The “Dark Side” of the Strength of Weak Ties: The Diffusion of Suicidal Thoughts*

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Granovetter’s theory on the strength of weak ties motivates hypotheses on the diffusive nature of suicidal thoughts in the friendship networks of adolescents. Using data from the National Longitudinal Study of Adolescent Health, the effects of friends-of-friends attempting suicide on the suicidal thoughts of respondents are estimated. A focus on friends-of-friends permits a test of the weaknesses thesis because respondents are indirectly linked to friends-of-friends by “open ties” that are both structurally weak and used as bridges. Results for “at-risk” respondents—or those with certain behaviors, statuses, and experiences that create psychological predispositions to suicide—are consistent with Granovetter’s theory and thus reveal the “dark side” of the strength of weak ties as at-risk respondents are more likely to seriously think about committing suicide when a friend-of-a-friend attempts suicide, controlling for past suicidal thoughts by the respondent and attempts by friends, family, and students in the respondent’s school, among other control factors. Barriers to diffusion are also considered.

In an effort to refine the sociological perspective on suicide, contemporary researchers argue that suicide is subject to diffusion processes (Baller and Richardson 2002; Bollen and Phillips 1982; Gould and Shaffer 1986; Phillips 1974; Phillips and Carstensen 1986; Stack 1987, 1994). The diffusion of suicide involves two steps. First, successful or unsuccessful suicide attempts may generate serious suicidal thoughts in others. Second, among those who seriously think about committing suicide, some make successful or unsuccessful attempts. Both steps are more likely to occur for at-risk individuals, or persons psychologically predisposed to suicide (Joiner 2005). In an effort to extend the literature on the diffusive nature of suicide, we assess the role played by weak ties in the first step of this diffusion process. We also determine if the presence of

* Research support was provided by the Center for Criminology and Socio-Legal Studies at the University of Iowa. We thank Ben Earnhart and Jim Moody for their technical assistance, and Jennifer Glanville, Richard Harris, Tony Paik, Lisa Troyer, and Matthew Zevenbergen for their helpful comments. This research uses data from Add Health, a program project designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris, and funded by a grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 17 other agencies. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Persons interested in obtaining data files from Add Health should contact Add Health, Carolina Population Center, 123 W. Franklin Street, Chapel Hill, NC 27516-2524 (addhealth@unc.edu). No direct support was received from grant P01-HD31921 for this analysis. Address correspondence to Rob Baller, Department of Sociology, University of Iowa, Iowa City, IA 52242-1401 (e-mail: robert-baller@uiowa.edu).
certain risk factors strengthens the process and whether barriers to diffusion exist.

In his theory on weak ties, Granovetter (1973) contributes to the Durkheimian tradition by considering how social ties produce integration in large collectivities. Weak ties access information that is distal in social space, and this information creates opportunities for participation, which is an important component of social integration. Research has shown that weak ties are useful for spreading information about job openings, and such ties may also contribute to the diffusion of suicidal thoughts, but that possibility has not been tested (Granovetter 1983, 1995; Yakubovich 2005).

Using a structural approach to the study of social networks, we define weak ties as open ties. An open tie links a respondent to a friend who has one or more friends who are not friends with the respondent. In other words, open ties are ties located next to openings in the network that exist between respondents and friends-of-friends. This is a reasonable conceptualization of tie weakness for two reasons. First, compared to closed ties that link individuals who share the same set of friends, open ties provide less social insulation to respondents. Second, these ties are capable of transmitting information that is not immediately available to respondents, namely, information about friends-of-friends. We test the strength of weak ties by estimating the effects of the number of friends-of-friends attempting suicide on the suicidal thoughts of respondents. The strength of weak ties can be established in this manner because, by definition, friends-of-friends are indirectly linked to respondents by open ties. We rely on differential association and social learning theories, and insights from psychology to describe the diffusion process, and we speculate that information about the suicide attempts of friends-of-friends reaches and influences respondents through gossip spread by friends (Akers 1994; Sutherland, Cressey, and Luckenbill 1992; Tarde 1903).

Relying on the social networks perspective allows us to illustrate three complexities that likely characterize the relationship between integration and suicidal tendencies (Pescosolido 1994). First, the mere presence of weak ties is disintegrating because such ties are less insulating and less supportive than strong ties, increasing suicidal tendencies (Bearman 1991; Pescosolido 1994; Stack 1994). We control for the presence of these ties using the intransitivity index (Bearman and Moody 2004). Scores on this index increase as respondents have more open ties or more friends-of-friends. Second, because of their superior range, weak ties are capable of diffusing outside information that increases integration. This countervailing increase to integration, which would often decrease suicidal tendencies, is a central insight of Granovetter’s (1973) work. Finally, when information transmitted across weak ties contains suicidal content, imitative suicidal tendencies may result, revealing the “dark side” of the strength of weak ties and the integration they create.

We test hypotheses using friendship network data from the National Longitudinal Study of Adolescent Health (widely referred to as “Add Health”). We estimate the impact of the number of friends-of-friends attempting suicide before wave one on the wave-two suicidal thoughts of respondents, controlling for the wave-one suicidal thoughts of respondents and wave-one attempts by friends, students in the respondent’s school, and family members. The result is an estimate of the amount of diffusion that occurs across the open or structurally weak ties that indirectly link friends-of-friends to respondents. Given that diffusion across weak ties should only occur for persons cognitively and behaviorally at risk for suicide, we examine the conditioning effects of a “risk” index that indicates behaviors, experiences, and statuses that create the acquired ability to self-harm and perceived burdensomeness, both of which may increase susceptibility to the type of diffusion studied here (Joiner 2005). Finally, we attempt to identify barriers to diffusion across weak ties for at-risk adolescents.

THE STRENGTH OF WEAK TIES

Granovetter (1973) argues that “those to whom we are weakly tied are more likely to move in circles different from our own and will thus have access to information different from that which we receive” (p. 1371). In structural terms, then, weak ties are more likely to be bridges than strong ties. Bridges link individuals to contacts who have access to outside information. This feature of weak ties, namely, their superior range, makes them integrative. While prior tests of Granovetter’s theory measured tie strength based on relational quality, as indicated by reciprocity (Friedkin 1980, 1982), intimacy (Bian 1997; Yakubovich 2005), or
time together (Bellair 1997; Feld 1997), we rely on tie openness—a characteristic of network structure—to both conceptualize and estimate the role of weak ties in the diffusion of suicidal thoughts. Such an approach is reasonable because open ties are structurally weak and used as bridges.

Open ties are structurally weak because they provide less social insulation and support to individuals, resulting in diminished integration and regulation. With respect to integration, friends and respondents linked by open ties spend less time together because friends may have to split their time between respondents and friends-of-friends who either do not know each other well or do not get along. Consider Figure 1 from the point of view of A, where B and C are friends and D is a friend-of-a-friend. The AB tie is open because A and B have a nonmutual friend, D, while the AC tie is closed because all of C's friends are also friends with A. In general, person B will divide her time between A and D, resulting in less time and integration for A (Durkheim [1897] 1951; Pescosolido 1994; Pescosolido and Georgianna 1989). Due to the closed AC tie, when B is with C she can simultaneously spend time with A, causing no drop in integration for A. Regarding regulation, Bearman’s (1991) work can be used to argue that open ties generate normative conflicts, as the individuals involved spend at least some time in separate social circles that may endorse different norms. Using Figure 1, A will be less regulated by B because B spends at least some time in an outside group, namely the friendship group that contains D, and this group may endorse norms different from those endorsed by A's friendship group, resulting in less normative consensus in the network capable of preventing suicidal tendencies in A (Pescosolido and Georgianna 1989). In spite of their structural weaknesses, open ties are often used as bridges to spread outside information, and that information is integrative.

Bearman’s (1992, 2004) work on structural holes is useful for understanding why open ties operate as bridges. Individuals who sustain relationships across structural holes receive more information than those who do not. For the purpose of our analysis, friends located between respondents and friends-of-friends sustain such relationships. Returning to Figure 1, the absence of a tie between A and D can be considered a structural hole, and B sustains relationships that span the hole. Given B's location next to a structural hole, B should have more information than A or D, all else being equal. Burt (2004) states his position succinctly: “people who stand near the holes in a social structure are at a higher risk of having good ideas” (p. 349). The central argument of our paper is that such persons also have greater access to “bad ideas.” The fact that B is located next to a structural hole gives B the opportunity to bridge the friendship groups of A and D. If D attempts suicide, B may act as a vector of transmission and diffuse information about D’s attempt to A, increasing the chances of serious suicidal thoughts by A.

As a final justification for conceptualizing weak ties as open ties, consider that in his book Getting a Job, Granovetter (1995) explains that tie weakness, in the relational sense, is merely a proxy for tie openness in his theory:

Ideally one would want to make this distinction [between a weak tie and a strong tie] according to whether one's friend had a substantial number of ties to individuals one did not know, or was mostly tied to the same people as one's self. The strength of tie is merely an indicator of this, but may be useful since it is generally impractical to collect the necessary detailed social network data. (P. 61)

Data contained in Add Health allow us to identify friends-of-friends who are indirectly linked to respondents by open ties. Should the suicide attempts of friends-of-friends affect the suicidal thoughts of respondents, the structurally weak ties that indirectly link them can be implicated in the diffusion process. The availability of data like those provided by Add Health compels researchers to test Granovetter’s ideas using a structural approach.

**DIFFERENTIAL ASSOCIATION AND SOCIAL LEARNING THEORIES**

The theories of differential association and social learning can be relied upon to anticipate the diffusion of suicidal thoughts across the friendship networks of adolescents. In his differential association theory, Sutherland argues that associations with others and exposure to their attitudes can affect the adoption of those
attitudes or definitions (Sutherland et al. 1992). Two kinds of information are relevant to diffusion according to Sutherland: evaluative and technical. Evaluative information affects the acceptability of behavior and attitudes, while technical information pertains to the ability to implement behavior and rationalize thoughts and attitudes. Sutherland also argued that associations and communications high on intensity, priority, duration, and frequency are most likely to produce diffusion.

Akers’s (1994) social learning theory is a valuable extension of Sutherland’s theory because it incorporates the concepts of imitation and vicarious reinforcement to more fully account for diffusion and social influence. Imitation involves the copying of another’s behavior or ideas, and imitation is more likely to occur in the presence of vicarious reinforcement that result when an individual sees a model rewarded for the model’s behavior or ideas. Research on juvenile delinquency provides strong support for these theories (Haynie 2001, 2002; Matsueda 1982; Matsueda and Anderson 1998; Warr and Stafford 1991), and we suggest that they are well suited to explaining the diffusion of suicidal thoughts.

Exposure to news of suicide attempts by friends or friends-of-friends may increase the acceptability of suicide and spread rationalizations and techniques that are likely to accompany serious suicidal thoughts. Exposure to such news also creates opportunities for imitation, and if an adolescent perceives the news of a suicide attempt by a friend or a friend-of-a-friend as attention for the person attempting suicide—a type of vicarious reinforcement—serious suicidal thoughts become more likely. These processes may explain, in general, why suicide attempts by friends and friends-of-friends produce suicidal thoughts in respondents; however, the processes are likely to be different in some respects when news of a suicide attempt refers to a friend versus a friend-of-a-friend.

Using Sutherland’s concepts, information about friends-of-friends should be perceived as less intense and received with less frequency compared to information about friends. Furthermore, the increased social distance that separates respondents and friends-of-friends diminishes opportunities for imitation and vicarious reinforcement. These points suggest that the diffusive effects of friends-of-friends attempting suicide will be smaller than those produced by friends.

While friends-of-friends can be expected to be less influential than friends, the logic of Granovetter’s theory suggests that the former will be influential, controlling for the impact of the latter, because friends-of-friends outnumber friends for most adolescents; therefore, the potential reservoir of suicide attempts available to ignite diffusion should be larger among friends-of-friends than friends. The ability to access this larger reservoir makes weak ties strong, integrative, and, in this context, potentially damaging.

GOSSIP AS A MECHANISM

An interesting feature of our focus on friends-of-friends is that it allows us to speculate on how gossip diffuses suicidal thoughts (Granovetter 1983). Using the hypothetical friendship network depicted in Figure 1, we suggest that B is likely to gossip with A about D for at least two reasons. First, A does not know D very well, if at all, making information about D novel and potentially interesting to A. Second, the odds that A will tell D that D was the subject of gossip spread by B is remote because A and D are not friends and are therefore less likely to communicate (Boissevain 1974; Burt and Knez 1995). Avoiding detection by the subjects of gossip is important to producers of gossip because gossip is a violation of trust between subjects and producers (Bergmann 1993). Of course, gossip about D may reach A via the closed AC tie, but it must first be passed along the other open ties that link A to D, namely, BD and then BC. These points suggest that efforts to spread novel gossip and avoid detection by the subjects of gossip should cause gossip to be shared across open ties, and empirical work finds that gossip is, indeed, spread across such ties (Burt and Knez 1995; Weimann 1983).4 If we find that suicide attempts by friends-of-friends are positively related to suicidal thoughts in respondents, and if our theorizing on the role of gossip is correct, such a result would suggest that both the subjects and receivers of gossip are potentially harmed by gossip.

DIFFUSION ACROSS WEAK TIES TO AT-RISK ADOLESCENTS

Anyone can casually think about committing suicide, but the serious consideration of it, which is the focus of our study, should be more
likely to happen to persons who are cognitive-
ly and behaviorally at risk for suicide. Joiner
(2005) explains that the ability to self-harm,
acquired in accord with principles of behav-
ioral psychology, is a necessary condition for
suicide, as it entails greater pain tolerance and
diminished fear of physical danger. Behaviors
such as heavy drinking and participation in
fights, and experiences such as rape victimiza-
tion, likely contribute to the ability to self-
harm. Joiner also argues that perceived bur-
densomeness—which results when individuals
think of themselves as liabilities to significant
others—and the psychological distress this
thinking creates are cognitive risk factors for
suicide. Perceived burdensomeness can result
from stigmatizing statuses, such as same-sex
attraction and obesity, that may be thought to
“rub off” on significant others (Corrigan,
Watson, and Miller 2006; Phelan 2005). The
presence of these risk factors, when combined
with news of a friend-of-a-friend attempting
suicide, may be sufficient to generate serious
suicidal thoughts in respondents. Conversely,
individuals who lack these risk factors should
be immune to diffusion. We test the extent to
which these risk factors facilitate diffusion
across weak ties.

BARRIERS TO DIFFUSION ACROSS
WEAK TIES

Traditional dimensions of integration may
prevent diffusion across weak ties to at-risk
adolescents. The following eight factors may
act as barriers because they produce normative
restraint, ties to others, resources, and self-es-
tee, while reducing strain, negative emotions,
and perceived burdensomeness: (1) employment
in the summer; (2) employment in the
school year; (3) participation in active sports;
(4) hanging out with friends; (5) church atten-
dance; (6) Catholic-denominational affiliation;
(7) length of current residence; (8) and the
presence of married parents (Agnew 1992;
Hirschi 1969; Joiner 2005; Leff and Warner
2006; Merton 1938). We consider the possibil-
ity that these factors prevent the type of diffu-
sion studied here.

HYPOTHESES

We test the following hypotheses:

\( H_1 \): The wave-one number of friends-of-
friends attempting suicide will be positive-
ly related to the presence of wave-two suici-
dal thoughts among at-risk respondents.

\( H_2 \): Traditional dimensions of integration mea-
sured at wave one and the wave-one num-
ber of friends-of-friends attempting suicide
will negatively interact as they affect the
presence of wave-two suicidal thoughts
among at-risk respondents.

DATA

Sample

Add Health data are well suited to the study
of diffusion because they reflect fairly com-
plete friendship networks within schools.
Junior high and high school students were
asked to name their five closest male friends
and five closest female friends in the in-school
survey. These nominations allow the surveys of
friends in the same school to be linked togeth-
er for the purpose of network analysis. Of the
13,570 students in grades seven through twelve
who completed the Add Health in-home survey
and had a wave-two sample weight, we study
those in the saturated sample for whom the in-
school and in-home surveys could be linked (N
= 2,654). The saturated sample, which refers to
schools where an attempt was made to in-home
survey every student in the school, is examined
because a greater proportion of friends-of-
friends in this sample completed a wave-one
in-home survey than in the larger sample, al-
lowing us to more accurately measure the sui-
cide attempts of friends-of-friends using their
reports (Marsden and Friedkin 1993). There
are fifteen schools in the study data. The in-
school surveys, from which friendship nomi-
nations have been drawn, were completed be-
 tween September 1994 and April 1995. The
wave-one and wave-two in-home surveys, used
to measure all other study variables, were com-
pleted between April and December of 1995
and between April and August of 1996, respec-
tively (Harris 2008).

Dependent Variable

The dependent variable, suicidal thoughts,
was measured during the wave-two in-home
survey and is based on the following: “During
the past 12 months, did you ever seriously
think about committing suicide?” Affirmative
responses are scored 1, and negative responses
are scored 0.
Friends and Friends-of-Friends Attempting Suicide

To more fully isolate the diffusive effects of friends-of-friends attempting suicide it is important to control for friends attempting suicide. We analyze a sent-or-received friendship network, meaning that the respondent is linked to a student if the respondent nominated the student as a friend or if the student nominated the respondent as a friend. Proceeding in this fashion is desirable because reliance on sent-only nominations would undoubtedly cause us to count some friends as friends-of-friends, which may lead to the overestimation of the effects of friends-of-friends. Our study network refers to students who provided nonmissing data on the wave-one measure of suicide attempts, and had at least one friend (N = 3,208). Respondents with no friends are included in our sample, but they are excluded from the network used to measure the suicide attempts of friends and friends-of-friends. The average numbers of friends and friends-of-friends in this network are 5.76 and 24.65, respectively. The adjacency matrix upon which this network is based was constructed in Stata 8.0 (StataCorp 2003) and imported into SpaceStat 1.80 (Anselin 1995) to compute the numbers of friends and friends-of-friends attempting suicide. We sometimes study subsets of at-risk respondents, but their scores on the network measures refer to all of their friends and friends-of-friends, even those not at risk for suicide.

It can be reasonably argued that reports of respondents should be used to measure the suicide attempts of friends and friends-of-friends because behaviors of others may only affect respondents if respondents are aware of them. In addition, the reports of respondents may be more valid than the reports of others if social desirability causes others to lie about their own suicide attempts. These points justify past research that relied exclusively on the reports of respondents to measure the suicidal tendencies of friends (Bearman and Moody 2004; Hagan and Foster 2001; Liu 2006; Thorlindsson and Bjarnason 1998). We depart from past practice and measure the suicide attempts of friends and friends-of-friends using their reports. Proceeding in this manner is desirable for at least three reasons. First, in their analysis of delinquency, Matsueda and Anderson (1998) find that when reports of respondents are used to measure friends’ delinquency, measurement errors for respondent delinquency and friends’ delinquency are positively correlated, suggesting that when respondents over- or underreport their own behavior they do the same for their friends (also see Regnerus 2002). Our use of the reports of friends and friends-of-friends alleviates this source of systematic measurement error. Second, computer-assisted self-interviewing used in Add Health’s in-home survey allowed friends and friends-of-friends to report their sensitive information into laptop computers so that interviewers could not see their responses. The use of this technology should reduce social desirability effects that might have caused friends and friends-of-friends to lie about their suicide attempts. Third, using Add Health it is impossible to measure the suicide attempts of friends-of-friends using the reports of respondents because respondents were not asked about friends-of-friends. Furthermore, even the reports of friends, from the point of view of a respondent, could not be used for this purpose because the reports of friends do not distinguish between the suicide attempts of respondents and those of friends-of-friends. For these reasons, we measure the numbers of friends and friends-of-friends attempting suicide in the 12 months before wave one using their reports. The question on attempts is, “[d]uring the past 12 months, how many times did you actually attempt suicide?” Responses were dichotomized so that 0 = “no attempts” and 1 = “one or more attempts.” As can be seen in Appendix A, the average number of friends who attempted suicide is .206, with a minimum of 0 and a maximum of 4, meaning that some respondents had as many as four friends who attempted suicide. The mean and maximum for the friends-of-friends measure are .863 and 8, respectively. The larger mean and maximum for friends-of-friends are well anticipated by Granovetter’s theory. Weak ties are influential because they expose individuals to more information.

Intransitivity Index

To further isolate the effects of diffusion across open ties, we control for the intransitivity index that measures the mere presence of such ties (for details see Bearman and Moody 2004). Respondents with more open ties, producing more friends-of-friends, score higher on this index. The same sent-or-received friendship network (N = 3,208) used to measure friends and friends-of-friends attempting
suicide was used to measure the intransitivity index.

**Risk Index**

The risk index includes factors that may create cognitive and behavioral predispositions to suicide, and we suggest that these factors facilitate diffusion. The index is the sum of the following five standardized variables that have been linked to suicide ideation in past research: heavy drinking, fighting, rape victimization, same-sex attraction, and obesity (Bearman and Moody 2004; Ferrada-Noli, Asberg, and Ormstad 1998; Grant and Hasin 1999; Kandel, Raveis, and Davies 1991; Noell and Ochs 2001). When this index is used in the analysis, in concert with a multiplicative term involving the index, the separate items used to create it are dropped from the model. When the index is not included in a model, the five separate items are included. Heavy drinking is measured by the question, “over the past 12 months, on how many days have you gotten drunk or ‘very, very high’ on alcohol?” The measure is reverse-scored as follows: 0 = “never” to 6 = “every day or almost every day.” Participation in fights—scored 0 = “never” to 2 = “more than once”—is based on how often the respondent “got into a physical fight” in the prior 12 months. Female respondents were asked about rape victimization, scored 1 = yes and 0 = no, using the question, “were you ever physically forced to have sexual intercourse against your will?” For male respondents, we substitute the value of 0 on this variable and control for sex of the respondent (see Allison 2002, note 4). Homosexual attraction is scored 1 = yes and 0 = no, and is derived from the respondent’s sex and answers to the following question: “have you ever had a romantic attraction to a female/male?” We use the body mass index as a measure of obesity; this measure is computed by dividing the respondent’s weight in kilograms by the respondent’s height in meters-squared.

**Barriers to Diffusion**

We determine if more traditional measures of integration prevent diffusion to adolescents who score higher on the risk index (Baller and Richardson 2002; Breault 1986). The frequencies of participation in active sports and hanging out with friends in the prior week are considered using separate measures, and both are scored 0 = “not at all” to 3 = “five or more times.” Frequency of church attendance in the prior 12 months is reverse-scored as follows: 0 = “never” to 2 = “once a week or more.” Catholic-denominational affiliation is scored 1 for Catholics and 0 for all other respondents. The analysis includes years lived in one’s current residence. Finally, we include two measures of hours worked for pay in a typical week during the summer and nonsummer months. We describe the presence of married parents, another possible barrier, below.

**Other Controls**

We include a number of controls that appear in the literature on suicidal thoughts (Bearman and Moody 2004). The presence of suicide attempts by a family member in the 12 months before wave one, scored 1 = yes and 0 = no, is based on the question, “[h]ave any of your family members tried to kill themselves during the past 12 months?” The number of students attempting suicide in the respondent’s school before wave one is included. This number is based on the sample sized 2,654, minus respondents with missing data on the measure of wave-one attempts (N = 2,625). We control for this variable in order to partially account for unmeasured features of schools.7 Gun availability—scored 1 = yes and 0 = no—is based on the question, “is a gun easily available to you in your home?” We include the presence of serious suicidal thoughts by the respondent before wave one; this measure is based on the same question used to measure the dependent variable at wave two.

The analysis controls for a number of demographic variables and indicators of emotion. Demographic controls include sex (0 = male, 1 = female), race (0 = other races, 1 = whites), ethnicity (0 = other ethnicities, 1 = Hispanics or Latinos), and age (years). The frequencies of depression, self esteem, and feeling like a failure in the prior week are based on the following: (1) “You felt depressed”; (2) “you felt that you were just as good as other people”; and (3) “you thought your life had been a failure.” These measures are scored 0 = “never or rarely” to 3 = “most or all of the time.”

The analysis controls for two characteristics of parents. Parent questionnaires were administered while respondents completed the computer-assisted self-interview during the wave-one in-home interview. One parent completed the questionnaire for each respondent, and mothers were more likely to participate than
METHODS

Appendix models

Estimation

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A.8

METHODS

Longitudinal Research Design

Controlling for the dependent variable

lagged in time partially remedies selection and

endogeneity effects that may create a spurious

association between friends-of-friends

attempting suicide and the suicidal thoughts of

respondents (Land and Deane 1992; Mouw

2003). Concerns over selection are also

partially remedied by our focus on friends-of-

friends, which reduces the “birds of a feather”

problem because respondents and friends-of-

friends have not “flocked together.” The time

lag of the dependent variable also adjusts the

analysis for unmeasured stable causes of sui-

cidal thoughts, such as biochemical predispo-

sitions.

While these benefits of controlling for the

time lag of the dependent variable are certain-

ly important for estimating diffusion, doing so

causes other effects to be underestimated. This

is especially true for variables that do not

change, or change very little, over time. For in-

stance, any effects of race will be underesti-

mated due to the inclusion of the time lag of the

dependent variable. Because of this, only ef-

fects relevant to hypothesized processes are

presented below.

Estimation

When analyzing data from Add Health, a

number of design effects should be controlled

(Chantala and Tabor 1999). The “svylogit” rou-
tine in Stata 8.0 has been used to estimate the

models presented below (StataCorp 2003).

First, to enhance the representativeness of our

analysis, we employ sample weights from wave

two using the “pweight” option and the weight

“gswgt2.” Second, the variable “region” is con-
trolled as a stratification variable using the

“strata” option. Third, respondents are nested

in schools, and we deal with this by controlling

for a school identifier using the “psu” option.

Finally, subsets of respondents are examined,

so cases have been selected using dummy vari-

ables and the “subpop” option, where the pop-

ulation equals 13,570.

Missing Data

Listwise deletion is used to deal with miss-
ing data. Listwise deletion is reasonable in this

case because missingness on our independent

variables is not related to the wave-two suicidal

thoughts of respondents (Allison 2002). To test

this, we created a dummy variable scored 1 for

the 570 respondents with some missing data

and 0 for the other 2,084 respondents. The

sample size for this analysis is 2,628 instead of

2,654 because 26 respondents had missing da-

ta on the wave-two measure of suicidal

thoughts. The dummy variable is not related to

the wave-two suicidal thoughts of respondents,

controlling for the design effects of Add

Health. The listwise-deleted sample size is

2,084.

Some respondents have neither friends nor

friends-of-friends in our sample (N = 171 of

2,084), while others have friends but no

friends-of-friends (N = 12 of 2,084). In some

instances, respondents did not participate in

the in-school survey, eliminating their opportu-

nity to send nominations. Missing values on

the numbers of friends and friends-of-friends

attempting suicide, and the intransitivity index

have been set to 0. To assess the consequences

of these imputations and participation in the in-

school survey, sets of dummy variables reflect-

ing each were added to the models shown be-

low, and in no case does their inclusion affect

our results; therefore, we exclude them from

the analysis.

Analytical Strategy

We first estimate a model of the full sample

(N = 2,084) that includes a multiplicative term

involving the risk index and the number of

friends-of-friends attempting suicide. Should

the interaction be positive and significant, hy-

pothesis one would be allowed to stand. In a

second model, we determine if the effect of

friends-of-friends attempting suicide is signif-

icantly different from zero among at-risk re-

spondents. “At-risk” respondents are the 1,300

respondents with the highest scores on the risk

index. The size of this subset was selected be-
cause it provides enhanced statistical power, while revealing the effect of friends-of-friends suggested by model one. Finally, to test hypothesis two, product terms involving the number of friends-of-friends attempting suicide and the more traditional measures of integration were added one at a time to the model of the at-risk subset. A negative and significant interaction in the final model would allow hypothesis two to stand, as it relates to the particular barrier in question. Variables involved in product terms have been mean-centered.

RESULTS

Table 1 presents survey-logic models of the presence of wave-two suicidal thoughts. Model one shows that the risk index and friends-of-friends attempting suicide positively and significantly interact. Supplementary analyses not shown indicate that fighting is particularly conducive to diffusion, controlling for the other items in the index. As can be seen in model two of Table 1, the effect of friends-of-friends attempting suicide is positive and significantly different from zero for respondents in the at-risk subset. These results allow hypothesis one to stand.

The respondent’s past suicidal thoughts, the intransitivity index, and friends attempting suicide produce positive and significant effects in the models of Table 1. Given the significant stability in suicidal thoughts over time, the inclusion of the time lag of the dependent variable is clearly important. The effect of the time lag is consistent with Joiner’s (2005) argument that past suicidal tendencies enhance subsequent ones, or the so-called “crescendo” effect, in accord with principles of cognitive and be-

### TABLE 1. Survey-Logic Models of Wave 2 Suicidal Thoughts

<table>
<thead>
<tr>
<th>Wave 1 predictors</th>
<th>Full sample</th>
<th>At-risk subset a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 2,084)</td>
<td>(N = 1,300)</td>
</tr>
<tr>
<td>Suicidal thoughts</td>
<td>1.991***</td>
<td>1.851***</td>
</tr>
<tr>
<td></td>
<td>(.295)</td>
<td>(.323)</td>
</tr>
<tr>
<td>Number of friends-of-friends who attempted suicide</td>
<td>.040</td>
<td>.140***</td>
</tr>
<tr>
<td></td>
<td>(.052)</td>
<td>(.037)</td>
</tr>
<tr>
<td>Number of friends who attempted suicide</td>
<td>.628***</td>
<td>.913***</td>
</tr>
<tr>
<td></td>
<td>(.183)</td>
<td>(.268)</td>
</tr>
<tr>
<td>Intransitivity Index</td>
<td>1.208***</td>
<td>1.246*</td>
</tr>
<tr>
<td></td>
<td>(.342)</td>
<td>(.621)</td>
</tr>
</tbody>
</table>

**Main effects involved in interactions**

Risk index b | .053* | N.I. | N.I. |
|             | (.031) |     |     |
| Hours worked for pay in a typical summer week | -.004 | -.017* | -.010 |
|                   | (.010) | (.009) | (.009) |

**Aggravating effect of risk factors**

Number of friends-of-friends who attempted suicide × Risk index | .041* | N.I. | N.I. |
|                   | (.021) |     |     |

**Barrier to diffusion**

Number of friends-of-friends who attempted suicide × Hours worked for pay in a typical summer week | N.I. | N.I. | -.014* |
|                   |       |     | (.007) |

F (df) | 5.58** (3,128) | 17.79*** (2,128) | 17.10*** (3,128)

*a p < .05; ** p < .01; *** p < .001 (one-tailed tests)

b The at-risk subset refers to the 1,300 respondents with the highest values on the risk index.

The risk index is the sum of the following standardized variables: participation in physical fights, homosexual attraction, body mass index, getting drunk, and forced sexual intercourse. The index is not included in the second and third models shown above, but these five separate items are included in those models.

Note: The table presents survey-logic regression coefficients and standard errors in parentheses. “N.I.” stands for not included. The F statistics test the joint null hypothesis that the effects of friends attempting suicide, friends-of-friends attempting suicide, and the included interaction term, where appropriate, are zero. All models also control for an intercept and the following wave 1 predictors: suicide attempt by a family member, suicide attempts by students in the respondent’s school, depression, self-esteem, failure, sex, race, Hispanic/Latino ethnicity, age, participation in active sports, hanging out with friends, church attendance, Catholic, hours worked for pay in a typical non-summer week, length of residence, gun availability in home, and the parent respondent’s marital status and educational attainment.
behavioral psychology. The effect of the intransitivity index suggests that the mere presence of structurally weak ties diminishes integration and regulation. Finally, the impact of friends attempting suicide replicates past work that did not use the reports of friends to measure this variable.

Friends are clearly more influential than friends-of-friends. Using results from model two, the predicted probability of suicidal thoughts is .049 when no friend attempts suicide and .113 when one friend does, with all other variables set to their means; therefore, the predicted probability of suicidal thoughts increases by 132 percent when a friend attempts suicide. The predicted probability of suicidal thoughts is .052 when no friend-of-a-friend attempts suicide, and .059 when one friend-of-a-friend does; therefore, the predicted probability of suicidal thoughts increases by only 14 percent when a friend-of-a-friend attempts suicide.

To determine if barriers to diffusion exist, we further study the at-risk subset of respondents. With one exception, the barrier interactions fail to produce effects that are both significant and consistent. The lone exception involves summer employment. As can be seen in model three of Table 1, this type of employment weakens the aggravating effect of friends-of-friends attempting suicide. Derivations show that the significant aggravating effects of friends-of-friends attempting suicide are eliminated when at-risk adolescents work 23 or more hours in a typical summer week. Results not shown indicate that younger at-risk respondents, those younger than age 16, need only work 10 hours in a typical summer week to enjoy the same benefit. On the whole, our tests for barriers produce weak support for hypothesis two.

**Sensitivity Checks**

We have subjected the models of Table 1 to a number of sensitivity checks. Effects involving the friends-of-friends measure can be reproduced when unweighted estimation is used and when imputed data are analyzed (N = 2,628). In some instances, different cut points in the risk-index distribution are required to replicate these effects. The pattern of significant effects shown in Table 1 is reproduced quite nicely when the unweighted analysis is restricted to younger white respondents. Interactions hold when the interaction involving friends attempting suicide is controlled. Interactions involving attempts by friends produce inconsistent effects, which may be due to the fact that the measure for friends exhibits less variation than the friends-of-friends measure, decreasing the statistical power of tests involving the former. Increasing or decreasing the size of the at-risk subset by 50 respondents, based on their rank in the risk-index distribution, does not alter our conclusions. Interactions hold when the respondent with the highest value on each conditioning variable is dropped from the analysis. When the respondent with the most friends-of-friends attempting suicide is dropped from the analysis (this respondent had eight such friends-of-friends) the effect of friends-of-friends in model two and the interaction in model three hold; however, the interaction in model one becomes insignificant. The deletion of this case does not affect the interaction suggested by model one when it is tested in an alternative fashion that involves thresholds. Specifically, when model two of Table 1 is estimated for respondents above and below multiple cut-points in the risk-index distribution, the effects of friends-of-friends attempting suicide are significantly different in those models, in the expected fashion, when this case is dropped from the analysis. This case is not an outlier, as there are several respondents with seven friends-of-friends attempting suicide; therefore, the case should be retained. These sensitivity checks indicate that our results are robust.

**SUMMARY AND CONCLUSIONS**

The effects of the number of friends-of-friends attempting suicide on the suicidal thoughts of respondents have been estimated to assess the role played by weak ties in the diffusion of suicidal thoughts. Such a focus on friends-of-friends provides a faithful test of the weak ties thesis because respondents are indirectly linked to friends-of-friends by open ties that are both structurally weak and used as bridges (Granovetter 1973, 1983, 1995). We relied on the theories of differential association, social learning, structural holes, and principles of cognitive and behavioral psychology to anticipate diffusion across weak ties. Results indicate that the number of friends-of-friends attempting suicide is positively related to subsequent suicidal thoughts in “at-risk” respondents, where risk is a function of heavy drinking, fighting, rape victimization, same-sex at-
traction, and obesity. Given that the effects of friends-of-friends are found while controlling for the respondent’s prior suicidal thoughts and the presence of suicide attempts by friends, family, and students in the respondent’s school, they contribute to the literature on the diffusive nature of suicide and to the empirical literature on Granovetter’s theory that had previously neglected the role of weak ties in the spread of suicidal thoughts.

Our results that pertain to diffusion across weak ties could be interpreted, erroneously in our view, to conclude that weak ties are entirely disintegrative. Such an interpretation is incorrect because as weak ties transmit information, even harmful information, their integrative nature is revealed; therefore, and ironically, the diffusive effects stimulated by the behaviors of friends-of-friends found in our analysis are supportive of the Durkheimian perspective on the integrative effects of weak ties. Past research has shown that information conveyed across weak ties is often beneficial, but our results suggest that this information, which is indeed integrative, can also be detrimental as it contributes to the diffusion of suicidal tendencies. Our results thus reveal the “dark side” of the strength of weak ties and the integration they create.

We found that friends are more influential than friends-of-friends, indicating that the theories of differential association and social learning are more predictive than the theory of weak ties. While our results are supportive of such a conclusion, we are impressed by the fact that diffusion across weak ties occurs at all. Such a result suggests that the theories of Sutherland, Akers, and Granovetter can be usefully integrated to attain a more complete understanding of diffusion. An integrated approach could emphasize that, while network ties high on intensity play a large role in the process, weak ties also facilitate diffusion due to their greater range or ability to access outside information. Since open ties can be conceptualized as manifestations of Durkheim’s (1893) organic solidarity, we prefer to call for the integration of these theories to avoid the type of one-sided and negative appraisal of Durkheim’s concept found in past work (Wirth 1938).

Our analysis revealed that working 23 or more hours in a typical summer week eliminates the damaging effects of friends-of-friends attempting suicide for at-risk adolescents. Younger at-risk respondents need only 10 such hours to reap the same benefit. This protective effect may be driven by the fact that employment provides resources that close the gap between expectations and aspirations, while reducing perceived burdensomeness and psychological distress (Agnew 1992; Joiner 2005; Leff and Warner 2006; Merton 1938). More generally, the analysis of barriers supports the notion that employment, compared to participation in other institutions, is important because of the preeminence of the economy in American culture (Messner and Rosenfeld 2007). Furthermore, the lack of consistent protective effects for school-year employment is in keeping with other work that finds that summer employment is more beneficial for adolescents than working in the school year (Oettinger 1999; Staff and Uggen 2003).

In addition to the protective effects of summer employment, our other results have policy implications. The aggravating effects of friends-of-friends attempting suicide suggest that school interventions designed to prevent the spread of suicidal tendencies should not be too narrowly focused on the friends of individuals who attempt suicide (Johnson 1999). Suicide attempts can have farther-reaching effects in the friendship networks of at-risk adolescents.

We have suggested that gossip is a vector of transmission that allows information about friends-of-friends to reach respondents. The plausibility of this vector is enhanced by the literature that finds that gossip is shared across open ties (Burt and Knez 1995; Weimann 1983). However, this part of our argument should be assessed in future research that directly examines the suicidal content of gossip shared across open ties.

Future work should ask respondents who have seriously thought about committing suicide if the attempts of particular friends and friends-of-friends played some causal role in their thinking. The ability to directly attach information flows and influence to specific ties and sources would be an improvement over our correlational study and would be more consistent with prior tests of Granovetter’s theory. Furthermore, future work should conceptualize and operationalize tie weakness in both structural and relational terms (Haines and Hurlbert 1992).

Future research should also estimate the effects of different types of friends and friends-
of friends. Differential identification theory (Glaser 1956) can be used to predict that friends and friends-of-friends who have characteristics in common with respondents, such as age or ethnicity, will be most influential. Various measures of homophily that compare characteristics of respondents to those of friends and friends-of-friends can be used to test this prediction in an analysis of interactions (McPherson, Smith-Lovin, and Cook 2001). We suspect that interactions will be stronger for measures of homophily that compare respondents to friends-of-friends because such measures should exhibit more variation than those that compare respondents to friends (Fararo and Skvoretz 1987). Our own tests for interactions support this suspicion. Special attention should be paid to the conditioning effects of status homophily because, contrary to differential identification theory, the literatures on the role of weak ties in status attainment (Granovetter 1995; Lin 1999) and the imitative effects of celebrity suicides (Stack 1987; Tarde 1903) suggest that friends and friends-of-friends who have more status than respondents will be more influential than those whose status is similar to that of respondents.

Sociological scholarship on networks and suicidal tendencies suggests that the mere presence of weak ties is disintegrating (Bearman and Moody 2004); however, as these ties transmit information that is distal in social space, they also simultaneously work to increase integration (Granovetter 1973). Our results indicate that this countervailing boost to integration is not always beneficial, as weak ties are capable of spreading suicide-relevant information that can produce serious suicidal thoughts in adolescents who are psychologically susceptible to suicide.

NOTES


2. Structural holes separate groups or cliques typically identified in a sociogram. We do not employ such a method here, but the logic of Burt’s theory can be used to anticipate the superior range of open ties, compared to closed ties.

3. The quotation by Granovetter (1995) suggests that open ties are weak when they connect respondents to friends who have “a substantial number of” friends who are not friends with the respondent. We conceptualize all open ties as weak, including those that link respondents to friends who have only one friend who is not friends with the respondent. Even these ties are less insulating than closed ones and are capable of accessing information that originates outside a respondent’s group of friends.

4. For gossip to produce diffusion, it need not have a ridiculing nature. A friend seeking constructive advice from a respondent on how to deal with a suicide attempt by a friend-of-a-friend may be good-natured and still produce serious suicidal thoughts in the respondent.

5. In a network autoregressive model where a first-order autoregressive process is the only one present, the effect of friends-of-friends will be insignificant once the effect of friends is controlled. Should the effect for friends-of-friends be significant in our analysis, such a result would support the presence of a second-order process and suggest that open or structurally weak ties play a role in the diffusion of suicidal thoughts.

6. The sample size is larger here, compared to 2,654, because there is no requirement that respondents have a wave-two sample weight.

7. Hypothesized effects presented below hold when school size and friendship density are controlled. Density is the number of friendships divided by the number of possible friendships, (N x N) – N, in each school.

8. Least-squares equivalents of the models presented below produce variance inflation factors that are all smaller than four, indicating that serious multicollinearity is not present among these predictors.
APPENDIX A. Descriptive Statistics (N = 2,084)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suicidal thoughts in prior 12 months, wave two (0 = No, 1 = Yes)</td>
<td>.101</td>
<td>.302</td>
</tr>
<tr>
<td>Independent variables involving suicide or social networks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of friends-of-friends who attempted suicide in prior 12 months (0–8)</td>
<td>.663</td>
<td>1.207</td>
</tr>
<tr>
<td>Number of friends who attempted suicide in prior 12 months (0–4)</td>
<td>.206</td>
<td>.474</td>
</tr>
<tr>
<td>Family member attempted suicide in prior 12 months (0 = No, 1 = Yes)</td>
<td>.042</td>
<td>.200</td>
</tr>
<tr>
<td>Number of students attempting suicide in the respondent’s school</td>
<td>24.005</td>
<td>17.736</td>
</tr>
<tr>
<td>in the 12 months before the wave 1 survey (0–44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intransitivity index (proportion of two-step relations that are not direct) (0–1)</td>
<td>.754</td>
<td>.284</td>
</tr>
<tr>
<td>Suicidal thoughts in prior 12 months (0 = No, 1 = Yes)</td>
<td>.132</td>
<td>.339</td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of getting drunk or very high on alcohol in prior 12 months</td>
<td>.661</td>
<td>1.252</td>
</tr>
<tr>
<td>(0 = Never, 6 = Every day or almost every day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homosexual attraction ever (0 = No, 1 = Yes)</td>
<td>.054</td>
<td>.226</td>
</tr>
<tr>
<td>Forced sexual intercourse victimization ever (0 = No, 1 = Yes)</td>
<td>.040</td>
<td>.196</td>
</tr>
<tr>
<td>Frequency of physical fights in prior 12 months (0 = Never, 2 = More than once)</td>
<td>.444</td>
<td>.711</td>
</tr>
<tr>
<td>Potential barriers to diffusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of participation in active sports in prior week</td>
<td>1.457</td>
<td>1.127</td>
</tr>
<tr>
<td>(0 = Not at all, 3 = Five or more times)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of hanging out with friends in prior week</td>
<td>2.019</td>
<td>.976</td>
</tr>
<tr>
<td>(0 = Not at all, 3 = Five or more times)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of church attendance in prior 12 months</td>
<td>1.936</td>
<td>1.167</td>
</tr>
<tr>
<td>(0 = Never, 3 = Once a week or more)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catholic (0 = No, 1 = Yes)</td>
<td>.335</td>
<td>.472</td>
</tr>
<tr>
<td>Length of residence (0–19 years)</td>
<td>7.790</td>
<td>5.541</td>
</tr>
<tr>
<td>Hours worked for pay in a typical non-summer week (0–100)</td>
<td>7.237</td>
<td>10.789</td>
</tr>
<tr>
<td>Hours worked for pay in a typical summer week (0–99)</td>
<td>14.536</td>
<td>17.130</td>
</tr>
<tr>
<td>Other characteristics of respondents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (0 = Male, 1 = Female)</td>
<td>.499</td>
<td>.500</td>
</tr>
<tr>
<td>White race (0 = No, 1 = Yes)</td>
<td>.597</td>
<td>.491</td>
</tr>
<tr>
<td>Hispanic or Latino ethnicity (0 = No, 1 = Yes)</td>
<td>.183</td>
<td>.387</td>
</tr>
<tr>
<td>Age (12 to 20 years)</td>
<td>16.248</td>
<td>1.479</td>
</tr>
<tr>
<td>Depression (felt depressed in prior week)</td>
<td>.544</td>
<td>.764</td>
</tr>
<tr>
<td>(0 = Never or rarely, 3 = Most or all of the time)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-esteem (felt just as good as other people in prior week)</td>
<td>1.811</td>
<td>.980</td>
</tr>
<tr>
<td>(0 = Never or rarely, 3 = Most or all of the time)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure (felt that life had been a failure in prior week)</td>
<td>.238</td>
<td>.556</td>
</tr>
<tr>
<td>(0 = Never or rarely, 3 = Most or all of the time)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gun easily available in home (0 = No, 1 = Yes)</td>
<td>.249</td>
<td>.433</td>
</tr>
<tr>
<td>Characteristics of parent respondent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married (0 = No, 1 = Yes)</td>
<td>.761</td>
<td>.427</td>
</tr>
<tr>
<td>Educational attainment (reference category = less than high-school graduate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-school graduate or equivalent (0 = No, 1 = Yes)</td>
<td>.316</td>
<td>.465</td>
</tr>
<tr>
<td>Business, trade, or vocational school after high school (0 = No, 1 = Yes)</td>
<td>.086</td>
<td>.281</td>
</tr>
<tr>
<td>Some college (0 = No, 1 = Yes)</td>
<td>.226</td>
<td>.418</td>
</tr>
<tr>
<td>College graduate or post-graduate education (0 = No, 1 = Yes)</td>
<td>.199</td>
<td>.399</td>
</tr>
</tbody>
</table>

Note: All measures were drawn from the in-home surveys with the exception of friendship nominations drawn from the in-school survey.

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