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

B. Keith Payne and Kent M. Lee
University of North Carolina at Chapel Hill

Matteo Giletta
Tilburg University

Mitchell J. Prinstein
University of North Carolina at Chapel Hill

Objective: Implicit attitudes toward alcohol predict drinking among adults and adolescents. If implicit attitudes reflected associations learned through direct experience with drinking, then they would likely only predict drinking among individuals who have previously consumed alcohol. In contrast, if implicit attitudes reflected indirect experience through social messages, they might also then predict future drinking, even among individuals with no drinking experience. In this study, we tested whether implicit attitudes would predict initiation of drinking for the first time, and whether parents' and friends' norms toward alcohol would influence the development of implicit attitudes. *Method:* For this study, we followed 868 adolescents between the ages of 12 and 15 years for 3 years. Implicit attitudes were measured using the affect misattribution procedure (Payne, Cheng, Govorun, & Stewart, 2005; Payne, Govorun, & Arbuckle, 2008). Explicit intentions to drink and the frequency of drinking and binge drinking were measured at each of 3 annual waves. *Results:* Implicit attitudes toward alcohol predicted future drinking behavior 1 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

Supplemental materials: http://dx.doi.org/10.1037/hea0000353.supp

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). Underage drinking is also associated with elevated risk for drinking while driving, sexual assault, and high-risk sexual behavior (Brown et al., 2008; Kokotailo, 2010). Those who begin alcohol use earlier have a greater likelihood of alcohol-related problems in later life, including alcohol dependence (American Academy of Pediatrics, 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. 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.

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,

B. Keith Payne and Kent M. Lee, Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill; Matteo Giletta, Department of Developmental Psychology, Tilburg University; Mitchell J. Prinstein, Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill.

Correspondence concerning this article should be addressed to B. Keith Payne, Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill, Campus Box 3270, Chapel Hill, NC 27599. E-mail: payne@unc.edu

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 such measures of memory associations (Ames & Stacy, 1998; Stacy, 1997) as 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 (AMP; Payne, Cheng, Govorun, & Stewart, 2005; Friese & Hofmann, 2009; Payne, Govorun, & Arbuckle, 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 regarding the extent to which implicit attitudes affect drinking behavior during adolescence. In one study of participants between 12 and 15 years of age, implicit associations with positive expectancies and arousal predicted binge drinking 1 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, van der Vorst, Engels, & Wiers, 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. The findings of this study suggest that adolescents may form alcohol-related memory associations in advance of any of their own experiences with alcohol, possibly by observing their parents' drinking behavior. Van Der Vorst et al. (2013) provided 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 theorists of addiction have argued that drug-related cues become associated with neurobiological reward signals (Jentsch & Taylor, 1999;

Robinson & Berridge, 2001; Volkow et al., 2003). According to this perspective, the pharmacological effects of alcohol become associated with cues such as the taste, sight, and smell of alcoholic drinks. If these conditioning experiences cause the automatic associations 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, alcohol drinking among adolescents is often positively rewarded within their peer environments (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. As mentioned earlier, 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, allowing us 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: 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. 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 (473 girls) between 12 and 15 years of age ($M_{age} = 13.12$ years, $SD_{age} = .78$). 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 the participants (46.3%) reported that their parents were currently married, 27.7% reported that their parents were divorced or separated, and 18.9% reported 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., stepmother/father or grandparent), and 4% with other caregivers (e.g., grandparents). The median household income (MHI) calculated from the 2000 United States Census Bureau and 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 the families (n = 1,205); of this, 74.7% of the 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), which occurred approximately 1 and 2 years after baseline when participants were in Grades 8–9 and 9–10, respectively. Attrition was mostly due to absenteeism on the days of data collection and child withdrawal of the school or study. 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 section).

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 using computer-assisted self-interviews during school hours. To participate in each of the assessments, each student was 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 five 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 "past-year" time frame because rates of drinking are generally low in adolescent populations. An overall measure of drinking behavior was computed by summing responses to the two items, as had been commonly done in earlier work (e.g., Choukas-Bradley, Giletta, Neblett, & Prinstein, 2015). The Spearman–Brown reliability coefficient was acceptable at each assessment wave, ρ = .76 at Time 1, ρ = .74 at Time 2, and ρ = .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 us for comparison with the implicit test. Although no good/bad evaluations of alcohol were available in the study, behavioral intentions provided a theoretically meaningful comparison with implicit attitudes because they measure participants' consciously guided intentions, and thus allowed 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 the *ages between 11 and 21* and *never*. Responses on each item were highly bimodal, with the most common responses being *21* and *never*; few participants chose intermediate values. Because of this bimodality, these variables were coded as binary variables, with *never* coded as 0, 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 reported the binary predictors.

Implicit attitudes. The 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 α = .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 Implicit Attitudes Test (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 125 ms, followed by a Chinese pictograph for 100 ms, 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 (Payne et al., 2005) was administered, in which participants completed two practice trials and 10 critical trials. Five pictures of alcoholic beverages and five pictures of drinking water were used as the primes, and 10 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 was 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 reports 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 remained unchanged when missing data were not estimated.

Finally, to estimate a comprehensive model, a path analysis was conducted using structural equation modeling. This final model allowed us 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 Times 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 MCAR. 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 0, $M = -.49$, $SD = .46$, $t(867) = 31.58$, $p < .001$. 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 inten-

Table 1
Zero-Order Correlations Among the Primary Variables of Interest

Variable	Mean/%	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**	—

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

tions? Standardized regression coefficients from ZIP regression models predicting alcohol use at Time 3 are reported in Table S1, found in the supplemental materials. 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 predicted 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 Table S3 in the supplemental materials. 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 had reported experiencing drinking. 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
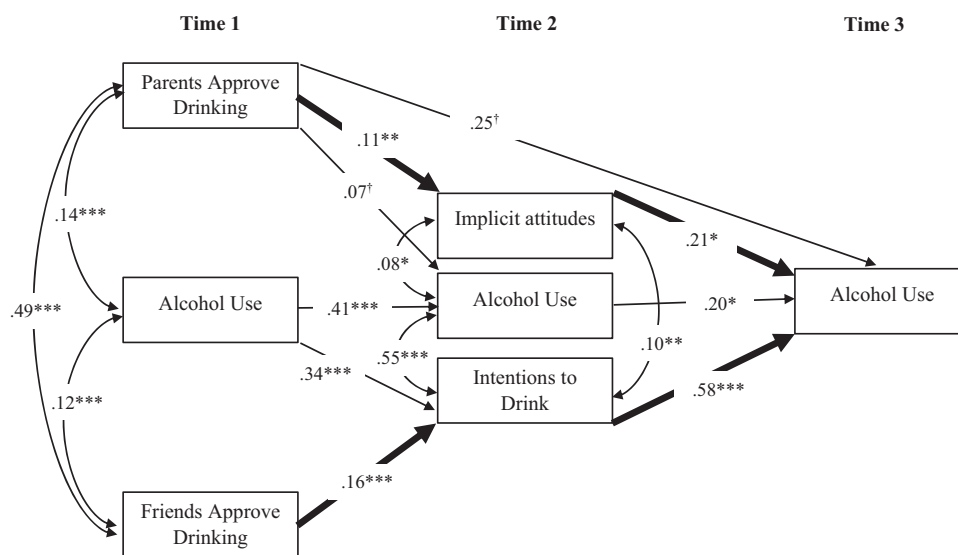

Figure 1. Final path-analysis model examining the indirect effects of adolescents' perceived parents' and friends' approval of drinking at Time 1 on alcohol use at Time 3 via implicit attitudes and intentions to drink at Time 2, respectively. *Note.* Alcohol use at Time 3 was modeled as a zero-inflated Poisson (ZIP) variable. Standardized path coefficients are reported. Only significant paths are displayed (see Table S3, online supplemental materials 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. $^\dagger p < .10$; $^* p < .05$; $^{**} p < .01$; $^{***} p < .001$.

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 earlier models of implicit attitudes, which have suggested that such attitudes can develop based on indirect experiences and cultural messages in the absence of direct experience (Olson & Fazio, 2004; Karpinski & Hilton, 2001; Dal Cin, Gibson, Zanna, Shumate, & Fong, 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 important, 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 underage 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, & Deković, 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 (Payne et al., 2005) 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 (Cameron et al., 2012) 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 et al., 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, Schmitz, Teige-Mocigemba, & Voss, 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 has 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 et al., 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 et al., 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 children perceive their attitudes toward drinking. 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 for the avoidance of unintended consequences on their children's implicit attitudes and potential drinking behaviors.

Strengths and Limitations of the Research

This study had several strengths, including a large sample, a longitudinal design spanning 3 years, and use of a highly reliable and valid implicit measure to test the central hypothesis. The study also had limitations, one of which was 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 was the use of brief measures, which limited reliability. Finally, the measurement of implicit attitudes at only one time point was a limitation. Future studies should include examinations about 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 im-

portant targets for intervention attempts that aim to act early in preventing risky alcohol use.

References

American Academy of Pediatrics, Committee on Substance Abuse. (2010). Alcohol use by youth and adolescents: A pediatric concern. *Pediatrics, 125,* 1078–1087. http://dx.doi.org/10.1542/peds.2010-0438

Ames, S. L., & Stacy, A. W. (1998). Implicit cognition in the prediction of substance use among drug offenders. *Psychology of Addictive Behaviors, 12,* 272–281. http://dx.doi.org/10.1037/0893-164X.12.4.272

Ary, D. V., Tildesley, E., Hops, H., & Andrews, J. (1993). The influence of parent, sibling, and peer modeling and attitudes on adolescent use of alcohol. *International Journal of the Addictions, 28,* 853–880. http://dx.doi.org/10.3109/10826089309039661

Bar-Anan, Y., & Nosek, B. A. (2012). Reporting intentional rating of the primes predicts priming effects in the affective misattribution procedure. *Personality and Social Psychology Bulletin, 38,* 1194–1208. http://dx.doi.org/10.1177/0146167212446835

Bollen, K. (1989). *Structural equations with latent variables.* New York, NY: Wiley. http://dx.doi.org/10.1002/9781118619179

Brechwald, W. A., & Prinstein, M. J. (2011). Beyond homophily: A decade of advances in understanding peer influence processes. *Journal of Research on Adolescence, 21,* 166–179. http://dx.doi.org/10.1111/j.1532-7795.2010.00721.x

Brener, N. D., Collins, J. L., Kann, L., Warren, C. W., & Williams, B. I. (1995). Reliability of the Youth Risk Behavior Survey questionnaire. *American Journal of Epidemiology, 141,* 575–580.

Brown, S. A., McGue, M., Maggs, J., Schulenberg, J., Hingson, R., Swartzwelder, S., . . . Murphy, S. (2008). A developmental perspective on alcohol and youths 16 to 20 years of age. *Pediatrics, 121,* S290–S310. http://dx.doi.org/10.1542/peds.2007-2243D

Cameron, C. D., Brown-Iannuzzi, J. L., & Payne, B. K. (2012). Sequential priming measures of implicit social cognition: A meta-analysis of associations with behavior and explicit attitudes. *Personality and Social Psychology Review, 16,* 330–350. http://dx.doi.org/10.1177/1088868312440047

Choukas-Bradley, S., Giletta, M., Neblett, E. W., & Prinstein, M. J. (2015). Ethnic differences in associations among popularity, likability, and trajectories of adolescents' alcohol use and frequency. *Child Development, 86,* 519–535. http://dx.doi.org/10.1111/cdev.12333

Dal Cin, S., Gibson, B., Zanna, M. P., Shumate, R., & Fong, G. T. (2007). Smoking in movies, implicit associations of smoking with the self, and intentions to smoke. *Psychological Science, 18,* 559–563. http://dx.doi.org/10.1111/j.1467-9280.2007.01939.x

Debell, M., Krosnick, J. A., & Lupia, A. (2010). *Methodology report and user's guide for the 2008–2009 ANES Panel Study.* Palo Alto, CA: Stanford University; Ann Arbor, MI: University of Michigan.

De Houwer, J., Beckers, T., & Moors, A. (2007). Novel attitudes can be faked on the Implicit Association Test. *Journal of Experimental Social Psychology, 43,* 972–978. http://dx.doi.org/10.1016/j.jesp.2006.10.007

Eisinga, R., Grotenhuis, M., & Pelzer, B. (2013). The reliability of a two-item scale: Pearson, Cronbach, or Spearman-Brown? *International Journal of Public Health, 58,* 637–642. http://dx.doi.org/10.1007/s00038-012-0416-3

Fiedler, K., & Bluemke, M. (2005). Faking the IAT: Aided and unaided response control on the Implicit Association Tests. *Basic and Applied Social Psychology, 27,* 307–316. http://dx.doi.org/10.1207/s15324834basp2704_3

Friese, M., & Hofmann, W. (2009). Control me or I will control you: Impulses, trait self-control, and the guidance of behavior. *Journal of Research in Personality, 43,* 795–805. http://dx.doi.org/10.1016/j.jrp.2009.07.004

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin, 132,* 692–731.

Gawronski, B., & Ye, Y. (2014). What drives priming effects in the affect-misattribution procedure? *Personality and Social Psychology Bulletin, 40,* 3–15. http://dx.doi.org/10.1177/0146167213502548

Gibbons, F. X., Gerrard, M., Cleveland, M. J., Wills, T. A., & Brody, G. (2004). Perceived discrimination and substance use in African American parents and their children: A panel study. *Journal of Personality and Social Psychology, 86,* 517–529. http://dx.doi.org/10.1037/0022-3514.86.4.517

Giletta, M., Scholte, R. H., Prinstein, M. J., Engels, R. C., Rabaglietti, E., & Burk, W. J. (2012). Friendship context matters: Examining the domain specificity of alcohol and depression socialization among adolescents. *Journal of Abnormal Child Psychology, 40,* 1027–1043. http://dx.doi.org/10.1007/s10802-012-9625-8

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology, 74,* 1464–1480.

Houben, K., & Wiers, R. W. (2006). Assessing implicit alcohol associations with the Implicit Association Test: Fact or artifact? *Addictive Behaviors, 31,* 1346–1362. http://dx.doi.org/10.1016/j.addbeh.2005.10.009

Jentsch, J. D., & Taylor, J. R. (1999). Impulsivity resulting from frontostriatal dysfunction in drug abuse: Implications for the control of behavior by reward-related stimuli. *Psychopharmacology, 146,* 373–390. http://dx.doi.org/10.1007/PL00005483

Johnson, B. A., Cloninger, C. R., Roache, J. D., Bordnick, P. S., & Ruiz, P. (2000). Age of onset as a discriminator between alcoholic subtypes in a treatment-seeking outpatient population. *The American Journal on Addictions, 9,* 17–27. http://dx.doi.org/10.1080/10550490050172191

Karpinski, A., & Hilton, J. L. (2001). Attitudes and the Implicit Association Test. *Journal of Personality and Social Psychology, 81,* 774–788. http://dx.doi.org/10.1037/0022-3514.81.5.774

Klauer, K. C., Schmitz, F., Teige-Mocigemba, S., & Voss, A. (2010). Understanding the role of executive control in the Implicit Association Test: Why flexible people have small IAT effects. *Quarterly Journal of Experimental Psychology, 63,* 595–619. http://dx.doi.org/10.1080/17470210903076826

Kokotailo, P. K. (2010). Alcohol use by youth and adolescents: A pediatric concern. *Pediatrics, 125,* 1078–1087.

Little, R. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83,* 1198–1202. http://dx.doi.org/10.1080/01621459.1988.10478722

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7,* 83–104. http://dx.doi.org/10.1037/1082-989X.7.1.83

Mayeux, L., Sandstrom, M. J., & Cillessen, A. N. (2008). Is being popular a risky proposition? *Journal of Research on Adolescence, 18,* 49–74. http://dx.doi.org/10.1111/j.1532-7795.2008.00550.x

McFarland, S. G., & Crouch, Z. (2002). A cognitive skill confound on the Implicit Association Test. *Social Cognition, 20,* 483–510. http://dx.doi.org/10.1521/soco.20.6.483.22977

Miller, J. W., Naimi, T. S., Brewer, R. D., & Jones, S. E. (2007). Binge drinking and associated health-risk behaviors among high school students. *Pediatrics, 119,* 76–85. http://dx.doi.org/10.1542/peds.2006-1517

Muthén & Muthén. (1998–2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Author.

Olson, M. A., & Fazio, R. H. (2004). Reducing the influence of extrapersonal associations on the Implicit Association Test: Personalizing the

IAT. *Journal of Personality and Social Psychology, 86,* 653–667. http://dx.doi.org/10.1037/0022-3514.86.5.653

Oxford, M. L., Harachi, T. W., Catalano, R. F., & Abbott, R. D. (2001). Preadolescent predictors of substance initiation: A test of both the direct and mediated effect of family social control factors on deviant peer associations and substance initiation. *The American Journal of Drug and Alcohol Abuse, 27,* 599–616. http://dx.doi.org/10.1081/ADA-100107658

Palfai, T. P., & Ostafin, B. D. (2003). Alcohol-related motivational tendencies in hazardous drinkers: Assessing implicit response tendencies using the modified IAT. *Behaviour Research and Therapy, 41,* 1149–1162. http://dx.doi.org/10.1016/S0005-7967(03)00018-4

Payne, B. K. (2005). Conceptualizing control in social cognition: How executive functioning modulates the expression of automatic stereotyping. *Journal of Personality and Social Psychology, 89,* 488–503. http://dx.doi.org/10.1037/0022-3514.89.4.488

Payne, B. K., Brown-Iannuzzi, J., Burkley, M., Arbuckle, N. L., Cooley, E., Cameron, C. D., & Lundberg, K. B. (2013). Intention invention and the affect misattribution procedure reply to bar-anan and nosek (2012). *Personality and Social Psychology Bulletin, 39,* 375–386.

Payne, B. K., Cheng, C. M., Govorun, O., & Stewart, B. D. (2005). An inkblot for attitudes: Affect misattribution as implicit measurement. *Journal of Personality and Social Psychology, 89,* 277–293. http://dx.doi.org/10.1037/0022-3514.89.3.277

Payne, B. K., & Dal Cin, S. (2015). Implicit attitudes in media psychology. *Media Psychology, 18,* 292–311. http://dx.doi.org/10.1080/15213269.2015.1011341

Payne, B. K., & Gawronski, B. (Eds.). (2010). A history of implicit social cognition: Where is it coming from? Where is it now? Where is it going? *Handbook of implicit social cognition: Measurement, theory, and applications* (pp. 1–15). New York, NY: Guilford Press.

Payne, B. K., Govorun, O., & Arbuckle, N. L. (2008). Automatic attitudes and alcohol: Does implicit liking predict drinking? *Cognition and Emotion, 22,* 238–271. http://dx.doi.org/10.1080/02699930701357394

Payne, K., & Lundberg, K. (2014). The affect misattribution procedure: Ten years of evidence on reliability, validity, and mechanisms. *Social and Personality Psychology Compass, 8,* 672–686. http://dx.doi.org/10.1111/spc3.12148

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). The meta-cognitive model (MCM) of attitudes: Implications for attitude measurement, change, and strength. *Social Cognition, 25,* 657–686. http://dx.doi.org/10.1521/soco.2007.25.5.657

Pieters, S., van der Vorst, H., Engels, R. C., & Wiers, R. W. (2010). Implicit and explicit cognitions related to alcohol use in children. *Addictive Behaviors, 35,* 471–478.

Prentice, D. A., & Miller, D. T. (1993). Pluralistic ignorance and alcohol use on campus: Some consequences of misperceiving the social norm. *Journal of Personality and Social Psychology, 64,* 243–256.

Rhodes, N., Ewoldsen, D. R., Shen, L., Monahan, J. L., & Eno, C. (2014). The accessibility of family and peer norms in young adolescent risk behavior. *Communication Research, 41,* 3–26. http://dx.doi.org/10.1177/0093650211429118

Robinson, T. E., & Berridge, K. C. (2001). Incentive-sensitization and addiction. *Addiction, 96,* 103–114. http://dx.doi.org/10.1046/j.1360-0443.2001.9611038.x

Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology, 106,* 61–73. http://dx.doi.org/10.1037/0021-843X.106.1.61

Stacy, A. W., & Wiers, R. W. (2010). Implicit cognition and addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology, 6,* 551–575. http://dx.doi.org/10.1146/annurev.clinpsy.121208.131444

Steffens, M. C. (2004). Is the Implicit Association Test immune to faking? *Experimental Psychology, 51,* 165–179. http://dx.doi.org/10.1027/1618-3169.51.3.165

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8,* 220–247. http://dx.doi.org/10.1207/s15327957pspr0803_1

Thush, C., & Wiers, R. W. (2007). Explicit and implicit alcohol-related cognitions and the prediction of future drinking in adolescents. *Addictive Behaviors, 32,* 1367–1383. http://dx.doi.org/10.1016/j.addbeh.2006.09.011

Van der Vorst, H., Engels, R. C., Meeus, W., & Deković, M. (2006). The impact of alcohol-specific rules, parental norms about early drinking and parental alcohol use on adolescents' drinking behavior. *Journal of Child Psychology and Psychiatry, 47,* 1299–1306. http://dx.doi.org/10.1111/j.1469-7610.2006.01680.x

Van Der Vorst, H., Krank, M., Engels, R. C., Pieters, S., Burk, W. J., & Mares, S. H. (2013). The mediating role of alcohol-related memory associations on the relation between perceived parental drinking and the onset of adolescents' alcohol use. *Addiction, 108,* 526–533. http://dx.doi.org/10.1111/add.12042

Van Zundert, R. M., Van Der Vorst, H., Vermulst, A. A., & Engels, R. C. (2006). Pathways to alcohol use among Dutch students in regular education and education for adolescents with behavioral problems: The role of parental alcohol use, general parenting practices, and alcohol-specific parenting practices. *Journal of Family Psychology, 20,* 456–467. http://dx.doi.org/10.1037/0893-3200.20.3.456

Volkow, N. D., Wang, G. J., Ma, Y., Fowler, J. S., Zhu, W., Maynard, L., . . . Swanson, J. M. (2003). Expectation enhances the regional brain metabolic and the reinforcing effects of stimulants in cocaine abusers. *The Journal of Neuroscience, 23,* 11461–11468.

Wallaert, M., Ward, A., & Mann, T. (2010). Explicit control of implicit responses: Simple directives can alter IAT performance. *Social Psychology, 41,* 152–157. http://dx.doi.org/10.1027/1864-9335/a000022

Wiers, R. W., Bartholow, B. D., van den Wildenberg, E., Thush, C., Engels, R. C., Sher, K. J., . . . Stacy, A. W. (2007). Automatic and controlled processes and the development of addictive behaviors in adolescents: A review and a model. *Pharmacology, Biochemistry and Behavior, 86,* 263–283. http://dx.doi.org/10.1016/j.pbb.2006.09.021

Wiers, R. W., van Woerden, N., Smulders, F. T., & de Jong, P. J. (2002). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of Abnormal Psychology, 111,* 648–658. http://dx.doi.org/10.1037/0021-843X.111.4.648