



Published in final edited form as:

J Youth Adolesc. 2014 September ; 43(9): 1527–1535. doi:10.1007/s10964-013-0058-7.

Community-level Adult Daily Smoking Prevalence Moderates the Association between Adolescents' Cigarette Smoking and Perceived Smoking by Friends

Johannes Thrul¹, Sharon Lipperman-Kreda², Joel W. Grube², and Karen B. Friend³

¹IFT Institut für Therapieforschung, München, Germany

²Prevention Research Center, Pacific Institute for Research and Evaluation, Oakland, CA, USA

³Decision Sciences Institute, Pacific Institute for Research and Evaluation, Pawtucket, RI, USA

Abstract

Few studies have investigated the complex interactions among the individual- and community-level social risk factors that underlie adolescents' smoking behaviors. This study investigated whether community-level adult daily smoking prevalence is associated with adolescents' smoking and whether it moderates the associations between perceived friends' smoking approval and smoking behavior and adolescents' own smoking. Self-reported data from 1,190 youths (50.3% female; 13–18 years old) in 50 midsized Californian cities were obtained through telephone interviews. Community characteristics were obtained from 2010 GeoLytics data. Community adult daily smoking prevalence was ascertained from telephone interviews with 8,918 adults conducted in the same 50 cities. Multilevel analyses, controlling for individual and city characteristics, were used to predict adolescents' past 12-month smoking from perceived friends' smoking approval and smoking behavior and from community adult daily smoking prevalence. Results showed that perceived friends' smoking approval and behavior were associated positively with adolescents' smoking, as was the community-level prevalence of adult daily smoking. Furthermore, the association between perceived friends' smoking behavior and adolescents' own smoking was moderated by the prevalence of adult daily smokers in the community. Specifically, the association was stronger in cities with higher prevalence of adult smokers. These results suggest that adult community norms that are more supportive of smoking may enhance the influence of friends' smoking behavior. Therefore, interventions designed to prevent or reduce youths' smoking should also focus on reducing smoking by adults.

*Corresponding author: Johannes Thrul, IFT Institut für Therapieforschung, Parzivalstr. 25, D-80804 München, Germany. Tel: +49-89-36080486; Fax: +49-89-36080469. thrul@ift.de.

The authors declare that they have no conflict of interest.

Authors' contributions

JT conceptualized the study and was primarily responsible for data analysis and manuscript preparation. SLK assisted in conceptualizing the study and in data analysis and contributed to the writing of this manuscript. JWG contributed to conceptions and design and assisted in substantial editing of the manuscript. KBF participated in substantial editing of the manuscript. All of the authors helped to interpret findings, review drafts of the manuscript, and approved the final manuscript.

Keywords

Peers; Adolescence; Smoking; Multilevel; Community; Norms

Introduction

Although smoking rates among adolescents in the U.S. have declined significantly in the past decade (e.g., Johnston, O'Malley, Bachman, & Schulenberg 2013), smoking by young people remains a serious public health concern. Cigarette smoking in adolescence is associated with a higher risk for smoking and nicotine dependence in adulthood and with a range of acute health problems, including an increased number and severity of respiratory illnesses, increased asthma-related symptoms, decreased fitness, reduced pulmonary function, and potential retardation of lung growth (U.S. Department of Health and Human Services 2012). In order to design and implement effective interventions targeting adolescents' smoking, it is necessary to understand the complex interactions among individual- and community-level risk factors that underlie this behavior. In this study, we address this issue by investigating whether community-level adult smoking is: 1) related to adolescents' smoking, and 2) whether it moderates the associations of adolescents' normative beliefs with cigarette use.

Normative beliefs and adolescents' smoking

Normative beliefs are central constructs in many social-cognitive theories of behavior (e.g., Bandura 1986; Fishbein & Ajzen 2010). Broadly defined, normative beliefs refer to perceptions of approval/disapproval of a behavior by significant others (injunctive norms) and to perceptions of the extent to which significant others engage in a behavior (descriptive norms). Both are important constructs in understanding adolescent smoking. Studies consistently show that normative beliefs are important correlates of adolescents' smoking behavior. Perceived approval of smoking by friends, peers, and parents has been found to be associated positively with adolescents' smoking intentions and susceptibility to smoking (Leatherdale, Brown, Cameron, & McDonald 2005; Olds, Thombs, & Tomasek 2005), smoking behaviors (McMillan, Higgins, & Conner 2005; Wium, Torsheim, & Wold 2006), and beliefs about the acceptability of smoking (Alesci, Forster, & Blaine 2003). Similarly, perceived smoking by friends is also a predictor of smoking behaviors among adolescents (Villanti, Boulay, & Juon 2011; O'Loughlin, Karp, Koulis, Paradis, & DiFranza 2009). These associations have been reported both cross-sectionally (Villanti et al. 2011) and longitudinally (Duan, Chou, Andreeva, & Pentz 2009; Bricker et al. 2006). Studies further indicate that descriptive norms may be related more closely to adolescents' smoking intentions and behavior than are injunctive norms (Vitória, Salgueiro, Silva, & de Vries 2011; Mercken, Candel, van Osch, & de Vries 2011). Given the role of normative beliefs in adolescents' smoking and their potential significance as targets for prevention, it is important to improve our understanding of how they may interact with the broader normative environment.

Community smoking norms and adolescents' smoking

Although studies indicate the importance of normative beliefs for adolescents' smoking, additional social risk factors originate at the community level. In particular, recent research has examined associations of community-level smoking and smoking norms with adolescents' smoking behaviors and beliefs. These studies have used different approaches to operationalize community-level smoking behaviors and smoking norms. For example, one study aggregated students' beliefs about smoking (i.e., smoking was wrong, smoking was cool, number of friends who smoked) at school levels and found that these smoking norms were associated positively with individual students' self-reports of ever smoking (Gilreath, Chaix, King, Matthews, & Flisher 2012). Using a different approach, a study in Taiwan operationalized community smoking norms as the prevalence of adult smoking measured at the county level through telephone interviews (Chen et al. 2010). County-level youth smoking rates were associated positively with adult smoking prevalence in a multilevel analysis. Another study measured community norms using multi-method multi-informant measures (Chilenski, Greenberg, & Feinberg 2010). Reports of students and community leaders, as well as geocoded data on alcohol and tobacco outlets were used to measure community-level perceived approval of, and perceived availability of, substances. This combined measure of norms was associated with community rates of adolescents' cigarette smoking. Overall, these studies indicate that community-level adult smoking norms may be important determinants of adolescents' smoking and thus important targets for prevention. Further research, however, is necessary to address how community smoking norms may interact with individual risk factors in order to design and target better preventive interventions.

Interactions between community smoking norms and individual risk factors

Only a few studies have examined how interactions among social risk factors in different domains (e.g., families, peer groups, schools, neighborhoods, and communities) may affect youths' smoking. Moreover, most of these studies have focused only on the school environment (Leatherdale, McDonald, Cameron, Jolin, & Brown 2006; Murnaghan, Leatherdale, Sihvonen, & Kekki 2008). For example, Leatherdale et al. (2005) found that smoking prevalence among high school seniors moderated the association between perceived close friends' smoking and students' experimental smoking. Specifically, smoking prevalence among seniors had a stronger association with smoking among those youth who reported having fewer close friends who smoked cigarettes. In contrast, in a study of non-smoking elementary students from Grades 6–7, Leatherdale et al. (2006) reported that susceptibility to smoking increased as the prevalence of smokers in Grade 8 increased, but only among those students who had two or more friends who smoked. Looking at a broader set of social domains and using several different data sources, including self-reports from adolescents and parents, as well as Census data, Ennett et al. (2010) simultaneously modeled factors at the family, peer group, school, and neighborhood contexts and their contribution to adolescents' smoking. Associations were found between adolescents' smoking and the risk factors in each context, such that smoking among schoolmates or friends enhanced the effect of smoking in the family on adolescents' smoking. This study, however, did not assess the cross-level interactions between neighborhood context and the other domains. Kelly et al. (2011) investigated adolescents' smoking using a multilevel approach of individuals

nested within schools and neighborhoods. Results showed no significant interactions between perceived adult approval of substance use at the community level and perceived family or peer contexts. Given these conflicting findings, more research is needed to understand the complex simultaneous effects of risk factors in different social domains related to youth smoking.

Research aims and hypotheses

The goal of this study was to investigate the associations of adult daily smoking in the community and adolescents' normative beliefs (i.e., perceptions of peers' approval of smoking and smoking behavior) with adolescents' smoking behaviors. Our hypotheses were based on considerations from cognitive social learning theories (e.g., Bandura 1986; Fishbein & Ajzen 2010) and social-ecological approaches to understanding substance use (Gruenewald 2011), as well as previous research on youth tobacco use. We hypothesized that community-level adult smoking rates and adolescents' normative beliefs would be related to adolescents' smoking behavior directly. Also, that it would interact synergistically such that smoking will be greatest among adolescents who were exposed to more adult smoking in the community *and* who perceived more peer smoking and approval of smoking. Specifically, we hypothesized that adolescents' own smoking will be greater when community-level adult daily smoking prevalence was higher (Hypothesis 1) and perceived friends' smoking and approval of smoking was higher (Hypothesis 2). We further hypothesized that adult daily smoking prevalence will moderate the effects of perceived friends' approval of smoking (Hypothesis 3a), and smoking behavior (Hypothesis 3b), such that these perceptions will be associated more closely with adolescents' own smoking in communities with greater prevalence of adult smoking than in communities with lower prevalence of adult smoking.

Methods

Study sample and survey methods

Data were obtained as part of a 5-year study on the impact of local California tobacco policies on adolescents' smoking. A geographic sampling method was used to select 50 non-contiguous California cities with populations between 50,000 and 500,000 (Lipperman-Kreda, Grube, & Friend 2012). Households for the study were sampled from a purchased list of telephone numbers and addresses. Youth were surveyed through a computer-assisted telephone interview (CATI). The interviews were given in either English or Spanish at the respondent's request and lasted approximately 40 minutes. An invitation letter describing the study was mailed to sampled households followed by telephone contact. Parental consent for the interviews was obtained followed by assent from the youth respondents. Respondents received \$25 for their participation. Institutional review board approval was obtained prior to study implementation.

Of 3,062 sampled households with eligible respondents, 1,543 (50.4%) participated in a first telephone interview (Wave 1). Of these youth, 1,312 also participated in a second telephone interview (Wave 2) one year later (85% follow-up). Our analyses are based on the Wave 2 survey data and include 1,190 youth (50.3% female, M age = 15.6 years, SD = 1.07) who

provided complete data for all study variables. An average of 23.8 youth (range: 13–40, $SD = 5.88$) participated in the study in each city. Sample characteristics are provided in Table 1.

Survey Measures

Adolescents' smoking behavior—Survey respondents were asked about their frequency of cigarette smoking in the past 12 months on a seven-point scale (“Never” to “Every day”). Because this variable was positively skewed, it was \log_{10} transformed.

Demographics—Youth reported their gender, age, race and ethnicity. Race and ethnicity were coded as dichotomous variables (i.e., White versus non-White and Hispanic versus non-Hispanic).

Perceived friends' smoking approval—Two items measured perceived friends' smoking approval: (1) “How much do you think your *best friend* would disapprove or approve if you smoked cigarettes?” and (2) “How much do you think *other good friends* would disapprove or approve if you smoked cigarettes?” Response options were on a four-point scale from “Strongly disapprove” to “Strongly approve.” These two items were correlated closely, $r(1188) = .62, p < .001$. An average score was calculated to measure overall perceived friends' smoking approval.

Perceived friends' smoking behavior—Two items were used to measure perceived friends' smoking behaviors: (1) “In the past twelve months, how often did your *best friend* smoke cigarettes?” and (2) “In the past twelve months, how often did *other good friends* smoke cigarettes?” Response options were on a seven-point scale from “Never” to “Every day.” A moderate correlation was found between these items, $r(1188) = .46, p < .001$. A mean score was calculated to represent perceived friends' smoking behavior.

City-level measures

City characteristics—Measures of city characteristics were obtained from 2010 GeoLytics data (GeoLytics Inc. 2010). City characteristics included population density (i.e., population per square mile), percentage of population under 18 years old, median family income, percentage with at least college education, percentage unemployed, percentage White, and percentage Hispanic. All city-level demographics were standardized.

Adult daily smoking prevalence—Adult daily smoking prevalence in each city was ascertained from a survey of 8,918 adults over the age of 18 years old conducted in the same 50 cities as a part of another study (Gruenewald & Remer, in press). Respondents were surveyed through a random digit dial computer-assisted telephone interview and were asked whether they currently smoked cigarettes every day, some days, or not at all. Adult daily smoking prevalence was computed as the percentage of daily smokers in each city.

Analyses

We used multilevel linear regression analyses to predict adolescents' smoking using HLM version 7.0 (Raudenbush, Bryk, Cheong, Congdon, & du Toit 2011) to adjust for clustering of observations within cities and account for city-level effects. The city-level intraclass

correlation for adolescents' past-12-month cigarette smoking was small ($\rho = .001$). We conducted two nested models to test our hypotheses. Model 1, which tested Hypotheses 1 and 2, included the main effects for community- and individual-level predictors and covariates. Specifically, perceived friends' smoking approval and perceived friends' smoking behavior were entered as predictors at the individual level and adult daily smoking prevalence was entered as a predictor at the community level. Gender, age, race, and ethnicity were included as individual-level covariates. Population density, percentage of population below 18 years old, median household income, percentage with college education, percentage unemployed, percentage White, and percentage Hispanic were included as community-level covariates. Model 2, which tested Hypotheses 3a and 3b, included all of the Model 1 variables plus the cross-level interactions between adult smoking prevalence and perceived friends' smoking approval and between adult smoking prevalence and perceived friends' smoking behavior. The variables in each model were entered simultaneously.

The equation is given as:

$$\begin{aligned} \text{Adolescent past-12-month smoking}_{ij} = & \beta_{0j} + \beta_{1j} * (\text{perceived friends' smoking approval}) + \beta_{2j} * (\text{perceived friends' smoking behavior}) + \\ & \beta_{3j} * (\text{gender}) + \beta_{4j} * (\text{age}) + \beta_{5j} * (\text{White}) + \beta_{6j} * (\text{Hispanic}) + r_{ij} \quad \text{with} \\ \beta_{0j} = & \gamma_{00} + \gamma_{01} * (\% \text{ adult daily smokers}) + \gamma_{02} * (\text{population density}) + \gamma_{03} * (\% \text{ population below 18}) + \gamma_{04} * (\text{median household income}) + \gamma_{05} * (\% \text{ college graduates}) + \gamma_{06} * (\% \text{ unemployed}) + \gamma_{07} * (\% \text{ White}) + \gamma_{08} * (\% \text{ Hispanic}) + u_{0j}, \end{aligned}$$

$$\begin{aligned} \beta_{1j} = & \gamma_{10} [+ \gamma_{11} * (\% \text{ adult daily smokers})], \\ \beta_{2j} = & \gamma_{20} [+ \gamma_{21} * (\% \text{ adult daily smokers})] \\ \text{and } \beta_{3j} = & \gamma_{30}, \quad \beta_{4j} = \gamma_{40}, \quad \beta_{5j} = \gamma_{50}, \quad \beta_{6j} = \gamma_{60} \end{aligned}$$

Results

Model 1

Consistent with Hypothesis 1, a positive relationship between community adult daily smoking prevalence and youth past-12-month cigarette smoking was observed in Model 1 (Table 2). Furthermore, and consistent with Hypothesis 2, perceptions of friends' approval of smoking and perceptions of their smoking behavior were associated positively with adolescents' smoking in this model. The association of adolescents' own smoking with perceived friends' smoking behavior appears to be somewhat stronger than the association of adolescents' smoking with perceived friends' approval of smoking.

Model 2

Contrary to Hypothesis 3a, no significant cross-level interaction effect between perceived friends' smoking approval and community-level adult daily smoking on adolescents' past-12-month cigarette smoking was observed. However, consistent with Hypothesis 3b, a significant cross-level interaction was found between perceived friends' smoking behavior

and community-level adult daily smoking prevalence on adolescents' past-12-month cigarette smoking (see Table 2, Model 2). Specifically, the positive association between perceived friends' smoking behavior and adolescents' past-12-month smoking was stronger in communities with higher rates of adult daily smokers. To illustrate this cross-level interaction effect, the regression slopes of perceived friends' smoking behavior and adolescents' past-12-month smoking were plotted for three levels of community adult daily smoking prevalence (25, 50, and 75 percentiles; Figure 1).

Discussion

In order to design effective interventions to prevent and reduce smoking among adolescents, it is important to understand the complex interactions among social risk factors at the individual and the community levels. At the individual level, perceived approval by friends (McMillan et al. 2005) and perceived peers' and friends' cigarette use (Villanti et al. 2011) are associated with adolescents' own smoking. Furthermore community-level smoking and smoking norms are related to adolescents' smoking behaviors and beliefs (Chen et al. 2010; Chilenski et al. 2010). Only a few studies, however, have examined the interactions among social risk factors in different domains (e.g., families, peer groups, schools, neighborhoods, and communities) in predicting youths' smoking, and the available studies have reported inconsistent results (Ennett et al. 2010; Kelly et al. 2011). The aim of the current study was to examine the mutually reinforcing effects of community-level adult smoking and individual normative smoking beliefs and behaviors on adolescents' smoking behavior.

Consistent with our hypotheses, we found that perceived friends' smoking approval, perceived friends' smoking behavior, and community adult daily smoking prevalence were related positively to adolescents' smoking. Furthermore, the association between perceived friends' smoking behavior and adolescents' smoking was moderated by the percentage of adult daily smokers in the community, such that the association was stronger in communities with more adult daily smokers. The percentage of adult daily smokers in the community did not moderate the association between perceived friends' smoking approval and adolescents' smoking.

The positive associations between perceptions of friends' approval of smoking and smoking behavior and adolescents' smoking are consistent with results from previous studies. In these studies, perceived approval of smoking by friends, peers, and parents predicted adolescents' smoking (McMillan et al. 2005; Wium et al. 2006) as did perceived peers' and friends' smoking behavior (Villanti et al. 2011; O'Loughlin et al. 2009). The results of the current study confirm the link between perceptions of smoking among friends and peers and smoking by adolescents themselves. There are several possible explanations for these observed relationships. Adolescents may select friends whose substance use behaviors are similar to their own or may adapt their own substance use to correspond to friends' expectations and behaviors (Simons-Morton & Farhat 2010). Young smokers may also overestimate the prevalence of smoking. It is likely that all of these processes are at work. Some previous studies have reported that descriptive norms (perceived behavior of others) rather than injunctive norms (perceived approval of others) are related to adolescents' smoking (Vitória et al. 2011; Mercken et al. 2011). In contrast, we found that both were

significantly related to adolescents' smoking in multivariate models, although the association between adolescents' own smoking and perceived smoking by friends may be somewhat stronger. Overall, our findings suggest that smoking prevention efforts, such as those focusing on correcting normative misperceptions, should focus on modifying both descriptive and injunctive norms.

Our findings regarding the role of adult smoking prevalence in the community are consistent with some previous research on the effects of broader smoking norms on adolescent smoking (e.g., Chen et al. 2010; Gilreath et al. 2012; Chilenski et al. 2010). Our results extend the current knowledge by examining how adult smoking in the community moderates the associations of normative beliefs with adolescents' smoking behaviors. Adult daily smoking prevalence in the community may affect youth smoking through a number of processes. It may reflect broader community norms that are more accepting of smoking in general, increase exposure to smoking models, provide easier access to cigarettes through adults, or be associated with laxer implementation and enforcement of policies restricting youths' access to tobacco products. Future research is needed to identify the exact processes through which adults smoking in the community affect young people's smoking behaviors. Importantly, our research shows that adult community norms that are more supportive of smoking reinforce the influence of beliefs about friends' smoking behavior.

Our findings extend previous research by providing evidence for the complex interrelations between individuals' normative beliefs and adult smoking in the wider community context. Contrary to the findings reported by Kelly et al. (2011), we found significant moderating effects of community smoking on the association between perceived friends' smoking behavior and adolescents' individual smoking. One possible reason for these different findings may be the use of a different outcome measure of adolescents' smoking. Whereas Kelly et al. (2011) analyzed adolescents' lifetime ever smoking as a dichotomous outcome, we used the frequency of adolescents' past-12-month smoking. Different normative processes may be involved in decisions to smoke or not smoke, as opposed to frequency of smoking. Another possible reason for the different results may be that Kelly et al. (2011) used adolescents' perceived adult approval of substance use as a measure of community smoking norms, whereas our measure of community smoking was obtained independently from adults in the community. Adolescents' subjective reports of adult smoking may reflect not only actual levels of smoking in the community, but also biases resulting from youth who smoke being more attentive to smokers in their environment or misperceiving smoking by others in order to rationalize their own behavior. The current study aggregated data on adult smoking obtained from an independent source. Using data obtained directly from adults in the community may allow a more valid test of the relationship of adult smoking at the community level with adolescents' smoking.

The findings of this study should be interpreted in light of some limitations. First, the data were cross-sectional and, as a result, causality cannot be inferred. Although this is especially an issue for interpreting the associations of adolescents' smoking with normative beliefs, it is less so for its association with adult smoking. It is unlikely that adolescent smoking causes adult smoking, although both may be the result of other common causal factors. Second, we relied on self-reported survey measures of adolescents' past year smoking. Such measures

may be susceptible to recall and social desirability biases. Real-time data collection techniques, such as ecological momentary assessment would allow assessing exposure to smoking in the community while reducing recall biases. Objective measures of smoking (e.g., cotinine levels) could help reduce any social desirability bases, but are difficult to implement in large community surveys. Importantly, however, youths participating in the survey were assured of confidentiality and were interviewed when privacy could be assured, which helps reduce self-report biases. Our study also focused on social risk factors only at the peer and community levels. Future studies should examine the associations among factors at the other social levels (i.e., family, peer group, school, and neighborhood) to improve our understanding of the complex effects of social risk factors and their contribution to adolescents' smoking. Finally, our measures of friends' smoking approval and behavior relied on reports of adolescents' perceptions. Independent data on friends' smoking approval and behavior would be preferred. Such data could be collected as part of a social network analysis approach.

Conclusion

This study provides important findings on the interrelationships among adult smoking in the community, adolescents' perceived peer group smoking approval and behavior, and adolescents' smoking. Our results suggest that greater adult smoking rates in the community were associated with more frequent smoking among adolescents and also strengthen the relationship of adolescents' perceptions of smoking among their friends and their own smoking behavior. Successful prevention and tobacco control efforts targeting adolescents' smoking should focus on adults in the wider community, as well as adolescents themselves. Since previous research has shown the effectiveness of various tobacco policies working synergistically in reducing overall smoking prevalence (Wilson et al. 2012) and preventing smoking in adolescents (Friend, Lipperman-Kreda, & Grube 2011), these measures should be further strengthened. Other measures to reduce smoking among adults may be the widespread implementation of evidence-based smoking cessation interventions (Abrams, Graham, Levy, Mabry, & Orleans 2010). Based on our findings, reductions in smoking among adults may lead to reductions in smoking among adolescents and thus should be promoted.

Acknowledgments

This research was funded by grant number CA138956 from the US National Cancer Institute (NCI), grant number AA006282 from the National Institute on Alcohol Abuse and Alcoholism (NIAAA), and grant number 19CA-016 from the California Tobacco Related Disease Research Program (TRDRP). The contents of this paper are solely the responsibility of the authors and do not necessarily represent the official views of NCI, NIAAA, NIH, or TRDRP. The first author was supported by a grant from the German Academic Exchange Service (DAAD).

Reference List

- Abrams DB, Graham AL, Levy DT, Mabry PL, Orleans CT. Boosting Population Quits Through Evidence-Based Cessation Treatment and Policy. *American Journal of Preventive Medicine*. 2010; 38(3, Supplement):S351–S363. [PubMed: 20176308]
- Alesci NL, Forster JL, Blaine T. Smoking visibility, perceived acceptability, and frequency in various locations among youth and adults. *Preventive Medicine*. 2003; 36(3):272–281. [PubMed: 12634018]

- Bandura, A. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall; 1986.
- Bricker JB, Peterson AV, Andersen MR, Leroux BG, Rajan KB, Sarason IG. Close Friends', Parents', and Older Siblings' Smoking: Reevaluating Their Influence on Children's Smoking. *Nicotine & Tobacco Research*. 2006; 8(2):217–226. [PubMed: 16766414]
- Chen YH, Chen PL, Huang WG, Chiou HY, Hsu CY, Chao KY. Association between social climate for smoking and youth smoking behaviors in Taiwan: An ecological study. *International Journal of Nursing Studies*. 2010; 47(10):1253–1261. [PubMed: 20233616]
- Chilenski SM, Greenberg MT, Feinberg ME. The Community Substance Use Environment: The Development and Predictive Ability of a Multi-method and Multiple-reporter Measure. *Journal of Community & Applied Social Psychology*. 2010; 20(1):57–71. [PubMed: 24000275]
- Duan L, Chou CP, Andreeva VA, Pentz MA. Trajectories of Peer Social Influences as Long-term Predictors of Drug Use from Early Through Late Adolescence. *Journal of Youth and Adolescence*. 2009; 38(3):454–465. [PubMed: 19636757]
- Eisenberg ME, Forster JL. Adolescent smoking behavior: measures of social norms. *American Journal of Preventive Medicine*. 2003; 25(2):122–128. [PubMed: 12880879]
- Ennett ST, Foshee VA, Bauman KE, Hussong A, Faris R, Hipp JR, et al. A social contextual analysis of youth cigarette smoking development. *Nicotine & Tobacco Research*. 2010; 12(9):950–962. [PubMed: 20688870]
- Fishbein, M.; Ajzen, I. *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press; 2010.
- Friend KB, Lipperman-Kreda S, Grube JW. The impact of local U.S. tobacco policies on youth tobacco use: a critical review. *Open Journal of Preventive Medicine*. 2011; 1(2):34–43. [PubMed: 22200035]
- GeoLytics Inc. *Estimates Premium*. East Brunswick, NJ: GeoLytics Inc; 2010.
- Gilreath TD, Chaix B, King G, Matthews S, Flisher AJ. Multi-level influence of school norms on tobacco use in South Africa: an econometric consideration of group differences. *Cancer Causes & Control*. 2012; 23(Suppl 1):27–36. [PubMed: 22350864]
- Gruenewald PJ, Remer LR. A social ecological model of alcohol use: The California 50 city study. *Addiction*. in press.
- Gruenewald PJ. Regulating availability: how access to alcohol affects drinking and problems in youth and adults. *Alcohol research and health*. 2011; 34(2):248–256. [PubMed: 22330225]
- Hamilton WL, Biener L, Brennan RT. Do local tobacco regulations influence perceived smoking norms? Evidence from adult and youth surveys in Massachusetts. *Health Education Research*. 2008; 23(4):709–722. [PubMed: 17947246]
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. *Monitoring the Future national survey results on drug use, 1975–2012: Volume I, Secondary school students*. Ann Arbor: Institute for Social Research, The University of Michigan; 2013.
- Kelly AB, O'Flaherty M, Connor JP, Homel R, Toumbourou JW, Patton GC, et al. The influence of parents, siblings and peers on pre- and early-teen smoking: a multilevel model. *Drug and Alcohol Review*. 2011; 30(4):381–387. [PubMed: 21355905]
- Leatherdale ST, McDonald PW, Cameron R, Jolin MA, Brown KS. A multi-level analysis examining how smoking friends, parents, and older students in the school environment are risk factors for susceptibility to smoking among non-smoking elementary school youth. *Prevention Science*. 2006; 7(4):397–402. [PubMed: 16823633]
- Leatherdale ST, Brown KS, Cameron R, McDonald PW. Social modeling in the school environment, student characteristics, and smoking susceptibility: A multi-level analysis. *Journal of Adolescent Health*. 2005; 37(4):330–336. [PubMed: 16182144]
- Leatherdale ST, Cameron R, Brown KS, McDonald PW. Senior student smoking at school, student characteristics, and smoking onset among junior students: a multilevel analysis. *Preventive Medicine*. 2005; 40(6):853–859. [PubMed: 15850887]
- Lipperman-Kreda S, Grube JW, Friend KB. Local Tobacco Policy and Tobacco Outlet Density: Associations With Youth Smoking. *Journal of Adolescent Health*. 2012; 50(6):547–552. [PubMed: 22626479]

- Mathers M, Toumbourou JW, Catalano RF, Williams J, Patton GC. Consequences of youth tobacco use: a review of prospective behavioural studies. *Addiction*. 2006; 101(7):948–958. [PubMed: 16771887]
- McMillan B, Higgins AR, Conner M. Using an extended theory of planned behaviour to understand smoking amongst schoolchildren. *Addiction Research & Theory*. 2005; 13(3):293–306.
- Mercken L, Candel M, van Osch L, de Vries H. No smoke without fire: The impact of future friends on adolescent smoking behaviour. *British Journal of Health Psychology*. 2011; 16(1):170–188. [PubMed: 21226790]
- Murnaghan DA, Leatherdale ST, Sihvonen M, Kekki P. A multilevel analysis examining the association between school-based smoking policies, prevention programs and youth smoking behavior: evaluating a provincial tobacco control strategy. *Health Education Research*. 2008; 23(6):1016–1028. [PubMed: 18559398]
- O’Loughlin J, Karp I, Koulis T, Paradis G, DiFranza J. Determinants of First Puff and Daily Cigarette Smoking in Adolescents. *American Journal of Epidemiology*. 2009; 170(5):585–597. [PubMed: 19635735]
- Olds RS, Thombs DL, Tomasek JR. Relations between normative beliefs and initiation intentions toward cigarette, alcohol and marijuana. *Journal of Adolescent Health*. 2005; 37(1):75. [PubMed: 15963910]
- Raudenbush, SW.; Bryk, AS.; Cheong, YF.; Congdon, R.; du Toit, M. HLM 7 for Windows. Chicago, IL: Scientific Software International, Inc; 2011.
- Simons-Morton BG, Farhat T. Recent findings on peer group influences on adolescent smoking. *Journal of Primary Prevention*. 2010; 31(4):191–208. [PubMed: 20614184]
- U.S. Department of Health and Human Services. Preventing Tobacco Use Among Youth and Young Adults: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2012.
- Villanti A, Boulay M, Juon HS. Peer, parent and media influences on adolescent smoking by developmental stage. *Addictive Behaviors*. 2011; 36(12):133–136. [PubMed: 20855170]
- Vitória PD, Salgueiro MF, Silva SA, de Vries H. Social influence, intention to smoke, and adolescent smoking behaviour longitudinal relations. *British Journal of Health Psychology*. 2011; 16(4):779–798. [PubMed: 21988064]
- Wiium N, Torsheim T, Wold B. Normative processes and adolescents’ smoking behaviour in Norway: A multilevel analysis. *Social Science & Medicine*. 2006; 62(7):1810–1818. [PubMed: 16165262]
- Wilson LM, Avila Tang E, Chander G, Hutton HE, Odelola OA, Elf JL, et al. Impact of tobacco control interventions on smoking initiation, cessation, and prevalence: a systematic review. *Journal of environmental and public health*. 2012; 2012:961724. [PubMed: 22719777]

Biographies

Johannes Thrul is a PhD student and junior researcher at the IFT Institut für Therapieforschung. He received his M.Sc. in Psychology in 2010 from Dresden University of Technology in Germany. His primary research interests focus on the prevention of substance abuse in adolescence.

Sharon Lipperman-Kreda is a Research Scientist at the Prevention Research Center of the Pacific Institute for Research and Evaluation. She received her PhD in Criminology in 2006 from Bar-Ilan University, Israel. Her interests include research on underage drinking and youth tobacco use, and the influences of policies, enforcement, and other environmental factors to reduce access, alcohol drinking, and tobacco use among adolescents.

Joel W. Grube is Director and Senior Research Scientist at the Prevention Research Center of the Pacific Institute for Research and Evaluation. He received his PhD in Psychology in

1979 from Washington State University. His research broadly focuses on social-psychological and environmental factors influencing alcohol, tobacco, other drug use, and other problem behaviors among adolescents and young adults.

Karen B. Friend is a Senior Scientist and Associate Center Director at the Decision Sciences Institute of the Pacific Institute for Research and Evaluation. She earned her PhD in Clinical Psychology in 1997 from the University of Maryland. Her research focuses on tobacco use, smoking cessation, and policy impact among smokers in the general population and among special groups, including youth, individuals with disabilities, and clients with use disorders.

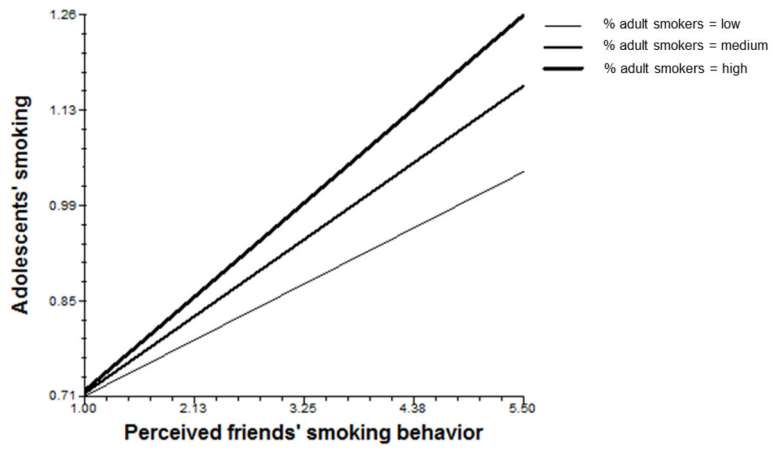


Figure 1. The relationships between perceived friends' smoking behavior and adolescents' past-12-month smoking by levels of % of adult daily smokers in the community (based on the estimates of Model 2)

Table 1

Sample characteristics

Variable	% or mean (SD)	Minimum-maximum
Individual level (<i>N</i> = 1190)		
Gender (%)		
Male	49.7	
Female	50.3	
Age	15.6 (1.07)	13–18
Race/ethnicity (%)		
White	68.1	
Hispanic/Latino	22.1	
Cigarette smoking behavior		
Any past 12-month cigarette smoking (%)	7.9	
Frequency of cigarette smoking, past 12 months	1.16 (.67)	1–7
Perceived friends' smoking approval and behavior		
Perceived friends' approval of smoking	1.34 (.53)	1–4
Perceived friends' smoking behavior	1.30 (.70)	1–5.5
City level (<i>N</i> = 50)		
Population density	4870.05 (3347.54)	1337.24–22330.14
Percentage population below 18 years old	23.7	17.0–30.0
Median household income	51027.22 (15093.11)	28628–83565
Percentage college graduates	12.8	2.7–35.2
Percentage unemployed	10.7	2.9–23.5
Percentage White	79.2	33.5–98.0
Percentage Hispanic	34.2	8.2–97.4
Percentage adult daily smokers	6.3	2.3–17.1

Note: SD, standard deviation

Table 2

Results of multilevel regression analyses to examine the associations among adult daily smoking prevalence, perceived friends' smoking approval, perceived friends' smoking behavior and adolescents' past-12-month smoking

	Community level (N = 50)		Model 1		Model 2	
	B	(S.E., d.f.)	t	B	(S.E., d.f.)	t
Community-Level Effects						
Intercept, γ_{00}	.444	.031, 41	14.4***	.565	.053, 41	10.6***
% adult daily smokers, γ_{01}	.006	.002, 41	3.4**	-.013	.007, 41	-1.9
Population density, γ_{02}	.002	.006, 41	0.3	.000	.006, 41	0.0
% population below 18, γ_{03}	-.000	.010, 41	-0.0	.002	.009, 41	0.2
Median household income, γ_{04}	-.006	.009, 41	-0.7	-.007	.009, 41	-0.8
% college graduates, γ_{05}	-.003	.008, 41	-0.3	-.005	.008, 41	-0.6
% unemployed, γ_{06}	-.026	.010, 41	-2.5*	-.026	.010, 41	-2.5*
% white, γ_{07}	-.000	.006, 41	-0.1	.000	.006, 41	0.0
% hispanic, γ_{08}	.002	.013, 41	0.1	-.000	.013, 41	-0.1
Individual-Level Effects						
Perceived friends' approval, β_1	.056	.016, 1134	3.5***	.044	.035, 1132	1.2
Perceived friends' behavior, β_2	.104	.020, 1134	5.2***	.030	.039, 1132	0.8
Gender, β_3	-.002	.007, 1134	-0.3	-.003	.007, 1132	-0.4
Age, β_4	.010	.005, 1134	2.1*	.010	.005, 1132	2.0*
White, β_5	.014	.009, 1134	1.5	.010	.009, 1132	1.2
Hispanic, β_6	.032	.019, 1134	1.7	.027	.018, 1132	1.5
Cross-Level Interactions						
Perceived friends' approval \times % adult daily smokers, γ_{11}	-	-	-	.002	.005, 1132	0.5
Perceived friends' behavior \times % adult daily smokers, γ_{21}	-	-	-	.012	.006, 1132	2.0*

Note:

* p < .05,

** p < .01,

p < .001; S.E., robust standard errors; d.f., degrees of freedom