A Network Pioneer Has Passed Away

We have lost one of the original thinkers in sociology. Steve Berkowitz died in Burlington, Vermont, October 8 2003. The immediate cause of death was a heart attack, while Steve was at a hospital Intensive Care Unit having something attended to. Just before he died, he called his wife Terry to come pick him up because he was feeling better. So, Steve does not appear to have suffered long at the end.

Steve had had heart attacks before, and he had serious diabetes and kidney problems. For those who remember his big booming voice, it was difficult to recognize his phone calls in the past while. He had also lost a great deal of weight.

But that is not the Steve that most of us experienced for many years. The images I have in my mind are of Steve consuming a dozen bagels one breakfast at my house, of copious amounts of Coke downed while we edited (in pre-diabetic days), of Steve propounding some fascinating idea around the lunch table and holding us all enthralled for hours, of many, many phone calls, and of Terry's sculpture of a Buddha-like sitting Steve, entitled, "Minor Living God." My last vision is of Steve arriving at the Sitges Sunbelt in a voortrekker outfit -- floppy hat, khaki vest, shorts and walking stick -- apparently having walked from South Africa where he was a visiting professor.

Steve was a complex guy who never took the easy way. There was always something going on in his life. He was my colleague at the University of Toronto in the late seventies and early eighties when the social network enterprise had much momentum and originality. He was a major supporter when I founded INSNA and this journal, *Connections,* always pushing for original ways of doing things.. He was a brilliant co-editor on our *Social Structures: A Network Approach*. We had great discussions about what the book should look like, and he performed the heroic feat of translating Harrison White into English. Yet, Steve could be maddening. When he was at Vermont and I in Toronto, so many deadlines were missed that I finally called the Burlington postmaster to ask about why they kept losing Steve's mail. (This was in the prehistoric, pre-Fedex, pre-attachment days.)

At the time of his death, Steve was in the early stages of working on a revised edition of *Social Structures* (along with Doug White). I look forward to seeing Cambridge publish it, both for its usefulness and as a testament to Steve.

As important as *Social Structures* has been (if I do say so myself), I believe that Steve's most important work was his *An Introduction to Structural Analysis,* long out of print. It was the first integrated statement of the social network approach. Importantly, it emphasized theory and substance, rather than treating social network analysis as a methodological parlor trick. I still send folks to read it.

Steve left Toronto for Vermont in the mid 1980s. Almost every day since, I have found myself missing his energy and his insights. Everything that Steve did, every call that Steve made was "urgent".

Steve loomed large to all who know him. The world is an emptier place today. I am sure that as long as social networkers sit around campfires, Steve Berkowitz stories will be told. Indeed, editor Bill Richards and I invite readers to contribute their own for publication in the next issue of *Connections.*

TOC

Barry Wellman

Ties & Bonds

BBS

Joanne Nagel (Soc, U Kansas) seconded to the National Science Foundation as sociology program officer..... ***Harrison White*** awarded the Career Achievement Award of the Mathematical Sociological section of the American Sociological Association.... ***Rob Sampson*** moves from Soc, Chicago to Soc, Harvard..... ***Mike Schwartz*** has returned to being a prof at Soc, Stony Brook... .. ***Manuel Castells*** moved from Berkeley to Annenberg Schl of Communication, U Southern Cal. He'll continue spending 6 months/year at International Internet Institute, Universitat Oberta de Catalunya, Barcelona.... Is this the first (known) Sunbelt-induced baby? ***Jeffrey Johnson & Christine Avenirus*** who met at the Sunbelt and later married had their first child, ***Bryn,*** in Spring 2003.... Mathematicians ***Benoit Mandelbrot*** (Yale) & ***James Yorke*** (U Maryland) won the 2002 Japan Prize for their pioneering work in chaos theory....***Barry Wellman***(U Toronto) has been elected to be 2004-2005 chair of the Communication and Information Technologies section of the American Sociological Association. He's also the North American editor of *Information Communication and Society*....

MANY NAMES DO YOU RECOGNIZE?

In preparation for INSNA's major new scanning project (coming soon to a website virtually near you), I took a look at *Connections'* Ur-issue, 1, 1, more than 25 years ago in Summer 1977. Here's the Advisory Committee of INSNA then: JA Barnes, Colin Bell, Steve Berkowitz, Paul Bernard, Jeremy Boissevain, Nancy Marshall Chapman, Bonnie Erickson, Claude Fischer, Lin Freeman, Harriet Friedmann, Gerald Gold, Mark Granovetter, Gudmund Hernes, Roxanne Hiltz, Les Howard, Charles Kadushin, Fred Katz, T. Dave Kemper, Ed Laumann, Joel Levine, Clyde Mitchell, Chris Pickvance, Christopher Smith, David Todd, Herman Turk, Lois Verbrugge, Peter Willmott, Bengt Rundblad. By my count, only 4 or 5 are still active in network analysis. Some have moved on to other things. Some have retired. And some have moved to network heaven. This turnover doesn't bother me: our society is larger and more vibrant than before, and we've done it with at least 1 generation's worth of institutional succession.

SOCIAL NETWORK SOFTWARE APPLICATIONS: THE TECHNOLOGY OF THE YEAR

Business 2.0 has just anointed "social network applications" as "The Technology of the Year" (Nov 2003). "There's valuable information locked up inside your relationships. Who holds the key? The answer is now just a few keystrokes away.... Graph theory made it possible to assign quantitative values to social networks that represent how people interact. More recent advances assess the intimacy of connections using statistical theory that considers specific behavior patterns within a group."

The author, David Pescovitz, thinks that popular consciousness of social networks goes back to Stan Milgram's six degrees study in 1967.

While inaccurate, of course, the assertion at least has more time depth and validity than current media attributions to Barabasi and Gladwell.

This batch of social network software applications are largely aimed at organizations who want to track who is talking with whom. Besides the corporate uses, several government spy agencies are doing social network analyses. I know of organizations using it to see the impact of mergers on relationships and, of course, to develop subterranean communication and influence patterns.

The activity is somewhat reminiscent of the dot.com boom of the 1990s, albeit in a lower key. I know one social networker working for Metalogix, another has been consulting to Spoke Software, Realize Networks is just getting going, while Visible Path has been visible at recent social network conferences. Non-organizationally, Friendster, claiming 2M members, creates personal profiles and publicly identifies friends who als use the service, enabling folks to browse the profiles and links of friends of friends.

[David Pescovitz, "The Best New Technologies of 2003." *Business 2.0*, Nov 03. The magazine's own site requires payment; the text of the article (but not the pix of Stan Wasserman, Duncan Watts, Stan Milgram and Kevin Bacon) are available at www.spoke.com/news/b20_73956.pdf.]

NETWORKS OF SCIENCE

It's in the Structure: It's the 50th anniversary of the discovery of DNA by Watson & Crick (& Franklin). Or is it? It turns out that DNA was discovered in the late 1800s. What W, C & F discovered was DNA's twisted shape and double helix structure.

It Isn't in the Structure: "Skeptics... question the ability of the drug discover market to handle a sudden influx of hundreds, possibly thousands, of new structures.... Each of the major pharmaceutical companies have only a few drugs in the pipeline at any 1 time..... Critics ... wonder if producing hordes of new structures is good science. Scientists don't know what most proteins do. `It is useless to have a structure if you can't tell the function' notes Thomas Steitz" (Yale). [David Ewing Duncan, "The Protein Hunters," *Wired,* Apr 01: 166.]

It's in the Loops: In loop quantum gravity, "reality is built of loops that interact and combine to form so-called spin networks -- first envisioned by English mathematician Roger Penrose in the 1960s as abstract graphs. ... The nodes and edges of these graphs carry discrete units of area and volume, giving rise to 3-dimensional quantum space.... Markopoulou Kalamara [asked]: ... Why not start with Penrose's spin network, mix in some of the results of LQG, and see what comes out. The result was networks that do not live in space and are not made of matter. Rather their very architecture gives rise to space and matter. In this picture, there are no things, only geometric relationships. Space ceases to be a place where objects such as particles bump and jitter and instead becomes a kaleidoscope of ever changing patterns and processes." [Amanda Gefter, "Throwing Einstein for a Loop," *Scientific American,* Dec02:40-41.]

It's in the Simulation: "Several model-building biologists suspect that what most strongly affect how a cell behaves in response to a drug or disease is not whether any particular gene is turned up or down, and not whether any single protein is blocked, but how all the genes and proteins interact dynamically." Bernhard Palsson, head of the genetic circuits group at U Cal - San Diego "combs the literature to reconstruct as much of the biochemical networks [of Helicobacter pylori, the ulcer germ] as they can. `Then we subject them to constraints they must abide.' Mass must be conserved. Electrical charges must balance. Thermodynamics makes many reaction irreversible." [W. Wayt Gibbs, "Cybernetic Cells," *Scientific American* Aug 01: 57.]

It's in the Connections: "While humans have only 20 to 30 per cent more neurons than great apes, they have 300 or 400 times more fine neural connections linking these brain cells." [Stephen Strauss, "Smart Food ," *Toronto Globe and Mail,* 1June03: F7].

It's in the Mating: To see which proteins link with whom, Myriad Genetics is adopting "a shotgun approach, throwing together collections of bait and prey to see what falls out." Tens of thousands of reactions are repeated, "and the bulk of the interactions will reveal themselves.... If the human proteome contains 300K-400K proteins, each of which interacts on average with an estimated 5-10 protein partners, it should take 3 years to generate a comprehensive map. At that point, the problem becomes ascertaining which of these interactions are biologically meaningful. 2 proteins may be physically able to interact but may never actually meet up in a cell." [Karen Hopkin, "The Post-Genome Project," *Scientific American,* Aug 01: 16.]

It's in the Emergent Properties: "Nothing is known of the emerging properties of animal societies.... Despite its small size (64 individuals), the Doubtful Sound community of bottlenose dolphins has [emergent properties]. The connectivity of individuals follows a complex distribution that has a scale-free power-law distribution for large k. In addition, the ability of 2 individuals to be in contact is unaffected by the random removal of individuals. The removal of individuals with many links to others does affect the length of the information path between 2 individuals, but unlike other scale-free networks, it does not fragment the cohesion of the social network. These self-organizing phenomena allow the network to remain united, even in the case of catastrophic death events." [David Lusseau, "The Emergent Properties of a Dolphin Social Network." 17 July -03. http://arXiv.org/abs/ cond-mat/0307439. via *Complexity Digest.*]

It's in the Collectivity: "The behavior of condensed matter is collective. The details of individuals molecules hardly matter; the system's properties emerge from the act of aggregation. When water freezes, the molecules do not change, but the collective behavior does, and the laws that apply to liquids no longer do." [George Musser, "Frozen Stars," *Scientific American,* July 02: 21.]

It's in the Database: The Cambridge (UK) Structural Database is compiling an inventory of molecular structure, with 3D atomic coordinates on the shapes/conformations which molecules like to adopt. There is also information on which types of molecular functionality likes to interact with which other types, and in what geometries. [Steve Maginn, "World Turns to Cambridge Database." *Bioinformatics World,* Jan 02: 8-10].

SHORT SHTICKS

It's in the Internet: Oxford UK real estate agent reports that access to broadband has become a major factor for people looking to rent homes. [*Oxford Times,* 12Sept03: P1).

Conspiracy Graphs as Art: The delicate filigree drawings of terrorist networks of the late artist Mark Lombardi is at the Drawing Center, NYC, to 17Dec03. "Solid and broken lines, circles and squiggles enmesh the names of organizations and individuals in webs of often surprising interconnections." One links the Vatican Bank, the Mafia, and firearms traffic. Virginia Commonwealth U art historian Robert Hobbs says the drawings "exists between what is known – the people, the organizations, the court judgements – and the unknown." [Eleanor Heartney, *NY Times,* 26Oct 03].

FrieNDA is "the verbal nondisclosure agreement one gives to a friend or trusted associate before sharing juicy insider gossip or confidential business information." [*Wired*, Nov00: 114]. Just yesterday (1Nov0 3) a prospective student in a graduate course told me that he would require NDAs from me and his fellow students before he did a presentation or handed

ed in his term paper. A computer science student, of course.

Crows Go Kin: The Northwestern (US) crow is passive when it attempts to take food from kin but aggressive when it tries to take food from non-kin. These crows clearly can discriminate kin from nonkin. [*ScienceDaily,* 12Mar03, via *Complexity Digest].*

From Guanxi to Social Support: "Existing support networks of East Asian students could be mobilized to encourage [depression] sufferers to seek professional help. This traditional network could help guarantee that an institutional memory or social schema of depression as a problem is integrated into various Harvard communities of Asian nationals. From this would emerge a `virtuous circle' (as opposed to a vicious circle) in which older students would, in effect, translate depression and its treatment to newcomers." [Xiaojian Hu & Miguel Salazar, "Sociology Students Shed New Light on Depression," *Harvard University GSAS Newsletter,* Summer 01: 18]

Tracy & Kristine Get What They Deserve: Grad students Tracy Kennedy (Soc, U Toronto) & Kristine Klement (Soc & Pol Though t, York U, Toronto) won the 2003 best student paper award from the American Sociological Association's Communication and Information Technology section. Their "Gendering the Digital Divide" shows that while similar percentages of North American men and women use the Internet, women use it more to socialize (email) while men use it more to seek information (web). The gendered division of labor has implications for the Internet. While women with children use the Internet less, this is not true for men. The final paper is published in *IT & Society* 1, 5 (Summer), with me as a third author of the final, published article.

The McKinsey Mob is the colloquial UK term given to partners and ex-partners of the McKinsey consulting firm.. "The firm, of course, doesn't use such crude terminology for its former partners: the `alumni network' is its preferred phrase.... One source says, `The network isn't openly exploited, but the firm maintains a database of members and holds an annual reception for the alumni.' [The firm] can count more former partners running Britain than anyone else." Plus Jeff Skilling, ex-Enron CEO. [Clayton Hearst, *The Independent on Sunday* (UK), 20Jan02.]

The Illusionist is a novel by Colson Whitehead depicting a slightly alternative universe in a city like NYC, where there is a major fight within the guild of elevator inspectors. The ***Empiricists*** plod thru their inspections one material criterion at a time, while the ***Intuitionists*** take a more gestalt approach to detecting safety flaws. Sounds like cultural studies to me. You don't crash in an Intuitionist-inspected elevator, you only think you do.

CONNECTIONS 25(2): 11-16 http://www.insna.org/Connections-Web/Volume25-2/0.Valente.pdf

Social Network Influences on Adolescent Substance Use: An Introduction[1]

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Studies have shown that an individual adolescent's substance use is associated with, and perhaps causally linked with, substance use by their friends. A number of different hypotheses regarding the relation between social networks and adolescent substance use have been tested. In the case of smoking, for example:

- Having a best friend who smokes is associated with smoking (Urberg, *et al.*, 1997);
- Having smoking friends is associated with smoking (Alexander, *et al.*, 2001; Botvin, *et al.*, 1993; Flay *et al.*, 1994; Unger *et al.*, 1999; Urberg, *et al.*, 1991);
- Network position is associated with smoking (Alexander *et al.*, 2001; Ennett and Baumann, 1993); and
- Group membership is associated with smoking (Aloise-Young, *et al.*, 1994; Ennett and Baumnan, 1993).

These studies have used sociometric techniques (Scott, 2000; Wasserman and Faust, 1994) involving some matrix manipulation. These smoking studies parallel empirical analysis conducted on social network influences on the diffusion of innovations (Burt, 1987; Valente, 1995), treating smoking as a behavior that diffuses through the population. From a network perspective then, the question becomes: What affects behavior more: network position or being surrounded by friends who influence, either overtly or by example, the uptake of (deviant) behavior?

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The answer of course, is both. Positions matter and sometimes this leads to persuasive influence by friends, and sometimes the (perceived) influence of friends leads to behaviors by people in certain positions. These processes are dynamic and contextual and situational factors that affect individual and communal behaviors and attitudes need to be included. The process of smoking uptake, and perhaps other substance use issues, is quite complex, but progress is being made.

This special issue of Connections presents five peer-reviewed papers that examine how adolescent social networks influence substance use behavior. Each paper acknowledges the multiple levels and factors that influence behavior starting with the subjects' own predisposition and including peer, family, school, community, social and policy as well as situational and contextual factors. No study can address, or measure, all of these levels, however, so each takes a different slice of analysis to present evidence on how social networks can and do influence substance use.

The substances studied in these articles include smoking, alcohol, marijuana, crack and injection drug use. The use of these substances can be studied singularly (e.g., what factors predict smoking initiation), or in a composite manner (e.g., what factors affect the use of any substance). It is also possible to compare predictors of substances (e.g., do social networks influence smoking more than marijuana use). All of these approaches are used here. Generalizations about the effects of social networks on substance use can and should be qualified, noting the magnitude of effects on which behaviors (i.e., smoking, drinking, or any substance). It may be that network effects are stronger for some behaviors rather than others, but there is no compelling evidence for this.

Not surprising, the papers cover different age ranges. Adolescence is typically thought of as the teen years, a transition time between childhood and adulthood. But this transition period is long, and starts at 12 or 13 years of age, and extends to 18 or in some cases 20 years old. During these years, adolescents spend a majority of their time in school, a place where much socialization and identity formation occurs. Consequently, three of these papers report data collected in schools, a natural setting conducive to social network analysis. The other two papers use data collected in community settings, and not surprisingly, the data come from older adolescents.

The first paper, by Gaughan, uses the Add Health data (Bearman, Jones and Udry) to show that adolescents are more likely to drink alcohol if their best friend drinks alcohol. Social influences on drinking are not unidirectional, but rather the process is one of mutual influence. Person A does not drink because B influenced him to drink, rather A and B drink together. Further, Gaughan shows that there are multiple, direct individual-level variables that influence alcohol consumption such as the family context, religiosity, age, ethnicity, school problems and school alienation.

The second paper, by Rice, Donohew and Clayton, presents data from three cohorts of junior and high school students. Complete network data were collected by asking students to name three friends in their same grade. This study shows that sensation- seeking and peers' drug use seem to be the primary influences on one's drug use within a given time period. Authors also compared generalized estimates of friends' substance use with that derived from the specific sociometric data. They find significant but weak correlations between the measures, concluding that generalized estimates of peer influence may have poor validity.

The third paper, by Pearson and West, reports data collected from 152 students over a three year period from 8th to 10th grade. Network data were generated by asking students to name up to 6 friends along with information about things they did with those friends. Subjects were classified as

group members, peripherals and isolates and whether they engaged in risk taking by consuming substances. These six states are then analyzed using Markov methods to estimate the probability a student transits from one state to another. The data show that students transition from group non risk-taking to group risk-taking over time. Authors also report estimates of how long students stay in each state, showing that group risk taking is a relatively stable state.

The fourth paper, by Flom Friedman, Neaigus and Sandoval, reports data collected among 18-24 year olds interviewed at homes and at outreach locations. The study design included a targeted sample of respondents who used cocaine, heroin, crack or injected drugs. Results showed that female crack smokers and female drug injectors were more likely than female non-users to have sexual network partners who were older, of a different race/ethnicity, and from another NY borough. For females, doing drugs was associated having sexual partners that crossed boundaries, perhaps putting them at greater risk to infection and providing bridges from one population to another.

The fifth and final paper, by Clair and others, presents a research note on the reliability of ego-centric network data collected among young adult drug users 16-24 years old, recruited at youth centers. Respondents were invited to name up to 15 members of their personal social networks. Results show that aggregate network indicators are relatively reliable (e.g., people who report many friends do so consistently). Reliability was also present at the micro-level, closer, stronger ties were more likely to be recalled at both time points.

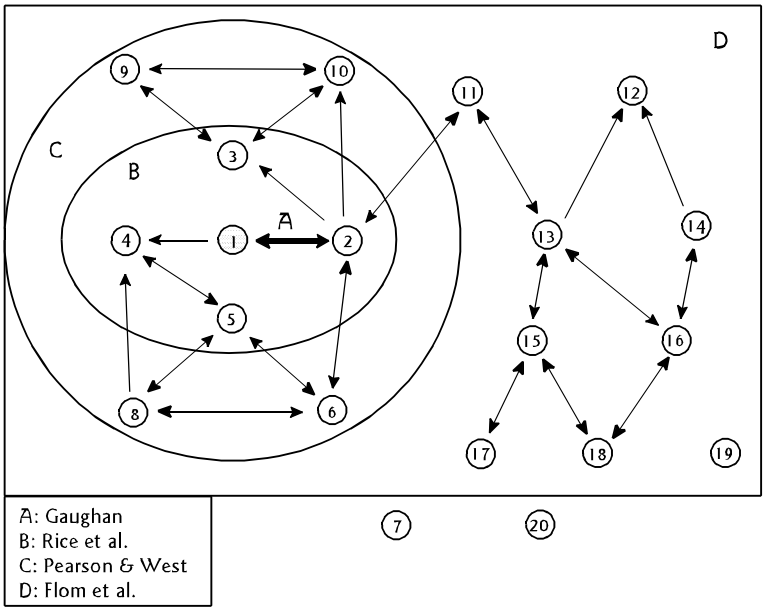

Figure 1 shows a small hypothetical network to illustrate the levels of analysis used in each paper. Gaughan focuses on the dyad (A, the tie between 1 and 2) while Rice and others include information from the personal network of immediate ties (B, 1's links with 2, 3, 4 and 5). Pearson and West construct groups (C, 1 thru 10, excluding 7) and study whether group membership and the risk taking of those groups influences transitions to substance use. Finally Flom and others (D) analyze boundary spanning, or linkages between groups as a risk factor. In this simple network, then, one can see the many different approaches that can be used to study social network influences on substance use.

To further complicate matters, these and other studies often make simplifying assumptions to manage the data. Ties are symmetrized, strengths reduced to binary indicators, groups defined as 50% or more communication within them and so on. In addition, network influences probably interact with individual level factors such as risk taking, sensation seeking, depression and others. These simplifications are necessary, but their implications for the science of social network effects are often not known.

We find in these results, and other studies, that social networks matter. Adolescents select friends like themselves, those friends influence their behavior, and they often engage in risky behavior together. Not so long ago, social network studies were content to show a correlation between network properties and behavior. Today, as these papers attest, studies have controlled for selectivity effects, used longitudinal (panel) data, and shown that social network factors can and do put adolescents at risk for substance use.

No one theory or approach is adequate to studying these influences. In response, the National Institute on Drug Abuse, and other NIH institutes have launched a number of transdisciplinary initiatives. The Transdisciplinary Tobacco Use Centers (TTURC) and the Transdisciplinary Prevention Research Centers (TPRC) being two notable examples. Transdisciplinarity is evident in these papers. These scholars use mathematical formulations to translate social, psychological, and communication theories into meaningful public health investigations. The end result is a well informed contribution to the causes and consequences of substance abuse among adolescents.

These papers were reviewed by two of the leading lights in social network research among adolescents, Professor James Moody (Ohio State University) and Professor Susan Ennett (University of North Carolina, Chapel Hill). Professor Moody has studied adolescent friendship networks from a structural point of view (Moody, 2001) and also studied how friendship social structure influences weapon carrying behavior and suicide (Bearman and Moody, in press). Professor Ennett has studied the impact of adolescent social networks on tobacco use (Ennett and Baumann, 1993; 1994) and has conducted an evaluation of Project DARE (Ennett, et al, 1994). I, and the authors, thank these reviewers for their time and the improvements they have made to this special issue.

Demonstrating that social networks influence substance use is, of course, only half the equation. For public health reasons, we need to translate these findings into effective interventions to prevent substance use, help those who already abuse substances to reduce or quit them, and minimize the harm that can come from risky behavior. At USC (University of Southern California), we have taken a small step in this direction in a recent study showing that social network information can be used to structure the delivery of a tobacco prevention program in schools (Valente *et al.*, in press). It is only a preliminary step, and only one possible way to use network data in interventions. As you read through the following papers, you might be able to envision other network-based interventions and certainly other interesting hypotheses regarding the effects of social networks on adolescent substance use.

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CONNECTIONS 25(2): 17-31 http://www.insna.org/Connections-Web/Volume25-2/1.Gaughan.pdf

Predisposition and Pressure: Mutual Influence and Adolescent Drunkenness

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Many explanations of adolescent alcohol use patterns rely on a combination of individual, family, and peer influences to explain transitions and levels of use. Peer use of alcohol is often found to be the most important predictor of an adolescent's own use of alcohol. The predominant inference drawn from this consistent finding is that an adolescent's peers influence him or her to use alcohol. A methodological limitation of these studies is that they rely on information from only one member of the friendship pair. I posit that the traditional psychosocial model gives an incomplete understanding of the peer influence process. This study uses the sociometric design of the National Longitudinal Study of Adolescent Health (Add Health) to demonstrate that adolescent friends influence one another to establish and maintain alcohol use patterns over time. I estimate the effect of mutual peer influence in the context of a broader model of adolescent alcohol use that controls for individual background factors of each friend. The mutual influence process demonstrated in cross-sectional analysis persists in two longitudinal model specifications that control for prior behavioral similarity between the friends.

INTRODUCTION

To evaluate the health and well being of adolescents requires an understanding of them not only as individuals, but also as members of families, friendships, and social institutions. In particular, adolescents look to peer influences to guide their attitudes and behavior to a much greater extent than in childhood (Coleman 1961; Duncan, Haller and Portes 1968). Perched between childhood and adulthood, adolescents forge identities and behaviors from this fertile mix of socializing influences.

[1] Direct correspondence to author at School of Public Policy, Georgia Institute of Technology, Atlanta, GA 30332-0345. monica.gaughan@pubpolicy.gatech.edu. This research is based on data from the Add Health project, a program project designed by J. Richard Udry (PI) and Peter Bearman, and funded by grant P01-HD31921-01 from the National Institute of Child Health and Human Development to the Carolina Population Center, University of North Carolina at Chapel Hill. The author was supported by a National Research Service Award 5T32HD07168-12 from the National Institute of Child Health and Human Development to the Carolina Population Center, University of North Carolina at Chapel Hill. The author gratefully acknowledges the assistance of Karl Bauman, Ken Bollen, Elisa Bienenstock, Glen Elder, Rob Foss, Jim Moody, and Dick Udry.

In this analysis, I combine the strength of network analytic data that link actual friends with the strength of the psychosocial tradition that examines individual risk and protective factors. Specifically, I evaluate how drinking patterns are influenced by individual, family, and social characteristics, and by actual longitudinal peer friendships. I control for prior friendship selection and behavioral similarity while examining how mutual influence processes between friends hold up over time.

PEER MODELS OF BEHAVIORAL SIMILARITY

By far the most important predictor of adolescent alcohol use to emerge is the use pattern of peers. Adolescents with alcohol using peers are more likely to use alcohol than adolescents without drinking friends (Bahr *et al.* 1993; Bentler 1992; Clapper *et al.* 1994; Curran *et al.* 1997; Donovan and Jessor 1983; Jessor 1987; Johnson 1986; Marcos *et al.* 1986; Windle and Barnes 1988). Furthermore, adolescents with heavy drinking friends, or friends who get drunk, are themselves likely to engage in such behavior (Barnes, Farrell and Banerjee 1994; Barnes and Welte 1986).

What many psychosocial theories of adolescent behavior have in common is the critical importance of social context in affecting deviant behavior, including alcohol use. Theories vary with regard to the importance of causal ordering of social factors, but all include an attention to the importance of peer relations. Differential association theory (Sutherland 1947) emphasizes interaction with others that create differential social conditions for developing deviant behaviors. The social conditions foster favorable attitudes toward rule violation, which results in greater involvement in deviance. The associated theory of social learning (Akers *et al.* 1979) posits that affiliation with deviant groups reinforces deviant behavior. The theory provides a role for behavioral reinforcement, imitation, and peer influence processes; however, specifications of these models focus more on cognitive and attitudinal processes, and do not include actual friends in the empirical analyses.

Social control theory (Hirschi 1969) assumes that deviance is the natural human condition, and that conventional behavior is developed in association with conventional others. Family, peers, schools, and other social institutions exert indirect control over behavior by reinforcing involvement, commitment, and attachment to conventional institutions and behaviors. Problem behavior theory (Jessor and Jessor 1977) elaborates the social control process by focusing on the interaction of the personality system with the perceived environment of parent and peer attitudes and behavior. Social control theory starts with the assumption of human deviance, while differential association and social learning start with the assumption of human conformity. Despite this fundamental difference, the theories complement one another by elaborating the role for peers (in the case of the former), and the role of institutions and agents of social control (in the case of the latter).

These contributions are particularly important in the development of psychological and familial correlates of deviant behavior, but the operationalization of peer influence is poor, relying on self-reports of friend behavior. Because of these self-reports, and an empirical lens that focuses exclusively on a primary adolescent respondent, these studies do not investigate selection effects, or the independent background predictors of the friend's behavior. Interactional theory (Thornberry 1987) combines social control and social learning theories by explicitly modeling longitudinal mutual influence processes while controlling for prior behavior of the friends. Such an approach provides for a role for selection processes as well as influence processes. Unfortunately, investigations of interactional theory continue to rely on self-report of friend behavior (Matsueda and Anderson, 1998; Krohn, Lizotte, and Thornberry, 1996).

Despite the apparent consensus about the importance of peers, there are a number of problems that must be considered. The most important theoretical problem was raised by Lazersfeld and Merton (1954) in their explication of homophily. Homophily--the observed tendency for friends to be similar to one another--can result from influence, selection, or deselection processes. Failure to address these issues can result in specification error. First, typical peer influence models assume unidirectional causality from the friend to the primary adolescent, eliminating mutual influence or selection as a plausible causal alternative. Second, adolescent reports of friends' use are biased to reflect the adolescent respondent's own use pattern (Wilcox and Udry 1986). Models that use actual friendship dyads (eliminating known reporting bias) do not account for the background and demographic factors of the friend that have been demonstrated to explain alcohol-related behavior in adolescence. Failing to control for factors affecting the friend's pattern of behavior may overstate the influence of the primary respondent in mutual influence models. Finally, influence models rarely explore the dynamic longitudinally. Studies may address some of these theoretical and practical problems, but not others.

The development of analytic techniques for sociometric nominations opened up friendship studies to new possibilities that included the inclusion of all theoretically relevant members of social groups. Most recently, Haynie (2001) found that the underlying structure of peer networks, and adolescent's position within them, conditions the influence of delinquent peers, but she does not address selection problems that earlier research has identified. Cohen (1977) and Kandel (1978a) were the first to use sociometric data to demonstrate that selection, or assortative pairing, accounted for about half of observed behavioral similarity in adolescent friendships. The importance of selection in explaining similarity between friends has been found for sexual behavior (Billy and Udry 1985a, b), drug use (Kandel 1978a, b), smoking (Bauman and Ennett, 1994; Ennett and Bauman, 1994; Fisher and Bauman 1988; Rodgers, Billy, Udry 1984), and alcohol use (Curran *et al.* 1997; Fisher and Bauman 1988; Rodgers, Billy, Udry 1984). Such findings weaken the causal argument often made about peer influence by showing that similarity operates at least in part through the selection of friends. Furthermore, these representations of the peer influence model do not provide for a mechanism of mutuality of influence.

Only a couple of studies of actual friendship pairs have controlled for demographic characteristics (Ennett and Bauman 1993; Rodgers *et al.* 1984). These studies also found important selection dynamics in addition to influence processes. Males tend to engage in problem drinking more than females (Robbins and Martin 1993), whites more than blacks, and age is an "organizing principle" of drinking, with adolescents and young adults establishing alcohol use patterns (Bucholz and Robins 1989). However, in addition to demographic characteristics, adolescents enter friendships with a variety of individual and family characteristics that influence alcohol use and exist independently of friendship dyads. These rich background predictors are amply demonstrated in the social psychological literature stemming from the interactional, differential association, social control, social learning, and problem behavior theories.

Family and Institutional Factors

Family contexts facilitate social bonds and involvement with family activities that protect against problem behavior. Supportive parents who monitor their children's behavior and engage in activities with them create conditions that limit opportunities to drink. Monitoring and control behavior that reduces drinking includes knowing the adolescent's whereabouts and activities, and knowing the adolescent's friends (Bahr *et al.*, 1993; Barnes and Farrell, 1992; Barnes *et al.*, 1994; Krohn *et al.*, 1988). Interaction and joint activities with parents engage adolescents in ways that inhibit drinking

and cigarette smoking (Johnson 1986; Krohn *et al.*, 1988). Finally, adolescents who feel close to and supported by their family engage in lower levels of alcohol use (Barnes and Farrell, 1992; Wills and Vaughan, 1989).

Adolescent commitment to conventional institutions tends to depress alcohol initiation and use. An extremely important dimension of the conventionality construct is the concept of religiosity. In previous studies, it was found that adolescent religiosity tends to inhibit or reduce a range of alcohol-related behaviors (Bentler, 1992; Donovan and Jessor, 1983; Jessor, 1987; Marcos *et al.*, 1986).

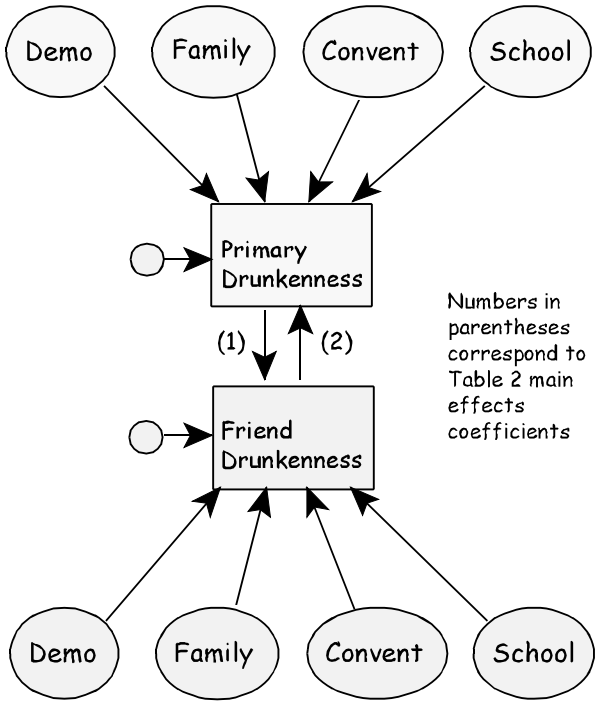

Figure 1. Cross-sectional Mutual Influence Model

Adolescents who are attached to school and involved in activities like sports or clubs have less time to get involved with cigarette smoking (Krohn, Massey and Zielinski, 1988) or delinquency (Hindelang, 1973; Hirshi, 1969). Theoretically, adolescents who do well in school and who are extensively involved will tend to score lower on school alienation. Those who struggle or who are not likely to be involved are more likely to score higher on school alienation, and, thus, to experience a risk factor with respect to frequency of drunkenness.

Conduct problems, where children and adolescents having conduct disorders in childhood, or in school, tend to develop early and/or problematic alcohol use (Barnes and Welte 1986; Robins and McEnvoy, 1989). The theoretical argument is that having trouble in school puts one at risk for deviance, including alcohol consumption.

Mutual Influence Theory of Adolescent Friendship Processes

Figure 1 depicts the theoretical model of the mutual influence process. I use family and individual characteristics as background controls in order to examine explicitly the mutual influence process in actual adolescent friends' alcohol use patterns, and to explore the effect of prior selection on later similarity. The improvement over extant models is the combination of the strengths of each research tradition. The importance of demographic characteristics, peers, families, and conventional affiliations is explicitly modelled while considering both friends simultaneously. Similar to the interactional model, this conceptualization incorporates paths of mutual influence between Friend 1 and Friend 2. Two additional features are noteworthy: each friend reports on his or her own behavior, eliminating a known source of reporting bias; furthermore, the individual and family characteristics of both friends are included in the model. Background characteristics include sex, age, race, religiosity, closeness to family, problems at school, and alienation from school.

The cross-sectional model provides an excellent opportunity to study possible confounding due to omitting the background characteristics of one of the friends. It can help examine how influence mechanisms operate among friends who do not continue longitudinally. Finally, cross-sectional

models create baselines against which longitudinal models of mutual influence may be evaluated. Despite the strength of the cross-sectional model, any observed mutual influence pattern may be the result of another factor. In this case, the greatest potential threat comes from the operation of a prior friendship selection mechanism also known to affect friends' similarity of alcohol behavior. Therefore, the longitudinal tests will control for prior similarity between friends. In the first panel of Figure 2, the cross-lagged model shows the impact of each friend's wave one behavior on the other's wave two behavior. In the second panel of the figure, a simultaneous mutual influence process is tested while controlling for prior friendship selection and behavioral stability.

In each of these two models, other theoretically relevant background determinants of behavior are controlled, as in the cross-sectional models.

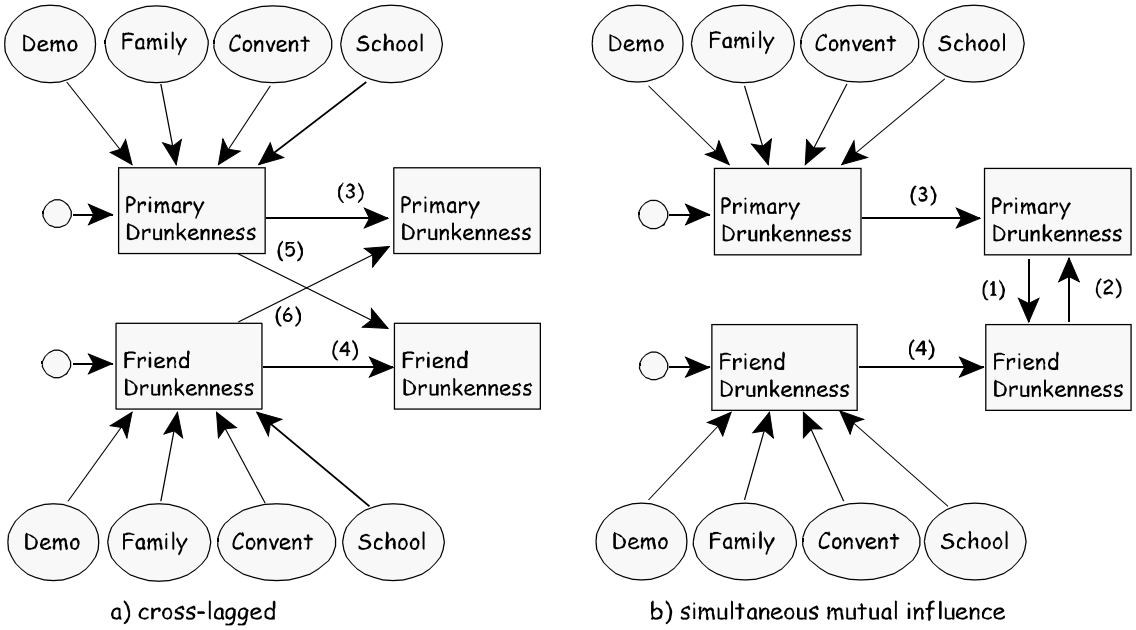

Figure 2. Longitudinal Mutual Influence Model

DATA AND METHODS

Data come from the National Longitudinal Study of Adolescent Health (Add Health) collected 1994-1998 by J. Richard Udry and collaborators at the Carolina Population Center. This nationally representative sample of American adolescents was conducted in eighty communities, and includes students from 134 junior and senior high schools (Bearman, Jones and Udry 1997).

I rely on longitudinal friendship dyads to conduct this study. To address the issue of longitudinal sample availability first, in 1995, 20,745 adolescents completed an in-home administration of the survey. The following year, a second wave of data was collected from 14,738 adolescents. Taking account of adolescents who were dropped from the survey (12th graders and some disabled students), more than 85% of the wave one sample was reinterviewed in wave 2, resulting in a sample of 13,776 adolescents. Of these, only white (57.5%), black (24.2%), and Hispanic (18.4%) adolescents were retained for my study, resulting in an eligible sample of 12,464 adolescents.[2] The proportions

[2] Initially, the study planned to study whether influence processes operated differently in racially heterogeneous friendships; only White, Hispanic, and Black adolescents had sufficient numbers of mixed race friendships to sustain such an analysis.

of blacks and Hispanics are larger than would be expected in the general population because of oversamples of these groups in the original Add Health sampling strategy.

Each of these 12,464 adolescents was asked to nominate at least one best male, and one best female friend in the school pair. That is to say, each student had a roster of student names in his or her junior and senior high school; upon selection, a numerical link was established. In this way, it is possible to link friends in Add Health to one another. The sample of friendships is limited to those comprised of two adolescent friends who participated in the in-home Add Health study. There are 3033 wave 1 and 3417 wave 2 friendship pairs eligible for the construction of longitudinal friendship pairs. When the friendship dyads from both waves are combined to create longitudinal friendship pairs, 2902 primary adolescents contribute 3413 longitudinal friendship pairs to the analysis.[3]

Dependent Variable

The key dependent variable is the frequency of drunkenness in the past year, which captures two important dimensions of alcohol involvement. Alcohol involvement tends to be assessed in terms of quantity, frequency, and alcohol-related problems (Hays and Ellickson 1996; White 1987). The measure used in this study captures the concepts of frequency and quantity (drunkenness, or "very, very high").

Independent Variables

Important risk and protective factors govern frequency of drunkenness at the individual level. It is therefore important to control for such factors so that any impact of friends on one another is interpreted net of these exogenous factors.[4]

Religiosity. In this study, I use indicators of religious involvement that cover a wide range of potential religious behavior by adolescents: frequency of attendance at religious services, importance of religion, frequency of prayer, and frequency of church youth group involvement (alpha=0.90).

School Problems. To represent the concept of school problems, I use four indicators of trouble in school: not getting along with teachers, not paying attention, trouble with homework, and difficulty getting along with other students (alpha=0.70).

School Alienation. My approach to school alienation is at best indirect. I construct a measure including three indicators of Bollen and Hoyle's (1990) cohesion scale that taps into school alienation, which I assume flows from a lack of success at, or involvement in school. The school alienation con-

[3] Given the complicated nature of how my sample is derived, it is important to consider selectivity bias. My general strategy was to compare the overall group of eligible adolescents (n=12,464) to various ways in which sample selection bias may operate: race, sex, absence of friendships, presence in dyads, reciprocation of the friendship, and two different sampling strategies of the original Add Health sampling strategy (core/noncore and saturated/ nonsaturated; see Chantala and Tabor 1999). Evaluating mean differences in ratio-interval and ordinal level data by categorical class generally does not reveal patterns of selectivity. A working paper on the details of the selectivity analysis is available from the author. In the causal analyses presented subsequently, controls are introduced for these sources of potential bias, a strategy recommended by Winship and Radbill (1994).

[4] In the causal model estimations to follow, I use simple summed scores, and report the alpha reliability coefficients. All measurement models were evaluated using confirmatory factor analysis with and without the assumption of measurement error (Bollen 1980, 1989; Joreskog and Sorbom 1993). The decision to use simple additive scales is based on the principle of parsimony, but interested readers may request a working paper on the subject from the author.

struct indicators are: closeness to people at school, feeling of being part of school, happy at school, feel safe at school, and sense that teachers are fair and care about students (alpha=0.77). Those who struggle or who are not likely to be involved are more likely to score higher on school alienation, and, thus, to experience a risk factor with respect to frequency of drunkenness.

Family Context. In this study, I represent the construct of family support with the indicators: parents care; family understands; family has fun together; and family pays attention to adolescent (alpha=0.75).

Table 1 presents descriptive statistics for the 2902 primary adolescent respondents who define the friendship dyads in the sample. The sample is 64% white, averaging slightly over 15 1/2 years of age. Generally, adolescents report very low frequencies of getting drunk in the past year, relatively high levels of religiosity and family support, and fairly low levels of school alienation and school related problems. In other words, these adolescents engage in low levels of problem behavior, experiencing low levels of risk and high levels of protective factors. These adolescents tend to share behavioral similarity with their nominated friends. As Bauman and colleagues have demonstrated repeatedly, American adolescent peer networks tend not, on average, to be deviant (Bauman and Ennett 1994; Fisher and Bauman 1988).

Table 1. Range, Means, Standard Deviations, and Scale Reliabilties: Primary Adolescent Nominators

Variables		Range	Mean	S.D.	Alpha
Alcohol					
	Frequency Drunk	0-7	0.98	1.44	n/a
Conventionality					
	Religiosity	0-17	11.32	5.11	0.9
	School Alienation	0-24	7.44	4.09	0.77
	School Problems	0-16	4.02	2.86	0.7
Parent Relationship					
	Family Support	0-16	12.23	2.62	0.75
Demographic					
	Age	11-21	15.63	1.45	n/a
	Grade	7-11	9.21	1.38	n/a
	Sex	1=male	0.48	0.5	n/a
	White	1=white	0.64	0.48	n/a

Notes: N=2902, the number of primary adolescents nominating friends.
Scores were calculated using simple additive scales, and Cronbach's alpha reported here.
Scale characteristics were also evaluated using confirmatory factor analysis with and without measurement error. The more conservative estimates of reliability (Bollen 1980) are similar to those presented here; therefore, the more parsimonious simple summed scales are used in the analyses.

Table 2: Unstandardized Maximum Likelihood Coefficients
Cross-sectional and Longitudinal Lagged, Cross-lagged Mutual Influence Models

		Model 1 Cross-sectional		Model 2 Cross-lagged		Model 3 Mutual Influence	
Dependent Variables		*Wave 1*	*Wave 2*	*Wave 1*	*Wave 2*	*Wave 1*	*Wave 2*
Primary Drunk (1)		.26***	.41***	--	--	--	.13***
		(0.054)	(0.077)				(.023)
Friend Drunk (2)		.28***	.37***	--	--	--	.06***
		(0.053)	(0.073)				(.022)
Lag of Primary Drunk (3)		--	--	--	.55***	--	.56***
					(.018)		(.018)
Lag of Friend Drunk (4)		--	--	--	.61***	--	.63***
					(.017)		(.017)
Cross Lag of Primary Drunk 5		--	--	--	.16***	--	--
					(.018)		
Cross Lag of Friend Drunk (6)		--	--	--	.12***	--	--
					(.017)		
Primary	Family	-.12***	-.06**	-.13***	--	-.13***	--
		(0.014)	(0.015)	(.015)		(.015)	
	School Problems	.09***	.08***	.09***	--	.09***	--
		(0.013)	(0.015)	(.014)		(.014)	
	School Alienation	0.02	-0.02	.03***	--	.03***	--
		(0.009)	(0.0097)	(.01)		(.01)	
	Religiosity	-.03***	-.03***	-.04***	--	-.04***	--
		(0.007)	(0.007)	(.01)		(.01)	
	Age	.26***	.22***	.33***	--	.33***	--
		(0.031)	(0.035)	(.026)		(.026)	
	White	.30***	.28***	.41***	--	.41***	--
		(0.077)	(0.095)	(.076)		(.076)	
	Male	0.06	-0.03	0.05	--	0.05	--
		(0.065)	(0.07)	(.068)		(.068)	
Friend	Family	-.11***	-.05***	-.12***	--	-.12***	--
		(0.014)	(0.014)	(.015)		(.015)	
	School Problems	.08***	.08***	.08***	--	.08***	--
		(0.014)	(0.015)	(.014)		(.014)	
	School Alienation	.05***	0.01	.05***	--	.05***	--
		(0.009)	(0.0096)	(.0097)		(.0097)	
	Religiosity	-.02***	-.03***	-.03***	--	-.03***	--
		(0.007)	(0.0075)	(.007)		(.007)	
	Age	.27***	.20***	.36***	--	.36***	--
		(0.03)	(0.036)	(.025)		(.025)	
	White	.40***	.40***	.51***	--	.51***	--
		(0.08)	(0.091)	(.075)		(.075)	
	Male	0.003	0.04	-0.01	--	-0.01	--
		-0.066	-0.069	-0.069		(.069)	
Dyad Controls	Saturated	0.06	.19***	0.06	--	0.06	--
		(0.066)	(0.071)	(.07)		(.07)	
	Core	-.17**	-.20***	-.22***	--	-.22***	--
		(0.074)	(0.079)	(.077)		(.077)	

Note: Numbers in parentheses are standard errors. ***p<=.001 **p<=.01 (two-tailed tests)

RESULTS

Cross-sectional models of peer influence

I use maximum likelihood analysis to estimate the models. The data are preprocessed using PRELIS 2.1 to declare the dependent variables as censored below, which helps to take account of the nonnormality in the dependent variables, the primary adolescent's and the friend's frequency of drunkenness (Joreskog and Sorbom 1996). The models are then estimated using LISREL 8.3 (Joreskog and Sorbom 1993). Exogenous variables are allowed to intercorrelate freely, and the error terms of the dependent variables are also allowed to correlate.

For the first look at the mutual influence process, see the cross-sectional Model 1 of Table 2. The dependent variables are numbered parenthetically to correspond to the relationships represented in Figures 1 and 2. This model includes the usual background factors of the primary adolescent (Primary variables) and the impact of the friend on the primary adolescent (Primary Drunk--1). In addition, I allow for a mutual influence process to work. I include the impact of the primary adolescent on the friend (Friend Drunk--2) while controlling for all of the friend's background factors (Friend variables).

The results for friendships in both waves reveal a mutual influence process at work. Friends in wave one have a moderate effect on the primary respondent, while friends in wave two have a stronger impact. As in wave one, however, the effect of each friend on the other is of the same order of magnitude, .41 from friend to primary and .37 from primary to friend. Constraining the effects of the friends on each other to be equal does not result in a loss of fit, supporting the inference that a truly mutual influence process is at work.

The effects of demographic, family, and institutional affiliations are often significant and as predicted. The closer each friend is to his or her family, the lower the frequency of drunkenness net of other variables. Similarly, greater religiosity is associated with lower levels of drunkenness. Alienation from school does not have an impact on the frequency of drunkenness, but experiencing problems in school tends to increase it. The causal order of this effect is investigated further in the longitudinal analyses to follow. Demographic effects exert their predicted impacts: older kids and whites get drunk more. Contrary to many findings, males are no more or less likely to get drunk than females, lending some support to the gender convergence hypothesis (Robins and Martin 1993). The reported estimates of background effects imposed no constraints on the parameters; however, constraining the effects of the friends' background characteristics to be equal does not result in a loss of fit.

I included dyad controls to account for potential design effects resulting from the Add Health design. The saturated schools – where every student in 16 schools was surveyed – contributed half of the friendship dyads in the study. Generally, it has little impact. Of some concern is the persistent negative effect of being a member of the "core" Add Health sample. The "core" part of the sample is the most nearly nationally representative of adolescents. It does not include special over-samples such as twins, or racial and ethnic group over samples. In this study, I follow Winship and Radbill (1994) in controlling for this potential source of bias.

Measures of overall fit are reported in Table 3. About a quarter of the variance in the adolescents' behavior in wave one is explained, and about 15% is explained in wave two. The minimum fit Chi Square is small and significant, and the RMSEA and AGFI each indicate good fit.

Table 3: Overall Measures of Fit

	Model 1 Cross-sectional Mutual Influence		Model 2 Longitudinal Cross-lagged	Model 3 Longitudinal Mutual Influence
R2 Primary in W1	0.24	0.15	0.17	0.17
R2 Friend in W1	0.23	0.15	0.17	0.17
R2 Primary in W2			0.3	0.3
R2 Friend in W2			0.34	0.35
Minimum Fit Chi Sq	18.45	44.92	275.66	269.81
Df	14	15	49	49
prob.	0.19	0	0	0
RMSEA	0.01	0.03	0.04	0.04
AGFI	0.99	0.98	0.96	0.96

Longitudinal Models of peer influence

It may be problematic to assume that the mutual influence processes revealed in these models represent a true equilibrium, or influence processes at all. The reason is because of the possibility of a spurious effect resulting from the selection of friends on the basis of behavioral similarity, among other factors. In the next analyses, I include both time periods in the models while controlling for background factors. Such analyses constitute more rigorous tests of influence processes than those presented earlier by controlling for the behavioral similarity between friends in prior time periods.

Previous approaches to resolving the selection problem have taken transitions to the behavior as their principal focus. The models have generally been simple, controlling at most for demographic characteristics of friends. Selection is inferred when new friends are more like the primary adolescent than old friends are. Influence is inferred when similarity between friends is greater than it was in the prior time period (Billy and Udry, 1985a, b), or when observed similarity patterns conform to hypothetical distributions of selection and social influence processes (Kandel 1978). This study introduces a residual concept for evaluating selection.

In this section, I test the cross-lagged and lagged simultaneous influence models. Note that each model includes the background controls that are theoretically and empirically related to adolescents' frequency of drunkenness. In both models, the direct lag effects represent the most important trajectory from each individual's wave one drunkenness to his or her wave two drunkenness. Individual-level alcohol-related behavior is highly correlated over time; therefore, I include a direct lag. The errors of the friends' frequency of drunkenness are allowed to correlate to specify the models, and to account for the prior relationship in wave one.

In wave two, the longitudinal mutual influence process is modeled in two ways. First, I represent the influence process with a cross-lag specification, in which each adolescent's wave one behavior influences the other adolescent's wave two behavior. Second, I specify a contemporaneous mutual influence process while controlling for prior behavior and background characteristics. Because the model is accounting for previous levels of individual behavior and similarity between the friends, these mutual paths of influence constitute conservative tests of the influence process. Any significant effects in the influence paths are interpreted as evidence of an influence process.

Model 2 of Table 2 shows the results of the cross-lagged longitudinal model. Coefficients are shown in two columns for each model. The Wave 1 column of each model shows the wave one background coefficients of both the primary adolescent and the friend nominee. The second column of Model 2 shows the direct lag and cross lag mutual influence effects in wave two. Specifically, the coefficient for "Lag of Primary Drunk (3)" represents the effect of the primary respondent's wave one drunkenness on his or her wave two drunkenness, while the coefficient for "Lag of Friend Drunk (4)" represents the stability of the friend nominee's behavior over time. The coefficients of primary theoretical interest are "Cross Lag of Primary Drunk (5)" and "Cross Lag of Friend Drunk (6)." These show that for each increase in the friend nominee's wave one frequency of drunkenness, there is a .16 increase in the primary adolescent's drunkenness. Likewise, for each increase in the primary adolescent's wave one frequency of drunkenness, there is a .12 increase in the friend nominee's wave two drunkenness. The family, demographic, and institutional influences operate as they do in the cross-sectional model.[5] Although the chi-square becomes significant, indicating a loss of fit, this is likely due to the large number of parameters. The AGFI and RMSEA continue to indicate good overall model fit.

Model 3 is the longitudinal representation of the mutual influence process investigated earlier in Model 1. The coefficient "Primary Drunk" represents the impact of the friend nominee's wave two frequency of drunkenness on the primary adolescent respondent. The coefficient "Friend Drunk" represents the impact of the primary adolescent's wave two frequency of drunkenness on the friend nominee. Although the coefficients are of smaller magnitude, they are significant at the .001 level. Background effects and measures of fit remain similar to earlier models.

Both Model 2 and Model 3 constitute conservative longitudinal tests of the mutual influence process. In each, prior behavior and background factors are controlled. Including the earlier frequency of drunkenness by the friends controls for prior similarity in their behavior. This allows examination of the mutual influence process purged of prior influence and selection processes. Comparing the longitudinal models to the cross-sectional model, one sees that the mutual influence process persists, but is attenuated. Such a finding is consistent with Kandel (1978a) and others: peer influence is an important component of substance use, but selection of similar friends is also critical to understanding behavioral similarity between friends. Furthermore, family, demographic, and institutional predictors remain important when controlling for peer influence, and over time. This is the first study to examine friendships while controlling for relevant social forces other than the peer.

SUMMARY AND DISCUSSION

Influence processes in adolescent friendships--at least with respect to drinking behavior--tend to be mutual rather than unidirectional. Both friends in dyads contribute to the dynamic leading to the establishment of a behavioral pattern. Furthermore, there are multiple direct, individual-level determinants of adolescent drunkenness that operate in addition to the mutual friendship influence processes. Although previous studies have demonstrated different aspects of this social process, this is the first to combine individual-level background factors of actual adolescent friends to study a

[5] The measurement stability models (results not shown) indicated a high degree--but not perfect--stability of these concepts. Ultimately, the longitudinal structural models were evaluated with the assumption that the impact of background factors is stable over time, controlling only for wave one background effects and wave one drinking behavior. The latter, more parsimonious model does not result in a significant loss of fit from a model in which the background effects are controlled in both waves.

mutual influence process. Furthermore, including a longitudinal component allows a conservative test of influence processes by controlling for prior behavior and friendship selection, known sources of behavioral stability and similarity.

The unique view of adolescent friendships provided here underscores the need to collect dyad and social network data to illuminate social dynamics. This study examines one behavior in one type of social network, the best-friend dyad. This is one of many types of studies that may be undertaken with data sets such as Add Health to study how friendship contexts affect key social behavior. Furthermore, including individual characteristics contribute to the understanding of behavioral dynamics in networks.

In addition to addressing critical theoretical and empirical limitations, this study raises important policy implications. If, indeed, adolescent behavior is established and maintained in social contexts, then it is important to recognize that healthy behavior--like risk behavior--is socially determined. This study demonstrates that those with high frequency of drunkenness tend to associate with others like them, and to reinforce one another's behavior over time. Often, this is where public health pronouncements end. However, it is equally supported here that adolescent friendships create social dynamics that exert protective effects such as reducing the frequency of drunkenness. Such an implication for policy suggests that peer resistance intervention campaigns may be teaching the wrong response to healthy friends. At the same time, the study also reinforces the idea presented by a current anti-drug message: parental involvement has a positive impact in helping adolescents shape healthier behaviors. Furthermore, involvement with conventional institutions such as schools and religion also exert strong protective effects.

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Peer Network, Sensation Seeking, and Drug Use among Junior and Senior High School Students[1]

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This study argues that both individual and social factors are strong influences on use of drugs by adolescents and teenagers, and, further, that these factors may interact. Thus, both individual and social factors offer avenues for targeting prime at-risk groups and designing messages and programs to reach them. The primary individual factors explored here are prior drug use, attitudes toward drug use, closeness toward family, susceptibility to peer pressure, and sensation-seeking, and the social factors explored are the attitudes, behaviors, and sensation-seeking of respondents' named friends/peers. In particular, peers' own responses are used instead of respondents' estimated or perceived peers' drug attitudes, behaviors and sensation-seeking. These factors are included in a model that is tested over three cohorts of an average of 1900 junior- and high-school students, each measured at three successive grades. Both one's own sensation-seeking, and peer influence (their drug use, and their sensation-seeking), along with one's own prior drug use, are the main predictors of specific drug use at the end of the periods.

INTRODUCTION

Before we can develop a comprehensive theory of drug use prevention that guides our interventions, much more needs to be known about the relationships among the various motivating forces leading to drug use. Although the mass media offer the most effective means of reaching large audiences and school-based programs offer the most parsimonious means of repeated instruction, unfortunately, neither the mass media nor interpersonal approaches have a history of consistent success. For example, though Project DARE (Drug Abuse Resistance Education) has received considerable press and research fanfare, overall analyses do not find that this traditional form of prevention has much effect. Ennet and Rosenbaum's (1994) longitudinal evaluation of Project DARE in 36 schools

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(1,334 adolescents) in Illinois found only a limited effect of DARE's impact on student drug use immediately following the intervention, and none for either continued or emerging impact on drug use 1 or 2 yrs after. Of relevance to the current study, DARE had no effect on social variables (there, peer resistance skills). More generally, Ennett and Tobler (1994) meta-analyzed eight methodologically rigorous DARE evaluations, finding that for all outcomes, the DARE effect size means were considerably smaller than those of programs emphasizing social and general competencies and using interactive teaching strategies. Similarly, Hallfors and Godette (2002) report that 82% of 81 school districts in 11 states were recently using the DARE program, even though research shows small short-term and no long-term effects on prevention.

This study analyzes influences in drug use in a cohort of sixth through eleventh graders. While it includes some of the more familiar influences identified by health communication and drug use research, this study has four particularly innovative components. First, it emphasizes the influence of peer attitudes and behavior at the respondent's ego-network level. Second, it emphasizes the influence of the need for sensation-seeking at the individual level. Third, it uses peer measures rather than respondents' perceptions of peer attitudes and behavior. Fourth, it tests a model of influence both across time and across cohorts of grade-school students. Panel studies of adolescents have concentrated on the relation of social psychological variables (e.g., self-esteem, distress) and peer influences to drug use (Kandel, 1985; Kandel, Smirch-Fagan, and Davies, 1986; Kaplan, Johnson, and Bailey, 1987; Kaplan, Martin, and Robbins, 1984). However, few if any studies consider individual and network variables in combination with peer measures simultaneously, permitting a more valid assessment of their contributions individually and together over an extended period of time.

REVIEW OF RELEVANT RESEARCH

Drug Use

Drug use, even of cigarettes and alcohol, is not common among sixth graders, but increases substantially in immediately following years (Clayton *et al.*, 1988). And the climate of opinion toward cigarette smoking has been changing recently, which Flay (1987) attributed in part to continued reports in the media over a period of years. However, while drug use such as marijuana had been declining through 1992, it has been rising in past years, along with more positive attitudes by high school students toward such use (Cappella *et al.*, 2001). Use of these drugs, whether early or later in life, is still a matter of great societal and individual concern. Considerable research and funding has been devoted recently to reducing American youth's attitudes toward and use of drugs, such as the 5-year National Youth Anti-Drug media campaign (Cappella *et al.*, 2001).

Peer Influence

Certainly socialization forces from family, school, and church influence adolescents' attitudes toward the use of drugs (Elliott, Huizinga and Ageton, 1985; Massey and Krohn, 1986; Oetting *et al.*, 1991). Research provides considerable support for the importance of peer networks in influencing many behaviors and attitudes (Friedkin, 1998; Friedkin and Cook, 1990; Rice, 1993), including use of alcohol, cigarettes, and other drugs (Flay *et al.*, 1983; Kandel, 1985).

Drug use among high school students was more strongly associated with drug use among peers than with any other variable in Kandel's study (1985) and social support for drug use was the strongest six-month predictor of drug use in Sadava's study of college students (1973). Wister and Avison

(1982) also found that peer group pressure among college students is an important correlate of marijuana use. Just over 1,000 students completed a survey concerning their, and their friends', beer drinking behaviors, in their 6th grade and again in their 7th grade in Ennett and Bauman's study (1991). Peer drinking indirectly influenced adolescent drinking by shaping adolescents' norms on drinking, drinking preferences, and expected consequences of drinking related to friends and problem behavior. Parental alcohol use and peer attitude toward alcohol had primarily direct influence on adolescent beer drinking.

A fair amount of research on peer influences has focused on tobacco use. From a network analysis of 461 9th graders, Ennett and Bauman (1994a) identified 87 adolescent friendship cliques. While smokers tended to be in cliques with smokers, most cliques were comprised entirely or mostly of nonsmokers, implying that friendship cliques may contribute more to the maintenance of nonsmoking than to the onset and maintenance of smoking. Ennett and Bauman's (1993) study of 1,092 9th graders in five schools in one school system asked the students to name their three best friends. At four of the schools, being a current smoker was significantly more likely for isolates than for clique members and liaisons. These effects were not explained by demographic variables or by the number of friends who smoke. Their related analysis (Ennett and Bauman, 1994b) of students (n=926) in five schools at two time periods concluded that influence and selection contributed about equally to peer group smoking homogeneity, but, as most smokers were not peer group members, selection provided more of an explanation than influence for why isolates smoke. An innovative analysis of 719 matched pairs of parent (usually mother) and child suggests that parents' former smoking is associated with adolescents' current smoking, and family influences were family disunion and parents' awareness of their child's activities (Bailey and Ennett, 1993).

Research shows consistent support for the relationship between one's own, and one's peers', delinquency. This is particularly likely as adolescents move from middle school to high school, where they are confronted with larger and more heterogeneous sets of students, so their own identity and being known become more salient and even difficult. Thus individuals become especially susceptible to peer influence, and groups work hard to strengthen peer cohesion and maintain group norms. However, adolescents belong to multiple friendship groups with varying cohesion and openness, so the total number of delinquent friends is an insufficient conceptual and empirical factor. Indeed, different delinquent groups tend to specialize in their delinquencies, group structures affect delinquent behaviors, and, counter to social control theory, there are generally few differences in friendship relations compared to delinquent and nondelinquent groups (Giordano, Cernkovich and Pugh, 1986; Kandel and Davies, 1991).

As most prior studies of student/peer influences on drug use represent peer attitudes and behavior by the respondent's estimation or perception of those attitudes and behavior, instead of the peers' own reported attitudes and behaviors, one important question is the extent to which these results are confounded by overestimates or common-method bias. We will return to that important methodological question.

Peer Influence Mechanisms

Social Control or Social Learning. There seem to be two major schools of thought on how peer networks influence adolescents' drug use. One may be called the social control model. This perspective argues that drug users experience less social control than non-users, due to personal isolation or weak personal ties, and thus are more disinhibited toward drug use, and tend to associate with other drug users who have also experienced less social control (Gottfredson and Hirshi, 1990).

Oetting and Beauvais (1987) argue that adolescents in general are embedded in clusters of similar peers, members of which all influence each other. As an example of weakened social control, adolescent smokers are less likely to have values centered around family, school or church (Jessor and Jessor, 1977) and thus are more likely to try deviant behavior and associate with deviant peers who model such behaviors (Massy and Krohn, 1986). Members of a 'punk' gang with weaker bonds to school, family and a home, were more likely to hold delinquent attitudes and to be more integrated into the gang (Baron and Tindall, 1993).

A social control perspective would predict weaker links, less multiplex ties, less support, more conflict, less group cohesion, less attraction to the group, and smaller groups. That is, there is less social control exerting influence on an individual's attitudes and behavior. Thus this model implies that similar patterns of drug use are due largely to selective association; that is, that one becomes associated with people who have similar drug attitudes or behaviors, due to similar social control contexts, and this largely explains the later similarity in drug usage or attitudes. That is, there is less influence toward drug use or attitudes, than common habits that drew the peer network together in the first place.

The other school of thought may be called the social learning model. This perspective argues that drug users' networks may be just as densely knit as nonusers', but present different role models, social behavior and values. Members develop or reinforce attitudes and behavior through social learning and conformity to group norms (Kandel and Davies, 1996; Skog, 1986). This model argues that one may develop friendships based on similarities, but that later similarity in drug usage or attitude comes about through role modeling, social learning and converging norms. Reference group theory, for example, suggests that salient groups serve individuals as a frame of reference for purposes of self evaluation and that individuals will often imitate the behavior of reference group members to improve their own self-concept. Analysis of a three-wave panel study of junior high school students conducted by Kaplan, Martin, and Robbins (1984) also found support for the viewpoint that drug use is a consequence of interaction with and an attempt to imitate the behaviors of peer group members.

These two distinctions imply that selective association must be separated out first in order to accurately assess any peer influence. For instance, Urberg, Cheng and Shy (1991) calculated the difference between the respondent's smoking and the named best friend's "actual" smoking as the peer influence variable, to remove the effect of selective association (Epstein, 1983; this measure was uncorrelated with the perceived proportion of friends who smoked). Cohen (1983) argued that similarity among peers fosters stability in attitudes and behavior. Davis (1963) also argued that similarity toward each other or toward a third person or object creates tensions toward cognitive and social balance – that is, transitivity. Thus if peers are similar in their smoking behavior, then stability of that behavior is likely, but if they are different, then there exists a pressure for the adolescent to change behavior. Thus if this difference is positive, social learning theory would predict an increase for one's smoking from one year to the next year. Indeed, Urberg *et al.* (1991) found significant changes in this difference score. This peer influence variable was stronger for 8th graders than 11th graders, and for boys than girls. However, the perceived proportion of friends who smoke was a stronger influence for 11th than 8th graders. The correlation between the respondent's smoking and friend's smoking was .09 for 8th graders, and .47 for 11th graders. This implies smoking is not, for 8th graders, a criterion, or at least not one salient enough, for selecting friends. The high 11th grade correlation is due to both selective association and cumulative peer influence. The authors also concluded that the influence process was not different for changing non-smokers to smokers versus

ongoing smokers (contradicting propositions by Flay *et al.*, 1983, and Leventhal and Clearly, 1980).

Krosnick and Judd (1982) found that perceived friends' smoking was a stronger influence for 8th graders than 5th graders, and Ary, Biglan, Gallison, Wiessman, and Severson (1983) found a stronger influence for higher grades (9th, 10th) but only for initial non-smokers. Other researchers have also found that early adolescents are likely to be more influenced by their peers (Berndt, 1979; Brittain, 1963), although some (Chassin, Presson, Sherman, Montello, and McGrew, 1986) find little grade influence once the effect of selective association was removed. Epstein (1983) argues that older adolescents may be more influenced by personality or behavior similarity. Both Cohen (1977) and Kandel (1978) found about equal influences of selective association and peer influence on similarity in smoking behavior, whereas Urberg *et al.* (1991) found the peer influence difference score explained approximately three times more variance in later smoking than did the perceived proportion of friends who smoked. These results imply a social learning effect in the earlier grades and a social control effect later on.

Haynie's (2001) research into delinquency extends social control theory (whereby bonding constrains natural tendencies toward antisocial behavior) (Hirschi, 1969) with differential association theory (Warr and Stafford, 1991), into a more general theory. Not only are some group members more susceptible to peer influence depending on their location in a network, but some networks have greater social control based on their structural characteristics. In this way, both nondelinquency, and delinquency (in the present study, non drug use and drug use), can conceivably be fostered through group influence. Social control through a strong group norm is not necessarily antithetical to delinquent behavior or drug use. Haynie (2001) shows that there are both direct influences (on delinquent peers) but also moderating influences of network structure. Respondents' delinquency was predicted by race, gender, middle of the age range, one-parent family, public assistance, involvement with friends, but lower friend attachment, lower parent attachment, lower school attachment, more friends' delinquency, and greater popularity. The strongest influence was peers' reported delinquency, but each additional friendship nomination received increased delinquency by 2%. A simple social control model does not explain this set of predictors. Further, the influence of peers' delinquency was significantly greater in networks with delinquent peers, that were dense, more centralized, and had more in-degrees popularity. There was a significant influence of an adolescent's friends' delinquency on the adolescent's delinquency, but this relationship was stronger in cohesive networks (see also Agnew, 1991). Haynie (2001) concludes that it is not that more cohesive, centralized or popular groups have stronger norms against delinquency, but that the influence of delinquent or nondelinquent peers is greater in such groups. So the results support both social control (social bonds constrain behavior) and differential association/social learning (network context and social norms influence behavior) (Sutherland and Cressey, 1974).

Source of Peer Influence. Another distinction has to do with the origin of the network influence. Is it due primarily to one's best friend or to a more generalized, subjectively perceived peer group? Admittedly, the inclusion of one or more named best friends creates some practical research problems: data collection is more difficult, the best friend may not have the most influence, and smokers are more likely to be out of grade or out of school than non-smokers. Other questions remain. Does the primary influence derive from an individual's whole contact network (such as several best friends, or a clique of densely interconnected people), or from the "social crowd" with which one does, or wants to, identify (such as structurally equivalent others, all of whom do not necessarily communicate with other, but are seen as joint members of a particular "social crowd"; Urberg, 1992)? Best friends may be more influential than other friends for drinking and smoking

(Lanes, Banks, and Keller, 1972), while the whole peer group, including influential leader, may be more influential than a single best friend (Kandel, Kessler, and Margulies, 1978), and the "social crowd" can influence one's drug use.

There are of course different ways of conceptualizing a peer or group norm. Friedkin and Cook (1990; see also Friedkin, 1998) conclude from simulations and empirical analyses that the best model involves: (a) the strength of group social influence is negatively related to the strength of exogenous conditions affecting group member opinions, and (b) social influence is a fixed resource so each individual can distribute the same amount of influence, although differently to each other group member. This leads to the conclusion that a reasonable, though still artifactual, conceptualization of "group norm" is the mean of the attitudes of an individual's group peers.

Rice (1993) discusses several conceptual and operational distinctions necessary to determine the exact nature of those significant others or of the influence group. One is whether the referenced others are generalized or specific -- that is, whether the 'group' or 'friend' or 'salient other' is a general category whose specific members are not identified, or whether the group or its constituents are specified. For example, 'your friends' or 'the artist crowd' is a generalized group, whereas 'the three best friends that you named above' is a specified group. The second is whether the attitudes or usage of those others is estimated or 'actual.' For example, asking a respondent what is the best friend's attitude toward, or usage of, alcohol involves an estimation, whereas identifying the best friend and then obtaining the best friend's attitude or usage represents an 'actual' response (even if misremembered by that friend). So, for instance a common measure of peer influence is to ask a respondent what is the general attitude toward drugs of his friends; this is a 'generalized estimate.'

We know two things about such generalized estimates. First, in matters such as friends' smoking, estimates (whether for general or specified others) are generally over-estimates (Sherman *et al.*, 1983; Urberg *et al.*, 1990). This over-estimation leads to a 'false consensus,' a particular kind of 'social projection' of one's own attitudes onto a putative other (individual or group). Consequently, second, one's own generalized estimates are much more highly correlated with the respondent's attitude toward use than are the specified others' actual attitudes (Rice, 1993). Urberg *et al.* (1990) tested a structural equation model of role modeling, direct pressure, and indirect normative pressure on adolescents' smoking. They found the false consensus effect of over-estimating (perceived) friends' smoking: there was a higher influence of perceived friend's smoking on self smoking than of friend's actual smoking (similar to Rice and Aydin's results, 1991).

We should note that under most social influence models, the actor is assumed to have consciously selected his or her normative referents, and is most influenced by the subjectively perceived norms of those referents. But some situations would make identification, much less recall, difficult, leading to a greater susceptibility to social exchange considerations (even implicit, unrecognized ones) than to willingness to comply with subjective norms of the actor's social network, or to subjective norms of the actor's emotionally close/supportive others (Richard, Bell, and Montoya, 2000). Richard e*t al.*'s study of female cocaine smokers found that these women have low power to influence condom use by their sexual partners, are therefore more dependent, and are thus more influenced by those who provide various social and resource exchanges than by subjective or social support norms. For those women who also experienced low self-efficacy, none of the three sources of norms was influential, as they had little material or psychological power.

Sensation-Seeking

The problem of persuading persons to engage in or avoid specific behaviors has been a subject of research for many years. Early experimental research dealt with such questions as the level of fear appeals in getting people to brush their teeth (Janis and Feshbach, 1953), and early survey research considered the effectiveness of mass media in persuading individuals to vote for particular candidates (Berelson, Lazarsfeld, and McPhee, 1954; Lazarsfeld, Berelson, and Gaudet, 1948). For many years, research on persuasion was influenced by findings from these and similar studies, which led to communication models that assumed a high level of rationality on the part of the receivers (Festinger, 1964), a relatively weak role for mass media, and the assumption that individuals could, for the most part, only be influenced by salient other persons or groups.

A modification of these views emerged from later studies. From the perspective of the individual, the 'rational' model of human behavior has given way to more complex models of human beings as information processors, guided both by cognitive (Lazarus, 1982) and affective (Zajonc, 1980) forces. Depending on the nature of the stimulus message and how much it directly involves the subject, it may generate considerable excitement or it may be largely ignored as the subject moves on to something providing more stimulating, even simply — and without being aware of it — shifting to stimulation supplied from his or her own thought stream; i.e., daydreaming (Palmgreen, 1976). The level of arousal needed varies across individuals (Zuckerman, 1978) and affects the kinds of stimuli to which individuals will likely attend (Christ and Medoff, 1984; Donohew, Finn, and Christ, 1988).

One indicator of arousal need is sensation-seeking. Need for sensation — which has been found to be associated with preferences for novel, complex and ambiguous stimuli (e.g., Zuckerman, 1978) – has been measured both as a personality trait (Pearson, 1970, 1971; Zuckerman, 1978, 1983; Zuckerman, Kolin, Price, and Zoob, 1964) and as part of a more general activation theory of information exposure (Donohew, Finn, and Christ, 1988).

A number of studies have linked sensation seeking with biochemical measures, including Monoamine Oxidase (MAO), an enzyme which regulates the levels of monoamine neurotransmitters in brain neurons. Lower levels of platelet MAO tend to be associated with higher levels of sensation seeking (e.g., Murphy, Belmaker, Buchsbaum, Martin, Ciaranello, and Wyatt, 1977). The disinhibition subscale of the Sensation-Seeking Scale (SSS) is positively associated among males with levels of testosterone and estrogens. Although there is evidence of high heritability of the trait (Fulker, Eysenck, and Zuckerman, 1980), the environment also is thought to account for at least a third of its variance (Zuckerman, 1978).

Studies consistently indicate significantly greater likelihood for high-sensation seekers, at both the junior and senior high school age levels, to use marijuana or have higher levels on an omnibus combined measure including marijuana, alcohol, cocaine and other substances (Segal and Singer, 1976; Zuckerman, 1978). Positive relationships were found between alcohol use and sensation-seeking (Earleywine and Finn, 1991) and between alcohol use and the disinhibition subscale in college student populations (Schwarz, Burkhart, and Green, 1978) but not among alcoholic populations (Kish, 1970). Individuals with higher needs for sensation begin using drugs earlier and are much more likely than lower-sensation seekers to become regular users (Bares, Labouvier, and White, undated; Schwarz, Burkart, and Green, 1978; Segal, Huba, and Singer, 1980; Zuckerman, 1983; Zuckerman, 1978). This may be due to both the experience of risk or illegality associated with drug use (one form of novelty), as well as neurological stimulation from use of the drug itself (Segal *et al.*, 1980).

Persons with high need for sensation also tend to tolerate or even require stronger messages for attracting and holding their attention (Donohew, 1982; Donohew *et al.*, 1980; Donohew, Finn, and Christ, 1988). Individual differences in need for sensation and, to a lesser extent, in prior drug use, play a major role in responses to drug use prevention messages about marijuana, including exposure preferences, physiological responses and changes in attitude and behavioral intentions (Donohew, Helm, Cook, and Shatzer, 1987). Thus the concept of sensation seeking offers an avenue for targeting prime at-risk groups and designing messages and programs to reach them (Clayton, Cattarello, and Waldon, 1991).

Sensation-seeking and Peer Influence

If need for sensation is such a powerful motivating force for drug use, how does one account for the demonstrated effects of environmental forces, such as peer influence? Sensation seeking and peer influence are not necessarily contradictory explanations. It is plausible that individuals with high sensation seeking needs will tend to have similar interests and be members of the same peer group. It also is plausible that both individual and social forces are operating in a two-way causal fashion, in effect 'causing' each other in a reinforcing spiral. Individuals with high need for sensation may be likely to become drug users unless external sources of influence, such as peer group and family (sources of social control), intervene to influence them to abstain or divert their attention to other sources of stimulation. And individuals with lower needs for sensation may be unlikely to become drug users unless they are pressured into doing so by peers or strongly influenced by family.

MODEL

The prior discussions lead to the general overall model. In the study reported below, other, more general influences, such as gender and school and family influences, were controlled for statistically. The model was analyzed for differences in drug (alcohol, cigarettes or marijuana) use for each cohort.

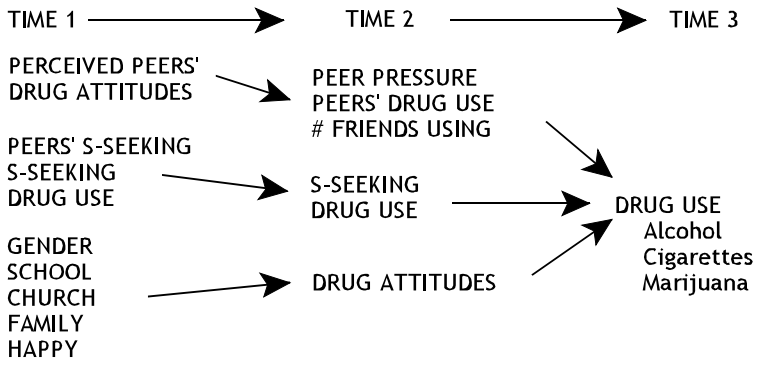

Figure 1. Model of Individual and Peer Influence on Later Drug Use

Taking into account the prior research and conceptualizations, Figure 1 presents a summary model of influences, intervening variables and outcomes over time. At some initial time period Y1, church norms, school norms and parental norms create positive pressure against drug use at Y2, which decreases drug use at Y3. Gender influences drug use and drug attitudes. Peer sensation-seeking at Y1 is associated with one's drug use at Y1, and peer drug use and one's drug attitudes at Y2. Peer sensation-seeking and one's drug use at Y1 influence one's drug attitudes at Y2, which, along with peer drug use at Y2, influence one's drug use at Y2. One's drug use at Y1 and Y2, peer drug use at Y2, and one's drug attitudes at Y2, all influence one's drug use at Y3.

Table 1. Sample Sizes, Response Rates, and Cohort/Year Samples

Used Drug in Past Year or Month		Cohort 1 (1988) N	Pct.	Cohort 2 (1989) N	Pct.	Cohort 3 (1990) N	Pct.
				Year			
		8th grade		7th grade		6th grade	
		1620a	*78.2b*	*1890*	*82.1*	*2173*	*89.8*
Year:	Cigarette	1609c	29.9d	1879	24.9	2153	14.0
	Alcohol	1604	38.8	1875	24.6	2147	13.9
	Marijuana	1609	11.6	1880	5.5	2148	2.0
Month:	Cigarette	1607	16.7	1877	11.8	2158	5.7
	Alcohol	1607	17.4	1881	10.1	2144	5.3
	Marijuana	1609	6.3	1876	3.5	2142	1.0
		9th grade		8th grade		7th grade	
		1346	*65.0*	*1542*	*67.0*	*1906*	*78.7*
Year:	Cigarette	1332	34.5	1529	29.1	1899	21.3
	Alcohol	1328	51.1	1525	38.4	1898	20.8
	Marijuana	1329	15.7	1527	9.4	1899	3.1
Month:	Cigarette	1330	20.8	1531	16.0	1900	10.6
	Alcohol	1327	27.1	1529	20.1	1899	7.9
	Marijuana	1338	10.2	1531	6.3	1897	1.4
		10th grade		9th grade		8th grade	
		1144	*55.2*	*1452*	*63.0*	*1675*	*69.2*
Year:	Cigarette	1138	40.9	1442	41.4	1666	32.4
	Alcohol	1137	59.9	1443	55.4	1660	39.2
	Marijuana	1139	21.3	1444	20.4	1664	9.4
Month:	Cigarette	1139	25.3	1438	26.6	1663	16.9
	Alcohol	1138	34.0	1441	31.9	1665	19.6
	Marijuana	1141	14.1	1448	13.0	1670	5.6

a: N of this particular sample; b: percent relative to initial cohort sample (from Clayton, Cattarello, Day, and Walden, 1991); c: N responding to this question; d: percent users relative to respondents to this question.

METHOD

Study Design

The sample comes from a NIDA study of adolescents involving survey evaluations of Project DARE, a primary prevention program taught to sixth graders in the Lexington, Kentucky, school system, whose attitudes and behaviors were tracked several years (Clayton, Cattarello, Day, and Waldon, 1991). The DARE longitudinal survey started with a sample size of approximately 2100; it is a replicated panel study. In 1987-1988, 23 schools were randomly assigned to receive DARE instructions, while eight schools were assigned to a no-treatment control condition. In the Fall of 1988, and in subsequent years, all 31 elementary schools received DARE instruction. The '87-'88 sixth graders were followed for four additional years. 1988-1989 sixth graders for three additional years, 1989-1990 sixth graders for two more years, 1990-1991 sixth graders for one more year, and 1991-1992 sixth graders for just that year. The present study added on an additional year of panel surveys, for 1992-1993.

Table 1 shows the initial sample sizes for each cohort, the remaining number and percent at each subsequent time period, and the cohort time periods used in the present study. Sample sizes all

began with around 1900 to 2175 subjects, and by the fifth post-DARE survey the first cohort included around 1150 subjects.

The surveys were completed by mass self-administration at each of the junior high schools, taking about 45 minutes, with makeup sessions for those absent. The percentage of those refusing to fill out the questionnaire at any given time was very low. Approximately 15-20% of the students each year moved into a new school district. Some students dropped out at age 16 or 17. And a small percentage had difficulty completing the questionnaire due to mental incapacities or lack of time in the classroom setting. Every attempt was made to keep dropouts in the study because their rates of drug use are higher (Clayton and Voss, 1982). Students chronically absent or those who subsequently dropped out or moved were contacted by the study director at their home or by mail to complete the questionnaire. Overall response rate of those remaining in the relevant population was close to 99%. However, as the current focus is on peer influences, we included only those respondents who named at least one best friend (they were asked to name up to three), who was also in the data set (that is, in the school system and responded to the survey), at all of the three time periods. This means we are analyzing only from about a third to a half of the original respondents.

MEASURES

Sensation-seeking was computed as the mean of the 24-item scale developed by Zuckerman (1978). Family distance was computed as the mean of seven items concerning relations at home. Negative attitudes toward drugs were measured by four items concerning drug usage in general. Peer pressure was measured by nine items indicating how susceptible one is to pressure from friends and others. One's own drug use was measured by asking how many times in the last year one smoked cigarettes, drunk a full glass of alcohol, or smoked marijuana. Perceptions of friends' drug use were measured by asking for categories of number of one's friends who used each of the three drugs. Peer attitude toward each of the drugs was measured by how good/bad "most students in my grade" thought the drug was. The survey instrument included other demographic and situational measures – sex, how frequently one went to church, how well the student was doing in school, and how happy the person was at the time.

Respondents were asked to name three friends in one's same grade. If those named alters also completed a questionnaire, their sensation and drug use scores were added to the respondent's data record for that time period. One's peer measures were computed by taking the mean of the named peers' sensation-seeking or drug use (for each of the three drugs). For a small number of cases, the 2nd or 3rd-named peers did not report their sensation-seeking and/or drug use. The method used here is similar to that used by Donohew *et al.* (1999), Krohn (1986), Haynie (2001), Rice and Aydin (1991) and others. A broad survey collects information on nearly all members of a social system. Each actor names alters with whom they interact. Data exists for both the actors and alters, so alter data can be integrated into actor records. Thus alter attitudes and behaviors can be tested, after being weighted by extent of interaction with the actor, and averaged, for influences on actor attitude and behavior, distinct from actor's perceptions (estimations and projections and generalizations) of each alter's attitudes and behaviors (Rice, 1993). Perceptions of others' norms or behaviors may be potent predictors, largely because of common method bias and pressures toward cognitive consistency, but they are poor levers for social change or communication messages when incorrect. For example, Valente *et al.* (1997), in their study of the social influence on and awareness of network partners' use of contraceptive methods among 9 voluntary associations of Cameroonian women, when comparing a respondent's report of their partner's use, and a network partner's report of their

own use of contraceptive methods, found that only about 31% were correct, 28% were incorrect, and the rest said they did not know. But whether they were correct or incorrect, perceiving that the other used a method, whether correct or not, was a significant predictor of the respondent's using a contraceptive method.

Table 1 provides descriptive statistics on drug usage by cohort and year. Table 2 provides the wording of the questions for separate items and constituting scales. Table 3 provides descriptive statistics for the items and scales across the nine datasets (three cohorts, three time periods).

Analysis Procedures

Most of the analyses used various combinations of waves of the panel data. Panel analysis researchers have generally rejected change scores and cross-lagged correlation approaches and moved to regression methods (Bohrenstedt, 1969; Markus, 1979). These researchers and others (Kessler and Greenberg, 1981) note that care must be taken because of the imprecise measurement of ostensibly 'perfect' indicators repeated over time, and they point to the advantages of latent structure equations. However, Heise (1970), recognizing the possibility that ordinary least squares (OLS) regression techniques underestimate parameters in panel models, points out that OLS has computational efficiency in assessing the initial examination of models using multiple analysis of variance, and multiple regression as a step in developing testable latent structure models for future research. Thus the results of these analyses are preliminary.

RESULTS

Sensation-Seeking and Drug Use Over Time

Respondents' and mean peers' reported use of alcohol, cigarettes and marijuana all increased significantly at each time period in each cohort, except for cohort three (C3) respondents' and mean peers' use of marijuana between Y1 and Y2. The percentage of the study's respondents who indicated they had ever used cigarettes ranged from 16% to 41%, alcohol from 16% to 60%, and marijuana from 6% to 21%. Except for some 6th graders, any use of alcohol is greater than any use of cigarettes. Respondents' and mean peers' sensation seeking also increased significantly across each time period (for respondents, from a low of 2.88 for C3Y1 to a high of 3.36 for C1Y3; for peers, from a low of 2.90 in C3Y1 to a high of 3.45 in C2Y3). While it may well be the case that respondents who stay in the study across all three time periods may have higher or lower drug use on sensation seeking than those who drop out, these comparisons used paired t-tests, so that the differences are not biased by this possibly confounding factor. Note too, that although we have not conducted significance tests, it does appear that the cohort differences, when aligned with the same years, mirror the time period differences: as the respondents get older, in general their drug use and sensation-seeking levels rise.

Correlations of Self and Peer Sensation-Seeking Over Time

Respondents' mean sensation seeking was strongly correlated across time, and for C1 and C3 is weaker across Y1-Y3 than either Y1-Y2 or Y2-Y3, as would be expected. However, for C3, it is stronger between Y2-Y3 ($r=.88$, all correlations $p<.05$) and Y1-Y3 (.85) than Y1-Y2 (.67). Mean peer sensation seeking is significantly, but weakly, correlated across time periods (around $r=.3$), as would be expected, insofar as different peers may be named at each time period. Finally, respondents' sensation seeking and mean peer sensation seeking are even more weakly, yet still significantly, correlated (around .2). Only for C3 is there any indication of a cross-lagged relationship. There, the

Table 2. Wording of Items on Survey, with Reliabilities of Scales

Sensation-seeking (SS): (1=I agree strongly; to 5=I disagree strongly; * reversed)
I like to jump off high diving boards.*
Someday I would like to try sky-diving or parachute jumping.*
I would like to learn how to scuba dive.*
Climbing a steep mountain would be too scary for me.
I would like to try to water-ski.*
I like to do dangerous things.*
I like to try all kinds of new things, even if they scare me or I know it's something I shouldn't do.*
I like loud music.*
A lot of drinking is what it takes to make a party fun.*
I like quiet parties.
I like to be with people who party a lot.*
I like to watch love scenes in movies or on TV.*
I would like to take a trip without having to make any plans ahead of time.*
I would like to visit a strange city all by myself, even if I might get lost doing it.*
I have -- or would like to have -- some unusual or different people for friends .*
People should dye their hair purple, if they want to.*
I like to test myself every now and then by doing something a little risky.*
People should dress neatly and follow the rules for good style.
I think it's funny when people do things just to shock or upset others.*
I would get bored looking at someone's home videos or travel slides.*
I get restless if I have to stay around home. *
I like people who are boring more than I like people who are rude.
I like watching a TV show/movie where I can tell what will happen.
I would rather be with people I know than meet new people.
Mean reliability over nine cohort/time periods: .78;
five dimensions emerged in every cohort/time except Y1 Cohort 1 (which showed six).

Family Distance (FD): (1=yes, most of the time; to 5=no, never)
Do you get along well with your mother or guardian?
Do you get along well with your father or guardian?
Do you and your parents have fun together?
Are you happy at home?
Do you get a lot of attention at home?
Do your parents understand you?
Do you feel close to your family?
Mean reliability over nine cohort/time periods: .89

Negative Drug Attitude (NDA): (1=I agree strongly; to 5=I disagree strongly)
It's OK to try drugs once or twice just to see what they are like.
It's OK for people to use drugs if drugs make them feel better.
There is really nothing wrong with using most drugs.
Kids who use drugs have more friends.
When you are under a lot of stress, it helpful to drink alcohol or take drugs.
Drugs help you have more fun.
Kids who take drugs are more grown-up.
Mean reliability over nine cohort/time periods: .87

Peer Pressure (PP): (1=definitely not; to 5=definitely would; except
* 1=I agree strongly; to 5=I disagree strongly -- reversed)
If a friend dares you to tear a page out of a school library book, would you do it?
If your friends are going to the movies and you have to study for a test, would you go to the movies anyway?
If your best friend is skipping school, would you skip too?
If you are at a party where your friends are drinking alcohol
would you feel left out if you are not drinking alcohol?
If a friend offers you a drink of alcohol, would you drink it?
If a friend dares you to smoke a cigarette and your parents don't want to you smoke, would you smoke it?
If a friend asks you to smoke marijuana with them, would you do it?
If my best friend offered me a drug, I would take it.*
If I was at a party and a lot of people there were drinking alcohol and using drugs, I probably would too.*
Mean reliability over nine cohort/time periods: .89

Sex: (1=male; 2=female)

School: (1=very well; to 5=not well at all) How well are you doing in school?

Church: (1=never; to 4=once a week) How often do you go to church?

Happy: (1=very happy to 4=not at all) How happy are you?

Cigs: How many cigarettes have you smoked in the past year:
(1=none; 2=less than one cigarette; 3=1-5 cigarettes; 4=6-10 cigarettes; 5=11-20 cigarettes [1/2 pack to 1 pack]; 6=21-30 cigarettes [1 to 1 1/2 packs]; 7=31 or more cigarettes [over 1 1/2 packs])

Alc: In the past year, how many times have you drunk a full glass of alcohol (beer, wine, liquor)?
(1=0 times; 2=1-2; 3=3-5; 4=6-9; 5=10-19; 6=20-39; 7=40 or more)

Marj: In the past year, how many times have you smoked marijuana (Grass, Pot, Hash)?
(1=0 times; 2=1-2; 3=3-5; 4=6-9; 5=10-19; 6=20-39; 7=40 or more)

About how many of your friends: (1=none; 2=1-2; 3=some; 4=most; 5=all)
smoke cigarettes?
get drunk at least once a week?
smoke marijuana?

Most students in my grade think that: (1=a very bad thing; 5=a very good thing)
cigarettes are
drinking is
marijuana is

Named Friend(s) (NF):
On the lines below, please PRINT the first and last names of 3 of your friends in this town who are in the same grade as you in school (the friends you name can go to a different school but need to be in the same grade as you). (First name/Last name/Friend's school)

Table 3. Descriptive Statistics of Scales and Drug Usage Across Cohort/Year Periods

Cohort/Year	C1Y1		C1Y2		C1Y3		C2Y1		C2Y2		C2Y3		C3Y1		C3Y2		C3Y3	
Variables	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Sex	1.6	0.5	1.6	0.5	1.6	0.5	1.6	0.5	1.6	0.5	1.6	0.5	2.6	0.5	2.6	0.5	1.6	0.5
School	1.8	0.7	2.0	0.7	1.9	0.7	1.8	0.6	1.8	0.7	2.0	0.7	1.7	0.6	1.8	0.7	1.9	0.7
Church	3.1	1.1	3.0	1.1	2.9	1.1	3.0	1.1	2.9	1.4	2.8	1.2	3.0	1.1	3.0	1.1	2.9	1.2
Happy	1.8	0.6	1.8	0.6	1.8	0.6	1.7	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6	1.8	0.6
Sensation-seeking	0.5	0.5	3.1	0.5	3.3	0.6	3.0	0.5	3.2	0.6	3.4	0.6	2.9	0.5	3.0	0.6	3.1	0.5
Family distance	0.7	0.9	2.0	1.0	2.1	1.0	1.8	0.9	2.0	0.9	2.1	1.0	1.7	0.7	1.8	0.9	2.0	1.0
Negative drug attitude	1.1	0.5	4.5	0.8	4.3	0.9	4.7	0.5	4.6	0.7	4.3	0.9	4.8	0.4	4.8	0.5	4.6	0.8
Peer pressure	0.6	0.8	2.3	0.9	2.5	1.0	1.8	0.7	2.1	0.9	2.5	1.0	1.5	0.6	1.7	0.7	2.2	0.9
In last year																		
cigarettes	1.6	1.3	1.8	1.6	2.5	2.2	1.5	1.2	1.8	1.7	2.3	2.1	1.2	0.8	1.4	1.1	1.9	1.7
drinks	1.5	1.0	2.0	1.6	2.6	1.9	1.3	0.9	1.8	1.3	2.3	1.7	1.2	0.6	1.3	0.8	1.8	1.4
marjuana	1.0	0.4	1.2	0.8	1.5	1.3	1.1	0.4	1.2	0.7	1.4	1.2	1.0	0.3	1.0	0.3	1.2	0.8
Most students think these are bad:																		
cigarettes	2.6	1.0	2.8	0.9	2.8	0.9	2.3	0.9	2.4	1.0	3.0	0.9	1.7	0.8	2.1	0.9	2.5	0.9
drinking	2.5	1.0	3.0	0.9	3.1	1.0	2.2	0.9	2.5	1.0	3.2	1.0	1.6	0.8	2.0	0.9	2.6	0.9
marijuana	1.9	1.0	2.1	1.1	2.4	1.1	1.6	0.9	1.8	1.0	2.4	1.1	1.2	0.5	1.5	0.8	1.7	0.9
# Friends who																		
smoke cigs	1.9	0.9	2.2	1.0	2.4	1.1	1.8	0.9	2.1	1.0	2.5	1.1	1.5	0.7	1.6	0.9	2.1	1.0
get drunk	1.5	0.8	1.9	1.0	2.3	1.1	1.3	0.6	1.6	0.9	2.2	1.1	1.1	0.5	1.3	0.6	1.7	0.9
smoke marj	1.4	0.7	1.5	0.8	1.9	1.0	1.2	0.6	1.4	0.7	1.8	1.0	1.1	0.4	1.2	0.5	1.3	0.7
# Respondents who name																		
1st peer	423		417		385		478		470		429		829		799		727	
2nd peer	426		368		363		483		444		421		801		728		698	
3rd peer	394		371		339		464		429		360		771		676		647	
Approx. # respondents	500		500		510		590		585		590		920		915		915	

correlation between respondents' sensation seeking at Y1 and mean peers' sensation seeking at Y3 (r=.15, still p<.05) is only half as strong as the correlation between peer sensation seeking at Ti and respondents' sensation seeking at one time to respondents' sensation seeking later on. Note that the similarity of sensation-seeking across time is slightly greater among one's peers (around .3) than it is between oneself and one's peers (around r=.2).

Correlations of Respondents' Estimations of Friends' Drug Use and Friends' Reported Drug Use

As discussed earlier, respondents' estimates of peers' drug use is usually the measure of choice in similar surveys. Here, we can conduct a general comparison between these two indicators. However, note that these measures are not the same. Respondents reported how many of their friends used each of the drugs in the past year, while peers' responses indicated how frequently they themselves used each of the drugs in the past year. Further, peer nominations were limited to a maximum of three, and we do not include respondents who did not name peers. And, of course, even the peer responses are subjective reported/recalled indicators of actual drug use. So these two measures must, of course, be only approximately related.

The correlations, though mostly significant, are quite weak, from marijuana use C3Y2 (r=.03, n.s.) to marijuana use C2Y3 (r=.23, p<.01). Estimations of cigarette use are a non-significant r=.05 for C1, all three time periods, but rise to between .16 and .20 for C3, all three time periods.

We might speculate that correlations would be greater either for the most frequent drug use (here, generally alcohol), because it would be easier to estimate overall usage, or for the least frequent drug use, because users would stand out so much or would be known only by one's closest peers (here, marijuana). So the first conclusion is that the inconsistent correlation patterns do not support such a general relationship.

The second conclusion is that respondents' estimated of peers' drug use is highly inaccurate (at most sharing only 4% of variance). So we would not want to rely on respondents' estimates of the number of their friends who use drugs as a reliable surrogate for the frequency of drug use by their peers. However, perceptions of others' behaviors, even if (or possibly especially if) inaccurate, may be a potent influence on one's own use of drugs. Indeed, some "peer norm" campaigns to reduce college drinking explicitly target the inflated perceptions of the extent to which one's peers engage in excessive drinking (Lederman *et al.*, 2001).

Multivariate Analysis of Variance Results

A focused, but simplifying, approach to testing for relationships of drug use, respondents' sensation-seeking, mean peer sensation-seeking and mean peer drug use is to dichotomize all these and test for main and interaction effects among these categories on respondents' drug use, all within the same time period. For these analyses we dichotomized the respondents' sensation seeking averaged across the three time periods at the median and categorized respondents into 'high'-sensation seekers and 'low'-sensation seekers in order to equalize the sample sizes of this main predictor. The other variables were categorized at the mean, within each time period, except the dependent variable, respondents' frequency of drug use (for alcohol, cigarettes, marijuana). Table 4 summarizes the significant main and interaction effects.

Table 4. Significant MANOVA Influences on Respondent's Reported Yearly Useof Alcohol, Cigarettes, and Marijuana

Cohort Drug Use	Y1 Var.	F	Y2 Var.	F	Y3 Var.	F
			Cohort 1 (N=from 448 to 501)			
Alcohol	SS	16.7	SS	13.0	SS	11.7
	pSS	7.1	pAlc	7.9	pAlc	13.0
Cigarette	SS	2.6	SS	10.5	SS	24.0
	pSS	7.3	pCig	25.0	pCig	27.0
	pCig	16.0				
	SS * pCig	6.6				
Marijuana	SS	5.0	Ss	7.0	SS	11.0
	p SS	3.4	pMj	39.0	pMj	30.0
	SS * pSS	5.0	ss * pMj	3.5	pSS * pMj	3.1
	SS * pMj	3.0				
	pSS * pMj	4.7				
	SS * pSS * pMj	3.1				
			Cohort 2 (N=from 558 to 582)			
Alcohol	SS	25.0	SS	21.0	SS	39.0
	pAlc	9.0	pAlc	22.0	pAlc	37.0
					SS * pAlc	10.0
Cigarette	SS	27.0	SS	13.5	SS	44.0
	pCig	19.0	pCig	2.8	pCig	49.0
					SS * pCig	13.5
Marijuana	SS	7.4	SS	10.3	SS	38.8
	pSS	6.8	pMj	4.2	pMj	36.3
	SS * pSS	7.3	SS * pMj	5.3	SS * pSS	6.1
					SS * pMj	21.1
					SS * pSS * pCig	9.7
			Cohort 3 (N=from 876 to 908)			
Alcohol	SS	61.7	SS	66.1	SS	72.3
	pAlc	12.5	pSS * pAlc	3.4	pAlc	20.5
	SS * pAlc	7.0			SS * pAlc	5.0
					pSS * pAlc	5.0
Cigarette	SS	48.2	SS	5.1	SS	49.9
	pSS	5.0	pCig	20.2	pCig	42.8
	pCig	30.8	SS * pCig	5.9	SS * pSS	4.1
	SS * pCig	10.8				
	pSS * pCig	5.1				
Marijuana	SS	2.9	---	---	SS	11.3
					pSS	4.2
					pMj	16.1
					pSS * pMj	5.0

All F-ratios significant at $p<.05$ or less.
SS = mean of respondent's sensation-seeking scale across three time periods
pSS = mean of named peers' sensation-seeking scale within time period
pAlc = mean of named peers' yearly use of alcohol
pCig = mean of named peers' yearly use of cigarettes
pMj = mean of named peers' yearly use of marijuana

In every cohort/time period, respondents' own sensation seeking was a significant main influence on all three kinds of drug use (except for marijuana, C3Y2). F-ratios for this influence increased considerably for each cohort (except for marijuana in C3), but not as clearly across time. In general, mean peers' sensation seeking was a significant influence in Y2, but disappeared in the subsequent time periods. However, mean peers' use of the corresponding drug was a significant main influence in nearly every Y2 and Y3 sample. That is, peers' behavior becomes a clearer influence over time than peers' sensation seeking. As we have seen, sensation seeking increases over time, and peers' sensation seeking in Y1 may influence respondents' sensation seeking in Y3, implying that the influence of peers' sensation seeking occurs early on by generating similarity of associations. Then, as respondent and peer sensation seeking are more similar, peers' behavior (drug use) becomes the discriminating influence.

Note, however, that there are numerous interaction effects as well. The primary one seems to be between peer sensation seeking and peer drug use. The combination of peers with slightly similar sensation seeking levels and greater use of drugs may heighten both the social control (through similar peers) and the social learning (through greater exposure to drug use) processes. For example, in C1Y2, the highest mean level of respondent's alcohol use in the past year occurred under conditions of (a) high peer sensation seeking and (b) peer alcohol use in past year, both for respondents with low sensation seeking (mean respondent alcohol use in past year=1.41, $p<.05$, compared to 1.14 for those with peers with low sensation seeking and no alcohol use) and with high sensation seeking (mean respondent alcohol use in past year = 2.04, $p<.05$, compared to 1.52 for those with peers with low sensation seeking and no alcohol use).

An interaction between respondents' sensation seeking and mean peers' sensation seeking occurs twice in Y2 (marijuana, C1; cigarette, C2) and twice in Y3 (marijuana, C2; cigarette, C3), implying, perhaps, that cigarettes and marijuana are seen as more risky or adventurous, and thus more likely when respondent and peers both have high sensation seeking, than alcohol, which is the more frequently used drug.

Multiple Regression Results

MANOVA restricts us unduly in this study because of the false dichotomization of mean scales and the limited number of variables that can be managed. A more straightforward approach is to regress relevant prior variables, entered in chronological sequence, on use by each of the three cohorts of each of the three drugs at Y3. Because some of the independent variables are the same across each of the three drug analyses, and because the drug use variables are likely to be intercorrelated themselves, these are not, therefore, independent analyses. They might be thought of as three overlapping perspectives on the same phenomenon. Finally, this approach does not consider the intervening or endogenous relations suggested in Figure 1. However, it is relatively straightforward, does take into account the longitudinal nature of the data and, because of the large sample sizes, allows the use of a good number of predictors.

Table 5 provides the results from the nine regressions (one each for yearly frequency use of alcohol, cigarettes and marijuana, for each cohort).

Alcohol and cigarette use (adjusted R-squares from .21 to .46) were predicted somewhat better than marijuana use (from .11 to .33), but the percentage of marijuana users was so low throughout that there would be little variance in that dependent variable. Predictability was also greater for C1 and C2 (from .31 to .46) than for C3 (from .11 to .36).

Table 5. Regressions of Reported Yearly Drug Use Y3 on Prior Influences Y2 and Y1

Ind. Variables		Alcohol		Cigarettes		Marijuana	
		Cohort 1					
Y2:	Drug Use/Year	0.38	***	0.33	**	0.32	***
	Peers' Use/Year	0.05		0.04		0.12	**
	Neg. Drug Att.	0.03		0.00		-.03	
	Sensation-seeking	0.02		0.11	**	0.05	
	Est. # Friends Use	0.02		0.10	**	0.07	
	Peer Pressure (Hi=more)	0.23	***	0.16	**	0.16	**
Y1:	Drug Use/Year	0.14	**	0.16	***	0.05	
	Peers' SS	0.05		0.02		0.10	
	Est. Friends' Drug Att	0.05		-.04		-.03	
	Sex (Hi=F)	0.00		0.03		-.03	
	School (Hi=poor)	0.03		-.02		-.02	
	Church (Hi=freq)	-.03		0.02		-.02	
	Home (Hi-distant)	0.00		-.02		-.03	
	Happy (Hi=not)	0.04		0.03		0.04	
	Adj. R-sq	0.46		0.44		0.33	
	d.f., F-ratio	14/444=29	***	14/488=27	***	14/440=17	***
		Cohort 2					
Y2:	Drug Use/Year	0.40	***	0.45	***	0.23	***
	Peers' Use/Year	0.13	***	0.06		0.15	**
	Neg. Drug Att.	0.08		0.05		-.10	*
	Sensation-seeking	0.11	**	0.00		0.01	
	Est. # Friends Use	0.05		0.03		0.07	
	Peer Pressure (Hi=more)	0.09		0.18	**	0.16	**
Y1:	Drug Use/Year	0.13	**	0.15	***	0.07	
	Peers' SS	-.03		0.01		-.04	
	Est. Friends' Drug Att	0.00		0.00		0.07	
	Sex (Hi=F)	0.05		0.05		-.02	
	School (Hi=poor)	0.05		0.06		0.01	
	Church (Hi=freq)	-.03		0.02		-.06	
	Home (Hi-distant)	-.03		-.01		0.02	
	Happy (Hi=not)	-.03		-.02		-.08	
	Adj. R-sq	0.37		0.46		0.31	
	d.f., F-ratio	14/517=24	***	14/517=33	***	14/511=18	***
		Cohort 3					
Y2:	Drug Use/Year	0.35	***	0.31	***	0.12	**
	Peers' Use/Year	0.00		0.00		0.09	**
	Neg. Drug Att.	0.02		0.03		0.00	
	Sensation-seeking	0.11	**	0.11	**	0.07	
	Est. # Friends Use	0.12	**	0.08	*	0.07	
	Peer Pressure (Hi=more)	0.08		0.00		0.13	**
Y1:	Drug Use/Year	0.15	***	0.09	*	-.08	*
	Peers' SS	-.01		0.00		0.03	
	Est. Friends' Drug Att	-.03		0.00		0.10	***
	Sex (Hi=F)	-.03		0.01		0.00	
	School (Hi=poor)	0.03		0.09	**	0.03	
	Church (Hi=freq)	-.07	*	-.03		-.05	
	Home (Hi=distant)	0.04		0.02		0.09	*
	Happy (Hi=not)	0.01		0.03		-.02	
	Adj. R-sq	0.36		0.21		0.11	
	d.f., F-ratio	14/821=34	***	14/830=17	***	14/820= 9	***

* = p<.05; ** = p<.01; *** = p<.001

Significant predictors of alcohol use were respondents' alcohol use at Y1 and at Y2, greater sensation seeking at Y2, greater susceptibility to peer pressure at Y2, and, for C3, greater estimated number of friends using the drug at Y2 and slightly less attendance at church at Y1.

Significant predictors of cigarette use were respondents' cigarette use at Y1 and Y2, peer pressure at Y2, respondents' sensation seeking at Y2, estimated number of friends who smoke at Y2, and, for C3, doing worse at school at Y1.

Significant predictors of marijuana use were respondents' marijuana use at Y2 (except for C1) and Y1 (except for C2), peer pressure at Y2, mean peers' sensation seeking at Y1 (for C1) and, for C3, distant home relations at Y1.

Identifiability and Number of Friends, Drug Use, and Sensation Seeking

Finally, the present data allow us to assess whether social control or social learning seems to be the more plausible explanation. The social control explanation would argue for smaller or even isolated networks, and thus greater disinhibition, and eventual association with other isolates with similar drug disinhibition. The social learning explanation would argue for equivalent sized networks between users and nonusers, but networks with different norms and attitudes concerning drug use.

The prior results show that predictors of one's own use of a specific drug include using that drug at prior time periods (all three drugs), use of the drug by one's peers at the immediate time period (alcohol and cigarettes), one's own sensation-seeking (alcohol and cigarettes), general susceptibility to peer pressure at the prior time period (alcohol and marijuana), doing worse at school at Y1 (cigarettes), and peers' sensation-seeking at Y1 (marijuana). This is not a clear-cut argument for either social control or social learning. To the extent that one's own use and sensation-seeking are primary predictors — that is, one's social network plays no role — a social control explanation is somewhat justified. However, to the extent that susceptibility to peer pressure, and use of a drug by one's peers, contributes — that is, one's social network does play a role — a social learning explanation is somewhat justified.

We can provide some analysis of the specific role of the size and nature of one's network. From the responses to the request to name up to three friends in one's grade anywhere in the school system, two ego network characteristics can be computed. The first characteristic is the number of friends named regardless of whether they are in the school district ("any") versus those who also exist in the dataset for that same grade ("identified"). For example, someone could name three friends (any=3), but only one of them is identifiable (identified=1). The second characteristic is whether they named none, or any (i.e., from one to three), identifiable friends.

Using Y1 as an example, there is a generally consistent difference between the ego network size of unidentified and identified friends, and between none versus any identified friends, though the results are stronger for C1. Generally, the greater the number of any friends named, the slightly less the use of most drugs (from r=.00 for marijuana C2 to -.07, $p<.01$ for marijuana C3). The greater the number of identified friends named, the use of drugs is noticeably less (from r=-.05, $p<.01$ for marijuana C3 to r=-.16, $p<.01$ for cigarette C1). The correlations are generally twice as strong between "any" and "identified" for C1 and C2, but become about equal by C3. The possible explanation here is that teenagers who have friends outside of the common school social network (i.e., the same grade in schools in the district) are somewhat less inoculated by belonging to a network, and may be slightly more likely to look outside the shared network for excitement and risk.

Consider, for example, the high school girl with a college boyfriend, or a high school student who spends time with dropouts.

Focusing just on identified friends, there is a consistently higher level of alcohol, cigarette and marijuana use for those who named no identifiable friends compared to those who named from one to three identifiable friends. Again, the relationship wanes from C1 (means of 2.2 vs. 1.8, 2.4 vs. 1.9, 1.6 vs. 1.2, respectively; all $p<.005$) to C3 (mean cigarette use 1.5 vs. 1.3, and mean marijuana use 1.1 vs 1.0, $p<.05$). The possible explanation here is a mix of social control with social learning at a larger societal level.

Also for Y1, respondent's sensation-seeking is generally unrelated to number of either any or identified friends, except $r=-.07$, $p<.01$ for C3 identified friends.

DISCUSSION

Summary

Self-reported use of drugs of all kinds -- both in terms of its frequency and the number of subjects reporting any use at all -- increases significantly across each yearly time period.

(Generalized) estimates of number of friends who use particular drugs are only very weakly correlated with (specified, or named) peers' own reports of their frequency of drug use. Although these are not measuring exactly the same thing, and thus we should not expect them to be highly correlated, it may well be that prior studies using self-reported estimates of generalized peers' drug usage and attitudes suffered from the poor validity of such estimates of generalized others' behavior trying to represent actual behavior of specified others (Rice, 1993).

Focusing just on self and peer sensation-seeking and drug use, one's own sensation-seeking and peers' drug use seem to be the primary influences on one's drug use within a given time period. Peers' sensation-seeking seems to be a significant influence primarily in earlier periods, then waning.

The combined, longitudinal multiple regression analyses help us understand both the independent influence of the factors as well as the time-order nature of their influence. Alcohol use is most strongly predicted, with the three cohort regressions explaining 46%, 37% and 36%, respectively. Cigarette use is next most strongly predicted, with explained variances of 44%, 46% and 21%. And marijuana use is least well predicted, with explained variances of 33%, 31% and, for cohort 3, 11%. All of the equations are significant at the $p<.001$ level.

In almost every case, one's prior use of a drug is the best predictor of one's current use. The use of a drug even two years earlier has an independent effect from use the prior year, indicating either (or both) a long latency of drug use norms or the likelihood that, once overcome, hesitations about further drug use are considerably reduced.

Peers' use of a drug the prior year seems to be a consistent influence only on marijuana use across all three cohorts, and for alcohol use in the first cohort. This behavioral influence might be identifiable only for marijuana because of the likely greater need to have friends who use it, than for the other drugs. This could be due to the very low percentage of students who actually use marijuana, and the greater difficulty in obtaining and affording it. That is, marijuana is, for practical and

cultural reasons, inherently a more 'social' drug in the sense that it is typically used within a more intimate social setting rather than more publicly as are smoking and alcohol, so peer influence would be more salient and powerful. Consistent with this specified peer pressure is the occasional influence of generalized susceptibility to peer pressure, a predictor of greater alcohol and cigarette use (C1), cigarettes and marijuana (C2), and marijuana (C3). So one does not need specific peer role models using drugs, necessarily; instead, a general susceptibility to peer modeling, along with some of the other influences, may be enough to influence later drug use.

One's own sensation-seeking at Y2 is a weak independent predictor of drug use at Y3 (for cigarettes, C1; alcohol, C2; and both for C3), and not at all for marijuana use. Again, this may be due to the very low frequencies and thus variance of marijuana use, but it also may be that, to the extent that it is a more 'social' drug, it does not satisfy the purpose of general individual sensation-seeking. Finally, early home, school and church experiences do not seem to play much of an independent role in predicting drug use several years later. Only in C3, slight effects exist for less church attendance (alcohol), poor school performance (cigarettes), and distant home relations (marijuana). In each case, no more than 1% of the variance was explained.

The results overall seem to provide support for both a social control explanation — because of higher drug use among those with no friends, and those with friends outside the common student social network — and for a social learning explanation — because of susceptibility to generalized peer pressure, friends who smoked cigarettes or marijuana the prior year, and possibly a general social trend away from alcohol and cigarette use over the time period of the three cohorts. However, the influences, especially peer influences, differ across these three drugs.

Concerning the ambiguity in causal direction between socialization (social control) and selection (differential association), Haynie (2001) argues that adolescents seldom have much choice in selecting groups, which offer limited opportunities to join, and which control acceptance. Thus peer networks seem to be the primary causal factor — that is, social control and social learning instead of selection. While Haynie's cross-sectional data cannot test for self-selection into delinquent peer networks based on prior dispositions or attitudes (rather than delinquency being caused by influence of peers in the group), he notes that even initial selection may be influenced both by attraction to similar peers as well other structural forces affecting exposure to and acceptance by various groups, and that friendship groups change frequently, making exact tests highly difficult. Valente *et al.*'s (1997) study of the social influence on and awareness of network partners' use of any, or specific, contraceptive methods, among 9 voluntary associations of Cameroonian women, argued against the selectivity process as an alternative explanation of their results. The two main results, that a respondent reporting that a network partner encouraged them to use "any" or a specific method was more likely to use any contraceptive method, and that women who use the same contraceptive method interacted in the network, both imply that discussion facilitates usage (i.e., social control and social learning), and not the other way around (i.e., selection).

Qualifications

Our present analyses emphasized the influence of peers' attitudes and behaviors on respondents' attitudes and behaviors. Thus we analyzed only those respondents who named at least one peer (out of a requested three) at each of the three time periods (within each cohort). Note that the social control model proposes that those with best friends are less likely to be delinquent or isolated, whereas the social learning model argues that number of links is not the influence, but the content of those relations is. Therefore, when we exclude all those respondents who do not name at least

one peer at each time period, the social control model implies that we are removing precisely those who are most at risk, and perhaps most of interest to research attempting to change positive attitudes toward, and use of, drugs. Indeed, as noted above in the analysis of year 1 data, those not naming any friends were more likely to use any of these drugs, except alcohol by C3. However, missing data on any of the peer variables was not associated with drug use, nor was missing data at one time period associated with missing peer responses at other time periods.

We should also note that while excessive use of any of these drugs in harmful, some are more socially acceptable than others, depending on the context and the age of the user. For example, cigarettes and alcohol are illegal on the basis of the user's age, while marijuana is generally illegal regardless of age. So legality, risk, harm and abuse are all important distinctions not assessed here. Also, while we did not analyze cross-influences here, some drug use may be gateways to other drug use (such as smoking and drinking leading to marijuana use) so a full model would be much more complex than Figure 1 portrays.

Another concern that inevitably arises in this type of research is the honesty and accuracy of respondent self-reports, especially concerning reports of illegal activities, such as drug use. However, in each cohort and each wave respondents were assured that their results were confidential and that no one who knew them or was in a position of authority has access to any identifying information.

Future studies might also include other indicators of social influence on adolescent and teenage drug use. Feld (1981) proposes that friendship ties are not just based in loosely connected social circles of relationships (especially transitive relations), but are also strongly influenced by both individual characteristics and other social structures around which individuals organize their social relations – what he calls "foci," or structures that "focus" relations, as suggested by Homan's social elements of activity, interaction and sentiments. That is, shared relations to foci create positive sentiments indirectly through positively valued interaction. Groups result from foci organizing more or less exclusive social interactions. These foci may be persons, places, social positions, activities, groups, etc., and not primarily direct similarities among individuals. However, these foci generate more social interaction only if they somehow constrain interactions. For example, larger and more general foci are less constraining on time, effort and emotion, so are less the basis for group formation. Further, if several foci are themselves more compatible, then they foster more social interactions. (Feld emphasizes that relations among individuals in this social context is largely due to the shared foci, not an individual drive toward psychological balance.) Conversely, for those involved in more foci, their social contacts are less likely to themselves interact, leading to less dense personal networks. So the driving forces in group interaction, and thus similar behaviors and attitudes, are the number, diversity and constraints of foci. For the present study, these might include obvious social categories salient to high school students (gender, race, school activities such as clubs or athletics, income, etc.) Feld does note, however, that because focus theory emphasizes structure over individual cognitive balance, it is probably more appropriate to use in studying entities (such as corporations or scientific projects) than individuals.

Another generalization of social control theory to explain delinquency and deviant behavior is developed and tested by Osgood *et al.* (1996). Similar to Haynie's argument, they argue that number of friends and the nature of one's group is not by itself the explanatory factor. Rather, "unstructured socializing with peers in the absence of authority figures presents opportunities for deviance", as these will be easier and more rewarding, there will be less social control, and more time for deviant behavior (p. 635), in accord with Cohen and Felson's (1979) routine activity perspective.

They analyzed five waves of data for a national sample of 1,700 16-18 year olds. The more time the teenagers spent in unstructured socializing activities (riding around in a car for fun, getting together with friends informally, going to parties, or spending evenings out for fund and recreation), the more criminal behavior (10 items), heavy alcohol use, use of marijuana and other drugs, and dangerous driving, over time, and the stronger the associations between age, gender and SES with these deviant behaviors. Further, deviant behaviors were not associated with either in-home or out-of-home activities, as long as they were structured. Even the traditional influence of age, gender, and grades on deviance significantly declined once structured activities were controlled for. Interestingly, greater parental education was associated with greater student deviancy, largely through providing more opportunities for unstructured socializing.

Their activity measures, over-time research design and statistical analyses preclude an alternative interpretation of selection (i.e., deciding to engage in deviance causes a selection of one of the unstructured activities). Thus Osgood *et al.* (1996) conclude that such relationships are moderated both by unstructured time (opportunity) and by an absence of an authority figure (less social control). This approach also explains why having more friends is not necessarily a damper on deviant behavior – having friends in a context of unstructured routine activities, without an authority figure (a public role such as a sales clear or teacher, but also including a group leader representing socially conforming values), can make deviance easier to accomplish and more rewarding, and provide a setting for the filling the symbolic role of bravery, toughness, etc. Nonetheless, as an aside, they do acknowledge that "The magnitude of these relationships between routine activities and deviance is exceeded only for measures of other deviant behaviors, attitudes about deviance, and the deviant behavior of one's peers" (pp. 651-652). Thus even their focus on unstructured informal activities does not reject a direct influence of one's peers, as the current study argues. However, including measures of unstructured time in activities not involving authority figures would be a valuable way to expand the scope of the present model.

There are also many more kinds of analyses, both more subtle as well as more statistically elegant, that could be applied to these and similar data. For example, the final nine regressions could be reduced to three by combining data within cohort, allowing for statistical testing of specific and overall cohort effects. The different conceptualizations of social influence by Feld (1981), Haynie (2001), and Osgood *et al.* (1996) call for including additional direct and moderating individual and social influences.

CONCLUSION

The main focus of this study was the influence of one's own behaviors, attitudes and sensation-seeking, and one's peers' behaviors, attitudes and sensation-seeking, on respondents' drug usage. Clearly, both nature and nurture, individual and social factors play a role in influencing one's drug use. However, the nature of that influence depends somewhat on the nature of the analyses, the time period, the length of the influence, the particular cohort, and the specific drug. From a network theory perspective, it does seem clear that studies that rely on respondents' estimates of generalized others' attitudes and behaviors, rather than on their named peers' own report of their attitudes and behavior, are prone to problems of validity, reliability and common method bias. Both theory and empirical evidence, such as this study, emphasize the need to include actual peer responses as predictors. This study also emphasizes the need for large-scale, longitudinal studies into the individual and network influences on different kinds of drug use among adolescents.

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Drifting Smoke Rings:
Social Network Analysis and Markov Processes in a Longitudinal Study of Friendship Groups and Risk-taking[1]

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Social network analysis is applied to three time points of a longitudinal study, which examines how risk-taking (represented by smoking and cannabis use) in adolescence is associated with social position within peer group structures. One hundred and fifty two students in the second year of secondary education in one Scottish school named up to six best friends, allowing for the categorization of each adolescent as a group member, a group peripheral or a relative isolate. Building on previous work, it is shown that transitions from non risk-taking to risk-taking behavior occur predominantly at peer group, rather than peripheral or isolate membership level. The transitions of pupils from time point one through to time point three are modeled as a Markov process, based on the assumption that the social position and risk-taking behavior (or transitional state) of a pupil at a certain time point depends only on their state at the previous time point. The results show that the Markov process is not stationary. The expected length of time spent by pupils in the various transitional states is also modeled, and provides another (time) dimension to the influence of peers on risk-taking behavior. We hypothesize that the influence exercised by an individual in a social network context increases with the cohesiveness of the individual's social network position and the length of time he or she occupies that position. The results testify to the importance of risk-taking peer groups, both as a source of influence and selection of peripheral members, and to the need for differential targeting by sociometric state when delivering health education and intervention programs.

INTRODUCTION

There is a large body of literature in social psychology attesting to the power of pressure toward social conformity within groups (Moscovici, 1985; Cialdini and Trost, 1998). In particular many

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studies have investigated the centrality of the peer group for adolescents (Thorlindsson and Vilhjalmsson, 1991; van Roosmalen and McDaniel, 1989), most focusing on shared attitudes and behavior. Some studies on smoking and other risk-taking behavior have employed sociometry to explore the interactive nature of peer groups based on models using social network cohesion (Ennett and Bauman, 1993,1994; Pearson and Michell, 2000). To our knowledge, none have studied the importance of duration of time spent by individuals in peer groups making use of a longitudinal sociometric survey.

While many studies testify to the centrality of the adolescent peer group for smoking (Sussman *et al.* 1990; Van Roosmalen and McDaniel 1989; Mosbach and Leventhal, 1988, West and Michell, 1999), there is also evidence of its importance for risk-taking more generally. For example, in a US study, the lack of peer influence on "Loners" appeared to contribute to less delinquency and drug use and more conventional lifestyle activities than "Socials" (Tolone and Tieman, 1990). In a recent study (Pearson and Michell, 2000) the first two stages of a longitudinal survey were analyzed in the context of primary socialization theory (Oetting and Donnermeyer, 1998) to demonstrate that risk-taking and non-risk-taking behaviors are (for adolescents at least) learned predominantly in the context of interaction with primary socialization sources. According to the theory, where the links to the family and the school are weak (as when, for example, there is a low attachment) the study of risk-taking behavior of peer clusters becomes more significant.

One definition of peer group is

a) 'an interaction-based cluster

b) of individuals (adolescents)

c) who spend more time with each other than with other adolescents

d) and who tend to share similar attitudes and behavior' (Brown, 1989).

This focus on interaction-based clusters (a) is the major justification for using cohesive social network analysis. It allows identification of groups who interact, potentially influence each other and tend to act as a 'team'. There is a sense in which each member inherits the group identity regardless of his or her own identity and particular role. They still remain as individuals (b) however with their own characteristics of prestige, popularity etc., which is often assessed using some equivalence measure, such as an ego-network measure naming them as being popular. Differing lengths of time spent with each other (c), depending on their social position (such as group, peripheral or isolate) is also a factor affecting the influence exerted on others. It seems reasonable to suppose that influence will be greater in groups existing for a longer period of time. Finally although attitudes and behavior (d) are theoretically separate from the structure of peer groups, in practice they are often an integral part of the culture of a group. We have not, however, assumed this in the sociometric analysis presented here.

The idea that risk-taking behavior is learned predominantly in the context of peers does not, however, necessarily mean that risk-taking is more prevalent among groups than isolates. This is what we refer to as the 'risk-taking network density paradox' generated by some apparent contradictions in research findings. Thus, one recent social network study reported network density as an important moderator of peer delinquency (Haynie, 2001), while another found higher smoking and risk-taking among liaisons and isolates than among peer group members (Ennett and Bauman, 1994). To some extent we have already addressed the paradox (Pearson and Michell, 2000) through examination of the longitudinal relationship between risk-taking and sociometric position. The analysis showed that transitions from non risk-taking into risk-taking behavior occurred

predominantly within peer groups, while risk-taking behavior was not, in general, more prevalent among group members than peripherals or isolates. The findings also showed that groups tend to be either risk-taking or non risk-taking, so that it could be argued that network density is an important moderator of both risk-taking and non risk-taking behavior patterns, as would be expected from primary socialization theory.

Another aspect of the 'risk-taking network density paradox' refers to the differing methodologies used by researchers. Network density has sometimes been defined in terms of egocentric networks (Udry and Bearman, Add Health, 2000; Haynie, 2001). While such measures undoubtedly add value to our understanding of networks, especially when there is limited data available, it is important to understand the limitations of using an ego-network definition to represent a group characteristic (see Appendix 1 for an example of misuse). The claim that 'network density … serves as an ideal measure of peer cohesion' (Haynie, 2000) is misleading and is certainly not the measure of network cohesion normally adopted in the literature. According to Wassermann and Faust (1994), there are four general subgroup properties which characterize 'cohesion' as a network concept: first, the mutuality of ties; second, the closeness or reachability of subgroup members; third, the frequency of ties among members; and fourth, the relative frequency of ties among subgroup members compared to non-members. Many social network software packages, such as NEGOPY, UCINET, STRUCTURE and GRADAP have special routines for handling and measuring cohesive networks.

In this paper we follow this approach, utilizing the methodology adopted in a previous analysis (Pearson and Michell, 2000), which was based on a greater number of friendship links between individuals than used in most other studies. This allowed the peer-oriented social positions of group member, liaison and isolate as used by Ennett and Bauman (1993) to be defined in terms of underlying sociometric structure measured as the degree of cohesion associated with social position. From this three such social positions (Peer Group member, Peripheral to peer group, and Relative Isolate) can be defined, which, with the addition of risk-taking and non risk-taking behavior, results in six states at each time point. This, in turn, gives rise to 36 possible Markov transitions (six states at the previous time point multiplied by six at the next time point).

Our aims are:

(i) to investigate the risk-taking social network behavior of adolescents under the assumption of an underlying continuous-time Markov process in relation to social network and risk-taking state at three successive time points.

(ii) to establish the expected periods of time spent by individuals in the six states:

Group Risk-Taker (GPRT), Peripheral Risk-Taker (PERT), Isolate Risk-Taker (ISRT), Isolate Non Risk-Taker (ISNRT), Peripheral Non Risk-Taker (PENRT), Group Non Risk-Taker (GPNRT).

(iii) to determine if an individual's membership of a sociometric/risk-taking position can be predicted by means of their position at the previous time point.

(iv) to show that individuals on the periphery of risk-taking peer groups tend to emulate their behavior at a later time point.

(v) to suggest ways in which new methodology can be effectively incorporated into health promotion intervention programs

Although these analyses of change over time suggest processes of selection and influence between peer group categories and (non) risk-taking, they can neither ascertain the relative importance of each of these causal mechanisms, nor the processes underlying them.

Data about smoking behavior are based on direct reports rather than subjects' perceptions of friends' behavior, thus avoiding the artificial inflation of friends' smoking behavior when adolescents project their own attitudes and attributes to others (Bauman and Fisher, 1986; Ianotti and Bush, 1992). The study also includes a qualitative component that has been reported in detail elsewhere (Michell, 1997; Michell and Amos, 1997; Michell and West 1996) and which has been crucial in formulating relevant hypotheses.

METHODS

Study design and Sample

This paper reports findings from three data collection points of a longitudinal study of pupils in their second year (S2) of secondary education in one school in Glasgow, Scotland (equivalent to US 8th graders). The findings are used to study friendship groups, peer influence and smoking and risk-taking behavior. The sample comprised one year group and the pupils (initially aged 13) were monitored over three years. At time point 1, during the spring and summer terms of 1995, all 152 pupils in S2 filled in a self-complete questionnaire which asked about their friends, lifestyle, and health behaviors. This was repeated in the following two years, at time point 2 (S3, 145 pupils) and at time point 3 (S4, 132 pupils). Some pupils joined or left the school year during the study, so that although 159 were interviewed, some pupils did not complete all three stages. Some qualitative material was also collected from 40 target pupils embedded in their school year.

The study school was selected from the sample frame of the West of Scotland 11-16 Study (West and Sweeting, 1996) and catered for pupils from a variety of social backgrounds, which included both private and council (public) housing. The percentage of pupils in the school receiving free dinners (50%) and the profile of examination results in academic league tables matched the average in Glasgow schools, suggesting the school was representative of others in the region in terms of social class composition.

Questionnaire, Sociometric data and Software

All pupils filled in the same two-part self-complete questionnaire comprising questions on lifestyle, family, self-esteem, smoking, alcohol, and drug use, together with friendship data used for the sociometric analysis (West and Sweeting, 1996). Each pupil could nominate up to six friends (best friend and just a friend) together with information on joint activities and location of activities with those friends. We carried out sociometric analysis with the NEGOPY software package (Richards, W., 1989), with the following strength equation based on questionnaire responses to these questions:

$$\mathit{Strength} = (2a1 + a2)(b1 + 2b2 + 2b3) + (c1 + c2 + c3 + c4)$$

where $a1$ is 'Best Friend,' $a2$ is 'Just a Friend,' $b1$ is 'Go around together in school,' $b2$ is 'See each other in and out of school,' $b3$ is 'Just see each other out of school' ($b2$ and $b3$ weighted to reflect the additional strength associated with seeing each other out of school), $c1$ is 'Do activities together,' $c2$ is 'Hang about together,' $c3$ is 'Are close; share secrets,' $c4$ is 'Are like each other.'

Richards (1989) defines a group cohesively as a set of at least three people who:

(i) have more than 50% of their linkage with one another (closeness)

(ii) are connected by some path lying entirely within the group to each of the other members in the group (reachability)

(iii) who remain so connected when up to 10% of the group is removed (relative frequency)

The mutuality of group cohesiveness was established by using only reciprocated ties. It was found that this was the best way to establish true mutuality among adolescents, since there was a strong desire among some isolated pupils to name other pupils who were not true friends. The 'two ties (Links)' option in Negopy was also used to establish a connection between two pupils who were linked via a third pupil. This was used to identify the groups more effectively, though it also imposed transitivity on the graph. We also carried out stability tests using the minimum strength parameter in Negopy to establish that the groups identified did not vary significantly as this parameter changed.

Risk-Taking Behavior

We defined a single category of risk-taking based on whether or not pupils were occasional or regular smokers and/or marijuana users at the time point of the interview. This definition does not distinguish between occasional and regular users and was retained to be comparable with that used in the previous paper (Pearson and Michell, 2000).

Markov Methods

The Markov model is based on transition tables that describe the transition from sociometric/risk-taking state at time points 1 to 2, and time points 2 to 3; for example, from group non risk-taking (GPNRT) at t_1 to group risk-taking (GPRT) at t_2 or from isolate risk-taking (ISRT) at t_2 to peripheral risk-taking (PERT) at t_3 (see Tables 2 and 3). An additional state termed OTHER was added to account for pupils who were not identified as being in a particular state. This occurred when a pupil entered or exited the year group from or to another school during the time period. They therefore appear as having a known state at one time period but not the other. The Markov transition matrix from period 1 to period 2 is obtained by dividing all of the row entries by the respective row total; for example the total for row 1 in Table 2 is 21. Thus, in the example, the probability of a transition from group risk-taking state at time point 1 to group risk-taking state at time point 2 is 9/21 that is approximately 0.43. Similarly the entry for GPRT-GPRT in Table 3 is 19 and the row total is 29 so the probability for this cell is 19/29 ~ 0.66. We can then use the transition matrix in an operation with the maximum likelihood (ML) state vector for a given time period to predict the expected state vector for the next time period.

Method for Finding the Expected Time in each Transitional State

An important aspect of the Markovian model is the identification of the expected waiting times in each transitional state before a pupil goes onto the next state. In particular, if some of the states had longer waiting times than others the influence exercised by pupils in that state could be related to the expected waiting time. Some research has already been carried out in this area (Leenders (1995); Kalbfleisch and Lawless (1985); Singer and Spilerman (1976)) where issues central to the modeling of social phenomena by continuous-time Markov structures are considered. In their paper, Singer and Spilerman (1976) discuss the issue of embeddability, or how to determine whether observations on an empirical process could have arisen via the evolution of a continuous-time Markov structure. Kalbfleisch (1985) avoids some of the complex issues surrounding embeddability by using a

maximum likelihood estimator for the intensity matrix, Q, rather than the transitional matrix P. Leenders (1995) further develops this modeling of transition rates and applies it to the evolution of social network dynamics. In this paper we outline the way in which these new evolutionary Markov methods can be incorporated into a broader network study. Appendix 2 summarizes the methods and results used to arrive at the values of the expected waiting (sojourn) times in the various transitional states.

RESULTS

Cross-Sectional Results

At time point 3 (S4), 13 peer groups were identified with an average of 5.8 members. This is a reduced number of groups in comparison with time point 1 (17 groups; average size 4.9) and time point 2 (16 groups; average size 4.4). This confirms the previously reported phenomenon that the number of peer groups tends to reduce as adolescents get older (Schrum and Cheek, 1987). However, a note of caution is warranted since the number of groups reported was from a smaller number of pupils at time point 3 (132).

Table 1 shows the proportion of pupils engaged in risk-taking by social position. There are no differences between males and females, 61% of group members, 56% of peripherals and 57% of isolates being risk-takers. Overall there is no evidence to support a difference in the risk-taking behaviour patterns associated with different social positions at time point three (χ^2 test, $p = 0.477$), although the small numbers involved could account for this. Previous analysis of data on time points 1 and 2 (Pearson and Michell, 2000) showed that such evidence exists at time point two only ($p < 0.01$).

Table 1. S4 (Time Point 3) Risk-taking by social position and gender

	Male			Female			Total		
	RT	NRT	%RT	RT	NRT	%RT	RT	NRT	%RT
Group	25	16	61%	22	14	61%	47	30	61%
Peripheral	10	8	56%	4	3	57%	14	11	56%
Isolate	10	6	63%	7	7	50%	17	13	57%
Total	45	30	60%	33	24	58%	78	54	59%

Longitudinal Results

The most significant finding of the longitudinal analysis is that transitions from non risk-taking status to risk-taking status occur predominantly in peer groups. This is shown by examination of the transition tables and matrices. Tables 2 and 3, which report the transitions from time point 1 to time point 2 and time point 2 to 3 respectively, show that the bulk of the transitions from non risk-taking behavior occur between groups. For example in Table 2, 13 out of 61 (21%) of group non risk-takers (GPNRT) at time point 1 became group risk-takers (GPRT) at time point 2, whereas only one of 24 (4%) isolate non risk-takers became group risk-takers. The same pattern is repeated in Table 3 at time point three, where 12 group non risk-takers make the transition and only one isolate non risk-taker. It is also of interest that 6/31 (19%) of peripheral non risk-takers at time point 2 also made the transition to GPRT at time point 3. In the next section we discuss the significance of the latter result as the reason why the Markov model is not stationary.

Table 2. Transition Table and Probability Matrix (Time point 1 to 2)

TP1 to TP2	S3NUM							
S2NUM	GPRT	PERT	ISRT	ISNRT	PENRT	GPNRT	OTHER	Total
GPRT	9(.43)	3(.14)	4(.19)	2(.10)	(0)	3(.14)	(0)	21
PERT	4(.44)	2(.22)	2(.22)	(0)	(0)	(0)	1(.11)	9
ISRT	(0)	1(.2)	1(.2)	(0)	1(.2)	1(.2)	1(.2)	5
ISNRT	1(.04)	4(.17)	2(.08)	5(.21)	8(.33)	2(.08)	2(.08)	24
PENRT	1(.03)	(0)	4(.13)	3(.09)	11(.34)	12(.38)	1(.38)	32
GPNRT	13(.21)	1(.02)	5(.08)	5(.08)	10(.16)	23(.38)	4(.03)	61
OTHER	1(.14)	(0)	(0)	(0)	1(.14)	(0)	5(.38)	7
Total	29	11	18	15	31	41	14	159

(0) implies no pupils made that transition

Table 3 Transition Table and Probability Matrix (Time point 2 to 3)

TP2 to TP3	S4NUM							
S3NUM	GPRT	PERT	ISRT	ISNRT	PENRT	GPNRT	OTHER	Total
GPRT	19(.66)	6(.21)	1(.03)	(0)	(0)	(0)	3(.10)	29
PERT	5(.45)	1(.09)	3(.27)	(0)	(0)	2(.18)	(0)	11
ISRT	4(.22)	1(.06)	9(.50)	(0)	1(.06)	(0)	3(.17)	18
ISNRT	1(.07)	(0)	1(.07)	4(.27)	2(.13)	3(.2)	4(.27)	15
PENRT	6(.19)	3(.10)	3(.10)	6(.19)	2(.06)	8(.26)	3(.10)	31
GPNRT	12(.29)	2(.05)	(0)	3(.07)	6(.15)	17(.41)	1(.02)	41
OTHER		2(.14)	4(.29)	(0)	(0)	(0)	8(.02)	14
Total	47	15	21	13	11	30	22	159

Markov Results

The Maximum Likelihood Estimator (MLE) of the state vector that gives the probabilities that the system is in state i at time i = 1 is

$$\underline{u}_i = \left[\frac{21}{159}, \frac{9}{159}, \frac{5}{159}, \frac{24}{159}, \frac{32}{159}, \frac{61}{159}, \frac{7}{159} \right] \tag{1}$$

We denote the MLE of the probability transition matrix (as shown in brackets in Tables 2 and 3) by *P(1,2)*. In this transition matrix, the rows represent the state of the process at time *n* and the columns the state at time *n+1* (in our example *n=1*). The elements of the transition matrix *P(1,2)* are also probabilities and hence lie between 0 and 1, and the rows add to 1. So (from Table 3)

$$\underline{u}_2 = \underline{u}_1 P(1,2) = \frac{1}{159} \left[29, 11, 18, 15, 31, 41, 14 \right] \tag{2}$$

and the expected numbers in the seven Markov states at time point 2 are 29,11,18,15,31,41, and 14 respectively. This is as observed, since we used the data to calculate the transition matrix *P(1,2)*. Now we can use this information to calculate $\underline{u}_3$, the state vector at time point 3, provided that *P(1,2)=P(2,3),* which would be an underlying assumption of a model whose transitional behavior does not change significantly over time (i.e. stationary). This is

$$\underline{u}_3 = \underline{u}_2 P\,(1,2) = \frac{1}{159}\,\left[29.65,\ 13.36,\ 20.06,\ 12.16,\ 27.98,\ 36.07,\ 19.73\right] \qquad (3)$$

The actual numbers at time point 3 observed in the respective Markov states were

$$\left[47 \quad 15 \quad 21 \quad 13 \quad 11 \quad 30 \quad 22\right] \qquad \text{(Observed result)} \qquad (4)$$

We can compare this observed result with the expected result obtained from the matrix transformation in (3). The expected result is

$$\left[29.7 \quad 13.4 \quad 20 \quad 12.2 \quad 28 \quad 36.1 \quad 19.7\right] \qquad \text{(Expected result)} \qquad (5)$$

We then apply a chi-squared test to compare the observed with the expected results. The difference is highly significant ($\chi^2 = 21.99$, $p < 0.01$), indicating that the observed results are different from those expected. We conclude that the Markov transition process is not stationary. Closer comparison, however, shows that the differences between these results appear mainly in the positions of group risk-takers and peripheral non risk-takers. Without GPRT and PENRT we get no significant difference ($\chi^2 = 1.59$, $p < 0.80$). If we assume that the transition from time point 2 to time point 3 is similar to that from time point 1 to time point 2, there has been an unexpected drift of 17 students from PENRT into GPRT (peripheral non-risk takers to group risk takers).

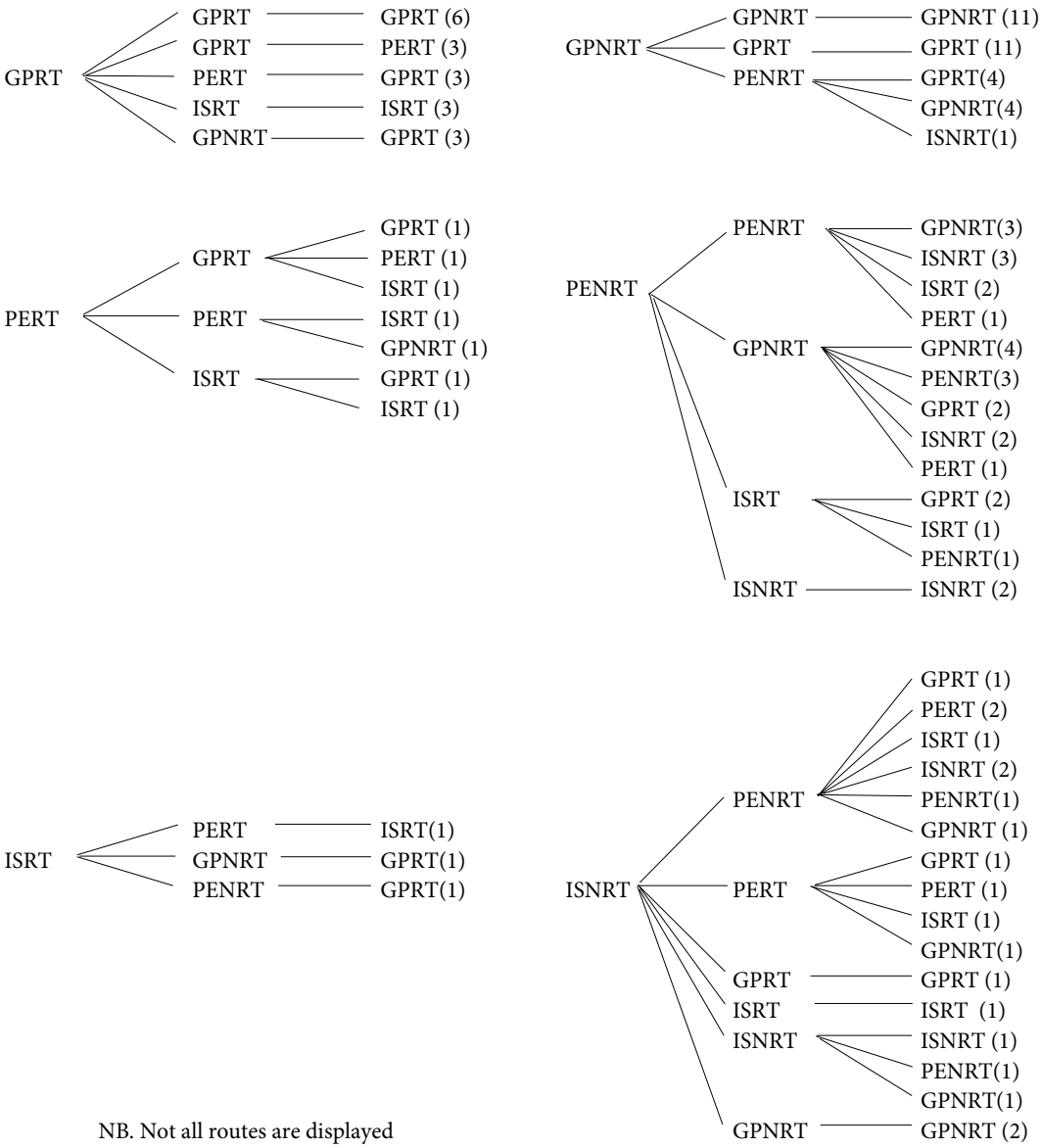
Allowing for this drift of the peripheral non risk-takers into group risk-taking status, the Markov model makes very good predictions of numbers of pupils in the different Markov states. The drift of the peripheral non risk-takers into the group risk-taking state is a characteristic of the transition from time point 2 to time point 3 (see Table 3). The transition from time point 1 to 2 showed a strong movement of peripheral non risk-takers into non risk-taking classes such as 'PENRT' and 'GPNRT' (see Table 2). This indicates that peripheral non risk-takers become increasingly at risk as they go from S3 to S4 (at about age 14). This increased drift from peripheral non risk-taking to group risk-taking points at the probable influence that the class of group risk-takers have in the school environment. There are a large number of peripherals (mostly non risk-taking) that are attached to risk-taking groups at time point 2. At time point 3 there are far fewer peripherals and more group risk takers.

Longitudinal Routes

Figure 1 shows the most frequent longitudinal routes from time point 1 to time point 3. The most striking feature is that the most common routes followed by group non risk-takers (GPNRT) are split evenly between GPNRT-GPNRT-GPNRT and GPNRT-GPRT-GPRT with eleven pupils taking the safe route while another eleven take the risky route. We note also that, for these latter pupils, the transition from non risk-taking to risk-taking behavior occurs at group level.

Another feature of interest is the high number of peripheral non risk-takers moving from time point 2 into risk-taking behavior at time point 3. There were twelve pupils, six of whom end up as group risk-takers. Five of these six were peripheral to group risk-takers at time point 2. One interpretation of this phenomenon is that they are 'trying to get into groups' and find risk-taking attractive.

Figure 1. Longitudinal Routes



NB. Not all routes are displayed

Expected Time in each Transitional State

The length of time pupils spent in each transitional state was modeled using the maximum likelihood approach described by Kalbfleisch and Lawless (1985). The algorithm was written using the MATLAB software package (Math Works Inc.). The observed times were also calculated as averaged over the two year period. They are calculated by averaging the time spent in each transitional state of pupils who had spent at least some time in that state over the two-year period. The analysis is outlined in Appendix 2 and the results displayed in Table 4, which shows the derived expected sojourn times and observed times in each of the transitional states occupied by pupils from S2 to S4. The results show that group risk-takers spend, on average, the longest time together followed closely by group non risk-takers. In the transition from S2 to S3 sojourn times decrease with degree of isolation; in that from S3 to S4, isolate risk-takers have higher sojourn times than isolate non risk-takers. The latter result might help to explain why isolates in some studies (Ennett and Bauman, 1993) have higher percentages of risk-takers than group members.

It is important to note that we are measuring the mean sojourn time of an individual in *a peer setting*, but not necessarily in the same peer group. The correlation between the overall average expected and the observed waiting times in the various transition states is 0.9 which is high. The expected sojourn times serve as a useful proxy for the observed values when there is only one set of transitional data (in this study there are two such sets so we can compare observed and expected).

Table 4. Expected and Observed Sojourn Times in Transition State

	GPRT	PERT	ISRT	ISNRT	PENRT	GPNRT
Expected (S2-S3)	12	7.3	8.5	7.6	11.2	11.2
Expected (S3-S4)	28.4	6.3	20.2	9.8	5.6	15.4
Overall Average	20.2	6.8	14.4	8.7	8.4	13.3
Observed (S2-S4)	13.4	7.8	10.8	9.5	9.7	12.9

Time in Months

Qualitative Findings (An Illustration)

Among the qualitative findings outlined in Pearson and Michell (2000) were five pupils ('top girls') as they progressed through the transitional period from t_1 to t_2. We are now able to complete this investigation by examining their progress (marked with arrows in Figures 2a, 2b and 2c) through t_1 to t_2 to t_3.

At time point 1 (see Fig. 2a), four of these pupils were in GPRT state (all in Group 3) and one was in PERT state (attached to Group 3). At time point 2 (Fig. 2b) three pupils were group risk-takers in separate groups and the other two were peripheral risk-takers attached to two of these groups. At time point 3 (Fig. 2c) four were in GPRT state (three in Group 1 and one in Group 7) while one had left the school (OTHER). At time point 2, they separate and enter different risk-taking groups, and then at time point 3 they reassemble to form another new group. These five key pupils have generally high esteem and form a focus of attraction and influence for other pupils while following differing paths from each other that eventually converge.

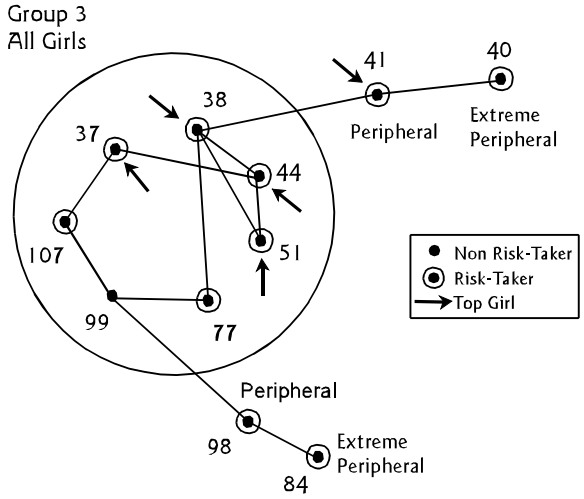


Figure 2a. Time point 1 (S2) 'Top Girls' and Peripherals

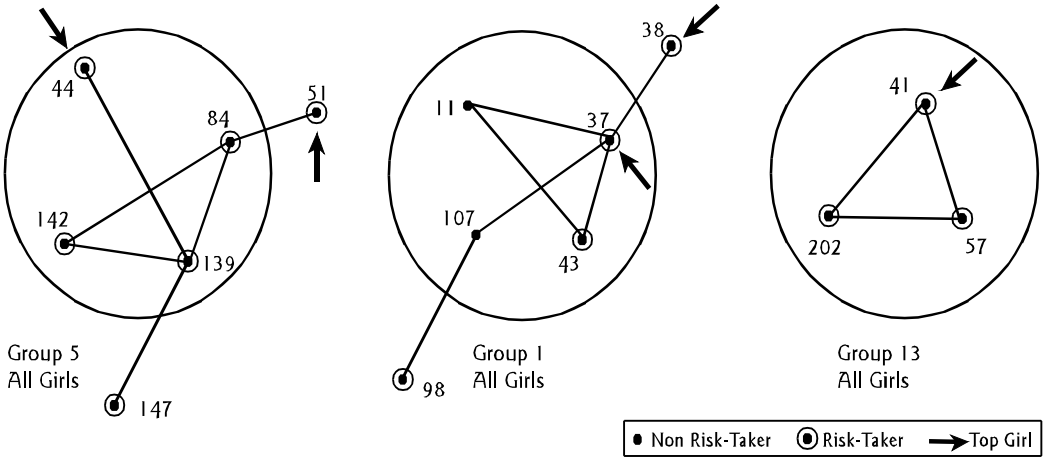


Figure 2b. Time Point 2(S3) 'Top Girls' and Peripherals

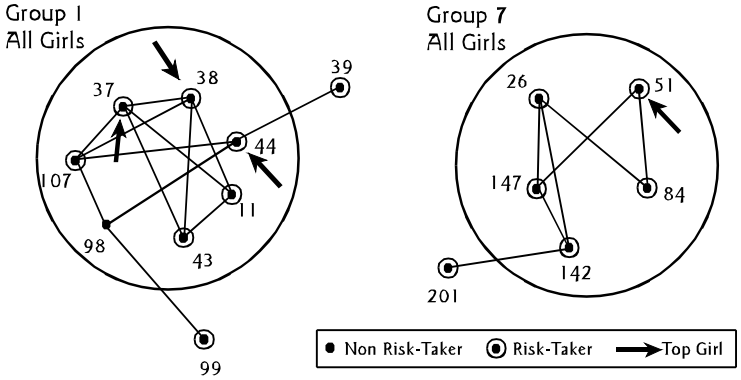


Figure 2c. Time Point 3 (S4) 'Top Girls' and Peripherals

SUMMARY

Our research has corroborated our earlier finding (Pearson and Michell, 2000) that among pupils in secondary schools there is a significant drift from group non risk-taking into group risk-taking status over time (S2-S4) together with a move of peripherals towards risk-taking groups. One interpretation of this is that group risk-takers exercise a powerful influence partly because of their relative stability over time. If the transitional process whereby pupils drift from one sociometric state to another over time is Markov, then the expected time spent in a group risk-taking state converges to a higher value than that for other states. We therefore hypothesize that pupils exercise greater influence by existing for longer periods of time in their transitional state as well as by the degree of cohesion associated with that state. This is consistent with the evidence.

We have also been able to offer a prediction, based on the first two time points, of the number of pupils occupying each sociometric state at time point three. Although there are more observed group risk-takers and fewer peripheral non risk-takers than would have been expected by the Markovian assumption, the result can be explained by the fact that there are fewer group non risk-takers to transfer into group risk-taking state. The next most important source for a transition into group risk-taking status involves the peripheral non risk-takers.

RECOMMENDATIONS

Influence Formula

Freidkin (1998) uses structural equivalence to measure the contribution of an individual to the effect of the position cluster. His model develops two formal equilibrium equations (p 24). The first is based on the origin of an actor's initial opinions on an issue; the second concerns the subsequent transformation of these initial opinions through repeated responses to influential opinions in a social network context. He uses a weighted average of these to develop his formula for social influence. Describing the importance of time for influence is implicit within this theory, but it is not often discussed in practice. One reason for this is the complexity that such modeling involves. Moody (2002) addresses the problem by incorporating starting and finishing times into a diffusion formula associated with evaluating the risk of disease transmission within a network.

These considerations lead us to formulate an influence formula that has the three dimensions of ego strength, cohesive strength and average time in transitional state as components. Egocentric strength would be measured via some sociometric measure of equivalence (such as individual popularity) that might be calculated from a simple survey to identify key individuals. Thus two individuals may be equivalent in the sense of being popular without having any linkage to each other. Cohesive strength (peer) would be measured using an indicator associated with a particular transitional state, such as the cohesive strength calculated for a particular peer group, this value being ascribed to the individual according to the appropriate peer category to which the individual belongs. Finally, the average time in a transitional state would act as another indicator of the influence of that transitional state. Thus, one of the components (ego-centric measure) is associated with the individual, while the other two are associated with the transitional state such as a peer group or peripheral state to which the individual belongs. The proposed formula is :

$$Individual\ \ Influence = Function\ (ego, (peer, time))$$

We would suggest this be an increasing function of the three components (or arguments, to use the mathematical term), so that the greater the value of the egocentric measure, the greater the value of the *Individual Influence* function, and similarly for the other two arguments of *peer* and *time*. We assume that the value of *peer* would increase from its minimum for a true isolate to its maximum for a highly cohesive peer group member. A multiplicative model (or additive in *ego* and multiplicative in *peer* and *time*) would seem appropriate.

We propose the following formula for the individual influence, I_{vw}, exercised by an individual *v* upon an individual *w* during the time, T_p^{vw}, that they spent together in the common peer setting *P*:

$$I_{vw} = I_v + I_p \qquad \text{(Influence formula)}$$

where $P \in \{GRP, PER, IS\}$, I_v is the ego-influence of the individual *v*, and I_p is the influence exercised by the peer setting during the time period $\left[0, T_p^{vw}\right]$. I_v could be calculated using an ego-centric measure such as the popularity. We would expect I_p to be a function of C_p^T, the mean cohesion of the members of the peer setting P during the time period $\left[0, T_p^{vw}\right]$, and the magnitude of T_p^{vw}, so that $I_p = F\left(T_p^{vw} \times C_p^T\right)$. The units used to measure the ego-influence, I_v, and the peer influence, I_p^T, would need to be standardized. The strongest individual in the network would be expected to have a significant influence if they were a member of a weak peer group, so that

$I_v >> F\left(T_p^{vw} \times I_p^T\right)$. Similarly, the weakest individual would be expected to have a very small influence if they were a member of a strong peer group, so that $I_v << F\left(T_p^{vw} \times I_p^T\right)$ The formula is readily extended to identify the influence exercised by an individual in one peer setting, such as a group member, upon an individual in another setting such as a peripheral.

The five 'top girls', for instance, provide an example for this influence formula. Consider the girl number 37 who is a group risk-taker at all three time points. For her the expected value of I_v (her ego-influence) might be measured by the number of respondents naming her as popular, which from the sociograms (Figures 2a, 2b and 2c) averages at 3.33 (=(4+2+4)/3). The cohesiveness of the groups at the three time points can also be calculated. For simplicity we calculate only the density of Group 1 at time point 3, which is 11/(7×6/2) =0.5238. Finally the expected time of 20.2 months (=1.68 years) in the group risk-taking position can be taken from Table 4. Suppose we standardized our units focusing on girl 37: first, relative to the peer influence of a true isolate risk-taker with zero in-degree and zero cohesion (assumed zero), and second, based on this individual (girl 37) having equal (expected) ego and peer influence. Then $I_p = I_v = 3.33$ and so:

$$I_p = F\left(T_p^{vw} \times C_p^T\right) = F(1.68, 0.5238) = \left(1.68 \times 0.5238\right)/0.2643 = 3.33$$

where $F(x,y) = \left(x \times y\right)/0.2643$, since $\left(1.68 \times 0.5238\right)/3.33 = 0.2643$. The expected influence of girl 37 would therefore be 6.66 (= $I_v + I_p$ = 3.33+ 3.33). We could then calculate the influence of girl 37 on, say, girl 43 using the above formula adjusted for the length of time they spent together in the same group. This gives:

$$I_{vw} = I_v + I_p = 3.33 + F(1.5 \times 0.5238) = 3.33 + \left(1.5 \times 0.5238\right)/0.2643 = 6.3$$

where the observed length of time the two pupils spent together in the same group is estimated as 1.5 years (=2-0.5) since they were observed together at t_2 and t_3, but not at t_1 (see Figures 2a, 2b and 2c).

Intervention Programs

In intervention programs egocentric measures are often effectively used as an initial identifier of key individuals with the propensity to change patterns of behavior (Bloor *et. al.*, 1999). The addition of sociometric measures of cohesion significantly increases the potential since it enables us to identify and trace the peer position and related group structures of such key individuals in both cross-sectional and longitudinal studies. In combination, it is hoped that more effective use of intervention policy can be developed which increases the influence that such programs may have in promoting (or reducing) certain behavior patterns. Most studies, however, are limited to egocentric measures, which are centered on reports by and about the individual rather than the cohesive structure of a peer group (Wasserman and Faust, 1994, Chaps 7, 9, 12). Thus, a recent study (Bloor e*t al.*, 1999) made use of an egocentric measure of popularity to identify key individuals who were then targeted for an intervention (Mosbach and Leventhal, 1988) to reduce smoking in schools. The method identified 'popular' pupils who are seen as centers of influence and anti-smoking training is offered to such pupils who are then used to 'intervene'. We argue that this approach is limited, and that adding the dimensions of 'level of cohesion' and 'expected waiting time' enables a truer picture of the individual's influence to be calculated.

Valente and others (2002; Valente and Davis, 1999) have recently proposed a more radical and efficient approach. An objective is to test whether using network data to identify peer opinion leaders and their assignments to groups is an effective strategy for such programs. The network condition consisted of identifying peer leaders using student nominations and matching those

leaders to students who nominated them. This approach employs results of one sociometric survey using cohesive measures to identify pupils of key influence and then assign them to a relevant peer group, rather than randomly. The method described can be further improved to advance health promotion efforts by targeting key pupils who are likely to be most influential on particular peer groups. In social network terms this would mean incorporating the three dimensions of 'ego-centric position' (such as popularity), 'cohesive social network position' (such as being a member of a strongly cohesive group) and 'expected time in network position' into the selection method to achieve the most efficient and effective results.

CONCLUSION

Peer groups have previously been defined as interaction-based clusters of individuals (adolescents) who *spend more time with each other* than with other adolescents and who tend to share similar attitudes and behavior (Brown, 1989). Our study based on three time points used an embedded Markov process to establish steady-state waiting times in each of the regularized patterns (cohesive 'states'). The Markov property in this context implies that the probability of an adolescent being a risk-taking peer group member at one time point depends solely on their peer position and risk-taking behavior at the previous time point. Previous publications (Kingman, J, 1962; Singer and Spilerman, 1976; Kalbfleisch and Lawless, 1985; Leenders, 1995) have addressed issues central to modeling social phenomena by continuous-time Markov structures. Our evidence shows, when using these modeling methods, that the Markov process in our study data is non-stationary, but that there are significant patterns emerging. It is hoped that this modeling will help to explain some of the anomalous findings in the literature, which in some studies suggest that smoking and risk-taking increases with isolate status (Ennett and Bauman, 1993) while in others (Haynie, 2001) that delinquency (including risk-taking behaviors) increases in strongly cohesive networks.

We hypothesize that, following the model of primary socialization theory (Oetting *et al.*, 1998) , the sociometric peer influence exerted by an individual can be attributed to three factors. The first is the egocentric position (such as the popularity of the individual). The second is the position of the individual within a cohesive network (influence at this level could be best described by the possession of shared peer identity). The third factor is the expected sojourn time that the individual spends in each network state (influence at this level would usually be increased if the sojourn time in a 'state' was higher).

Incorporating all three dimensions, making use of Markovian methodology, provides some rich and interesting results, which could prove valuable when intervening, or delivering (health or other) education programs. For instance the length of time spent by individuals in group risk-taking states in our study is significantly higher than that in other (group/peripheral/isolate, risk-taking/non risk-taking) states. It seems likely that this is related to the influence they have: risk-taking peer groups exercising greater influence because of the increased length of time spent by pupils in this state. Our study also reveals an accumulation of risk-takers into isolate positions, since there is a greater expected time spent there than in the isolate non risk-taking positions. In addition, qualitative work showed that certain 'top girls' displayed increased risk-taking behavior and acted as a focus of attraction in the formation of peer groups, the relevant sociograms further illustrating the influence these pupils appear to have. In combination, the evidence points to the need for differential targeting making use of all three dimensions associated with the individual (egocentric), the peer group (cohesive), and over time (longitudinal). The design of health programs using intervention techniques should incorporate these factors when selecting key pupils for anti-smoking or anti-drug programs.

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Appendix 1

The definition of egocentric network density when there are a maximum of six nominations is

$$ERSDEN = \left(\sum SR \middle/ \left(sr\left(sr-1\right)\right)\right) \middle/ \left(abs\left(6sr \middle/ \left(sr\left(sr-1\right)\right)\right)\right)$$

where SR = total number of ties (where a reciprocated tie counts as two ties) in the send/receive-network, sr = number of nodes in the send/receive network. As an example we will take a highly cohesive group of 6 individuals all of whom have nominated and been nominated by each other, so that

$$ERSDEN = \left(6\times 5 \middle/ 6\times 5\right) \middle/ abs\left(\left(6\times 6\right) \middle/ 6\times 5\right) = 0.833$$

Suppose an isolated pupil has a strong desire to be associated with this group and therefore nominates all 6 pupils in the group but receives no nominations in return from any other pupils in the local ego-network. This isolated pupil has a falsely identified local ego-network consisting of his/herself plus the six members of the highly cohesive group. The density of this ego-network is

$$ERSDEN = \left(6\times 5+6\right) \middle/ \left(7\times 6\right) \middle/ abs\left(\left(6\times 7\right) \middle/ \left(7\times 6\right)\right) = 0.857$$

and so the isolated pupil appears to be even more integrated into the highly cohesive group than the group were if considered apart from the isolate. If this pupil then displays some level of delinquency replicating that of the group, this behavior would appear to be associated with the membership of a highly cohesive network, rather than as an isolated individual.

Appendix 2

We search for a solution, Q, to the equation $P\left(t\right)=e^{Qt}$ (t=1 year) where P is the transitional matrix and Q is the intensity matrix. The solution enables us to identify the expected waiting (sojourn) times ($=-1/q_{ii}$) spent in the transitional state i (such as group risk-taking) during one transitional time period. If the discrete (that is, measured at discrete time points) process is embeddable in continuous time (over, say, a number of years) and converges to a steady state equilibrium solution then the more general solution $P\left(t\right)=e^{Qt}$ (t>0) can be modeled. This identifies the value of the transitional matrix over a longer period of time. We developed an algorithm in MATLAB, which identified the maximum likelihood estimator for Q. We identified an initial approximation for Q by assigning the values $\ln\left(p_{ii}\right)$, $i=1,..7$ to the leading diagonal. $q_{ii}=\ln\left(p_{ii}\right)$. These times serve as a good initial indicator of the expected sojourn times (Cox & Miller, 1965; Kalbfleisch & Lawless, 1985).

We assigned the other values using the equation $\sum_{j=1}^{7} q_{ij}=0$, and the equation, exp $m(Q) = P$ where exp $m(\ )$ is the MATLAB operator for matrix exponentiation. We chose a basis, $\theta_0=\left[\lambda_1,\ldots,\lambda_b\right]$, for the intensity matrix, Q, such that $q_{ij} = f\left(\lambda_1,..,\lambda_b\right)$ for i = 1,..,7; j = 1,..,7 (Kalbfleisch & Lawless, 1985). We tested models with b =12, 18 and 22 and found b = 18 the most effective. We identified an improved value of $\hat{Q}$. We then used a random search method based on the MLE $\hat{Q}$ over the fully saturated parameter space, again developed in MATLAB. The MLE estimates of the intensity matrices for the two transitions through time are given by Q_1 and Q_2, where:

$$Q1 = \begin{bmatrix} -0.9972 & 0.3324 & 0.3324 & 0 & 0 & 0.2324 & 0.1000 \\ 0.9095 & -1.6542 & 0.5298 & 0 & 0 & 0 & 0.2149 \\ 0 & 0.4524 & -1.4096 & 0 & 0.3524 & 0.3524 & 0.2524 \\ 0 & 0.5229 & 0 & -1.5688 & 0.9459 & 0 & 0.1000 \\ 0 & 0 & 0.2669 & 0 & -1.0677 & 0.8008 & 0 \\ 0.1682 & 0 & 0 & 0 & 0.1682 & 0 & -0.3365 \end{bmatrix}$$

and

$$Q2 = \begin{bmatrix} -0.4228 & 0.3228 & 0 & 0 & 0 & 0 & 0.1000 \\ 1.0980 & -1.8980 & 0.5000 & 0 & 0 & 0.3000 & 0 \\ 0.2400 & 0.0800 & -0.5931 & 0 & 0.0800 & 0 & 0.1931 \\ 0.1000 & 0 & 0.1000 & -1.2216 & 0.2000 & 0.4000 & 0.4216 \\ 0.3500 & 0.2400 & 0.2000 & 0.6811 & -2.1411 & 0.6700 & 0 \\ 0.4500 & 0.0804 & 0 & 0.1300 & 0.2200 & -0.7804 & 0 \\ 0 & 0.1797 & 0.2800 & 0 & 0 & 0 & -0.4597 \end{bmatrix}$$

We can corroborate these waiting times by observation using the formula

$$[(\text{Total time in a given state from TP1 to TP3}) - 0.5]$$

We get the values of observed average waiting times from TP1 to TP3 as 1.114,0.648,0.9,0.794,0.808 and 1.077 (in years) which match favorably with the overall expected sojourn times.

Further research is planned making use of a maximum likelihood estimator for the intensity matrix and successive approximation to the probability transition matrix by modeling of the transitions from time point one through to time point three as part of a continuous process (Snijders, 1996; Leenders, 1995; Kalbfleisch & Lawless, 1985). We plan to make this the subject of a future publication.

CONNECTIONS 25(2): 77-87 http://www.insna.org/Connections-Web/Volume25-2/4.Flom.pdf

Boundary-crossing and drug use among young adults in a low-income, minority, urban neighborhood

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This paper examines the relationship between boundary-crossing sexual partnerships (i.e., those between partners who are 5 or more years older, of a different race or ethnicity, or live in a different neighborhood or borough) and use of crack or injected drugs among young adults in Bushwick, Brooklyn. Women who smoked crack or injected drugs were more likely to have a sexual partner who was older, of a different race/ethnicity, or from a different borough than were women who did not use these drugs; men who used these drugs were more likely to have older sex partners than men who did not. Young people who use these drugs are known to be at higher risk of having HIV and a number of other sexually-transmittable infections such as hepatitis B, genital herpes, and syphilis. The results of this paper imply this risk may be even higher for people who cross these these boundaries. In addition, if these young people become infected, they may be particularly likely to serve as a gateway for spreading infection to other social groups.

INTRODUCTION

One important issue in population epidemiology is whether sexually transmitted diseases (STDs) such as HIV and Herpes Simplex type 2 (HSV2) cross social boundaries such as age, race, and geography. This is clearly shaped by sexual networks, since young crack smokers and drug injectors are much more likely to be infected with HIV and other STDs than the general population is. (Buchacz *et al.*,2000; DiCarlo, Armentor, and Martin, 1995; Edlin*et al.*, 1994; Ellen, Langer, Zimmerman, Cabral, and Fichtner, 1996; Fleming *et al.*,1997; Friedman *et al*.1999; Garfein, Vlahov, Galai, Doherty, and Nelson, 1996; Gunn, Montes, Toomey*et al.*, 1995; Mertz, Weiss, Webb*et al.*,

1998; Rolfs, Goldberg, and Sharrar, 1990; Schwarcz, Bolan, Fullilove *et al.*, 1992; Zenilman, Hook, Smith, Rompalo, and Celentano, 1994). We explored whether crack smokers and drug injectors have sexual networks that are particularly prone to cross social and geographical boundaries.

This type of boundary crossing is important for several reasons. First, as noted above, it has clear implications for the spread of HIV and sexually transmitted infections generally. Drug injectors and, to a lesser extent, crack smokers, may be a core group (Thomas and Tucker, 1996) and core groups have been shown to be important for the establishment and persistence of numerous infections, including HIV (Anderson and May, 1992; Boily, Lowndes, and Alary, 2002; Hethcote and York, 1984). Second, some of these relationships (especially those where the man is older than the woman (Alan Guttmacher Institute, 1994; Males, 1995, cited in Zierler and Krieger, 1997) or where the man is white and the woman is not) may be likely to have particularly unequal power relationships, and power in relationships is related to HIV-risk behaviors (Amaro, 1995; Bowleg, Belgrave, and Reisen, 2000).

Third, HIV may be concentrated in certain neighborhoods within cities. In San Francisco in 1998, 70% of all people diagnosed with AIDS lived in six of the city's 26 ZIP codes.[1] The incidence of newborns diagnosed with AIDS in New York City by ZIP code ranged from 0 to 4.1%.[2] This concentration may make certain neighborhoods more likely to contain core groups, and makes inter-neighborhood boundary crossing important.

Research on injection networks of IDUs in Bushwick found that 1) having a partner of a different race/ethnicity helped predict the higher HIV-seroprevalence among Puerto Rican IDUs than among others (Jose, 1996) and having a partner who was 5 or more years older than the subject predicted HIV serostatus among injectors in general and among young and female injectors in particular (Friedman, Curtis, Neaigus, Jose, and Des Jarlais, 1999). Kottiri (2002) and his colleagues found that, in Bushwick, "racially/ethnically discordant risk partnerships involving black IDUs may function as bridges of transmission [of HIV] between groups" (p. 95). Similar patterns may be found among the sexual-risk networks of a more general population, and one purpose of this paper is to explore these networks In summary, there is substantial theoretical and empirical evidence to indicate that HIV-risk between couples of different ages, different races/ethnicities, and different neighborhood is important to study, and this paper is one part of such study.

Methods

The data for this paper come from a survey of 18-24 year old youth in Bushwick, a low-income minority neighborhood in Brooklyn, New York with a population of approximately 100,000. Drug use and drug selling are widespread in Bushwick (Curtis, Friedman, Neaigus, Goldstein, and Ildefonso, 1995; Friedman, Flom, Jose *et al.*, in press; Maher, 1997; New York State Office of Alcoholism and Substance Abuse Services, 1992) as are some STIs, including herpes simplex virus (type 2) and chlamydia among 18 – 21 year olds (Friedman *et al.*, 1997).

We included two sub-samples: A probability sample of household youth, and a targeted sample of youth who use cocaine, heroin, crack or injected drugs. We did this in order to have a sufficient number of users of these drugs for analysis (i.e. to have reasonable statistical power). While there are important advantages to using a probability sample, there are also important advantages to using a

[1] Available online at http://www.ncccsf.org/6%20Community_Assessment/Report_San_Francisco/Aids-sf.pdf

[2] Available online at http://www.health.state.ny.us/nysdoh/aids/98/aidsny3.pdf

targeted sample to study rare, sensitive, or illegal behaviors. In our household sample, only 1.1% of the subjects had smoked crack in the past year, and less than 0.6% had injected drugs. In our combined sample, there were 28 people (5.3%) who had injected drugs; to obtain this number from a household sample would have required a sample of approximately 5,000 people, which would have been prohibitively expensive in terms of both time and money. This combined sample is not representative of any general population, but it is the only type of sample which would allow these relationships to be understood. Additionally, users of the most stigmatized drugs may be underrepresented in the household sample (Friedman *et al.*,1997).

Subjects were interviewed with informed consent, and were offered a range of tests for STDs and HIV. Subjects were assured of the confidentiality of their responses and of the results of all tests (except insofar as public health regulations require reporting of active STDs). Subjects were paid $20 for completing the interview, and an additional $10 for giving blood and urine specimens.

Household sample

Probability sampling of household youth was accomplished through a multistage sampling design. The first stage was the random selection of face-blocks. A face-block is both sides of one street between adjacent city streets. As of the start of the project (April, 1996), there were 577 face-blocks in Bushwick. Face-blocks, rather than city blocks, were chosen in order to use social interaction effects to help the recruitment process by quickly establishing the field staff as trustworthy people; and prior ethnographic research showed that social interaction in Bushwick takes place more often among neighbors on face-blocks (i.e. along and across a street) than with persons around the corner or across a back yard (Friedman *et al.*,1997). Face-blocks were screened sequentially, after being ordered randomly. One face-block could not be sampled because of intense hostility to our interviewers.

Young adults (18-24 years old) living in the household for at least 14 consecutive days prior to the screening were eligible for this study. Attempts were made to screen each dwelling unit. Screening was mainly conducted door-to-door; if the initial attempt failed to confirm the presence or absence of age-eligible residents, repeated attempts were made to screen each dwelling unit, and a variety of methods were used to determine the presence or absence of eligible persons in each dwelling unit. If more than one eligible person lived in a particular unit, one was randomly chosen. Extensive attempts were made to encourage selected individuals to take part in the study. The 43 selected face-blocks contained 2675 dwelling units, 90% of which (2404) were screened. Of the screened dwelling units, 21% (499) had an eligible resident. Of the 499 eligibles, 73% (364) were interviewed; one subject completed only part of the interview, and is not included in the results.

Targeted sample

The targeted sample of young adults who used heroin, cocaine, crack, or injected drugs in the last 6 months were recruited by a combination of ethnographically-based targeted sampling in drug use venues and chain-referral by household and targeted-sample participants. Age and residence eligibility were determined through at least one form of identification (such as driver's license, school ID, etc.).

All subjects, whether recruited as part of the targeted or the household sample, were asked to recruit other 18-24 year old Bushwick residents whom they had listed in their 12-month networks (defined below) as users of cocaine, heroin, crack, or any injected drugs. For each such eligible participant they brought in they received a $5 finder's fee. Some respondents also functioned as auxiliary

recruiters and brought in age-eligible Bushwick residents who used heroin, cocaine, crack or injected drugs and who were not originally listed in their 12-month network. The use of chain-referral may bias the sample in that more extroverted or popular people, or those with high degree centrality, may be more likely to be nominated (Rothman and Greenland, 1998). However, it is not possible to obtain a truly random sample of the population of drug users and others have used similar strategies to study hidden populations (Braunstein, 1993; Watters and Biernacki, 1989).

Data Collection

Data were collected by face-to-face structured interview; the first interview was conducted in July, 1997, and the last in June, 2000. The interviews lasted between 1.5 and 2.5 hours, and were conducted either in our Bushwick storefront or in the respondent's homes (if privacy could be assured). The main part of the questionnaire was administered by trained interviewers, who were fully bilingual in Spanish and English. Most interviewers had extensive ties to the community.

The questionnaire focuses on issues of drug use and its relationship to behaviors and to network characteristics that may put youth at risk for HIV or STDs. Relevant parts of the questionnaire include questions on use of marijuana, cocaine, crack, heroin, and injected drugs in the past 12 months, as well as on sexual behaviors and networks. In addition, urinalysis for drug metabolites was performed prior to the interview; this may have had a "pipeline" effect in increasing the accuracy of self-report of drug use (Hamid, Deren, Beardsley, and Tortu, 1999); that is, the knowledge that they were going to be tested may have decreased the likelihood of false negative self-report.

Each subject was asked to name up to 3 people with whom they had had sex in the last year. They were then asked to supply a variety of information about each of these (and other) network links; relevant here are questions about their age, race, and location of residence. We compared data from the "behavioral section" of the questionnaire in which we asked them how many people they had had sex with in the past 12 months with data collected in the network section. If the two values were logically incompatible (e.g. they said they had had sex with only two people in the last year, but named three partners), we labeled them 'discordant'. Among those who did not use crack or inject drugs, there was very low discordance (15/459; 3.3%). Among the users of crack and injection drugs, discordance was somewhat higher (9/69; 13%). These nine people did not fall into any particular pattern; six named more people in the behavioral section, and three named more in the network section.

Dependent variables

The dependent variable was boundary-crossing, which we operationalized in five ways:

1) Having any sex partner five or more years younger than the subject;
2) having any partner five or more years older than the subject;
3) having one of a different race or ethnic group (where the categories were defined as Latino, non-Latino Black, non-Latino White, and other);
4) having any partner from a different neighborhood (i.e. outside of Bushwick)[3]; and
5) having any partner from outside of Brooklyn. While it would have been useful to be able to analyze the amount of boundary-crossing of each type (e.g., the number of partners who were

[3] This was operationalized by asking the subject what neighborhood the partner lived in. No list of neighborhoods was read.

five or more years older, rather than simply whether there were any), our data do not permit this, as detailed information was collected only on those partners named in the network. Although many participants named all their partners, this was not true for those who had more than three partners, nor for everyone with less than three, since not all participants who had three partners named all of them in the network section.

Independent variables

The main independent variable was whether a participant had injected drugs or smoked crack in the last year.

Analysis

Because the sex networks of men and women tend to be quite different, we present the data analyzed separately for men and women. This does not allow us to determine the statistical significance of differences between men and women, but it does focus attention on gender-specific network patterns, which is important because both disease transmission probabilities and power relations may vary by gender. In order to determine the significance of differences, we also ran the analyses using sex and the interaction between sex and use of crack or drug injection. We indicate significant differences in the tables.

Analyses are presented below three ways: First, without any controls; second, with controls for number of sexual partners named in the network section; and third, controlling for both number of partners named and for age and racial/ethnic group of the subject (Latino/a vs. not). This is done because the analyses serve different purposes. The analysis without control for number of partners is more important for describing the potential spread of STDs. This is so because the spread of STDs does not depend on the reasons why boundary crossing takes place, but simply on its extent. The two models with statistical controls are more important for determining whether anything about the crack smokers and drug injectors other than their larger average number of partners might increase their likelihood of having boundary-crossing partnerships. The model controlling only for number of partners shows which types of boundary crossing are more or less likely among crack smokers and IDUs than among others, per relationship (rather than overall). The model with additional controls shows whether it is the race or age of the subject which is accounting for these differences.

Results

Of the 528 subjects, 363 (69%) came from the household sample; 289 (55%) were male; 78% were Latino, and 16% were African-American; 78% had never been married, 7% were legally married, and 11% were informally married or living together. Most (58%) had neither graduated from high school nor received a GED; of those who had neither, 27% were currently in school or a training program; of those who had either graduated high school or gotten a GED, 36% were in school or a training program. Just under a third (31%) were currently employed. Median household income in the past year was $16,700. One-quarter of the subjects (141, or 27%) had been incarcerated, 16% (82) in the last 12 months. People in the targeted sample were more likely than those in the household sample to be male (78% vs. 44%, $p < .001$), and Latino (95% vs. 78%, $p < .01$), and less likely to have graduated from high school or gotten a GED (32% vs. 47%, $p < .001$), or to be employed (20% vs. 36%, $p < .001$). There were no significant differences between the two samples on marital status or household income.

Just over a third (187, or 35%) of the subjects had not used any illicit drug in the last 12 months; 136 (26%) had used only marijuana, 91 (17%) had used noninjected cocaine other than crack (and neither injected any drug nor used heroin), 46 (9%) had used noninjected heroin (and not injected any drug or smoked crack), 40 (8%) had smoked crack but not injected any drug, and 27 (5.4%) had used injected drugs.

There was substantial boundary crossing (see Table 1), although few subjects had younger partners (19 men and 3 women); no further analysis of the younger partner data was conducted because the small numbers did not permit analysis. More than a third of women (92 of 239, or 39%) and more than a quarter of men (81 of 289, 28%), had at least one partner who was five or more years older than they were. About a quarter of both men and women had at least one partner of a different racial/ethnic group, and about half had at least one partner from outside Bushwick.

Table 1. Levels of boundary crossing (entire sample)

Type of boundary crossed	Females (N = 239)	Males (N = 289)
Had at least one sexual partner five or more years younger	3 (1.2%)	19 (6.6%)
Had at least one sexual partner five or more years older	92 (39%)	81 (28%)
Had at least one sexual partner of different racial/ethnic group	61 (26%)	67 (23%)
Had at least one sexual partner from outside Bushwick	110 (54%)	154 (58%)
Had at least one sexual partner from outside Brooklyn	27 (14%)	56 (21%)

Male and female crack smokers and drug injectors were substantially and significantly more likely than nonusers of these drugs to have older partners, and women who smoked crack or injected drugs were more likely to have partners of a different racial/ethnic group, and to have partners from outside Brooklyn than women who did not (see Table 2).

Table 2. Relationship between being a crack smoker or drug injector and boundary crossing

Type of boundary crossed	Females (N = 239)		Males (N = 289)	
	OR	95% CI	OR	95% CI
Partner five or more years older	7.78	3.03-19.98	2.73	1.38-5.41
Partner of different racial/ ethnic group	2.41	4.58-26.85	1.31[b]	0.61-2.78
Partner from outside Bushwick	2.05	0.88-4.75	1.39	0.68-2.87
Partner from outside Brooklyn	3.41	1.32-8.86	1.10[a]	0.47-2.57

[a] Main effect of sex significant
[b] Interaction between sex and use of crack or IDU significant

Most of these effects remained significant after controlling for number of partners identified, but the female crack smokers and drug injectors were no longer significantly more likely to have had a partner outside Brooklyn (see Table 3); when, in addition, age and racial/ethnic group were controlled for (see Table 4), the only significant effect was that females who smoked crack or injected drugs were more likely to have a partner of a different racial/ethnic group. In addition, there was

some evidence that both males and females who smoked crack or injected drugs were more likely to have a partner five or more years older than they were; although this was not statistically significant, the effect sizes were fairly large, and, for females, larger than when age and race/ethnicity were not controlled. The general pattern of results was similar when members of the targeted sample who did not smoke crack or inject drugs were deleted.

Table 3. Relationship between being a crack smoker or drug injector and boundary crossing, adjusted for number of partners

Type of boundary crossed	Females (N = 239)		Males (N = 289)	
	AOR	95% CI	AOR	95% CI
Partner five or more years older	2.22	1.09-4.59	3.12[a]	1.09-8.92
Partner of different racial/ethnic group	5.09	1.90-13.62	0.83[b]	0.36-1.89
Partner from outside Bushwick	0.61	0.21-1.80	0.88	0.44-1.94
Partner from outside Brooklyn	0.34	0.07-1.69	0.46	0.17-1.28

[a] Main effect of sex significant
[b] Interaction between sex and use of crack or IDU significant

Table 4. Relationship between being a crack smoker or drug injector and boundary crossing, adjusted for number of partners, and for subject's race and age.

Type of boundary crossed	Females (N = 239)		Males (N = 289)	
	AOR	95% CI	AOR	95% CI
Partner five or more years older	2.78	0.94-8.23	2.03[a]	0.98-4.22
Partner of different racial/ethnic group	4.77	1.71-13.31	0.82[b]	0.35-1.94
Partner from outside Bushwick	0.5	0.16-1.54	0.9	0.40-2.02
Partner from outside Brooklyn	0.5	0.17-1.55	0.51	0.18-1.45

[a] Main effect of sex significant
[b] Interaction between sex and use of crack or IDU significant

Conclusions

Female crack smokers and drug injectors are substantially more likely than female nonusers to have one of their listed sexual network members be older, of a different race/ethnicity, and from another borough. All of these may be consequences of the social life patterns of users of these high-risk drugs, but the age and race/ethnicity results may be mediated by number of partners. However, the overall message is that smoking crack and injecting drugs are related to both a greater number and a more diverse set of sexual partners. Among males, there is a similar relationship for age boundary-crossing, but the other relationships are not statistically significant, and are not large.

It should be noted that the differences in boundary-crossing between subjects who smoke crack or inject drugs and those who do not are not due to commercial sex work. While crack smokers and

drug injectors were more likely to engage in commercial sex work, the results in this study come from people named as partners. We asked the subjects what relationship the partner was to them, and none were commercial partners.

It should also be noted that none of these results imply any particular causal pathway; in an observational study such as this, alternative causal pathways are impossible to rule out. In particular, we cannot infer that something about the drug use behavior itself causes greater boundary crossing; one alternative is that some other characteristic is causing both greater boundary crossing and use of crack or injected drugs.

It is possible that some of these boundary-crossing behaviors, while increasing the possibility of spread of HIV or other STIs from group to group, may be perceived (rightly or wrongly) by the subjects as decreasing their own risk. For instance, if a subject believes that people in Bushwick are more likely to be HIV-positive than people in other neighborhoods, than having partners from another neighborhood might be perceived as safer.

These findings are important for modeling the spread of infectious diseases. Earlier research has shown that that crack smokers and drug injectors tend to have more partners than people who do not use these drugs (Flom *et al.*, 2001). It is also important to consider who these partners are. Even among the partners they were allowed to describe, there is a tendency for young female crack smokers and drug injectors to have more partners outside their own age group, outside their race/ethnicity, and from different geographic locations; and for young male crack smokers and drug injectors to have older partners. Given that crack smokers and drug injectors tend to have a great many more sexual partners (in our data, males who either smoked crack or injected drugs had an average of 17 partners, and female crack smokers or drug injectors an average of 44) than non-users of these drugs (in our data, male non-crack smokers or drug injectors had an average of 2.8 partners, and females an average of 1.3), the effects of this boundary-crossing will be magnified. That crack smokers and drug injectors have a greater number of partners implies that they may be at risk for becoming infected with viral STDs such as HIV or HSV-2 from older partners. If they become infected, they may be gateways for the transmission of STDs into their local community and/or race or ethnic group and outside it. It also suggests that, if crack smokers and drug injectors in a locality become a core group for a disease (due to their internal patterns of sexual and perhaps injecting relationships and behaviors; and to their potentially-restricted access to medical care), they might transmit these infections across social boundaries.

These results suggest that harm reduction, drug treatment, and STD services should be made easily available to crack smokers and drug injecting youth in order to protect them and also to slow the diffusion of diseases through communities.

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Will You Remember Me In The Morning?
Test-Retest Reliability of a Social Network Analysis Examining HIV-Related Risky Behavior in Urban Adolescents and Young Adults[1]

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In recent years there has been a growing interest in applying social network models to the problem of adolescent substance use. However, there has been little research conducted examining the reliability of social network information within this population. The current study attempts to address this gap, specifically by examining social network test-retest reliability over a two week period among a sample of adolescent substance users. The results of the current study suggest that for social network variables dealing with substance use, reliabilities are at least moderate with correlations of .6 or above. However, there is a large degree of turnover with regards to the specific individuals being named in the network with only 62% of alters mentioned at Time 1 being mentioned at Time 2.

INTRODUCTION

Findings from recent research have generated widespread public concern about adolescent drug use with the highest rates of use appearing in youth between the ages of 16 and 25. Of particular concern has been a general rise in the popularity of marijuana, viewed by researchers and the

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public as an important "gateway" drug leading to the use of "hard drugs" such as cocaine and heroin, (Kandel, Yamaguchi, and Chen, 1992; Kandel, and Yamaguchi, 1993; Newcomb and Bentler, 1986; Osgood, Johnston, O'Malley, and Bachman, 1988). Questions arise as to why youth continue to use drugs, how new drugs diffuse into new populations of youth and young adults, and how youth make choices about which drugs to use for what purposes.

Peer influence through personal networks is recognized as central to promoting increased use of drugs, and the introduction of new drugs into existing drug use repertoires. Thus, social networks may hold the key to understanding the initiation and progression of drug use over time. Social network analysis at both the personal and the macro level locates risk not at the individual level but in the interaction between or among members of the social network. Networks have the potential to influence drug use patterns through peer persuasion, imitation, and/or close interaction with friends and acquaintances that share or sell drugs and by promoting participation in activities where drug use is common and drugs can be easily obtained (Hawkins, and Fraser, 1985; Westermeyer and Neider, 1988). Friedman (et al, 1997) notes the likelihood that sexual risk taking and hard drug use will be present in peer groups of adolescent problem drinkers, and calls for network studies to expand our understanding of the ways in which these behaviors of network members influence individual youth.

Social network research depends on the reliability of self report, as well as the accuracy of reporting on alters. The efficacy of these studies is determined in part by whether change in networks is a consequence of inaccurate recall or actual change in network composition and reported behavior. Some studies suggest low levels of informant accuracy in social network data while others suggest that recall accuracy varies with behavior, type of relationship between ego and alters and other situation-specific factors (Bernard and Killworth, 1977; Bernard, Killworth, Kronenfeld, and Sailer, 1985; Bondonio, 1988; Killworth and Bernard, 1976, Freeman, Romney, and Freeman, 1987). Reliability and accuracy are particularly important in longitudinal studies of drug use (Johnson, and Mott, 2001) where changes in network characteristics are central predictors of change in patterns of drug use or drug sequencing. Many recent network studies of drug use and HIV risk over time – usually six month periods – have shown significant differences in network composition and characteristics across two or three time points (Clair, Weeks, and Borgatti, 2000; Clair, Singer, Heimer, et al, 2000; Neaigus, Friedman, Curtis, et al , 1994; Miller and Neaigus, 2001) which are not easily interpretable for these reasons.

There are two types of variables that have been examined in social network test-retest reliability studies. The first set examines aggregate level variables over time with network size being the most frequent variable assessed (McFarlane, et al, 1981; Sarason, et al, 1990; Barrerra, 1980; Brewer, 2000). For example, Sarason and colleagues (1990) found that the number of people mentioned on the social support questionnaire had a test-retest reliability of .90 with a 4-week follow-up period. The second set of studies looks at the recall of named individuals across both time points (Marsden, 1990; Barrera, 1980; Brewer et al, 1999; Brewer, 2000). Looking at social support relations Barrera (1980) found that recall rates ranged from 48% of those providing material aid in the past month to 73% for typical sources of material aid, given up to a 10 day follow-up period. Looking at behavioral relations Brewer and colleagues (1999) found that 86% of sexual partners mentioned at time one were recalled at time two and 78% of injection partners mentioned at time 1 were recalled at time 2 with a follow-up of seven days.

There are currently two lines of research that offer predictions as to which alters are more likely to be recalled. First, is the belief that those with closer more intense ties will be more likely to be recalled (Marsden, 1990; Brewer and Yang, 1994). The other line of research looks at the name generators used to create the list of alters and suggests that specific wording will cue the recall of specific individuals (Smith, 2002; Kirke, 1996; Bailey and Marsden, 1999; Straits, 2000; Bernard, Shelley and Killworth, 1987, White and Watkins, 2000). Based on past research we hypothesize that those alter variables at Time 1 that directly relate to the name generator questions will be predictive of recall at Time 2. For example, one of the name generators asks about those that you have used drugs with, so we hypothesize that those alter variables that assess drug use with ego will be predictive of recall at Time 2. In addition, those alter variables that do not directly relate will not predict recall at Time 2. So, given the name generator above, we would not expect gender to be a significant predictor of recall.

This paper reports on the reliability of self report on social networks among adolescent drug users, using data from a pilot study of 60 adolescents designed to test a survey instrument to be used in a larger study of transitions to hard drug use. Sixty adolescents were recruited from two youth serving centers in two urban areas of Connecticut, representing the target populations for the larger study – African American and Puerto Rican male and female youth between the ages of 16 and 24. Twenty-five of the adolescents were re-interviewed approximately two weeks later to establish test-retest reliability of the survey instrument. The instrument included a social network component. This component asked participants to identify up to fifteen members of their personal social networks including family members, friends and other people important to them. Participants then answered approximately 25 questions about their alters. In addition they answered three questions about every alter's relationship with every other – whether the alter knew, did drugs or had sex with each of the others. The data we report on here are drawn from the social network component of the pilot survey.

METHODOLOGY

Participants

All study participants were from two large metropolitan areas within Connecticut. Participants were recruited through outreach that met the selection criteria for the Pathways project. Specifically: 1) they were between the ages of 16 and 24 and 2) they had reported using at least one drug other than alcohol, tobacco, or marijuana in the last 30 days. The analyses presented here are based solely on those participants who completed both an initial survey and a second survey which was completed within two weeks of the initial survey. There were 25 participants from the total sample that met these criteria.

Procedure

The participants were asked various questions about their social networks as part of a longer survey interview examining risky behavior in this population. Four name generators were used to create the list of alters for the current study: 1) Please tell me the names of all the different people who you spend a lot of time with, more than a few hours a week, or talk with on the phone often. 2) Please tell me the names of all the different people who you have used any kind of drugs with in the last 6 months. 3) Please tell me the names of all the different people who are close to you. 4) Please tell me the names of all the different people who you have had sex with in the last 6 months. The interviews were conducted individually by trained project staff. Interview rooms were selected that

allowed for privacy for the respondent and nobody other than the respondent and the interviewer were present in the rooms during the interviews. Informed consent was obtained prior to all interviews and the participants were assured of confidentiality. The importance of the participants answering as thoughtfully and honestly as possible was emphasized. Participants were paid $20 for their participation.

Measures

The network instrument inquired about several different facets of the participants' social networks. To assess the demographic characteristics of the networks we asked about the gender, ethnicity, age, and neighborhood of residence for the network members. We also asked about a number of different types of relational measures such as the length of time known, how important the person was to them (on a 5-point scale), how much they trust the person (on a 5-point scale), nature of the relationship with the network member (kin or non-kin), and frequency of contact. Finally we inquired about a number of different risk behaviors of network members and if the risk behaviors were performed with ego. Specifically, we asked if their network members used alcohol, marijuana, or other drugs, and whether the network members used any of these substances with ego. We also asked if ego had sex with any of their network members.

RESULTS

Overview

To examine the relative stability and reliability of networks over the two-week period we will conduct two different sets of analyses. First, we will examine the structural characteristics of the aggregate level information by assessing the test-retest reliability of a variety of important network indices. This will allow us to examine the aggregate level reliability over time. For example, does an individual have the same number of friends that use drugs over time irregardless of whether or not these are the same individuals. Second, we will examine the characteristics that distinguish between those network members listed at time 1 who are recalled at time 2 and those network members listed at time 1 that are not recalled at time 2. This will allow us to examine the predictors of recall for specific individuals. This helps to answer the question of what network member characteristics make them more likely to be remembered. Given the number of variables that will be examined we will use an alpha value of .01 to determine statistical significance.

Reliability of Ego Network Indices

To assess the test-retest reliability of the network variables we calculated the correlations for 11 pairs of network variables measured at both time points. These eleven variable pairs included: overall network size, number of males in the network, number of kin in the network, number of important persons in the network, number of network members that used alcohol, number of network members that used alcohol with ego, number of network members that used marijuana, number of network members that used marijuana with ego, number of network members that used other drugs, number of network members that used other drugs with ego, and the number of network members ego had had sex with. For ten of the eleven pairs of variables the correlations among the paired variables were statistically significant ($p<.01$). The one variable that was not significant was for the number of sex partners ($r = .47$, $p=.04$) and the largest correlation was for the number of network members that used marijuana with ego ($r = .89$, $p<.001$) (see Table 1 for details).

Table 1. Test-retest Reliability

Variable	r	Time 1 Mean	Time 2 Mean
Network Size	0.66**	6.64	6.16
# of Males	0.62**	3.75	3.12
# of Kin	0.58*	1.32	1.44
# of Important Persons	0.59*	3.08	3.16
# Who do Alcohol	0.67**	4.75	4.25
# Who do Alcohol With You	0.73**	4.27	3.90
# Who do Marijuana	0.69**	4.43	4.65
# Who do Marijuana With You	0.89**	3.83	3.78
# Who do Drugs	0.83**	4.30	4.43
# Who do Drugs With You	0.62**	3.56	3.52
# of Sex Partners	0.47	1.30	1.80

* p<.005
** p<.001

Network Characteristics Effect on Recall

The reliability of the ego-network indices addresses the reliability at the macro level. At the micro level it is important to determine if the same specific individuals are remembered over time and what characteristics predict recall at time 2. To assess reliability at this level we first examine the total recall estimates and conduct t-tests, on various characteristics of the network member (demographics, risk behaviors, etc). We then assess whether relationship characteristics (days contact, how important, ask for advice, etc) are significantly related with recall at time two. For the 25 participants that completed the survey 161 alters were named at time 1. At time 2, 147 alters were named including 100 of the alters mentioned at time 1, approximately 62% of those named at Time 1, and 47 new alters. Put another way 68% of those listed at Time 2 were also listed at Time 1.

There were 21 variables assessed for their potential role in alter recall at time 2. The three demographic variables (gender of alter, age of alter, and whether the alter lived in the same neighborhood) were not significantly associated with recall at time 2 ($p > .45$). The seven risk variables that were assessed included: does the alter use alcohol, has ego used alcohol with the alter, does the alter use marijuana, has ego used marijuana with the alter, does the alter use drugs (other than marijuana or alcohol), has ego used drugs (other than marijuana or alcohol) with the alter, and has ego had sex with the alter. Two of the seven risk variables, used marijuana with ego and used drugs with ego, were associated with recall at time 2 (see Table 2 for details). In each case for the risk variables the more risk the person represented (using drugs with ego) resulted in them being more likely to be remembered at time 2. So, for example if someone named an alter at time 1 that they used marijuana with they were more likely to recall that person at time 2 compared to an individual they did not use marijuana with.

Table 2. Demographic and Risk Variables and Recall

Variable	t	Sig. (2-tailed)
Gender	0.74	0.46
Age	0.67	0.51
Live in Your Neighborhood	0.46	0.64
Alter Uses Alcohol	0.87	0.39
Alter Used Alcohol with You	1.15	0.25
Alter Uses Marijuana	2.47	0.015
Alter Used Marijuana with You	3.99	0.001**
Alter Uses Drugs	2.14	0.035
Alter Used Drugs with You	2.94	0.004*
Alter had Sex with You	2.28	0.024

* p<.005
** p<.001

The remaining 11 variables that were assessed included six social dynamics variables and five social support variables. The six social dynamics variables included: how close ego rated alter (on a scale of 0 to 4), how important ego rated alter (on a scale of 0 to 4), how much they trust the alter, how much time they spend with alter, the number of days ego has been in contact with alter in the last 30, and the number of years ego had known the alter. Of the six, four significantly predicted recall at time 2 (p<.01) with the exceptions being the number of years ego had known the alter and how much they trusted the alter. The five social support variables included: if the alter gives ego good advice, if the alter asks ego for advice, if ego could get money from alter, if alter is someone ego would give money to, and if alter is someone they could go to if they needed a place to stay. Of the five, one significantly predicted recall (p<.01) whether ego would give money to the alter (for details see Table 3). For all 11 social variables the pattern was the same with the closer social relationships resulting in a greater likelihood of recall at Time 2. So, if the alter is rated as important, or someone that ego would give money to they were more likely to be recalled at Time 2.

DISCUSSION

The popularity of social networks analysis is growing rapidly in the area of adolescent substance use despite the lack of research conducted on the reliability of this data. The current study begins to address this important issue by looking at the reliability of social network data over a two-week interval for twenty-five 16 to 24 year olds. Two distinct types of reliability were examined: 1) an aggregate level reliability that addresses the level of function and 2) a micro level that looks at specific individuals being named in the network. At the aggregate level the test-retest reliabilities on a series of network variables of interest showed reliabilities ranging from .47 for number of sex partners to .89 for the number of network members ego smoked marijuana with. Using conventional estimates for reliability .89 is acceptable but the .47 warrants some caution. It is worth noting that all six of the drug use variables had correlations above .6.

TABLE 3. Social Dynamics and Social Support and Recall

Variable	t	Sig. (2-tailed)
Spend Time With	2.77	0.007*
How Close	4.59	0.001***
Years Known	0.06	0.95
Days Contact	2.89	0.005**
How Important to You	3.47	0.001***
How Much Trust	2.3	0.023
Give You Good Advice	-1.14	0.26
Ask You for Advice	2.07	0.04
Get Money From	2.16	0.033
Give Money To	2.71	0.008*
Go To If Need a Place to Stay	2.37	0.02

* p<.01
** p<.005
*** p<.001

Shifting to the micro level, only 62% of the alters mentioned at Time 1 were also listed at Time 2 two weeks later and an additional 47 names were listed at Time 2 that were not mentioned at Time 1. Clearly there is a great deal of variability in the specific individuals mentioned over time despite the relatively short time frame of two weeks. To examine the question of recall the current study hypothesized that those alter variables at Time 1 that directly related to the name generator questions will be predictive of recall at Time 2. The current study results support this hypothesis with one notable exception.

Two of the name generators dealt with social dynamics and social support type relations. Specifically they asked for participants to report those individuals that were close to them and those that they spend a lot of time with. Examining the social dynamics and social support variables in the current study we found that spending a lot of time with the alter, reporting that you were very close to the alter, the number of days in contact with the alter, rated importance of the alter, and the tendency to give money to the alter were all significantly related to recall at Time 2. This pattern of findings is consistent with past research that has found that close ties are remembered better (Brewer and Yang. 1994; Hammer, 1984). Another similarity with past research was that the length of time ego had known the alter was not a significant predictor of recall (Hammer, 1984).

The remaining name generators asked the participants to list the people they had used any kinds of drugs with or had sex with in the last 6 months. The two variables that significantly predicted recall were did the alter use marijuana with you and did the alter use drugs with you. The variable had sex with you was not a significant predictor of recall at Time 2. In addition, the general drug use and alcohol use by alter items did not significantly predict recall. These findings suggest that researchers should be very precise in the wording of the name generators they choose. In the current study the name generator specified those individuals that had used drugs with ego and as a

result partners who used drugs but not with ego were more likely to be forgotten. Also, the lack of recall for sex partners in the current study is particularly troubling though having a specific timeframe attached to the name generator may account for some of the lack of consistency (Brewer, 2000) and other research has begun to look at how this can be improved (Brewer et al, 1999).

A number of factors can effect network reliability as others have noted (Killworth and Bernard, 1976) these include memory and the salience of the individual as well as the rapport between the individual and the interviewer. In the present study there were no prompts given at the retest regarding who ego had named at Time 1 so it was essentially a "worst-case scenario" for recall. If the names of the alters given at Time 1 were included at Time 2 very likely the number of individuals listed at both time points would have increased. However, for the current study we wanted to develop a baseline estimate for specific recall. In addition, the sample for the current study was only 25 individuals because of the small sample it is difficult to know how generalizable the current study findings are. Future studies should assess reliability of network measures with larger samples.

Given the lack of research to date in the area of network reliability for adolescent drug research there is a lot of work left to be done. Looking at the effectiveness of various prompts in increasing recall as has been conducted in other topical areas is needed. In addition, future research should examine the relative reliabilities of network variables to better determine which ones should be used more cautiously in future research. It is also clear from the current research that one important aspect of network reliability is the specific wording chosen for the name generators so particular attention should be given to this issue. Given the importance of understanding adolescent substance use patterns, it is critical that the issues surrounding the reliability of the social network information provided be addressed more fully in the future.

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CONNECTIONS 25(2): 98-117 http://www.insna.org/Connections-Web/Volume25-2/6.translations.pdf

Translating INSNA

provoked, encouraged, collected, compiled, edited by **Bill Richards**
18 November, Vancouver, British Columbia, Canada

informed by **Tad Soza½ski** and many **readers of *Connections***

A collection of email messages I received between September 10 and November 1, 2003; a clear demonstration of how little I know about the languages spoken by the readers of Connections; a multilingual trip around an international network; an interesting – and instructive – commentary on languages and the difficulties faced by those who want to move from one to another.

9-10 Dear Bill, In the last days I received the newest edition of Connections. As every time very interesting for me and nice to read. Just a hint: on the backside of the cover you bring the names of International Network for Social Network Analysis in different languages, there is a very little typo in the **German** title, please omit the "r" in the word "Sozialer" and write together "Netzwerk analyse", so the correct title should be:

"Internationales Netzwerk für Soziale Netzwerkanalyse".

But, anyway have a nice day and best regards, Gerhard

9-10 Dear Bill, Just a comment about the back cover: the correct sentence in **Spanish** is:

"Asociación Internacional para el Análisis de Redes Sociales". :-)

PD: INSNA French version is also mistaken.

9-18 Bill, regarding the entries: ... for both european and latin-american Portuguese, it should read: "Rede internacional para a análise de redes sociais." I'm a native speaker of European Portuguese, but also familiar with the Brazilian idiom. The Spanish and French entries are also in need of correction — I'm quite fluent in those languages, but I'll let native speakers take care of it ... (if none shows up, let me know.) – miguel

9-18 Dear Editors of Connections, Socnetters, I've just received by airmail a copy of Connections' volume 25, Issue 1, the first issue sent to me as to the member of INSNA since July 2002. The back cover page shows how the Editors of the journal imagine the translations of INSNA into several European languages. It is a good idea to let the world know in such a way that INSNA is an international organization, even if only the minority of its members speak languages other than the official one.

I know to a greater or smaller degree some of the languages represented in the list. Hence I cannot view this stuff in the same way as I would look at **Chinese** writing or all **Hebrew** alphabet except alef (א) known to me as a mathematician. That is why I can't help complaining about too many errors that I traced in few lines, not only the one on top of the list.

Let me begin from correcting this first item which is in my mother language. The translation of INSNA into **Polish** is OK, ("Międzynarowa Sieć Analizy Seici Spolecznych") but the effect has been spoilt by three mistakes made by the person who retyped the text with the use of WordPerfect: (1) One syllable (do) was omitted in the first word which should read Mi ędzynarodowa; (2) two letters were transposed in the fourth word: it should be "Sieci", not "Seici"; (3) The last word "Społecznych" should have ł instead of "l".

Let me show in turn two errors in the **French** translation of INSNA: (1) "pour" was mistyped as "piur"; (2) mute "x" is missing at the end of Réseau in its second appearance where the noun should be in plural. The latter error might also happen to a native user of French. As regards the

first error, I wonder why it has not been noticed in the country which hosts the headquarters of INSNA, where in many places the English speaking citizens can see French inscriptions, frequently containing pour=for. Leaving this error makes me deduce that no proofreading was done after the back cover page had been typed and printed.

My purely visual knowledge of **Spanish** has turned out sufficient to locate the following errors in the Spanish version: (1) "Associatión" instead of "Asociación"; (2) "Socials" instead of "Sociales". The **Dutch** translation which I recognized from voor = for looks correct. Probably the European Editors of Connections took care of this.

It seems to me that the **Hungarian** translation (the one in which "Network" is translated as "Hálózat") is also good. I can't say the same about the **German** translation. In spite of my poor knowledge of this language, I bet the text on the back cover page also violates some spelling or grammar rules. Let the German subscribers of Socnet (the second largest group among European Socnetters) look at this and send the proofs themselves.

As regards other most widely spoken European languages, one of them is missing. My moderate knowledge of **Italian** prompts me the following translation: La Rete Internazionale per l'Analisi delle Reti Sociali. Let the Italian colleagues (24 names are listed when REVIEW SOCNET (BY COUNTRY is sent to the list server) say if this is OK (I'm not sure if there should be "delle" rather than "di").

Lastly, let me comment on the line in the Cyrillic alphabet, or the item which precedes the penultimate one (probably in **Welsh** or **Gaelic**). I suspect that the Russian translation was included in the list just to mark that the scholars from the postcommunist East are not excluded from the world community of science. Let the **Russian** members of INSNA, if there are any, say themselves what would make them more angry: the omission of their language or a translation like that. Myself, I'm shocked by the low level of language consciousness revealed by the person responsible for this translation. He or she must have forgotten that every language is a structured system rather than a collection of words. If you translate a statement from a typically analytical language like **English** into a highly inflected language like **Latin** or most Slavic languages, you can't just look up in a dictionary the counterparts of the words which make up the statement. If you proceed in this way, the result will be meaningless or ridiculous.

It seems to me even more likely that the Translator (**T**), did not even use an English-Russian Dictionary, but asked an accidentally met Russian immigrant (**R**) with a pretty poor knowledge of English to give the counterparts of "international," "network", "for", "social", "analysis".

I suspect that the dialogue between **T** and **R** ran as follows.

T: Can you help me translate into Russian a couple of common English words?
R: Sure, what's the first word?
T: <international>
R: <mezhdunarodnyi'>

Comment: Russian words are transliterated here according to rules used in the library catalogs. Note also that **R** gave the masculine form of the adjective <international>; the feminine form is <mezhdunarodnaya>.

T: Tell me now what is the Russian word for <network>
R: I'm sorry, I don't know this word.
T: Perhaps you know the simpler noun <net>.
R: Unfortunately, I'm not familiar with this word, either.
T: I'll try to describe its meaning. To make a net, you must weave strings together.
R: Then, I guess that what you mean is called <pletenka> in Russian.

Comment: To explain the meaning of <net> to **R**, **T** tried to avoid any abstract connotations in the hope that this would help **R** to find the right counterpart. As a consequence, **R** translated <weave> as <plesti>. Hence

<pletennyi>, or <woven>, and the derived noun <pletenka>.

R: What is the next word?
T: <for>
R: <dla>
T: <social>?
R: <obshchestvennyi'>
T: <analysis>?
R: <analiz>
T: That's all. Thank you very much.

What is wrong with this dialogue? First, the Translator did not show the whole statement to **R**. Second, **T** did not ask **R** to check the result. If **R** saw the text printed in "Connections", the dialogue could go on as shown below and would end up with finding the right translation.

R: <Mezhdunarodnyi' pletenka>? This is not grammatically correct, it should be <mezhdunarodnaya pletenka>

Comment: a noun and adjective must agree in gender (not only in Slavic languages).

T: OK, but is the meaning of the statement clear to you after this correction?
R: Is INSNA an international group of acrobats specialized in making nets from their bodies?
T: No! INSNA is an international association which is called a network because its members communicate and establish ties among each other.
R: Why didn't you say this to me at the very beginning? Now I can translate properly the word <net> as <set'> and the whole Russian name for INSNA will be <Mezhdunarodnaya set' dla analiza obshchestvennoy seti>

Comment: **R** has corrected **T**'s translation of <for social network analysis>, retaining the noun <network> in singular in the second place. This prompts him to ask the question.

R: What social network is analyzed by the members of this association?
T: They don't analyze a single network. There are many social networks and all of them can be studied.
R: Therefore, the correct translation should be: <Mezhdunarodnaya set' dla analiza obshchestvennykh setei'>.

Comment: **R** changed singular to plural and put all nouns and adjectives in appropriate "cases".

T: Thus, what remains yet to be done is to write this text in the Cyrillic alphabet.

I can do it myself instead of **R**. Here is the spelling of the key term: сеть

The Russian word for "net" and "network" is similar to the Polish word (sie ć) and possibly to its counterparts in other Slavic languages, though not all, as I infer from the line having "Mre()a" (where () stands for a character not recognized by WordPerfect). Can somebody tell me whether this line (second from top of the list) is in **Slovenian** or **Croatian**. I visited Yugoslavia in 1987 but failed to get familiar with the basics of these two languages which I usually do when I go to an alien language environment.

However, my one day visit to Slovenia was not planned in advance. To conclude, let me take this opportunity to send my greetings to Anushka and Vladimir whom I met that day in Ljubljana. And the last question: can anybody translate INSNA to Latin, the language used by the European scholars before English.

Tad Soza½ski (in Poland: Tadeusz Sozański; "sz" is the counterpart of English "sh", ń sounds like Spanish ñ or "gn" in French or Italian).

9-18 Maybe the problem with many of the translations lies in the fact that interpreters were not into

social sciences and not into SNA. They didn't know what exactly Social Network Analysis would mean in their native language because it didn't have much meaning to them in English. Sometimes a language doesn't actually have a direct equivalent for "network" with the same general meaning as in English so to some degree interpreters will be inventing new terminology. I think it is important that translations are done or verified by social scientists-native speakers.

One comment on Tom's suggestion. SOCNET list has to be adapted for a variety of fonts before you send any translation drafts. I received abracadabra for Tad's spelling of foreign words, although usually I have no trouble reading messages in non-latin fonts. Olga

9-18 Hi, The **German** line has an error too. It should say: Internationales Netzwerk für Soziale Netzwerk Analyse (not Sozialer) Jana (reliable German native speaker)

9-18 Bill, I will send you a **Russian** version, if nobody else does, but in a while. I have to do some research first as to the best word for "networks." There is no direct equivalent and there is not much network literature in Russian sociology so it will take me some time. We may even have to borrow this word from English like it happened with "gender." The present Russian version, besides being grammatically incorrect, actually says "International Basket for Social Basket Analysis" if you translate it back to English.

Sorry the readers didn't appreciate your decorating efforts , on the other hand, you don't meet multilingual and knowledgeable people like Tad very often. On the third hand, no need to be shy asking list members for help in this kind of matters. The list is pretty international and people are happy to help. Thanks, Olga

9-18 Dear Bill, Attached ... is (just one, but, in my humble opinion, a rather good) translation of INSNA to Finnish: Sosiaalisen verkostoanalyysin kansainvälinen tutkijaverkosto Best, Ville Siivonen

9-18 Hello, the **swedish** translation should rather be: Internationellt nätverk för social nätverksanalys Regards

> That evening I collected all of the translations I had received and all of the ones I could find, once again using the infamous web-based translation services, and put them on the web. I sent a message to SOCNET asking people to have a look at them and let me know if any were correct and if not, would they please send me a correct version in their language. This prompted another outpouring of messages.

9-19 Hi Bill, I guess there's no Romanian version there. If you find this useful (as I'm a Romanian native speaker): RIARS: Reţeaua Internaţionalã pentru Analizã de Reţele Sociale.

All the best, Marius.

9-19 i am really disillusioned by the way this is going.

i thought that the errors on the back cover were put there intentionally to encourage those whose first language is NOT english (who can now clearly see how those of us whose first language IS english struggle with other languages) to be less reluctant to contribute to discussions about social networks. : -) regards, al

9-19 **Spanish**: None of them is correct, but the two first are very wrong. I suggest:
1) "Asociación internacional para el análisis de redes sociales". This is the more similar to the one in the journal, and it is correct. Nevertheless, if instead of 'asociación' (association) you want to make use of the wold 'net' (red), you can use the second suggested sentence.
2) "Red internacional para el análisis de redes sociales".

Best regards, María

9-19 Bonjour, petite correction pour le **Français**: "Réseau International pour l'Analyse des Réseaux Sociaux" Amicalement, Pierre

9-19 Bill, How can you stand this?? You must have nerves of steel!! Anyways, if you're seriously pursuing the matter, the **Swedish** should rather read: "Internationellt Nätverk för Social Nätverks Analys" Best wishes, Christofer PS. I really like it that **Klingon** made the list.

9-19 Hi Bill, In **Dutch** the correct form should be:

Internationaal Netwerk voor Sociale Netwerk Analyse

I like the second option you put on the web much more interesting though! Great fun, but totally unintelligible... Good luck with the flood of mails you would probably get from your question.
Eelke

9-19 Dear Bill, you are right; there is more than one translations. Here it is in -Bahasa Indonesia- (**Indonesian**) in no particular order:

--Jejaring Antarbangsa untuk Analisa Jejaring Sosial
--Jaringan Antarbangsa untuk Analisa Jaringan Sosial
--Jaringan Internasional untuk Analisa Jaringan Sosial

PS. Thanks for compiling the translations. Cheers, Gindo Tampubolon

9-19 Hi, Bill! Concerning the **Greek** translation, the correct one is a modification of your first version:
Διεθνές Δίκτυο για την Κοινωνικών Δικτύων
Your second version is completely wrong ('analysis' which is a Greek word becomes 'psychoanalysis' there. .... Best, Moses

9-19 Hi again, Yes, they are all incorrect really. Here are two correct options. I used **Turkish** characters. Let me know if you can read them. Also, the first one is the contextually correct translationç The latter is more loyal to the actual words. I guess the main glitch is the repetition of the word 'network' in the original name. (All the translations you sent me read like 'social networks for international analysis'. They were done other way round:)

1. Uluslararasi Toplumsal Ag Analiz Agi (preferred)
2. Toplumsal Ag Analizi için Uluslararasi Ag

Please contact me for further help. Best, Lale

9-19 dear bill: none of the**spanish** tranlations are correct. the first two, in fact, are ridiculous -- amazing goofs. the third comes close, but change

Red internacional para el análisis de red social
to
Red internacional para el análisis de redes sociales

.... russ

9-19 Bill, I can help with the **Italian**, since I was born and lived there most of my life. now you have:

1-- Internazionale Rete poich, sociale Rete Analisi.
2-- Rete internazionale per analisi di rete sociale

#1 is no good. #2 is close, but no cigar. the correct one is:

3-- Rete internazionale per l'analisi delle reti sociali

Now, two caveats (I am no linguist, but this is quite basic stuff):

a. 'Reti sociali' is plural, i.e. it means 'social networks'. while I know that in the insna acronym the wording is singular ('social network'), again I believe that keeping it such would greatly diminish its meaningfulness in **Italian**.

b. The world 'rete' is the proper translation for network. But a more proper word in this context would be 'associazione' which means 'association'. It's not literal translation, but no good translation is done word by word. In this case, the proper wording would be:

4-- Associazione internazionale per l'analisi delle reti sociali

#4 is probably what would get my vote, although I may be willing to accept #3. but, hey, this is my take, other fellow Italians may have different opinions. Thanks for doing this, by the way.

best, Fabio.

9-19 Hi Socnetters, I have followed this discussion with interest, because I am a member of the American Translators Association. It is particularly upsetting for ATA-certified translators to come across mumbo-jumbo "machine translations" in otherwise high-quality publications. Case in point: The proposed translation of INSNA for **Portuguese** (Latin America): "Internacional Rede for Social Rede Análise" is clearly not the work of a human being. The correct translation: "Rede Internacional para Análise de Redes Sociais."

In the **Spanish** "translations", "Baile" and "Tertulia" sound very amusing; perhaps the idea of social networks has something to do with dancing.

9-19 Hi Bill, The **Danish** translation on your list isn't correct. Your list says: International Netværk nemlig Sociale Netværk Analyse. Much better would be: Internationale Netværk for social netværksanalyse. Thanks! Tony

9-19 Dear Bill, Please find attached a correct translation of INSNA to **Hungarian**: A Társadalmi Kapcsolatháló Elemzés Nemzetközi Hálózata; and to **Dutch**: Internationaal Netwerk voor Sociaal Netwerk Analyse. Best regards, Karoly

9-23 Dear Bill, the first proposed translation into **German** is quite correct and is marked with a "yes". A problem in the German language is that the adjective "social" now denotes the compound substantive "Netzwerkanalyse". Usually it denotes the second noun, so "analysis" ist meant. The english and romanian languages - as far as they understand, speak of the analysis of social networks (but not social analysis of networks). So another translation might be "Internationales Netzwerk für die Analyse sozialer Netzwerke". But the version you chose will be understood, of course. Dorothea

9-23 Dear Prof. Richards, I appreciate your initiative to translate the INSNA title into other languages. I enclosed the translations into my native Slovak language and into the **Czech** language. I saved the file in MS Word in the .rtf format, so you should be able to open it in WordPerfect too. Please let me know if you have a problem with the file format. With kind regards, Zuzana

9-23 Dear Bill Richards! In my opinion the **German** translation is correct. You may also translate: "Internationales Netzwerk für die Analyse Sozialer Netzwerke" but this translation is a little bit "heavy", so I think it's best to translate it in the way you did. Sincerly, Anton Laireiter

9-24 Dear Socnet subscribers, The weather on Monday Sept 22 was so beautiful across all Central Europe that I chose hiking in the mountains instead of keeping to my promise to send the next letter to the list. Now the letter I completed Tuesday is ready to send. It is very long (some 750 lines). However, if you are interested in linguistic problems, you should not be disappointed when you read my scholarly comments mixed with personal stories.

When we translate from one language into another, four types of errors are possible: spelling errors, grammatical or syntactical, semantical, and stylistic. The distinction between semantical and stylistic mistakes cannot be drawn too clearly because both types have to do with "meaning". The translation of "stupid guy" to **Polish** as "glupi czlowiek" (which means "stupid man") is semantically correct, but a translator would probably choose to translate it as "glupi facet" as such a translation would be stylistically more adequate. However, a translator might prefer less literal translation, if he or she feels that the overall level of negative evaluation in "glupi facet" is much greater than in "stupid guy" because the Polish word "facet" is probably a bit less "polite" than the English word "guy". "Oxford Advanced Learner's Dictionary of Current English" I always consult when I write in English has only "informal" as the stylistic qualification of the word "guy".

Stylistic problems usually arise with translating poetry, novels, newspaper articles, political speeches, etc. Professional translators who do this job must have highest competence in the two languages, though not necessarily in their specialized fields. Do not seek help from them if you want to translate INSNA, but you can ask them to verify how these translations sound in general contexts. Instead I recommend the use of a one-language dictionary like Webster's if it is available for a given language. To close this point, let me remark that some stylistic features of a language cannot be translated into another language at all. For example, it is impossible to render in Polish the language etiquette of the New English to which I occasionally yield, say, replacing "translator" by "he or she".

Sometimes radical solutions are needed to help the reader feel the "taste" of a translated language or rather that of the world of the native speakers of this language. Hemmingway who had a perfect command of **Spanish** decided to revive the old English pronoun "thou", now restricted to man-God relations. He felt that the dialogues between the Spanish heroes of "For Whom the Bell Tolls" would lose the climate of intimacy if he used ordinary "you" instead of thou. Although I do like and appreciate English, I prefer my native language in interpersonal communication. In particular, Polish provides the ways to mark the distinction between "interaction partners of different status," to use the sociological jargon.

However, I prefer **English** over my native language when I write mathematical papers. The articles ("a" and "the") which are missing in Polish often help me say more precisely what I want to say, even if many times I am not sure of which to use. English has certainly become the means of international communication not only for political reasons. It is really well suited for this role. First, it is easy to learn. The beginner can produce very fast meaningful statements. Early success in communicating with others motivates him to learn more. However, when you cease to be a beginner, you will soon realize that you'll never put into your brain all Oxford Advanced Learner's Dictionary.

There are many frustrating experiences which happen to advanced learners of English. I remember the necessity to rewind the tape back several times until I guessed that that what I heard as "do" is in fact "due" pronounced by an American speaker. This happened to me when I prepared the typescript of Robert Merton's speech delivered in Krakow when he received the honorary doctorate of the Jagiellonian University.

Let me mention another feature of English which makes this language difficult for the speakers of the languages with long words and rich inflections. Many if not most English words are one-syllable. Although they are mixed in the speech stream with auxiliary words (articles, prepositions and other particles), the fact that ALL English words are short forces the listener to process more information per unit of time than he processes while hearing his native language. In addition, there are so many homophones (net!). The fact that the grammatical function of a word (verb, noun, adjective, etc.) can't be recognized from its form makes it difficult to decipher momentarily the syntax of a statement. However, the mathematical simplicity of English syntax compensates for this.

Al Klovdahl <alden.klovdahl@anu.edu.au> jokes, saying that "the errors on the back cover were put there intentionally to encourage those whose first language is NOT english (who can now clearly see how those of us whose first language IS English struggle with other languages) to be less reluctant to contribute to discussions about social networks." Intendedly or unintendedly they were put there, they must have comforted those wrestling with English by showing them that the native speakers of English experience similar troubles with foreign languages.

Sometimes the reluctance of the speakers of English to learn other languages is understandable. When I lived in a small town in the middle of Wisconsin, I could watch my roommate learning German, the native language of his grandparents. I saw how painful was for him to repeat: Ich

habe, du hast, er hat, wir haben, etc. He said to me "Why the hell does German have that many words where English has only two? (<have> and <has>, the latter being equivalent to regular <have> + <s>)". "You are right - I replied - even one word would be enough, as English could be made even simpler by dropping the redundant "s" in the third person of a verb's present tense. If you learn **German** in order to feel safer while travelling to Germany, it's not worth your effort. You'll always find someone speaking English, but if you would like to get familiar with the culture of your ancestors, you have to load these words into your memory. Take comfort from the fact that you don't have to learn **Latin** conjugations and declinations, which had for centuries been considered the best way to discipline students' minds until the teaching of mathematics began to play the similar role".

If the Anglosaxons were more open to learning foreign languages, this would help those learning **English** as a second language. Let me explain this point in more detail. If you are a beginner in English, the simpler the vocabulary of your interlocutor, the better you can understand what he says. However, the occurrence of just one rare word together with commonly used words can make it difficult to understand the whole statement. Then additional communication becomes necessary. Usually, it is the beginner who asks first for help "please, explain me the meaning of this word." Every time when the initiative was taken by the other side, that is, every time the speaker of English was first to notice that he had used a difficult word, it turned out that the speaker of English knew another language. The daughter of my roommate who learned Spanish at school helped me more than her father. He used to explain to me the words he considered difficult himself, but these words, usually with **Greek** or **Latin** roots, never appeared to me as difficult as "native" English words.

Let me go back to translation problems. Computer programs cannot be blamed for SPELLING ERRORS found in the translated texts. Machines are more reliable than human writers in this matter. I often use the WordPerfect spellchecker to correct my English texts. I suppose that the spellchecking modules for other languages also behave more decently than the typists. It is not my intention to blame anybody for neglect. Many office workers saved their lives due to neglect: they failed to come to WTC at 9:00. Possibly, more supervision is needed as regards rewriting non-English texts. I suppose that the skill of exact reproducing meaningless symbol strings is no longer required of the university technical staff because the task of rewriting data from paper forms to computer files is now performed by scanners.

Unfortunately, I'm not familiar with the programs which correct grammar. Nor have I ever used an automatic translation program. I suspect that such a program first identifies some components of the text in the source language and looks for their counterparts in the target language. Next, the pieces are put together and the output becomes the input to the grammar correction routine. The overall success depends on the extent to which the "rough" translation is semantically correct. If only the smallest meaningful units have been assigned counterparts, the translation is unlikely to be satisfactory. The larger are the units that are taken into account, the greater the chance for a good translation.

The list of translations into MANY languages given by Bill Richards in the file available on Internet would be more informative if it included the source of each translation (computer program, a native speaker, a professional translator, etc.). To quote the Editor of Connections, "Most languages have more than one translation. I strongly suspect that many of the ones I have are not correct; translated back into English they will result in something like 'Between nation-states entanglement in case of human-socialistic entwinement dissociation'." Indeed, the first **Polish** translation given there is blatantly absurd. It can be translated back to English as: "International Capital of owners seen from the angle Sociable Capital of owners". In my previous letter, I tried to guess how the **Russian** translation (the one with "pletenka" for "network") might have arisen - by

showing a hypothetical conversation. Now I can't even state a hypothesis explaining why the expression "wlascicieli" (=of owners) appears here.

Since the time I started my work as a social scientist I have always believed that it is the METHOD that distinguishes my cognitive activities from exploratory behavior of the "ordinary" people. Let us look methodically at the task of translating a rather simple English text as INSNA is, the task that has caused so much trouble to the translators. "Maybe the problem with many of the translations lies in the fact that interpreters were not into social sciences and not into SNA. They didn't know what exactly Social Network Analysis would mean in their native language because *It didn't have much meaning to them in english*. (...) I think it is important that translations are done or verified by social scientists-native speakers" (quoted from the letters sent by Olga Mayorova, emphasis mine). Imagine that I'm an "interpreter" like those mentioned by Olga, not familiar at all with SNA.

What can be done *methodically* when one must resort solely to one's competence in general English? The first step that a human or machine translator should make is to decompose the complex text into lower level meaningful units, not necessarily words. Here is my decomposition of INSNA:

(International Network) (for) (Social Network Analysis)
(1) (2) (3)

Now we can try to translate the three components. The translation of (1) seems to be the simplest task. "International" is an international word which sounds and reads similarly in many European languages. Assume that the word "network" has the unique most adequate counterpart in a given language. Shall we use this counterpart in translating the whole unit (1)? Some translations use in this context the counterparts of English "association" (meant as in "International Sociological Association") instead of the counterpart of "network" (the latter is retained only in the translation of (3)). Why? Because a translator may find it desirable to remove any suggestions that "International Network" might be a *technical* system (say a network of measurement stations dispersed across the world) rather than a *social* organization.

I strongly recommend to reject this objection. INSNA is not like other scientific associations. It IS a network.

(***But is insna really a network? Why not to pose this question quite seriously?***)

As such it deserves to bear a name in every human language that tells what it is. It is the task of those who do understand the name to explain its meaning to those who don't. If my advice is followed, then the translations of (1) into 6 European languages will be

Le Reseau International (**French**)
La Rete Internazionale (**Italian**)
La Red Internacional (**Spanish**)
Internationales Netzwerk (**German**)
Miedzynarodowa Siec (**Polish**)
Mezhdunarodnaya Set' (**Russian**)

The ultimate decision on what to do should be made by the members of INSNA who speak a given language. My tips as to how to proceed are as follows: try to identify the main language groups within INSNA, select a "spokesman" (for this particular task only) for each group, ask him or her to provide a translation, put the results in a pdf file on INSNA web page, and ask all members for comments, leaving the final say to the "spokesman". Following the suggestion of Tom Valente <tvalente@USC.EDU> I can take the responsibility for the Polish translation. I don't know if there are any Polish members of INSNA besides me. The Socnet list, sorted by country, has four names, unknown to me, but a subscriber need not be a member of INSNA. I suppose that more

Poles work outside Poland so that their names may be listed elsewhere. The largest US group of subscribers contains my late colleague Jacek Szmatka with his old South Carolina email address.

Mais, revenons a nos moutons, as the French would say, that is, let's go back to translating (1)+(2)+(3). The translation of component (2) should be left for the last step, since (2) depicts a relation between (1) and (3)

Thus, let us try to translate first (3). Having seen more translations supplied by Bill, I realized that the problems have arisen because the translators used two different interpretations of (3).

(a) Social Network Analysis = Analysis of Social Networks

(b) Social Network Analysis = Social Analysis of Networks

For me – an advanced non-native user of **scientific English** – (a) is the only possible reading of SNA. Similarly, "Rational Choice Theory" means for me the "Theory of Rational Choice", not a "Rational Theory of Choice".

The **Russian** translation "Mezhdunarodnoye obshchestvo po socialnomu analizu setei" quoted by Bill Richards is beyond doubt based on understanding of SNA as (b). I found this translation in the letter I received from him besides the one sent to Socnet. Bill consulted a "Russian graduate student" (by the way, this construction is not quite clear to me: was the graduate student Russian or did he or she graduate in Russian?) [she is a native of the Ukraine and a native speaker of Russian]

A similar remark refers to the translations into **German** and related Germanic languages (**Dutch**, **Swedish**, and others). A few people I consulted (they teach German, but are not native speakers of German) say it should be "Soziale Netzwerkanalyse," but this seems to fall under (b) rather than (a). Jana Diesner <jdiesner@ andrew. cmu. edu> who has introduced herself as a "reliable German native speaker" has proposed "Soziale Netzwerk Analyse". Maybe she's right.

The translations into three Romance languages and two Slavic ones perfectly render the meaning of (3) as understood according to the pattern (a):

l'Analyse des Reseaux Sociaux (**French**)
l'Analisi delle Reti Sociali (**Italian**)
l'Analisis de las Redes Sociales (**Spanish**)
Analiza Sieci Spolecznych (**Polish**)
Analiz Socialnych/Obshchestvennych Setei (**Russian**).

Once we've got the translations of (1) and (3), we have to solve the last problem of how to connect (1) and (2) to obtain a meaningful whole. The preposition "for", having counterparts in most languages I considered (pour, per, para, fur, dla) suggests that INSNA is more than a SET of communicating people who analyze social networks using various methods. As such INSNA should be in itself a TOOL that helps analyze social networks. This shade of meaning is lost if "for" is replaced by another preposition ("po" in **Russian**, Genitive case=of in **Polish**), but it may well be that retaining "for" will make the "instrumental relation" too strong. INSNA is not a task group united by a definite common research program.

This was the problem I had myself with translating INSNA into Polish. The story began in July 1994 when I received an email letter from my friend Jacek Szmatka[1] then teaching in South Carolina. The message I've extracted from my archives and now translated into English reads as follows:

> Tad: Steve Borgatti, the editor of the journal "Connections" and possibly the co-founder of a new association which is called "International Network for Social Network Analysis" has asked me to say how this name would sound in **Polish**. They want to publish this name in

[1] Jacek died Oct 20, 2001: see http://www-is.phils.uj.edu.pl/; click "Struktura Instytutu", next "Zaklad Badania Procesow Grupowych", "english version", "Jacek SZMATKA"

> various languages in one of the issues to appear. Thus, we face the problem of how to translate it. I have four versions, which of them seems to you the best one? "Free" translations are permitted.
>
> Miedzynarodowa Siec Analizy Sieci Spolecznych
> Miedzynarodowe Stowarzyszenie do Analizy Sieci Spolecznych
> Miedzynarodowe Stowarzyszenie Analizy Sieci Spolecznych
> Miedzynarodowa Siec do Analizy Sieci Spolecznych.
>
> That is the small question. Regards! Jacek

Unfortunately, I can't quote my answer to the "small question". My message was not recorded into the Sent folder (created by Elm mail program I use until today along with Pine) because of a system failure. However, I remember that my answer rejected the two middle versions which have "association" ("stowarzyszenie").

> (Let me put in a digression here. I did not know at that time what SNA and INSNA is, although I had by then published two mathematical papers on "signed graphs"; they are listed in the Bibliography prepared by Thomas Zaslavsky. Jacek himself learned about SNA from Steve Borgatti. Later he attended Sunbelt conferences many times. We worked together on "exchange networks". Jacek was interested, first of all, in empirical theories of power distribution and their experimental testing. I focused on the "mathematics of exchange networks". I will say more about this when my monograph, I'm still writing in English, will be published by the Jagiellonian University. Recently, having looked at what I've already done, I realized that what I do as a mathematical sociologist has much to do with SNA. Hence the decision to join INSNA I made last year.)

I found it too hard to make a definite choice between the first and last version. The entry "Social Network" I wrote for the Polish Encyclopaedia of Sociology (2002) has a paragraph on INSNA but no official **Polish** name is given there. Jacek's last version with "do" (the counterpart of "for" which is most appropriate in this context) seemed to me too strong (INSNA as a tool for...), the version without a preposition (the Polish translation of expression (3) is in the Genetive case; Polish does not have "of") seemed to me to weak because no instrumentality was marked.

Jacek made the choice himself (today I think it was the right choice) and that is how the Polish text appeared on the back cover of Connections. The text Jacek had written and printed with the use of WordPerfect must have been mistyped by someone else so that spelling errors crept in. Bill Richards said in his letter to Socnet "I didn't hear any complaints or suggestions or comments about the back covers of 23(1), 24(1), 24(2), 24(3). They were all the same as what you see on 25(1)". For me issue 25(1) is the first of these issues which I saw as hard copy so I could not respond earlier. "It was a decoration for the back cover. I put the longer lines below the shorter ones, rather than, say, putting the languages in alphabetical order. The bottom line is not, as far as I know, text in any language spoken by humans on this planet." (from Bill Richards' letter to Socnet).

As regards the bottom line, at first glance I thought that the text came into being at a big, full-fledged university which should have a Chair of Egyptology so that one can ask a fellow professor familiar with ancient **Egyptian** writing. At second glance I gave up such a theory: the pictures are too simple to be hieroglyphs. The enlightenment came after the third glance. Why haven't I discovered at once that the last language must be English? It suffices to count words and characters in each to see the isomorphism with the original English text typed with the use English alphabet. The English letters are coded in such a way that "n" is replaced by the black box, "l" with the large diamond, etc. The only sophistication that may mislead the viewer is the use of different symbols for lowercase and uppercase letters.

Jacek might have seen the "decorated" issues, though I can't say with certainty that he saw. Jacek knew **German** and **Russian** but not well enough to suggest corrections. If he located spelling

mistakes only in the **Polish** line, he might have found them not worth responding. Who cares about spelling today? Jacek would certainly agree with Steve who has said now "I think it is good to fix the errors (even if it destroys a natural experiment), but I hope *no one takes them too seriously*." (emphasis mine). Myself, I wouldn't have reacted either, unless I had noticed *so many errors in so many lines*.

Who cares about the way the words are recorded to paper to make them readable to others? Possibly, the **Japanese**. I asked my Japanese acquaintance "Why do you still use kanji, once you could fully switch to hiragana or katakana?" The answer was "Because the kanji signs you perceive as abstract graphics convey the meanings we do recognize, having acquired the ability to recognize through long and tedious process of learning. We would lose these meanings, thus losing part of our cultural identity, if we were to adopt the European view on the purpose of writing."

Actually, we the Europeans believe that the system of writing (alphabet, spelling rules) invented for a given language must serve one purpose: to graphically code the speech in such a way that the phonological structure of the language is represented by the structure of the written text as faithfully as possible. Thus, the spelling need not have much to do with other structures of a given language. Such is the principle, even if it is not always respected (some **French** spelling rules are constructed so as to reflect grammatical rules of this language).

If a language has more phonemes than its alphabet has letters, some phonemes must be represented by letter combinations. Particular languages may use different codes for the same phonemes. The example is given below

Phoneme (written in English)	Polish spelling	Hungarian spelling
s	s	sz
sh	sz	s

Why does **Polish** differ from **Hungarian**? I suspect that in Hungarian the phoneme (sh) occurs more frequently than (s), while (s) is found in Polish speech samples more frequently than (sh). This is a hypothetical explanation. I don't know if the two national spellings meet these requirements. The orthographies of most natural languages did not grow out from theoretical considerations but were shaping up in a historical process. If my hypothesis on Polish and Hungarian spelling is true, the 16th century founders of Polish and Hungarian spelling systems must have unintendedly discover the principle theoretically elaborated in 20th century.

The use of letter strings as the ONLY method of coding some phonemes is a special feature of **English**, though it can applied to **German** too (by replacing ö with oe, etc.). An alternative solution which consists in the use of letters with diacriticals has been implemented in many European languages.

Diacriticals are perceived as a nightmare not only by the Anglosaxons. The editorial staff of Polish professional journals are trained to handle **German** "umlauts" and **French** "accents". They know also how to spell correctly **Spanish** "señor" (with a tilde over n). However, if an expression is not in a "world language" they behave like their American colleagues. For example, when I sent a report on an international conference to a **Polish** sociological journal, they lost a diacritical in the last name of Hamit Fi şek, where "s" should have "," attached at the bottom ("s" with "," is the **Turkish** and **Rumanian** counterpart of English "sh", French "ch", German "sch", Polish "sz", **Italian** "sc" before "e/i"). Hamit has published a lot in English. So far as I know he does not complain that his last name is written "Fisek" and hence pronounced "fisek" instead of "fishek".

(The digressions make this letter very long, but listen again to my story. In 1991 I had a course on Polish political parties for a group of Canadian students. The participants of the international program came to Krakow to take courses offered by Polish professors lecturing in English. After the

semester the Canadian organizers decided to publish the best students' essays along with some papers prepared as handouts by the lecturers. I sent the printout of my paper and attached the disk with the Wordperfect file. Next year I received a copy of the book. I saw all proper names (names of political parties and their leaders) stripped of diacriticals. My last name was "cleaned" more radically: not only the counterpart of **Spanish** tilde over "n" disappeared, but the following "s" was also cut off. The Polish co-editor of the book apologized to me, she said that the book was edited by the students. I thought to myself "don't worry, be happy", or more melancholically "Muss es sein? Yes, it must be so.")

The real problem is that the letters with diacriticals gathered from all European languages are too many to be coded simultaneously as ASCII characters. As a consequence, Microsoft has prepared several variants of the nonstandard upper half of ASCII extended set. The variant recommended by the Gates' men for use in Poland contains all special letters which exist in Slavic languages using Latin alphabet. However, these letters were coded at the expense of omitting few letters with diacriticals found in the main languages of Western Europe. Most Polish users have considered this solution inadequate. They would prefer to combine with their own language the main world languages rather than to put one minority language with other minority languages into one sack. I don't know if Microsoft has made corrections to meet such requirements of **Polish** users. As regards myself I never use extended ASCII characters at the operating system level or in text files. Accordingly, my current message does not contain letters with diacriticals. So don't treat the non-English texts given earlier in this letter as ready to use (e.g. I've written "reseau" without "accent aigu" over first "e"). My aim in this letter is not to "fix the errors" but to disclose the source of errors.

I can also help out more technically within the limits of my competence. I learned **English** 4 years in high school, 3 years while studying sociology, and 2 years at the course organized by the British Council for our university lecturers. English is the foreign language that I know best. I should mention **Russian** in the second place. I had learned Russian for 7 years from 5th grade of elementary school. Under communist regime everybody had to learn the official language of the Soviet empire, but the results were generally poor. In addition the knowledge of Russian did not help anyhow when you traveled across the middle European protectorates of the Soviet Union.

(When I traveled to Hungary I did not know German the knowledge of which could help a foreigner at that time /by now English has probably superseded German in this role/, so I had to speak Russian to ask a timetable question at Keleti railway station. My too good Russian pronunciation resulted in obtaining misleading data from the lady at the information desk. The Hungarians still remained Soviet tanks in the street of Budapest in 1956).

I mastered **Russian** much better than an average student because I wanted to read Russian 19th century literature in the original language. Paradoxically, having never visited the Soviet Union or Russia, I had more opportunities to train my Russian communication skills in the West. I can boast of some experience in translating from Russian and into Russian. The first trial came in 1974 when I participated in 7th UNESCO International Seminar on the Use of Mathematics in the Social Sciences held in Jablonna near Warsaw. What is called now "political correctness" had some influence on this conference. The Soviet professors enjoyed special rights. A professor from Leningrad, a member of the Academy of Sciences or so, who showed up in the last minute, induced the organizers to add his presentation to the agenda, although he did not know the official language of the conference. The organizers found a way out of that uneasy situation. They asked me to translate his paper from Russian to English and to read it for him. A Bulgarian sociologist (I forgot his name) agreed to work as an interpreter so a regular discussion could follow the lecture.

I'm glad to hear that INSNA does not base its activities on political considerations. I don't treat the decision to hold Sunbelt conferences in Europe every third year as political but simply just and rational.

The second serious job I did was to translate from **Russian** into **Polish** a chapter on sociometry from the book "The Structure of Interpersonal Relations" which appeared in Kiev. The chapter I translated was chosen by Jacek Szmatka for the reader he edited. He was induced to include in the volume a few papers representing the Soviet social sciences besides the classical papers by American social psychologists. The Soviet Union did not then recognize the copyright law so that we did not have to ask the author's permission to publish the translation. I recall this story because the author in question, Vladimir Paniotto, might be the best person to take responsibility for the Russian translation of INSNA. In 1990 we failed to meet face-to-face in New York where I spent a week as a tourist, while he was a visitor to the Columbia University. We talked by phone and later exchanged letters, but I don't know what he is doing now.

French is the second foreign language I chose to learn with English as a student of sociology (English was mandatory for all sociology students, the second foreign language was left for individual free choice). I wrote my first paper on signed graphs in **French** because I did not know then that "Mathematiques et Sciences Humaines" accepted English papers as well.

The knowledge of French helped me when I learned **Italian** a few weeks preceding my travel to Italy. Actually, the travel was only a pretext, I like learning languages. I usually use a pocket dictionary with appendices on pronunciation and spelling, and grammar. I learned many languages in this way, in particular, Hungarian and Rumanian. A couple of years ago I threw out all materials concerning all minor languages to make room for new books. The dictionaries and manuals for **Spanish** and **German** are still on the shelf so that I can consult them if necessary. I'm not familiar at all with **Portuguese** and **Scandinavian** languages. I have never heard about the language called **Klingon**.

The file I've attached with separate letter sent to Bill Richards contains the translations of INSNA to the following 6 languages: French, German, Italian, Spanish, Russian and Polish:

ENGLISH: International Network for Social Network Analysis
GERMAN: Internationales Netzwerk für Soziale Netzwerk Analyse
FRENCH: Le Réseau International pour l'Analyse des Réseaux Sociaux
ITALIAN: La Rete Internazionale per l'Analisi delle Reti Sociali
SPANISH: La Red Internacional para el Análisis de Las Redes Sociales
POLISH: Międzynarodowa Sieć Analizy Sieci Społecznych
RUSSIAN: Международная Сеть для Анализа Социальных Сетей

The codes I placed in my previous message are the "coordinates" assigned to the characters by WordPerfect, the wordprocessor *strongly preferred* by the editors of 'Connections'. While all my acquaintances failed to resist the invasion of Microsoft Word, I still remain faithful to Wordperfect. I prefer its DOS version 5.1 because I don't have to check if a given character can be reproduced under a given font. WordPerfect has many "character sets". The multinational set, or character set #1, allows you to write in all European languages which use Latin alphabet. Since "e" with "accent aigu" is item #41 in character set #1, the correct spelling of "reseau" was coded as "r#1,41#seau". If you don't know **French** and can't recognize this variant of "e" in the table shown when you press Ctrl-W, type "1,41" after Ctrl-W to see the character marked in the table. If you press Enter, the character will be copied into the text you write. Greek alphabet is available as character set #8, and Cyrillic as #10.

That is all what I can do. Don't worry, be happy. Tad

P.S. I completely forgot about the communication I had with Jacek concerning the **Russian** translation. Now I found in my archives the following two letters.

Tad: I can't help telling you exactly where you go (to attend ASA meetings - TS). You go to El Pueblo de Nuestra Senora la Reina de los Angeles del Rio de Porciuncula, that is to

> say, to the Village of Our Lady Queen of Angels on the River Porciuncula, the village which is now simply called Los Angeles. Would you like to try to translate into **Russian** the name of Borgatti's association. I don't have a dictionary here and don't even recall how is "network" in Russian. Steve will be happy. I've already told him that we will do it for him.
>
> That is all. Take care, and see you soon! Jacek.

My response:

> Jacek, My answer will be short. The physicists are going to close the terminal room in a moment. I confirm receipt of your letters.
> I would translate International Network... as "Miezdunarodnaja siet' po analizu socialnych sietiej. This should be rewritten in the English transcription, but I don't know exactly how to do it, one should ask someone competent. There should Chairs of Russian in the States.
> See you soon! Tad.

Let me comment on my answer to Jacek's question. I did not suppose that Steve would need the translation written in the Cyrillic alphabet, so I sent to Jacek the Polish transcription, actually a nonstandard transcription I invented myself for that occasion. Today I know more how to transcribe **Russian** text into **English** (in general ask librarians about these matters).

Now my 1994 Russian translation of INSNA can be rewritten as "Mezhdunarodnaya set' po analizu socialnykh setei". I chose "po" (which forces the Dative case: "po analizu") instead of "dla" (which forces Genetive case: "dla analiza") and translated "social" as "socialnyi" rather than "obshchestvennyi". The first of two synonymic words which sounds more bookish and scientific may be more appropriate here.

I don't know what Jacek did with the translation I sent to him. We did not talk about this when we met in Los Angeles in August 1994 nor any time later. Maybe he tried to rewrite the translation with the use of WordPerfect but the task appeared to him too tedious so that he suggested to Steve to look for a native speaker of Russian. T.

9-24 Hi, You have four for**Turkish**. I'm afraid that none of these proposed translations for Turkish are correct. They all have translated the phrase word for word and got the order of the words in reverse (and in the fourth, also got the word 'social' wrong). The correct phrase should be something like: Toplumsal ilişki ağlarını inceleyen uluslararası bilim ağı

This translates into **English** as 'International science network that studies social relationship networks'. I have chosen to qualify the word network (ag) with 'social relationship' and 'science' because the word 'ag' (net) gained its social scientific meaning just recently and especially its repeated use in one phrase makes it confusing.

You may get other suggestions for the **Turkish** translation. The choice of words partly depends on lifestyle and political taste. The word 'analysis' for instance has three counterparts: 'tahlil', imported from **Arabic**; 'analiz', imported from English more recently; and 'inceleme', which is Turkish in origin. I have chosen the third (in verb, rather than noun form, which I thinks helps the flow). Similarly, 'sebeke' is the Arabic word for 'net' and younger generations of scholars prefer 'ag' over it. If you type the phrase in capital letters, keep in mind that the i's retain their dots when capitalized. Toplumsal İlişki Ağlarını İnceleyen Uluslararası Bilim Ağı — TİAİUBA

I hope this helps. Best, Ozgecan

10-3 I think that in **Finnish** INSNA could be:

> "Kansainvälinen verkosto sosiaalisten verkostojen tutkimukseen" or
> "Kansainvälinen verkosto sosiaalisten verkostojen analyysiin"

In your site the Finnish translation is not correct.

With Regards, Markku Jokisaari, Finnish Institute of Occupational Health

On October 17, a Chinese post-doc at SFU gave me three possible Chinese versions which I posted to SOCNET:

1. 全球网络之社会网络分析
2. 全球社会网络分析网络
3. 社会网络分析之国际网络

10-17 Hi, Bill, 1st is the only one make sense to me but still not so perfect. I am from mainland China. I am not sure if this is correct, but for me, Social network is more like "Social relationship network" in **Chinese**. Jun

10-17 Dear Bill, "3" is better. Good job. Shih-Shin

10-19 Dear Bill: It seems to me the third one to be the best translation for INSNA in terms of the three items. Thank you for making effort to the usage of **Chinese** regarding social network analysis. I look forward to seeing the INSNA conference in Asia sometimes in the future.
Have a nice weekend, Li-Wen Liu

10-20 Third translation is good. Nick Williams (currently studying Chinese literature in Beijing)

10-29 Bill, The third one is the most accurate translation and makes the best sense in **Chinese**. Literally– International Network for Social Network Analysis. The first two refer to Global Networks.Jeff

10-29 Dear Bill Richards, Dear Colleagues listed in the Cc: Let me report with this letter on the results of my search for a translation into **Russian** of "International Network for Social Network Analysis" - the best text to replace the funny expression "Mezhdunarodnyi pletenka..." I found on the back cover of "Connections".

The translation which I'd like to suggest to the Editor is as follows

"Mezhdunarodnaya set' dla analiza socialnykch setei"

My decision has emerged as a result of correspondence with those who responded to my letter to the Socnet list and two other colleagues whom I had known earlier as competent in mathematical social sciences (.... having found their location in the cyberspace by means of Google). Last but not least, I've just found a useful printed source (S.A. Kravchenko. Sociologicheskiy anglo-russkiy enciklopedicheskiy slovar'. Moskva 2002: "Russo". ISBN 5-88721- 203-9)

I came across this volume at a guest exhibition of Russian books organized last weekend in Krakow. Later I learnt from Internet that Kravchenko's "Encyclopedic English-Russian Sociological Dictionary" had been published in the US by The Edwin Mellen Press; ISBN: 0-7734-3363-7. The dictionary has the entry "Social networks" (in plural). The term is translated to and explained in Russian as follows

> Socialnye seti: struktury otnoshenii, v kotorykh vzaimodeystvuyut socialnye subiekty (ludi uznayut o vozmozhniostiakch raboty, otdykha, lecheniya i.t.d. nakhodias' w seti socialnoi kommunikacii, a ne ot formalnykch struktur)

This reads in English more or less like this

> Social networks: structures of relations in which social actors interact (people learn about available jobs, leisure, medical treatment etc. - being in a social communication network, not from some formal structures).

The addition in brackets shows that the author might have known Granovetter's papers on job finding through weak ties networks.

It was a matter of dispute among my correspondents whether one should translate "social network" as "socialnaya set'" or rather coin a shorter term "socioset'" similar to "neiroset'" already

used to replace "neironnaya set'". As regards myself, I voted for "socioset'" but the authority of the dictionary in question (is it the unique source of the kind?) should not be ignored. Hence I finally decided to stay with "socialnaya set'".

Some correspondents have suggested that "network" in "International Network" should be translated as "associacia" or "obshchestvo" (association, society). I did not follow this suggestion because otherwise the meaning deliberately attached with the first use of "network" in the association's name would be lost. In addition, it seems that the word "set'" tends to acquire a broader meaning in current Russian as evidenced by the new big dictionary of Russian (Bolshoi tolkovyi slovar' russkogo jazyka. St.Petersburg 1998: "Norint"; ISBN 5-7711-0015-3) I bought at the same exhibition to learn more the postSoviet Russian and to replace my 1978 edition of Ozhegov's dictionary.

Let me close my message with the words the Chief Editor (S.A. Kuznetsov) of the new dictionary addresses at the end of the Foreword to his collaborators from the Russian Academy of Sciences: "Dai Bog wam wsem, dorogie moi, zdorovya I blagopoluchiya" (May God give you all, my dear, health and well- being). Tad Sozanski

10-29 Dear All, I would like to thank Tadeusz for bringing this issue to our attention in the first place and also for his great suggestions regarding the **Russian** translation.

However, I am strongly opposed to INSNA legitimizing the term "social'naya set'". This is simply a direct translation of the respective English phrase (social network). There's nothing wrong with direct translations in principle, but in this case it does acquire a very specific connotation. The adjective "social" in Russian is very loaded politically, so the proposed translation would be rather associated with social work than with sociological research.

I have proposed a shorter term "socioset'" (which is essentially the same, just does not have all those political and social work connotation). I am convinced that it would convey the meaning much better than "social'naya set'". I have discussed this issue with my colleagues at Nizhny Novhgorod State University and they agreed that a shorter new version is preferable.
Social networks research in Russia is a very young field, and so we should not be obliged to follow an unfortunate precedent. I would guess that the editors of the dictionary included annd translated the term because it was mentioned in some Western dictionary rather than frequently used in practice by Russian sociologists. Please correct me if I am wrong. Best regards, GK

Sorry I forgot to mention the whole variant that I suggest:

Mezhdunarodnaya set' po analizu sociosetej

Please note the conjunction is different from what Tadeusz proposed -- it should rather be "po", not "dlya" (the latter is appropriate if the subject is inanimate, e.g. a tool or machine). I can a create a postscript file (or any other graphics format) with the translation typeset in Cyrillic once we have agreed on the wording. Regards, Gueorgi Kossinets

10-29 I support Gueorgi's point and vote for sociocet'.

A small observation: Overall all that has changed in the translation is that pletenka was replaced with set'. The whole final translation offered by Tadeusz sounds to me more like a word-by-word translation from **English** to **Russian** to which he was so opposed at the very beginning and which is so fashionable in Russia nowadays. Olga

10-31 Dear Gueorgi and Other Colleagues: I also prefer "socioset" to "socialnaya set'". Has the short term already appeared in a published text? If it has, I would support its use even more. Unfortunately, I did not manage to locate Kravchenko's email address so I could not ask himself about "socioset'". As it were, his dictionary is a serious new published source which has also appeared outside Russia (don't buy it from the Mellen Press, the price is some $130!). The author (probably, a full professor of sociology active outside his homeland, as shown by some results of a Google search) certainly knows the meaning of SN better than the persons [machine translation services] the editors of

Connections had asked for translations before I trapped the funny error, and decided to respond, thus showing a sort of "Slavic solidarity" a pretty rare thing in Poland (if you want to make a Pole angry, tell him, as the Americans occasionally do, that Poland is part of Eastern instead of Central Europe).

Let me refer to another printed source. The Russian Academy of Sciences Great Dictionary of Russian, edited by Kuznetsov has the entry "socio-" explained as "pervaya chast' slozhnykh slov; vnosit znachenie <socialnyi>"; the explication is followed by two examples ("sociolingvistika, sociopsikhologia") given also as separate entries.

You say, Gueorgui

> "I am strongly opposed to INSNA legitimizing the term "social'naya set'". This is simply a direct translation of the respective English phrase (social network). There's nothing wrong with direct translations in principle, but in this case it does acquire a very specific connotation. The adjective "social" in Russian is very loaded politically, so the proposed translation would be rather associated with <social work> than with sociological research."

I have too little contact with current Russian spoken in Moscow or St.Petersburg nor with the Russian spoken by the "diaspora", the variety probably far from the "Soviet Russian", but possibly a bit different as well from the language of the postSoviet Russia of which a good source seems to me the Kuznetsov dictionary I've got on my shelf since the last weekend. The entry "socialnyj" given there does not suggest a "political loading". Among many word combinations given there very few (e.g. the counterpart of "social insurance") seem to have a shade of "political" connotation. A Polish professor of Russian I had asked about this matter says, "socialnyj" differs from "obshchetvennyi" in that the former is a more bookish or scientific word. However, if the impression of political loading in "socialnyi" is confirmed by other native and educated speakers of Russian (sociologists from Nizhnyi Novgorod consulted by Gueorgi) let us all vote for "socioset'".

By the way, your remark, Gueorgi, fits very well the usage of two analogous Polish adjectives: "spoleczny" and "socjalny". The latter word (solely used in the contexts like "praca socjalna", "dzial socialny") is currently becoming politically-laden, especially since the time when the right-wing press has begun to use the noun "socjal", the word, with strongly derogative meaning, which was coined to denote the excessive state budget expenses for helping the poor, unemployed etc. the policy considered by the Reagan-Thatcher right (let me confess, closer to my heart, than Clinton-Schroeder left) as a way of wasting the taxpayers' money.

At last, let me recall to our mini discussion group that I suggested to the Editor of Connections to accept the translation offered by Vladimir Paniotto, the person whom I found myself the most competent in this matter. Probably he cannot take part in our debate because his trouble with eyes (he mentioned in a his letter to me) continues. I think he would not object to "socioset'" nor to "po analizu" instead of "dla analiza" of which I also approve.

So let me conclude this (I hope the final) stage of our discussion with proposing to Bill Richards the following translation

"Mezhdunarodnaya Set' po Analizu Sociosetei"

I hope that Boris in London and Elena in St.Petersburg will also cast their votes for this variant and our Anglosaxon colleagues will be happy that East Europeans are able to make decisions rather than constantly debate over the issue.

Of course, there is nothing wrong in continuing the debate, especially if it turns to more important issues, that is, sharing our knowledge of social networks studies carried out in our part of the world and letting the Western world know about this. As a by-product - such a discussion may help Russian colleagues to extend their contacts with the West. A report from Russia (which I've read in a Polish weakly) about handling the Dubrovka victims by the authorities shows that the postSoviet Russia has not yet moved close enough toward Western standards. I don't know if

Internet correspondence with Russia is monitored by post-KGB special services. Yet let's try to practice communication despite fears we may still have.

Gueorgi says: "Social networks research in Russia is a very young field" [like in Poland – TS]. It may well be that "the editors of the dictionary [Kravchenko – TS] included and translated the term because it was mentioned in some Western dictionary rather than frequently used in practice by Russian sociologists."

Let me remark in this connection, that "sociometriya" is also among sociological terms beginning with socio included in the Kuznetsov dictionary. Thus, this special scientific term was not considered by the RAN editorial committee responsible for the contents of the Dictionary as a too technical word that should rather be omitted in the dictionary for general use. This indirectly proves that sociometry, historically, the first variety of SNA, must be known in Russia, probably not only due to the publications of Vladimir Paniotto.

That is all for this letter which I could write so long today thanks to Rector of our University who has cancelled the classes on the eve of All Saints Day, the holiday when all Poles used to visit the cemeteries.   With best regards, Tad

I've summarized the translations on the next page. If you can fill in one of the blank cells or correct an improper version in one of the others, please write to insna@sfu.ca. Please include a complete version, with all accents, diacriticals, and alphabetical characters that look different from the ones in this paragraph. Wordperfect, rtf, Word, Acrobat, gif, jpg, bmp, png, and tif formats are all ones I can work with. I hope you've enjoyed this unusual piece.   Bill

INSNA in your language

Arabic	ةيلودلا ةكبشلا لييلحتلل ةيلودلا ةكبشلا	ةيلية
Chinese	全球网络之社会网络分析	
Czech	Internacionál Přenosový článek do Společenský Síťová Analýza	IPČSSA
Danish	Internationale Netværk for Social Netværksanalyse.	INSN
Dutch	Internationaal Netwerk voor Sociaal Netwerk Analyse	INSNA
English	International Network for Social Network Analysis	INSNA
French	Réseau International pour l'Analyse de Réseaux Sociaux	RIARS
Finnish a	Kansainvälinen Verkosto Sosiaalisten Verkostojen Tutkimukseen	KVSVT
Finnish b	Sosiaalisen Verkostoanalyysin Kansainvälinen Tutkijaverkosto	SVKT
German a	Internationales Netzwerk für Soziale Netzwerk Analyse	INSNA
German b	Internationales Netzwerk für die Analyse Sozialer Netzwerke	INASN
Greek	Διεθνές Δίκτυο για την Κοινωνικών Δικτύων	ΔΔΚΔ
Hungarian	A Társadalmi Kapcsolatháló Elemzés Nemzetközi Hálózata	TKENH
Indonesian	Jaringan Antarbangsa untuk Analisa Jaringan Sosial	JAAJS
Irish Gaelic		
Italian	Rete Internazionale per l'Analisi delle Reti Sociali	RIARS
Japanese		
Klingon		
Polish	Międzynarodowa Sieć do Analizy Sieci Społecznych	MSASS
Portugese	Rede Internacional para Análise de Redes Sociais	RIARS
Romanian	Reţeaua Internaţionalã pentru Analizã de Reţele Sociale	RIARS
Russian a	Международная Сеть для Анализа Социальных Сетей	MCACC
Russian b	Международная Сеть по Анализу Социосетей	MCAC
Spanish	Red Internacional para el Análisis de Redes Sociales	RIARS
Slovenian		
Swedish	Internationellt Nätverk för Social Nätverks Analys	INSNA
Turkish a	Toplumsal İlişki Ağlarını İnceleyen Uluslararası Bilim Ağı	TİAİUBA
Turkish b	Uluslararasi Toplumsal Ag Analiz Agi	UTAAA