Published in final edited form as:
Addict Behav. 2011 December ; 36(12): 1305–1308. doi:10.1016/j.addbeh.2011.07.008.

Social network influences of alcohol and marijuana cognitive associations

Kathryn Coronges, MPH, PhD[1],
University of Southern California, Department of Preventive Medicine, Alhambra, CA

Alan W. Stacy, PhD[2], and
University of Southern California, Department of Preventive Medicine, Alhambra, CA

Thomas W. Valente, PhD
University of Southern California, Department of Preventive Medicine, Alhambra, CA

Abstract

Decision-making is a social process whereby behaviors are often driven by social influences and social consequences. Research shows that social context also plays an integral role in decision-making processes. In particular, evidence suggests that implicit or non-conscious cognitions are linked to social information in memory and that implicit attitudes can be communicated and assimilated between people on an unconscious level. This study assesses social contagion of implicit cognitions regarding alcohol and marijuana among high school friend networks. Data are from an evidence-based drug education program delivered by either a health educator or by nominated class leaders over a 3-month period. Implicit attitudes were found to be susceptible to social influences, particularly for alcohol. Surprisingly, social contagion was stronger for cognitions than for behaviors. In addition, results support prior research that has found that implicit attitudes are not entirely stable and may be more susceptible to change than are behaviors. Public health initiatives to engender behavioral change could be facilitated by targeting flexible cognitive associations within existing social network structures.

Keywords

Social Network Analysis; Implicit Cognition; Alcohol; Marijuana; Social Contagion; Intervention

1. Introduction

In the last decade, awareness and understanding of the interconnectedness of our behaviors and thoughts have become widespread. It is common to talk about the influence of our

[1]Authors current addresses/affiliations: United States Military Academy, 601 Cullum Road, Thayer Hall, Room 282G, Department of Behavioral Sciences & Leadership & Network Science Center, West Point, NY 10996, 323-356-4492 mobile, 845-938-2491 office
[2]Claremont Graduate University, School of Community & Global Health, Claremont, CA

Contributors
Authors Alan Stacy and Thomas Valente wrote the protocol and provided mentorship with data analysis and theoretical foundations. Author Kathryn Coronges conducted the statistical analysis, provided analytic design and hypotheses, and wrote first draft of paper. All authors contributed to and approved final manuscript.

Conflict of Interest
All authors declare that they have no conflicts of interest.

friends' behaviors on our own, and the viral spread of attitudes or ideologies. Behavioral research finds that cognitive processes involved with decision-making are indeed driven by social influences and social consequences. Social network analysis is a set of theories and tools that allow us to assess how relationships influence individual decisions from the perspective that behaviors are not self-contained, but rather embedded within networks of social influences and meanings (Burt, 1987; Friedkin, 2004; Valente, 2010). The importance of social network influences in behavioral outcomes has been well documented. Drug use, in particular, is a highly social activity which is often initiated with friends and maintained among groups (Kandel, 1985; Kobus, 2003; Pearson et al., 2006). Alcohol and marijuana use are typically surrounded by rituals and cultural values, which engender cognitive associations and norms around these activities.

Network studies typically focus on contagion of overt behaviors and explicit attitudes. Yet limiting measurements to overt activities implies that social influence occurs entirely through explicit knowledge of others and entirely at the rational and conscious levels. However, several domains of psychological and cognitive research suggest that social influence may also occur at the unconscious or implicit level. The importance of implicit attitudes is that they can contradict explicit attitudes and in some cases, correlate with behaviors more so than consciously-held attitudes (Greenwald & Banaji, 1995; Dovidio, Kawakami, & Gaertner, 2002; Kahneman, 2003). Automatic memory pathways have been found to account for up to 30% of variances in health-related decisions, independent of explicit cognitions (McCusker, 2001). For example, Stacy (1997) found that among college students, associative strengths between positive outcomes ('relaxing' or 'feeling good') was a better longitudinal predictor of alcohol and marijuana use than explicit attitudes towards drug use, after controlling for sensation-seeking, acculturation, and gender.

A key feature of implicit pathways is that they are embedded within memories of physical and social settings such that relevant information is more easily accessed in particular contexts. Some studies have also shown that implicit information can be communicated person-to-person. For example, research in non-verbal communication shows that emotion and social status (e.g., empathy, dominance) are communicated through symbolic language. In group-task research, congruent cognitive structures are found to lead to more effective & efficient communication, collaboration, problem-solving and coordination of activities (Levesque, Wilson, & Wholey, 2001; Palazzolo, 2005). Unconscious cognitions appear to be essential to how individuals relate to one another, and may be passively communicated unconsciously assimilated. At the very least, these kinds of studies support the need to consider social context when investigating implicit cognitive changes.

Despite a number of studies establishing the relationship between implicit attitudes and substance use (Stacy, 1995), as well as between social networks and substance use (Valente, 2010), there has been little attention devoted to dependencies between social interactions and memory processes. The current study investigates whether alcohol and marijuana-related implicit cognitions can spread via social contagion among high school friend networks. Analysis is presented that assesses whether exposure to friends' cognitions and behaviors help explain individual's cognitions after a 3-month long drug education program (hypothesis 1), and whether contagion of cognitions has any influence on corresponding behaviors (hypothesis 2).

2. Materials and Methods

Data were collected during an evidence-based drug education program 'Towards No Drug Abuse' (TND) as part of the University of Southern California's Transdisciplinary Drug Abuse Prevention Research Center (Valente, et al., 2007). The curriculum includes twelve

1-hour classroom lessons over the course of three months, and incorporates role-playing and reducing misconceptions about drug use (Sussman, 1995; Sussman et al., 2004). The participants attended Continuation high schools in Los Angeles County, which are alternative settings that focus on technical and life skills. Of the 1493 students invited to participate, 980 provided valid consent forms. Of those, complete data was collected from 567 students, representing 74 classrooms within 40 schools. Subjects completed baseline paper-and-pencil surveys in the spring of 2004 and a post-test survey upon completion of the program.

A classroom randomized controlled trial design was implemented to compare two forms of the curriculum: (1) standard condition, where students received TND in a typical classroom format delivered by health educators, and (2) TND experimental (networked) condition, where students work in groups lead by nominated peer leaders. The control condition received no intervention and acts as the reference for the analyses.

2.1 Survey Instruments

Data collected includes: demographic information (gender is coded '1' for male, and '2' for female; for ethnicity, '1' = Latin American and '2' for all other ethnicities; socio-economic status represents parents' education and profession, ranging from 0 to 2); social networks (egocentric, "list your 5 best friends" and sociometric "list your 5 best friends in the class"); self-reports of drug behaviors (30-day recall of alcohol and marijuana use); and drug cognitions (free word associations). Word association scores were generated from continuous cue-behavior tasks, which ask participants to write the first behavior or action that comes to mind given a phrase stimulus (see Stacy, Galaif, Sussman, & Dent, 1996). Responses to each cue word were coded by two judges (average Kappa = 0.82) with a third judge making the tie-breaking decisions when discrepancies occurred (Ames et al., 2005). At baseline, students were given one of three tasks, randomized within class: (1) *outcome cues* (e.g., "feeling relaxed", "having fun"), (2) *location cues* (e.g., "my bedroom"; "parking lot"), and (3) *compound cues* (e.g., "*having fun, in my bedroom*"; "*feeling good, in my yard*"). At post-test, all students received the same outcome cues task.

From the surveyed data, alter and ego variables were calculated. *Ego effects* refer to the influence of the individual's own characteristics and *alter effects* refers to the influence of friends. Ego variables include: (1) *in-school best friends*, the proportion of best friends who attend the same school; (2) *popularity*, in-degree centrality or the number of friend nominations a person receives divided by the total number of students in the class. Alter variables include: (1) *friends' drug behaviors*, the number of friends who report alcohol or marijuana behaviors divided by total number of friends nominated; (2) *friends' drug cognitions*, the number of friends who elicit word association responses related to alcohol or marijuana divided by total number of friends nominated.

2.2 Analytic Procedure

Four models are presented to evaluate post-intervention outcomes: alcohol use, alcohol cognitions, marijuana use, and marijuana cognitions. For brevity, alcohol and marijuana will be labeled together as "drugs." Alter effect scores were calculated from available friend data - if there was no data on a nominee for a specific attribute, their nomination was not counted. Multilevel mixed-effects analysis were conducted using STATA software, version 10.0 (StataCorp, 2007). The random-effects portion of the model accounts for variances across schools. Lagged analysis approach is used, where baseline effects are controlled for in order to detect change in variables over time. Odds ratios and standard errors are reported.

3. Results

Students were mostly Hispanic/Latino (68%) and male (57%). On average, 62% of students reported using alcohol in the last month, and 49% reported using marijuana. In response to the word association cues, 20% generated alcohol responses, and 28% gave marijuana responses. The demographic and behavioral characteristics are typical of California Continuation high school population.

Tables 1 and 2 show results predicting behaviors and cognitions, respectively. Parsimonious models are the result of an unconstrained stepwise elimination process, and include variables that were significant at the 0.05 level, representing the best predictive model with the fewest number of variables.

Control Variables—Popular students were somewhat more likely to be marijuana users compared to those with fewer friends. Non-Latino students were more likely to generate alcohol associations than were Latinos, and boys were about 50% more likely than girls generate marijuana cognitions.

Ego-Effects—As expected, past drug using behaviors are the best predictors of future behaviors. However, contrary to expectations, baseline alcohol cognitions are not associated with cognitions at follow-up and are relatively low for marijuana. Analysis of cognition-behavioral cross-effects showed that individual's cognitions was associated to future behaviors, and baseline behaviors are associated with follow-up cognitions. Effects were greater for alcohol than for marijuana, and greater for cognitions than for behaviors.

Alter Effects—Friends' behaviors and cognitions were found to be associated with ego's corresponding activities, particularly for alcohol. Surprisingly, the influence of friends' cognitions on ego's cognitions were considerably stronger than their influence on behaviors. There were no significant cognitive-to-behavioral or behavioral-to-cognitive alter influences.

Notably, 95% confidence intervals for cognition variable estimates are quite large, particularly in alcohol use models. In the alcohol model, the cognition OR equals 9.4 indicating that the value ranges from −0.44 to 19.24 for 95% of the population. Large variances are often due to insufficient power. Thus, while associations between behavior and cognitions are statistically suggestive they are not conclusive.

4. Discussion

This study uses a social contagion perspective to evaluate changes in implicit associations as a result of a drug and alcohol intervention in high school classrooms. Results support hypothesis 1, where cognitions are influenced by friends' cognitions. This simple finding suggests an untapped and powerful social mechanism where implicitly held attitudes can be communicated and spread through social networks. Surprisingly, implicit cognitions were found to be more susceptible to social influences than were behaviors, particularly cognitions around alcohol. These results suggest that cognitions are not determined by previously established cognitive pathways, but may instead be highly malleable within as little as three months. Evidence for hypothesis 2 was not found - cognitive influence did not directly affect behaviors and social behavioral influences did not affect cognitions. No differences were found across program conditions, which suggest that the intervention message was equivalent whether it was disseminated through peer- or teacher-led format.

4.1 Cognitive Contagion

Until recently, implicit attitudes were considered to be stable pathways resulting from a lifetime of associative learning and socialization (Gawronski & Bodenhausen, 2005). Contrary to this, a number of studies have shown that implicit evaluations are not simply retrieved from memory, but instead are constructed and altered as they are reconstructed, making them vulnerable to change (Blair, Ma, & Lenton, 2001; Mitchell, Nosek, & Banaji, 2003; Schwarz, 2007; Wilson & Hodges, 1992).

Cognitions may change more readily than behaviors because implicit attitudes may need to accumulate before individuals commit to changing their behavior. Therefore, gradual shifts in cognitions may be detected before a person is even aware of their intention to adopt a new behavior. Behavioral changes also require willingness on the part of the individual, which necessitates that the activity is harmonious with previously held beliefs. Implicit cognitions largely circumvent rational conscious processes, and therefore, cognitive contagion might occur more easily than behavioral contagion because there are fewer deliberative cognitive barriers to overcome. Further, cognitive tendencies around alcohol use may be more easily spread because there are fewer attitudinal barriers, while marijuana carries with it greater social stigma and conscious resistance.

4.1 Limitations of the Study

A few limitations to the study are mentioned briefly: (1) automaticity of responses are hard to ensure given the nature of classroom survey data collection, (2) generalizability of these findings may be limited to high-risk adolescents given that alcohol and marijuana use is relatively common and network exposure may not substantially increase susceptibility, and (3) logistic regression does not account for inherent social structural dependencies, which can better addressed using stochastic actor-oriented modeling (Snijders, Steglich, & Schweinberger, 2007).

4.2 Public Health Applications

There are many challenges to reversing the progression of substance use among teenagers. Education focused on the consequences of drug use is often ineffective. Unconscious pro-drug cognitions appear to be partially responsible for the persisting trends of alcohol and marijuana use. The findings presented here suggest that social influences also contribute to implicit evaluations from the perspective that unconsciously held attitudes can be exchanged and maintained by social networks. Interventions that attempt to create cognitive and behavioral changes without accounting for social context may be stifled by the strength of socially embedded implicit associative meanings. Educational program strategies might benefit if they can harness cognitive social influences by infusing healthy associative norms into existing social networks.

Research Highlights

- Students assimilate drug-related implicit attitudes of their friends after only three months of classroom drug education program.
- Implicit cognitions around alcohol and marijuana were more socially contagious through classroom friendship networks than were alcohol and marijuana behaviors.
- Cognitions were found to be more fluid than behaviors, particularly for alcohol, where implicit cognitive tendencies were more susceptible to social influences.

- Mapping social dynamics may be essential to understanding implicit processing of intervention material.

Acknowledgments

The authors wish to thank Steve Sussman who developed the intervention curriculum for TND (Towards No Drug Abuse), and Joseph Dunn who assisted in the proof-reading of the manuscript.

Role of Funding Sources

This work was funded by grant #DA16094 from the National Institute on Drug Abuse. NIDA had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

References

Blair IV, Ma JE, Lenton AP. Imagining stereotypes away: The moderation of implicit stereotypes through mental imagery. 2001; Vol. 81:828–841.

Burt RS. Social Contagion and Innovation: Cohesion Versus Structural Equivalence. American Journal of Sociology, 1987. 1987; 92(6):1287–1335.

Dovidio JF, Kawakami K, Gaertner SL. Implicit and explicit prejudice and interracial interaction. J Pers Soc Psychol. 2002; 82(1):62–68. [PubMed: 11811635]

Friedkin NE. Social cohesion. Annual Review of Sociology. 2004; 30(1):409–425.

Gawronski, B.; Bodenhausen, GV. Accessibility effects on implicit social cognition: The role of knowledge activation and retrieval experiences. Vol. Vol. 89. American Psychological Association; 2005. p. 672

Greenwald AG, Banaji MR. Implicit Social Cognition: Attitudes, Self-Esteem, and Stereotypes. Psychological Review. 1995; 102(1):4–27. [PubMed: 7878162]

Kahneman D. A perspective on judgment and choice: Mapping bounded rationality. American Psychologist. 2003; 58(9):697–720. [PubMed: 14584987]

Kandel DB. On processes of peer influences in adolescent drug use: A developmental perspective. Alcohol and Substance Abuse in Adolescence. 1985; 4(3–4):139–163.

Kobus K. Peers and adolescent smoking. Addiction. Supplement(Abingdon). 2003; 98(1):37–55.

Levesque LL, Wilson JM, Wholey DR. Cognitive divergence and shared mental models in software development project teams. Journal of Organizational Behavior. 2001; 22(2):135–144.

McCusker CG. Cognitive biases and addiction: an evolution in theory and method. Addiction. 2001; 96(1):47. [PubMed: 11177519]

Mitchell JP, Nosek BA, Banaji MR. Contextual variations in implicit evaluation. Journal of Experimental Psychology: General. 2003; 132(3):455–469. [PubMed: 13678378]

Palazzolo ET. Organizing for Information Retrieval in Transactive Memory Systems. Communication Research. 2005; 32(6):726.

Pearson M, Sweeting H, West P, Young R, Gordon J, Turner K. Adolescent substance use in different social and peer contexts: A social network analysis. Drugs: education, prevention and policy. 2006; 13(6):519–536.

Schwarz, N. Attitude construction: Evaluation in context. Vol. Vol. 25. Guilford Publications; 2007. p. 638-656.

Snijders TAB, Steglich CEG, Schweinberger M. Modeling the co-evolution of networks and behavior. Longitudinal models in the behavioral and related sciences. 2007:41–71.

Stacy AW. Memory association and ambiguous cues in models of alcohol and marijuana use. Experimental and Clinical Psychopharmacology. 1995; 3:183–194.

Stacy AW. Memory activation and expectancy as prospective predictors of alcohol and marijuana use. Journal of Abnormal Psychology. 1997; 106(1):61–73. [PubMed: 9103718]

StataCorp.. Stata Statistical Software: Release 10. College Station, TX: StataCorp LP.; 2007.

Sussman, S. Developing school-based tobacco use prevention and cessation programs. Sage Publications Thousand Oaks; 1995.

Sussman, S.; Earleywine, M.; Wills, T.; Cody, C.; Biglan, T.; Dent, CW., et al. The motivation, skills, and decision-making model of drug abuse prevention. Vol. Vol. 39. Dekker; 2004. p. 1971-2016.

Valente, TW. Social networks and Health. New York: Oxford University Press; 2010.

Valente TW, Ritt-Olson A, Stacy A, Unger JB, Okamoto J, Sussman S. Peer acceleration: effects of a social network tailored substance abuse prevention program among high-risk adolescents. Addiction. 2007; 102(11):1804–1815. [PubMed: 17784893]

Wilson, TD.; Hodges, SD. Attitudes as temporary constructions. In: Tesser, A.; Martin, L., editors. The construction of social judgment. Hillsdale, NY: Erlbaum; 1992. p. 37-65.

Table 1

Logistic Regression for Alcohol & Marijuana Behaviors

	Alcohol Use		Marijuana Use	
	Full Model	***Parsimonious Model***	***Full Model***	***Parsimonious Model***
n	374	427	377	431
Wald Chi2	89.59	98.61	123.36	145.68
Probability	0.000	0.000	0.000	0.000
Log Likelihood	−174.94	−202.75	−145.11	−167.7
EGO ATTRIBUTES				
Age	1.00 (0.10)		0.90 (0.11)	
Gender	1.05 (0.29)		1.23 (.40)	
Ethnicity	1.24 (0.37)		0.94 (.31)	
SES	0.92 (0.26)		0.81 (.25)	
Centrality	1.02 (0.07)		1.18 (.09)**	1.13 (0.08)*
In-School Friends	0.99 (0.07)		0.87 (.07)	
Experimental Condition	1.28 (0.45)		0.95 (.36)	
Standard Condition	0.87 (0.31)		0.72 (.29)	
EGO EFFECTS				
Drug Use (T1)	8.05 (2.27)***	8.01 (2.05)***	17.70 (5.60)***	20.78 (5.86)***
Drug Cognitions (T2)	9.40 (9.84)**	11.41 (11.84)***	5.64 (2.42)***	6.36 (2.32)**
Drug Cognitions (T1)	1.86 (0.65)*	1.95 (.65)**	1.47 (.48)	
ALTER EFFECTS				
Friends' Drug Use (T2)	3.52 (1.45)**	3.11 (1.07)**	1.96 (.90)	1.95 (0.73)*
Friends' Drug Use (T1)	1.26 (0.60)		1.71 (.89)	
Friends' Drug Cognitions (T2)	1.47 (1.08)		0.74 (.35)	
Friends' Drug Cognitions (T1)	0.56 (0.25)		0.85 (.43)	

* p<0.10,

** p<0.05,

*** p<0.001

Table 2

Logistic Regression for Alcohol & Marijuana Cognitions

	Alcohol Cognition		Marijuana Cognition	
	Full Model	***Parsimonious Model***	***Full Model***	***Parsimonious Model***
N	374	430	377	539
Wald chi2	33.14	33.35	86.67	117.82
Probability	0.005	0.000	0.00	0
Log Likelihood	−96.16	−111.59	−141.6	−226.32
EGO ATTRIBUTES				
Age	0.96 (.14)		0.85 (.10)	
Gender	0.60 (.25)		0.43 (.14) **	0.63 (.15) *
Latino	2.72 (1.06) **	2.74 (.96) **	1.19 (.38)	
SES	0.80 (.31)		0.91 (.29)	
Popularity	1.06 (.09)		1.05 (.07)	
In-School Friends	0.99 (.10)		1.03 (.09)	
Network Condition	1.33 (.70)		0.94 (.37)	
Standard Condition	1.92 (1.07)		1.34 (.56)	
EGO EFFECTS				
Drug Cognitions (T1)	1.52 (.44)		3.77 (1.03) ***	4.83 (.99) ***
Drug Use (T2)	11.75 (12.51) **	14.42 (15.17) **	5.28 (2.27) **	6.04 (1.62) ***
Drug Use (T1)	3.54 (2.42) *	4.08 (2.67) **	1.12 (.48)	
ALTER EFFECTS				
Friends' Drug Cognitions (T2)	5.97 (4.67) **	8.19 (5.17) ***	6.72 (3.08) ***	
Friends' Drug Cognitions (T1)	0.89 (0.51)		1.12 (.51)	
Friends' Drug Use (T2)	1.54 (1.06)		0.90 (.45)	
Friends' Drug Use (T1)	0.47 (.34)		1.56 (.84)	

* p<0.10,

** p<0.05,

*** p<0.001