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The effects of a brief meaning in life intervention on the incentive salience of alcohol

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HIGHLIGHTS

- There is accumulating research showing that meaning in life is inversely related with alcohol use.
- We examined whether a life meaning induction reduced the incentive salience of alcohol (using an alcohol Stroop task).
- The intervention reduced incentive salience as measured by alcohol Stroop errors, but not as measured by reaction time.
- Incentive salience may be one mechanism through which individuals with greater life meaning regulate their alcohol use.

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ABSTRACT

There is an increasing body of evidence that life meaning is inversely related to alcohol consumption. Much of this research is cross-sectional and few studies have examined mechanisms for the inverse relation. The current study investigated whether a brief meaning intervention would lead to reduced incentive salience of alcohol. Seventy undergraduate students who reported regular alcohol consumption were assigned either to control or a meaning condition, which involved thinking about and committing to pursue intrinsically valued goals. The incentive salience of alcohol was operationalized as the extent to which alcohol cues interfered with the correct completion of an alcohol Stroop task. The results indicated that the meaning intervention led to reduced incentive salience as measured by alcohol Stroop errors, but not incentive salience as measured by reaction time. The findings suggest that incentive salience may be one mechanism through which individuals with greater life meaning regulate their drinking behavior.

1. Introduction

Alcohol consumption among university students is associated with a host of negative consequences, such as academic failure, negative health outcomes, assaults, and other criminal behavior (Perkins, 2002). Motivational models propose that problem drinking can be understood in part as a dysfunctional imbalance in incentive salience – i.e., the capacity of cues to elicit appetitive motivational responses of attracting attention and eliciting approach behavior (Robinson & Berridge, 1993). More specifically, this imbalance consists of excessively strong incentive salience of alcohol (Goldstein & Volkow, 2002; Robinson & Berridge, 1993; Wise & Bozarth, 1987) and excessively weak incentive salience of long term, non-alcohol reinforcers (Ainslie, 2017; Cox & Klinger, 1988). This imbalance is reflected in the DSM criteria for alcohol dependence, with enhanced incentive salience of alcohol represented in criteria such as craving for alcohol and spending a great

deal of time in obtaining and consuming alcohol. Devalued incentive salience of long-term, non-alcohol reinforcers are represented in criteria such as giving up important activities due to alcohol use and alcohol use leading to failures in fulfilling major role obligations (American Psychiatric Association, 2013). The current study examined whether increasing the salience of non-alcohol reinforcers would result in reducing the incentive salience of alcohol cues.

A variety of cognitive tasks have been used to examine the relation between the incentive salience of alcohol and problem drinking. These *indirect* (implicit) tasks operationalize incentive salience as the extent to which alcohol cues impair performance (greater errors and reaction time) on the targeted task specified in the instructions. For example, attentional bias tasks demonstrate that problem drinkers have difficulty in disengaging attention from alcohol cues in order to respond to the location of a target (Townshend & Duka, 2001). Related, modified Stroop tasks have shown that the extent to which the semantic meaning

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of alcohol words interfere with naming the color in which the words are printed is related to problem drinking. Such alcohol Stroop tasks have been shown to predict heavy drinking (Murphy & Garavan, 2011), post-treatment relapse (Cox, Hogan, Kristian, & Race, 2002), and reduced incentive salience of long-term reinforcers (Field, Christiansen, Cole, & Goudie, 2007).

A number of interventions have been developed to shift the dysfunctional balance involving excessive incentive salience of alcohol versus long term, non-alcohol reinforcers. One category of interventions focuses on directly reducing the excessive incentive salience of alcohol. This category consists of tasks designed to shift attentional bias away from alcohol cues (Fadardi & Cox, 2009) and evaluative conditioning tasks designed to reduce positive attitudes toward alcohol (Houben, Schoenmakers, & Wiers, 2010). Another category of interventions focuses on enhancing the incentive salience of long term, non-alcohol reinforcers.

Existential psychologists have long suggested that a meaningful life – that is, clarity of and commitment to pursuing intrinsically valued goals – serves as a protective factor against addiction and other clinical disorders (Frankl, 1959; Yalom, 1980). Related, Carl Jung's idea that the temptation of alcoholics could best be counteracted through commitment to higher-order values helped inspire the creation of Alcoholics Anonymous (Alcoholics Anonymous, 2001; Jung & Adler, 2014). Recent theorizing by self-regulation researchers has adopted a similar model of self-control in which outcomes are understood as a conflict between the relative value of two behavioral options instead of as a dual-process conflict between hot/impulsive processes and cold/deliberative inhibitory processes (Berkman, Hutcherson, Livingston, Kahn, & Inzlicht, 2017). The idea that meaning protects against heavy drinking has been supported in a number of studies. For example, several studies have shown that greater life meaning predicts less alcohol consumption in university students (Palfai & Weafer, 2006; Schnitzer, Schulenberg, & Buchanan, 2013; Shamloo & Cox, 2010). Research with patient samples has similarly shown an inverse relation between life meaning and alcohol behavior. One study found that life meaning predicted greater perceptions of the ability to control alcohol consumption (Marsh, Smith, Piek, & Saunders, 2003) and another found that life meaning predicted better post-treatment outcomes for alcohol dependent patients going through a skills-based intervention (but not patients in a treatment program based on confrontation) (Waisberg & Porter, 1994).

Although the initial findings are promising, little is known about how meaning may allow the individual to overcome craving for alcohol and other drugs. One study found that individuals with greater life meaning are more motivated to limit their drinking behavior (Palfai & Ralston, 2011). Another possibility is that a meaningful life reduces the incentive salience of alcohol. Such an effect could be due to (i) perceiving the capacity of alcohol to change affect (more positive or less negative) to be less valuable when there are important non-alcohol incentives that can reliably lead to affective changes without the costs involved in drinking (Cox & Klinger, 1988) or (ii) the costs of alcohol consumption outweighing the benefits when there are valued life goals with which drinking may interfere (Miller & Rollnick, 2013).

The current study was designed to examine whether a meaning intervention would reduce the incentive salience of alcohol cues. We examined this idea in a sample of undergraduate participants who reported that they regularly consumed alcohol. Specifically, we hypothesized that compared to control, participants who were reminded of their valued goals and developed plans for achieving those goals would show reduced incentive salience of alcohol in a modified Stroop task, operationalized as reduced interference of alcohol words (relative to non-alcohol words) in naming the color in which words were printed.

2. Method

2.1. Participants

Eighty-three undergraduate students from a Dutch university volunteered to participate in a study as partial fulfillment of a course requirement. The study was conducted in English; participants were fluent in English, as they were recruited from the English-language psychology program in the department. The study was approved by the psychology department Institutional Review Board. The study advertisement recruited students who regularly consumed alcohol to participate in a study on the topic of alcohol and attention. The data from 13 participants were omitted from the analyses for the following reasons: (i) five participants did not have data from the alcohol Stroop task (due to computer or experimenter error), (ii) three participants did not have baseline questionnaire information, including measures of color blindness and alcohol consumption (both of which are used for study inclusion), (iii) two participants did not consume alcohol, (iv) two participants did not receive an intervention (due to computer or experimenter error), and (v) one participant was color blind. The remaining 70 participants were mostly male ($n = 37$) and had a mean age of 20.6 ($SD = 2.0$) years.

2.2. Materials

2.2.1. Typical alcohol use

Alcohol use over the previous month was assessed with the Daily Drinking Questionnaire (Collins, Parks, & Marlatt, 1985). Participants reported how many servings of alcohol they typically consumed for each day of the week. Two variables were calculated from this measure – frequency of alcohol consumption and average number of servings consumed per drinking occasion. The servings per occasion variable demonstrated a positive skew and was thus log-transformed.

2.2.2. Incentive salience of alcohol cues

A computerized version of the modified Stroop task was administered to measure participants' attentional bias toward alcohol. The task was presented on Inquisit software (Draine, 2004). The task stimuli consisted of ten alcohol related words (Vodka, Gin, Wine, Alcohol, Whiskey, Pint, Liquor, Beer, Lager, and Brandy) and ten alcohol-unrelated words consisting of the names of musical instruments (Piano, Oboe, Banjo, Guitar, Flute, Violin, Trumpet, Drums, Cello, and Clarinet). These stimuli have been used in previous research (Cox, Yeates, & Regan, 1999). The words were displayed in one of three colors: red, blue, or green.

Participants were instructed to indicate the color in which each word was displayed by pressing one of three response keys that had a red, blue, or green sticker on it. Participants were instructed to respond as quickly and accurately as possible. The word "Error" (displayed in red) was presented after incorrect responses and remained on the screen until the correct response was made. A 300 ms interval separated each trial. Before starting the actual task, the participants were administered 12 practice trials using four stimuli that were not used in the critical trials (Box, Card, Telephone, and Invitation). After a reminder of the task instructions, four lead-in trials were administered using the same stimuli as the practice trials, after which the critical trials were administered. Following the recommendations of Cox and colleagues (Cox, Fadardi, & Pothos, 2006), the main task was presented in blocked format. That is, three blocks of alcohol stimuli were presented, with each block consisting of 30 trials (each word was presented once in each of the three colors). After this, three blocks of the music stimuli were presented.

2.2.3. Meaning and control inductions

Participants were randomly assigned to one of two conditions, both of which involved reading an essay (377 words), summarizing the essay

(maximum of 25 words), and then receiving further essay-specific instructions (i.e., listing important or unimportant goals). The meaningful values manipulation consisted of reading an essay about the importance of living an authentic life versus a life of conformity to the group. After summarizing the essay, participants were instructed to list three “true-self” values (e.g., “...the main thing is that these are values that you hold deeply, irrespective of what others think is important.”) and one behavior they could exert over the next month that would be in accordance with each value. The unimportant values (control) manipulation consisted of reading an essay about the group-level benefits of subsuming individuality to the group. After summarizing the essay, participants were instructed to list three values of their group of origin that were personally unimportant (e.g., “...values present in the culture in which you were raised but which you DO NOT find to be meaningful”) and one behavior they have done that was in accordance with each value. The meaningful values manipulation was adapted from Ostafin and Proulx (2018), who found that compared to control, this manipulation led to a greater sense of purpose in life.

2.2.4. State affect

State positive and negative affect were assessed with two items, “Right now, I feel positive (negative)” using a 10-point scale ranging from 1 (*Not at all*) to 10 (*Very much so*).

2.3. Procedure

Participants were run in groups of one to three participants seated in private workstations. Participants first received instructions about the study protocol and signed an informed consent form. Participants were assigned to either a meaning condition ($n = 36$) or control ($n = 34$). The baseline questionnaires (including alcohol use and baseline state affect) and manipulations were administered by a batch file so that the experimenter was unaware of the manipulation condition. Once the manipulation was completed, participants completed the post-manipulation measures of state affect and then notified the experimenter, who then started the alcohol Stroop task. Following completion of the study, the participants were thanked, debriefed and dismissed.

3. Results

3.1. Data reduction

The alcohol Stroop effect was calculated both with error rates and with reaction times. Responses faster than 200 ms or slower than 2000 ms were considered to reflect anticipations or distractions and were omitted from all analyses (0.40% of data). The error rate scoring of the alcohol Stroop was calculated as a difference score of the percent of errors of the remaining alcohol trials (5.27%, $SD = 4.86$) minus the percent of errors of the remaining music trials (5.41%, $SD = 4.57$). The score of one participant (in the unimportant values condition) on the error rate Stroop (14.44 errors) represented an outlier (mean + 3 SD) and was thus omitted from analyses. The reaction time scoring of the alcohol Stroop was calculated by first removing the errors (5.34% of the total data) and creating a difference score of the mean reaction time of the remaining alcohol trials (628.98 ms, $SD = 80.58$) minus the mean reaction time of the remaining music trials (635.51 ms, $SD = 79.22$). See Table 1 for the means, standard deviations, and correlations among the study variables.

3.2. Effect of intervention on alcohol Stroop task

We hypothesized that the meaningful values intervention would result in reduced interference of alcohol cues in an alcohol Stroop task. The results supported this hypothesis regarding error rates, with the alcohol cues (relative to control cues) showing more interference in the control group ($M = 0.35$ errors, $SE = 0.44$) compared to the meaning

Table 1

Bivariate Correlations Among Study Variables ($N = 70$).

Variable	Mean	SD	1	2	3
1-Error rate stroop	-0.35	2.67	–		
2-RT stroop	-5.07	47.60	-.04	–	
3-Alcohol frequency	3.26	1.55	.27*	.22	–
4-Alcohol quantity/occasion	4.60	2.	.05	-.12	.16

Note. The error and reaction time (RT) measures of the alcohol Stroop represent a difference score of alcohol (error rate or RT) minus music (error rate or RT). Positive scores for the Error rate Stroop and RT Stroop thus indicate greater interference by alcohol stimuli. For the error Stroop correlations, $N = 69$. The log-transformation of the quantity/occasion variable is used in the analyses.

* $p < .05$.

Fig. 1. Effects of meaning intervention on interference of alcohol cues as assessed by the alcohol Stroop measured by the difference score of alcohol error rate minus music error rate (top panel) and alcohol reaction time minus music reaction time (bottom panel). Error bars represent 1 SE.

group ($M = -1.08$ errors, $SE = 0.44$), $F(1,67) = 5.23$, $p = .025$. The partial eta-squared of this result was 0.072, representing a medium effect size. The hypothesis was not supported with the reaction time index of the alcohol Stroop, as the control group ($M = -8.99$ ms, $SE = 8.19$) showing no difference from the meaning group ($M = -3.94$ ms, $SE = 8.42$), $F(1,68) = 0.19$, $p = .668$. See Fig. 1 for a graphical representation of the alcohol Stroop results and see Table 2 for the two conditions' mean error rate and reaction time values for each category of Stroop task stimuli. The control and meaning groups did not differ on age, sex, typical alcohol consumption, or state positive or negative affect after the manipulation (controlling for baseline), p 's > 0.50 , indicating that these variables did not confound the results.

4. Discussion

The idea that temptation can be overcome by increasing the value of competing goals has a long history in psychology, from the clinical theories of Viktor Frankl and Carl Jung to modern elaborations by self-regulation researchers (Berkman et al., 2017). Although this idea is

Table 2

Mean reaction time (in milliseconds), error rates (%), and Stroop interference scores as a function of condition.

Measure	Meaning condition		Control condition	
	Mean	SD	Mean	SD
Error rate, alcohol stimuli	5.13 ^A	(3.93)	4.57 ^A	(2.73)
Error rate, music stimuli	6.21 ^A	(5.01)	4.22 ^A	(3.11)
RT, alcohol stimuli	630.28 ^A	(63.79)	627.74 ^A	(94.66)
RT, music stimuli	634.22 ^A	(75.31)	636.73 ^A	(83.80)
Error rate Stroop	−1.08 ^A	(2.94)	0.35 ^B	(2.20)
RT Stroop	−3.94 ^A	(55.46)	−8.99 ^A	(42.25)

Note. RT = reaction time. The Error rate Stroop and RT Stroop scores represent a difference score of alcohol (error rate or RT) minus music (error rate or RT). Positive scores for the Error rate Stroop and RT Stroop thus indicate greater interference by alcohol stimuli. Values in each row that have different superscripts indicate a group difference of $p < .05$.

supported by findings that meaning in life is inversely related to alcohol consumption (Palfai & Weafer, 2006; Schnitzer et al., 2013), previous research with life meaning has generally used cross-sectional designs and has rarely examined mechanisms through which the inverse relation occurs. Given theory that a meaningful life should reduce the need for and thus attractiveness of alcohol as a means of emotion regulation (Cox & Klinger, 1988) and should increase the cost to benefit ratio of consumption (Miller & Rollnick, 2013), we expected that an experimental design involving reflection on and commitment to valued goals would reduce the appetitive incentive salience of alcohol stimuli as measured by an alcohol Stroop task.

The results of the current study showed that the meaning intervention led to reduced incentive salience as measured by alcohol Stroop errors but did not lead to reduced incentive salience as measured by reaction time. The positive finding with alcohol Stroop errors suggests that one reason why individuals who experience life meaning drink less is that they find alcohol to be relatively unattractive. That is, alcohol should be less tempting and thus be less likely to attract attention and elaborative processing that contribute to greater likelihood of consumption (May, Kavanagh, & Andrade, 2015).

There were several strengths in the study design. One strength was the use of an experimental design to investigate the relation between life meaning and the incentive salience of alcohol, thus facilitating the ability to make causal inferences. A second strength was the use of an indirect measure to assess the incentive salience of alcohol, thus reducing the likelihood of experimental demand and increasing the ability to capture the automaticity involved in incentive salience (De Houwer, 2006). A third strength is that researchers were blind to the manipulation condition, thereby reducing the possibility of experimental demand.

In addition to the study strengths, the design also resulted in a number of limitations regarding the inferences that can be made from the results. One limitation is that the study did not assess the influence of the meaning intervention on post-session drinking behavior. Thus, the results are best interpreted as suggesting the potential usefulness of incentive salience as a mediator of the meaning-alcohol use relation. This potential should be examined in future research that includes both a measure of incentive salience and subsequent alcohol consumption in daily life. Such research with the aim of examining mediation would bring together and extend disparate findings that (i) enhancing life goals may lead to reductions in the incentive salience of alcohol cues (current study), (ii) enhancing life goals may lead to less alcohol consumption (Cox, Fadardi, Hosier, & Pothos, 2015) and (iii) incentive salience as measured by the alcohol Stroop predicts alcohol-related behavior (Cox et al., 2002). The sample represents another limitation, as it is unclear whether the effects generalize to individuals diagnosed with alcohol use disorder. Future research should include a design that allows for a clearer examination of mediation in a clinical sample. A

third limitation is that the single presentation of the alcohol Stroop limits the ability to examine whether the meaning intervention's effects were due to influence on the processing of the alcohol stimuli, the music stimuli, or both. Designs that administer the alcohol Stroop both before and after the meaning intervention will allow a more detailed examination of how the intervention may work. Another possible limitation regards the use of music stimuli as a contrast category. Music as a contrast category has several benefits, including that it controls for the semantic relatedness found among the alcohol category stimuli and that an alcohol Stroop with a contrast category of music has demonstrated construct validity (Cox et al., 1999). However, the relevance of music for young adults means that there are likely to be individual differences in the incentive salience of music, thereby creating noise in the ability of the modified Stroop to assess incentive salience to alcohol cues. Future research may benefit from the use of a semantically related contrast category that is more nearly neutral to participants (Jonides & Mack, 1984).

Although the meaning intervention led to less incentive salience of alcohol cues when the alcohol Stroop interference was measured with errors, it did not do so when interference was measured with reaction time. The reason for this discrepancy is unclear. Alcohol Stroop studies generally report either the error or the reaction time interference score, though previous research that reports both has found that the error score shows a stronger relation with alcohol behavior (Duka & Townshend, 2004; Duka, Townshend, Collier, & Stephens, 2002). The correlation results in the current study also showed that alcohol behavior was more strongly related with the error score than the reaction time score. Given that previous research has also found that the error score but not the reaction time score increased after a preload dose of alcohol (Duka & Townshend, 2004), it is possible that the alcohol Stroop error score is more sensitive to alcohol-related manipulations.

In sum, the current study indicates that a life meaning intervention can reduce the incentive salience of alcohol. The results support and extend previous research on the relation between meaning and alcohol use by using an experimental design, thereby allowing causal inferences regarding the influence of meaning on alcohol-related outcomes and by examining incentive salience as a potential mechanism of the inverse meaning-alcohol use relation. The question of how to facilitate self-control in the face of temptation is an old one. Previous work suggests that meaning facilitates self-control by increasing motivation to inhibit alcohol impulses (Palfai & Ralston, 2011). The current study adds the perspective that meaning may also facilitate self-control by reducing the relative strength of the impulse.

Declarations of interest

None.

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