Positive Attitude Toward Alcohol Predicts Actual Consumption in Young Adults: An Ecological Implicit Association Test

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ABSTRACT. Objective: Excessive alcohol drinking, particularly among college students, is a major health concern worldwide. The implicit associations between alcohol-related concepts and affective attributes have been repeatedly postulated as a reliable predictor of these drinking behaviors. The Implicit Association Test (IAT) is considered one of the most reliable tasks for measuring these associations and their impact on actual alcohol consumption. However, the majority of these tests used verbal materials as stimuli, thus being unadapted to some categories of participants. The present study aims to develop a new IAT, using pictures exclusively as stimuli, to provide a cross-cultural and language-independent evaluation of implicit associations that is more closely related to real-life drinking contexts. **Method:** Sixty-five undergraduate young adults took part in this study. A new visual IAT was used to measure the implicit association between alcohol cues and alcohol-related positive attributes. Pictorial stimuli, previously validated, were used to represent both target (alcohol vs. soft drinks) and attribute (positive vs. neutral affective states) categories in seven successive experimental blocks. The IAT was followed by self-reported measures of explicit alcohol-related expectancies and alcohol consumption. **Results:** The new IAT highlighted significant implicit associations between positively valenced and alcohol-related representations conveyed by pictures, with good internal consistency, thus proving its validity and reliability. Importantly, regression analyses showed that these implicit associations are a strong predictor of self-reported alcohol consumption. **Conclusions:** This visual IAT further underscores that positive implicit associations with alcohol constitute an important factor in predicting effective alcohol-related behaviors and offers a more ecological and cross-cultural way to test these associations in non–alcohol-dependent populations. Moreover, this version of the IAT might be implemented in prevention and prophylactic programs. (*J. Stud. Alcohol Drugs, 79,* 733–740, 2018)

EPISODIC EXCESSIVE ALCOHOL DRINKING among college students constitutes a major health concern worldwide (Johnston et al., 2007; Kanny et al., 2013) and a crucial risk factor for the development of chronic harmful consumption and severe alcohol use disorders (e.g., Bonomo et al., 2004; Enoch, 2006). The deleterious consequences of this alcohol consumption pattern have been established at cognitive and cerebral levels (Hermens et al., 2013; Petit et al., 2014). Therefore, there is an urgent need to better understand and act on the key psychological factors underlying these drinking habits and to develop new prophylactic tools to prevent their occurrence or reduce their intensity.

Among these factors, it has been established that explicit and implicit affective associations with alcohol predict both current and prospective alcohol use (e.g., Stacy & Wiers, 2010; Wiers et al., 1997, 2002) and play an important role in the development of risky drinking behaviors. Whereas explicit cognitions can be directly assessed using self-reported questionnaires, implicit ones are mainly explored by indirect measures since they are automatically triggered and can influence behaviors that are beyond conscious awareness (e.g., De Houwer, 2006; Gawronski et al., 2006). The Implicit Association Test (IAT) is currently one of the most valid and reliable reaction time-based measures of implicit cognitions (e.g., Bar-Anan & Nosek, 2014). It relies on a concept categorization task that evaluates the relative association strength between target and attribute categories through processing speed measures (Greenwald et al., 1998). It is argued that mapping two concepts (a target and an attribute) onto a single response is easier when those concepts are similar or associated in memory. In view of its flexibility, ease of use, and robustness (Nosek et al., 2007; Stacy & Wiers, 2010), the IAT has been used to explore a wide range of implicit associations, including those between alcohol (i.e., alcohol-related words used as targets) and affective valence (i.e., positive/negative words used as attributes).

Although stronger alcohol-approach and alcohol-arousal associations have been consistently demonstrated in recently detoxified alcohol-dependent individuals (De Houwer et al., 2004; Wiers et al., 2017), the few studies assessing implicit alcohol-valence associations in this population have reported either stronger positive (McPherson & Harris, 2013) or

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negative (De Houwer et al., 2004; but see also Dickson et al., 2013) implicit associations with alcohol-related words compared with control individuals. Similar studies were conducted in young adults with various consumption patterns (light, hazardous, binge or heavy drinkers). Most IAT studies have reported positive and/or negative implicit associations, although the strength of these associations varied considerably (e.g., Houben et al., 2010; Houben & Wiers, 2008; Lindgren et al., 2013; Ostafin & Palfai, 2006; Palfai et al., 2016). From these studies, it appears that three main methodological features, namely, attribute categories, emotional valence, and stimulus modality, are critical to consider when assessing implicit alcohol-valence associations.

First, two types of attribute categories have been classically used in alcohol-specific IAT studies: general positive/negative affective stimuli (i.e., love, sunshine, pain, or fight; Houben & Wiers, 2006) or alcohol-related positive/negative affective states (i.e., mood states linked to alcohol drinking, such as happy, funny, nauseous, or sad; Jajodia & Earleywine, 2003; Wiers et al., 2002). The direct comparison of these two types reveals more positive implicit affective associations with alcohol and a stronger link with explicit measures when alcohol-related affective states are used as attribute categories than when attribute categories consist of general affective stimuli (Houben et al., 2010).

Second, the original alcohol-specific IAT (i.e., bipolar alcohol-specific IAT; De Houwer et al., 2004; Wiers et al., 2002) contrasted positive and negative affective dimensions, which was problematic because alcohol can generate mixed positive/negative feelings, leading to ambivalent emotions related to implicit attitudes toward alcohol (e.g., Conner & Sparks, 2002). New versions of the task (e.g., unipolar positive or negative IAT; Houben & Wiers, 2008; Jajodia & Earleywine, 2003; McCarthy & Thompsen, 2006) have thus been developed to oppose either positive or negative attribute categories with neutral ones, allowing a distinct exploration of the positive and negative implicit associations with alcohol. This unipolar version demonstrated good efficiency to measure implicit attitudes toward alcohol. In particular, the unipolar positive IAT had a more reliable relationship with current or future drinking behaviors than the negative one (Houben et al., 2010; Jajodia & Earleywine, 2003; McCarthy & Thompsen, 2006).

Third, alcohol-specific IAT studies have traditionally used words to represent targets and attributes (e.g., Wiers et al., 2002). However, everyday life occurrences of alcohol-related stimuli are more often based on pictures (e.g., alcohol bottle, alcohol advertisement) than words (Nicholls, 2012); this also applies for affective stimuli (e.g., real-life pictures or scenes with emotional valence; De Houwer & Hermans, 1994). To increase the salience of appetitive stimuli and to provide a stronger association with automatic relevant responses to alcohol, some studies have used pictorial representations to illustrate categories (Gray et al., 2011; Lindgren et al., 2013; Ostafin & Palfai, 2006; Palfai et al., 2016; Ramirez et al., 2017; Slabbinck et al., 2011). Interestingly, using pictorial cues of appetitive stimuli such as alcohol appears highly relevant for capturing stable traits such as motivations (Gschwendner et al., 2008). Thus, these cues more closely match real-life drinking contexts and may facilitate the priming of automatic associations (Fazio et al., 1995), as observed in a picture-picture naming task (Descheemaeker et al., 2014). Moreover, using words as stimuli necessarily limits the validity of the task for some participants, as it implies that participants have sufficient reading and cognitive abilities to correctly decode and understand the meaning of the words presented. Beyond their higher ecological validity, pictorial stimuli may thus also provide a universal tool to assess implicit alcohol-related associations independent of language constraints and may facilitate comparisons across studies and cultures (Slabbinck et al., 2011). However, since pictorial and verbal stimuli related to the same concept are not fully interchangeable and may capture different association sets (Foroni & Bel Bahar, 2010), the selection of pictorial materials must be carefully performed.

Given these results and to provide a most reliable and ecological visual measure of implicit associations, we developed a new IAT version using alcohol-related affective attributes and pictorial stimuli to represent both target and attribute categories. Since we targeted implicit associations in a population of nonproblematic young student drinkers, we focused on a positive unipolar version of the IAT because positive associations toward alcohol are most common in that population (Houben & Wiers, 2006; Jajodia & Earleywine, 2003) and appear to be a better predictor of drinking behaviors than negative associations (Houben et al., 2010). Therefore, we aimed to (1) experimentally test this new ecological version of the IAT and determine its internal validity and reliability and (2) demonstrate the possible relationships between explicit and implicit associations as well as their comparative predictive value toward the self-reported consumption of alcohol in undergraduate young adults. We predicted that this new IAT would allow the identification of (1) relevant implicit associations between alcohol-related pictures and positive alcohol-related affective states in nondependent drinkers and (2) significant predictive power of the IAT scores toward self-reported alcohol consumption measures.

Method

Participants

Sixty-five Belgian undergraduate students (Psychological Science Faculty, Université catholique de Louvain, Belgium) were recruited through Faculty student subject pool to take part in the experiment (Table 1). To explore implicit associations in a wide range of alcohol consumption patterns,

Table 1. Demographic, alcohol consumption and implicit/explicit measures of the sample

Variable	Participants (N = 65)
Demographic measures	
Age, *M* (*SD*)	20.9 (1.8)
Gender ratio, female/male	39/26
Alcohol consumption measures, *M* (*SD*)	
AUDIT total score	10.49 (6.61)
AUDIT Item 1	2.45 (1.00)
AUDIT Item 2	1.38 (1.17)
AUDIT Item 3	2.06 (1.28)
Explicit and implicit alcohol-related measures, *M* (*SD*)	
D-600 score	0.276 (4.99)
Positive expectancies score	5.61 (0.84)
Attitudes score	5.31 (1.34)

participants were not screened or selected based on their alcohol consumption before the experiment. All participants had normal or corrected-to-normal vision. The experimental protocol was approved by the local ethics committee and was carried out in accordance with the Declaration of Helsinki, as revised in 2008. Participants received course credits for their participation.

Measures and procedures

Each participant completed an individual session in a quiet room. The session included the IAT and an online questionnaire measuring self-reported alcohol consumption and explicit alcohol-related cognitions (LLC, Qualtrics Software). The implicit measure (IAT) was administered before the explicit one to avoid carry-over effects (Bosson et al., 2000) and was presented using E-Prime 2 Professional (Psychology Software Tools, Pittsburgh, PA).

Alcohol use and alcohol-related problems. The severity and frequency of alcohol consumption was assessed by the French version of the Alcohol Use Disorders Identification Test (AUDIT; Gache et al., 2005), which uses 10 items to compute a total score (AUDIT total score) measuring the harmfulness of alcohol consumption (Aalto et al., 2009). The AUDIT is the most widely used screening questionnaire for general alcohol-related problems and thus offers a reliable estimation of the frequency, intensity, and riskiness of alcohol consumption in a general population (Aalto et al., 2009). It can also be easily compared to other studies in the field. In particular, the first three questions evaluate drinking frequency (AUDIT Item 1), mean quantities consumed on drinking occasions (i.e., drinking intensity; AUDIT Item 2), and the frequency of occasions on which the amount consumed exceeded six drinks (i.e., binge drinking habits; AUDIT Item 3).

Implicit measure. In our IAT version, participants had to categorize pictures from four categories—two target categories (i.e., pictures of alcohol or soft drinks) and two attribute categories (i.e., positive or neutral pictures)—by pressing one of two response keys. The target and attribute pictures were selected from the Amsterdam Beverage Picture Set (Pronk et al., 2015) and the Nencki Affective Picture System (NAPS; Marchewka et al., 2014), respectively (see Supplemental Materials for a complete list of the pictures used). The target pictures consisted of alcoholic drinks (i.e., beers, wine, or distilled spirits) and soft drinks (i.e., water, juice, or soda), whereas the attribute set consisted of positive (e.g., woman smiling, dolphins, beach) and neutral (e.g., bicycle, pigeon, highway) pictures corresponding to three "pleasant" affective states related to alcohol drinking (happy, funny, lively) and to three "neutral" affective states (average, normal, usual). To ensure the reliability of attribute pictures selection, a validation pilot study was conducted. A pre-selection of 152 pictures (76 neutral and 76 positive) from the NAPS (Marchewka et al., 2014) was submitted to a pilot sample of 94 students (83 females, 10 left-handed, mean age: 21.0 ± 3.0 years old). An online questionnaire was implemented on Qualtrics software (Qualtrics LLC, Provo, UT). The valence of each picture was first globally evaluated (positive, neutral, or negative) and each picture was then rated on six different 9-point Likert-scale items ranging from 1 (*not at all*) to 9 (*totally agree*), with 5 corresponding to neutral, for three positive adjectives (i.e., funny, happy, and lively) and three neutral adjectives (i.e., average, normal, and usual). These adjectives were previously used in an alcohol-related positive unipolar IAT variant showing significant implicit association with drinking behaviors (Houben et al., 2010). From this evaluation, eight positive (mean ratings for the positive adjectives: 6.9 ± 0.4; mean ratings for the neutral adjectives: 5.0 ± 0.8) and eight neutral (mean ratings for the positive adjectives: 3.8 ± 0.4; mean ratings for the neutral adjectives: 7.0 ± 0.5) pictures were selected. Positive and neutral pictures were matched on luminance, $t(14) = 0.661$, $p = .519$, and contrast, $t(14) = 0.487$, $p = .634$, parameters. The selected pictures were thus highly representative of the chosen affective states.

The IAT was presented in seven blocks: (1) a 32-trial target discrimination block (left = alcohol; right = soft); (2) a 32-trial attribute discrimination block (left = positive; right = neutral); (3) a 32-trial training congruent combination block (left = alcohol + positive; right = soft + neutral); (4) a 64-trial test block with the same combination as (3); (5) a 32-trial target discrimination block in which target categories were reversed (left = soft and right = alcohol); (6) a 32-trial training incongruent combination block (left = soft + positive; right = alcohol + neutral); and (7) a 64-trial test block with the same combination as (6). Stimuli for the target, attribute, and combination discrimination blocks were presented randomly. Each stimulus was presented twice in the test combination block. Target and attribute stimuli were always presented in the middle of the computer screen (picture size: 13.23 cm × 13.23 cm for targets, 17.65 cm × 13.23

cm for attributes). Each trial started with the appearance of a black fixation cross in the middle of the screen for a variable duration between 500 and 1,500 ms. Then, a target or attribute stimulus appeared and remained on the screen until a response was given or for a maximum of 2,000 ms. Between the trials, a blank screen was presented [2,000 ms – reaction time of the previous trial]. During the task, the labels of the categories assigned to the left and right response keys were presented in the corresponding upper corners of the screen. Instructions were presented before each block. The IAT congruent and incongruent blocks were counterbalanced across participants.[1]

The IAT data were transformed following the IAT scoring algorithm (Greenwald et al., 2003) to obtain a D-600 measure, which is based on the difference in the score between congruent (alcohol pictures/positive pictures and soft pictures/neutral pictures) and incongruent (alcohol pictures/neutral pictures and soft pictures/positive pictures) response times. Moreover, error penalties (600 ms) were added, and results were standardized at the individual level (Greenwald et al., 2003). Higher positive D-600 scores reflect faster performance for alcohol/positive attributes and soft drinks/neutral attributes pairings, whereas negative D-600 scores correspond to faster performance for alcohol/neutral attributes and soft drinks/positive pairs. Internal consistencies were calculated by correlating the D-600 scores from the training part with scores from the test part (Greenwald et al., 2003).

Explicit expectancies and attitudes measures. The explicit measure of positive alcohol-related cognitions was a six-item questionnaire (Wiers et al., 2002, 2005). Each item consisted of a statement on drinking alcohol (i.e., "drinking alcohol makes me feel . . .") that was completed with the following positive words presented randomly: *talkative, excited, cheerful, happy, funny,* and *lively* (the same positive words that were used as attribute pictures in the IAT). Participants indicated their level of agreement with each item on a 7-point Likert scale from 1 (*completely disagree*) to 7 (*completely agree*). A mean score was calculated for the six positive items of the expectancy questionnaire toward alcohol (explicit positive expectancies score). The larger the score, the more positive are the participant's expectancies toward alcohol. Finally, explicit attitudes toward alcohol (explicit attitudes score) were assessed using a semantic differential (Wiers et al., 2002, 2005) with a 7-point Likert scale from 1 (*alcohol is totally unpleasant*) to 7 (*alcohol is totally pleasant*). Low scores indicate negative attitudes toward alcohol, whereas high scores reflect positive attitudes toward alcohol.

[1]Note that no significant difference was observed between the two possible IAT orders for the mean D-600 scores, $t(63) = 1.203$, $p = .234$. Consequently, this variable was not considered in the following main analyses.

Table 2. Correlations between implicit (D-600 score) and explicit (positive expectancies, attitudes score) measures and alcohol consumption (AUDIT total score, AUDIT Items 1–3)

Variable	D-600 score	
AUDIT total score	0.353*	
AUDIT Item 1	0.307	
AUDIT Item 2	0.248	
AUDIT Item 3	0.361*	
	Explicit positive expectancies score	Explicit attitudes score
AUDIT total score	0.269	0.574**
D-600 score	0.180	0.189

Notes: The presented p values are adjusted after Bonferroni correction for multiple comparisons.
*$p < .05$; **$p < .001$.

Data analytic plan

First, descriptive data about alcohol consumption (AUDIT total score, Items 1–3), IAT (D-600 score) and explicit scores (positive expectancies and attitudes scores) were reported (Table 1). The D-600 internal reliability was assessed and a t test to zero on the mean D-600 was performed to assess implicit associations for the congruent condition. Then, Pearson correlation analyses, adjusted for multiple comparisons by applying Bonferroni correction [each initial p value has been multiplied by the number of comparisons (i.e., 8), the p values presented here being the corrected ones], were performed between (1) alcohol consumption (AUDIT total score, AUDIT Items 1–3) and implicit (D-600 score) measures; (2) explicit (explicit positive expectancies, attitudes scores) and implicit (D-600 score) outcomes (Table 2). Finally, the predictive and incremental validity of our IAT version was examined using a hierarchical regression analysis[2] with explicit positive expectancies and attitudes factors entered in Step 1, and implicit D-600 score entered in Step 2.

Results

Alcohol consumption data, implicit and explicit measures

The mean AUDIT total score was 10.49 ± 6.61 [range: 0–28; 29.2% of the sample showing low-risk consumption (AUDIT score lower than 8), 41.5% presenting risky consumption (score between 8 and 15), 18.5% having a harmful consumption (score between 16 and 19), 10.8% having a possible dependence (score higher than 19)]. Specifically, the mean scores for Items 1 (drinking frequency), 2 (drinking intensity), and 3 (frequency of excessive drinking episodes, corresponding to 6 or more drinks) were 2.45 ± 1.00, 1.38 ± 1.17, and 2.06 ± 1.28, respectively. The D-600 split-half

[2]As coefficients for the demographic variables (i.e., gender and age) were not significant, these variables were not included in the regression model.

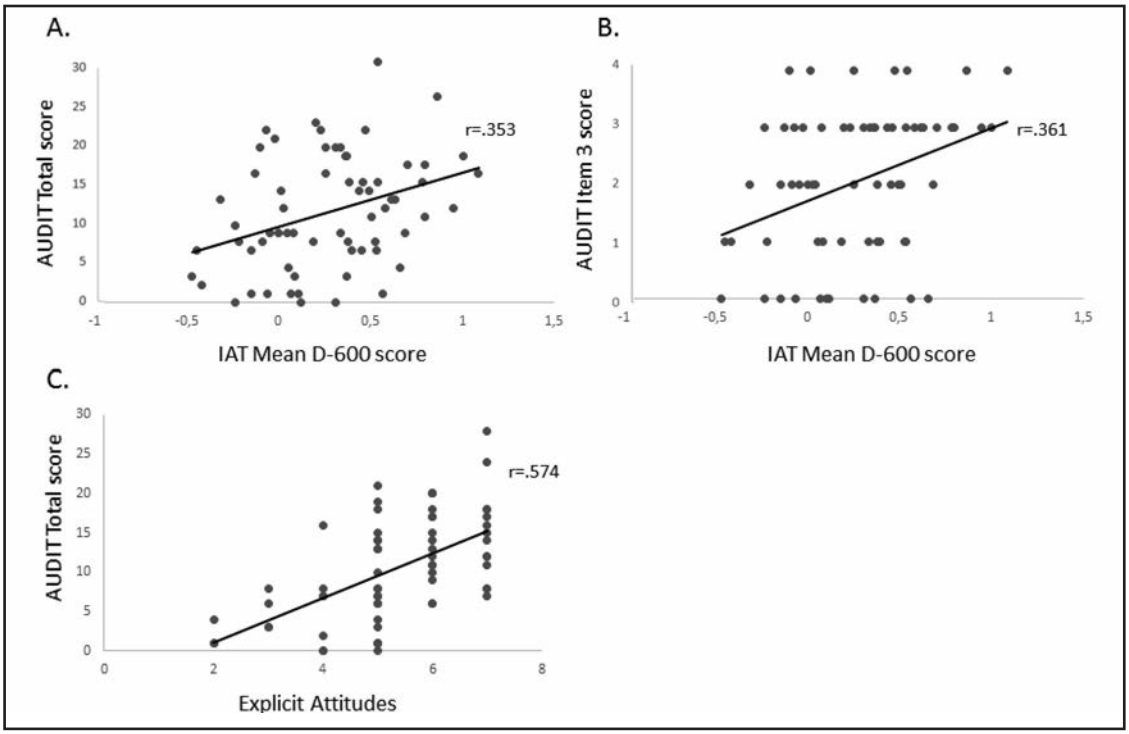

FIGURE 1. Graphical representation of the links between (A) Alcohol Use Disorders Identification Test (AUDIT) total score and mean D-600 score, (B) AUDIT Item 3 score and mean D-600 score, and (C) AUDIT total score and mean explicit attitudes score. Lines correspond to the linear relation.

reliability (Pearson correlation) was $r = .447$ ($p < .001$), suggesting good IAT internal consistency. The D-600 score significantly and positively differed from zero, mean D-600 = 0.276 ± 0.367, $t(64) = 6.051$, $p < .001$, showing an implicit association between alcohol and positive pictures. Results showed that participants reported large positive feelings toward alcohol (mean explicit positive expectancies score = 5.61 ± 0.84). The mean explicit attitudes score also revealed a positive attitude toward alcohol (mean score = 5.31 ± 1.34).

Links between implicit and explicit outcomes and drinking behaviors

First, the IAT score (i.e., D-600 score) was significantly related to alcohol consumption, as reflected by the significant correlation with the mean AUDIT total score ($r = .353$, $p = .032$; Figure 1). In particular, the D-600 score was linked to AUDIT Item 3, corresponding to the frequency of excessive alcohol drinking episodes ($r = .361$, $p = .024$). Conversely, the correlations with global frequency (AUDIT Item 1) and intensity of alcohol consumption (AUDIT Item 2) were not significant (Item 1: $r = .307$, $p = .104$; Item 2: $r = .248$, $p = .368$). Stronger positive implicit associations with alcohol were thus associated with higher levels of alcohol consumption, particularly with a higher frequency of excessive drinking episodes.

A significant correlation was also observed between AUDIT total score and explicit attitudes ($r = .574$, $p < .001$; Figure 1), whereas the correlation between the AUDIT total score and explicit positive expectancies was not significant ($r = .269$, $p = .240$). None of the correlations between implicit and explicit cognitions reached significance (D-600 score/explicit positive expectancies: $r = .180$, $p = 1$; D-600 score/explicit attitudes: $r = .189$, $p = 1$).

The predictive and incremental validity of our IAT version was examined using a hierarchical regression analysis (Table 3). Explicit positive alcohol-related expectancies and attitudes toward alcohol were entered in Step 1, where only explicit attitudes toward alcohol significantly predicted the AUDIT total score ($\beta = .573$, $p < .001$). Further, the mean D-600 score entered in Step 2 significantly increased the explained variance ($\beta = .256$, $p = .015$).

Discussion

The implicit associations between alcohol-related concepts and positive affective attributes, as measured by the IAT, have been found to predict excessive alcohol consumption. By capitalizing on previous attempts to assess implicit alcohol-valence associations, the present study aimed to develop a new IAT using pictures exclusively as stimuli to provide an ecological and efficient evaluation of these as-

TABLE 3. Summary of the hierarchical regression analysis exploring the predictive value of explicit and implicit alcohol-related measures for drinking behavior

Step	Variables	*B*	SE *B*	β	[95% CI]	*t*	*p*
1	Explicit positive expectancies	0.024	0.918	.003	[-1.810, 1.859]	0.026	.979
	Explicit attitudes	2.817	0.577	.573	[1.664, 3.970]	4.882	<.001
2	Explicit positive expectancies	-0.210	0.886	-.027	[-1.982, 1.562]	-0.237	.419
	Explicit attitudes	2.647	0.558	.538	[1.531, 3.763]	4.743	<.001
	D-600 score	4.601	1.840	.256	[0.921, 8.281]	2.500	.015

Notes: $F(2, 64) = 15.265$, $p < .001$, $R^2 = .330$ for Step 1. Final model: $F(3, 64) = 13.121$, $p < .001$, $R^2 = .392$.

sociations that is more closely related to real-life drinking contexts.

The results showed that our new IAT version is valuable for highlighting unambiguous positive implicit associations with alcohol in a population of young adults with various alcohol consumption patterns. These findings support the idea that using a unipolar version with positive, relevant, alcohol-related attributes uncovers these types of automatic associations among young alcohol drinkers beyond populations presenting alcohol use disorders. Moreover, because this new and ecological version uses pictorial stimuli that were carefully selected through a validation study and reliably represented the chosen affective states, it can be used independently of the participants' language, thus constituting an efficient international tool for the evaluation of implicit associations with alcohol and for the development of wider studies evaluating the variation of these associations across countries and cultures. This new IAT, exclusively using pictorial stimuli, might also allow measurement of explicit associations among populations with limited reading or cognitive abilities, which was impossible with word-based IAT versions. This applicability to populations with low instruction level should, however, be confirmed by future studies, as we focused here on highly educated individuals.

Importantly, positive implicit associations with alcohol, as measured by the new IAT version, were significantly correlated with the AUDIT score, specifically with the item assessing the frequency of excessive drinking episodes, thereby confirming their link with self-reported excessive alcohol consumption. In line with previous studies (e.g., Houben & Wiers, 2006, 2008; Jajodia & Earleywine, 2003; Thush & Wiers, 2007), the lack of a significant correlation between implicit and explicit associations suggests that these two measures tap distinct psychological constructs or at least different processes involved in alcohol-related expectancies. Moreover, implicit associations predicted actual drinking behavior beyond the variance explained by explicit alcohol-related expectancies (which were not significantly correlated with self-reported alcohol consumption) and attitudes, further demonstrating the predictive usefulness of the implicit measure. Both explicit and implicit positive alcohol-related associations should be systematically explored and compared to offer an integrated view of the mechanisms underlying alcohol consumption, and notably to determine how these associative processes can be involved in the currently dominant models of addictive disorders, namely the dual-process models conceptualizing addictive disorders as an imbalance between overactivated automatic system and underactivated control system (Stacy & Wiers, 2010). At a more clinical level, implicit measures such as our visual version of the IAT can be useful for prophylactic assessment in populations presenting low to moderate alcohol use disorders and for which self-reported explicit measures of alcohol consumption are not fully reliable (Del Boca & Darkes, 2003).

The present study is a first step toward offering an innovative and ecological IAT that efficiently explores implicit associations with alcohol-related concepts. First, the magnitude of the associations evidenced with this new IAT version should be directly compared with those highlighted by more "standard" versions of IATs within the same experiment to determine whether this visual measure demonstrates the same level of association with drinking as well-established alcohol-related IATs using words. Second, the focus in this study was on a positive unipolar version, which has been proven to offer a better evaluation of implicit associations with alcohol and to be a better predictor of current or future consumption (e.g., Houben & Wiers, 2006; Jajodia & Earleywine, 2003; McCarthy & Thompsen, 2006). Although this positive version should be replicated in a larger sample and extended to include more specific alcohol consumption patterns (e.g., heavy and binge drinking), a picture-based IAT that tests negative associations should be developed to directly compare the valence of implicit associations of populations presenting alcohol use disorders among which attitudes toward alcohol are more ambivalent (e.g., Conner & Sparks, 2002). It is also worth noting that our sample was composed exclusively of undergraduate students who have consequently a high level of abstract thinking. Future studies should control that the sensibility of our visual IAT version is not affected by this variable. Importantly, this study relied exclusively on self-reported measures of past alcohol consumption (i.e., AUDIT; Gache et al., 2005). Those measures are well validated and widely used, but additional studies should include more precise estimates of actual daily drinking, such as the Alcohol Timeline Followback Method (e.g., Freisthler et al., 2014; Sobell & Sobell, 2000). Moreover, although our pictorial stimuli are by essence more cross-cultural than the words used in previous versions, consti-

tuting a crucial asset of our approach, we cannot exclude that the implicit positive associations with alcohol-related pictures might vary across cultures. This should be further explored by international studies using this task, notably to ensure that the selected pictures fit with each cultural context. Craving or intoxication measures should also be considered before the task to determine the possible influence of these factors on both explicit and implicit attitudes toward alcohol. Finally, it is worth noting that because our study was cross-sectional, causal conclusions about the role of implicit positive associations on drinking behavior cannot be derived. Future research using longitudinal designs should be developed to determine the causal link between implicit-explicit associations and actual alcohol consumption, primarily to determine how these associations might shape the development of excessive alcohol consumption and alcohol use disorders in young populations.

As a whole, the present study underlines the usefulness of implicit positive alcohol-related associations for predicting drinking behavior and offers a more ecological and universal way to test these associations in non–alcohol-dependent populations. Beyond its methodological and experimental implications, this ecological version of the IAT might constitute an innovative tool for prevention and prophylaxis to refine the evaluation of alcohol consumption and distinguish dangerous drinking from moderate ones, in at least three contexts. First, although requiring a computer, this task is easy to understand, language independent and quite short, which claims for its implementation as a prophylactic tool in prevention structures, where it could characterize, after a first screening, implicit positive associations related to alcohol in the most at-risk individuals. This would help to more clearly predict actual drinking behavior (beyond explicit attitudes), thus guiding the following counseling or intervention. Second, this task could easily be implemented online and thus be used worldwide as a complementary tool for practitioners to better understand the characteristics of their patients' alcohol consumption. Centrally, once online, this test could be performed at home by patients, ending up in an automatically computed implicit association score guiding practitioners. Third, this task could be implemented in clinical structures treating patients with severe alcohol use disorders, to offer a complementary clinical tool measuring implicit associations, and thus to potentially initiate innovative cognitive remediation treatments aiming at reducing alcohol consumption through implicit associations' modifications, in line with what has been done for alcohol-related attentional biases (e.g., Schoenmakers et al., 2010).

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