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Cross-domain influences on youth risky driving behaviors: A developmental cascade analysis

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Abstract

We apply a developmental cascade approach to study the longitudinal, cross-domain effects of negative family influence, deviant peer associations, and individual substance use on risky driving among a sample of low-income African American youth. Participants (N = 681) were followed from age 16 to age 21. Using structural equation modeling, we examined conceptual models of pathways to risky driving. Results indicated strong associations between domains within time points among negative family environment, deviant peer associations, individual substance use, and risky driving. Deviant peer associations were related to future risky driving. Alcohol and marijuana use also predicted later deviant peer relationships. The pathways were observed both between age 16 and 18 and between age 18 and 21. Consistent with the cascade hypotheses, we found that risks in one domain manifested as risks in the same domain across time in addition to spreading to other domains.

Keywords

Developmental cascades; Risky driving; Negative family environment; Deviant peer associations; Substance use; Adolescence; Emerging adulthood

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Introduction

Developmental cascades refer to the notion that developmental effects in one ecological domain may spill over to influence multiple domains later in development (Garmezy, Masten, & Tellegen, 1984; Masten et al., 2005; Masten, Desjardins, McCormick, Kuo, & Long, 2010; Obradovic, Burt, & Masten, 2010). Although researchers have examined how mechanisms in both family and peer domains during late adolescence influence substance use (Staff et al., 2010; Van Ryzin, Fosco & Dishion, 2012), few researchers have focused on the co-occurrence of family factors, peer substance use, and risky driving during late adolescence and early adulthood using the cascade framework. Examining a variety of risk behaviors, instead of a single problem behavior, has been emphasized in previous studies indicating that different types of risk behavior were consistently correlated with one another. Researchers have found that high risk driving during youth is associated with other risk-taking behaviors, such as delinquency, unprotected sex, drinking and the use of drugs (Donovan, 1993; Pharo, Sim, Graham, Gross, & Hayne, 2011; Shope, Waller, et al., 2001). Researchers have also supported the notion that a certain constellation of related risk behaviors exists for young adults, meaning that people who engage in one type of risk behavior are likely to engage in others as well (Arnett, 1998; Ketterlinus & Lamb, 1994; Schwartz et al., 2009). Examining whether common factors exist that explain co-occurring problem behaviors adds to our understanding of problem behaviors during adolescence. In this study, we examine the cascading effects of negative family influence, deviant peer associations, and individual substance use on risky driving behaviors (e.g. speeding and unsafe driving) in an urban, African American sample of adolescents/young adults.

Substance Use and Risk Behavior in Adolescence

During late adolescence and early adulthood, youth experience considerable social role transitions, which involve a high frequency of person-context interactions (Shanahan, 2000; Staff et al., 2010). During this developmental period, youth actively explore life's options with social interactions, thus commonly engaging in more risk-taking activities and behaviors (Bingham & Shope, 2004a; Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, & Kapardis, 2011; Jessor, 1987; Pharo et al., 2011; Staff et al., 2010). Rates of substance use and heavy drinking, for example, increase dramatically during adolescence and the transition to adulthood, and then decline afterwards (Chassin, Hussong, & Beltran, 2009). Substance use in adolescence is associated with habitual use later in life with concomitant negative health consequences (National Center on Addiction and Substance Abuse, 2012). Although African American youth typically report lower rates of alcohol and tobacco (but not marijuana) use as compared to both Hispanic and non-Hispanic youth, they experience a disproportionate burden of substance use related consequences such as incarceration and school dropout (Kakade et al., 2012).

Within this dynamic context for individual developmental change, many of the individual-level changes can be viewed as a function of the cascading effects from earlier risk and protective factors within the social contexts involving family and peers (Schulenberg, Maggs, & Hurrelmann, 1999). Negative peer and family influences on individuals' substance use and risk-taking behavior are intertwined because most adolescents draw upon

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both their families and peers for support and modeling behavior. Families and peers play a critical role in influencing adolescents' decisions to initiate substance use. Moreover, family and peer influences may determine adolescents' subsequent developmental trajectories towards substance use behavior, including continued experimentation and escalation toward abuse (Darling & Cumsille, 2003). Examining the multiple-domain influence of family, peer and individual behaviors over time using the developmental cascade framework facilitates an understanding of how ecological domains influence each other at different stages of development, which may ultimately predict behavioral outcomes.

Family and Peer Influence on Risky Behaviors during Adolescence and Young Adulthood

Family factors influencing problem behavior—Family conflict has been found to be associated with negative developmental outcomes (Vandewater & Lansford, 2005). Family conflict during childhood predicts negative interactions during adolescence, which further predicts negative interactions in early adulthood (Belsky, Jaffee, Hsieh, & Silva, 2001). Hostility between parents and adolescents is also associated with externalizing behavior during mid-adolescence (Kim, Conger, Lorenz, & Elder, 2001), and poorly managed parent-child conflict is associated with adolescent delinquency (Caughlin & Malis, 2004).

Parental substance use also contributes to adolescent problem behavior. Parental substance use has been linked to drug and alcohol initiation during adolescence (Darling & Cumsille, 2003; Jang & Johnson, 2011). In addition, Biederman and colleagues found that, independent of socio-economic status, adolescents exposed to parents with substance use disorders were more likely to develop substance dependence (Biederman, Faraone, Monuteaux, & Feighner, 2000). Similarly, Li, Pentz & Chou (2002) found that adolescents of substance-using parents were at greater risk for using substances themselves and were more susceptible to peer pressure around substance use than adolescents with non-using parents. With regard to driving behavior, researchers have also found parents' drinking and lenient attitudes toward young people's drinking were associated with serious youth traffic offenses or crashes (Shope et al., 2001). Furthermore, low parent connectedness is associated with high-risk driving in early adulthood (Shope et al., 2001).

Peer factors influencing problem behavior—Peer relationships are a strong predictor of antisocial behavior, particularly during adolescence when peers become increasingly influential relative to parents (Allen & Brown, 2008; Bogenschneider, Wu, Raffaelli, & Tsay, 1998). Although socializing with deviant peers is strongly associated with antisocial behavior, this correlation may be reciprocal, as gravitation toward deviant peers is predicted by early peer rejection and poor social skills (Laird, Jordan, Dodge, Pettit, & Bates, 2001).

During this developmental stage, adolescents may have higher susceptibility to peer pressure than when they are younger (Cauffman et al., 2010; Steinberg et al., 2008) partly because they have a heightened responsiveness to social reward and desire to fit in among peers (Spear, 2000). Concurrent with this increased peer involvement, adolescents frequently initiate experimentation with smoking and drinking (Flory, Lynam, Milich, Leukefeld, & Clayton, 2004). Most adolescent risk-taking (e.g., drinking, reckless behavior), takes place when other teenagers are present and adolescents are more likely to take risks in the

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presence of their friends (Steinberg, 2008). After examining a nationally representative sample of 677 teen drivers involved in serious motor-vehicle crashes, for example, Curry and colleagues (2012) found that male drivers with peer passengers had higher risk-taking behaviors compared with males driving alone.

Further, researchers have linked peer substance use behavior and adolescents' own substance use (Arthur, Hawkins, Pollard, Catalano, & Baglioni Jr., 2002; Elkington, Bauermeister, & Zimmerman, 2011a; Petraitis, Flay, & Miller, 1995). Involvement with deviant or substance-using peers can increase the likelihood of adolescents' drug use through social learning, facilitation, peer pressure, and deviancy training (Dishion & Owen, 2002; Patterson, Dishion, & Yoerger, 2000). Yet, the direction of this association remains unclear. Specifically, adolescents may initiate or escalate their substance use or delinquent behaviors through their relationships with deviant peers.

Co-occurrence of Adolescent Substance Use and Risky Driving

Motor vehicle crashes are the leading cause of mortality and morbidity among adolescents in the U.S. (National Highway Traffic Safety Administration.[NHTSA], 2009). Although inexperience and distracted driving are the leading risk factors for teen driver's motor-vehicle crashes (Centers for Disease Control and Prevention, 2014; Curry, Hafetz, Kallan, Winston, & Durbin, 2011; Mcknight & Mcknight, 2003; Olsen, Shults, & Eaton, 2013), risky driving (e.g. speeding and aggressive driving) and substance-impaired driving may exacerbate the already high risk for crashes, injuries, and deaths. Increased sensation-seeking and the emphasis on social benefits of their behaviors during adolescence may lead to risk-taking behaviors, especially in the presence of peers (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004; Steinberg, 2008). Alcohol and drug use are associated with risky driving (Bingham & Shope, 2004a; Copeland, Shope, & Waller, 1996; Donovan, 1993; Shope, Elliott, Raghunathan, & Waller, 2001). Bingham & Shope (2004a), for example, found a consistent association between substance use behaviors and young adult risky driving behaviors. Specifically, the most risky young adult drivers reported the most substance use, while the lowest risk young drivers were least likely to report substance use behavior. In another longitudinal study of 1,845 young adults, risky driving was predicted by greater alcohol misuse and tolerance of deviance during adolescence; moreover, drinking-driving and drug-driving were predicted by marijuana use and alcohol misuse during adolescence (Bingham & Shope, 2004b).

Risky Driving Behaviors among African American Adolescents

Despite traveling less in motor vehicles, researchers have reported that African Americans are at greater risk for vehicular injury and death than their white counterparts across a range of risky driving behaviors (Braver, 2003). Researchers have found that African American teens were less likely to wear seatbelts (Everett et al., 2001; H. K. Kim, Pears, Capaldi, & Owen, 2009) and motorcycle helmets (Kim et al., 2009) than their white counterparts. African Americans (especially males) were also more likely to be involved in an alcohol-related traffic accident and were at greater risk for vehicular death than white drivers (Braver, 2003; Popkin & Council, 1993), but researchers have reported that African American teens may be *less* likely to either ride with a driver who has been drinking or drive

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after consuming alcohol (Everett et al., 2001). This data, collected from 1991–1997, however, may not reflect changing patterns of substance use in African Americans. While still less likely to drink alcohol relative to their white and Hispanic peers, relative rates of adolescent alcohol use across racial/ethnic groups are converging (Johnston, O'Malley, Bachman, & Shulenberg, 2012). Much less is known about marijuana use and risky driving behavior, but the association of marijuana use and risky driving among African Americans has been reported in a nationally representative sample of high school seniors (O'Malley & Johnston, 2013). In an effort to address the paucity of studies focused on risky driving behaviors among African Americans, our study focuses on an at risk African American population and tests for cross-time, cross-domain effects on risky driving under the cascade model.

The Present Study: Testing the Multiple-domain Cascade Models for Risky Driving

We examined negative family environment, deviant peer associations, and individual alcohol and marijuana use as predictors of risky driving. We apply a developmental cascades framework (Masten et al., 2005) to guide our study. The cascade models were developed explicitly to examine directional and cumulative effects over time across developmental domains after considering concurrent cross-domain effects and the stability of within-domain effects (Masten et al., 2005). Researchers have focused their developmental cascade approach on individual competence in different domains (Dodge, Greenberg, & Malone, 2008; Garmezy et al., 1984; Masten et al., 2010; Obradovic et al., 2010). Masten and colleagues (2010) used the term--*transactional effects*--to represent the within-time covariance of the developmental task domains at any assessment time point. The pathways by which effects in one domain will influence factors in other domains over time were defined as *cascade effects* (Masten et al., 2010). Masten et al. (2010) note, however, that developmental cascades are identified after considering the within-time covariance between domains and across time stability within a single domain (Masten et al., 2010). Most of these longitudinal studies focused on how developmental outcomes starting from early childhood influence later functioning (Dodge, Greenberg, & Malone, 2008; Garmezy et al., 1984; Masten et al., 2010; Obradovic et al., 2010), but they typical do not consider both transactional and cascade effects. Our study builds on this program of research by examining the effects between socio-ecological domains and individual behaviors across time. Based on prior research of risky driving (Bingham & Shope, 2004a, 2004b; Shope et al., 2001) and research on developmental cascades (Masten et al., 2005, 2010), we expected that negative family environment would begin a cascade of negative influences on risky driving behavior. We expected this cascade to begin with family which in turn would exacerbate negative peer influences on adolescent alcohol and substance use, which in turn, would result in risky driving behavior. We study this developmental cascade from ages 16 to 21. Thus, we expected early negative family environment and deviant peer associations to predict both more subsequent alcohol and marijuana use and more subsequent risky driving over time.

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Method

Participants

This study is based on five years of data collected as part of a longitudinal study of youth from mid-adolescence to the transition into young adulthood. Data were collected from 850 adolescents at risk for high school dropout at the beginning of the ninth grade in one of four public high schools in Flint, Michigan. To be eligible for the study, participants had a grade point of 3.0 or lower at the end of the eighth grade, were not diagnosed by the school as having emotional or developmental impairments, and were identified as African American, White, or both (Zimmerman, Caldwell, & Bernat, 2002). Of the 979 adolescents who met the inclusion criteria and were contacted to participate in the study, 52 had left the public schools; 67 were consistently absent from school after several attempts to interview them; and 10 participants either refused to participate or were refused participation by their parents. Therefore, 87% of the eligible youth (*n=850*) completed the data collection at wave 1 (9th grade, age 15) in the original study. Our study focused on data collected during 1995 to 2000 when the participants were in 10^{th} grade (age 16, data collected in 1995), 12^{th} grade (age 18, 1997), and at age 21(2000) in order to capture the beginning of the period of time when they could have a license to drive alone. The retention rate of participants was 83% (*n=812*) at 10th grade, 79% (*n=770*) at 12^{th} grade, and 65% (*n=639*) at age 21. Our study included only the African American participants (*N = 681*) to avoid the effects of racial differences in our analysis. Our sample was 51% female with a mean age at 10^{th} grade of 15.86 years (*SD = 0.65*).

Data Collection

Trained interviewers conducted structured face-to-face interviews with participants during school hours annually in high school. Participants who dropped out of school were interviewed in their homes or a community setting. Each interview lasted 50–60 minutes. After the interviews, participants completed a self-administered paper-and-pencil questionnaire about alcohol and substance use, sexual behavior, and other sensitive information. Participants were given $30 per assessment as remuneration for participating in the study. This study was approved by IRB and meets the requirements for the protection of human subjects.

Measures

During the first two time points (10^{th} and 12^{th} grade) of this longitudinal study, participants reported perceived family environment, perceived peer associations, individual drinking and marijuana use. Self-reported risky driving behaviors during 12^{th} grade and age 21 were also assessed. Table 1 includes descriptive statistics and Cronbach Alphas (where applicable) for all study variables.

Negative family environment—Two indicators were included for negative family environment, family conflict and parental substance use. Moos' (1974) Family Conflict Scale was employed to measure *family conflict*. Five items using a 4-point frequency scale from 1 (*hardly ever*) to 4 (*often*) assessed participants' family members fighting a lot, losing their tempers, throwing things when angry, hitting, and criticizing each other. Adolescents'

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reports of family conflict in 10th and 12th grade were measured by averaging across five items. Seven items using a 5-point frequency scale ranged from 1 (*never*) to 5 *(very often)* were used to assess *parental substance use*. This scale was described and used in previous articles of this study (Elkington et al., 2011a; Elkington, Bauermeister, & Zimmerman, 2011b). At 10th and 12th grade, adolescents reported substance use by parents or adults who live with them. We asked participants to rate the frequency that they have known [[this parent or guardian]] to "drink beer or wine," "drink hard liquor (e.g., gin, whiskey)"get drunk," "get high or stoned on drugs," "smoke marijuana this past year," "have been busted for driving while high on alcohol or other drugs," and "have been busted for using or having drugs." A mean score was calculated by averaging all seven items.

Deviant peer associations—Deviant Peer Associations were measured by 13 items in all three time points (10th, 12th grade, and 21-year old). This scale has been employed by other articles of this study (Doljanac & Zimmerman, 1998a; Elkington et al., 2011b). Participants responded to questions regarding the number of friends they believed that were involved in substance use and delinquent behaviors using a 5-point scale from 1 (*none*) to 5 (*all*). Based on the underlying common feature of the items, we parceled the thirteen items into three categories: friends' alcohol, tobacco, and marijuana use (four items); friend's other drugs use (four items); friend's delinquent behavior (five items). Three variables were then calculated by averaging items' scores in each category.

Individual substance use—Participants reported the frequency of their alcohol use and marijuana use at all three time points. The questions were drawn from the *Monitoring the Future* study (Johnston, O'Malley, & Bachman, 2003). Adolescents reported the frequency of alcohol use over the past 30 days using a 7-point frequency scale: 1 (*none*), 2 (*1 to 2 times*), 3 (*3 to 5 times*), 4 (*6 to 9 times*), 5 (*10 to19 times*), 6 (*20 to 39 times*), and 7 (*more than 40 times*). They also reported the frequency of having five or more drinks in a row over the last two weeks and the frequency of drinking enough to feel pretty high in the last two weeks using a 6-point scale: 1(*none*), 2 (*once*), 3 (*twice*), 4 (*3 to 5 times*), 5 (*6 to 9 times*), and 6 (*more than 10 times*). One item was used to measure the frequency of marijuana use over the past 30 days using the same 7-point Likert scale as alcohol use over the past 30 days. We standardized the three items and created a sum value for alcohol use. Both alcohol use and marijuana use were included as individual variables for a latent construct of substance use.

Risky driving behaviors—Young adult risky driving during the last six months was assessed with measures of high-risk driving (Donovan, 1993). Participants reported the frequency of unsafe driving (six items) and speeding (two items) when they were 12th grade and 21 years old. For unsafe driving behaviors, we asked participants in the past six months, how many times have they "changed lanes when unsafe", "cut in front of a car to turn", "switched lanes to speed through slower traffic", "ran a red light", "ran a yellow light as it changed to red", and "ran a stop sign." For speeding, we asked participants in the past six months, how many times have they "driven 10 to 19 mph over the limit" and "driven more than 20 mph over the limit. The response choices of 6-point frequency categories are: 1

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(*never*), 2 (*once*), 3 (*twice*), 4 (*3 to 5 times*), 5 (*6 to 9 times*), and 6 (*more than 10 times*) in the past six months.

Analytic Plan

We examined the conceptual model of cross-domain cascade effects on risky driving using confirmatory latent-variable structural equation modeling (SEM) (Bentler, 1995). Variables used in this study were screened for normality. Descriptive statistics indicated that most variables were normally distributed and within acceptable limits of skewness and kurtosis. All variables described were then entered as indicators of latent constructs as noted in Table 1 (e.g. negative family environment, deviant peer associations, individual substance use, and risky driving behaviors) for each time point. In order to test the cascade effects, we examined systematically the models built in multiple steps. At each step, we compared the model's Akaike's (1987) Information Criterion (AIC) with the previous model. When comparing a series of models, AIC is a useful indicator that helps to choose a model that balances adequacy of model fit with parsimony. The model that produces the minimum AIC may be considered to be a superior model (Bentler, 1995). We controlled for sex in all our models because sex differences are typically found in risky driving research (Jackson, Sher, Cooper, & Wood, 2002). Male teenagers are more likely than females to ride in a car with a driver who has been drinking (Everett et al., 2001) and to engage in high-risk driving influences (Elliott, Shope, Raghunathan, & Waller, 2006). We did not study sex differences because this was not a focus of an already somewhat complicated and innovative cascade analysis approach. We also controlled for opportunity to use a car (either as a passenger or a driver) and whether the participant had a driving permit or license at age 18. Opportunity to use a car was measured by one item at age 18, "how often do you have the use of a vehicle?" on a 5-point scale. The response choices are: 1 (*never*), 2 (*rarely*), 3 (*sometimes*), 4 (*often*), and 5 (*always*). Whether a participant had a driving permit or license was coded as 1 (*has a permit/license*) and 0 (*does not have a permit/license*). Both variables were included as covariates to risky driving at age 18.

Measurement models—To better manage and interpret the analysis, we examined the measurement model at each time point prior to fitting the structural models. We allowed the latent factor with indicators within the wave to correlate between each other in the measurement models. The initial fits of the measurement models were acceptable (NFI>0.90, NNFI>0.90, CFI>0.90, RMSEA <0.07), except time 1 (NFI= 0.75, NNFI= 0.61, CFI= 0.76, RMSEA= 0.13), but model fits were improved significantly when we fit the structural model across time and indicator residuals of common measures were allowed to covary across time. No modifications were done to improve the fit of the time 1 measurement model.

Structural models—Following Masten and colleagues' analytic strategies of developmental cascades (Masten et al., 2010), we first examined the baseline model (continuity model) where the longitudinal stability of each construct was evaluated. In the baseline model, latent constructs at the same time point were allowed to correlate with each other, but no other cross-lagged paths across domain were included (Figure 1). The baseline model is nested within all the following models. In successive steps, we added cross-lagged

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paths between family, peers, substance use and risky driving consistent with the literature on substance use and risky driving (Bingham & Shope, 2004; Shope, Waller, et al., 2001; Shope, Raghunathan, & Patil, 2003; Van Ryzin et al., 2012). In the second model, ten cross-domain paths were added, corresponding to our hypothesis of down-streaming cascades from family, peer, and individual factors of substance use to risky driving. In the third model, two additional paths were added from substance use to deviant peer associations between age 16 and 18, and age 18 to 21, corresponding to the hypothesized cascade effect of substance use. Finally, to address the hypothesis of the influence from individual marijuana and alcohol use to perceived family environment, the fourth model added a path from substance use (age 16) to negative family environment (age 18). In Figure 2 we present the three subsequent models tested in the study.

Structural equation modeling was conducted for all models with the EQS program (Bentler, 1995). The goodness-of-fit indices examined according to the recommendation of (Raykov, Tomer, & Nesselroade, 1991) were: normed fit index (NFI), non-normed fit index (NNFI), and comparative fit index (CFI). The widely used misfit index root mean square error of approximation (RMSEA) was also reported. According to Hu and Bentler, fit indices that exceeded .90 and RMSEA misfit indices that are .06 or lower are considered acceptable fit of the model (Hu & Bentler, 1999). The robust statistics and Yuan-Bentler corrections of model fit indices (K.-H. Yuan & Bentler, 2005) provided in EQS outputs for ML approach were then reported in the result section.

Missing Data

We conducted a preliminary missing data analysis to determine the adequacy of the sample. Percentage of missing data on core variables ranged across measures and time points, from a low of 4.7% missing for parental drug and alcohol use at age 16 to a high of 25.8% missing for speeding and high risk driving assessment at age 18. The mean percentage missing across indicators is 14.9%. In order to address the issues of missing data, we specified full information maximum likelihood (FIML) estimator, also called case-based maximum likelihood, provided by EQS 6.0. Because the normality kurtosis indicated our data is not multivariate normally distributed, we also specified a robust methodology in EQS 6.0 provided by Yuan and Bentler (2000) to obtain corrected test statistics and standard errors for data with non-normality (Bentler, 1995, pp. 283). These statistical methods were particularly designed to handle missing data with more accurate test statistics even when the assumption of normality is violated. (Bentler, 1995, pp. 65).

Results

Model Selection

Table 2 shows the model fit indices for the four structural models tested. The second column of the table presents the relative model fit, AIC value, for each hypothesized model. The ΔAIC value in the next column indicates the difference in AIC between each model and the model with the lowest AIC (Model 3, down-streaming cascade with substance use effects on deviant peer association). The fit indices were identical for model 3 and model 4 (added the path from substance use to negative family environment), with AIC score slightly lower for

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model 3 (ΔAIC = 0.98). According to the criteria of Burnham and Anderson (2004), models having ΔAIC ≤ 2 have substantial support of having equivalence fit. In this case, the most parsimonious model would be selected because the additional path did not improve the model sufficiently.

Consequently, model 3 is the most parsimonious model with the best absolute model fit indices and favorable AIC value. The results of the analysis based on the sample provided a good fit to the data [Yuan-Benler $\chi 2$ (248, N =672) = 430.28 ($p < .001$), NFI = .92, NNFI = .95, CFI = .96, RMSEA = .033, within 90% confidence interval.] The overall model explained 43% of the variance in deviant peer associations, 42% of the variance in alcohol and marijuana use, and 20% of the variance in risky driving at age 21.

Cross-domain influences of family and peers to individual substance use and risky driving

Figure 3 illustrates the adopted model with correlations, standardized coefficients for the statistical significant paths, and the variance explained (R^2). All the indicators and the continuity paths were significant. All within-time covariances of latent constructs at time 1 (age 16) and covariances of constructs' residuals at time 2 (age 18) and time 3(age21) were significant. At the assessment time 1 negative family environment, deviant peer associations, and individual substance use positively correlated with each other (r = .55 to .68). At time2 and time 3, risky driving behaviors were measured and all the above constructs positively correlated with risky driving within each time point. All the correlations were shown in figure 3. Notably, alcohol and marijuana use were strongly associated with risky driving at both time 2 (r=.42) and time 3 (r=.51).

Table 3 shows the standardized coefficients, robust standard errors, and the statistical significance for the cross-domain paths. Early individual alcohol and marijuana use predicted higher levels of deviant peer association later in life (β = 0.27 between both time1 to 2 and time 2 to 3). Deviant peer associations at time 1 predicts higher level of risky driving at time 2 (β = 0.23). Deviant peer associations at time 2 also predicts higher level of risky driving at time 3 (β = 0.14).

Discussion

Cross-domain Cascade Effects for Risky Driving

Our findings support our cascade hypotheses of the longitudinal cross-domain influences on risky driving. Our results also provide evidence of strong links between African American's risky driving in emerging adulthood (age 18 and 21) with concurrent problems in other key domains of family environment, deviant peer, and individual substance use. Moreover, we found continuity of problems within the four domains we examined across time. These results are consistent with the *transactional effects* noted in the prior developmental cascade studies (Masten et al., 2010),

Over and above the observed stability within domain and within-time concurrence across social-ecological domains, the most notable direct *cascade effect* for risky driving involved the effect of deviant peer involvement to later risky driving behaviors. The pathways were observed both between age 16 and 18, as well as between age 18 and 21. The magnitude of

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the standardized effect sizes (Table 3) were consistent with previous research examining individual and interpersonal risk factors associated with risky driving behavior (Mirman, Albert, Jacobsohn, & Winston, 2012). This finding is consistent with previous research indicating an association between peer influence and risky driving (Bingham & Shope, 2004a; Shope, 2006; Shope et al., 2003; Simons-Morton et al., 2012). Researchers who followed adolescents from 5th to 10th grades found that the highest probability of serious offense or crash was found among adolescents whose friends support drinking behaviors, who are susceptible to peer pressure, and who are tolerant of deviance (Shope et al., 2003). Simons-Morton et al. (2012) also reported that speeding among newly-licensed teenage drivers was associated with substance use, tolerance of deviance, susceptibility to peer pressure, and number of deviant friends. Risk behaviors during adolescence and young adulthood, including high-risk driving, may be affected by negative peer pressure, deviant social norms around risk behavior, and affiliation with risk-taking peers (Allen & Brown, 2008; Scott-Parker, Watson, & King, 2009). As noted by Keating and Halpern-Felsher, peers are the primary source of social norms toward risky driving (Keating & Halpern-Felsher, 2008). Our findings suggest that interventions targeted toward African American youth that address negative social influence of peers beginning in early adolescence and through emerging adulthood may have beneficial effects for safer driving as well. Approaches that seek to decrease the tolerance of deviance in the peer group or to redirect peer norms toward risky driving to be less socially acceptable may offer potential benefits.

We also found evidence for a cascading effect of substance use predicting later deviant peer associations. Researchers have demonstrated a close link between associating with peers who use alcohol and other drugs with an adolescent's own substance use in both predominantly white and African American samples (Arthur et al., 2002; Elkington et al., 2011a; Petraitis et al., 1995), providing evidence that adolescents are likely to initiate and escalate their own substance use as a result of peer influence. Researchers have also found that substance use is associated with membership in adolescent social cliques (Sussman, Dent, & McCullar, 2000). The youth in our sample who reported belonging to high-risk peers at age 16 reported greater levels of subsequent substance use and problem behaviors two years and five years later. A less studied, but alternative etiological explanation is that adolescents choose friendships based on similarities in their substance use behavior, and that the formation of such peer groups around substance using behavior is particularly problematic (Bauman & Ennett, 1996; Ennett & Bauman, 1994; Stoddard, Bauermeister, Gordon-Messer, Johns, & Zimmerman, 2012). Our results support this explanation as individual substance use predicted later deviant peer associations, but we found no evidence for the reverse relationship. The peer context may be particularly salient in the present study due to peers providing both models and opportunities for engaging in substance use, as well as social norms and support related to problem behavior.

Adolescence marks a developmental shift away from family influence towards rising levels of peer influence. During this period of increased peer involvement, substance use initiation is also likely, underscoring the importance of the peer context during this time. Bingham and Shope (2004b) found that greater alcohol misuse, less cigarette smoking, and greater tolerance of deviance predicted risky driving behavior. Our results are consistent with previous findings that in emerging adulthood the influence from deviant peers was a

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stronger predictor of substance use (Van Ryzin et al., 2012) and risky driving behaviors (Bingham & Shope, 2004b) compared to family factors. This result was somewhat surprising given previous research indicating the protective influence of African American families on youth risk behaviors, particularly in high risk contexts (Cleveland, Gibbons, Gerrard, Pomery, & Brody, 2005; Wallace & Muroff, 2002). One explanation for the relatively small role of family factors is that, in the current study, only negative family influences were included as predictors. It is possible that positive family influences would equal or outweigh positive peer influences on the outcome variables.

Both developmental and neurological research point to susceptibility to peer influence being particularly high during adolescence, and also important to determining risky behavior (Falk, Way, & Jasinska, 2012). Across races and ethnicities, adolescents take more risks, focus more on the benefits of risky behavior, and also take more risks in the presence of their peers, compared to younger children and adults (Gardner & Steinberg, 2005). Researchers have found that adolescents engaging in risky driving may focus more on the benefits of driving (including gaining independence and looking “cool” in front of their peers), than the risks of the behavior (Harré, 2000; Keating & Halpern-Felsher, 2008). Our findings are consistent with previous research suggesting that peer influence is particularly influential for risky decision making (Arnett, 2010; Gardner & Steinberg, 2005). By emerging and young adulthood, susceptibility to peer influence is less clear, with some evidence supporting young adults’ ability to resist peer pressure and other results concluding the opposite (Arnett, 2010; Bradley & Wildman, 2002; Steinberg & Monahan, 2007). Our findings indicate that peer influence may manifest well into young adulthood (age 21), with risky driving predicted by both previous and current peer associations.

Although we did not find significant cascading effects for the role of family influencing substance use and risky driving, our result of within-time covariation between family environment, individual substance use, and risky driving at age 18 is consistent with the prior findings (Bingham & Shope, 2004b; Shope et al., 1996a; Shope et al., 2001). Family and peer influences on problem behaviors are inherently intertwined. Our result of within-time covariation provides evidence that negative family influences were associated with concurrent substance use and risky driving during emerging adulthood. Researchers have found that while parental influences did not *directly* predict high-risk driving, parental permissiveness and monitoring were *indirectly* associated with both substance-related problem driving and risky driving behaviors (Bingham & Shope, 2004b). Young peoples’ substance use is well known to be influenced by various family factors, such as parents’ lenient attitude toward young people’s drinking (Shope et al., 2001), inconsistency in parenting discipline and less monitoring(Kung & Farrell, 2000). It is also evident that adolescent substance use, particularly alcohol, is associated with high-risk driving (Lang, Waller, & Shope, 1996; Shope et al., 1996a; Shope, Waller, & Lang, 1996b).

In addition, our study provides evidence for bidirectional associations between family conflict and parental drug use, and deviant peer associations within age 16 and 18. It is possible, that negative family environment leads to inconsistent parenting and less parental monitoring of adolescent friendships and activities, and therefore exerts an indirect effect on substance use and risky driving through negative peer associations. Shope et al (2001) noted

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that it is important to include family structure and parents attitude toward young people's drinking and driving behavior when studying risky driving behaviors. The concurrent cross-domain associations along with the cascade effect of peer associations in our study, therefore, converge to suggest that negative family and deviant peer influence in late adolescence have ominous implications for risky driving behaviors.

Contrary to our hypothesis, we did not find direct longitudinal cascade effects from individual substance use to risky driving. One potential explanation for the lack of a relationship is that the risky driving behavior assessed in our study excluded substance-related problem driving. Bingham & Shope (2004a) have identified similar, but distinct patterns of predictions between substance-related driving behaviors versus risky-driving behaviors. Specifically, they found risky driving was predicted by a stronger social bond and differed from drinking or drug using and driving. Similarly, our results indicate that risky driving represents a pattern of driving behavior that is not predicted directly by early substance use, but may be influenced through other social bonds (i.e., peer use, family environment). Future studies that include measures of driving under the influence of alcohol and drugs in examining the relationship between non-driving substance use and risky driving would be a critical next step in a cascade analysis. Research considering the differences of developmental trajectories between risky driving and drinking/substance using-driving would provide further direction of prevention efforts.

Nevertheless, individual alcohol and marijuana use was associated with concurrent risky driving at both age 18 and age 21. Individual substance use was also stable throughout late adolescence and into emerging adulthood. The stability of substance use behavior and the cross-sectional association between substance use and risky driving indicate that young adult behavior may be a continuation of similar risky behaviors in adolescence. These results are consistent with Problem Behavior Theory and supports the notion that multiple risk behaviors need to be studied together (Jessor, 1987; Jessor et al., 2003).

Study Limitations

Several study limitations should be noted. First, our sample included urban, African American youth from one public school district in a particularly economically distressed community. Although our sample provides insight into this at-risk population, caution is needed when interpreting the results, as findings may not generalize to all youth. Further, factors that contribute to risky driving may vary by race/ethnicity and/or geographic location. Future research examining the associations between ecological risk factors and risky driving across racial/ethnic groups would advance our understanding of risky driving, particularly focusing on periods of adolescence and early adulthood. Nevertheless, our focus on African American youth was one of the first studies that examined risky driving in this population, and that applied a developmental cascade approach.

Caution should also be noted for the generalizability of the risky driving behaviors measured in our study (e.g. speeding and unsafe driving) as our driving data was collected during 1997–2000 and the policy environment related to driving has changed since then (i.e. graduated driver licensing was implemented in Michigan in 1997). Nevertheless, the primary goal of our study is to test the concept of developmental cascade where cross-

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domain influences from family, peer and individual factors may lead to heightened risk over time. Our results suggest that developmental cascade may extend to new samples and behavior than in studies where the model was originally test (Masten et al., 2005; Masten, Desjardins, McCormick, Kuo, & Long, 2010; Obradovic, Burt, & Masten, 2010). The results also contribute to our understanding of socio-ecological influences on adolescent risk behaviors (Bingham & Shope, 2004a; Jessor, 1987; Staff et al., 2010; Van Ryzin, Fosco & Dishion, 2012). These findings support the idea that intervening across socio-ecological domains early in life may be necessary and that interventions aimed at only one domain should be reconsidered as opportunities to capitalize on cross-domain effects.

Although researchers have reported male/female differences in risky driving (Copeland et al., 1996; Shope et al., 1996a, 1996b), we did not examine the conceptual model explicitly by sex. Rather, we controlled for sex because we were more interested in the cascading effects. Our results suggest, however, that a useful next step in understanding the cascading effects of family and peers on risky driving would be to explore how these effects may differ for males and females. Our study also included driving permit/license and the opportunity to use a car at age 18 as covariates in our model. Opportunity to use a car was correlated with risky driving at age 18, whereas whether an adolescent has a driving permit/license at age 18 did not predict risky driving. The driving permit/license and driving exposure data were not available at age 21, which could possibly improve our model if they were included. In addition, the item measuring opportunity to use a car may only partially capture the idea of driving exposure. Nevertheless, the potential to use a car is likely highly correlated with driving exposure which may be why it was correlated with risky driving in our data. Moreover, the graduated driver licensing (GDL) programs instituted for adolescents under age 18 may alter certain risk behaviors in our sample given increased monitoring and restrictions of additional passengers. Our study is based on self-reported data which may over- or under- estimate problem behaviors, including our outcome of interest (risky driving). Yet, we relied on commonly used and validated measures, and our approach was consistent with many studies in developmental science.

Finally, our model may be missing other key contributors to risky driving such as personality factors (e.g. sensation seeking or tolerance to deviance) (Constantinou et al., 2011; Simons-Morton et al., 2012) and presence of peer passengers (Allen & Brown, 2008; Lam, Norton, Woodward, Connor, & Ameratunga, 2004). Yet, our model did explain 21% of risky driving behavior. Future research that includes additional risk factors may help explain more variation in risky driving.

Conclusions

Despite these limitations, our results contribute to new evidence that risky driving is influenced by multiple pathways of cross-domain influences across adolescence and early adulthood (Tilleczek, 2010). Our study added to our understanding of developmental cascades in several ways. First, we applied a cascade approach to a significant adolescent health compromising behavior, risky driving. Second, we applied a cascade model in a low to middle income African American sample. Third, we examined social influences for substance use from both family and peers to understand risky driving. Although researchers

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have examined risky driving in the context of problem behavior and psychosocial adjustment (Bingham & Shope, 2004; Donovan, 1993; Shope & Bingham, 2002), much less is known about the longitudinal associations between family and peer influences, substance use, and risky driving.

Our findings support a developmental cascade framework for explaining risky driving behaviors. That is, early alcohol and marijuana use predicted subsequent deviant peer relationships, and early negative peer relationships predicted later risky driving behaviors. These pathways highlight the role of deviant peers and substance use as predictors of future risky driving behaviors. Our findings also provide additional support for a developmental cascade approach for understanding developmental consequences across ecological domains. Our results suggest that strategies designed to help youth resist negative peer pressure may also reduce risky driving behavior. This is especially promising because of the high rate of mortality and morbidity associated with risky driving especially in adolescence and young adulthood. Substance use prevention strategies that include education about the dangers of risky driving may also be useful. Our results also suggest that ongoing research examining risky driving behavior using a developmental cascade approach that included multiple influences across ecological levels may serve to refine and strengthen our understanding of a significant public health issue.

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Highlights

- We examined the cascade hypotheses of the longitudinal cross-domain effects on risky driving.
- Deviant peer associations were related to future risky driving.
- Alcohol and marijuana use predicted later deviant peer relationships.
- Risks in one domain manifested as risks in the same domain across time in addition to spreading to other domains.

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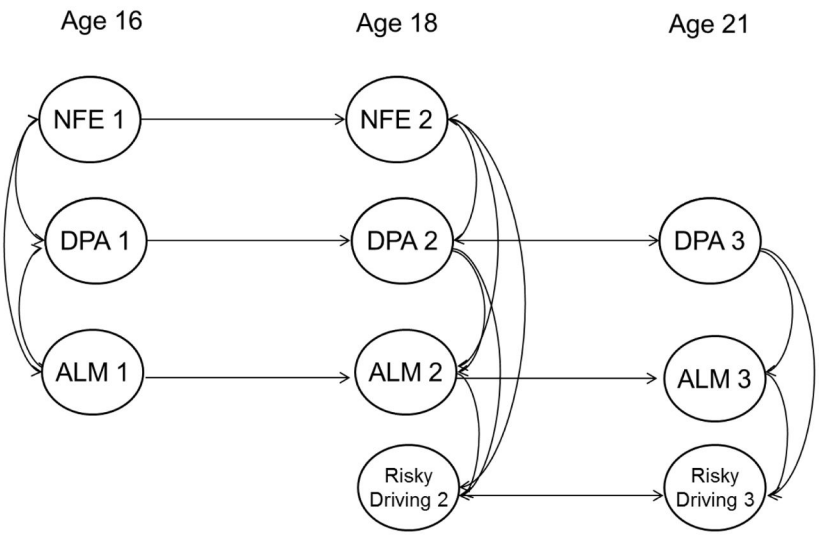

Figure 1.

Continuity model (model 1) represents the most parsimonious model considered, and it was nested within all other models tested in the study. NFE, negative family environment; DPA, deviant peer associations; ALM, individual alcohol and marijuana use

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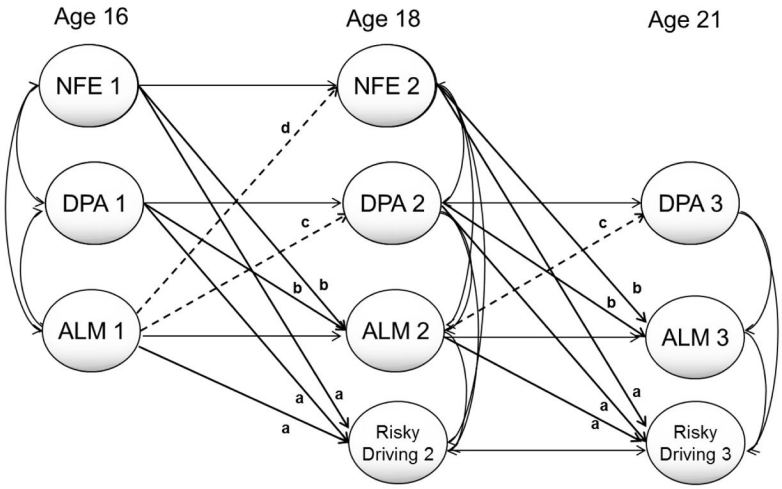

Figure 2.

An illustration of the conceptual models tested in the analyses. NFE, negative family environment; DPA, deviant peer associations; ALM, individual alcohol and marijuana use; The numbers indicate the assessment time period (1, 2 or 3). The *down-streaming cascade model (model 2)* includes all paths from negative family environment and deviant peer associations to individual alcohol/marijuana use (paths labeled “b”) and all the paths from early factors to risky driving (path labeled “a”) plus the most parsimonious model shown in figure 1. The *model 3* included two paths from early alcohol/marijuana use to later deviant peer associations (paths labeled “c”) plus the paths in down-streaming cascade model. The *model 4* included one path from ALM1 to NFE 2 (path labeled “d”) plus the second model. All models tested were controlled by sex, permit/license status and driving frequency.

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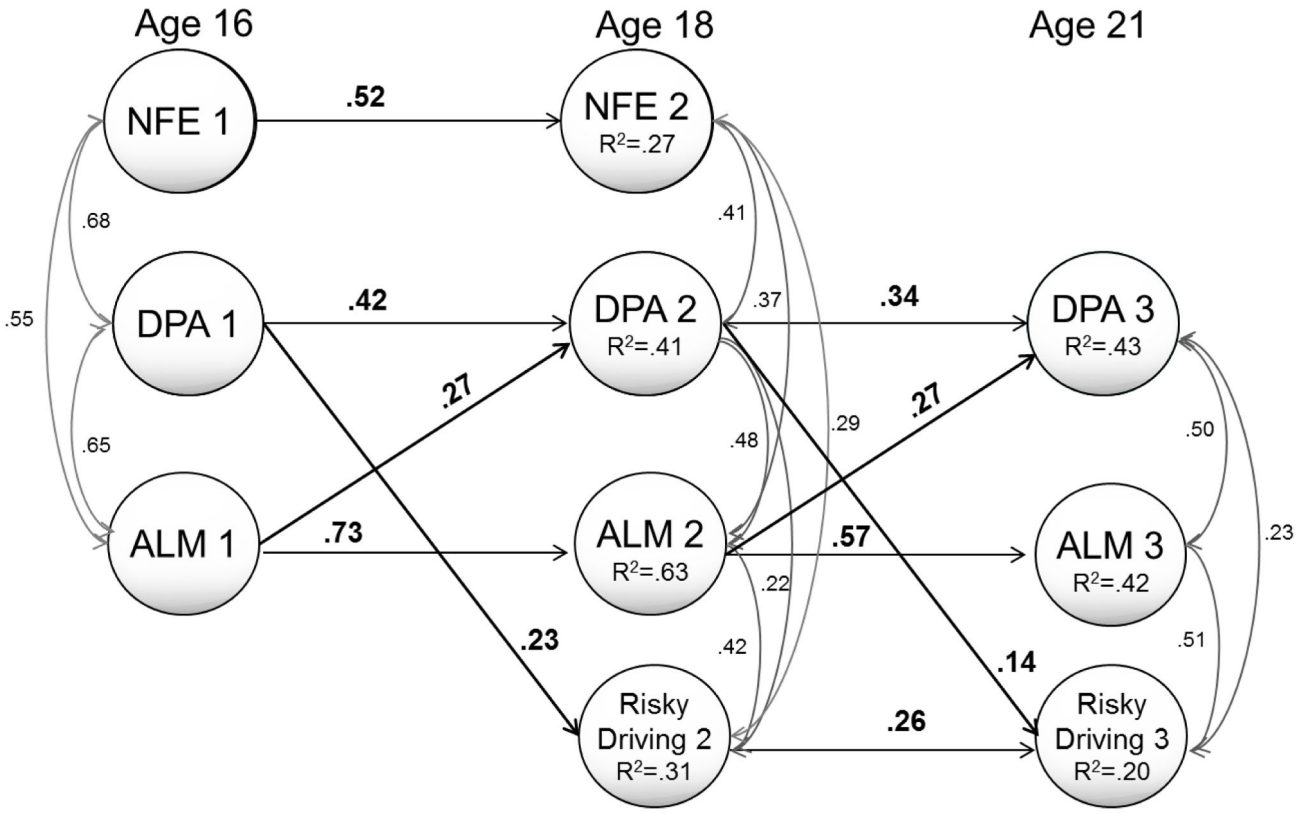

Figure 3.

Final Model. The standardized coefficients for the significant paths of model 3, which is the most parsimonious of the best-fitting models. All numeric paths are significant at $p<.05$. Residuals between endogenous latent factors were allowed to covary. Indicator residuals of the same measure were allowed to covary across time points. NFE, negative family environment; DPA, deviant peer associations; ALM, individual alcohol and marijuana use. Yuan-Bentler $\chi 2$ (248, n =672) = 430.28 ($p < .001$), NFI = .92, NNFI = .95, CFI = .96, RMSEA = .033. Model AIC = − 65.72.

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Table 1

Descriptive Statistics of individual measures for latent constructs

Variables (number of items)	Age 16 Median (IQR)	Age 18 Median (IQR)	Age 21 Median (IQR)	α/r*	Sample item
Negative Family Environment					
Family conflict (5)(Moos & Moos, 1994)	1.40 (.60)	1.40 (.80)	N/A	.79 – .81	Family member so angry and throw things
Parental substance use (7) (Elkington et al., 2011a)	1.00 (.29)	1.00 (.29)	N/A	.72 – .77	Does your parent/adult live with you get high or stoned on drugs?
Deviant Peer Associations					
Friends use alcohol, tobacco, or marijuana (4)	2.25 (1.75)	2.25 (1.50)	2.25 (1.50)	.86 – .88	How many of your friends drink hard liquor at least once a month?
Friends use other drugs (4)	1.25 (.75)	1.25 (.75)	1.00 (.75)	.73 – .85	How many of your friends have been busted for having drugs?
Friends delinquency (5) (Doljanac & Zimmerman, 1998b)	1.63 (1.00)	1.40 (.80)	1.40 (1.00)	.76 – .80	How many of your friends have shoplift from stores?
Individual Substance Use					
Alcohol use (3)(Sum of standardized scores)	−1.55 (.99)	−1.27 (1.42)	−1.39 (2.79)	.80 – .88	During the last 30 days, how many times have you had alcoholic beverages to drink?
Marijuana use (1) (Johnston, O'Malley, & Bachman, 1996)	1.00 (2.00)	1.00 (2.00)	1.00 (2.00)	N/A	During the last 12 month, how many times (if any) have you used marijuana or hashish
Risky Driving Behaviors					
Speeding (2)	N/A	2.00 (2.00)	1.50 (2.50)	.63–.72*	In the last six month, how often have you driven 10–19 mph over the limit?
Unsafe driving (6) (Donovan, 1993a)	N/A	1.83 (1.17)	1.33 (1.67)	.81–.84	In the last six month, how often have you run a red light?

Note:

*Speeding has only two items. The numbers shown are correlations for the two items.

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Table 2

Relative and absolute fit indices for the examined models

Model	x^2/df	AIC	ΔAIC	NFI	NNFI	CFI	RMSEA
1. continuity	498.62/260	−21.38	44.34	0.91	0.94	0.95	0.037
2. down-streaming	455.99/250	−44.01	21.71	0.91	0.95	0.96	0.034
3. add ALM to DPA	430.28/248	−65.72	0	0.92	0.95	0.96	0.033
4. add ALM to NFE	429.26/247	−64.74	0.98	0.92	0.95	0.96	0.033

Note: ΔAIC = AIC*i* − AIC_{min}, where AIC*i* is the AIC value for the *i*th model and AIC_{min} for the minimum value. All fit indices are based on maximum likelihood with robust standard errors and Yuan-Bentler corrections.

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Table 3

Standardized path coefficients for all cross-domain paths in model 3

Path	β	Robust SE
Nfe1→Alm2	.19	.71
Dpa1→Alm2	−.09	.27
Nfe1→RD2	.06	.29
Dpa1→RD2	.23*	.13
Alm1→RD2	−.08	.03
Alm1→Dpa2	.27*	.02
Nfe2→Alm3	−.03	.32
Dpa2→Alm3	.07	.17
Nfe2→RD3	.06	.20
Dpa2→RD3	.14*	.09
Alm2→RD3	.03	.04
Alm2→Dpa3	.27*	.02

Note:

* $p < .05$.

Nfe 1–2, negative family environment at times 1–2; Dpa 1–3, deviant peer associations at times 1–3; Alm 1–3, alcohol and marijuana use at times 1–3; RD 2–3, risky driving at times 1–2.