PENNSTATE

PROSPER Partnerships

Why Do Kids Who Drink Have More Friends? Friendship Dynamics and the Emergence of Alcohol Use

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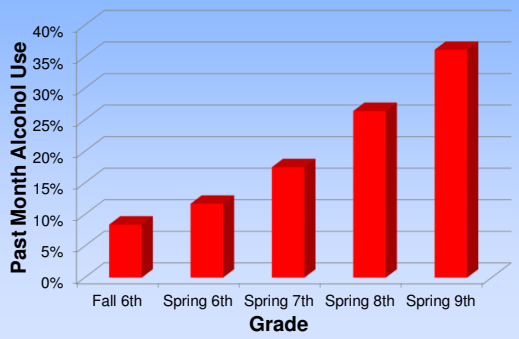
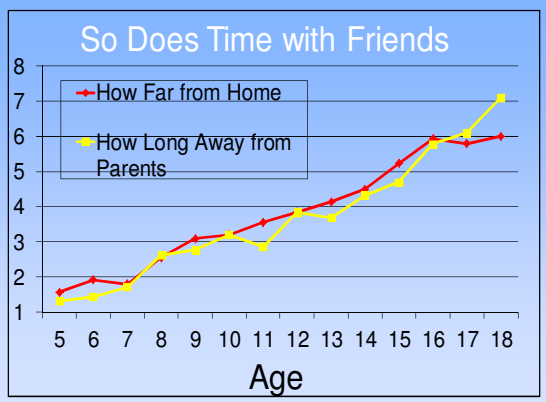
Alcohol Use Takes Off in Early Adolescence



So Does Time with Friends



Prominence of Peer Influence in the Study of Adolescent Problem Behavior

- Theory
  - Balance/cognitive consistency, social learning, peer cluster theory, symbolic interaction, reference group, . . .
- Research
  - Friends' behavior highly reliable correlate
- Prevention/Intervention Practice
  - Emphases on refusal skills, friendship choice, parent monitoring about friends

Limits of Earlier, Non-Network Research on Peer Influence

- Over-reliance on perceptual measures
  - How many of your friends . . .
  - Versus: who are your friends + their reports
- Need to consider peer processes jointly:
  - Influence, selection, shared environment, network structure
- Lack of attention to network implications of dyadic processes
  - Diffusion, reciprocal influence

Selection, Influence, & Similarity

- Selection versus influence?
  - Long competing explanations of similarity
  - Growing evidence of both (depends on topic)
- If peer influence is genuine:
  - We should be concerned about who chooses friends who drink
- What if only influence (selection random)?
  - Friends' drinking unrelated to own prior
  - Limited variation in mean friends' drinking
  - New friends undo similarity from influence

Choosing Drinkers as Friends

- What if BOTH influence & selection?
  - Maintain and increase similarity
  - Supports drinking of most drinkers
  - Produce greater segregation for drinking
  - BUT, similarity per se won't produce increase

Choosing Drinkers as Friends

- What if kids who drink have more friends?
  - WOULD contribute to increases in drinking
- Why would drinkers be selected more often?
  - Drinking is an attractive, high status activity
    - Sykes & Matza, Moffitt, Allen, Moody

  Drinking ⟶ Attractiveness
  - Routine activities perspective:

  Friends ⟶ "Parties" ⟶ Opportunity ⟶ Drinking

The PROSPER Study

- 27 communities, 2 grade cohorts, 5 waves
  - Iowa & Pennsylvania, Small towns
  - 11,000+ Students per wave; 15,000+ total
- Questionnaires assess friendships
  - Fall of 6th grade & Spring of 6th, 7th, 8th, & 9th
  - Also assess variety of attitudes and behaviors
- Programming targeting substance use:
  - Random assignment of communities

The PROSPER Friendship Data

Who are your best and closest friends in your grade?		
First name	**Last Name** (or if you don't know their last name, . . .)	**How often do you "hang out" with this person outside of school, (without adults around)?** 1) Never . . . 5) Almost Every Day
YOUR BEST FRIEND or FRIENDS		
OTHER CLOSE FRIENDS		

Quality of the Friendship Data

- Questionnaire response rate: 87.2%
- Valid nomination data, Overall: 81.9%
  - Of respondents: 93.9%
  - 263,622 friends named!
- Name matching, Overall: 81.5%
  - Inter-rater agreement, 98%
  - Non-matches primarily out of school
- Reciprocation rate
  - Overall: 48%,
  - 1st choice: 76%

The SIENA Dynamic Model of Social Networks and Behavior

- A joint model of network and behavioral change
  - Linked discrete choice models
- Actor oriented model simulation
  - Simulation derives consequences of parameter estimates for assumed processes
- SIENA: Simulation Investigation for Empirical Network Analysis
  - Tom Snijders & colleagues, Oxford U & U. of Groningen
  - Software: programmed in R, free
  - http://www.stats.ox.ac.uk/~snijders/siena/

SIENA Actor Oriented Model Simulations

- Each simulation a sequence of micro-steps
  - Randomly select one person (node) for opportunity to make one change in either
    - Network: add or delete one tie (or no change)
    - Behavior: one level up or down (or no change)
- Simulations begin with origin state (Wave 1)
- Result of simulation compared to later waves
  - Estimates selected to optimize correspondence
  - Method of moments, for moments reflective of processes

SIENA Discrete Choice Model for Network Change

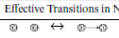
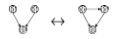
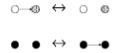
- Probability of person i changing friendship with person j (i.e., add or drop)

$$P\left(\Delta_{x_{ij}}\right) = \frac{exp\left(f\left(\Delta_{x_{ij}}\right)\right)}{\sum_{m=1}^{M} exp\left(f\left(\Delta_{x_{im}}\right)\right)}$$

- Evaluation function for that change

$$f\left(\Delta_{x_{ij}}\right) = \sum_{k=0}^{K}\left[\beta_k NS_k\left(\boldsymbol{X}|\Delta_{x_{ij}}, a_i, b_j, c_{ij}\right)\right]$$

Selection of Possible Effects for Modeling Network Evolution

Effect	Network Statistic	Effective Transitions in Network[a]	Verbal Description
1. Outdegree	$\sum_j x_{ij}$		Overall tendency to have ties
2. Reciprocity	$\sum_j x_{ij}x_{ji}$		Tendency to have reciprocated ties
4. Transitive triplets	$\sum_j x_{ij}\sum_h x_{ih}x_{hj}$		Tendency toward triadic closure of the neighborhood (linear effect of the number of indirect ties)
7. Balance	$\sum_j x_{ij}$trsim$_{ij}$		Tendency to have ties to structurally similar others (structural balance)
8. 3-cycles	$\sum_j x_{ij}\sum_h x_{jh}x_{hi}$		Tendency to form relationship cycles (negativ measure of hierarchy)
10. Covariate alter	$\sum_j x_{ij}(z_j - \bar{z})$		Main effect of alter's behavior (covariate determines popularity in network)
11. Covariate ego	$\sum_j x_{ij}(z_i - \bar{z})$		Main effect of ego's behavior on tie preference (covariate determines activity in network)
12. Covariate similarity	$\sum_j x_{ij}$sim$_{ij}$		Tendency to have ties to similar others (homophile selection on covariate, linear in score differences)

From Steglich et al., *Sociological Methodology*, 2010, 40: 329-393

SIENA Discrete Choice Model for Behavioral Change

- Probability of person i changing behavior to level l

$$P(y_i = l) = \frac{exp(g(y_i{=}l))}{\sum_{M=l-1}^{l+1} exp(g(y_i{=}m))}$$

- Behavioral choice function for i changing behavior to level l

$$g(y_i = l) = \sum_{k=0}^{K}\left[\gamma_k NS_k\left(\boldsymbol{y}|y_i = l, \boldsymbol{X}, a_i, b_j, c_{ij}\right)\right]$$

Selection of Possible Network Effects for Modeling Behavioral Evolution

Effect	Network Statistic	Effective Transitions in Behavior[a]	Verbal Description
1. Shape: linear and quadratic	$(z_i - \bar{z})$ and $(z_i - \bar{z})^2$		*The two parameters together define a parabola shape of the objective function, allowing it to capture the basic shape of the observed distribution of the behavioral variable.*
2. Average similarity	$(\sum_j x_{ij}$sim$_{ij})/(\sum_j x_{ij})$		Assimilation to neighbors' average behavior (small neighborhoods pull as much as big ones)
4. Average alters	$(\sum_j x_{ij}(z_j - \bar{z}))/(\sum_j x_{ij})$		Main effect of neighbors' average behavior (contagion/influence, but not necessarily assimilation)
5. Indegree × behavior	$(z_i - \bar{z})\sum_j x_{ji}$		Effect of own popularity in the network on behavior

[a]In the *effective transitions* illustrations, it is assumed that the behavioral dependent variable is dichotomous and centered at zero; the color coding is ○ = low score (negative), ● = high score (positive), ⊙ = arbitrary score. Actor **i** is the actor who changes color z_i in the transition indicated by the double arrows. Illustrations are not exhaustive.

From Steglich et al., *Sociological Methodology*, 2010, 40: 329-393

PROSPER Peers SIENA Analyses

- Separate SIENA analysis for each community / cohort combination
  - Two days total computer time on high speed cluster to estimate one complex model
- Combined through multi-level regression
  - SIENA standard errors as "known variance"
  - Level 2 = cohort, level 3 = community
  - Yields precision weighted estimates of means & variances across networks
- Variability an additional substantial topic

SIENA models in PROSPER

- 50 community-cohort networks, 5 waves
- Alcohol use: use in past 30 days,
  - None versus once versus two or more times
- Composite risk:
  - School bonds, school grades, family relationships, religious participation, and sensation seeking

Contributions of Network Structure to Friendship Choices, SIENA Estimates

	O.R.	β	S.E.	S.D.
Reciprocity	7.00	1.95 *	0.041	0.205
Transitive triplets	1.40	0.34 *	0.014	0.070
Balance	1.11	0.10	Fixed	
Three cycles (hierarchy)	0.66	-0.42 *	0.016	0.076

O.R. = odds ratio, β = mean coef, S.E. = standard error of β
S.D. = standard deviation of estimate over networks, * p < .05

Selection of Friends for Other Attributes

Popularity (alter)	**O.R.**	**β**	**S.E.**	**S.D.**
Prior number of friends	1.18	0.17 *	0.009	0.042
Male gender	1.01	0.01	0.007	0.024
White race/ethnicity	0.93	-0.08 *	0.011	0.042
Free school lunch	0.96	-0.04 *	0.008	0.023
Composite risk	1.01	0.01 *	0.003	0.011
Homophily (similarity)				
Gender	2.06	0.72 *	0.024	0.126
Race/ethnicity	1.18	0.17 *	0.025	0.121
Free school lunch	1.05	0.04 *	0.012	0.057
Composite risk	1.64	0.49 *	0.041	0.170

O.R. = odds ratio, β = mean coef, S.E. = standard error of β
S.D. = standard deviation of estimate over networks, * p < .05

Similarity & Popularity Effects for Alcohol Use, SIENA Estimates

	O.R.	β	S.E.	S.D.
Selection of Alcohol Users as Friends				
Attractiveness (alter)	1.08	0.08 *	0.009	0.003
Homophily (similarity)	1.29	0.25 *	0.021	0.008
Influence of Friends on Alcohol Use				
Mean similarity	4.99	1.61 *	0.098	0.020
Number of friends	1.06	0.06 *	0.004	0.006

O.R. = odds ratio, β = mean coef, S.E. = standard error of β
S.D. = standard deviation of estimate over networks, * p < .05

Conclusions: Influence & Similarity

- Considerable social forces toward similarity and segregation for drinking
  - Influence toward friends' drinking (or non-drinking)
    - Why when more ambiguous in some studies?
    - With U.S. sample, these regions, this age group.
    - Precise estimates from large sample & 5 waves.
  - Choose friends like oneself for drinking & risk
    - Risk for drinking especially important.
  - But not dominant basis for selection
    - Gender and network structure matter most.

Conclusions: # of Friends & Drinking

- Drinking spreads (in part) through popularity of drinkers
  - Drinking brings more friends
    - Drinking a potential source of status
    - Which provides an avenue of influence toward those attracted
    - Fits notion of risky behavior being seen daring, sophisticated, etc.
  - Kids with many friends drawn into drinking
    - Avenue for spread independent of appeal to others
    - Fits routine activity/opportunity explanation.

Conclusions: Variability of Friendship Processes

- Minimal variability across communities & grade cohorts for processes connecting alcohol use and friendship
  - Mean estimate at least 9 times SD
  - Except moderate variation for selection for similarity on composite risk
- Matches Knect et al 2010, Netherlands
- Surprising consistency
  - Limits and basis unknown

The PROSPER Peers Team

- Lead Investigators
  - Wayne Osgood, Mark Feinberg, Scott Gest, Jim Moody (Duke Univ.), Derek Kreager
- Other Investigators
  - Sonja Siennick (Florida State Univ.) , Kelly Rulison (UNCG), Michael Cleveland, Suellen Hopfer
- Graduate Assistants
  - Wendy Brynildsen, Robin Gautier, Lauren Molloy, Dan Ragan, Debra Temkin, Lacey Wallace
- PROSPER Study Lead Investigators
  - Dick Spoth, Mark Greenberg, Cleve Redmond, Mark Feinberg

Correlations of N of Friends, Alcohol Use, and Risk (n = 50,000)

	In degree	Out degree	Alcohol Use	Comp Risk
Times chosen as friend (in degree)	1.00	0.42	0.04	-0.12
Number of friends selected (out degree)	0.42	1.00	-0.01	-0.18
Drinking, past month	0.04	-0.01	1.00	0.37
Composite Risk Index	-0.12	-0.18	0.37	1.00

Composite risk: school grades, school bonds, family relations, religious partic., sensation seeking

Relationships of Individual Controls to Alcohol Use

	O.R.	β	S.E.	S.D.
Male gender	0.92	-0.09 *	0.015	0.000
White race/ethnicity	0.96	-0.04	0.026	0.009
Free school lunch	0.95	-0.05 *	0.023	0.042
Composite risk	1.33	0.28 *	0.009	0.002

O.R. = odds ratio, β = mean coef, S.E. = standard error of β
S.D. = standard deviation of estimate over networks, * p < .05

Delinquency and Friendships

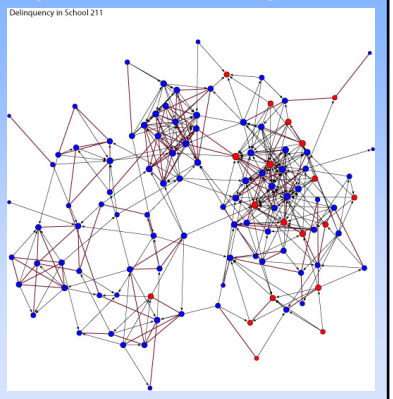
One school,
7th grade N=112

A → B
A named B
A ↔ B
Reciprocal

- Delinquent
- Non-delinquent

r = .12

Size reflects # of friends



Gender and Friendships

One school,
7th grade N=112

A → B
A named B
A ↔ B
Reciprocal

- Girl
- Boy

r = .92

Size reflects # of friends