

Recent Findings on Peer Group Influences on Adolescent Smoking

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Abstract This review addresses peer group influences on adolescent smoking with a particular focus on recently published longitudinal studies that have investigated the topic. Specifically, we examine the theoretical explanations for how social influence works with respect to adolescent smoking; discuss the association between peer and adolescent smoking; consider socialization and selection processes with respect to smoking; investigate the relative influence of best friends, close friends, and crowd affiliations; and examine parenting behaviors that could buffer the effects of peer influence. Our review indicates the following with respect to adolescent smoking: (a) substantial peer group homogeneity of smoking behavior; (b) support for both socialization and selection effects, although evidence is somewhat stronger for selection; (c) an interactive influence of best friends, peer groups, and crowd affiliation; and (d) an indirect protective effect of positive parenting practices against the uptake of adolescent smoking. We conclude with implications for research and prevention programs.

Keywords Adolescents · Smoking · Peer influence · Literature review

Introduction

Adolescent Smoking

The prevalence of smoking increases dramatically during adolescence (Johnston et al. 2007). Though not all experimental users increase their uptake over time (Abroms et al. 2005; Tucker et al. 2004), early initiation increases the likelihood of habituation, leading to a host of negative outcomes (Pierce and Gilpin 1995). Therefore, prevention of initiation and progression is an important national health objective (U.S. Department of Health and Human Services 2000). The development of effective prevention programs depends on a firm understanding of the factors associated with adolescent smoking. Social influences are among the most consistent and important factors associated with adolescent smoking (Kobus 2003).

Social influences are important with respect to a wide range of health behaviors, including medication taking (Berkman 2000), diet (Larson et al. 2007), sexual intercourse (Henry et al. 2007), and substance use (Kobus 2003). Adolescents may be particularly susceptible to social influences given their developmental stage and the importance of school and peer groups in adolescent life (Steinberg and Monahan 2007). Moreover, there may be uniquely social aspects

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of adolescent smoking and other substance use in that other adolescents provide access, opportunity, and reinforcement (Kirke 2004; O’Loughlin et al. 1998). Therefore, it should not be surprising that adolescent substance use and peer use are highly associated. Although the effects of peer groups on adolescent substance use have been widely documented, much remains to be learned, especially regarding the mechanisms of peer influence (Kobus 2003).

Purpose

The purpose of this paper is to review and summarize the literature on peer group influences on adolescent smoking, building on the several recent reviews of the topic (Hoffman et al. 2007; Kobus 2003; Tyas and Pederson 1998) and focusing on the recent publications on smoking. We conducted Internet searches with Web of Science and other search engines using key words such as “adolescent smoking,” “adolescent substance use,” “longitudinal studies,” “peer influence,” “socialization,” and “selection.” To be included in this review, studies had to have been published in 1999 or more recently, be longitudinal, include adolescent smoking as an outcome (either separately, or investigated within the context of adolescent substance use), and include measures of peer smoking at a minimum of two time points.

To provide a useful framework for the discussion of social influence in general and peer influence in particular on smoking, the paper is organized around the following key questions: What is social influence? What are the theoretical explanations for how social

influence works? To what extent does peer smoking predict adolescent smoking? Are adolescents influenced by their friends (socialization), or do adolescents select friends with similar interests (selection) with respect to smoking? Are best friends, close friends, or crowd affiliations more important? Do positive parenting behaviors buffer the effects of peer influence?

Conceptual and Theoretical Perspectives on Social Influences on Behavior

What Is Social Influence?

Social influence is the effect others have on individual and group attitudes and behavior (Berkman 2000). A conceptualization of multilevel social influences on adolescent smoking is presented in Fig. 1. The conceptualization suggests that social influences on adolescent smoking are exerted through social context, social networks, and group membership that operate mainly on social norms. Details of these constructs and of the relationships between them are presented in the following paragraphs.

Social norms are the patterns of acceptable beliefs, attitudes, and behaviors (Axelrod 1984; Kameda et al. 2005). Because human development occurs very slowly, individuals are socialized over time by family, school, and community and religious institutions according to the prevailing social norms. Social norms are influenced by but also influence social context, group membership, and social networks. The social influence processes that facilitate these

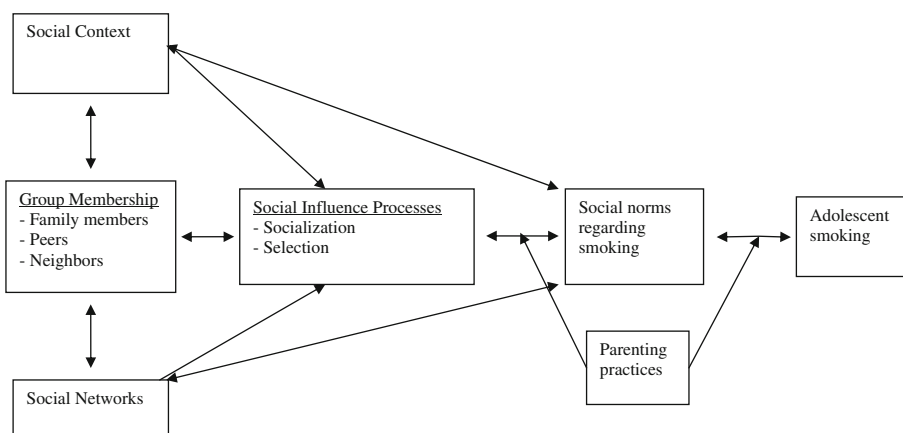


Fig. 1 Conceptual model for social influences on adolescent smoking

reciprocal relationships between social norms and social structures are socialization and selection. Briefly, socialization is the tendency for individuals' norms and behaviors to be influenced by the norms and behaviors of one's group and conforming to them. Selection, however, refers to the tendency of individuals to seek-out peers with similar norms and behaviors (Simons-Morton 2007).

Social context refers to the opportunities for interaction and the contexts within which individual interaction occurs (Webster et al. 2001). Social context determines the breadth, extent, and nature of interpersonal interaction and therefore shapes the interpretation of social norms. As noted, humans are social creatures who live in families, reside in neighborhoods, belong to religious organizations, attend school, and go to work, all social enterprises through which most social interactions occur and which define the social context. Direct and primary social influence is thought to occur mainly within individuals' proximal social context, which includes the family and peer groups (Dawkins 1989). Our experiences and the information we gain in these settings shape our understanding of what is normative and acceptable behavior and train us in social relations (Dawkins 1989).

Social context determines opportunity for social interaction through social network formation. In its simplest form, a social network is a map of all of the relevant ties between individuals and groups (Valente et al. 2004). One's social network consists of all the people and groups with whom one has contact and the nature and extent of social interactions. The formation of each person's social network is largely determined by shared social context such as neighborhood, school, church, and family (Wilcox 2003). Social networks are important because connected people share information and shape each other's perceptions of social norms. However, it is not just who individuals know or how often they spend time with them but the nature of relationships (e.g., closeness, reciprocity, frequency of contact) that also contributes to social influence (Valente et al. 2004).

Group membership (e.g., family, religious, school, peer) is a particularly powerful socializing experience, and people often change their perceptions, opinions, and behavior to be consistent with standards or expectations (norms) of the group (Forgas and Williams 2001; Kameda et al. 2005). Peer group affiliation becomes particularly important and

influential during adolescence (Brown 1989). Being a friend or part of a larger group, such as a clique, classroom, grade, school, club, or activity, or loosely affiliating with an amorphous crowd with similar interests (e.g., sports, music, drugs) provides great benefits of acceptance, friendship, and identity but can also demand conformity (Brown 1989). Group members tend to share common attitudes and behavior, and this is particularly true for adolescent peer groups (Eiser et al. 1991). Substance use is one factor about which friends and groups of adolescents tend to come to agreement, leading to group homogeneity (Kandel 1978), although there may be periods of adolescence when peer influence is greatest (Eckhardt et al. 1994; Steinberg and Monahan 2007). Susceptibility to peer influences may vary by gender and race (reviewed in Hoffman et al. 2007).

In summary, adolescents experience a range of social influences that may provide some direct effects on the likelihood of substance use, including smoking, but mainly provide indirect effects through social norms. In this section, we have presented social context, social networks, and group membership as discrete sources of influence; however, they are highly overlapping and interactive. As proposed by Bronfenbrenner (1979), it may be useful to think of the strength of various social influences as depending on proximity & frequency of contact, where the closest circles of influence include the people with whom adolescents associate most of the time (family and peers) and whose influence on their behavior, particularly smoking, is likely to be the greatest.

What Are the Theoretical Explanations of How Social Influence Contributes to Adolescent Smoking?

No one theory fully explains social influence, but many theories emphasize that people learn through social interaction. A substantial discussion of theory is beyond the scope of the present review, and other papers have presented excellent overviews of theory relating to adolescent smoking uptake (Hoffman et al. 2007; Kobus 2003). However, it may be useful here to point out the centrality of social norms in the prominent theories typically used to design research and explain findings on peer group effects. Social cognitive theory (Bandura 1996) emphasizes the importance of cognitive representations in the form

of expectations about social norms that arise from observational and experiential learning. Reasoned action (Fishbein and Ajzen 1975) emphasizes the importance of perceived social (subjective) norms on intentions. Primary socialization (Oetting and Donnermeyer 1998) and social bonding theories (Hirschi 1969) suggest that adolescent peer group effects will be stronger in the absence of strong social bonds with family and school. Social identity theory (Terry et al. 2000) suggests that adolescents try on various identities and adopt the norms that are central to the social identity of the peer group to remain in good standing. Similarly, social exchange theory (Kelley and Thibaut 1985) argues that friendships and group membership requires fair exchanges (reciprocity), leading to conformity of behavior between friends and group members. Of course, the nature of the relationships of group members greatly influences the nature of this reciprocity (Plickert et al. 2007). Social network theory suggests that social norms are shaped by information shared among members of a social system (Scott 2000; Valente 1995). Norms also figure prominently in the literature on persuasion and social marketing (Hastings and Saren 2003). Indeed, social influence is the basis for two-stage communication strategies in which persuasive communications are directed not at the ultimate target but at opinion leaders whose attitudes and behavior influence others in their social groups (Rogers 2003). Urberg et al. (2003) described the two-stage model of social influence as it applies to adolescent substance use.

Each of these theories shares the perspective that close (proximal) relationships provide a primary social influence while the media and other aspects of culture provide important but secondary influences. Close relationships are most important because they are persistent, valued, and emotional. Individuals interact more often and spend more time with close relationships, and time spent together provides opportunities for influence. Each of these theories also recognizes that adolescents develop perceptions about social norms from information sharing (via interaction or observation) with people and groups in their social environment. In brief, social influence is implicit or explicit in many psychosocial theories and is one of the most consistently considered phenomenon in social psychology and persuasion (Terry and Hogg 2000).

Peer Group Homogeneity with Respect to Adolescent Smoking

To What Extent Does Peer Group Smoking Predict Adolescent Smoking?

The tendency for adolescent peer group members to share common characteristics such as smoking, termed alternatively as *peer group clustering* or *homogeneity*, has been well described (Andrews et al. 2002; McPherson et al. 2001; Alexander et al. 2001). Good evidence of this association comes from studies using prospective research designs, which allow the researcher to determine if peer use predicts future adolescent use, thereby providing stronger evidence of causality than cross-sectional associations. Indeed, research using prospective designs assess adolescent and peer substance use at baseline (Time 1) and adolescent substance use at follow up (Time 2 or at multiple time points), providing a test of the extent to which peer substance use predicts eventual adolescent use while controlling for adolescent baseline use. Through standard literature review procedures (as discussed in the introduction), we identified 40 prospective studies published since 1999 linking peer group smoking or measures of substance use that include smoking to future adolescent use.

The studies reviewed included a wide range of methods and populations. Nevertheless, all but one of the papers reviewed reported positive associations between peer use at Time 1 and adolescent smoking at follow-up, including the following: (a) 23 of 24 papers that examined the relationship of friend smoking or smoking as part of a measure of substance use at Time 1 and smoking or substance use at follow-up; (b) all nine papers that examined the relationship between grade-level prevalence at Time 1 and smoking at follow-up (Bricker et al. 2007; Eisenberg and Forster 2003; Ellickson et al. 2003a, b; Epstein et al. 2000; McCabe et al. 2005; Rodriguez et al. 2007; Spijkerman et al. 2005); (c) all five papers that reported both friend and grade level prevalence (Epstein et al. 2007; Gritz et al. 2003; Simons-Morton and Haynie 2003b; Simons-Morton 2002; Smet et al. 1999); and (d) all three papers that examined the influence of friend use at Time 1 on adolescent smoking trajectory groups (Abroms et al. 2005; Vitaro et al. 2004; Wills et al. 2004). All previous articles examined smoking as a distinct outcome,

with the exception of the article by Wills et al. (2004), which considered smoking as part of a substance use composite score. To better illustrate the influence of peer smoking on adolescent smoking, we describe select findings in the subsequent paragraphs.

Does Peer Group Influence on Adolescent Smoking Vary by Adolescent Subgroups?

A main finding emerging from this literature points to the variation of peer influence on adolescents' smoking by sociodemographic characteristics. Though gender differences are well established, with girls shown to be more strongly influenced by peer smoking than boys (Griffin et al. 1999), age differences were less clear. For example, Vitaro et al. (2004) found that friend use predicted adolescent smoking progression in the peer 12–13- and 13–14-year-old groups but not in the 11–12-year-old groups. Conversely, Abrams et al. (2005) found that 6th graders (age = 11 years) with friends who smoke were more likely over time to become intenders, experimenters, or regular smokers.

This literature also provides valuable information on peer group effects in minority populations. Several studies found that African American youth with friends who smoke were more likely to initiate smoking over time than those with no such friends (Brook et al. 2006; White et al. 2007). Similarly, positive associations between friends' smoking and adolescent smoking were observed among Latino (Livaudais et al. 2007) and Chinese (Chen et al. 2006) adolescents. A comparison of peer influence by race/ethnicity yields conflicting findings, with studies showing less effect of peer smoking on adolescent smoking among African American than White adolescents (Ellickson et al. 2003b; Robinson et al. 2006b) whereas others reporting similar peer group influence for White, Black, and Hispanic students (Gritz et al. 2003). The different findings could be because of differences in samples by age or geographic location. Peer group influence also varies by individual characteristics including genetics, which could influence exposure to substance-using friends (Cleveland et al. 2005), and personal attributes such as competency skills (Epstein et al. 2007) or perceptions of personal harm due to smoking (Rodriguez et al. 2007). Finally, peer influences on smoking may

be moderated by strong social bonds to school and family (Ellickson et al. 2003b).

Overall, this literature is surprisingly consistent in reporting positive associations between peer smoking and future adolescent smoking and provides evidence that peer behavior affects initiation, progression, and trajectories. It also documents the influence of peer use on adolescent use among adolescents of various race and ethnicity groups and shows that this influence may be mediated or moderated by cognitions, gender, and maturation. This research provides substantial evidence that smoking among friends predicts adolescent future smoking but modest evidence that general prevalence, for example, within a particular grade or school, predicts future smoking, with the exception, though, of cases where a higher general prevalence of smoking among senior students is related to an increase in smoking among lower-grade students (Leatherdale et al. 2006). However, while this literature bettered our understanding of peer influence on adolescent smoking, it does not address how peer group influences actually work.

The research on peer influence is limited by the fact that it is not possible to determine the extent to which friendships in existence at study initiation were formed due to selection or socialization processes. These friendships that are already in place at the beginning of a study would have been influenced by past socialization and selection processes that would be difficult or impossible to determine (Cohen and Syme 1985). However, beyond that caveat, it can reasonably be assumed that associations between friends who smoke and smoking uptake are evidence of socialization, and associations between smoking status and increases in the number of smoking friends is evidence of selection.

Are Adolescents Influenced (Socialized) by Their Friends, or Do Adolescents Select Friends with Similar Interests (Selection) with Respect to Smoking?

The processes by which peer influence leads to peer group homogeneity of behavior are socialization and selection. Socialization is the tendency for attitudes and behavior to be influenced by the actual or perceived attitudes and behavior (e.g., norms) of one's friends and the conforming properties of group

membership. Selection, on the other hand, is the tendency to affiliate and develop friendships with those who have similar attitudes and common interests (Simons-Morton 2007).

Peer Socialization

Peer socialization is the effect of existing social relationships on the formation of social norms. With socialization, the group accepts an adolescent based on shared characteristics. To be accepted, the adolescent takes on the attitudes and behaviors of the group (Evans et al. 2006). Peer socialization can be overt, as in peer pressure, or perceived, where the adolescent accepts or changes attitudes and behavior based on perceived group norms that may or may not be actual. Socializing processes that facilitate the uptake of adolescent smoking can also discourage use (Stanton et al. 1996).

Peer socialization is often referred to as peer pressure, a term that suggests that adolescents directly persuade their friends to conform to their behavior. However, peer pressure is only one aspect of socialization. Although there is evidence that adolescents do offer their friends cigarettes and that smoking is typically initiated in the context of peers (Kirke 2004; Lucas and Lloyd 1999; Robinson et al. 2006b), most of the evidence indicates that socialization is mainly a normative process and not one of overt peer pressure. In surveys, youth report that overt peer pressure is not a factor for their smoking but report that they sometimes experience internal pressure to smoke in the presence of other adolescents who are smoking, evidence for the influence of perceived social norms rather than overt peer pressure (Nichter et al. 1997). These findings suggest that perceived social norms exert a socializing effect.

Social norms need only be perceived to influence behavior. It has been shown that adolescents sometimes perceive that the prevalence of smoking is higher among their peers than they are in actuality (Bauman and Ennett 1996; Iannotti et al. 1996), which may be due to several possible factors. Adolescents may psychologically project their own smoking behavior onto others, thereby overestimating smoking prevalence (Miller et al. 2000). Adolescents may also develop a false consensus that one's attitudes and behavior are normative when they are not (Berkowitz 2004).

Overall, it seems that socialization occurs mainly through indirect pressure to conform to actual or perceived social norms. Although direct and overt peer pressure almost certainly operates, there is substantially less empirical evidence of its importance compared with the indirect influence on social norms.

Peer Selection

Unlike socialization, where the person conforms to group norms, selection occurs when an individual seeks or affiliates with a friend or group with common attitudes, behaviors, or other characteristics. Selection processes include deselection. When some members of a peer group begin smoking or experimenting with other substances, other members of the peer group can respond by dropping out of the group (deselection); conforming to the new group norm (socialization), risking group disapproval; or living with the dissonance between their norms and the group's (Andrews et al. 2002).

Selection may be abstract and internal, when a person affiliates with others by identifying with them or with what they represent rather than affiliating on the basis of observable behaviors. For example, adolescents may identify with groups according to musical preferences, reputation, or interests (Ter Bogt et al. 2006). Such affiliations may be highly transient among adolescents. Selection also involves actual affiliation and, within the limits of their social network, people gravitate toward individuals or groups who share their interests and values and provide a supportive context for their own views and behavior (Urberg et al. 1998). Adolescents who are interested in smoking, for example, may select as friends adolescents with similar interests in smoking (Ennett and Bauman 1994), although smoking may be just one manifestation of a constellation of social norms leading to social selection.

Recent Evidence Regarding Effects of Selection and Socialization on Smoking

Although selection and socialization processes can operate independently, they may also be interactive. Previous reviews have noted that some studies have found support for selection, some for socialization, and some for both with respect to adolescent smoking

uptake (Hoffman et al. 2007; Kobus 2003). However, there has been considerable disagreement about the relative importance of these two processes (Arnett 2007; Bauman and Ennett 1996; Ennett and Bauman 1994).

To examine the latest findings on the topic, we reviewed published studies not included in previous reviews, using the methodology outlined in the introduction. Of the 13 papers reviewed (several papers were unique analyses of separate questions asked of the same data), seven used structural equation, general linear equation, or latent growth modeling; two used cross-lagged autoregressive analyses to evaluate adolescent and peer substance use relationships from year to year; and four studies employed social network methods. All these methods are particularly useful for sorting out the effects of socialization and selection.

The findings of the first seven studies in Table 1 used latent growth modeling or similar analyses. All studies examined adolescent smoking as a distinct outcome, with the exception of Wills and Cleary's study (1999), where smoking was part of a substance use composite score. Evidence of socialization or selection is based on the longitudinal relationships between peer and adolescent substance use: Peer smoking at Time 1 predicting an increase in adolescent smoking over time would be evidence of socialization whereas adolescent smoking at Time 1 predicting peer smoking over time would be evidence of selection. The findings were mixed, with one study reporting effects only for socialization, five studies reporting effects for selection only, and three studies reporting effects of both socialization and selection. Wills and Cleary (1999) found effects of socialization and not selection on a combined measure of smoking, drinking, and marijuana use. De Vries et al. (2003), Simons-Morton et al. (2004), De Vries et al. (2006), and Hoffman et al. (2007) found evidence of selection but not of socialization on smoking progression. Urberg et al. (2003) found effects of both socialization and selection on smoking and drinking, Mercken et al. (2007) found effects of both processes on smoking, and Audrain-McGovern et al. (2006) found a direct effect on smoking progression of socialization and an indirect effect of selection through growth over time in friends who smoke.

Two studies used autoregressive analyses where the cross-lagged relationship between adolescent and

peer smoking (Tucker et al. 2008) or substance use (Simons-Morton and Chen 2006) at each time point was examined. Both studies found evidence of reciprocal effects of socialization and selection. Tucker et al. (2008) found evidence for both selection and socialization on smoking, with stronger effects for selection than socialization. Simons-Morton and Chen (2006) found similar magnitude of effects but a more consistent effect of selection than socialization on a combined measure of adolescent and peer substance use.

The four social network studies found effects of socialization, and the three that assessed selection also found evidence of selection. Urberg et al. (2003) reported effects of both selection and socialization on adolescent substance use. Maxwell (2002) reported effects of both socialization and selection on smoking, drinking, and chewing tobacco. Kirke (2004) reported that Irish adolescents tended to have common substance use behaviors over time, with selection a somewhat stronger effect than socialization. Hall and Valente (2007) reported direct effects of selection and indirect effects of socialization on smoking.

Findings of these studies with advanced study designs suggest that both socialization and selection processes contribute to peer group homogeneity with respect to smoking, probably in some sort of syncoption (Urberg et al. 2003), with rather stronger evidence for selection than socialization. Effects were found for a variety of populations and varying measures of both peer and adolescent substance use. These modern designs and methods provide stronger evidence and richer findings than the traditional prospective analyses, where future adolescent substance use is predicted by current peer use.

Methodologies for Investigating Socialization Processes: Comparative Assessment

Growth modeling provides an elegant test of the relationship of peer use at Time 1 to the growth in adolescent use (socialization) and of adolescent use at Time 1 to peer use over time (selection), and these studies provided stronger support for selection than socialization. The findings of the two studies that used autoregressive approaches indicated that the magnitude of the effect of selection is relatively consistent but the effect of socialization varies over

Table 1 Review of recent studies of peer socialization and selection on adolescent smoking

Author and year	Sample and location	Adolescent use measure (outcome)	Peer use measure	Assessment	Analyses	Significant findings	Conclusion
<i>Latent growth model, general linear equation, structural equation modeling</i>							
Wills and Cleary (1999)	1,190 7th graders The US; New York metropolitan area	Frequency of use of tobacco, alcohol or marijuana (composite measure) Having more than three drinks on one occasion in the past month	Number of friends who smoke cigarettes, drink beer or wine, smoke marijuana	<i>Respondents</i> Questionnaires at three time points (3-year follow-up) <i>Peers</i> Respondents' reports at all three time points	Analyze peer-influence versus peer selection mechanisms in adolescent tobacco, alcohol and marijuana use <i>Analysis strategy</i> Latent growth modeling; multiple regression	Peer smoking associated with change in adolescent smoking Adolescent smoking did not increase Friends who smoke	Evidence of socialization No evidence of selection
De Vries et al. (2003)	15,705 adolescents; mean age = 13.6 Six European countries: Denmark, Finland, The Netherlands, Portugal, Spain, UK	(1) Never smokers (2) Tried, but not regular smokers; (3) Regular smokers: smoking at least once a week	A three-point scale for best friend (yes, maybe, no) A five-point scale for friends in general (all, more than half, half, less than half, hardly anybody)	<i>Respondents</i> Questionnaires at two time points <i>Peers</i> Participants' report of their friends' smoking at two time points	Assess the relationship between smoking behaviors of adolescents and smoking status of their parents and friends <i>Analysis strategy</i> Multiple regression analyses	Longitudinal regression analysis showed that the β coefficients of the smoking status of the best friend and friends in general were comparable to that of parental smoking	No evidence of socialization Evidence of selection
Simons-Morton et al. (2004)	1,320 6th graders The US; Maryland	Frequency of smoking in the past 30 days and past 12 months	Number of five closest friends who smoke Number of five closest friends who drink, cheat on a test, bully someone, act disrespectfully, steal, lie to parents, damage property	<i>Respondents</i> Questionnaires at five time points (3-year follow-up) <i>Peers</i> Respondents' reports at all time points	Examine associations between initial and continuing peer affiliation and parent influences and smoking stage progression <i>Analysis strategy</i> Latent growth curve; lagged autoregressive latent trajectory analyses	Consistency between adolescents and peers in smoking at baseline and over time Protective effect of authoritative parenting practices on the formation of friends who smoke	No evidence of socialization Evidence of selection

Table 1 continued

Author and year	Sample and location	Adolescent use measure (outcome)	Peer use measure	Assessment	Analyses	Significant findings	Conclusion
Audrain-McGovern et al. (2006)	918 9th graders The US; Northern Virginia	Variable measuring smoking progression that includes: never smokers, puffers, experimenters, current smokers and frequent smokers	Composite measuring smoking among nine best friends: – Best friend smoking – Number of other 4 best male and best female friends who smoke	<i>Respondents</i> Questionnaires at 5 time points (4-year follow-up) <i>Peers</i> Respondents' reports at 4 time points	Determine whether self-control had indirect effects on smoking practices through effects on peer smoking <i>Analysis strategy</i> Latent curve growth modeling	Evidence that peer smoking directly influences adolescent smoking progression Problems with impulse control increased likelihood of having peer who smokes, indirectly increasing smoking likelihood at baseline; opposite effect for increased planning	Evidence of socialization Indirect effect of selection
De Vries et al. (2006)	7,102 adolescents; mean age of 12.78 years Six European countries: Finland, Denmark, the Netherlands, the United Kingdom, Spain and Portugal	Weekly smoking	Best friend ever smoking Number of friends who smoke	<i>Respondents</i> Questionnaires at two time points (1-year interval) <i>Peers</i> Adolescents' reports of their friends' smoking at two time points	Examine the influence of friends' smoking at Times 1 and 2 on respondents' smoking at Time 2 <i>Analysis strategy</i> Structural equation modeling	No association between friends' smoking at T1 and adolescent smoking at T2 for most countries Significant positive association between adolescent smoking at T1 and friends' smoking at T2	No evidence for socialization Evidence of selection
Mercken et al. (2007)	1,886 adolescents; mean age of 12.7 years. The Netherlands	Average # cigarettes smoked during week	Average # cigarettes smoked during week	<i>Respondents</i> Questionnaires at two time points (1 year interval) <i>Peers</i> Self-reported smoking of five best friends attending the same school at two time points	Examine the influence of friends' smoking at Times 1 and 2 on respondents' smoking at Time 2 <i>Analysis strategy</i> Structural equation modeling	Within non-reciprocal friendships, effect of social selection Within reciprocal friendships, effect of socialization and to a lesser extent, social selection	Evidence of socialization Evidence of selection

Table 1 continued

Author and year	Sample and location	Adolescent use measure (outcome)	Peer use measure	Assessment	Analyses	Significant findings	Conclusion
Hoffman et al. (2007)	20,747 participants in Add Health 7th–12th grade The US; National	Ever tried smoking	Number of friends who smoke at least one cigarette a day, out of three best friends	<i>Respondents</i> Questionnaires at two time points (1-year follow-up) <i>Peers</i> Respondents' reports at both time points	Test a model of peer influence and peer selection on ever smoking by adolescents <i>Analysis strategy</i> Structural equation modeling	Smoking at Time 1 was more strongly associated with peer smoking at Time 2 than Time 1 peer smoking with Time 2 adolescent smoking	No evidence of socialization Evidence of selection
<i>Auto-regressive analyses</i>							
Simons-Morton and Chen (2006)	2,453 6th graders The US; Maryland	Frequency of smoking, drinking, marijuana use past 30 days (composite measure)	Number of five closest friends who smoke, drink, or use marijuana	<i>Respondents</i> Questionnaires at five time points (3-year follow-up) <i>Peers</i> Respondents' reports at all time points	Examine reciprocal influence of adolescent and peer substance use from one time point to the next <i>Analysis strategy</i> Lagged autoregressive latent trajectory analyses	Great consistency between adolescents and peers in substance use over time Evidence of reciprocal effects of peer use leading to adolescent use and adolescent use leading to peer use	Socialization was a less consistent predictor than selection
Tucker et al. (2008)	6,527 7th graders The US; Oregon	Composite measuring quantity and frequency of smoking	Best friend smoking Frequency the participant is around kids who are smoking cigarettes	<i>Respondents</i> Questionnaires at four time points (10-year follow-up) <i>Peers</i> Respondents' reports at all time points	Investigate the temporal associations of adolescent smoking with pro-smoking family and peer influences <i>Analysis strategy</i> Path analyses of cross-lagged effects	Stronger effect of youth smoking on friendship formation than the reverse Household smoking and parent approval predicted smoking, while parent disapproval was negatively associated with future smoking and friendships with smokers	Reciprocal influences Socialization effects less consistent over time than selection effects
<i>Social network analyses</i>							
Maxwell (2002)	1,969 adolescents, aged 12–18 The US; national sample	Current smoking, marijuana use and chewing tobacco (past 30 days) (separate outcomes) Current drinking (past 12 months)	Current smoking, marijuana use and chewing tobacco (past 30 days) Current drinking (past 12 months)	<i>Respondents</i> Questionnaires at two time points (1-year follow-up) <i>Peers</i> Self-reported at both time points (one same-sex friend per participant, among all nominated friends)	Examine peer influence across five risk behaviors: cigarette smoking, alcohol consumption, marijuana use, tobacco chewing, and sexual debut <i>Analysis strategy</i> Logistic regression	Random same sex peer behavior predicted teen smoking and marijuana initiation and alcohol initiation and discontinuation Friends protect against risk activities as well as promote initiation	Evidence of socialization Did not measure selection

Table 1 continued

Author and year	Sample and location	Adolescent use measure (outcome)	Peer use measure	Assessment	Analyses	Significant findings	Conclusion
Urberg et al. (2003)	1,028 6th, 8th and 10th grade (some attrition for future waves) The US, Midwest	Ever use of cigarettes or alcohol (separate outcomes) Current use of cigarettes or alcohol Frequency of drunkenness in the past month	Same as adolescent use measures Computed for best friends and other friends	<i>Respondents</i> Questionnaire at 4 time points (3-year follow-up) <i>Peers</i> Friends' reports at all time points	Assess (1) the initial selection of cigarette- and alcohol using peers and (2) influence from peers <i>Analysis strategy</i> Hierarchical regressions	Adolescents with low school achievement value or little time with parents more likely to choose friends who smoked High peer acceptance and high friendship quality associated with greater adolescent conformity to friend's substance-use	Evidence of socialization Evidence of selection
Kirke (2004)	267 adolescents, aged 14–18 Ireland	Ever use of cigarettes, alcohol and drugs (separate outcomes)	Ever use of cigarettes, alcohol and drugs	<i>Respondents</i> Questionnaire at one time point (use information about when the friendship was formed) <i>Peers</i> Self-reported from nominated friends	Examine relative impact of peer influence and selection on similarity in the substance use <i>Analysis strategy</i> Social network analysis	Similarity in the substance use of adolescents is due to both peer socialization influence and selection Greater role of peer influence	Evidence of socialization Evidence of selection
Hall and Valente (2007)	1,960 6th graders Location not specified	Ever trying smoking, even a few puffs Ever trying smoking, even a few puffs	Ever trying smoking, even a few puffs	<i>Respondents</i> Questionnaires at three time points (1-year follow-up) <i>Peers</i> Self-reported at all time points (from 5 best friends)	Examine the processes of peer socialization and selection on adolescent smoking <i>Analysis strategy</i> Social network analysis	Nominating smokers as friends predicted future smoking Being nominated as a friend provided indirect influence on future smoking	Evidence of indirect effect of socialization Evidence of selection

Some of the studies have included other risk behaviors (generally other substance use), in addition to smoking

All of the included studies are longitudinal except for Kirke (2004), but this study was included because of its importance in addressing the socialization/selection paradigm

time, which suggests that these processes may be interactive and may vary by age or friendship dynamics.

Social network analyses are informative because they follow the same adolescents and peers over time, thus overcoming the objection that growth model analyses may overestimate selection effects to the extent that adolescents' reports of their friends' substance use may be projections rather than true measures of friend use (Arnett 2007; Bauman and Ennett 1996; Iannotti et al. 1996). It is particularly interesting that the social network studies reviewed consistently demonstrated effects of both socialization and selection (where measured), similar to the findings of previous social network studies (Ennett et al. 1994). Social network studies can also provide unique information about the nature of peer influence that cannot be learned from other designs. For example, Urberg et al. (2003) reported that reciprocal friendships provided greater influence than non-reciprocal friendships, consistent with theory (Plickert et al. 2007) and other research (Terry et al. 2000). Also, Kirke (2004) demonstrated among Irish adolescents that adolescent smoking is a highly social activity in that adolescents smoke in groups and offer and borrow cigarettes.

Collectively, the studies reviewed provide strong evidence for peer influence effects on adolescent smoking and suggest that selection is at least as important as socialization and that these two processes are probably interactive. However, more can be learned about the nature of peer influence processes; how they might vary by age, gender, race, and friendship qualities; and what factors mediate the relationship between adolescent and peer smoking.

Are Best Friends, Close Friends, or Crowd Affiliations More Important?

Though substantial information exists on the independent influences of best friends and peer groups on adolescent smoking, few studies have examined the differential impact of these relationships. Establishing a close relationship with one friend and belonging to a peer group are thought to be more or less equally important for adolescents, and both types of relationships may facilitate essential developmental tasks such as the building of social skills, identity

formation, and social support (Giordano 2003). Yet, best friends and peer groups may not equally influence adolescents' behavior. If influence results from wanting to please friends, then best friends would be expected to be more influential. However, if influence derives from the desire to conform to the group norms, then peer group influence would be expected to supersede the influence of one close friend (Urberg et al. 1997).

Only four studies were identified that examined whether best friendships and peer groups function differently to affect adolescent smoking and other substance use. Several findings emerged from these studies. First, the influence of a best friend as compared to the influence of a group of friends varied depending on the behavior under consideration (a best friend's influence was greatest for behaviors that are illegal) and the stage of use (best friends predicted initiation whereas peer groups predicted transition to current use; Urberg et al. 1997). Second, best friendships and peer groups interacted to better predict adolescent use (Hussong 2002). For example, adolescents with substance-using best friends showed a decreased risk for substance use if they had other close friends who were not high substance users. However, the influence of a best friend was shown to be independent of peer groups in another investigation (Alexander et al. 2001). Finally, adolescents with reciprocal friendships within a group were less influenced by the overall level of smoking among the group than adolescents with no reciprocal friendships (Aloise-Young et al. 1994).

Crowd affiliation has been identified as another source of influence on adolescent smoking (Engels et al. 2006; Michell 1997; Michell and Amos 1997; Urberg et al. 1990). Each crowd has a reputation that allows adolescents to recognize youth who share similar beliefs, attitudes, and behaviors. As adolescents affiliate with specific crowds, they tend to embrace the behaviors of the crowd, perhaps as a result of their perceptions of the crowd's reputation rather than direct peer pressure from crowd members (Kobus 2003).

The prevalence of smoking varies considerably between youth crowds. Crowds that are perceived as "deviant" or unconventional are likely to have the highest smoking rates (La Greca et al. 2001; Schofield et al. 2003; Verkooijen et al. 2007). Reasons for smoking also vary across crowds and can range from

the maintenance of high social status to the need to climb up in the hierarchy (Michell and Amos 1997). The association between crowd membership and smoking can best be explained by social identity theory, which emphasizes the importance of group membership for adolescents' self-identity. Accordingly, adolescents affiliated with a crowd are likely to be influenced by the crowd's norms and will tend to adopt the crowd's normative behaviors (Verkooijen et al. 2007).

In summary, best friends, peer groups, and social crowds all appear to affect adolescents' smoking and other substance use. Though few studies have examined whether their effects are independent or interactive, results suggest that effects are dependent on (a) the specific substance used, (b) the stage of use, and (c) relationship characteristics (e.g., adolescent is a member of the group but not central to it). More research is needed to clarify the mechanisms through which these influence processes occur, particularly using national samples, to allow for the simultaneous evaluation of the effects of best friends, peer groups, and social crowds across a range of substances and for different demographic subgroups.

Do Positive Parenting Behaviors Buffer the Effects of Peer Influence?

Parent influence has frequently been found to be associated with adolescent smoking. However, associations have generally been modest (Avenevoli and Merikangas 2003). Household smoking has been identified as a modest predictor of adolescent smoking (Hoffman et al. 2007; Kobus 2003), but it is not clear if this effect is because of increased availability of cigarettes, modeling, or parenting practices. Prospective studies have shown protective effects of a variety of positive parenting practices (Simons-Morton and Haynie 2003a) including setting expectations (Abroms et al. 2005; Forrester et al. 2007; Simons-Morton 2004; Tucker et al. 2004), parent support (Simons-Morton 2004, 2007; Wills et al. 2004), and parental monitoring (Dishion and Andrews 1995; Mounts and Steinberg 1995; Simons-Morton 2007; Simons-Morton et al. 2004). The effect of positive parenting practices may be influenced by the strength of family ties (Urberg et al. 2003). Parents and peers appear to provide independent effects on

smoking (Simons-Morton and Haynie 2003a). However, of the few studies that have examined both peer and parent effects, most indicate that peers provide greater influences on adolescent smoking than parents (Hoffman et al. 2007).

One mechanism by which parents can protect their children from smoking and other undesired behaviors is to discourage their association with friends who engage in these behaviors, provide bad examples, and otherwise exert negative socializing influences, as indicated in Fig. 1 (Simons-Morton and Chen 2005). Several studies have demonstrated that parent influence on adolescent smoking occurs indirectly by preventing friendship formation with smoking peers (Avenevoli and Merikangas 2003; Simons-Morton et al. 2001), moderating the effects of friend influence (Dielman et al. 1993), or moderating affiliation with smoking peers (Engels and van der Vorst 2003). Urberg et al. (2003) reported that teens who value their parents are less likely to select substance-using friends. Several recent studies reported that positive parenting practices and parent–teen relationship factors reduce likelihood of adolescents forming friendships with substance using peers, providing indirect protective effects on adolescent smoking (Simons-Morton 2004; Tucker et al. 2008).

Limitations of Existing Literature

Although there are many papers on peer influences on adolescent smoking and other substance use, a limited number of papers have reported prospective findings in which both peer and adolescent smoking were assessed. For example, few such papers have compared the relative effects of best friend, close friends, or general peer group. There is also a paucity of research on social influences among ethnic groups. Further, though current studies examining the effects of socialization and selection suggest that an increase in smoking uptake at Time 2 by the number of friends who smoked at Time 1 is evidence of socialization and that an increase in friends who smoke at Time 2 among adolescents who smoke at Time 1 provides evidence of selection, the two processes may not be that distinct and are actually interactive. More information is, however, needed regarding the circumstances surrounding socialization and selection. For example, a smoker at Times 1 and 2 with

non-smoking friends at Time 1 but with friends who smoke at Time 2 may illustrate selection (choosing new friends) or socialization (influencing Time 1 friends to smoke) processes that could only be disentangled through gathering more information about group composition and dynamics over time. Finally, many studies have used a measure of substance use that includes smoking and other substance use, usually drinking and sometimes marijuana use. The main advantage of this convention is it allows for the configuration of a continuous or ordinal measure, with many analytic advantages over nominal measures of smoking. However, this convention makes it impossible to know the relative influences on smoking compared with overall substance use.

Summary

In this manuscript, we provided a conceptual model showing social influence on adolescent smoking occurring at multiple levels. Within this context we discussed the literature on proximal social influences on adolescent smoking, including peer and parent influences. Based on this review we offer the following tentative conclusions:

1. There is substantial peer group homogeneity with respect to adolescent smoking and other substance use. This is to say that adolescents with friends who smoke are likely to smoke themselves or to take up smoking over time. The reverse is also the case that adolescents without friends who smoke are less likely to take up smoking than adolescents with friends who smoke.
2. Both socialization and selection appear to provide important influence on adolescent smoking. They also appear to be interactive. The evidence from studies based on advanced research designs is somewhat stronger for selection than socialization effects.
3. Best friends appear to provide the greatest peer influence on adolescent smoking; peer groups (close friends) provide independent influence, but their influence may also interact with that of the best friend. Crowd affiliation is another friendship dimension that appears in limited research to be associated with adolescent substance use. It is modestly associated with adolescents' smoking and may interact with peer group influence. Few studies have examined the relative influence of best friends, peer groups, and crowd affiliations, and more research is needed.
4. Parenting appears to remain an important influence on adolescent smoking during adolescence, with parental smoking increasing the likelihood of adolescent smoking and protective parenting practices that are maintained over time providing both direct and indirect (by reducing the number or influence of smoking friends) protective effects against the uptake of adolescent smoking.

Implications and Future Directions

We believe the rich literature on the effects of peer and parent influences on adolescent smoking, though incomplete, provides a strong basis for the development of next generation prevention programs. Based on the literature, interventions could be designed to focus on cognitive factors, such as social skills, that mitigate the effects of peer group influences (Haege-rich and Tolan 2008). Alternatively, interventions might be directed at the peer group and designed to alter social norms, or they could be directed at facilitating protective parenting practices.

Future research on peer influences on adolescent smoking would benefit from further examination of the relative effects of best friend, close friends, and general peer group, especially among adolescent subgroups (e.g., by gender, age, race/ethnicity). Furthermore, examining the effects of socialization and selection deserves continued attention as methodological advances (e.g., social network analyses software) and more refined study designs (e.g., longitudinal studies following adolescents and their peer group) facilitate the differentiation of these two processes.

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