Published in final edited form as:

J Quant Criminol. 2013 September ; 29(3): 347–368. doi:10.1007/s10940-012-9183-9.

Differential Effects of Parental Controls on Adolescent Substance Use: For Whom Is the Family Most Important?

Abigail A. Fagan¹, M. Lee Van Horn², J. David Hawkins³, and Thomas Jaki⁴

²Department of Psychology, University of South Carolina, Columbia, SC

³Social Development Research Group, School of Social Work, University of Washington, Seattle, WA

⁴Medical and Pharmaceutical Research Unit, Department of Mathematics and Statistics, Lancaster University, Lancaster, United Kingdom

Abstract

Objective—Social control theory assumes that the ability of social constraints to deter juvenile delinquency will be invariant across individuals. This paper tests this hypothesis and examines the degree to which there are differential effects of parental controls on adolescent substance use.

Methods—Analyses are based on self-reported data from 7,349 10th-grade students and rely on regression mixture models to identify latent classes of individuals who may vary in the effects of parental controls on drug use.

Results—All parental controls were significantly related to adolescent drug use, with higher levels of control associated with less drug use. The effects of instrumental parental controls (e.g., parental management strategies) on drug use were shown to vary across individuals, while expressive controls (e.g., parent/child attachment) had uniform effects in reducing drug use. Specifically, poor family management and more favorable parental attitudes regarding children's drug use and delinquency had stronger effects on drug use for students who reported greater attachment to their neighborhoods, less acceptance of adolescent drug use by neighborhood residents, and fewer delinquent peers, compared to those with greater community and peer risk exposure. Parental influences were also stronger for Caucasian students versus those from other racial/ethnic groups, but no differences in effects were found based on students' gender or commitment to school.

Conclusions—The findings demonstrate support for social control theory, and also help to refine and add precision to this perspective by identifying groups of individuals for whom parental controls are most influential. Further, they offer an innovative methodology that can be applied to any criminological theory to examine the complex forces that result in illegal behavior.

¹Corresponding author: College of Criminology and Criminal Justice, Florida State University, Tallahassee, FL. (850) 644-4050; afagan@fsu.edu.

A version of this paper was presented at the 2011 Society for Prevention Research Annual Meeting in Washington, D.C.

Keywords

social control theory; adolescent substance use; risk and protective factors; regression mixture models

1. Introduction

Criminological theories attempt to identify the circumstances that cause individuals to engage in or refrain from law-breaking activities. Most prominent theories attempt to avoid overly complex statements about criminal behavior. Instead, they seek to explain crime with succinct, specific, and relatively few hypotheses regarding the primary causes of crime and how these causes lead to offending behavior (Tittle, 1995). For example, control theory states that juvenile delinquency occurs “when an individual’s bond to society is weak or broken” (Hirschi, 1969, p. 16). While theories should be parsimonious, it is also true that the causes of criminal behavior are complex and theories that are too simplistic will lack precision and the ability to explain a significant amount of criminal behavior (Bernard & Snipes, 1996; Tittle, 1995).

While theoretical elaboration is needed in order to increase precision and explanatory value—for example, by more fully delineating the individuals for whom theoretically-identified precursors of offending are most salient (Tittle, 1995)—empirical research can also assist in this process. Such work can help to identify the specific experiences, conditions, and individual characteristics that influence offending; or, stated conversely, to identify constructs that affect the direction and/or strength of the relationships between independent and dependent variables. These types of empirical studies are becoming more common, but advanced statistical methods for modeling such conditions have been underdeveloped and under-utilized. The goal of this paper is to introduce and explore the use of regression mixture models (Desarbo, Jedidi, & Sinha, 2001; Van Horn et al., 2009; Wedel & Desarbo, 1995) for investigating differences in the effects associated, in this case, with social control theory. Regression mixture models allow the specification of groups (i.e., latent classes) of individuals for whom the relationship between an independent and dependent variable is most influential. In this paper, we examine potential heterogeneity in the effects of social constraints on delinquency; specifically: 1) the degree to which parental controls have varying levels of influence on adolescent substance use, and 2) the characteristics of individuals for whom parental controls are most important.

2. Review of the Literature

2.1 Social Control Theory

This paper focuses on social control theory because it is a prominent and well supported theoretical criminological perspective, and because, like other theories, it posits a relatively simple explanation for offending: illegal behavior will occur in the absence of social constraints. Following Emile Durkheim, control theorists assert that *all* individuals seek to satisfy their own individual needs and wants, and, in doing so, are prone to law-breaking activities. The key to restraining these desires and ensuring conformity among *all* potential law-breakers is the application of social constraints. Implicitly, this perspective assumes that

social constraints will be equally effective in preventing illegal behavior across all individuals.

The types of social constraints considered most successful in controlling delinquency vary among control theorists, but most identify ‘outer/direct’ and ‘inner/indirect’ controls as important (Kornhauser, 1978; Reckless, 1961), and all control theories acknowledge the family as a primary agent of social control (Burton et al., 1995; Thornberry, 1987; Wright & Cullen, 2001). Parents apply direct, external constraints by setting clear rules regarding appropriate and inappropriate behaviors, monitoring children’s activities, and consistently enforcing standards for behavior, with the goal of inhibiting children’s misbehavior (Catalano & Hawkins, 1996). According to Gottfredson and Hirschi (1990), instrumental parenting practices such as supervision and monitoring of children also have an indirect effect on delinquency, by instilling internal controls (i.e., self-control) that help children regulate their own behavior even in the absence of direct parental oversight. Parental expressive controls are also important. Parents who provide children with support and affection increase parent/child bonding, which should also instill self-regulation in children and increase the likelihood that they will internalize their parents’ norms, beliefs, and standards (Catalano & Hawkins, 1996; Hirschi, 1969). Individuals will regulate their own behavior to be in compliance with these principles and to maintain the warm, close relationships they share with their parents.

2.2 Factors That Moderate the Effects of Parental Controls on Delinquency

Control theorists allow for variation in the degree to which individuals are subject to constraints and parental controls; indeed, the theory explicitly states that crime is committed by those with low *levels of* control. They do not, however, posit individual variation in the *effect of* controls on crime. Hirschi, for example, “makes no attempt to spell out the circumstances within which social bonds will have more or less effect in restraining deviance” (Tittle, 1995, p. 37). Instead, Hirschi (1969) contends that social bonds have a direct, ameliorating effect on delinquency that is presumably of similar strength for all individuals.

Our paper departs from a strict control theory perspective by assuming that the effects of social constraints—specifically parental controls—will vary across individuals. Although not directly posited by control theory, past empirical studies, including Hirschi’s (1969) own research, provide support for this approach. Numerous studies have shown that instrumental and affective parental controls reduce delinquency, but the size of this association varies considerably across studies, which suggests that family influences may be conditioned by other factors (Derzon, 2010). Relatedly, life-course developmental theories, most notably the risk and protective factor paradigm (Hawkins, Catalano, & Miller, 1992), emphasize that multiple factors affect delinquency, including individual, peer, family, school, and community characteristics, and that these factors may interact with one another and/or have different effects on different individuals. This approach recognizes that “family factors never operate in a vacuum but take place against a backdrop of other influences” (Loeber & Stouthamer-Loeber, 1986, p. 128). That is, the extent to which families shape delinquency may vary according to other important factors in a child’s life. Hirschi’s (1969) analyses of

the Richmond Youth Project data support this perspective in showing that the impact of attachment (measured, in part, by boys' closeness to their fathers) on delinquency was stronger for children who had deviant peers. Based on these findings, Hirschi (1969, p. 231) conceded that his theory would be improved by more attention to interaction effects: "when the processes through which these [other] variables affect delinquency are spelled out, they will supplement rather than seriously modify the control theory."

Although Hirschi (1969) did not enumerate factors other than peer delinquency that might interact with controls to affect delinquency, empirical studies have identified individual characteristics such as gender and race/ethnicityⁱ and social influences including peer, school, and neighborhood factors as potential moderators. The effects of parental controls are hypothesized to be more influential for girls because females tend to spend more time at home and place more importance on family relationships (Hagan, Gillis, & Simpson, 1987; Kroneman, Loeber, Hipwell, & Koot, 2009). Similarly, some research suggests that parents of minority racial/ethnic backgrounds place stricter controls on children and may have closer affective relationships with them, and that the strength of these protective factors are greater for minority youth. In fact, the evidence for each of these hypotheses is mixed. Some studies have found that the effects of parenting practices on substance use and delinquency are stronger for girls than boys (Blitstein, Murray, Lytle, Birnbaum, & Perry, 2005; Hill & Atkinson, 1988), but the opposite has also been found (Burton et al., 1995; Canter, 1982; Cernkovich & Giordano, 1987; Fagan, Van Horn, Hawkins, & Arthur, 2007; Heimer & De Coster, 1999), and some studies report no gender differences in family influences (Fagan et al., 2007; Moffitt, Caspi, Rutter, & Silva, 2001; Rowe, Vazsonyi, & Flannery, 1995; Smith & Paternoster, 1987). Likewise, some studies have found that the influence of parental controls varies by race/ethnicity (Cusworth Walker, Maxson, & Maxfield, 2007; Holsinger & Holsinger, 2005), but others report no evidence of differential effects across ethnic groups (Henry, Tolan, & Gorman-Smith, 2001; Wallace & Muroff, 2002; Windle et al., 2010).

Peer, school and neighborhood influences may also condition the effects of parental controls, given that during this stage of development, teenagers are seeking independence from parents, are likely to spend more time outside of their home than with parents, and may be more strongly influenced by others (Dishion, Nelson, & Bullock, 2004; Thornberry, 1987). Parental controls are still important for adolescents, but the degree to which parents directly or indirectly control their teenagers may be compromised by conditions occurring in other social contexts.

Interestingly, *how* parental controls interact with other variables is uncertain. The risk and protective factor paradigm suggests "risk amplification," in that experiencing one risk factor (e.g., weak parental attachment) makes one more susceptible to the negative influences of another risk factor (e.g., residence in a disorganized neighborhood). Hirschi's (1969) finding that delinquency was more common among youth with delinquent peers and weak attachment versus those with strong attachment supports this position. His assertion that

ⁱThere is also some evidence that the effects of parenting practices vary by age, whereby parental controls are more effective for younger children versus adolescents (Hoeve et al., 2009; Jang & Krohn, 1995; Thornberry, Lizotte, Krohn, Farnworth, & Jang, 1991). Since our analyses contain youth in only one age group (10th graders), we are unable to investigate this hypothesis.

weak bonds allow the individual more freedom to be deviant is also compatible with the idea that such individuals would be more susceptible to other risk factors for crime. Other empirical work showing that youth who experience weak parental controls (e.g., low levels of supervision, monitoring, and attachment) and deviant peers engage in more delinquency and drug use than those with greater controls supports risk amplification processes (Barnes, Hoffman, Welte, Farrell, & Dintcheff, 2006; Dishion et al., 2004; Elliott, Huizinga, & Ageton, 1985; Farrell, Henry, Mays, & Schoeny, 2011). Likewise, research has shown that rates of delinquency are highest among those with weak attachments and who attend high-risk schools (Farrell et al., 2011) or who live in economically or socially disadvantaged neighborhoods (Brody et al., 2003; Hay, Fortson, Hollist, Altheimer, & Schaible, 2006; Plybon & Kliewer, 2001; Schonberg & Shaw, 2007).

In contrast, “evaporation” (Simons et al., 2002) or “contextual dissipation” (Wickrama & Bryant, 2003) effects have also been posited, whereby effects of parental controls are *weaker* among those experiencing other risk factors. Stated conversely, parenting practices are most effective for lower-risk youth and lose their salience in the context of “serious external stressors” (Luthar, Cicchetti, & Becker, 2000, p. 554). In some ways, this perspective is also compatible with Hirschi’s control theory. As Krohn and Massey (1980) note, tests of social bonding theory often find it better able to explain minor forms of delinquency than serious offenses. This evidence suggests that bonds may be more influential among those just beginning their criminal careers—who, by extension—would likely have lower levels of exposure to risk factors than more frequent offenders. Evaporation effects have been supported in the research. Studies have shown that the influence of parental controls is weaker among children who have delinquent peers (Crosnoe, Erickson, & Dornbusch, 2002; Marshal & Chassin, 2000), and for children attending high-risk schools or living in disadvantaged communities (Cleveland, Feinberg, & Greenberg, 2010; Gorman-Smith, Tolan, & Henry, 2000; Simons, Gordon Simons, Burt, Brody, & Cutrona, 2005; Simons et al., 2002; Wickrama & Bryant, 2003).

In summary, although control theorists tend to assume that social constraints have similar effects on delinquency for all individuals, some empirical evidence suggests otherwise. However, studies examining differential effects of parental controls are relatively uncommon and have produced mixed results, with some studies finding weak evidence for differential effects and others showing either risk amplification or evaporation processes. In addition, prior studies have typically examined only one or two types of parenting practices and potential moderators from a single other context (e.g., community or peer factors). Very few studies have assessed substance use outcomes, even though social control theory has posited a relationship between family factors and drug use (Catalano & Hawkins, 1996; Gottfredson & Hirschi, 1990). Moreover, rates of drug use among adolescents are significant and use of drugs such as marijuana has recently been increasing (Johnston, O’Malley, Bachman, & Schulenberg, 2010), which reinforces the need to better understand the factors that lead to these outcomes.

Importantly, there has been an almost exclusive reliance on interaction terms to identify heterogeneity in the effects of parental controls. While commonly used, this methodology has significant limitations in terms of power to detect significant moderators if they are

present and in the ability to find moderating effects if they are a function of more than one variable (Boyce et al., 1998; Luthar et al., 2000). Research suggests that individual differences in the effects of parental controls and other influences are often a function of multiple factors, for which the interactions framework requires the estimation of multiple interaction terms, and, as such, is not well suited to identifying complex differential effects (Van Horn et al., 2009).

The current investigation offers an innovative methodological approach—regression mixture models—for assessing differential effects of parental controls on adolescent substance use. We endorse the long-standing belief that social control theory offers a useful explanation of adolescent offending, but we seek to add precision to this theory and better specify the individuals for whom social controls are most effective. Two research questions are addressed: 1) Do parental controls have a different impact on adolescent substance use for different groups of individuals? 2) To what degree and in which direction will community, peer, school and individual factors predict the differential impact of parental controls on drug use?

2.3 Methodological Contributions of the Current Paper

A primary goal of this paper is to demonstrate the use of regression mixture models for exploring heterogeneity in the effects of social (parental) controls on drug use, but in doing so, to also illustrate the benefits of using this approach to explore differential relationships more generally. Assessment of differential effects of a predictor on an outcome is typically accomplished by modeling statistical interactions between individual variables, one of which is identified as a “moderator” of the effects of the other (Aiken & West, 1991; Baron & Kenny, 1986). In contrast, regression mixtures start with a global test of whether or not the effects of a particular variable are constant in the population. If evidence of differential effects is found, this approach then focuses on identifying predictors of these differences. The contrast between these two approaches is depicted in Figure 1. The interaction model allows for differential effects of parental controls, but only as a function of the other predictor variable(s) included in the interaction term. The regression mixture model includes an (unobserved) latent class variable where the effects of parental controls on the outcome (substance use) are allowed to differ across classes. Evidence for differential effects is provided through the identification of more than one latent class, with classes differing in the strength of parental controls. A key distinction is that regression mixtures do not require the predictor(s) of differential effects to be included in the model, and they do not require that specific hypotheses about moderator variables be made *a priori*. If subgroups of individuals who differ in the effects a predictor variable on an outcome are identified, then the predictors of these latent classes (differential effects) are assessed.

Regression mixture models have been used in the marketing literature to identify groups of consumers who differ in the values they place on products (Desarbo et al., 2001) but have not been widely used in the social sciences (a few exceptions are Kaplan, 2005; Schmiede, Levin, & Bryan, 2009; Van Horn et al., 2009). A goal of this paper is to introduce this method and its potential advantages to criminological research. Regression mixtures are particularly useful when differential effects are expected to be a function of multiple

predictors, each of which only partially predicts the differential effects and which may not be perfectly measured. Because this approach identifies differential effects empirically, it can find differential effects which would otherwise be difficult to model (Bauer, 2011; Van Horn et al., 2009). Because regression mixtures do not assume that differential effects are due to a limited number of variables, they offer a powerful approach for modeling individual differences in effects of independent variables.

2.4 Statistical Model for Regression Mixtures

Regression mixtures are an extension of finite mixture models (McLachlan & Peel, 2000) differentiated by the outcome in each class being modeled as conditional on the effects of a set of class specific covariates. The general form of a multivariate regression mixture model (B. O. Muthén & Asparouhov, 2009; Van Horn et al., 2009; Wedel & Desarbo, 1995) assumes that the residual distribution of the outcome variable is normally distributed within class. For criminologists, the assumption of normality is problematic because the distribution of criminal behavior typically is highly skewed. Previous work has shown that violations of the assumption of normality lead to serious bias in finding evidence for differential effects (latent class enumeration) and in parameter estimates (Van Horn et al., In Press). In this study, an ordered polytomous regression model is used as an alternative approach; it does not assume normal errors and has been shown to work well with skewed outcomes (George et al., In Press).

To estimate this model a continuous outcome is transformed to have S different ordered levels and the proportional odds assumption used is used for model identification. Expressed in its linear form, the model for the outcome conditional on covariate(s) $\mathbf{X}$ is

$$\text{logit}(\theta_s^k) = \text{logit}(P(Y_i \geq s | k, \mathbf{X})) = \beta_{0,s}^k + \sum_{p=1}^P \beta_p^k X_{ip} \quad s=1, \dots, S \quad (1)$$

Where the outcome is the logit of the probability that Y is greater than or equal to category s is conditional on the covariates. Model thresholds $\beta_{0,s}^k$ are estimated separately for each class and represent the logit of the probability of being at or above the response category on the outcome conditional on other predictors in the model. Differential effects across classes appear in the class specific regression of Y on covariate p : β_p^k . Model identification requires parameter constraints. Here we use the last class as a reference group and estimate the thresholds $\beta_{0,s}^k$ for classes 1 through $S-1$. No specific distributional assumption is made; however, the model does assume that θ_s^k is independent conditional on $\mathbf{X}$. The probability of being in each latent class and predictors of class membership can then be modeled in a separate logistic regression equation.

3.0 Research Methods

3.1 Sample

Because we want to clearly differentiate the use of regression mixture models from longitudinal latent class analyses and because the assessment of differential effects is not itself an inherently longitudinal question, we use cross sectional data in this paper. Data

were obtained in 2002 from 10th-grade students in public schools participating in a prior study of the dissemination of science-based prevention programming in 41 rural and suburban communities in seven states. Surveys were administered during one classroom period and students were ensured of the anonymity and confidentiality of their responses. Screening criteria were used to guard against dishonest or biased answers and included student reports of how honest they were in completing the survey, use of a fictitious drug, and inconsistencies in patterns of reported substance use and delinquency. Using these criteria, approximately 5% of the students were excluded from the analyses. The final sample in this paper was 7,349 10th grade students (mean age of 15.7 years) representing about 66% of the eligible population. Students were from 40 communities ranging in size from 1,578 to 106,221 residents, with an average population of 18,275 residentsⁱⁱ. About half (48%) the sample was male and the rest (52%) were female. About 78% of the students described themselves as Caucasian, 8% as Hispanic, 4% as African American, and 10% as from another racial/ethnic background. Two-thirds (67%) of the sample resided in two-parent households, 23% with a single parent, and 10% with neither parent.

3.2 Measures

Students completed the Communities That Care Youth Survey (Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002), which measures a variety of risk and protective factors and self-reported problem behaviors. The survey was developed using a large sample of public school students and has been shown to have strong measurement properties, including high reliability of the risk and protective factors, good criterion validity, and measurement invariance across gender and race/ethnicity (Arthur et al., 2002; Glaser, Van Horn, Arthur, Hawkins, & Catalano, 2005).

3.2.1 Parental Controls—Hirschi's (1969) description of the particular constructs that comprise parental controls and attachment is somewhat vague (Cernkovich & Giordano, 1987), but he emphasized that both instrumental (i.e., rule-setting, supervision and discipline) and expressive (e.g., warmth and attachment) controls were needed to prevent delinquency. He also discussed the importance of communication between parents and children, particularly the need for parents to clearly express their expectations for children's behavior (Gove & Crutchfield, 1982). The CTC Youth Survey includes six measures with 2 to 8 indicators of each that capture these types of parental controls, as discussed below and shown in Table 1. Factor scores for each measure were created using a confirmatory factor analysis (CFA) model, with items assumed to be ordinal. Factor scores were scaled to have means of zero, and standard deviations are a function of the reference variable. The psychometric properties and criterion validity of the scales are reported in detail elsewhere (Arthur et al., 2002; Glaser et al., 2005). Model fit for the CFA from which the factor scores were derived was $\chi^2 = 10209$, $df = 620$, $RMSEA = .045$ and $TLI = .963$. An examination of residuals showed no residual correlations outside the $-.20$ to $.20$ range.

Poor Family Management was assessed using eight items ($\alpha = 0.82$) that asked about parents' rules, expectations, and monitoring of children's behaviors (e.g., *Would your*

ⁱⁱData from 10th graders was available from only 40 of the 41 communities in 2002.

parents know if you did not come home on time? If you [drank alcohol, carried a handgun, skipped school], would you be caught by your parents?). Respondents indicated agreement with each item using a 4-point Likert scale in which higher scores indicated poor family management.

Parental Approval of Drug Use was measured with three items ($\alpha=0.82$) asking students' perceptions of the degree to which their parents would feel it was wrong for them to use alcohol, cigarettes, and marijuana. Parental Approval of Delinquency was measured with three similar items ($\alpha=0.78$) that asked students' perceptions of the degree to which their parents would feel it was wrong for them to steal, draw graffiti, or pick a fight with someone. All six items in these two scales were measured on a 4-point scale (from very wrong to not very wrong) such that higher scores indicated more approval of children's deviance.

Parental Reinforcement of Prosocial Behavior was measured using two items ($\alpha=0.88$) regarding parents' use of positive reinforcement (e.g., *How often do your parents tell you they're proud of you for something you've done?*). Each item was rated on a 4-point scale (from never to all of the time) and coded so that higher scores indicated more reinforcement.

Attachment to Mothers ($\alpha=0.88$) and Attachment to Fathers ($\alpha=0.91$) assess affective relationships between children and parents (e.g., *Do you feel very close to your mother/father?*). Each variable was assessed using three items measured on a 4-point scale (from very low to very high agreement), with higher scores representing more attachment.

3.2.2 Variables Predicting Differential Effects—Six variables reported by students on the CTC Survey were included as predictors of differential effects. Given the lack of explicit, theoretically-driven hypotheses regarding the potential for parental controls to have differential effects, and the specific variables that would moderate the effects of parental controls, the variables included in the analyses were selected based on prior studies that have examined the differential ability of parental controls to affect delinquency and drug use. These variables also represent a subset of important risk factors across contexts that have been related to adolescent drug use in empirical research (Hawkins et al., 1992). As such, they were thought to have strong potential to interact with parental controls to either increase or decrease adolescent drug use.

Two individual characteristics were assessed: gender and race/ethnicity (Caucasian versus other racial/ethnic backgrounds). Community norms favorable to drug use were assessed using student ratings on three items ($\alpha=0.87$) regarding how wrong adults in their neighborhood think it is for adolescents to use marijuana, alcohol, and tobacco (rated on a four-point Likert scale, from very wrong to not wrong at all). Low neighborhood attachment was based on students' endorsement of three items ($\alpha=0.79$) rated on a four-point scale assessing how much they enjoy living in their neighborhood (e.g., *If I had to move, I would miss the neighborhood I now live in*). Low commitment to school was measured with seven items ($\alpha=0.81$) assessing truancy, lack of effort in school, feeling that homework is unimportant, etc. (all rated on a five-point scale). Peer drug use was rated by students as the number of their best friends who used cigarettes, alcohol, marijuana and other drugs (four

items, $\alpha=0.84$, each rated on a five-point scale). Factor scores were created for these risk factors using one common factor model for all measures and following previously established measurement models (Glaser et al., 2005), and were scaled such that higher levels would be expected to predict more drug use. Descriptive information for all variables is shown in Table 1.

3.2.3 Substance Use—Based on survey items and response choices identical to those used in the Monitoring the Future Survey (Johnston et al., 2010), students reported the number of occasions in their lifetime they had used five substances: smokeless tobacco, cigarettes, alcohol (beer, wine, or hard liquor), inhalants, and marijuana. The dependent variable was a count of the number of substances used in the respondent's lifetime. Because only 3% of students reported lifetime use of all five substances, use of four and five substances was combined into a single category, such that the variable ranged from 0 (indicating no use of drugs) to 4 (indicating lifetime use of 4 or 5 of the drugs assessed) (see Table 1). As discussed above, previous work has shown biased results from analyses which assume a normal distribution of outcomes which are actually non-normal and has suggested ordered categorical variables as a viable alternative (Van Horn et al., 2012). Because the count of the number of substances used over one's lifetime provides a natural ordinal variable, we use that as the outcome in these models.

3.3 Data Analysis

Regression mixture models were estimated with Mplus version 6 (L. K. Muthén & Muthén, 2010). To evaluate the presence of differential effects of parental controls on substance use (the first research question), regression mixture models were used to identify latent classes representing differential effects of each of the six parental controls on adolescent substance use. For each parenting variable, this involved selecting the number of latent classes to be interpreted and determining whether or not classes were differentiated by differences in the effects of the parental control on drug use. The optimal number of classes was determined by estimating models with an increasing number of classes, K , and then comparing those models using information criteria, class proportions, and the interpretability of each class. Lower values of the Akaike information criterion (AIC), Bayesian information criterion (BIC), and adjusted BIC are preferred. Because the AIC has been found to perform poorly in regression mixture models (Van Horn et al., 2009; Van Horn et al., In Press), our interpretation of the results relied primarily on the BIC and adjusted BIC. The number of subjects in a class was also a key consideration in choosing a final model. Initial simulation studies suggest that with the ordinal outcome model, classes containing less than 750 subjects (about 10% in this case) may be unreliable.

Classes were interpreted based on class-specific thresholds, residual variances, and regression coefficients. To help interpret the latent classes, we estimated the mean substance use for each class by taking multiple samples of subjects in which each subject was assigned to one latent class with the probability of class assignment equal to the posterior class probabilities estimated from the model. Results were combined across all samples using the same method as when combining results in multiple imputation (Schafer, 1997). Because the design of the dataset is clustered with observations nested within 40 communities, intraclass

correlation coefficients (ICCs) and design effects were evaluated for evidence that analyses needed to account for the clustered data. ICCs ranged from .008 to .06. For analyses looking at the effects of within community predictors, the design effect is calculated by $1 + (n - 1) * ICC_Y * ICC_X$ (Neuhaus & Segal, 1993). In this case the maximum design effect was 1.49, which indicated relatively small bias in standard errors associated with clustering, but to be conservative, all analyses were run using sandwich estimators which adjust standard errors to account for clustering. Few differences were seen between results with and without this adjustment.

The second research question was assessed by a multinomial regression in which sex, race/ethnicity, and community, school, and peer risk factors were included as predictors of the latent classes. The multinomial regression parameters can be interpreted as the change in log odds of being in a given class versus the reference class for a one unit increase of the corresponding predictor. Because each predictor was also expected to be associated with substance use, we included the direct effects of each predictor on the outcome. In our experience, failure to include this direct effect, if it is present for individuals within a class, can lead to bias in other model parameters, a result supported by other preliminary simulations (Nylund & Masyn, 2007). Including a set of relatively strong predictors of drug use was expected to change the results of the regression mixture portion of the model and result in higher levels of entropy. Results were examined to determine if the substantive meaning of the latent classes was retained after the covariates were included.

4. Results

4.1 Evidence of Differential Effectiveness in the Effects of Parental Controls

The first research question examined whether or not parental controls were differentially related to substance use for different respondents, as indicated by the presence of two or more latent classes which differed in the effects of parental controls. Table 2 presents the results used to choose the appropriate number of classes, based on comparisons of models with 1, 2, and 3 classes. For the three instrumental parental controls--poor family management, parental approval of drug use, and parental approval of delinquency--the lowest values of the AIC, BIC, adjusted BIC were obtained for the three-class model (see Table 2). However, in each case, the size of the third class was small (containing 6% to 11% of the sample), and when the three-class solutions for all three outcomes were examined (results not shown), all but four parameter estimates for the smallest class were inadmissible (i.e., thresholds were outside the -15 to +15 range and the effect of each parental control was extreme: -7.2 in one case and 127 in the other case, which indicates near perfect collinearity on the logit scale). Importantly, the effects for the other two classes remained substantively the same as those in the two-class solution. Given the stability of the two-class solution, small class sizes, and unrealistic parameter estimates of the third classes, we chose to interpret the differential effects from the two-class solutions.

As shown in Table 2, there was little evidence of differential effectiveness for the other three parental controls: parental reinforcement of prosocial behaviors, attachment to mothers, and attachment to fathers. The BIC and adjusted BIC values were lower for the one-class versus

the two-class solutions for all three controls, indicating little evidence of differential effects for these predictors.

Given evidence of more than one latent class for the instrumental parental controls, differential effects were further examined by considering differences in the regression weights of poor family management, parental approval of drug use, and parental approval of delinquency on drug use (see Table 3). The thresholds correspond to the logit of being in the next highest level of substance use for someone at the mean of the parental control, and differential effects are evidenced in differences between classes in the slopes of the parental control variables. For each parenting variable, the effects of parental controls on substance use were significant for each of the two classes, indicating that higher levels of family risk—or weaker parental controls—were significantly associated with increased drug use among 10th grade students. In each case, the strength of this relationship was greater for the smaller class (Class 2), which contained 25% of the sample for poor family management, 33% of the sample for parental approval of drug use, and 32% for parental approval of delinquency. We refer to Class 2 as the strong effects class and Class 1 as the weaker effects class from this point on.

To better understand the differences between classes, the two-class solutions were graphically depicted. As shown in Figures 2-4, higher levels of weak parental controls (e.g., poor family management in Figure 2) were associated with higher predicted drug use, and the effects of this relationship were stronger for the smaller class of students, depicted using the steeper dashed lines. Although not shown in the figures, mean levels of drug use were *lower* for respondents in the strong effects classⁱⁱⁱ. Students in the strong effects class for poor family management were 0.92 standard deviations lower on substance use, students in this class for parental approval of drug use were 0.89 standard deviations lower, and students in this group for parental approval of delinquency were 0.92 standard deviations lower. Those in the strong effects class thus represent groups of students who on average used fewer drugs than other respondents, but in the presence of weak parental controls, their drug use increased dramatically.

4.2 Variables Predicting Differential Effects of Parental Controls

The second research question aimed to identify characteristics of the individuals for whom parental controls were more influential. Estimates for the six predictors of the latent classes identified above are shown in Table 4. The results in the first section of the table (“Class Invariant Covariates”) indicated that all of the variables except low neighborhood attachment had significant direct effects on adolescent substance use in the expected directions. Males and Caucasian respondents were more likely than females and those from other racial/ethnic groups to report substance use, as were adolescents living in communities with norms favorable to drug use, those having low commitment to school, and those reporting peers who used drugs.

ⁱⁱⁱMean levels of drug use were assessed using models which included the additional risk factor covariates and the imputation approach described in the data analysis section.

The results shown in the second section of Table 4 (“Class Specific Effects”) should be interpreted alongside those in Table 3 in order to assess whether the proportions of students in the two classes remained the same when class predictors were added and whether or not the classes maintained their substantive meaning. The findings indicated that the proportion of students in each of the two classes was similar (though not identical) in the models with and without the predictor variables. Also, the relationships between each of the parental controls and substance use remained statistically significant for both classes when the predictors were added, and these relationships continued to be stronger for individuals in the strong effects class (Class 2) compared to the weaker effects class (Class 1). However, the strength of these coefficients was diminished when the latent class predictors were added to the models, which was expected given that most predictors also had direct effects on adolescent substance use.

The findings in the bottom of Table 4 directly pertain to the second research question, as they indicate the association between each risk factor and membership in the strong effects versus the weaker effects class (the reference class). The results indicated that gender (i.e., being male) and low commitment to school did not predict class membership, but the other variables were significant predictors. Caucasian youth were more likely to be in the strong effects class, compared to those from other racial/ethnic groups, for all three parental control variables. In addition, across all three parental controls, youth who reported higher levels of community and peer risk factors were less likely to be in the strong effects class and more likely to be in the weaker effects class. That is, the strength of the association between weak parental controls and drug use was less for youth who reported that their neighbors were more supportive of adolescent drug use and who had lower attachment to their neighborhoods and more exposure to drug-using peers. These results do not indicate risk amplification—that weak parental controls would increase drug use more for children experiencing other risk factors—but rather evaporation or contextual dissipation, in which the effects of weak parental controls were *smaller* for youth who also faced risk factors in their communities and peer groups.

5. Discussion

Implicit in social control theory is the assumption that social constraints have the same potential to deter delinquency across individuals. The purpose of this paper was to test this assumption. We hypothesized that the impact of social constraints (i.e., parental controls) would not be the same for all individuals and aimed to identify, using a relatively novel statistical methodology, the individuals for whom parental controls were most important. While this paper illustrated the potential of regression mixture models to assess differential effects based on social control theory, this methodology can also be applied to other theories and outcomes in order to better specify the complex forces leading to involvement in illegal behaviors.

The findings, like much past research (Burton et al., 1995; Derzon, 2010; Hirschi, 1969), demonstrated support for social control theory, in that weak parental controls were significantly related to increased adolescent substance use. That these results were found for a relatively diverse group of 10th grade students is important in indicating that parents

remain influential even later in adolescence, a developmental period in which children tend to seek autonomy from their parents and face significant risk factors for problem behaviors in other areas of their life (Dishion et al., 2004; Thornberry, 1987).

The results also help to refine and add precision to social control theory by identifying groups of individuals for whom parental controls are most influential. In this study, the effects of instrumental controls--poor family management, parental attitudes regarding drug use, and parental attitudes regarding delinquency--differed across individuals. These variables were related to drug use for the full sample, but were particularly important for Caucasian children (compared to other racial/ethnic groups) and for those who reported lower levels of exposure to community and peer risk factors; specifically, those with stronger neighborhood attachment and who were less likely to have neighbors who supported drug use and peers who used drugs. Differential effects were not predicted by gender or students' commitment to school. The latter results are consistent with past research that has found similar effects of parenting practices on drug use for females and males (Fagan et al., 2007; Scaramella, Conger, & Simons, 1999; Smith & Paternoster, 1987). Very few studies have examined family by school interactions, and more research is needed to explore these relationships.

The differential effects that were demonstrated differ from past work indicating risk amplification, which occurs when family risk has a greater impact for children experiencing greater risk in other social contexts (Barnes et al., 2006; Brody et al., 2003; Dishion et al., 2004; Hay et al., 2006; Plybon & Kliwer, 2001). However, the results are similar to studies indicating evaporation or contextual dissipation effects (Cleveland et al., 2010; Gorman-Smith et al., 2000; Simons et al., 2005; Simons et al., 2002; Wickrama & Bryant, 2003), in which the influence of parental controls is *weaker* for children facing risk factors in other contexts. While Hirschi's (1969) analyses of the Richmond Youth Project data showed risk amplification effects, with attachment having a stronger effect for children with deviant peers, evaporation effects are not completely incompatible with control theory. Krohn and Massey (1980) assert that this theory is better able to explain minor forms of delinquency than more serious offending, and thus, bonding may be more effective for lower-risk youth.

In contrast to the findings for instrumental parental controls, there was no evidence of differential effectiveness for the three expressive parental controls assessed--parental reinforcement of prosocial behaviors, attachment to mothers, and attachment to fathers. As social control theory would predict, these parenting practices were equally effective in reducing drug use across individuals. It is difficult to determine why affective controls would have universal effects while the influence of instrumental controls would vary across individuals, given that Hirschi (1969) suggests that both types are important. The results could be related to the age of the sample. The fact that teenagers are asserting their freedom and independence from parents may limit the salience of parents' rules and expectations, at least for adolescents experiencing other important risk factors. Parents tend to reduce their monitoring of children during late adolescence, which will also leave children more vulnerable to deviant influences. Even though affective relationships between parents and children can be strained during adolescence, the emotional bond may still be strong enough to deter delinquency.

These interpretations are speculative, however, and more research is needed to explore the potential for differential effectiveness across different types of parental controls, different developmental periods, and other types of illegal behaviors. Other limitations of the current study should be considered. The data were obtained from a school-based sample which likely under-represents youth at greatest risk for engaging in substance use: those who are chronically truant or who have dropped out of school. Although information was collected from a large, diverse sample of 10th grade students, the communities in which they resided were rural and suburban and the majority of students were Caucasian; the findings may not be generalizable to youth from other racial/ethnic groups or living in urban, high-risk communities. Finally, the use of cross-sectional data and reliance on a measure of lifetime drug use limits our ability to determine causal relationships between parental controls and adolescent drug use and cannot rule out reciprocal effects, whereby children's behaviors affect parenting practices.

The regression mixture modeling technique used in this study also has some limitations. This method is best conducted using large samples, as in the current paper. Further, parameter estimation is dependent on model assumptions. For example, in this study, we relaxed the assumption of normality in favor of the proportional odds assumption. However, as outcome distributions become highly skewed, which is common in criminological research, this assumption may also be less tenable. We measured substance use using a count of the number of drugs used over the lifetime, rather than the prevalence or frequency of past month drug use because the latter would have been more highly skewed and the proportional odds assumption not likely to hold. Identification of alternative model parameterizations which are more appropriate for very low frequency outcomes is an important area for future work to explore. Another issue to be considered is that this methodology is inherently a data driven approach to finding differential effects. This is advantageous in that it can be quite difficult to specify a priori the complex processes which lead individuals to respond differently to particular influences, and this methodology can provide a useful first step in identifying heterogeneity in the effects of key variables (parental controls in this case). However, given that this is largely an exploratory approach, the current findings must be subject to further validation to rule out the possibility that they are due to chance features of the data or particular model assumptions.

Further application of regression mixtures is needed to better understand its strengths, weaknesses, and application to other theoretical perspectives and/or illegal behaviors. This method offers a methodologically advanced approach to theory-testing and theory-building, as it allows for more detailed examination of processes underlying illegal behavior. Regression mixture models offer a somewhat different way of examining differential effects, using an inductive rather than deductive process that begins by searching for evidence of differential effectiveness, then seeking to identify predictors of these effects. This approach contrasts to other methods which require a priori identification of potential moderators and then individual tests of each interaction term. A substantive advantage of the regression mixture models approach is that the identification of differential effects becomes a focus of the research. A statistical advantage is that this approach can be more effective in examining the differential effects caused by multiple predictors than traditional interaction models, and it does not require the moderating variable to be perfectly measured. Given these advantages

and the ability for better specified theories to more realistically and fully explain criminal offending (Tittle, 1995), we hope to see expanded use of regression mixture models in the future.

Acknowledgments

This research was supported by grant #R01 HD054736, M. Lee Van Horn (PI), funded by the National Institute of Child Health and Human Development. Data for the paper are from the Diffusion Study, J. David Hawkins (PI), funded by Grant #R01 DA10768 from the National Institute on Drug Abuse (NIDA).

References

- Aiken, LS.; West, SG. Multiple regression: Testing and interpreting interactions. Thousand Oaks, CA: Sage Publications; 1991.
- Arthur MW, Hawkins JD, Pollard JA, Catalano RF, Baglioni AJ Jr. Measuring risk and protective factors for substance use, delinquency, and other adolescent problem behaviors: The Communities That Care Youth Survey. *Eval Rev.* 2002; 26(6):575–601. [PubMed: 12465571]
- Barnes GM, Hoffman JP, Welte JW, Farrell MP, Dintcheff BA. Effects of parental monitoring and peer deviance on substance use and delinquency. *J Marriage Fam.* 2006; 68(4):1084–1104.
- Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J Pers Soc Psychol.* 1986; 51:1173–1182. [PubMed: 3806354]
- Bauer DJ. Evaluating individual differences in psychological processes. *Curr Dir Psychol Sci.* 2011; 20:115–118.
- Bernard TJ, Snipes JB. Theoretical integration in criminology. *Crime and Justice.* 1996; 20:301–348.
- Blitstein JL, Murray DM, Lytle LA, Birnbaum AS, Perry CL. Predictors of violent behavior in an early adolescent cohort: Similarities and differences across genders. *Health Educ Behav.* 2005; 32(2): 175–194. [PubMed: 15749965]
- Boyce WT, Frank E, Jensen PS, Kessler RC, Nelson CA, Steinberg L. Social context in developmental psychopathology: Recommendations for future research from the MacArthur Network on Psychopathology and Development. *Dev Psychopathol.* 1998; 10:143–164. [PubMed: 9635219]
- Brody G, Ge X, Kim SY, Murray VM, Simons RL, Gibbons FX, et al. Neighborhood disadvantage moderates associations of parenting and older sibling problem attitudes and behavior with conduct disorders in African American children. *J Consult Clin Psychol.* 2003; 71(2):211–222. [PubMed: 12699016]
- Burton VS Jr, Cullen FT, Evans TD, Dunaway RG, Ketheneni SR, Payne GL. The impact of parental controls on delinquency. *J Crim Justice.* 1995; 23(2):111–126.
- Canter RJ. Family correlates of male and female delinquency. *Criminology.* 1982; 20(2):149–167.
- Catalano, RF.; Hawkins, JD. The Social Development Model: A theory of antisocial behavior. In: Hawkins, JD., editor. *Delinquency and crime: Current theories.* New York, NY: Cambridge University Press; 1996. p. 149-197.
- Cernkovich S, Giordano PC. Family relationships and delinquency. *Criminology.* 1987; 25(2):295–319.
- Cleveland MJ, Feinberg ME, Greenberg MT. Protective families in high- and low-risk environments: Implications for adolescent substance use. *J Youth Adolesc.* 2010; 39:114–126. [PubMed: 20084558]
- Crosnoe R, Erickson KG, Dornbusch SM. Protective functions of family relationships and school factors on the deviant behavior of adolescent boys and girls: Reducing the impact of risky friendships. *Youth Soc.* 2002; 33(4):515–544.
- Cusworth Walker S, Maxson C, Maxfield MG. Parenting as a moderator of minority, adolescent victimization and violent behavior in high-risk neighborhoods. *Violence Vict.* 2007; 22(3):304–317. [PubMed: 17619636]

- Derzon JH. The correspondence of family features with problem, aggressive, criminal, and violent behavior: A meta-analysis. *J Exp Crim.* 2010; 6:263–292.
- Desarbo WS, Jedidi K, Sinha I. Customer value analysis in a heterogeneous market. *Strategic Manage J.* 2001; 22:845–857.
- Dishion TJ, Nelson SE, Bullock BM. Premature adolescent autonomy: parent disengagement and deviant peer process in the amplification of problem behaviour. *J Adolescence.* 2004; 27:515–530.
- Elliott, DS.; Huizinga, D.; Ageton, SS. Explaining delinquency and drug use. Beverly Hills, CA: Sage Publications; 1985.
- Fagan AA, Van Horn ML, Hawkins JD, Arthur M. Gender similarities and differences in the association between risk and protective factors and self-reported serious delinquency. *Prev Sci.* 2007; 8(2):115–124. [PubMed: 17226092]
- Farrell AD, Henry DB, Mays SA, Schoeny ME. Parents as moderators of the impact of school norms and peer influences on aggression in middle school students. *Child Dev.* 2011; 82(1):146–161. [PubMed: 21291434]
- George MRW, Yang N, Van Horn ML, Smith J, Jaki T, Feaster D, et al. Using regression mixture models with non-normal data: Examining an ordered polytomous approach. *J Stat Comput Sim.* In Press.
- Glaser RR, Van Horn ML, Arthur MW, Hawkins JD, Catalano RF. Measurement properties of the Communities that Care Youth Survey across demographic groups. *J Quant Criminol.* 2005; 21(1): 73–102.
- Gorman-Smith D, Tolan PH, Henry DB. A developmental-ecological model of the relation of family functioning to patterns of delinquency. *J Quant Criminol.* 2000; 16(2):169–198.
- Gottfredson, MR.; Hirschi, T. A general theory of crime. Stanford, CA: Stanford University Press; 1990.
- Gove WR, Crutchfield RD. The family and juvenile delinquency. *Sociol Q.* 1982; 23(3):301–319.
- Hagan J, Gillis AR, Simpson J. Class in the household: A power-control theory of gender and delinquency. *AJS.* 1987; 92(4):788–816.
- Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychol Bull.* 1992; 112(1):64–105. [PubMed: 1529040]
- Hay C, Fortson EN, Hollist DR, Altheimer I, Schaible LM. The impact of community disadvantage on the relationship between the family and juvenile crime. *J Res Crime Delinq.* 2006; 43(4):326–356.
- Heimer K, De Coster S. The gendering of violent delinquency. *Criminology.* 1999; 37(2):277–318.
- Henry DB, Tolan PH, Gorman-Smith D. Longitudinal family and peer group effects on violent and nonviolent delinquency. *J Clin Child Psychol.* 2001; 30(1):172–186. [PubMed: 11393918]
- Hill GD, Atkinson MP. Gender, familial control, and delinquency. *Criminology.* 1988; 26(1):127–147.
- Hirschi, T. Causes of delinquency. Berkeley, CA: University of California Press; 1969.
- Hoeve M, Dubas JS, Eichelsheim VI, Van der Laan PH, Smeenk W, Gerris JRM. The relationship between parenting and delinquency: A meta-analysis. *J Abnorm Child Psych.* 2009; 37:749–775.
- Holsinger K, Holsinger AM. Differential pathways to violence and self-injurious behavior: African American and White girls in the juvenile justice system. *J Res Crime Delinq.* 2005; 42(2):211–242.
- Jang SJ, Krohn MD. Developmental patterns of sex differences in delinquency among African American adolescents: A test of the sex-invariance hypothesis. *J Quant Criminol.* 1995; 11(2): 195–222.
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future: National results on adolescent drug use: Overview of key findings, 2009. Bethesda, MD: National Institute on Drug Abuse; 2010.
- Kaplan D. Finite mixture dynamic regression modeling of panel data with implications for response analysis. *J Educ Behav Stat.* 2005; 30(2):169–187.
- Kornhauser, R. Social sources of delinquency. Chicago: University of Chicago Press; 1978.
- Krohn MD, Massey JL. Social control and delinquent behavior: An examination of the elements of the social bond. *Sociol Q.* 1980; 21:529–543.

- Kroneman L, Loeber R, Hipwell AE, Koot HM. Girls' disruptive behavior and its relationship to family functioning: A review. *J Child Fam Stud*. 2009; 18:259–273. [PubMed: 20161077]
- Loeber, R.; Stouthamer-Loeber, M. Family factors as correlates and predictors of juvenile conduct problems and delinquency. In: Tonry, M.; Morris, N., editors. *Crime and Justice: An annual review of the research*. Vol. 7. Chicago: University of Chicago Press; 1986. p. 29-149.
- Luthar SS, Cicchetti D, Becker B. The construct of resilience: A critical evaluation and guidelines for future work. *Child Dev*. 2000; 71(3):543–562. [PubMed: 10953923]
- Marshall MP, Chassin L. Peer influence on adolescent alcohol use: The moderating role of parental support and discipline. *Applied Dev Sci*. 2000; 4(2):80–88.
- McLachlan, G.; Peel, D. *Finite mixture models*. New York: John Wiley & Sons, Inc; 2000.
- Moffitt, TE.; Caspi, A.; Rutter, M.; Silva, P., editors. *Sex differences in antisocial behaviour: Conduct disorder, delinquency, and violence in the Dunedin Longitudinal Study*. Cambridge: Cambridge University Press; 2001.
- Muthén BO, Asparouhov T. Multilevel regression mixture analysis. *J R Stat Soc, Ser A*. 2009; 172:639–657.
- Muthén, LK.; Muthén, BO. *Mplus (Version 6)*. Los Angeles: Muthén & Muthén; 2010.
- Neuhaus JM, Segal MR. Design effects for binary regression models fitted to dependent data. *Stat Med*. 1993; 12:1259–1268. [PubMed: 8210825]
- Nylund, K.; Masyn, K. Covariates and growth mixture modeling: Early simulation results into the mystery of when and how to include covariates; Paper presented at the Annual Meeting of the Society for Prevention Research; Washington DC. 2007.
- Plybon LE, Klierer W. Neighborhood types and externalizing behavior in urban school-age children: Tests of direct, mediated and moderated effects. *J Child Fam Stud*. 2001; 10(4):419–437.
- Reckless, W. *The crime problem*. Third. New York: Appleton-Century-Crofts; 1961.
- Rowe DC, Vazsonyi AT, Flannery DJ. Sex differences in crime: Do means and within-sex variation have similar causes? *J Res Crime Delinq*. 1995; 32:84–100.
- Scaramella LV, Conger RD, Simons RL. Parental protective influences and gender-specific increases in adolescent internalizing and externalizing problems. *J Res Adoles*. 1999; 9(2):111–141.
- Schafer, JL. *Analysis of incomplete multivariate data*. New York: John Wiley & Sons, Inc; 1997.
- Schmiege SJ, Levin ME, Bryan AD. Regression mixture models of alcohol use and risky sexual behavior among criminally-involved adolescents. *Prev Sci*. 2009; 10:335–344. [PubMed: 19459047]
- Schonberg MA, Shaw DS. Do the predictors of child conduct problems vary by high- and low-levels of socioeconomic and neighborhood risk? *Clin Child Fam Psychol*. 2007; 10(2):101–136.
- Simons RL, Gordon Simons L, Burt CH, Brody G, Cutrona C. Collective efficacy, authoritative parenting and delinquency: A longitudinal test of a model integrating community- and family-level processes. *Criminology*. 2005; 43(4):989–1029.
- Simons RL, Lin K-H, Gordon LC, Brody GH, Murry V, Conger RD. Community differences in the association between parenting practices and child conduct problems. *J Marriage Fam*. 2002; 64:331–345.
- Smith DA, Paternoster R. The gender gap in theories of deviance: Issues and evidence. *J Res Crime Delinq*. 1987; 24(2):140–172.
- Thornberry TP. Toward an interactional theory of delinquency. *Criminology*. 1987; 25:863–891.
- Thornberry TP, Lizotte AJ, Krohn MD, Farnworth M, Jang SJ. Testing interactional theory: An examination of reciprocal causal relationships among family, school, and delinquency. *J Crim Law Criminol*. 1991; 82(1):3–35.
- Tittle, CR. *Control balance: Toward a general theory of deviance*. Boulder, CO: Westview; 1995.
- Van Horn ML, Jaki T, Masyn K, Ramey SL, Antaramian S, Lemanski A. Assessing differential effects: Applying regression mixture models to identify variations in the influence of family resources on academic achievement. *Dev Psychol*. 2009; 45:1298–1313. [PubMed: 19702393]
- Van Horn ML, Smith J, Fagan AA, Jaki T, Feaster D, Masyn K, et al. Not quite normal: Consequences of violating the assumption of normality with regression mixture models. *Struct Equ Modeling*. 2012; 19:227–249. [PubMed: 22754273]

- Wallace JM, Muroff JR. Preventing substance abuse among African American children and youth: Race differences in risk factor exposure and vulnerability. *The J Prim Prev.* 2002; 22(3):235–261.
- Wedel M, Desarbo WS. A mixture likelihood approach for generalized linear models. *J Classif.* 1995; 12:21–55.
- Wickrama KAS, Bryant CM. Community context of social resources and adolescent mental health. *J Marriage Fam.* 2003; 65:850–866.
- Windle M, Brener N, Cuccaro P, Dittus P, Kanouse DE, Murray N, et al. Parenting predictors of early-adolescents' health behaviors: Simultaneous group comparisons across sex and ethnic groups. *J Youth Adolesc.* 2010; 39(6):594–606. [PubMed: 20422349]
- Wright R, Cullen FT. Parental efficacy and delinquent behavior: Do control and support matter? *Criminology.* 2001; 39(3):677–706.

Figure 1. Statistical Model for Identifying Predictors of Differential Effects of Parental Controls on Drug Use

Figure 2. Relationship of Poor Family Management to the Probability of Responding at the Next Highest Drug Use Category

Note: Each line represents a step function indicating the level of family management at which greater than 50% of respondents in that class would be expected to endorse each level of drug use.

— Weaker Effects Class - - - - Strong Effects Class

Figure 3. Relationship of Parental Approval of Drug Use to the Probability of Responding at the Next Highest Drug Use Category Two

Note: Each line represents a step function indicating the level of parental approval at which greater than 50% of respondents in that class would be expected to endorse each level of drug use.

Figure 4. Relationship of Parental Approval of Delinquency to the Probability of Responding at the Next Highest Drug Use Category Two

Note: Each line represents a step function indicating the level of parental approval at which greater than 50% of respondents in that class would be expected to endorse each level of drug use.

Table 1

Sample Descriptive Information

	Mean	SD	Skew	Range	
				Min	Max
Parent Controls					
Poor Family Management	0	.66	.48	-.86	2.52
Parental Approval of Drug Use	0	1.05	2.01	-.42	4.76
Parental Approval of Delinquency	0	.90	2.33	-.48	4.98
Reinforcement of Prosocial Behavior	0	.96	-.26	-2.12	1.10
Attachment to Mother	0	.93	-.70	-2.55	.91
Attachment to Father	0	.91	-.39	-1.96	1.08
Moderating (Predictor) Variables					
Male	48%				
Caucasian (vs. Other)	78%				
Community Norms Favorable to Drug Use	0	1.02	.96	-.62	3.27
Low Neighborhood Attachment	0	.87	.44	-.98	2.07
Low Commitment to School	0	.65	.52	-1.22	2.89
Peer Drug Use	0	.94	.86	-.60	2.85
Substance Use					
No Use	32%				
Used 1 drug	18%				
Used 2 drugs	15%				
Used 3 drugs	19%				
Used 4 or more drugs	17%				

Table 2

Fit Indices for Latent Class Enumeration for Parental Controls

FIT INDICES	Poor Family Management			Parent Approval of Drug Use			Parent Approval of Delinquency			Reinforcement of Prosocial Behavior			Attachment to Mother			Attachment to Father		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	
Classes																		
-2LL	-11050	-11001	-10961	-10869	-10771	-10663	-11222	-11178	-11127	-11354	-11345	-11408	-11401	-11385	-11370			
Entropy	1.0	0.53	0.54	1.0	0.32	0.61	1.0	0.23	0.44	1.0	0.50	1.0	0.88	1.0	0.38			
AIC	22110	22024	21956	21748	21563	21361	22455	22379	22289	22717	22713	22827	22823	22780	22762			
BIC	22145	22100	22073	21783	21639	21478	22490	22455	22406	22752	22789	22861	22899	22815	22838			
Adj BIC	22129	22065	22019	21767	21604	21424	22474	22420	22352	22736	22754	22845	22864	22799	22803			
Smallest Class	n/a	0.25	0.06	n/a	0.33	0.11	n/a	0.32	0.11	n/a	0.15	n/a	0.05	n/a	0.34			

NOTE: N=7349 AIC=Akaike information criterion; BIC=Bayesian information criterion; Adj BIC=adjusted Bayesian information criterion; For the penalized information criteria the optimal model is in bold.

Table 3
Parameter Estimates, Standard Errors and Effects of Parental Controls for the Two-class Models

Parameters	Poor Family Management				Parent Approval of Drug Use				Parent Approval of Delinquency			
	Class 1 (75%)		Class 2 (25%)		Class 1 (67%)		Class 2 (33%)		Class 1 (68%)		Class 2 (32%)	
	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
$\tau 1$ vs 2	-0.51	0.12	-1.19	0.18	-1.31	0.13	-0.35	0.16	-1.21	0.13	-0.24	0.21
$\tau 2$ vs 3	0.42	0.11	-0.58	0.20	-0.39	0.11	1.57	0.29	-0.28	0.12	0.64	0.16
$\tau 3$ vs 4	1.29	0.13	-0.33	0.28	0.41	0.09	2.78	0.46	0.41	0.11	1.48	0.27
$\tau 4$ vs 5	4.00	0.84	-0.06	0.35	1.66	0.08	4.83	1.09	1.56	0.14	2.80	0.48
Slope of parental control	0.82*	0.11	3.06*	0.38	0.34*	0.06	4.12*	0.75	0.20*	0.07	2.50*	0.40

* statistically significant slopes ($p < .05$).

Note: τ (tau) is the logit of being in the next highest level of substance use for someone at the mean of the parental control.

Table 4

Parameters and Standard Errors for Predictors of Class Membership for the Three Parental Controls

	Poor Family Management	Parent Approval of Drug Use	Parent Approval of Delinquency
	Class Invariant Covariates ¹		
Male	0.20* (0.08)	0.22* (0.07)	0.22* (0.07)
Caucasian	0.20* (0.08)	0.21* (0.09)	0.21* (0.08)
Comm norms favorable to drugs	0.20* (0.04)	0.11* (0.04)	0.19* (0.03)
Low neighborhood attachment	-0.06 (0.03)	-0.03 (0.03)	-0.04 (0.03)
Low commitment to school	0.18* (0.05)	0.24* (0.05)	0.23* (0.05)
Peer drug use	1.01* (0.06)	1.02* (0.07)	1.03* (0.06)
	Class Specific Effects		
	Class 1 (73%)	Class 2 (27%)	Class 1 (74%) Class 2 (26%)
Parent Controls ²			
τ1 vs 2	0.31* (0.06)	0.67* (0.11)	0.27* (0.03) 1.54* (0.43) 0.18* (0.03) 0.66* (0.34)
τ2 vs 3	-1.06 (0.09)	1.14 (0.20)	-1.02 (0.10) 0.71 (0.21) -1.07 (0.10) 1.09 (0.21)
τ3 vs 4	0.17 (0.09)	3.32 (0.47)	0.19 (0.09) 2.66 (0.39) 0.16 (0.09) 3.19 (0.47)
τ4 vs 5	1.17 (0.08)	11.19 (390.8)	1.21 (0.08) 3.94 (0.49) 1.16 (0.08) 7.69 (10.19)
	2.66 (0.09)	11.19 (390.8)	2.72 (0.08) 4.96 (0.51) 2.64 (0.08) 7.69 (10.19)
	Covariates Predicting Membership in the Strong Effects Class (Class 2)		
Intercept	--	-3.26* (0.87)	-- -3.73* (1.13) -- -3.57* (0.89)
Male	--	0.15 (0.25)	-- 0.24 (0.31) -- 0.29 (0.26)
Caucasian	--	1.21* (0.29)	-- 1.61* (0.35) -- 1.24* (0.32)
Comm norms favorable to drugs	--	-0.47* (0.17)	-- -0.62* (0.22) -- -0.49* (0.19)
Low neighborhood attachment	--	-0.37* (0.16)	-- -0.53* (0.22) -- -0.43* (0.17)
Low commitment to school	--	-0.29 (0.21)	-- -0.25 (0.31) -- -0.32 (0.22)
Peer drug use	--	-5.69* (1.24)	-- -5.98* (1.68) -- -6.00* (1.23)

N=7349;

* statistically significant slopes ($p < .05$).Note: τ (tau) is the logit of being in the next highest level of substance use for someone at the mean of the parental control.¹ The parameters indicate the effects of the covariates on substance use, with the effects constrained to be the same across classes.

² Each of the three models predicting class membership includes the relevant parent control variable (e.g., the first model predicting poor family management includes the poor family management and the other risk factors).