



# Potions for Emotions: Do self-reported individual differences in negative-emotional drinking predict alcohol consumption in the laboratory following exposure to a negative experience?

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## ABSTRACT

**Aims:** Research suggests that self-reports on inferred motives for engaging in behavior may be biased by limited introspective access into such processes. Self-reports on observable behavior, on the other hand, may generate more accurate responses with which to predict behavior. The aim was to determine whether drinking alcohol in response to negative emotion (*negative-emotional drinking; NED*) is best predicted by self-reported individual differences in (a) motives to use alcohol to regulate negative emotion, or (b) the degree to which negative emotion impacts alcohol consumption (observable behavior).

**Methods:** Thirty-nine beer drinkers completed the Drinking Motives Questionnaire-Revised (DMQ-R) which measures individual differences in drinking motives, including the motive to regulate negative emotion (coping motives). They also completed a new self-report measure of the degree to which negative emotion impacts their alcohol consumption. Participants were randomized into a negative emotion induction condition or control condition and completed a subsequent alcohol consumption task to serve as a behavioral measure of drinking in response to negative emotion.

**Results:** Self-reports on the degree to which negative emotion impacts respondents' alcohol consumption strongly predicted alcohol consumption in the negative emotion induction condition ( $r = 0.72, p < .001$ ) and not in the control condition ( $r = 0.09, p = .696$ ). Self-reported coping motives did not predict alcohol consumption in either condition.

**Conclusions:** The amount of alcohol consumed in response to negative emotion is best predicted by self-reports on observable behavior, and not by self-reports on drinking motives.

## 1. Introduction

Relationships between negative emotion and addictive behaviors are frequently reported (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Negative emotions have been identified as antecedents of tobacco and cannabis smoking (Fox, Towe, Stephens, Walker, & Roffman, 2011; Kassel, Stroud, & Paronis, 2003), cocaine, heroin, and amphetamine use (Khantzian, 1985; Piazza, Deminière, Le Moal, & Simon, 1989; Sinha, Garcia, Paliwal, Kreek, & Rounsaville, 2006), as well as other problematic consumption behaviors such as binge eating (Greeno & Wing, 1994; Stice, Presnell, Shaw, & Rohde, 2005). Drinking alcohol in response to negative emotion (*negative-emotional drinking; NED*) is also commonly reported and is strongly associated with heavy drinking and related problems (Cooper, 1994; Cooper, Frone, Russell, & Mudar,

1995; Kuntsche, Knibbe, Gmel, & Engels, 2005; Wills & Shiffman, 1985). Lapses during addiction treatment are often preceded by heightened negative emotion (Woody, Urschel, & Alterman, 1992), negative-emotional states are reported to increase relapse susceptibility among recovering alcoholics (Brady et al., 2006; Breese et al., 2005; Cooney, Litt, Morse, Bauer, & Gaupp, 1997; Fox, Bergquist, Hong, & Sinha, 2007) and alcohol use and mood disorders are highly comorbid (American Psychiatric Association, 2013). Perhaps surprisingly, research investigating the relationship between negative emotion and alcohol consumption has typically relied on self-reported drinking instead of observed alcohol consumption (Arbeau, Kuiken, & Wild, 2011; Cooper et al., 1995; Dvorak, Pearson, & Day, 2014; Gorka, Hedeker, Piasecki, & Mermelstein, 2017; Littlefield, Talley, & Jackson, 2012; Mohr et al., 2013; Piasecki et al., 2014). Thus, it remains unknown

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whether self-reports of negative-emotional drinking represent a *true* tendency to drink alcohol in response to negative emotion, or only a *perceived* tendency. Given evidence that negative-emotional states may be important antecedents of escalating alcohol problems and relapse, there is a need to determine whether self-reported individual differences in negative-emotional drinking predict the amount of alcohol consumed in response to a negative-emotional experience.

At present, there are no self-report measures which directly interrogate the impact of negative emotion on alcohol consumption. Instead, research has focused on emotion regulation motives for drinking. The Drinking Motives Questionnaire Revised (DMQ-R) (Cooper, 1994) is the most frequently used measure of drinking motives. It has also been adapted to measure motives for using tobacco and cannabis (Comeau, Stewart, & Loba, 2001). This measure posits two emotion regulation motives: drinking to enhance positive emotion (enhancement motives) and drinking to cope with negative emotion (coping motives) (Cooper et al., 1995; Wills & Shiffman, 1985). Coping motives are strongly associated with self-reported drinking problems (Cooper et al., 1995; Kuntsche, Knibbe, Gmel, & Engels, 2006a; Kuntsche, Stewart, & Cooper, 2008) and have been found to be associated with an increase in the belief that alcohol use will reduce negative emotion (Piasecki et al., 2014). Daily coping motives have also been found to be positively associated with daily negative emotion (Arbeau et al., 2011) and daily negative emotion has been found to predict self-reported night-time alcohol use via daily coping motives (Dvorak et al., 2014). On the other hand, there is research showing no relationship between coping motives and daily self-reported alcohol use in response to negative emotion (Littlefield et al., 2012). In fact, some studies report that coping motives diminish the relationship between daily negative emotion and self-reported alcohol use (Mohr et al., 2013) or diminish its tension-reducing effects (Gorka et al., 2017).

With regard to laboratory studies examining the relationship between coping motives and *observed* (instead of self-reported) alcohol consumption following the induction of negative emotion, we found only two. These studies found that coping motives did not predict alcohol consumption in the laboratory after induction of negative emotion (Salemink, Woud, Roos, Wiers, & Lindgren, 2019; Thomas, Merrill, von Hofe, & Magid, 2014). From these interesting, and often contrasting, findings we can infer two possibilities about self-reported negative-emotional drinking. First, that such self-reports represent only a perceived tendency to drink alcohol in response to negative emotion and, in fact, there is no true relationship between negative emotion and alcohol consumption. The second (and perhaps more plausible) possibility is that a true relationship exists but current methods of interrogating such a relationship yield inaccurate self-reports. This emphasizes the need to determine whether an alternative method of collecting self-reports on negative-emotional drinking, one that attempts to maximize the accuracy of those self-reports, predicts observed alcohol consumption in the laboratory after exposure to a negative-emotional experience.

It may be that an assessment of reasons for drinking (*motives*) is not a reliable predictor of actual alcohol consumption because it requires respondents to speculate on *unobservable* cognitive processes behind their drinking. In a seminal series of studies, Nisbett and Wilson examined the accuracy of self-reported motives in everyday situations (e.g., selecting one brand of a desired product over another) and found that interrogating reasons for behavior frequently resulted in inaccurate responses (Nisbett & Wilson, 1977). It may be that assessing motives for drinking alcohol requires respondents to access similarly unobservable cognitive processes. Asking respondents to report on the influence of a given stimulus on their (self-) observable behavior, on the other hand, has shown greater validity for predicting behavior than self-reports on motivations (MacLeod, 1993). Thus, negative-emotional drinking may be more accurately interrogated by enquiring about the impact of negative emotion on observable drinking behavior than reasons for drinking (motives).

Furthermore, seminal work by Schwarz has found that respondents are easily influenced by their interpretations of questionnaire items (Schwarz, 1999). It is conceivable that respondents who hold beliefs such as “people who drink to remediate their negative feelings are losers” may be reluctant to endorse coping motives. Indeed, the coping motives mean is typically lower than that of social and enhancement motives, even in people who score relatively high on coping motives (Cousijn, Luijten, & Wiers, 2014; Kuntsche et al., 2008) which could be interpreted as representing a tendency to downwardly adjust responses on the coping motives subscale. Thus, it may also be the case that an instrument which enquires about the impact of negative emotion on alcohol consumption is less prone to biased responding than one which requires respondents to report on motivations for drinking that could be considered socially undesirable.

The aim of the current study was twofold. The first aim was to determine the degree to which those who endorse coping motives also report an increased tendency to drink alcohol in response to negative emotion. This aim leads to two competing hypotheses. Hypothesis 1a was that individuals who endorse coping motives are more likely to report drinking alcohol in response to negative emotion. This hypothesis predicts that self-reported coping motives will be positively related to self-reported individual differences in the degree to which negative emotion impacts alcohol consumption. The alternative, Hypothesis 1b, was that individuals who endorse coping motives are no more or less likely to report drinking alcohol in response to negative emotion. This hypothesis predicts that self-reported coping motives will be unrelated to self-reported individual differences in the degree to which negative emotion impacts alcohol consumption.

The second aim was to determine whether drinking in response to negative emotion is best predicted by (a) self-reported individual differences in motives to use alcohol to regulate negative emotion, or (b) self-reported individual differences in the degree to which negative emotion impacts alcohol consumption. Hypothesis 2 was that self-reports on observable behavior better predict drinking in response to negative emotion than coping motives. This hypothesis predicts that self-reported individual differences in the degree to which negative emotion impacts alcohol consumption will predict increased alcohol consumption following a negative-emotional experience, above and beyond the capacity of coping motives.

## 2. Method

### 2.1. Participants

Thirty-nine Dutch-speaking participants (24 female,  $M_{\text{age}} = 24.82$ ,  $SD_{\text{age}} = 7.49$ , range = 18–59 years) completed the study at the University of Amsterdam for course credit or €10 payment. Participants were recruited with posters advertising an experiment on individual differences in perception of taste. The study was open to students and non-student members of the community. As the beverage included in the alcohol consumption task in this study was beer, only those who indicated on a screening measure that they enjoyed drinking beer were invited to participate. All participants were required to be at least 18 years of age to comply with Dutch alcohol laws.

### 2.2. Materials

#### 2.2.1. Self-reported individual differences in coping motives

We administered a Dutch version of the Drinking Motives Questionnaire, Revised (DMQ-R). This questionnaire is comprised of 20 items assessing various reasons for drinking across four subscales: social, conformity, enhancement and coping motives. Participants indicate how often they drink alcohol for each reason on a 5-point Likert scale from “Almost never/Never” to “Almost always/Always”. The coping motives subscale is composed of five items. The DMQ-R shows good internal psychometric properties (Cooper, 1994; MacLean & Lecci,

2000), though there has been no research demonstrating the validity of the coping motives subscale for predicting observed drinking following exposure to a negative-emotional experience.

### 2.2.2. Self-reported individual differences in the impact of negative emotion alcohol consumption

Hypotheses addressed in previous research investigating the impact of negative emotion on alcohol consumption typically do not differentiate between the impact of negative emotion on an individual's likelihood of drinking and the amount of alcohol consumed (Cooper et al., 1995; Cooper, 1994; Wills & Shiffman, 1985). Indeed, typical questionnaire measures of alcohol use probe both of these important domains of individual differences (Saunders, Aasland, Babor, De La Fuente, & Grant, 1993). To ensure that the self-report measure employed in the present study was influenced by both these facets of consumption, we asked participants to report on the degree to which negative emotion impacts their alcohol consumption with two items. These two items assessed the degree to which heightened negative emotion impacted: (1) an individual's likelihood of drinking alcohol and (2) the amount of alcohol they consume, as compared to an unemotional state. An unemotional state was defined as one in which we experience no distinctive feeling of either positive mood, negative mood, or combination of these. The two items were assessed on a 7-point Likert scale ranging from a score of  $-3$  ("Decreases a lot") to a score of  $3$  ("Increases a lot"). An NED index score was generated by summing the two items. Total scores varied between  $-6$  and  $6$ , with a higher score indicative of a greater impact of negative emotion on alcohol consumption.

### 2.2.3. Visual-analogue Mood Scales (VAMS)

To measure the effectiveness of the Emotion Induction Task, participants reported the intensity of positive and negative mood that they were currently feeling on independent scales ranging from zero ("None") to 90 ("Extreme"), before (Time 1) and after the task (Time 2).

## 2.3. Experimental tasks

### 2.3.1. Emotion Induction Task

Participants underwent an emotion manipulation procedure based on the anagram stress task (Grafton, Ang, & MacLeod, 2012; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). This task was composed of two conditions. A high-failure condition was contrived to induce negative emotion by delivering a high-failure experience, while a control condition delivered a low-failure experience. The task required participants to solve word puzzles derived from a Dutch version of the anagram stress task (Salemink, van den Hout, & Kindt, 2007) under timed conditions. Participants were informed that their performance would serve as a measure of their intellectual ability. A word puzzle was presented (e.g. WRDO) and participants were required to enter the correct solution (i.e. WORD). A bar graph with percentile ranks provided bogus feedback to participants on their performance. A green bar represented the participant's score and a yellow bar represented a bogus average score of previous participants' performance. Participants in the high-failure condition were instructed that the yellow bar displayed data collected from the general population. They were instructed that, as tertiary students, they should aim for, and could expect to easily achieve, a score in the upper 10%. In fact, this condition consisted of difficult puzzles and was contrived such that participants could only earn a percentile rank in the bottom 10%, thereby delivering an experience of high-failure with the goal of inducing negative emotion. Participants in the low-failure condition were instructed that the yellow bar displayed data that were collected from people with superior verbal fluency. They were asked to aim for a percentile rank above the lower 10%. This condition consisted of easy puzzles and was contrived such that participants would earn a percentile rank in the upper 10% (Grafton et al., 2012), thereby delivering an experience of low-failure.

### 2.3.2. Alcohol Consumption Task

As a measure of observed alcohol consumption, participants completed a conventional alcohol consumption task which they understood was related to an investigation of individual differences in taste perception (Houben, Nederkoorn, Wiers, & Jansen, 2011; Zack, Poulos, Fragopoulos, Woodford, & MacLeod, 2006). This task was modelled after a conventional protocol widely employed in the alcohol literature to measure laboratory alcohol consumption (George, Phillips, & Skinner, 1988; Houben et al., 2011; Marlatt, Demming, & Reid, 1973; Zack et al., 2006). In this task, participants were presented with one 300 ml glass of alcoholic (4.8%) pilsner beer. Over a period of five minutes, they were free to consume as much or as little of this beer as they wished. At the same time, they completed a beer taste rating questionnaire to conceal the true variable of interest (amount consumed) from participants to prevent their consumption from being impacted by the knowledge that it was being measured (McCambridge, Witton, & Elbourne, 2014). Each glass of beer was weighed before and after the task, and beer consumption in grams (g) served as a measure of alcohol consumption (Wiers, Rinck, Kordts, Houben, & Strack, 2010).

## 3. Procedure

Testing sessions were scheduled in the afternoon or evening. After providing informed consent, participants provided demographic information (age and sex), and completed a battery of questionnaires including the DMQ-R and the self-report measure of the impact of negative emotion on alcohol consumption. Participants were breathalyzed to ensure a Blood Alcohol Content (BAC) of zero before beginning the experiment. To ensure that no participant was unduly thirsty, they were provided with one 300 ml glass of water and, over a period of two minutes, were free to consume as much or as little water as necessary so that they were not thirsty. Participants then completed the Emotion Induction Task. This was followed by the Alcohol Consumption Task. After completion of the experiment, participants were breathalyzed again to ensure a BAC within the legal driving limit. They were thanked, reimbursed and debriefed. The study was approved by the Faculty of Social and Behavioral Sciences Ethics Review Board at the University of Amsterdam.

## 4. Results

### 4.1. Are coping motives associated with the impact of negative emotion on alcohol consumption?

To determine whether those who endorse coping motives also report an increased tendency to drink alcohol in response to negative emotion, correlation analyses were conducted. If Hypothesis 1a is true, then self-reported coping motives will be positively related to self-reported individual differences in the degree to which negative emotion impacts alcohol consumption. If Hypothesis 1b is true, then self-reported coping motives will be unrelated to self-reported individual differences in the degree to which negative emotion impacts alcohol consumption. Both variables were normally distributed and participants' scores fell within 3 standard deviations of the mean for each variable (Field, 2009). Upon analysis, coping motives showed a positive relationship with NED indices with,  $r = 0.49$ ,  $p = .002$ , indicating that 24% of the variance between coping motives and self-reported impact of negative emotion on alcohol consumption was shared.

### 4.2. Is negative-emotional drinking better predicted by self-reports on observable behavior?

#### 4.2.1. Emotion manipulation check

Prior to testing Hypothesis 2 it was necessary to confirm the effectiveness of the Emotion Induction Task. If the High-failure condition was effective in inducing negative emotion, we would expect

participants in this condition to demonstrate an increase in the intensity of negative mood from Time 1 (immediately before the task) to Time 2 (immediately after the task). If the Low-failure condition was effective as a control condition, we would expect participants in this condition to demonstrate no increase in the intensity of negative or positive mood from Time 1 to Time 2. To test this, we conducted a  $2 \times 2 \times 2$  Mixed-design Analysis of Variance (ANOVA). The within-participants variables were Mood rating (positive vs. negative mood) and Time (Time 1 vs. Time 2). The between-participants variable was Emotion induction condition (High-failure vs. Low-failure). All variables were normally distributed, participants' scores fell within 3 standard deviations of the mean for each variable, and the assumption of homogeneity of variance was satisfied with Box's M Test ( $p = .066$ ) (Field, 2009). There was a main effect of Mood rating, with  $F(1, 37) = 97.11, p < 0.001$ . There was also an interaction between Mood rating and Time, with  $F(1, 37) = 9.61, p = .004$ . Crucially, these effects were subsumed within a three-way interaction between Mood rating, Time, and Emotion induction condition, with  $F(1, 37) = 7.31, p = .001$ . No other significant effects were observed (smallest  $p = .175$ ).

Follow-up paired-samples  $t$ -tests on this three-way interaction revealed that, as expected, participants in the High-failure condition ( $N = 19$ ) demonstrated a significant increase in negative mood from Time 1 ( $M = 17.47, SD = 17.59$ ) to Time 2 ( $M = 36.89, SD = 21.12$ ), with  $t(18) = -3.10, p = .006$ . They also demonstrated a significant decrease in positive mood from Time 1 ( $M = 65.21, SD = 9.52$ ) to Time 2 ( $M = 47.95, SD = 18.90$ ), with  $t(18) = 3.58, p = .002$ . On the other hand, participants in the Low-failure condition ( $N = 20$ ) demonstrated no change in negative mood from Time 1 ( $M = 21.75, SD = 16.66$ ) to Time 2 ( $M = 24.30, SD = 18.66$ ), with  $t(19) = -0.77, p = .453$ . They also demonstrated no change in positive mood from Time 1 ( $M = 62.00, SD = 13.63$ ) to Time 2 ( $M = 62.05, SD = 13.73$ ), with  $t(19) = -0.01, p = .990$ . Negative mood rating data are presented in Figs. 1a and 1b.

#### 4.2.2. Data preparation

To test Hypothesis 2, a moderated regression analysis was performed using the PROCESS macro for IBM SPSS (Hayes, 2013). This approach calculated traditional  $p$ -values and bias corrected 95% bootstrap confidence intervals (BCIs) based on 10,000 samples. BCIs entirely above or below zero indicate (with 95% confidence) the presence of an effect. Analysis of  $P$ -plots, scatterplots and histograms showed residuals to be linear, homoscedastic and normally distributed. Data were screened for outliers by calculating Mahalanobis' distance, Cook's distance, centered leverage, and standardized residual values. All cases fell within acceptable ranges on all outlier screening analyses (Field, 2009;

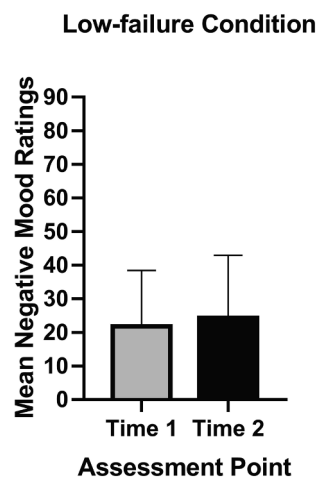


Fig. 1a. Mean negative mood ratings in the low-failure condition before (Time 1) and after (Time 2) completion of the Emotion Induction Task.

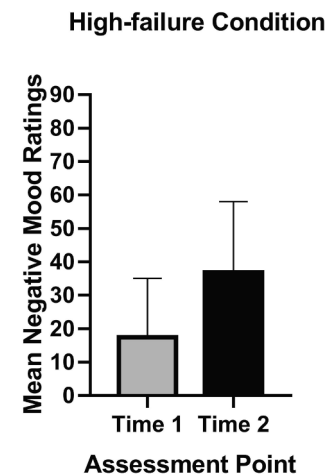


Fig. 1b. Mean negative mood ratings in the high-failure condition before (Time 1) and after (Time 2) completion of the Emotion Induction Task.

Meyers, Gamst, & Guarino, 2006).

#### 4.2.3. Primary statistical analysis

Hypothesis 2 predicted that self-reported individual differences in the impact of negative emotion on alcohol consumption would predict increased alcohol consumption in the High-failure condition, above and beyond the capacity of coping motives. To test this, a moderated regression analysis was conducted. The independent variable was Emotion induction condition (0 = low-failure condition, 1 = high-failure condition). Coping motives and NED indices were entered as simultaneous moderators. The dependent variable was Beer consumption (in grams). There is some evidence to suggest that variation in coping motives may be related to variation in age and sex (Jerez & Coviello, 1998; Kairouz, Glikman, Demers, & Adlaf, 2002; Kuntsche et al., 2005; Plant, Bagnall, & Foster, 1990).<sup>1</sup> Thus, in order to statistically control for any impact of Age or Sex, we included both of these variables as covariates. See Fig. 2 for a schematic of this analysis. The regression yielded a significant overall model with  $R = 0.60, R^2 = 0.36, F(7, 31) = 2.50, p = .037$ . Neither Age ( $p = .190$ ) nor Sex ( $p = .078$ ) impacted the model, and no direct effects were observed (smallest  $p = .101$ ). The interaction between Coping motives and Emotion induction condition was not significant ( $p = .141, BCI = -50.31$  to  $7.47$ ) indicating that the relationship between Emotion induction condition and Beer consumption was not moderated by Coping motives. However, the interaction between NED indices and Emotion induction condition was significant, with  $b = 7.82, t(31) = 2.38, p = .024$  ( $BCI = 1.11$  to  $14.92$ ) indicating that the relationship between Emotion induction condition and Beer consumption was moderated by NED indices. We examined this significant moderation effect by performing correlation analyses between NED indices and Beer consumption separately for the Low-failure and High-failure conditions. If self-reports on observable behavior predict negative-emotional drinking, NED indices would be positively correlated with Beer consumption only in the High-failure condition. Consistent with this, there was no significant relationship between NED indices and Beer consumption in the Low-failure condition ( $r = 0.09, p = .696$ ). In the High-failure condition, there was a positive correlation between NED indices and Beer consumption ( $r = 0.72, p < 0.001$ )<sup>2</sup>. See Figs. 3a

<sup>1</sup> Coping motives were positively correlated with Age in the present sample ( $r = 0.40, p = .012$ ), though there was no significant relationship between NED indices and Age ( $r = 0.10, p = .545$ ). There was no significant relationship between Coping motives and Sex ( $r = -0.01, p = .943$ ) or between NED indices and Sex ( $r = -0.02, p = .898$ ).

<sup>2</sup> We also conducted partial correlations between NED indices and Beer

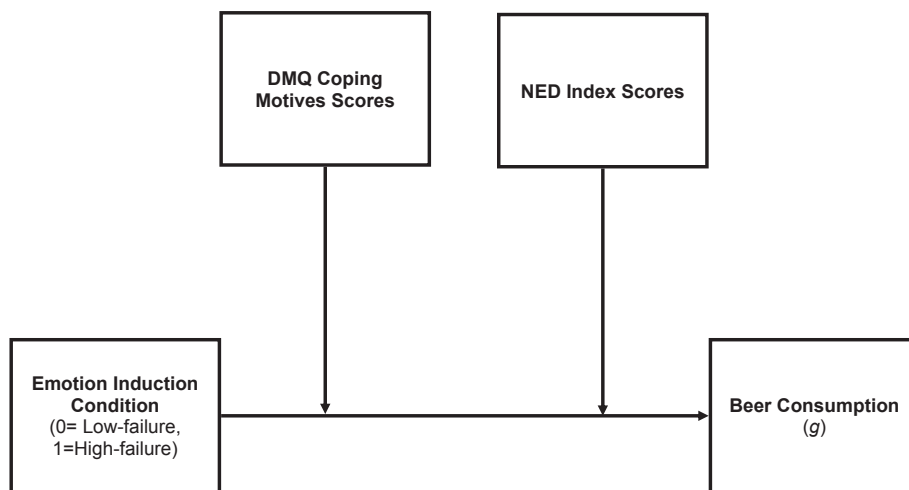


Fig. 2. A schematic for the moderated regression analysis to test whether self-reported individual differences predict negative-emotional drinking in the laboratory, covarying for Age and Sex.

and 3b for correlation scatterplots.

5. Discussion

Our findings demonstrate that negative-emotional drinking can be predicted in the laboratory by self-reports on the impact of negative emotion on alcohol consumption, but not by motives to use alcohol to cope. To our knowledge, this is the first study to demonstrate that self-reports predict observed alcohol consumption in response to negative emotion in the laboratory. In alignment with past research, our findings suggest that self-reports on observable behavior offer greater validity for predicting behavior than self-reports on motivations, which may be impacted by limited introspective access.

The strong, positive association between Coping motives and NED indices suggests that those who drink to cope do display a greater tendency to drink alcohol in response to negative emotion. However, this correlation indicated that only 24% of the variance was shared between these two variables. Therefore, 76% of the variance measured by self-reports on the impact of negative emotion on alcohol consumption was not indexed by coping motives. This finding suggests that, although those who endorse coping motives may report a greater impact of negative emotion on alcohol consumption, these two domains of individual differences measure somewhat unique constructs. This may be because self-reports on observable behavior are less affected by noise introduced by inaccurate responses when respondents are asked to provide motives for behavior, in line with classical studies by Nisbett & Wilson (Nisbett & Wilson, 1977) and Schwarz (Schwarz, 1999).

It is notable that the results of this study were not influenced by age. Although fewer young people report drinking to cope (Jerez & Coviello, 1998; Kairouz et al., 2002; Kuntsche et al., 2005; Plant et al., 1990), our behavioral data suggest that people may demonstrate increased alcohol consumption in response to negative emotion, regardless of age. Given that the current sample consisted mostly of tertiary students, it was possible that there was not enough variance in participants' age to detect such an effect. However, there was enough variance in these data to detect the frequently reported relationship between coping motives and age. On the other hand, there was no relationship between self-reports on the impact of negative emotion on alcohol consumption and age. This may offer further evidence that the tendency to engage in

(footnote continued)

consumption controlling for Age and Sex. Both relationships remained unchanged, with  $r = 0.11, p = .672$  (Low-failure condition) and  $r = 0.75, p < 0.001$  (High-failure condition).

Low-failure Condition

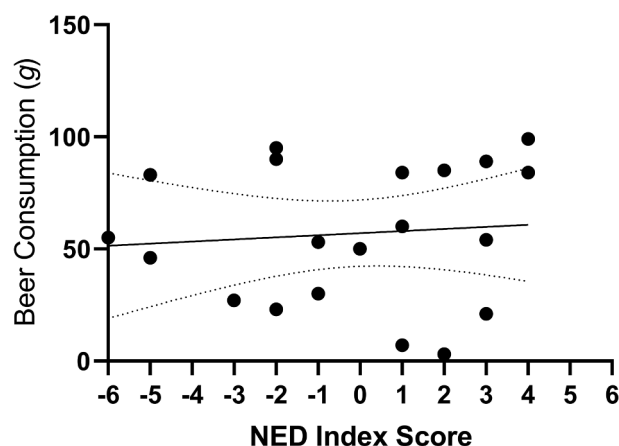


Fig. 3a. The relationship between NED index scores and beer consumption in the low-failure condition. Note. Maximum possible beer consumption = 300 ml.

High-failure Condition

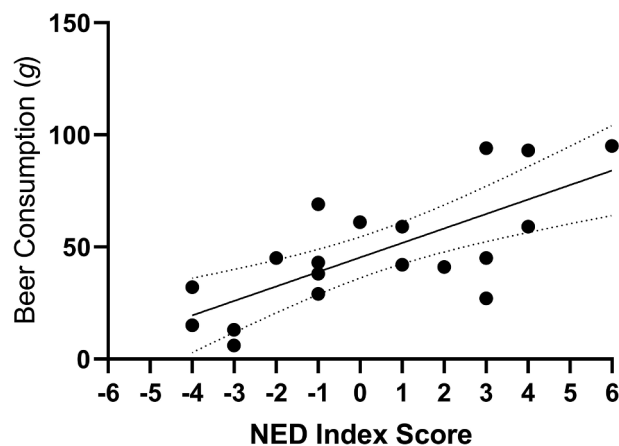


Fig. 3b. The relationship between NED index scores and beer consumption in the high-failure condition. Note. Maximum possible beer consumption = 300 ml.

negative-emotional drinking is not actually increased with age as data with self-reported coping motives have been interpreted to suggest. Further research should be conducted to more deeply evaluate, *a priori*, the relationship between self-reported negative-emotional drinking and age.

These findings provide rich opportunities for future research. First, the present methodology could be used to determine how self-reports of drinking in response to positive emotion (*positive-emotional drinking*) are associated with motives to enhance positive emotion, and whether they predict alcohol consumption after exposure to a positive experience. Second, this methodology could be used to investigate the impact of emotion on the consumption of other harmful substances, (e.g. tobacco, cocaine, heroin, amphetamines, cannabis) or problematic consumption behaviors such as binge eating. Third, a number of cognitive processes have been implicated in alcohol use (e.g. attention, approach-avoidance, interpretation, memory associations, inhibitory control) (Chow et al., 2018; Cox, Hogan, Kristian, & Race, 2002; Nederkoorn, Baltus, Guerrieri, & Wiers, 2009; Salemink & Wiers, 2014; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). In particular, there is increasing focus in the broader substance use literature on the role of positive and negative emotion on impulsivity, or positive and negative urgency (Cyders & Smith, 2008; Cyders et al., 2014; Pessoa, Padmala, Kenzer, & Bauer, 2012). These constructs represent individual differences in the tendency to act impulsively during states of heightened emotion (Cyders & Smith, 2008) and have been related to alcohol cognitions (Cyders et al., 2014) and use (Coskunpinar, Dir, & Cyders, 2013). Future research could investigate the role of these candidate cognitive processes in mediating the effect of negative emotion on drinking by using the present methodology for eliciting negative-emotional drinking in the laboratory.

As has been noted, theories implicating heightened negative emotion as an antecedent of alcohol use are typically silent with respect to whether negative emotion drives an increase in the *likelihood* of drinking alcohol, in the *amount* of alcohol consumed, or both. Both facets of consumption were highly correlated when using the self-report instrument employed in the present study<sup>3</sup>. However, if future research can successfully develop a psychometrically sound assessment instrument that more sensitively distinguishes variation on these two facets of alcohol consumption, then it will become possible to determine whether one or the other is more strongly affected by negative emotion. Additionally, it will be of considerable interest to establish how variation in self-reported negative-emotional drinking relates to other variables including, but not restricted to, alcohol-related problems and mental health indicators such as mood disorder symptoms. This represents another potentially valuable avenue of future research.

Although the Alcohol Consumption Task employed in the present experiment is widely used in laboratory studies, such a task does not permit conclusions concerning the impact of emotion on *problematic* drinking, given that the maximum possible consumption was one bottle of beer. Future extensions of the present research could employ measures of alcohol consumption better able to capture individual differences in the tendency to engage in heavy, protracted drinking episodes, which are often reported to characterize drinking in response to emotion (Cooper et al., 1995; Cooper, 1994; Kuntsche, Knibbe, Gmel, & Engels, 2006b). Ecological Momentary Assessment (EMA) methodologies could be employed for this purpose, to assess the naturalistic impact of negative emotion on alcohol consumption in real world settings (Wray, Merrill, & Monti, 2014), and we believe this would be an exciting future research direction. Future research should also employ larger samples, to overcome the limitation of the presently small sample size. Although this study revealed that observed alcohol consumption following negative mood induction was strongly predicted by our new

self-report measure of negative emotional drinking, and was not significantly predicted by coping motives, this does not preclude the possibility that coping motives may predict drinking in response to negative emotion within a larger sample. Finally, given that this study was conducted on a (majority) student sample, and considered only consumption of beer, replication with different cohorts and different types of alcohol drinks will be necessary to determine the generalizability of the present findings.

For the moment, however, the present findings suggest that researchers or clinicians seeking to accurately identify the emotional antecedents of drinking (with the goal of replicating this effect in the laboratory or ameliorating it in the clinic) should collect self-reports on observable behavior rather than motivations for drinking. Identifying the emotional antecedents of drinking or substance use (and associated mechanisms), will enhance our understanding of harmful consumption behavior and may provide novel targets for treatment and relapse prevention.

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### Declaration of Competing Interest

None.

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<sup>3</sup> The two items assessing the impact of negative emotion on the likelihood and amount of alcohol consumption were correlated at  $r = 0.60, p = <.001$ .

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