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Implicit Attitudes Predict Drinking Onset in Adolescents: Shaping by Social Norms

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Abstract

Objective—Implicit attitudes toward alcohol predict drinking among adults and adolescents. If implicit attitudes reflect associations learned through direct experience with drinking, then they may only predict drinking among individuals who have previously consumed alcohol. In contrast, if implicit attitudes reflect indirect experience through social messages, they may predict future drinking even among individuals with no drinking experience. This study tested whether implicit attitudes predict initiation of drinking for the first time, and whether parents' and friends' norms toward alcohol influence the development of implicit attitudes.

Methods—This study followed 868 adolescents between 12 and 15 years old for three years. Implicit attitudes were measured using the Affect Misattribution Procedure. Explicit intentions to drink and the frequency of drinking and binge drinking were measured at each of three annual waves.

Results—Implicit attitudes toward alcohol predicted future drinking behavior one year later, and effects were similar for adolescents who had previously tried alcohol and for those who had not. To understand what factors might shape implicit attitudes among participants without drinking experience, we examined the role of parental norms and friends' norms toward drinking. Parental approval of drinking predicted the development of more positive implicit attitudes, which in turn predicted later drinking.

Conclusion—Implicit attitudes toward alcohol can develop in advance of direct experience drinking alcohol. Results have implications for the implicit processes underpinning adolescent drinking, and the processes by which implicit associations are learned.

Keywords

Implicit attitudes; Implicit cognition; Alcohol; Addictive behavior; Peer influence

Most people who drink alcohol begin drinking as adolescents or young adults (Oxford, Harachi, Catalano, & Abbott, 2001). Alcohol use among youth is associated with leading causes of death among adolescents including injury, homicide, and suicide (Miller, Naimi, Brewer, & Jones, 2007). Under-age drinking is also associated with elevated risk for drinking while driving, sexual assault, and high-risk sexual behavior (Brown et al., 2008; Kokotailo et al., 2010). Those who begin alcohol use earlier have a greater likelihood of alcohol-related problems in later life, including alcohol dependence (Kokotailo et al., 2010), behavioral problems, and mood disorders (Johnson, Cloninger, Roache, Bordnick, & Ruiz, 2000). Understanding when and why young people begin drinking alcohol is therefore an important psychological and public health problem.

The first goal of this study was to examine the role of implicit attitudes in predicting the initiation of drinking among adolescents. Implicit attitudes are evaluations activated automatically and expressed unintentionally through their influence on task performance (Payne & Gawronski, 2010). Whereas explicit attitudes require introspection and are deliberately expressed using traditional self-report methods, implicit attitudes do not require introspection or deliberate reports. Implicit attitudes may therefore reveal insights about alcohol-related cognitions that go unexpressed on explicit measures, either due to self-presentation concerns, or because thoughtful responses about alcohol are different than more impulsive initial reactions.

Implicit cognition and alcohol drinking

Dual-process theories have been developed to characterize the relationships between implicit and explicit attitudes and predict the conditions under which each is likely to influence behavior (Gawronski & Bodenhausen, 2006; Petty, Briñol, & DeMarree, 2007; Strack & Deutsch, 2004). These models argue that decisions and behavior are driven by an interaction between automatically activated associations and more explicit deliberation. Concerning addictive behavior, Wiers and colleagues (2007) articulated a dual process model suggesting that implicit associations to drug cues predict drug use, especially when those associations are unopposed by inhibitory processes (see also Stacy & Wiers, 2010).

Consistent with dual process models, implicit responses to alcohol cues are associated with alcohol use among adults. Studies have documented associations between alcohol use and implicit responses using measures of memory associations (Ames & Stacy, 1998; Stacy, 1997), the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998; e.g., Houben & Wiers, 2006; Palfai & Ostafin, 2003; Wiers, Van Woerden, Smulders, & De Jong, 2002) and the Affect Misattribution Procedure (Payne, Cheng, Govorun, & Stewart, 2005; Friese & Hofmann, 2009; Payne et al., 2008). Less is known about the role of implicit associations in the initiation of alcohol use (as opposed to the frequency of drinking among drinkers).

Existing evidence is inconclusive with regard to the extent to which implicit attitudes affect drinking behavior during adolescence. In one study of participants between 12 and 15 years old, implicit associations with positive expectancies and arousal predicted binge drinking one year later (Thush & Wiers, 2007). However, the unique contribution of implicit associations was not significant after controlling for baseline drinking. A study of children between 10 and 12 years old tested the relationship between drinking experience and implicit associations between alcohol and happy versus angry faces (Pieters et al., 2010). In one sample ($n = 99$), there was no correlation between implicit associations and drinking experience, but in a second sample ($n = 35$), greater drinking experience was correlated with more negative associations to alcohol. In another study among adolescents who had not initiated drinking, participants who produced more alcohol-related responses on a word association test were more likely to have initiated drinking a year later (Van Der Vorst et al., 2013). Moreover, parental alcohol use at baseline was associated with adolescents' word associations, and the accessibility of alcohol concepts mediated the association between parental alcohol use and the initiation of drinking. This study suggests that adolescents may form alcohol-related memory associations in advance of experience with alcohol, possibly by observing their parents' drinking behavior. This study provides important evidence that implicit memory associations may precede and predict the onset of drinking. The association measure in that study, however, did not distinguish between positively and negatively valenced associations. Dual process attitude theories suggest that positive or appetitive associations in particular should be predictive of later drinking behavior.

Theoretical models of how implicit alcohol associations develop

Two theoretical perspectives make opposing predictions about whether implicit attitudes should be expected to contribute to taking a drink for the first time. Associative learning theories of addiction have argued that drug-related cues become associated with neurobiological reward signals (Jentsch and Taylor, 1999; Robinson and Berridge, 2001; Volkow et al., 2003). According to this perspective, the pharmacological effects of alcohol become associated with cues such as the taste, sight, or smell of alcoholic drinks. If these conditioning experiences cause the automatic associations that are detected by implicit tests, then implicit associations should result from – but not precede – experience with alcohol.

An alternative theoretical perspective suggests that implicit associations result largely from cultural messages rather than personal experience (e.g., Olson & Fazio, 2004; Karpinski & Hilton, 2001; Payne & Dal Cin, 2015). Several studies point to the importance of parental and peer norms as environmental factors shaping adolescent drinking attitudes, expectancies, and behaviors (e.g., Ary, Tildesley, Hops, & Andrews, 1993; Brechwald & Prinstein, 2011; Van Der Vorst et al., 2013). Notably, among adolescents alcohol drinking is often positively rewarded within the peer environment (Giletta et al., 2012; Mayeux, Sandstrom, & Cillessen, 2008). Thus, adolescents who observe their parents and friends drinking, or who receive messages that they approve of drinking, may be more likely to form positive implicit associations with alcohol. The second goal of the present study was to test whether parental and peer norms may be an early source of indirect experience in the formation of implicit associations with alcohol.

The Present Study

This study employed a three-wave design to examine the ability of implicit affective responses to prospectively predict the initiation of drinking in a sample of adolescents between 12 and 15 years of age at the start of the study. The study addressed three primary research questions. First, do implicit attitudes predict later drinking after controlling for explicit reports of drinking intentions? Second, do implicit attitudes predict the initiation of drinking among adolescents who have not previously consumed alcohol? Our third question is: What factors predict the development of implicit and explicit cognitions toward alcohol? To answer this question we predicted implicit and explicit measures at Time 2 from prior drinking behavior, parental norms, and friend norms measured at Time 1. Finally, we estimated a path analysis to examine whether these potential precursors had indirect effects on later drinking via their associations with implicit and explicit responses toward alcohol.

Method

Participants

Participants were 868 adolescents (54.5% girls) between 12 and 15 years old ($M_{\text{age}} = 13.12$ years, $SD = .78$). At the study onset, participants were enrolled in grades 7 (53.9%) and 8 (46.1%) of three junior high schools located in a rural, low income area in the southeastern United States. Most participants were born in the United States (94.7%); the ethnic distribution of the sample was 47.1% Caucasian, 23.1% Latino, 22.2% African-American, 1% Asian and 6.6% mixed or other ethnicity. At the study onset, about half of participants (46.3%) reported that their parents were currently married, 27.7% reported that their parents were divorced or separated, and 18.9% that their parents never married. The remaining participants (7.1%) indicated that one parent was deceased or they did not report information on their parents' relationship. Half of the participants (50.4%) lived in a family with both biological parents, 24.7% lived with only one biological parent, 20.9% with a biological parent and another adult (e.g., step mother, father, or grandparent), and 4% with other caregivers (e.g., grandparents). The Median household income (MHI) calculated from the 2000 U.S. Census Bureau, based on participant addresses, was \$40,759 (range = \$12,600 – \$89,000). According to the school district records, the demographics of the study sample matched the recruitment community.

Procedure

Data were collected as part of a larger ongoing study of adolescent health risk behavior. All students in 7th and 8th grades in three rural, low income junior high schools in the southeastern United States were recruited ($n = 1,463$), excluding those in self-contained special education classes. A letter of consent describing the study goals and procedures was mailed to each adolescent's family, asking adolescents' caregivers to provide permission for their child to participate in the study. Response forms included an option for caregivers to grant or deny consent. Consent forms were returned from approximately 82.4% of families ($n = 1,205$); of this, 74.7% of caregivers granted consent for their child to participate in the study ($n = 900$).

At the baseline assessment (Time 1), data were collected among 868 adolescents (59.3% of the targeted population), due to absenteeism on the day of data collection ($n = 32$). Of the adolescents who participated in the Time 1 assessment, 89.5% also completed the assessment at Time 2 ($n = 777$) and 87.4% at Time 3 ($n = 759$), occurring approximately one and two years after baseline, when participants were in grades 8–9 and 9–10, respectively. Attrition was mostly due to absenteeism on the days of the data collection and school or study withdrawal. Attrition analyses did not reveal significant differences on any of the study variables between participants who completed the Time 1 assessment only and those who completed two or all three assessments. In addition to missing data due to longitudinal attrition, additional missing data occurred because of incomplete answers. To compare participants with and without missing data Little's (1988) Missing Completely at Random (MCAR) test was conducted. Although the test was significant, $\chi^2(334) = 489.56, p < .001$, the normed $\chi^2 (\chi^2/df)$ of 1.47 justified the inclusion of adolescents with missing data in the analyses (Bollen, 1989; see Plan of Analyses).

A battery of measures was administered at each time point, including measures of risk behaviors unrelated to the present hypotheses about alcohol. Alcohol use was measured at all three time points, but implicit attitudes were measured only at Time 2 due to time constraints. Because a large battery of measures was administered, we used brief measures whenever possible to minimize the administration time for each measure. At each time point, trained research assistants administered measures via computer-assisted self-interviews during school hours. To participate in each of the assessments, adolescents were rewarded with a \$10 gift card. All study procedures were approved by the university human subjects committee.

Measures

Drinking behavior—At each time point, drinking behavior in the past year was measured with two items adapted from the Center for Disease Control and Prevention's Youth Risk Behavior Survey (YRBS; Brener, Collins, Kann, Warren, & Williams, 1995). One item assessed the frequency of having at least one drink of alcohol ("number of days you had at least one drink of alcohol in the past year"), and the second item assessed binge drinking ("number of days you had consumed 5 or more alcoholic drinks within a few hours in the past year"). Response options ranged from 0 (*zero days*) to 4 (*10 or more days*). We used the "last year" time frame because rates of drinking are low in this adolescent population. An overall measure of drinking behavior was computed by summing responses to the two items, as commonly done in prior work (e.g., Choukas-Bradley, Giletta, Neblett, & Prinstein, 2015). The Spearman-Brown reliability coefficient was acceptable at each assessment wave, $\rho = .76$ at Time 1, $\rho = .74$ at Time 2, and $\rho = .79$ at Time 3, supporting the reliability of the drinking behavior measure (Eisinga, Grotenhuis, Pelzer, 2013).

Behavioral intentions—Explicit intentions to drink were assessed at Time 2 by asking adolescents how likely they were to have a drink of alcohol in the next year. Participants responded on a 1 (Extremely unlikely) to 9 (Extremely likely) scale. This item has been widely used to assess drinking intentions among youth (e.g., Gibbons, Gerrard, Cleveland, Wills, & Brody, 2004; Rhodes, Ewoldsen, Shen, Monahan, & Eno, 2014). Because this

study was part of a larger data collection, we were limited in the explicit measures available to compare to the implicit test. Although no good-bad evaluations of alcohol were available in the study, behavioral intentions provide a theoretically meaningful comparison to implicit attitudes because they measure participants consciously guided intentions, and thus allow us to compare the predictive ability of implicit attitudes after controlling for the effects of conscious intent.

Perceived norms for alcohol use—Perceived parental and friend norms about drinking behavior were each assessed with a single item. Participants were asked at what age they thought their parents and close friends would think it was ok for them to drink more than a few sips of alcohol. Response options included “never,” and years between 11 and 21. Responses on each item were highly bimodal, with the most common responses being “21” and “never” and few participants choosing intermediate values. Because of this bimodality, these variables were coded as binary variables, with “never” coded as zero, and 21 and all other values coded as 1. Supplemental analyses indicated that scoring these as continuous variables did not explain any significant variance beyond the binary variables, so we report the binary predictors.

Implicit attitudes—The Affect Misattribution Procedure (AMP; Payne et al., 2005) was used to measure implicit attitudes toward alcohol. Our choice of implicit measures was guided by three considerations: reliability, validity, and efficiency as a brief assessment. The AMP is a highly reliable measure of implicit attitudes (average Cronbach’s $\alpha = .81$) that has demonstrated validity for a wide range of attitude topics (Payne & Lundberg, 2014), including predicting drinking behavior among adults (Payne et al., 2008). Meta-analytic evidence suggests that the AMP is a valid implicit measure, as it predicts relevant behavior with an average $r = .35$, higher than for other commonly used implicit measures, including sequential priming tasks and the IAT (Cameron, Brown-Iannuzzi, & Payne, 2012). The AMP has acceptable reliability even as a brief form ($\alpha = .71$; Payne & Lundberg, 2014), and this is one reason that it has been selected for use in large-scale collaborative studies in which time is valuable (e.g., American National Election Studies, DeBell, Krosnick, & Lupia, 2010).

On each trial participants viewed a prime image of alcohol or soft drinks for 125ms, followed by a Chinese pictograph for 100ms, and finally a visual mask of a black and white “noise” pattern. Participants were instructed to judge whether they found the Chinese pictograph more or less pleasant than the average pictograph by pressing one of two keys. Participants were warned that the prime image preceding the pictograph may influence their judgments and that they should do their best not to be influenced by the prime. A brief form of the AMP was administered, in which participants completed 2 practice trials and 10 critical trials. Five pictures of alcoholic beverages and five pictures of drinking water were used as the primes, and ten unique pictographs were targets. Internal consistency was acceptable ($\alpha = .76$).

Plan of Analyses

To test the main study hypotheses, a stepwise analytic approach was adopted. First, a series of zero-inflated Poisson (ZIP) regression models with robust standard errors were estimated. ZIP models were used because of the count nature of the outcome variable (i.e., alcohol use at Time 3) which included a preponderance of zeros (65.8% reported no alcohol use at Time 3). ZIP models allowed predicting alcohol use at Time 3 while accounting for the excess of adolescents reporting no alcohol use. ZIP regression models were used to examine (a) the predictive effect of implicit attitudes at Time 2 on alcohol use at Time 3 after controlling for previous alcohol use and explicit report of drinking intentions at Time 2 (Research question 1) and (b) whether implicit attitudes at Time 2 were equally predictive of later alcohol use at Time 3 among adolescents who had previous experience drinking alcohol and those who did not (Research question 2). Second, a multiple regression model was conducted to examine the unique effects of Time 1 alcohol use, parental and friends' approval of drinking on implicit attitudes at Time 2 (Research question 3). In all these models, age and gender were covaried. All 868 adolescents who took part in the baseline assessment were included in these analyses and missing data were estimated using the expectation maximization algorithm. Supplemental analyses found that all reported effects are unchanged when missing data are not estimated.

Finally, to estimate a comprehensive model, path analysis was conducted using structural equation modeling. This final model allowed to simultaneously examine the effects of Time 1 predictors (e.g., parental and friends' approval of alcohol) on implicit attitudes and intentions to drink at Time 2 and the subsequent effects of implicit attitudes on alcohol use at Time 3. Moreover, this model accounted for the effects of Time 1 predictors on alcohol use at Time 2 and 3, as well as the within-time associations among each study variable (e.g., implicit attitudes and intention to drink). In this final model, the indirect effects of Time 1 predictors on alcohol use at Time 3 via implicit attitudes at Time 2 (as well as intention to drink) were tested using the joint significance of the paths (see MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). As in the prior analyses, alcohol use at Time 3 was modeled as a ZIP variable and the effects of both age and gender were controlled for. In the path analysis, full information maximum likelihood (FIML) estimation with robust standard errors was used to handle missing values under the assumption of missing at random. All analyses were performed in M-plus version 7.0 (Muthén & Muthén, 1998–2012).

Results

Preliminary Results

To examine individual differences in implicit attitudes, the proportion of pleasant judgments on control trials was subtracted from the proportion of pleasant judgments on alcohol trials for each participant. Higher numbers represent more positive attitudes toward alcohol. On average, implicit attitudes toward alcohol were negative, and significantly different from zero, $M = -.49$, $SD = .46$, $t(867) = 31.58$, $p < .001$. The zero-order correlations among the key variables are displayed in Table 1. Implicit attitudes toward alcohol, measured at Time 2, were significantly associated with drinking at Times 2 and 3 but not at Time 1. Moreover,

drinking at Time 3 was positively associated with greater explicit intentions to drink, age, and the perception that parents and peers approved of the participant drinking.

Research Question 1—Do implicit attitudes predict later drinking after controlling for explicit reports of drinking intentions? Standardized regression coefficients from ZIP regression models predicting alcohol use at Time 3 are reported in Supplemental Table 1. Implicit attitudes were a significant predictor of drinking at Time 3 after controlling for alcohol consumption at Time 2, $\beta = .39$, $SE = .11$, $p < .001$. Moreover, implicit attitudes continued to be a significant longitudinal predictor of drinking after controlling for explicit reports of intentions to drink in the following year, $\beta = .19$, $SE = .08$, $p < .001$. Implicit attitudes toward alcohol did indeed predict changes in drinking over time among adolescents.

Research Question 2—Do implicit attitudes predict the initiation of drinking among adolescents who have not previously consumed alcohol? An additional ZIP regression was estimated by adding to the model the interaction term between implicit attitudes and previous alcohol use. Previous alcohol use was treated as a dichotomous variable differentiating between participants who never drank at both Time 1 and Time 2, and those who reported drinking at either time. Results from this model revealed that the interaction term was not significant, $\beta = -.11$, $SE = .08$, $p = .16$, indicating that implicit attitudes similarly predicted alcohol use at Time 3 for participants who had consumed alcohol and for those who had not.

Research Question 3—Given that implicit attitudes predicted drinking even for youth with no experience drinking alcohol, what factors predict the development of implicit attitudes? The associations between implicit attitudes and perceived norms based on parents' and friends' expectations were examined. As shown in Table 1, participants who perceived that parents and friends approved of drinking had more favorable implicit attitudes toward alcohol at Time 2. These associations suggest that parental norms regarding drinking predict the development of implicit attitudes, and that implicit attitudes predict changes in later drinking. These associations were further examined using path analysis, as described in the plan of analyses section. The final model is displayed in Figure 1, and the coefficients are displayed in Supplementary Table 3. Parental approval of drinking at Time 1, but not friends' approval, predicted implicit attitudes at Time 2, which in turn, predicted alcohol use at Time 3. It is noteworthy that these effects remained significant while accounting for within-time associations as well as stability of alcohol use over time. Although not hypothesized, this model also showed an interesting effect of friends' approval of alcohol at Time 1 on intentions to drink at Time 2. Conversely, parental approval of drinking was not associated with intentions to drink.

We found a marginally significant indirect effect of parental norms at Time 1 on alcohol use at Time 3 through implicit attitudes at Time 2 ($b = .03$, $SE = .017$, $p = .08$). A significant indirect effect was found from friends' norms on alcohol use at Time 3 via intentions to drink ($b = .14$, $SE = .042$, $p < .01$). Parental drinking norms may contribute to the development of implicit attitudes toward alcohol, which in turn predict later drinking behavior.

General Discussion

This study indicated that implicit attitudes were a significant predictor of later drinking, and this effect was similar for adolescents who had not tried alcohol and for those who reported drinking experience. These results suggest that implicit attitudes toward alcohol exist even among adolescents who have no direct pharmacological experience with alcohol, and these implicit attitudes predict the initiation of drinking in the following year. This is the first evidence, to our knowledge, that implicit attitudes developed before a youth has tried alcohol can predict the initiation of drinking. This finding is consistent with models of implicit attitudes that suggest they can develop based on indirect experiences and cultural messages in the absence of direct experience (Olson & Fazio, 2004; Karpinski & Hilton, 2001; Dal Cin et al., 2007).

How did these implicit attitudes develop if not from experience drinking? The perception that one's parents approved of drinking alcohol and the perception that friends approved of drinking were both associated with later drinking (in zero-order correlations). More importantly, implicit attitudes mediated the unique effect of parental norms (but not friend norms) on subsequent drinking. Substantial prior research has implicated parents' alcohol-related attitudes as relevant predictors of adolescents' drinking initiation, yet proposed mechanisms explaining this association have remained elusive. Some data suggest that parents' drinking may lead to increased availability of alcohol to under-aged adolescents, perceptions of social rewards associated with alcohol use, or reduced concerns regarding parent-imposed sanctions for adolescent drinking (e.g., Van Der Vorst, Engels, Meeus, & Dekovi, 2006; Van Zundert, Van Der Vorst, Vermulst, & Engels, 2006). Findings from this study suggest that adolescents who perceive that their parents are permissive regarding alcohol use also may develop more favorable affective associations with alcohol use, which may counter public health campaigns attempting to use fear to reduce risky drinking.

Comparative merits of different implicit measurement strategies

Most research relating implicit attitudes to alcohol have used the IAT or related tasks, but the AMP measures implicit attitudes differently. The AMP measures effects of task-irrelevant primes on judgments of unrelated targets. AMP effects are therefore interpreted as measuring spontaneous evaluations of the prime items. In contrast, the IAT measures the ease with which subjects can associate two categories when they try to do so. Both involve unintended effects of the attitude items, but they are measured in different ways and scores on the two tasks appear to be weakly positively correlated (e.g., Payne, Govorun, & Arbuckle, 2008).

All implicit measures have been the subject of some debate about the degree to which they reflect automatic rather than controlled processes. For example, the IAT has been criticized because it is not immune to faking (De Houwer, Beckers, & Moors, 2007; Fiedler, & Bluemke, 2005; Steffens, 2004; Wallaert, Ward, & Mann, 2010), and IAT scores are influenced by executive control processes (Klauer et al., 2010; McFarland, & Crouch, 2002; Payne, 2005). The AMP has also been criticized based on the potential involvement of controlled processes because subjects who reported intentionally rating the primes showed greater priming effects (Bar-Anan & Nosek, 2012). However, subsequent research suggested

that this association was most likely driven by retrospective reporting biases in subjective reports of intent (Gawronski & Ye, 2014; Payne et al., 2013). Moreover, AMP responses have been demonstrated to resist intentional manipulation better than explicit self-reports (e.g., Payne, Govorun, & Arbuckle, 2008). Overall, the evidence for the validity of the AMP is at least as strong as for other implicit measures (for a meta-analysis see Cameron, Brown-Iannuzzi, & Payne, 2012).

Implications of the research findings

The present results add to accumulating evidence for dual process theories of alcohol use. These theories argue that drinking behavior is influenced by both explicit (intentional and deliberative) thought processes and implicit (automatic or impulsive) responses (e.g., Ames & Stacy, 1998; Friese & Hofmann, 2009; Houben & Wiers, 2006; Palfai & Ostafin, 2003; Payne et al., 2008; Stacy, 1997; Wiers et al., 2002). This study provides the first evidence that the valence of implicit associations (not only the accessibility of cognitive associations, Van Der Vorst et al., 2013) predicts the initiation of drinking.

An implication of this research is that parental norms may contribute to the attitudes and expectancies they develop about drinking. Parents should be alerted to the fact that their attitudes toward drinking are perceived by their children. Moreover, even norms communicated when children are young and have not tried alcohol may have consequences for the children's drinking much later. Our measures of parental norms were self-reported perceptions by the adolescent participants. These perceptions, of course, may not align with parents' own perceptions of their approval regarding drinking. Studies of "pluralistic ignorance" suggest that norms are often miscommunicated or misperceived. As a result, people sometimes respond to perceived social norms even when none of the people involved actually share those norms (Prentice & Miller, 1993). Clear and intentional communication of parent's expectations regarding alcohol may be important to avoid unintended consequences on implicit attitudes and eventual drinking behavior.

Strengths and limitations of the research

This study had several strengths, including a large sample, a longitudinal design spanning three years, and use of a highly reliable and valid implicit measure to test the central hypothesis. The study also had limitations, one of which is the reliance on self-reported drinking behaviors. Self-reports may be influenced by a variety of biases, including social desirability, and this is one of the main reasons for using implicit measures in assessing attitudes. Future research should include behavioral or observer-report measures of drinking behavior to avoid self-report biases. Another limitation is the use of brief measures, which limits reliability. Finally, the measurement of implicit attitudes at only one time point was a limitation. Future studies should examine whether social norms predict changes in implicit attitudes over time.

Conclusion

This research adds to the growing understanding of the role that implicit processes play in mediating alcohol use and abuse. Affective responses to alcohol cues can be automatically activated, and these associations appear to be learned even among adolescents who have

never taken a drink. Implicit affective responses and the messages conveyed through social networks may be important targets for intervention attempts that aim to act early in preventing risky alcohol use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Final path analysis model examining the indirect effects of adolescents' perceived parents' and friends' approval of drinking at Time 1 on alcohol use at Time 3 via implicit attitudes and intentions to drink at Time 2, respectively.

Note. Alcohol use at Time 3 was modeled as a zero-inflated Poisson (ZIP) variable. Standardized path coefficients are reported. Only significant paths are displayed (see Supplementary Table 3 for all estimated paths). The paths that indicate indirect effects are displayed in bold. The paths from age and gender also were estimated but are not displayed for clarity purposes.

$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Table 1

Zero-order correlations among the primary variables of interest.

	Mean/pct	1	2	3	4	5	6	7	8	9
1. Implicit attitude	-.49	--								
2. Alcohol use T1	.36	.04	--							
3. Alcohol use T2	.59	.10**	.44**	--						
4. Alcohol use T3	.91	.17**	.34**	.56**	--					
5. Age	13.12	.04	.13**	.20**	.12**	--				
6. Sex	55% f	-.08*	.03	.03	-.04	-.06	--			
7. Intentions to drink	2.65	.12**	.38**	.63**	.55**	.15**	.06	--		
8. Parents approve	66%	.13**	.14**	.14**	.17**	.05	.08*	.17**	--	
9. Friends approve	82%	.09*	.11**	.12**	.16**	.00	.10**	.22**	.48**	--

*Note.** $p < .05$ ** $p < .01$