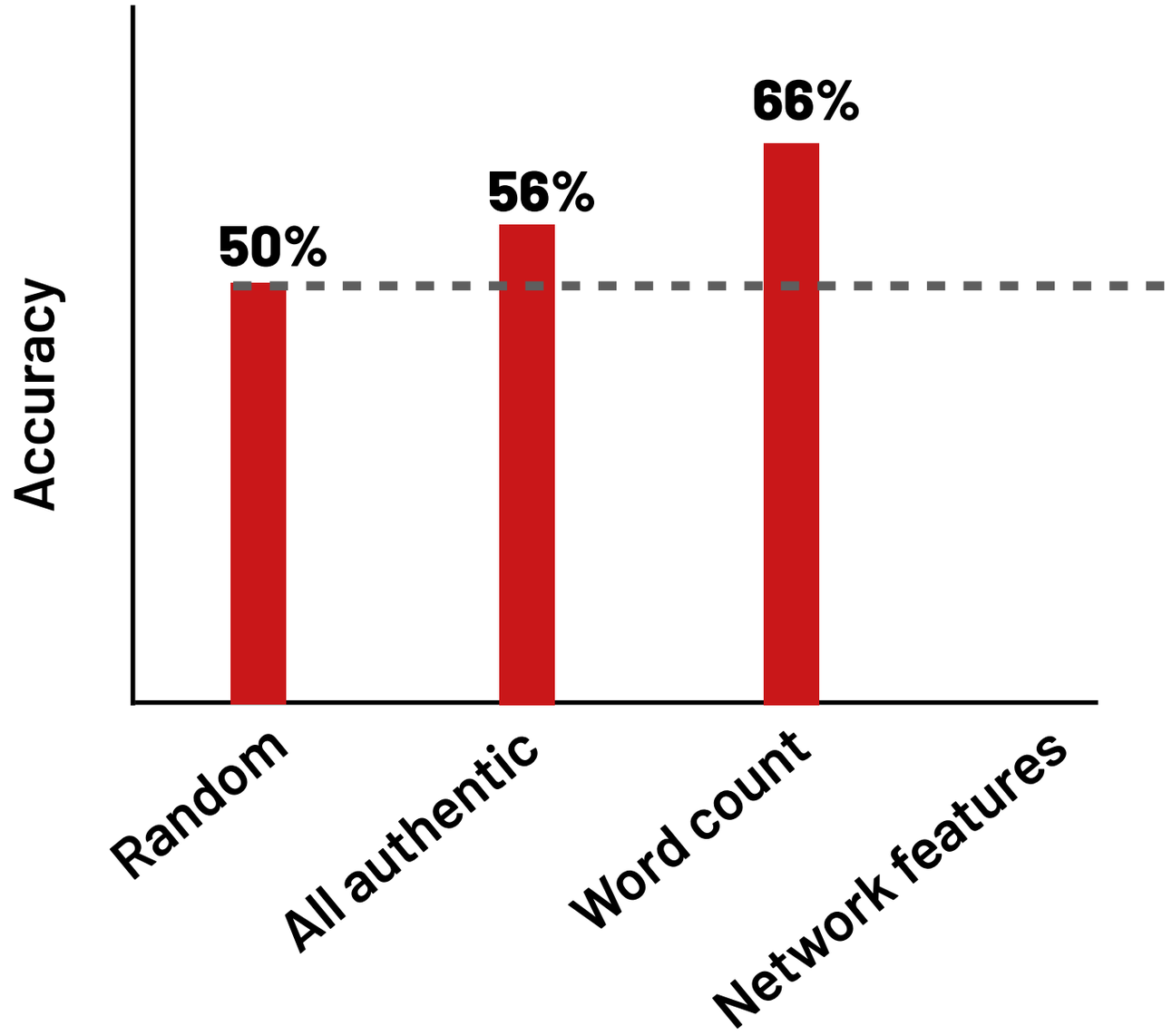
- Can we tell “authentic” from “ironic” responses?



3. Potential for Behavioral Insights

Does structure suggest argument quality?

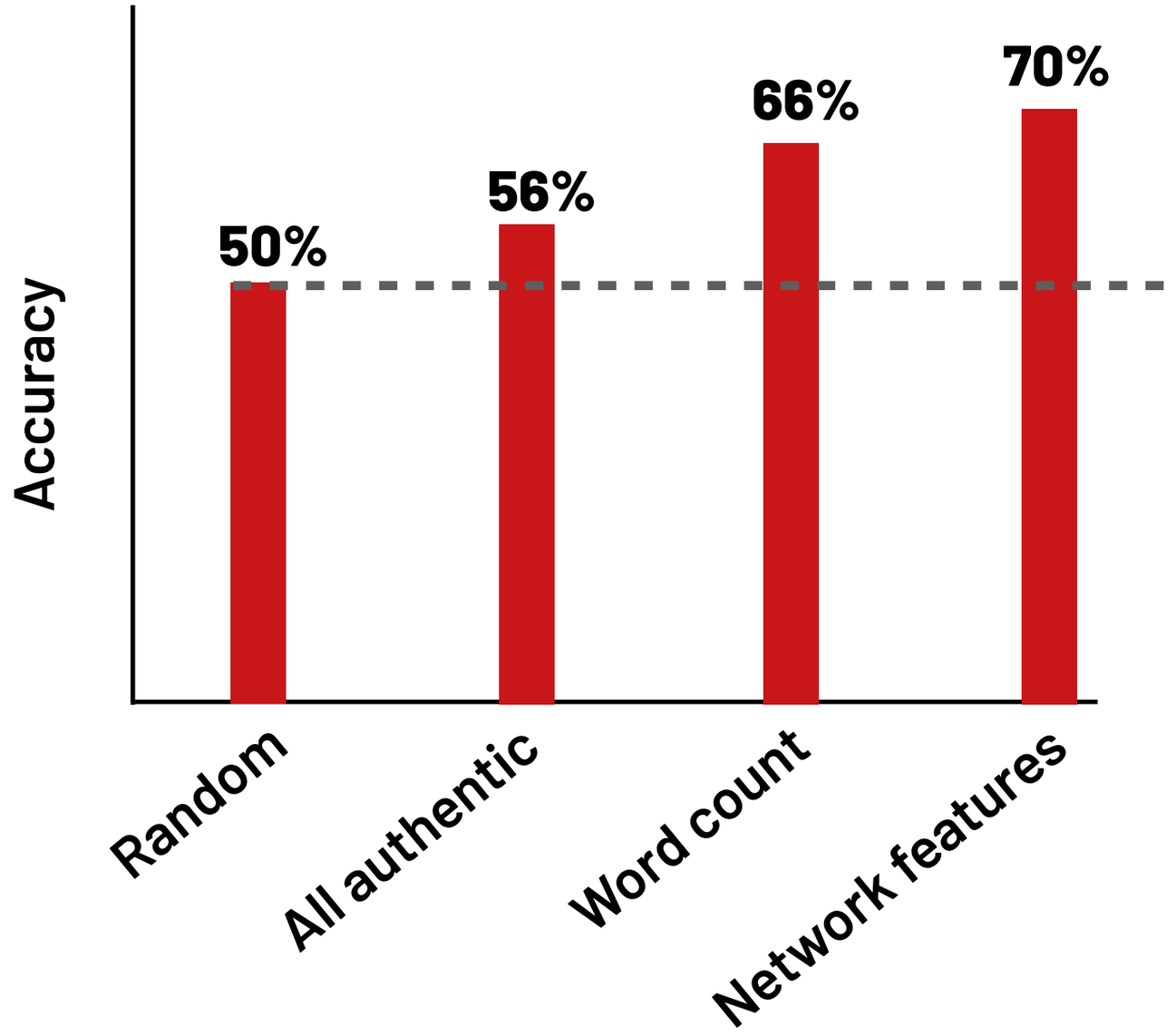
- Can we tell “authentic” from “ironic” responses?



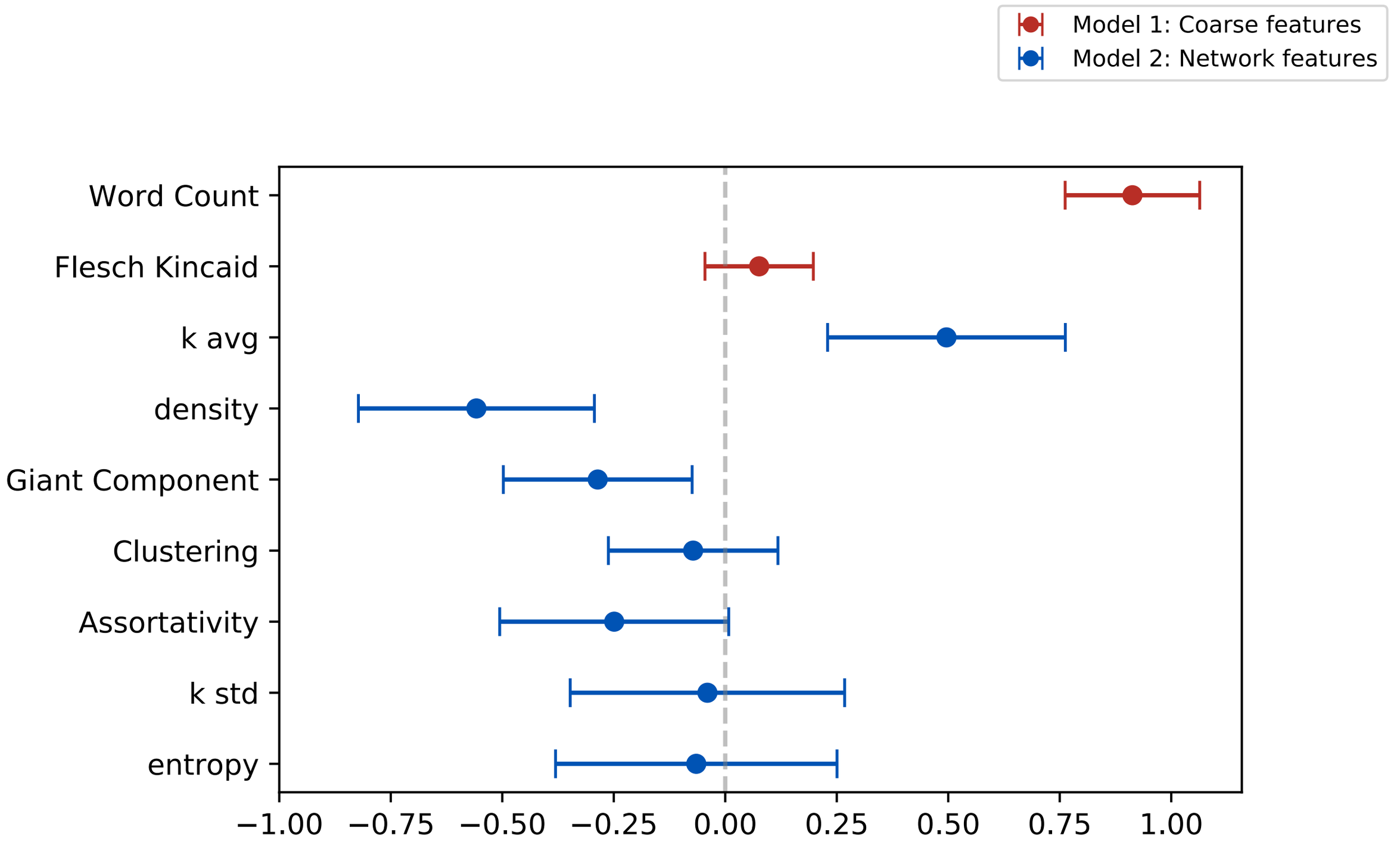
3. Potential for Behavioral Insights

Does structure suggest argument quality?

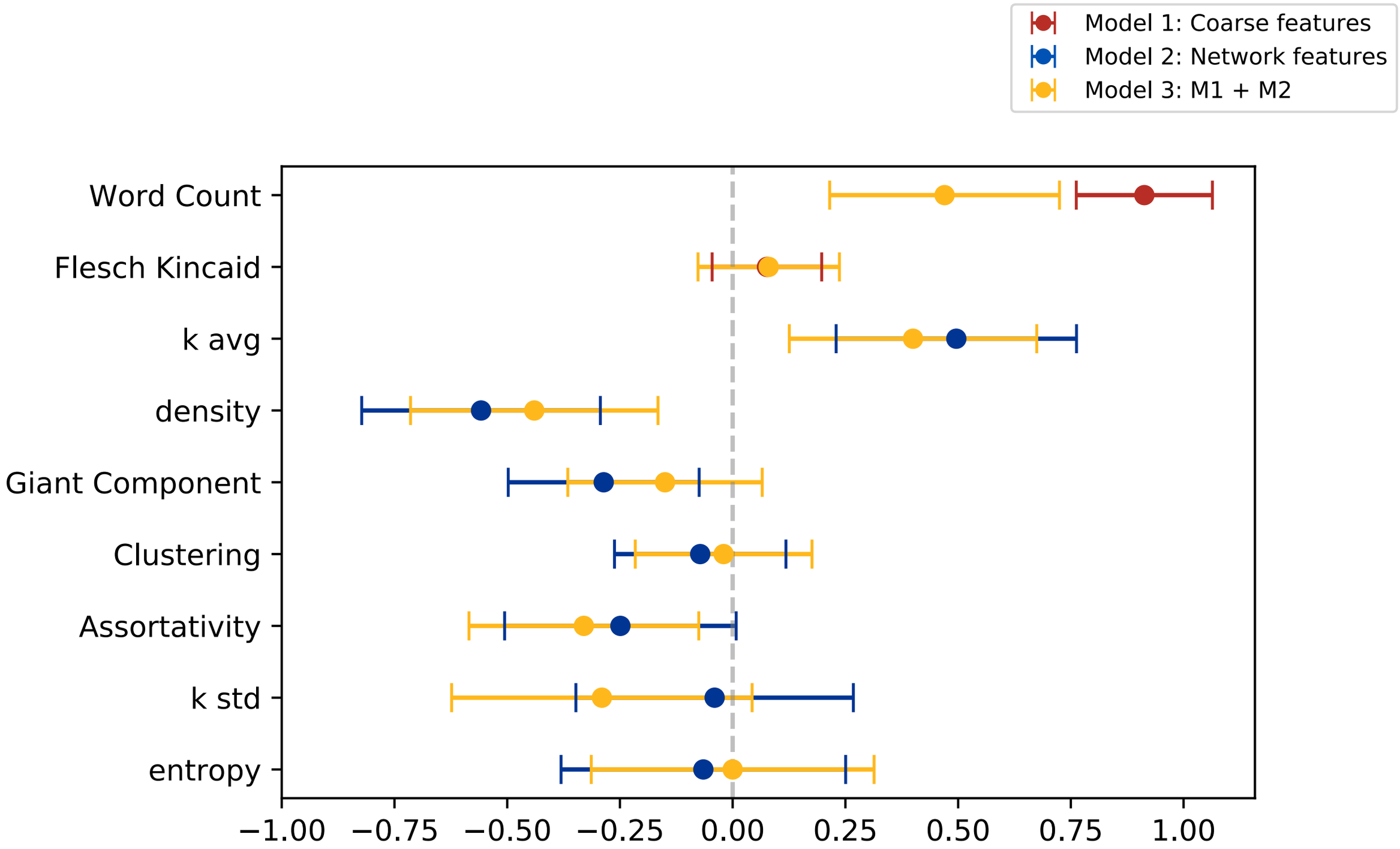
- Can we tell “authentic” from “ironic” responses?



3. Potential for Behavioral Insights



3. Potential for Behavioral Insights



3. Potential for Behavioral Insights

2. Ideological “Turing test"
    - 1000 subjects, recruited by YouGov
    - Asked to provide “liberal” and “conservative” positions on one of three topics
      (1) abortion (2) minimum wage (3) national defense

Research Questions

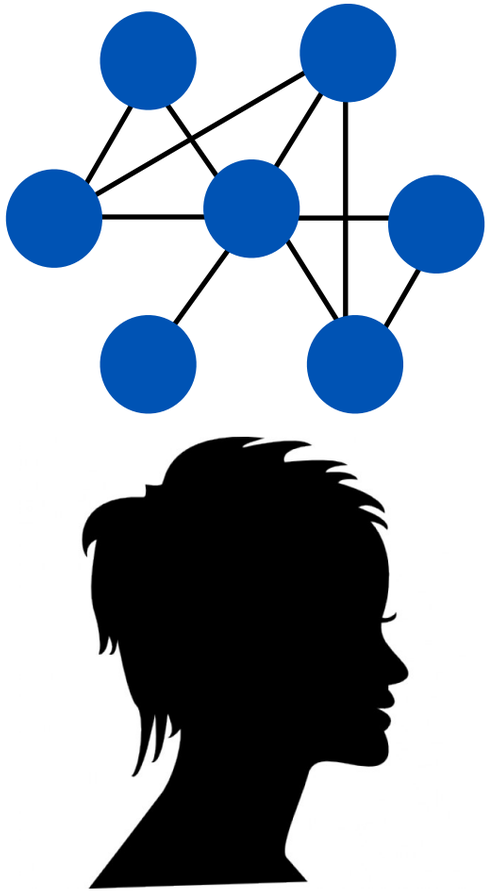
- Is structure driven by ideology or by individual traits? **Individual traits.**
- Does structure suggest argument quality? **Yes.**

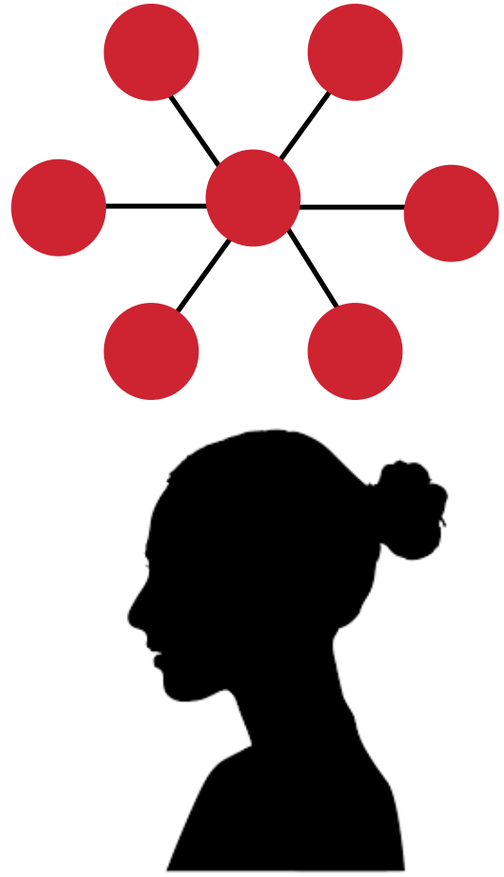
Hopkins and Noel, 2016

What's Next?

What's Next?

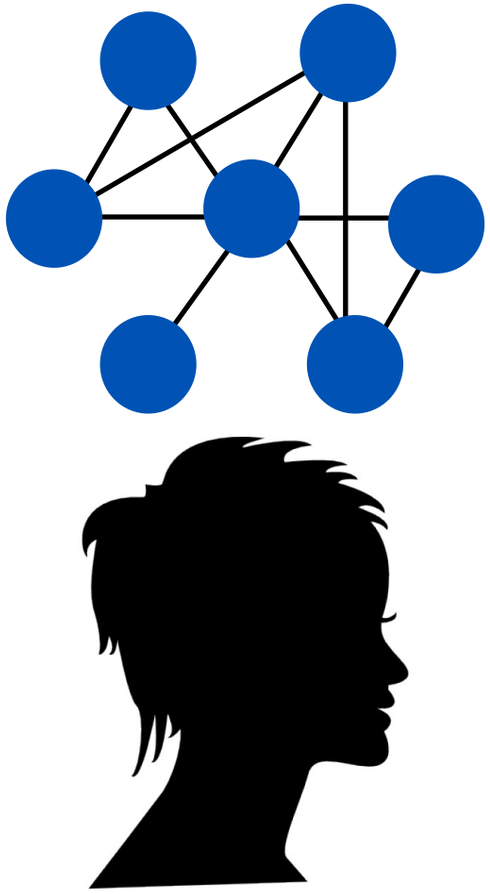
Can we measure individual variation in how people structure their political expressions, and do we really care anyway?



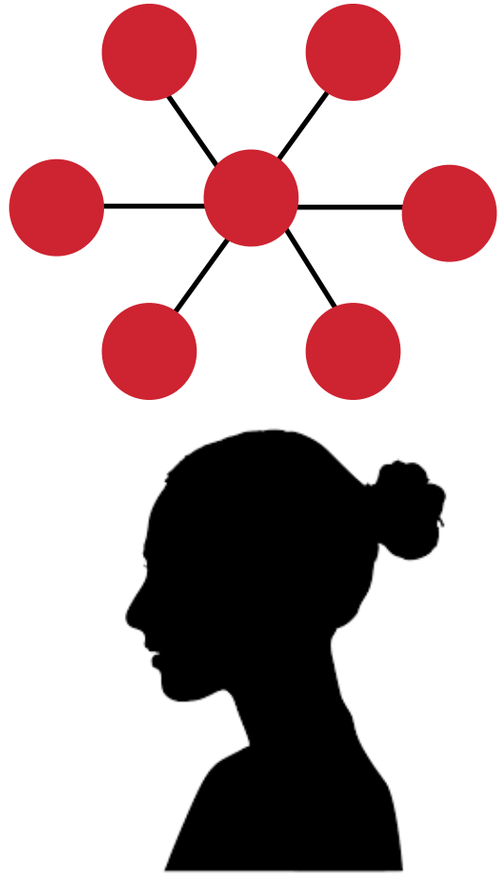


What's Next?

Can we measure individual variation in how people structure their political expressions, and do we really care anyway?

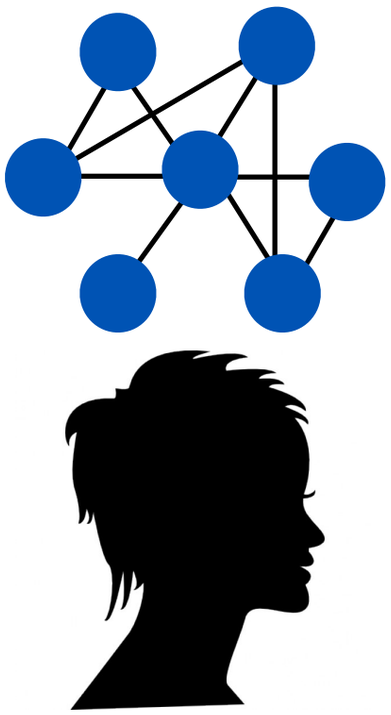


Yes.



Summary

- New method for inferring structure of expressed reasons
- Reveals small but meaningful individual variation
- Correlated with known personality traits
- Potential for new insights into dynamics of public opinion



Sarah Shugars

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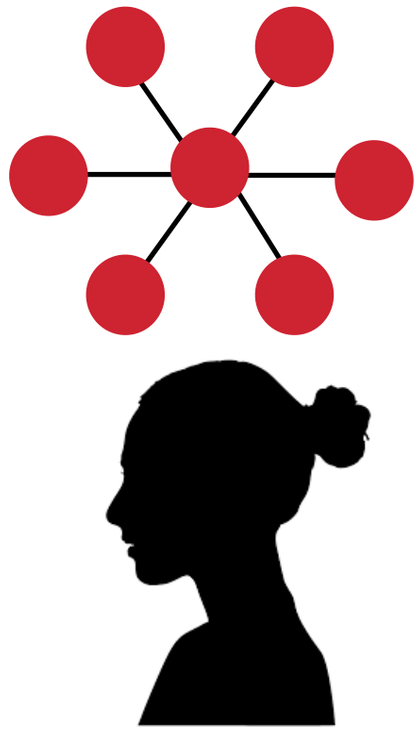
@Shugars she/her



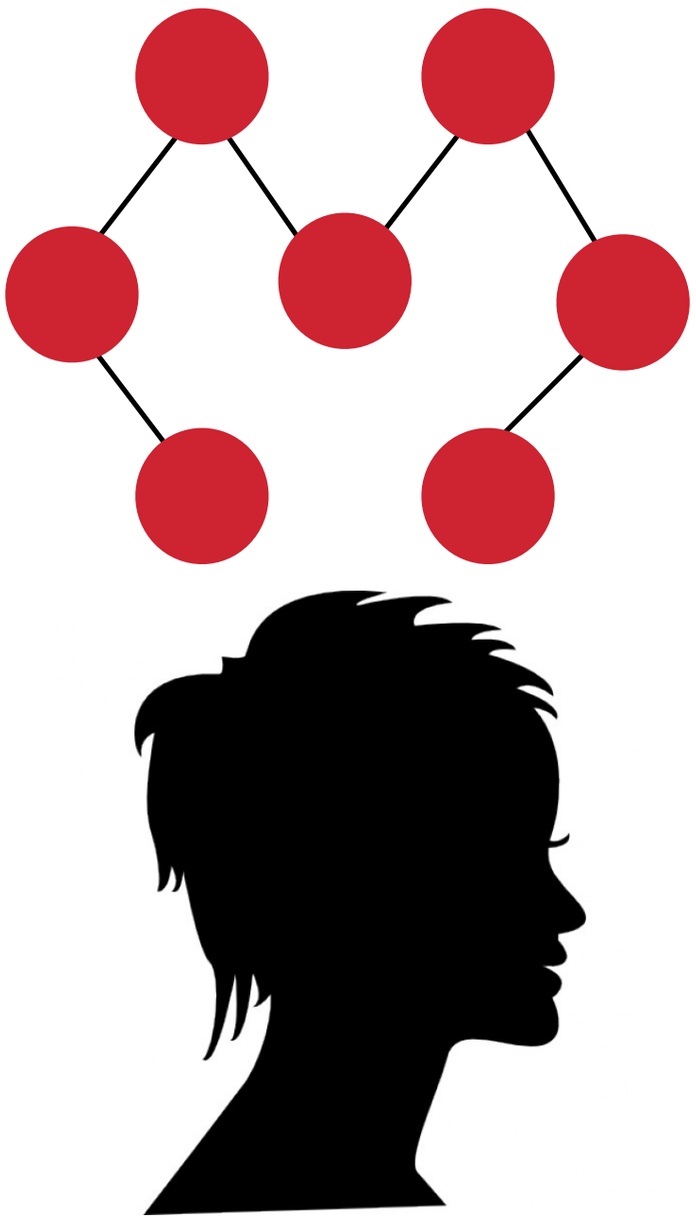
Appendix:

Network Measures

Connectivity

Connectivity

Baseline



$\frac{N_G}{N}$: % of nodes in giant component

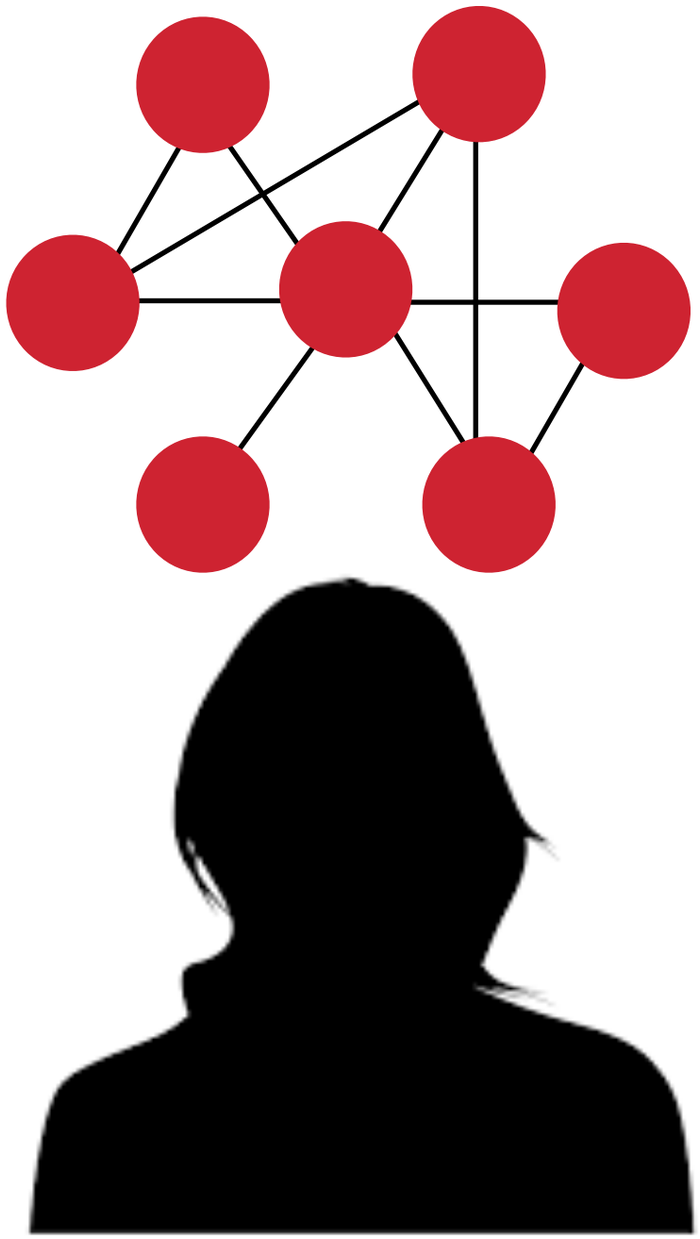
Range

$\frac{1}{N}$: (Completely disconnected)

1 : (Completely connected)

Complexity

Complexity



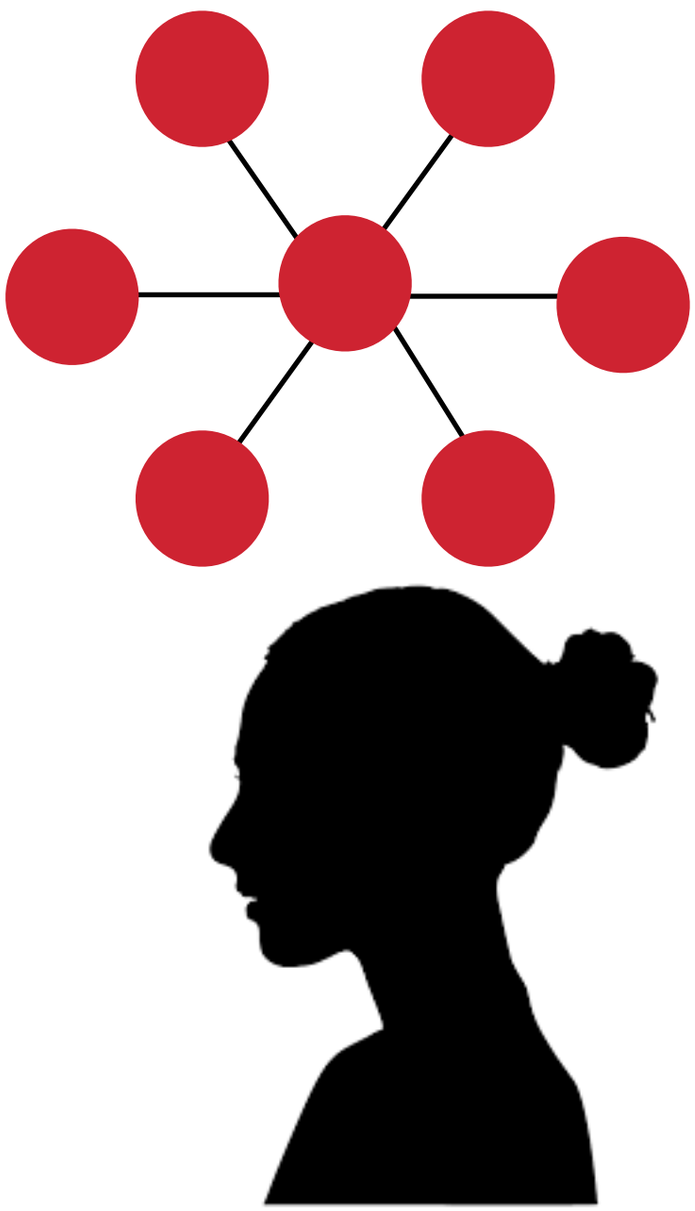
$$\frac{2E}{N(N-1)} \quad : \quad \text{Density}$$

$$\frac{1}{N}\sum_i k_i \quad : \quad \text{Average degree}$$

$$\frac{1}{N}\sum_i C_i \quad : \quad \text{Clustering}$$

Hierarchy

Hierarchy



σ_k : Standard deviation of degree *k*

r : Disassortativity (Negative Pearson coefficient)

$-\sum(p_k \times \log(p_k))$: Entropy

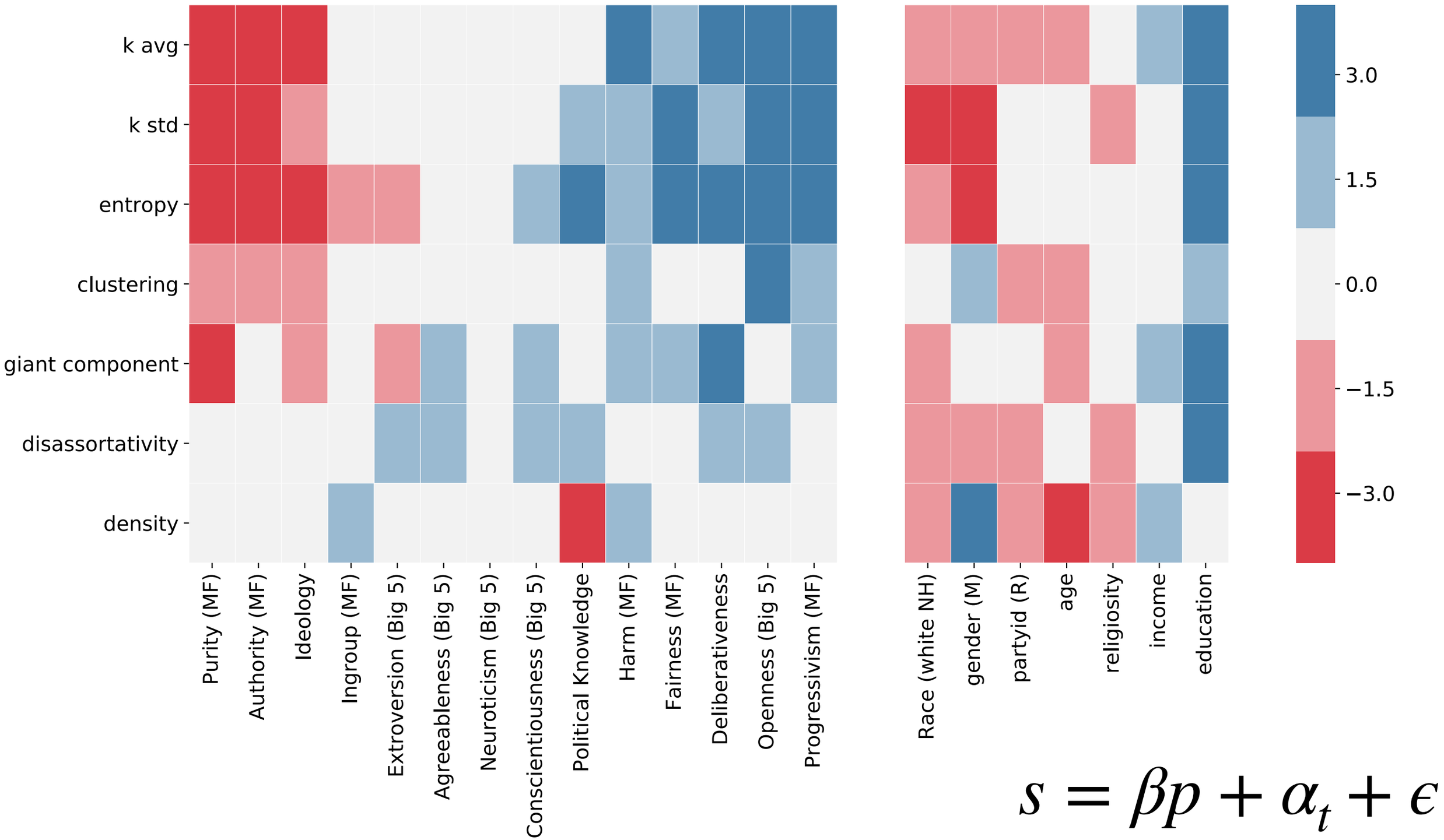
Appendix:

MTurk Experiment

MTurk Study: Structure & Personality

- 100 MTurk Subjects
- Multiple topics
    - Abortion
    - Healthcare
    - Childrearing / authoritarianism
- Survey measures
    - Demographics
    - Personality: Moral Foundations (Haidt, 2008), Big 5 (John, 1999)
    - Deliberativeness (Gastil, 2012), Political Knowledge (Carpini, 1993), Ideology (Pew, 2017)

3. Potential for Behavioral Insights



$$s = \beta p + \alpha_t + \epsilon$$

Interactive network drawing

Please think about this question: **Do you think it is the responsibility of the federal government to make sure all Americans have health care coverage?**

1. In the box below at left, please type all of your own important values, beliefs or ideas that are relevant to your answer.
   Please type each separate value, belief or idea on a line of its own; each can be as long or as short as you wish.
   To make sure your list is complete, please ask yourself for each item whether there is a reason behind it, and if that reason is missing, add it to the list.
   When you are done, hit "submit changes," and your ideas will appear as nodes below.

2. Now ask yourself whether any of these values, beliefs or ideas are connected to, support, or provide a reason for any other value, belief or idea.
   For those that are connected, create a link between two nodes by clicking first one node and then another.
   When you are done, click "submit changes," and the figure below will be updated.

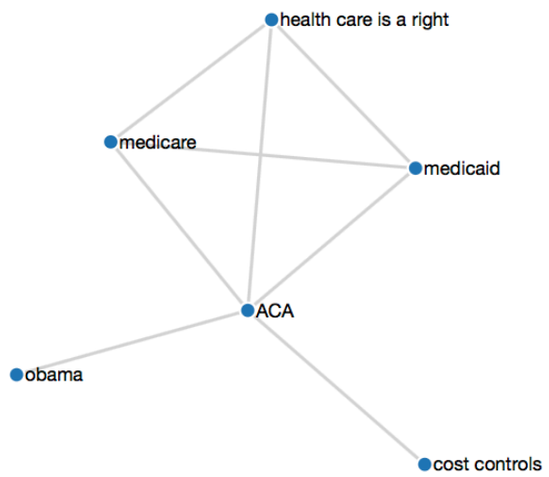
3. Think about any additional values, beliefs or ideas you may have omitted, or connections between them, and add those.
   You can also edit an existing idea by double-clicking on an existing node and editing in the box below right, or delete links by double-clicking on two nodes just as you would create a new link.
   Please continue this process until you feel the network you have created is a complete representation of your values, beliefs, and ideas on this topic.

Add new ideas

health care is a right
cost controls
medicare
medicaid
obama
ACA

Add new ideas in the box above, each separated with a carriage return.

Add nodes



Chatbot conversation

Topic: 1

This section of the survey explores your views on an issue through a series of questions and answers.

Do you think it is the responsibility of the federal government to make sure all Americans have health care coverage?

Yes, in most cases.

Can you explain why?

No one deserves to die for lack of insurance if society can afford it.

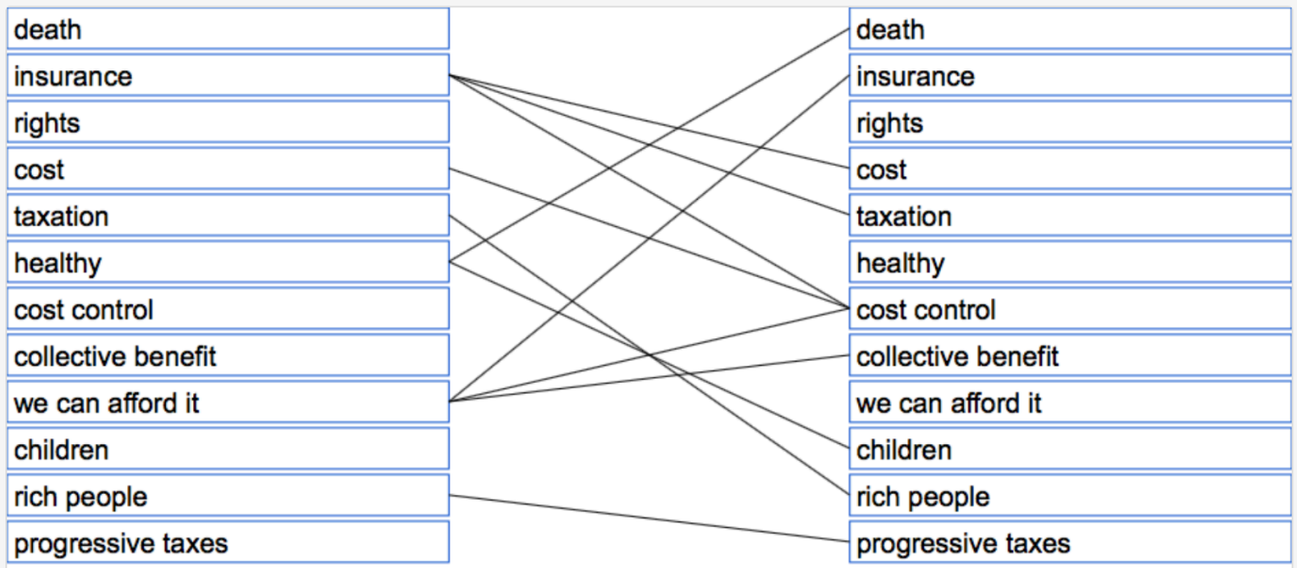
Thanks for that answer. Would you please state the important ideas or keywords that were included in your response? Each idea should be just 1-5 words.

•death
•insurance
•rights
•cost

Can you explain why you listed "death" in your response "No one deserves to die for lack of insurance if society can afford it."?

Topic: 1

Below are all the important ideas and keywords you just listed. Each item is listed once in the Column A and once in the Column B. Ask yourself whether any of these values, beliefs or ideas are connected to, support, or provide a reason for any other value, belief or idea. If two *different* items seem connected to you, please draw a line between them by dragging your cursor from one to the other. Click on an existing link if you want to remove it.



Networks summary

Short response:

- Nodes: **18.5**
- Edges: **37.4**
- Density: **0.2**
- Giant component %: **0.7**

- Clustering: **0.7**
- Assortativity: **0.0**
- k_{avg}: **3.9**
- k_{std} : **2.2**

- Entropy: **2.7**

Self-generated:

- Nodes: **8.1**
- Edges: **5.6**
- Density: **0.3**
- Giant component %: **0.7**

- Clustering: **0.1**
- Assortativity: **-0.3**
- k_{avg}: **1.4**
- k_{std} : **0.7**

- Entropy: **1.7**

Short response

"Do you think it is the responsibility of the federal government to make sure all Americans have health coverage?"

YES:

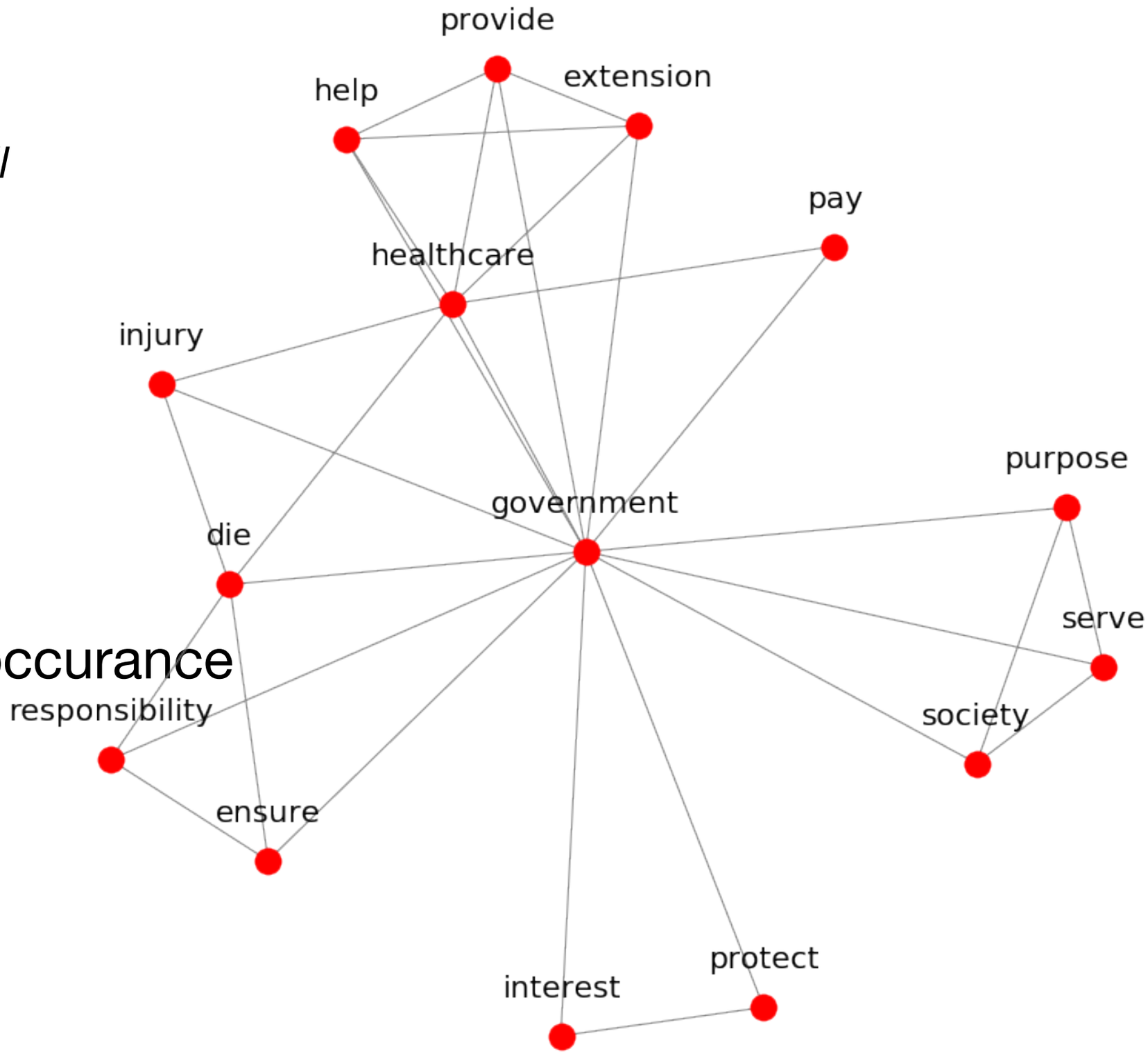
It is absolutely the responsibility of the government to ensure that our citizens do not needlessly die. This by extension means that the government must provide healthcare and medical help when needed. A government is useless if it does not protect the interest and well being of the people. What good is a government if it intentionally let it's own citizen die due to injury and disease. What good is a government that let's it's people wallow in poverty trying to pay off their medical bills. Such a government does not serve a purpose that is beneficial to society or the people within it.

Short response

"Do you think it is the responsibility of the federal government to make sure all Americans have health coverage?"

YES:

- Cluster words
- Connect by co-occurance



Short response

"Do you think it is the responsibility of the federal government to make sure all Americans have health coverage?"

NO:

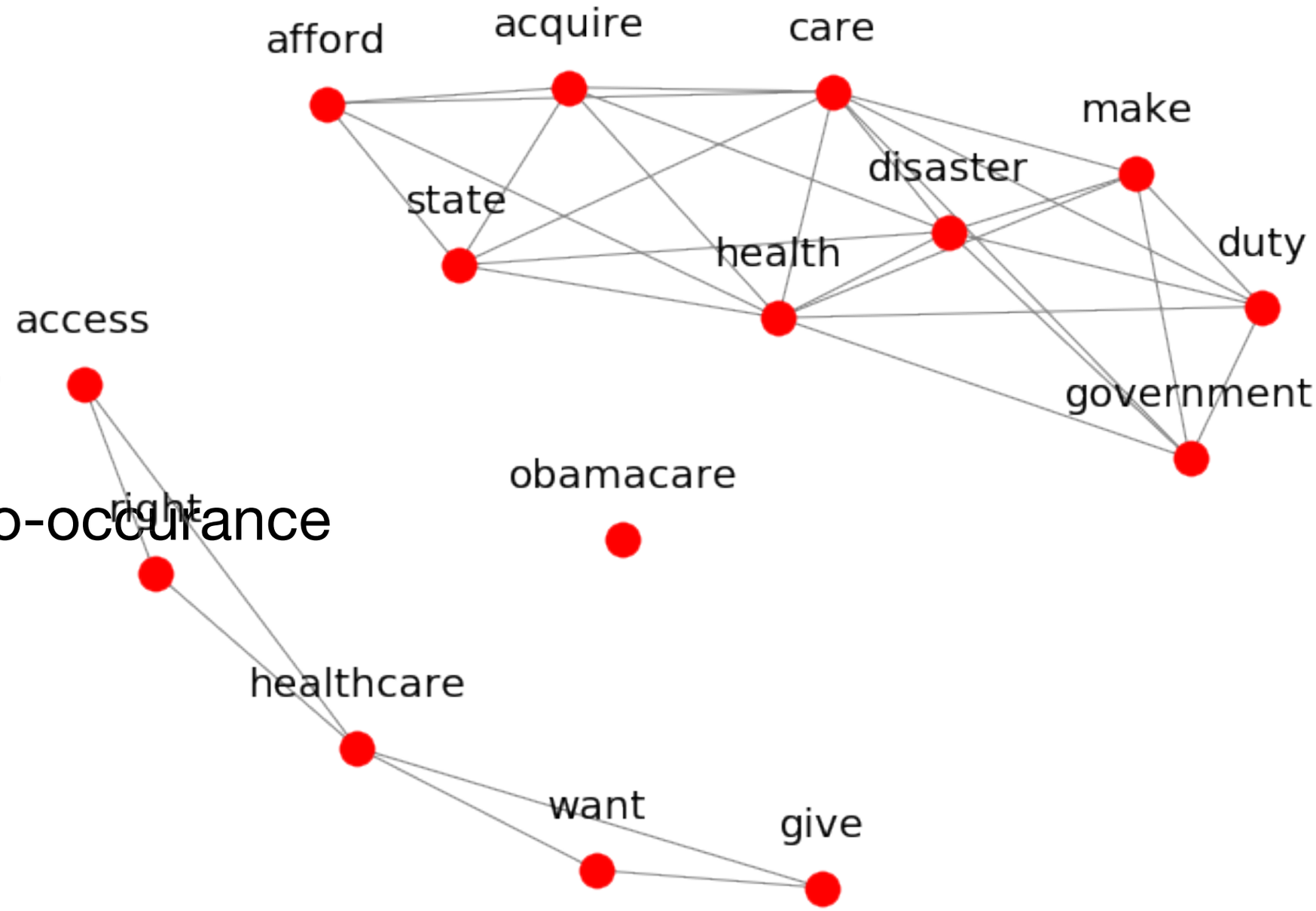
The federal government does not have the duty to make sure that all American have health care coverage. The only things that the government guarantees its citizens are the rights listed in the Constitution. **Nowhere** in the **Constitution**, is there a **right** for all citizens to be provided or have access to healthcare. Government run health care is a **disaster** and has **cost** many people thousands of dollars. If a person cannot afford healthcare, there are many independent and state programs that help people acquire health care. I am sure that all of the politicians would never want to give up their healthcare and go on Obamacare.

Short response

"Do you think it is the responsibility of the federal government to make sure all Americans have health coverage?"

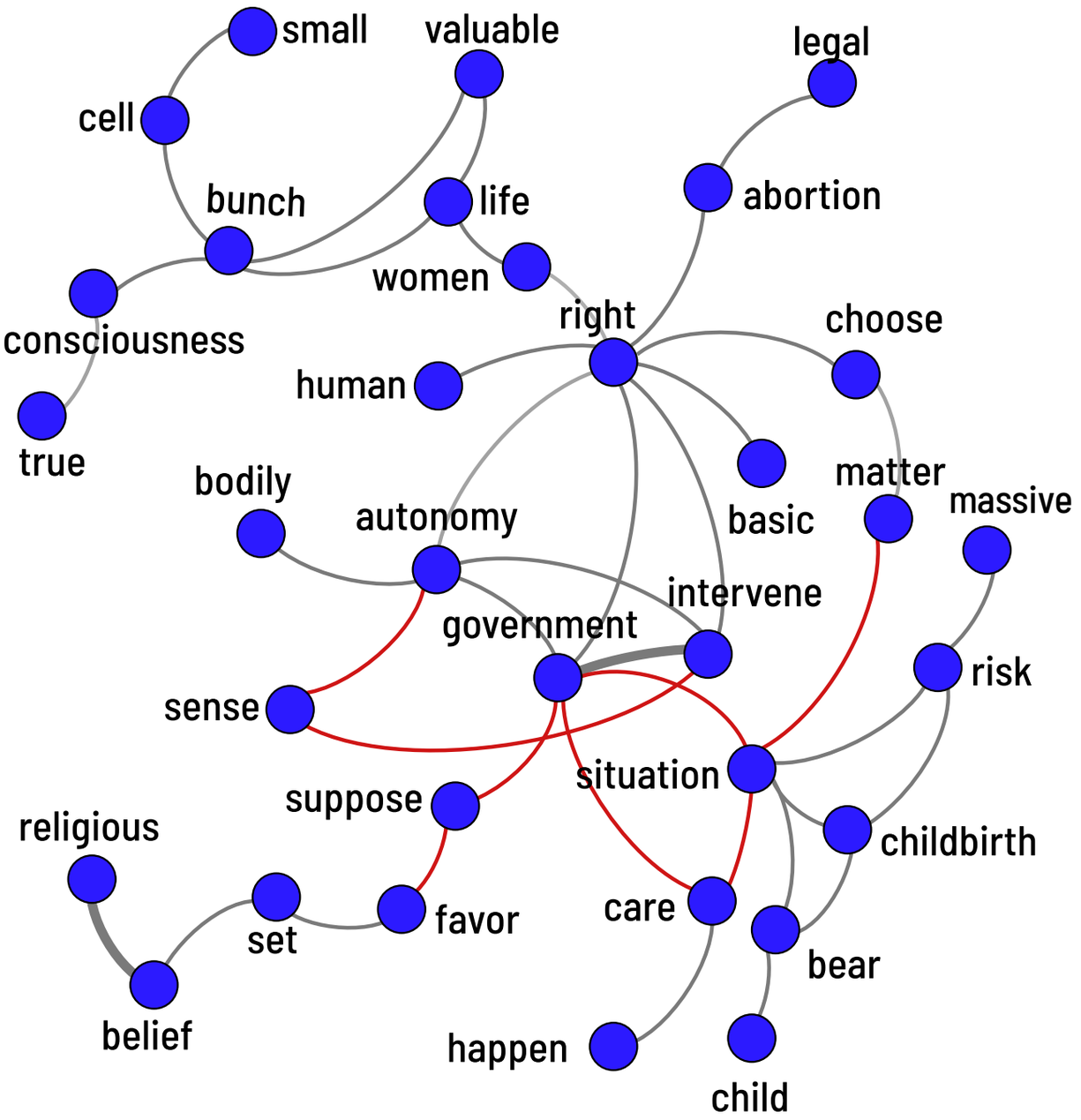
NO:

- Cluster words
- Connect by co-occurance



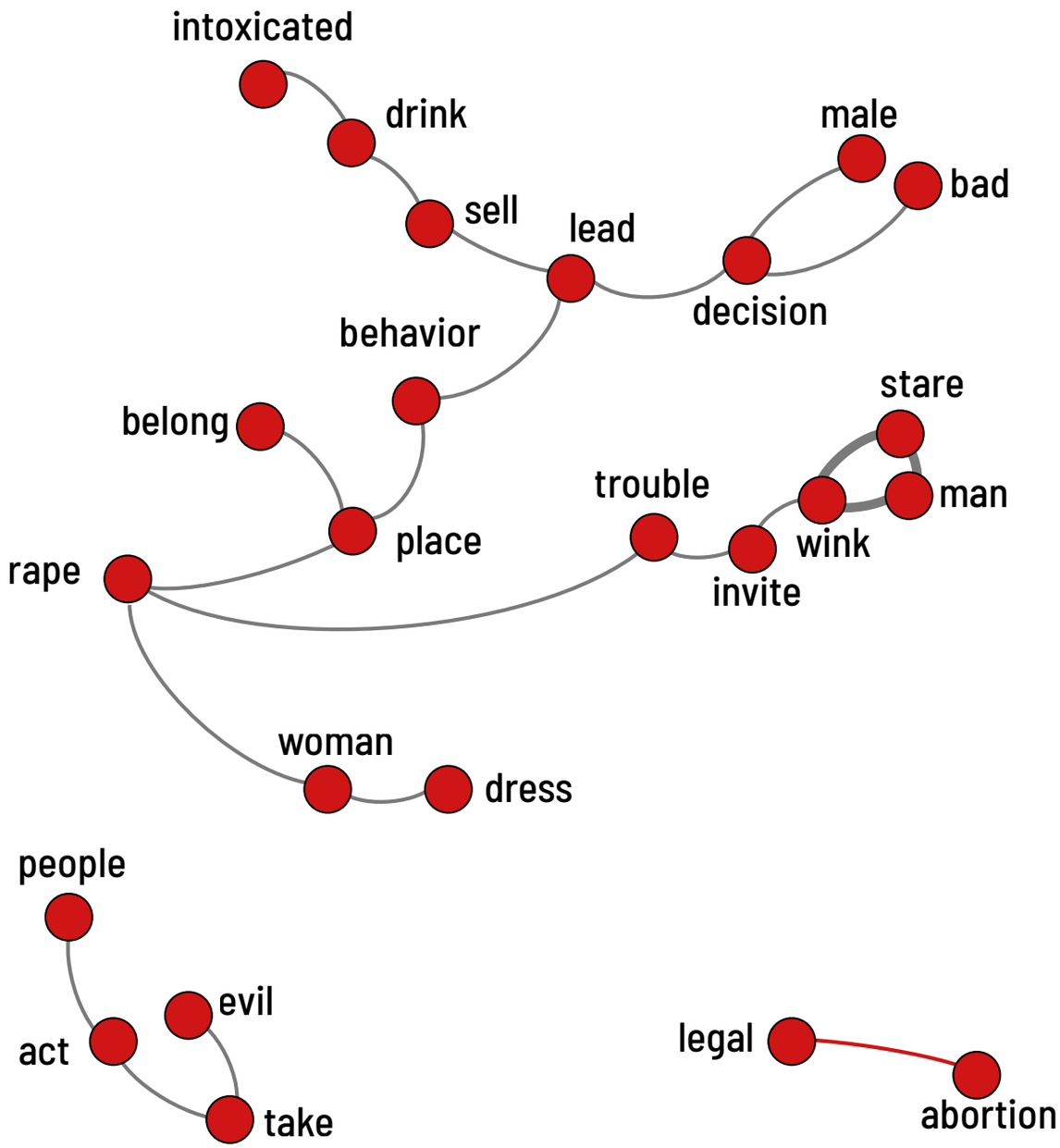
3. Potential for Behavioral Insights

Abortion should be legal under all circumstances. Bodily autonomy is a basic human right and it doesn't make sense why the government would intervene with something like abortion rights unless it is due to religious beliefs. Also, pregnancy and childbirth are massive financial risks and there are any situations where as soon as the child is born, the government doesn't seem to care what happens. Women should have the right to chose because a women's life is much more valuable then a bunch of small cells without true consciousness.



3. Potential for Behavioral Insights

No I do not think abortion should be legal. What actions and conditions lead to such behavior in the first place? If a woman dressed modestly and was not in places where she did not belong, then she would not get raped. Winking at men and starring at them invitingly just invite trouble. Selling intoxicated drinks also lead to bad decisions by both male a female. Take the evil out of the people and they'll act right.



Appendix:

Word Embeddings

Continuous Bag of Words (CBOW)

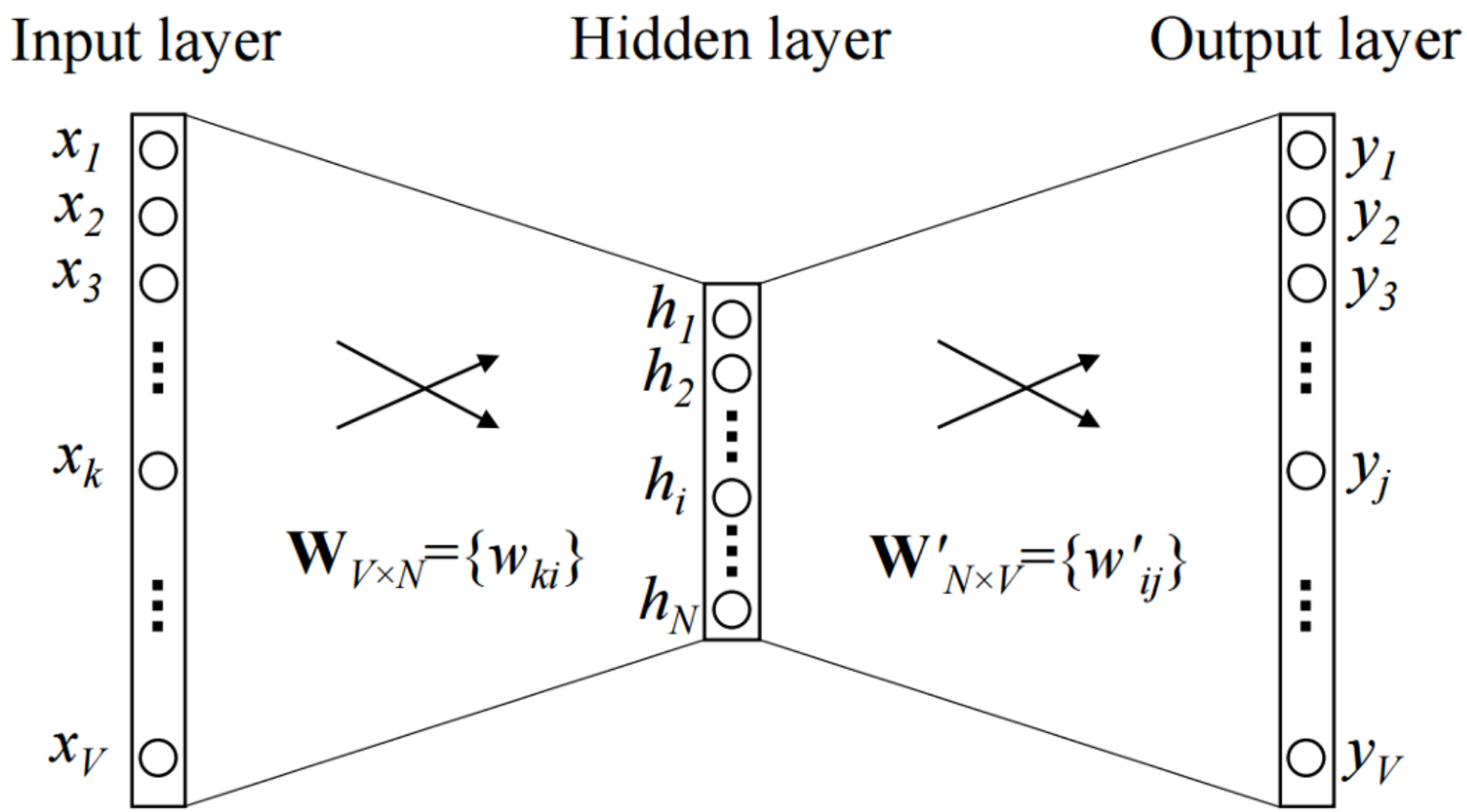
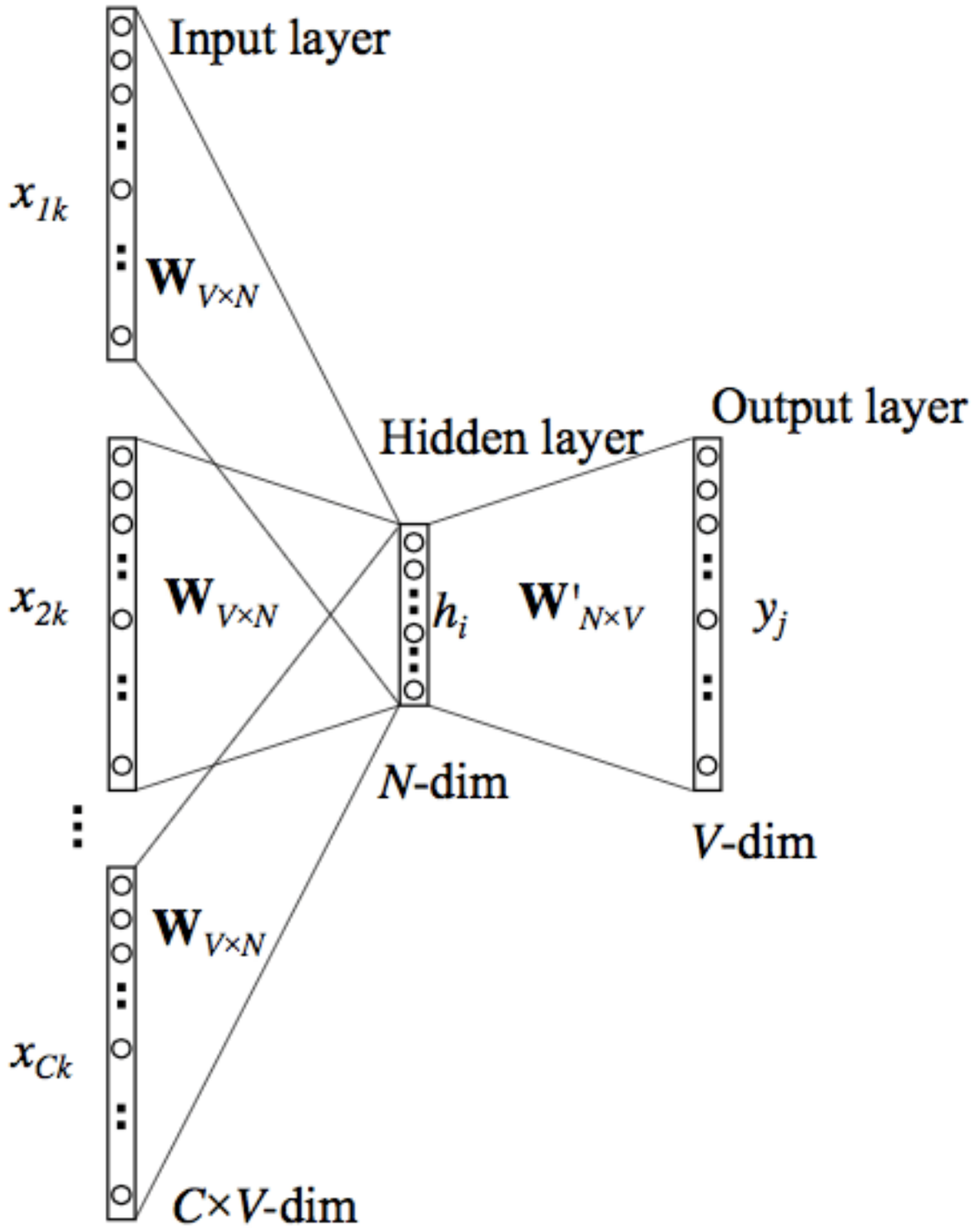


Figure 1: A simple CBOW model with only one word in the context

Mikolov et al, 2013
Rong, 2016

Continuous Bag of Words (CBOW)



Mikolov et al, 2013
Rong, 2016