DEPARTMENT
OF ENVIRONMENTAL
STUDIES

Network analysis:

social, ecological, and social-ecological approaches

FSS:ENSb1315 (Spring 2024)

Yanhua Shi & Harald Waxenecker

Complexity

…complex system [organized complexity]

- interacting parts are self-similar
- a system with a sizable number of agents
- adhere to specific norms/rules
- behave in ways not predicted by the parts in isolation (non-linear)

= collectively exhibit emergent properties and self-organization
= producing global-level patterns and properties for the system as a whole

[Nicolás-Carlock & Luna-Pla, 2021]

Social Network Analysis (SNA)

Ecological Network Analysis (ENA)

Social-Ecological Network Analysis (SENA)

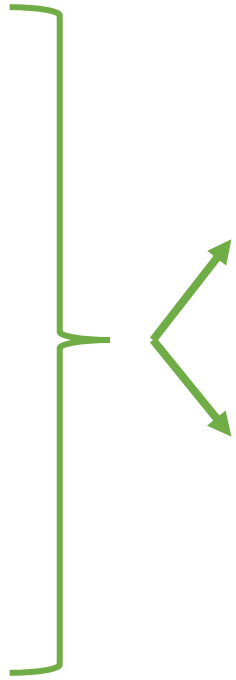
Social networks

"The most general characteristic of social science data is that they are rooted in cultural values and symbols. Unlike the pysical data of the natural sciences, social science data are constituted through meanings, motives, definitions and typifications. […] The principle type of data can be referred to as 'attribute data' and 'relational data'."

[Scott, 2013: 3]

We need relational data!!!

Style of research	Source	Type of data	Type of analysis
Survey research	Questionnaires, interviews	Attribute	Variable analysis
Ethnographic research	Observations		
Documentary research	Texts	Relational	Network analysis



[Based on Scott, 2013]

Comte: social physics, social atoms, social gravitation

Durkheim: human societies are like biological systems = interrelated elements
"social regularities were to be found not in the intentions of individuals but in the structure of the social environments in which they were embedded"

[Borgatti et al., 2009: 892]

Georg Simmel: web of group affiliations, power of structural properties
…to understand social behavior, we must study patterns of social interactions

➔ Social psychologists: who emphasized how organized patterns shape how we see and interpret the world

➔ Social anthropologists: who focused on the relationship between social patterns and social structure

Jacob Moreno, psiciatrist, 1932

"Moreno and his collaborator, Helen Jennings, had mapped the social network at Hudson using "sociometry," a technique for eliciting and graphically representing individuals' subjective feelings toward one another (Fig. 1). The links in this social network, Moreno argued, provided channels for the flow of social influence and ideas among the girls."

[Borgatti et al., 2009: 892]

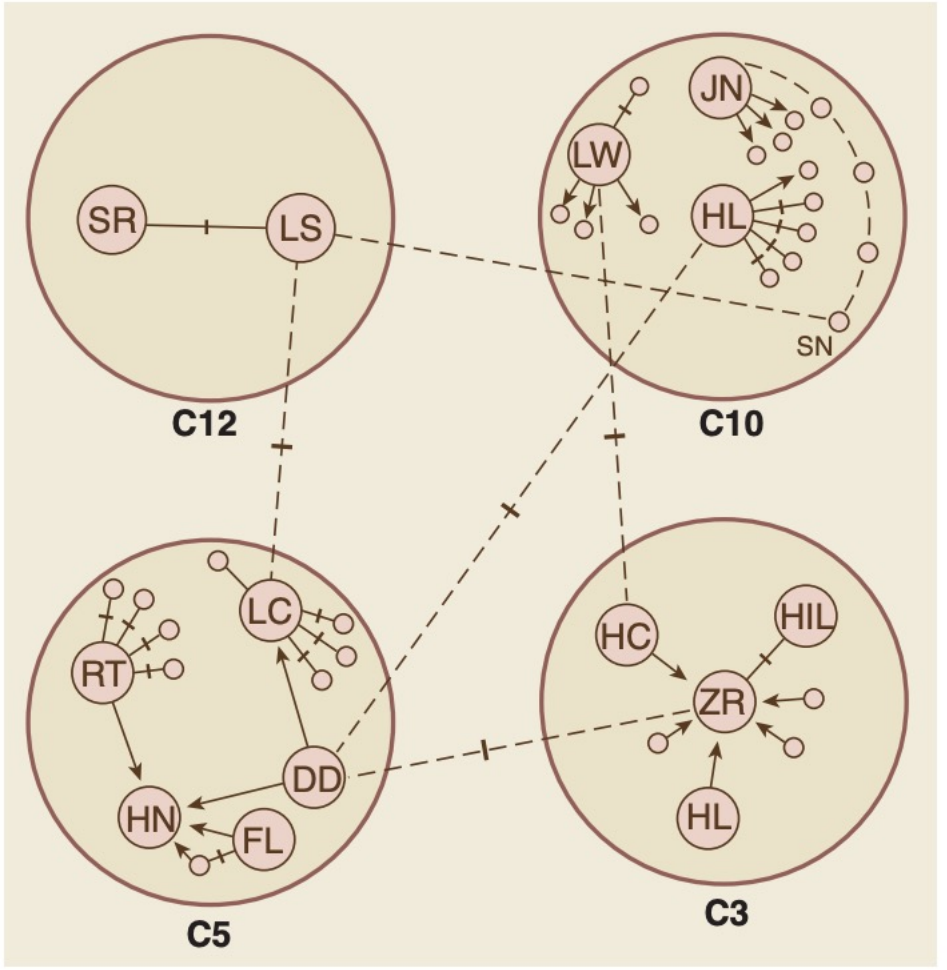


Fig. 1. Moreno's network of runaways. The four largest circles (C12, C10, C5, C3) represent cottages in which the girls lived. Each of the circles within the cottages represents an individual girl. The 14 runaways are identified by initials (e.g., SR). All nondirected lines between a pair of individuals represent feelings of mutual attraction. Directed lines represent one-way feelings of attraction.

Radcliff Brown, anthropologist, 1960s

3 main lines of inquiry:
"…societies not as monolithic entities but rather as a "pattern or network (or 'system')…"

"…kinship systems as relational algebras… regularities might underlie the apparent chaos of human social systems…"

"…network-based explanations to account for a range of outcomes…"

[Borgatti et al., 2009: 893]

1970s: Harrison White, Mark Granovetter, Barry Wellman, etc.

"…sociology, in spite of its claims to study social phenomena, was beholden to individualistic forms of analysis that drew conclusions based on the aggregated characteristics of individuals, often aided by statistical analysis of survey data. This, he believed, was a mistake. Thus, along with his students, he developed an approach that drew on case studies to focus on social relations and the patterns that emerge from them. The result is what we now know as social network analysis…"

[Everton, 2012]

"…strength of weak ties (SWT) theory developed by Granovetter. Granovetter argued that strong ties tend to be "clumpy" in the sense that one's close contacts tend to know each other. As a result, some of the information they pass along is redundant—what a person hears from contact A is the same as what the person heard from B. In contrast, weak ties (e.g., mere acquaintances) can easily be unconnected to the rest of one's network, and therefore more likely to be sources of novel information. Twenty years later, this work has developed into a general theory of social capital—the idea that whom a person is connected to, and how these contacts are connected to each other, enable people to access resources that ultimately lead them to such things as better jobs and faster promotions."

Social network analysis

…its own journal: Social Networks

Several applied fields: business administration, resource management, decision-making processes, public health, crime fighting, corruption studies, dynamics on social media, etc.

"…the oldest criticism of social network research is that the field lacks a (native) theoretical understanding—it is "merely descriptive" or "just methodology."

[Borgatti et al., 2009: 893]

…growing body of theory

- Types of ties
- Importance of structure
- Research questions / goal
- Theoretical mechanisms

Types of ties

Table 1.2 Taxonomy of types of dyadic relations.

Relational states							Relational events	
Similarities			Relational roles		Relational cognition			
Location	**Participation**	**Attribute**	**Kinship**	**Other role**	**Affective**	**Perceptual**	**Interactions**	**Flows**
Same spatial and temporal space	Same clubs, same events	Same gender, same attitude	Mother of, sibling of	Friend of, boss of, student of, competitor	Likes, hates	Knows, knows of, sees as happy	Sold to, talked to, helped, fought with, condescended to	Information, beliefs, money

Borgatti, Everet, Johnson & Agneessens, 2022: 6

Importance of structure

"… a fundamental axiom of social network analysis is the concept that structure matters."

[Borgatti et al., 2009: 893]

Structural characteristics
Node position
Dyadic characteristics

Research questions

Table 1.4 Types of network studies classified by direction of causality and level of analysis.

	Network variables as independent/ explanatory	**Network variables as dependent/outcomes**
Dyad level	Friendship between pairs of farmers to predict which pairs of farmers make the same decision about going organic	Similarity of interests (e.g., sky diving) to predict who becomes friends with each other
Node level	Centrality in organizational trust network to predict who is chosen for promotion	Extraversion to predict who becomes central in friendship network
Network level	Shortness of paths in a group's communication network to predict group's ability to solve problems	Type of organizational culture (emphasizing either cooperation or competition) to predict structure of the trust network

…explain the formation of ties
…predict network propierties

What is the basis of friendship ties? How do NGOs pick alliance partners?
= opportunity-based
= benefit-based

…consequences of networks
"…a node's position in a network determines in part the opportunities and constraints that it encounters, and in this way plays an important role in a node's outcomes."

[Borgatti et al., 2009: 894]

How or to what extend does the network influence your outputs, results, decisions, etc.?

Theoretical mechanisms

Direct transmision from node to node (biophysical resources, ideas, etc.)

"The adaptation mechanism states that nodes become homogeneous as a result of experiencing and adapting to similar social environments. Much like explanations of convergent forms in biology, if two nodes have ties to the same (or equivalent) others…"

= homophily
= reciprocity
= binding: "…a new entity whose properties can be different from those of its constituent elements"

[Borgatti et al., 2009: 894]

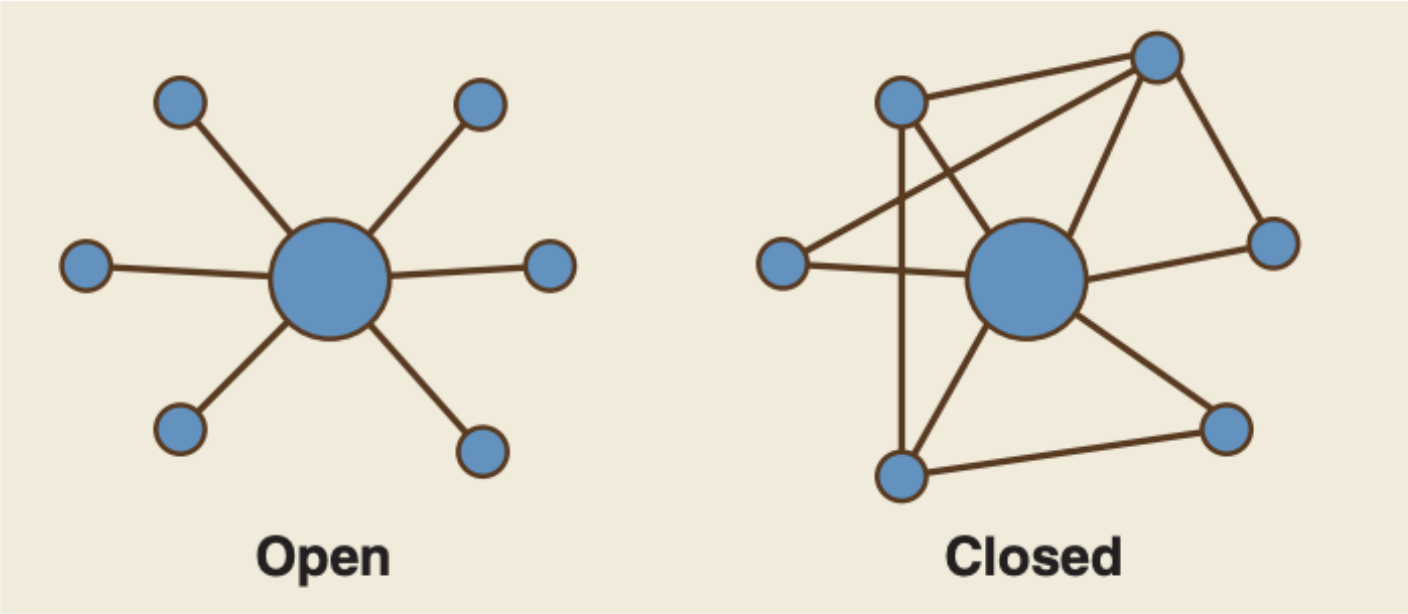


Fig. 4. Two illustrative ego networks. The one on the left contains many structural holes; the one on the right contains few.

[Borgatti et al., 2009: 894]

= exclusion: "…competitive situations in which one node, by forming a relation with another, excludes a third node."

[Borgatti et al., 2009: 895]

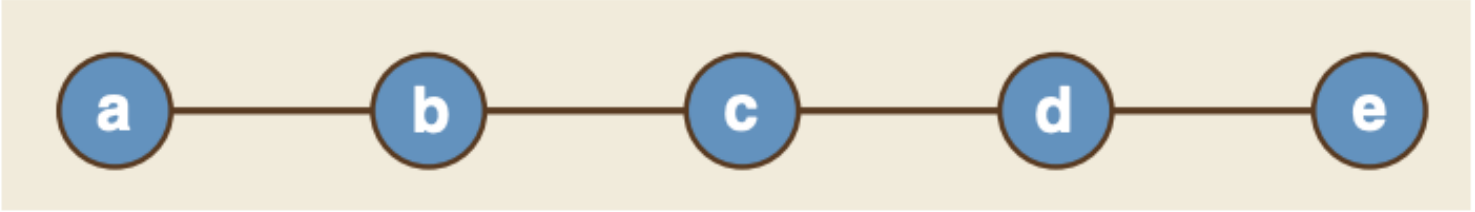


Fig. 5. A five-person exchange network. Nodes represent persons; lines represent exchange relations.

Some research papers…

Contents lists available at ScienceDirect

Social Networks

journal homepage: www.elsevier.com/locate/socnet

The evolution of global trade and impacts on countries' carbon trade imbalances

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Stochastic actor-oriented models

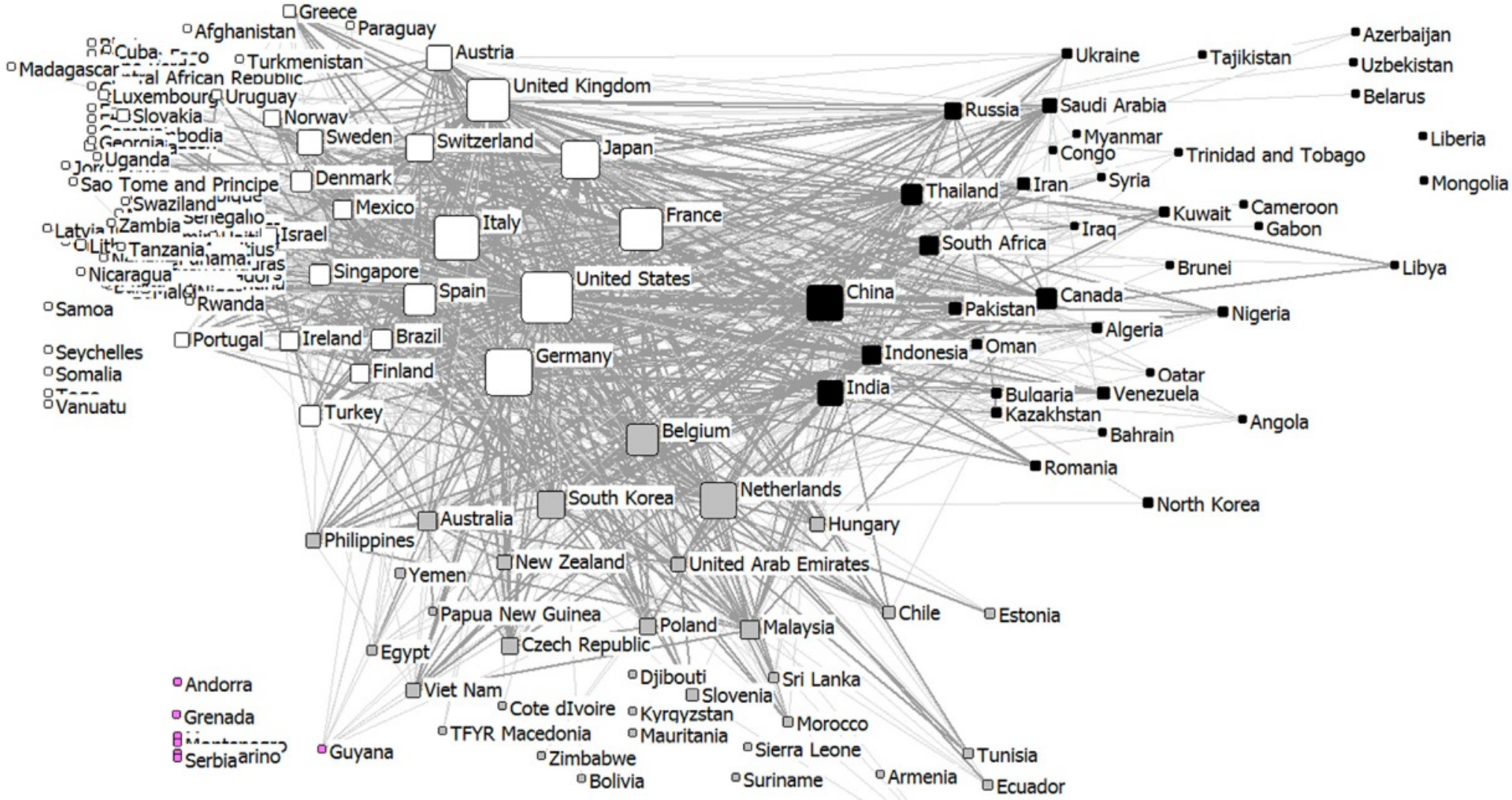
ABSTRACT

We examine carbon trade imbalances among 172 countries over a 10-year period (2000–2010). A carbon trade imbalance refers to the extent to which the carbon emissions embodied in a country's exports exceeds the emissions embodied in its imports. Although past research has considered how such imbalances coincide with variances in wealth and/or trade patterns, none have considered how such imbalances arise in the context of an evolving network structure. In this paper, we consider trade networks and carbon trade imbalances as co-evolving phenomena, and study these using an innovative combination of multi-regional input–output (MRIO) analysis with stochastic actor-oriented models (SAOMs). Our findings both challenge and support arguments made by ecological unequal exchange theory and the Gravity Model, and highlight the role emerging economies play in shaping network structure and the distribution of carbon trade balances overtime.

1. Introduction

The interconnectivity of international trade implies that activities and events in one part of the world have consequences, with winners and losers, around the globe. These consequences are numerous, and in this paper, we focus on the distribution

stochastic actor-oriented models (SAOMs), statistical models used for studying how networks and attributes of actors within these networks change overtime (Snijders et al., 2010). In combining MRIO with SAOMs, we are better equipped to test a number of intuitive concepts about the interdependencies of international trade and their impacts on carbon imbalances of countries. As of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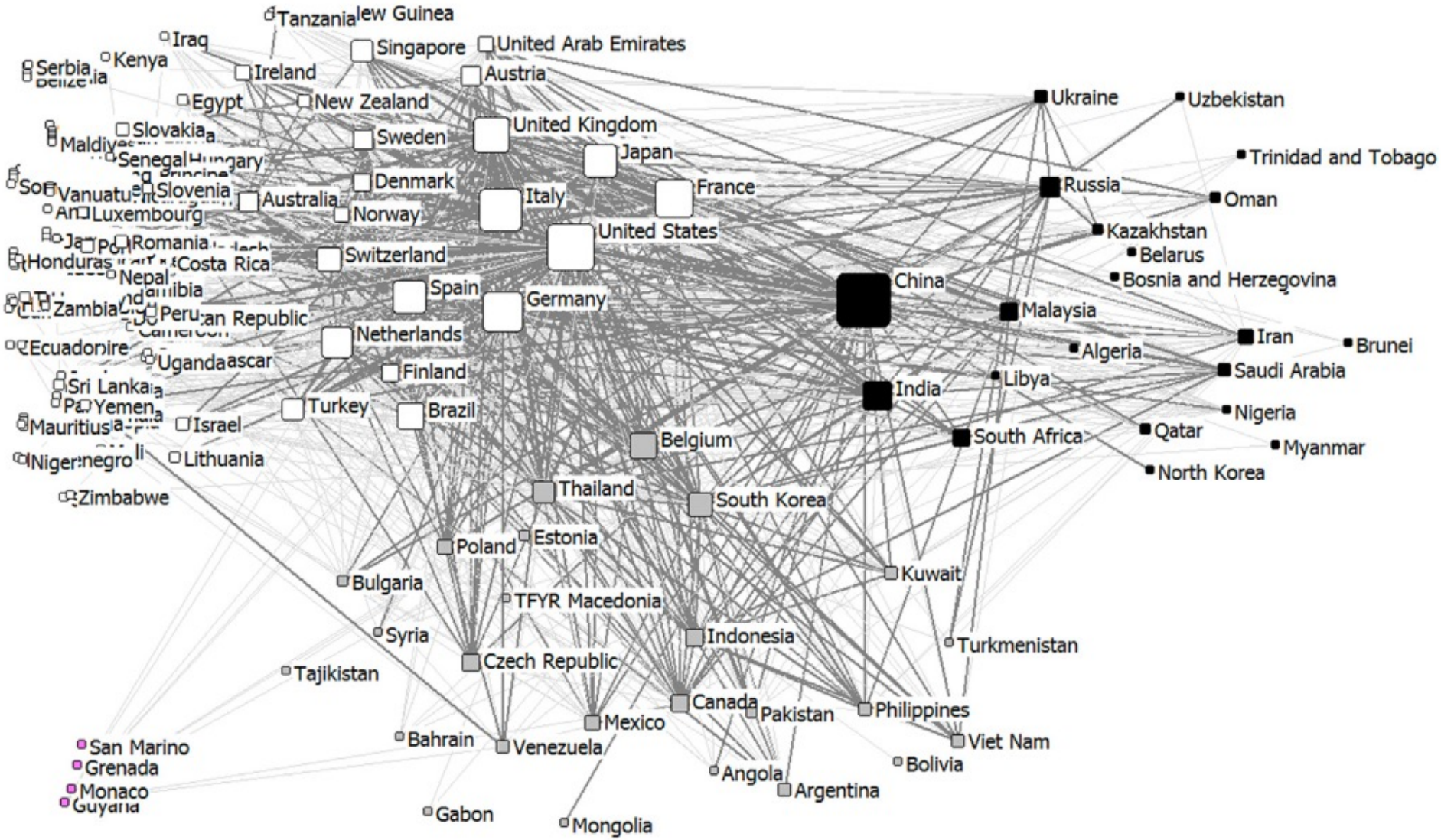
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Viet Nam
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Venezuela
San Marino
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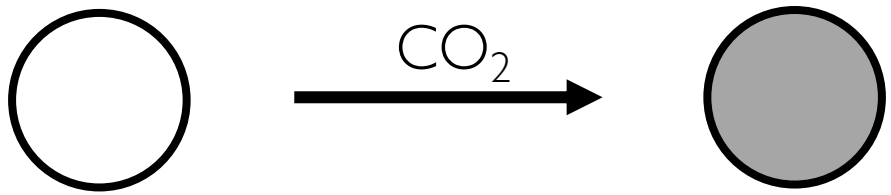
Mongolia

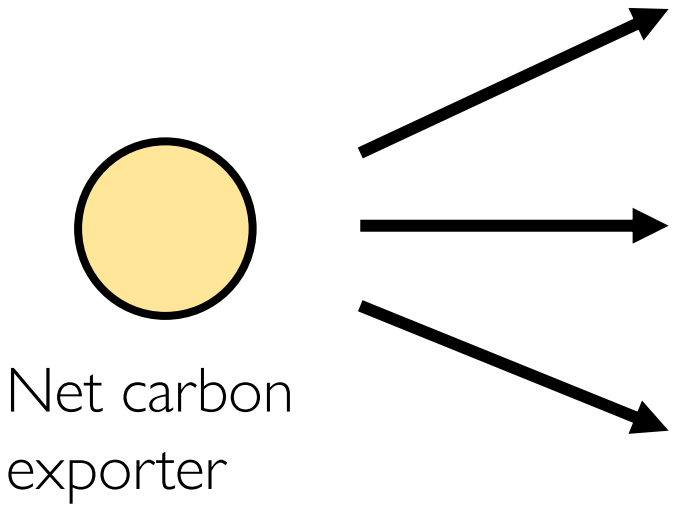
Year 2010

H1. Countries with wealthier trading partners tend to become or remain being net exporters of carbon overtime.



Wealthy trading partner

H3. Countries that are net carbon exporters will tend to increase their export ties to wealthier countries overtime.



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Social Networks

journal homepage: www.elsevier.com/locate/socnet

How do youth choose activities? Assessing the relative importance of the micro-selection mechanisms behind adolescent extracurricular activity participation

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ARTICLE INFO

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Segregation
Two-mode network
Extracurricular activities
Stochastic actor-oriented model

ABSTRACT

We investigate the network micro-selection mechanisms responsible for patterns of high school student extracurricular activity (ECA) participation, with a particular focus on those that can lead to ethnoracial segregation. We identify six types of mechanisms by which students select into activities (e.g., peer influence, homophily), which we test using a unique longitudinal dataset that combines student surveys with yearbook data on ECA involvement. These contexts represent two ethnoracially diverse U.S. high schools involving 2403 students and over 200 different activities spanning two school years. Using a stochastic actor-oriented model for two-mode networks, we find support for the hypothesized activity selection mechanisms. Follow-up analyses convey the relative importance of different mechanisms and inform our discussion of how ECA participation patterns develop and possible sources of segregation. Whereas selection is driven by mechanisms that include influence from friends and co-participants and similarity to fellow participants, no single overarching mechanism appears strong enough to fully account for ECA segregation

1. Introduction

Social networks are inextricably linked to contexts that support and sustain interactions between individuals (Blau, 1977; Simmel, 1955), premise that individuals select into foci based on some form of similarity. However, little work has gone beyond documenting that foci have relatively homogeneous memberships to actually test the processes by which this occurs. How strongly do individuals choose activities because

Actor

Extracurricular activity

e.g., environmental education

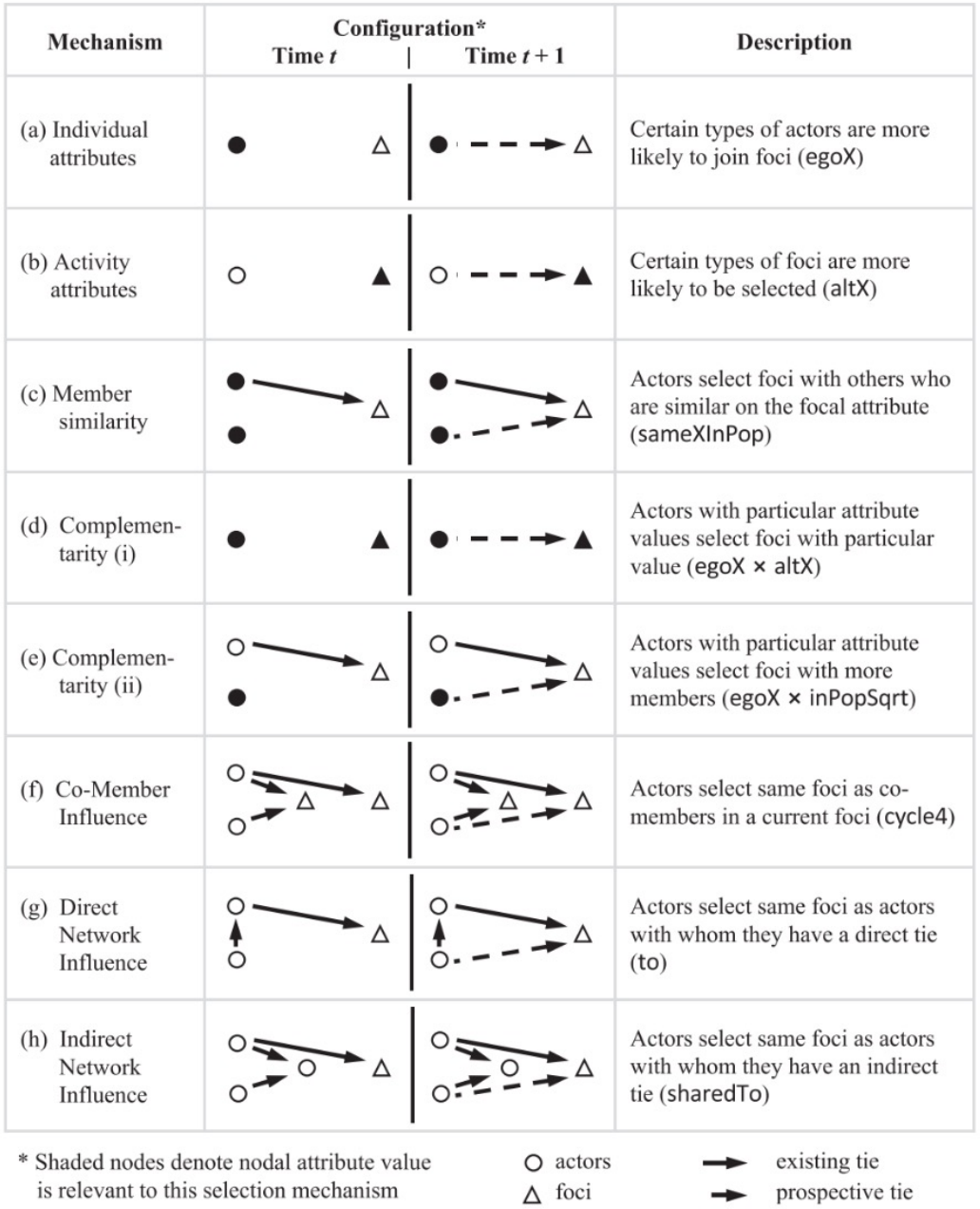

Fig. 1. Select two-mode micro-selection mechanisms.

How do youth choose activities?

Assessing the relative importance of the micro-selection mechanisms behind adolescent extracurricular activity participation

[Schaefer et al., 2022]

= Stochastic Actor-Oriented Model (SAOM)
= longitudinal data

https://www.tandfonline.com/doi/epdf/10.1080/23251042.2023.2216371?needAccess=true

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https://doi.org/10.1080/23251042.2023.2216371

Animals and climate change: A visual and discourse network analysis of Instagram posts

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ABSTRACT

Animals featured prominently during the United Nations' 2021 Climate Change Conference (COP26), both within the meeting and outside during protests. This begs the question: How are animals portrayed in climate change discourse? To answer this question, we conduct visual and discourse network analysis of animal-related Instagram posts collected around COP26. We present a typology of four ways in which animals are framed as (1) metaphors for climate-related concerns, (2) citizens with interests worth respecting, (3) biodiversity or key ecosystem components, and (4) resources for human use, showing how each framing connects to various discourses and organizations/collective actors. Compared to previous research on climate communication, our findings reveal a broader range of animals are integrated into climate change discourse, and humans are often framing animals in multiple ways at once for various eco-political purposes. In addition, our analysis suggests that, compared with other sectors of society, governmental organizations are giving much less attention to animal issues in their climate communications. Finally, our results show how engaging a diversity of perspectives about animals – and eschewing the dominant resource-framing of animals – can enhance climate change discourse by broadening the range of discussions and potential solutions to the current ecological crisis.

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KEYWORDS
Discourse network analysis; environmental sociology; climate change; biodiversity; animal studies; Instagram

Introduction

The 2021 United Nations Climate Change Conference

imagery. Here, we focus on four major ways in which posts portray animals as (1) metaphors, (2) citizens, (3)

Animals as…

…metaphor/symbols
…citizen
…biodiversity
…resources

[Koop-Monteiro et al., 2023]

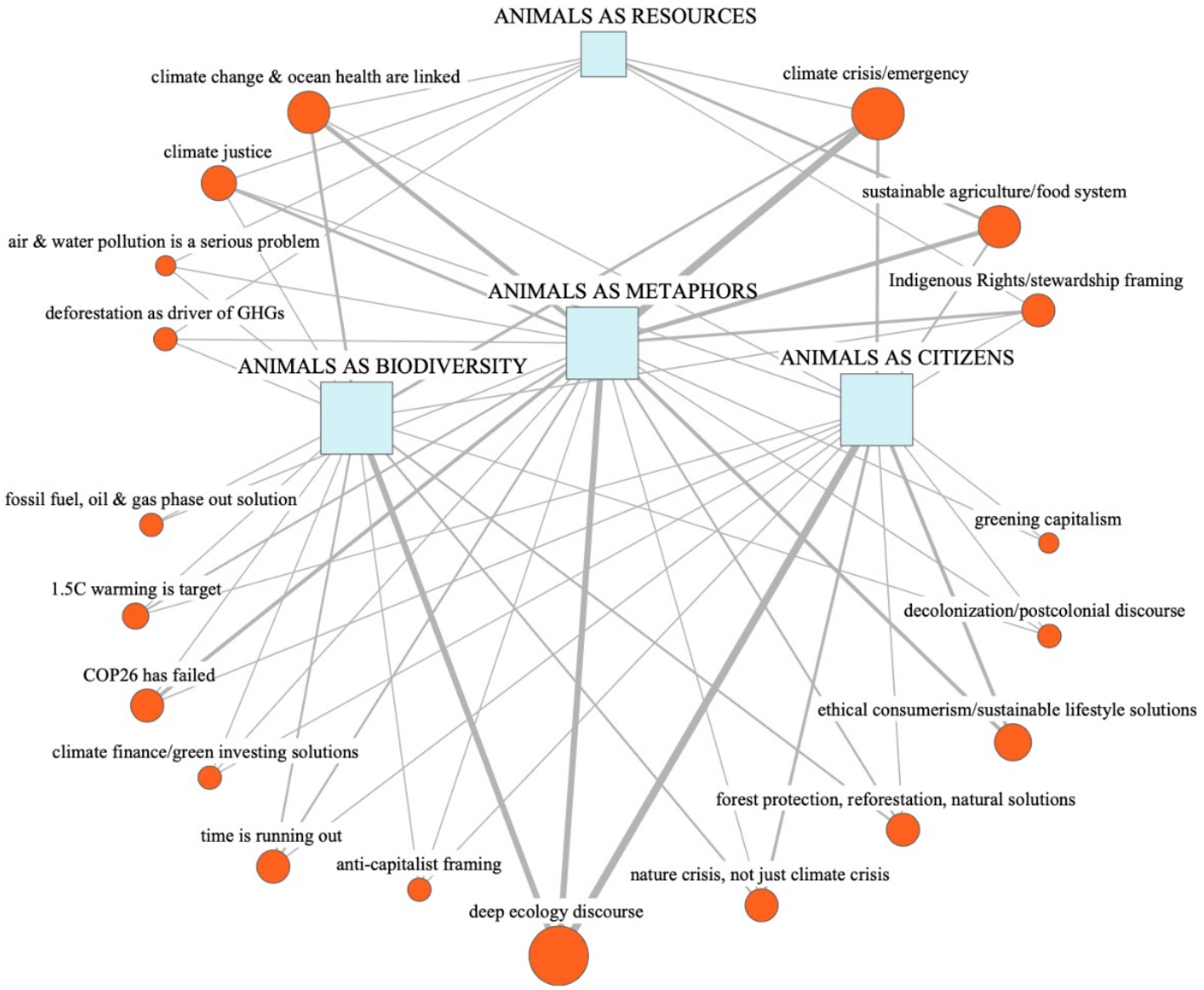

Figure 9. 'Animals as' and discourse network.
Two-mode network showing discourses that appear 3 or more times alongside any number of 'animals as' codes (discourses with fewer than 3 appearances removed). Node size reflects vertex strength; Linethickness reflects tie strength.

[Koop-Monteiro et al., 2023]

Discourse Network Analyzer (DNA)

The Java software Discourse Network Analyzer (DNA) is a qualitative content analysis tool with network export facilities. You import text files and annotate statements that persons or organizations make, and the program will return network matrices of actors connected by shared concepts.

- Download the latest release of the software.
- Annotate documents, such as newspaper articles or speeches, with statements of what actors say; then export network data.
- You can use the stand-alone software visone (or any other network analysis software) for analyzing the resulting networks.
- The software comes with an R package called rDNA for remote controlling DNA and for further ways of analyzing the networks.

https://github.com/leifeld/dna
https://www.philipleifeld.com

Computers in Human Behavior 129 (2022) 107145

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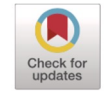

Like to drink: Dynamics of liking alcohol posts and effects on alcohol use

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Experience sampling
Networks
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Substance use

ABSTRACT

Alcohol posts on social media frequently receive likes that are often perceived by emerging adults as peer approval of alcohol consumption and have been linked to their drinking intentions in previous research. This research, however, has generally not considered the fact that liking is a reciprocal behavior that differs from day to day. By conducting an app-integrated daily diary study and employing a network analytic approach, the current study contributes to this line of research by providing a better understanding of the dynamics of likes for alcohol posts and how these likes, in turn, affect emerging adults' actual alcohol use. In total, 265 college stu-

Like to drink: Dynamics of liking alcohol posts and effects on alcohol use

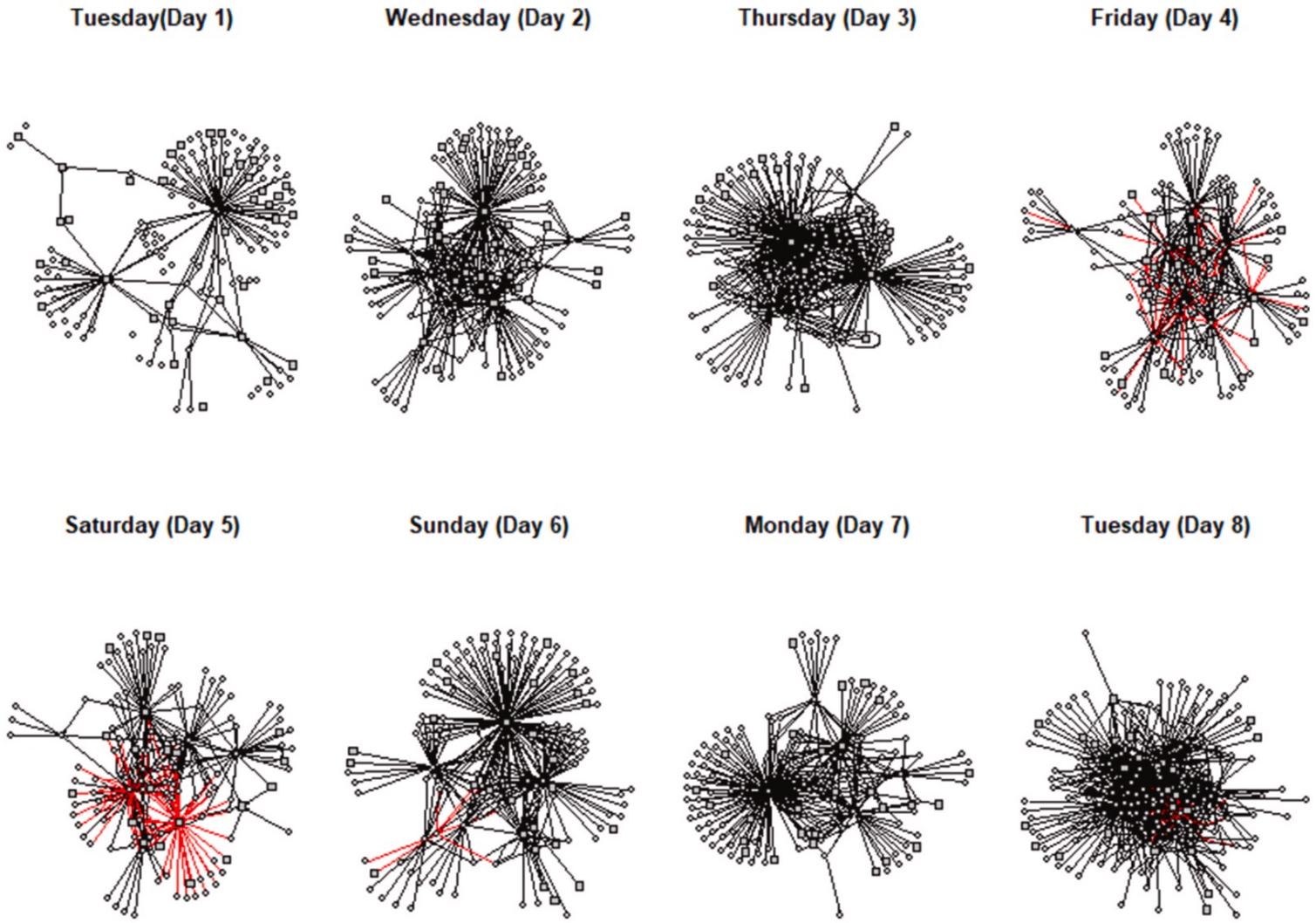
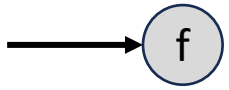


Fig. 1. Network structure of the data.

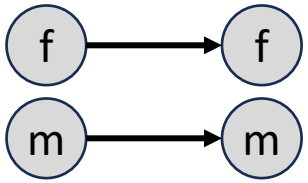
[Kurten et al., 2022]

Like to drink: Dynamics of liking alcohol posts and effects on alcohol use

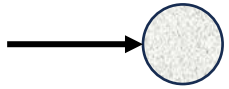
[Kurten et al., 2022]



Girls are (1.38) more likely to receive a like compared to boys.



It is 1.5 times more likely that someone receives a like form the same gender.



The likelihood to receive a like if you post a non alcohilic post (0.011) is 1.48 times lower, compared to the likelihood to receive a like when posting an alcohol post (0.017).

= Exponentiall Random Graph Model (ERGM)
= cross-sectional data

Males were more likely to drink alcohol than females; for example, […] the probability of a 20-year-old male drinking on a Friday would be 38.9% compared to 31.4% for a same-aged female. […] The fictional male would increase his likelihood of drinking further if he also liked an alcohol post, from 38.9% to approximately 53.5%.

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Schaefer, D., Khuu, T., Rambaran, J.A., Rivas-Drake, D. & Umaña-Taylor, A.J. (2022). How do youth choose activities? Assessing the relative importance of the micro-selection mechanisms behind adolescent extracurricular activity participation, Social Networks, https://doi.org/10.1016/j.socnet.2021.12.008

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