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Does Change in Teenage Religiosity Predict Change in Marijuana Use Over Time?

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ABSTRACT

Previous research on religiosity and substance use primarily used cross-sectional data or, at best, two waves of data separated by a year. In contrast, we use five waves of the National Youth Survey to determine whether religiosity predicts long-term trajectories of marijuana use and whether changes in religiosity predict changes in marijuana use over time. The results suggest that religious youths use marijuana less often initially and, in contrast to nonreligious youths, exhibit smaller increases in marijuana use over time. In fact, the results suggest that highly religious adolescents are unlikely to experience any increase in marijuana use over time. When religiosity changes over time, the initial level of religiosity does not predict changes in marijuana use. However, changes in religiosity are significantly related to changes in marijuana use. When adolescent religiosity increases, marijuana use tends to decrease, and vice versa. Adolescents who maintain their high levels of religiosity over time are less likely to use marijuana, while consistently nonreligious youths are less likely to decrease their marijuana use.

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Only a limited number of studies have used longitudinal data to examine the relationship between religiosity and delinquency or substance use (for a few exceptions, see Giordano et al. 2008; Jang, Bader, and Johnson 2008; Jang and Johnson 2010; Petts 2009; Ulmer et al. 2010). Instead, research on religiosity has relied heavily on cross-sectional designs. For instance, a recent systematic review, which included more than 100 studies on religiosity and substance use, revealed that four out of five studies published between 1997 and 2006 were cross-sectional (Chitwood, Weiss, and Leukefeld 2008). Similarly, an earlier review of research on religiosity and delinquency found that thirty-five out of forty studies were cross-sectional (Byron Johnson et al. 2000). In addition to the overabundance of cross-sectional studies, many longitudinal studies consist of only two waves of data separated by a year. Therefore many of the existing longitudinal studies of religiosity and substance use have covered very short periods of time.

Because there have been few longitudinal studies of religiosity and substance use, we know little about the long-term effects of adolescent religiosity on substance use or about how changes in religiosity influence changes in delinquency over the life course. Previous research indicates that religious behaviors and attitudes do change, especially as adolescents make the transition to young adulthood (Desmond, Morgan, and Kikuchi 2010; Uecker, Regnerus, and Vaaler 2007). Among adolescents who attend religious services at least once a month, almost 70 percent attend less often when they become young adults (Uecker, Regnerus, and Vaaler 2007). Furthermore, 20 percent of adolescents report that religion is less important when they become young adults (Uecker, Regnerus, and Vaaler 2007). Although such studies have shown that religious behaviors and attitudes, especially religious service attendance, change significantly from adolescence to young adulthood, few studies have examined how changes in religiosity over an extended period of time influence substance use.

Jang, Bader, and Johnson (2008: 771–772) contend that "previous studies of religious effects on drug use have been mostly nondevelopmental, despite the increasing emphasis on life course perspectives within criminology over the last 20 years" (see also Giordano et al. 2008). Jang, Bader, and Johnson (2008: 772) additionally argue that childhood religiosity can "result in cumulative advantages that build throughout the life course." Using three waves of data from the National Survey of Children, they also found that children who were reared in religious households were more likely than other children to be religious and to remain religious into adulthood. Children's religiosity was also positively related to protective factors, such as attachment to parents and school, and negatively related to risk factors, such as associating with delinquent peers and low self-control. Ultimately, children who were raised by religious parents were less likely to use drugs in adolescence and young adulthood. Therefore childhood religiosity

results in advantages, such as strong parental attachment and higher self-control, which gradually accumulate through adolescence and continue into adulthood.

To address some of the limitations of previous research, we use growth curve modeling to examine how adolescent religiosity influences marijuana use across five waves (1978–1987) of the National Youth Survey (NYS), a longitudinal study of adolescents living in the United States. After determining how patterns of marijuana use change from adolescence to young adulthood, we attempt to address the following research questions. First, does adolescent religiosity predict long-term trajectories of marijuana use? To answer this question, we examine the relationship between adolescent religiosity, measured at Wave III of the NYS, and patterns of marijuana use from Wave III to Wave VII. Second, do changes in religiosity predict changes in marijuana use over time? For the second question, we model the effect of changes in religiosity from Wave III to Wave VII of the NYS on changes in marijuana use during the same time period.

THEORETICAL BACKGROUND AND LITERATURE REVIEW

Previous research consistently shows that religious youths are less likely than nonreligious youths to engage in delinquency and/or substance use (Baier and Wright 2001; Chitwood, Weiss, and Leukefeld 2008; Byron Johnson et al. 2000). Several different theories have been used to study the relationship between religiosity and delinquency and substance use, including social bonding theory (Bahr, Hawks, and Wang 1993; Cretacci 2003), social learning theory (Bahr, Hawks, and Wang 1993; Marcos, Bahr, and Johnson 1986), strain theory (Jang and Johnson 2005; Matthew Johnson and Morris 2008; Wills, Yaeger, and Sandy 2003), and low self-control theory (Geyer and Baumeister 2005; Welch, Tittle, and Grasmick 2006).

Social Bonding Theory

Social bonding theory assumes that individuals are self-serving and will act in ways that provide the greatest benefit to themselves (Hirschi 1969). Because of this hedonistic view of human nature, Hirschi (1969: 10) argued that criminologists need to explain "why people obey the rules" rather than why they commit crimes. According to Hirschi (1969), adolescents refrain from substance use when they develop a bond to social institutions, such as family and school. In contrast, when adolescents do not have a strong social bond, they are free to engage in substance use.

According to Hirschi (1969), the social bond consists of four elements: attachment, commitment, involvement, and belief. Attachment is the emotional bond adolescents have with others, including parents, teachers, and peers (Hirschi

1969). When adolescents do not care about the expectations of other people, they are more likely to engage in substance use. Commitment is the investment individuals have in society or social institutions and the amount of risk involved in using illegal substances (Hirschi 1969). Adolescents who lack commitment are more likely to engage in substance use because they have nothing to lose. Involvement refers to adolescents' participation in conventional activities (Hirschi 1969). Heavy involvement in legitimate activities leaves no time for substance use. The last element, belief, refers to the extent to which individuals think they should obey the law (Hirschi 1969: 23–26). Adolescents who do not believe in the rules of society, or who do not believe that a particular behavior is wrong, are more likely to break those rules than are adolescents who believe that the rules should be followed.

When discussing the elements of the social bond, Hirschi (1969) emphasized the family and school. Scholars argue that religiosity is an additional element of the social bond that can influence both initiation into and desistance from delinquency and substance use (Adamczyk and Palmer 2008; Chu 2007; Longest and Vaisey 2008). Like attachment, commitment, involvement, and belief, religious behaviors and attitudes can prevent substance use. The other elements of the social bond may also be influenced by religiosity. For example, adolescent religiosity is significantly related to parental attachment (Smith and Denton 2005). Commitment can be reinforced by religious institutions, which often foster a cognitive orientation toward the future. Involvement in religious activities, including church attendance and religious youth groups, absorbs time that might otherwise be used for recreational substance use. Finally, religiosity enhances conventional moral beliefs, which then reduce delinquency (Byron Johnson et al. 2001). Thus religiosity, in conjunction with attachment, commitment, involvement, and belief, can play an important role in preventing substance use.

Social Learning Theory

The relationship between religiosity and substance use has also been investigated within the framework of social learning theory (Akers 1973). Social learning theory extends Sutherland's (1947) differential association theory by reframing and broadening the scope of how substance use is learned. In essence, "social learning theory offers an explanation of crime and deviance which embraces variables that operate both to motivate and control criminal behavior; both to promote and undermine conformity" (Akers and Sellers 2004: 85). Based in behavioral psychology, social learning theory argues that the social environment that individuals' interact with and learn from is the most important source of reinforcement for behavior.

According to social learning theory, substance use is learned through four distinct processes: differential association, definitions, imitation, and differential reinforcement (Akers and Sellers 2004). Differential association, or whom people interact with, forms the foundation for how people learn to behave and whether or not their behavior will be law-abiding or law-violating (Akers and Sellers 2004). Through interaction with other people, adolescents learn how they define themselves, others, and particular behaviors. Definitions include personal beliefs, such as morals or ethics, and the meaning people attach to specific behaviors, such as smoking marijuana (Akers and Sellers 2004). Imitation occurs when individuals act in certain ways after observing the same or similar behaviors (Akers and Sellers 2004). Behavior might or might not be imitated, depending on the people being observed, their behavior, and whether there are visible consequences (Vold, Bernard, and Snipes 2002). Finally, with differential reinforcement, individuals act according to their perception of the rewards and/or punishments that follow their behavior (Akers and Sellers 2004). Overall, learning to use substances begins by associating with people who have definitions that are favorable to violating the law. Substance use can then be modeled and imitated. For individuals who begin to use substances, rewards and punishments will determine whether or not their substance use continues.

Religious socialization and exposure to religious activities have the potential to influence differential association, definitions, differential reinforcement, and imitation. As a result of participation in religious activities, adolescents may become differentially associated with other religious people who do not engage in substance use and are more likely to express attitudes against such behaviors. As a result of their exposure to nonusers, religious youths are more likely to learn definitions that clearly define substance use as wrong or undesirable. In addition, religiosity may offer differential reinforcement in the form of rewards for not using drugs or alcohol, such as a prized place in the afterlife, or punishments, such as penance. As Baier and Wright (2001: 4) argue, "religion deters individual-level criminal behavior through the threat of supernatural sanctions and promotes normative behavior through the promise of supernatural reward." Finally, religious youths are likely to model and imitate the "virtuous" behaviors of other religious individuals.

General Strain Theory

According to general strain theory, there are three types of strain (Agnew 1992). First, following Merton (1938), strain is caused by a failure to achieve positively valued goals, such as wealth, respect, and autonomy. Second, strain can result when individuals lose something they value, such as a friend or family member (Agnew 1992). Third, strain occurs when individuals are treated in a negative

manner by others, such as being bullied at school (Agnew 1992). In short, the more strain adolescents feel, the more likely they are to turn to substance use. This does not mean, however, that all strain will lead to substance use. Many factors, such as coping skills, social support, and association with substance-using peers, can influence how people cope with strain.

Several studies have found that religiosity can reduce the impact of strain on the likelihood of delinquency and substance use (Jang and Johnson 2005; Matthew Johnson and Morris 2008; Wills, Yaeger, and Sandy 2003). Jang and Johnson (2005: 335) found that religiosity had a significant buffering effect on situational distress such that "non- or less religious African Americans are more vulnerable to the deviance-inducing effects of distress than their more religious counterparts." Wills, Yaeger, and Sandy (2003) found that the impact of life stress on adolescent substance use was reduced by high levels of religiosity. Matthew Johnson and Morris (2008) determined that religiosity diminished the impact of stressful school problems on violent and property offenses, although the effects were small.

Low Self-Control Theory

Gottfredson and Hirschi (1990) proposed a general theory to explain individual differences in the propensity to commit delinquent acts and substance use, regardless of age and circumstances. Gottfredson and Hirschi (1990) argued that when individuals have low self-control, they are more likely to engage in substance use. Low self-control results from a lack of proper socialization, primarily ineffective child rearing. The amount of self-control that is formed during childhood solidifies around age eight and then remains relatively stable throughout life. Gottfredson and Hirschi deduced several dimensions of low self-control. In short, these authors conclude that "people who lack self-control will tend to be impulsive, insensitive, physical (as opposed to mental), risk-taking, short-sighted, and nonverbal, and they will tend therefore to engage in criminal and analogous acts" (Gottfredson and Hirschi 1990: 90). Low self-control has consistently been linked to involvement in a variety of deviant behaviors, although the strength of the relationship appears to be modest (Pratt and Cullen 2000). Not all individuals with low self-control use substances, however, because substance use depends on the available opportunities. That is, even individuals with low self-control might not engage in substance use if the risk of getting caught is high or their access to substances is limited.

Previous research suggests that religious individuals often exhibit greater levels of self-control than nonreligious individuals do (Aziz and Rehman 1996). Therefore adolescents may develop greater self-control as a result of participation in organized religious activities. Put another way, as a result of their religious

commitment, individuals may learn to suppress their deviant impulses and to deny the temptation for immediate gratification. In turn, as a result of having greater self-control, adolescents might be less likely to engage in substance use. Although very few studies have examined religiosity and self-control, Welch, Tittle, and Grasmick (2006) found that religiosity was positively related to self-control and that religiosity had a negative effect on projected acts of deviance that was not rendered spurious by self-control.

In summary, many sociological theories of delinquency and substance use, including social bonding theory, social learning theory, general strain theory, and low self-control theory, predict that adolescent religiosity will be negatively related to delinquency and substance use. According to these theoretical perspectives, religious youths should be more likely to have strong social bonds, learn definitions that prohibit substance use, cope with strain in constructive ways, and develop greater self-control. Because few studies have examined how religiosity influences patterns of substance use over the life course, however, we use growth curve modeling to examine the relationship between adolescent religiosity and smoking marijuana, using five waves of the NYS. In doing so, we hope to determine whether adolescent religiosity predicts long-term trajectories of marijuana use. Also, we investigate whether changes in religiosity predict changes in marijuana use over time.

METHODS

Sample

The National Youth Survey is a probability sample of households in the continental United States. The original sample was drawn in 1976, and 2,360 youths were eligible for the survey. Of the eligible youths, 1,725 (73 percent) agreed to participate in the study. Five waves of data were collected annually between 1976 and 1980. A sixth and a seventh wave of data were collected in 1983 and 1987, respectively. We use Waves III through VII of the NYS because religion-related items were not included in the first two waves of the survey. At Wave III, the adolescents were between the ages of 13 and 19 years. By Wave VII, which was collected nine years later, respondents were 22 to 28 years old. Respondent loss over the first seven waves of the NYS was approximately 20 percent, which compares favorably with that of other longitudinal studies (see Menard 2002). On the basis of the first six waves of the NYS, Elliott, Huizinga, and Menard (1989: 3) reported that "loss by age, sex, ethnicity, class, place of residence, and reported delinquency did not substantially influence . . . the representativeness of the

sample." For a more complete description of the NYS sample, see Elliott, Huizinga, and Ageton 1985.[1]

Dependent Variable: Marijuana Use

Although the NYS contains a large number of items that can be used to measure delinquency, for our analysis we focused on marijuana use. For marijuana use, adolescents were asked how many times in the last year they had used marijuana or hashish, measured on a scale that ranged from never to two or three times a day. Because the same item appears in every wave of the NYS, we were able to examine changes in marijuana use over time. We chose to focus on marijuana use for two reasons. First, previous research suggests that religiosity has a stronger effect on victimless crimes, such as marijuana use, than on other types of crimes (Burkett and White 1974; Cochran and Akers 1989).[2] Second, since the peak age for involvement in property offenses and violent offenses is 16 to 18 years, very few respondents in later waves of the NYS reported committing these delinquent acts.

Religiosity

Unfortunately, no religion-related items were included in the first and second waves of the NYS, and only two religion-related items were included in the third wave. The first of these was "During the past year, how often did you attend church, synagogue, or other religious services?" Church attendance was measured on a scale ranging from 4 = several times a week to 0 = never. The second question was "How important has religion been in your life?" Importance of religion was also measured on a scale ranging from 4 = very important to 0 = not important at all. We combined church attendance and importance of religion to create a measure of adolescent religiosity that ranges from 0 to 8 (mean = 4.4).

For the first part of the analysis, we use religiosity at Wave III to predict trajectories of marijuana use over five waves (Waves III to VII) of the NYS. For the second part of the analysis, we examine the effect of change in religiosity on change in marijuana use. When focusing on change in religiosity, we constructed

[1] For missing values, we used Full Information Maximum Likelihood (FIML), which is preferable to other methods that are commonly used with missing data, such as listwise deletion, pairwise deletion, and mean substitution (Acock 2005; Enders 2001).

[2] Although some researchers have argued that religiosity has a stronger effect on victimless crimes (Burkett and White 1974; Cochran and Akers 1989), such as substance abuse, research on the "antiascetic hypothesis" is mixed. In short, there is a substantial body of research that suggests that religiosity is significantly related to a wide variety of delinquent behaviors, not just victimless crimes (Baier and Wright 2001; Johnson et al. 2000). Nonetheless, the effects of religiosity on other forms of delinquency may be different from the effects on marijuana use.

identical measures of religiosity, combining church attendance and importance of religion, for Waves IV through VII of the NYS. Since we have items that measure religiosity at all five time points, we can determine how adolescent religiosity changes over time and how the changes correlate with adolescents' marijuana use.

Control Variables

Since previous research suggests that sex (Chapple, McQuillan, and Berdahl 2005; Liu and Kaplan 1999), age (Sampson and Laub 1993; Steffensmeier and Streifel 1991), and race (Hawkins 2003; Matsueda and Heimer 1987) are significantly related to delinquency and substance use, we controlled for the effects of these variables in our analysis. Sex was coded as a dichotomous variable (1 = male, 0 = female). Age is an interval-level variable that ranges from 13 to 19 years for our sample. Because the NYS does not include many Asian, Hispanic, or Native American youths, race was coded 1 = nonwhite and 0 = white.

In addition to basic demographic characteristics, previous research suggests that family structure and process are significantly related to delinquency and substance use (Cernkovich and Giordano 1987; Laub and Sampson 1988), so we included a measure of family structure and family attachment in our models. For family structure, adolescents who were living with both biological parents were coded as 1, and all other family structures were coded as 0. Family attachment was measured by using an index of five agree/disagree items ($\alpha = 0.810$): "I feel like an outsider with my family" (reversed), "My family is willing to listen if I have a problem," "Sometimes I feel lonely when I'm with my family" (reversed), "I feel close to my family," and "My family doesn't take much interest in my problems" (reversed). Higher scores on the index indicate greater attachment to family.

Peer influences, such as peer attachment and associating with delinquent peers, are strongly related to delinquency and substance use (Warr 2002). Peer attachment was measured by agreement/disagreement with the following statements, which were combined to form an index ($\alpha = 0.754$): "I don't feel that I fit in very well with my friends" (reversed), "My friends don't take much interest in my problems" (reversed), "I feel close to my friends," "My friends are willing to listen if I have a problem," and "Sometimes I feel lonely when I'm with my friends" (reversed). Higher scores on the index indicate greater attachment to peers. To measure association with delinquent peers, adolescents were asked how many of their friends (all, most, some, or none) had used marijuana.

School experiences are also significantly related to delinquency and substance use (Cernkovich and Giordano 1992; Crosnoe 2006), so we controlled for the effects of school attachment and grades. School attachment was measured by agreement/disagreement with the statements "Teachers don't call on me in class,

even when I raise my hand" (reversed), "I often feel like nobody at school cares about me" (reversed), "I don't feel as if I really belong at school" (reversed), "Even though there are lots of kids around, I often feel lonely at school" (reversed), and "Teachers don't ask me to work on special classroom projects" (reversed) ($\alpha = 0.664$). Higher scores on the index indicate greater attachment to school. Grades were measured with the item "Which of the following best describes the grades you are getting at school?" Responses ranged from 4 = mostly A's/excellent to 0 = mostly F's/failing.

Table 1: Descriptive Statistics for Marijuana Use, Religiosity, and Control Variables

Variables	Mean	Standard Deviation	Minimum	Maximum
Dependent				
Marijuana use (Wave III)	1.30	2.20	0.00	8.00
Marijuana use (Wave IV)	1.48	2.27	0.00	8.00
Marijuana use (Wave V)	1.61	2.34	0.00	8.00
Marijuana use (Wave VI)	1.54	2.31	0.00	8.00
Marijuana use (Wave VII)	1.25	2.12	0.00	8.00
Religiosity (Wave III)	4.45	2.28	0.00	8.00
Religiosity (Wave IV)	4.20	2.27	0.00	8.00
Religiosity (Wave V)	4.14	2.25	0.00	8.00
Religiosity (Wave VI)	3.81	2.32	0.00	8.00
Religiosity (Wave VII)	3.76	2.26	0.00	8.00
Independent				
Sex[a]	0.53	0.50	0.00	1.00
Age	15.87	1.94	13.00	19.00
Race (Non-white) [a]	0.20	0.40	0.00	1.00
Biological family [a]	0.62	0.48	0.00	1.00
Family attachment	15.24	3.08	0.00	20.00
Peer attachment	15.16	2.60	4.00	20.00
School attachment	14.54	2.63	4.00	20.00
Grade	2.71	0.82	0.00	4.00
Peers marijuana	1.28	1.37	0.00	4.00
Moral marijuana	1.94	1.07	0.00	3.00

[a] For dichotomous variables, means correspond to the proportion of cases.

Finally, previous research suggests that moral beliefs are significantly related to delinquency and substance use (Hannon, DeFronzo, and Prochnow 2001; Mears, Ploeger, and Warr 1998). In general, adolescents who believe that a particular behavior is wrong are less likely to engage in that behavior. To measure the effect of moral beliefs on marijuana use, we used an item that asks adolescents how wrong they think it is for someone to use marijuana (3 = very wrong to 0 = not wrong at all). Descriptive statistics for marijuana use, religiosity, and the control variables are provided in Table 1.

Analytic Strategy: Latent Growth Curve

We used latent growth curve modeling to analyze the relationship between adolescent religiosity and changes in marijuana use over time. In a latent growth curve framework, researchers are primarily interested in finding the latent factors that are assumed to have given rise to the observed data (Bollen and Curran 2006; Duncan et al. 1999). The basic idea behind the latent growth curve is to estimate regression lines (or curves) for each individual, where a dependent variable is regressed on time. For example, in the current research, for each adolescent in the sample, marijuana use is regressed on time. It is quite possible that such regression lines vary considerably in their functional form across individuals. Some adolescents may show an increase in marijuana use, while others may show stability over time, and still others may show a decrease in marijuana use. The varying regression lines for each individual are then smoothed to produce an unobserved (latent) growth curve that captures the average trend for the adolescents in the sample. It is this unobserved curve that is believed to have given rise to the observed data. While various regression lines based on observed data reflect individual-level patterns, the unobserved (latent) curve represents the group-level trend. In short, a latent growth curve model allows researchers to simultaneously examine the overall trends (the group level trajectory) and individual variability in such trends.[3] Two parameters associated with latent

[3] Formally, a latent growth curve model can be considered a multilevel model with two levels (Bollen and Curran 2006). The first-level equation that assesses changes within individuals is $y_{it} = \alpha_i + \beta_i\lambda_t + \varepsilon_{it}$, where y_{it} is marijuana use for individual i at time t and α_i and β_i are an intercept and slope, respectively, that characterize the trajectory pattern for each individual. The subscript i of α and β indicates variation across individuals in their trajectory patterns. The second-level equations that express the intercept and slope are $\alpha_i = \mu_\alpha + \xi_{\alpha_i}$ and $\beta_i = \mu_\beta + \xi_{\beta_i}$, respectively. ξ indicates the deviation from the mean intercept and slope for each individual trajectory pattern. If we substitute α_i and β_i in the first-level equation, the combined model is $y_{it} = (\mu_\alpha + \lambda_t\mu_\beta) + (\xi_{\alpha_i} + \xi_{\beta_i} + \varepsilon_{it})$. The terms in the first set of parentheses reflect a fixed component, while the terms in the second set of parentheses reflect a random component. That is, while the fixed component captures the overall trajectory pattern across individuals, the random component reflects individual variability in trajectory patterns.

growth curves, mean and variance, are summary measures that represent the overall trend as well as the amount of individual variability.

Using a latent growth curve is advantageous for the analysis of longitudinal data for several reasons (Bollen and Curran 2006; Duncan et al. 1999). First, a latent growth curve provides summary measures that capture an underlying trajectory that has given rise to a large set of observations. For example, the initial level of marijuana use and the shape and rates of change over time can be analyzed with a latent growth curve. The mean and variance parameters of the latent growth curve indicate the overall trend in marijuana use as well as the extent of individual variability. Second, various functional forms of change over time can be modeled. For example, changes in marijuana use can be linear (increase or decrease) or quadratic (acceleration or deceleration). Third, covariation between the initial level and rates of change can be examined. For example, adolescents who start with a high level of marijuana use might experience a slower decrease in marijuana use over time than other adolescents do. Finally, both time-invariant and time-variant covariates can be incorporated to explain variability in the initial level of marijuana use and rates of change over time at the individual level. For example, compared to nonreligious adolescents, religious adolescents might have lower levels of marijuana use initially, and they might decrease their marijuana use more rapidly over time.

RESULTS

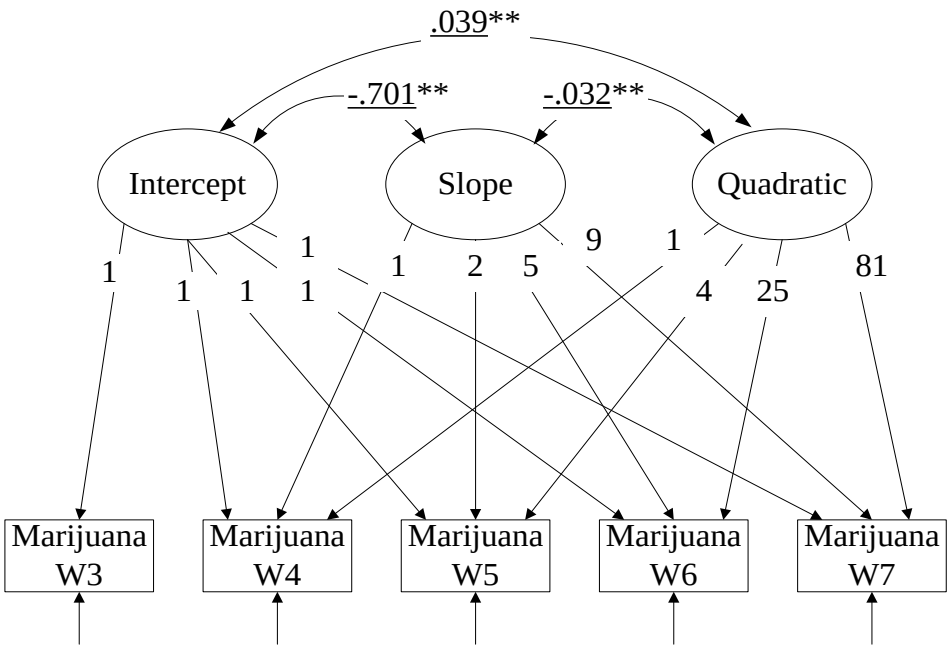
Unconditional Latent Growth Curve Model

Latent growth curve models allow for the analysis of group-level changes and individual variability in changes simultaneously. In particular, latent growth curve models can be specified via observed data and latent factors. Figure 1 depicts an unconditional latent growth curve model for marijuana use. Variables in rectangles represent observed data—the level of marijuana use—at each time point, while latent factors are represented by ovals. By formulating single-direction arrows from the latent factors to the observed data, the model specifies that the latent growth curve factors represent unobserved and underlying trajectories of marijuana use that have given rise to the observed data.

The model in Figure 1 has three latent growth curve factors: the intercept, slope, and quadratic components. Furthermore, each factor has two parameter estimates, a mean and variance, which capture the group-level trend and the individual variability in trajectories, respectively. For example, the mean of the intercept represents the estimated mean level of marijuana use at Wave III, the initial data point. Thus in our data, a statistically significant mean intercept (1.320, $p < 0.01$) indicates that the mean level of marijuana use at Wave III is

significantly different from 0. Although the mean captures the average trend for the entire sample, the variance associated with each growth curve parameter indicates the individual variability in trajectories. That is, a statistically significant variance for the intercept (4.622, $p < 0.01$) indicates that the amount of marijuana use at Wave III varied considerably across individuals. Some individuals used marijuana more often than others did.

Figure 1: Unconditional Latent Growth Curve Model for Marijuana Use



	Mean	Variance
Marijuana Intercept	1.320**	4.622**
Marijuana Slope	.127**	.439**
Marijuana Quadratic	-.015**	.002**

Note: Underlined covariances, as well as means and variances, are estimated parameters. Numbers without underlines were fixed for estimation. Fixed factor loadings represent the passage of time.
* $p < 0.05$. ** $p < 0.01$.

While the intercept captures the initial level of marijuana use, two additional latent growth curve parameters, slope and quadratic, capture changes in marijuana use across time. In particular, the slope component captures linear change, and the

quadratic component captures nonlinear change over time. Like the intercept, the change components of the latent growth curve have mean and variance estimates, which capture the group level trend and individual variability in the shape of trajectories. The mean slope is positive (0.127, $p < 0.01$), indicating that adolescents increased their level of marijuana use by 0.127 annually on a scale ranging from 0 to 8. A statistically significant variance associated with the slope component (0.439, $p < 0.01$), however, indicates the linear rate of change in marijuana use varied considerably across individuals. Additionally, the mean for the quadratic component was negative (−0.015, $p < 0.01$), indicating that the nonlinear change was downward. That is, on average, people use marijuana less often as they age. A statistically significant variance for the quadratic component (0.002, $p < 0.01$) indicates that the shape and rate of nonlinear change in marijuana use vary significantly across individuals.

The adequacy of latent growth curve models can be examined in two ways. First, predicted mean levels of marijuana use (or model implied means) can be compared with observed means. The predicted means for marijuana use across the five waves of data were 1.32, 1.43, 1.51, 1.57, and 1.21, whereas the observed means for marijuana use were 1.30, 1.48, 1.61, 1.54, and 1.25, respectively. If we compare the predicted and observed means for marijuana use, the predicted means closely follow the observed means, implying the adequacy of the model specification. Second, a series of model fit statistics can also be examined. A comparative fit index (CFI) or a normative fit index (NFI) higher than 0.90, and a root mean square error of approximation (RMSEA) lower than 0.10 are indicative of good model fit (Bollen and Curran 2006; Kline 2005). Following these rules of thumb, we found that our model was an acceptable fit (CFI = 0.996, NFI = 0.995, and RMSEA = 0.055).

In sum, the average trajectory of marijuana use indicated an initial increase and a subsequent decrease. The shape and rate of change, however, significantly varied across individuals. Individual variability in both the initial level and the rate of change in marijuana use indicates that we need to consider characteristics such as adolescent religiosity to account for the variability among individuals.

Conditional Latent Growth Curve Model with Predictors

On the basis of the unconditional latent growth curve model, predictors are included in subsequent analyses to explain individual variability in each growth curve component. The effects of independent variables on marijuana use, in terms of initial levels (intercept), linear change (slope), and nonlinear change (quadratic), are reported in Table 2. The coefficients for the initial level of marijuana use show the effects of independent variables, measured at Wave III, on marijuana use, also measured at Wave III. Therefore for the intercept, the coefficients can be

Table 2: Latent Growth Curve Model of Marijuana Use with Predictors

	Intercept	Linear	Quadratic
Coefficient Estimates			
Sex	0.251**	0.079	−0.006
	(0.071)	(0.043)	(0.004)
Age	−0.021	−0.061**	0.004**
	(0.020)	(0.012)	(0.001)
Race	0.029	−0.006	−0.001
	(0.091)	(0.056)	(0.006)
Biological family	−0.165*	0.025	−0.003
	(0.076)	(0.046)	(0.005)
Family attachment	−0.038**	0.007	0.000
	(0.013)	(0.008)	(0.001)
Peer attachment	0.045*	0.016	−0.002
	(0.018)	(0.011)	(0.001)
School attachment	−0.020	−0.007	0.000
	(0.019)	(0.011)	(0.001)
Grade	−0.155**	0.011	−0.002
	(0.046)	(0.028)	(0.003)
Peer Marijuana Use	0.739**	−0.071**	0.000
	(0.037)	(0.022)	(0.002)
Moral beliefs	−0.649**	0.067*	−0.005
	(0.048)	(0.029)	(0.003)
Religiosity	−0.047**	−0.025*	0.002*
	(0.017)	(0.010)	(0.001)
Growth Curve Parameters			
Mean	2.739**	0.825**	−0.046
	(0.431)	(0.261)	(0.026)
Variance	1.346**	0.293**	0.002**
	(0.137)	(0.046)	(0.001)
Covariance			
Intercept			
Linear	−0.210**		
	(0.057)		
Quadratic	0.012*	−0.022**	
	(0.005)	(0.005)	
Model Fit Statistics			
CFI	0.998		
NFI	0.995		
RMSEA	0.022		

* $p < 0.05$; ** $p < 0.01$.

interpreted like an OLS regression. For example, sex was positively related to marijuana use, so males had higher initial levels of marijuana use than females. Similarly, peer attachment and peer marijuana use were positively related to the initial level of marijuana use. Therefore adolescents who were more attached to their peers and associated with more peers who smoked marijuana had higher levels of marijuana use. In contrast, adolescents who (1) lived with both biological parents, (2) were attached to their family, (3) had higher grades in school, and (4) believed that marijuana use was wrong had significantly lower initial levels of marijuana use. Of particular interest for our purposes, religious youths also showed significantly lower initial levels of marijuana use. Including predictors in the model reduced the individual variability in initial levels of marijuana use considerably, as indicated by a reduction in the variance associated with the intercept from 4.662 to 1.346. That is, much of the variability in the initial level of marijuana use was explained by predictors that were included in the model.

With respect to the change components, age and religiosity exhibited strong effects on both linear and nonlinear change, while peer marijuana use and moral beliefs about using marijuana affected linear change. The interpretation of the coefficients in a latent growth curve model depends on the baseline model in which no predictors are included. Because the baseline model indicated that adolescents increase their marijuana use over time, both positive and negative coefficients are interpreted with reference to this increase. Age, peer marijuana use, and religiosity were negatively associated with the linear component, indicating that adolescents who (1) were older, (2) had more marijuana-using peers, and (3) exhibited higher religiosity increased their marijuana use more slowly than other adolescents did. Conversely, younger adolescents, youths who had fewer marijuana-using peers, and nonreligious adolescents increased their frequency of marijuana use more rapidly. Moral beliefs about the wrongfulness of marijuana use positively affected the linear component of the growth curve, indicating that adolescents who believed that marijuana use was wrong at Wave III increased marijuana use more rapidly.[4] A meaningful reduction in the variance of the slope component from 0.439 to 0.293 indicated that predictors included in

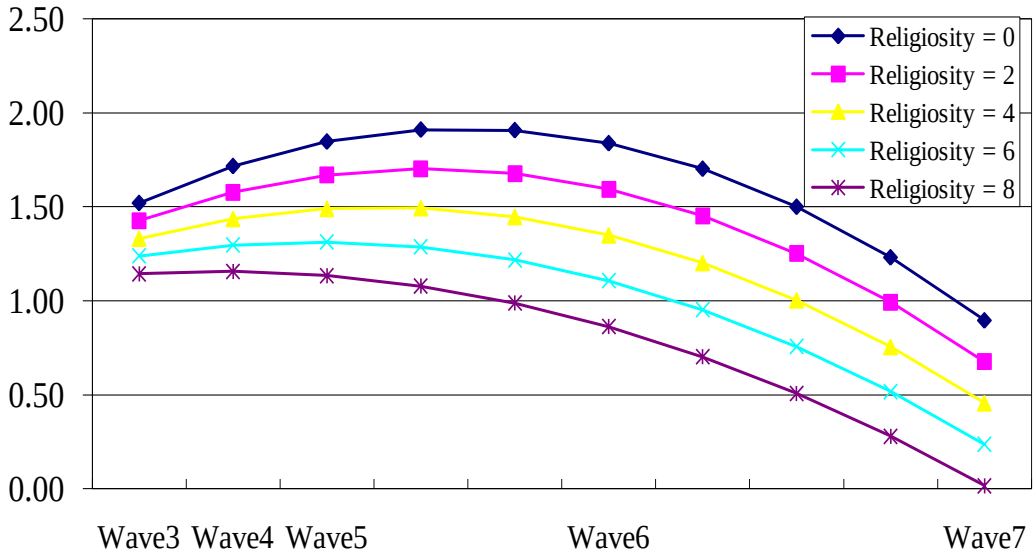
[4] Latent growth curve models can sometimes produce results that seem counterintuitive. For example, we found that adolescents who had more marijuana-using peers at Wave III increased their marijuana use more slowly and adolescents who believed that marijuana use was wrong increased marijuana use more rapidly. Effects such as these are most likely the result of a "ceiling effect." For example, adolescents who believe that there is nothing wrong with using marijuana already use marijuana frequently, so there is not much room for them to increase in marijuana use over time (i.e., they are already at the high end of the distribution, so there is a ceiling on how high their marijuana use can get). In contrast, adolescents who believe that using marijuana is wrong at Wave III rarely, if ever, use marijuana. As a result, if adolescents who believe that using marijuana is wrong use marijuana in the future, their increase in marijuana use may appear more rapid because they started at a low level.

the growth curve model explained a considerable amount of the individual variability in the rate of linear change in marijuana use over time.

Turning to the growth curve component for nonlinear change in marijuana use over time, we found that only the effects of age and religiosity were statistically significant. Both of these variables were positively associated with the quadratic component (0.004 for age and 0.002 for religiosity), indicating that older adolescents and those with higher religiosity at Wave III were likely to experience a slower nonlinear change in marijuana use over time. Because nonlinear change followed a downward trajectory, these coefficient estimates indicated that older adolescents and those with higher religiosity experienced a slower deceleration (desistance) from marijuana use over time. The variance associated with the quadratic component was small to begin with, so a notable reduction in explained variance was not observed when predictors were included in the model.

The interpretation of latent growth curve models can be facilitated by examining trajectories with typical characteristics (see Figure 2). To illustrate the effects of religiosity on the predicted levels of marijuana use over time, controlling for the effects of other independent variables, all independent variables except for religiosity were set to their means. Trajectories of marijuana use for adolescents with religiosity equal to 0, 2, 4, 6, and 8 at Wave III are illustrated in Figure 2.

Figure 2: Religiosity and Trajectories of Marijuana Use



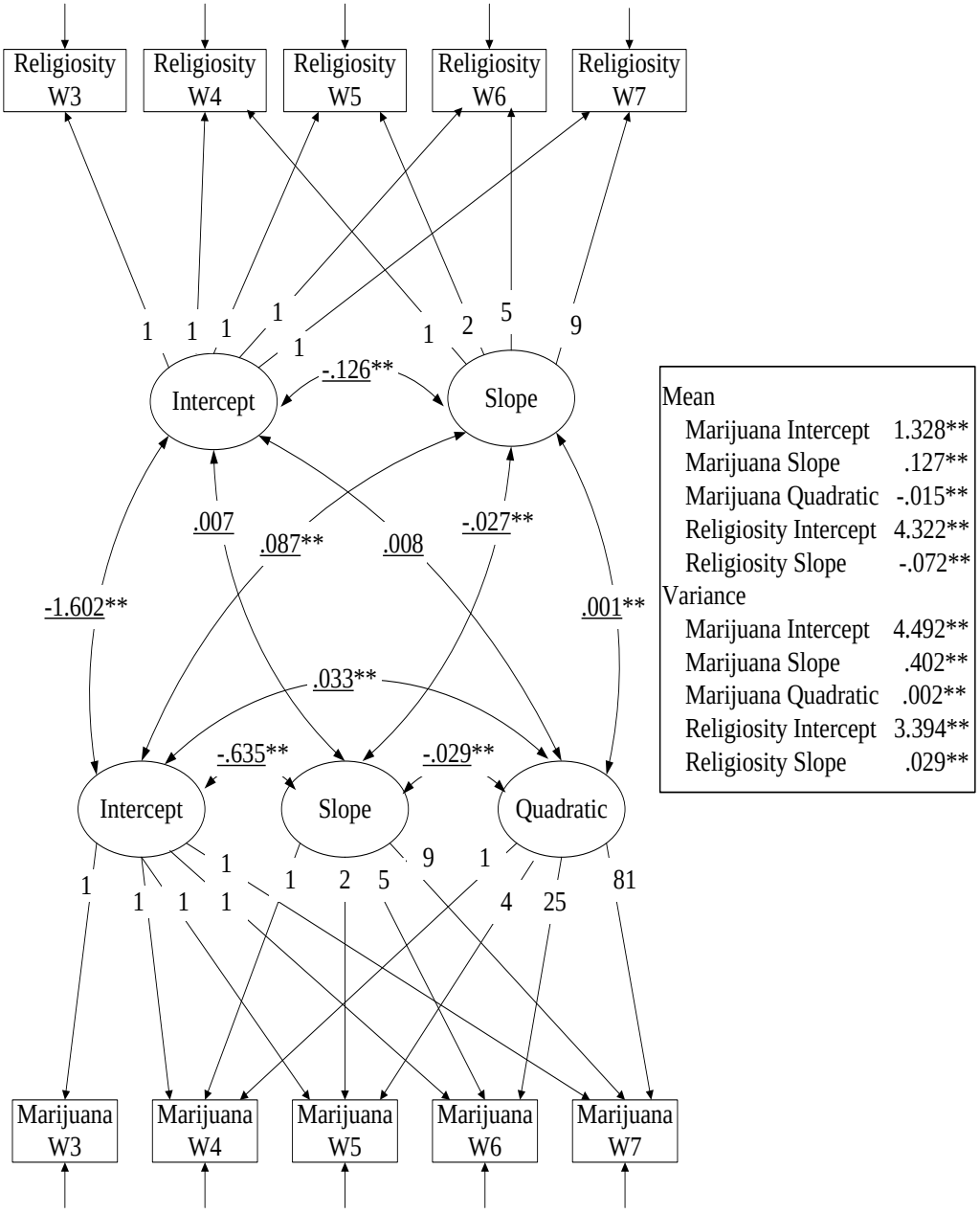
First, religiosity was negatively associated with the initial level of marijuana use, indicating that the higher adolescents' religiosity was, the lower their initial level of marijuana use at Wave III. The coefficient estimate for the linear slope was also negative, indicating that the higher adolescents' religiosity, the smaller their linear increase in marijuana use. Conversely, the lower adolescents' religiosity, the larger their linear increases in marijuana use. In fact, the effect of religiosity on the linear slope was so strong that there was *no apparent increase in marijuana use for the most religious adolescents* (see Figure 2). Finally, the coefficient estimate for the quadratic term was positive (0.002), indicating slower nonlinear change for individuals with higher religiosity.

Because the nonlinear change in the data had a downward curvature (the mean associated with the quadratic term was negative), this nonlinear effect can also be called *deceleration*. At first, slower deceleration among highly religious youths might seem counterintuitive. However, these highly religious adolescents were already experiencing a decrease in marijuana use because of the effect of religiosity on the linear change component. That is, although highly religious individuals might not have experienced nonlinear downward change, their levels of marijuana use decreased nonetheless because of religiosity's effect on the linear component of the latent growth curve. Nonreligious adolescents, on the other hand, were more likely to experience this nonlinear deceleration because their levels of marijuana use were high when nonlinear change started to take effect. By the time these nonreligious adolescents reached young adulthood, they had more opportunity to decrease their level of marijuana use.

Dual-Trajectory Latent Growth Curve Model

Our analysis indicated that religiosity was the only variable that had a statistically significant effect on all three growth curve components. That is, adolescents' initial level, linear change, and nonlinear change in marijuana use varied depending on their religiosity. However, our model formulation so far included predictors measured at Wave III. To examine further the dynamic relationship between religiosity and marijuana use, we formulated a dual-trajectory model in which changes in religiosity and changes in marijuana use were analyzed simultaneously (see Figure 3). Thus we focus on religiosity as an explicit time-varying predictor. Similar to the previous model formulation, latent growth curve components are depicted in ovals. Our initial analysis of an unconditional growth curve model for religiosity indicated that linear change was the best model. Therefore although the marijuana use trajectory was represented by three components (intercept, slope,

Figure 3: Dual-Trajectory Model of Religiosity and Marijuana Use



Note: Underlined covariances, as well as means and variances, were estimated parameters. Numbers without underlines were fixed for estimation. Fixed factor loading represent the passage of time.
* $p < 0.05$. ** $p < 0.01$.

and quadratic), the religiosity trajectory was represented by only two components: the intercept and slope.[5]

First of all, each growth curve can be examined by analyzing the mean and variance associated with each growth curve component. For the religiosity trajectory, the mean of the intercept was 4.322 ($p < 0.01$), while the mean of the linear slope was −0.072 ($p < 0.01$). Thus adolescent religiosity at Wave III was, on average, 4.3 (the scale ranges from 0 to 8), and adolescents decreased their religiosity over time. However, there was considerable variability in both the initial level and the rate of change in religiosity over time, as indicated by the statistically significant variances for the intercept (3.394, $p < 0.01$) and slope (0.029, $p < 0.01$) components.

The latent growth curve for marijuana use was similar to the unconditional model depicted in Figure 1. All parameters associated with the three latent growth curve components were statistically significant. The average trajectory for marijuana use was found to be a nonlinear curve with an initial increase, followed by a subsequent decrease over time, indicated by the significant positive slope (0.127, $p < 0.01$) and negative quadratic component (−0.015, $p < 0.05$). The initial level, as well as linear and nonlinear rates of change, in marijuana use varied considerably across individuals, as indicated by statistically significant variances for the intercept (4.492, $p < 0.01$), slope (0.402, $p < 0.01$), and quadratic (0.002, $p < 0.01$) components.

In a dual-trajectory model, covariance estimates capture the temporally dynamic association between changes in religiosity and marijuana use over time. First, covariances among growth curve components can be examined for religiosity and marijuana use separately. For example, for the religiosity trajectory, the covariance estimate was negative and statistically significant, indicating that adolescents with higher levels of religiosity at Wave III were more likely to experience a steeper decrease in religiosity over time, compared to those with lower levels of religiosity at Wave III.[6]

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[5] A series of model specifications were tested for religiosity, including a quadratic latent growth curve component and nonlinear factor loadings. However, the observed means for religiosity indicated a uniform decrease over time. Because the rate of change diverged from a linear decrease only slightly, it was determined that the nonlinear change in religiosity was negligible. A linear model specification for religiosity is also advantageous for interpretation because of its parsimonious covariance structure. For example, covariances between two quadratic (nonlinear) components in a dual-trajectory model would have been extremely difficult to describe in words.

[6] Again the pattern for religiosity is most likely the result of a ceiling effect (see note 4). Adolescents who start at the highest levels of religiosity can only maintain or decrease their religiosity over time, so their decrease appears steeper. In contrast, adolescents who start at a low or moderate level of religiosity cannot decrease their religiosity much over time, so their decrease in religiosity appears more gradual.

For the marijuana use trajectory, there were negative covariances between the intercept and slope components (−0.635, $p < 0.01$) and between the slope and quadratic components (−0.029, $p < 0.05$). The negative covariance between the intercept and slope components means that adolescents with higher levels of marijuana use at Wave III were likely to experience less of an increase in marijuana use over time. The negative covariance between the slope and quadratic component means that a large slope value (i.e., a steeper increase in marijuana use) was associated with a smaller value for the quadratic component (i.e., a smaller nonlinear change or a deceleration in marijuana use over time). That is, adolescents who experienced a steeper increase in marijuana use were less likely to desist from using marijuana over time. Finally, the covariance between the intercept and the quadratic component was positive (0.033, $p < 0.01$), indicating that adolescents with higher initial levels of marijuana use at Wave III experienced smaller nonlinear change and were less likely to experience desistance from marijuana use over time.

Additionally, we can examine the covariances among growth curve components across the two trajectories. For example, the covariance between the intercepts for religiosity and marijuana use was negative (−1.602, $p < 0.01$), meaning that adolescents with higher levels of religiosity at Wave III used marijuana less frequently than did those with lower levels of religiosity. Covariances among the intercept for the religiosity growth curve and the slope and quadratic factors for the marijuana use growth curve were not statistically significant (covariance estimates were 0.007 and 0.008, respectively). These findings indicated that the initial level of religiosity at Wave III did not predict changes in marijuana use over time. Rather, change in marijuana use was predicted by change in religiosity, signifying a temporally dynamic association between changes in religiosity and changes in adolescents' delinquent behavior. For example, the negative covariance between the religiosity slope and the marijuana use slope (−0.027, $p < 0.01$) indicated that adolescents whose religiosity trajectory was closer to a flat line (i.e., had less of a decrease) were less likely to experience an increase in marijuana use. That is, adolescents who maintained their high levels of religiosity were less likely to engage in marijuana use over time. A positive covariance between the religiosity slope and the quadratic component for marijuana use (0.001, $p < 0.01$), on the other hand, indicated that adolescents with a larger slope value (a less steep decrease or a flatter trajectory in religiosity) were associated with a larger curvature value (less downward trajectory). That is, adolescents who maintained their religiosity over time were less likely to experience a nonlinear decrease in marijuana use over time.

Variances associated with each growth curve component decreased to some extent when religiosity was considered as a time-varying predictor. Nonetheless, a considerable amount of individual-level variability remained for initial levels,

linear change, and nonlinear change over time. In fact, all variances associated with the dual-trajectory model were statistically significant. Hence, a final analysis was performed by including all independent variables as predictors in the dual-trajectory model.

Dual-Trajectory Latent Growth Curve Model with Predictors

Table 3 summarizes the results for the dual-trajectory latent growth curve model in which the effects of independent variables on both the marijuana use and religiosity trajectories are taken into account. Looking at the intercept component for the marijuana use growth curve, we see that the results are comparable to the first set of analyses (see Table 1). The effects of sex, biological family, family attachment, peer attachment, grades, peer marijuana use, and moral beliefs about marijuana use retained significant effects on the intercept component of the marijuana use trajectory, with the same direction and magnitude, even after we treated religiosity as a time-varying variable. Such results were expected, however, because coefficient estimates on the intercept component are essentially the same as a cross-sectional analysis. Thus allowing religiosity to change over time should not have much effect on other variables predicting the initial level of marijuana use. When the change components for the marijuana use trajectory were examined, several differences were observed. When religiosity was treated as a time-varying predictor, the effect of sex on the linear change in marijuana use became statistically significant. In particular, a positive effect of sex on the linear slope indicated that males, who had higher initial levels of marijuana use than females, increased their levels of marijuana use faster than females did. The effect of moral beliefs about marijuana use on the linear change in marijuana use, on the other hand, became statistically insignificant when religiosity was treated as a time-varying variable.

In the dual-trajectory model with predictors, the effects of independent variables on the religiosity growth curve can also be examined. Sex and peer marijuana use were negatively associated with the initial level of religiosity. Non-white race, greater peer attachment, higher grades, and stronger moral beliefs against marijuana usage were associated with higher initial levels of religiosity. Many independent variables were also associated with changes in religiosity. Sex, peer attachment, and beliefs about marijuana use were negatively associated with the linear slope component of religiosity, indicating that males, adolescents who were less attached to their peers, and youths who believed that marijuana use was wrong experienced steeper decreases in religiosity over time than others did. Older, non-white youths with many peers who used marijuana were likely to experience less of a decrease in religiosity over time.

Table 3: Dual-Trajectory Model of Religiosity and Marijuana Use

	Marijuana Use			Religiosity	
	Intercept	**Slope**	**Quadratic**	**Intercept**	**Slope**
Coefficient Estimates					
Sex	0.265**	0.087*	−0.006	−0.291**	−0.028*
	(0.071)	(0.043)	(0.004)	(0.100)	(0.012)
Age	−0.024	−0.062**	0.004**	0.019	0.015**
	(0.020)	(0.012)	(0.001)	(0.028)	(0.003)
Race	0.006	−0.016	0.000	0.472**	0.039*
	(0.091)	(0.055)	(0.006)	(0.129)	(0.016)
Biological family	−0.171*	0.022	−0.003	0.148	−0.017
	(0.076)	(0.046)	(0.005)	(0.107)	(0.013)
Family attachment	−0.037**	0.007	0.000	−0.002	0.001
	(0.013)	(0.008)	(0.001)	(0.018)	(0.002)
Peer attachment	0.043*	0.014	−0.002	0.062**	−0.010**
	(0.018)	(0.011)	(0.001)	(0.025)	(0.003)
School attachment	−0.021	−0.007	0.000	0.021	0.005
	(0.019)	(0.011)	(0.001)	(0.026)	(0.003)
Grade	−0.165**	0.007	−0.002	0.260**	−0.014
	(0.046)	(0.028)	(0.003)	(0.065)	(0.008)
Peer marijuana use	0.751**	−0.066**	0.000	−0.217**	0.014*
	(0.037)	(0.022)	(0.002)	(0.052)	(0.006)
Moral beliefs	−0.664**	0.054	−0.004	0.498**	−0.017*
	(0.048)	(0.029)	(0.003)	(0.067)	(0.008)
Growth Curve Parameters					
Mean	2.680**	0.786**	−0.043	1.376*	−0.177*
	(0.432)	(0.262)	(0.026)	(0.607)	(0.075)
Variance	1.353**	0.292**	0.002**	3.080**	0.029**
	(0.137)	(0.046)	(0.001)	(0.143)	(0.006)
Covariance					
Marijuana intercept	1.000				
Marijuana slope	−0.202**	1.000			
	(0.058)				
Marijuana quadratic	0.011*	−0.022**	1.000		
	(0.005)	(0.005)			
Religiosity intercept	−0.169*	−0.143**	0.014**	1.000	
	(0.067)	(0.041)	(0.004)		
Religiosity slope	0.015	−0.013**	0.001	−0.094**	1.000
	(0.008)	(0.005)	(0.000)	(0.016)	
Model Fit Statistics					
CFI	0.994				
NFI	0.989				
RMSEA	0.026				

* $p < 0.05$; ** $p < 0.01$.

Most important, all covariance estimates among the growth curve parameters for marijuana use and religiosity were statistically significant, except for the covariance between the marijuana use intercept and the religiosity slope and the covariance between the quadratic change in marijuana use and the religiosity slope. These covariances were statistically significant even after controlling for the effects of other independent variables. Thus the dual-trajectory model with predictors further suggests a temporally dynamic relationship between changes in religiosity and marijuana use.

CONCLUSION

Despite the recent emphasis on longitudinal research, few studies have examined the long-term effects of adolescent religiosity on delinquency. Using latent growth curve modeling, we examined the association between religiosity and marijuana use over time. While a variety of individual characteristics were considered as additional independent variables, the trajectory of marijuana use for adolescents was largely characterized by the adolescents' religiosity. Highly religious adolescents used marijuana less often than others did at the beginning of the marijuana use trajectory. While adolescents, on average, followed an initial increase and subsequent decrease in marijuana use, highly religious adolescents were unlikely to experience an increase in marijuana use over time. Although most adolescents, as they aged, matured out of their illicit activities, if they ever engaged in them, the predicted frequency of marijuana use was always lower for religious adolescents than for nonreligious adolescents. Overall, our results suggest that religiosity is an important variable in predicting the trajectory of marijuana use from adolescence to young adulthood. Religiosity acts as a protective factor that deters youths from marijuana use.

When religiosity was treated as a time-varying predictor, the importance of religiosity in characterizing change in marijuana use over time was further highlighted. In particular, when religiosity was allowed to change over time in the latent growth curve model, the initial level of religiosity did not predict changes in marijuana use. Rather, changes in marijuana use were significantly related to changes in religiosity. Such associations between changes in religiosity and changes in marijuana use remained even after we controlled for other independent variables.

We believe that our study adds to the growing body of research on the effects of religiosity on substance use. However, like all studies using secondary data, ours is limited by the questions in the NYS. For example, the first two waves of the NYS do not include any measures of religiosity. Although a few religion-related items were added to the third wave of the NYS, the measures of religiosity are still very limited. Therefore while we included both a public (attendance) and

a private (importance) measure of religiosity in our analysis, future research should examine the longitudinal effects of additional measures of religiosity on substance use, such as frequency of prayer, images of God, participation in religious youth groups, how religion affects life decisions, and how close adolescents feel to God. Future research should also examine whether or not life course trajectories in substance use differ on the basis of denominational affiliation, given that religious groups differ in terms of how strongly they prohibit substance use (Beeghley, Bock, and Cochran 1990).

In addition to adolescent religiosity, it could be important to measure parents' religiosity, since previous research suggests that parents' religiosity can influence adolescent involvement in delinquency and substance use (Foshee and Hollinger 1996). Regnerus (2003) determined that parents' religiosity was negatively related to female delinquency, but among boys, an increase in parents' religiosity contributed to an increase in delinquency. Pearce and Haynie (2004: 1553) determined that the combination of parents' religiosity and adolescents' religiosity can influence delinquency, such that "when either a mother or child is very religious and the other is not, the child's delinquency increases." Therefore future research should examine the long-term effects on substance use of parents' religiosity and of religious agreement between adolescents and parents. It will be interesting to determine whether religious adolescents who live with religious parents have substance use trajectories that are the same as or similar to those of adolescents who do not live with religious parents.

Along with additional measures of religiosity, future research should examine additional measures of delinquency. Although we found that religiosity has a significant effect on marijuana use, researchers have noted that religion has a stronger effect on "antiascetic" or victimless forms of deviance, such as alcohol and drug use (Burkett and White 1974). Since there is some debate about the types of deviance that religiosity influences, future research should examine other types of delinquency, such as theft and violence. Future research would also do well to examine the long-term effects of religiosity on prosocial behaviors, such as grades and volunteering.

Finally, although growth curve modeling allows for a sophisticated analysis of how adolescent religiosity influences changes in marijuana use over time, researchers still need to specify the mechanisms that account for the effect of religiosity on delinquency. Although we argued that religiosity can influence adolescents' marijuana use by strengthening social bonds, influencing the learning process, helping adolescents to cope with strain, and increasing self-control, our analysis does not enable us to specify which of these processes account for religiosity's effect on trajectories of marijuana use. Therefore future research should focus on specifying the theoretical mechanisms that account for religiosity's long-term effects on delinquency and substance use.

In sum, the results of our study offer several avenues for future research. At the most general level, we recommend that researchers put more emphasis on longitudinal studies using data collected over extended periods of time (i.e., more than two waves separated by a year). Although previous research generally emphasized the contemporaneous effects of religiosity, a small but growing body of research suggests that religiosity could have long-term effects on behavior over the life course (Giordano et al. 2008; Jang, Bader, and Johnson 2008; Petts 2009; Ulmer et al. 2010). Establishing the immediate effects of religiosity on delinquency is a productive approach, but testing longitudinal models to identify the cumulative advantages of religiosity over the life course might be more fruitful.

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