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Sex Differences in Predictors of Adolescent Smoking Cessation

Phyllis L. Ellickson, Joan S. Tucker, and David J. Klein
RAND

Sex differences in predictors of smoking cessation were investigated among 337 male and 490 female participants in the RAND adolescent panel study. Participants reported smoking at least 11–20 times during the past year at Grade 10, with cessation defined as not smoking during the past year at Grade 12. Controlling for demographics, sex-specific analyses indicated that girls who quit smoking within 2 years had friends who smoked less frequently, perceived less parental approval of their smoking, had weaker intentions to continue smoking, used marijuana less frequently, attended fewer different schools, were more likely to have an intact nuclear family, experienced greater peer support, and rated themselves as healthier. Similar analyses for boys yielded results that were generally weaker and nonsignificant, with smoking quantity accounting for several associations in the sex-specific models. Despite these differences, interaction tests revealed significant sex differences for only three predictors. Implications of these results for understanding adolescent smoking cessation are discussed.

Key words: smoking cessation, sex differences, adolescent, longitudinal

National data indicate that the ranks of current smokers (defined as people who have smoked during the past 30 days) include 30% of 10th graders and 37% of 12th graders (Johnston, O'Malley, & Bachman, 1998). Most adolescent smokers believe that they can quit smoking on their own (Sussman et al., 1998) and tend to overestimate the percentage of smokers their own age who succeed in quitting (Stanton, Lowe, & Gillespie, 1996). Contrary to their optimistic projections, actual cessation rates among young smokers are low. For example, recent results from a national survey with a longitudinal follow-up indicated that only 16% of adolescent smokers had quit smoking 4 years later (Zhu, Sun, Billings, Choi, & Malarcher, 1999). Further, research on adolescents indicates that girls have more difficulty quitting than boys (Brownson, DiLorenzo, Van Tuinen, & Finger, 1990; Burt & Peterson, 1998). Various explanations for this sex difference have been offered (Grunberg, Winders, & Wewers, 1991), but the data supporting such explanations are limited. Compared with the many studies focusing on the smoking initiation process (Conrad, Flay, & Hill, 1992), relatively few studies have investigated predictors of smoking cessation among adolescents. Even fewer of these have focused on sex differences, despite evidence from several substance use prevention programs indicating that they are not equally effective for boys and girls (Botvin, Baker, Filazzola, & Botvin, 1990; DeJong, 1987; Graham, Johnson, Hansen, Flay, & Gee, 1990). Understanding the determinants of cessation, including whether there are sex differences in these determinants, is impor-

tant in terms of better informing tobacco prevention efforts that may need to be adapted to meet the special needs of male and female smokers.

Smoking cessation is likely influenced by a complex interaction of cultural, psychosocial, behavioral, and biological factors. Within the psychosocial and behavioral domains, which are the primary foci of our study, there may be sex differences in exposure and susceptibility to facilitative and inhibitory factors for cessation. We focus on five categories of variables that previous theory and research have indicated are important to understanding the psychosocial and behavioral contexts of cessation: pro-smoking social influences; smoking-related attitudes and intentions; rebelliousness and problem behaviors, including other types of substance use; bonds to school, peers, and family; and perceptions of physical and psychological well-being. We discuss each of these categories in the next sections, including the limited evidence addressing whether there are sex differences in their associations with smoking cessation.

Successful cessation should be more likely to the extent that the smoker is not exposed to pro-smoking social influences (social learning theory: Akers & Lee, 1996; Bandura, 1977). These influences may include exposure to family and peers who smoke, interacting with family and peers who approve of smoking, perceiving a high prevalence of smoking among peers, and receiving offers of cigarettes. Although research findings have not been entirely consistent, there is some evidence that peer and parental influences play a role in smoking cessation. Less smoking among peers has been found to predict cessation over periods ranging from 6 to 15 months (Burt & Peterson, 1998; Ershler, Leventhal, Fleming, & Glynn, 1989; Hansen, Collins, Johnson, & Graham, 1985), although other studies with relatively long follow-ups of 3–4 years have not found associations between peer smoking and cessation (Engels, Knibbe, de Vries, & Drop, 1998; Zhu et al., 1999). At least two studies finding associations between cessation and peer smoking did not find similar links with parental smoking (Ershler et al., 1989; Hansen et al., 1985), although parental

Phyllis L. Ellickson, Joan S. Tucker, and David J. Klein, RAND, Santa Monica, California.

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Correspondence concerning this article should be addressed to Phyllis L. Ellickson, RAND, 1700 Main Street, P.O. Box 2138, Santa Monica, California 90407-2138. Electronic mail may be sent to phyllis_ellickson@rand.org.

smoking was a predictor of relapse in one of these studies (Hansen et al., 1985). A third study of parental influences found that having a nonsmoking mother predicted cessation, but having a nonsmoking father did not (Zhu et al., 1999). In one of the few studies of adolescents addressing sex differences, Skinner, Massey, Krohn, and Lauer (1985) reported that friend smoking was a significant predictor of quitting for girls only, although data were not presented. A limitation of this study is that conclusions were based on an analysis that stratified by sex, rather than one that explicitly tested for sex differences. Nonetheless, this finding is consistent with research on smoking initiation suggesting that adolescent girls are more vulnerable to social influences than adolescent boys (e.g., Chassin, Presson, Sherman, Corty, & Olshavsky, 1984).

Smoking-related attitudes should also be relevant to the cessation process, with quitting more likely among adolescents who hold less positive and more negative attitudes toward smoking, feel efficacious in resisting smoking, and intend to not smoke in the future (theory of reasoned action; Ajzen, 1988). Although research has not consistently found that negative beliefs about smoking predict cessation (Hansen et al., 1985; Zhu et al., 1999), several studies have indicated that smoking beliefs are important predictors of quitting. Skinner et al. (1985) found that those who quit were more inclined than continuing smokers to believe that alcohol and tobacco use are wrong. Similarly, negative attitudes toward smoking and strong resistance self-efficacy differentiated between adolescents who were not motivated to quit and those who had quit at a 3-year follow-up (Engels et al., 1998). In addition, definite intentions to quit in the future has emerged as a significant predictor of cessation in at least two studies (Sargent, Mott, & Stevens, 1998; Zhu et al., 1999). Possible sex differences in the role of smoking-related attitudes on cessation remain largely unexplored.

According to problem behavior theory (Jessor & Jessor, 1977), many problem behaviors in adolescence have similar etiologies (e.g., rebelliousness) and serve common purposes. Smoking often co-occurs with academic problems (Escobedo, Anda, Smith, Remington, & Mast, 1990; Pirie, Murray, & Luepker, 1988), impaired psychosocial functioning (Stein, Newcomb, & Bentler, 1996), and other types of substance use and delinquency (Escobedo, Reddy, & DuRant, 1997). Further, adolescents sometimes smoke as a way of coping with their problems (Wills, 1986). Thus, adolescents who are rebellious, engage in problem behaviors, or use other substances may find it particularly difficult to quit smoking. Given the considerable research comparing adolescent smokers and non-smokers on rebelliousness and a wide range of problem behaviors, there is surprisingly little research on whether these factors are deterrents to smoking cessation. In one study of rebelliousness, Hansen et al. (1985) found that rebellious adolescents were not less likely to quit smoking, but they were more likely to relapse after quitting. We know of no studies investigating whether engagement in problem behaviors, such as delinquency and other types of substance use, decreases the likelihood of quitting. Nor is it clear whether early pregnancy for adolescent girls is associated with cessation, although this is one case where deviancy may actually facilitate quitting because of concerns over the health effects of smoking on the fetus or child. In light of the consistent associations that have been found between problem behaviors and smoking initiation and the limited attention given to problem behaviors as predictors of cessation, this is an important direction for future

research. Relevant research on sex differences has shown that during both early and late adolescence, male smokers are more likely than female smokers to experience a wide range of problem behaviors including academic difficulties, other types of substance use, and deviancy (Ellickson, Tucker, & Klein, *in press*). However, further research is needed to determine whether rebelliousness and engagement in these problem behaviors pose a more significant barrier to successful cessation for male or female smokers.

Social bonding theory proposes that the restraining effects of conventional institutional bonds discourage adolescents from engaging in deviant behavior (Burkett & Jensen, 1975; Hirschi, 1969). For example, research has indicated that having weak social bonds in adolescence predicts increased smoking (Krohn, Massey, Skinner, & Lauer, 1983). However, it is less clear whether social bonds facilitate cessation of deviant behavior. In terms of academic bonds, at least one study has found that below-average students are less likely to become former smokers (Hu, Lin, & Keeler, 1998), whereas other studies have not found a clear association of cessation with school performance (Burt & Peterson, 1998; Skinner et al., 1985; Zhu et al., 1999), educational aspirations, or commitment to school activities (Skinner et al., 1985). Research on family bonds indicates that adolescent smokers experience less parental supervision (girls only) and weaker paternal attachments than those who quit, but not necessarily weaker maternal or peer attachments (Skinner et al., 1985). Together, these studies point to the potential importance of social bonds on the smoking cessation process and provide some evidence that these influences may be stronger for female smokers.

Finally, perceived physical and mental health status as predictors of smoking cessation have rarely been studied among adolescents. Most adolescent smokers have not yet developed serious physical health problems due to smoking, although they may be experiencing physical consequences of smoking such as loss of stamina or withdrawal symptoms (Stanton et al., 1996). Adolescent smokers who perceive their health to be relatively poor may be more likely to quit because of their awareness of the negative health consequences of smoking. Although Rose, Chassin, Presson, and Sherman (1996) found that trying to quit smoking for health reasons did not predict successful cessation in young adults, little is known about whether general perceptions of poor health contribute to successful cessation among adolescents. Mental health status may also be an important predictor of cessation for adolescents. A number of studies have linked emotional distress with smoking in adolescents (Covey & Tam, 1990; Escobedo, Reddy, & Giovino, 1998; Patton et al., 1996), perhaps due to the antidepressant effects of nicotine and smoking (Lerman et al., 1996). Indeed, a recent study using the RAND adolescent panel found that emotional distress in Grade 10 was associated with increased smoking in Grade 12 (Orlando, Jinnett, & Ellickson, 2000). If smoking is used to self-medicate for emotional distress, then adolescents with better mental health should be more successful in quitting. At least one study has found that less depressed adolescents were more likely to quit smoking (Zhu et al., 1999). Although there is no evidence suggesting that the predictive utility of physical health should differ by sex, there is some suggestion in the literature that emotional distress may be a more significant impediment to successful cessation for women (Borrelli, Pinto, Bock, Marcus, & King, 1996).

The goal of this study was to investigate predictors of smoking cessation from 10th to 12th grade, with particular emphasis on testing sex differences. This study significantly extends previous research on adolescent predictors of cessation in several respects. It investigates a wide range of psychosocial and behavioral variables that previous theory and research indicate may be relevant to the cessation process: pro-smoking social influences; smoking-related attitudes; rebelliousness and problem behaviors, including other types of substance use; bonds to school, peers, and family; and perceptions of physical and psychological well-being. It explicitly tests for sex differences in the predictors of cessation. It defines cessation as having not smoked within the past year, a more stringent definition than is used in many studies and one that increases the likelihood that any significant effects will be relevant to understanding the factors contributing to successful and long-term cessation. Finally, given that nicotine dependence is an important obstacle to quitting (Engels et al., 1998; Sargent et al., 1998), this study tests the robustness of psychosocial and behavioral predictors of cessation when taking into account how long participants have smoked and their average daily cigarette consumption.

Method

Participants

Participants in the original full sample were 6,527 students recruited from 30 California and Oregon schools at Grade 7 (1985), with follow-up assessments conducted in Grades 10 and 12. These adolescents participated in the RAND adolescent panel study, conducted to evaluate the effectiveness of the Project ALERT drug use prevention program for middle school children (Ellickson & Bell, 1990). The schools were chosen to represent a wide range of community type (urban, suburban, and rural), socioeconomic status (18 schools drew from neighborhoods with household incomes below the median for their state), and racial and ethnic composition (nine schools had minority populations of 50% or more). Because there were no lasting effects of the Grade 7 smoking prevention program at Grades 10 or 12, there was no need to include treatment effects in the analyses.

Extensive tracking methods allowed us to retain 85% of the original baseline sample by the Grade 10 follow-up ($N = 5,523$). However, participants who could not be located or dropped out of the study were more likely to have exhibited early behavioral problems compared to those who were retained. We weighted the sample to further reduce bias associated with sample attrition, using logistic regression to create predicted probabilities of responding to both the 10th- and 12th-grade surveys that were derived from 7th-grade information about each 7th-grade respondent (including race, sex, family structure, deviance, substance use, and grades). Similar weights developed to deal with attrition by 12th grade were found to remove 90% or more of the bias exhibited in the unweighted sample (Ellickson, Saner, & McGuigan, 1997).

For this study, participants were initially restricted to those who reported smoking at least 11–20 times during the past year at Grade 10 ($N = 1,230$). Of those, 403 were then dropped because they did not complete the 12th-grade survey ($n = 378$), were missing smoking information at Grade 12 ($n = 24$), or were missing data on ethnicity ($n = 1$). These exclusions resulted in a final sample size of 827. Twenty-nine percent of the weighted final sample is self-classified as a minority (African American: 4.0%; Hispanic: 13.8%; Asian: 4.2%; Other: 7.3%), 51.6% are girls, and 28% had dropped out of school by the Grade 12 assessment.

Measures

Smoking and cessation statuses. We initially restricted the sample to adolescents who reported smoking a minimum of 11–20 times during the

past year. The majority of the sample were regular smokers: during the past month, 15% reported smoking 3–5 days, 17% reported smoking 6–19 days, and 53% reported smoking 20 or more days. Smoking cessation at Grade 12 was defined as having not smoked at all during the past year and was assessed through self-report.

Demographics. Demographic information includes age at baseline and race/ethnicity (dummy coded as Caucasian versus African American, Hispanic, Asian, and Other). We used the educational attainment of the participants' parent or parents to indicate family socioeconomic status (1 = some high school, 2 = high school graduate, 3 = post-high school vocational or trade school, 4 = some college, 5 = college graduate, 6 = some graduate school).

Social environment. Six aspects of the adolescents' smoking-related social environment were assessed: smoking by important adults and peers, approval of the participants' smoking by parents and peers, perceived prevalence of peer smoking, and cigarette offers. Specifically, participants indicated how often the adult man or woman who is most important to them smoked; we recoded this information to indicate whether either of these individuals smoked (0 = no, 1 = yes). Peer smoking was assessed with two items: how often they are with kids who are smoking and how often their best friend smokes (ranging from 1 = never to 4 = often; $\alpha = .75$). Participants rated how their parents and friends would feel if they found out that they smoked (parent rating ranged from 1 = very upset to 4 = not at all upset or wouldn't care; friend rating ranged from 1 = they would disapprove and stop being my friends to 4 = they would approve). Participants also estimated the percentage of 10th-grade students in their school who smoked at least one cigarette in the last month as well as how many times they had been offered cigarettes during the past year (ranging from 0 = never to 4 = 10 or more times).

Smoking beliefs. We assessed four types of smoking-related beliefs: intentions to smoke in the future, beliefs about the consequences of smoking, beliefs about the harmful effects of smoking, and participants' ability to resist smoking in various situations. Specifically, participants rated whether they would smoke a cigarette in the next six months (ranging from 1 = definitely no to 4 = definitely yes). Beliefs about the positive consequences of smoking were assessed with a seven-item scale (ranging from 1 = strongly agree to 4 = strongly disagree): "Smoking cigarettes . . . relaxes you; makes you do poorly in sports; makes you feel more at ease with others; gets you into trouble at school; can harm other people, not just the smoker; makes other people not want to be around you; makes you feel less bored." We reverse coded these items as necessary, such that higher scores indicated more positive beliefs about smoking ($\alpha = .77$). Participants also rated the extent to which people their age might harm themselves if they smoked cigarettes occasionally (on a scale from 1 = a lot to 4 = not at all). Finally, we used a four-item scale to measure smoking resistance self-efficacy. Participants were asked what they would do if they were offered a cigarette on a date and did not want it (1 = I would tell my date 'No' and not smoke it; 2 = I would say 'Not now, maybe some other time'; 3 = I would take the cigarette and smoke it). They were also asked how strongly they agreed or disagreed with the following statement: "If all my friends were smoking cigarettes at a party, I would probably smoke too" (on a scale ranging from 1 = strongly agree to 4 = strongly disagree). The other two items asked how sure they were that they could resist smoking if offered a cigarette if their best friend was smoking and if they were bored (on a scale ranging from 1 = very sure I could to 5 = not at all sure I could). We reverse coded these items as necessary such that higher scores indicated lower resistance self-efficacy; we then standardized and averaged them to form the scale ($\alpha = .73$).

Rebelliousness and problem behaviors. We used a four-item scale to assess rebelliousness: (ranging from 1 = strongly agree to 4 = strongly disagree). "Sometimes I enjoy doing things I shouldn't do just for the fun of it; I feel guilty when I break a rule; When I'm told to do something by a teacher, I do it; I get away with as much as I can." We reverse coded the items as necessary such that higher scores indicated more rebelliousness

($\alpha = .64$). Problem behaviors included other types of substance use (alcohol and marijuana), delinquent behavior, and early pregnancy for girls. Frequency of alcohol use and marijuana use were coded on separate 11-point scales (ranging from 0 = *never used* to 11 = *used 20 or more days in past month*). To assess engagement in delinquent behavior, we asked participants how often they had done each of the following eight things over the past year: skipped school; broken into property; stolen from a store; been sent out of the classroom; gotten into trouble with police; damaged others' property on purpose; stolen something worth more than \$20; run away from home (0 = *not at all* to 3 = *more than three times*; $\alpha = .64$). Finally, at the Grade 12 assessment, female participants indicated whether and when they had been pregnant. From this information, we determined whether they had been pregnant by Grade 10.

School and social bonds. School bonds were assessed in terms of academic success and stability. Participants reported on their grades (ranging from 1 = *mostly As* to 5 = *mostly Fs*) and the number of different schools that they had attended by Grade 10. We assessed social bonds in three ways. First, participants indicated whether they had an intact nuclear family (were living with both biological parents; 0 = *yes*, 1 = *no*). Not having an intact nuclear family provided evidence that family bonds with one or both biological parents were weakened by diminished contact. Second, parental support was assessed by three items: "My parents . . . listen to my opinions even when they disagree with me; respect my feelings; don't trust my judgment" (on a scale ranging from 1 = *strongly agree* to 4 = *strongly disagree*). We reverse coded items as necessary such that higher scores indicated weaker parental support ($\alpha = .73$). Third, peer support was assessed by a five-item scale (ranging from 1 = *strongly agree* to 4 = *strongly disagree*): "I trust my friends; My friends don't respect my feelings; I often feel my friends leave me out of things they are doing; I tell my friends about my problems and troubles; If my friends know something is bothering me, they ask me about it." We reverse coded items as necessary such that higher scores indicated weaker peer support ($\alpha = .63$).

Health status. Health status included both physical and mental well-being. Physical health was assessed by two items ($\alpha = .33$). Respondents were asked to rate their overall health (ranging from 1 = *excellent* to 5 = *poor*), as well as to indicate the number of days during the past 3 months they had stayed in bed all or most of the day because of illness (ranging from 1 = *none* to 5 = *5 or more days*). Mental health was assessed by five items asking how much of the time, during the past month, that they had: been a very nervous person; been a happy person; felt calm and peaceful; felt downhearted and blue; felt so down in the dumps that nothing could cheer them up (on a scale ranging from 1 = *all of the time* to 6 = *none of the time*). We reverse coded items as necessary such that higher scores indicated poorer mental health ($\alpha = .50$).

Statistical Methods

Although the students who participated in the study at Grade 10 generally completed the entire survey, there is a small amount of missing data for most variables (0–6%). For multivariate analyses that require complete information for all included variables, this amount of missing data can result in a significant reduction in sample size (as much as 8% for the models shown in Table 2). To avoid the drop in sample size that would otherwise occur, we used missing value imputation on all variables, except for the Grade 10 smoking and the Grade 12 cessation variables. This procedure involves using regression analysis to generate a predicted value (the criterion) from other variables that are derived from the same data source and are strongly empirically correlated with the criterion value. The predicted value is then substituted for the missing value.

We accounted for the clustering of observations within schools and the use of sample weights by computing Huber standard errors (Huber, 1967; Stata Statistical Software: Release 6.0, 1999). Huberized regression techniques were used to determine the independent associations of the Grade 10 predictor variables on Grade 12 smoking cessation.

Results

At grade 10, 337 boys and 490 girls reported smoking 11 or more times in the past year. Two years later, 45 (13%) boys and 55 (11%) girls had stopped smoking (reported they had not smoked during the past year). Table 1 provides descriptive information on the Grade 10 variables that were used to predict Grade 12 smoking cessation. This table also provides results from *t* tests and chi-square tests of sex differences in these variables. Of particular note is the sex difference in ethnicity; comparisons of the 95% confidence intervals for these percentages indicated that there were significantly more female than male Caucasians, but more male than female Hispanics.

Logistic Regression Analyses by Sex

We performed separate logistic regression analyses to predict smoking cessation for boys and girls. These results are presented in Table 2. We tested six separate models, with the initial model including only demographic variables (age, ethnicity, and parental education). The remaining five models each included the demographic covariates and one of the conceptually related groups of Grade 10 psychosocial and behavioral predictors. In each of the separate models, all of the variables shown were entered simultaneously.

The model for demographic variables indicates that higher parental education was associated with greater likelihood of cessation for girls only. Participants' age and ethnicity were not associated with cessation for either sex.

The model for pro-smoking social environment indicates that both boys and girls were more likely to quit smoking if they perceived their parents to be less approving of their smoking. For girls, less smoking among friends was also associated with greater likelihood of cessation. Smoking among important adults, peer approval of smoking, prevalence of peer smoking, and cigarette offers were unrelated to cessation for both sexes. The model for smoking-related attitudes indicates that females who had weaker intentions to smoke in the future were more likely to quit, although this was not found for males. Believing that smoking has positive non-health consequences, believing that it is not harmful, and having low resistance self-efficacy were unrelated to cessation for both sexes.

The model for rebelliousness and problem behaviors found that girls who engaged in less frequent marijuana use were more likely to quit smoking, although this was not true for boys. Alcohol use, rebelliousness, and engagement in deviant behaviors were not associated with cessation for either sex, nor was early pregnancy for girls. Results from the model of school and social bonds indicate that female smokers who attended fewer different schools, had an intact nuclear family, and experienced more peer support were more likely to quit smoking, although this was not found for boys. Having better grades and receiving more parental support did not predict cessation for either sex. Finally, the model for health status indicates that girls, but not boys, who rated their health as better were more likely to quit. Mental health was not associated with cessation for either sex.

Controlling for Smoking Variables

We conducted subsequent analyses to determine whether the psychosocial predictors of smoking cessation for boys and girls

Table 1
 Descriptive Information and Tests for Sex Differences on Grade 10 Predictor Variables

Variable	Boys (n = 337)			Girls (n = 490)			t test
	M	SD	Range	M	SD	Range	
Age (years)	16.0	0.7	15-18	15.7	0.6	15-18	-5.6***
Parental education	3.0	1.5	1-6	2.8	1.4	1-6	-2.7*
Friends smoke	3.3	0.8	1-4	3.5	0.7	1-4	2.9**
Friend approval of smoking	3.1	0.7	1-4	3.0	0.7	2-4	-1.2
Parent approval of smoking	2.5	1.1	1-4	2.5	1.1	1-4	<1
Smoking prevalence (%)	65.3	22.8	3-100	64.2	23.0	0-100	<1
Cigarette offers	3.3	1.3	0-4	3.4	0.2	0-4	1.5
Intention to smoke in future	3.4	0.8	1-4	3.3	0.8	1-4	-1.1
Belief in positive consequences of smoking	2.5	0.5	1-4	2.5	0.5	1-4	<1
Low belief in harm of smoking	2.1	0.9	1-4	2.1	0.9	1-4	<1
Low resistance self-efficacy	0.7	0.8	-0.6-2.4	0.6	0.8	-0.7-3	-4.0***
Rebelliousness	2.7	0.7	1-4	2.5	0.6	1-4	-2.7*
Alcohol use	7.7	2.8	1-11	7.6	2.4	1-11	<1
Marijuana use	6.5	3.9	0-11	5.2	3.6	0-11	-3.9***
Delinquency	1.0	0.8	0-3	0.7	0.6	0-3	-5.2***
Poor grades	2.9	1.0	1-5	2.7	0.9	1-5	-3.2**
Number of schools	3.8	1.8	2-10	3.6	1.6	2-10	-1.1
Lack of parental support	2.3	0.8	1-4	2.3	0.9	1-4	<1
Lack of peer support	3.1	0.6	1-4	3.4	0.5	1-4	5.3***
Poor physical health	2.3	0.9	1-5	2.7	0.9	1-5	6.1***
Poor mental health	2.7	1.0	1-6	3.1	1.1	1-6	4.7***
Age at first use of cigarettes	9.9	2.6	4-17	10.4	2.5	3-16	2.2*
Number of cigarettes per day	4.6	5.5	0-17	4.5	5.0	0-17	<1
Dichotomous variables (%)							
Caucasian	65.9			75.2			
African American	3.9			4.1			
Hispanic	19.3			8.7			
Asian	4.5			3.8			
Other race	6.3			8.3			
Important adult smoker	74.3			75.6			
Early pregnancy				12.9			
No nuclear family	56.3			57.7			

Note. For the ethnicity variable, $\chi^2(4, N = 827) = 2.9, p < .05$. For both the important adult smoker and the no nuclear family variables, $\chi^2(1, N = 827) < 1$.

* $p < .05$. ** $p < .01$. *** $p < .001$.

remain significant after taking into account how long they have been smoking (age at first use) and smoking quantity (the average number of cigarettes smoked during the last 30 days). Initiating smoking at an older age (smoking for a shorter period of time) was associated with greater likelihood of cessation (girls: odds ratio (OR) = 1.14, $p = .059$; boys: OR = 1.20, $p = .01$), as was lighter smoking (girls: OR = 0.77, $p = .004$; boys: OR = 0.87, $p = .05$), after controlling for the demographic variables. Bivariate correlations of these two smoking variables with the other Grade 10 predictor variables are shown in Table 3.

The predictors of cessation changed somewhat when taking age at first use and smoking quantity into account. Parental approval of smoking no longer predicted cessation for males (OR = 0.82, *ns*), although greater delinquency (OR = 1.76, $p = .04$) emerged as a significant predictor of quitting after controlling for initial smoking characteristics. For girls, friend smoking (OR = 0.55, $p = .05$), number of different schools (OR = 0.80, $p = .04$), lack of peer support (OR = 0.56, $p = .03$), and poor physical health

(OR = 0.70, $p = .05$) remained significantly associated with cessation status after controlling for smoking quantity. However, parental education (OR = 1.07, *ns*), not having an intact nuclear family (OR = 0.75, *ns*), parental approval of smoking (OR = 0.91, *ns*), intention to smoke in the future (OR = 0.85, *ns*), and marijuana use (OR = 0.96, *ns*) were no longer associated with quitting. When controlling for initial smoking behavior, greater friend approval of smoking was marginally associated with greater likelihood of quitting for girls (OR = 1.70, $p = .06$). Subsequent analyses indicated that these changes were primarily due to the effects of controlling for smoking quantity, not age at first use.

Testing for Interactions With Sex

To determine whether the predictors of smoking significantly differed for girls and boys, fully crossed interaction models were tested whereby sex interaction terms for each of the predictor variables were added to the models. These analyses controlled for

Table 2
Logistic Regression Models Predicting Grade 12 Cessation From Grade 10 Variables

Grade 10 Variable	Boys (n = 337)				Girls (n = 490)			
	Model F	df	OR	95% CI	Model F	df	OR	95% CI
Demographics	<1	6, 24			1.14	6, 24		
Age (years)			0.84	0.51, 1.39			1.06	0.61, 1.83
African American			6.65	0.76, 58.47			1.85	0.36, 9.41
Hispanic			1.05	0.39, 2.81			1.91	0.90, 4.04
Asian			0.32	0.04, 2.36			0.82	0.20, 3.38
Other race			1.09	0.18, 6.48			0.77	0.21, 2.87
Parental education			1.05	0.84, 1.31			1.22*	1.01, 1.47
Social Environment	1.91	12, 18			3.19*	12, 18		
Age (years)			0.87	0.52, 1.46			1.10	0.67, 1.80
African American			4.71	0.51, 43.09			0.92	0.20, 4.25
Hispanic			0.88	0.29, 2.65			1.63	0.77, 3.45
Asian			0.25	0.03, 2.15			0.55	0.12, 2.43
Other race			1.04	0.15, 7.37			0.70	0.16, 3.01
Parental education			1.03	0.84, 1.28			1.06	0.84, 1.35
Friends smoke			0.63	0.37, 1.10			0.44**	0.24, 0.80
Important adult smokes			0.86	0.45, 1.64			0.57	0.30, 1.10
Friend approval			1.22	0.68, 2.18			1.69	0.91, 3.12
Parental approval			0.67*	0.46, 0.97			0.76†	0.57, 1.01
Smoking prevalence			1.01	0.99, 1.02			1.00	0.98, 1.01
Cigarette offers			1.11	0.83, 1.48			0.90	0.73, 1.11
Smoking Beliefs	1.53	10, 20			2.08†	10, 20		
Age (years)			0.80	0.47, 1.37			0.92	0.56, 1.51
African American			12.06*	1.01, 143.23			1.36	0.30, 6.22
Hispanic			1.04	0.37, 2.89			2.09	0.97, 4.53
Asian			0.31	0.03, 2.78			0.56	0.15, 2.01
Other race			1.08	0.15, 7.59			0.57	0.14, 2.30
Parental education			1.04	0.82, 1.32			1.20	0.99, 1.46
Intentions to smoke			0.98	0.63, 1.52			0.62*	0.43, 0.89
Positive consequences of smoking			0.59	0.28, 1.26			0.71	0.34, 1.49
Low belief in harm of smoking			0.82	0.50, 1.35			0.89	0.56, 1.41
Low resistance self-efficacy			0.76	0.47, 1.22			0.86	0.58, 1.27
Rebelliousness and Problem Behaviors	1.50	10, 20			3.98**	11, 19		
Age			0.81	0.50, 1.29			1.30	0.75, 2.26
African American			6.20	0.90, 42.90			1.99	0.47, 8.36
Hispanic			1.27	0.47, 3.44			2.12	0.90, 5.00
Asian			0.33	0.04, 2.52			0.62	0.15, 2.53
Other race			1.23	0.24, 6.32			0.85	0.23, 3.17
Parental education			1.06	0.85, 1.32			1.19	0.97, 1.44
Rebelliousness			0.88	0.44, 1.79			1.01	0.57, 1.79
Alcohol use			0.90	0.76, 1.07			1.09	0.90, 1.32
Marijuana use			0.96	0.87, 1.06			0.90*	0.82, 0.99
Delinquency			1.40	0.87, 2.28			0.60	0.33, 1.09
Early pregnancy							0.36	0.09, 1.43
School and Social Bonds	2.77*	11, 19			3.41**	11, 19		
Age			0.91	0.54, 1.54			1.09	0.61, 1.94
African American			6.36*	0.97, 41.70			1.46	0.29, 7.24
Hispanic			1.03	0.35, 3.00			2.37*	1.22, 4.63
Asian			0.33	0.04, 2.81			0.85	0.22, 3.30
Other race			1.16	0.18, 7.34			0.89	0.25, 3.14
Parental education			1.01	0.78, 1.32			1.14	0.94, 1.39
Poor grades			0.74	0.54, 1.02			0.96	0.68, 1.36
Number of schools			0.93	0.80, 1.09			0.81*	0.66, 0.99
No nuclear family			0.66	0.31, 1.42			0.57*	0.36, 0.90
Lack of parental support			0.89	0.62, 1.29			0.78	0.53, 1.15
Lack of peer support			1.36	0.68, 2.71			0.57*	0.35, 0.94
Health Status	1.70	8, 22			2.40*	8, 22		
Age			0.82	0.50, 1.33			1.06	0.62, 1.80
African-American			7.56*	1.12, 50.88			1.82	0.40, 8.22
Hispanic			1.13	0.46, 2.79			2.04	0.94, 4.43
Asian			0.30	0.04, 2.39			0.77	0.19, 3.16
Other race			1.21	0.21, 6.93			0.75	0.22, 2.63
Parental education			1.03	0.82, 1.29			1.20	0.98, 1.48
Poor physical health			0.67	0.41, 1.08			0.64*	0.45, 0.91
Poor mental health			0.90	0.63, 1.29			1.16	0.91, 1.47

Note. OR = odds ratio, CI = confidence interval.
 † $p = .06$. * $p \leq .05$. ** $p < .01$.

Table 3
*Bivariate Correlations of Grade 10 Smoking Variables With
 Grade 10 Predictor Variables*

Predictor	Age at first use		Smoking quantity	
	Boys	Girls	Boys	Girls
Friends smoke	-.10	-.09*	.35**	.39**
Important adult smokes	-.12*	-.20**	.05	.25**
Friend approval of smoking	-.04	-.04	.29**	.29**
Parental approval of smoking	-.08	-.22**	.52**	.46**
Smoking prevalence	-.05	-.02	.25**	.17**
Cigarette offers	-.11*	-.08	.13*	.18**
Intentions to smoke in the future	-.17**	-.09	.32**	.43**
Positive consequences of smoking	-.06	-.03	.32**	.15**
Low belief in harm of smoking	-.01	.01	.13	.17**
Low resistance self-efficacy	-.01	.00	.16*	.15**
Rebelliousness	.00	-.01	.10	.14*
Alcohol use	-.09	.04	.15**	.18**
Marijuana use	-.23**	-.16**	.28**	.36**
Delinquency	-.04	-.14*	.28**	.31**
Early pregnancy		-.17**		.20**
Poor grades	-.06	-.05	.01	.25**
Number of schools	-.17*	-.15**	.18	.07
No nuclear family	-.06	-.18**	.13*	.22**
Lack of parental support	-.09	-.06	.19**	.04
Lack of peer support	-.08	.07	-.11	.02
Poor physical health	-.07	-.07	.08	.16**
Poor mental health	-.07	.00	.13*	.02

* $p \leq .05$. ** $p < .01$.

age at first use and smoking quantity. Sex differences were found for only three variables: delinquency ($OR = 0.43$, $p = .04$), poor grades ($OR = 1.64$, $p = .02$), and peer support ($OR = 0.40$, $p = .03$). In each case, associations of these predictor variables with cessation are in opposite directions for boys and girls. When controlling for the smoking variables, a greater likelihood of quitting is associated with less delinquency, poorer grades, and higher peer support for girls, whereas it is associated with more delinquency, better grades, and lower peer support for boys. Although some of these effects run counter to expectations, it should be noted that the associations with grades for girls and peer support for boys are not statistically significant in the sex-specific analyses.

Discussion

The aim of this study was to investigate a wide range of psychosocial and behavioral variables that previous theory and research have indicated may be relevant to adolescent smoking cessation. We were particularly interested in examining sex differences in these predictors to evaluate whether they might help explain sex differences that have been found in the ability of adolescents to quit smoking (Brownson et al., 1990; Burt & Peterson, 1998) and the effectiveness of certain cessation programs (Botvin et al., 1990; DeJong, 1987; Graham et al., 1990). Results for boys and girls were mostly in the same direction and of similar magnitude. When sex interaction effects were explicitly tested, only three significant differences were found. The stronger pattern of results found for girls in the stratified analyses may have been due to somewhat weaker effects for boys and less statistical power

to detect them. Previous research has shown that male and female adolescent smokers identify similar reasons for why they would quit smoking (Sussman et al., 1998). Further, at least one study of young adults that explicitly tested for sex differences in the predictors of cessation found few differences (Rose et al., 1996). Although this research points to a lack of sex differences in predictors of quitting, it would be premature to draw firm conclusions from these few studies. There are important aspects of social environment, smoking beliefs, problem behaviors, academic and social bonds, and well-being that have not been included in each study. Other types of influences on adolescent smoking, such as biological and cultural factors, have also received little empirical attention in terms of possible sex differences. Given the relatively limited amount of research on predictors of adolescent smoking cessation, particularly with reference to sex differences, this is an important area of research that deserves further attention.

Results from this study point to the key role of the smoking-related environment in the cessation process, suggesting that important adults and friends influence the smoking behavior of adolescents through somewhat different mechanisms. We simultaneously considered several aspects of the environment: approval of the adolescent's smoking by parents and friends, the actual smoking behavior of important adults and friends, perceived prevalence of smoking within the adolescent's grade cohort, and the frequency with which the adolescent was offered cigarettes. It was particularly important to tease apart the relative influence of others' attitudes toward smoking versus their own smoking behavior on the likelihood of cessation.

Previous research has found that adolescents are less apt to initiate smoking if their parents engage in antismoking socialization practices, an effect that was independent of the parents' own smoking behavior (Chassin, Presson, Todd, Rose, & Sherman, 1998; Jackson & Henriksen, 1997). Extending these findings, our results indicate that adolescent boys and girls are also more likely to quit smoking if their parents disapprove of their smoking, but not necessarily if the parents are nonsmokers. Adolescents who perceived more parental disapproval of their smoking also tended to be lighter smokers, which likely made it easier for them to quit. Although information was not available on the antismoking efforts of these disapproving parents, the lighter smoking of their children may have been due to the parents' active efforts to restrain their children's smoking behavior.

In contrast, our results indicate that less smoking among friends, but not the friends' attitudes toward smoking, predicted greater likelihood of cessation for females. This effect could not be explained by how long the adolescents had smoked or how heavily they smoked. Adolescent friends who disapprove of smoking are probably less likely than parents to voice their disapproval or actively restrain the smoker's behavior. However, although their attitudes may not have a significant impact on the smoker's likelihood of quitting, their own smoking behavior appears to be an important influence. Less smoking by friends should facilitate quitting both by providing fewer models of smoking and by limiting easy access to cigarettes. Perceived prevalence of peer smoking and receiving cigarette offers were not associated with cessation when taking these other adult and peer influences into account.

Previous research has shown that adolescents who have definite intentions to quit smoking are more likely to eventually quit

(Sargent et al., 1998; Zhu et al., 1999). In this study, information was available on intentions to smoke in the future, rather than intentions to quit. It cannot be assumed that these are simply two ends of the same spectrum, and it is likely that a measure of intentions to quit would have been more strongly associated with cessation. Nonetheless, weaker intentions to smoke in the future predicted cessation for girls, but general negative attitudes toward smoking and perceptions of one's ability to resist smoking did not. This pattern of results is consistent with previous research finding associations of cessation with behavioral intentions (Sargent et al., 1998; Zhu et al., 1999), but not necessarily with general attitudes toward smoking (Hansen et al., 1985; Zhu et al., 1999). It is also consistent with the social psychological literature on attitude-behavior consistency, indicating that engagement in specific behaviors is more strongly predicted by specific attitudes toward the behavior than more general attitudes (Krause, 1995). From an intervention perspective, it is important to identify the factors influencing behavioral intentions, which can then be targeted through prevention efforts. Health belief models that give a central role to behavioral intentions, such as the theory of planned behavior (Ajzen, 1988), would suggest that intentions to quit smoking are influenced by such factors as anticipating that quitting will have positive consequences and believing that significant others support one's effort to quit. Although participants in our study were not asked about the anticipated positive consequences of quitting, our finding that quitting was associated with greater parental disapproval of smoking is consistent with this perspective. It is also important to point out that the association between intentions to smoke and cessation could be largely explained by smoking quantity, with less committed smokers having weaker intentions to smoke in the future.

Problem behaviors such as substance use and delinquency have received much empirical attention as potential contributors to smoking initiation among adolescents (e.g., Escobedo et al., 1997) but very little attention as potential deterrents to quitting. Results from this study provide evidence that engagement in other types of substance use can be an impediment to the cessation process for female smokers. Specifically, adolescent girls were less likely to quit smoking if they engaged in greater marijuana use, with the lower cessation among these adolescents being partially explained by their heavier smoking. One explanation for these results is that engagement in other substance use serves to reinforce and sustain smoking behavior, resulting in heavier smoking and lesser likelihood of quitting. Given that alcohol use did not predict quitting, the mode of consumption (smoking vs. drinking) may be important to consider in understanding the influence of other substance use on smoking cessation. It is also possible that the type of adolescents who engage in other substance use have fewer resources available to them, making it even more challenging for these heavier smokers to quit. Consistent with at least one previous study (Hansen et al., 1985), general rebelliousness was not a significant deterrent to cessation. The infrequent occurrence of pregnancy and engagement in delinquent behaviors in this sample may have contributed to the lack of significant associations of these variables with cessation.

Female smokers were also more likely to quit if they had stronger bonds with school, family, and friends. These associations could be due to a number of factors. As proposed by social bonding theory (Hirschi, 1969), the restraining effects of conven-

tional institutional bonds may not only discourage adolescents from initiating certain problem behaviors such as smoking, but may facilitate cessation of these behaviors once they have begun. These social bonding variables may also reflect the degree of stability in the adolescents' lives. Instability associated with attending multiple schools and the dissolution of relationships with friends and family may be a deterrent to quitting for adolescents if they use smoking as a coping mechanism. In addition to providing a stable environment, strong social bonds may also provide female smokers with emotional support and encouragement. Research has demonstrated the important role of social support in the smoking cessation process (Fisher, 1997). Although adolescents from nuclear families were less committed smokers, a factor that could partially explain their greater likelihood of cessation, smoking variables could not account for the associations of school and peer bonds with quitting.

Finally, associations of physical and mental health with cessation ran counter to predictions. Girls who quit smoking tended to rate their physical health as better compared to those who remained smokers. Although a similar effect size was found in the smaller subsample of boys, it was not statistically significant. Given that most adolescents have not yet developed significant health problems, it is probably not the case that actual health status played a causal role in cessation (in which case it would be expected that less healthy smokers would be more likely to quit). It is plausible that a third variable is responsible for this association; for example, relatively health-conscious smokers may tend to perceive their health more favorably and be more likely to stop smoking. Consistent with this idea, previous research has shown that adolescents who report engaging in other activities to improve their health are more likely to try to quit smoking (Fisher, Stanton, & Lowe, 1999). Despite a previous study finding that greater depression among adolescent smokers was associated with less likelihood of quitting (Zhu et al., 1999), we did not find a similar association in this study. This is particularly surprising in light of recent results from this cohort showing that emotional distress at Grade 10 was prospectively associated with increased smoking in Grade 12 (Orlando et al., 2000).

This study is limited in several respects. Participants were recruited from schools that were chosen to represent a broad spectrum of communities, socioeconomic status, and racial and ethnic composition. Nonetheless, results of this study are based on a single sample of Oregon and California adolescents, and the extent to which they would generalize to adolescents in other parts of the country are unknown. Further, attrition occurred in the cohort over the 5-year follow-up period, although the use of sample weights effectively reduced attrition-related bias in the remaining sample. Another limitation of the study is that information on smoking and cessation came exclusively from self-reports. However, external validation of self-reported smoking in Grades 7 and 8 found these reports to be highly accurate (Reinisch, Bell, & Ellickson, 1991), and there is little reason to suspect that participants would become more motivated to distort their reports of smoking behavior over time. Finally, the relatively small number of adolescents who quit smoking over the 2-year period made it more difficult to detect associations with cessation, particularly for boys. Strengths of this study include its prospective design, the stringent definition of cessation that was used, the wide range of variables that were investigated, and the use of key demographic

and smoking variables to determine the extent to which psychosocial and behavioral variables predicted cessation.

This study highlights a number of psychosocial and behavioral factors that are relevant to the smoking cessation process for adolescents, although it provides limited evidence that these factors substantially differ for boys and girls. To identify and target adolescent smokers who are unlikely to quit on their own, it is necessary both to pinpoint the factors that are associated with successful cessation and to understand how they operate to influence smoking behavior. Our study is an initial step in this effort. Results from this study also have implications for smoking cessation programs, in that programs aimed at adolescents need to take a multidimensional approach. Parental attitudes toward smoking, peer smoking, school and social bonds, and other substance use are some of the relevant psychosocial and behavioral factors that should be considered.

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Health Psychology is inviting competitive submissions for a special section devoted to research on physical health (or disease) and cognition. Numerous health-related factors have been shown to influence cognitive performance, thereby potentially affecting quality of life and daily functioning. Examples include lifestyle (e.g., smoking, physical activity), endocrine (e.g., cortisol, thyroid), and genetic (e.g., apolipoprotein E [APOE] factors; systemic diseases (e.g., cardiovascular, pulmonary, renal, hepatic); neurotoxic exposures (e.g., solvent, lead); and medical, surgical, and lifestyle interventions (e.g., medication use, coronary artery bypass surgery, exercise).

Papers that include direct assessment (rather than self-report) of relevant health-related variables are strongly preferred. Research with the following objectives would be appropriate: (a) understanding what domains of cognition are most affected by various dimensions of health and disease; (b) determining relevant moderator variables (e.g., age, education, race/ethnicity, genetic polymorphisms) to identify whether certain subgroups of individuals are vulnerable; (c) characterizing the biological and psychological mechanisms underlying health-cognition relations; (d) determining whether medical, surgical, or lifestyle treatments improve (or further compromise) cognitive performance; and (e) identifying whether changes in cognition associated with health status affect individuals' quality of life, daily functioning, or medical adherence.

Other topics may be relevant. Authors with questions regarding the appropriateness of particular research may contact either of the editors of this special section, Shari R. Waldstein (waldstei@umbc.edu) or Merrill F. Elias (mfelias@aol.com). Papers should be submitted with a cover letter identifying the submission as a response to the call for papers on health and cognition. Submit two manuscript copies and one electronic version, conforming to usual *Health Psychology* submission requirements (consult Instructions to Authors in *Health Psychology*) by September 1, 2001, to Arthur A. Stone, Ph.D., State University of New York at Stony Brook, Department of Psychiatry, South Campus, Putnam Hall, Stony Brook, New York 11794-8790.