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Perceived Peer Behavior and Parental Support as Correlates of Marijuana Use: The Role of Age and Gender

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Abstract

Introduction—Parental support and perceptions of peer behavior on substance use are well-studied, but precisely how their associations vary as a function of age, and how those age-specific patterns vary by gender, remain unknown components of the developmental process underlying substance use.

Methods—Using data from an 18-year longitudinal study of predominantly African-American students at high-risk for high school dropout in Flint, Michigan (baseline average age = 14.8 years), we examined longitudinal associations between past 30-day marijuana use and three self-reported variables: perceived friend drug use, perceived friend aggression, parental support. We used varying-coefficient regression models to semiparametrically estimate how covariate effects on past 30-day marijuana use vary smoothly as a function of age; gender differences in these age-specific coefficient trajectories were also tested.

Results—In the unadjusted tests, the risk-enhancing effect of perceived friend drug use decreased with age in both genders, but the effect of perceived friend aggression varied only in females; in both cases, gender differences were not significant. In males, parental support had protective effects that decreased with age. The effect of both parental support differed in females, with less protective baseline effects and no evidence of age-variation. Adjusted models simultaneously including both friend and parental variables produced qualitatively similar results.

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Declaration of Interest

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Conclusions—Prevention strategies focusing on social exposures may be more effective if they are age- and gender-specific. In particular, interventions focusing on perceived peer behaviors may be more appropriate during adolescence, and those involving parental relationships may be more appropriate for males.

Keywords

Age; gender; marijuana; parental support; peer behaviors

Introduction

Marijuana is a drug of choice across a wide age range, with past 30-day use prevalence steadily above 11.5% from age 16 to 34 (SAMSHA, 2013). Rapidly shifting norms and legality regarding marijuana use may have implications for increased availability and use; this, combined with consistently observed associations between marijuana use and outcomes like psychological distress (Hayatbakhsh et al., 2007), social problems (Green & Ensminger, 2006), motor vehicle crash (Elliott, Shope, Raghunathan, & Waller, 2006), and violence involvement (Bohnert et al., 2015; Goldstick et al., 2015; Goldstick et al., 2016; Stoddard et al., 2015), make continued study of its use crucial.

The age span where marijuana use rates remain high represents a period of rapid biological, cognitive, and social development, suggesting that the etiology of marijuana use may differ across this continuum. Although certain components of the age-specific nature of marijuana use — e.g., that use increases beginning in early adolescence, peaks in young adulthood, and decreases thereafter (SAMSHA, 2013) - are well established, age-specific effects of particular risk factors are a less well-understood component of the developmental process. In particular, social - peer and parental - factors have been identified consistently as important drivers of substance use (Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002; Elkington, Bauermeister, & Zimmerman, 2011), but knowledge of how these associations vary by both age and gender is limited, particularly in urban populations. The purpose of this work is to elucidate the age-specific effects of perceived peer behaviors and reported parental support on marijuana use - and how they differ by gender - in an urban population across a wide age range (roughly 15–33).

Development and social correlates of substance use

Both peer and parental relationships have been consistently identified as important correlates of substance use. Peer influences are perhaps the most important risk factor for substance use, both in terms of direct association with substance-using peers (Marschall-Lévesque, Castellanos-Ryan, Vitaro, & Séguin, 2014) and affiliation with more generally deviant (e.g., aggressive or otherwise delinquent) peers (Pires & Jenkins, 2007). In addition, parental support/attachment is frequently observed as a protective factor for substance use (Ackard, Neumark-Sztainer, Story, & Perry, 2006; Crawford & Novak, 2008). Studies analyzing these factors, as they relate to substance use, are often restricted to adolescence and possibly shortly thereafter, restricting a full understanding of the role of these predictors throughout the period that marijuana use rates remain high.

Prior research provides several reasons to suspect that the effects of peers and/or parents on substance use are age-specific. Researchers have reported that the role of peer acceptance in influencing risk-taking behavior increases during adolescence (Cauffman et al., 2010; Duan, Chou, Andreeva, & Pentz, 2009; Gardner & Steinberg, 2005), perhaps due to heightened responsiveness to social reward and desire to fit in among peers (Spear, 2000). Emerging adulthood is often characterized by increased autonomy, exploration of one's identity and less clearly defined social roles compared to adolescence (Arnett, 2000; Aseltine & Gore, 1993; Bachman et al., 2012) and as individuals grow into adult roles such as parenthood, they may become more risk-adverse (Bachman et al., 2012), regardless of social influences. Consistent with this, researchers have also found that adults, relative to adolescents, place lower importance on short-term rewards, and have greater concern for the potential risks of their behavior (Smith, Steinberg, Strang, & Chein, 2015; Steinberg & Monahan, 2007). These observations suggest that the role of social factors in etiology of substance use is age-specific, with its importance possibly peaking during adolescence; yet, existing research on the epidemiology of substance use has not comprehensively explored such dynamics.

Although gender-based differences in age-specific rates of substance use behaviors are established (Chen & Jacobson, 2012), age-specific differences between males and females in the role of social factors remains understudied, despite known differences in how males and females interact with both their parents and their peers. Females, for example, are more likely to have strong parental attachment and are also more likely to rely on, and be influenced by peers, than males (Gorrese & Ruggieri, 2012; Svensson, 2003). These differences plausibly translate to differential roles of both perceived peer behavior and parental relationship quality on marijuana use. Some researchers report that parental disapproval (Kelly et al., 2011) and parental awareness (Tebes et al., 2011) are more influential for sons than daughters in preventing substance use, but others indicate parental control and emotional support is more protective in girls (Choquet, Hassler, Morin, Falissard, & Chau, 2008), while others indicate no difference (Branstetter, Low, & Furman, 2011). Although some evidence suggests that females are more resistant to peer influences, during and after adolescence (Crosnoe, Glasgow-Erickson, & Dornbusch, 2002; Steinberg & Monahan, 2007), most researchers have not found evidence for effect modification by gender (Marschall-Lévesque et al., 2014). One explanation given for that lack of evidence is the omission of relevant secondary effect modifiers (Marschall-Lévesque et al., 2014), which may include age. If this hypothesis is true, studying gender differences in age-specific risk factor effects is an important next step in understanding gender differences in the etiology of substance use.

Empirical research on age-specific effects

Empirical research on the age-specific importance of peers exists (Cauffman et al., 2010; Steinberg & Monahan, 2007), but less is available on age-specific associations between substance use and social factors. In one study, the effect of peers on substance use remained significant into early adulthood, whereas familial factors became nonsignificant (Van Ryzin, Fosco, & Dishion, 2012). Yet, due to the categorization of age, information was not directly borrowed across ages to produce a single covariate-effect trajectory, and thus a precise characterization of how those associations fluctuated continuously over time could not be

inferred. In another study, deviant peer associations mapped onto marijuana use more strongly in older subjects (ages 17–18, 20–21) than young (ages 14–15, 15–16) (Fergusson, Swain-Campbell, & Horwood, 2002); however, this work used generalized linear models, prespecifying the age-based moderation to be monotonic in nature and changing at a constant rate, inhibiting the possibility of more general age-varying effects.

Much research on drivers of developmental differences in substance use utilizes growth mixture modeling to identify heterogeneity in age-trajectories of use (Brook, Lee, Brown, Finch, & Brook, 2011; Jackson, Sher, & Schulenberg, 2008), and what distinguishes trajectory types. Multitrajectory models have been used to detect age-specific patterns of comorbidity, such as cooccurrence of substance use and violence (White, Jackson, & Loeber, 2009). These approaches have provided valuable information, e.g., that partner substance use is a distinguishing feature between early adopters who develop into chronic users versus those who grow out of it (Brook et al., 2011). Yet, by distilling longitudinal data into a nontime-varying categorical indicator, the ability to determine when in the developmental process particular risk/protective factors are most important is lost.

Study overview

We use data from a long-term study of students initially at high risk for high school drop-out in Flint, Michigan, to study the effect of perceived peer behaviors (substance use, aggression) and reported parental support on marijuana use, how these effects vary with age, and how those age-specific patterns vary by gender. To maximize the age-range of the data, we restricted parental variables to measures of parent-child relationship quality, rather than including parental monitoring and parental drug use, which were only available during adolescence. We use varying-coefficient regression models (Fan & Zhang, 2008; Hastie & Tibshirani, 1993) to semiparametrically estimate how covariate effects vary with age. This approach allows data-driven, rather than prespecified (e.g., linear interaction by age), determination of the age-specific covariate effect. Our initial hypotheses were that peer and parental factors, both negative and positive, would become less important with age, but that the baseline effect and/or the timing and magnitude of these shifts may differ by gender.

Methods

Study design and setting

Twelve waves of data were collected from mid-adolescence (ninth grade, mean age = 14.8) to young adulthood (mean age = 32.0 years old) in a longitudinal study assessing risks and resilience among urban youth at high risk of school drop-out. Eligible adolescents included ninth graders attending one of four public high schools in Flint, Michigan. Eligible participants had a grade point of ≤3.0 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. Of the 979 adolescents who met the inclusion criteria and were contacted to participate, 52 had left the public schools; 67 were consistently absent from school after several contact attempts; and 10 either refused to participate or were refused participation by their parents. Therefore, 87% of the initially eligible youth (n = 850, 51% females) completed the data collection at wave 1 (ninth grade) in the original study.

Participants self-identified as Black or African-American (80%), White or Caucasian (17%), or Mixed African-American and White (3%). This study was approved by the University of Michigan IRB and meets the requirements for the protection of human subjects.

Participants completed a paper and pencil questionnaire for more sensitive information regarding substance use and sexual behavior. Prior to data collection, researchers obtained consent from all participants. Each interview lasted 50–60 minutes. Four waves of data collected during high school years (waves 1–4; 1994–1997), four years after high school (waves 5–8; 1999–2002), and four more years when respondents were in their late 1920s/early 1930s (waves 9–12; 2008–2012). The retention rates were generally high for the first eight waves (average 90% from waves 1–4 and 65% from waves 5–8) and dropped to around 45% for the last four waves due to a six-year hiatus between waves 8 and 9. Because some of the relevant variables described below (maternal/paternal support) were not measured in wave 1, only waves 2–12 are analyzed here. The analytic sample was comprised of individuals with responses on all variables.

Measurements

Outcome variable—Participants reported the frequency of marijuana use over the past 30 days at all 12 time points. The frequency was rated using a seven-point frequency scale: 1(*none*), 2(*1–2 times*), 3(*3–5 times*), 4(*6–9 times*), 5(*10–19 times*), 6(*20–39 times*), and 7(*more than 40 times*). The questions were drawn from the *Monitoring the Future* study (Johnston, O'Malley, & Bachman, 2002). Although such an outcome variable is likely to produce nonnormally distributed residuals, their effect on the resulting inference is likely to be minimal given the sample size (Lumley, Diehr, Emerson, & Chen, 2002).

Occupational prestige score—A coding system developed by the National Opinion Research Center (Nakao & Treas, 1990) as used to quantify parental socioeconomic status. The maximum of the two parents' occupational prestige score was used. For children from single-parent households, only the available parent was used. The score was divided by 10 in this work to put it on a similar scale to the other covariates.

Family structure—Baseline measurements of who cohabitated with the participant were used to create an indicator of whether or not the child lived with both biological parents (Assari, Smith, Caldwell, & Zimmerman, 2015).

Friend drug use—Five questions regarding the number of friends they believed that were involved in substance use/substance-related problems using a five-point scale (1 = *none*; 5 = *all*) were used to measure friend drug use. These items, as a subscale of deviant peer associations, have been employed by other articles from this longitudinal study (Doljanac & Zimmerman, 1998; Elkington et al., 2011). A mean friend drug use score was created for each wave by averaging responses on these items.

Friend aggressive behavior—Three items pertaining to deviant peer associations (Doljanac & Zimmerman, 1998; Elkington et al., 2011b) were used to measure the number of friends participants believed that were involved in aggressive behavior (get into fights, have carried a knife or razor, and have carried a gun). Participants rated the number of

friends using the same five-point scale as the friend drug use questions. A mean friend aggression score was created for each wave by averaging responses on the three items.

Parental support—Maternal and paternal supports were measured with a perceived support scale using five items for each parent (Procidano & Heller, 1983). These questions assessed parental support provided in the participant's daily life (e.g., "I rely on my mother/father for emotional support and my mother is good at helping me solve problems"). The full set of parental support questions are shown in appendix table 6. Each question was rated from 1 (not true) to 5 (very true). A mean of the five items was calculated for each of maternal support and paternal support. As in prior publications using these data (Caldwell, Sellers, Bernat, & Zimmerman, 2004), a value of "0" was entered for paternal support in measurements from individuals reporting have no father figure, or having no current contact with their father figure, which corresponded to 948 rows (19.1%) in the final analytic data set. Due to the very similar age-trajectories and gender differences in the effects of both maternal and paternal support (Figures S3 and S4), these two were averaged to produce a single parental support measure, which was used in all subsequent analyses for parsimony.

Statistical analysis

We began with descriptive statistics to describe each scale, demographics, and the prevalence of marijuana use, by gender/age. To descriptively address the research question, we stratified into age groups and calculated the unadjusted regression coefficient with each scale as a predictor and plotted these coefficients against age. To address the primary research questions, we used generalized additive models (GAM) (Wood, 2006) - a modification of generalized linear models that allow empirically based estimation of the shape of the regression function (as opposed to *a priori* linear specification) - to fit varying-coefficient regression models. Specifically, we use a modification of the usual linear mixed effects model with a single random intercept:

$$Y_{it}=\alpha+X_{it}\cdot\beta+\eta_i+\varepsilon_{it}$$

by allowing the covariate to have an age-specific regression coefficient:

$$Y_{it}=\alpha(a)+X_{it}\cdot\beta(a)+\eta_i+\varepsilon_{it}$$

Thus, our primary research question was addressed by testing whether or not $\beta(a)$ was a constant function of age. In the case where both $f(a)$ and $\beta(a)$ are linear functions, this is equivalent to an ordinary age main-effect and interaction, respectively. Within the GAM framework, we estimated both functions semiparametrically with shape and smoothness level (with linear being the smoothest function possible) dictated by the data as part of the fitting process. All model fitting and hypothesis testing here are based on facilities provided by the R package *mgcv* (Wood, 2016).

For tests involving whether or not the regression coefficient varies by age, we compared the full model that allows $\beta(a)$ to be freely estimated with that model that constrained the coefficient to be a constant function of age using a generalized likelihood ratio test (Wood,

2006). To test whether the covariate effects varied by gender, we replaced $\beta(a)$ in the equation above with $\beta_1(a) + \beta_2(a) \times male$, and test $\beta_2(a) \equiv 0$, which is analogous to testing an age-gender-X interaction in a linear model. This test is based on the Wald framework described by Wood (2012) and implemented in *mgcv*. For practical reasons related to convergence of models containing both random effects and several nonparametric terms (most saliently for the gender-age interaction tests), we conducted these tests one variable at time.

Finally, we fit adjusted models - stratified by gender - with fixed (nonage-varying) effects for each variable, and estimated age-varying effects for each variable. Only age-interactions with variables showing significant age-variation in the unadjusted regression coefficients were included. In the adjusted models, we also control for race, baseline occupational prestige score, and baseline family structure, and correlations due to repeated measures using individual-level random effects.

Results

Descriptive statistics

Descriptive statistics for the demographics and each of the scales across waves, and overall, are shown in Table 1. There were 4964 total measurements included in the analysis from 728 unique individuals. Among the 728 participants, 79.3% were African-American, 48.6% were female, 31.6% lived with both parents at baseline, and the average occupational prestige score was 39.9 (SD = 10.4), indicating blue collar employment. The percentage female ranged from 50.1% to 59.6% across the waves, with 52.8% of the overall observations coming from females. The percentage of African-American participants ranged from 72.2% to 81.0% across the waves, with 78.1% of the overall observations from African-Americans. Figure 1 shows the trajectory of simple regression coefficients for past 30-day marijuana use regressed on each scale. We found an apparent decreasing trend in the coefficient for friend drug use, but the year-to-year fluctuation in each panel obscures the true features of each trajectory.

Tests for age- and gender-specific effects

Gender-specific fitted estimates of the (unadjusted) age-varying regression coefficient for friend drug use, friend aggression, and parental support, controlling for within-individual correlations induced by the repeated measures, are shown in Figure 2. Notably, the data-driven smoothness selection indicated that linearity sufficiently captured the age-specific effect in most cases. Friend drug use was found to have an age-varying effect in both males ($p < .001$) and females ($p < .001$), with its effect becoming less risk-enhancing with age; the age-specific effect of friend drug use did not vary by gender ($p = .491$). Friend aggression displayed a risk-enhancing effect at younger ages in both genders and this effect decreased in females ($p = .010$); the effect of friend aggression showed some decrease for males at older ages, but was not significantly age-varying ($p = .416$). We did not find a gender difference in the effect of friend aggression ($p = .701$). The effects of combined parental support varied by age in males ($p = .002$) but not females ($p = .621$), and the gender difference was significant ($p = .007$). Trajectories for maternal and paternal support,

separately, are shown in Figures S3 and S4; the inference about age-dependence in males and females, and the tests of gender difference in those effects - namely that the effects varied significantly by age in males, but not females, and the gender difference was significant - was consistent across both maternal and paternal support.

The results of the joint models are shown in Table 2. Because the significant age-varying effects identified in the univariate modeling were essentially linear, we restricted the joint model to linear interactions. Caucasian respondents had higher rates of marijuana in females, but this trend was not significant in males. Baseline occupational prestige was protective in females ($p = .024$) but not males. Friend drug use showed a substantial main effect in both genders (both $p < .001$), and this effect declined with age in both males ($p = .009$) and females ($p < .001$). In particular, the regression coefficient for friend drug at baseline (age ≈ 15) was approximately 0.97 and 1.16 in males and females, respectively; for each year aged from that point, these coefficients shrunk by approximately 0.03 and 0.05 per year in males and females, respectively. Friend aggression did not have a significant main effect or age-interaction in females; the attenuation of this effect in the joint model may be due to its effects being partially subsumed by friend drug use. Friend aggression had a significant risk-enhancing main effect ($p = .041$) for males; age-interactions were not explored because there was no evidence for age-dependence effects of friend aggression in the unadjusted analyses. In males, parental support had a protective main effect ($p = .002$), whose magnitude decreased with age ($p = .032$). In particular, at baseline, the regression coefficient for parental support was approximately −0.19 in males and, from that point, this coefficient shrunk (toward zero) by approximately 0.01 per year. The protective effects of parental support were not significant in females.

Finally, in a separate model not shown in Table 2 which included males and females and all of the same covariates, all main effects, and all age interactions, we tested the three-way interaction between gender, parental support, and age, while controlling for all other variables and including a main effect for gender. The three-way interaction ($p = .019$) was significant, in agreement with the univariate analyses that showed gender differences in the age-specific effect of parental support.

Supplemental analyses

To examine how the effect of attrition after wave 8, we refit the models using only waves 2–8. We found no changes in significance with respect to the age-specific or gender-specific effects related to friend aggression or friend drug use. With regard to parental support, the inference for age-specific effect trajectories in females, and for the tests of gender differences, did not change when restricting the sample to waves 2–8. The age-varying effects of parental support variables in males, however, were not maintained.

To quantify differences between those who were ($n = 290$), and were not ($n = 438$), lost to attrition after wave 8, we compared these two groups on the primary study variables marijuana use and each of the four main predictors in each of waves 2–8; the results of those comparisons are shown in the supplemental materials (Tables S1–S5). These comparisons generated a total of 35 tests and only revealed two significant differences (both marijuana use and aggression at wave 6), indicating limited evidence of differences between those lost

to attrition and those retained in the study. We also note that females were more likely to be retained in the later waves but, given that the analysis is stratified by gender, and that no differences were found in the inference about gender differences, we do not believe this affects our final conclusions. Similarly, more African-Americans were lost to attrition; however, we adjust for race in our final models and found that this does not affect our conclusions.

Discussion

Using varying-coefficient regression models, we estimated age-specific associations between past-30-day marijuana use and measures of perceived peer behavior and reported parental support. We found that, in both males and females, the positive association between perceived peer drug use and self-reported marijuana use decreased with age. By young adulthood, parental support was unassociated with marijuana use in both males and females. During adolescence, the negative association between parental support and marijuana use was only present in males. Taken together, our results suggest both age- and gender-specific prevention strategies may be indicated to address these dynamic social exposures.

This study contributes to our understanding of age-related social exposures and drug use in several ways. First, we studied a wider age-range in the longitudinal cohort than past researchers. Second, we emphasized both peer and parental correlates of marijuana use across this wide developmental range. Third, we examined gender differences in age-dynamic covariate effects. Fourth, we used statistical methodology that has not been applied widely in drug use research. While similar goals are achievable in principle using stratification, having a data-driven way of smoothing the trajectory is important to help distinguish age-specific signal from year-to-year random fluctuation. In light of the high level of fluctuation seen in Figure 1, the apparent change in the relationship depends heavily on what age groups are chosen for analysis, which underscores this need. It is worth noting that, notwithstanding some nonlinearity in the age-specific trend of marijuana use (not shown), our analyses give evidence that linear specification is largely sufficient to estimate how the association between the variables studied here and marijuana use varies by age. Yet, we note that a modeling framework which does not assume this fact *a priori* is more resistant to model misspecification than generalized linear models.

Consistent with theory and prior research (Fergusson et al., 2002; Steinberg & Monahan, 2007), our data indicated that perceived peer behaviors remain important well beyond adolescence in both genders, but decreases in importance. Our analysis reveals that perceived association with drug-using peers corresponds to substantial excess risk of marijuana use among adolescents, but that this gradient flattens out by the mid-to-late 1920s. These results underscore the potential power of peer group-based substance use interventions during adolescence, for several reasons: (a) those associations are most pronounced at younger ages; (b) those strong associations are robust across genders; and (c) disrupting these deleterious peer influences (whether they are perceived or actual) early is key, as they become more difficult to change after they are well-established (Van Ryzin et al., 2012).

The finding that the association between parental support (both maternal and paternal) and marijuana use is negligible after adolescence is consistent with prior research (Van Ryzin et al., 2012). Shifts in parental relationships, increased autonomy, decreased cohabitation with parents, and changing perceptions of parental authority may explain this finding. Specifically, establishing independence and a more equitable parent-child relationship is frequently viewed by emerging adults as a marker for adulthood (Aquilino, 2006), which likely leads to less parental monitoring and shifting of support from parents to peers or significant others. Our findings are consistent with others who found parental awareness and approval was not protective for marijuana use in females (Kelly et al., 2011; Tebes et al., 2011). Further investigation of these dynamics with emphasis on other components of the child-parent relationship, such as parental monitoring and parental substance use, would be a useful direction for future research to gain a greater understanding of gender differences in parental relationships and the resulting effect on substance use.

Our results constitute new findings about gender differences/similarities in development. With regard to friend drug use, we found qualitatively similar age-specific effects on past 30-day marijuana use in males versus females. In both genders, the risk-enhancing effect of perceived negative peer behavior decreased dramatically with age, suggesting that prevention programs focusing on perceptions of peer behavior are best concentrated on adolescents, regardless of gender. Although the effect of perceived friend aggression did vary by age in females, but not males, we did not have enough evidence to detect a clear gender difference in this effect. On the other hand, we found evidence for differences in the age-specific effect of parental support on past 30-day marijuana use. Although parental support is protective in males during adolescence, we found no evidence it is protective for females at any age, and supplemental analyses showed relatively little qualitative difference in the effects for maternal vs. paternal support. This is consistent with prior findings that parental support is more protective for preventing problem behavior in African-American males (Salem et al., 1998); the maternal support findings here suggests that dynamic may be most relevant during adolescence and early adulthood. Whatever the explanation, our findings suggest that interventions focusing on parental closeness may be (a) more effective in adolescents than young adults; and (b) such strategies may be most effective among males, as their utility for females even as young as 15 years old is questionable.

Limitations

Our work is not without limitations. First, our study is based on self-reported data. This may present some respondent over or under reporting of peer behaviors. Thus, with the data analyzed here only captures the participants' perception of their peers' behaviors, rather the truly quantifying social exposure to deviant influences. However, respondent's perceptions may be more relevant than the actual behavior of others because the youth's interpretation is what is likely to be most influential. Given that individuals' perceptions about their peers' substance use behavior is often inflated (Borsari & Carey, 2001), these results may indicate that interventions aimed at modifying individuals' perception of substance use norms could be fruitful. Relatedly, the number of friends for the participant is not measured, so that the responses about friend behavior capture only their perceived relative frequency, rather than perceived levels of exposure to those behaviors. Future studies that incorporate more varied

measures of parental and peer influences may be useful. Second, the geographically restricted locale of Flint, Michigan, and the ≤3.0 GPA criterion for participation presents issues with generalizability; our results may be most appropriately generalized to a broadly at-risk urban population. Yet, the concordance of our results with existing literature provides evidence that substance use dynamics in our study population may comport with those of other populations. Nonetheless, future work is needed to examine these questions in cohorts from more representative populations.

Our final limitation relates to attrition. Due to the long-term nature of this study, and the roughly six-year hiatus between waves 8 and 9, slightly under half of the original study population was lost after wave 8; however, those lost were found to be similar to those retained on the outcome variable, and the primary covariates in waves 2–8. Only one finding (i.e., that the protective effect of parental support decreased with age in males) lost significance when using only waves 2–8, likely due to the fact that the decreases (toward zero) in the effect of parental support in males occur largely after wave 8. The aforementioned similarity between those lost to attrition and those who remained in the study gives evidence that the significant finding in the full (i.e., wave 2–12) data set arose from a true change in the effect of parental during the late 20s in males, rather than attrition bias. These limitations notwithstanding, the research literature is lacking analyses of long-term longitudinal data from high-risk samples of youth (lower SES, primarily African-American) and, in particular, studies of age-specific risk factors for substance use in such populations.

Conclusions

Addressing substance use among adolescents and emerging adults requires identifying the developmental timing of key intervention content. We have elucidated a component of the developmental process underlying marijuana use that heretofore has eluded precise characterization; namely how the role of perceived social norms and parental support in the etiology of substance use varies continuously with age, and how that development differs by gender. Our findings indicate clear developmental points where social-based prevention efforts for marijuana use should be concentrated, with gender-specific tailoring of content based on parental support. Further research is required to determine what socioecological factors relate to marijuana and other drug use in this age-specific way, including other measures of the social context, and well as the broader (e.g., neighborhood-level) environment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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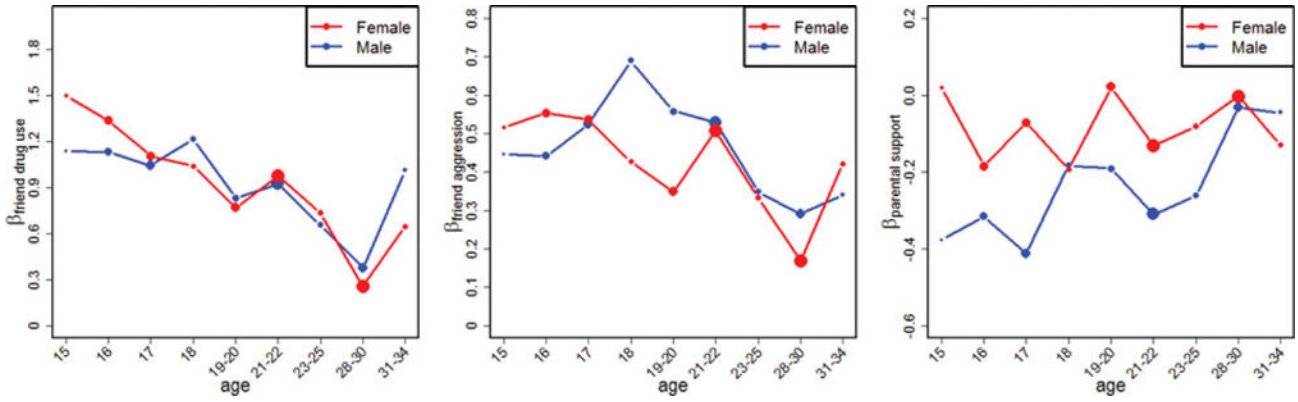

Figure 1.

Linear regression coefficients across nine age groups, relating past 30-day marijuana use to each social variable, stratified by gender. Individuals were assigned to age groups by rounding their age to the nearest whole number. *Note 1*: Age groups for the plots were chosen so that each age group contained at least 100 measurements for each gender. The size of the plotting characters is proportional to the number of observations in the given age group. *Note 2*: The y-axis in each plot is the regression coefficient estimate for the given variable in that age group. For example, in the left panel, the regression coefficient of friend drug use (predicting past 30-day marijuana) use is approximately 1.5 for 15-year old girls and 1.2 for 15-year old boys.

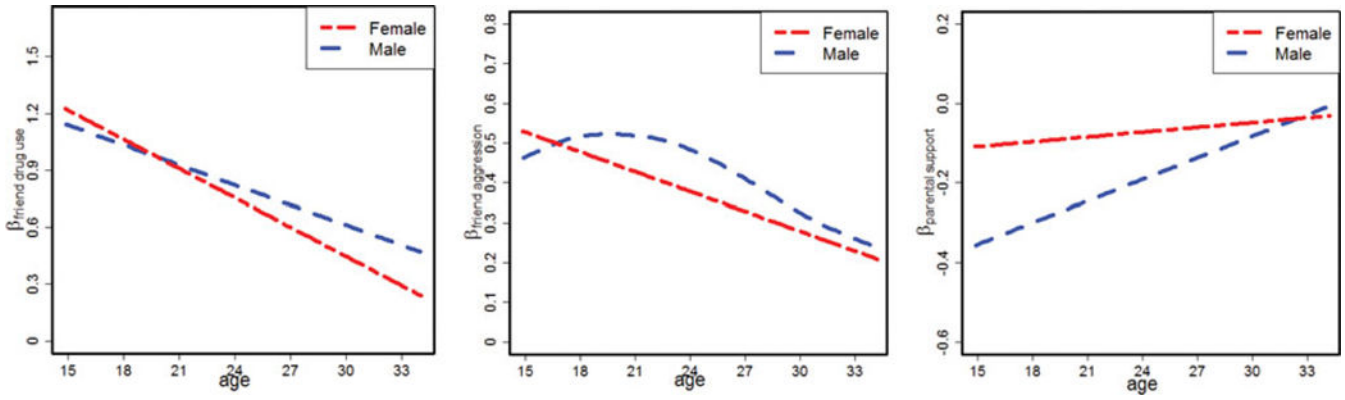

Figure 2.

Smooth estimates of the age-varying regression coefficient relating past 30-day-marijuana use to each social influence variable, stratified by gender, controlling for within-individual correlation using a random intercept. *Note 1*: In the modeling used to produce these trajectories, age is treated as a continuous variable, as opposed to the descriptive plot in Figure 1, which bins age in categories. *Note 2*: The y-axis in each plot is the estimated regression coefficient relating that the corresponding variable to past 30-day marijuana use. For example, in the left panel, the coefficient of friend drug use decreases linearly from about 1.2 to 0.3 among females from age 15 to 33.

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Table 1

Descriptive statistics for the main predictors at each wave analyzed.

	Wave 2	**Wave 3**	**Wave 4**	**Wave 5**	**Wave 6**	**Wave 7**
N	670	653	627	437	517	433
Age	15.84 (0.61)	16.78 (0.61)	17.77 (0.61)	20.01 (0.64)	20.94 (0.64)	22.02 (0.63)
Female (%)	50.1%	50.2%	50.2%	55.4%	52.0%	53.6%
African-American (%)	78.1%	79.0%	78.5%	81.0%	78.5%	78.5%
Marijuana (Female)	1.81 (1.52)	1.77 (1.52)	2.01 (1.81)	1.81 (1.66)	1.68 (1.53)	1.93 (1.75)
Marijuana (Male)	2.02 (1.74)	2.07 (1.84)	2.25 (1.99)	2.62 (2.28)	2.55 (2.24)	2.75 (2.31)
SES score (divide by 10)	40.00 (10.42)	40.10 (10.51)	39.91 (10.38)	40.14 (10.40)	39.83 (10.18)	39.64 (10.12)
Live w/ both parents	32.4%	32.6%	33.3%	33.9%	32.7%	35.6%
Friend drug use	1.46 (0.44)	1.68 (0.69)	1.73 (0.71)	1.67 (0.76)	1.71 (0.75)	1.79 (0.80)
Friend aggression	2.05 (0.92)	1.85 (0.83)	1.80 (0.86)	1.74 (0.83)	1.73 (0.81)	1.75 (0.80)
Maternal support	3.98 (0.94)	4.08 (0.93)	4.01 (0.97)	4.07 (0.98)	4.05 (0.97)	4.00 (1.00)
Paternal support	2.90 (1.53)	2.86 (1.64)	2.68 (1.66)	2.56 (1.62)	2.60 (1.71)	2.69 (1.65)
	Wave 8	Wave 9	Wave 10	Wave 11	Wave 12	Total
N	451	277	310	307	282	4964
Age	23.02 (0.65)	29.26 (0.63)	30.25 (0.62)	31.23 (0.60)	32.32 (0.62)	21.84 (5.51)
Female (%)	52.1%	59.6%	57.8%	54.7%	55.0%	52.8%
African-American (%)	79.6%	72.2%	74.8%	75.9%	78.0%	78.1%
Marijuana (Female)	1.85 (1.72)	1.67 (1.59)	1.91 (1.90)	1.63 (1.56)	1.53 (1.48)	1.80 (1.64)
Marijuana (Male)	2.78 (2.42)	2.50 (2.30)	2.08 (2.01)	2.40 (2.26)	2.31 (2.21)	2.36 (2.12)
SES score[a]	39.98 (10.45)	39.94 (10.37)	39.82 (10.42)	39.95 (10.30)	39.69 (10.23)	39.93 (10.34)
Live w/ both parents[a]	34.4%	31.8%	34.2%	32.6%	30.5%	33.1%
Friend drug use	1.74 (0.82)	1.44 (0.54)	1.49 (0.56)	1.48 (0.56)	1.48 (0.54)	1.62 (0.68)
Friend aggression	1.70 (0.83)	1.48 (0.66)	1.45 (0.53)	1.53 (0.62)	1.47 (0.57)	1.74 (0.81)
Maternal support	4.01 (1.00)	4.00 (1.14)	3.94 (1.16)	3.89 (1.19)	4.02 (1.15)	4.01 (1.02)
Paternal support	2.59 (1.70)	2.46 (1.84)	2.46 (1.89)	2.38 (1.86)	2.52 (1.92)	2.65 (1.71)

Note: Unless specified as a percentage, entries are mean (SD).

[a]Measured during wave 1.

Table 2

Regression model of past 30-day marijuana use with age-interactions, stratified by gender.

	Male	Female
Main effects		
Intercept	0.89 (0.32)**	1.01 (0.25)***
Race (Black)	(Ref)	(Ref)
Race (White)	0.30 (0.17)	0.36 (0.13)**
Race (Multi)	0.02 (0.45)	0.06 (0.28)
Baseline SES score (divided by 10)	0.06 (0.06)	− 0.11 (0.05)*
Baseline family structure	− 0.21 (0.14)	0.05 − (0.11)
Friend drug use	0.97 (0.10)***	1.16 (0.09)***
Friend aggression	0.12 (0.06)*	0.06 (0.07)
Parental support	− 0.19 (0.06)**	− 0.04 (0.03)
Age-interactions		
Friend drug use	− 0.03 (0.01)**	− 0.05 (0.01)***
Friend aggression	N/A	− 0.00 (0.01)
Parental Support	0.01 (0.00)*	N/A
Model statistics		
R^2	0.52	0.47
Random effect variance	1.10	0.59
Residual variance	2.46	1.61

Notes:

* $p < .05$;

** $p < .01$;

*** $p < .001$.

Age was centered by its minimum (approximately 14.8 years old), so that mean effects for friend drug use, friend aggression, and parental support reflect effects at age 14.8, and interactions reflect differences per-year after that age. The main effect of age (as a nonparametric trend) was included in the model but not shown here.