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Prospective prediction of arrests for driving under the influence from relationship patterns with family and friends in adolescence



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HIGHLIGHTS

- Youth's family and friendship environments were assessed at age 16-17 in a community sample (n = 999).
- These environments were prospectively related to arrest for driving under the influence between ages 16 and 32.
- Parental monitoring, prosocial peer affiliation, and deviant peer affiliation were individually predictive of later arrests.
- When friendship and family environments were in the same model, the friendship environment was more predictive.
- Attenuated family ties and substance-use-based friendships in adolescence may increase subsequent risk for DUI.

A R T I C L E I N F O

Keywords: Alcohol Driving Family Friends

ABSTRACT

Driving under the influence (DUI) is dangerous and costly, yet there are few prospective studies on modifiable risk and protective processes that would inform prevention. Middle adolescence, when most individuals are first learning to drive and first using alcohol, may be a particularly salient period for family and friendship influences on DUI risk. In the present study, youth's family and friendship environments were observed and measured at age 16 in a diverse community sample (n = 999), and then court records were used to document arrest for DUI through the age of 32 years. We first examined the univariate effects of family and friendship variables on later DUI and then fit more comprehensive structural equation models to test predictive effects on the level of construct (e.g., parental monitoring) and environment (e.g., family). Results indicate that parental monitoring (Odds Ratio [OR] = 0.77), positive family relations (OR = 0.84), prosocial peer affiliation (OR = 0.77), and deviant peer affiliation (OR = 1.43) at age 16 were individually predictive of arrests for DUI from ages 16 to 32, even after controlling for both teen and parent alcohol use. The comprehensive, multivariate models indicated that the friendship environment was most predictive of arrests for DUI during the follow-up period. Together, these results are consistent with a model in which attenuated family ties contribute to substance-use-based friendships at age 16, which in turn contribute to an increased likelihood of arrest for DUI in later adolescence and early adulthood. Implications for prevention are discussed.

1. Introduction

Driving under the influence (DUI) is dangerous and costly. In 2015, 10.6 k individuals in the United States were killed in a motor vehicle crash involving a driver with a blood alcohol content (BAC) above 0.08 g/dL, and more than one third of these fatalities were passengers, occupants of other vehicles, or pedestrians (National Center for Statistics and Analysis, 2016). The most recent estimates indicate al-cohol-impaired driving costs the United States \$44b per year in emergency services, legal expenses, insurance, congestion, and property damage (National Center for Statistics and Analysis, 2016), in addition

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to the non-monetary cost of human suffering experienced by both victims and perpetrators.

The significant adverse public health impact of DUI has motivated research into what factors promote it, and thus how it might be prevented. Because the incidence of DUI is relatively low, studies often involve large sample sizes and survey measurement. Such large, nationally representative survey studies have demonstrated that risk factors for self-reported DUI include being male, being Caucasian or Native American, being younger, being unmarried, consuming more alcohol, being alcohol-dependent, first using alcohol at an early age, having a family history of alcoholism, and using tobacco and drugs (Caetano & McGrath, 2005; Chou et al., 2006; Hingson, Heeren, Levenson, Jamanka, & Voas, 2002; Hingson & Zha, 2009). In addition, other studies have identified sensation-seeking and aggressive tendencies as psychological risk factors (Arnett, 1990; Donovan, 1993).

Few studies have examined family or friendship environments that may contribute to DUI. Several studies have identified family and peer factors that promote general risky driving behavior including low parental monitoring (Hartos, Eitel, Haynie, & Simons-Morton, 2000; Eitel, & Simons-Morton, 2002: Shope, Hartos. Waller. Raghunathan, & Patil, 2001), parental nurturing (Shope et al., 2001), and having problem-behaving friends (Hartos et al., 2002). Because these studies have collapsed several risky driving behaviors together (e.g., DUI, speeding, reckless driving, etc.), they do not permit nuanced investigation into which family and peer factors are risks when considering DUI in particular. DUI may be a driving behavior particularly susceptible to family and peer influences since it reflects socialization about two separate topics (i.e., driving norms and drinking norms) and typically arises in social contexts such as after parties, after eating or drinking at restaurants and bars, and on holidays (Chen, Grube, Nygaard, & Miller, 2008; Chou et al., 2006; National Center for Statistics and Analysis, 2016).

At least four studies have examined the role of family and peer factors in predicting DUI specifically. Barnes et al. (Barnes & Welte, 1988) found that having a greater proportion of friends who get drunk weekly was associated with increased rates of self-reported driving while intoxicated (n = 11,539 high school students), and Grube & Voas (1996) showed that perceiving one's peers to be less disapproving of DUI is also a risk factor (n = 706 drivers age 16–20). Complementing these findings of peer influence, Ginsburg et al. (Ginsburg, Durbin, García-España, Kalicka, & Winston, 2009) found that youth who perceive their parents to be authoritative (i.e., both high in support and in monitoring) were less likely to report DUI when compared to those who perceived their parents to be uninvolved (n = 4519 high school students). Finally, Chen et al. (2008) examined both family and peer influences in a sample of 1534 individuals ages 15-20 interviewed by telephone. Results indicated that perceiving peers to DUI or to be less disapproving of DUI was directly associated with increased rate of DUI, and that reporting lower parental monitoring, less frequent fun time with parents, and feeling less close to parents were all indirectly associated with increased rate of DUI.

Despite being informative, the studies to date have been limited by the use of cross-sectional designs, undermining inferences of causality (Hernan & Robins, 2016); by the reliance on adolescent report of both DUI and its predictors, potentially overestimating the covariation (Young, Rebellon, Barnes, & Weerman, 2014); and by the analysis of self-reported driving under the influence, which has a relatively high base rate and may not necessarily reflect the severe behavior associated with substantial costs and consequences (Chou et al., 2006).

The present study extends the literature on family and friendship environments predicting DUI in three ways. First, we use a longitudinal community sample recruited from three public middle schools (90% participation; n = 999) and followed for > 20 years to investigate whether these family and friendship influences on DUI are present prospectively. Second, we use a multimethod measurement strategy to assess family and friendships, including youth report, parent report, and coded videotapes of youth-parent and youth-friend interactions. Third, we analyze official criminal records of DUI arrests to focus on identifying predictors of the most frequent, serious, and costly offenders. Together, these features permit investigation of the absolute, incremental, and comparative effects of family and friendship environments at ages 16-17 on the probability of arrest for DUI in later adolescence and early adulthood. Based on previous literature, we hypothesize that (a) healthy family environments will be prospectively predictive of reduced risk of arrest for DUI, (b) unhealthy peer environments will be prospectively predictive of increased risk of arrest for DUI, and (c) that the peer environments will emerge as more predictive than the family ones (Dishion, Capaldi, Spracklen, & Li, 1995; Van Ryzin & Dishion, 2014).

2. Material and methods

2.1. Sample

The sample was recruited in two cohorts from three public middle schools in Portland, Oregon in the springs of 1997 and 1999, and it has been followed for nearly twenty years. Families were initially approached to participate in a school-based assessment when students were in the sixth grade, and over 90% of the student body agreed to participate. The sample is 53% male, 42% European American, 29% African American, and 7% Latino. At initial recruitment, the median family income was between \$30 and 40 k (cf. national median household income of \sim \$39 k at this time (U.S. Census Bureau, 1999)), 59% of youths lived with their biological fathers, and 42% lived in singlefamily homes. Half of the participants were randomized to a schoolbased family intervention as part of a randomized, controlled trial, and 23% of these participants actually engaged in some level of intervention services. The present analyses utilized only the developmental, long-itudinal aspects of the study, and did not examine intervention effects.

2.2. Predictors

All predictors were assessed when youth were ages 16–17, via both direct observation and questionnaire.

2.2.1. Direct observation

Four predictors were measured via direct observation and coding of videotaped interaction tasks. Youth completed two approximately 45minute interaction tasks in the laboratory and/or at home, first with the parent, then with a same-sex friend of their choice between ages 14 and 21. Trained, blinded undergraduate research assistants then coded this videotaped interaction to produce a series of macro ratings indicating general impressions of the youth and peer's interactive behavior (Dishion & Kavanagh, 1997; Dishion & Kavanagh, 2003; Forgatch, Fetrow, & Lathrop, 1984). Coding was reliable: inter-rater agreement was 82% (family task) and 86% (peer task) in a random subsample of 15% of the videos coded by two raters. See supplementary material and Dishion, Mun, Ha, & Tein (2017) for more detail.

2.2.1.1. Family interaction task. Following instructions, youth and parent discussed a series of eight different topics for five to eight minutes each: (1) parent-led discussion regarding areas of growth for the child, (2) youth-led discussion of an area in which they would like to grow, (3) discussion about parental monitoring and listening, (4) discussion about a youth-parent disagreement and how they solved it, (5) discussion of family problem-solving, (6) discussion of beliefs regarding substance use, (7) planning a fun family activity, and (8) positive recognition of family members. The present study used two specific composites of rated items: first, "parental monitoring" was the mean of seven items assessing the parent's knowledge of the youth's whereabouts, the youth's disclosure of activities and companions, and the overall sense of adult supervision levels ($\alpha = 0.77$). Second, "positive family activities" was the mean of four items assessing whether the family successfully planned a family activity, seemed enthusiastic about the planned activity, and appeared to enjoy spending time together ($\alpha = 0.83$).

2.2.1.2. Friendship interaction task. Youth and friend were prompted to discuss eight different topics for five minutes each: (1) plan an activity to do together in the next week, (2) discuss a current problem of the participant, (3) discuss a current problem of the peer, (4) discuss drug and alcohol use, (5) discuss goals for the next year, (6) discuss friends and peer groups, (7) discuss dating, and (8) plan a party. The present

Table 1

Variable	Response scale	Med. [25th-75th]		n
Predictors				
Parental monitoring (direct observation)	1 (not at all) to 9 (very much)	6.1 [5.4, 6.7]	6.1 (1.0)	644
Positive family activities (direct observation)	1 (not at all) to 9 (very much)	6.0 [5.1, 7.0]	5.9 (1.4)	646
Parental monitoring (youth report)	1 (never or almost never) to 5 (always or almost always).	3.8 [3.0, 4.5]	3.7 (1.0)	749
Parental monitoring (parent report)	1 (never or almost never) to 5 (always or almost always).	4.2 [3.5, 4.8]	4.0 (1.0)	641
Positive family relations (youth report)	1 (never or almost never) to 5 (always or almost always).	3.6 [2.8, 4.1]	3.5 (0.9)	750
Positive family relations (parent report)	1 (never or almost never) to 5 (always or almost always).	4.0 [3.4, 4.5]	3.9 (0.7)	639
Deviant talk with peer (direct observation)	1 (not at all) to 9 (very much)	1.7 [1.4, 2.2]	2.0 (0.8)	721
Drug use talk with peer (direct observation)	1 (not at all) to 9 (very much)	2.0 [1.2, 3.2]	2.4 (1.3)	721
Prosocial peer affiliation (youth report)	1 (never) to 5 (always)	3.5 [3.0, 4.0]	3.5 (0.8)	790
Prosocial peer affiliation (parent report)	1 (never) to 5 (always)	4.0 [3.0, 4.0]	3.7 (0.8)	684
Deviant peer affiliation (youth report)	1 (very few) to 5 (almost all)	2.0 [1.5, 2.8]	2.1 (0.9)	791
Deviant peer affiliation (parent report)	1 (very few) to 5 (almost all)	1.6 [1.2, 2.0]	1.8 (0.7)	685
Covariates				
Current alcohol use of youth (self-report)	0 (never) to 7 (2–3 times per day)	0.3 [0.0, 0.7]	0.4 (0.6)	787
Current alcohol use of mother (self-report)	1 (never tried) to 11 $(3x + per day)$	4.0 [2.0, 6.0]	4.0 (2.3)	630

Note. Med. = median, 25th = 25th percentile, 75th = 75th percentile, SD = standard deviation. Values are based on available data for each variable.

study used two specific composites of rated items: first, "deviant talk" was the mean of 13 items assessing how often the youth made deviant/ antisocial statements, indicated involvement with deviant groups (e.g., gangs), mentioned the possibility of physical violence, or spoke derogatorily of other genders, races, and so on ($\alpha = 0.81$). Second, "drug use talk" was the mean of three items assessing how often the youth and the peer referenced or spoke favorably about drugs and alcohol throughout the discussion ($\alpha = 0.78$). See supplementary material for a full list of items in each composite.

2.2.2. Questionnaires

Two questionnaires administered to the youth and to the parent measured the remaining eight predictors (Dishion, Kavanagh, Schneiger, Nelson, & Kaufman, 2002; Dishion, Kim. Stormshak, & O'Neill, 2014). Youth and parent reports of prosocial peer affiliation was the mean of two items assessing (1) how often youth associated with peers who take school seriously and (2) how often youth associated with others involved in positive activities. Youth and parent report of deviant peer affiliation was the mean of four items ($\alpha = 0.61$ for the adolescent, 0.69 for parent) assessing the proportion of the youth's friends who (1) behaved well in school, (2) misbehaved or broke rules, (3) experimented with smoking or other substances, and (4) dressed or acted like a gang member.

Concerning family management practices, the adolescent and parent report of parental monitoring was the mean of four items ($\alpha = 0.84$ for youth, 0.89 for parent) assessing the extent to which (1) parent knew what the youth was doing when away from home, (2) parent knew where the youth was after school, (3) parent knew the youth's plans for coming day, and (4) parent had a good idea of the youth's interests and activities. Youth and parent report of positive family relations was the mean of eight items ($\alpha = 0.91$ for youth, 0.88 for parent) assessing the extent to which youth and parent enjoyed being together and spent time together (see supplementary material for the full list of items).

2.3. Covariates

A covariate measuring the youth's current alcohol use consisted of the average of three self-report items assessing the frequency of use of beer, wine, and liquor. The response scale ranged from 0 (*never*) to 7 (2–3 *times per day*). A second covariate was the mother's report of her own frequency of alcohol use, ranging from 0 (*never tried alcohol*) to 11 ($3 \times$ + per day).

2.4. Outcome

The dependent measure was whether a participant had ever undergone arrest for DUI, per official records (see supplementary material for description of records collection). One-hundred six participants had ever been arrested for DUI, with 18 participants first being arrested between ages 16 and 20, 55 first being arrested between ages 21 and 25, 26 first being arrested between ages 26 and 30, and 10 first being arrested between ages 30 and 32. Thus, approximately 10.6% of our sample had been arrested for DUI over a fifteen-year period, which is roughly consistent with national averages. For example, the past-year rate of self-reported arrest for DUI was 0.65% in a large probability sample of adults (Caetano & McGrath, 2005), which suggests a fifteen-year rate of approximately 9.3% (see supplementary material for details of this calculation). Finally, DUI was uncorrelated with intervention status (r < 0.03), confirming that the full dataset would be appropriate for investigating developmental pathways to DUI.

2.5. Analytic plan

Structural equation models were fit in Mplus version 7.4 (Muthén & Muthén, 2012), and all other analyses were conducted in the R statistical software environment, version 3.4.1 (R Core Team, 2017). Descriptives for all included variables are provided in Table 1.

2.5.1. Individual variable regression models

To begin, we fit a series of bivariate logistic regressions to relate individual family and peer variables to the odds of arrest for DUI. These analyses help to contextualize our subsequent structural equation models and to connect our current findings to past work that used only youth report (i.e., self-report) of family and peer characteristics.

2.5.2. Construct-level structural equation models

We next fit a series of structural equation models that utilized our multimethod measurement strategy to investigate the relationship of well-measured family and peer constructs to the odds of being arrested for DUI. As in the regressions, the DUI outcome was modeled as binary. A separate model was fit for each of four constructs—parental monitoring, positive family relations, prosocial peer affiliation, and deviant peer affiliation—with a latent factor loading on all measurements of that construct (i.e., youth report, parent report, and direct observation) with this latent factor predicting ever being arrested for DUI.

Next, each of these models was fit again incorporating both youth and parent frequency of alcohol use as covariates to produce adjusted estimates. These analyses tested whether there is an *incremental* relation of family and friendship variables to DUI, over and above the more salient influences of alcohol-use patterns.

2.5.3. Environment-level structural equation models

Next, we fit larger structural equation models that related latent family and peer environment factors to the odds of ever being arrested for DUI. These latent factors were indicated by all methods of measurements of the respective environments, and specific measurements arising from the same informant (i.e., youth or parent) were related either by correlating these measurements' residual variances or (in the case of the most comprehensive model) including method factors. We fit three models—one with only the family environment predicting DUI, one with only the friendship environment predicting DUI, and one with both environments simultaneously predicting DUI.

2.5.4. Missing data

Data on predictors ranged from 63 to 79% complete, with no missing data on the DUI outcome. Missing data was multiply-imputed, so n = 999 for all analyses and all estimates reflect pooled quantities (see supplementary material for more detail).

3. Results

3.1. Individual variable regression models

Table 2 shows the results of the individual variable models. The odds ratios of those variables measuring family factors were generally not statistically significant, although three were marginally so and all were in the anticipated direction. In contrast, all prosocial peer variables were significantly negatively associated with DUI and all deviant peer variables were significantly positively associated with DUI, regardless of measurement method.

3.2. Construct-level structural equation models

Table 3 shows the results of the construct-level structural equation models. Factor loadings ranged from 0.17 to 0.65, consistent with previous work showing medium-to-low correlation between self-report

Table 2

Bivariate logistic regressions predicting ever arrested for DUI with individual family and friendship variables.

Predictor	Effect on DUI Odds Ratio [95% CI]	
Family factors		
Direct observation		
Parental monitoring	$0.82 \ [0.65, \ 1.03]^{\dagger}$	
Positive family activities	$0.86~[0.73,1.01]^{\dagger}$	
Questionnaires		
Parental monitoring (youth report)	0.83 [0.66, 1.04]	
Parental monitoring (parent report)	$0.80 \ [0.64, \ 1.01]^\dagger$	
Positive family relations (youth report)	0.85 [0.66, 1.09]	
Positive family relations (parent report)	0.83 [0.60, 1.15]	
Friendship factors		
Direct observation		
Deviant talk with peer	1.47 [1.14, 1.89]**	
Drug use talk with peer	1.27 [1.08, 1.51]**	
Questionnaires		
Prosocial peer affiliation (youth report)	0.68 [0.52, 0.88]**	
Prosocial peer affiliation (parent report)	0.74 [0.55, 0.99]*	
Deviant peer affiliation (youth report)	1.86 [1.46, 2.37]***	
Deviant peer affiliation (parent report)	1.41 [1.03, 1.92]*	

Note. DUI = driving under the influence. All estimates are unstandardized; see Methods section for the measurement scale of each predictor.

 $^{\dagger} p < 0.10.$

* p < 0.05. ** p < 0.01.

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*** p < 0.001.
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and direct observation of family and peer characteristics (Table 3, fourth column). Fit statistics indicated adequate to excellent fit (Table 3, fifth column), and relations of all constructs to DUI were statistically significant (positive family relations only marginally so). First considering the unadjusted results, each 1-SD increase in parental monitoring or prosocial peer affiliation was associated with a 23% decrease in the odds of DUI (ps < 0.01). Each 1-SD increase in positive family relations was marginally associated with a 16% decrease in the odds of DUI (p < 0.10). Finally, each 1-SD increase in deviant peer affiliation was associated with a 43% increase in the odds of DUI (p < 0.001). Adjusting for youth and parent alcohol use had minimal impact on the magnitude of these relations and did not change the pattern of statistical significance.

3.3. Environment-level structural equation models

Fig. 1 shows the results for the environment-level structural equation models, which fit the data well. Factor loadings ranged from 0.19–0.50 for the family factor and 0.40–0.58 for the peer factor. In separate models, both the family environment ($\beta = -0.24$, SE = 0.08 p < 0.01) and the friendship environment ($\beta = 0.38$, SE = 0.07 p < 0.001) predicted future arrest for DUI. With both environments in the same model, the two environments were correlated at -0.64 (SE = 0.06, p < 0.01). Only the peer factor remained statistically significantly predictive of DUI ($\beta = 0.34$, SE = 0.12, p < 0.01), and the relation of the family environment to DUI was almost completely occluded ($\beta = -0.03$, SE = 0.13, *ns*).

4. Discussion

We investigated how family and peer environments at ages 16–17 related to DUI, including absolute, incremental, and comparative influences. Results extend the previous literature by demonstrating that parental monitoring, positive family relations, prosocial peer affiliation, and deviant peer affiliation in middle adolescence all prospectively predict arrests for DUI in later adolescence and early adulthood. To the best of our knowledge, this has been the first study of family and friendship influences on DUI to utilize a prospective longitudinal design, multimethod measurement strategy, and official arrest records.

Considering the family domain, results indicated that both parental monitoring (p < 0.01) and positive family relations constructs (p < 0.10) predicted reduced odds of DUI, with the effect of parental monitoring being greater. However, when assessing either construct with a single-method measurement (e.g., parent report of monitoring), these variables were at best marginally significantly related to DUI, although the estimated coefficients were all in the anticipated direction. The bottom panel of Fig. 2 depicts one illustrative relationship: the estimated probability of arrest for DUI decreases from approximately 18% to 8% as the level of parent-reported parental monitoring increases from "never" to "always."

Considering the friendship domain, results indicated that the deviant peer affiliation construct was prospectively associated with significantly increased odds of DUI, extending previous demonstration of this association in cross-sectional self-report survey data (Barnes & Welte, 1988). In fact, we found that individual measures collected by direct observation and parent report were also significantly predictive, suggesting that previous observations of this relation were not due to measurement bias (i.e., using the same informant). Notably, observer ratings of youths' and friends' discussions of alcohol and drug use for merely 10 min robustly predicted later DUI. The bottom panel of Fig. 2 depicts one illustrative relationship: the estimated probability of arrest for DUI increases from approximately 5% to 40% as the youthreported proportion of peers who are deviant increases from "almost none" to "almost all." Finally, to the best of our knowledge, our findings are the first to show that prosocial peer affiliation (i.e., having friends who take school seriously and are involved in positive activities) is

Table 3

Construct-level structural equation models.

Effect of latent factor on DUI		Model: latent factor & indicators	Factor loading (SE)	Model fit		
Odds ratio Coefficient (SE)						
Adjusted	Unadjusted	Adjusted	Unadjusted			
0.77	0.77	- 0.26 (0.11)*	- 0.26 (0.10)**	Model 1 – parental monitoring Parental monitoring (direct observation) Parental monitoring (youth report) Parental monitoring (parent report)	+ 0.30 (0.06) + 0.42 (0.08) + 0.47 (0.08)	RMSEA = 0.008, CFI = 0.993
0.84	0.84	- 0.17 (0.10) [†]	- 0.18 (0.10) [†]	Model 2 – positive family relations Positive family activities (direct observation) Positive family relations (youth report) Positive family relations (parent report)	+ 0.17 (0.06) + 0.45 (0.13) + 0.57 (0.18)	RMSEA = 0.032, CFI = 0.961
0.77	0.77	- 0.26 (0.09)**	- 0.26 (0.09)**	Model 3 – prosocial peer affiliation Prosocial peer affiliation (youth report) Prosocial peer affiliation (parent report)	+ 0.65 (0.20) + 0.47 (0.14)	RMSEA = 0.000, CFI = 1.000
1.49	1.43	+ 0.40 (0.08)***	+ 0.36 (0.07)***	Model 4 – deviant peer affiliation Deviant talk with peer (direct observation) Drug use talk with peer (direct observation) Deviant peer affiliation (youth report) Deviant peer affiliation (parent report)	+ 0.51 (0.04) + 0.64 (0.04) + 0.51 (0.04) + 0.39 (0.04)	RMSEA = 0.067, CFI = 0.945

Note. DUI = driving under the influence, SE = standard error, RMSEA = root mean square error of approximation, CFI = comparative fit index. Models 1–4 comprise four separate structural equation models. All numbers are from standardized solutions. Adjusted estimates are from models that include youth's and parent's alcohol use as covariates. Factor loadings and model fit statistics are per unadjusted model. Odds ratios indicate the multiplicative effect on odds of DUI for each one-standard-deviation increase in the respective factor score.

 $^{\dagger} p < 0.10.$

* p < 0.05.

** p < 0.01.

*** p < 0.001.

associated with significantly *reduced* odds of DUI. It seems that, just as having deviant peers can be a risk factor, having prosocial peers can be a protective factor.

Considering the full family and friendship environments, results indicate that, while both environments were independently predictive, the friendship environment emerged as more predictive when we incorporated them into the same model. In other words, when predicting arrests for DUI, information about family appeared to be largely redundant after accounting for information about friends. However, it is important to note that the correlation between the broad family and friendship constructs was moderately high. This finding fits well within the notion of friends and family forming a 'mesosystem' of influence, as originally coined by Bronfrenbrenner (Bronfenbrenner, 1986). In this framing, parents and friends work in tandem, so that the more engaged a youth is with substance-using friends, the less often the parents can track and influence the youth outside the home. Over time, youth pull themselves out of the surveillance of caregiving adults to reduce barriers to activities and time with friends, resulting in premature autonomy (Dishion, Nelson, & Bullock, 2004).

4.1. Implications

The most common evidence-based interventions for DUI operate at the community level and are clearly and directly connected to alcohol use and driving patterns: blood alcohol concentration laws, legal drinking age laws, sobriety checkpoints, and training programs for servers of alcoholic beverages (Shults et al., 2001). Results from a longitudinal trial with three matched intervention communities suggest that implementing a comprehensive package of these interventions suggests can reduce the incidence of DUI and associated outcomes (Holder et al., 2000). The current results suggest that interventions that promote healthy family functioning and discourage the formation of deviant peer groups may offer additional tools in the growing arsenal of approaches to reducing DUI. Importantly, family and peer influences remained, even after accounting for youth and parent alcohol-use frequency, indicating value in targeting these potential mediators of reductions in DUI. There is strong evidence that family- and school-based interventions can increase parental monitoring (Dishion, Nelson, & Kavanagh, 2003) and positive family relations (Smith, Knoble, Zerr, Dishion, & Stormshak, 2014; Van Ryzin & Dishion, 2012); emerging evidence indicates that these programs can reduce selection into deviant peer groups (Chang, Shaw, Shelleby, Dishion, & Wilson, 2016; DeLay, Ha, Ryzin, Winter, & Dishion, 2015). Thus, the possibility of ancillary effects on DUI should be investigated in data from existing trials of these interventions, and new trials should consider driving safety in general and DUI specifically as intervention targets.

4.2. Limitations

Several limitations should be noted. First, we used official records of arrest for DUI to focus on the most serious offenders who incur costs to themselves and to society, so our findings on family and peer influences are necessarily limited to these individuals. It may be that these relations differ when considering DUI behavior that does not lead to an arrest, which has an estimated past-year prevalence approximately 17 times greater than that of arrest (11.3% versus. 0.65%) (Caetano & McGrath, 2005; Chou et al., 2006). Research that integrates both self-report of DUI and arrest records would inform this question. Second, despite the longitudinal data set, the analysis is ultimately correlational and cannot establish that the family and friend effects are causal. More positive family environments or greater deviant peer affiliation could be serving as proxies for the variables that are truly increasing risk for DUI (e.g., youth's impulsivity). Although family and peer effects remained after adjusting for both the youth's and the parents' current alcohol use (i.e., two potential confounders), the data and design of the current study precluded the use of a more comprehensive analysis that could yield a better estimate of the true causal effect (e.g., propensity score matching (Imbens & Rubin, 2015)).

5. Conclusion

Results demonstrate that family and especially friendship patterns during adolescence are prospectively predictive of later arrest for DUI, per official records. Findings suggests that interventions delivered



Fig. 1. Environment-level structural equation models.

Note: Numbers are from standardized solutions, with standard errors in parentheses. Standard errors are omitted for factor loadings since all are statistically significant, p < 0.001. All three models fit the data well (Model A: RMSEA = 0.033, CFI = 0.968; Model B: RMSEA = 0.039, CFI = 0.976; Model C: RMSEA = 0.043, CFI = 0.933). In Model C, figure does not depict the two method factors for all variables per (a) youth and (b) parent report—see supplementary material for complete model specification and results. **p < 0.01, ***p < 0.001.

during adolescence that aim to (a) promote parental monitoring, (b) promote the acquisition of prosocial, school-oriented peers, and (c) disrupt the formation of deviant peer groups may complement existing approaches to combating DUI. Given the substantial cost of DUI to both individuals and society, these interventions are sorely needed.

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Fig. 2. Illustrative relations of family and friendship variables to estimated probability of arrest for DUI.

Note: Depicts effects listed in second column of Table 2. Shading indicates 95% confidence interval about predicted mean.

interpretation of the data, or writing of the manuscript.

Contributors

Author TJD designed the study and wrote the protocol. Author WEP conducted the statistical analyses and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Conflicts of interest

All authors declare that they have no conflict of interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2017.10.004.

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