ARTICLE

Parental Influence on Substance Use in Adolescent Social Networks

Holly B. Shakya, PhD; Nicholas A. Christakis, MD, PhD; James H. Fowler, PhD

Objective: To evaluate the relationship between the parenting style of an adolescent's peers' parents and an adolescent's substance use.

Design: Longitudinal survey.

Setting: Adolescents across the United States were interviewed at school and at home.

Participants: Nationally representative sample of adolescents in the United States.

Main Exposure: Authoritative vs neglectful parenting style of adolescent's parents and adolescent's friends' parents and adolescent substance use.

Main Outcome Measures: Adolescent alcohol abuse, smoking, marijuana use, and binge drinking.

Results: If an adolescent had a friend whose mother was authoritative, that adolescent was 40% (95% CI, 12%-58%) less likely to drink to the point of drunkenness, 38% (95% CI, 5%-59%) less likely to binge drink, 39% (95% CI, 12%-58%) less likely to smoke cigarettes, and 43% (95% CI, 1%-67%) less likely to use marijuana than an adolescent whose friend's mother was neglectful, controlling for the parenting style of the adolescent's own mother, school-level fixed effects, and demographics. These results were only partially mediated by peer substance use.

Conclusions: Social network influences may extend beyond the homogeneous dimensions of own peer or own parent to include extradyadic influences of the wider network. The value of parenting interventions should be reassessed to take into account these spillover effects in the greater network.

Arch Pediatr Adolesc Med. 2012;166(12):1132-1139.
Published online October 8, 2012.
doi:10.1001/archpediatrics.2012.1372

Author Affiliations:
Department of Medicine, School of Medicine (Dr Shakya), and Medical Genetics Division and Political Science Department (Dr Fowler), University of California, San Diego; and Harvard Faculty of Arts and Sciences and Harvard Medical School, Boston, Massachusetts (Dr Christakis).

RESEARCH ON ADOLESCENT and adult social networks has focused on the impact of peers on risk behaviors involving drugs, tobacco, and alcohol use.[1-8] Networks may influence individual substance use behavior via the prevalence of substance use within the network as well as the interpersonal dynamics among network members.[9,10] These effects may have serious consequences; for example, the probability of a future overdose is related to both the number of members of an individual's social network using drugs and the degree of conflict within that network.[11]

At the same time, there is evidence that parents may influence adolescents via their style of parenting.[12-14] The parenting styles framework encompasses 4 distinct parenting categories that are derived from 2 dimensions of interaction: (1) parental control (how much a parent intervenes in their adolescent child's life) and (2) parental warmth (how much positive affect a parent shows for their adolescent). Authoritative parents are warm and communicative, but they also exert appropriate control. Neglectful parents exhibit neither warmth nor control. Authoritarian parents exert control while lacking warmth, while permissive parents show warmth but do not exert control. Studies of these 4 parenting styles suggest that the authoritative parenting style is optimal, with long-term benefits including academic success, positive peer relationships, minimal delinquent behavior, risk avoidance, and positive psychosocial adjustment, including higher levels of psychological well-being.[14-20] Adolescents with authoritative parents are also less likely to have delinquent peer networks.[21]

Herein, we explore the possibility that parenting matters not only because of the direct and proximal effect of parent on child

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but also because of the indirect and more distal relationship between parents and their adolescent children's friends. In other words, do the benefits of good parenting spill over, spreading from person to person and affecting multiple adolescents in a network? This question has implications both for how parents supervise the social networks of their adolescent children as well as for how policy makers view the potential benefits of parenting education and interventions. In a previous cross-sectional study by Fletcher and colleagues,[22] network authoritativeness (an average of the degree to which the parents of an adolescent's peers used authoritative parenting) was correlated with a decreased propensity toward delinquency, lower levels of substance abuse, and greater psychosocial competence. To investigate this question more thoroughly using longitudinal analyses and complete network data, we use the National Longitudinal Study of Adolescent Health (Add Health), a source of data that contains information about adolescent social networks, their parents' styles of parenting, and self-reported measures of substance abuse. Using longitudinal dyadic network regression models, we measured the association between adolescents' behavior and their friends' behavior, their mothers' parenting style, and their friends' mothers' parenting style.

METHODS

DATA

Add Health is a nationally representative study that explores multiple facets of adolescent well-being. Four waves of the Add Health study have been completed: Wave I was conducted in 1994-1995 and included adolescents who were then in seventh through 12th grade; Wave II, in 1996; Wave III, in 2001-2002; and Wave IV, in 2007-2008. In Wave I of the Add Health study, researchers collected an "in-school" sample of 90 118 adolescents chosen from a nationally representative sample of 142 schools.

As part of the survey, these students named up to 5 male and 5 female friends who were later identified from schoolwide rosters to generate information about each school's complete social network. A subset of this group was then chosen for in-depth follow-up in subsequent waves. This "in-home" sample was administered longer questionnaires about their social networks, health behaviors, family dynamics, and emotional/developmental outcomes. We drew our information about parenting and adolescent substance abuse from the Wave I and II in-home data sets.

Adolescent-friend dyads were included in each analysis only if the observations for both individuals included data on all measures of interest and if the pair indicated that they were friends for both Wave I and Wave II. Furthermore, adolescents who indicated that they were siblings, either full or half, were removed from the sample. Questions on maternal warmth were not asked of individuals for whom no one was acting in the role of mother (which could include nonbiological mothers such as aunts or grandmothers). **Table 1** provides summary statistics for the sample populations. Adolescents in our sample, compared with those in the complete Add Health Wave II sample, were less likely to be black (13% vs 23%), slightly less likely to be Hispanic (13% vs 17%), and similar in likelihood to be Asian (8% vs 7.4%) and came from marginally wealthier households (mean income, $48 670 vs $46 000) but had similar levels of parental education (mean, 5.62 vs 5.45 years).

Table 1. Summary Statistics for 1386 Respondents and 1404 Friends

	%	
	Wave I Value	Wave II Value
Drunk in last year		
Respondent	26	29
Friend	29	31
Cigarette in last month		
Respondent	24	32
Friend	37	35
Marijuana use in last month		
Respondent	11	13
Friend	14	16
Binge drinking in last year		
Respondent	26	30
Friend	28	31
Neglectful parenting		
Respondent	24	28
Friend	25	33
Permissive parenting		
Respondent	22	30
Friend	24	30
Authoritarian parenting		
Respondent	24	22
Friend	23	18
Respondent age, y, mean (SD)	16.68 (1.48)	
Female	51	
Household income, 1000s of dollars, mean (SD)	48.67 (40.48)	
Parent's education, mean (SD)[a]	5.62 (2.31)	
Hispanic	13	
Black	13	
Asian	8	

[a] Parent's education is a 10-item scale: 0 = never went to school; 1 = eighth grade or less; 2 = more than eighth grade but did not graduate from high school; 3 = went to a business, trade, or vocational school instead of high school; 4 = high school graduate; 5 = completed a General Education Development program; 6 = went to a business, trade, or vocational school after high school; 7 = went to college but did not graduate; 8 = graduated from a college or university; and 9 = professional training beyond a 4-year college or university.

MEASURES

Adolescents in the Add Health data set responded to a battery of questions regarding their parents' parenting behavior. Parental control was assessed using yes/no responses to 7 questions from which we created a composite measure,[20] based on the average responses to all 7 questions (Cronbach α of .63).[20] Adolescents whose parents were reported to exert less than the median level of control were categorized as low control. Those more than or equal to the median were categorized as high control. Maternal warmth was assessed using responses to 5 questions used in prior research.[20] Cronbach α on the 5 questions was .85. Warmth, like control, was categorized by placing those at the median level of warmth and higher in the high-warmth parenting category and those less than the median in the low-warmth parenting category. The combination of the control and warmth categories allowed us to define 4 different parenting types[20] coded as follows: authoritative: high warmth, high control; authoritarian: low warmth, high control; permissive: high warmth, low control; and neglectful: low warmth, low control. While adolescent responses regarding their parents could be biased because of respondent error, Steinberg et al[23] found that adolescent report was less biased than parent self-report because parents tend to err toward depicting their own behavior in the most positive light.

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Table 2. Bivariate Association Between Friend's Mother's Parenting Style (Wave II) and Adolescent Risk Behavior[a]

	Binge Drinking in Last Year[b]		Smoked in Last Month[c]		Was Drunk in Last Year[d]		Used Marijuana in Last Month[e]	
	RR (95% CI)	*P* Value	RR (95% CI)	*P* Value	RR (95% CI)	*P* Value	RR (95% CI)	*P* Value
Friend's mother permissive	0.87 (0.74-1.02)	.09	0.93 (0.79-1.08)	.34	0.84 (0.71-0.99)	.03	0.80 (0.61-1.05)	.11
Friend's mother authoritarian	0.65 (0.52-0.81)	<.001	0.82 (0.67-0.99)	.04	0.7 (0.56-0.86)	<.001	0.92 (0.68-1.24)	.60
Friend's mother authoritative	0.49 (0.38-0.64)	<.001	0.64 (0.5-0.79)	<.001	0.46 (0.36-0.6)	<.001	0.46 (0.31-0.68)	<.001

Abbreviation: RR, risk ratio.
[a] Reference is neglectful parenting style.
[b] Consumed 5 or more drinks in a row at least once within last year: n = 2056.
[c] Smoked cigarettes at least once in last month: n = 2033.
[d] Been drunk or high on alcohol at least once in last year: n = 2061.
[e] Smoked or used marijuana at least once in last month: n = 2003.

In a comprehensive section on substance use, adolescents were asked a variety of detailed questions about prior and current substance use related to alcohol use, cigarette smoking, marijuana use, and binge drinking. We coded 4 separate dichotomous substance abuse outcomes from questions asked in Waves I and II to represent either having engaged in the behavior or not. Details on variable coding are in the eAppendix (http://www.archpediatrics.com).

To identify the networks, we treated each friendship nomination as a "directed tie" from the namer to the named friend. We called interviewed individuals "adolescents" and the people who they named "friends." Dyadic observations were created so that each observation included data from both an adolescent and a friend at Waves I and II for adolescent-friend pairs observed in the data. Dyads in which the adolescents and their friends were not friends in both Waves I and II were removed from the data set. Likewise, we removed all adolescent-friend pairs for which data were missing for either the adolescent, the peer, or the peer's parent.

Control variables included adolescent age, race (white, Hispanic, black, or Asian), and sex. We measured socioeconomic status with 2 separate variables: mother's self-reported education level and mother's self-reported household income. Because associations between peer's behaviors could be the result of neighborhood or other contextual factors relating to geographic proximity, we included school-level fixed effects in all models. This effectively eliminates any spurious correlations that may arise because of between-school variation in the incidence of the dependent variables.

While the total population for the Add Health data set was 20 746 for Wave I and 14 738 for Wave II, our final sample was much smaller because of our strict inclusion criteria and missing data on some measures. Also, our measure for socioeconomic status included mother's education, a variable that was only available among a subset of observations for whom a parent survey was conducted, which served to significantly lower the total sample size. The total number of egos was 1386 while the number of dyads used in the analyses ranged from 2003 to 2066.

HUMAN SUBJECTS

The research was approved by the institutional review board at the University of California, San Diego.

ANALYSES

We conducted separate regression analyses for each substance abuse outcome. A logit form of a generalized estimating equation was used to analyze each model testing the behavioral outcome of the adolescent at wave 2 as a function of friend's mother's parenting at wave 2, controlling for friend's mother's parenting at wave 1, adolescent's and friend's behavior at wave 1, adolescent's mother's parenting at both waves, sex, age, socioeconomic status, and school-level fixed effects (eAppendix). Both adolescent and friend parenting were coded as 4-category variables, with neglectful parenting used as the reference category against which the other 3 categories were compared (for detailed methods, see the eAppendix).

We used generalized estimating equation procedures to account for multiple observations of the same adolescent across ego-friend pairings and we assumed an independent working correlation structure for the clusters (see eTable 1 for results of alternate analysis clustering on alters). To explore possible causal pathways by which influence may occur, we also present the results of a mediation analysis in which we tested the hypothesis that the friend's mother's parenting influences the friend's behavior, which in turn has an effect on the adolescent's behavior. To do so, we followed the steps of testing for mediation laid out by Baron and Kenny,[24] using the results of a Sobel test (for details, see the eAppendix) to determine significance. For significant mediators, we calculated the proportion of the main effect that was mediated by dividing the indirect effect by the main effect.

The generalized estimating equation regression models in **Tables 1**, **2**, and **3** and the eAppendix provide parameter estimates in the form of β coefficients, whereas the results reported in the text and Figures are in the form of risk ratios. The key coefficient in these models that measures the effect of influence is on the variable for friend's mother's Wave II parenting style. Risk ratios were calculated from predicted probabilities of substance abuse as a function of parenting style (changing it from 0 to 1) with 95% confidence intervals estimated using 1.96 plus or minus the standard error and assuming all other variables are held at their means.

RESULTS

In **Figure 1**, we show social network graphs that include parenting styles and substance abuse behaviors. These graphs illustrate that behavior tends to cluster in the social network and that adolescents who do not engage in substance abuse are often connected to authoritative parents via their friends, even if their own parents are not authoritative (as evidenced by the large green squares in Figure 1).

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Table 3. Multivariate Association Between Friend's Mother's Parenting Style and Adolescent Risk Behavior[a]

	Binge Drinking in Last Year[b] (n = 2056)		Smoked in Last Month[c] (n = 2033)		Was Drunk in Last Year[d] (n = 2061)		Used Marijuana in Last Month[e] (n = 2003)	
	RR (95% CI)	*P* Value	RR (95% CI)	*P* Value	RR (95% CI)	*P* Value	RR (95% CI)	*P* Value
Friend's mother permissive Wave II	0.82 (0.6-1.11)	.20	0.87 (0.66-1.14)	.31	0.8 (0.58-1.09)	.16	0.87 (0.59-1.3)	.51
Friend's mother authoritarian Wave II	0.66 (0.46-0.94)	.02	0.84 (0.61-1.16)	.29	0.82 (0.56-1.19)	.30	1.12 (0.72-1.72)	.62
Friend's mother authoritative Wave II	0.62 (0.41-0.95)	.03	0.61 (0.42-0.88)	.01	0.6 (0.41-0.89)	.01	0.57 (0.33-0.99)	.05
Friend's mother permissive Wave I	1.25 (0.87-1.81)	.23	1.17 (0.84-1.61)	.34	1.27 (0.89-1.81)	.19	1.01 (0.63-1.63)	.96
Friend's mother authoritarian Wave I	0.92 (0.63-1.36)	.68	1.14 (0.81-1.56)	.45	0.93 (0.63-1.36)	.70	0.95 (0.59-1.51)	.82
Friend's mother authoritative Wave I	1.03 (0.69-1.54)	.88	1.43 (1.03-1.95)	.03	0.92 (0.62-1.36)	.69	1.05 (0.63-1.76)	.84
Own mother permissive Wave II	0.7 (0.44-1.13)	.15	0.49 (0.32-0.75)	<.001	0.72 (0.46-1.11)	.14	0.55 (0.3-1)	.05
Own mother authoritarian Wave II	0.72 (0.43-1.19)	.20	1.06 (0.68-1.62)	.80	0.56 (0.34-0.92)	.02	0.87 (0.45-1.67)	.67
Own mother authoritative Wave II	0.58 (0.31-1.08)	.09	0.58 (0.34-0.97)	.04	0.43 (0.23-0.8)	.01	0.86 (0.4-1.83)	.69
Own mother permissive Wave I	0.89 (0.53-1.48)	.65	0.87 (0.54-1.37)	.55	0.88 (0.55-1.42)	.61	1.49 (0.75-2.97)	.25
Own mother authoritarian Wave I	0.62 (0.37-1.02)	.06	0.94 (0.6-1.44)	.78	0.84 (0.52-1.37)	.49	1.93 (0.96-3.89)	.07
Own mother authoritative Wave I	0.6 (0.34-1.06)	.08	1.31 (0.81-2.06)	.26	0.58 (0.34-0.99)	.04	1.32 (0.63-2.76)	.46
Friend use Wave 1	1.7 (1.29-2.25)	<.001	1.53 (1.17-1.97)	<.001	1.81 (1.38-2.38)	<.001	2.92 (1.94-4.38)	<.001
Own use Wave 1	7.53 (5.17-10.88)	<.001	6.77 (5.33-8.27)	<.001	7.33 (5.17-10.26)	<.001	11.14 (6.5-19.08)	<.001
Deviance	287.04		307.82		285.26		181.49	
Null deviance	427.8		449.19		427.81		232.14	

Abbreviation: RR, risk ratio.
[a] Reference is neglectful parenting style. All models run controlling for respondent age, sex, race, mother's education, mother's income, plus school-level fixed effects.
[b] Consumed 5 or more drinks in a row at least once within last year.
[c] Smoked cigarettes at least once in last month.
[d] Been drunk or high on alcohol at least once in last year.
[e] Smoked or used marijuana at least once in last month.

Statistically, we first studied the relationship between an adolescent's behavior and the friend's behavior, controlling for the parenting style of the adolescent's parent and the adolescent's friend's parent, plus fixed effects and demographics (**Figure 2**). The behavior of an adolescent's friend was significantly associated with the behavior of the adolescent, such that having a friend who drinks to the point of drunkenness increased the probability of the adolescent doing the same by 32% (95% CI, 1%-72%), having a friend who is a smoker increased the probability of the adolescent smoking by 90% (95% CI, 48%-141%), having a friend who smokes marijuana increased the probability of an adolescent smoking marijuana by 146% (95% CI, 62%-271%), and having a friend who is a binge drinker increased the probability of the adolescent binge drinking by 47% (95% CI, 9%-96%). (These estimates are net of the baseline behavior of both parties.) eTables 2, 3, 4, and 5 show the results of all the analyses for all 4 outcomes, where the β coefficient on the row for friends Wave II substance abuse shows the relevant result.

We then looked at the direct effects of an adolescent's mother's parenting style on the adolescent's behavior, controlling for the adolescent's friend's mother's parenting style (**Figure 3**). If an adolescent had an authoritative parent, the probability of drinking to the point of drunkenness was reduced by 57% (95% CI, 20%-77%) and the probability of smoking was reduced by 43% (95% CI, 3%-66%). These results are presented in Table 3 for variable "own mother authoritarian Wave II" for all 4 outcomes.

Finally, we tested the hypothesized network effect of the mother of an adolescent's friend (**Figure 4**). If an adolescent had a friend whose mother was authoritative, that adolescent was 40% (95% CI, 12%-58%) less likely to drink to the point of drunkenness, 38% (95% CI, 5%-59%) less likely to binge drink, 39% (95% CI, 12%-58%) less likely to smoke cigarettes, and 43% (95% CI, 1%-67%) less likely to use marijuana than an adolescent whose friend's mother used neglectful parenting, controlling for the parenting style of the adolescent's own mother, school-level fixed effects, and demographics. Furthermore, if an adolescent had a friend whose mother was authoritarian, that adolescent was 46% (95% CI, 6%-54%) less likely to use marijuana than an adolescent who friend's mother was neglectful. These results are pre-

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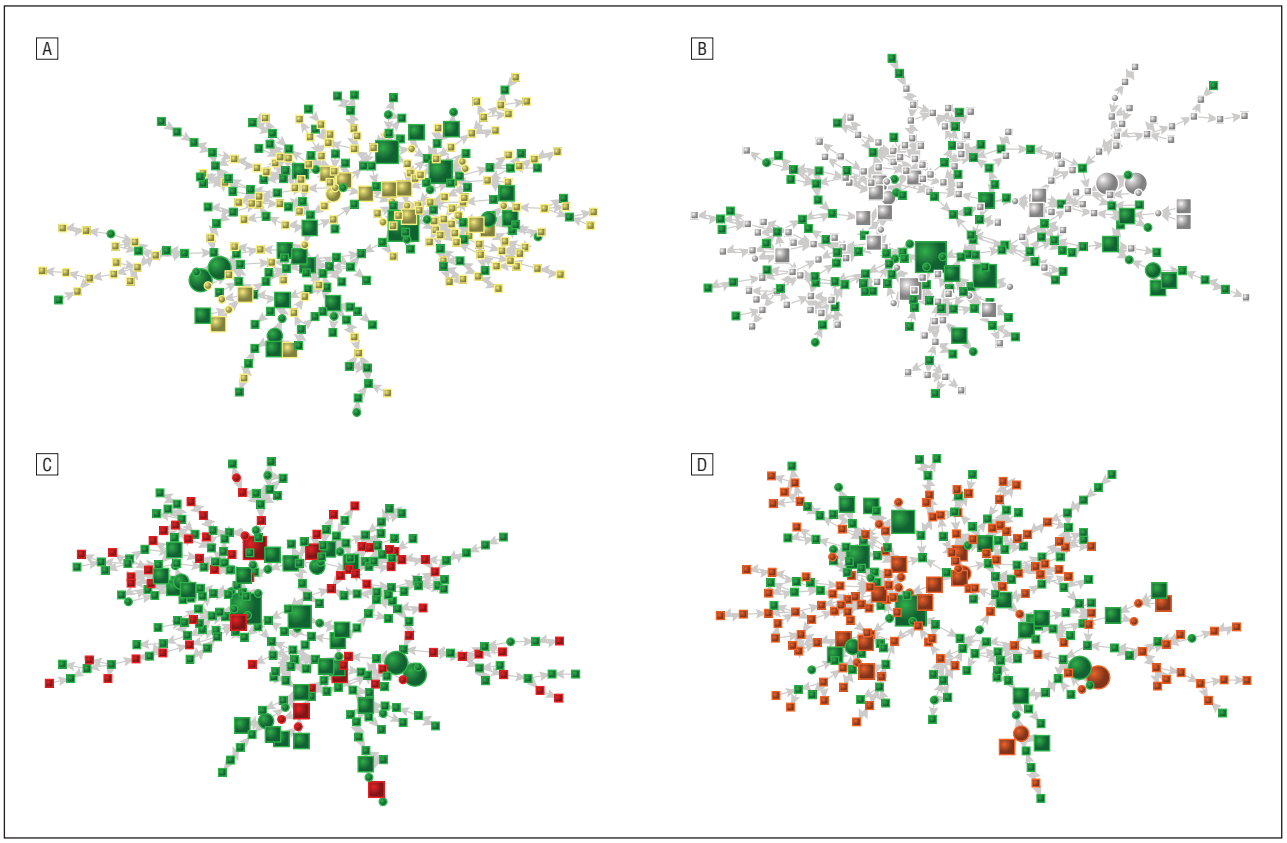

Figure 1. Illustrative network maps of a school in the National Longitudinal Study of Adolescent Health (N = 304). Each node represents an adolescent and each arrow between them, a friendship nomination. Node color indicates substance use behavior, yellow for drinking alcohol (A), gray for smoking tobacco (B), red for smoking marijuana (C), and orange for binge drinking (D). Green nodes indicate adolescents who do not engage in the substance abuse behavior shown in that panel. Circle nodes are adolescents with an authoritative parent, and square nodes are those with some other type (neglectful, authoritarian, or permissive). The size of each node is proportional to the number of friends' parents who are authoritative. This Figure shows that behavior tends to cluster in the social network, and adolescents who do not engage in substance abuse are often connected to authoritative parents via their friends, even if their own parents are not authoritative (indicated by large green squares).

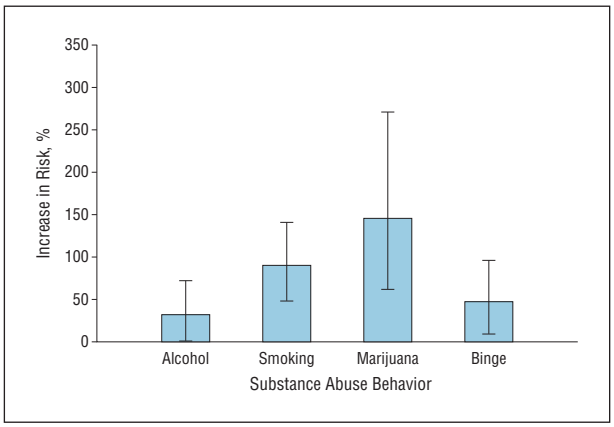

Figure 2. Percentage of increase in risk (includes 95% confidence interval) of abusing alcohol, smoking, using marijuana, and binge drinking for an adolescent whose peer engages in the same behavior. All probabilities are estimated controlling for respondent age, sex, race, mother's education, mother's income, Wave I substance abuse, parent's Wave I and Wave II parenting style, friend's Wave I substance abuse, friend's parent's Wave I and Wave II parenting style, plus school-level fixed effects.

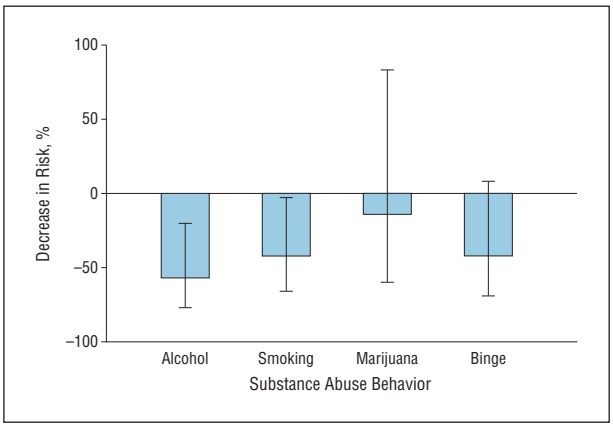

Figure 3. Percentage of decrease in risk (includes 95% confidence interval) of abusing alcohol, smoking, using marijuana, and binge drinking for adolescents whose parents are authoritative vs adolescents whose parents are neglectful. All probabilities are estimated controlling for respondent age, sex, race, mother's education, mother's income, Wave I substance abuse, parent's Wave I parenting style, friend's Wave I substance abuse, friend's parent's Wave I and Wave II parenting style, plus school-level fixed effects.

sented in eTables 2, 3, 4, and 5 and the variable of interest is friend mother authoritative Wave II. Surprisingly, the strength of association with the parenting style of an adolescent's friend's mother was of about the same magnitude as the association with the parenting style of the adolescent's own mother for alcohol abuse and smoking (the Wald test of differences between coefficients for own mother and friend's mother with significance at

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$P \leq .05$ was insignificant in both cases), while the association was stronger for the friend's mother than own mother for marijuana smoking and binge drinking.

We conducted a mediation analysis (eTables 2, 3, 4, and 5) to explore whether parents may have a direct effect on their children's friends, or if this effect is indirect, resulting from the direct effect on their own children, which then spreads through the adolescent social network. The results suggest that 7.7% of the association between the friend's mother's authoritative parenting and an adolescent's alcohol abuse behavior may be explained by the influence that the friend's mother may have on the friend's behavior, which in turn may influence the adolescent's behavior. This proportion was 8.9% for marijuana use and 7.0% for binge drinking. The results of the mediation analysis were insignificant for smoking behavior. In all cases, the association of the friend's mother's parenting style with the friend's behavior was significant, as was the association between the friend's behavior and the adolescent's behavior. Furthermore, as can be seen in the last 3 columns of Tables 1, 2, and 3, adding friend's behavior to the model significantly reduced the association between the friend's mother's parenting and the adolescent's behavior. Sobel tests were significant in all cases, with the exception of alcohol abuse (which at 1.80 was only slightly below the 1.96 level required for significance). Hence, in all cases, the majority of the effect of the peer's parents was direct.

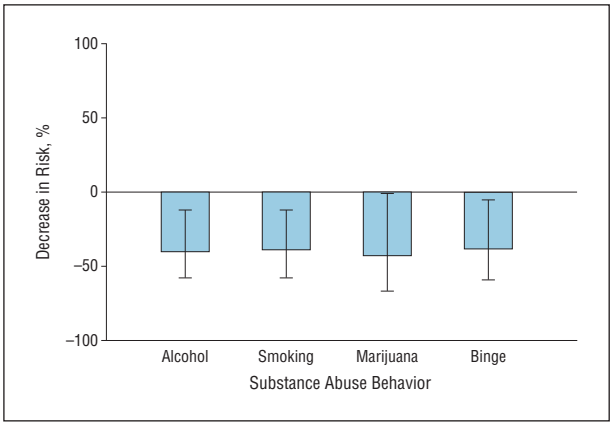

Figure 4. Percentage of decrease in risk (includes 95% confidence interval) of abusing alcohol, smoking, using marijuana, and binge drinking for adolescents whose peers' parents are authoritative vs adolescents whose peers' parents are neglectful. All probabilities are estimated controlling for respondent age, sex, race, mother's education, mother's income, Wave I substance abuse, parent's Wave I and Wave II parenting style, friend's Wave I substance abuse, friend's parent's Wave I parenting style, plus school-level fixed effects.

COMMENT

Most research on social networks focuses on social influence in direct relationships. In other words, when considering adolescent behavior, we tend to focus on their peers and parents, assuming that influence spreads only from peer to peer or from family member to family member. We have discounted less obvious social influences or pathways that bridge more heterogeneous dimensions of an adolescent's social network.

This study used longitudinal complete network data to show a positive correlation between the parenting practices of an adolescent's friends' parents and the substance abuse outcomes of that adolescent. Our analyses demonstrate that if an adolescent has friends whose parents use "authoritative parenting" that adolescent is less likely to abuse alcohol, smoke, use marijuana, and binge drink. Our results are consistent with previous research that shows the influence of both peers and parents on adolescent substance abuse outcomes, although in this study we find that the indirect influence of a peer's parents may be just as important, if not more so. Furthermore, our results show that while the pathway between a friend's parent and an adolescent is partially mediated through the behavior of the peer, this accounts for only a small proportion of the observed relationship.

A large body of literature has supported the idea that peers influence adolescent substance abuse mainly through the modeling of behavior, social norms around substance use, and overt offers to participate in the behavior.[25,26] However, results of studies by de Vries and colleagues[27] and Biederman and colleagues[28] challenge the peer influence paradigm, suggesting that similarity in substance abuse behavior among adolescents is likely a function of friendship selection and that parental substance abusing behavior is both a stronger predictor of adoption of substance use than peer influence as well as a significant predictor of choosing substance abusing peers. Both peer influence and peer selection based on shared attributes surely occur.[29-33] Herein, we demonstrate that a peer's engagement in substance abuse is strongly correlated with an increased probability of the adolescent initiating that same behavior. By controlling for endogenous factors, that is, the baseline behavior of both the adolescent and his or her peers, we reduce the likelihood that choosing substance-abusing peers is the driving force behind the peer effect we observe in the model.

The influence of a parent, on the other hand, has been studied from the dimension of behavioral modeling[28,34] (adolescents with substance-abusing parents are more likely to abuse themselves) as well as from the perspective of parenting practices. These are 2 distinct (though possibly interacting) pathways of influence because the parenting practices of an adolescent's family appear to promote positive outcomes through the shaping of psychological resilience and emotional well-being rather than simply as the result of modeling specific behaviors.[35] These practices empower the adolescent to make beneficial choices and engage in positive behavior along a wide variety of dimensions.

The results of our mediation analysis suggest that, to some degree, the influence of the positive parenting of a friend's mother on an adolescent may be mediated through the behavior of the friend. That is, positive parenting discourages substance abuse in adolescents, which then leads to reduced substance abuse in their friends. However, this is only part of the story. The mediation model did not account for the majority of the observed effect. This suggests that positive parenting may benefit an adolescent's friendship network either through a buffering effect via the adolescent's positive psychological outcomes and behaviors and/or a direct contact effect with the friend's par-

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ent. That is, adolescents may have frequent contact with their friends' parents and may therefore benefit directly from observing the positive parenting interactions that are taking place within those families. A second possibility is that having peers who are psychologically bolstered by good parenting benefits an adolescent through the interactions between them, independent of whether those peers are modeling substance abuse behaviors. A third possibility is that adults who use positive parenting behaviors with their own adolescent children are also able to act as effective mentors for their children's friends. Research on mentoring has identified ways in which unrelated adults can positively influence adolescents along many dimensions,[36,37] partially because as these unrelated adults are external to the normal adolescent-parent conflict,[14] adolescents may feel freer to express needs and concerns they may not be able to express with their own parents.[37] Mentoring is most successful when the relationship is long-term and imbued with positive affect and the mentor is able to offer some sort of instrumental support.[38] Positive relationships with friends' parents may have multiple advantages consistent with this view of successful mentorship.

This study has limitations. The results may not be generalizable to all adolescents in the United States, as the final network cannot be weighted to be nationally representative. Moreover, self-report substance abuse measures may be subject to bias due to social desirability or inexact recall. However, unlike measures used in many social influence studies, the peer substance abuse measures in this study are not reported as conjecture by the adolescent but directly reported by the friend regarding his or her own behavior.

Any association between adolescents' drug use and their friends' parents' parenting style is based on observational data, and as such, it is possible that either (1) adolescents are influenced by the neglectfulness of their friends' parents and this neglectfulness promotes drug use or (2) parents are influenced by their children's friends' drug use, which causes them to become more neglectful. Darling and colleagues[37] note that adolescents seek out nonparental adult role models, suggesting that parents affect adolescents and not the other way around, but we stress that the association we report herein may be in part due to reciprocal influence.

There is a body of evidence to suggest that offering education on parenting can bolster parenting competence, which in turn results in a wide variety of improved outcomes for adolescents.[39-41] The results of our research suggest that investments in such interventions may pay off not only through the direct connection between parent and child but through the less obvious direction of parent to child to child's friends, as well as directly from parent to child's friend. As a consequence, we may be undervaluing the total benefit that parenting education has on adolescent populations.[42]

Accepted for Publication: May 8, 2012.
Published Online: October 8, 2012. doi:10.1001/archpediatrics.2012.1372
Correspondence: Holly B. Shakya, PhD, 9500 Gilman Dr #0521, La Jolla CA 92093-0521 (hshakya@ucsd.edu).
Author Contributions: *Study concept and design:* Shakya, Christakis, and Fowler. *Acquisition of data:* Christakis and Fowler. *Analysis and interpretation of data:* Shakya, Christakis, and Fowler. *Drafting of the manuscript:* Shakya and Christakis. *Critical revision of the manuscript for important intellectual content:* Shakya, Christakis, and Fowler. *Statistical analysis:* Shakya and Fowler. *Obtained funding:* Christakis. *Administrative, technical, and material support:* Christakis and Fowler. *Study supervision:* Christakis and Fowler.
Financial Disclosure: None reported.
Funding/Support: This research uses data from Add Health, a program project directed by Kathleen Mullan Harris at the University of North Carolina at Chapel Hill and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. No direct support was received from grant P01-HD31921 for this analysis. Research for this article was supported by National Institutes of Health grants R01 AG024448 and P01 AG031093 and by Robert Wood Johnson Foundation Award 58729.
Disclaimer: Our funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
Online-Only Material: The eTables and eAppendix are available at http://www.archpediatrics.com.

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