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Alcohol Intake Can Reduce Gambling Behavior

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Prolonged and risky gambling can have negative consequences financially and in health (e.g., developing an addiction). As gambling frequently occurs together with alcohol intake, we investigated whether we could reduce persistent and risky gambling under the influence of alcohol. Specifically, following alcohol myopia theory (Steele & Josephs, 1990), stating that intoxicated people's behavior is disproportionally guided by salient cues, we propose that making low chances of winning salient in a gambling situation should reduce persistent and risky gambling in alcohol intoxicated participants. In 3 laboratory studies, participants either consumed alcohol or a placebo. We made low chances of winning salient (vs. not) by explicitly displaying the low chances in large letters. Making low chances salient led intoxicated participants to gamble less persistently on a computerized slot machine (Study 1 and 2) and with less risk in a lottery game (Study 3) compared with sober participants and compared with sober and intoxicated participants in a control condition in which low chances were not salient. Moreover, using eye-tracking in Study 3, we found that the effect of alcohol on less risky gambling was mediated by intoxicated participants' greater attention to the salient low chances. Finally, we replicated the findings from our laboratory studies in the field: When low chances were made salient, the more alcohol bar patrons had consumed, the less persistently they gambled on a slot machine (Study 4). The findings have applied implications for reducing excessive gambling under the influence of alcohol by making low chances salient on games of chance.

Keywords: alcohol myopia, field experiment, gambling, risk-taking, nudge

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Many people believe that acute alcohol consumption fosters ongoing gambling. The scientific evidence for the effect of alcohol on gambling, however, is mixed. Whereas some studies found that alcohol fostered gambling (Ellery, Stewart, & Loba, 2005), other studies found no effect of alcohol on gambling (Breslin, Sobell, Cappell, Vakili, & Poulos, 1999; Meier, Brigham, Ward, Myers, & Warren, 1996; Sagoe et al., 2017). Again other studies found alcohol reduced gambling (Cutter, Green, & Harford, 1973; Sjöberg, 1969). As gambling frequently occurs with alcohol intake (Markham, Young, & Doran, 2012), learning the conditions under which alcohol may foster or inhibit gambling may have important consequences for preventing escalated gambling under the influence of alcohol. We employ alcohol myopia theory (Steele & Josephs, 1990) to investigate whether alcohol can be used to reduce (rather than enhance) prolonged and risky gambling.

Alcohol Myopia

According to alcohol myopia theory, alcohol reduces processing capacity and thus intoxicated people no longer attend to all situational cues. Instead, they disproportionally focus on salient rather than peripheral cues. Consequently, intoxicated people's responses are more strongly guided by salient cues. For example, intoxicated participants responded more aggressively than sober participants when provocative cues were salient; when provocative cues were not salient, however, intoxicated and sober participants did not differ (Giancola & Corman, 2007). The pattern that alcohol myopia makes people's responses more extreme, depending on the cues that are salient, has been observed in the domains of attention, aggression, altruistic behavior, stress, risky sex, causal inferences, temporal focus, intergroup evaluations, goal commitment, drunk driving, and self-evaluation (e.g., Fairbairn & Sayette, 2013; Fleming et al., 2013; Loersch, Bartholow, Manning, Calanchini, & Sherman, 2015; summaries by Giancola, Josephs, Parrott, & Duke,

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2010; Hull & Slone, 2004). We investigated alcohol myopia in a new domain, gambling.

Moreover, the effect of alcohol myopia on behavior is assumed to be mediated by disproportionate attention to the salient cues. For example, when viewing scenes (traffic or police violence scenes) which contained salient cues (an assault) and more peripheral cues (passers-by), intoxicated (vs. sober) participants fixated longer on the salient cues and shorter on the peripheral cues. By contrast, when viewing scenes which contained about equally salient cues (kitchen or landscape scenes), the fixation duration did not differ between intoxicated and sober participants (Harvey, Kneller, & Campbell, 2013; Moser, Heide, & Kömpf, 1998). Drawing on these findings, we also aimed to test whether enhanced visual attention to salient cues is a mechanism for the effect of alcohol on gambling.

Gambling

In gambling, people bet money (the "stakes" or "wager") to win additional money (the "reward" or "jackpot") with a certain probability of success (the "chances" or "odds"). In most gambling situations (e.g., the lottery, slot machine gambling) the chances of winning the highest reward (jackpot) are relatively low. At the same time, distorted perceptions of the chances of winning, such as the gamblers' fallacy (the belief that after a series of the same outcomes, an alternative outcome becomes more likely) and the illusion of control (the belief that one has some degree of control over the gambling outcome) are perhaps the most important factors that contribute to pathological gambling (Clark et al., 2013; Walker, 1992; meta-analysis by Goodie & Fortune, 2013). One study assessed gamblers' verbalized perceptions of their chances of winning while they gambled on a video lottery terminal and found that although pathological and nonpathological gamblers expressed distorted chances to a similar extend, the pathological gamblers were more convinced in the truth of their distorted chances (Ladouceur, 2004). Another study found that pathological (vs. nonpathological) gamblers evinced a general preference for risky options regardless of their actual chances (Ligneul, Sescousse, Barbalat, Domenech, & Dreher, 2013).

On the basis of alcohol myopia theory, we suspected that making low chances of winning salient should lead intoxicated people to focus on their low chances and as a consequence, they should gamble less persistently and with less risk. Preliminary support for this idea comes from two studies on the effect of alcohol myopia on commitment to unattainable goals (Sevincer, Oettingen, & Lerner, 2012). In these studies, making low chances of goal attainment salient by highlighting them in a questionnaire and by priming them, lead intoxicated participants to feel less committed to their unattainable goals than sober participants. When low chances were not salient, however, goal commitment did not differ between intoxicated and sober participants.

The Present Research

We tested our hypothesis that making low chance salient should reduce gambling under the influence of alcohol in the domain of slot machine gambling, which is the most common and most addictive form of gambling (Chóliz, 2010). Specifically, we designed a computerized slot machine, modeled after commercial slot machines, on which we made low chances of winning salient. Early conceptualizations of salience emphasized that large, bright, or colorful objects attract attention (Koffka, 1935). Later researchers contended that objects could also be salient because they are novel in a given context (Berlyne, 1958) or because they do not correspond with observers' expectations about the situation (Taylor & Fiske, 1978). Drawing on these conceptualizations, Higgins (1996) distinguished between two dimensions of salience: natural prominence and comparative distinctiveness. Natural prominence refers to how noticeable the properties of an object are (e.g., size, brightness, or color). Comparative distinctiveness refers to the degree to which the properties of an object differ in comparison with other objects in the environment (a female in a male group) and whether they are atypical or unexpected in a context (a cow in an apartment rather than on a pasture).

Low Chances Salient

Previous research on alcohol myopia manipulated salience by focusing (vs. distracting) participants to a stimulus (e.g., distracting them by an irrelevant activity), graphically highlighting information (e.g., printing text in bold), and verbally directing participants' attention to stimuli (e.g., warning them about an upcoming stressor; summary by Giancola et al., 2010). Going beyond earlier research, we explicitly manipulated the salience of the low chances of winning on both dimensions, prominence, and distinctiveness: In the experimental condition (low-chances-salient condition), we displayed the slogan "Chance of winning 1/100" in large letters on the upper part of the slot machine (Figure 1, upper image on the left). By displaying the slogan in large letters, we made the chances prominent. The chances were also distinctive: Explicitly indicating low chances of winning is atypical and unexpected in a gambling context.

In the control condition (low-chances-*not*-salient condition), we displayed the low chances in a nonprominent way, in small letters (Figure 1, upper image on the right). By definition, low chances on a slot machine were still distinctive, but they were not prominent and therefore participants should perceive them as less salient than in the low-chances-salient condition in which they were both prominent and distinctive.

To mimic the surface of conventional slot machines, we displayed as a comparative stimulus the highest reward (using a slogan: "Win up to 100€"). By definition, rewards displayed on a slot machine are not distinctive because they are a typical feature of slot machines. In the low-chances-salient condition, the reward was displayed in small letters, (i.e., it was *not* prominent); in the low-chances-*not*-salient condition, it was displayed in large letters (i.e., it *was* prominent). Because the rewards never fulfilled both attributes of salience, prominence, and distinctiveness, they should be perceived as less salient than the low chances in the low-chances-salient-condition but not in the low-chances-*not*-salient condition, in which the low chances also fulfilled only one attribute of salience.

In short, only in the low-chances-salient condition, but not in the low-chances-*not*-salient condition, the low chances were manipulated in a way that both attributes of salience were guaranteed: prominence and distinctiveness. To test whether the displays elicit the hypothesized effects on participants' perceptions of salience we conducted a pilot study.

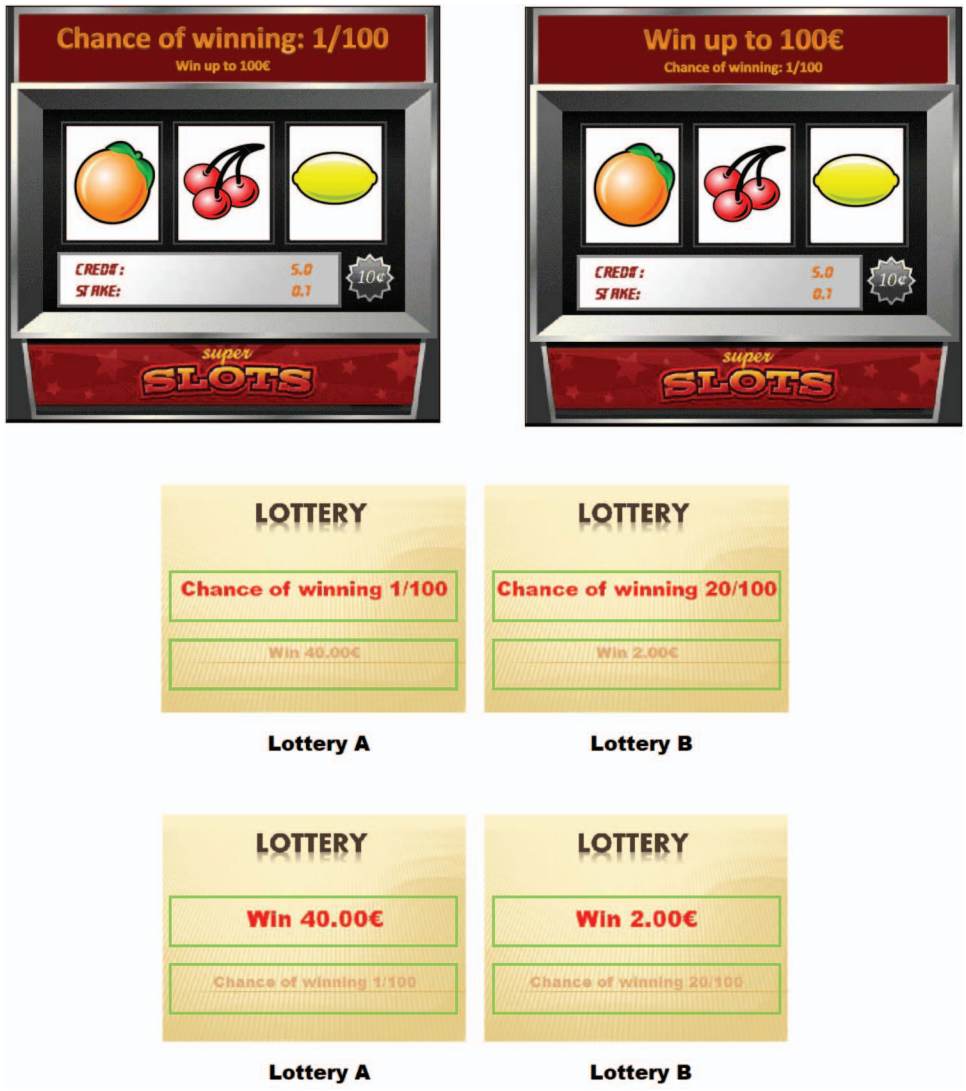

Figure 1. Computerized slot machine used in Study 1 (above) and lottery tickets used in Study 3 (below). Low-chances-salient condition on the left/above and low-chances-*not*-salient condition on the right/below. Areas within the green rectangles are the defined AOIs for the eye-tracking. See the online article for the color version of this figure.

Pilot Study

We presented 51 users of Amazon MTurk (26 female, M_{age} = 38.80 years) either with the low-chances-salient display of our slot machine or with the low-chances-*not*-salient display. We then asked them to judge the prominence and distinctiveness of both the displayed slogans (the low chances *and* the highest reward). We employed four items for prominence (e.g., "How prominent was the slogan?") and four items for distinctiveness (e.g., "How surprised were you by the slogan?") using 7-point scales ranging from 1 (*not at all*) to 7 (*very*). For each of the four slogans, we combined the prominence items into one index (αs between .81 and .95) and the distinctiveness items into another index (αs between .84 and .91). We then combined the prominence index and the distinctiveness index into one overall salience index.

Table 1 depicts the descriptive statistics for participants' ratings. Comparing the salience of the low chances between conditions, as we expected, participants in the low-chances-salient condition rated the chances as more salient (prominence and distinctiveness combined) than those in the low-chances-*not*-salient condition, $t(49) = 2.98$, $p = .004$. This difference in salience was due to a difference in the prominence, $t(49) = 3.27$, $p = .002$, but not the distinctiveness of the chances between conditions, $t(49) = 1.54$, $p = .131$.

Comparing the salience of the low chances with that of the reward within conditions, as we expected, participants in the low-chances-salient condition rated the chances as more salient than the reward, $t(25) = 5.11$, $p < .001$, and this difference was due to the chances being rated as both, more prominent and more distinctive, $ts > 3.10$, $ps < .005$. By contrast, in the low-chances-

Table 1
Pilot Study: Means and Standard Deviations (in Parenthesis) for Participants' Ratings of the Prominence, Distinctiveness, and Overall Salience of the Low-Chances Slogan and the Highest-Reward Slogan in the Two Salience Conditions

Slogan	Prominence	Distinctiveness	Overall salience
Low-chances-salient condition			
Low chances	5.34 (1.18)	5.14 (1.38)	5.24 (1.10)
Highest reward	4.32 (1.42)	3.54 (1.42)	3.93 (0.69)
Low-chances-*not*-salient condition			
Low chances	4.12 (1.47)	4.44 (1.87)	4.28 (1.20)
Highest reward	4.68 (1.61)	3.64 (1.73)	4.16 (1.22)

not-salient condition, the salience did not differ between the chances and the reward, $t(24) = 0.58$, $p = .567$; participants rated the chances as less prominent but at the same time as more distinctive than the reward, $ts > 2.18$, $ps < .040$.

The results of the pilot study suggest that we successfully manipulated the salience of the low chances. First, in the low-chances-salient condition, where the chances were prominent and distinctive, the chances were rated as more salient than in the low-chances-*not*-salient condition, where the chances were distinctive but not prominent. Moreover, within the low-chances-salient condition the chances were also rated as more salient than the reward, which was neither prominent nor distinctive. Therefore, intoxicated participants presented with this display should gamble less persistently. Within the low-chances-*not*-salient condition by contrast, both the low chances and the reward fulfilled only one attribute of salience and thus the chances and the reward did not differ in salience. Therefore, in this condition, intoxicated and sober participants' gambling behavior should not differ.

One might surmise that participants in the low-chances-*not*-salient condition should have rated the reward as more salient than the low chances (because the reward was more prominent) which would lead to the prediction that intoxicated participants show increased gambling (because they would disproportionally focus on the reward). The reward in the low-chances-*not*-salient condition, however, was prominent but not distinctive. Consequently, participants did not differ in their salience ratings between the reward and the low chances.

In sum, only in the low-chances-salient condition, and only for the low-chances slogan, the attributes of distinctiveness and prominence are present. This is reflected in our findings of the pilot study showing highest salience ratings for the chances in the low-chances-salient condition. Therefore, we predicted for the main studies that only in the low-chances-salient condition, intoxicated participants will play fewer trials than sober participants, and fewer trials than sober and intoxicated participants in the low-chances-*not*-salient condition.

Overview of the Main Studies

In Study 1 and 2, participants either consumed alcohol (vodka tonic) or a placebo (tonic only) in the lab. All participants were informed they would receive alcohol to make the participants in the placebo condition believe they consumed alcohol. Because the belief in having consumed alcohol may alter participants' behavior, using an alcohol versus a placebo condition enabled us to examine the pharmacological effect of alcohol on gambling while keeping participants' beliefs in having consumed alcohol constant (Hull & Bond, 1986). After participants consumed their beverages, they gambled with our slot machine on which either the low chances were made salient or not. As dependent variable, we measured the number of trials played. Study 1 used a student sample. To test whether our hypothesized pattern generalizes to a population in which gambling-related problems are more prevalent than in students, in Study 2, we recruited a sample of people who gambled occasionally.

Study 3 examined whether making low chances salient not only reduces persistence but also risk-taking in gambling. To assess risk-taking, we used the random lottery pair paradigm (Hey & Orme, 1994). Participants either consumed alcohol or a placebo in the lab. We manipulated the salience of the low chances analogously as in Study 1 and 2, by displaying a respective slogan on the lottery tickets. Study 3 also examined whether enhanced visual attention to the salient low chances, measured by eye-tracking, is a mechanism for the predicted effect of alcohol on gambling. Finally, to explore the real-life relevance of our hypothesis we conducted Study 4, a field study: We measured the breath alcohol concentration of patrons in a local bar and then invited them to gamble with our manipulated slot machine.

Study 1: Alcohol Myopia and Gambling Persistence in Students

Method

Participants and design. A total of 130 students from a large German university (79 female, $M_{age} = 24.01$ years) took part. Based on our earlier studies (Sevincer et al., 2012), we aimed for a sample size of 30 participants per condition. Student participants were recruited on campus for a study on "alcohol and perception." To be eligible, they had to be at least 18 years of age and not on medication. We screened them by telephone to exclude students who consumed alcohol at a high-risk level (score of 5 or greater on the Brief Michigan Alcoholism Screening Test; Selzer, 1971) or gambled on a pathological level (score of 5 or greater on the South Oaks Gambling Screen [SOGS]; Lesieur & Blume, 1987). Students were requested to abstain from eating for 4 hr and from drinking alcohol for 12 hr before the study. They were also told that they must not drive to the study. Moreover, directly before the experiment, female students took a pregnancy test to assure they were not pregnant. All studies reported in this article were approved by the ethics committee of the German Medical Association.

In all four studies, to control for individual differences that may be related to gambling behavior, students completed individual difference measures before they took part in the study. The measures are described in the online supplemental materials. Students received course credit, and in addition they could keep the money earned in the slot machine game. The study used four conditions: alcohol-low-chances-salient, placebo-low-chances-salient, alcohol-low-chances-*not*-salient, and placebo-low-chances-*not*-salient.

Procedure. Students were tested individually after 12:00 p.m. We informed them about the procedure, and they gave their written consent.

Beverage administration. We aimed for a peak blood alcohol content (BAC) of .06%. Students either consumed alcohol (vodka tonic) or a placebo (tonic only). All students were told they would receive alcohol. The procedure for the beverage administration was adopted from Hull, Levenson, Young, and Sher (1983), Sayette, Dimoff, Levine, Moreland, and Votruba-Drzal (2012), and Sevincer and Oettingen (2014).

The experimenter mixed the drinks from appropriate bottles in view of the students. Students in the alcohol conditions saw their drinks being mixed from a tonic bottle and a bottle of vodka (Moskovskaya, 40%); those in the placebo conditions from a tonic bottle and a vodka bottle that actually contained decarbonated tonic. The amount of alcohol students in the alcohol conditions received was calculated individually for each student using a BAC calculator that considered gender, weight, height, and age to result in a peak BAC of .06%. Students in the placebo conditions received the respective amount of decarbonated tonic. The drinks were mixed in a ratio of five parts tonic and one part vodka. At this dilution, people cannot reliably detect whether tonic water contains vodka (Marlatt, Demming, & Reid, 1973). The experimenter poured the beverages into four glasses and instructed the students to finish each drink within 10 min. To enhance the credibility of the placebo, the glasses in the placebo conditions were sprayed with vodka from a perfume vaporizer directly before the study.

While students consumed their drinks, they watched a neutral movie about traveling in Austria (Bavarian Broadcasting, 2009). During that period students were alone in the laboratory room. A tone sounded every 10 min to prompt the students to finish their current drink and start drinking the next. After students finished their last drink, the movie continued for another 20 min, allowing for the absorption of the alcohol (total playtime was 60 min). Once the movie ended, we assessed participants' breath alcohol concentration with a breathalyzer (Dräger Alcotest 6510). The machine measured the alcohol concentration of participants' breath (BrAC) in milligrams of alcohol per one liter of breath (mg/L) and converted it to grams of alcohol per 100 ml of blood (% BAC) using the formula 1 mg/L BrAC = 0.2% BAC. For example, a BrAC of .3 mg/L corresponded to our target peak BAC of .06%. Whereas students in the alcohol conditions saw their actual BAC displayed, for students in the placebo conditions we preset the breathalyzer to read a random value of around .06% as another measure to enhance the placebo credibility.

Slot machine game. After the BAC measurement, we asked students to remain in the lab until their BAC drops to zero. Following a procedure successfully used by Cronce and Corbin (2010) and Kyngdon and Dickerson (1999), we offered them that during this time they could play with our computerized slot machine. As a cover story, we told them that we were testing the machine for another study. Of the 130 students, 120 agreed to gamble. Of the 10 students who did not agree, seven had consumed alcohol, three the placebo. The remaining students were then presented with the machine.

For the slot machine, we used the display tested in the pilot study: In the low-chances-salient conditions the slogan about the low chances ("Chance of winning 1/100") was displayed in large letters on the upper part of the machine and the highest reward ("Win up to 100€") in small letters below, while the reverse was the case in the low-chances-*not*-salient conditions. The game was modeled after commercial online slot machine games and a slot machine game used in previous studies (Chóliz, 2010). It featured a row of three reels in the middle with six symbols on each reel (orange, the number *seven*, the word *BAR*, cloverleaf, lemon, cherry). Below the reels, the machine displayed the current credit and stake of each spin (Figure 1, upper image). Students' credit at the beginning of the game was set at 5€.

We then informed students about the game. We told them that they could quit anytime and would then be paid their remaining credit in real money. We also told them that in each trial, they could bet 10 cents and that, as indicated by the slogans on the machine, they had a 1/100 chance of winning the reward (jackpot) of 100€ in the case of three identical symbols of the number *seven* appearing. If three identical symbols of any of the six types appeared, they would win a small reward always worth 20 cents. We stressed that the chance of winning a small reward was not displayed and thus unknown to the students.

By pressing a button, the reels started to turn, and by pressing the button a second time, the reels stopped in succession and showed a preset combination of the symbols. There were also sensory features—the clatter of the reels, a sound of money payout in case of a small win, and a single tone in case of a loss. Although students could stop the reels by pushing a button, they had no control over the outcome.

All students were presented with the same sequences of wins and losses. Small wins occurred at Trials 3, 8, 15, 20, 28, 35, 40, and 50. A win of the jackpot did not occur. This sequence of wins and losses resembles a real-life gambling situation. With their preset credit of 5€ students could play a maximum of 66 games then their credit was used up. As dependent variable, we measured the number of trials played (i.e., amount of money lost).

Low subjective chances and attractiveness of winning. After students saw the machine but before they gambled, to verify that they estimated their subjective chances as low, we asked: "How high do you estimate your chances to win the jackpot?" using a 7-point scale ranging from 1 (*very low*) to 7 (*very high*). Because the displayed chances were the same in all four conditions (1/100), the estimated chances should be low (below the scale midpoint) and should *not* differ between conditions. Further, to verify that winning the reward was attractive to students, we asked: "How attractive is winning the jackpot to you?" using a 7-point scale ranging from 1 (*very unattractive*) to 7 (*very attractive*).

Further, to examine whether making low chances salient (vs. not) lowered intoxicated (vs. sober) students' perceived (subjective) chances over time and in this way may reduce their gambling persistence, we assessed the subjective chances a second time after students finished gambling; we also assessed attractiveness of winning a second time, using the same items as the first time.

Placebo manipulation check. Finally, we checked the effectiveness of the placebo manipulation by asking students to estimate the amount of alcohol consumed ("Please estimate the amount of alcohol you consumed in bottles of beer"). At the end, students were fully debriefed and offered snacks and drinks.

Results

Blood alcohol content. All students had .00% BAC before the study. After the consumption of the drink, those who received alcohol had a mean BAC of .064% (SD = .012). BAC did not differ between the alcohol-low-chances-salient and the alcohol-low-chances-*not*-salient condition, $t(65) = 1.16$, $p = .25$.

Placebo manipulation check. As recommended by Martin and Sayette (1993), we excluded three students (2%) who received the placebo from the analyses because they reported not having consumed any alcohol. The remaining students in the placebo conditions estimated having consumed less alcohol (equivalent in bottles of beer; $M = 2.22$, $SD = 1.10$) than those in the alcohol conditions ($M = 3.39$, $SD = 1.31$), $t(115) = 5.24$, $p < .001$. This pattern is common for studies employing moderate alcohol doses (Martin & Sayette, 1993). Given that all remaining students in the placebo conditions reported having consumed at least some alcohol, however, the placebo manipulation appeared credible.

Persistence in gambling. On average, students played 37.53 (SD = 21.80) trials. We predicted that making low chances salient should lead intoxicated but not sober students to gamble less long. Specifically, students in the alcohol-low-chances-salient condition should play fewer trials than those in each of the other three conditions (placebo-low-chances-salient, alcohol-low-chances-*not*-salient, placebo-low-chances-*not*-salient). As recommended by Furr and Rosenthal (2003), we conducted three planned contrasts with the number of trials played as the dependent variable.

As predicted, students in the alcohol-low-chances-salient condition played fewer trials ($M = 26.23$, $SD = 19.48$) than those in the placebo-low-chances-salient condition ($M = 43.52$, $SD = 20.80$), $t(113) = 3.12$, $p = .002$, $d = 0.86$; those in the alcohol-low-chances-*not*-salient condition ($M = 37.50$, $SD = 21.20$), $t(113) = 2.09$, $p = .039$, $d = 0.55$; and those in the placebo-low-chances-*not*-salient condition ($M = 43.47$, $SD = 21.96$), $t(113) = 3.20$, $p = .002$, $d = 0.83$ (Figure 2, upper graph). We also performed analyses to investigate whether there is a beverage content (alcohol vs. placebo) by salience (low-chances salient vs. low chances *not* salient) interaction effect on gambling persistence. The analyses are described in the online supplemental materials.

Money lost. On average, students lost 2.72€ (SD = 1.69). We conducted analogous analyses as above. Because money lost was a function of the number of trials played (rs > .98 in all three studies) the pattern mirrored the above pattern: All three contrasts were in the predicted direction and significant ($p = .002$, $p = .042$, and $p = .001$), respectively.

Alternative explanations.

Differences in low subjective chances and attractiveness of winning before gambling. Before students started to gamble, their subjective chances were below the midpoint of the 7-point scale ($M = 2.06$, $SD = 1.07$), indicating that, as intended, students estimated their chances as low. Also as intended, subjective chances did not differ between conditions, $F(3, 112) = .94$, $p = .424$. Thus, the salience manipulation of low chances did not affect the level of students' estimated chances. Therefore, our finding that students in the alcohol-low-chances-salient condition gambled fewer trials than those in the other three conditions cannot be explained by differences in the level of subjective chances between conditions.

Subjective attractiveness of winning was above the midpoint of the 7-point scale ($M = 5.91$, $SD = 1.03$), indicating that winning the 100€ was attractive to students. Also as intended, attractiveness did not differ between conditions, $F(3, 113) = 2.19$, $p = .093$, suggesting that our results cannot be explained by differences in attractiveness between conditions.

Changes in low subjective chances and attractiveness of winning from before to after gambling. A mixed-design ANOVA with measurement time (before to after gambling) as within-subjects factor and the four conditions as between-subjects factors was used to examine whether making low chances salient lowers intoxicated students' subjective chances. Estimated chances decreased from before ($M = 2.06$, $SD = 1.07$) to after gambling ($M = 1.66$, $SD = .87$), $F(1, 110) = 22.47$, $p < .001$. Because students were losing over time rather than winning this finding comes as no surprise. We did not observe an interaction effect between the four conditions and measurement time, $F(3, 110) = .63$, $p = .60$, indicating that the salience manipulation did not affect students' estimated chances in the four conditions differently.

We conducted analogous analyses for the subjective attractiveness of winning. Subjective attractiveness decreased from before ($M = 5.92$, $SD = 1.03$) to after gambling ($M = 5.67$, $SD = 1.33$), $F(1, 110) = 7.01$, $p = .009$. Perhaps, because students were losing over time rather than winning, they devalued the attractiveness of the 100€. We did not observe an interaction effect with measurement time, $F(3, 110) = 1.04$, $p = .38$, indicating that the salience manipulation did not affect students' attractiveness of winning in the four conditions differently.

Discussion

Rendering low chances of winning salient led intoxicated students to gamble less persistently and lose less money than sober students. Salient low chances also led intoxicated students to gamble less persistently and lose less money than intoxicated and sober students in a control condition in which low chances were *not* salient.

Neither the subjectively estimated chances nor the subjective attractiveness of the highest reward differed between conditions *before* gambling or differentially decreased *during* gambling. Therefore, the observed pattern is unlikely due to differences in the subjective chances or attractiveness, but rather due to the difference in the salience of the low chances. This pattern is consistent with the results of Sevincer and Oettingen (2009, 2013) who did not observe alcohol-induced changes in subjective expectations of success or the subjective attractiveness of a desired outcome.

Study 1 used a student sample. Students gamble less often and have fewer gambling-related problems than the general population (Gainsbury, Russell, & Blaszczynski, 2014). Therefore, we conducted Study 2 with a sample of people who have recently gambled. Moreover, in Study 1, compared with real-life gambling situations, the alleged chances of winning the jackpot were relatively high (1/100), and the jackpot was relatively low (100€). To mimic a situation that more closely approaches a realistic gambling situation, in Study 2, we raised the amount of the jackpot. As it should still appear credible to the students that they could, in fact, obtain the jackpot, we displayed a reward of 300€. Because usually, the higher the reward is, the lower the chances are of winning it, we lowered the displayed chances to 1/1,000.

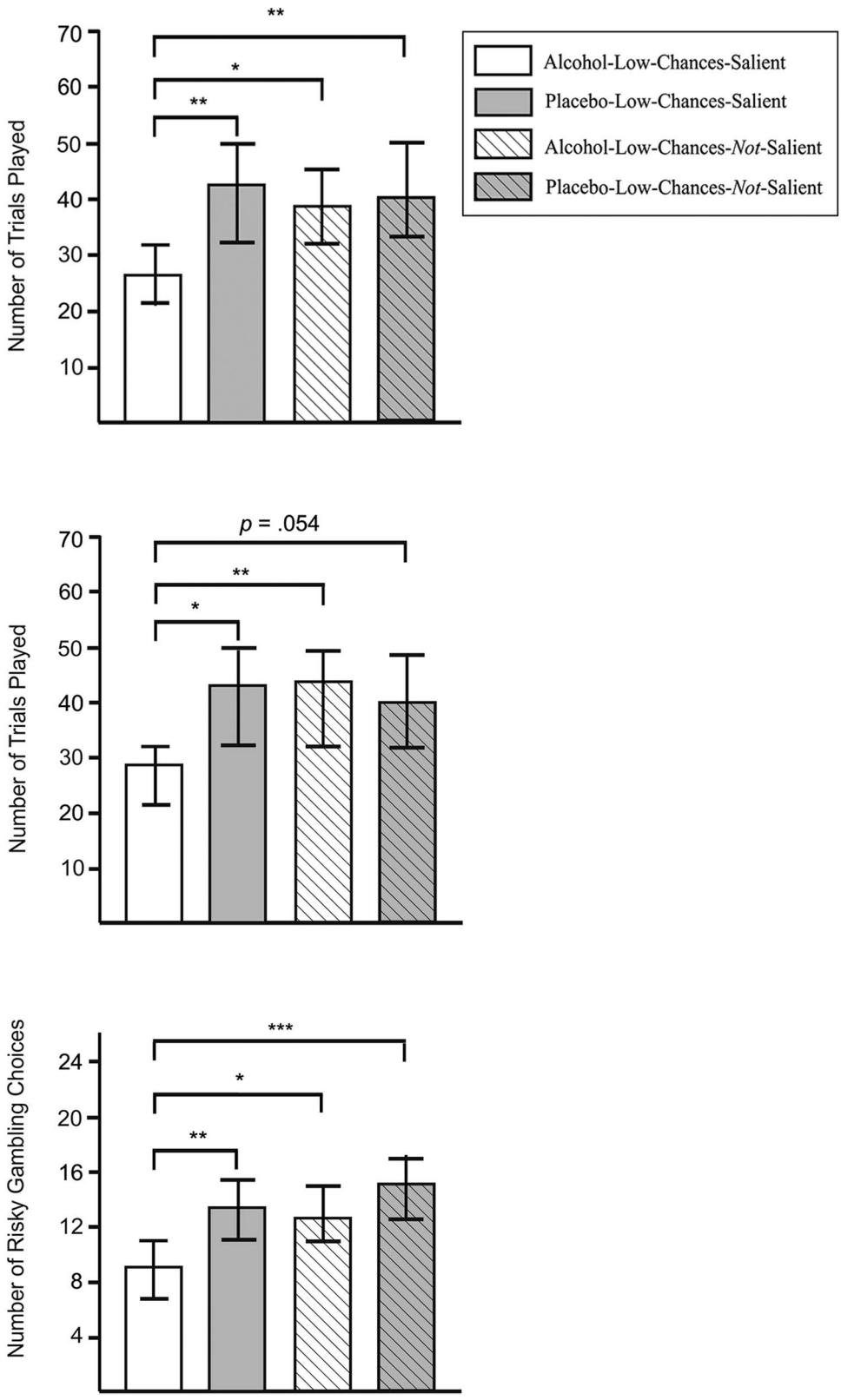

Figure 2. Mean number of trials played in the four conditions in Study 1 (above) and Study 2 (middle) and mean number of choices of the risky gambling ticket in the four conditions in Study 3 (below). Error bars indicate 95% confidence intervals. * $p < .05$. ** $p < .01$. *** $p < .001$.

Study 2: Alcohol Myopia and Gambling Persistence in Recent Gamblers

Method

Participants and design. A total of 128 participants (50 female, M_{age} = 26.72 years) from the general population took part. They were recruited through advertising on the Internet for a study on "alcohol and perception" with the possibility to participate in another study on developing a slot machine. The ethical precautions and eligibility requirements were the same as in Study 1. Also, to be eligible a person had to report having engaged in at least one or more forms of gambling (e.g., online poker, slot machine gambling) in the last 3 months. When we screened participants with the SOGS (Lesieur & Blume, 1987), we found that 67 (52%) participants were classified as having no problems with gambling (SOGS score: 0), while 61 (48%) had some gambling problems (SOGS score of 1 to 4). Participants were paid 17€, and in addition they could keep the money earned in the slot machine game. As in Study 1, the study used four conditions: alcohol-low-chances-salient, placebo-low-chances-salient, alcohol-low-chances-*not*-salient, and placebo-low-chances-*not*-salient.

Procedure. The study used the same procedure as Study 1. We also used the same slot machine game as in Study 1 except that the amount of the jackpot displayed was 300€, and the chance of winning displayed was 1/1,000. Of the 128 participants, 120 agreed to gamble. Of the eight participants who did not agree, four had consumed alcohol, four the placebo. We measured participants' subjective chances and attractiveness of winning and the effectiveness of the placebo manipulation in the same way as in Study 1.

Results

Blood alcohol content. All participants had a BAC of .00% before the onset of the study. Participants who consumed alcohol had a mean BAC of .055% (SD = .010). BAC did not differ between the alcohol-low-chances-salient condition and the alcohol-low-chances-*not*-salient condition, $t(58) = 0.57$, $p = .571$.

Placebo manipulation check. Two participants (2%) were excluded because they did not report having consumed any alcohol. As in Study 1, the remaining participants in the placebo conditions estimated having consumed less alcohol (M = 3.01, SD = 1.38) than those in the alcohol conditions (M = 4.06, SD = 1.16), $t(114) = 4.44$, $p < .001$.

Persistence in gambling. On average, participants played 39.21 (SD = 23.80) trials. We conducted analogous analyses as in Study 1. The pattern mirrored that of Study 1. Participants in the alcohol-low-chances-salient condition played fewer trials (M = 29.18, SD = 13.33) than those in the placebo-low-chances-salient condition (M = 43.41, SD = 26.46), $t(41.67) = 2.58$, $p = .014$, $d = 0.68$, and those in the alcohol-low-chances-*not*-salient condition (M = 44.34, SD = 25.64), $t(42.43) = 2.82$, $p = .007$, $d = 0.74$. They also tended to play fewer trials than the participants in the placebo-low-chances-*not*-salient condition (M = 39.53, SD = 25.08), $t(44.81) = 1.98$, $p = .054$, $d = 0.52$ (Figure 2, middle graph).

Money lost. On average, participants lost 2.63€ (SD = 1.79). The pattern mirrored the pattern for the number of trials: All three contrasts were in the predicted direction and significant ($p = .006$, $p = .004$, and $p = .034$), respectively.

Alternative explanations.

Differences in low subjective chances and attractiveness of winning before gambling. As in Study 1, participants' estimated chances were below the midpoint of the 7-point scale (M = 1.94, SD = 1.43) and their subjective attractiveness was above the midpoint (M = 5.63, SD = 1.61). Also as in Study 1, subjective chances and attractiveness did not differ between conditions (Fs < 1.92, ps > .130).

Changes in low subjective chances and attractiveness of winning from before to after gambling. As in Study 1, estimated chances decreased from before (M = 1.94, SD = 1.43) to after gambling (M = 1.61, SD = .94), $F(1, 111) = 7.64$, $p = .007$. No condition by measurement time interaction effect was found, $F(3, 111) = 2.37$, $p = .074$, indicating that the salience manipulation did not affect estimated chances in the four conditions differently. For attractiveness, we did not observe any main, $F(1, 111) = 1.14$, $p = .289$, or interaction effect of measurement time, $F(3, 111) = .68$, $p = .566$.

Discussion

We replicated the results of Study 1 with a sample of people who had recently gambled: Making low chances salient reduced gambling persistence and money lost for intoxicated participants. We could rule out the same alternative explanations as in Study 1: Neither the subjective chances or the subjective attractiveness of the reward differed between conditions *before* gambling or decreased differentially between conditions *during* gambling.

Escalated gambling, however, not only involves more persistent gambling but may also involve riskier gambling choices. Study 3, therefore, aimed to replicate our findings in the domain of risk-taking during gambling. To assess risk-taking, we used a gambling paradigm from behavioral economics, the random lottery pair paradigm (Hey & Orme, 1994). We also tested a mechanism for the predicted effect. Specifically, we recorded participants' eye-movements to examine whether intoxicated participants' greater attention to the salient cues mediates the effect of alcohol and salient low chances on less risky gambling.

Study 3: Alcohol Myopia and Risk-Taking

Method

Participants and design. A total of 128 participants (75 female, M_{age} = 25.72 years) took part. This time, we recruited people from the general population without the explicit experience of gambling. They were recruited through advertisement on the Internet for a study on "alcohol and perception" (the same cover story as in Study 1 and 2) and paid 17€. In addition, they could keep the amount won in the lottery task. Participants were randomly assigned to one of the four conditions (alcohol-low-chances-salient, placebo-low-chances-salient, alcohol-low-chances-*not*-salient, and placebo-low-chances-*not*-salient).

Procedure. We used the same procedure as in Study 1 and 2. However, after participants consumed their beverages, we presented them with a lottery task rather than our slot machine.

Lottery task. For the lottery task, we used the same cover story as in Study 1 and 2: The possibility to test a new game designed for another study. We stressed that participants could keep the amount earned in the lottery game. Of the 120 participants, 117 decided to play the lottery game; the three participants who did not play had consumed alcohol.

We designed the computerized lottery task to measure individual risk-taking in gambling situations. Previous studies used a similar variation of this lottery paradigm to measure risk-taking (Hey & Orme, 1994; Lane, Cherek, Pietras, & Tcheremissine, 2004). We asked participants to choose between 25 lotteries presented in pairs on the screen. Each pair consisted of two lottery tickets A and B with two possible outcomes (i.e., rewards) and their probabilities (i.e., chances)—one lottery ticket offered a higher reward with a lower chance (risky option: e.g., 40€ with a 1:100 chance) and the other offered a lower reward with a higher chance (nonrisky option: e.g., 2€ with a 20:100 chance). Participants then indicated which lottery ticket they chose. The expected value (i.e., the gain multiplied by the chances) of the two lottery tickets was the same in each decision.

We told participants that after they had concluded the gambling task, we would randomly determine which one of the chosen lottery tickets we would use for participants' payoff. This particular lottery then was actually played. For example, after a participant made the 25 choices, we randomly selected one of his or her 25 selected tickets and played that ticket (e.g., winning 40€ with a 1/100 chance). If the ticket won, we paid the participant the reward on the ticket in addition to the 17€ he or she received for taking part in the study. We adapted this procedure from Dohmen et al. (2011).

Manipulation of low chances of winning. To manipulate the low chances in our lottery task, we used an analogous salience manipulation as in Study 1 and 2: In the low-chances-salient condition, the chances were displayed in large, red letters. The reward was displayed in small letters below. In the low-chances-*not*-salient condition, the lottery ticket resembled a commercial lottery ticket, displaying the value of the reward in large, red letters. The low chances were indicated in small letters below (Figure 1, lower image).

Eye-tracking. While participants performed the lottery task, we recorded their eye movements. We employed a Tobii ×120 eye tracker using projection patterns and optical sensors with a sampling data rate of 120 Hz. We determined 100 ms as minimum fixation duration and the threshold for saccade detection was chosen at a velocity of 30°/s (Tobii Studio's default setting). We assessed the fixation duration to defined areas of interest (AOIs; depicted in Figure 1, lower image) and then computed an index of how long participants gazed at the chances relative to the rewards on the two tickets. The eye-tracking procedure and the formula for computing the index of fixation duration on the chances relative to the rewards are described in the online supplemental materials.

We predicted that greater visual attention (longer fixation duration) of the intoxicated participants on the salient low chances mediates the effect of alcohol on risky choices: In the low-chances-salient condition, alcohol (vs. placebo) should lead to more visual attention on the low chances (relative to the rewards), which should, in turn, predict reduced risk-taking in the lottery game. This mediation effect by increased attention on low chances should only emerge in the low-chances-salient conditions (alcohol-low-chances-salient and placebo-low-chances-salient) but not in the low-chances-*not*-salient conditions (alcohol-low-chances-*not*-salient and placebo-low-chances-*not*-salient) because participants in the alcohol-low-chances-*not*-salient conditions should not be constrained by the alcohol myopic effect. Finally, we checked the effectiveness of the placebo manipulation as in Study 1 and 2.

Results

Blood alcohol content. All participants had a BAC of .00% before the onset of the study. Participants who consumed alcohol had a mean BAC of .052% (SD = .012). BAC did not differ between the alcohol-low-chances-salient condition and the alcohol-low-chances-*not*-salient condition, $t(56) = 1.34$, $p = .186$.

Placebo manipulation check. One participant (1%) in the placebo condition reported not having consumed any alcohol and was excluded. As in Study 1 and 2, the remaining participants in the placebo conditions estimated having consumed less alcohol ($M = 2.19$, $SD = 1.61$) than those in the alcohol conditions ($M = 3.36$, $SD = 1.54$), $t(113) = 3.99$, $p < .001$.

Risk-taking. On average, participants chose the risky lottery ticket 12.79 ($SD = 6.80$) times. As in Study 1 and 2, we conducted three planned contrasts. This time with number of risky lottery choices as dependent variable. The results mirrored the pattern of Study 1 and 2: Participants in the alcohol-low-chances-salient condition chose the risky ticket less often ($M = 9.11$, $SD = 5.94$) than those in the placebo-low-chances-salient condition ($M = 13.86$, $SD = 6.77$), $t(109) = 2.78$, $p = .006$, $d = 0.75$; those in the alcohol-low-chances-*not*-salient condition ($M = 12.55$, $SD = 6.32$), $t(109) = 2.02$, $p = .046$, $d = 0.56$; and those in the placebo-low-chances-*not*-salient condition ($M = 15.70$, $SD = 6.75$), $t(109) = 3.79$, $p < .001$, $d = 1.04$ (Figure 2, lower graph).

Eye-tracking. Eye movements of six participants were not recorded due to poor calibration results. Table 2 depicts the fixation durations to the low-chances slogans and the highest-reward slogans in the four conditions. To test whether the effect of alcohol on risk-taking was mediated by intoxicated (vs. sober) participants' greater attention on the low chances relative to the rewards, we conducted a mediation analysis using the macro PROCESS (Model 4; Hayes, 2013) with 10,000 biased bootstrap samples focusing only on the low-chances-salient conditions. We entered number of choices of the risky lottery ticket as the dependent variable, beverage administration (0 = placebo; 1 = alcohol) as independent variable, and the index of fixation duration on low chances relative to rewards as mediator.

As predicted, in the low-chances-salient conditions, alcohol (vs. placebo) led to a lower number of risky lottery choices, $b = -3.61$, 95% CI [−6.20, −0.24], $p = .036$. Alcohol (vs. placebo) also led to a longer fixation duration on the low chances relative to the rewards, $b = 71.93$, 95% CI [9.20, 134.66], $p = .025$. Longer fixation duration on the low-chances in turn predicted a lower number of risky lottery choices, $b = -0.02$, 95% CI [−0.03, −0.01], $p = .016$. Moreover, we observed a significant indirect effect of alcohol (vs. placebo) on risky lottery choices via fixation duration on the low chances relative to the rewards, $b = -1.26$, 95% CI [−3.22, −0.01], $\kappa^2 = .10$ (medium effect size; Figure 3).

In the low-chances-*not*-salient conditions, alcohol (vs. placebo) tended to lead to a lower number of risky gambling choices, $b = 3.62$, 95% CI [−0.12, 7.35], $p = .057$. Thus, at first sight, the

Table 2
Study 3: Means and Standard Deviations (in Parenthesis) for the Fixation Duration (in Milliseconds) on the Low-Chances Slogans and on the Highest-Reward Slogans

Condition	Slogan		
	Low chances	Highest reward	D^f
Alcohol-low-chances-salient	404.82 (156.78)	368.43 (144.50)	36.39 (141.69)
Placebo-low-chances-salient	331.83 (139.34)	367.37 (116.44)	−35.54 (84.03)
Alcohol-low-chances-*not*-salient	468.79 (132.85)	437.56 (75.38)	31.23 (110.43)
Placebo-low-chances-*not*-salient	480.09 (138.54)	455.41 (90.62)	24.68 (146.50)

Note. D^f = sum of fixation duration on the two low-chances slogans minus the sum of fixation duration on the two highest-reward slogans.

effect of alcohol seems to be similar to the low-chances-salient condition. However, alcohol (vs. placebo) did not affect the fixation duration on the chances relative to the rewards, $b = 6.55$, 95% CI [−65.71, 78.82], $p = .856$. Fixation duration tended to predict riskier lottery choices, $b = -0.01$, 95% CI [−0.03, .0.01], $p = .064$. In contrast to the low-chances-salient conditions there was no significant indirect effect of alcohol on risk-taking via fixation duration, $b = -0.09$, 95% CI [−1.28, 0.89]. The difference between the low-chances-salient conditions and the low-chances-*not*-salient conditions was that alcohol (vs. placebo) led to a longer fixation duration on the low chances and to less risky gambling only when the low chances were salient.

Discussion

We replicated the results of Study 1 and 2 in the domain of risk-taking: Making low chances salient led intoxicated (vs. sober) participants to make fewer risky lottery choices. Moreover, using eye-tracking, we found that the observed effect of alcohol on reduced risk-taking was mediated by intoxicated participants' greater attention to the salient low chances.

Study 1, 2, and 3 were laboratory studies. When people consume alcohol and gamble in a lab, they are removed from a situation in which they typically engage in this behavior. Therefore, to investigate whether making low chances salient can reduce gambling behavior in a real-life situation, we conducted Study 4 in the field. To set up a situation that resembles a naturalistic gambling situation we once more raised the amount of the jackpot displayed (5,000€) and lowered the chances of winning it (1/5000).

Study 4: Alcohol Myopia and Gambling in Bar Patrons

We measured the BAC of patrons in a bar and invited them to gamble with our manipulated slot machine from Study 1 and 2.

Method

Participants and design. A total of 121 participants (54 female, $M_{age} = 30.08$ years) took part. The experimenter randomly approached patrons in a local music club with a bar in Germany and asked them whether they were interested in learning their BAC and testing a new slot machine. Participants could keep the money earned in the slot machine game. There were two conditions (low-chances-salient, low-chances-*not*-salient).

Procedure. We conducted the study between 8:00 p.m. and 1:30 a.m. Participants signed informed consent and completed the screening questionnaires. We then assessed their BAC by a breathalyzer. Directly before the BAC reading participants rinsed their mouth with water to minimize confounding the BAC reading due to alcohol in the mouth. After that, we presented participants with the slot machine from Study 1 and 2. Of the 121 participants, 119 agreed to gamble. They received 5€ to gamble and the same instructions as in Study 1 and 2. The amount of the jackpot

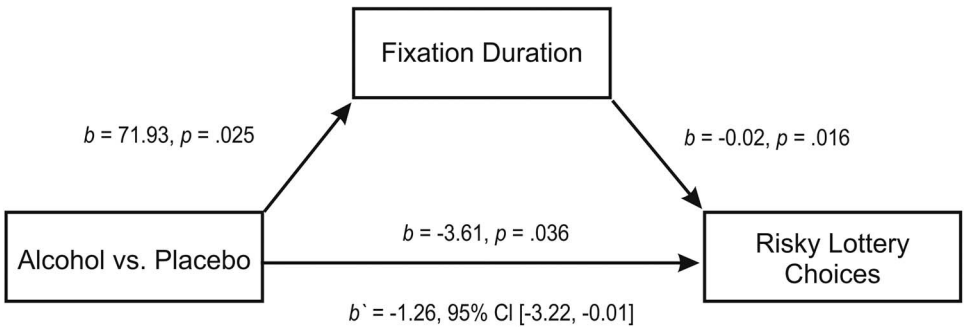

Figure 3. Study 3: Mediator model for the low-chances-salient condition only, showing the indirect effect of condition (1 = alcohol; 0 = placebo) on number of risky lottery choices as mediated by the fixation duration on low chances relative to the rewards. The confidence interval (CI) for the indirect effect is a bias-corrected bootstrapped CI based on 10,000 samples.

displayed was 5,000€, and the chance of winning displayed was 1/5,000. We measured estimated chances and attractiveness of winning before participants started to gamble using the same items as in Study 1 and 2, this time using 5-point scales. Because in Study 1 and 2 the salience manipulation did not affect subjective chances and attractiveness over time and because of time constraint due to the field setting, in Study 4, we did not assess these variables a second time. Finally, participants were fully debriefed.

Results

Two participants (2%) were excluded from the analyses because they reported difficulties in understanding the slot machine.

Blood alcohol content. Participants' BAC ranged from .00% to .18% with a mean BAC of .055% (SD = .046). There was no difference in the BAC between the low-chances-salient condition and the low-chances-*not*-salient condition, $t(107.34) = 0.94$, $p = .350$.

Persistence in gambling. On average, participants played 32.25 (SD = 17.61) trials. Because in Study 4, we measured rather than manipulated participants' BAC, we predicted that when low chances were made salient, the more alcohol participants had consumed, the fewer trials they would play. To test this hypothesis, we first conducted simple slopes analyses. As predicted, in the low-chances-salient condition, the higher participants' BAC the fewer trials they played, $b = -12.67$, $t = -2.24$, $p = .029$. By contrast, in the low-chances-*not*-salient condition, there was no relation between BAC and the number of trials played, $b = 5.03$, $t = 1.19$, $p = .238$. Using the Johnson-Neyman Technique (Johnson & Neyman, 1936), that calculates at which point a significant difference between two conditions starts, we found that from a BAC of .031% on there was a significant difference between the low-chances-salient condition and the low-chances-*not*-salient condition in number of trials played.

Because the studies were conducted relatively late at night and participants' tiredness may have affected their responses, we controlled for the time of night the studies were conducted. We repeated the above analyses adding the time of night as a predictor into the regression equations. The observed pattern remained the same. Participants' BAC predicted a lower number of trials played in the low-chances-salient condition, $b = -118.40$, $t = -2.04$, $p = .047$, but not in the low-chances-*not*-salient condition, $b = 55.14$, $t = 1.27$, $p = .210$.

Finally, participants with a high BAC (i.e., .10%, 1 SD above the mean, Aiken & West, 1991) played fewer trials when low chances were salient than when low chances were *not* salient, $b = 20.17$, $t = 4.96$, $p < .001$. By contrast, among participants with a low BAC (i.e., .01%, 1 SD below the mean) there was no difference between the two salience conditions, $b = 3.75$, $t = .76$, $p = .452$.

Money lost. On average, participants lost 2.26€ (SD = 1.36). The pattern was the same as for the number of trials. In the low-chances-salient condition, the higher participants' BAC the less money they lost, $b = -9.97$, $t = -2.35$, $p = .022$. In the low-chances-*not*-salient condition, there was no relation between BAC and money lost, $b = 3.73$, $t = 1.13$, $p = .264$. The difference between the two conditions was significant starting from a BAC of .032%. Participants with a high BAC (1 SD above the mean) lost less money when low chances were salient (vs. not), $b = 1.54$, $t = 4.98$, $p < .001$. Among participants with a low BAC (1 SD below the mean), there was no difference between the two conditions, $b = 0.27$, $t = 0.71$, $p = .480$.

Alternative explanation: Differences in low subjective chances and attractiveness of winning. Mirroring the pattern in Study 1 and 2, subjectively estimated chances were below the midpoint of the 5-point scale (M = 1.76, SD = 0.73) and subjective attractiveness was above the midpoint (M = 3.69, SD = 0.56). Subjective chances and attractiveness did not differ between conditions, ts < 1.21, ps > .228.

Discussion

When low chances were made salient, the more alcohol participants had consumed, the fewer trials they played. This association did not evince when the low chances were *not* salient. Moreover, when low chances were salient (vs. not), participants with a high BAC but not those with a low BAC played fewer trials.

General Discussion

Making low chances of winning salient by displaying slogans about the low chances of winning the highest reward on slot machines (Study 1 and 2) and the low chances of winning on lottery tickets (Study 3) led intoxicated but not sober participants to gamble less persistently and with less risk. In Study 4, we extended our findings from the lab to a real-life situation: Making low chances salient led intoxicated patrons in a local bar to gamble less persistently with our slot machine. The effect arose after participants consumed only a small amount of alcohol (.031% BAC). The observed patterns cannot be explained by changes in subjective chances or attractiveness of winning.

The observed effect emerged in the lab and field, with different samples (students, recent gamblers, participants from the general population, and bar patrons), gambling tasks (slot machine and lottery game), and with different odds (1/100, 1/1,000, and 1/5,000) and rewards (100€, 300€, and 5,000€) in the slot machine task. We also examined a mechanism for the observed effect: Using eye-tracking, in Study 3, we found that alcohol led participants to focus longer on the salient low chances and shorter on the rewards and this effect mediated the effect of alcohol on fewer risky lottery choices. In sum, making low chances salient could be an effective (medium effect size) nudge to reduce gambling persistence and risk-taking under the influence of alcohol that could be easily applied on a large scale.

Nudges are devices to help people regulate their behavior without imposing prohibitions or restrictions (Thaler & Sunstein, 2009). Nudges can be environmental changes through the government (policy shifts) or any institution. An example is healthy food placed in prominent places making it easier for people to choose the healthier food option. In this way, people are not limited in their options but encouraged to choose options which are in their broad self-interest. Salient low chances on games of chance could therefore be a nudge to reduce gambling. One caveat may be, however, that if slogans about the low chances became a common feature on games of chance, this could reduce the distinctiveness of the low chances and in this way diminish their salience.

Myopia as a Mechanism for the Effect of Alcohol on Gambling

We applied alcohol myopia theory to a new domain: gambling. Our findings support the hypothesis of alcohol myopia theory that intoxicated people's behavior is influenced by their disproportionate attending of the salient cue (low chances). Further support for this idea stems from work by Phillips and Ogeil (2007, 2010) who found that intoxicated (vs. sober) participants who played a computer blackjack program paid more attention to a clearly visible decision aid (providing whether the odds were in their favor) and relied more on this aid.

Our research may help to explain the mixed findings of the effect of alcohol on gambling: Studies that found that alcohol *fostered* gambling (Cronce & Corbin, 2010; Kyngdon & Dickerson, 1999; Phillips & Ogeil, 2007) used gambling tasks that—unlike in both of our experimental conditions (the low-chances-salient and the low-chances-*not*-salient condition)—did *not* display the chances of winning in any way (video lottery terminals or simulated slot machines). By contrast, most of the studies that found that alcohol did *not* affect gambling (Balodis, MacDonald, & Olmstead, 2006; Breslin et al., 1999; Corazzini, Filippin, & Vanin, 2015; Meier et al., 1996) or that alcohol *reduced* gambling (Cortes Aguilar et al., 2013; Sjöberg, 1969) used tasks that—like in both of our experimental conditions—displayed the chances in some way (e.g., lottery or betting tasks).

Expectancy Effect of Alcohol as an Alternative Explanation

It is well-established that the belief of having consumed alcohol may influence behavior (expectancy-effect of alcohol; Martin & Sayette, 1993). Thus, one may argue that our results are due to participants' beliefs about how alcohol would affect their gambling rather than the effect of alcohol. This possibility seems unlikely for three reasons. First, our placebo manipulation check in the lab studies revealed that the participants in the placebo conditions indicated having consumed at least some alcohol. Thus, we held the belief of having consumed *at least some* alcohol constant across conditions. Second, people commonly believe that alcohol *fosters* gambling. We found, however, that alcohol *reduced* gambling (when low chances were salient) or had no effect on gambling (when low chances were not salient). Third, alcohol influenced gambling only when low chances were salient. Thus, the belief of having consumed alcohol cannot explain the effect of the salience manipulation of low chances on intoxicated versus sober participants' gambling. The observed pattern is consistent with a meta-analysis on the effect of alcohol myopia on various behaviors that concluded that the effects of alcohol myopia were not caused by drinking expectancies (Steele & Southwick, 1985).

Clinical Implications: Reducing Gambling Under the Influence of Alcohol

Americans spend more on gambling than on all other forms of entertainment combined (about $90 billion a year; American Gaming Association, 2007) and about 80% of adults in the U.S. have gambled in the past year (Welte, Barnes, Tidwell, Hoffman, & Wieczorek, 2015). When gambling and drinking occur in conjunction, problematic (i.e., addictive) behavior is more likely to arise: Simultaneous drinking and gambling (Welte, Barnes, Wieczorek, & Tidwell, 2004) and heavy drinking (Smart & Ferris, 1996) strongly predicted pathological gambling. Because maladaptive behavior within even a single gambling session can set the stage for the development of problematic or pathological gambling ("chasing" for a certain amount of money lost earlier by continuing gambling; Cronce & Corbin, 2010), interventions at an early stage are needed to prevent excessive gambling.

Our findings provide indications for the development of interventions to prevent excessive gambling under the influence of alcohol. For example, gamblers who are trying to reduce their gambling may surround themselves with cues related to the low chances after having consumed alcohol. In real-life, however, the chances are often not indicated. Therefore, one may explore whether the use of a simple self-regulation strategy that makes the low chances cognitively accessible and thereby salient (e.g., mental contrasting with implementation intentions; Oettingen & Gollwitzer, 2010; summary by Oettingen & Sevincer, 2018) can reduce gambling. Perhaps using such self-regulation strategies may even help pathological gamblers take steps to cut back their gambling, such as self-exclusion from gambling (Hayer & Meyer, 2011).

Limitations and Future Directions

Several limitations merit discussion. First, we recruited participants with no gambling experience or participants who gambled recently. Future studies should test whether making low chances salient could also be effective in reducing gambling in pathological gamblers. Second, we used a computerized slot machine and an adapted version of the lottery pair paradigm. Both tasks were simplified compared to modern gambling machines. Future studies should devise tasks which resemble modern machines even more. Third, according to alcohol myopia theory, alcohol should lead to increased gambling when the reward is salient. Our pilot study showed, however, that in our low-chances-*not*-salient condition, the reward was prominent but not distinctive and thus no more salient than the low chances. Future work should look at whether by displaying an unexpected reward like a journey or restaurant coupons instead of money, one could make the reward prominent and distinctive which should lead to enhanced gambling behavior under the influence of alcohol.

Conclusion

We predicted and found in the lab and the field that alcohol intake reduced persistence and risk-taking in gambling when low chances of winning were made salient. Attention allocation toward the low chances was a mechanism for the observed effect. Our findings provide hope that minimal nudges on gambling machines may reduce gambling under the influence of alcohol.

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