DRK-12 RESEARCH METHODS WEBINAR | MARCH 26, 2020

SOCIAL NETWORK ANALYSIS: AN INTRODUCTION

MAKING RESEARCH RELEVANT

Kyle Fagan, PhD
Researcher

Ben Kalina, MA
Senior Researcher

with

Melissa Rasberry, EdD
Senior Technical Assistance Consultant

Welcome!

Take a moment to introduce yourself in the chat box.

Please tell us: your name, organization, and affiliation with the DRK-12 program (e.g., PI, project team member, evaluator, aspiring PI).

DRK-12 Research Methods Webinar Series

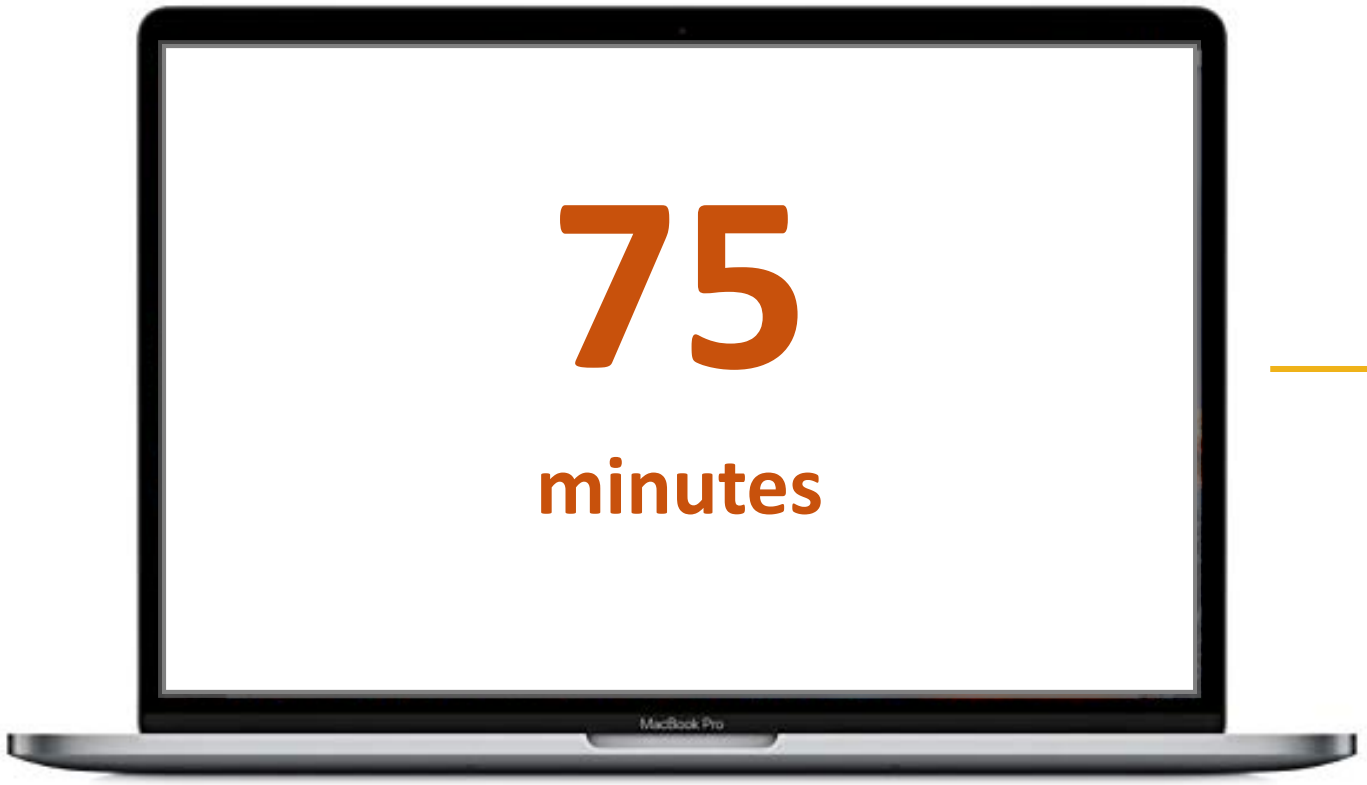
Melissa Rasberry, EdD
Senior Technical Assistance Consultant

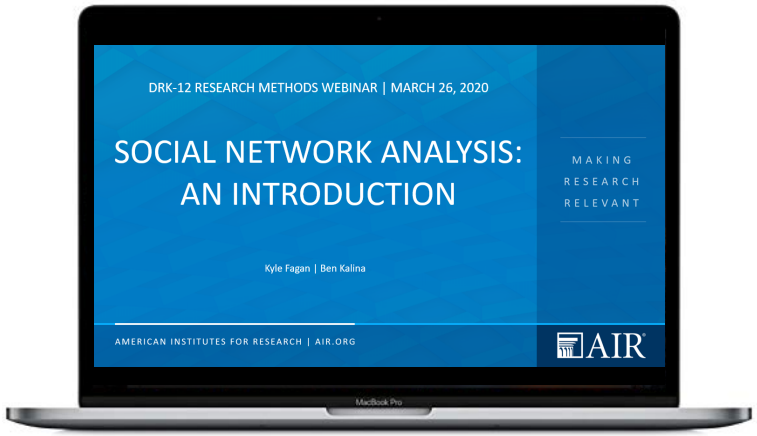
Learning outcomes

Following this session, participants will be able to:

- Define social network analysis (SNA) terminology.
- Identify the uses, benefits, and limitations of SNA.
- Understand key considerations for data collection, analysis, and network visualization.
- Consider ways SNA might be useful in future research in STEM education.

Today's webinar

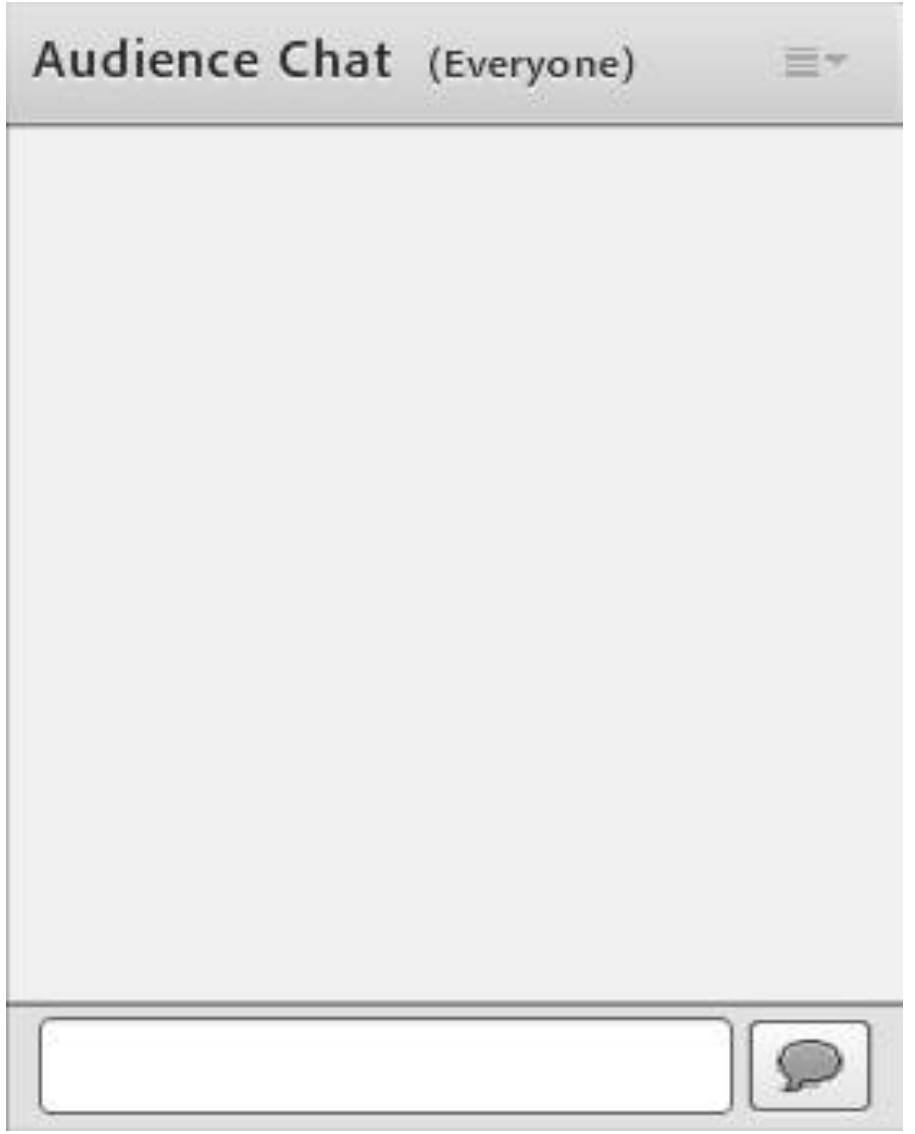




http://cadrek12.org/

Today's webinar

- Listen-only mode
- Use chat pod to submit content and technical questions at any time
- Opportunity for Q&A at the end of each section



Today's webinar

- To see this most clearly, you may want to use the "Full Screen" button in the upper right of the presentation pod.

- In order to submit a question, you will need to click the "Full Screen" button again to resume normal view.

Presenters

Kyle Fagan, PhD

Researcher
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Ben Kalina, MA

Senior Researcher
bkalina@air.org

Logistics

There are a few tools we will use throughout the webinar, so let's test them out:

Drawing Tool: Where are you calling in from? Use the marker tool to mark on the map.

Logistics

There are a few tools we will use throughout the webinar, so let's test them out:

Poll 1: Respond to the poll indicating your pet preference.

Presenters

Mable

Kyle Fagan, PhD

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kfagan@air.org

Ben Kalina, MA

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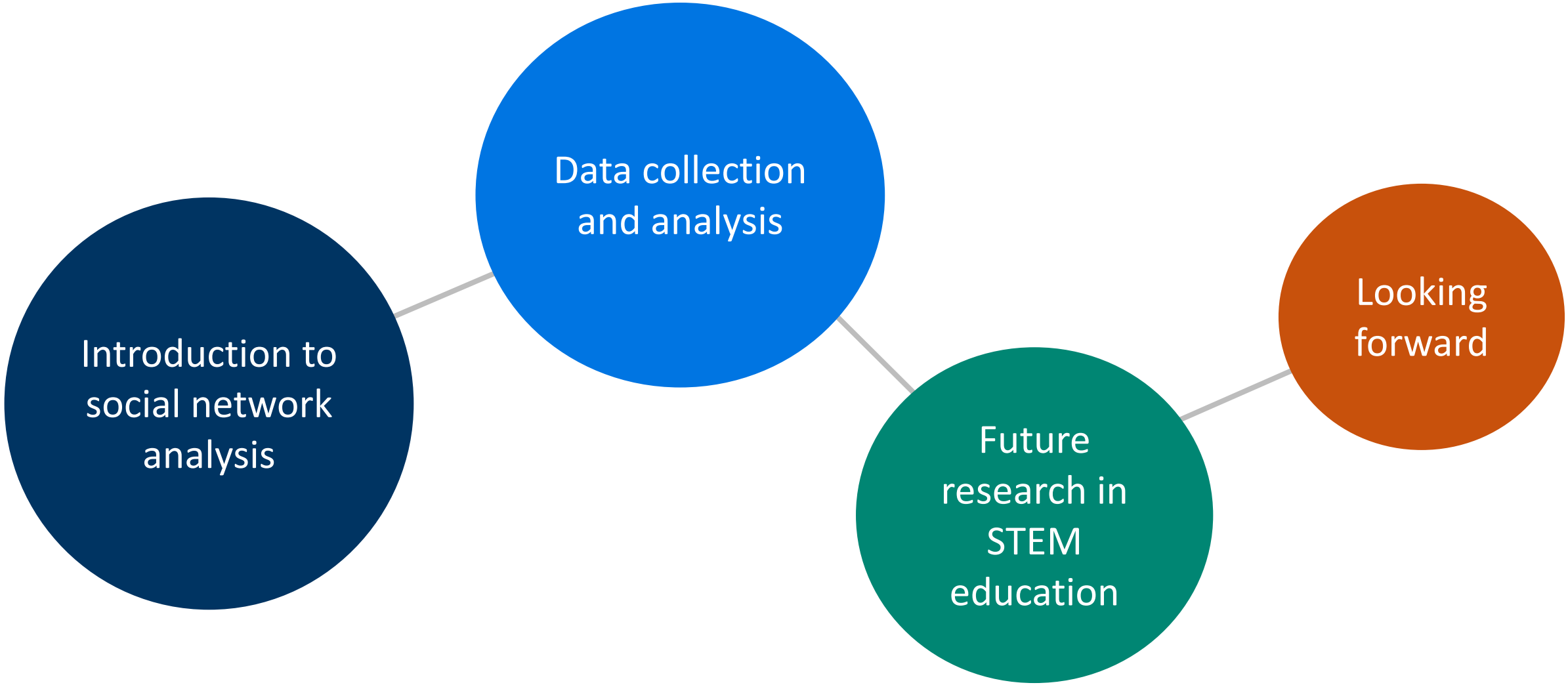
Trip

Agenda


Introduction to social network analysis
Data collection and analysis
Future research in STEM education
Looking forward

Introduction to social network analysis

Introduction to social network analysis

How would you describe your level of understanding of social network analysis?

This is the first I am hearing about it.

I've heard about it but I don't know much about it.

I have a fair amount of knowledge about it.

I am pretty much an expert.

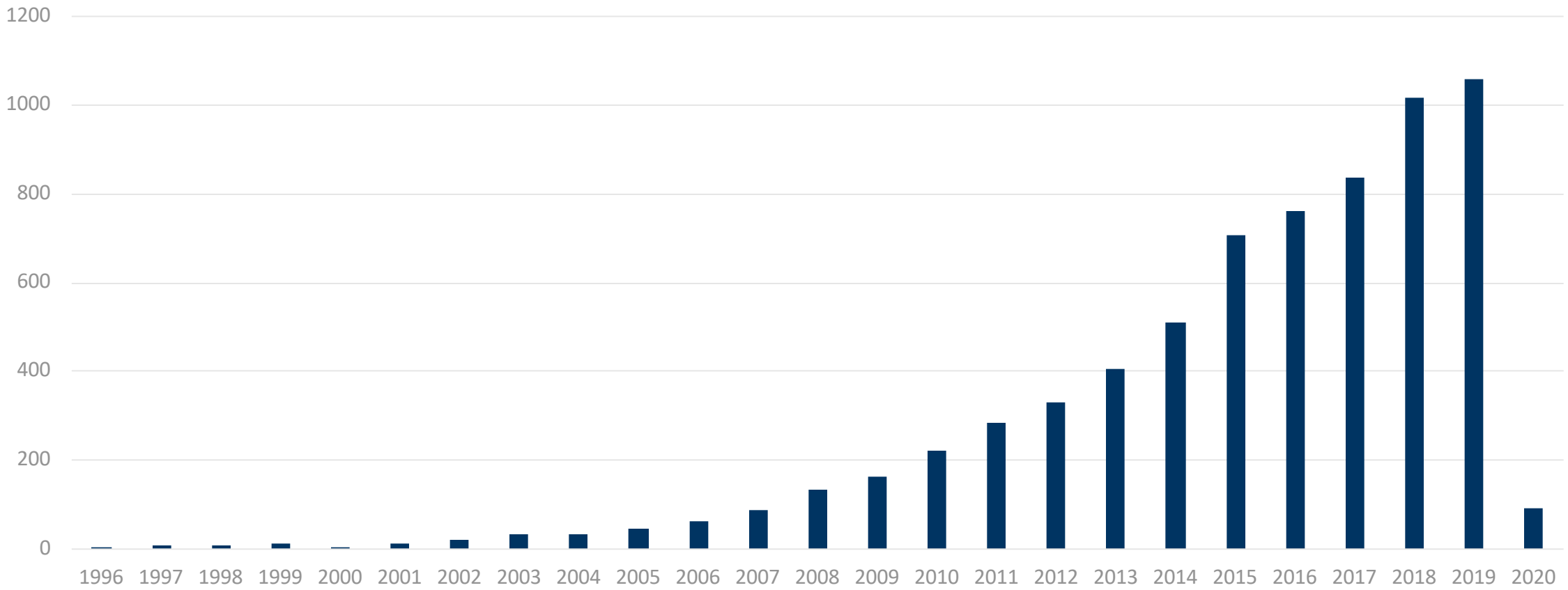
Introduction to social network analysis

Social network analysis

- A way of thinking about social systems that focuses on the relationships between the actors that make up a system.
- A set of methodological techniques that aim to describe and explore patterns apparent in social relationships that individuals and groups form with one another within a given context.

Introduction to social network analysis

Articles with *social network analysis* identified as a topic (1996–2020)



Web of Science: Retrieved from https://apps.webofknowledge.com/ on February 19, 2020

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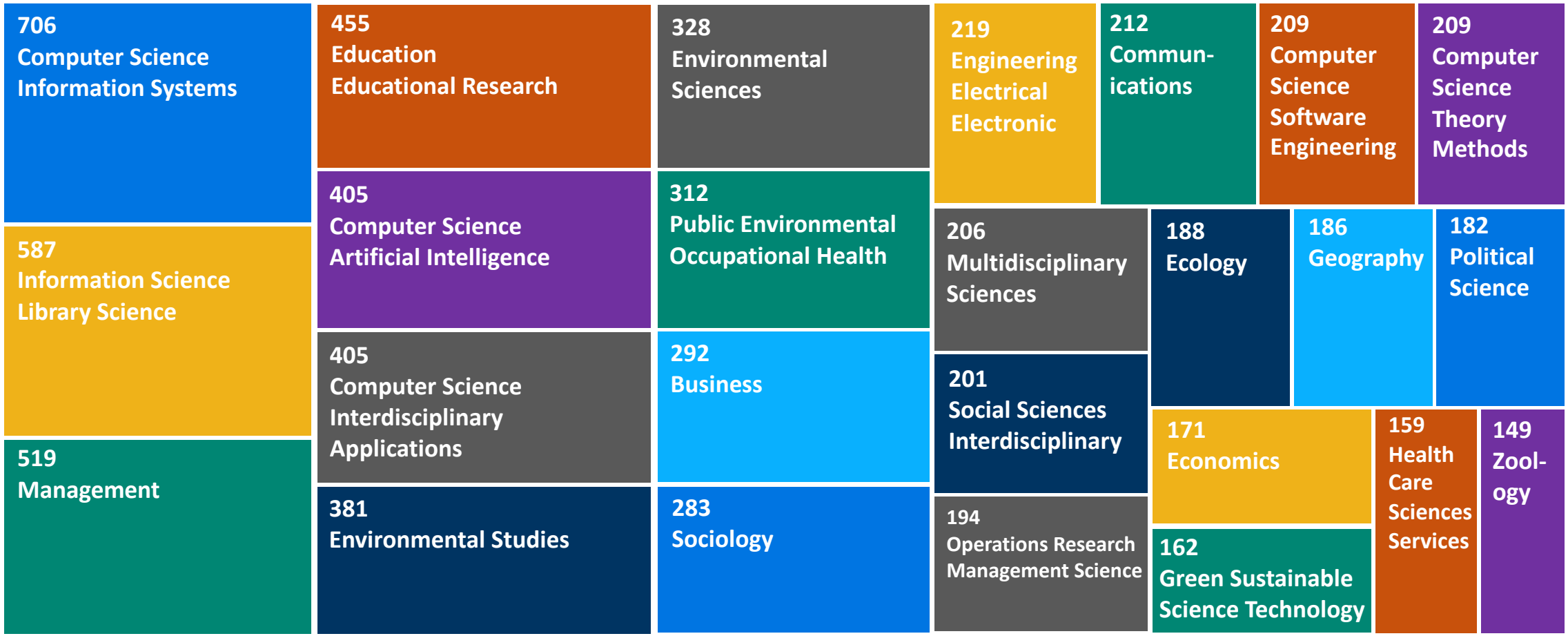

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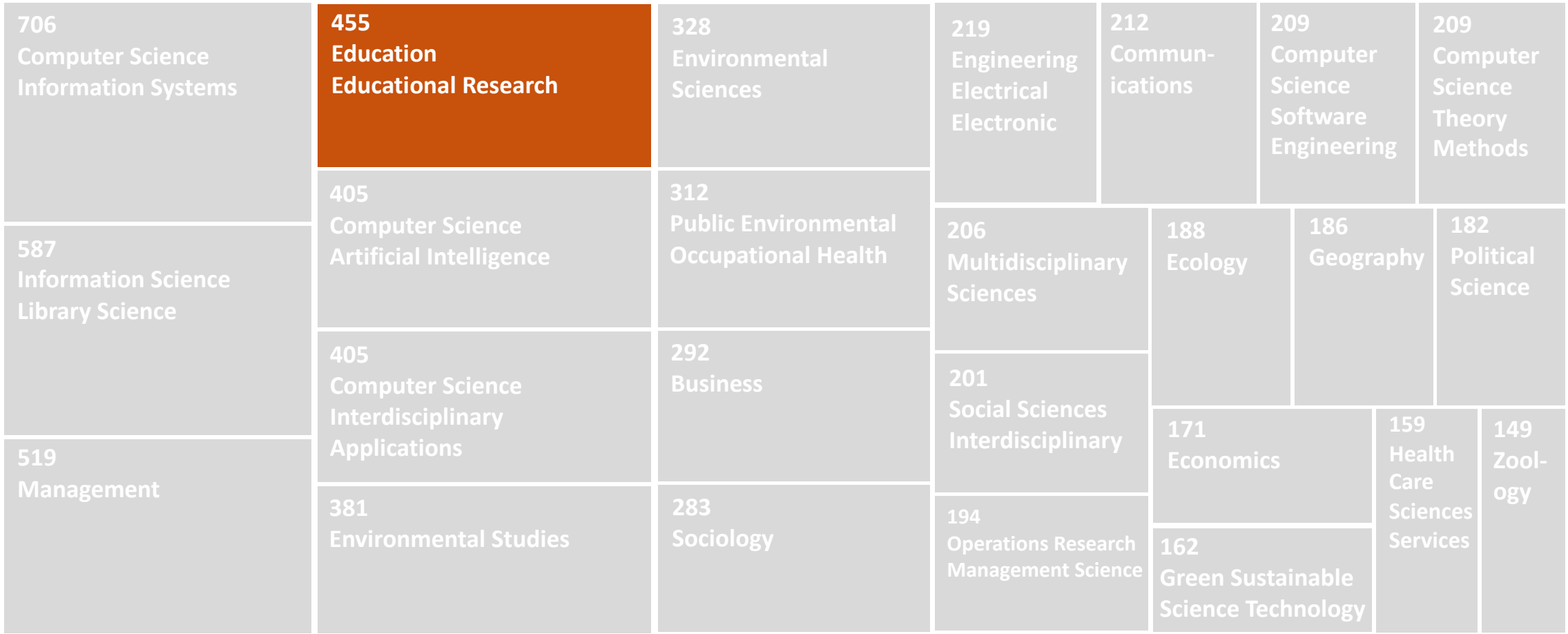

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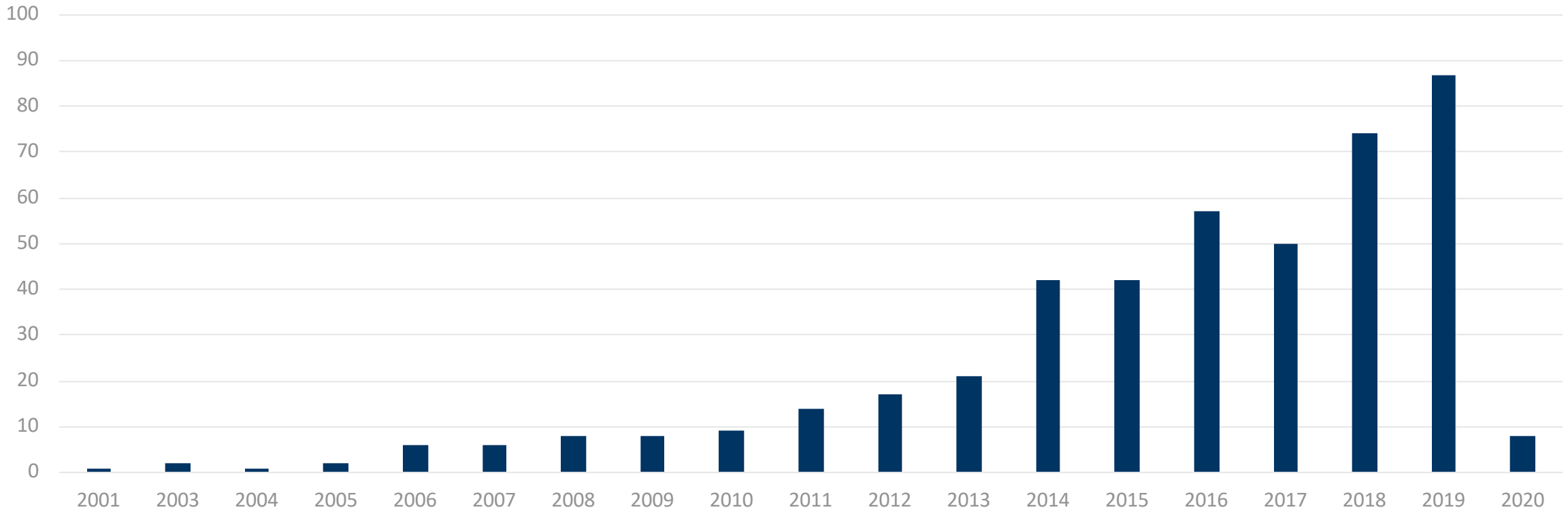
Introduction to social network analysis

Articles with *social network analysis* identified as a topic (2001–2020) in Education and Educational Research



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Introduction to social network analysis

Social network analysis helps us:

- Visualize data through sociograms to gain insights.
- Understand the structure of a network.
- Understand the position of actors within a network.

Introduction to social network analysis

Let's take **happy hour.** We can see in this image a number of individuals celebrating happy hour.

Introduction to social network analysis

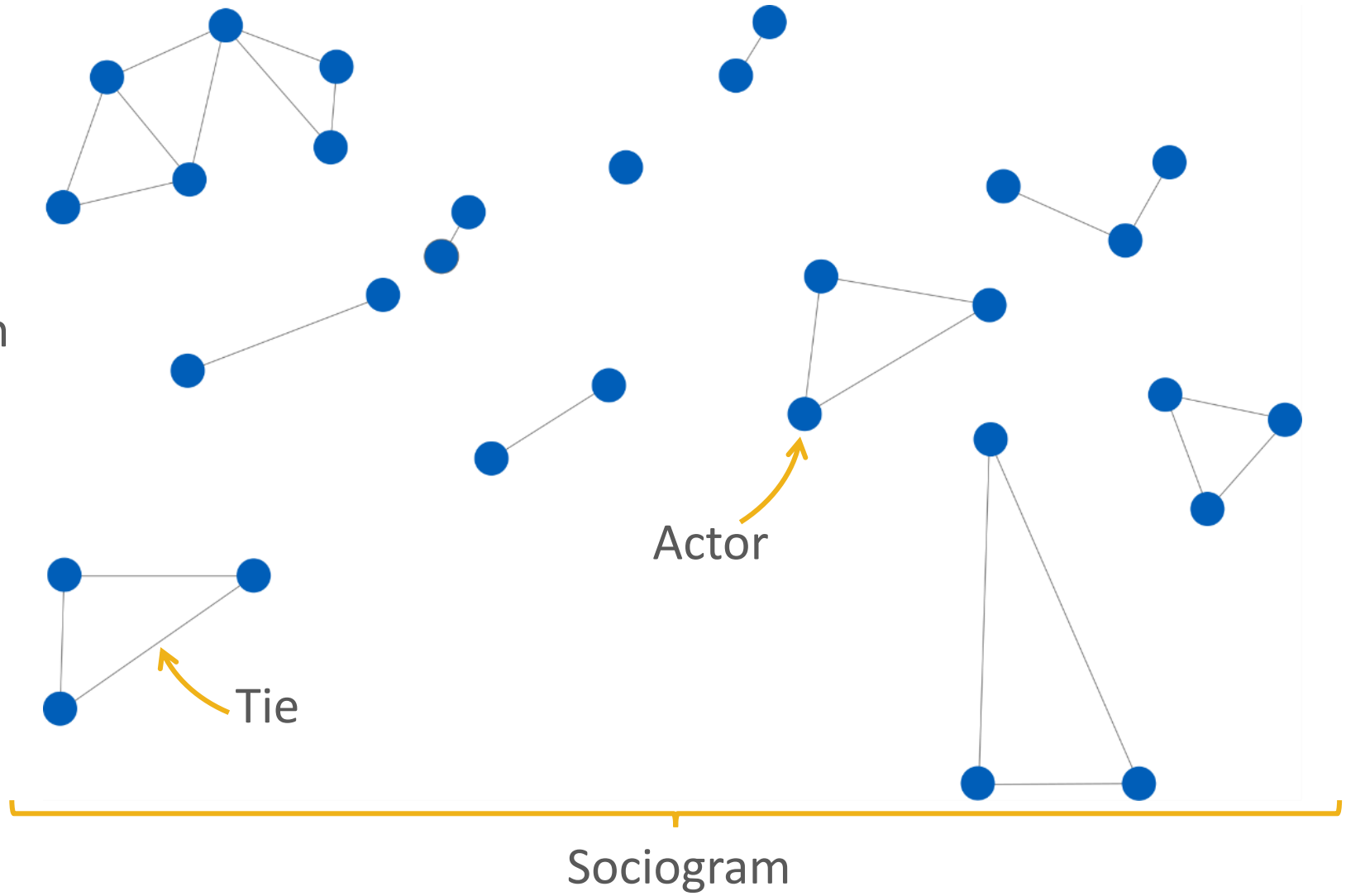
Each of these individuals can be represented by a blue dot.

Introduction to social network analysis

If we were to watch for a while, we could start to track who is talking to whom.

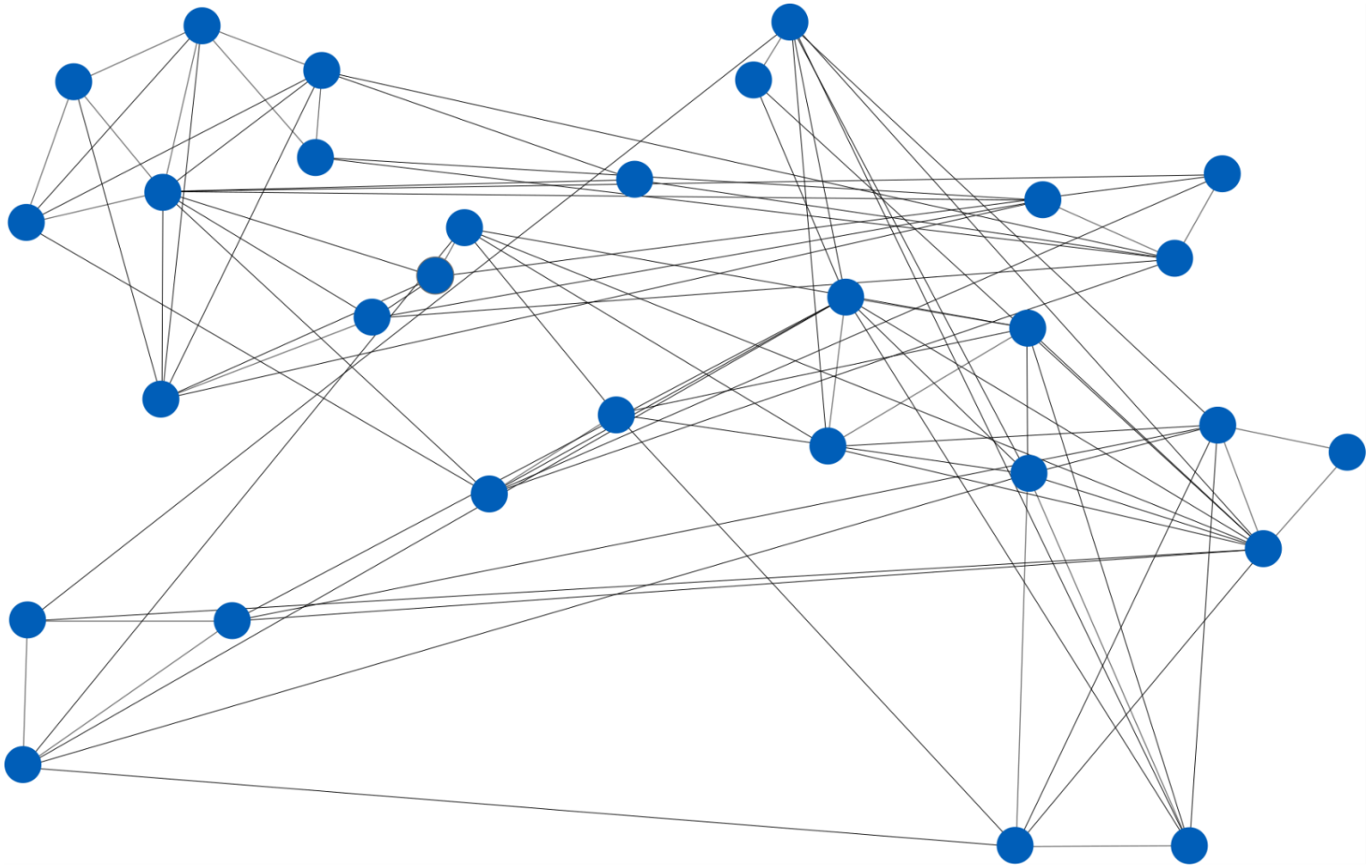
Introduction to social network analysis

A sociogram is simply a representation of a network—in this case, individuals conversing at happy hour.



Introduction to social network analysis

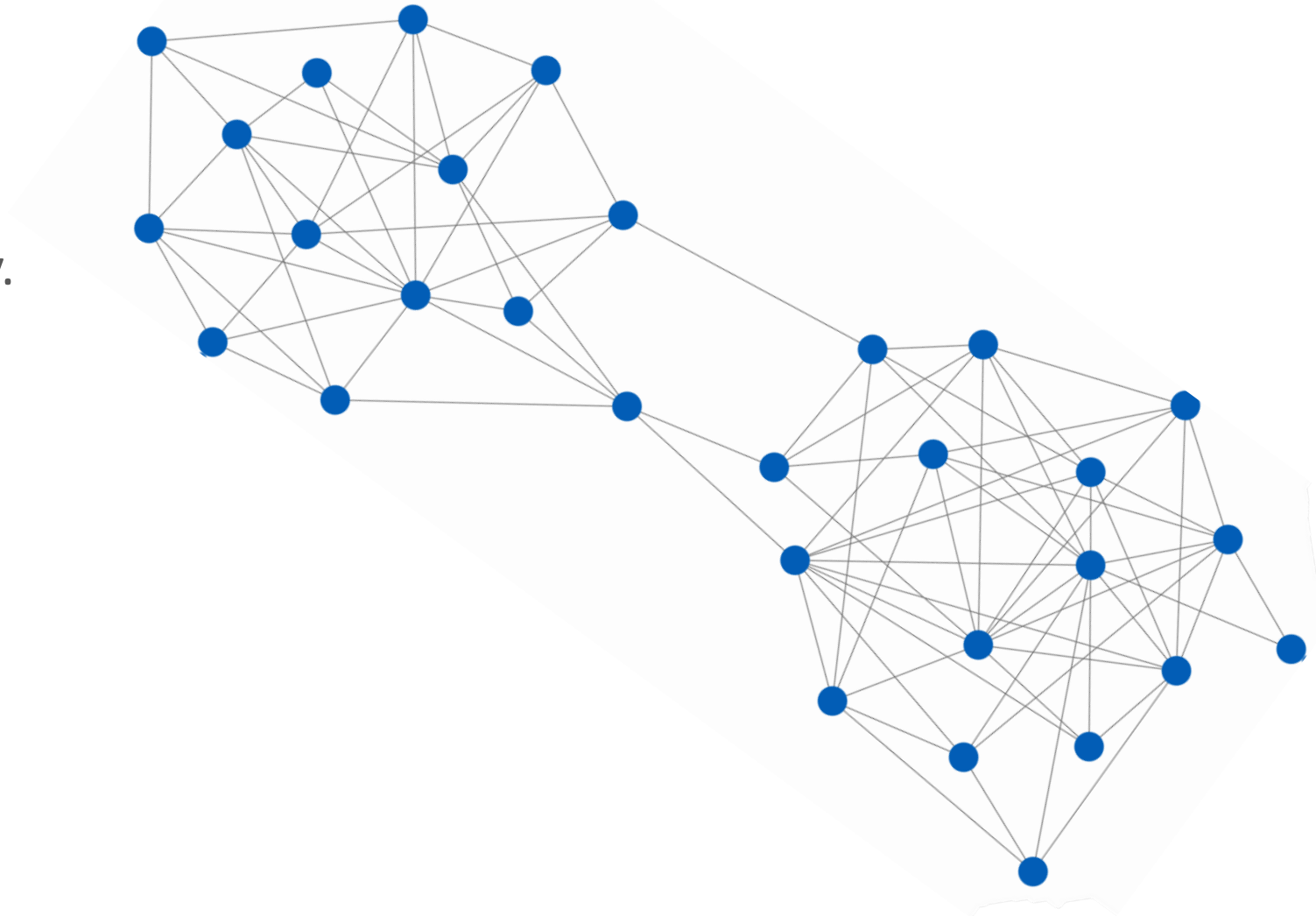
If we were to watch the room for an hour, we could continue to track who talks to whom.



Introduction to social network analysis

These are the same actors, the same ties, just arranged differently.

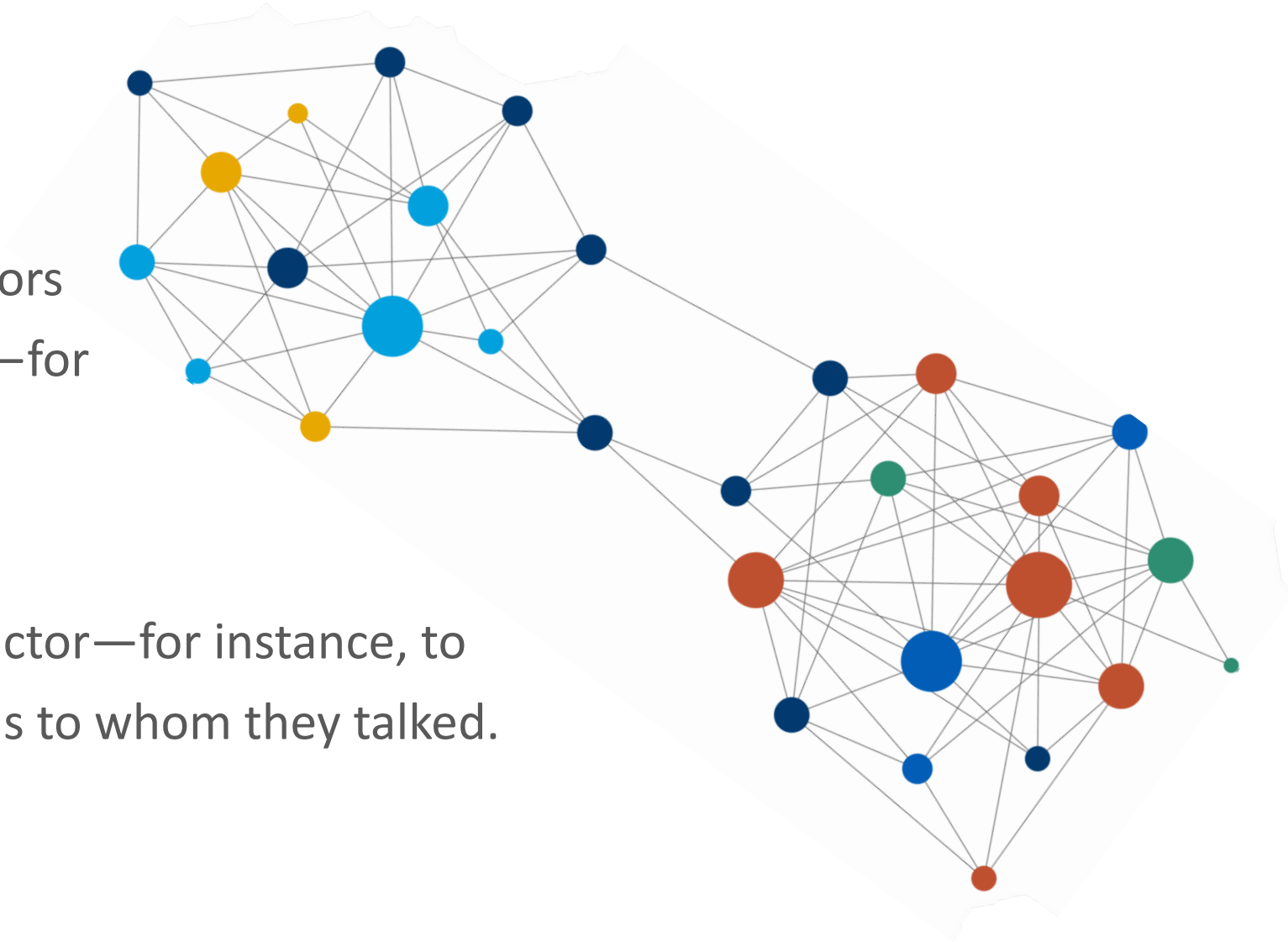
So what was a busy, messy sociogram becomes an image that we can use to make sense of the patterns of conversations taking place at this happy hour.



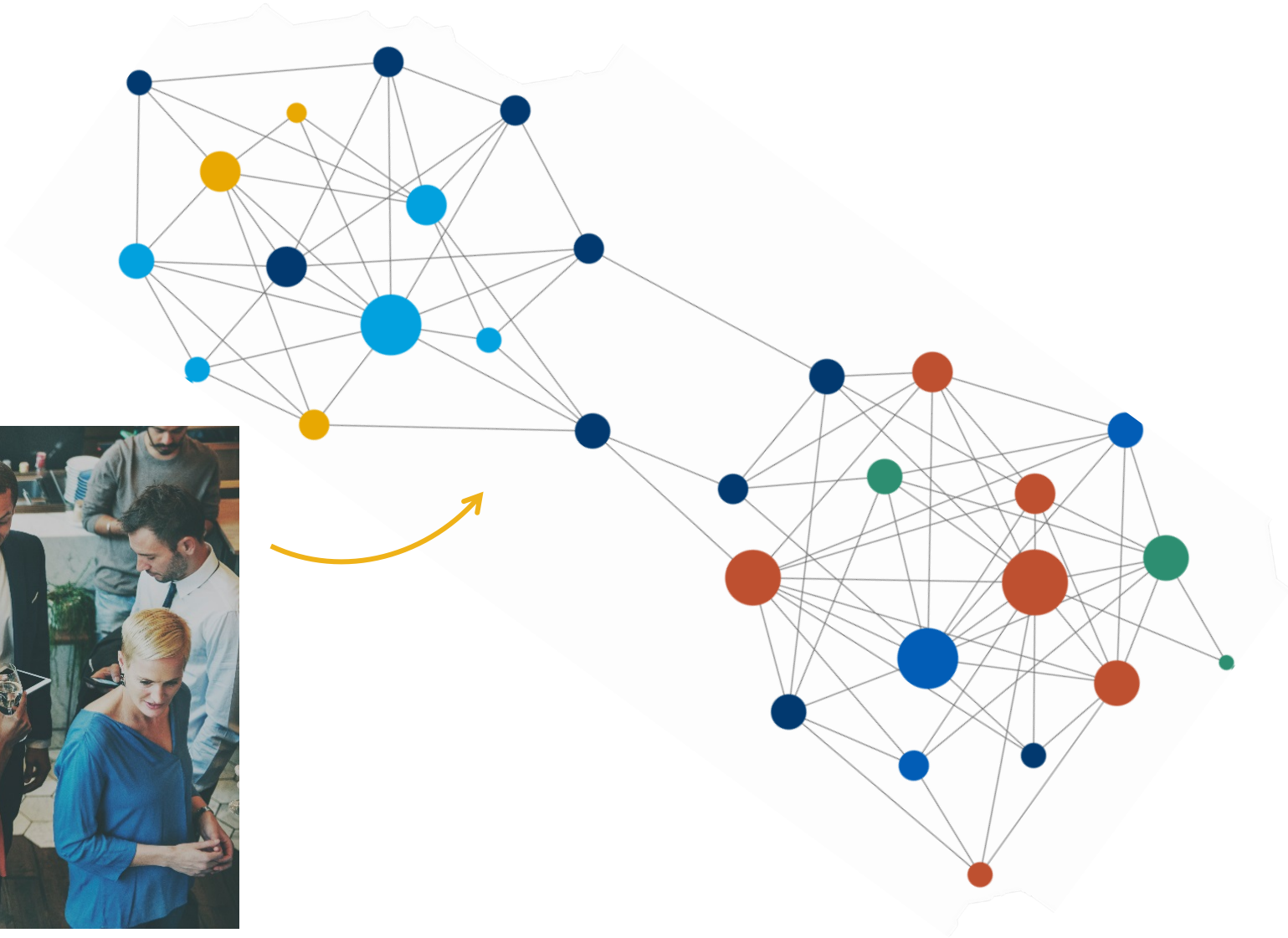
Introduction to social network analysis

We can change the color of the actors to illustrate some sort of attribute—for instance, the company where an individual works.

We can also adjust the size of the actor—for instance, to represent the number of individuals to whom they talked.



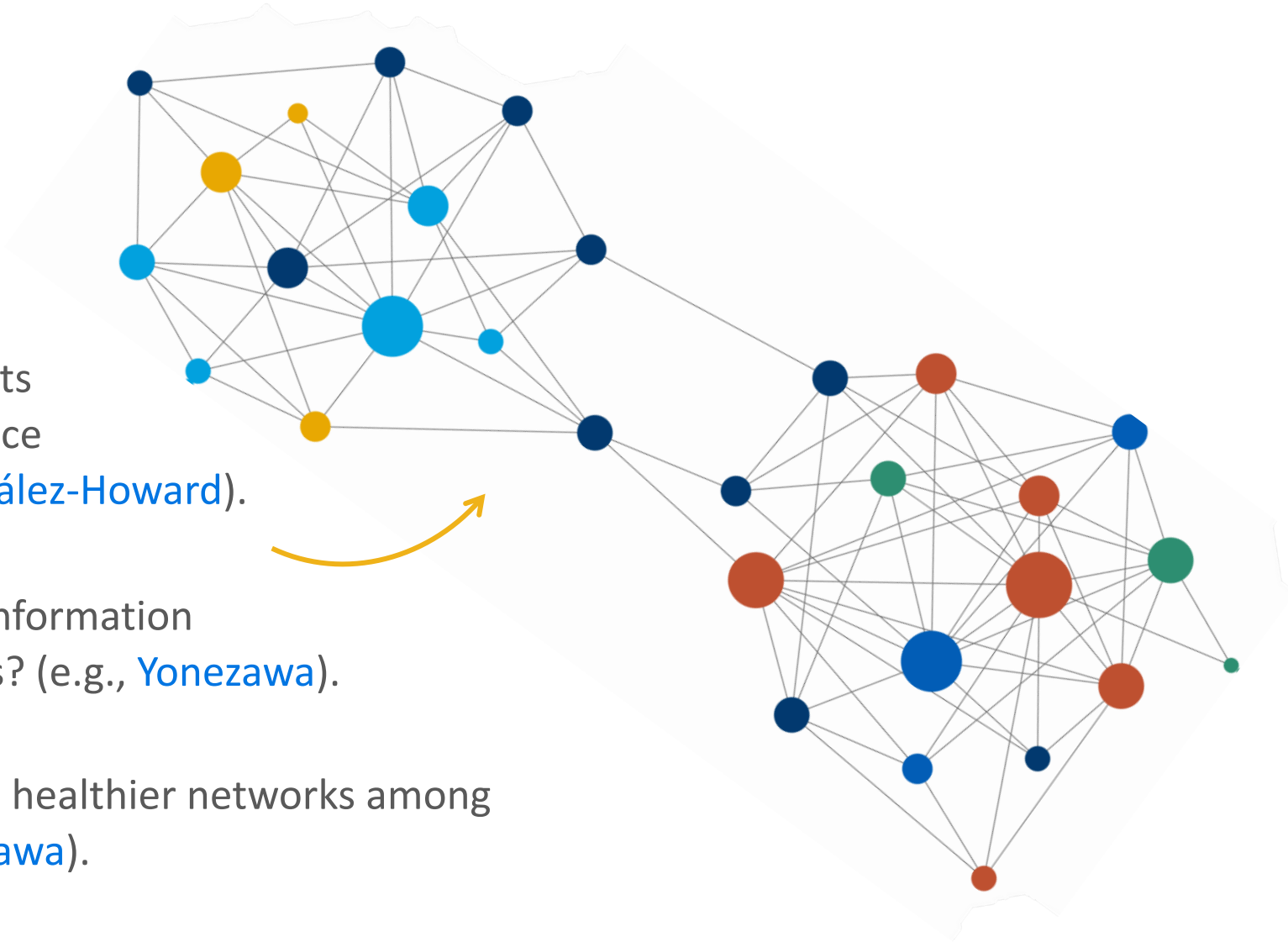
Introduction to social network analysis



Introduction to social network analysis

Within **STEM education**, social network analysis can help answer a number of research and evaluation questions—for instance:

- What communication patterns emerge when classroom members (i.e., students and their teachers) engage in the science practice of argumentation? (e.g., González-Howard).
- How do individuals shape the flow of information among a school team of math teachers? (e.g., Yonezawa).
- What types of learning events produce healthier networks among educators across districts? (e.g., Yonezawa).



Introduction to social network analysis

How would you describe your level of understanding of social network analysis?

I still don't get it.

I understand it in the context of a happy hour.

I can see how this could apply to my work.

I've already got ideas on how to use it in my work.

Data collection and analysis

Before we move on to data collection and analysis, **are there any questions**?

Data collection and analysis

Data collection and analysis

Actors | Ties | Methods

Visualization | Structure | Position

Data collection and analysis

Actors

- Actors are the entities that make up the network.
- Actors can be individuals (e.g., a person or a gorilla) or collectivities (e.g., teams or organizations).
- Actors can also be called *nodes*, *vertices*, and *agents*.

Data collection and analysis

Actors | Ties | Methods

Ties

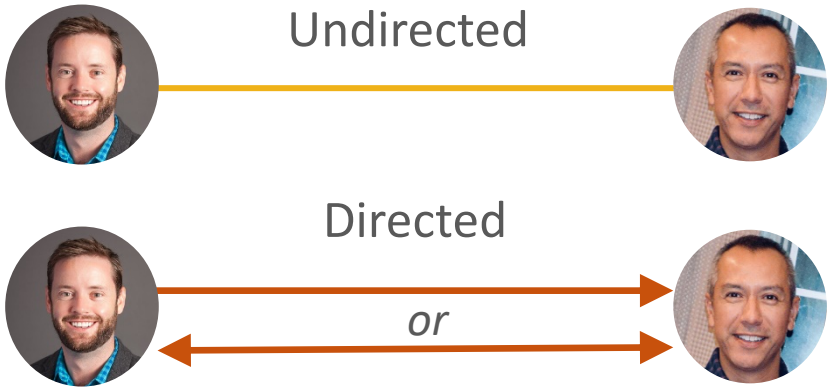
A typology of ties studied in social network analysis.

Similarities			Social Relations				Interactions	Flows
Location	**Membership**	**Attribute**	**Kinship**	**Other role**	**Affective**	**Cognitive**	e.g.,	e.g.,
e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	e.g.,	Sex with	Information
Same spatial and temporal space	Same clubs	Same gender	Mother of	Friend of	Likes	Knows	Talked to	Beliefs
	Same events	Same attitude	Sibling of	Boss of	Hates	Knows about	Advice to	Personnel
	etc.	etc.		Student of	etc.		Helped	Resources
				Competitor of		Sees as happy	Harmed	etc.
						etc.	etc.	

Borgatti, Mehra, Brass, & Labianca (2009)

- Ties can also be called *edges, links,* and *arcs*.

Data collection and analysis



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Data collection and analysis

Actors | Ties | Methods

Surveys

Interviews

Observations

Archival data

Data collection and analysis

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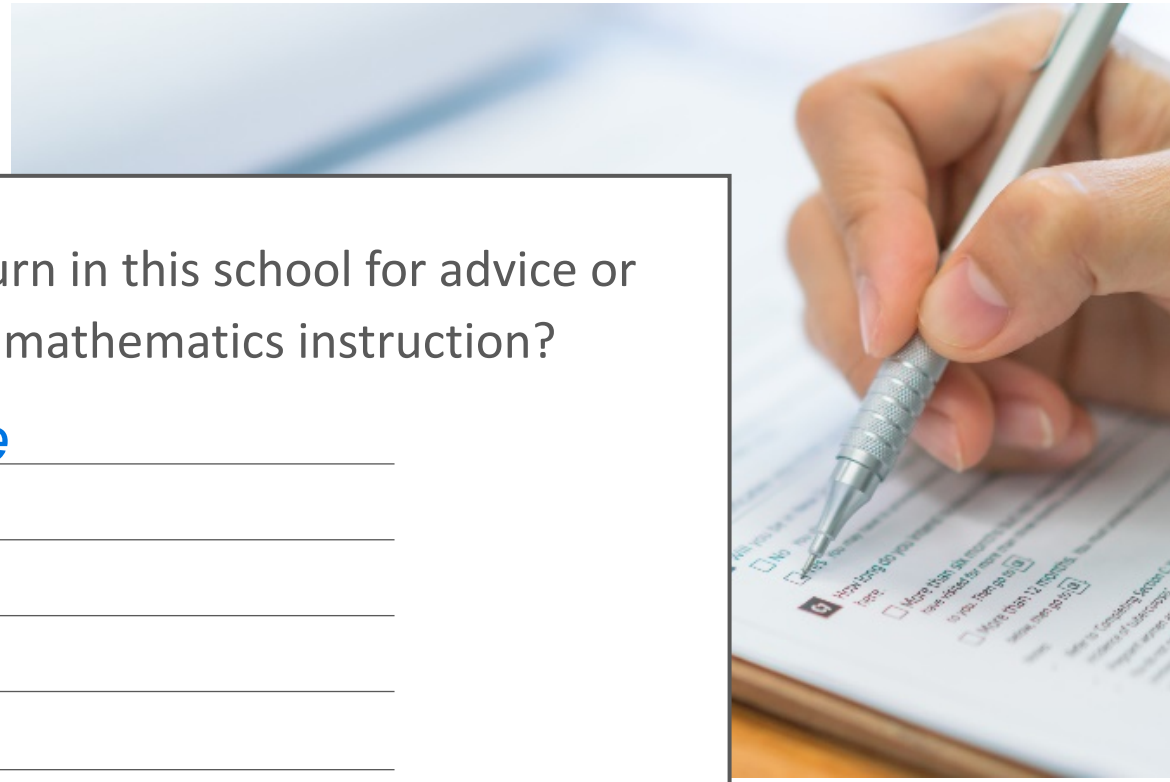

To whom do you turn in this school for advice or information about mathematics instruction?

1. *Tyrone*
2. *Shana*
3. *Luis*
4.
5.
6.
7.

Spillane, Healey, & Min Kim (2010)

Data collection and analysis

Actors | Ties | Methods

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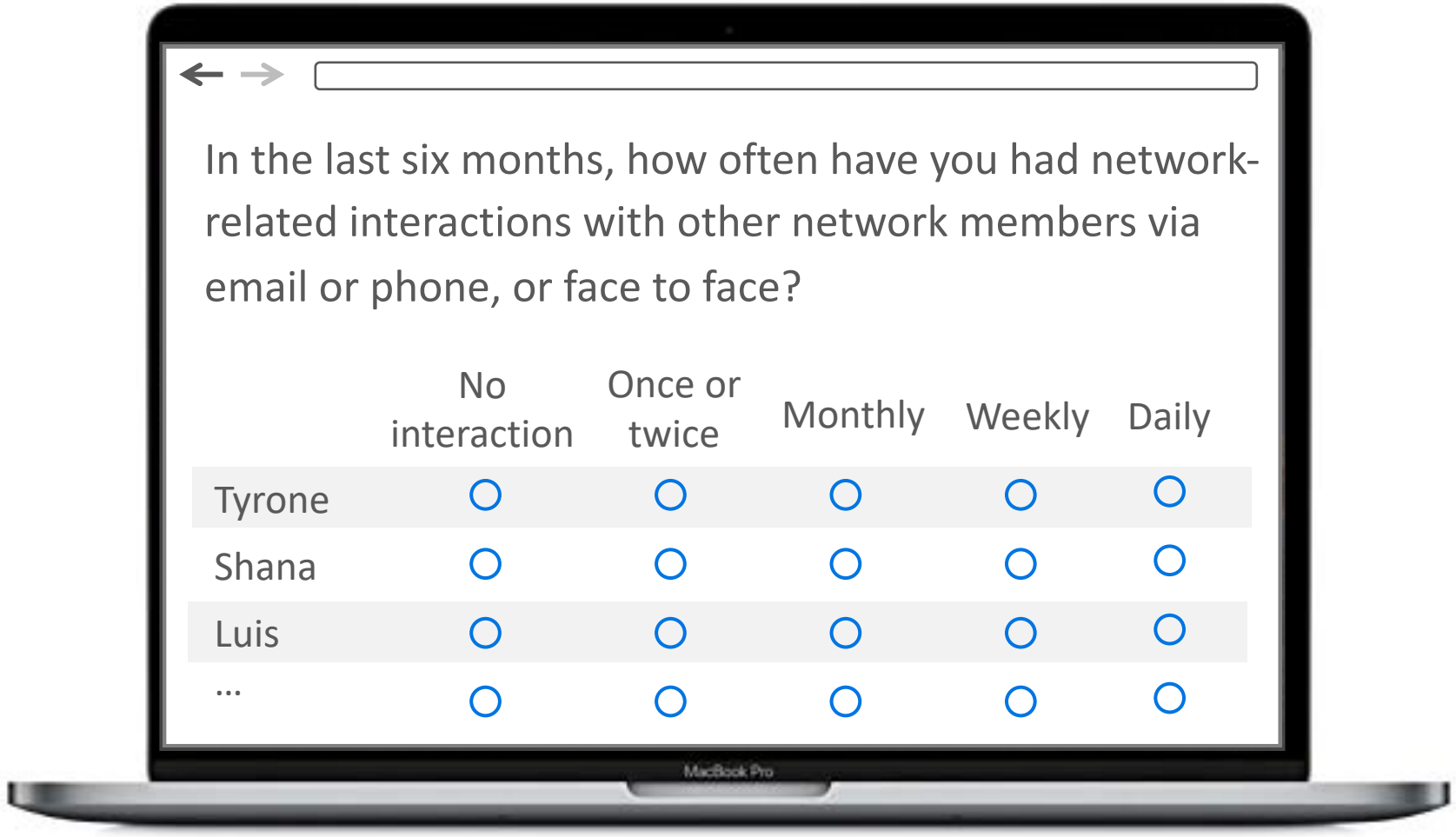

Feldstein & Sherer (2018)

Data collection and analysis

Actors | Ties | Methods

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Whom do you regard as a critical ally or partner in the reform movement?

Ansell, Reckhow, & Kelly (2009)

Data collection and analysis

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Wagner & González-Howard (2018)

Data collection and analysis

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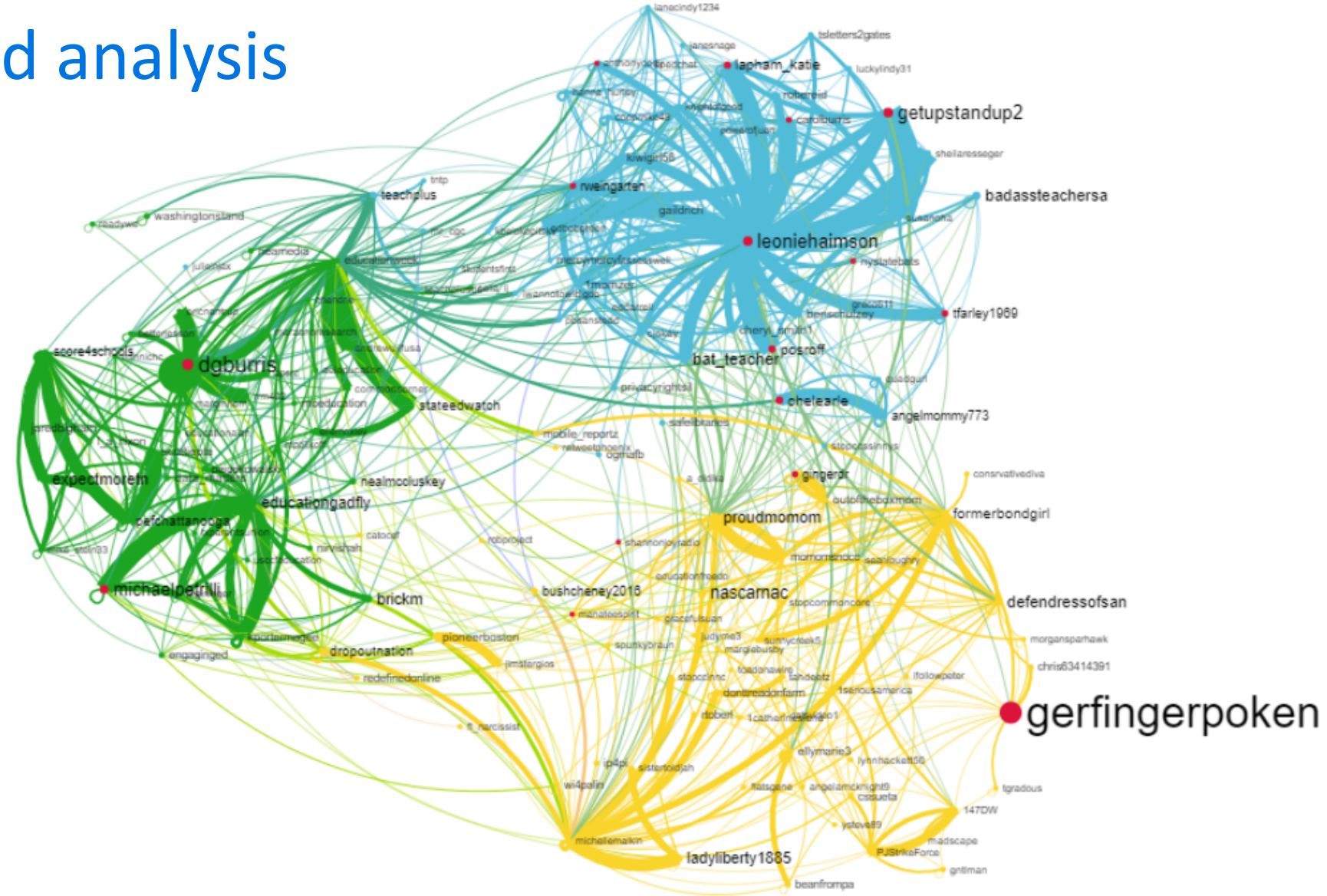

Supovitz, Daly, del Fresno, & Kolouch (2017)

Data collection and analysis

Actors | Ties | Methods

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Archival data

?

Poll 2: Given the context of your work, which method seems most appropriate?

Data collection and analysis

Visualization | Structure | Position

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UCINET Software

R

STATA

Gephi

Data collection and analysis

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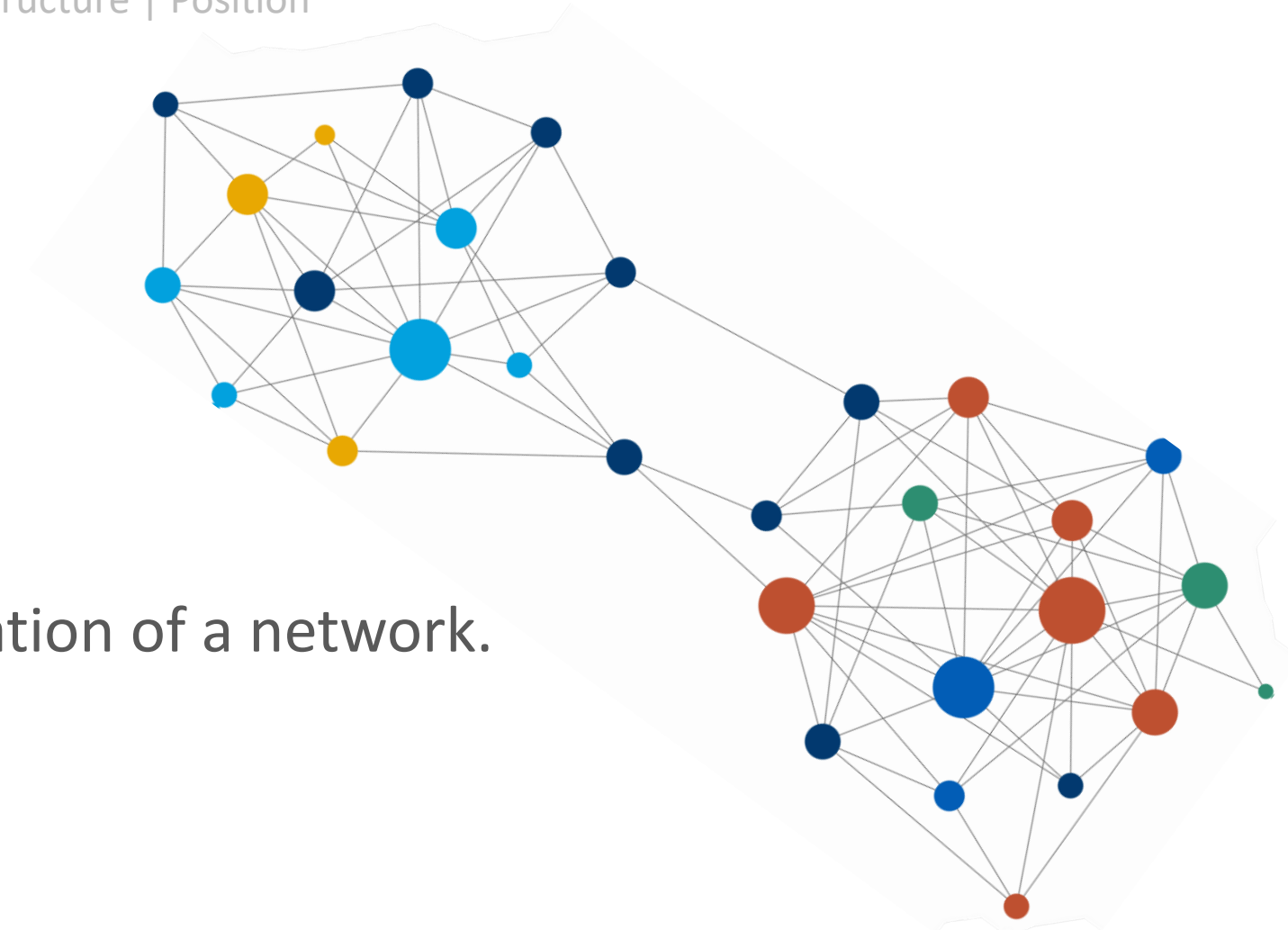
Data collection and analysis

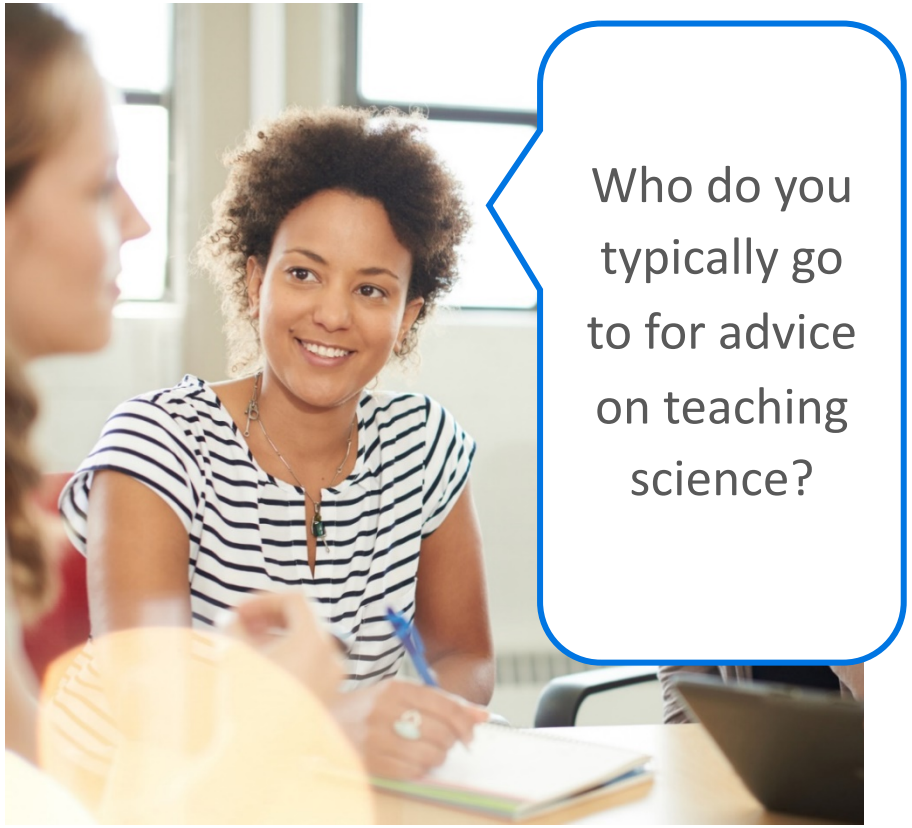
Visualization | Structure | Position



A **sociogram** is a visual representation of a network.

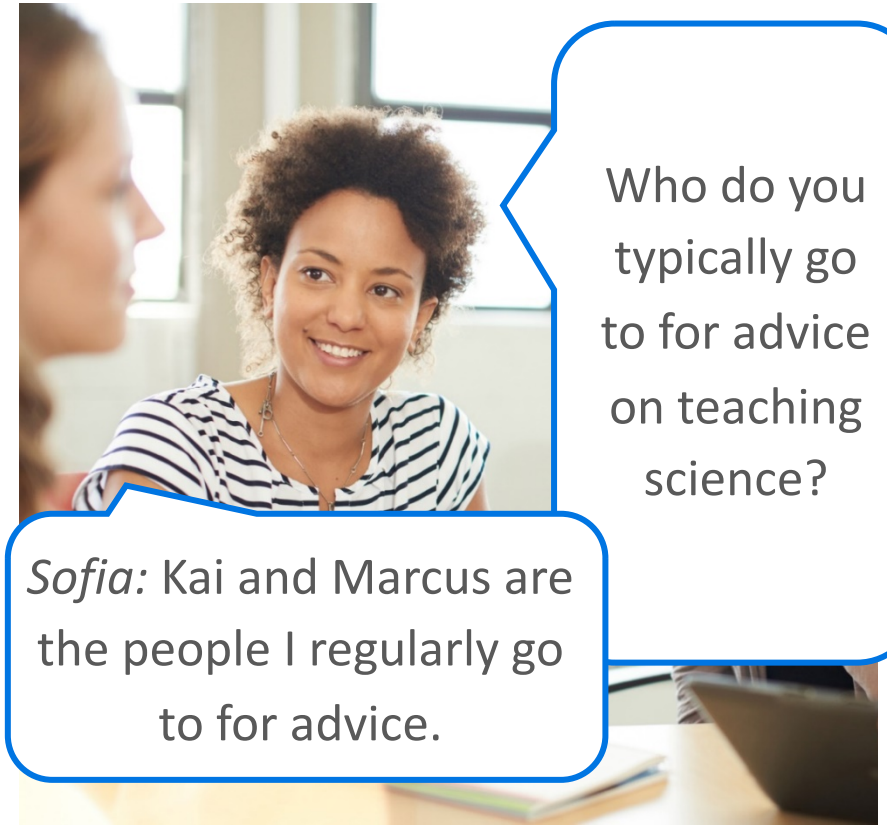
Data collection and analysis

Visualization | Structure | Position



Data collection and analysis

Visualization | Structure | Position



Data collection and analysis

Visualization | Structure | Position

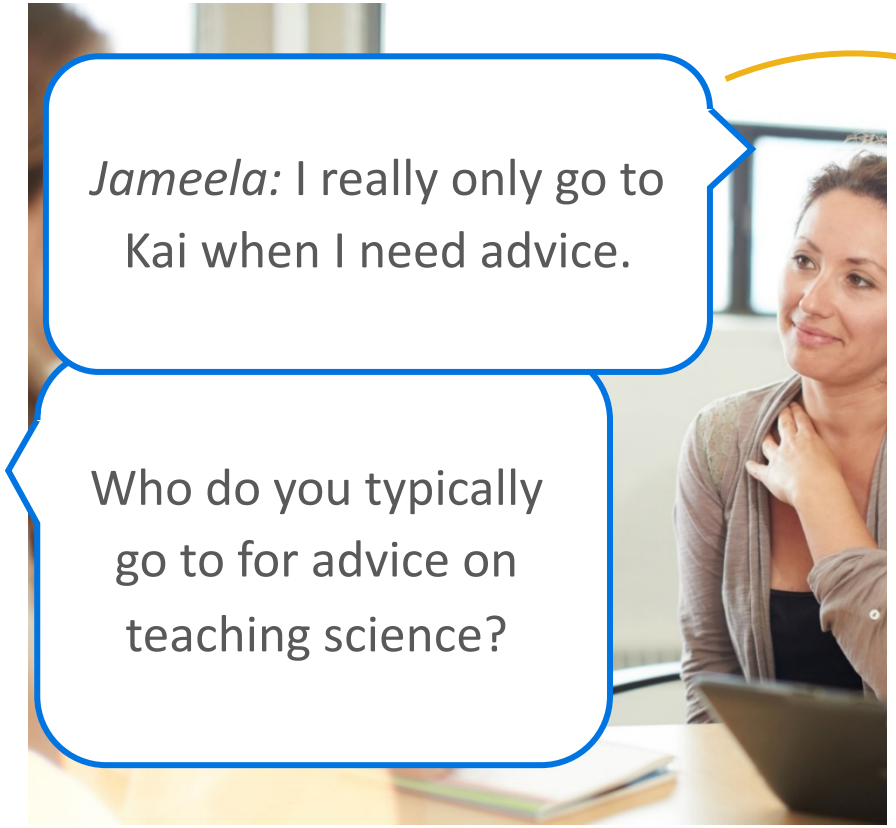
Who do you typically go to for advice on teaching science?

Sofia: Kai and Marcus are the people I regularly go to for advice.

Sofia	Kai
Sofia	Marcus

Data collection and analysis

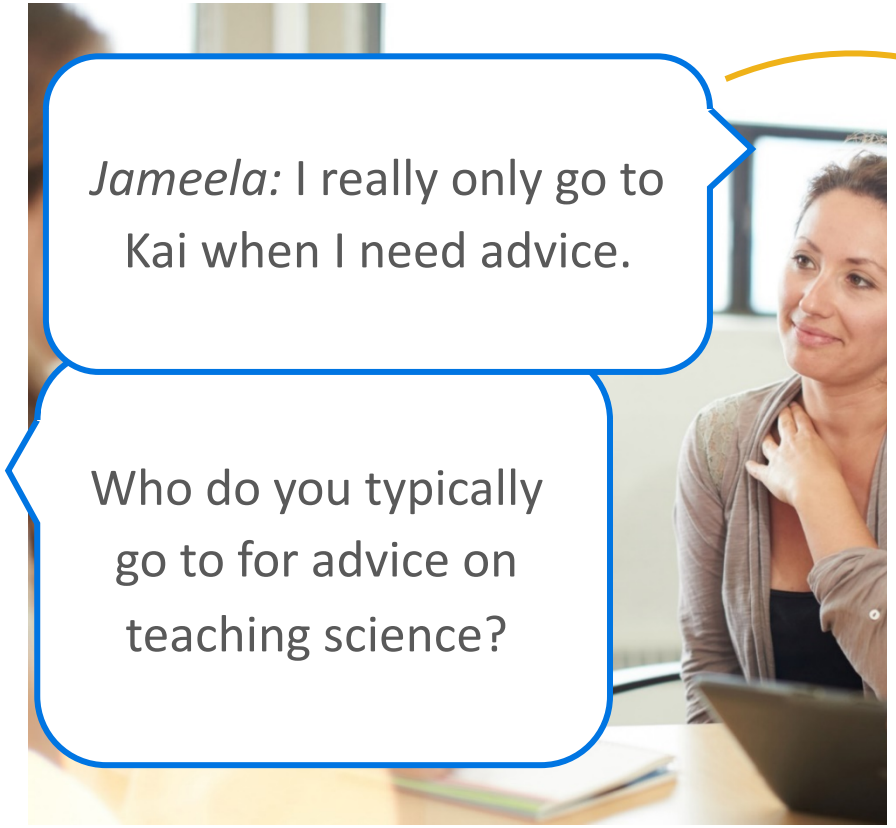
Visualization | Structure | Position



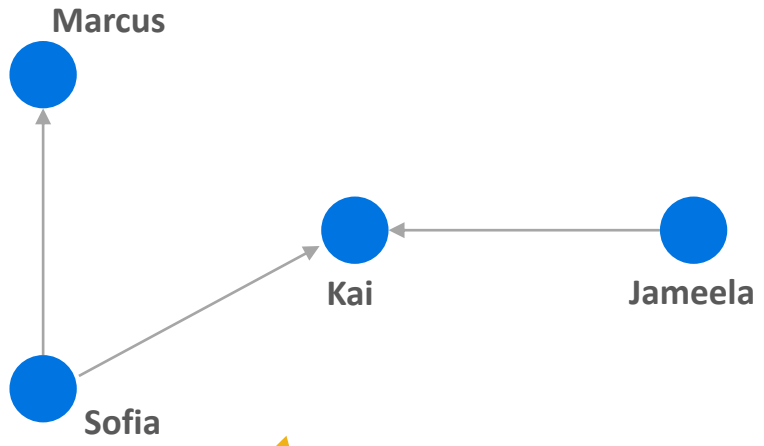
Sofia	**Kai**
Sofia	**Marcus**
Jameela	**Kai**

Data collection and analysis

Visualization | Structure | Position



Sofia	Kai
Sofia	Marcus
Jameela	Kai



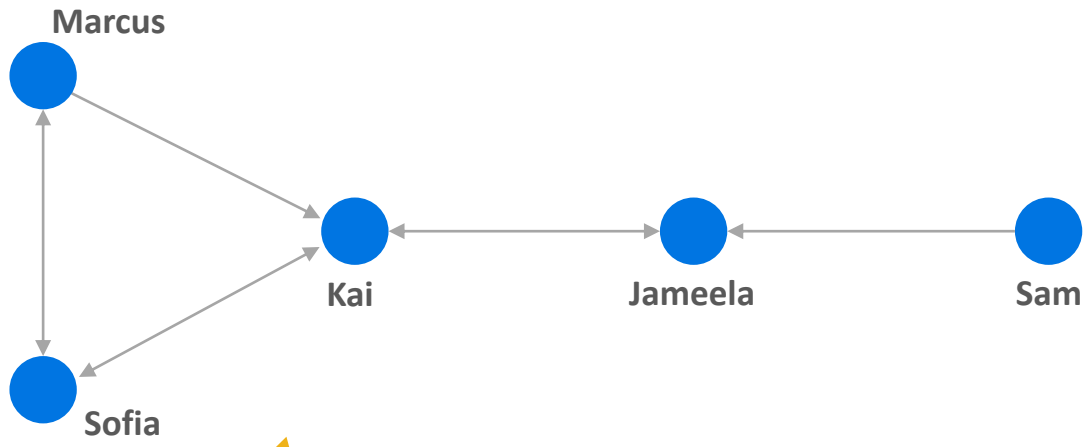
Data collection and analysis

Visualization | Structure | Position

All interviewee responses

Who do you typically go to for advice on teaching science?

Sofia	Kai
Sofia	Marcus
Jameela	Kai
Sam	Jameela
Kai	Sofia
Kai	Jameela
Marcus	Sofia
Marcus	Kai

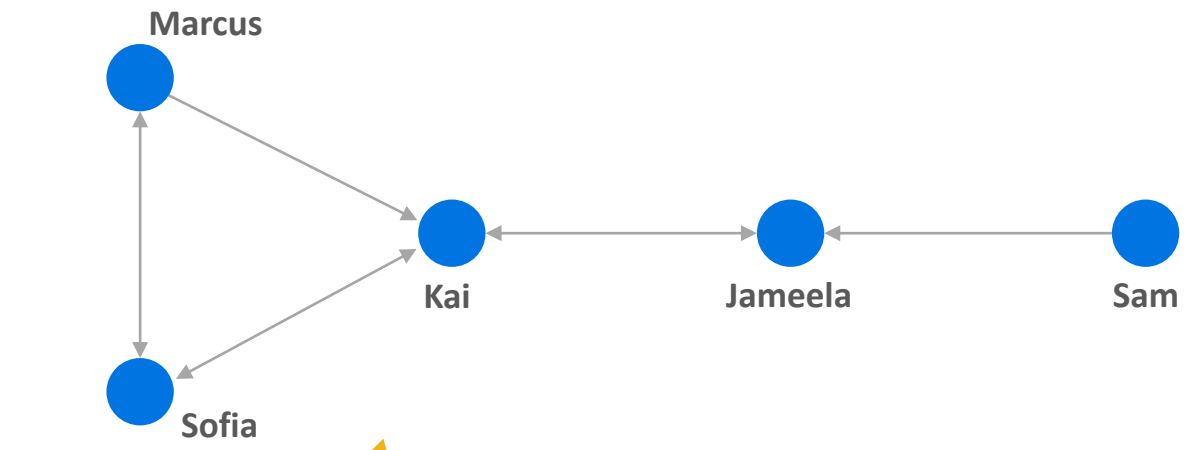


Data collection and analysis

Visualization | Structure | Position

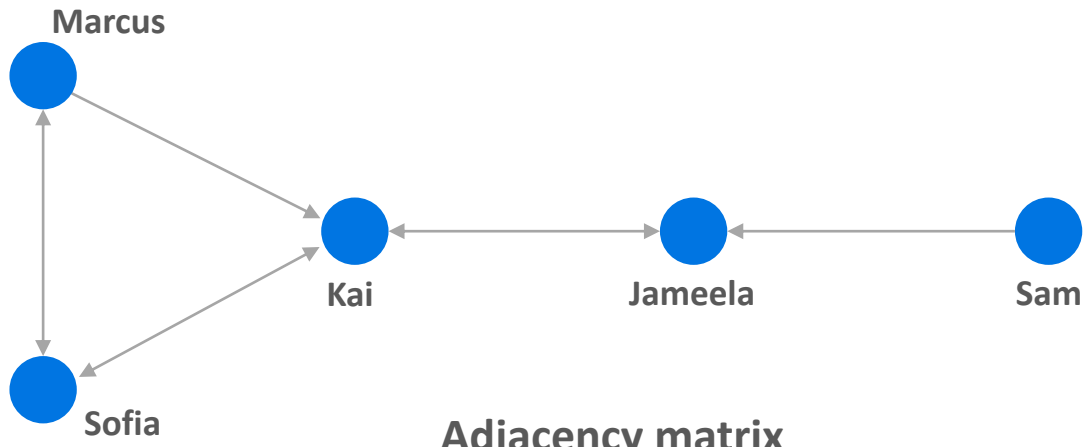
Adjacency list

Sofia	Kai
Sofia	Marcus
Jameela	Kai
Sam	Jameela
Kai	Sofia
Kai	Jameela
Marcus	Sofia
Marcus	Kai



Data collection and analysis

Visualization | Structure | Position



Adjacency list

Sofia	Kai
Sofia	Marcus
Jameela	Kai
Sam	Jameela
Kai	Sofia
Kai	Jameela
Marcus	Sofia
Marcus	Kai

Adjacency matrix

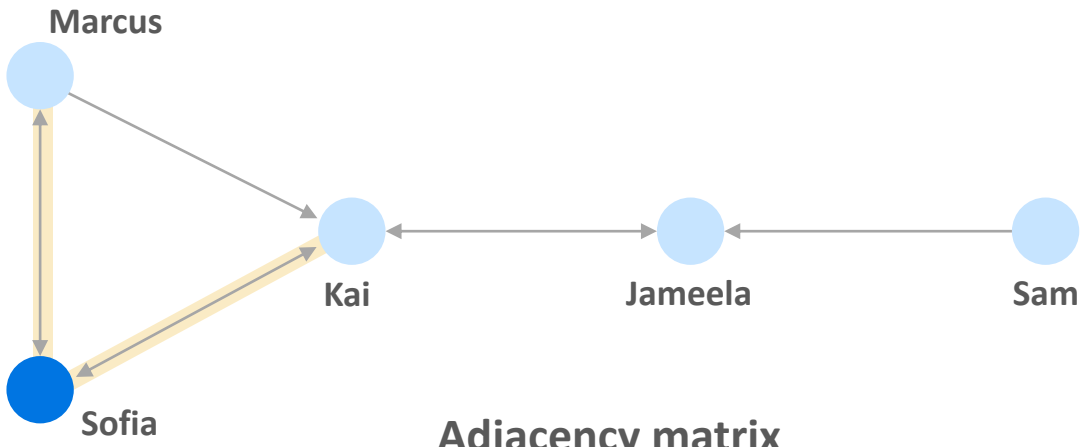
Incoming ties

Outgoing ties

	Sofia	Jameela	Sam	Kai	Marcus
Sofia	0	0	0	1	1
Jameela	0	0	0	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	0
Marcus	0	0	0	1	0

Data collection and analysis

Visualization | Structure | Position



Adjacency list

Sofia	Kai
Sofia	Marcus
Jameela	Kai
Sam	Jameela
Kai	Sofia
Kai	Jameela
Marcus	Sofia
Marcus	Kai

Adjacency matrix

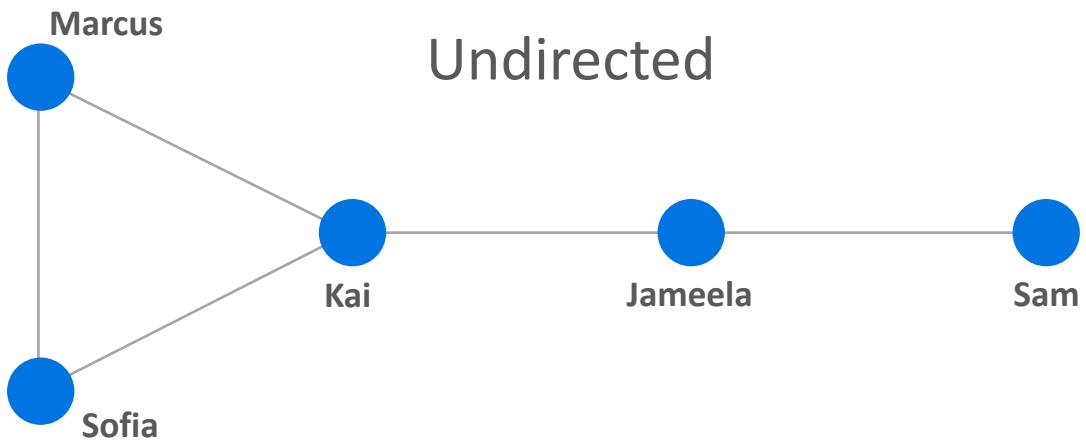
Incoming ties

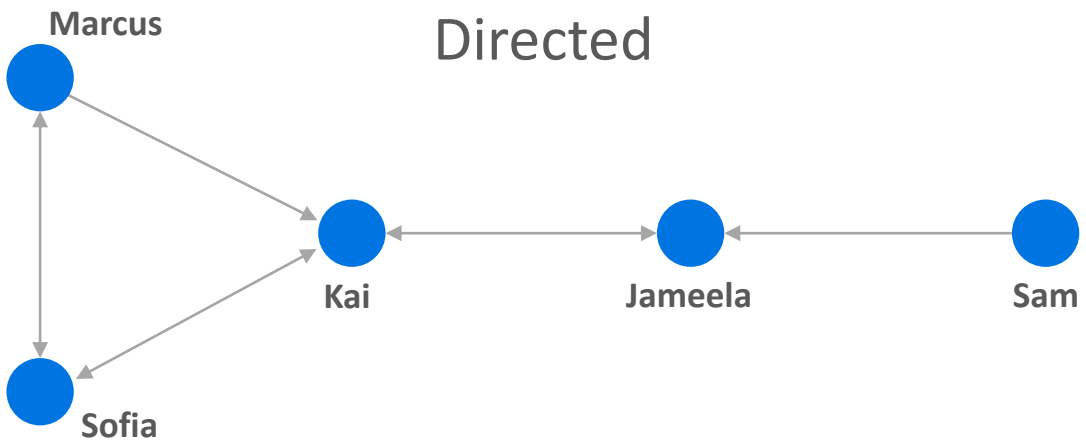
Outgoing ties

	Sofia	Jameela	Sam	Kai	Marcus
Sofia	0	0	0	1	1
Jameela	0	0	0	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	0
Marcus	0	0	0	1	0

Data collection and analysis

Visualization | Structure | Position





	Sofia	Jameela	Sam	Kai	Marcus
Sofia	0	0	0	1	1
Jameela	0	0	1	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	1
Marcus	1	0	0	1	0

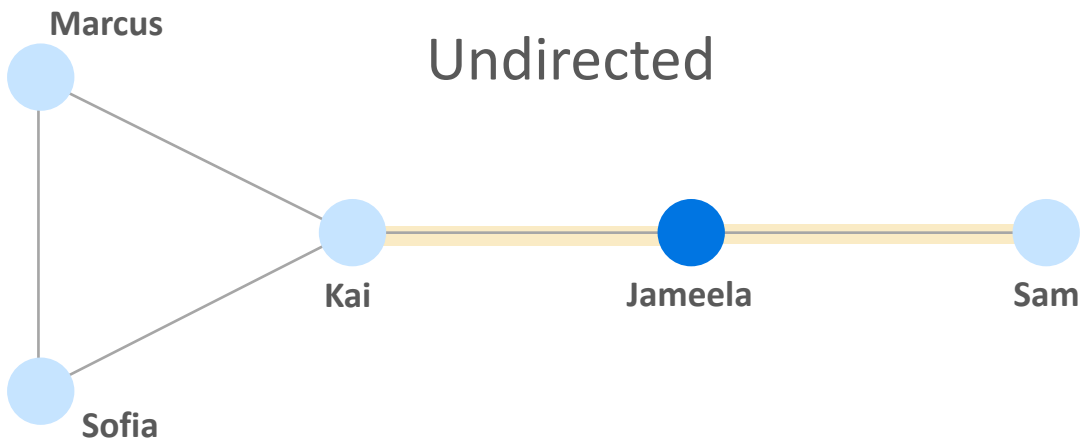
Incoming ties

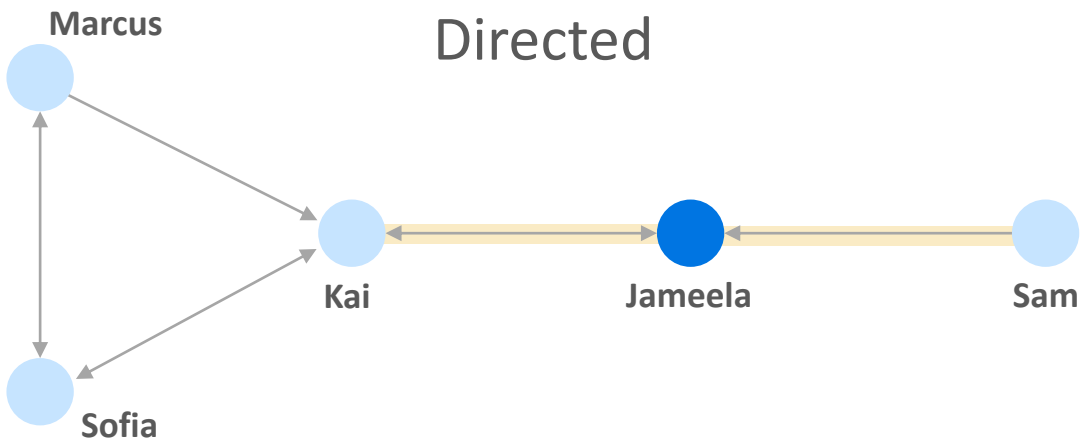
Outgoing ties

	Sofia	Jameela	Sam	Kai	Marcus
Sofia	0	0	0	1	1
Jameela	0	0	0	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	0
Marcus	0	0	0	1	0

Data collection and analysis

Visualization | Structure | Position





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Jameela	0	0	1	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	1
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Incoming ties

Outgoing ties

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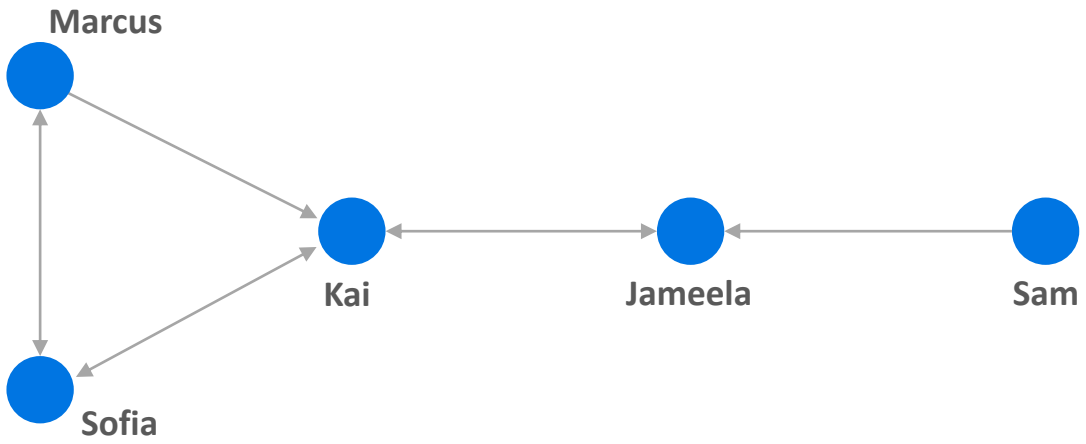
Jameela	0	0	0	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	0
Marcus	0	0	0	1	0

Data collection and analysis

Visualization | Structure | Position



Attribute list

Actor	School	Role	Age
Sofia	1	Teacher	24
Jameela	1	Teacher	38
Sam	1	Instructional Aide	54
Kai	1	Instructional Coach	45
Marcus	1	Teacher	48

Incoming ties

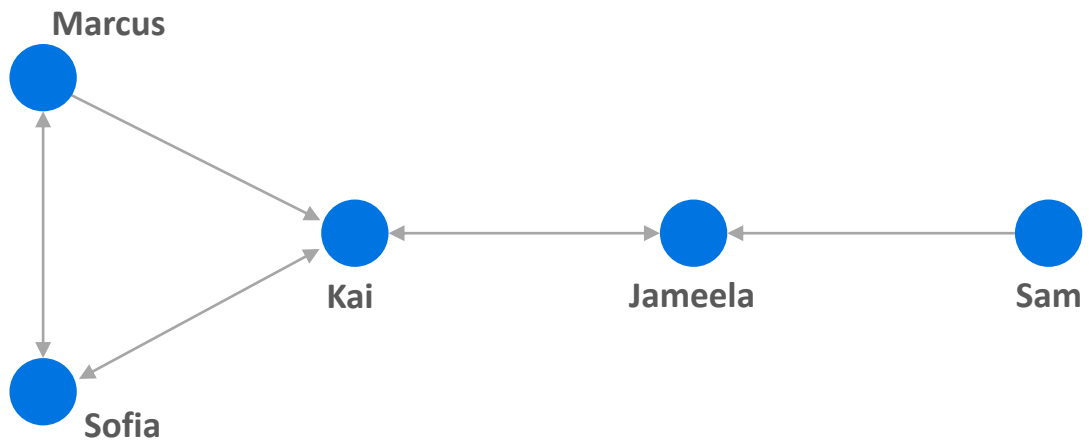
Outgoing ties

	Sofia	Jameela	Sam	Kai	Marcus
Sofia	0	0	0	1	1
Jameela	0	0	0	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	0
Marcus	0	0	0	1	0

Data collection and analysis

Visualization | Structure | Position

Color-coded by school



Attribute list

Actor	School	Role	Age
Sofia	1	Teacher	24
Jameela	1	Teacher	38
Sam	1	Instructional Aide	54
Kai	1	Instructional Coach	45
Marcus	1	Teacher	48

Incoming ties

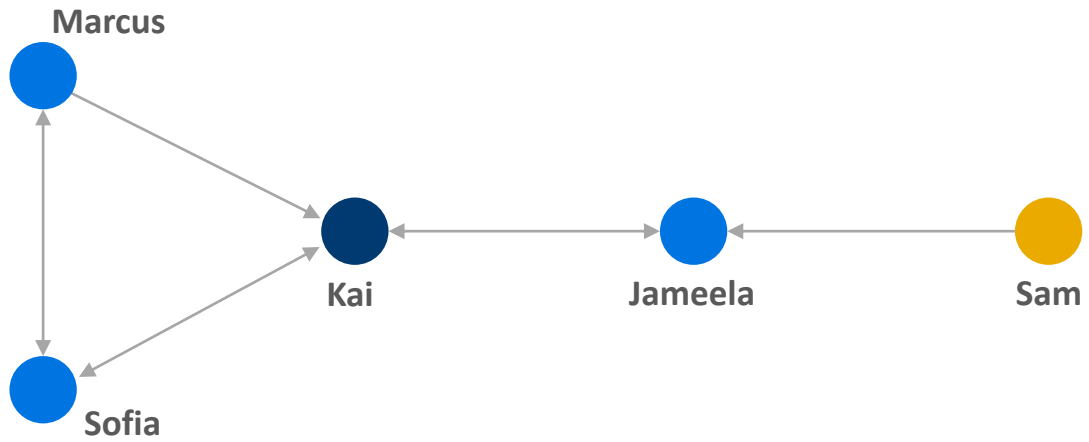
Outgoing ties

	Sofia	Jameela	Sam	Kai	Marcus
Sofia	0	0	0	1	1
Jameela	0	0	0	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	0
Marcus	0	0	0	1	0

Data collection and analysis

Visualization | Structure | Position

Color-coded by role



Attribute list

Actor	School	Role	Age
Sofia	1	Teacher	24
Jameela	1	Teacher	38
Sam	1	Instructional Aide	54
Kai	1	Instructional Coach	45
Marcus	1	Teacher	48

Incoming ties

Outgoing ties	Sofia	Jameela	Sam	Kai	Marcus
Sofia	0	0	0	1	1
Jameela	0	0	0	1	0
Sam	0	1	0	0	0
Kai	1	1	0	0	0
Marcus	0	0	0	1	0

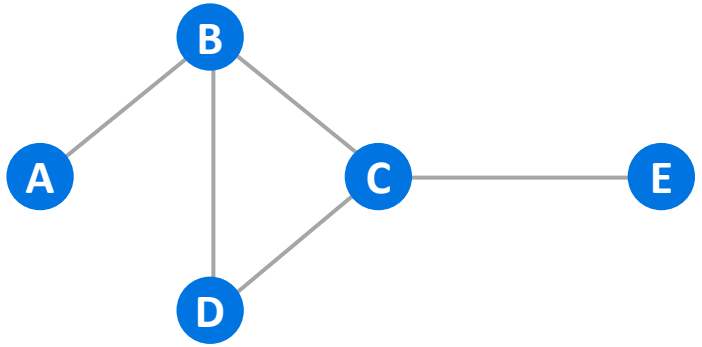
Data collection and analysis

Visualization | Structure | Position

Poll 3: Which of these sociograms fits the data in the adjacency list?

A	B
B	A
B	C
B	D
C	B
C	D
C	E
D	B
D	C
E	C

1



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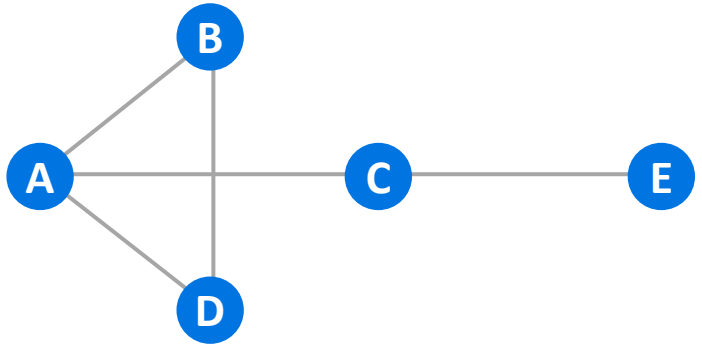

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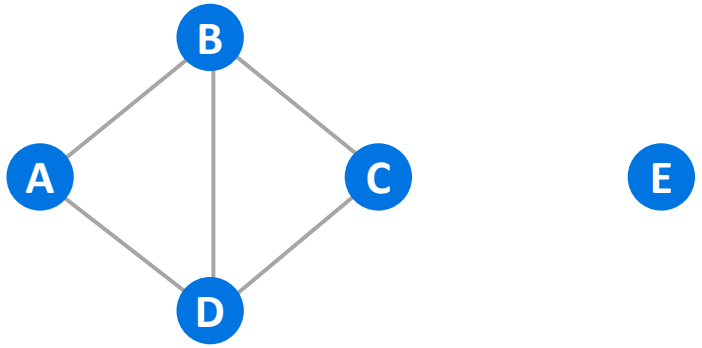


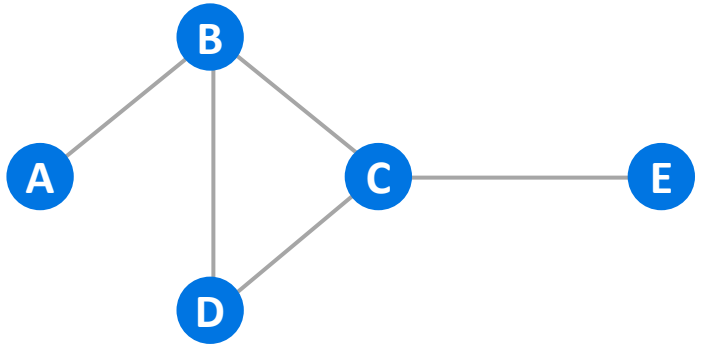
Data collection and analysis

Visualization | Structure | Position

Poll 3: Which of these sociograms fits the data in the adjacency list?

A	B
B	A
B	C
B	D
C	B
C	D
C	E
D	B
D	C
E	C

1



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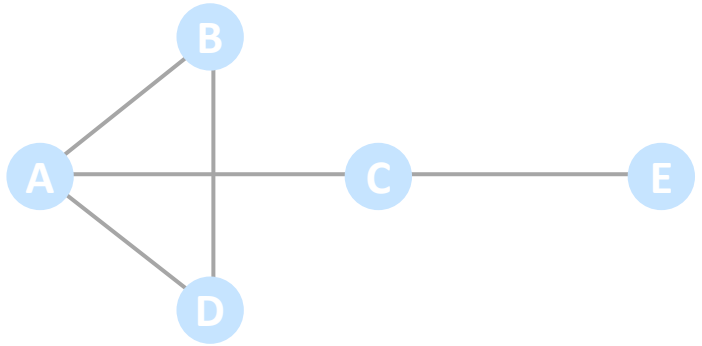

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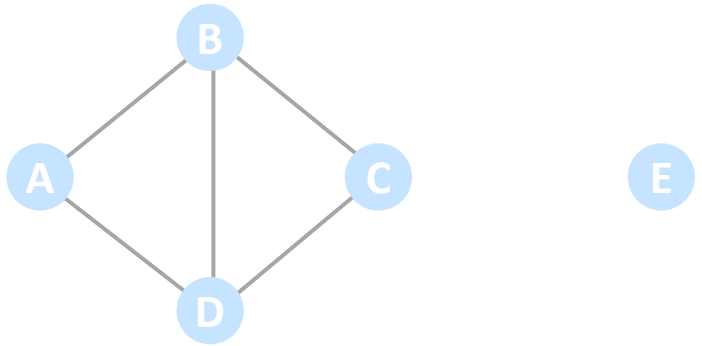


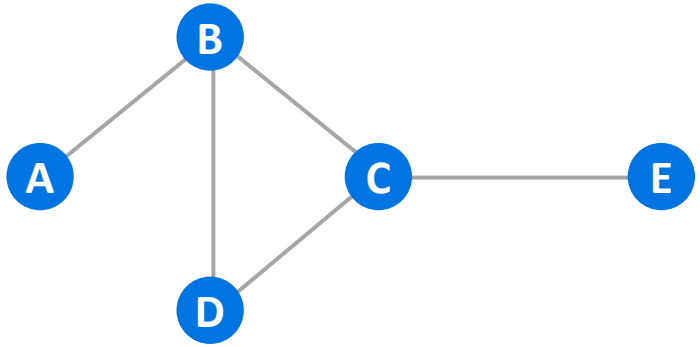
Data collection and analysis

Visualization | Structure | Position

Poll 4: Which of these sociograms fits the data in the adjacency matrix?

	A	B	C	D	E
A	0	1	0	1	0
B	1	0	1	1	0
C	0	1	0	1	0
D	1	1	1	0	0
E	0	0	0	0	0

1



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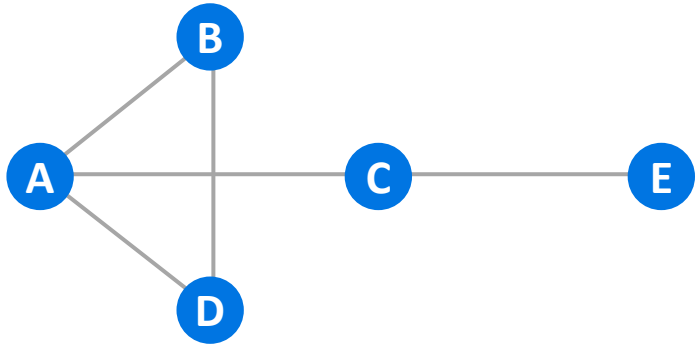
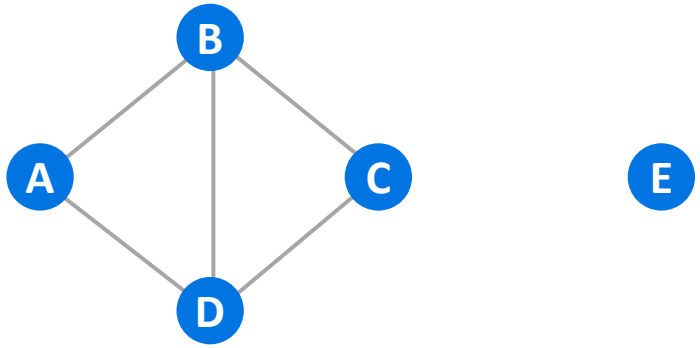


3



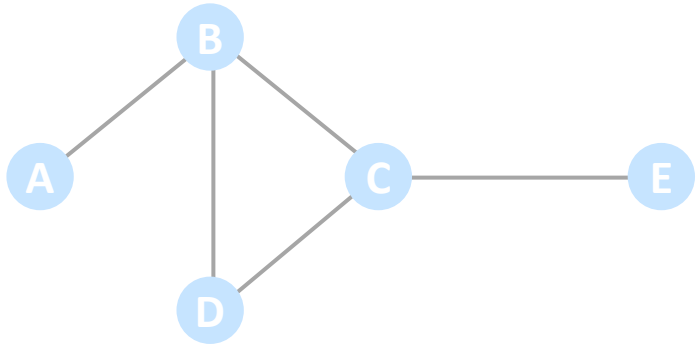
Data collection and analysis

Visualization | Structure | Position

Poll 4: Which of these sociograms fits the data in the adjacency matrix?

	A	B	C	D	E
A	0	1	0	1	0
B	1	0	1	1	0
C	0	1	0	1	0
D	1	1	1	0	0
E	0	0	0	0	0

1



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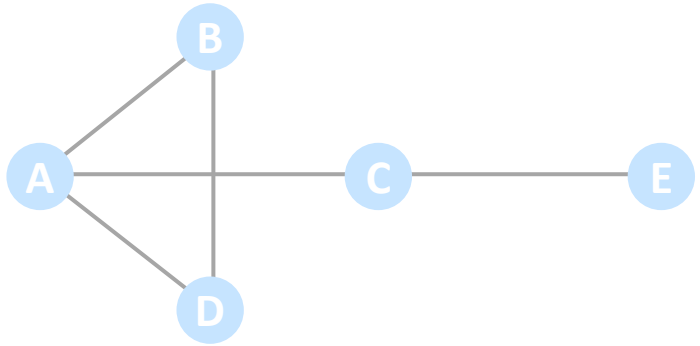

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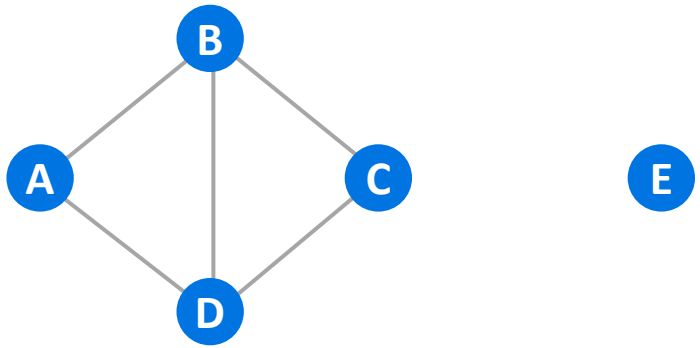
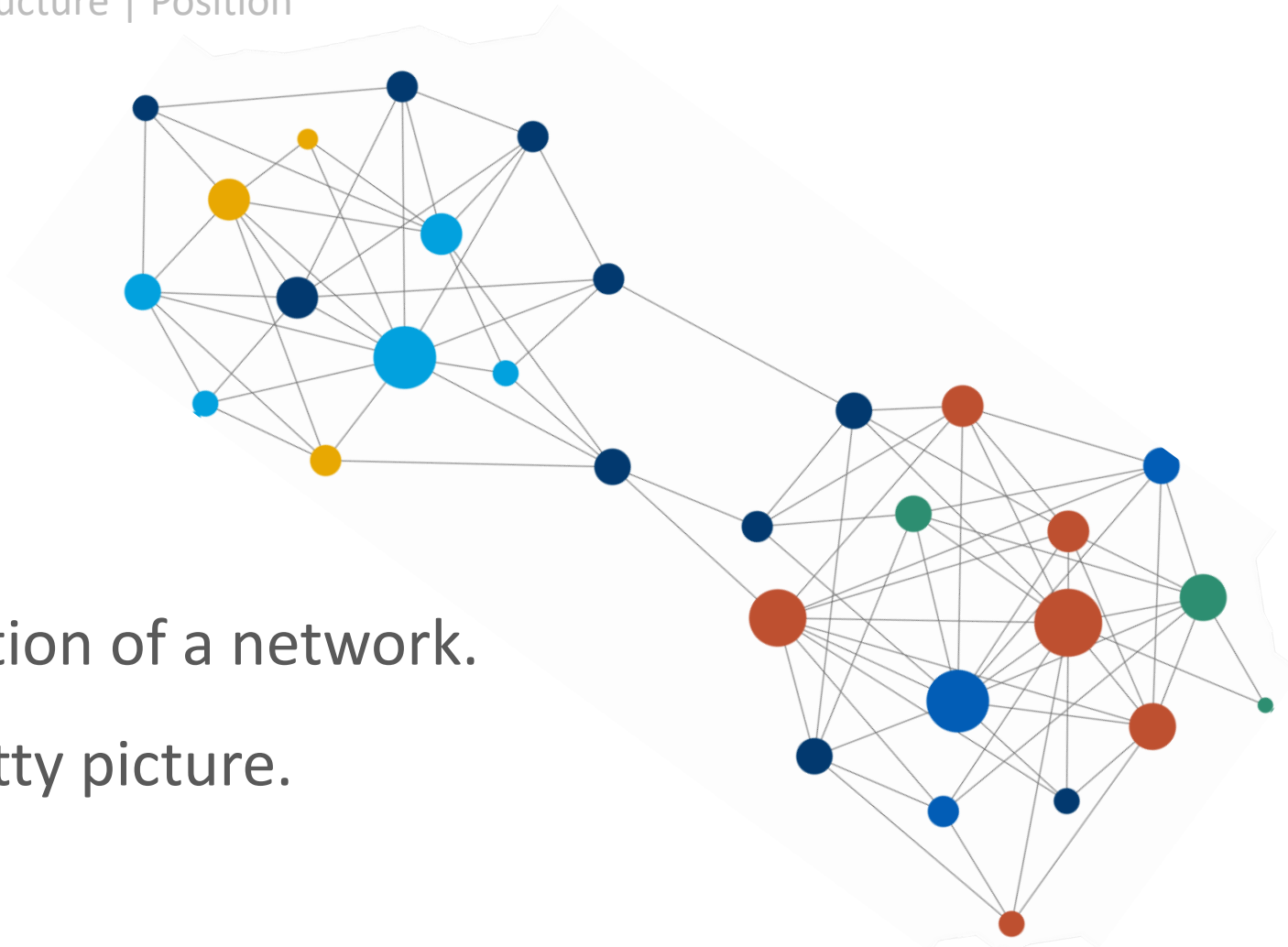


Data collection and analysis

Visualization | Structure | Position



A **sociogram** is a visual representation of a network.

→ And it is more than a pretty picture.

Data collection and analysis

Visualization | Structure | Position

Social network analysis helps us:

- **Visualize** data through sociograms to gain insights.
- Understand the **structure** of a network.
- Understand the **position** of actors within a network.

UCINET Software

R

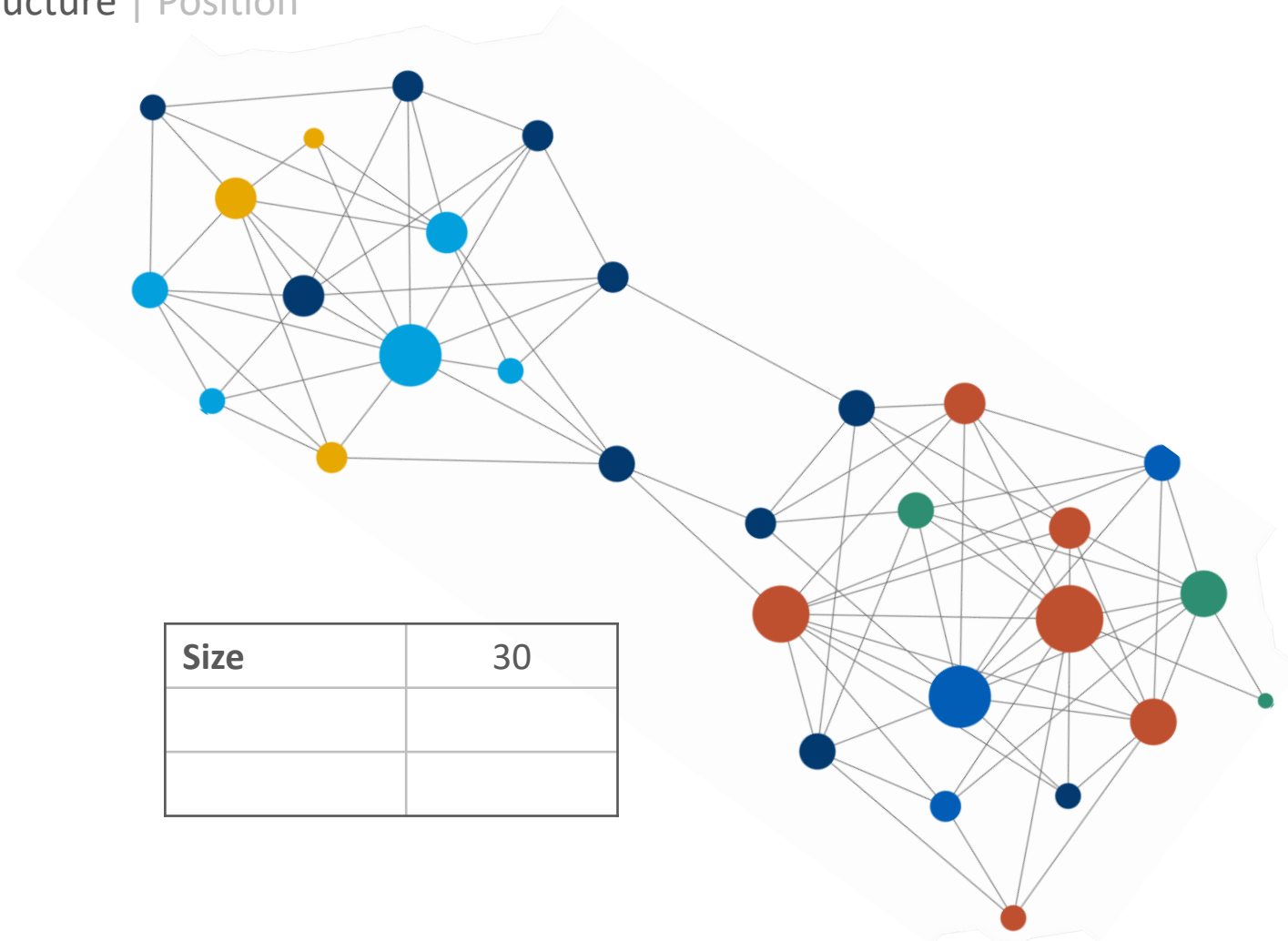
STATA

Gephi

Data collection and analysis

Visualization | Structure | Position

Size is the number of actors in the network.



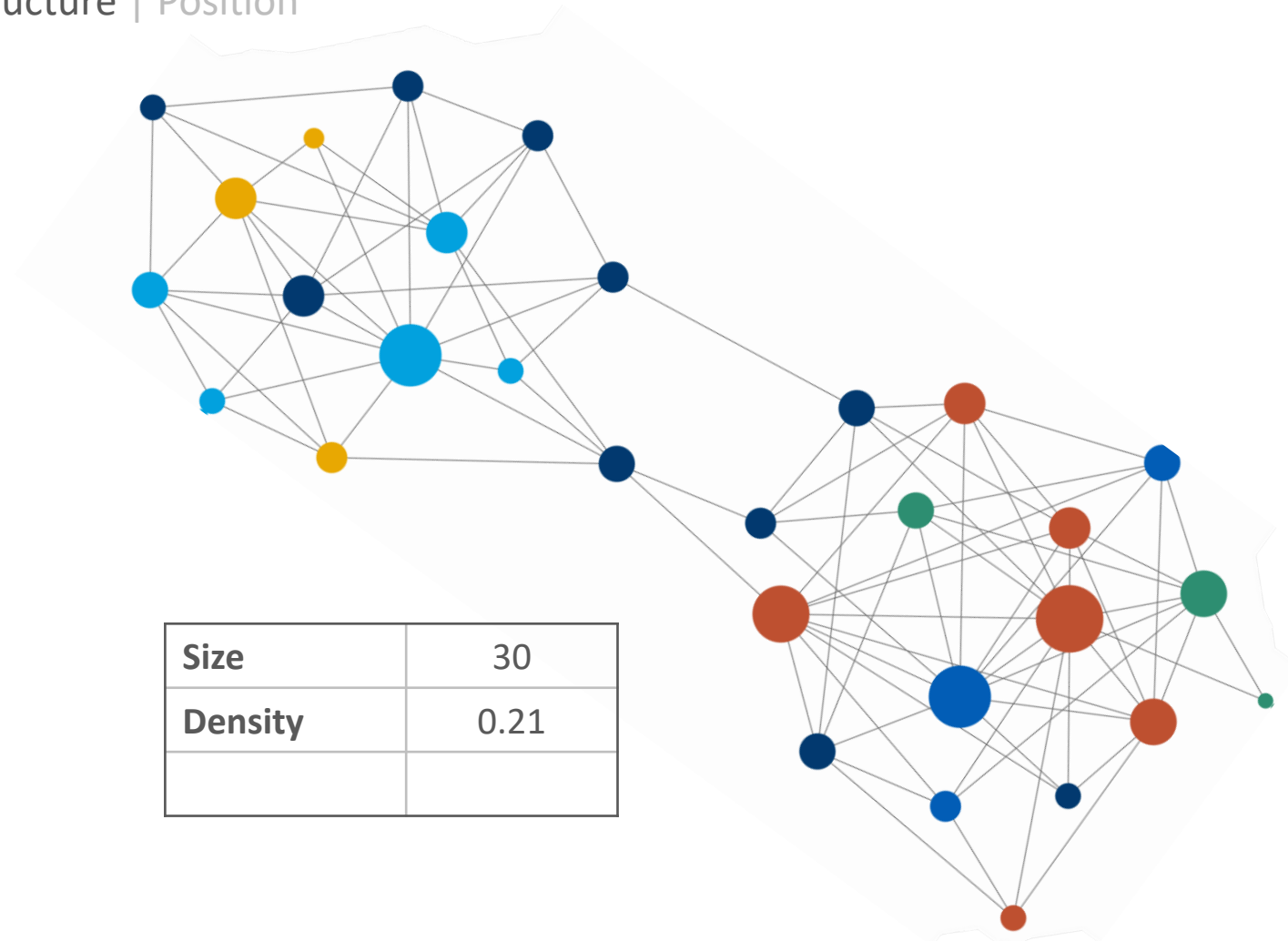
Size	30

Data collection and analysis

Visualization | Structure | Position

Size is the number of actors in the network.

Density is the number of ties relative to the total possible number of ties.



Size	30
Density	0.21

Data collection and analysis

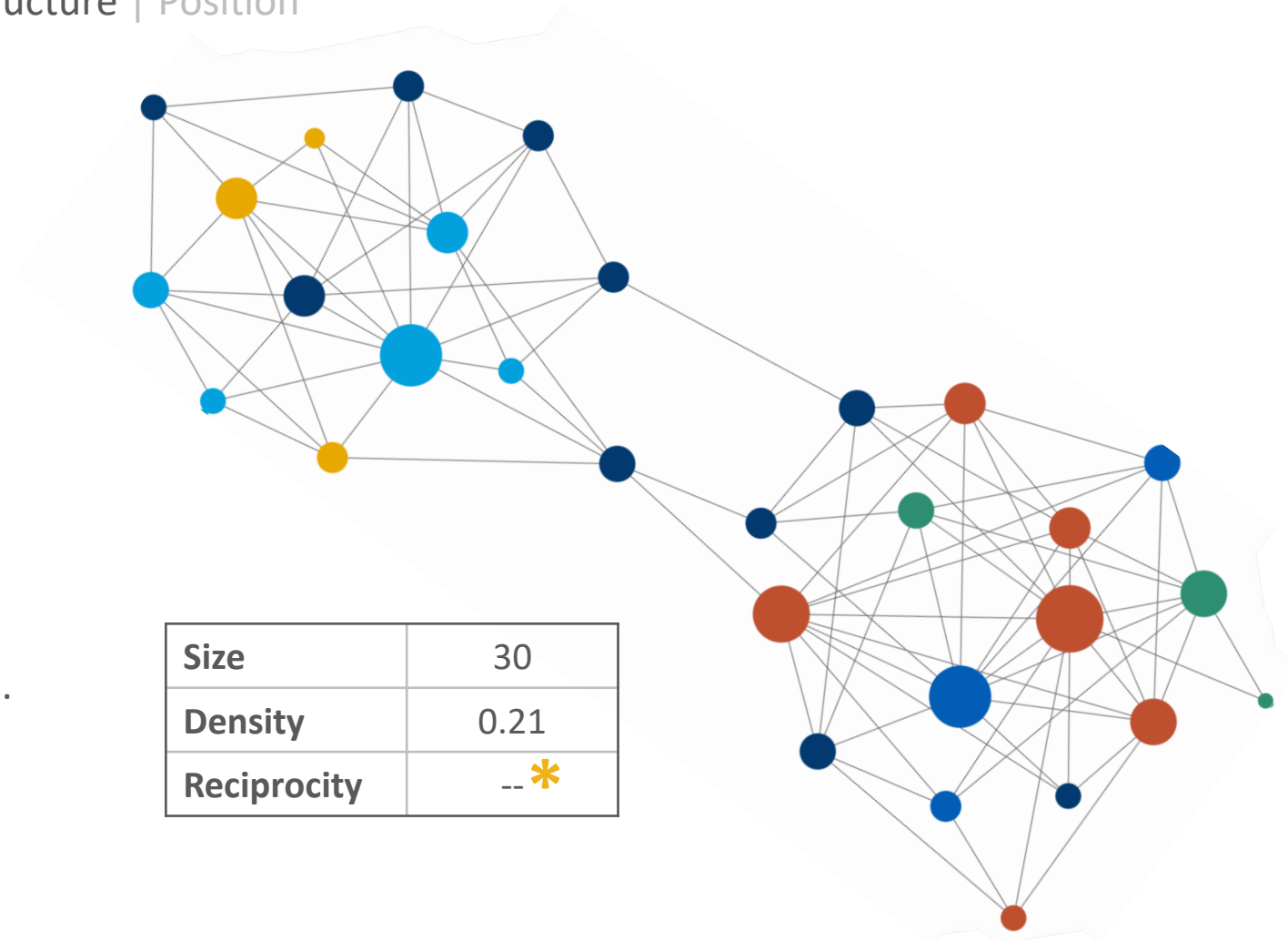
Visualization | Structure | Position

Size is the number of actors in the network.

Density is the number of ties relative to the total possible number of ties.

Reciprocity is the extent to which ties are bi-directional; it indicates the mutuality of the network's ties.

* Needs to be calculated on directed networks.



Size	30
Density	0.21
Reciprocity	--*

Data collection and analysis

Visualization | Structure | Position

Social network analysis helps us:

- **Visualize** data through sociograms to gain insights.
- Understand the **structure** of a network.
- Understand the **position** of actors within a network.

UCINET Software

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STATA

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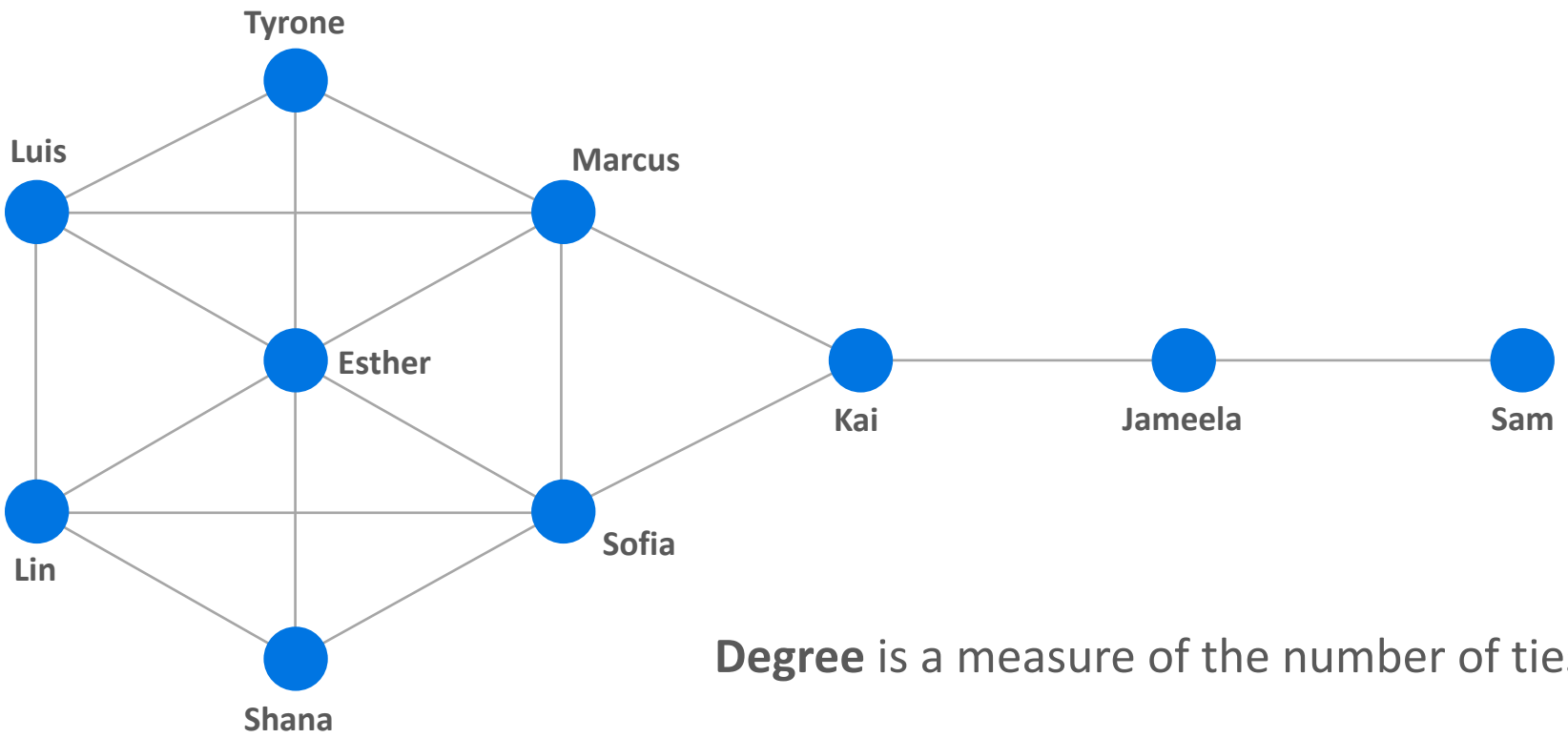
Data collection and analysis

Visualization | Structure | Position

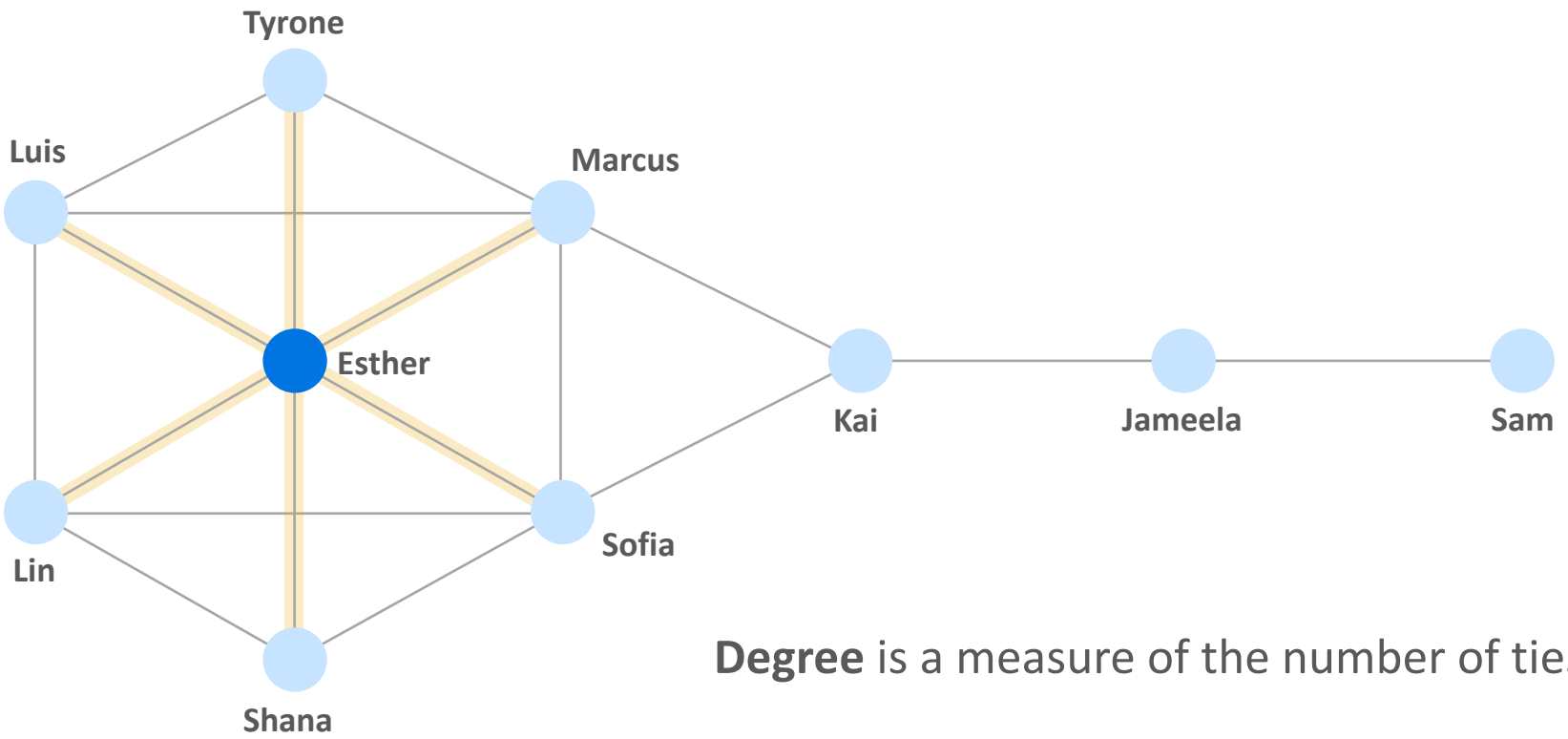


Degree is a measure of the number of ties.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

Visualization | Structure | Position



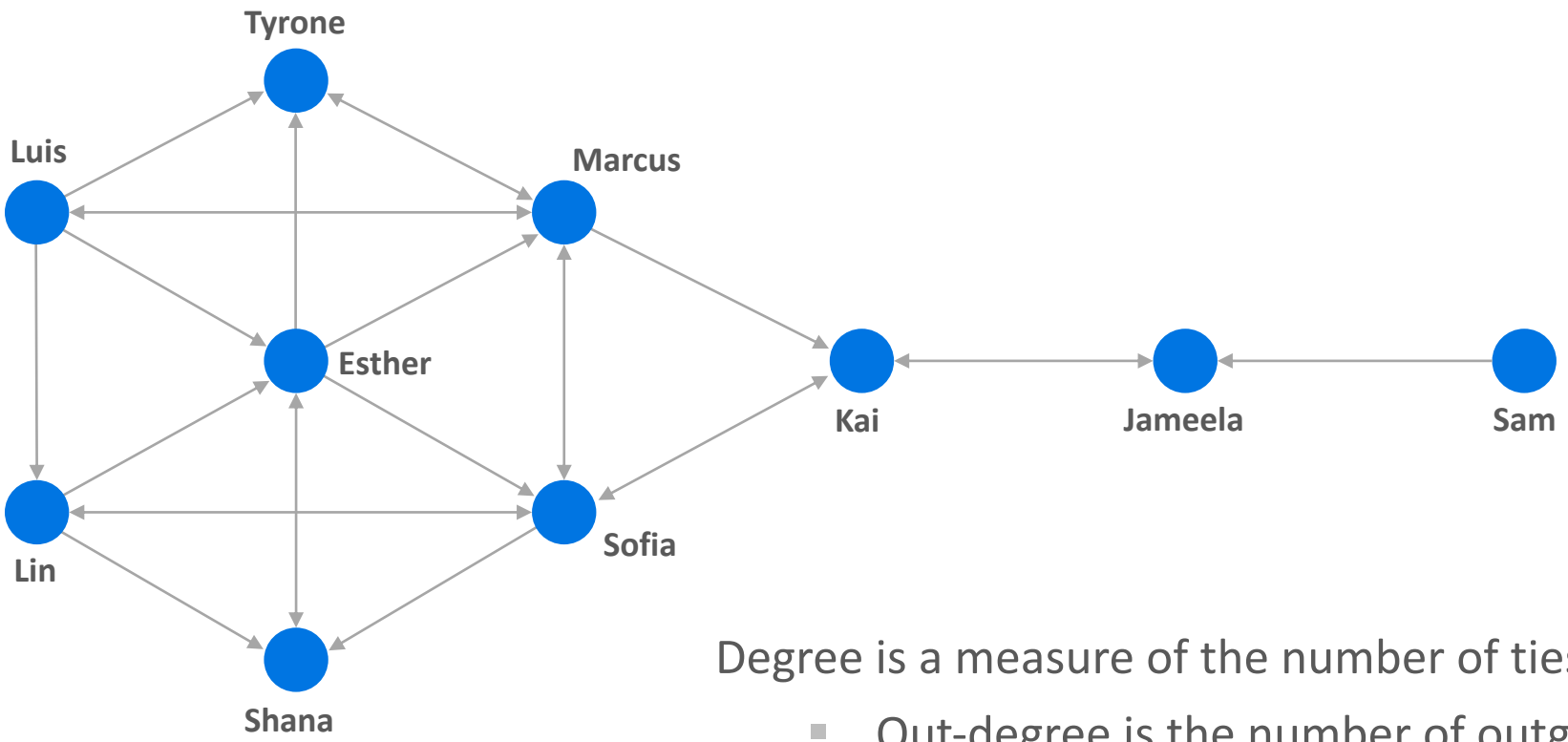
Actor	Degree
Tyrone	3
Shana	3
Luis	4
Jameela	2
Sam	1
Lin	4
Esther	6
Kai	3
Sofia	5
Marcus	5

Degree is a measure of the number of ties.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

Visualization | Structure | Position



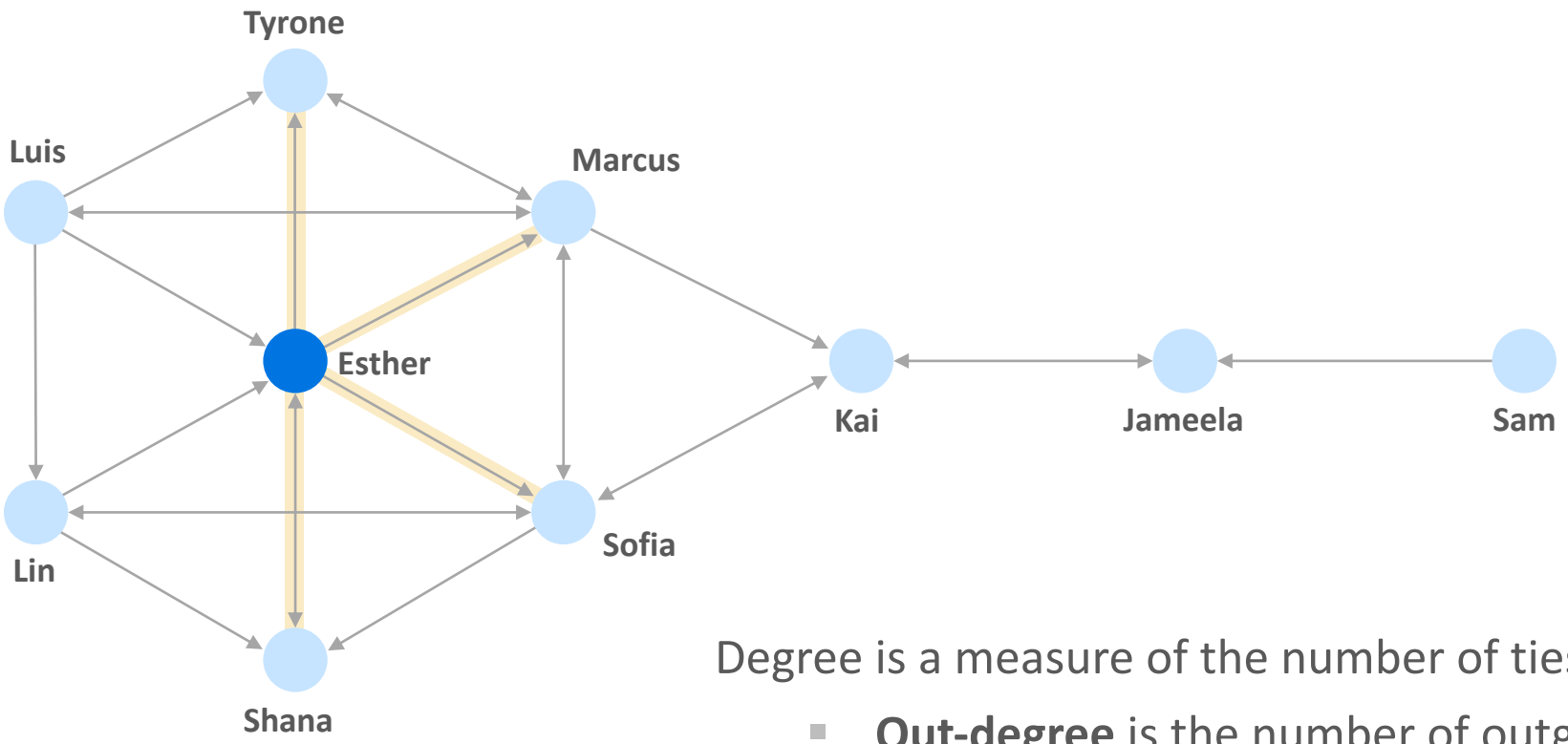
Degree is a measure of the number of ties.

- Out-degree is the number of outgoing ties.
- In-degree is the number of incoming ties.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

Visualization | Structure | Position



Actor	Out-degree
Tyrone	1
Shana	1
Luis	4
Jameela	1
Sam	1
Lin	3
Esther	4
Kai	2
Sofia	4
Marcus	4

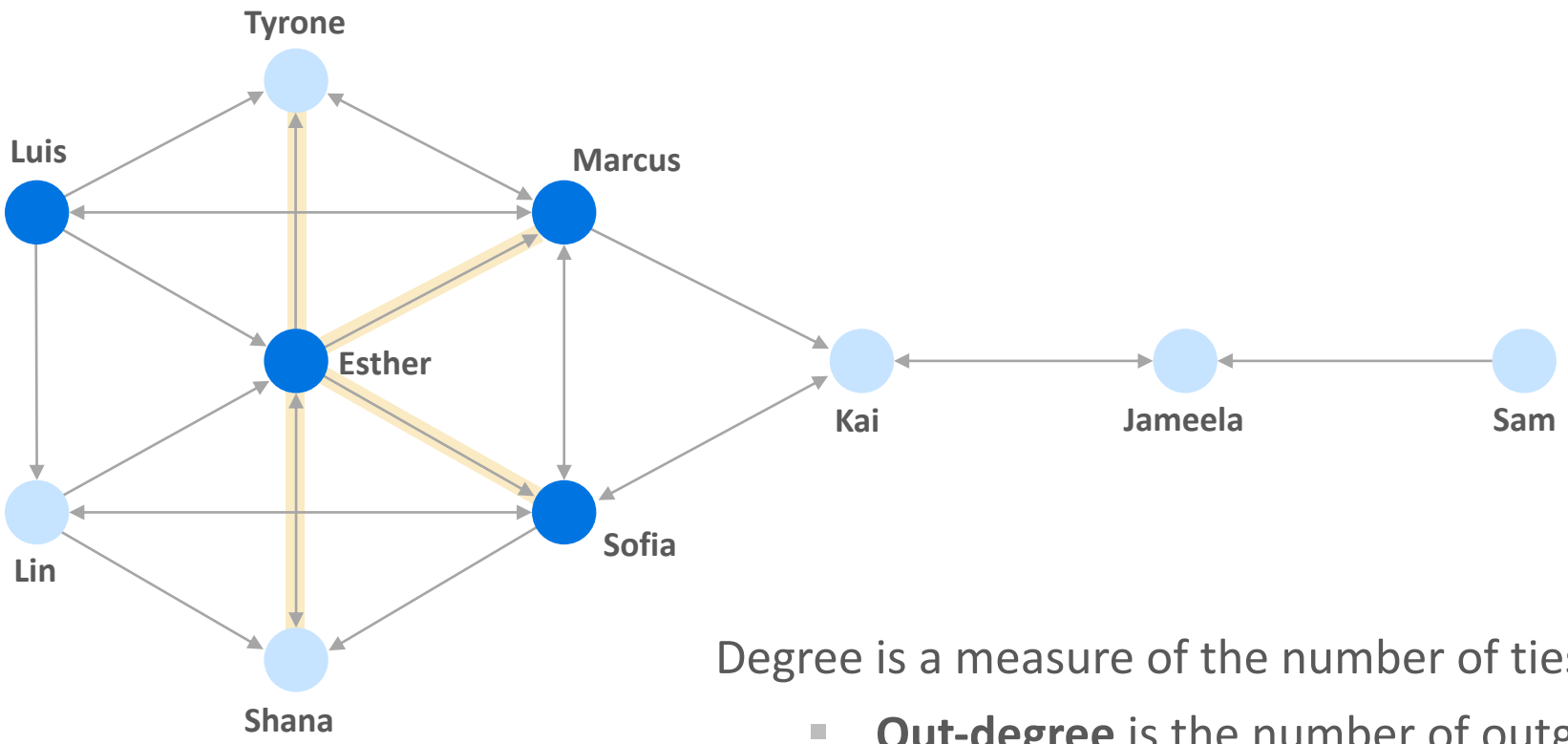
Degree is a measure of the number of ties.

- **Out-degree** is the number of outgoing ties.
- In-degree is the number of incoming ties.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

Visualization | Structure | Position



Actor	Out-degree
Tyrone	1
Shana	1
Luis	4
Jameela	1
Sam	1
Lin	3
Esther	4
Kai	2
Sofia	4
Marcus	4

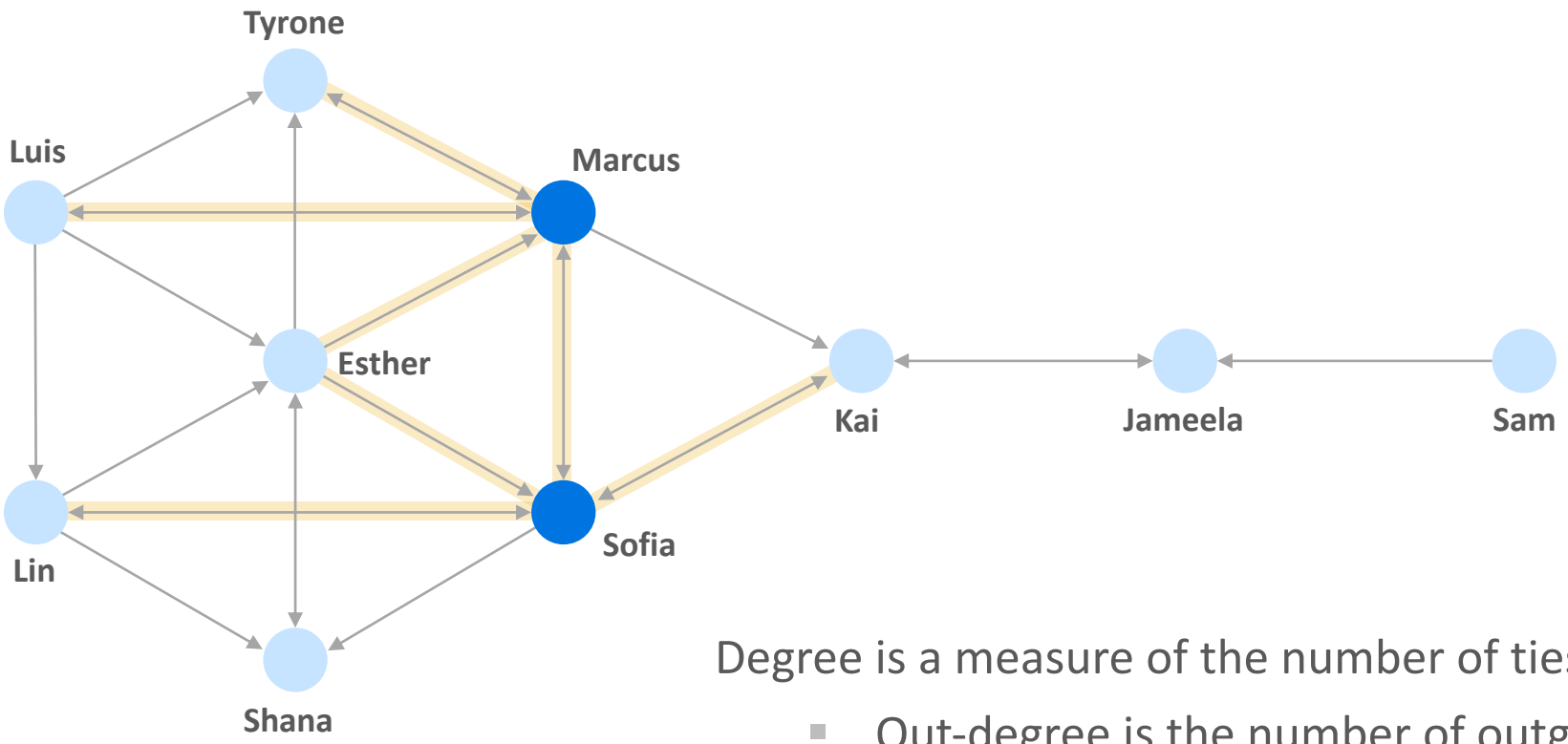
Degree is a measure of the number of ties.

- **Out-degree** is the number of outgoing ties.
- In-degree is the number of incoming ties.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

Visualization | Structure | Position



Actor	In-degree
Tyrone	3
Shana	3
Luis	1
Jameela	2
Sam	0
Lin	2
Esther	3
Kai	3
Sofia	4
Marcus	4

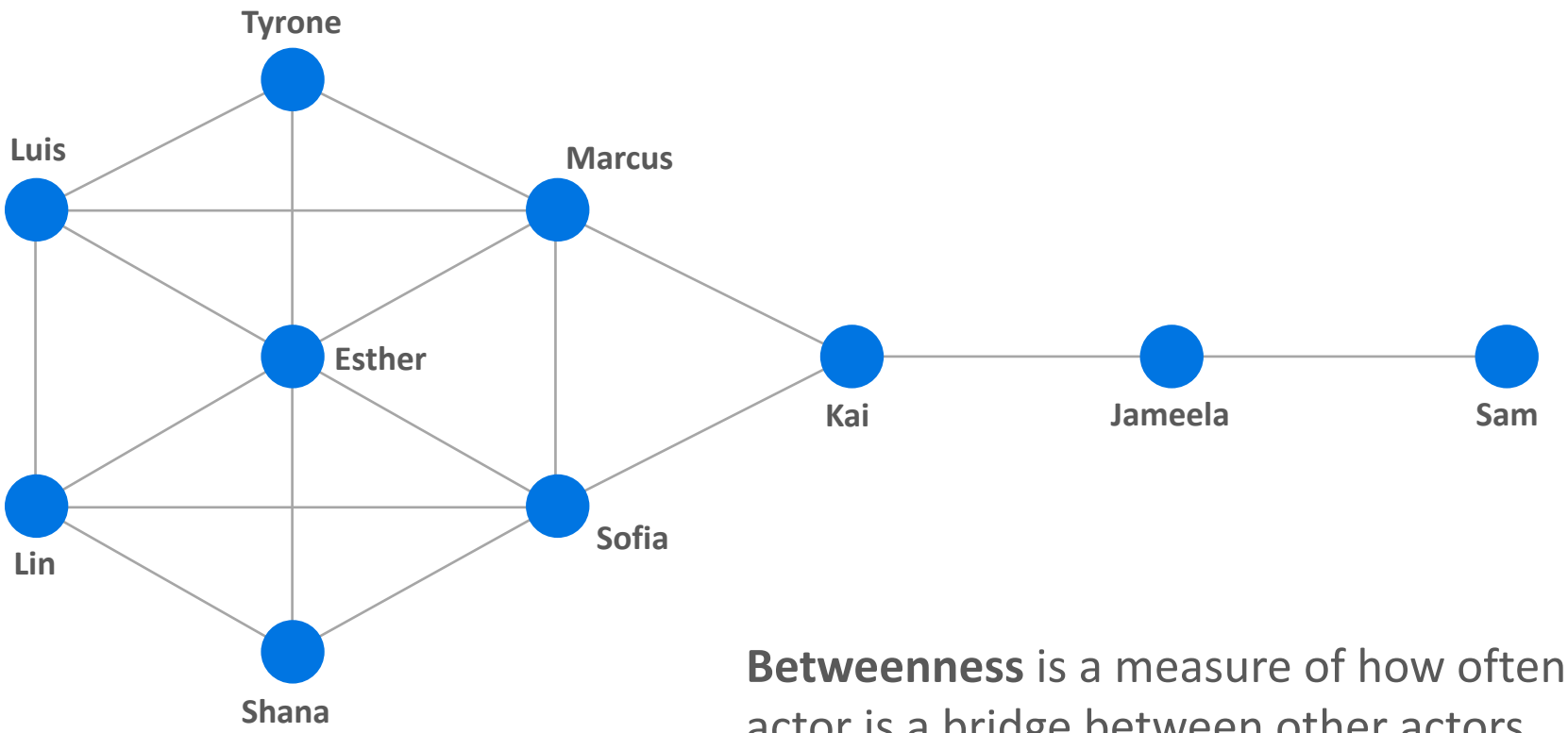
Degree is a measure of the number of ties.

- Out-degree is the number of outgoing ties.
- **In-degree** is the number of incoming ties.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

Visualization | Structure | Position

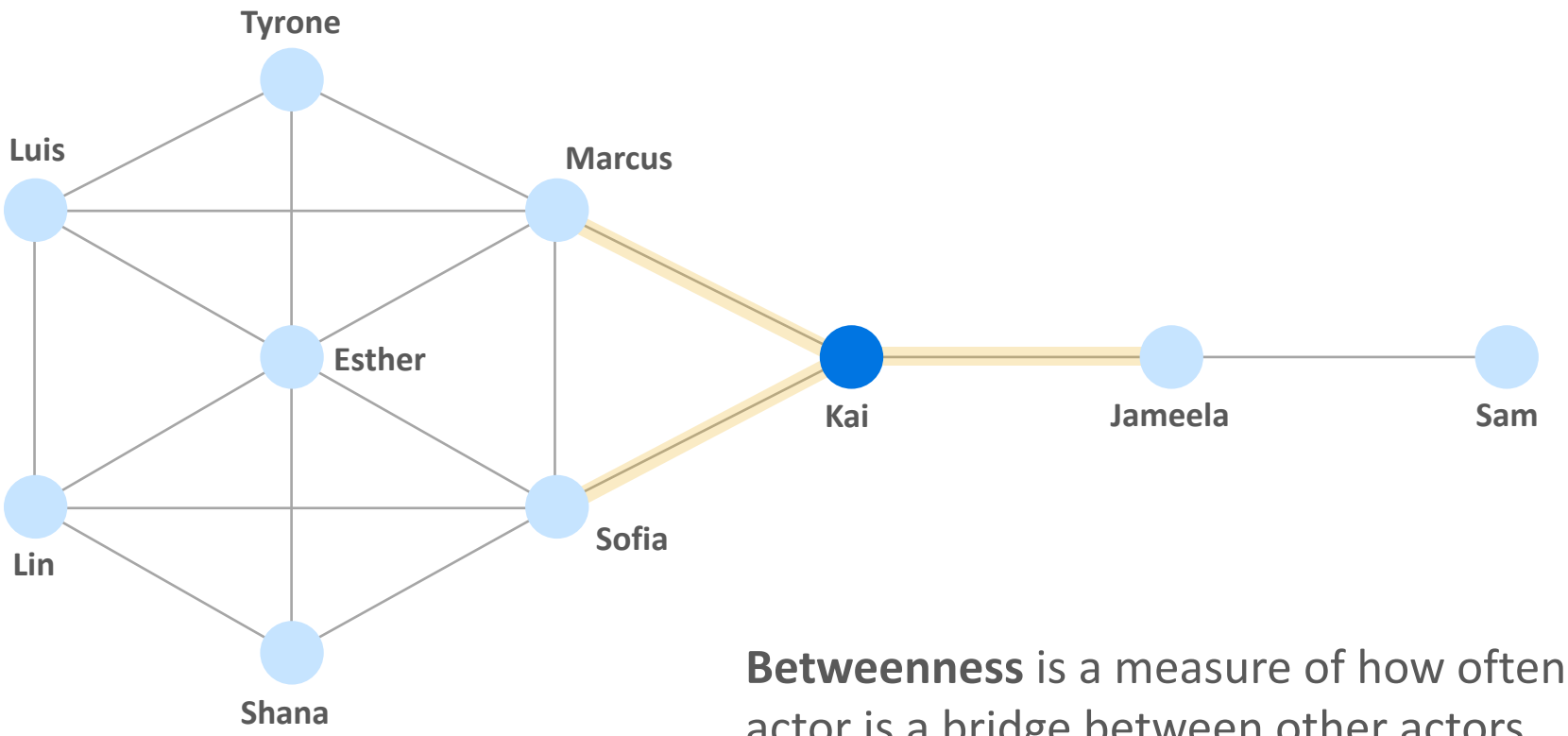


Betweenness is a measure of how often an actor is a bridge between other actors.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

Visualization | Structure | Position

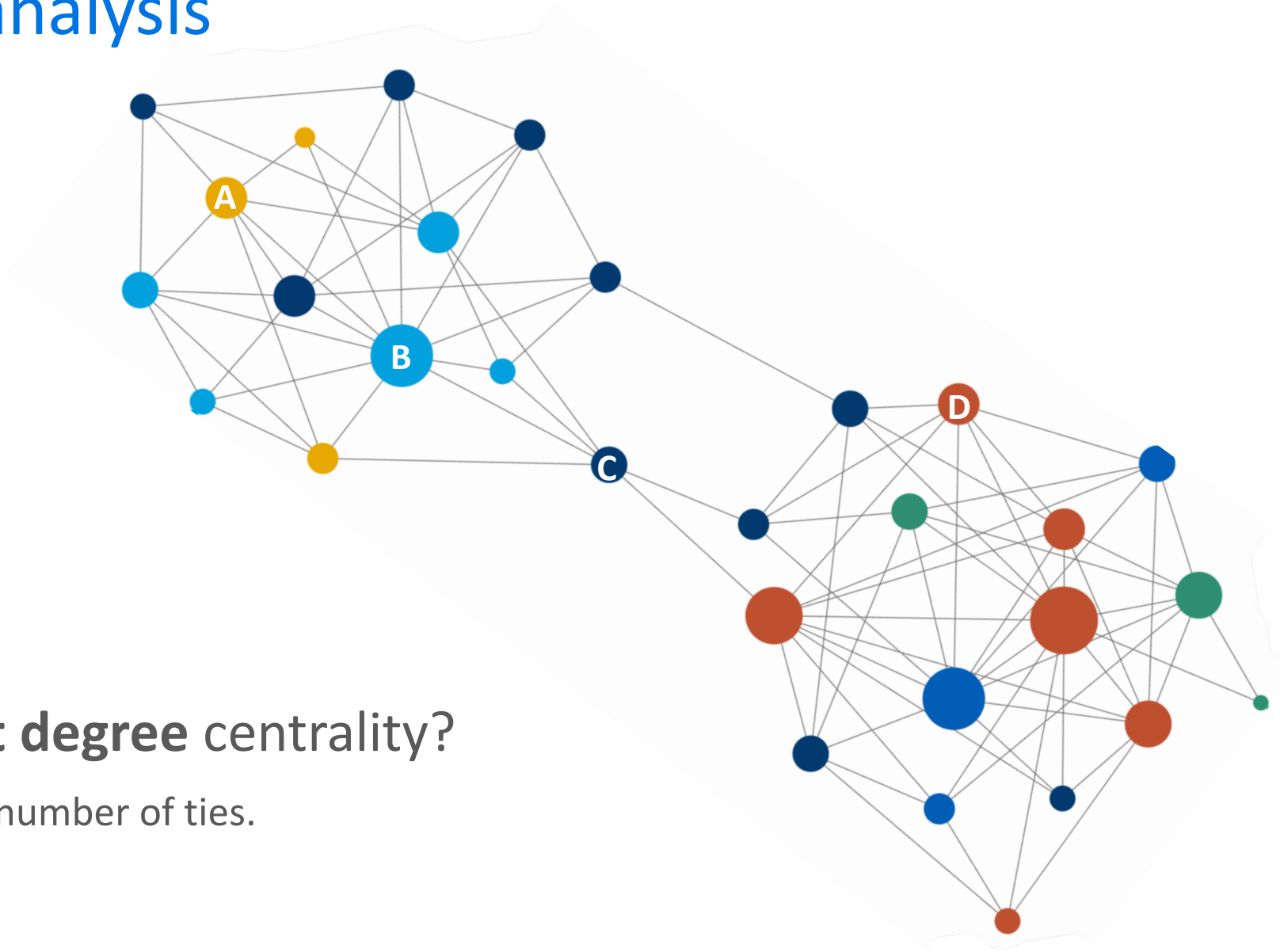


Actor	Betweenness
Tyrone	0.00
Shana	0.00
Luis	0.83
Jameela	8.00
Sam	0.00
Lin	8.33
Esther	3.67
Kai	14.00
Sofia	8.33
Marcus	8.33

Betweenness is a measure of how often an actor is a bridge between other actors.

Adapted from Duke Mod-U: Social Science Research Institute

Data collection and analysis

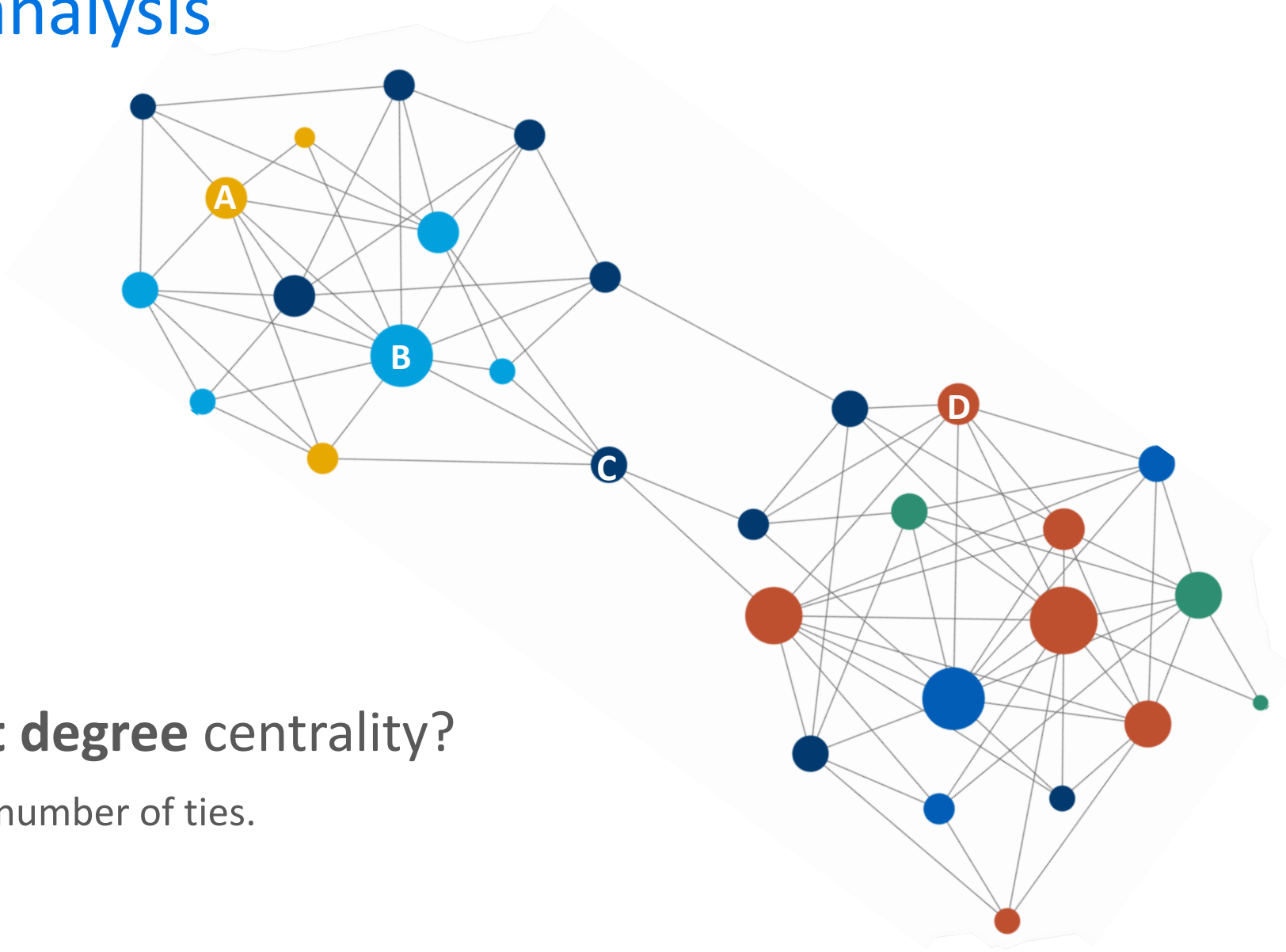


Poll 5: Who has the **highest degree** centrality?

Degree is a measure of the number of ties.

Data collection and analysis

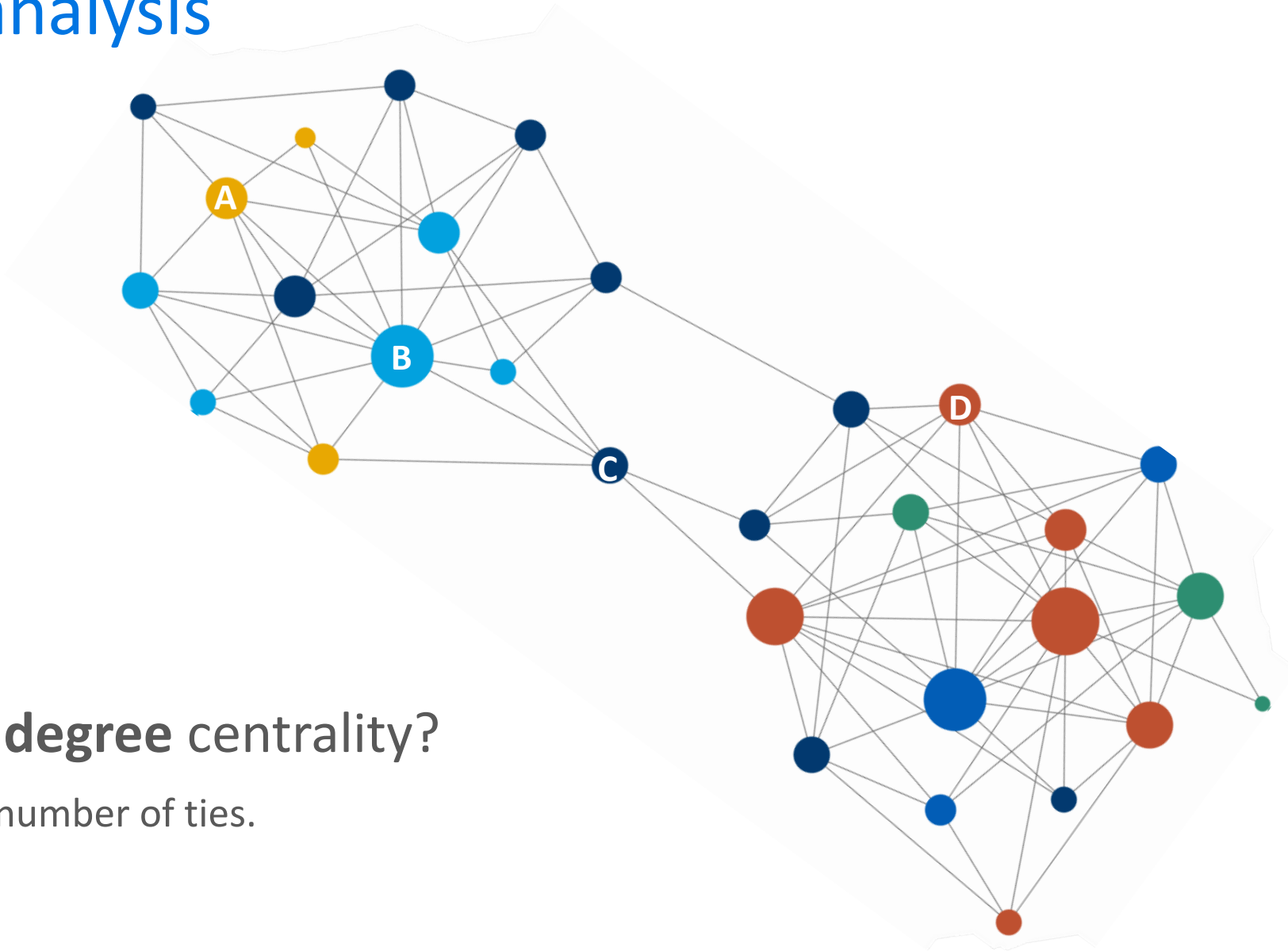
B



Poll 5: Who has the **highest degree** centrality?

Degree is a measure of the number of ties.

Data collection and analysis

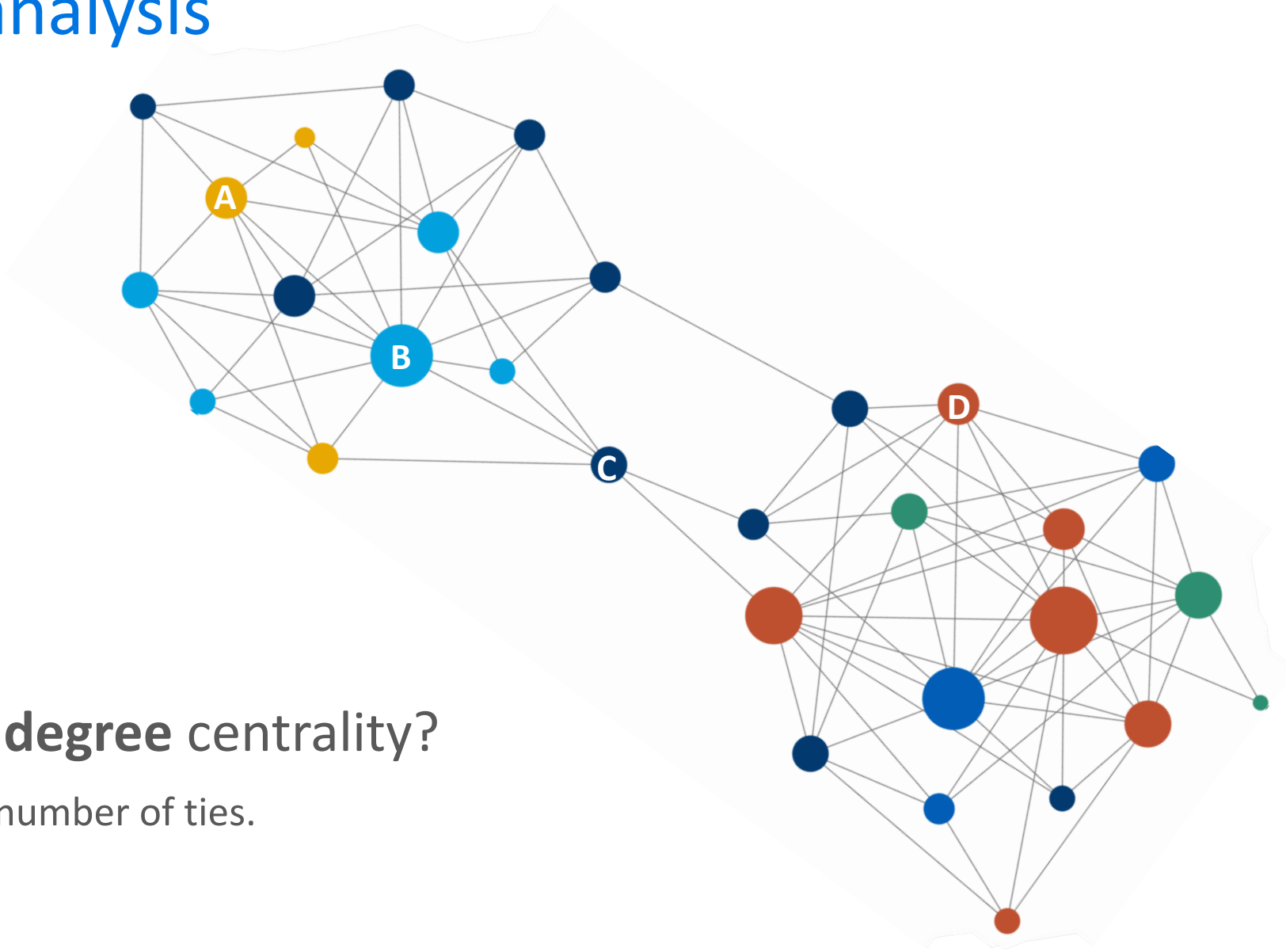


Poll 6: Who has the **lowest degree** centrality?

Degree is a measure of the number of ties.

Data collection and analysis

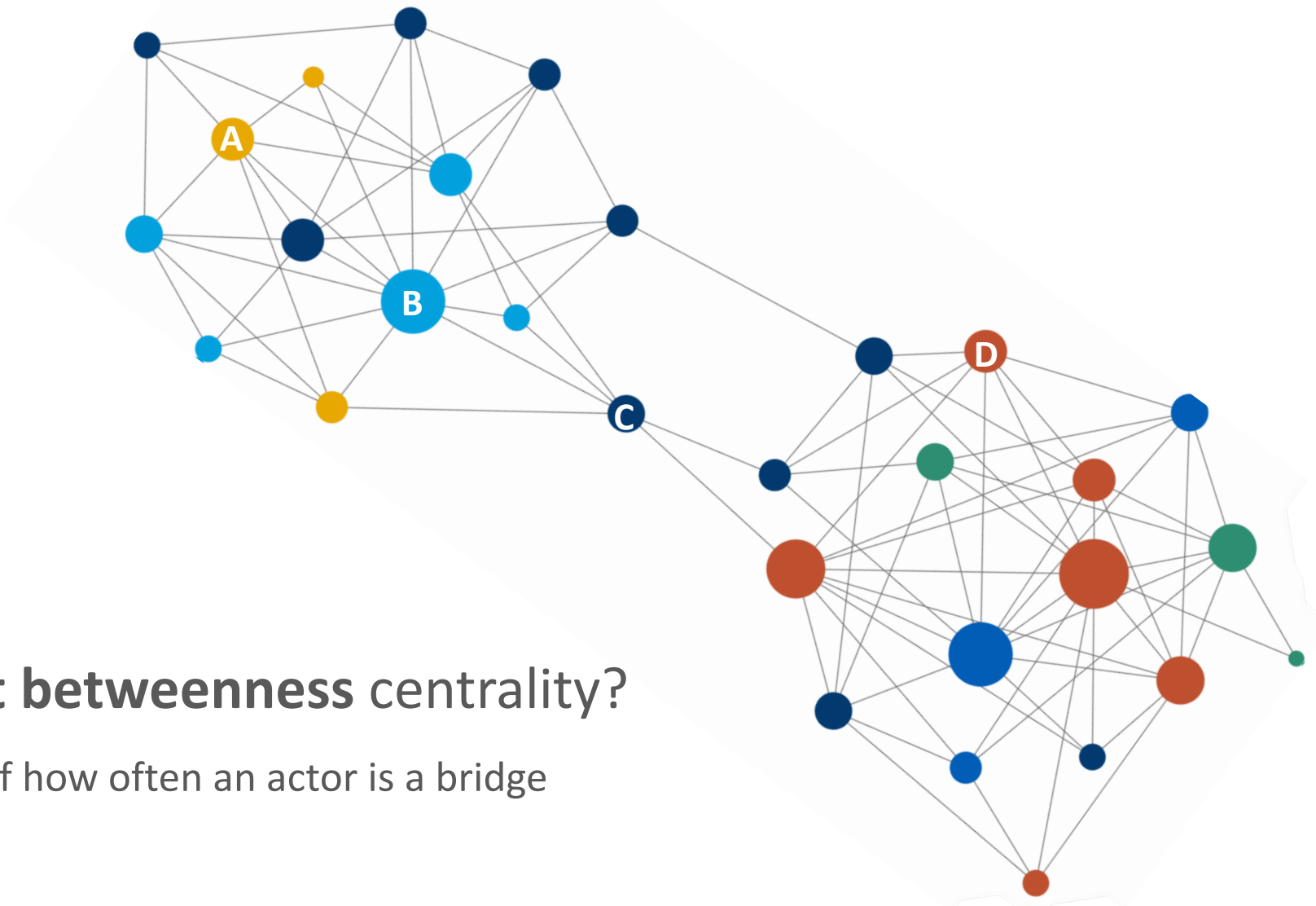
C



Poll 6: Who has the **lowest degree** centrality?

Degree is a measure of the number of ties.

Data collection and analysis

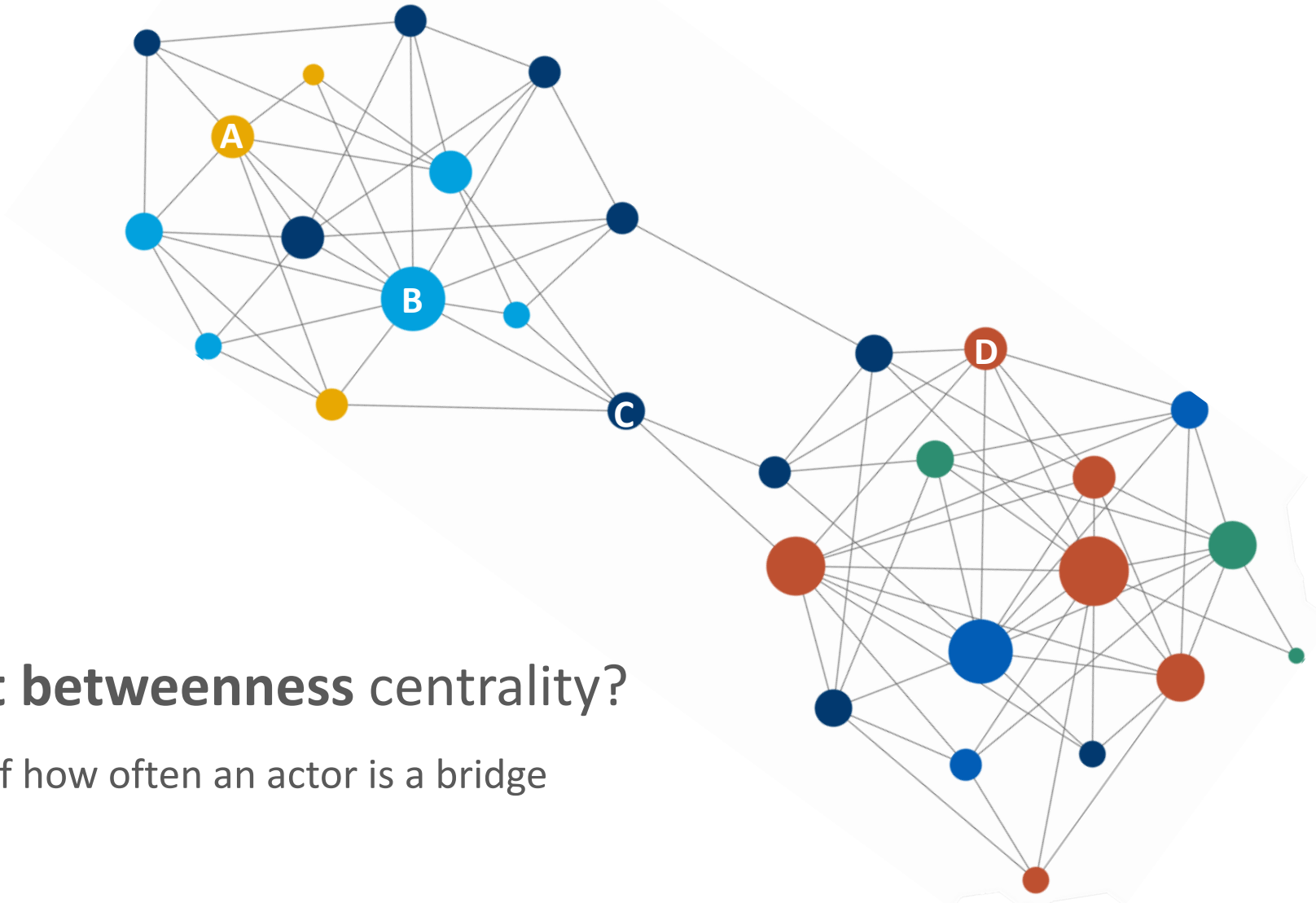


Poll 7: Who has the **highest betweenness** centrality?

Betweenness is a measure of how often an actor is a bridge between other actors.

Data collection and analysis

C



Poll 7: Who has the **highest betweenness** centrality?

Betweenness is a measure of how often an actor is a bridge between other actors.

Data collection and analysis

Challenges and Limitations

- Defining network boundaries
- Gaining access and issues of confidentiality
- Limitations associated with data collection methods
- Missing data
- Violating the assumption of independence
- Learning curve with new platforms

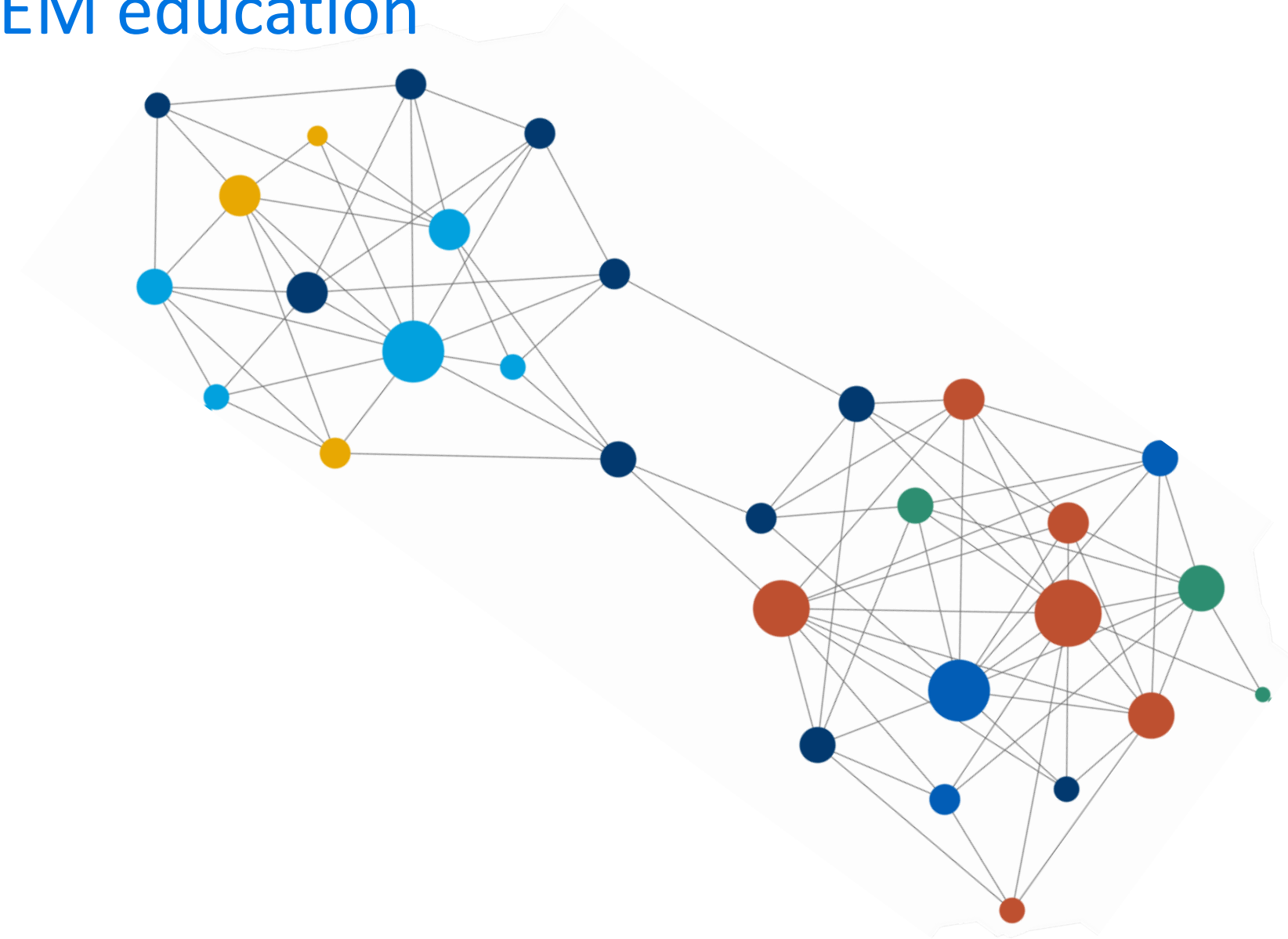
Data collection and analysis

Before we move on to future research in STEM education, **are there any questions**?

Future research in STEM education

Future research in STEM education

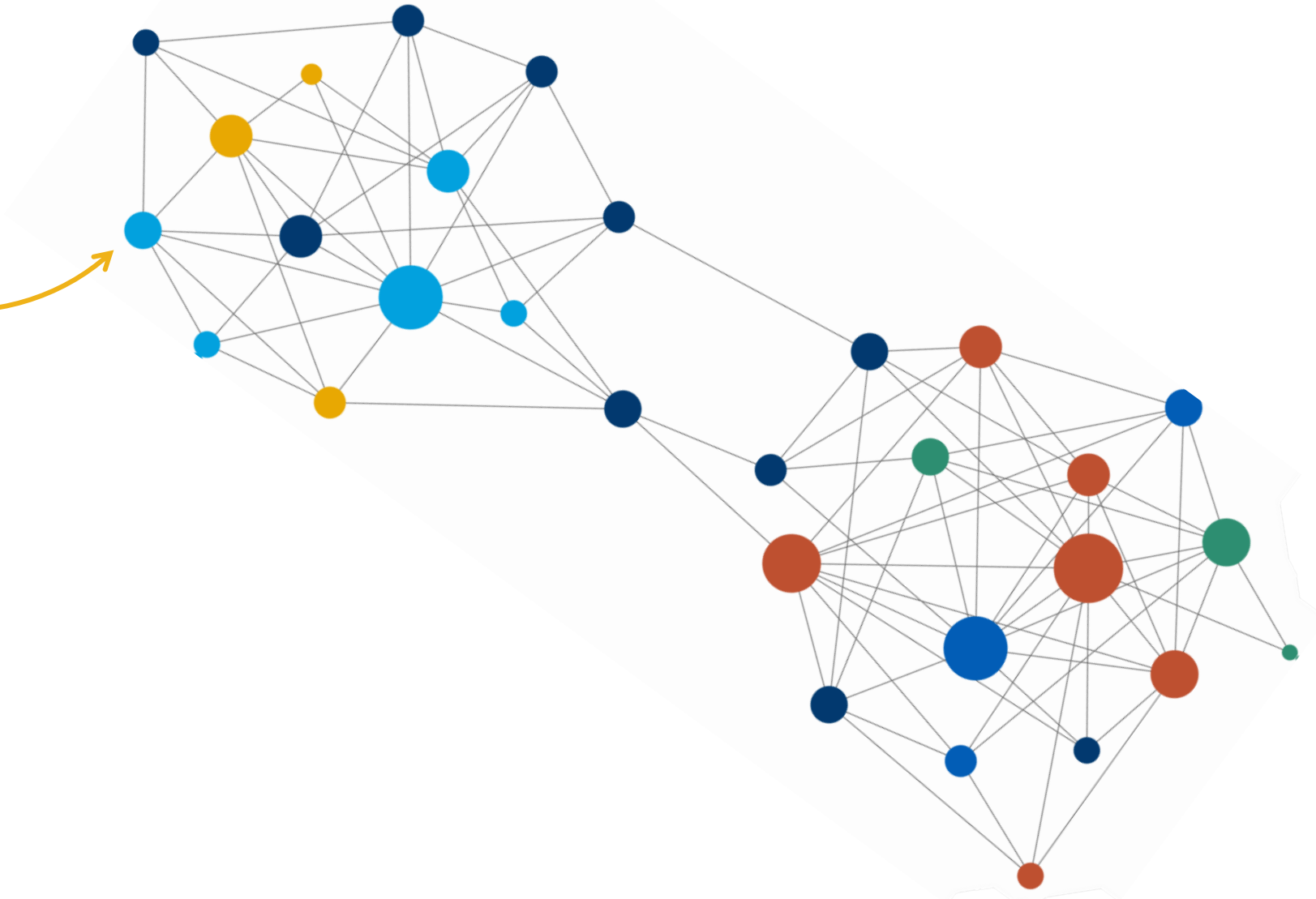
Think about a future project in which SNA might be a good fit.



Future research in STEM education

Think about a future project in which SNA might be a good fit.

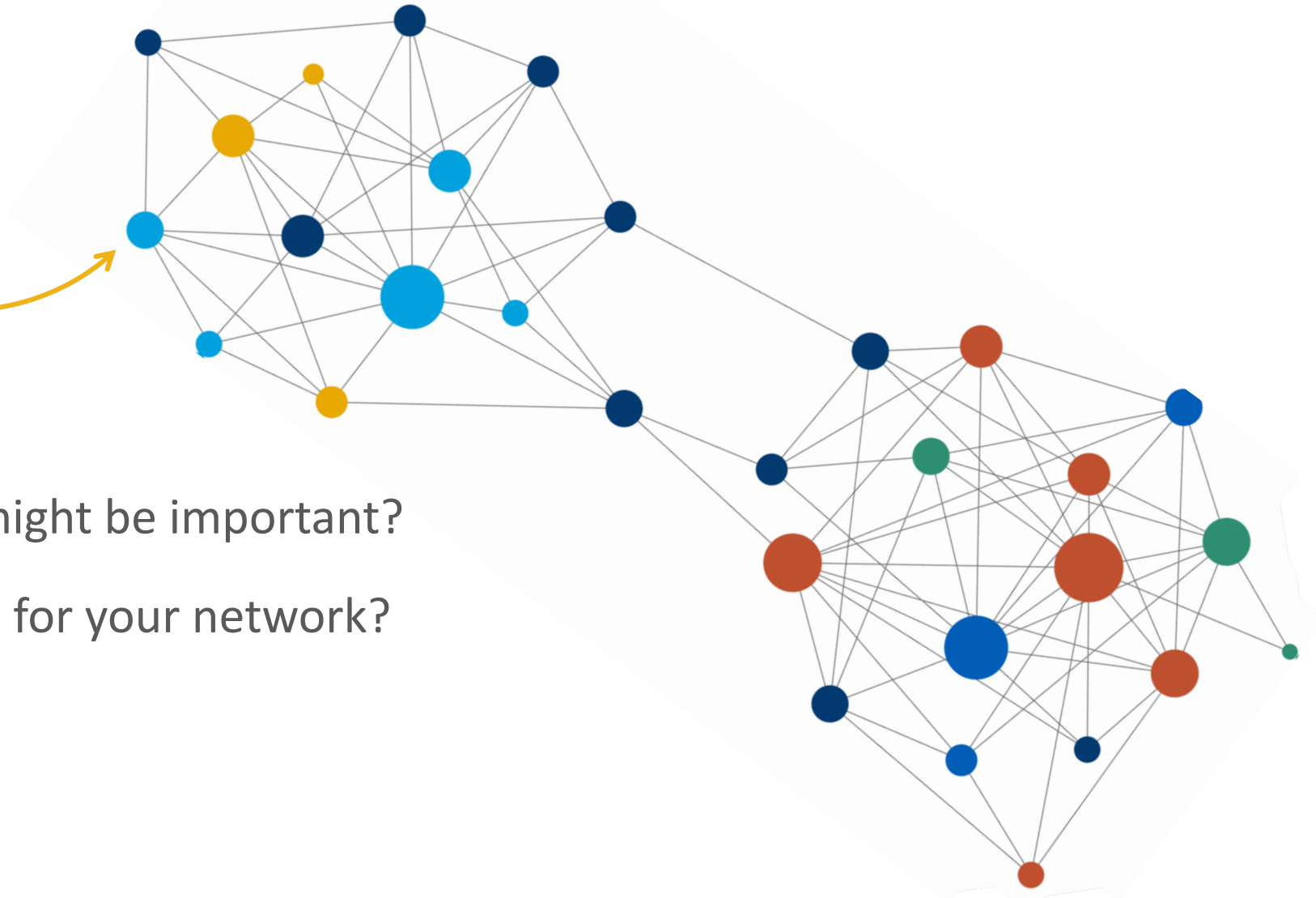
Who are the **actors**?



Future research in STEM education

Think about a future project in which SNA might be a good fit.

Who are the **actors**?



What attributes of the actors might be important?

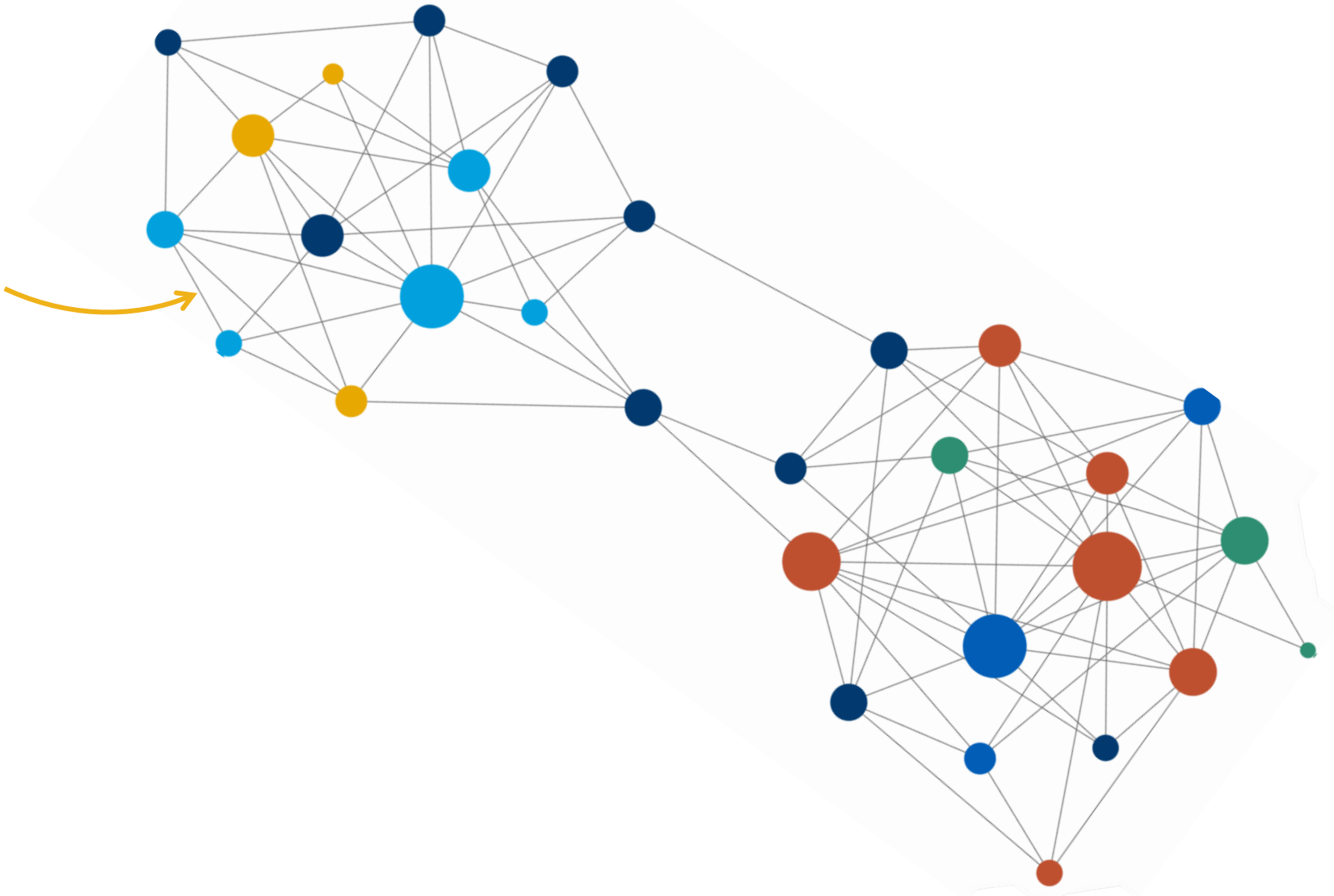
How would you set boundaries for your network?

- Who would be included?
- Who would be excluded?

Future research in STEM education

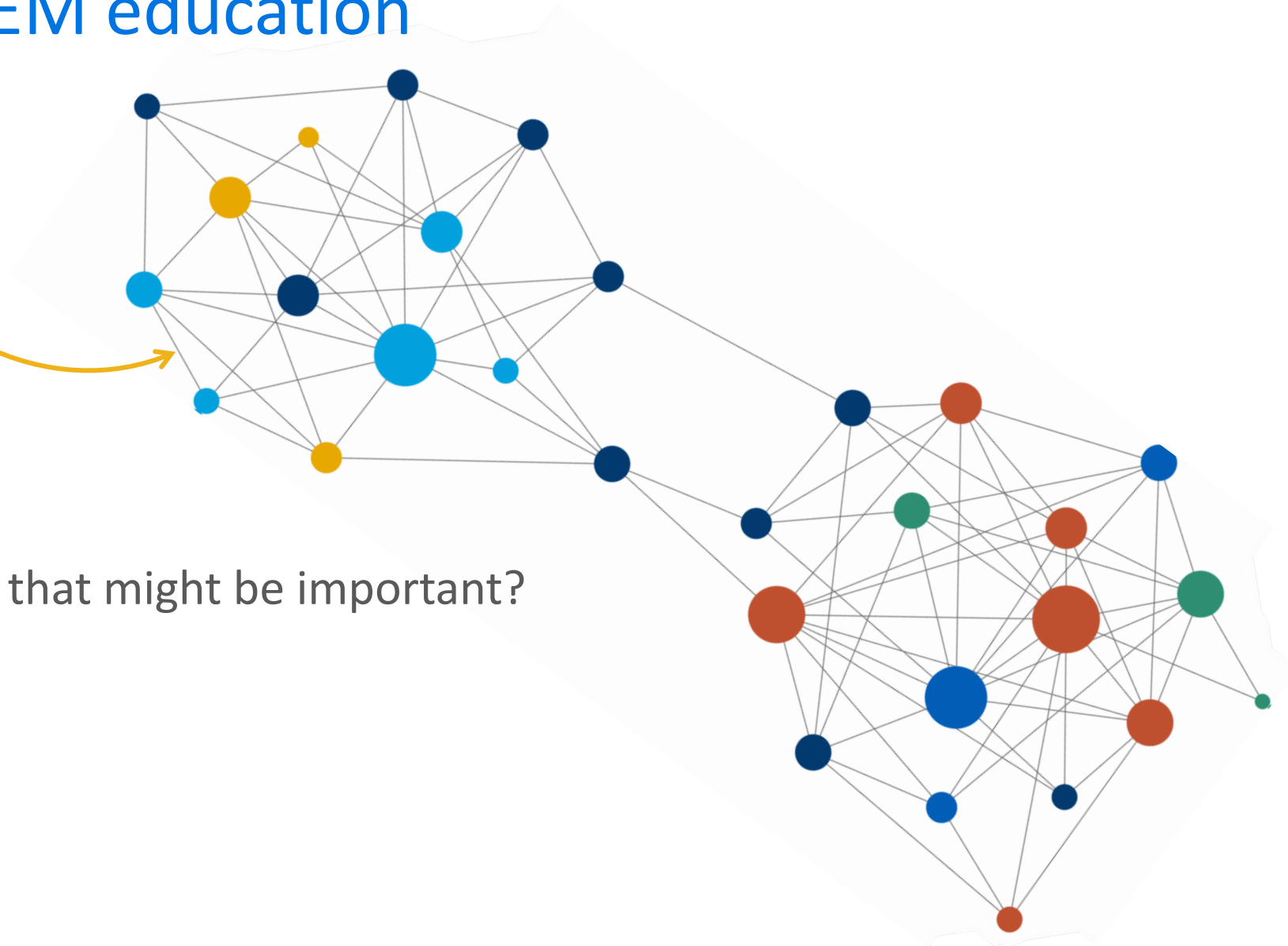
Think about a future project in which SNA might be a good fit.

What **ties** are of interest?



Future research in STEM education

Think about a future project in which SNA might be a good fit.



What **ties** are of interest?

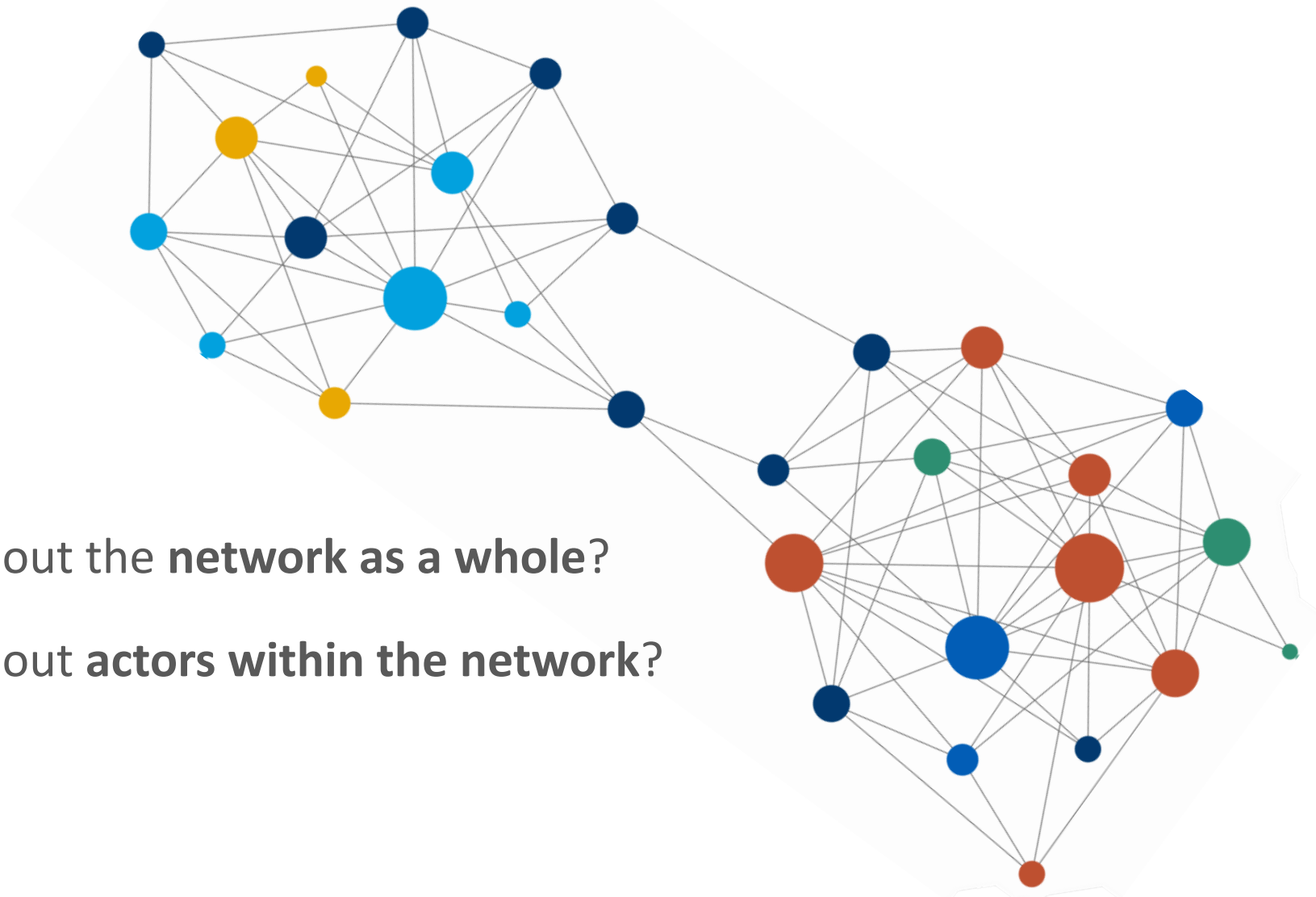
Are there multiple types of ties that might be important?

Are the ties:

- Directed or undirected?
- Binary or valued?

Future research in STEM education

Think about a future project in which SNA might be a good fit.



What would you want to know about the **network as a whole**?

What would you want to know about **actors within the network**?

Looking forward

Looking forward

Which aspects of social network analysis are you interested in learning more about?

Use the pen tool to place a ✓ mark.

Collecting social network data.

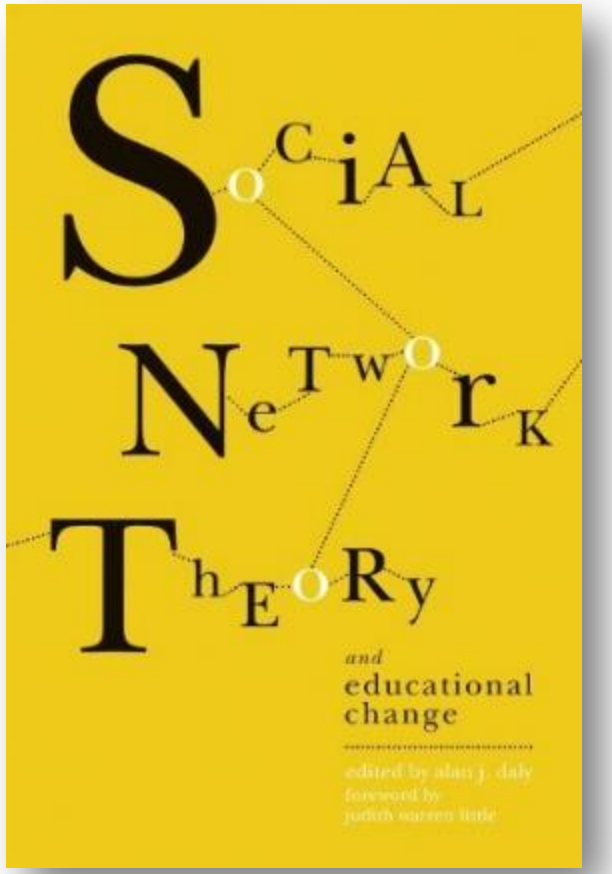
Analyzing social network data.

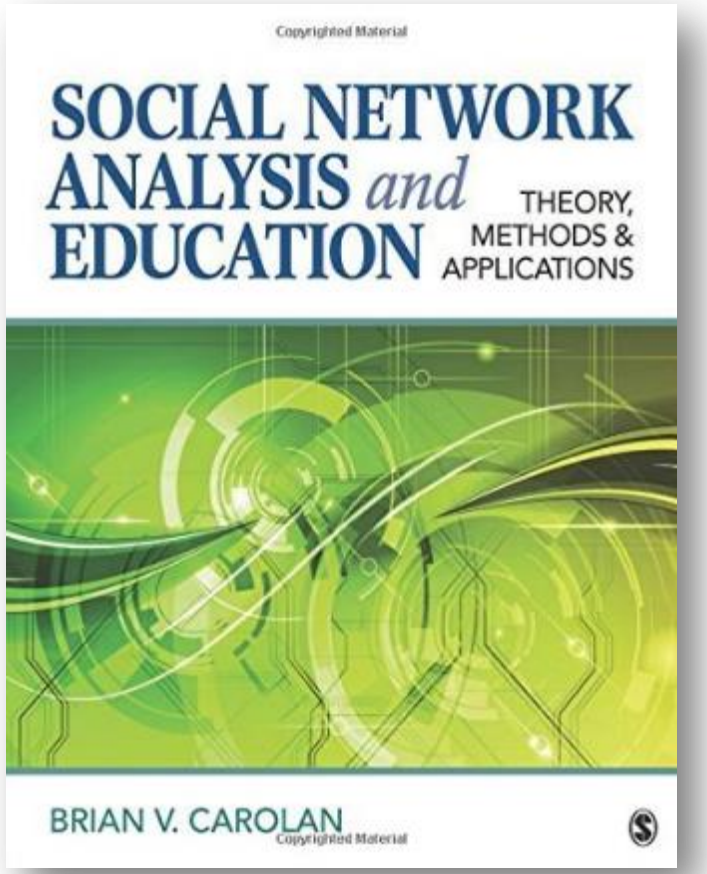
Interpreting sociograms.

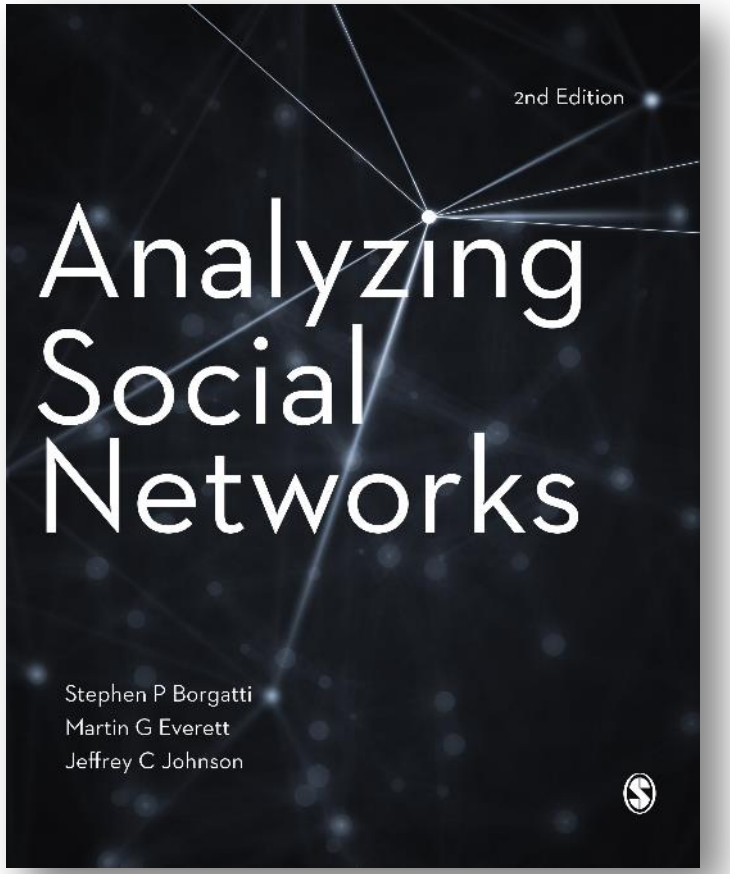
Incorporating social network analysis into research and evaluation designs.

Looking forward

Recommended reading







Looking forward

Webinar 2: Applying Social Network Analysis to STEM Education Research

Monday April 20, 2020
12:00 – 1:15 pm CT

María González-Howard, PhD
Assistant Professor in STEM Education at The University of Texas at Austin

Susan Yonezawa, PhD
Project Research Scientist at UC San Diego-CREATE

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Thank you!

DRK-12 METHODS SERIES WEBINAR

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RELEVANT

THANK YOU

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