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Nonmedical Prescription Drug Use Among Adults in Their Late Twenties: The Importance of Social Bonding Trajectories

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Abstract

Although weak social bonds are found to be associated with addictive behaviors in cross-sectional studies, few studies have explored the longitudinal impacts of social bonds on nonmedical prescription drug use (NPDU). This study adopted a developmental perspective on social bonds and tested how their different trajectories are associated with NPDU among adults. With panel surveys from the National Longitudinal Study of Adolescent to Adult Health from 1994 to 2008, this study employed group-based latent trajectory modeling to obtain the different trajectories of social bonds including religious, civic, familial, educational, and marital, and then used them as predictors of NPDU while controlling for potential confounders and the baseline NPDU. The findings show that constant and high-level social bonds significantly reduce the risk of NPDU, except for educational bond. However, for religious, civic, and educational bonds, the "low initial" trajectories are not significantly different from the "high-decrease" trajectories, implying that strong early-life social bonds do not prevent NPDU if such bonds register a recent decline. Weak social bonds constitute significant risk of NPDU for adults in their late twenties, and recent social bonds override the contribution of early-life bonds in most cases. Policy makers may consider strategies to sustain the active and meaningful participation in conventional institutions, and not solely rely on programs that facilitate early-life social integration.

Keywords

social bond, life course, nonmedical prescription drug use, social control theory, latent trajectory modeling

Introduction

Nonmedical prescription drug use (NPDU) is an emerging public health concern in the United States. Compared with several decades ago, today's NPDU spreads well beyond adolescents and into the adult population (Inciardi & Cicero, 2009). Between 2005 and 2010, emergency room visits caused by NPDU had doubled (Mazer-Amirshahi, Mullins, Rasooly, van den Anker, & Pines, 2014). As reported by the U.S. Centers for Disease Control and Prevention (CDC; 2012),

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more overdose fatalities come from NPDU than cocaine and heroin combined since 2003. As of 2016, about 50% of all drug overdose deaths involve NPDU, claiming 15,000 lives annually (CDC, 2016). Epidemiologists estimate that 7% of the adult population in the United States are nonmedical users of psychotherapeutic drugs, 4.7% use painkillers for nonmedical purposes, 2% are nonmedical users of tranquilizers, and 1.7% are nonmedical users of stimulant and sedative medications (Substance Abuse and Mental Health Services Administration, 2015).

NPDU as a deviance is fundamentally a social problem, and one prominent risk factor of deviant substance use is the lack of social bonds. Originally described by Hirschi (1969), social bonds involve four components as the restraints of delinquency: attachment, commitment, involvement, and belief. By focusing on the restraints of delinquency (hence a necessary but not sufficient condition for its occurrence), the theory circumvents the difficulty of identifying a causal motive of delinquency in its contemporary literature (Hirschi, 1977). In essence, social bond theory argues that the existence of bonds to conventional institutions reduces the overall likelihood of conducting deviant behaviors.

Scholars have long suspected that the disruption of social bonds may constitute an underlying structural force behind the nationwide increase in NPDU. For example, Monnat (2016) has shown the correlation between the abuse of prescription opioids in electoral areas with declining social bonding institutions and the reactionary sentiment that culminated in the 2016 presidential election. In the general form, social bonds to conventional institutions such as family, religious organization, and education reduce the risk of deviant behaviors by imposing informal social control and diluting the time otherwise available for deviant peer association. Bonding with important conventional institutions can prevent the chronic accumulation of stressors (Curtis, Liu, Aragona, & Wang, 2006), help maintain a stable lifestyle (Wright, Caspi, Moffitt, & Silva, 1999), and, more importantly, keep the level of substance use within a socially acceptable limit (Krohn, Massey, Skinner, & Lauer, 1983; Sampson & Laub, 2003; Umberson, 1987).

A wealth of literature has found that bonds with conventional institutions, such as marriage, family, educational institutions, religious and civic organizations, reduce the risk of substance use in general. Scholars have found the negative association between stable marital bond and the likelihood of using substances of various types (Duncan, Wilkerson, & England, 2006; Maume, Ousey, & Beaver, 2005; Staff et al., 2010), and the positive association between substance use and divorce, or postponed marriage (Green, Doherty, Fothergill, & Ensminger, 2012). In terms of familial bonds, weak or conflictual parent–child relationship proves to trigger earlier initiation of drug use (Hoffmann, 1995; Reynolds & Rob, 1988; Schroeder & Ford, 2012). Bonding with religious institution constitutes another powerful mechanism for preventing substance use, as the majority of the contemporary religious institutions exercise the peer pressure and norm ascriptions to dissuade their members from recreational drug use (Desmond, Ulmer, & Bader, 2013; Stark & Bainbridge, 1997). In addition, the weakening of educational bonds exposes one to deviant peers and unstructured activities, deprive him of the credentials to establish employment and marital bonds, and delay the successful transition to a normative adult identity (Bernburg & Krohn, 2003; Ford, 2008; Giordano, 2014; Massoglia & Uggen, 2010).

Although not in abundance, some studies have addressed the impact of social bonds on NPDU. Focusing on familial and educational bonds, Ford (2009) has shown that bonding with these two conventional institutions are associated with lower likelihood of nonmedically using a variety of prescription drugs including painkillers, stimulants, tranquilizers, and sedatives. Using the 2009 National Survey on Drug Use and Health (NSDUH) dataset, a study by Schroeder and Ford (2012) "shows strong support" for social bond theory, social learning, and strain theories regarding prescription drug abuse along with other types of drug use. In contrast, another study based in a Midwestern college student population renders evidence for social bond theory but not strain theory when testing prescription stimulant abuse (Maahs, Weidner, & Smith, 2016). In the 2010 NSDUH survey, marital bonds were found negatively associated with various types of NPDU,

while employment bonds were negatively related to the nonmedical use of painkillers (Dollar & Ray, 2013).

Despite the fruition of cross-sectional studies on social bond and substance use (or specifically NPDU), few have considered social bonds with a developmental and longitudinal perspective, and this became a significant limitation in the existing scholarship. Shanahan argues that life course should be considered a composite trajectory rather than independent life events (Shanahan, 2000). Thus, social bonds may follow trajectories irreducible to individual time points. Schroeder, Higgins, and Mowen (2014) contend that a prototypic perspective that treats social bonds (in their case it was familial bond) as stable and static fails to capture the experience of a large portion of the population who have encountered the constantly renewing social situations and the changed quality of social bonds across different life stages. Therefore, the substantial temporal variations in social bonds may more significantly affect deviant behaviors, even though the absolute level of social bond is often implicated as the sole determinant of deviant behaviors. For example, scholars have found that the decreasing parental bond is more harmful than the weak but consistent parental bond (Higgins, Jennings, & Mahoney, 2010). Developmental psychologists have long recognized certain "vulnerable" and "critical" stages for effective bonding to occur (Sroufe & Rutter, 1984), and our behaviors are sensitive to the timing of establishing social relationships (Allison & Furstenberg, 1989; Bengtson, Elder, & Putney, 2012; Jacobson, 1986). For adolescents, disrupted early-life parental ties can evolve into adult violence and alcohol abuse (Dodge, Greenberg, & Malone, 2008; Wiles et al., 2007); childhood antisocial behaviors may leave a continuing legacy for subsequent deviant patterns (Collica, 2013); for young adults, unsuccessful transition to appropriate family roles, including becoming a spouse or wage-earner, will cascade into substance use (Staff et al., 2010).

The limitation of previous studies compels this study to frame social bonds as lifelong trajectories to influence NPDU. This study is particularly interested in NPDU at the late twenties, when most people would already hold a stable lifestyle, and there would be few experimenting users who are just trying to be culturally innovative. We will use panel datasets from the National Longitudinal Study of Adolescent to Adult Health and employ latent-class modeling and logistic regressions to systematically test how the trajectories of social bonds lead to NPDU at this life stage.

Method

Data

This study used the household surveys from the National Longitudinal Study of Adolescent to Adult Health (Add Health), an ongoing nationally representative longitudinal survey that has followed youths in the United States for four waves as of 2008. The panel surveys employed systematic sampling with implicit strata based on region, school size, school type, and ethnicity (Chen & Chantala, 2014). The first wave of data was collected from 1994 to 1995, the second in 1996, the third from 2001 to 2002, and the fourth in 2008. To ensure that the sample consists of people with comparable life history at any single wave, we only retained respondents of age 14, 15, and 16 at Wave 1, or dropped those who reportedly had not reached adulthood (age 18) at Wave 3. By restricting to this subsample, the cohort would meaningfully correspond to the groups demarcated by two important legal definitions: 18 years old for adulthood and 21 years old for legal drinking. The restriction also solves the notorious difficulty of decomposing cohort effects from age effects. Weight for population representativeness came from a variable prepared in the fourth wave of Add Health—"GSWT4," which weights Add Health's panel data by demographic characteristics and attrition (Chen & Chantala, 2014).

Measurement

A dichotomous dependent variable for NPDU was measured at the fourth wave of the survey, when the respondents were between 28 and 30 years of age and were less likely to nonmedically use prescription drugs as an experiment as adolescents often do. The respondents were asked whether they had "taken any prescription drugs that were not prescribed for you, taken prescription drugs in larger amounts than prescribed, more often than prescribed, for longer periods than prescribed, or taken prescription drugs that you took only for the feeling or experience they caused?" The time frame for recalling NPDU was specified as "since the last survey." Following the above filter question, the respondents were further asked to check whether the prescription drugs they had taken included "sedative or downers such as barbiturates, sleeping pills, Quaalude, or Seconal"; "tranquilizers such as Librium, Valium, or Xanax"; "stimulants or uppers such as amphetamines, prescription diet pills, Ritalin, Preludin, or speed"; "pain killers or opioids, such as Vicodin, OxyContin, Percocet, Demerol, Percodan, or Tylenol with codeine." The respondents who had given a positive answer to the filter question and also checked any of the above four categories of prescription drugs were coded as 1 for NPDU, or otherwise as the none-users.

Social bond measurements included the marital bond, parent–child bond, educational bond, religious bond, and civic bond. We primarily focused on the attachment/involvement quality of these social bonds rather than the more psychological dimensions as indicated by the commitment to and belief in the conventional institution. For marital bond, we used marriage events at Waves 3 and 4 when the respondents were old enough to be possibly married. This would yield at maximum four possible trajectories of marriage: married at Waves 3 and 4, married at Wave 4, married at Wave 3 but not at Wave 4, married neither at Wave 3 or 4. We used the question "frequency of church attendance in the past year" for religious bond and combined related categories to ensure they all correspond across different waves to "never," "less than once a month," "once a month or more," or "once a week or more." For child–parent bond, the survey asked in all four waves how close does the respondent feel toward mother and father on a 5-point scale: *not at all, very little, somewhat close, quite close*, and *very much*. For participation in civic organizations, Wave 4 asked how many hours did one spend in voluntary service last year, which was recoded to a binary variable (yes/no). The same question was also retrospectively asked in Wave 3. Another question in Wave 3 ensures that the civic service during adolescence was voluntary instead of court-ordered. Social bonds with education were measured by one's consistent and committed participation in an educational institution, which often means a school for adolescents and a college or training program for young adults. At each wave of the survey, the respondents were asked about their enrollment in any school/college/vocational school/training program, and if they had ever dropped out or been suspended/expelled from the current institution. A strong bond to educational institution existed when a person was enrolled in an education institution without any voluntary or involuntary disruptions.

Respondents' race (white, black, Asians, or others) and biological sex were taken from the first wave and applied to all the subsequent waves as fixed. Respondent's average self-reported health status was controlled for, so was their concurrent conservative/liberal attitude at Wave 4. We have also included a baseline report of NPDU from Wave 1 to prevent endogeneity and to control for potentially reversed causality between social bond trajectories and NPDU.

Other than the respondent's own demographic background, it is important to include parental and neighborhood variables. The Add Health interviewed one or both parents in baseline household surveys, and we have created four control variables from the interviews with parents: how big a problem are drug dealers and users in their neighborhoods (four ordinal levels), whether they were on welfare (binary), and their highest education level (10 ordinal levels). We have also constructed a parental social capital variable by summating the total count of membership in the

following organizations: parent/teacher organizations, veteran organizations, labor unions, hobby or sport groups, and civic organizations.

Statistical Methods

Applying the concept of the trajectory to social bonds is a methodological acknowledgment that our relationship with conventional institutions involves a complex process that results in heterogeneous distributions. Other methodologies, such as growth curve modeling or structural equation modeling, assume that the population follows the same distribution on the dependent variable so that everyone just more or less deviates from an underlying curve. Group-based latent trajectory modeling, on the other contrary, allows heterogeneity between latent groups and assigns group memberships based on posterior likelihood (Haviland & Nagin, 2005; Huang, Lanza, & Anglin, 2013; Nagin, 2005).

Therefore, we utilized group-based latent trajectory modeling as the main analytical tool. The likelihood function for individual i over t measurements $Y_i = y_{i1}, y_{i2} \ldots y_{it}$ takes the form $P(Y_i) = \sum_{j}^{J} \pi_j P^j(Y_i)$, which equals the sum of the likelihood that i belongs to the jth group times the probability of membership in the jth group in the entire population. In this study, the trajectories of social bonds assumed the form of either censored normal (for religious and familial bonds) or of the logit function (for educational, civic, and marital bonds). The selection of the optimal number of trajectories was based on both group morphs and the goodness of fit (Nagin, 2005). After each individual had been assigned a trajectory membership, a number of social bonding trajectories were obtained as nominal variables, which were then used as predictors for NPDU while controlling for other covariates.

To conduct latent-group trajectory modeling, a package "traj" written for Stata (Jones & Nagin, 2013) was employed; logistic regression model was then used to predict the dependent variable by social bonding trajectories. We also utilized the multiple imputation technique to handle missing data before all major analyses, and followed the popular application of Rubin's rule to calculate the pooled coefficients and fit indices (Rubin, 1996).

Results

Sample characteristics of the variables are shown in Table 1. At baseline, 5.8% of the sample reported NPDU, but the figure advanced to 18.6% in Wave 4. Average church attendance gradually declined from 1.84 to 1.24 over the four waves. Their relationship with parents dived in Wave 3 but resumed in Wave 4 to a similar level as in Wave 1. About 37% of the sample engaged in voluntary civic activities in Waves 1 and 2; the number declined to 31% in Wave 3 but then resumed to 36.6% in Wave 4. Few were married in the first two waves, 13% were married in Wave 3, and 45% were subsequently married in Wave 4. The majority of the respondents were consistently enrolled in an educational institution during the first two waves (73.4% and 85.6%, respectively) without any intermittent record of dropping out or suspension. Although the educational bond had declined quickly through the third and fourth waves, a nonnegligible number of adults were still enrolled in a college or training program at Wave 4 (18%), indicating a considerable variation in educational bond even for adults in their late twenties.

After testing the different combinations of exponential terms and selecting meaningful trajectory curves by comparing their coefficients, Bayesian information criterion (BIC), and Akaike information criterion (AIC), we arrived at the optimal tuning as shown in Figure 1. There are three different trajectories of religious bond: 34% of the sample consistently attended church with high frequency, 43.2% of the sample gradually decreased their attendance, which are named

Table 1. Descriptive Demographics and Variables by Wave.

	Wave 1 (*n* = 2,708)		Wave 2 (*n* = 2,533)		Wave 3 (*n* = 2,372)		Wave 4 (*n* = 2,434)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Nonmedical prescription drug use							18.6%	
Nonmedical prescription drug use (baseline)	5.8%							
Age	15	0.8	16	0.8	22	0.8	28	0.8
Sex (male = 1)	45.6%		45.5%		44.9%		44.4%	
Race								
White	63%		64%		63%		64%	
Black	23%		22%		23%		23%	
Asian	3.4%		3.4%		3.6%		3.2%	
Other	10%		10%		10%		9.7%	
Average health condition							3.86	0.66
Conservative/liberalism							3.07	0.93
Neighborhood drug problems	1.5	0.6						
Parent social capital	0.8	0.91						
Parent education	5.7	2.32						
Parent on welfare	8.9%							
Church attendance	1.84	1.2	1.78	1.22	1.23	1.04	1.24	1.06
Child–parent relationship	3.73	1.21	3.6	1.19	1.63	1.95	3.85	1.21
Civic participation (1 = yes)	37.1%		37.1%		30.5%		36.6%	
Marriage (1 = yes)	0%		0.1%		12.9%		44.8%	
In education	73.4%		85.6%		44.3%		18%	

the "high decrease" group; another 22.8% never really frequented church but registered an increase over the life course, which are named the "low increase" group. There are three types of child–parent bond trajectory: 23% kept a consistently good relationship with parents; 15.4% had a high bonding level at Wave 1 or 2 but experienced a sudden weakening of parental bond during the coming-of-age ("high decrease"); another 61.7% with lower initial parental bond experienced a moderately weakened relationship with their parents ("low decrease"). Civic bonds collapse into three different trajectories: a constantly high group (9.3%), a low but increasing majority (62.9%), and a decreasing group (27.8%). For marital bond, most respondents (84.2%) got married at Wave 4, while the others were married earlier at Wave 3 (15.8%). Social bond with education also shows three divergent trajectories: a minority of those who had consistently attended an educational institution across all four waves (19.8%), another smaller minority of those who consistently lacked a bond with educational institutions across all four waves (14.3%), and a majority of people (the "high decrease" group, 65.9%) who had a strong bond with school during the first two waves but stopped attending an educational institution when they had become an adult at Wave 3.

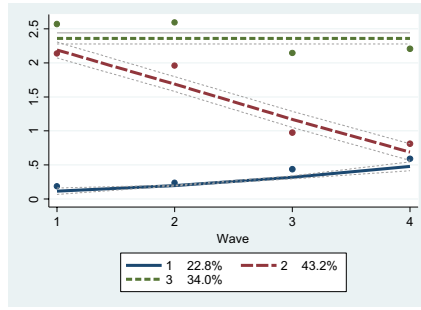
Table 2 presents two logistic regressions on NPDU with the social bonding trajectories obtained from group-based latent-class modeling. Model 1 contains only the trajectory variables and gender and race, while Model 2 adds a host of important control variables including a baseline measure of NPDU.

In Model 1, people in the "low-increase" (0.59, $p < .001$) and "high-decrease" trajectories (0.61, $p < .001$) of religious bond were more likely to use prescription drug nonmedically, as compared with those who had constantly high level of religious bond. Compared with the "high constant" trajectory, the "low-decrease" trajectory of familial bond elevated the risk of NPDU

Religious bond

Group 1: low increase
Y=-1.18+0.33x
Group 2: high decrease
$Y=2.69-0.46x-0.02x^2$
Group 3: high constant
Y=2.38

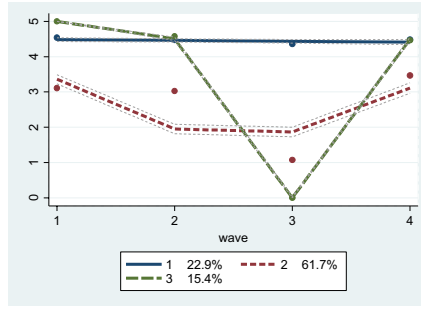
BIC: -14589 (N=2708) AIC: -14563



Child-parent bond

Group 1: high constant
Y=5.43-0.06x
Group 2: moderate U curve
$Y=6.82-4.07x+0.79x^2$
Group 3: dramatic U curve
$Y=89.5-63.08x+10.51x^2$

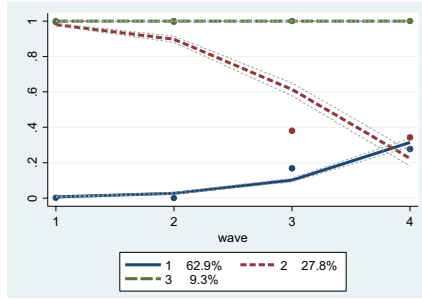
BIC: -16665(N=2708) AIC: -16633



Civic bond

Group 1: low increase
Y=-6.36+1.39x
Group 2: high decrease
Y=5.58-1.7x
Group 3: high constant
Y=18.22

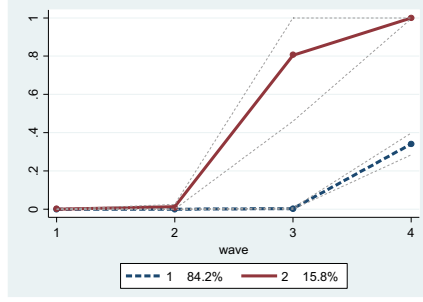
BIC: -4632(N=2707) AIC: -4612



Marital bond

Group 1: married late
Y=-21.18+5.13x
Group 2: married early
Y=-15.92+5.78x

BIC: -2400(N=2708) AIC: -2386



Educational bond

Group 1: low constant
Y=-1.71
Group 2: high constant
Y=1.42
Group 3: high decrease
$Y=-7.04+11.76x-3.16x^2$

BIC: -5258(N=2708) AIC: -5237

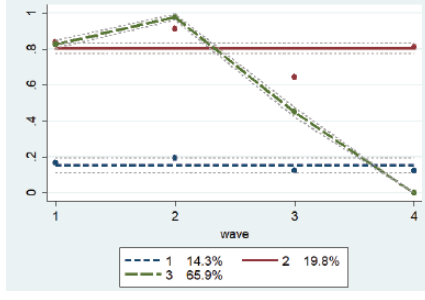


Figure 1. Latent trajectories of social bonds.

Table 2. Logistic Regressions Predicting Nonmedical Use of Prescription Drugs by Social Bond Trajectory Groups (Reference Group for All Bonding Trajectories Is "Constantly High Level").

	Model 1		Model 2	
NPDU	Coefficients	95% CI	Coefficients	95% CI
Religious bonds				
Low increase	0.59***	[0.27, 0.91]	0.40*	[0.07, 0.74]
High decrease	0.61***	[0.28, 0.93]	0.48**	[0.20, 0.76]
Familial bonds				
Low decrease	0.58***	[0.28, 0.89]	0.49**	[0.16, 0.81]
High decrease	0.09	[−0.32, 0.49]	0.14	[−0.26, 0.54]
Civic bonds				
Low increase	0.58*	[0.13, 1.04]	0.48*	[0.04, 0.90]
High decrease	0.52*	[0.10, 0.94]	.55*	[0.09, 1.01]
Educational bonds				
Constant low	−0.04	[−0.41, 0.33]	−0.01	[−0.39, 0.38]
High decrease	−0.33*	[−0.61, −0.05]	−0.22	[−0.51, 0.06]
Marital bonds				
Married later	0.42*	[0.05, 0.79]	0.41*	[0.02, 0.80]
Men	0.27*	[0.06, 0.49]	0.39***	[0.17, 0.61]
Race				
Black	−1.45***	[−1.84, −1.06]	−1.31***	[−1.71, −0.90]
Asian	−0.17	[−0.78, 0.44]	−0.22	[−0.84, 0.38]
Others	−0.78***	[−1.18, −0.39]	−0.73**	[−1.15, −0.31]
Baseline NPDU			1.08***	[0.67, 1.48]
Health			−0.30**	[−0.47, −0.11]
Liberalism			0.25***	[0.13, 0.37
Neighborhood drug			0.02	[−0.15, 0.19]
Parent education			0.03	[−0.03, 0.09]
Parent social capital			−0.01	[−0.14, 0.13]
Parent on welfare			0.11	[−0.56, 0.34]
Efron's R^2	.06		.26	
Cor(predicted, observed)	.25		.32	
Deviance, *df*	14810, 2694		14400, 2687	

Note. NPDU = nonmedical prescription drug use; CI = confidence interval. Estimates were based on pooled results from imputations using Rubin's rule. Weight used "GSWGT4."
*$p < .05$. **$p < .01$. ***$p < .001$.

(0.58, $p < .001$), but such risk was not significantly elevated by the "high decrease" trajectory. Both "low increase" (0.58, $p < .05$) and "high decrease" trajectories (0.52, $p < .05$) of civic bond raised the likelihood of NPDU compared with the constantly strong civic bond. People who married later were more likely to have NPDU (0.42, $p < .05$), denoting the positive impact of delayed marital bond on substance use. Contrary to the hypotheses, people in the "high decrease" educational bond trajectory were less likely to report NPDU as compared with those belong in the "high constant" trajectory, suggesting that enrollment in advanced education or training as an adult may pose as a risk factor of NPDU.

Model 2 controls for parental and neighborhood background because childhood living environment may simultaneously conflate social bond formation and drug use; it controls for social value as contrasted between conservatism and liberalism because it may be argued that bonding with conventional institutions simply reflect a person's value orientation; it also controls for

Table 3. Final Model From Table 2 With the "Low-Initial" Trajectories as Reference Group, All Other Parameters Unchanged But Not Shown.

Nonmedical use of prescription drugs	Coefficients	95% CI
Religious bonds		
High constant	−0.43**	[−0.75, −0.09]
High decrease	−0.06	[−0.20, 0.32]
Familial bonds		
High constant	−0.51**	[−0.84, −0.18]
High decrease	−0.26	[−0.58, 0.05]
Civic bonds		
High constant	−0.41*	[−0.84, −0.01]
High decrease	0.08	[−0.19, 0.35]
Educational bonds		
High constant	0.15	[−0.27, 0.57]
High decrease	−0.28	[−0.68, 0.11]
Marriage		
Married later	−0.41*	[−0.77, −0.04]

Note. CI = confidence interval. Weight used "GSWGT4."
*$p < .05$. **$p < .01$. ***$p < .001$.

average level of self-reported health. To address the potential endogeneity issue and the possibility of a reversal causal interpretation (that NPDU may lead to the formation of different bonding trajectories), a baseline measure of NPDU is also included in Model 2. Therefore, the interpretation of the coefficients of the bonding trajectories in Model 2 should follow as any risk of NPDU relative to NPDU at Wave 1 and after controlling for the covariates.

After having thoroughly considered the influence of these covariates, the differential effects of most social bonding trajectories still remain significant, although the magnitudes of some have settled. The model shows that compared with constantly high-level trajectories, trajectories with low initial strength or decreasing strength led to greater likelihood of NPDU, except for educational bond. Among the covariates, baseline NPDU led to greater likelihood of NPDU in people's late twenties (1.08, $p < .001$), confirming that people who had NPDU at Wave 1 are more likely to still report NPDU at Wave 4. Better health was negatively associated with NPDU (−0.30, $p < .01$), and self-described liberalism was positively associated with NPDU (0.25, $p < .01$). Model 2 explains 26% of the variance in the dependent variable per Efron's R-square, and the correlation between the model-predicted values and observed values is .32. Model 2 is also a significant improvement over Model 1 as judged by the changes in log-likelihood deviance and degree of freedom.

What about the difference between the "low initial" and "high decrease" trajectories? Table 3 presents the same model as Model 2 but sets the "low initial" category as reference. Surprisingly, for all types of social bond, significant difference in NPDU was only found between the "low initial" and "high constant" trajectories, while there was no difference between the "low initial" and "high decrease" groups. Recall Figure 1, one may notice that the only difference between the "low initial" and "high decrease" trajectories was that the early bonding strength of the "low initial" trajectory was much weaker, while they shared a similar level of bonding strength at Wave 4. In other words, for people with comparable level of religious, familial, and civic bonds in their late twenties, their risk of NPDU would be of no significant difference no matter if they had stronger or weaker early-life bonds. The lack of significant difference between the "low initial" and "high decrease" trajectories implies that the initial bonding strength may not matter

as much as the contemporaneous bonding strength. However, for most types of social bond, people in the "constant high" trajectories are significantly less likely to report NPDU than all other shapes of trajectories, pointing out the crucial importance of the cumulative level of social bonds for NPDU.

Discussion

Scholars have long realized the important functions on substance use brought by social bonds and the informal control they exert. Defined by the mainstream society as a deviant behavior, substance use could be avoided when people establish strong attachment and commitment to conventional institutions, which prescribe behavioral regulations on their members and instill them with norms that favor conformity (Gottfredson & Hirschi, 1990; Schroeder, 2015). Today, NPDU has surpassed traditional powder heroin and cocaine to become one of the top three most popular substances used in the United States and is now causing more fatalities than gun violence (CDC, 2012; Mazer-Amirshahi et al., 2014). Not a coincidence, the breakdown of social bonds with conventional institutions across the country and the emerging crisis of prescription drug abuse have received timely attention from some scholars (LeClair, Kelly, Pawson, Wells, & Parsons, 2015; Monnat, 2016), as well as in popular writings (Murray, 2013; Reding, 2010).

Although social control theory has been widely applied to the analysis of deviant behaviors, very few studies have considered the role of social bonds from a longitudinal and life-course perspective. What cross-sectional studies cannot inform us are some important questions regarding the roles played by the early-life bonds relative to the later-life bonds. With four waves of panel data from the National Longitudinal Survey of Adolescent and Adult Health between 1994 and 2008, this study has demonstrated the association between the trajectories of social bonds and NPDU in the United States.

Focusing on the attachment and involvement dimensions of Hirschi's social control theory (Hirschi, 1969, 1977); this study confirms that stronger bonds with conventional institutions, including family, religion, marriage, civic participation, and education, reduce the likelihood of NPDU in 28 to 30 years of age in relation to one's baseline NPDU during adolescence. Trajectories marked by constantly high-level social bonds are associated with lower likelihood of NPDU, compared with other shapes of trajectories. After controlling for baseline NPDU and other covariates, it further shows that the effects of social bonding trajectories are not likely caused by endogeneity—the argument that people using drugs are less likely to hold a stable social bond. Overall, people who belong in a constant and high-level trajectory of social bond are significantly less likely to report NPDU than all others. These evidences reinforce social control theory (Gottfredson & Hirschi, 1990; Hirschi, 1969) that a stable and strong relationship with conventional institutions prevents one from carrying out deviant behaviors.

Second, this study has further found that the strength of early-life social bonds may not be as important as that of the contemporaneous social bonds. For all types of social bonds measured in this study, the two trajectories with similar recent bonding strength but dramatically different early-life bonding strength do not show different impacts on NPDU, although people in both trajectories are still more likely to report NPDU as compared with the "constant and high" bonding trajectory. Such evidence casts doubt on the relative importance of early-life social bonds (during age 14-17) on adult deviant behaviors (age 28-30), as compared with the more contemporaneous social bonds formed after adolescence. The self-control proposition of Gottfredson and Hirschi (1990) suggests that bonds formed during early-life have a determinant influence, and the cascading theory in developmental psychology also suggests that adverse environment during the adolescence will linger on even decades later (Dodge et al., 2008). However, in the criminological literature, scholars realized that some social bonds may subject to fluctuations in adulthood and become critical turning points for the desistence/initiation of deviant behaviors

(Craig & Foster, 2012; Sampson & Laub, 1993). While these two broadly delineated theoretical camps do not necessarily contradict one another, they emphasize different life-course stages at which social bonds exert the most effective control on deviance. Shown in this study, the facts that the "high decrease" trajectory reports significantly more NPDU than the "high constant" trajectory and that the "high decrease" trajectory does not differ from the "low initial" trajectory constitute evidence against the self-control proposition, which posits that strong and self-forming early-life bonds offer the best protection against deviance.

Instead, the evidence retrieved by this study offers support to the "critical turning point" theory of Sampson and Laub (1993, 2003). Described as "shared beginnings but divergent lives," the critical turning point theory contends that the desistence or initiation of a deviance occurs when a person experiences certain life events that can happen relatively late in the life course, such as marriage, employment, the death of a relative, and so forth. This study shows that "shared beginnings" indeed lead to divergent NPDU patterns depending on the strength of later-life social bonds: On one hand, except for educational bond, high-level initial bonds do not protect one from NPDU if such bonds weaken at Wave 4; meanwhile, people with low initial bonds are no riskier than the "high decrease" group if their social bonds register some increases, which can be achieved by joining civic or religious organizations and improving their relationship with parents.

The findings of this study suggest policy makers not only rely on social programs that facilitate early-life communal integration among the adolescents. It is more important to sustain the availability of social institutions that provide bonding opportunities to adults as well as to adolescents. Most victims of the current prescription drug crisis across the United States were not born into the crisis, but grow up into it, especially considering that overdose rates are highest among the middle aged (CDC, 2012, 2016). Domestic social changes and globalization in the recent decades have restructured these people's opportunity to form social bonds with conventional institutions (Dombrowski, Crawford, Khan, & Tyler, 2016; Murray, 2013; Reding, 2010): Employment opportunities dwindle when they grow up, the prospect of getting married and forming a stable nuclear family dims, religious institutions have become meaningless. Therefore, programs providing small-business startup opportunities, social reintegration, civic participation, and secular or faith-based community engagement may be needed to avert the consequential impacts of having negative "critical turning points" in people's lives.

Limitations

Despite its merits in adopting a theory-informed approach for an emerging sociomedical issue and mature analytical techniques, this study acknowledges a few inevitable limitations for future scholars to attend to. First, we did not use the trajectory of NPDU as the dependent variable but instead controlled for baseline usage. Doing thus would require more complicated modeling involving treating both dependent and independent variables as latent trajectories simultaneously. Another limitation is this study's inability to measure educational bond using a single indicator across all four waves. There was virtually no variation in school enrollment at Waves 1 and 2, and no survey item on the teacher–pupil relationship after Wave 2. Constructing the latent trajectory of educational bond can be improved if a survey has a single indicator that meaningfully measures educational bond for both adolescents and adults. Last, future scholars may also want to use a more refined medical criterion to define NPDU. The "any of the following . . . since the last interview" question in the Add Health surveys has yielded a higher prevalence of NPDU (18%) than several other medical surveys.

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