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The Effects of Treatment as Usual supplemented with Alcohol Avoidance Training on Approach-Avoidance Bias and Alcohol Consumption in a Double-Blinded Randomized Control Trial Employed in an Outpatient Treatment Setting

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The Effects of TAU supplemented with AAT on Avoidance Bias and Alcohol Consumption.

Abstract

Background: Alcohol abuse is a severe problem in today's society that can lead to a range of social, physical and psychological problems. Research suggest that addictive behaviour can partially be explained by implicit cognitions and that cognitive bias modification is effective in decreasing alcohol consumption by retraining approach biases into avoidance biases.

Objective: The aim of the current study was to investigate whether or not treatment as usual supplemented with cognitive bias modification training would lead to a stronger decrease of alcohol consumption when being compared to treatment as usual supplemented with a placebo condition. Further, it was assessed whether the training had an effect on the avoidance bias scores and whether or not part of the effect of the training on alcohol consumption operated via the avoidance bias.

Methods: The current study was a double-blinded randomized placebo-controlled study conducted online with an outpatient sample. Two datasets were used. The main dataset only included participants that took part in all pre and post-test (n=83). Additionally, another dataset was constructed with multiple imputations (n=139).

Results: Results of both datasets were compared, and indicated that condition (training, placebo) had no effect on alcohol consumption. Further, no mediation effect was found. However, it was found that the training had an effect on avoidance bias scores. Participants in the training condition had a stronger avoidance bias after the training when compared with participants in the placebo condition.

Conclusion: In contrast to previous studies, the current study did not find a significant effect of condition on alcohol consumption. However, previous studies have used inpatient samples. Therefore, future research should assess the different results of inpatient and outpatient samples.

Introduction

Nowadays, alcohol consumption is widely seen as normal. According to the World Health Organisation (WHO, 2018), around 3.1 billion people consume alcohol. However, of those, an estimate of 76.3 million people worldwide is considered to have an alcohol use disorder, which is characterized among other by the abuse of alcohol (National Institute on Alcohol Abuse and Alcoholism, n.d.; WHO, 2018).

Alcohol abuse can affect the individual and his or her surrounding in several negative ways. The study of Whitman et al. (2017) found a link between cardiac disease, one of the most common causes of death, and alcohol abuse. According to the WHO (2018) there are an estimate of 200 types of diseases and injuries that can be linked to alcohol abuse as it affects practically every organ in the human body. Further, the abuse of alcohol can lead to a range of psychological and mental problems. Findings of the study of Fergusson, Boden and Horwood (2009) suggest that alcohol abuse increases the risk of being affected by a major depression. Additionally, alcohol abuse is related to or comorbid with mania, hypomania, panic disorders, phobias, suicide and many more (Cargiulo, 2007; WHO, 2018). Alcohol abuse does not only affect oneself but also society and ones surrounding. According to the Centers for Disease control and Prevention (n.d) drunk driving was the cause of 28% of all traffic related death in 2016 in the USA. Additionally, heavy drinking can be related to violent crimes (Murdoch & Ross, 2009). According to the WHO (2018), alcohol is the cause of around 3 million deaths and many more injuries per year. Therefore, it can be stated that the negative effects of alcohol misuse range from social, physical to mental harms and are a major problem in today's society.

Paradoxically, most people who abuse alcohol know that this kind of behaviour is harmful to them and can lead to the above-mentioned negative consequences (Stacy & Wiers, 2010). According to Stacy and Wiers (2010) addictive behaviour can be partially explained by implicit cognitions. While some decisions are based on a careful reflection of the potential consequences, others are guided by memory associations that are unconsciously activated. Those associations are learned through numerous experiences in different conditions. The associations are activated spontaneously and guide behaviour unconsciously. Therefore, an individual does not notice that the association is activated and that it influences his or her behaviour. According to Stacy and Wiers (2010), even if an individual would reflect on the behaviour influenced by such an association, her or she would not be able to detect the association. This also seems to be the case with alcohol addiction and several different implicit cognitive biases have been found that play a role in it (Field & Cox, 2008; Palafai &

Ostafin, 2003; Wiers, Eberl, Rinck, Becker & Lindenmeyer, 2011; Wiers, Van Woerden, Smulders & De Jong, 2002). The three main groups of biases are attentional bias, memory bias and approach-avoidance bias.

The current study will focus mainly on the approach-avoidance bias. The approach bias can be defined as "a behavioural tendency to be faster at approaching rather than avoiding drug cues" (Watson, de Wit, Cousijn, Hommel & Wiers, 2013, p.250). This bias is assumed to guide individuals to physically approach a (alcohol) cue in an environment, rather than to avoid it (Schumacher, Kemps & Tiggemann, 2016). Measurements of the approach bias have been found to correlate with drug and alcohol abuse (Field, Kiernan, Eastwood & Child, 2008; Watson et al., 2013). Field et al. (2008) found that heavy drinkers were faster in approaching alcohol cues than light drinkers. Further, the approach bias has been associated with craving as well as relapse and an increased appetitive motivation to drink alcohol (Schoenmakers, Wiers & Field, 2007).

Avoidance bias can be seen as the opposite of the approach bias. In the study of Wiers et al. (2011), patients that had been trained to avoid alcohol drank less than patients in the approach condition and had a decreased relapse rate. Interestingly, several studies have found that abstaining alcohol-dependent patients as well as early adolescent heavy drinkers had automatically activated avoidance tendencies and a relative avoidance bias when presented with alcohol cues (Van Hemel-Ruiter, De Jong & Wiers, 2011; Wiers et al., 2011). Spruyt et al. (2013) assume that this is due to an inner conflict, arising between the immediate temptation to drink alcohol and the long-term goal not to do so. This assumption is in line with the findings of Fischbach and Shah (2006). In their study, individuals had to either push or pull a lever in response to stimuli. A pushing response is assumed to display avoidance tendencies while a pulling response is assumed to display approach tendencies. The stimuli were either temptation related (e.g. partying) or related to a long-term goal (e.g. studying to eventually obtain good grades). Findings showed that individuals compensated tempting stimuli by a faster pushing response, therefore displaying avoidance tendencies. The opposite was observed when individuals were confronted with stimuli related to their long-term goals.

According to the article of Barkby, Dickson, Roper and Field (2011) approach and avoidance tendencies are guided by two motivational systems. If confronted with a cue, behaviour can be directed towards it by the approach motivational system or directed away from it by the avoidance motivational system. Therefore, research suggests that alcohol abuse is a result of an overactivation of the approach motivational system and an under activation of the avoidance motivational system (Ostafin, Palfai & Wechsler, 2003).

In order to direct individuals towards avoiding alcohol related cues, the above-mentioned automatic processes need to be retrained. The most common treatments for alcohol addiction are cognitive behaviour therapies (CBTs). CBTs have been found to be effective in the treatment of alcohol use disorders (Magill & Larry, 2009; Riper et al., 2014). However, CBT programs mainly focus on the conscious decision-making processes (Thush et al. 2009; Wiers, Van De Luitgaarden, Van Den Wildenber, & Smulder, 2005). Therefore, the implicit cognitive biases are not or only secondary targeted. However, some CBT programs have been augmented with cognitive bias modification (CBM) trainings. The CBM programs are computerized training programs that are able to target, among other, attentional biases, memory biases and approach biases which are all considered implicit cognitive biases related to alcohol use disorders (Field et al., 2007; Hoouben, Havermans, Nederkoorn & Jansen, 2012; Houben, Nederkoorn, Wiers & Jansen, 2007; Wiers , Rinck, Kordts, Houben & Strack, 2010; Wiers et al, 2011; Eberl et al., 2013). By targeting those biases, the CBM programs have been shown to be effective in reducing drinking behaviour and decreasing the relapse rate of individuals with drinking problems.

The retraining of automatic tendencies to approach alcohol, using CBT programs that have been augmented with CBM trainings, has been conducted in several studies. Especially Wiers and colleagues have been doing a lot of research in this area (e.g.: Wiers et al., 2010; Wiers et al., 2011). In their study, Wiers et al. (2010) tested whether or not it was possible to modify automatic action-tendencies to approach alcohol. Further, they wanted to see if this would affect drinking behaviour. In order to do so, they used a sample of 42 hazardous drinkers who were randomly assigned to two conditions. Depending on their condition, participants had either to push or pull a joystick. Similar to the above-mentioned study of Fischbach and Shah (2006), pulling the joystick was associated with approach tendencies while pushing the joystick was associated with avoidance tendencies. This notion is the same for all subsequently named studies that use the same procedure, as well as the current study itself.

In their study, Wiers et al. (2010) employed an implicit training procedure. The participants had to pull or push the joystick depending on a picture-format (landscape or portrait). The pictures themselves depicted alcoholic or non-alcoholic drinks. When assigned to the avoid-alcohol condition they had to pull mostly non-alcoholic drinks and push mostly alcoholic drinks. For the participants in the approach-alcohol condition it was the other way around. Therefore, the participants were engaging in an implicit training as they did not directly focus on the beverages. The post-test showed that the automatic approach tendencies

changed depending on the condition the participants were in. Especially, for the avoid-alcohol condition a large effect was found. The effect even generalized to different test, e.g. when words instead of pictures were used. The drinking behaviour change also in accordance with the condition. Participants in the avoid-alcohol condition drank less when compared to the once in the approach-alcohol condition. Importantly, the effects occurred outside the patience subjective awareness. Therefore, the results seem to be in accordance with the notion that (unhealthy/addictive) drinking behaviour can be explained by implicit cognitions and that those can also be used to alter such behaviour.

In another study, Wiers et al. (2011) used a CBM intervention to especially target the approach bias. The sample of this study consisted of 214 alcoholic inpatients that were assigned to two experimental and two control conditions. It was thereby the first study that tested the CBM method in a clinical sample. In the first experimental condition, participants received explicit instructions. They had to push away pictures of alcoholic drinks and pull the joystick when seeing a non-alcoholic drink. In the second experimental condition patients had to react to the same irrelevant feature used in the study of Wiers et al. (2010). In the control conditions, the participants received an equal amount of alcoholic and non-alcoholic drinks they had to approach or avoid. After conducting the CBM intervention all participants received abstinent-oriented inpatient CBT-based treatment for about 3 months. Results showed that the CBM intervention was able to retrain the approach to an avoidance bias. Further, it also seemed to have a long-term effect as relapse rates in the experimental group were significantly lower than in the control group, one year after the initial study.

The results of the studies mentioned above indicate that implicit automatic approach tendencies can be retrained towards automatic avoidance tendencies. Further, CBM interventions seem to be effective when trying to retrain automatic approach tendencies. Additionally, it was associated with less alcohol consumption directly after the training and a reduced relapse into drinking behaviour after a year (Eberl et al., 2013; Wiers, et al., 2010). However, by now, the results can only be attributed to alcohol – dependent inpatients. The current study is therefore interested in examining the effect the training has on the avoidance bias as well as subsequent alcohol consumption, when administered/used online in an outpatient sample.

The Present Study. In this study, it is hypothesized that participants of the Treatment as Usual (TAU) + CBM training condition (subsequently named Training) will have a stronger decrease of alcohol consumption when compared to the TAU + Placebo condition (subsequently named Placebo) (H1). Second, it is hypothesized that Training has a stronger

effect on the Avoidance Bias when compared to Placebo (H2). Third, it is hypothesized that the post-test Avoidance Bias scores negatively correlate with the post-test alcohol consumption scores (H3). Fourth, it is hypothesized that part of the effect of the added CBM Training on alcohol consumption operates via Avoidance Bias (H4, see figure 1).

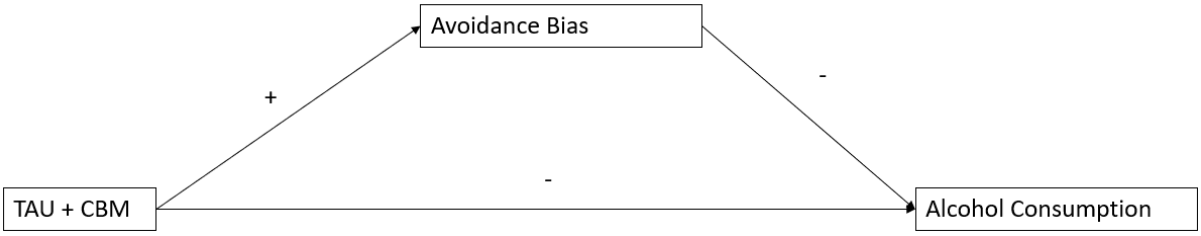

Figure 1: Hypothetical Model of TAU+CBM and Avoidance Bias effects on alcohol consumption as well as assumed mediation.

Methods

Participants

The participants of the current study were of the age 18 years or older. The requirement to take part in the study was that the participant had to have a primary alcohol problem. Further, the participant needed to follow the TAU at the Tactus Addiction Treatment Institute in the Netherlands. Additionally, the participant needed to have access to the internet as well as the ability to use it. The exclusion criteria were "(1) serious psychiatric illness with a risk to decompensate while decreasing alcohol consumption; and (2) the possibility of sever physical illness as a consequence of decreased alcohol consumption" (Bratti-Van der Werf et al., 2018, p.3). In the current study, the data was only analysed while the screening procedure as well as the testing was done by Bratti-Van der Werf et al. (2018).

Trial Design

The current study was a double-blinded randomized placebo-controlled study conducted online with an outpatient sample. The participants were randomly assigned to one of two conditions. In the training condition, participants received TAU supplemented with CBM alcohol avoidance training. In the placebo condition, participants received TAU supplemented with a CBM placebo training. Participants were assigned automatically, therefore without the involvement of the researchers (Scot, McPherson, Ramsay & Campbell, 2002). Further, the design was double-blinded. Therefore, the condition the participant was assigned to was neither known to the researcher nor the participant him-herself. By the means

of a manipulation check, the participant's awareness of the condition he or she was on, was checked in a post assessment.

Trial Procedure

The participants were recruited by therapists that work at the Tactus Addiction Treatment Institute. First, an intake procedure was conducted. This included baseline questionnaires. Second, the TAU started and before the goal-setting assignment was reached by the participant, the therapist would inform him or her about the CBM training. If the participant was interested, he or she was provided with further information about the study. After agreeing to participate, the participant will receive an informed consent. In the case that the participant signs the form, he or she receives his or her login credentials for the CBM training. As the training was designed for an outpatient population, the participant received his or her information on how to conduct the training after logging in. The CBM training started at once with the behaviour change part of the CBT treatment. Patients were asked to conduct a CBM session twice per week. Before each training session the participant was asked to fill out a self-report on weekly alcohol consumption. Overall, participants took part in eight CBM training sessions with a duration of 15 minutes per session over the course of five weeks. An online pre-as and post assessment was conducted before the first - and after the last training. After completing all sessions, the participants received a € 20 voucher. Further, after three and six months, each participant received a follow-up questionnaire.

The Interventions

Treatment as Usual. The TAU was conducted in an outpatient treatment setting. It was mainly guided by the principles of cognitive behaviour therapy as well as motivational interviewing (Hester & Miller, 1995; Miller & Rollnick, 2002). Each participant received an individually tailored form of the TAU depending on his or her needs. The treatment was either face-to-face or web based. Nevertheless, the sessions were identical except for contact with the therapist. In the face-to-face version, the contact was synchronous while in the web-based version, the contact was asynchronous. Further, the intensity (5 weeks or 3 month) was also based on the needs of the participants. When assigned to the 3-month version, participants had one to two sessions per week. Each day, they were asked to report their alcohol consumption. The first part of the training was focused on the drinking habits of the patients. The second part was focused on the desired behaviour change based on goals that the client had set him-or herself. The purpose of the first part was to give the patients insight into their drinking behaviour. When participants already gained that knowledge, they were

assigned to the 5-week version of the treatment as this was identical with the second part of the 3-month training. However, the essential basic ingredients were the same for everyone.

The current study investigated whether or not the added CBM training had an effect on alcohol consumption as well as the avoidance bias. Therefore, no differentiation of the four subgroups was done. However, as participants were randomly assigned, it was expected that both treatment modality and intensity were equally distributed among the experimental and control group.

CBM Training. The current study used the Alcohol Avoidance Training (Eberl et al., 2013; Wiers et al., 2011). This training was based on the Approach-Avoidance Task (AAT; Wiers, Rinck, Dictus & Van Den Wildenberg, 2009). Participants are presented with pictures that either depict alcoholic beverages or soft drinks. However, instead of focusing on what the picture was showing, participants were asked to respond to the format of the picture (either tilted 3 degrees to the right or to the left). Participants were asked to respond to avoid the one format (e.g. when tilted to the right) and approach the other (e.g. when tilted to the left).This was done by striking the "u" key (avoid) or the "n" key (approach) or by the aforementioned pull – push movement. A zooming effect was used, thus if the participant selected "approach" the picture increased in size while it decreased in size if the participant selected "avoid". This version of the training is called the irrelevant-feature version as participants were not responding to the content of the picture itself (Eberl et al., 2013; Wiers et al., 2011). According to De Houwer and Moors (2010), approach avoidance tasks are implicit measures. Implicit measures are "the outcome of a measurement procedure that is casually produced by psychological attributes in an automatic manner" (De Houwer & Moors, 2010, p. 178). Using an implicit measure provides the advantage that the condition allocation (training vs. placebo) is blinded and that the switch from measurement to training can be made without changing the content of the pictures (Wiers, Gladwin & Rinck, 2013).

Measurements

Demographics. Items for the following demographics of the participants were included in the baseline assessment of the TAU: Gender, age and nationality.

Alcohol Consumption. In order to assess the weekly alcohol consumption, the Timeline Follow Back (TLFB) method was used (Bratti-Van der Werf, et a., 2018; Sobell et al., 2001). The participants were asked to fill in an estimate of the number of standard alcohol units they had consumed in the previous week. According to Sobell et al. (2001) the TLFB is reliable and valid when used on outpatient alcohol abusers.

Approach-Avoidance Bias. In order to assess the Approach Avoidance bias of the participants the Approach-Avoidance pre-and post-training (AAT) was used (Eberl et al., 2013). The training consisted of a total of 172 trials. There were two types of trials, the 12 practice trials and the 160 assessment trials. The assessment trials were further divided into four blocks. During the assessment, participants were randomly assigned to either set A or set B. Each set consisted of 20 pictures depicting alcohol beverages and 20 pictures depicting soft drinks. They were presented 4 times with the 2 formats (tilted to either left or right) as well as two repetitions. In both formats, both kinds of pictures were equally often presented.

In order to measure the change of the bias, the scores of the pre- and post-assessments were used. Participants had to either push pictures away or pull them towards themselves. The median reaction time scores were calculated for pushing the pictures as well as pulling the pictures of one category. Higher (positive) median reaction time scores indicated approach tendencies while lower (negative) scores indicated avoidance tendencies.

Statistical Analysis

The results of the current study were calculated with the statistical program SPSS as well as the PROCESS add-on for SPSS (Hayes, 2013; Hinton, McMurray & Brownlow, 2014; Preacher & Hayes, 2004). The mean age of the participants was calculated, and the distribution of gender and nationality assessed. Further, baseline characteristics, like the mean average alcohol consumption and the mean bias score before the training, were calculated. For all analysis, only cases that had values in all three post-tests were included.

The exclusion of participants with incomplete data majorly reduced the dataset. Therefore, a multiple imputation analysis was conducted. This was done in order to check whether or not the exclusion of the participants had a significant effect on the results as well as to conduct analysis according to the intention to treat principle (ITT) (McCoy, 2017). The multiple imputation was also done with SPSS. The aim of multiple imputation was to replace missing data with data that was most likely to be similar to the current data that was available (Graham 2012; Rubin & Schenker, 1991). Before conducting a multiple imputation, it was crucial to check for patterns in the missing values and whether or not the missing data was missing randomly or systematic (Van Buuren, 2011). For example, whether or not there was a specific question that was not answered by all the participants. In the case of the current study, the missing value patterns showed a random pattern. Therefore, the chance for a bias in the missing values was minimized. The analysis of the missing values further showed that all variables had missing data. Further, 108 cases missed values while 31 cases were complete.

Additionally, 20.22% (281 out of 1.109) of all values were missing. Accordingly, a multiple imputation adjusted to the findings of the analysis was conducted.

In the case of the current study, 10 imputations were used. Therefore, the program ran 10 imputations, performed in a sequence. During each of those imputations, SPSS checked for patterns in the available data in order to make a probability judgment about what the missing values would most likely be (Graham 2012; Rubin & Schenker, 1991). In the end of the imputations, the values of all of the imputations were averaged together in order to take into account the variance of the missing values (Graham, 2012, Rubin & Schenker, 1991). Thereby, the missing values were replaced with a value that was likely to be very accurate to the value that could have been there. Results of the imputed dataset were used to either confirm or challenge the results of the per protocol dataset. However, only results that were majorly different to the once from the per protocol dataset were displayed in full detail. Figure 2 depicts the analysis of result flow chart of the study.

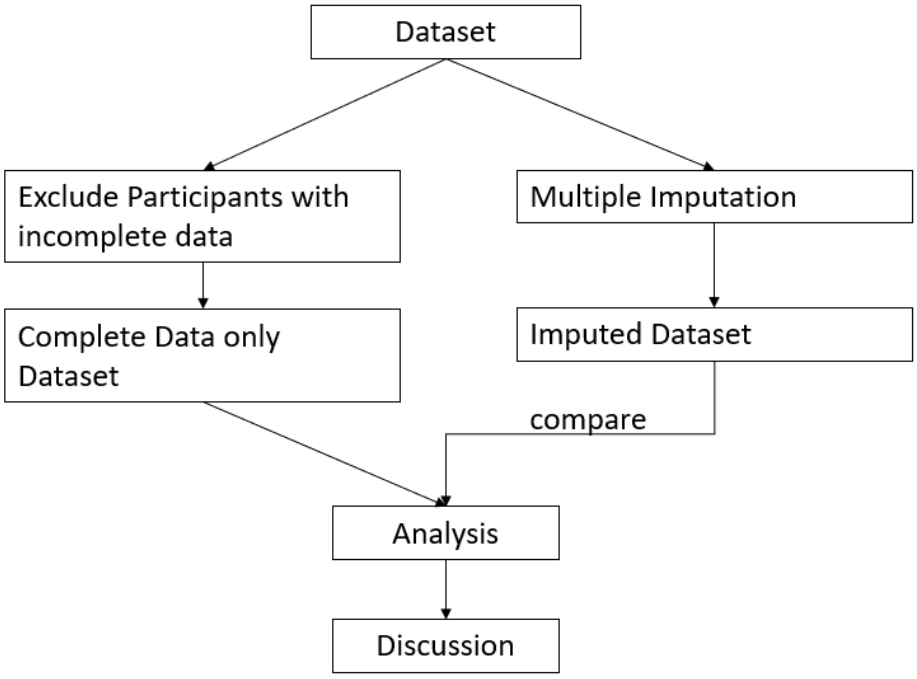

Figure 2. Analysis of Results flowchart.

In order to assess the effect of the treatment on the average alcohol consumption of the participants, a repeated measure analysis of variance (ANOVA) was conducted. This analysis takes into account the between-subject factors, that is the condition placebo or training and the within-subject factor, that is the alcohol consumption. Alcohol consumption was measured with a pre-test and three post-tests which are all included in the analyses. In order to use an ANOVA, it has to meet certain assumptions.

The first assumption that had to be met was the assumption for the independence of observation (UT Austin, n.d.). The independent variable, which in this case was the condition, needed to have at least two categorical groups. This was given as the condition had the categories: "placebo" and "training". Further, all four dependent variables (Alcohol-Consumption$_{Pre\text{-}Test}$; Alcohol-Consumption$_{post\text{-}test1}$; Alcohol-Consumption$_{post\text{-}test2}$; Alcohol-Consumption$_{post\text{-}test3}$) were continuous and the participants were randomly assigned to the conditions. Therefore, independence of observation was given. As alcohol consumption is mostly not normally distributed, this assumption was neglected in the current study. Further, sphericity needed to be given (Laerd Statistics, n.d.). The Mauchly's test did not show any significance for alcohol consumption (p=.37). Therefore, the assumption for sphericity was given.

In order to assess hypothesis 2 an analysis of covariance (ANCOVA) has been conducted. As recommended by Field (2013) the assumptions for ANCOVA were tested before the ANCOVA was conducted. Several assumptions needed to be tested. First, for ANCOVA, independence of observations was needed (UT Austin, n.d.). The independent variable was the same as used in the ANOVA. Further, the dependent variable (Bias$_{Post\text{-}Test}$) and the covariate (Bias$_{Pre\text{-}Test}$) needed both to be continuous. This was also the case. Therefore, independence of observation was given.

Second, the assumption for normality was assessed (Kalla, 2011). The results showed that the dependent variable (Bias$_{Post\text{-}Test}$) for the groups of the independent variable (condition: training/placebo) was normally distributed as a non-statistically significant result was found for both levels ($P_{Training}$ =.12, $P_{Placebo}$ =.59). Further, no outliers were found for both levels (see appendix 1). As they were normally distributed and no outliers were found, the assumption for normality was met.

Third, the homogeneity of regression slopes was tested. In order to meet this criterion, both regression slopes in the two groups needed to be similar (Field, 2013). However, results of the test of between-subjects effects showed a significant effect ($P_{condition*pre\text{-}test}$= .002). Therefore, it can be assumed that this assumption was not met.

Lastly, the homogeneity of variance was tested. Levene's test of equality of error variance showed a non-significant result. Therefore, it can be assumed that this assumption was met and that all comparison groups had the same variance (StatisticsSolutions, n.d.). Further, a statistically significant difference between the conditions was found ($P_{between\_conditions}$=.001). Therefore, while controlling for the pre-test, a statistically significant

difference for the post-test was found. To conclude, except for the homogeneity of regression slopes, all assumptions were met.

Hypothesis 3 was assessed using a Pearson correlation. Correlation do not display causation but show the strength and direction of an association between two variables (Field, 2013). Further, in order to answer hypothesis 4, the PROCESS ad-on for SPSS was used (Hayes, 2013). This ad-on allows to assess the statistical and practical significance of indirect effects. Additionally, different mediation model templates can be used. The current study used Model Template 4 as depicted in Hayes (2013) in order to answer hypothesis 4. A nonparametric bootstrapping procedure was used. A total of 5000 bootstrap samples were used. As the PROCESS add-on is not compatible with the imputed dataset, the imputed data could not be used for this analysis. Using a mediation analysis further provided the opportunity to confirm whether or not a significant correlation between alcohol consumption and bias scores existed.

Results

Participants Baseline Characteristics. As mentioned above, for the current study per protocol analysis were conducted with a sample of n_{total} = 83 ($n_{training}$= 40; $n_{placebo}$= 43), and ITT analysis with an imputed dataset of n=139. The mean age of participants at the start of the treatment was 50.1 (SD=10.9) years, with the youngest being 25 years old and the oldest 68 years old. However, four individuals did not indicate their gender, age or nationality. Nevertheless, as these were not seen as information that could interfere with the results for the current study, it was not used as exclusion criteria. The sample consisted of 45 male and 34 female participants. Further, 70 participants were of Dutch nationality while 9 participants were of a different nationality.

Although the average alcohol consumption of the participants in the placebo condition was found to be 5 points lower than in the training condition prior to the assessment (Table 1), this difference was found to be non-significant (p= .27), indicating that the difference was not due to a bias in the randomization procedure. The mean bias score of the participants in the placebo condition was with 0.15 points significantly higher than in training condition prior to the training (p= .05) (Table 1), indicating that the avoidance bias was on average already stronger in participants of the training condition prior to the training itself. Calculations with the imputed dataset confirmed the above-mentioned results.

Table 1. *Baseline scores of Weekly Alcohol consumption and Bias for the Training-Condition and Placebo-Condition.*

		Training (n=40)	Placebo (n=43)	Total (n=83)
Weekly Alcohol Consumption	Mean (SD)	29.3 (20.8)	24.51 (18.4)	26.8 (19.6)
	Maximum			90
	Minimum			7
	t (df)			1.1 (81)
Bias	Mean (SD)	-.14 (.33)	.01 (.31)	-.06
	t (df)			-2 (81) *

Note: SD = Standard Deviation, df = degrees of Freedom

*p<.05

Effect of CBM on Alcohol Consumption. The repeated measure ANOVA showed that there was a strong decrease of alcohol consumption within the training condition. However, a nearly similar decrease of alcohol consumption in the placebo group was also shown (Table 2). Both groups can be seen to have strong decrease in alcohol consumption between the pre-test and the post-test (F (3,90) = 7.2, p<.001) (Figure 3). Afterwards, the decrease is continuing, however not as strong. Further, the multivariate test showed a non-significant effect of condition on alcohol consumption (F (3,90) = .3, p=.82). Therefore, it seems that condition was not responsible for the decrease of alcohol consumption. Calculations with the imputed dataset confirmed the above-mentioned results. Accordingly, hypothesis 1 cannot be supported.

Table 2. *Mean and Standard Deviation Scores of the Pre-test and Post-tests of Alcohol Consumption of the Participants for the Training-Condition and the Placebo-Condition.*

Alcohol Consumption		Training (n=13)	Placebo (n=19)
Pre-Test	Mean (SD)	35.47 (27.82)	23.32 (20.90)
Post-Test	Mean (SD)	21.85 (14.96)	15.74 (11.19)
3 months follow-up	Mean (SD)	20.31 (16.92)	13.68 (22.55)
6 months follow-up	Mean (SD)	17.69 (18.49)	10.16 (8.68)

Note: SD= Standard Deviation

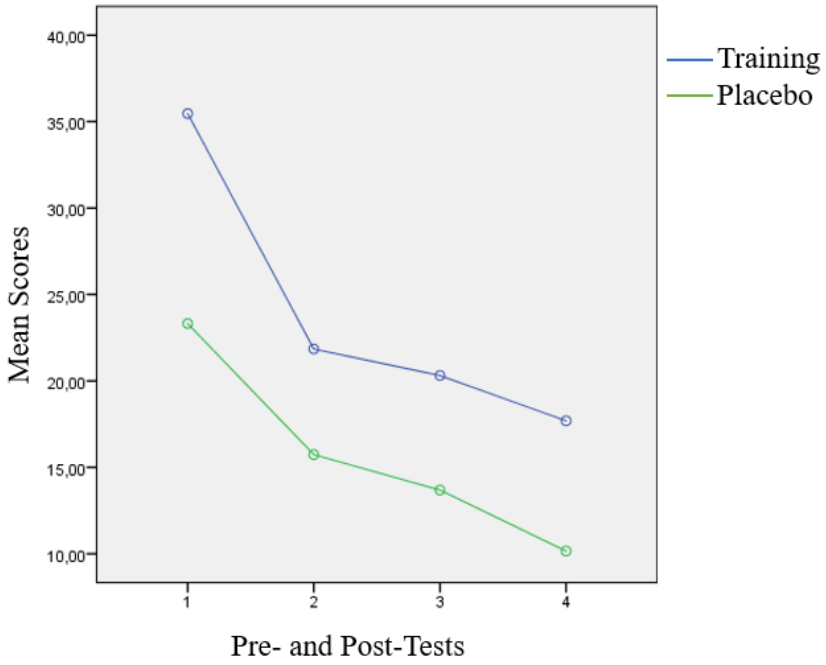

Figure 3. Alcohol Consumption Pre – and Post-test scores of Participants in the Placebo and Training Condition.

Effect of Condition on Avoidance Bias Scores. The ANCOVA analyses showed a significant effect for condition on avoidance bias ($p<.001$) (Table 3). Participants within the training condition had lower bias scores in the post-test than participants in the placebo condition, indicating a stronger avoidance bias. According to the results, the effect of the training on bias was stronger for the training condition than for the placebo group (Table 3).

Calculations with the imputed dataset confirmed the above-mentioned results. Accordingly, the results support hypothesis 2.

Table 3. *Univariate Analysis of Variance. Descriptive Statistics with the Dependent Variable Bias. Pre – and Post assessment scores.*

	Training (n= 40)	Placebo (n=43)	Total (n= 83)
$Mean_{Pre\text{-}Test}$ (SD)	-.14 (.33)	.01 (.31)	
$Mean_{Post\text{-}Test}$ (SD)	-.29 (.40)	.07 (.41)	
F (df)			12,25 (1,80) *

Note: SD = Standard Deviation, df = degrees of Freedom

*p<.001

Correlation between Post-test Avoidance Bias Scores and Post-Test Alcohol Consumption Scores. A Pearson correlation was conducted to assess hypothesis 3. The values of the post-test for the bias scores were used as well as the values of the first post-test assessing alcohol consumption (Table 4). No significant correlation was found (p= 0.99). Calculations with the imputed dataset did not find any significant correlation either. Therefore, the results do not support hypothesis 3.

Table 4. *Bivariate Correlation and Descriptive Statistics for Alcohol Consumption Post-Test 1 scores and Avoidance Bias Post-Test scores.*

	1	2
Mean (SD)	-.10 (.44)	20.76 (14.97)
1. Avoidance Bias	-	-.001
2. Alcohol Consumption	-	-

Note: SD = Standard Deviation

*p<.05

Mediation. In the final step, it was analysed whether the effects of the Training or the Placebo Condition on the alcohol consumption of the participant were mediated by the avoidance bias. The per protocol values of the post-test for Bias as well as the post-test of Alcohol Consumption were used. When Condition was regressed on Bias, a significant effect was found (Table 5). This was in line with the findings of the ANCOVA. Further, the mediator Bias was regressed on Alcohol Consumption. No significant direct effect was found. This was in line with the findings of the correlation conducted for hypothesis 3. Furthermore,

Condition was regressed on Alcohol Consumption. Again, no significant direct effect was found. Additionally, the bootstrap procedure showed a non-significant indirect effect of Condition through Bias, on Alcohol Consumption (B=.02, SE=1.5, 95% CI [-3.03; 3.03]). Thus, indicating that Bias does not mediate the relation between Condition and Alcohol Consumption.

Table 5. *Unstandardized Regression Coefficients with Standard Errors 95% Confidence Intervals (CIs) estimating the Relations between the Condition, the Mediators Bias and the Outcome Variable Alcohol Consumption Pre-Test 1 (Simple Mediation).*

	Dependent Variables					
	Bias (Mediator)			Alcohol Consumption		
Independent Variable	B	SE	95% CI	B	SE	95% CI
Condition	.36	.09	[.18, .53]	-.20	3.65	[-7.47, 7.07]
Bias (M)				.06	.01	[-8.22, 8.35]

Note. N= 83, SE= Standard Error,

Discussion

The aim of the paper was to investigate the effect of CBT programs that have been augmented with CBM training on the avoidance bias as well as subsequent alcohol consumption, when administered online in an outpatient sample.

The results indicated that the training did have an effect on the avoidance bias itself. According to the results, participants in the training condition had an increased avoidance bias after the training. The scores of the participants in the placebo condition actually indicated a decrease of the avoidance bias. Therefore, it is very likely that due to the training, avoidance bias can be increased. Those findings are in line with the findings of Wiers et al. (2010, 2011). In their study, Wiers and Colleagues found that through CBM training, approach bias was retrained into an avoidance bias.

According to the results the CBT program that had been augmented with CBM training did not have a stronger effect on alcohol consumption compared to placebo CBT training. Studies have shown that CBT programs are effective in the treatment of alcohol use disorders (Magill & Larry, 2009; Riper et al., 2014). Therefore, it can be explained why both groups had a decrease of alcohol consumption. However, the expected effect of the added CBM training did not take place and is not in line with previous findings (Wiers et al. 2010;

Wiers et al. 2011). Wiers and colleges (2010, 2011) had found a significant effect of the added CBM training on alcohol consumption. The difference in findings might be due to the fact that, in the current study, patients administered the training in an outpatient setting. Those settings have the potential to be distracting (e.g. when administered at home and other people are present). These distractions could have an effect on the training-responsiveness of the patients (Bratti-Van der Werf et al, 2018). This would explain why studies that have used inpatients have found an effect and the current study did not (Wiers et al., 2010; Wiers et al., 2011). Nevertheless, the training mechanism seemed to have worked as, as stated above, the training had an effect on bias.

However, the change in bias was not found to correlate with alcohol consumption. These findings are contradictory to previous findings (Field et al., 2008; Watson et al., 2013, Wiers et al., 2010, Wiers et al., 2011). Further, there was no indication that part of the effect of the added CBM Training on alcohol consumption operates via avoidance bias. This might be due to the findings in the current study, that the added CBM training did not have any effect in itself. Therefore, if the training has no effect, an effect through a mediation would be unlikely as well. More precise, mediation is not possible.

Another reason why avoidance bias scores did not correlate with alcohol consumption scores as well as why part of the effect of the CBM training on alcohol consumption did not operate via avoidance bias, might be found in the study of Fischbach and Shah (2006). According to their results, the strength of an avoidance bias towards a cue was dependent on the individual's strength of attraction towards the cue and the subjective importance of a long-term goal. In the case of the current study, the long-term goal would be to decrease or stop alcohol consumption. Avoidance bias was shown to help avoid tempting cues when the participant had a high motivation to reach his or her long-term goal. However, this was not the case when the motivation to reach the long-term goal was lower or not given. Therefore, it can be assumed that the effect of the avoidance bias on alcohol consumption might be mediated or moderated by motivation to reach the long-term goal. DiClemente, Bellino and Neavins (1999) state that people with substance abuse problems vary greatly in their motivation to change. Further, motivation can be influenced by external influences and pressures. The current study was conducted in an outpatient setting. It can be assumed that participants in outpatient settings are more prone to external influences when compared to an inpatient sample. Therefore, their motivation could be more influenced than in inpatient samples. However, this only applies to the clinical period of the first three months, after

which both groups are exposed to the external influences. Thus, further research is needed to test this assumption.

Another reason why there was no effect found for the bias on alcohol consumption and as mediator might be related to executive control (EC). Several studies found that EC capacities might be a relevant predictor for individuals' alcohol consumption in relation to implicit cognitive processes (Houben & Wiers, 2009; Peeters et al., 2012). It seems, that for individuals that have weak EC capacities implicit cognitive processes were better predictors of alcohol consumption than for those individuals that had higher EC capacities. The relationship between alcohol-approach tendencies and drinking behaviour was found to be moderated by EC (Peeters et al., 2012). Further, results of the study of Salemink and Wiers (2012) indicated that EC moderated training effects. The findings suggested that individuals with a weaker EC had stronger training effects. It is not clear whether or not the participants in the current study had weak or strong executive control and if that had an impact on the results. Future studies should therefore consider measuring the EC capacities of the participants before conducting the training in order to see whether or not it has any influence on the avoidance bias.

Strength and Limitations. The current study has several advantages and limitations that need to be taken into account. The study design is a randomized double-blind controlled trial. Misra (2012) describes randomized double-blind control trials as the gold standard in terms of the quality of evidence that a study can provide. In her article, Misra (2012) names several advantages provided by using such a design. That is, the elimination of the influence of confounding variables, like baseline variables (randomization), the elimination of the influence of differential use of other treatments (blinding) and the demonstration of causality (control trials), to name a few. Further, by using an outpatient setting, the CBM training effect is assumed to be more naturalistic (Bratti-Van der Werf et al., 2018). This is due to the fact that patients practice directly in their relevant setting. Those settings are likely to be their home, were they are presented by alcohol-related cues that are more relatable to them as cues provided in a clinical setting. Therefore, it can be assumed that the collected data might be more applicable as it is directly collected in the relevant settings when compared to inpatient settings.

However, outpatient settings might also have a negative side to it. As already stated above, patients are likely to be confronted with several distractions, like sounds or other people, that could be threat to the treatment fidelity. Being distracted could have an influence

on the concentration as well as training-responsiveness of the patients. This would not be the case in a clinical environment.

Further, as was evident in the current study, online interventions often have a considerable high drop-out rate (Bratti-Van der Werf et al., 2018). Many participants did not participate in all of the post-tests, wherefore the final dataset had to be reduced from 139 participants to 83. However, as the imputed dataset was used to compare the results, this is only considered a minor limitation. Nevertheless, the current study was prematurely ended as there was an insufficient number of participants that could be included within the timeframe. A major reason for this was the fast-developing nature of technology. For example, the CBM training was not tablet or mobile proof.

Another limitation can be found when assessing the differences in baseline scores between the placebo and training group. The results indicated that the avoidance bias was on average already stronger in participants of the training condition prior to the training itself. Even though, the randomization procedure was conducted properly, the difference in groups was still existing. Future studies should control for baseline differences.

Conclusion and Recommendation. The results of the current study indicate that CBT programs augmented with CBM do not yield higher effectiveness than CBT with placebo CBM programs when conducted in an outpatient setting. However, previous research has shown that they are effective when conducted in an inpatient setting. Therefore, it should be thoroughly investigated why this is the case and if the programs can be adjusted to outpatient settings in so far that they achieve greater results. Further, studies indicate that the relationship of the avoidance bias and motivation as well as executive control capacities should be investigated as they seem to influence each other.

The current study signalises that we still do not know enough about how to effectively tackle alcohol abuse. Nevertheless, it is clear the CBM training has an effect on implicit cognition or more specific on the approach-avoidance bias. Why the bias itself did not seem to have an effect on alcohol consumption should be further investigate in future studies. Additionally, future studies should include technology like mobile phones or tablets, to make it more adapted to today's technology. Further, it could help increase the sample size as most people nowadays own a mobile phone and know how to operate it.

Based on the results of the current study, it is recommended for addiction treatment organisations to make us of CBT programs as they clearly decrease individual's alcohol consumption. If the participants are inpatients, CBM training should also be applied as previous studies have it found to be effective in decreasing alcohol consumption and changing

approach to avoidance bias. The current study underlines the notion that the avoidance bias can be strengthened through the CBM training.

The abuse of alcohol is a severe problem in our society. Every step we get closer to a solution, is a step worth taking. Scientific studies have always been about trying out new solutions, some of them work, others don't, but every study increases our knowledge we have about a certain issue. The current study adds to the pool of knowledge that will ultimately help to discover a feasible solution.

References

Barkby, H., Dickson, J.M., Roper, L., & Field, M. (2011). To Approach or Avoid Alcohol? Automatic and Self-Reported Motivational Tendencies in Alcohol Dependence. *Alcoholism: Clinical and Experimental Research, 36*(2), 361-368. Doi: doi.org/10.1111/j.1530-0277.2011.01620.x

Bratti-Van der Werf, Marlen K.J., Laurens, M.C., Postel, M.G., Pieterse, M.E., Allouch, S.B., Wiers, R.W., Bohlmeijer, E.T., & Salemink, E. (2018). Augmenting Outpatient Alcohol Treatment as Usual with Online Alcohol Avoidance Training: Protocol of a Double-Blind Randomized Control Trial. *JMIR Research Protocols, 7*(3), e55. Doi: 10.2196/resprot.9287

Cacioppo, J.T., Gardner, W.L., & Berntson, G.G. (1999). The affect system has parallel and integrative processing components: Form follows function. *Journal of Personality and Social Psychology, 76*(5), 839-855. Doi: 10.1037/0022-3514.76.5.839

Cargiulo, T. (2007). Understanding the health impacts of alcohol dependence. *American Journal of Health-System Pharmacy, 64*(5), 5-11. Doi: https://doi.org/10.2146/ajhp060647

Centres of Disease Control and Prevention (n.d). *Impaired Driving: Get the facts.* Retrieved on December 28, 2019 from: https://www.cdc.gov/motorvehiclesafety/impaired_driving/impaired-drv_factsheet.html

Choi, H.J., Krieger, J.L. & Hecht, M.L. (2013). Reconceptualizing Efficacy in Substance Use Prevention Research: Refusal Response Efficacy and Drug Resistance Self-Efficacy in Adolescent Substance Use. *Health Communications, 28*(1), 40-52. Doi: 10.1080/10410236.2012.720245

De Houwer, J., & Moors, A. (2010). *Handbook of implicit social cognition: Measurement, theory and application.* New York: Guildford Press.

DiClemente, C.C., Bellino, L.E., & Neavins, T.M. (1999). Motivation for Change and Alcoholism Treatment. *Alcohol research and Health, 23*(2), 86-92. Retrieved on June 20, 2020 from: https://pubmed.ncbi.nlm.nih.gov/10890801/

Eberl, C., Wiers, R.W., Pawelczack, S., Rinck, M., Becker, E.S., & Lindenmeyer, J. (2013). Approach Bias modification: Do clinical effects replicate and for whom does it work

best. *Developmental Cognitive Neuroscience, 4*, 38-51. Doi: 10.1016/j.dcn.2012.11.002

Ellickson, P.L. & Hays, R.D. (2009). Beliefs about Resistance Self-Efficacy and Drug prevalence: Do they really affect drug use? *International Journal of Addictions, 25*(11), 1353-1378. Doi: 10.3109/10826089009068468

Fergusson, D.M., Boden, J.M., & Horwood, J. (2009). Tests of Causal Links Between Alcohol Abuse or Dependence and Major Depression. *Arch Gen Psychiatry, 66*(3), 260-266. Doi: 10.1001/archgenpsychiatry.2008.543

Field, A. (2013). *Discovering Statistics using SPSS: and sex and drugs and rock 'n' roll (4th Edition.* London: Sage.

Field, M., & Cox, W.M. (2008). Attentional bias in addictive behaviors: a review of its development, causes, and consequences. *Drug and Alcohol dependence, 97*(1-2), 1-20. Doi: 10.1016/j.drugalcdep.2008.03.030

Field, M., Duka, T., Eastwood, B., Child, R., Santarcangelo, M., & Gayton, M. (2007). Experimental Manipulation of Attentional Biases in Heavy Drinkers: Do the Effects Generalise. *Psychopharmacology, 192*(4), 593-608. Doi: 10.1007/s00213-007-0760-9

Field, M., Lemma, L.D., Christiansen, P., & Dickson, J. (2017). Automatic Avoidance Tendencies for Alcohol Cues Predict Drinking After Detoxification Treatment in Alcohol Dependence. *Psychology of Addictive Behaviors, 31*(2), 171-179. Doi: 10.1037/adb0000232

Field, M., Kiernan, A., Eastwood, B., & Child, R. (2008). Rapid approach responses to alcohol cues in heavy drinkers. *Journal of Behavior Therapy and Experimental Psychiatry, 39*(3), 209-218. Doi: 10.1016/j.jbtep.2007.06.001

Fischbach, A. & Shah, J.Y. (2006). Self-control in action: Implicit dispositions toward goals and away from temptations. *Personality and Social Psychology, 90*(5), 820-832. Doi: 10.1037/0022-3514.90.5.820

Graham, J.W. (2012). *Missing Data: Statistics for Social and Behavioral Sciences.* New York: Springer.

Hayes, A.F. (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach.* New York: Guildford Publications.

Hester, W.R., & Miller, W.R (1995). *Handbook of alcoholism treatment approaches: effective alternatives.* Boston: Ally & Bacon.

Hinton, P.R., McMurray, I., & Brownlow, C. (2014). *SPSS Explained (Second Edition)*. Sussex, New York: Routledge.

Houben, K., Havermans, R.C., Nederkoorn, C., & Jansen, A. (2012). Beer a No-Go: Learning to Stop Responding to Alcohol Cues Reduces Alcohol Intake via Reduced Affective Associations Rather Than Increased Response Inhibition. *Addiciton, 107*(7), 1280-1287. Doi: 10.1111/j.1360-0443.2012.03827.x

Houben, K., Nederkoorn, C., Wiers, R.W., & Jansen, A. (2011). Resisting Temptation: Decreasing Alcohol-Related Affect and Drinking Behavior by Training Response Inhibition. *Drug and Alcohol Dependence, 116*(1-3), 132-136. Doi: 10.1016/j.drugalcdep.2010.12.011

Houben, K., & Wiers, R.W. (2009). Response Inhibition Moderates the Relationship Between Implicit Associations and Drinking Behavior. *Alcoholism: Clinical and Experimental Research, 33*(4), 626-633. Doi: 10.1111/j.1530-0277.2008.00877.x

Kalla, S. (2011). *Normal Distribution Assumptions.* Retrieved on April 13, 2020 from: https://explorable.com/normal-distribution-assumptions

Laerd Statistics (n.d). *ANOVA with Repeated Measures using SPSS Statistics.* Retrieved on April 14, 2020 from: https://statistics.laerd.com/spss-tutorials/one-way-anova-repeated-measures-using-spss-statistics.php

Magill, M., & Larry, A.R. (2009). Cognitive-Behavioural Treatment with Adult Alcohol and Illicit Drug Users: A Meta-Analysis of Randomized Controlled Trials. *Journal of Studies on Alcohol and Drugs 70*(4), 516-527. Doi: 10.15288/jsad.2009.70.516.

McCoy, C.E. (2017). Understanding the Intention-to-treat Principle in Randomized Controlled Trials. *The Western Journal of Emergency Medicine 18*(6), 1075-1078. Doi: 10.5811/westjem.2017.8.35985

Miller, W.R., & Rollnick, S. (2002). *Motivational interviewing: preparing people for change.* New York: Guildford Press.

Misra, S. (2012). Randomized Double Blind Placebo Control Studies, the "Golden Standard" in intervention based studies. *Indian Journal of Sexually Transmitted Diseases and Aids, 33*(2), 131-134. Doi: 10.4103/0253-7184.102130

Murdoch, D., & Ross, D. (2009). Alcohol and Crimes of Violence: Present Issues. *International Journal of Addictions, 25*(9), 1065-1081. Doi: 10.3109/10826089009058873

National Institute on Alcohol Abuse and Alcoholism (n.d.) *Alcohol Use Disorder: A Comparison between DSM-IV and DSM-5.* Retrieved on April 4, 2020

Ostafin, B.D., Palfai, T.P., & Wechsler, C.E. (2003). The Accessibility of Motivational Tendencies Toward Alcohol: Approach, Avoidance, and Disinhibited Drinking. *Experimental and Clinical Psychopharmacology, 11*(4), 294-301. Doi: 10.1037/1064-1297.11.4.294

Palafai, T.P., & Ostafin, B.D. (2003). Alcohol-related motivational tendencies in hazardous drinkers: assessing implicit response tendencies using the modified-IAT. *Behaviour research and therapy, 41*(10), 1149-1162. Doi: 10.1016/s0005-7967(03)00018-4

Peeters, M., Wiers, R.W., Monshouwer, K., Van De Schoot, R., Janssen, T., & Vollebergh, W.A.m. (2012). Automatic processes in at-risk adolescents: the role of alcohol-approach tendencies and response inhibition in drinking behavior. *Addiciton, 107*(11), 1939-1946. Doi: 10.1111/j.1360-0443.2012.03948.x

Preacher, K.J., & Hayes, A.F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers, 36*(4), 717-731.

Riper, H., Andersson, G., Hunter, S.B., De Wit, J., Berking, M., & Cuijpers, P. (2014). Treatment of Comorbid Alcohol Use Disorders and Depression with Cognitive Behavioural Therapy and Motivational Interviewing: A Meta-Analysis. *Addiction, 109*(3), 394-406. Doi: 10.1111/add.12441

Rubin, D.B. & Schenker, N. (1991). Multiple Imputation in Health-Care Databases: An Overview and Some Applications. *Statistics in Medicine, 10*(4). Doi: 10.1002/sim.4780100410

Salemink, E., & Wiers, R.W. (2012). Adolescent threat-related interpretive bias and its modification: The moderating role of regulatory control. *Behaviour Research und Therapy, 50*(1), 40-46. Doi: 10.1016/j.brat.2011.10.006

Schoenmakers, T., Wiers, R.W., & Field, M. (2007). Effects of a low dose of alcohol on cognitive biases and craving in heavy drinkers. *Psychophamracology, 197*, 169-178. Doi: 10.1007/s00213-007-1023-5

Schoenmakers, T., Wiers, R.W., Jones, B.T., Bruce, G., & Jansen, A.T.M. (2007). Attentional Re-training Decreases Attentional Bias in Heavy Drinkers Without Generalization. *Addiction, 102*(3), 399-405. Doi: 10.1111/j.1360-0443.2006.01718.x.

Schumacher, S.E., Kemps, E., & Tiggemann, M. (2016). Bias modification training can alter approach bias and chocolate consumption. *Appetite, 96*, 219-224. Doi: 10.1016/j.appet.2015.09.014

Scot, N.W., McPherson, G.C., Ramsay, C.R., & Campbell, M.K. (2002). The method of minimization of allocation to clinical trials. A review. *Controlled Clinical Trials, 23*(6), 662-674. Doi: 10.1016/s0197-2456(02)00242-8

Spruyt, A., De Houwer, J., Tibboel, H., Verschuere, B., Crombez, G., Verbanck, P., Hanak, C., Brevers, D., & Noel, X. (2013). On the predicitive validity of automatically activated approach/avoidance tendencies in abstaining alcohol-dependent patients. *Drug and Alcohol Dependence, 127*(1-3), 81-86. Doi: 10.1016/j.drugalcdep.2012.06.019

Sobell, L.C., Agrawal, S., Annis, H., Ayala-Velazquez, H., Echeverria, L., Leo, G.I, Rybakowski, J.K., Sandahl, C., Saunders, B., Thomas, S., & Zioikowski, M. (2001). Cross-cultural evaluation of two drinking assessment instruments: alcohol timeline followback and inventory of drinking situations. *Substance Use & Misuse, 36*(3), 313-331. Doi: 10.1081/ja-100102628

Stacy, A.W., & Wiers, R.W. (2010). Implicit Cognition and Addiction: A tool for explaining paradoxical behavior. *Annual Review of Clinical Psychology, 6*, 551-575. Doi: 10.1146/annurev.clinpsy.121208.131444

StatisticsSolutions (n.d). *The Assumption of Homogeneity of Variance.* Retrieved on April 12, 2020 from: https://www.statisticssolutions.com/the-assumption-of-homogeneity-of-variance/

Thush, C., Wiers, R.W., Moerbeek, M., Ames, S.L., Grenard, J.L., Sussman, S., & Stacy, A.W. (2009). Influence of Motivational Interviewing on Explicit and Implicit Alcohol-Related Cognition and Alcohol Use in At-Risk Adolescents. *Psychology of Addictive Behaviors, 23*(1), 146-151. Doi: 10.1037/a0013789

UT Texas (n.d). *Independent Observations Assumption.* Retrieved on April 14, 2020 from: http://sites.utexas.edu/sos/indobs/

Van Buuren, S. (2011). Multiple Imputation of Multilevel Data. In Hox, J., & Roberts, K. (Eds.). *Handbook of Advanced Multilevel Analysis* (pp.173 - 193). Sussex, New York: Routledge.

Van Hemel-Ruiter, M.E., De Jong, P.J., & Wiers, R.W. (2011). Appetitive and regulatory processes in young adolescent drinkers. *Addictive Behaviors, 36*(1-2), 18-26. Doi: 10.1016/j.addbeh.2010.08.002

Watson, P., de Wit, S., Cousijn, J., Hommel, B., & Wiers, R.W. (2013). Motivational Mechanisms Underlying the Approach Bias to Cigarettes. *Journal of Experimental Psychopathology, 4*(13), 250-262. Doi: 10.5127/jep.030512

Whitman, I.R., Agarwal, V., Nah, G., Dukes, J.W., Vittinghoff, E., Dewland, T.A., & Marcus, G.M. (2017). Alcohol Abuse and Cardiac Disease. *Journal of the American College of Cardiology, 69*(1). Doi: 10.1016/j.jacc.2016.10.048

Wiers, R.W., Eberl, C., Rinck, M., Becker, E.S, & Lindenmeyer, J. (2011). Retraining automatic action tendencies changes alcoholic patient's approach bias for alcohol and improves treatment outcome. *Psychological Science, 22*(4), 490-497. Doi: 10.1177/0956797611400615

Wiers, R.W., Gladwin, T.E., & Rinck M. (2013). Should we train alcohol-dependent patients to avoid alcohol? *Frontiers in Psychiatry, 4*(33). Doi: 10.3389/fpsyt.2013.00033

Wiers, R.W., Rinck, W., Dictus, M., & Van Den Wildenberg, E., (2009). Relatively strong automatic appetitive action-tendencies in male carriers of the OPRM1 G-allele. *Genes, Brain and Behavior, 8*(1), 101-106. Doi: 10.1111/j.1601-183X.2008.00454.x

Wiers, R.W, Rinck, M., Kordts, R., Houben, K., & Strack, F. (2010). Retraining automatic action-tendencies to approach alcohol in hazardous drinkers. *Addiction, 105*(2), 279-287. Doi: 10.1111/j.1360-0443.2009.02775.x.

Wiers, R.W. & Stacy, A.W. (Eds). (2006). *Handbook of Implicit Cognition and Addiction.* Sage, Thousand Oaks, CA.

Wiers, R.W., Van De Luitgaarden, J., Van Den Wildenberg, E., & Smulders, F.T.Y. (2005). Challenging Implicit and Explicit Alcohol-Related Cognitions in Young Heavy Drinkers. *Addiction, 100*(6), 806-819. Doi: 10.1111/j.1360-0443.2005.01064.x

Wiers, R.W., Van Woerden, N., Smulders, F.T.Y., & De Jong, P.J. (2002). Implicit and explicit alcohol-related cognitions in heavy and light drinkers. *Journal of abnormal psychology, 111*(4), 648-658. Doi: 10.1037/0021-843X.111.4.648.

World Health Organisation (2018). *Global Status Report on Alcohol and Health 2018.* Retrieved on February 29, 2020 from: https://www.who.int/substance_abuse/publications/alcohol/en/

Appendix:

Appendix 1: