Published in final edited form as:

Pers Soc Psychol Bull. 2014 August ; 40(8): 1037–1049. doi:10.1177/0146167214534993.

Are You Insulting Me? Exposure to Alcohol Primes Increases Aggression Following Ambiguous Provocation

William C. Pedersen[1], **Eduardo A. Vasquez**[2], **Bruce D. Bartholow**[3], **Marianne Grosvenor**[1], and **Ana Truong**[1]

[1]California State University, Long Beach, USA

[2]University of Kent, Canterbury, UK

[3]University of Missouri, Columbia, USA

Abstract

Considerable research has shown that alcohol consumption can increase aggression and produce extremes in other social behaviors. Although most theories posit that such effects are caused by pharmacological impairment of cognitive processes, recent research indicates that exposure to alcohol-related constructs, in the absence of consumption, can produce similar effects. Here we tested the hypothesis that alcohol priming is most likely to affect aggression in the context of ambiguous provocation. Experiment 1 showed that exposure to alcohol primes increased aggressive retaliation but only when an initial provocation was ambiguous; unambiguous provocation elicited highly aggressive responses regardless of prime exposure. Experiment 2 showed that alcohol prime exposure effects are relatively short-lived and that perceptions of the provocateur's hostility mediated effects of prime exposure on aggression. These findings suggest modification and extension of existing models of alcohol-induced aggression.

Keywords

alcohol; priming; aggression; provocation

Theorists and the general public have long known of an association between drinking alcohol and increases in aggression (e.g., Critchlow, 1986). Numerous quantitative (e.g., Bushman & Cooper, 1990; Hull & Bond, 1986; Ito, Miller, & Pollock, 1996) and narrative reviews (e.g., Bègue & Subra, 2007; Chermack & Giancola, 1997) have concluded that consuming alcohol generally increases the likelihood that a person will behave aggressively. Recent evidence indicates that alcohol is by far the most problematic drug of abuse in terms of health and financial costs to society, due in significant part to the violence and aggression that accompany its consumption (T. R. Miller, Levy, Cohen, & Cox, 2006; Nutt, King, & Phillips, 2010).

Corresponding Author: William C. Pedersen, Department of Psychology, California State University, Long Beach, 1250 Bellflower Boulevard, Long Beach, CA 90840, USA. bill.pedersen@csulb.edu.

Declaration of Conflicting Interests: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

A number of theoretical explanations for the alcohol-aggression relation have been offered, most focusing on the idea that alcohol's pharmacological effects on neural systems lead to impairment of various higher order cognitive processes, including attention (e.g., Gallagher & Parrott, 2011; Giancola & Corman, 2007; Giancola, Josephs, Parrott, & Duke, 2010; Steele & Josephs, 1990) and inhibitory control (see Giancola, 2000, 2004). Such cognitive impairments cloud judgment and decision making and generally increase the likelihood that intoxicated persons will respond according to the most salient cues in the environment, including those facilitating aggression. That alcohol's pharmacological effects increase aggression has been supported by a large body of research (see Bushman & Cooper, 1990; Chermack & Taylor, 1995; Giancola, 2000). However, research also shows that the mere belief that alcohol has been consumed, even when it has not been, can increase aggression (i.e., placebo effects; see Bègue et al., 2009; Lang, Goeckner, Adesso, & Marlatt, 1975), suggesting that although pharmacological impairment of cognitive control processes can be sufficient to increase aggressiveness, such impairments might not be necessary. Such placebo effects can result from a number of processes associated with the belief that alcohol was consumed, including a general cultural norm that people are less responsible for their actions when intoxicated (e.g., Paglia & Room, 1998; Room, 2001) as well as memory associations between alcohol and its presumed effects (but see Chermack & Taylor, 1995). Indeed, considerable archival (Critchlow, 1986) and empirical evidence (e.g., Fromme, Stroot, & Kaplan, 1993; Goldman, Greenbaum, & Darkes, 1997; Leigh, 1989) indicates that people generally believe drinking alcohol will facilitate aggression.

Given the prevalence of beliefs concerning the aggression-enhancing effects of alcohol, and based on research outlining implicit memory associations between alcohol and its consequences that can be activated by exposure to alcohol-related semantic constructs (see Stacy, 1995; Stacy, Leigh, & Weingardt, 1994), a number of researchers recently have tested the idea that simply being exposed to alcohol-related primes (i.e., images or words related to alcohol) might be sufficient to both increase the accessibility of aggressive cognitions and to facilitate aggressive responding. In an initial study, Bartholow and Heinz (2006) found that participants made faster lexical decisions for aggression-related words when primed with either alcohol images or weapon images relative to neutral images (plants), indicating that, similar to the weapons-priming effect reported in previous studies (Anderson, Benjamin, & Bartholow, 1998; Bartholow, Anderson, Carnagey, & Benjamin, 2005), exposure to alcohol-related primes increases accessibility of aggressive thoughts (see also Subra, Muller, Bègue, Bushman, & Delmas, 2010).

But can exposure to such primes actually increase aggressive behavior? To address this question, Friedman, McCarthy, Bartholow, and Hicks (2007) randomly assigned participants to complete one of two versions of a primed lexical decision task (LDT) in which target letter strings were preceded by briefly presented (and subsequently masked) prime words. Depending on the condition, these prime words were either alcohol related (e.g., beer, vodka) or nonalcohol related (e.g., water, juice). After more than 100 trials of this task, the computer appeared to crash (see Chen & Bargh, 1997), at which point the experimenter informed participants that the task had been improperly set up, and therefore they would need to re-do it. First, though, participants were asked to complete an “incident report,” essentially an evaluation of the experimenter's performance, aptitude, and courteousness. As

predicted, participants primed with alcohol words rated the experimenter more harshly than participants primed with nonalcohol words (see also Subra et al., 2010, Experiment 2).

Taken together, the findings of these previous studies support the idea that consumption of an alcoholic or placebo beverage is not necessary for alcohol to enhance aggression; simply being exposed to alcohol-related images or words, even subliminally (see Friedman et al., 2007; Subra et al., 2010), is sufficient to elicit aggressive thoughts and actions. However, no study to date has tested whether alcohol construct-priming can enhance physical aggression (i.e., action intended to cause physical pain or discomfort to another). This distinction has both theoretical and practical significance, given that (a) concerns about alcohol's aggression-enhancing effects in real-world situations typically focus on physical aggression and (b) the vast majority of studies examining effects of alcohol consumption on aggression in the lab have focused on physical aggression.

In addition to alcohol, one of the most potent predictors of aggressive responding is provocation (see Bettencourt, Talley, Benjamin, & Valentine, 2006). That is, a perceived insult or injury will reliably elicit some retaliatory aggressive behavior in most people. Critically, the effect of provocation appears to depend largely on attributions of intent: If it appears that a provocateur intended harm, then aggressive retaliation is likely under nearly all conditions (see Betancourt & Blair, 1992; Dodge & Crick, 1990); if a provocateur's actions are interpreted to have been unintentional, aggressive retaliation is much less likely. From a psychological perspective, the most interesting circumstances are those in which a provocateur's intentions are not clear, both because such situations likely are more common in real social environments than situations where another's intentions are obvious, and because in such situations other factors are likely to shape interpretation and, ultimately, the likelihood of an aggressive response (see Anderson, Krull, & Weiner, 1996).

Social-cognitive theory and research shows that interpretation of ambiguous social stimuli is highly influenced by whatever information is currently most accessible in memory (see Higgins, 2011). Research supports the idea that priming or otherwise making aggressive constructs highly accessible leads people to interpret ambiguously hostile situations in an aggressive manner (for a review, see Todorov & Bargh, 2002). Most relevant to the current research, recent studies have shown that brief exposure to alcohol-related primes has a similar effect. For example, Bartholow and Heinz (2006, Experiment 2) found that participants exposed to magazine advertisements for alcohol beverages subsequently rated an ambiguously aggressive target person as more hostile than participants who initially viewed control advertisements, an effect analogous to that observed when participants actually consume alcohol (see Ogle & Miller, 2004; Sayette, Wilson, & Elias, 1993). Such findings suggest that, just as with other aggression-related cues, exposure to alcohol-related stimuli activates aggressive constructs in memory, which subsequently biases interpretation of ambiguous information as hostile.

In contrast to situations involving ambiguous provocation, situations in which the provocateur's intentions are clearly hostile are far less susceptible to factors that could influence interpretation. Clearly hostile situations lend themselves to a tit-for-tat “matching rule” (Axelrod, 1984) and norms of behavioral reciprocity (Gouldner, 1960). Consistent with

this idea, Vasquez, Denson, Pedersen, Stenstrom, and Miller (2005) found that initially provoked participants displayed more aggression than unprovoked participants only when a subsequent aggression-eliciting trigger (an essay evaluation) was ambiguous; when the subsequent trigger was clearly hostile, provoked and unprovoked participants displayed similar levels of aggression. Vasquez et al. argued that this pattern supports the importance of attributional distortions in determining aggressive responding and that the likelihood of such distortions depends upon the extent to which prior events (provocation in that case) make aggressive constructs accessible in memory (see Berkowitz, 1990; N. Miller, Pedersen, Earleywine, & Pollack, 2003).

In sum, previous research has shown that simple exposure to alcohol primes increases the accessibility of aggressive thoughts (Bartholow & Heinz, 2006, Experiment 1; Subra et al., 2010, Experiment 1), biases interpretation of others' ambiguous behaviors as hostile (Bartholow & Heinz, 2006, Experiment 2), and enhances aggressive behavioral responding (e.g., Friedman et al., 2007; Subra et al., 2010, Experiment 2). Previous work also shows that effects of various moderating factors on aggressive responding tend to be most evident in situations where others' behavioral intentions are unclear (Subra et al., 2010) because such situations are more susceptible to attributional distortions (Pedersen, Gonzales, & Miller, 2000).

Experiment 1

The first study was designed to assess the moderating effect of provocation ambiguity on alcohol-primed physical aggression. Participants were primed with either alcohol or neutral words followed by an ambiguous provocation, an unambiguous provocation, or no provocation and then were given an opportunity to aggress against an ostensible other. We predicted an interaction between prime content and prime ambiguity on subsequent aggressive behavior such that alcohol priming would significantly augment aggression only when paired with an ambiguous provocation.

Pilot Study

A pilot test was conducted to assess the effectiveness of the provocation ambiguity manipulation. Participants were 40 undergraduate students from various psychology courses at California State University, Long Beach. Participants were asked to imagine that they and another student were participating in a study in which they evaluated each other's essays. Participants then received one of the two potential evaluations from the other individual: (a) “This is one of the worst essays I have ever read” or (b) “I don't even know where to begin.” They were then asked to rate these evaluations using a 7-point Likert-type scale from 1 (*strongly agree*) to 7 (*strongly disagree*) on the degree to which they were ambiguous, vague, understandable, confusing, clear, comprehensible, and precise. After reverse-scoring relevant items, the ratings were used to create a composite *ambiguity* score ($\alpha = .76$), with higher scores equating to more ambiguity. Results indicated that the evaluation stating, “I don't even know where to begin” ($M = 5.62$, $SD = 0.81$) was rated as more ambiguous than the evaluation stating, “This is one of the worst essays I have ever read” ($M = 4.65$, $SD = 1.41$), $t(38) = 2.63$, $p = .012$, $d = 0.84$.

Method

Participants and design—Participants were 182 undergraduate students enrolled in Introductory Psychology courses at California State University, Long Beach, who received partial course credit in return for their participation. Fourteen participants' data were removed due to suspicion; ancillary analyses showed that their exclusion did not substantively change any of the findings. This resulted in 168 participants (132 women and 36 males) being used in the analyses (*M* age = 18.88 years). The sample was very ethnically diverse (38.1% Hispanic, 23.8% Asian, 23.8% Caucasian, 8.3% African American, and 6% "Other"). The study used a 2 (prime: alcohol/neutral) × 3 (provocation condition: ambiguous/unambiguous/no provocation control) between-subjects design.

Procedure—Prior to each participants' arrival at the lab, an experimenter randomly assigned them to one of the six conditions of the experiment. Upon their arrival (and after they gave informed consent), participants were told that the study concerned the relationship between verbal ability and decision making. In individual sessions, participants were led to believe that they would be interacting with another participant in a separate experiment room; in actuality, this second participant was fictitious. Due to differences in aggression that can occur during cross-sex interactions (see Bettencourt & Miller, 1996), the ostensible other participant was always described as being of the same sex as the participant.

Participants were next instructed to spend 5 min writing an essay on abortion, taking a stance of their own choosing (either pro-choice or pro-life). They were told that this essay would be exchanged with the other (bogus) participant and that they would have the opportunity to evaluate each other's essays. After 5 min had passed, the experimenter returned to collect the essay and then left the room to ostensibly bring the essay to the other (bogus) participant. Next, the experimenter returned with an essay, supposedly written by the other participant, and a blank evaluation sheet. Participants were asked to read the other (bogus) participant's essay and fill out the evaluation sheet.

Priming manipulation—After completing the evaluation, participants were informed that the next part of the study was a word-detection task wherein they would need to determine whether strings of letters form proper English words. This LDT served as the context for the alcohol priming manipulation. Each of 100 trials began with the presentation of a fixation cross (+) in the center of a computer screen for 1,000 ms, replaced by a forward masking string (&&&&) for 400 ms. The string was then replaced with a beverage-related word for 34 ms. In the *alcohol prime* condition, 1 of the 14 alcohol-related words (e.g., beer, wine) was presented. In the *neutral prime* condition, 1 of the 14 nonalcoholic beverage words (e.g., milk, water) was shown.[1] A backward mask (XXXXX) was then presented for 400 ms. Finally, a string of 5 to 8 letters was presented for 1,000 ms. If these letters formed a proper

[1]The alcohol beverage words were ale, beer, booze, cognac, gin, liquor, martini, rum, scotch, tequila, vodka, whiskey, and wine. The nonalcohol beverage words were coffee, coke, juice, lemonade, milk, milkshake, orange-juice, smoothie, soda, tea, and water. The average number of letters (*M*s = 5.36 and 5.73, *SD*s = 1.82 and 2.00 for alcohol and nonalcohol words, respectively) and syllables per word (*M*s = 1.79 and 1.73, *SD*s = 0.97 and 0.65, respectively) were highly similar across lists. Average word-use frequency across lists was compared using the Zipf metric, equal to log 10 (frequency per million words) +3 (see van Heuven, Mandera, Keuleers, & Brysbaert, 2014), applied to frequencies given in the SUBTLEX-US corpus (see Brysbaert & New, 2009). Average Zipf scores for the alcohol and nonalcohol words were 4.01 (*SD* = 0.47) and 4.24 (*SD* = 0.85), respectively.

English word (e.g., yellow), participants were instructed to press the “Z” key on the computer keyboard as quickly as possible; if the string of letters did not form a proper word (e.g., kopoj), they were instructed to press the “M” key. This procedure is consistent with recommendations for effective subliminal priming (Bargh & Chartrand, 2000; Todorov & Bargh, 2002) and has been used effectively in previous studies of alcohol priming (see Friedman et al., 2007). After explaining the task and administering 5 practice trials, the experimenter advanced the computer program to begin the 100 experiment trials and then immediately left the room.

Provocation ambiguity manipulation—Following the completion of the LDT, participants received one of the two evaluations of their essay, ostensibly written by the other (bogus) participant. Those in the *unambiguous* condition received an evaluation stating, “This is one of the worst essays I have ever read.” Participants in the *ambiguous* condition were given an evaluation that stated, “I don't even know where to begin.”[2] Participants in the *control* condition were told that they would receive their evaluation later in the study; this actually never occurred.

Dependent variables—Next, the experimenter told participants that the final task examined how sensory distraction affects a person's cognitive abilities. The experimenter indicated that the participant and the “other participant” would receive different distractions. Participants were told that they had been randomly assigned to a visual distraction (e.g., a pleasant nature video), whereas the other participant was assigned to a tactile distraction (e.g., placing their hand in painfully cold ice water). Participants then put their own hand in a bucket of cold water (10°C, 50°F) for 5 s, ostensibly to guide their decision about the length of distraction to assign the other participant (Vasquez et al., 2005). The participant was also informed that the other participant was simultaneously previewing the nature video and would be making a similar decision.

Next, participants received two envelopes. A form in the first envelope instructed them to circle the duration that the other participant should be distracted using a 9-point scale, which started at 1 = *no distraction at all* (*0 s*) and increased by 10-s intervals to 9 = *very strong distraction* (80 s). As in previous studies (e.g., Ballard & Lineberger, 1999; Pedersen, 2006; Pedersen, Bushman, Vasquez, & Miller, 2008, Pedersen et al., 2011; Vasquez et al., 2005; Vasquez et al., 2013), longer duration recommendations were taken to indicate greater physical aggression toward the other participant. The validity of this so-called *cold pressor task* as a measure of aggression is supported by studies indicating that the cold pressor and other measures of physical aggression (e.g., hot sauce allocation and white noise blast intensity) demonstrate similar patterns of association with independent variables intended to elicit aggression (see Pedersen et al., 2008; Vasquez et al., 2013), and by studies in which

[2]Admittedly, there is a conceptual overlap between provocation ambiguity and provocation intensity. Although we did not specifically measure the latter, in the pilot study, we did assess participants' negative affective response to the provocation, which presumably would correspond to differences in perceived provocation intensity. Participants who were told “This is one of the worst essays I have ever read” (viz., the unambiguous condition) reported directionally more negative affect ($M = 5.32$) than participants who were told “I don't even know where to begin” (viz., the ambiguous provocation) ($M = 4.74$), but this difference was not significant, $t(38) = 1.46$, $p = .154$. Furthermore, the effect of provocation condition was nearly twice as large for provocation ambiguity ($d = 0.84$) as for negative affect ($d = 0.45$). Taken together, this evidence suggests that our manipulation influenced ambiguity perception as intended.

the cold pressor has been used to induce pain in the laboratory (e.g., Lovallo, 1975; Rutchick & Slepian, 2013). The second envelope contained the same provocation manipulation check measure used in the pilot study. Participants rated each of the items (ambiguous, vague, understandable, confusing, clear, comprehensible, and precise) using a 7-point scale ranging from 1 (*strongly agree*) to 7 (*strongly disagree*). After reverse-scoring of relevant items, higher scores equated to more perceived ambiguity ($\alpha = .74$). Participants in the no provocation control condition did not receive this second envelope.

Results

Provocation ambiguity manipulation check—Consistent with expectations based on the pilot study, participants perceived the ambiguous evaluation (viz., "I don't even know where to begin") as more ambiguous ($M = 4.60$, $SD = 1.23$) than the unambiguous evaluation (viz., "This is one of the worst essays I have ever read"), ($M = 3.63$, $SD = 1.28$), $t(112) = 4.13$, $p < .001$, $d = 0.77$.

Aggression—Participants' decisions concerning the length of time their counterparts should submerge their hands in ice water were submitted to a 2 (prime content: alcohol/neutral) × 3 (provocation content: ambiguous/unambiguous/no provocation control) between-subjects ANOVA. Neither the main effect of Prime content, $F(1, 162) = 2.51$, $p = .12$, nor the main effect of Provocation content, $F(2, 162) = 2.22$, $p = .11$, was significant. However, consistent with expectations, a significant Prime content × Provocation interaction was found, $F(2, 162) = 3.13$, $p = .046$ (see Figure 1). Simple effect analyses indicated that alcohol priming significantly augmented aggression for participants in the ambiguous provocation condition, $F(1, 162) = 7.69$, $p = .006$, $d = 0.72$, but not for those in either unambiguous provocation condition, $F(1, 162) = 1.08$, $p = .300$, $d = 0.27$, or the control condition, $F(1, 162) = 0.75$, $p = .390$, $d = 0.25$.

The specific pattern of means predicted by our main hypothesis (i.e., that alcohol priming would augment aggression only when paired with an ambiguous provocation) is only partially correlated with the omnibus interaction F test just presented. That is, whereas the omnibus F test indicates merely that aggression differed across provocation conditions as a function of prime type, our hypothesis specifically implies that the priming effect will be larger in the ambiguous provocation condition than in both other conditions. This prediction can be tested more directly using a focused contrast in which larger weights are assigned to the priming conditions under ambiguous provocation (i.e., +2 and −2 for alcohol and nonalcohol, respectively) than under unambiguous provocation (-1 and +1) and no provocation (−1 and +1). This contrast was significant, $F(1, 166) = 4.57$, $p = .034$. Moreover, this specific, predicted contrast pattern accounted for 75% of the variance in the interaction, leaving no meaningful residual between-groups variability ($F = 1.58$, *ns*).

Discussion

Consistent with our expectations, alcohol priming significantly increased physical aggression compared with priming with neutral (nonalcohol) constructs but only when paired with an ambiguous provocation. When their partner's feedback was clearly hostile, participants responded with relatively high levels of aggression regardless of priming

condition. However, when their partner's feedback was ambiguous, alcohol-primed participants were much more aggressive than neutral-primed participants (also see Ogle & Miller, 2004; Sayette et al., 1993). This finding mirrors what previous researchers have reported when using actual alcohol administration (see Ito et al., 1996), suggesting that effects similar to those often attributed to alcohol pharmacology also can be observed as the result of simple construct activation in the presence of alcohol primes.

The findings of the first experiment are the first to show that making alcohol-related constructs accessible in memory augments physical aggression and to show that properties of the target of aggression (i.e., how provoking the target is) moderate effects of alcohol priming, both of which represent important advances. However, Experiment 1 was limited in terms of our ability to draw conclusions concerning the specific mechanism(s) driving alcohol priming effects and the temporal duration of those effects. Experiment 2 was designed to address these issues.

Experiment 2

Experiment 2 extends the findings of Experiment 1 in two important ways. First, this experiment investigates a possible mediator of the effect of alcohol priming on the subsequent aggression, namely, perceptions of target hostility. Research in other domains has shown that perceptions of a target's hostility can explain, at least in part, differences in levels of aggression displayed toward that target. For example, Bartholow, Sestir, and Davis (2005) found that, following a brief exposure to a violent video game, levels of noise punishment delivered to an opponent during a reaction-time competition were significantly influenced by perceptions of the opponent's hostility (also see Bushman & Anderson, 2002). Also, as noted previously, Bartholow and Heinz (2006, Experiment 2) demonstrated that alcohol priming increases perceptions of target hostility. The current study assesses whether this increase may help explain effects of alcohol cue priming on aggressive behavior.

Second, Experiment 2 assesses the temporal duration of the priming effects observed in Experiment 1. Srull and Wyer (1979) showed that the ability of priming to impact perceptions of behavior diminishes over time (also see Higgins, 2011). In contrast, other work suggests that priming effects can be sustained over relatively long durations if priming activates goals that influence how people think or behave in accordance with their motivations (Bargh & Gollwitzer, 1994; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trotschel, 2001). By manipulating the temporal delay between the provocation manipulation and the opportunity to engage in aggressive action, the design of Experiment 2 permits us to determine the extent to which the effects of alcohol prime exposure on aggression reflect relatively short-lived accessibility of associations (as in Bartholow & Heinz, 2006; Subra et al., 2010) versus more sustained goal priming.

Method

Participants and design—Participants were 308 undergraduate students enrolled in Introductory Psychology courses at California State University, Long Beach, who received partial course credit in return for their participation. In all, 32 participants' data were removed due to suspicion; as in Experiment 1, their exclusion did not substantively change

the findings of the study. This resulted in 276 participants (220 women and 56 men) being used in the analyses (*M* age = 19.02 years) representing an ethnically diverse sample (37.0% Hispanic, 27.9% Caucasian, 22.1% Asian, 3.6% African American, and 9.4% "Other"). The study used a 2 (prime: alcohol/neutral) × 3 (time delay: 0 min/7 min/15 min) between-subjects design.

Procedure—The initial part of the procedure was identical to that used in Experiment 1. Specifically, participants were told that there was another (bogus) participant and that the two of them would be writing essays on abortion and then exchanging them for evaluation. After ostensibly exchanging essays, participants then engaged in the same priming task used in Experiment 1 (i.e., the LDT).

Provocation induction—After participants finished the priming task, they all received an evaluation of their essay supposedly written by the other participant, which was identical to the ambiguous evaluation used in Experiment 1: "I don't even know where to begin." Based on the findings of Experiment 1, the unambiguous provocation and control conditions were not used in the current experiment.

Time delay manipulation—After receiving the ambiguous evaluation, participants in the delay conditions were asked to draw a map of the campus from memory for either 7 or 15 min (viz., the 7 min and 15 min delay conditions, respectively). This task is considered an effectively neutral filler activity that allows time to pass without interrupting any ongoing affective or cognitive processes (Martin, Ward, Achee, & Wyer, 1993; also see Sestir & Bartholow, 2010). Participants assigned to the 0 min delay condition skipped this task and continued on to the dependent measures. The 0 min delay condition was, therefore, identical to the procedure used in the ambiguous provocation condition of Experiment 1, and thus allows for a replication of the main finding from Experiment 1 (i.e., that alcohol priming augments aggression in the context of an ambiguous provocation).

Dependent variables—Participants completed two dependent measures. First, following the procedures used in Experiment 1, participants were given the opportunity to determine how long the other (bogus) participant would have their hand submerged in painfully cold ice water (i.e., physical aggression).

Next, participants were asked to rate the extent to which they perceived the other participant as hostile, given their essay evaluation, using a scale anchored at 0 (*not at all*) and 10 (*extremely*). This measure was based on paradigms used in previous research in which participants have rated the behavior of ambiguously hostile targets after having been exposed to priming manipulations intended to influence perceptions of hostility (e.g., Bartholow & Heinz, 2006; Devine, 1989; Srull & Wyer, 1979).

Results

Aggression—Given that time delay is a continuous variable, participants' decisions concerning the length of time their counterparts should submerge their hands in ice water (i.e., aggression) were submitted to a multiple regression analysis in which aggression was regressed on prime content (alcohol, neutral), time delay (0 min, 7 min, 15 min) and their

interaction. The time delay variable was mean-centered prior to creation of the cross-product (Prime × Time delay) term. Neither the main effect of Prime, β = .147, $t(271) = 1.76$, $p = .079$, nor the main effect of Time delay, β = .084, $t(271) = 1.03$, $p = .305$, was significant. However, the predicted Prime × Time delay interaction was significant, β = -.216, $t(271) = -2.59$, $p = .010$. Figure 2 displays the means associated with this interaction. Focused contrast analyses comparing effects of prime content within each level of the time delay variable showed that, as predicted, alcohol priming elicited more aggression ($M = 31.3$ s, $SD = 19.4$) than neutral priming ($M = 21.3$ s, $SD = 13.3$) in the 0 min delay condition, $F(1, 96) = 9.10$, $p = .003$, $d = 0.61$, replicating the findings of Experiment 1. However, levels of aggression elicited by alcohol priming and neutral priming did not differ significantly in the 7 min delay condition (Ms = 27.6 and 22.9 s, SDs = 17.7 and 14.9, respectively), $F(1, 91) = 1.87$, $p = .174$, $d = 0.28$, or in the 15 min delay condition (Ms = 22.1 and 24.7 s, SDs = 13.9 and 15.3, respectively), $F(1, 83) = 0.62$, $p = .432$, $d = 0.17$.

Although consistent with our prediction, the interaction and simple effect contrasts just described do not directly address the prediction that aggression should decrease as delay increases for those in the alcohol-primed condition only. Additional linear contrasts computed within each priming condition confirmed that, for participants exposed to alcohol primes, aggression decreased significantly as delay increased, $F(1, 270) = 7.32$, $p = .007$, whereas delay duration had no effect on aggression levels for participants exposed to neutral primes, $F(1, 270) = 1.05$, $p = .306$. More complex polynomial (i.e., quadratic) contrasts were nonsignificant in both priming conditions (Fs < 0.10).

Hostile perception as a mediator—To test our hypothesis that alcohol priming influences aggression by affecting the extent to which others' actions are viewed as hostile, we examined whether prime content (alcohol vs. neutral) indirectly affected subsequent aggressive behavior via perceptions of target hostility. To test this idea, we first modeled the effect of priming condition (alcohol or neutral) on hostile perceptions; this effect was significant, $t(274) = 2.10$, $p = .037$, indicating that, across delay conditions, participants exposed to the alcohol prime perceived the target as more hostile ($M = 6.10$, $SD = 2.01$) than participants exposed to the nonalcohol prime ($M = 5.55$, $SD = 2.34$). Next, we tested whether hostility ratings were associated with aggression and found this association to be significant and positive, $r(274) = .19$, $p = .002$. Finally, we tested the indirect effect of prime condition on aggression via hostility ratings using the Monte Carlo– based bootstrapping procedure (see MacKinnon, Lockwood, & Williams, 2004) developed by Selig and Preacher (2008; also see Preacher & Hayes, 2004) with 10,000 bootstrapping resamples.[3] This analysis indicated that the predicted indirect effect was significant, in that its 95% confidence interval (CI) did not include zero, bootstrapped 95% CI = [1.66, 0.04]. Figure 3 graphically depicts these associations.

[3]In essence, this procedure uses parameter estimates (and standard errors) derived from regressing the mediator on the independent variable (a), and from regressing the dependent variable on the mediator when the independent variable is also in the model (b), to randomly draw from the distributions of a and b and compute the product of those values (i.e., the indirect effect). This procedure is repeated a very large number of times, and the resulting distribution of the $a \times b$ values is used to estimate a confidence interval around the observed value of $a \times b$. According to the logic of the procedure (as discussed in Preacher & Hayes, 2004), a confidence interval that does not include zero permits the conclusion that the true indirect effect is significantly different from zero at a pre-selected alpha level ($p < .05$, in this case).

Given that the dependent measure of aggression was collected before the proposed mediator of aggression, an additional analysis was conducted in which aggression was used as the mediator between prime content and hostility ratings. Although the indirect effect (0.1006) of this model was significant (95% CI = [0.25, 0.02]), the magnitude of the indirect effect using hostility as a mediator (0.6923) was nearly 7 times larger. This difference can be seen as evidence in favor of our preferred interpretation of process (i.e., hostile perception mediates the effect of priming on subsequent aggressive behavior) over the alternative (i.e., aggressive behavior mediates the effect of priming on hostile perceptions).

Discussion

The findings of this experiment replicate and extend those from Experiment 1, contributing novel information concerning both the duration and the mechanisms of alcohol cue priming effects on aggression. As in Experiment 1, very brief exposure to alcohol-related words, coupled with ambiguous provocation, caused participants to behave more aggressively toward a target individual than brief exposure to non-alcohol words. Going beyond Experiment 1, the current study also showed that this effect appears to be rather shortlived, diminishing in a linear fashion over the course of 15 min. This finding supports the contention that alcohol cue priming affects behavior primarily by increasing the accessibility of information in long-term memory (see Higgins, 1996), a phenomenon that previous research has shown to dissipate considerably within a handful of minutes (e.g., Higgins & Brendl, 1995; Smith & Branscombe, 1987; Srull & Wyer, 1979) and does not appear to activate behavioral goals (see Bargh & Gollwitzer, 1994; Bargh et al., 2001). Furthermore, the current results extend previous work (Bartholow & Heinz, 2006) by showing that the content made accessible by alcohol priming leads participants to view others' ambiguous behaviors as hostile, and, importantly, that this perceptual bias significantly mediates effects of alcohol priming on aggression.

General Discussion

The current research provides the first evidence that alcohol (or even placebo) consumption is not required in order for alcohol to enhance physical aggression but that this effect can result from brief exposure to alcohol-related words. This finding adds to a growing body of evidence indicating that simply being exposed to cues related to alcohol is sufficient to bring about numerous cognitive, affective, and behavioral changes often attributed to alcohol's pharmacological effects (Bartholow & Heinz, 2006; Freeman, Friedman, Bartholow, & Wulfert, 2010; Friedman, McCarthy, Forster, & Denzler, 2005; Stepanova, Bartholow, Saults, & Friedman, 2012; Subra et al., 2010). Of greater importance, the current research makes three substantive contributions to understanding the parameters and mechanisms of alcohol cue exposure effects. First, the findings from Experiment 1 (replicated in Experiment 2) demonstrate that alcohol cue exposure augments aggression only in situations involving ambiguous provocation, where there is room for interpretation concerning a provocateur's intentions—what Vasquez et al. (2005) referred to as “attributional distortion.” This pattern is consistent with a classic behavioral priming effect, whereby ambiguous social interactions are strongly influenced by whatever information is most accessible in memory (see Higgins, 1996, 2011). As reviewed by Todorov and Bargh (2002), individuals exposed

to situational cues that increase accessibility of aggressive thoughts interpret ambiguous situations in a more hostile manner than do other individuals. Numerous theories (e.g., Anderson & Bushman, 2002; Berkowitz, 1993; Dodge, 1980; Huesmann, 1998) and empirical demonstrations (see Orobio De Castro, Veerman, Koops, Bosch, & Monshouwer, 2002) indicate that such hostile attribution biases facilitate strong retaliatory, aggressive responses.

Consistent with this idea, the current findings show that not only does exposure to alcohol-related cues increase perceptions of a provocateur's hostility, but this interpretational bias provides an important mechanism by which alcohol cue exposure increases physical aggression. This is the second substantive contribution made by the current report. Although previous demonstrations of alcohol priming effects have shown that such exposure influences processes known to be antecedents of aggression, such as the accessibility of aggressive thoughts (Bartholow & Heinz, 2006, Experiment 1; Subra et al., 2010) and hostile perception biases (Bartholow & Heinz, 2006, Experiment 2), previous studies have not empirically demonstrated mediation via such processes (also see Friedman et al., 2007). The current meditational results are consistent with the tenets of a recent formulation of behavioral priming effects (Loersch & Payne, 2011), which holds that primes influence behavior primarily when individuals misattribute the effects of the prime to their own natural, internal responses to a situation (e.g., a perceived provocation).

Finally, the current report is the first to characterize the temporal dynamics of alcohol cue exposure effects on behavior. The fact that the effect appears to diminish in a linear fashion over the course of approximately 15 min is consistent with prior work indicating that the heightened accessibility of information in long-term memory that results from exposure to situational cues dissipates over the course of a dozen or so minutes (e.g., Higgins & Brendl, 1995; Smith & Branscombe, 1987; Srull & Wyer, 1979). Of particular relevance, the current results are in-line with a previous study (Sestir & Bartholow, 2010) showing that the effect of exposure to violence-related cues on aggressive thoughts and behaviors decreases over time at approximately the same rate.

Considered together, these findings converge on an understanding of alcohol cue exposure effects in terms of heightened accessibility of relevant knowledge structures (i.e., a priming effect). As such, the current data have notable implications for theories of alcohol-related aggression. A common theme in several such theories (e.g., Giancola, 2000; Lange, 2002) is the idea that alcohol consumption pharmacologically impairs neural circuits important for higher order cognitive control processes, leading to disinhibition of numerous socially proscribed behaviors, including aggression. Although considerable research has provided evidence in support of this idea (see Fillmore & Vogel-Sprott, 1999, 2000; Giancola, 2000, 2004), the current data imply that neither alcohol consumption (i.e., pharmacological impairment) nor the belief that one has consumed alcohol (see Bègue et al., 2009; Lang et al., 1975) or even the knowledge that one has been exposed to an alcohol-related stimulus (Friedman et al., 2007; Subra et al., 2010) is required in order for alcohol to increase aggression. Still, it is important to emphasize that the current findings are in no way intended to supplant or otherwise challenge the notion that alcohol's pharmacological effects lead to increases in aggression. Rather, priming provides an alternative, arguably separate

route through which simply being exposed to alcohol in the absence of any consumption can facilitate aggressive responses. In terms of the relative strength of priming and pharmacological effects, it could be argued that any alcohol consumption study involving an effective placebo manipulation essentially allows for this comparison; those in which a true alcohol dose leads to more aggression than a placebo provide evidence for pharmacological effects being greater than priming effects.

Perhaps of greatest relevance, the current findings have clear implications for Lange's (2002) two-channel theory of aggression identification. The theory incorporates concepts from person perception, including attributions of intent for ambiguous behavior and the idea that people are motivated to understand others' actions, into a model useful for predicting the circumstances under which alcohol will increase (or decrease) perceptions of others' aggressiveness, thereby influencing one's own behavioral decisions. Importantly, the model directly predicts that alcohol consumption influences perceptions of threat during ambiguous social interactions, and specifically proposes that “alcohol may serve as a priming stimulus that activates associated mental representations, thus making them more likely to be used in subsequent epistemic activities” (Lange, 2002, p. 47) (e.g., interpretation of others' behavior). The current findings are in-line with this idea and also extend the model by demonstrating that this process is not only important for perception and interpretation but also for aggressive behavioral responses. Furthermore, the current study provides a clearer test of this priming hypothesis, given that participants did not consume any beverage, and therefore the current results cannot be confounded by pharmacological or explicit expectancy-related effects.

Moreover, whereas Lange's (2002) model begins with the premise that alcohol causes changes in perceptual and motivational processes due to cognitive impairment, the current data and those of another recent study indicate that impaired cognitive control is not necessary for these effects to emerge. Specifically, Stepanova et al. (2012) randomly assigned participants to alcohol cue or nonalcohol cue exposure conditions prior to completing a challenging, speeded reaction-time task intended to measure implicit racial bias (see Payne, 2001). In-line with the results of previous studies showing that alcohol consumption increases expression of race bias (see Bartholow, Dickter, & Sestir, 2006; Bartholow, Henry, Lust, Saults, & Wood, 2012; Schlauch, Lang, Plant, Christensen, & Donohue, 2009), Stepanova et al. found that participants in the alcohol cue condition (relative to the non-alcohol cue condition) made more errors indicative of racial bias. However, whereas each of those prior studies found that alcohol's effect on race bias resulted from impairment of control-related processes, Stepanova et al. found that alcohol cue exposure had no effect on estimates of control but rather increased the extent to which participants' responses were driven by automatic associations.

Taken together, the current findings and those of Stepanova et al. (2012), along with other recent work on alcohol priming (Bartholow & Heinz, 2006; Freeman et al., 2010; Friedman et al., 2007), point to the possibility that alcohol cue exposure effects influence behavior by inducing greater reliance on automatic processes triggered by heightened accessibility of relevant mental constructs. In the current study, this process appeared to unfold, in part, due to alcohol cue exposure biasing perceptions of another's intentions. However, it is important

to acknowledge that this specific effect was modest, that is, hostility ratings appeared to account for only a small proportion of the variance in aggression levels associated with the priming manipulation. This could suggest that hostile perceptions were not measured optimally here, or could indicate that hostile perceptions play only a small role in explaining alcohol cue priming effects on aggression and that other factors not directly measured here provide additional explanatory power. For example, and consistent with the current argument, it could be that exposure to alcohol primes induces a stronger reliance on automatic, retaliatory responses to provocation, at the expense of the (more typical) reliance on controlled processes that inhibit aggression. Future research should explore the role of other factors that might be involved in mediating the effects of alcohol priming on aggression.

Limitations and Future Directions

The current research suffered from some limitations that should be taken into consideration. For example, although the map-drawing task used to affect the 7 and 15 min delays in Experiment 2 was designed to be a neutral filler activity, it is possible that it served to distract participants. Thus, the decrease in aggression levels observed in those conditions may be at least partly due to such a distraction and not due completely to a simple dissipation of priming effects. Although we cannot completely discount this possibility, previous research suggests that this task does not interfere with cognitive or affective tasks (see Martin et al., 1993; see also Sestir & Bartholow, 2010), providing some measure of confidence in our conclusion that alcohol priming effects are indeed short-lived.

Another limitation of the current study is the relatively small number of men in the sample relative to women. Although some experimental studies indicate that men generally behave more aggressively than women, the presence of provocation significantly attenuates this sex difference (Bettencourt & Miller, 1996). Thus, it seems likely that the effects reported here will generalize to other samples comprised of different male-to-female sex ratios.

Further, two issues limit the interpretation of the mediation effects reported in Experiment 2. First, the timing of administration of the presumed mediator—perceptions of the essay evaluator's hostility—relative to the primary aggression criterion variable is inconsistent with typical assumptions that the mediator occur temporally prior to the criterion it is presumed to affect. Given that this typical order was reversed in Experiment 2, it is possible that participants' perceptions of their essay evaluator's hostility were influenced by how aggressively they behaved toward them (i.e., the duration of ice water immersion they recommended). Although this possibility limits the extent to which perceptions of hostility can be directly attributed to the effects of the primes, a similar concern could have been raised had the order of administration of these variables been different. That is, if hostile perceptions had been assessed prior to the main aggression measure, it would have been difficult to know whether levels of aggression were chosen as a means to justify reports of the essay evaluator's hostility, rather than as a consequence of exposure to the primes per se. The issue of the timing of primary dependent measures and presumed mediators in aggression research has been discussed at length elsewhere (see Bartholow et al., 2005; Lindsay & Anderson, 2000), and simple solutions have yet to emerge. For now, we can

identify this issue as a potential limitation and caution readers to consider it when evaluating the current results.

A second issue with the mediation test reported here is that the effect was quite modest, indicating that hostile perception is likely only one of several possible mechanisms linking alcohol cue exposure with increased aggression. This issue raises the possibility that this particular variable might only mediate alcohol cue exposure effects among some individuals; for example, those for whom such exposure actually increases accessibility of aggression-related knowledge structures. If so, then the magnitude of mediation would be expected to be small at a mean level (i.e., across all participants, as assessed here). This possibility is suggested by models of aggression, such as the General Aggression Model (see Anderson & Bushman, 2002), which posit that the influence of situational variables on internal states (e.g., aggressive cognitions) and relevant outcomes (e.g., aggressive behavior) varies according to person-level factors, such as individual differences in experience with specific aggressive cues (see Bartholow et al., 2005). Future work could directly examine the extent to which alcohol-related constructs prime aggressive thoughts (e.g., Bartholow & Heinz, 2006), trigger hostile affect or cause changes to other internal states, and then use this variability in association with hypothesized mediators to construct moderated mediation models (see Preacher, Rucker, & Hayes, 2007).

Our findings suggest several avenues for future research. For example, bars and other similar establishments where alcohol-related cues abound would provide ideal locations for field studies designed to replicate and extend the findings obtained in these and other laboratory experiments. In addition, other moderators (beyond provocation ambiguity) of the impact of alcohol priming on aggression could be explored. For example, characteristics of the target of aggression (e.g., attitude similarity, in-group status, etc.) are likely to buffer the effect of alcohol priming on subsequent aggressive behavior (i.e., Pedersen et al., 2008).

Conclusion

The current results provide arguably the strongest demonstration to date that incidental exposure to alcohol-related primes, accomplished here via very brief presentation of words referring to alcohol, can influence social behavior in ways consistent with effects of alcohol consumption. The findings reported here go beyond previous demonstrations by showing that alcohol prime exposure effects operate in a similar manner to other priming effects, that is, by biasing perception in prime-congruent ways, leading to predictable changes in behavior, and by diminishing over the course of 7 to 15 min. Beyond these theoretical contributions, the current research has implications for understanding behavior in numerous situations and contexts where alcohol is typically present, such as parties, bars, and sporting events: Patrons do not have to drink to experience or be subject to the aggression-enhancing effects of alcohol, a fact that would seem to suggest caution in all such environments.

Acknowledgments

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Preparation of this article was supported in part by Grants P60 AA011998 and R01 AA020970 from the National Institute on Alcohol Abuse and Alcoholism.

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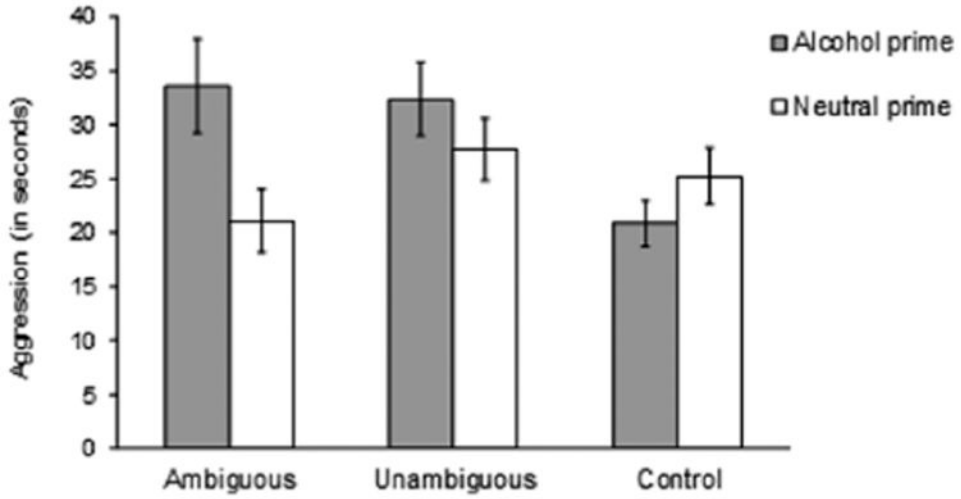

Figure 1.

Levels of aggression as a function of prime content and provocation, Experiment 1. *Note*. Values on the aggression measure represent the duration of time participants recommended the target submerge her or his hand in painfully cold water. Error bars represent ±1 *SE*.

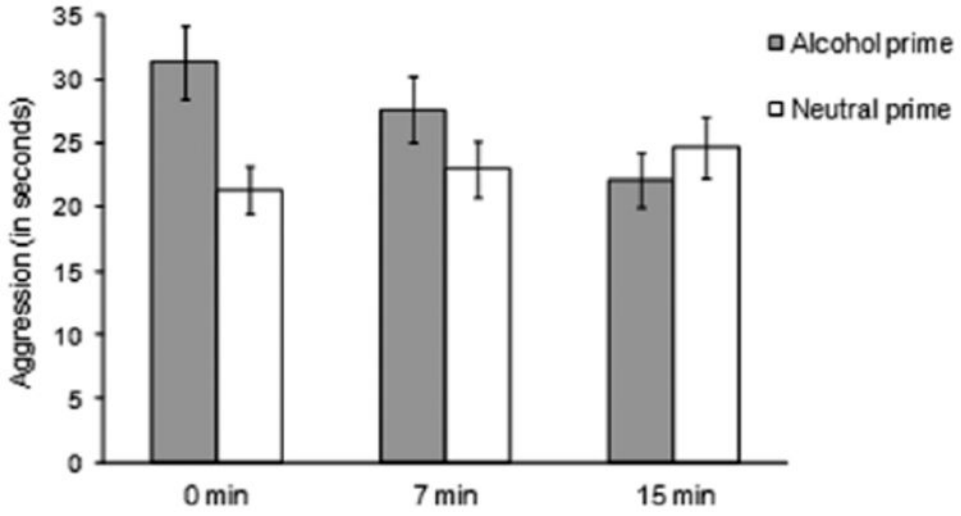

Figure 2.

Levels of aggression as a function of prime content and delay between provocation and assessment of aggression, Experiment 2.

Note. Values on the aggression measure represent the duration of time participants recommended the target submerge her or his hand in painfully cold water. Error bars represent ±1 *SE*.

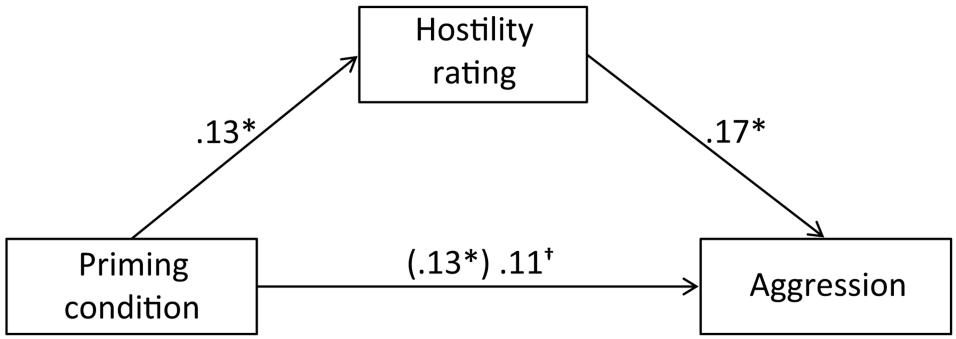

Figure 3.

Path model depicting associations among prime content, hostility ratings, and aggression, Experiment 2.

Note. Monte Carlo simulations based on repeated resampling from the distributions of the coefficients (Selig & Preacher, 2008) indicated that the indirect effect of prime content on aggression via hostility ratings was significant (see text for details).

*$p < .05$; †$p < .07$.