Week 5 Video 6

Epistemic Network Analysis

Today's Class

- Epistemic Network Analysis

Epistemic Network Analysis (ENA) (Shaffer, 2017)

- Studying relationships between elements in coded data
- Lots of applications
- Conference founded around this method (in large part)
  - International Conference on Quantitative Ethnography

Nodes and links

- Nodes = occurrences of the codes
- Links = co-occurrences of the codes

Let's start with an example

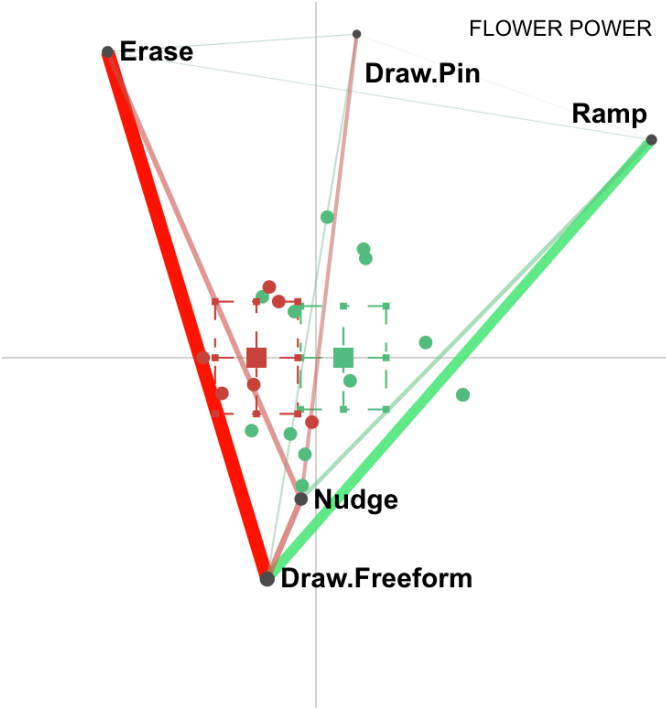
- Chosen primarily because I understand it well

Analyzing Quitting Behavior (Karumbaiah et al., 2019)

- Comparing students who quit a level in the game *Physics Playground* to students who do not quit a game level
- In terms of the gameplay actions each group of students makes

Nodes and links

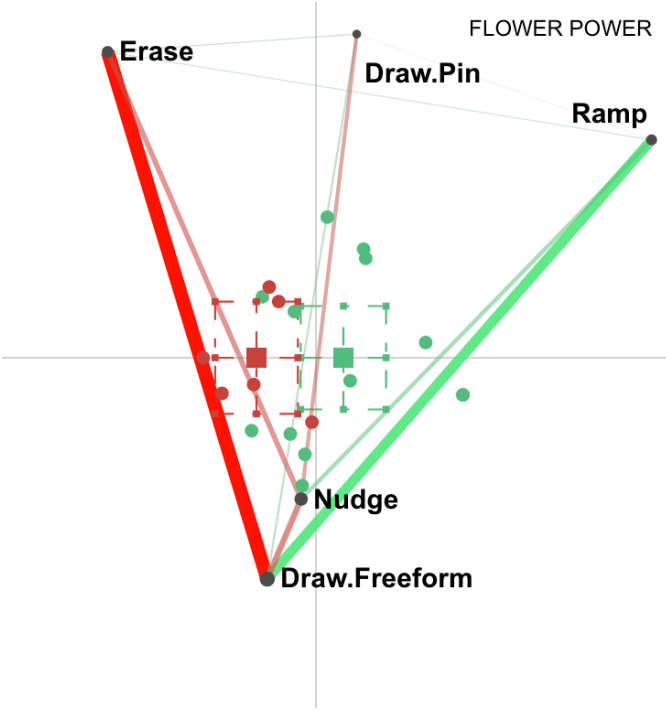
- Nodes are behaviors
- Links represent when a player demonstrates both behaviors in one session playing one level



Nodes and links

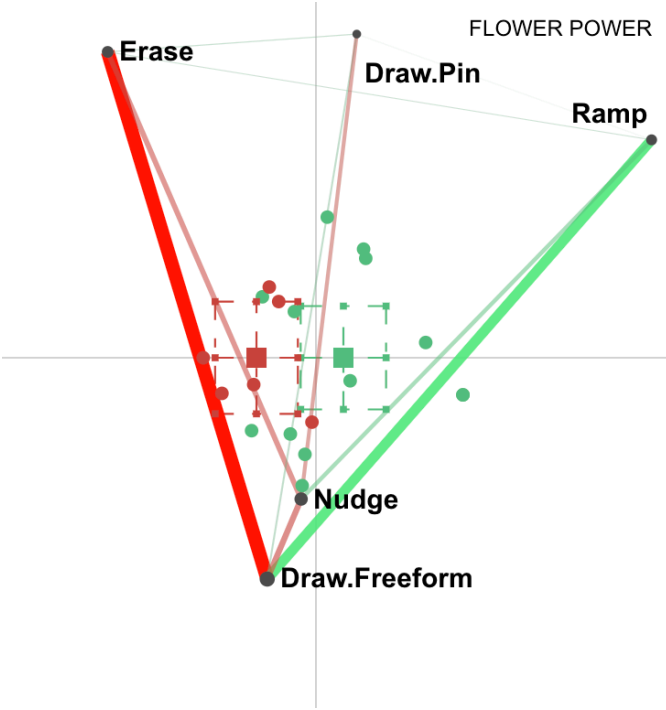
- When red students draw.freeform, they also erase
- Less commonly, when they draw.freeform, they also nudge

- When green students draw.freeform, they also ramp
- Less commonly, when they nudge, they also ramp

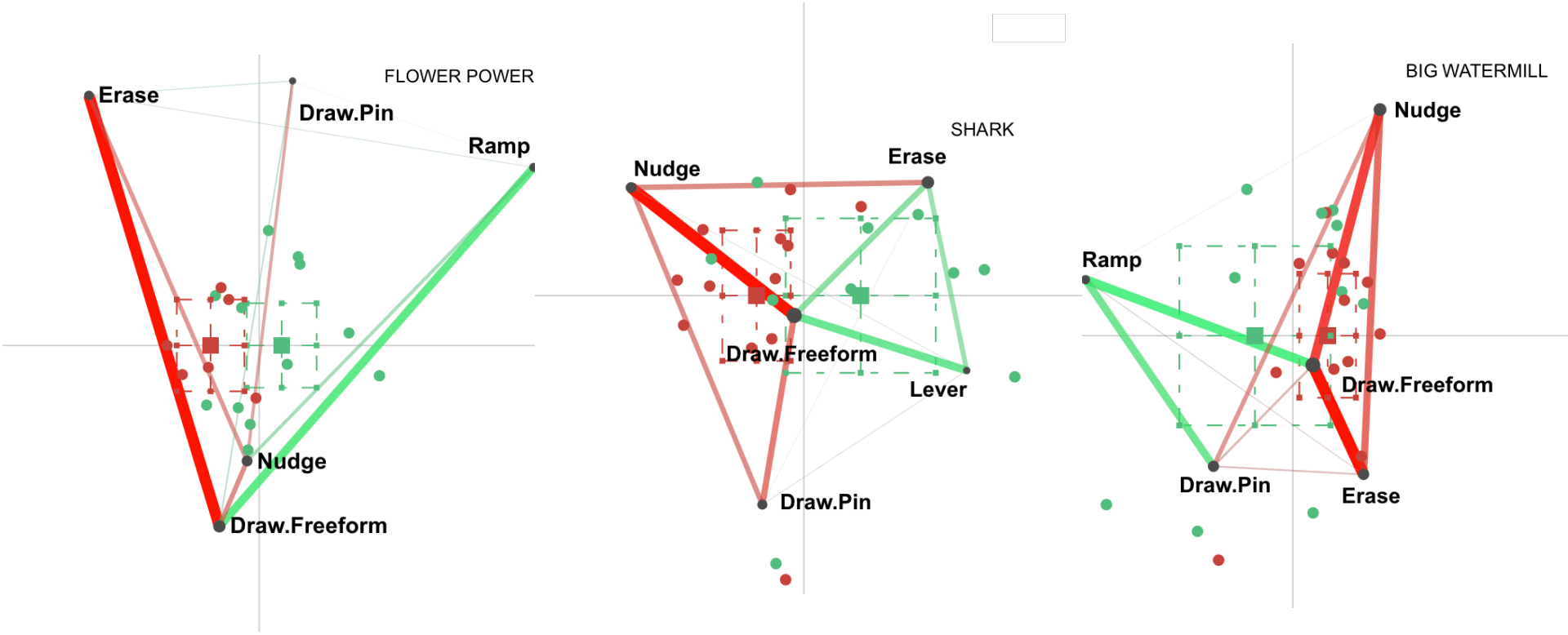


Comparing groups in data

- In this case,
  red= people who quit a game
  green = people who do not quit



Can Compare Graphs Between Contexts (here: game levels)



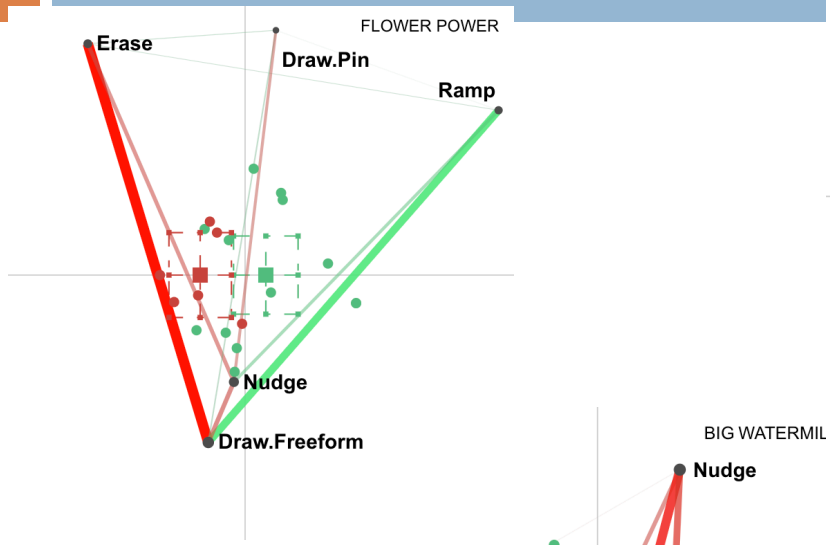
Interpreting the graphs in (Karumbaiah et al., 2019)

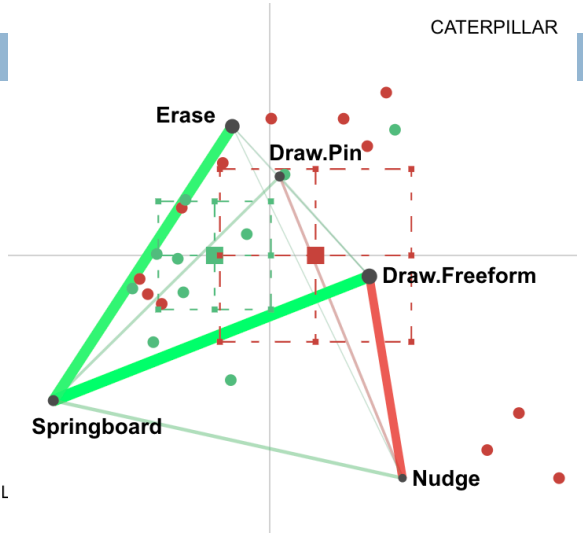
- Can seem tricky
- Very powerful when you dig into the graphs

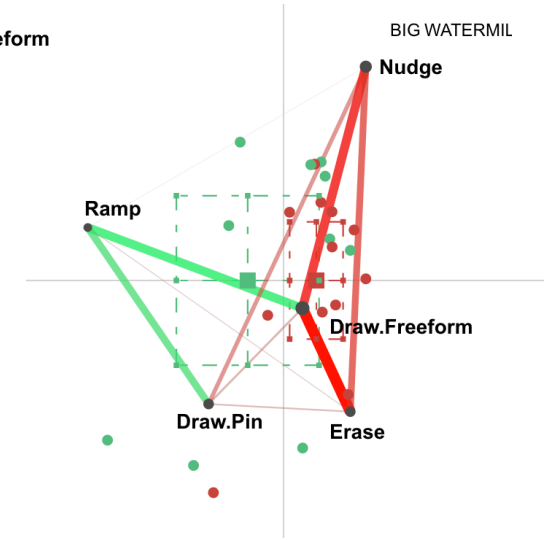
Key Themes identified by Karumbaiah et al. (2019)

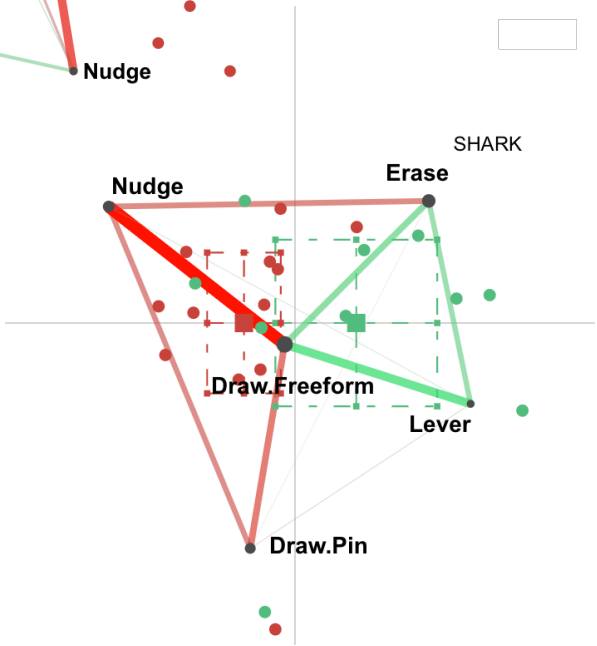
- Identifying Key Action
- Missing Identification of Supporting Objects
- Over-reliance on Nudge
- Limited Early Action Expansion and Later Action Convergence

Identifying Key Action



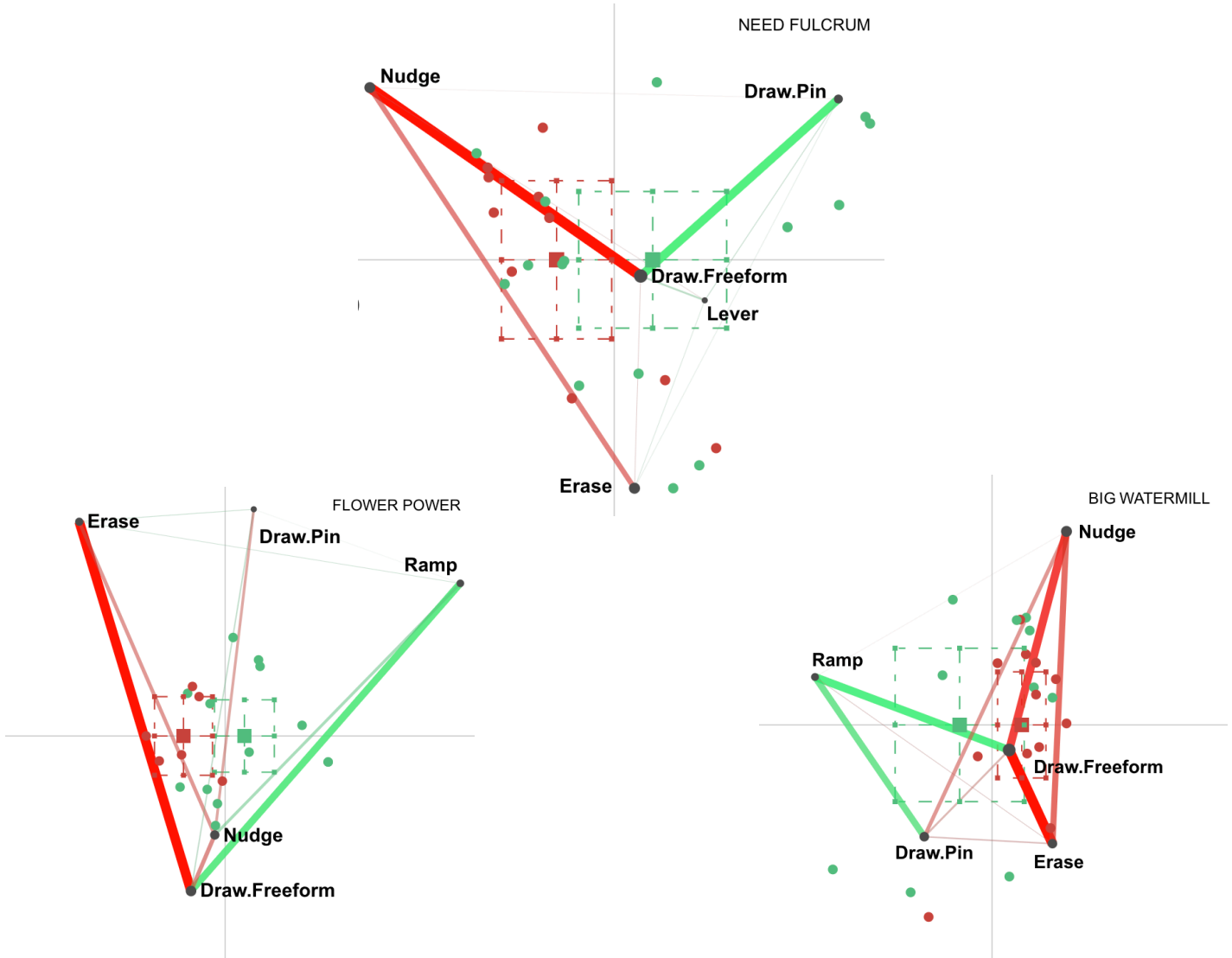




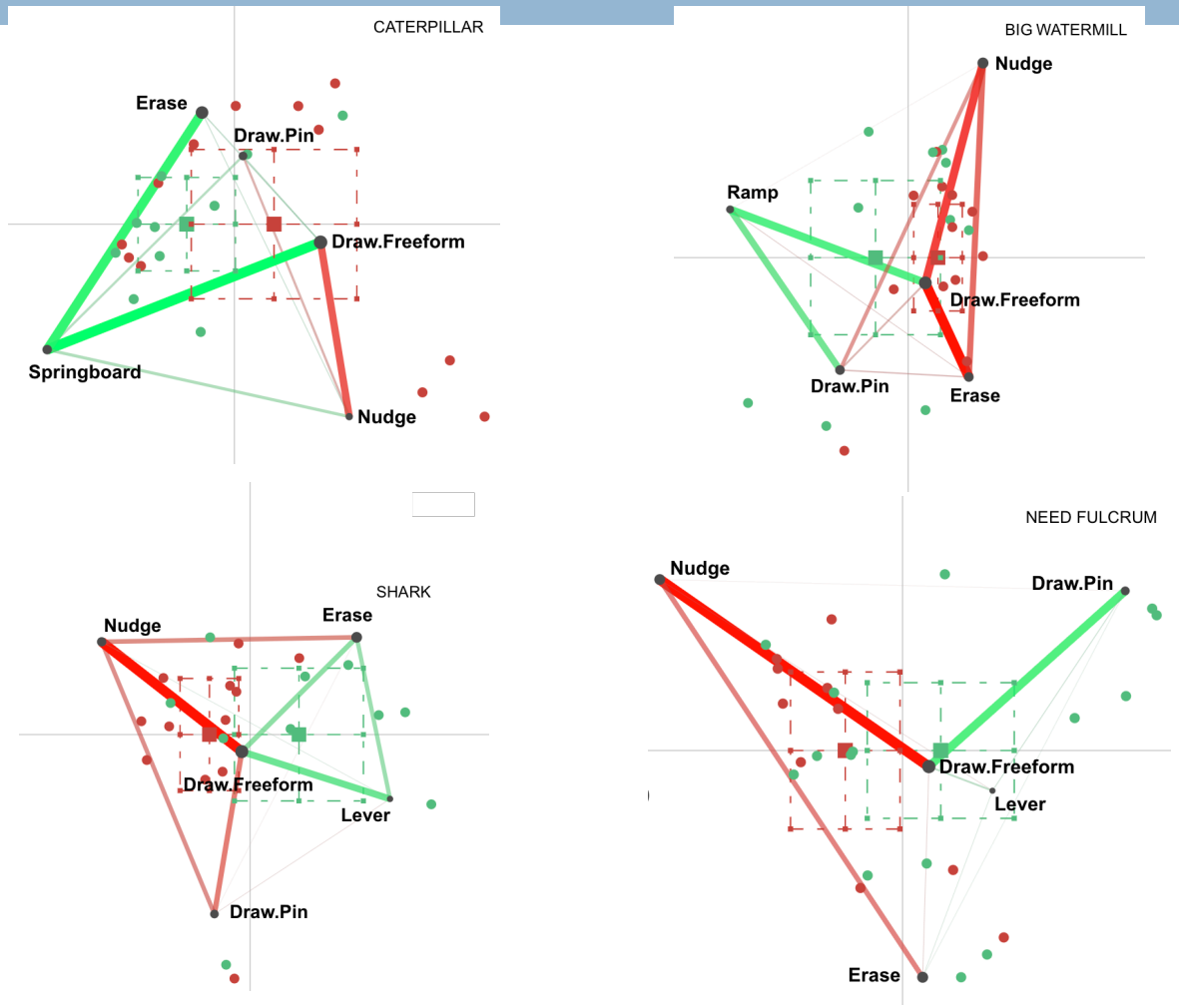


Indicates their lack of conceptual understanding of Physics

Missing Identification of Supporting Objects

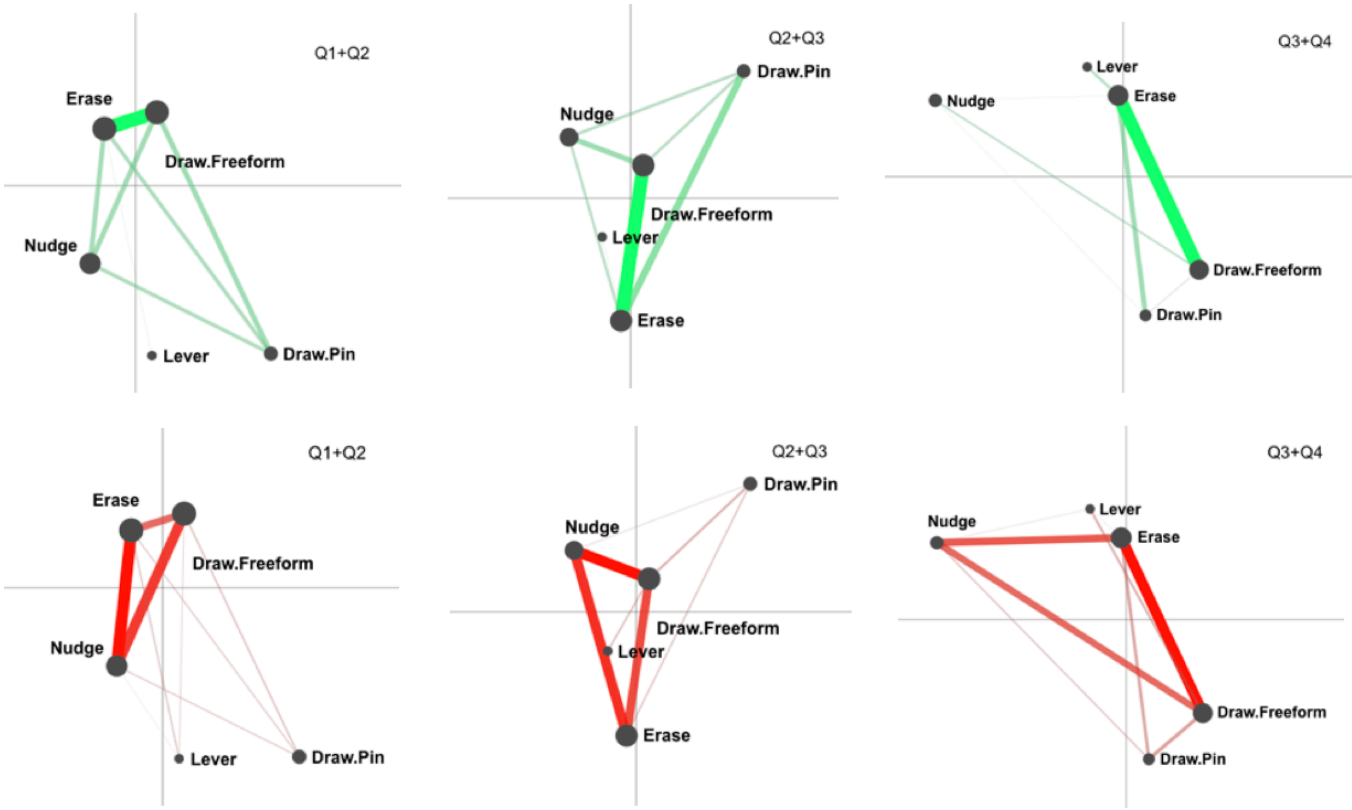


Over-reliance on Nudge



Indicates potential wheel spinning tendencies

Limited Early Action Expansion and Later Action Convergence



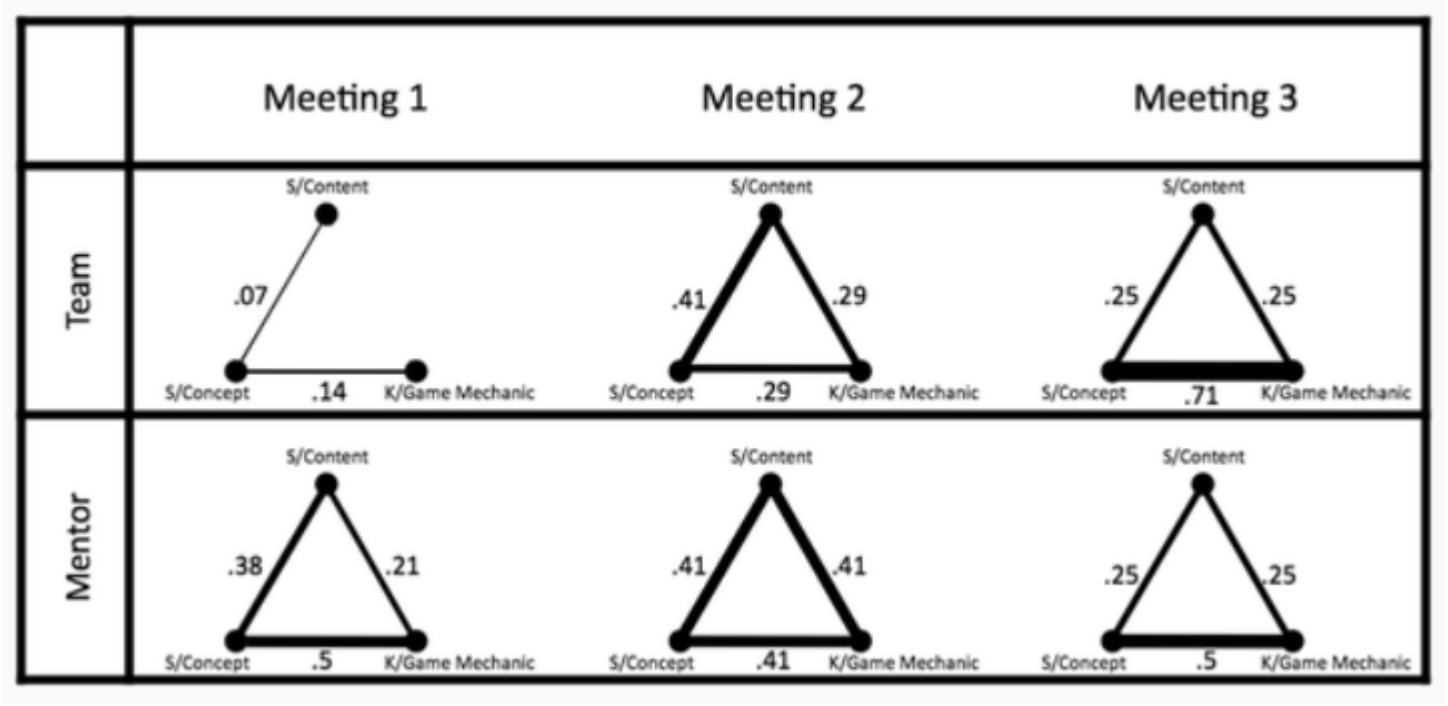
Need Fulcrum

Note

- We looked at these graphs qualitatively, but statistical analysis of differences is possible too
  - Is link A stronger than link B?
  - Is link Q stronger in group R or group S?

Other examples

Studying connections between topics in meetings over time (Nash & Shaffer, 2013)



Studying Process of Successful and Unsuccessful Teams (Arastoopour et al., 2016)

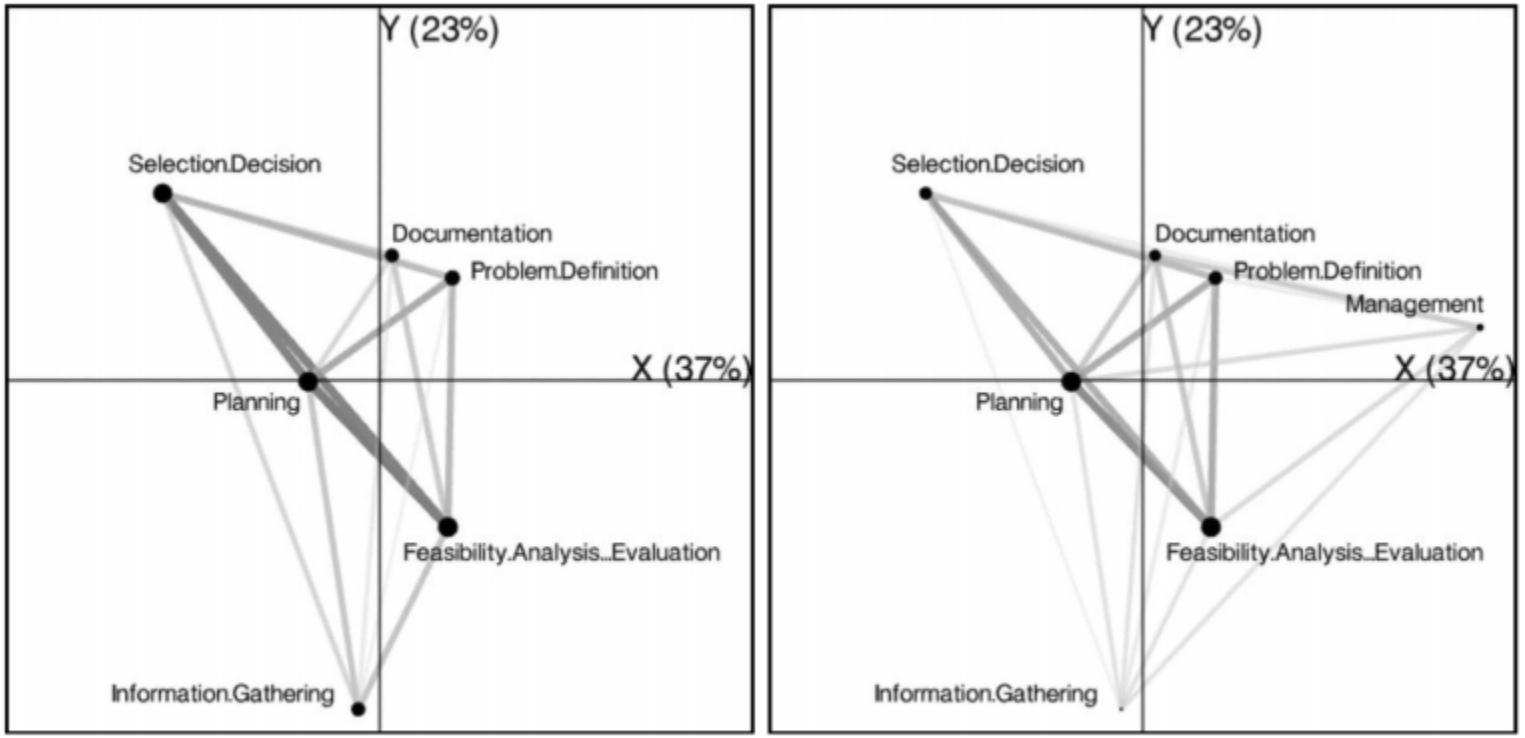
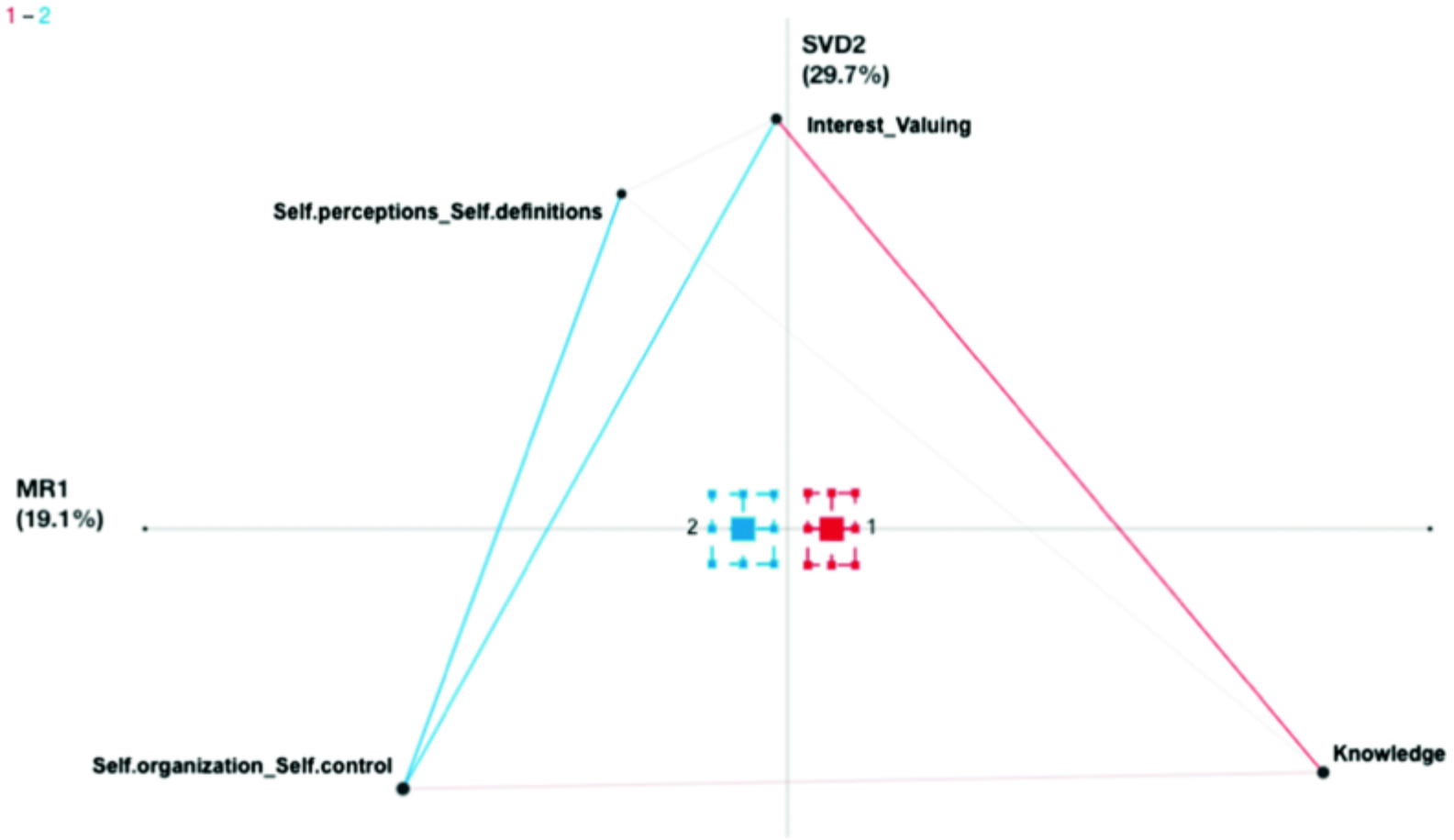


Fig. 4. Mean network representations of student teams that generate low-quality devices (left) and teams that generate high-quality devices (right). Thicker lines indicate stronger and more frequent connections between elements. Teams that generate high-quality devices have networks with more connections to management, which is why the centroids in Fig. 2 are plotted higher on the first dimension than teams with low-quality devices.

Exploring Shifts in Student Identity over Time (Barany & Foster, 2019)



Important setup questions

- What makes a relationship “stronger”?

Important setup questions

- What are your codes?
- How did you derive those codes?
  - Behaviors in data
  - Text mining
  - Hand coding
  - Hand coding THEN text mining (nCoder+) (Cai et al., 2019)

Important setup questions

- Which codes do you display?
- What are your aggregation units (stanzas)?
  - Everything a learner does together
  - Everything a learner does on a specific level together
  - Everyone in a group of learners/team
  - Everything in a piece of content
  - Everything in a meeting

Referred to as Stanza-Based Interaction Data (Shaffer et al., 2016)

1. A set of objects
2. The way they relate to each other
3. Grouped into a set of stanzas
4. That reveal evidence about the relationships between the objects

Important setup questions

- One-directional relationships or bi-directional relationships?

- Usually bi-directional, but some work looks at one-directional relationships over time (Karumbaiah et al., in press)

Important setup questions

- What do the X and Y axes mean?
  - Typically determined empirically by collapsing the feature space using SVD, singular value decomposition
    - Similar to factor analysis (week 7)
  - This approach can make X and Y hard to interpret but best splits out the variables visually

ENA

- Important method, growing in scope and community applying it

Knowledge Graphs/Spaces

- Another key application of network analysis
- We will discuss this in week 7 as well

Next week

- Visualization