Social Network Patterns in Adolescent Substance Use

Exploring Centrality, Homophily, and Gender in the Glasgow Teenage Friends & Lifestyle Study (1995)

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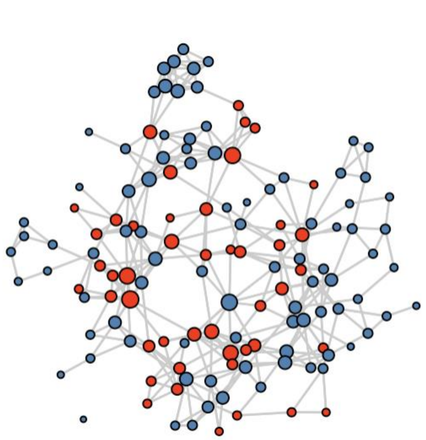
Research Questions

- Do adolescents who engage in high-risk substance use tend to form friendship ties with others who engage in the same behaviors?
  - High-risk substance use in this context can be defined as 13-year-olds who drink at least once a week, use cannabis at least occasionally, or use tobacco at least occasionally.
- Are adolescents who engage in high-risk substance use more centrally positioned in the friendship network than low to no usage peers?
- Does gender moderate the relationship between substance use and network structure?

Network

Fig. 1 (below): R statnet Network Plot



- Constructed using publicly available network data from the Glasgow Teenage Friends & Lifestyle Study (1995).
- One-mode undirected friendship network, where nodes represent students and edges represent reciprocated/mutual friendship ties at Wave I.
- The original valued friendship nominations were recoded into binary ties (1 = friend, 0 = non-friend).
- The network includes 134 students after restricting to complete cases and removing NA values.
- Node color indicates high-risk substance use (red = high-risk, blue = low/no use), where high-risk is defined as:
  - Alcohol use weekly or more, or
  - Tobacco use occasional or regular, or
  - Cannabis use occasional or regular
- Node size reflects degree centrality, with larger nodes indicating students with more friendship connections.
- Generated using Fruchterman-Reingold layout, which positions highly connected students towards the center of the network.

Hypotheses

- Adolescents who engage in high-risk substance use will demonstrate significant behavioral homophily, forming friendship ties with peers who engage in the same behaviors.
- High-risk substance users will occupy more central positions in the friendship network (reflected in higher degree and eigenvector centrality) compared to low to no usage peers.
- The relationship between high-risk substance use and network structure will differ by gender, with girls expected to show stronger clustering and higher centrality among high-risk users than boys.

Plots

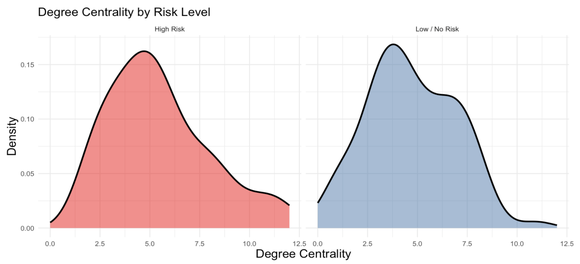


Fig. 2 (above): Degree centrality density plot generated in R, faceted by risk level.

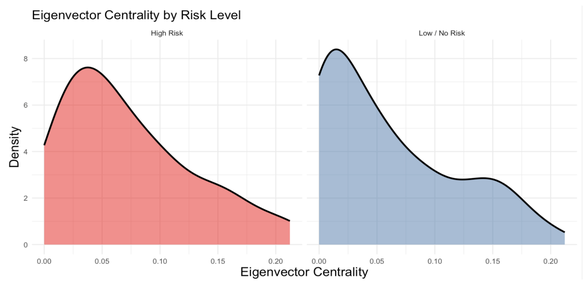


Fig. 3 (above): Eigenvector centrality density plot generated in R, faceted by risk level.

- High-risk and low/no-risk adolescents show overlapping degree distributions (Fig. 2), but the high-risk group is slightly shifted toward higher values.
  - This indicates that adolescents engaging in high-risk substance use tend to have larger friendship networks.
- The distributions of influence largely overlap between high-risk and low/no-risk adolescents (Fig. 3).

Results

```
Results
=================================================
                          Dependent variable:
                      ---------------------------
                           Degree Centrality
-------------------------------------------------
High-Risk Substance Use          0.150*
                                 (0.081)

Girl                              0.016
                                 (0.078)

Constant                         1.541***
                                 (0.060)

-------------------------------------------------
Observations                       134
=================================================
Note:                  *p<0.1; **p<0.05; ***p<0.01

Results
=================================================
                          Dependent variable:
                      ---------------------------
                         Eigenvector Centrality
-------------------------------------------------
High-Risk Substance Use           0.008
                                 (0.010)

Girl                             0.034***
                                 (0.010)

Constant                         0.045***
                                 (0.007)

-------------------------------------------------
Observations                       134
R2                                0.098
Adjusted R2                       0.084
Residual Std. Error          0.055 (df = 131)
F Statistic                7.084*** (df = 2; 131)
=================================================
Note:                  *p<0.1; **p<0.05; ***p<0.01
```

Fig. 4 (above): R Stargazer Poisson regression output for degree centrality (top result) and linear regression output for eigenvector centrality (bottom result).

```
Call:
ergm(formula = glasgow_net ~ edges + nodematch("highrisk_any"))

Maximum Likelihood Results:

                      Estimate Std. Error MCMC %
edges                  -3.4546     0.0912      0
nodematch.highrisk_any   0.3514     0.1154      0
                      z value Pr(>|z|)
edges                 -37.878  < 1e-04 ***
nodematch.highrisk_any   3.045  0.00232 **
---
Signif. codes:
0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Fig. 5 (above): ERGM output in R to examine friendship tie formation by high-risk substance use.

Discussion

POPULARITY:

- Adolescents who engage in high-risk substance use are estimated to have about 16% more friends than low/no-risk adolescents: exp(0.150) = 1.161834. This effect is statistically significant at the 0.10 level.
  - High-risk adolescents tend to have slightly larger friendship networks.
- There is no meaningful difference in degree centrality between girls and boys after accounting for substance use.
  - Gender does not predict degree centrality in this context.

INFLUENCE:

- There is no evidence that adolescents who engage in high-risk substance use are more connected to highly influential peers than low/no-risk adolescents ($p > 0.10$).
- Girls have significantly higher eigenvector centrality than boys ($p < 0.01$).
  - Gender predicts influence within the friendship network independent of substance use.

BEHAVIORAL HOMOPHILY:

- A statistically significant nodematch effect for high-risk substance use was observed ($p < 0.01$).
- Students are approximately 42% more likely to form friendship ties with those who share high-risk substance use behaviors: exp(0.3514) = 1.421056.

Conclusion

- Students who engage in high-risk substance use show strong behavioral homophily, forming friendships significantly more often with peers who share the same risky behaviors.
- High-risk adolescents tend to have slightly larger friendship networks than low/no-risk peers.
- High-risk substance use does not predict greater influence, suggesting that being popular does not equate to being structurally influential.
- Gender plays a key role in network influence, with girls occupying significantly more influential positions in the friendship network, but independent of substance use.

Sources

- Michell, L., & West, P. (n.d.). Glasgow Teenage Friends and Lifestyle Study: Friendship and Substance Use Data. Medical Research Council/Medical Sociology Unit, University of Glasgow. https://www.stats.ox.ac.uk/~snijders/siena/Glasgow_data.htm
- University of Glasgow. (n.d.). Net4Health: Social networks and adolescent health. MRC/CSO Social and Public Health Sciences Unit. https://www.gla.ac.uk/schools/healthwellbeing/research/mrccsosocialandpublichealthsciencesunit/programmes/relationships/pcsn/net4health/