Journal of Abnormal Psychology
2008, Vol. 117, No. 2, 420–427

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0021-843X/08/$12.00 DOI: 10.1037/0021-843X.117.2.420

Impulses Got the Better of Me: Alcohol Moderates the Influence of Implicit Attitudes Toward Food Cues on Eating Behavior

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This study shows that alcohol consumption enhances the prediction of candy consumption by implicit attitudes and at the same time decreases the predictive validity of cognitive restraint standards. Female participants were assigned to either an alcohol or a control condition and were then given an opportunity to taste candies. For participants in the alcohol condition, candy consumption was uniquely predicted by previously assessed implicit attitudes toward the candy. In contrast, candy consumption was primarily predicted by cognitive restraint (Three Factor Eating Questionnaire) in the control condition. Moreover, participants who consumed alcohol ate significantly more candy at the group level. These results indicate that alcohol increases the behavioral impact of impulsive determinants on eating behavior while disrupting the behavioral impact of reflective determinants. They further demonstrate that measures of implicit attitudes toward tempting stimuli add incremental validity for the prediction of self-control outcomes.

Keywords: alcohol, implicit attitudes, cognitive restraint, eating behavior, impulsive behavior

In many circumstances, the implications of a certain impulse (e.g., the desire to eat a delicious piece of cake) are at odds with personal standards (e.g., "I want to keep a slim figure"). In such cases, the person faces a conflict between impulse and restraint, similar to a tug-of-war in which the stronger competitor wins (e.g., Herman & Polivy, 2004). Even though such conflicts are a common part of the human condition (Carver, 2005), the dominance of either side can seriously disrupt normal functioning. On the one hand, the temporary or chronic failure to resist one's impulses is indicative of a large range of impulse control disorders such as binge eating and overeating, drug abuse, pathological gambling, antisocial personality, or sexual harassment, and often implies far-reaching costs for individuals and society at large (e.g., Baumeister, Heatherton, & Tice, 1994). On the other hand, the chronic suppression of impulses may likewise have serious negative psychological and health-related consequences (see Polivy, 1998, for a review), as becomes evident from disorders such as anorexia nervosa.

The outcome of the struggle between impulse and restraint often depends on the circumstances. For instance, research on the self-regulation of eating has accumulated considerable evidence about conditions that disrupt the normal self-control of eating, especially for people who generally limit their food intake (restrained eaters). In a seminal study, Herman and Mack (1975) demonstrated that an initial high-calorie preload led restrained eaters to overeat in a subsequent taste-and-rate task, a finding that has since been replicated multiple times (Herman & Polivy, 2004). Other studies have investigated the role of ego depletion (Vohs & Heatherton, 2000) and low self-monitoring (Collins, 1978) as disinhibiting factors. Furthermore, emotional distress, particularly anxiety, depression, and ego threat, appear to disrupt the control of eating behavior (for a review, see Herman & Polivy, 2004), arguably because eating may serve as a means to regulate negative emotions (Tice, Bratslavsky, & Baumeister, 2001).

This article is concerned with a particular factor that has been found to influence eating behavior: alcohol consumption. As a great deal of clinical and social psychological research has shown, alcohol acts as a disinhibitor of impulses across a wide range of domains (for a review, see Hull & Bond, 1986). Most importantly for the present research, alcohol intake has been found to increase food consumption (Hetherington, Cameron, Wallis, & Pirie, 2001; Polivy & Herman, 1976a, 1976b; Yeomans, 2004, for a review), especially among restrained eaters (Polivy & Herman, 1976b). In this article, we provide more direct laboratory evidence for the conjecture that alcohol enhances the impact of people's impulses on eating behavior while at the same time reducing the impact of personal standards to restrain food intake.

So far, research on the self-regulation of eating has primarily focused on the interplay between external influences (e.g., a preload manipulation, alcohol) and the restraint components (e.g., individual differences in dietary restraint). However, the impulse component has received much less attention. Even though there is some research showing that impulsivity as a personality trait affects eating behavior (e.g., Guerrieri, Nederkoorn, & Jansen, 2007; Nederkoorn, Van Eijs, & Jansen, 2004), the influence of specific impulses toward the food object of interest is typically

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This research was supported by a grant from the German Science Foundation (DFG) to Manfred Schmitt (Schm 1092/5-1). We thank Anne Roefs, Jane Thompson, and Reinout Wiers for valuable comments and Katharina Fischer and Nadine Thomas for their help in data collection.

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inferred only post hoc from observed group differences in behavior (e.g., in the form of more consumption in one group than in the other). This leaves unanswered the question what specific forces within the person actually drive disinhibited behavior. As Herman and Polivy (2004) pointed out recently, "a truly comprehensive analysis of self-regulatory success and failure . . . will have to include both the state of the dieter and the power of the tempting stimulus" (p. 505). The present study aims to fill this gap by specifying and assessing a crucial determinant of the strength of the impulse component, *implicit attitudes* toward the tempting stimulus, sometimes also referred to as *automatic attitudes* (for a review, see Petty, Fazio, & Briñol, in press). More specifically, we argue that the understanding of conflicts between impulse and restraint can be advanced by linking these concepts to dual-system models of human information processing (cf. Carver, 2005). According to Strack and Deutsch's (2004) reflective-impulsive model, implicit attitudes are part of the impulsive system and can be defined as quick evaluative reactions that are triggered automatically and unintentionally upon encounter of environmental stimuli. Implicit attitudes have been found to predispose the person to spontaneously approach or avoid these stimuli, thus providing a quick and efficient means of behavioral orientation (Chen & Bargh, 1999; Neumann, Hülsenbeck, & Seibt, 2004). In other words, implicit attitudes may be seen as the springs of impulsive behavior toward a given stimulus in the environment in that they provide the person with a quick motivational orientation to approach or avoid that stimulus.

In contrast, the reflective system is a higher order mental system that guides behavior in accordance with long-term goals and standards. Often, impulsive action tendencies triggered by implicit attitudes are in conflict with reflective action tendencies resulting from personal standards (Strack & Deutsch, 2004). Although the reflective system is capable of monitoring and overriding these competing impulsive action tendencies under normal conditions, its operation may be impaired by factors that reduce available control resources or otherwise disrupt its normal functioning (Strack & Deutsch, 2004), allowing the impulsive system to take over control of behavior determination. Consequently, a breakdown of the reflective system's capacity to inhibit the impulsive system should result in behavior that can be better predicted by behavioral precursors in the impulsive system such as implicit attitudes.

In this research, we hypothesized that alcohol impairs the controlling influence of the reflective system, thus leading to a stronger impact of implicit attitudes on eating behavior as compared with a sober condition. Within the present framework, there are at least four rationales for this conjecture. First, it is possible that alcohol consumption leads to weaker representations of personal standards in the reflective system (Baumeister et al., 1994). For instance, otherwise strongly represented intentions to diet may become temporarily inaccessible in drunken people. Without a clear representation of standards, the reflective system will not be able to effectively guide behavior in the first place, allowing implicit attitudes to drive behavior more strongly. Second, people who have consumed alcohol may lose the ability to successfully attend to and monitor their behavior (Hull, Levenson, Young, & Sher, 1983). Under the influence of alcohol, discrepancies between the actual state and relevant standards to diet may go unnoticed, rendering disinhibited eating behavior more likely. This view is also reflected in Steele and Joseph's (1990) alcohol myopia theory. According to this theory, alcohol narrows the focus of attention to the most salient environmental cues—most often the temptation at hand. As a consequence, people who consume alcohol may become shortsighted with regard to their long-term dietary standards unless these standards are made salient (e.g., MacDonald, Fong, Zanna, & Martineau, 2000). Third, even though persons who consumed alcohol may still be aware of existing conflicts between their impulses and their personal standards to some degree, they may nevertheless lack the cognitive resources for behavioral control necessary to stop impulsive action tendencies from becoming transformed into action (e.g., Fillmore, 2003). The previous accounts help to explain the heightened impact of impulses under alcohol consumption by the reduced potential of the reflective system to represent and monitor personal standards and to inhibit impulsive action tendencies. A fourth possibility holds that alcohol may directly boost impulse strength without necessarily reducing the capacity for restraint. Again, the result would be disinhibited behavior. Whether as independent factors or in combination with each other, these four mechanisms all converge on the previously untested prediction that is the focus of the present research: Individual differences in implicit attitudes exert a stronger influence on eating behavior under the influence of alcohol. Under normal conditions, however, eating behavior should be primarily predicted by individual differences in restraint standards as goal-directed behavior should be carried out more efficiently by a properly functioning reflective system.

In recent years, quite a number of so-called implicit measures such as the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) have been developed (for discussions, see De Houwer, 2006; Wittenbrink & Schwarz, 2007). These implicit measures can be used to assess implicit attitudes toward specific objects of interest (e.g., Roefs & Jansen, 2002; Teachman, Gregg, & Woody, 2001). Because implicit measures do not hinge on participants' introspective abilities and their willingness to self-report, these new measures may be ideally suited to tap into the associative network of the impulsive system (Greenwald et al., 1998; Strack & Deutsch, 2004). Even though implicit measures—like any other measurement tool—have been shown to contain measurement-specific sources of variance (e.g., Mierke & Klauer, 2003), consensus exists that implicit measures reflect an automatic, affective basis of information processing (e.g., Gawronski & Bodenhausen, 2006; Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). Moreover, implicit measures have been found to be sensitive to bodily need states. For instance, Seibt, Häfner, and Deutsch (2007) have shown that implicit preferences toward food stimuli increase as participants are deprived of food, suggesting that implicit measures are sensitive to state variance in addition to stable trait components (e.g., Schmukle & Egloff, 2004). Furthermore, performance on an IAT measure has been shown to correlate with amygdala activation in response to social stimuli (e.g., Phelps et al., 2000), lending further support to the assumption that these measures provide a window for the strength of impulsive precursors in the brain.

In the present research, we assessed implicit attitudes toward candies with a variant of the IAT (Greenwald et al., 1998). Cognitive restraint was measured with a subscale of the Three-Factor Eating Questionnaire (TFEQ-R; Stunkard & Messick, 1985). Before performing a taste-and-rate task of candies, we gave half of the participants a moderate alcohol dose. We expected implicit attitudes to exert a relatively stronger influence on candy consumption for participants who consumed alcohol than for sober participants. Conversely, we hypothesized that cognitive restraint should have a relatively stronger influence on eating for sober participants.

Method

Participants

Participants were 63 normal to slightly overweight female students from the University of Landau, Germany, with a mean age of 21.6 years ($SD = 2.4$) and a mean body mass index of 21.80 ($SD = 2.18$), ranging from 18 to 29. All participants were informed at the time of recruitment that the experiment may involve the tasting of an alcoholic beverage. Furthermore, they were asked not to eat at least 1 hr before the study and not to drink alcohol on the same day. All participants indicated at the beginning of the study that they had adhered to these prerequisites.

Procedure

The study always took place between 2 p.m. and 5 p.m. Upon arrival, participants were greeted by a female experimenter and seated at separate cubicles, each equipped with a computer. They were informed a second time about the possibility of alcohol intake and provided their informed consent to the study. Participants were told that the study concerned "tastes and entertainment" and that it included a perception task, two different product testing phases, and an entertainment part.

Initially, participants were asked to complete a screening questionnaire containing demographic variables, a measure of alcohol dependency, and the cognitive restraint scale. In the subsequent perception task, participants performed a measure of implicit attitudes on the computer. In the first product test to follow, participants were randomly assigned to taste and rate either an alcoholic or a nonalcoholic beverage. In order to ensure the absorption of alcohol in the alcohol group, we then had all participants watch a 10-min video clip from the documentary *Deep Blue* (Byatt, Fothergill, & Attenborough, 2003) describing ocean life, followed by several filler questions about the film and a mood scale. In the second product testing phase, participants were asked to test and rate a 125-g package of m&m's chocolate candies.

At the end of the study, approximately 30 min after the alcohol intake, participants in the alcohol group were tested for breath alcohol concentration as measured with a professional breath analyzer. They were informed of their breath alcohol concentration and of legal issues connected with alcohol intake and were given the opportunity to wait, drink water, and eat snacks in order to recover. Finally, all participants were thanked, probed for suspicion, and debriefed. Two participants were excluded from the analyses because they expressed the correct suspicion that the study concerned the effects of alcohol on candy consumption.

Alcohol Manipulation

Participants in the control condition received 300 ml of orange juice; those in the alcohol group received 300 ml of a vodka–orange mix. Participants in both experimental conditions were informed correctly about the content of their drinks. Thus, participants in the alcohol condition were fully aware that they were consuming alcohol. We used vodka of the brand Jelzin with an alcohol concentration of 37.5%. Individual vodka dose was determined adaptively with respect to the weight of the participant with the help of a table indicating the amount of alcohol in the drink necessary to achieve a blood alcohol level of 0.030%, 30 min after intake. For instance, a person weighing 66 kg received 70 g of vodka in her mix. We used the EZ-ALC computer software (Kuwatch, 1986) in order to estimate the required target amount of alcohol (approximately 0.4 g alcohol/kg). Three participants were excluded from the analyses because they failed to consume the vodka mix.

Measures

Implicit attitudes. We assessed participants' implicit attitudes toward m&m's with a variant of the Implicit Association Test by Greenwald et al. (1998) that included only a single target category (m&m's) rather than two target categories (Karpinski & Steinman, 2006). The task was explained to participants as a categorization task in which they were to react as quickly as possible to the stimuli presented according to the category label assignments at the top of the screen. In the first critical block, participants had to respond with a right-hand key to pictures of m&m's. In addition, participants had to respond with the same right-hand key to pleasant (i.e., positively valenced) pictures or words and with a left-hand key to unpleasant (i.e., negatively valenced) pictures or words. Hence, m&m's stimuli and pleasant attribute stimuli shared the same response key in the first block (see Figure 1). In the second critical block, the key assignment for m&m's pictures was reversed, such that participants now responded with the left-hand key to m&m's pictures as well as unpleasant pictures or words, and they responded with the right-hand key to pleasant pictures or words. Hence, m&m's stimuli and unpleasant attribute stimuli shared the same response key in this block. The order of block assignment was kept constant for each participant as the primary goal of this research was to assess individual differences in our sample (for a discussion, see Gawronski, 2002).

As target stimuli, we used six different pictures of m&m's. As attribute stimuli, we used three pleasant and three unpleasant pictures taken from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2005) and three pleasant and unpleasant words (see the Appendix). Each of the two critical blocks consisted of 75 trials. An index of implicit attitudes was calculated according to the D600 measure proposed by Greenwald, Nosek, and Banaji (2003), which essentially reflects the mean reaction time difference between the two critical blocks. Positive values indicate faster reactions when m&m's stimuli and pleasant attribute stimuli share the same response key than when m&m's and unpleasant attribute stimuli share the same response key. In order to estimate the reliability of this index of implicit attitudes, we created four mutually exclusive subsets of trials and calculated IAT scores separately for each subset. Cronbach's alpha across these four scores was good ($\alpha = .83$).

Cognitive restraint. We assessed participants' cognitive restraint standards with the Cognitive Restraint subscale of the TFEQ-R (Stunkard & Messick, 1985). The 21 items of the scale were combined to form an index of cognitive restraint, with a value

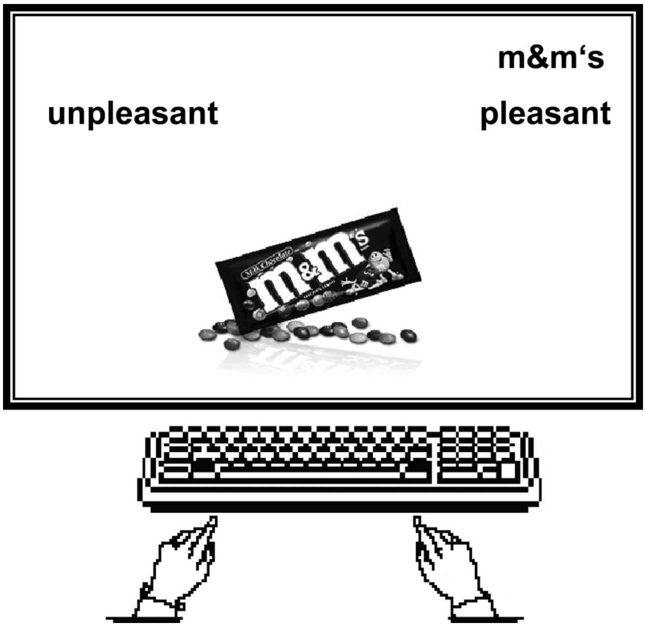

Figure 1. Schematic description of the Single-Category Implicit Association Test used to assess implicit attitudes toward m&m's. A single trial from a block of 75 trials is presented in which m&m's stimuli and pleasant attribute stimuli share the same response key. Participants have to react as quickly as possible in order to make the correct classification. Participants reacting faster within the present block assignment as compared with a reversed block assignment in which m&m's and unpleasant attribute stimuli share the same response key are assumed to harbor more positive implicit attitudes toward m&m's.

of 0 indicating the lowest and a value of 1 indicating the highest possible score ($\alpha = .88$).

Candy consumption. In the product testing phase, a 125-g m&m's package was cut open and placed on a table napkin in front of each participant. Participants were asked to taste and rate the product on a questionnaire handed to them. The questionnaire contained a total of 22 questions related to product taste (e.g., tastiness, naturalness, pleasantness, sweetness, thickness of the candy coating, strength of chocolate flavor), product look (e.g., color composition, package design), product price, and the product's suitability for various occasions (e.g., party, cinema, watching television at home). Participants were told that they had 5 min to complete their ratings, that they could do the tasting and rating simultaneously, and that they could have as many m&m's as they wanted (including a second package). After time had expired, the m&m's were taken out of the participants' reaches. Candy consumption was later determined by weighing the amount left with a precision balance and subtracting it from the preconsumption weight.

Mood and alcohol dependency as control variables. We assessed state affect in order to control for possible effects of emotional state on eating (Tice et al., 2001). Immediately before the taste-and-rate task, participants completed the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988), a 20-item mood state questionnaire with a 5-point rating scale. Positive ($\alpha = .87$) and negative affect ($\alpha = .76$) were significantly negatively correlated ($r = -.33$, $p = .013$). We also controlled for alcohol dependency because dependent persons may be less affected by alcohol due to habituation. We used the Alcohol Use Disorders Identification Test (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) for this purpose. It consists of 10 items tapping into behavioral and social symptoms of alcohol dependency. We averaged responses across all 10 items (each item was scored from 0 to 4) with higher values indicating greater alcohol dependency ($\alpha = .80$).

Results

Manipulation Check and Preliminary Analyses

The estimated mean blood alcohol concentration in the alcohol group was 0.033% ($SD = .009$) and differed significantly from zero, $t(28) = 17.89$, $p < .001$, $d = 3.32$, indicating that our manipulation of alcohol consumption was effective. Because candy consumption was somewhat positively skewed, we applied a log-transformation on grams of candy consumed in order to normalize the data (Vohs & Heatherton, 2000). Statistical analyses were conducted using the transformed data. For ease of interpretation, means and standard deviations are reported for untransformed grams of candy consumption in Table 1, together with the descriptive statistics for the other main variables. We performed independent sample *t* tests in order to detect significant differences between means. As shown, candy consumption was reliably affected by alcohol intake, $t(56) = 2.14$, $p = .037$, $d = 0.57$, such that participants in the alcohol condition consumed significantly more candies than control participants, corroborating the findings from previous studies on the increase of food consumption after alcohol intake (e.g., Hetherington et al., 2001; Yeomans, 2004).

Candy Consumption

In order to investigate our main hypothesis that alcohol moderates the relative impact of implicit attitudes and cognitive restraint on eating, we first calculated zero-order correlations between candy consumption and predictors separately by experimental condition. As can be seen from Table 2, implicit attitudes were correlated positively with candy consumption in the alcohol condition, indicating that participants with more positive implicit attitudes toward m&m's consumed more candies. This relationship

Table 1
Means and Standard Deviations of Main Variables by Experimental Condition

	Alcohol condition		Control condition	
Variable	*M*	*SD*	*M*	*SD*
Implicit attitudes	0.32_a	0.32	0.27_a	0.31
Cognitive restraint	0.36_a	0.21	0.34_a	0.20
Candy consumption (g)	22.82_a	10.96	17.26_b	13.48
Positive affect	2.48_a	0.65	2.79_a	0.73
Negative affect	1.23_a	0.40	1.34_a	0.37
Alcohol dependency	3.93_a	2.34	4.48_a	4.66

Note. $N = 29$ in each condition. Row means with different subscripts differ significantly at $p < .05$.

did not hold in the control condition. Conversely, candy consumption significantly decreased as a function of cognitive restraint for sober participants but was not reliably correlated with cognitive restraint for participants who had previously consumed alcohol.

In order to test the differential impact of implicit attitudes and cognitive restraint as a function of condition more adequately, we performed a multiple moderated regression analysis (Aiken & West, 1991) on *z* standardized log-transformed grams of candy consumption as the dependent variable. As predictors we entered the dummy-coded condition factor with the control condition as the reference group, *z* standardized implicit attitudes, cognitive restraint, as well as all possible interactions among these predictor variables. Finally, we included positive affect, negative affect, and alcohol-related problems as covariates.[1]

The regression analysis ($R^2 = .42$) yielded a main effect of alcohol on eating behavior, $\beta = .49$, $F(1, 46) = 4.20$, $p = .046$, $f^2 = .09$, confirming that alcohol led to more eating at the group level.[2] More importantly, the expected interaction between implicit attitudes and experimental condition emerged, $\beta = .50$, $F(1, 46) = 4.11$, $p = .048$, $f^2 = .09$, indicating that the relative influence of implicit attitudes on eating behavior was significantly different in the alcohol group as compared with the control group. Figure 2 illustrates this interaction via a plot of candy consumption as a function of experimental condition and low (1 *SD* below the mean) versus high (1 *SD* above the mean) implicit attitudes. Simple slope tests (Aiken & West, 1991) showed that candy consumption was positively predicted by implicit attitudes in the alcohol condition, $\beta = .41$, $t(46) = 2.32$, $p = .025$, $f^2 = .11$, and slightly negatively but not significantly in the control condition, $\beta = -.09$, $t(46) = .51$, $p = .613$, $f^2 = .01$.

Regarding cognitive restraint, the expected interaction with experimental condition emerged, $\beta = .55$, $F(1, 46) = 4.96$, $p = .031$, $f^2 = .11$. As Figure 3 indicates, candy consumption in the control condition was negatively predicted by cognitive restraint such that persons high in cognitive restraint ate less candy, $\beta = -.47$, $t(46) = 2.80$, $p = .007$, $f^2 = .17$. In contrast, the regression analysis showed that cognitive restraint standards did not have an independent effect on candy consumption in the alcohol condition, $\beta = .08$, $t(46) = .46$, $p = .651$, $f^2 = .004$. No other regression weights were statistically significant.

Table 2
Intercorrelations Between Predictors and Candy Consumption by Experimental Condition

Variable	1	2	3
Alcohol condition			
1. Implicit attitudes	—		
2. Cognitive restraint	−.26	—	
3. Candy consumption	.40*	−.25	—
Control condition			
1. Implicit attitudes	—		
2. Cognitive restraint	−.02	—	
3. Candy consumption	−.19	−.47*	—

Note. $N = 29$ in each condition.
* $p < .05$.

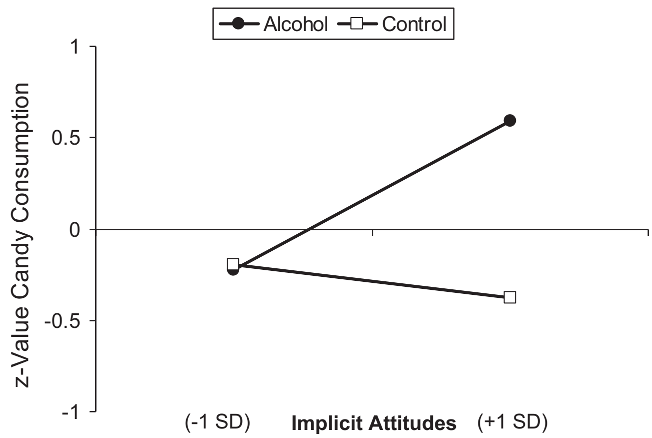

Figure 2. Candy consumption as a function of implicit attitudes (1 *SD* below and 1 *SD* above mean) and experimental condition.

Discussion

The present study demonstrates for the first time that alcohol simultaneously moderates the impact of impulsive versus reflective precursors on eating behavior. Specifically, the predictive validity of implicit attitudes (as part of the impulsive system) was markedly increased for participants who had consumed alcohol as compared with sober participants. On the other hand, cognitive restraint standards (as part of the reflective system) guided behavior under normal conditions but were less effective under the influence of alcohol. Both focal interaction effects were of a small to medium effect size (Cohen, 1988) and remained significant in the presence of the control variables positive affect, negative affect, and alcohol-related problems.

In the introduction, we discussed in more detail several mechanisms from the self-regulation literature that may jointly help to explain why alcohol boosts the impact of impulsive precursors such as implicit attitudes on behavior, while at the same time reducing the impact of reflective determinants such as cognitive restraint standards: suppressed or inaccessible restraint standards (Baumeister et al., 1994), a failure to monitor actual behavior with regard to restraint standards (Hull et al., 1983), a breakdown of inhibitory control (Fillmore, 2003), or the amplification of preexisting impulses. How exactly alcohol exerts these effects remains the focus of considerable debate: Physiological approaches tend to stress the deleterious effects of alcohol on the functioning of the prefrontal cortex (Curtin & Fairchild, 2003), a region responsible

[1] In this regression analysis, neither the covariate positive affect ($\beta = .13$, $p = .337$) nor the covariate negative affect ($\beta = -.19$, $p = .141$) accounted for significant variance in eating behavior. The influence of alcohol dependency was negative but not significant ($\beta = -.13$, $p = .339$). Both focal interaction terms (IAT × Condition; Restraint × Condition) remained significant ($p < .05$) when all covariates were removed from the regression equation.

[2] Effect sizes for the predictors in the multiple regression analysis were computed as Cohen's f^2, which indicates the percentage of variance accounted for in the context of the other predictors in the model. By convention, f^2 effect sizes of 0.02, 0.15, and 0.35 are considered small, medium, and large, respectively (Cohen, 1988).

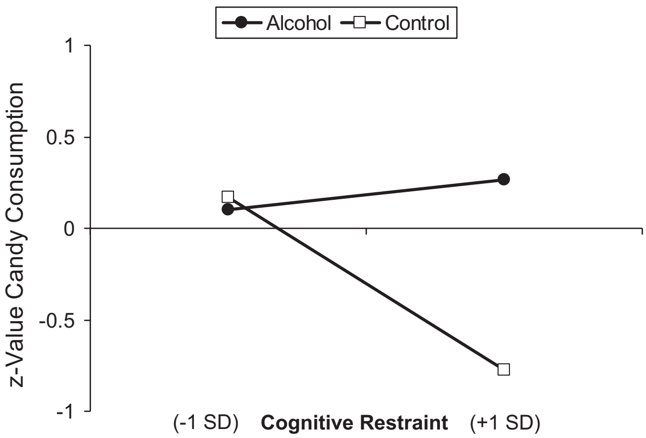

Figure 3. Candy consumption as a function of cognitive restraint standards (1 *SD* below and 1 *SD* above mean) and experimental condition.

for the control of impulses stemming from other regions of the brain such as the amygdala (Bechara, 2005; Källmén & Gustafson, 1998). These effects may become noticeable even with a comparatively mild dose of alcohol similar to the one used in the present study (e.g., Hetherington et al., 2001; King & Byars, 2004; Koelega, 1995; Marczinski & Filmore, 2005).

Psychological explanations on the other hand have emphasized the role of expectancies regarding the effects of alcohol (Goldman, Brown, & Christiansen, 1987; Hull & Bond, 1986). According to this interpretation, alcohol consumption may change perceived behavioral norms (e.g., "It is ok to let oneself go when drinking alcohol") and thus provide a proper justification of disinhibited behavior. Applied to the present findings, participants' beliefs that they had consumed alcohol may have been sufficient to cause a shift from goal-directed behavior in the service of personal restraint standards (in the control group) to impulsive behavior driven by implicit attitudes (in the alcohol group) even in the absence of physiological impairments. This interpretation may be strongly related to what Baumeister and Heatherton (1996) have called acquiescence, that is, the tendency to "give in to the impulse rather than go through the exertion and frustration that would accompany self-restraint" (p. 6).

In a general sense, the physiological account suggests a cognitive impairment of self-control (i.e., people cannot control themselves as well even if they would like to), whereas the expectancy account suggests a motivational deficit in self-control (i.e., people do not want to control themselves as well even if they could do so). Within the present design, we cannot estimate the degree to which physiological effects or expectancy effects or both account for our findings. In order to determine the relative contribution of physiological and expectancy effects, actual alcoholic content and subjective beliefs about the alcoholic content of the drinks should be manipulated independently from each other in a balanced-placebo design (Hull & Bond, 1986) in future studies. Regarding the present contribution it is important to keep in mind that under everyday circumstances people usually know whether they are consuming alcohol. Hence, although the clarification of the relative influence of physiology and expectancy is clearly of interest, the conditions realized in the present study may be particularly informative from an applied perspective.

Two specific characteristics in the pattern of moderator effects obtained for implicit attitudes and restraint standards deserve further attention. First, it is noteworthy that implicit attitudes were not reliably related to eating behavior in the control group. This is a finding that accords well with other null relationships reported with regard to complex behaviors such as eating, product choice, or condom use under circumstances in which people have full control resources available (e.g., Friese, Hofmann, & Wänke, in press; Hofmann, Rauch, & Gawronski, 2007; Marsh, Johnson, & Scott-Sheldon, 2001). One potential explanation is that the reflective system is often quite successful at inhibiting and overriding competing behavioral schemas activated by the impulsive system (Norman & Shallice, 1986). Under many circumstances such as alcohol intake, however, reflective control may break down and formerly suppressed automatic influences may gain significant influence over behavior determination.

Second, other than in previous research on alcohol and eating (Polivy & Herman, 1976b), we did not find a counterregulatory effect in restrained eaters due to alcohol consumption. That is, people high in cognitive restraint as measured with the TFEQ-R ate considerably less candy than people low in cognitive restraint under normal circumstances. Alcohol appeared to undermine (or disinhibit) the restraint that sober restrained eaters exercised to the extent that high and low cognitive restrainers in the alcohol condition showed a similar consumption pattern as indicated by the line with a virtually zero slope in Figure 3. However, high restrainers did not consume more food than low cognitive restrainers under the influence of alcohol (Polivy & Herman, 1976b). We believe that the main reason for the difference between the present moderator effect and a true counterregulatory effect lies in the difference between the TFEQ-R scale and the original Restraint Scale by Herman and Polivy (1980): Whereas the former scale was designed to assess "specific cognitive and behavioral strategies for reducing caloric intake" (Lowe, 1993, p. 102), the original Restraint Scale is assumed to identify dieters who also experience episodes of disinhibited overeating (e.g., Heatherton, Herman, Polivy, King, & McGree, 1988). This conceptual difference may explain why only the latter scale has been shown to predict counterregulatory eating in past research (Heatherton et al., 1988; Lowe, 1993).

The present findings should be generalized only with caution to clinical populations of eating disordered patients who also suffer from alcohol abuse, because this research used a female college student sample and because our study precludes strong inferences about long-term effects. Although our results cannot speak with regard to the causal long-term connection between alcohol abuse and eating disorders such as bulimia nervosa, they may nevertheless shed some light on the acute consequences of alcohol intake in disordered patients. Specifically, acute alcohol consumption may increase the likelihood of subsequent impulsive consumption (e.g., bingeing) by shifting the relative weight of impulsive and reflective processing in favor of the former, that is, by increasing the behavioral impact of implicit attitudes toward hedonic food cues and by reducing the efficiency of dietary restraint standards for the regulation of food intake. From this perspective, additional research may help to identify new avenues for the treatment of patients with a cooccurrence of eating disorders and alcohol abuse by incorporating procedures aimed specifically at changing implicit attitudes toward tempting stimuli (e.g., Wiers et al., 2006) or by increasing individuals' ability to resist such stimuli. Furthermore, research scrutinizing the exact nature of the long-term connection between dietary restraint and eating symptomatology (e.g., Lowe & Gleaves, 1998; Presnell & Stice, 2003; Stice, 2002) may profit from including alcohol abuse as a potential moderator variable of this relationship.

Under many circumstances such as alcohol consumption, ego depletion, or stress people may act according to their impulses rather than according to their personal standards to restrain behavior. In previous research, the operation of impulses has been inferred indirectly from behavioral outcomes, leaving unanswered what forces within the person actually drive disinhibited behavior. We believe that basic clinical and self-regulation research may benefit from looking more directly at the strength of impulsive precursors of behavior by incorporating the notion of implicit attitudes that can be linked to concepts such as impulse, desire, or urge. The present approach can also be applied to other domains besides eating behavior in which implicit attitudes and personal standards may conflict such as aggression, sexual behavior, or drug abuse. Conversely, research on implicit attitudes may gain important insights into the limits of controlling one's impulses from applying findings obtained in clinical and self-regulation research. The present study was intended as a first step in this direction and we hope to stimulate further research on the far-reaching conflict between impulse and restraint.

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Appendix

Attribute Stimuli (Words and Pictures) Used in the Single Category Implicit Association Test

Pleasant: *pleasure*, *fun*, *luck*; romantic couple (IAPS #2550); baby (IAPS #2070); beautiful landscape (IAPS #5780)
Unpleasant: *disgust*, *fear*, *disaster*; violent act (IAPS #6550); raging dog (IAPS #1300); garbage dump (IAPS #9340)

Note. Words are translated from German. IAPS = International Affective Picture System (Lang et al., 2005)

Received October 10, 2006
Revision received November 27, 2007
Accepted November 29, 2007 ■