Reciprocal Associations Between Drinking-and-Driving Behavior and Cognitions in Adolescents*

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ABSTRACT. Objective: The present study tested reciprocal associations between drinking-and-driving behavior and cognitions as youths transition to driving independently. We hypothesized that experience with driving and experience with drinking and driving would effect changes in cognitions about drinking and driving over time. We also tested cognitions as predictors of later drinking-and-driving behavior. **Method:** Two hundred and two high school youths completed mailed questionnaire measures at two time points, approximately 8 months apart. Questionnaire measures assessed youths' drinking-and-driving behavior, riding with a drinking driver, drinking-and-driving attitudes, normative beliefs, and perceived negative consequences at both time points. **Results:** Consistent with hypotheses, prior drinking-and-driving experience influenced changes in drinking-and-driving cognitions. Youths with drinking-and-driving experience at Time 1 saw drinking and driving as more dangerous over time; however, they perceived their peers as more accepting of this behavior. Time 1 attitudes predicted increased drinking-and-driving frequency at Time 2, and normative beliefs predicted increased frequency of riding with a drinking driver. **Conclusions:** These results support reciprocal associations between drinking-and-driving cognitions and behavior. Results of this study may have implications for the timing and content of drinking-and-driving interventions to reduce drinking and driving as well as riding with a drinking driver. (*J. Stud. Alcohol Drugs* **70:** 536-542, 2009)

DRIVING AFTER ALCOHOL USE represents a major public health problem for youths. Although a lower percentage of young drivers (age 16-20) report driving after use of alcohol than young adults (age 20-25; Substance Abuse and Mental Health Services Administration, 2007), young drivers consume a greater amount of alcohol before driving and consider it safe to drive at higher blood alcohol concentrations than older drivers (Hingson and Winter, 2003). Compared with older drivers, youths are also at increased risk for alcohol-related traffic crashes (Keall et al., 2004; Zador et al., 2000). Given this, it is important to understand risk processes that can influence and maintain youths' drinking-and-driving behaviors.

The present study examines reciprocal associations between drinking-and-driving behavior and cognitions as youths transition to driving independently. Cognitive factors, such as attitudes and normative beliefs, are conceptualized as significant antecedents of health risk behaviors in general (e.g., Ajzen and Fishbein, 2005; Sturges and Rogers, 1996) and substance-related behaviors in particular (Petraitis et al., 1995). However, there is also ample evidence from laboratory (Olsen and Stone, 2005) and longitudinal (Gerrard et al., 1996; Smith et al., 1995a) studies that engaging in a behavior can influence cognitions about that behavior. Reciprocal influences over time are an important component of developmental models of risk for externalizing problems in youths (Dodge and Pettit, 2003).

Adolescent driving behavior can provide an ideal platform for examining reciprocal associations between cognitions and behavior. For youths, obtaining a driver's license is an important developmental transition, which can influence both the frequency and context of substance involvement (McCarthy and Brown, 2004). Cognitions about risky behaviors have been found to develop before engagement in the behavior (Carvajal et al., 1999; Donovan et al., 2004; Miller et al., 1990). Examining youths as they make the transition to driving independently allows us to assess cognitions about drinking and driving before any direct experience with driving behavior and to test the effect of gaining experience driving (and drinking and driving) on later cognitions.

Many studies have demonstrated that attitudes, expectancies, and perceived peer behaviors prospectively predict substance involvement (for a review, see Sher et al., 2005). For drinking-and-driving behavior, cross-sectional studies have indicated that attitudes and normative beliefs about drinking and driving are associated with drinking-and-driving behavior in both adults (Jewell et al., 2008; Turrisi and Jaccard, 1992; Turrisi et al., 1997) and adolescents (Armitage et al., 2002; Chen et al., 2008; Grube and Voas, 1996). However,

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relatively little is known about the longitudinal prediction of drinking-and-driving behavior from cognitions and beliefs about drinking and driving. Trajectories of cognitions concerning general risk taking (e.g., tolerance for deviance) have been found to predict later drinking-and-driving offenses and crashes (Shope et al., 2003).

Engagement in risk-taking behaviors has also been found to alter cognitions about the behavior. For example, there is evidence for reciprocal associations between alcohol use and positive expectancies about alcohol (Smith et al., 1995a). These associations were consistent with a positive feedback loop, such that positive alcohol expectancies were associated with increases in alcohol use, and alcohol use was associated with later increases in positive alcohol expectancies. However, Gerrard and colleagues (1996) examined several types of risk-taking behavior (e.g., drinking, smoking, reckless driving) and found that engagement had different effects on different cognitions. Youths who participated in risk-taking behaviors later perceived the negative consequences of these behaviors to be more likely but also overestimated their peers' participation in these behaviors. Gerrard et al. (1996) argued that the increase in perceived peer participation serves to normalize these behaviors, allowing youths to engage in them despite the increase in perceived risk.

The present study was designed to examine reciprocal influences between engagement in drinking-and-driving behaviors and cognitions about the perceived dangerousness (attitudes), peer acceptance (normative beliefs), and negative consequences of drinking and driving. We tested whether either making the transition to driving independently or having prior experience with drinking and driving influenced risk perceptions. Based on prior research (McCarthy and Brown, 2004), we hypothesized that youths who make the transition to driving independently would show the largest increase in perceived risk from drinking and driving. We also sought to test whether the pattern of results found for other risk-taking behaviors (Gerrard et al., 1996) would hold for drinking-and-driving experience. We therefore hypothesized that youths with drinking-and-driving experience at Time 1 would view drinking and driving as more dangerous and the consequences as more likely at Time 2. Additionally, we hypothesized that engagement in drinking-and-driving behavior would lead to increases in perceived engagement and acceptance of drinking and driving by peers.

Finally, we tested cognitions as prospective predictors of changes in drinking-and-driving behavior. We hypothesized that youths who perceived drinking and driving as less dangerous, less likely to result in negative consequences, and more acceptable to peers at Time 1 would engage in more drinking-and-driving behavior at Time 2. Analyses controlled for Time 1 alcohol use and drinking-and-driving behavior, as well as participant age and gender. Separate models were estimated for drinking and driving as well as riding with a driver who had consumed alcohol.

Method

Participants

The original sample consisted of 266 high school age youths. Two hundred and two participants completed surveys at both time points, a follow-up rate of 76%. Those who did not complete the second survey were not different from those who did in terms of gender, age, ethnicity (Hispanic or non-Hispanic), Time 1 license status, or Time 1 drinking and driving. Attriters were more likely to be current drinkers at Time 1 (77% vs 60%; $\chi^2 = 5.85$, 1 df, $p < .05$; $N = 266$). Attrition was also higher in black participants (57% vs 19%; $\chi^2 = 24.14$, 1 df, $p < .01$; $N = 266$).

The mean (SD) age of participants in the final sample was 16.14 (1.00) at Time 1. The sample was primarily white (85%), with 7% black participants and 8% of other racial background. Three percent identified their ethnicity as Hispanic/Latino. The sample was 67% female.

Procedures

All study materials and procedures were approved by the University of Missouri Institutional Review Board. Participants were recruited through fliers distributed at local high schools, as well as through community advertisements. Interested participants contacted the research lab and were given more information about the study. For participants younger than age 18, verbal parental consent was obtained. Participants were then sent a packet with a cover letter, either a parental consent and child assent form (if younger than age 18) or youth consent form (if age 18 or older), a postage-paid return envelope, and study questionnaires. A total of 374 packets were mailed, with a 71% return rate, resulting in our initial sample at Time 1 ($N = 266$). Once materials were returned, adolescents received a $20 gift certificate to the local mall as payment for their participation.

Participants were then contacted approximately 7 months after their Time 1 participation. Procedures were identical to those at Time 1, apart from wording changes in survey questions where appropriate (i.e., time period for reporting). Participants' Time 2 questionnaires were returned approximately 8 months after completion of Time 1 materials (an average of 8.54 months between assessments). Participants again received a $20 gift certificate to the local mall on completion of their participation.

Measures

Demographic information. A self-report questionnaire was used to collect demographic information, including age, gender, race, and ethnicity.

Drinking-and-driving behavior. At Time 1, participants were asked how often in the past year they had driven after

drinking alcohol and how often they had ridden with a driver who had consumed alcohol. At Time 2, the same questions were used, but the questions assessed these behaviors for the past 3 months.

Perceived negative consequences. Perceived likelihood of negative consequences from drinking and driving were assessed through four Likert-style questions (4-point scale) adapted from prior studies (Grube and Voas, 1996; Turrisi et al., 1997). Questions asked participants to estimate the likelihood that a driver their age would be stopped by police, be breath tested, be arrested, and have an alcohol-related accident. Internal consistency reliability of these items in the current sample was high at both time points (α = .86 and .85, respectively).

Attitudes. Drinking-and-driving attitudes were assessed using three Likert-style questions (4-point scale) adapted from prior studies (Grube and Voas, 1996), asking participants how dangerous they think it is to drive after one drink, three drinks, and five or more drinks. Internal consistency reliability of these items in the current sample was moderate at both time points (α's = .78 and .77, respectively).

Normative beliefs. Perceived acceptance of drinking and driving was assessed using two questions asking participants how many (0-3) of their three closest friends disapprove of drinking and driving and how many of these friends would refuse to ride with a friend who had been drinking. Internal consistency reliability of these items in the current sample was moderate at both time points (α's = .71 and .74, respectively).

Alcohol use. The Drinking Styles Questionnaire (Smith et al., 1995b) was used to assess drinker or nondrinker status, as well as past-month and typical frequency, frequency of heavy drinking, and quantity of alcohol consumption. This measure has demonstrated good reliability and validity in adolescent samples (Smith et al., 1995b). Typical frequency of alcohol use was used as a covariate in study analyses.

Analytic strategy

All cognition variables were coded so that higher scores reflected lower perceived risk of drinking and driving (i.e., less dangerous, more acceptable to peers, consequences less likely). Changes in cognitions over time were analyzed with repeated measures analysis of variance (ANOVA). For each analysis, time functioned as a within-subjects factor, driving experience and drinking-and-driving experience as between-subjects factors, and gender and participant age as covariates. For driving experience, participants were coded as either nondrivers (not licensed at either time point), new drivers (licensed and reporting independent driving only at Time 2), and established drivers (licensed and reporting independent driving at both time points). For drinking-and-driving experience, two dichotomous variables were used, indicating whether participants reported either drinking and driving or riding with a drinking driver in the past year at Time 1.

For analyses predicting Time 2 drinking-and-driving behavior, we estimated zero-inflated Poisson regression models using Mplus 4.2 (Muthén and Muthén, 1998-2004). Zero-inflated Poisson regression is appropriate when the dependent variable is a count variable with a high proportion of zero values. The dependent variable for these analyses was frequency of drinking and driving (or riding with a drinking driver) in the past 3 months at Time 2. Mplus estimates two components in this type of model. The first, a zero-inflation component, estimates the odds of being in the zero class or of not engaging in the behavior. This component is similar to logistic regression, and an odds ratio can be obtained for each independent variable. To simplify reporting, odds ratios were inverted so that higher values indicated greater likelihood of being in the nonzero class or engaging in drinking-and-driving behavior. The second, a count component, estimates the association between the independent variables and the frequency of the dependent variable for those able to assume values other than zero. This component provides a Poisson regression coefficient for each independent variable. This coefficient can be used to calculate the predicted rate of increase in the dependent variable for a one-unit increase in the independent variable (Cohen et al., 2002).

Results

Descriptive statistics

At Time 1, 111 participants reported having their driver's license and driving independently, and 91 reported not having a driver's license. Of the nonlicensed participants at Time 1, 51 received their driver's license by Time 2. Table 1 presents riding with a drinking driver, and driving after alcohol use by license status for each time point. Licensed drivers at Time 1 were more likely to report lifetime use of alcohol than nonlicensed youths (74% vs 43%; $\chi^2 = 20.03$, 1 df, $p < .01$; $n = 202$) and to ride with a drinking driver in the past year (63% vs 48%; $\chi^2 = 4.06$, 1 df, $p < .05$; $n = 202$) but did not differ from nonlicensed participants in gender or race.

Table 1. Percentage reporting drinking and driving, and riding with a drinking driver at each time point

Variable	Time 1 Past year	Time 2 Past 3 months
Nonlicensed		
Rode with a drinking driver, %	48	38
Frequency, mean (SD)	4.58 (15.52)	0.87 (1.83)
Licensed		
Rode with a drinking driver, %	63	49
Frequency, mean (SD)	7.84 (22.60)	1.73 (5.94)
Drove after drinking, %	43	36
Frequency	8.39 (33.10)	2.11 (4.29)

Experience and changes in drinking-and-driving cognitions

Repeated measures ANOVAs were used to examine changes in drinking-and-driving cognitions as a function of experience with both driving as well as drinking and driving. For attitudes, there were significant main effects of gender ($F = 10.92$, 1/195 df, $p < .01$; $\eta^2 = .06$) and drinking and driving ($F = 8.99$, 1/195 df, $p < .01$; $\eta^2 = .05$), with males and those with drinking-and-driving experience rating drinking and driving as less dangerous. Significant interactions included Time × Gender ($F = 4.25$, 1/195 df, $p < .05$; $\eta^2 = .02$), Time × Drinking-and-Driving Experience ($F = 3.08$, 1/195 df, $p < .05$; $\eta^2 = .02$), and Time × Experience Riding with a Drinking Driver ($F = 4.20$, 1/195 df, $p < .05$; $\eta^2 = .02$). Probing the Time × Gender interaction did not indicate significant time effects for either males or females. Probing the Time × Drinking-and-Driving Experience interaction indicated no change in attitudes over time for youths with no drinking-and-driving experience at Time 1 ($F = 0.91$, 1/151 df, $p = .34$; $\eta^2 = .01$; means = 1.91 [Time 1] and 1.96 [Time 2]), whereas those with drinking-and-driving experience at Time 1 viewed this behavior as more dangerous at Time 2 ($F = 4.40$, 1/49 df, $p < .05$; $\eta^2 = .08$; means = 2.36 [Time 1] and 2.19 [Time 2]). For riding with a drinking driver, youths with no experience at Time 1 viewed drinking and driving as less dangerous over time ($F = 3.91$, 1/90 df, $p < .05$; $\eta^2 = .04$; means = 1.87 [Time 1] and 1.98 [Time 2]), whereas those with experience riding with a drinking driver at Time 1 viewed this behavior as more dangerous at Time 2 ($F = 5.38$, 1/110 df, $p < .05$; $\eta^2 = .05$; means = 2.16 [Time 1] and 2.03 [Time 2]).

For normative beliefs, there was a main effect of time ($F = 6.33$, 1/195 df, $p < .05$; $\eta^2 = .03$) and drinking-and-driving experience ($F = 8.20$, 1/195 df, $p < .01$; $\eta^2 = .04$), as well as a trend for experience riding with a drinking driver ($F = 3.43$, 1/195 df, $p = .07$; $\eta^2 = .02$). There were significant Time × Gender ($F = 6.37$, 1/195 df, $p < .05$; $\eta^2 = .03$) and Time × License Status ($F = 3.12$, 2/195 df, $p < .05$; $\eta^2 = .03$) interactions. Probing the Time × Gender interaction indicated that female participants showed an increase in perceived peer engagement in drinking and driving ($F = 4.74$, 1/135 df, $p < .05$; $\eta^2 = .04$; means = 0.56 [Time 1] and 0.71 [Time 2]), whereas male participants did not ($F = 0.74$, 1/65 df, $p = .39$; $\eta^2 = .01$; means = 0.52 [Time 1] and 0.62 [Time 2]). Probing the Time × License Status interaction indicated that established drivers showed an increase in perceived peer engagement in drinking and driving over time ($F = 5.06$, 1/110 df, $p < .05$; $\eta^2 = .05$; means = 0.59 [Time 1] and 0.78 [Time 2]), whereas new drivers ($F = 0.00$, 1/50 df, $p = 1.0$; $\eta^2 = .00$; means = 0.58 [Time 1] and 0.58 [Time 2]) and those without a driver's license ($F = 2.19$, 1/90 df, $p = .15$; $\eta^2 = .05$; means = 0.40 [Time 1] and 0.58 [Time 2]) did not show a change in normative beliefs over time.

Table 2. Poisson regression results for Time 1 variables predicting Time 2 drinking and driving

Variable	Drinking and driving	Riding w/ drinking driver
Drinking and driving/riding with a drinking driver	.21*	.66†
Alcohol use	.25*	.67
Male gender	.31†	.72
Age	.22	.70
Normative beliefs	.23	.97†
Attitudes	.48†	.62
Perceived consequences	.21	.57

Notes: Values are predicted rate of increase in frequency from Poisson regression. For drinking and driving, $n = 162$. For riding with a drinking driver, $n = 202$.
*$p < .05$; †$p < .01$.

Results for perceived negative consequences indicated no significant main effects. There was a significant Time × Gender interaction ($F = 5.06$, 1/195 df, $p < .05$; $\eta^2 = .05$). However, probing this interaction did not indicate significant time effects for either male or female participants.

Cognitions as predictors of drinking-and-driving behavior

We next used zero-inflated Poisson regression models to test whether Time 1 drinking-and-driving cognitions were associated with changes in drinking-and-driving behavior over time. Analyses were conducted separately for drinking and driving and riding with a drinking driver, and Time 1 past-year frequency of each behavior was included in each analysis. Gender, age, and typical frequency of alcohol use were included as covariates. For riding with a drinking driver, license status (at Time 2) was included as a covariate. For drinking-and-driving behavior, only participants who were driving at Time 2 were included in the analysis.

For the logistic regression portion of both models, frequency of alcohol use at Time 1 predicted likelihood of drinking and driving at Time 2 (drinking and driving odds ratio = 1.79, $p < .01$; riding with a drinking driver, odds ratio = 1.81, $p < .01$). None of the cognition or control variables predicted likelihood of drinking and driving or riding with a drinking driver at Time 2.

Results for the Poisson regression portion of the model are presented in Table 2. Time 1 drinking-and-driving behavior was significantly associated with increased frequency of both drinking and driving and riding with a drinking driver. Alcohol-use frequency and being male were associated with increased frequency of drinking and driving. For riding with a drinking driver, having a driver's license at Time 2 (predicted rate = 1.20, $p < .01$) and Time 1 frequency of riding with a drinking driver were associated with increased frequency.

Poisson regression results for cognition variables differed across dependent variables. For drinking and driving, attitudes were uniquely associated with increased frequency.

For riding with a drinking driver, normative beliefs were associated with increased frequency. Perceived negative consequences were not uniquely associated with either drinking-and-driving variable.

Discussion

The present study found evidence for reciprocal influences between drinking-and-driving behavior and cognitions in a sample of high school age youths. In contrast to the positive feedback loop found in studies of alcohol use and expectancies (Smith et al., 1995a), our results suggest that engagement in drinking and driving can have different effects on youths' perceptions of the behavior. Youths with prior drinking-and-driving experience, either as a driver or passenger, viewed drinking and driving as more dangerous over time. However, experience with drinking and driving was also associated with perceiving peers as more accepting of drinking and driving.

There are several ways to integrate the disparate effects of prior experience on youths' perceptions. Gerrard et al. (1996) conceptualized both these changes as part of a single motivated cognitive process. They speculated that greater perceived peer acceptance by those who engage in risk-taking behavior serves to normalize the behavior despite acknowledgment of its risks.

However, these two effects may also be the result of separate, competing processes. It may be that greater perceived peer acceptance by youths who drink and drive reflects an accurate assessment of their peers' attitudes and behaviors. Adolescent peer groups show increasing levels of similarity in externalizing and risk-taking behaviors over time (Gifford-Smith et al., 2005). This interpretation is also supported by evidence: Changes in normative beliefs became more positive not only for those with prior drinking-and-driving experience but also as a function of time, and these changes exhibited an interaction between time and license status. Youths who were more established drivers viewed drinking and driving as more acceptable to peers. This effect was not attributable to age differences between license groups—in fact, no significant effects were observed for age in this study. Taken together, these results may indicate that perceived increases in peer engagement and acceptance of drinking-and-driving behavior reflect actual increases in peer engagement in the behavior. For youths who engage in drinking-and-driving behavior, greater perceived peer acceptance would then compete with increases in perceived dangerousness in determining future drinking-and-driving behavior.

Our results also provide some evidence for differences in the relative importance of cognitions for driving after use of alcohol and for riding with a drinking driver. Results indicated that attitudes are more important determinants of the decision to drive after drinking, whereas normative beliefs are more important in accepting a ride from someone who has been drinking. This finding is consistent with the conceptualization of drinking and driving and riding with a drinking driver as distinct constructs (Yu and Shacket, 1999), with peer factors exerting a greater influence on riding with a drinking driver. Results of intervention studies also find differences between riding and driving after drinking, with school-based programs being found to be more effective in reducing riding with a drinking driver (Elder et al., 2005).

Perceived consequences from drinking and driving were not influenced by either driving or drinking-and-driving experience and were not predictive of later drinking-and-driving behavior. Prior studies found cross-sectional associations between perceived consequences and self-reported drinking and driving in both adolescents and adults (Grube and Voas, 1996; Turrisi et al., 1997). However, our results, as well as results from longitudinal studies of adult driving-under-the-influence offenders (Greenberg et al., 2005), may indicate that these perceptions are not important determinants of drinking-and-driving decisions over time. Recent studies have indicated that perceptions about potential consequences are not as influential as perceived benefits in determining laboratory risk decisions (Gardner and Steinberg, 2005), risky driving (McKenna and Horswill, 2006), and driving after drinking (McCarthy et al., 2006).

There are several limitations to the present study. The study used self-report measures of drinking-and-driving behavior, which can be influenced by response bias and underreporting or overreporting. However, there is evidence that self-report measures of alcohol-related behavior can be valid in youths when data collection is confidential (Smith et al., 1995b; Wilson and Grube, 1994). Additionally, although gender was controlled for in study analyses, our sample size prevented us from conducting study analyses separately by gender.

There are also limitations to the generalizability of our sample. Although efforts were made to recruit high school age youths from community sources, the majority of youths were recruited from local high school campuses. School-based recruitment can introduce sample biases owing to absenteeism, truancy, or disengagement from academics by some youths, particularly disinhibited or substance-involved youths. All participants were from the central Missouri area. There are significant differences in licensing laws across states, as well as regional differences in the prevalence of drinking-and-driving behavior (Chou et al., 2006). The return rate was relatively high for both packets initially mailed to interested participants (71%) and for retention from Time 1 to Time 2 (76%). However, attrition was associated with drinking status at Time 1 and was higher for black participants. Those who did not respond to the initial mailing may also have differed from the present sample.

Our study examined the influence of engagement in drinking-and-driving behavior on drinking-and-driving cognitions. Cross-sectional studies have also found that exposure to

negative consequences of risk-taking behaviors, including drinking and driving, are associated with differences in cognitions about these behaviors (Halpern-Felsher et al., 2001; McCarthy et al., 2005). Further research is required to examine potential interactions between experience, exposure to consequences, and cognitions concerning drinking and driving in adolescents.

Both attitudes and perceived negative consequences were assessed as general rather than personal perceptions of risk (e.g., likelihood of consequences for someone your age vs likelihood for you). Although personal risk perceptions are often more predictive of behavior, as some authors have observed (Weinstein and Nicolich, 1993), these measures can confound behavior and intentions with risk perceptions. One direction for future research is to evaluate reciprocal influence between drinking and driving and personal risk perceptions.

Results of this study provide evidence for a reciprocal relation between drinking-and-driving cognitions and behavior. Although our results indicate that early experience with drinking and driving differentially affects attitudes and normative beliefs, further research is required to understand the mechanism underlying these effects. Longer term longitudinal studies are needed to examine the effect of persistent engagement in drinking and driving on these cognitions and to examine whether the observed associations are consistent over time or are specific to this developmental period. Given the importance of peers in influencing adolescent risk decisions (Gardner and Steinberg, 2005) and substance-related behaviors (Wood et al., 2004), the role of normative beliefs may be unique to this developmental period. Another direction for future research is to improve our understanding of the interplay between attitudes and normative beliefs in predicting drinking and driving. Social identity theory (Terry and Hogg, 1996) holds that, for those strongly identified with a group, group norms can alter the association between attitudes and behaviors.

Improving our understanding of youths' perceptions of drinking-and-driving risk before beginning driving and early in their driving careers can help inform and target prevention and intervention efforts. There is some evidence for timing effects on the efficacy of substance-use intervention programs, which may have greater impact on middle-school youths than on older or younger children (Gottfredson and Wilson, 2003). Further research is needed to determine whether drinking-and-driving interventions can benefit from selective targeting. Our results suggest that drinking-and-driving interventions may benefit from focusing on attitude change in less-experienced youths and on social-norming interventions in more-experienced youths.

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