Standardized Versus Personalized Mobile Alcohol Approach Bias Measurement

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Abstract

Aims: An application (app) that is developed to reduce or stop alcohol consumption is the *Breindebaas* app. This app is based on cognitive behavioural modification methods, namely the approach avoidance task and the approach avoidance task-training. The present study aims to compare the psychometric properties of the standardized alcohol approach bias measurement of the Breindebaas app with the personalized alcohol approach bias measurement of the Breindebaas app. Additionally, the associations with the number of personalized alcoholic stimuli will be exploratively researched. **Method:** Twenty-seven participants, of which males consumed at least seven standard glasses of alcohol per week and of which females consumed at least four standard glasses of alcohol per week, took part in a cross-sectional validity study. All participants individually completed an online questionnaire, and a standardized and a personalized alcohol approach bias measurement in the Breindebaas app. Eventually, the data of 14 participants was used in the analyses after correcting for incomplete and erroneous alcohol approach bias measurement data, and after removing the outliers. **Results:** The correlation analysis between the standardized alcohol approach bias measurement and the personalized alcohol approach bias measurement was not significant. Also, the two alcohol approach bias measurements were not significantly positively correlated with the three self-report constructs. There was however a significant negative correlation between the standardized alcohol approach bias measurement and the self-report construct craving visual analogue scale. Next, there was no significant mean alcohol approach bias score difference between the two alcohol approach bias measurements. Furthermore, there were no significant associations between the number of personalized alcoholic stimuli and several participants' demographic characteristics. Here, a remarkable finding was that on average the participants personalized alcoholic stimuli significantly more than non-alcoholic stimuli. Lastly, the participants gave comments about the two alcohol approach bias measurements of which the most prevalent comment was that participants had the feeling that their set of personalized stimuli was not truly personalized. **Conclusions:** This study indicated that a personalized approach to measure the alcohol approach bias, did not provide an added value to measure the alcohol approach bias. Also, the amount of personalization was not associated with relevant results. However, due to a number of reasons, no firm conclusions can be drawn from this study.

Keywords: alcohol, cognitive bias modification (CBM), approach bias, approach avoidance task (AAT).

Introduction

Excessive alcohol consumption contributes to several physical, social, and economic harms, such as several kinds of cancer (Rehm, 2011), property damage (World Health Organization, 2014), and absenteeism (Anderson & Baumberg, 2006), respectively. Next to harms, in the year 2016 the excessive consumption of alcohol was accountable for three million deaths globally (5.3% of all the deaths around the world; World Health Organization, 2018). This means that alcohol consumption can be found all around the world, with the Netherlands being no exception. Of the Dutch population in the year 2018, aged 18 years and older, 8.2% were excessive alcohol users, which is defined by males consuming more than 21 glasses of alcohol per week and by females consuming more than 14 standard glasses of alcohol per week (Centraal Bureau voor de Statistiek, 2019).

A paradox in the excessive use of alcohol is that users are aware of the harms, but still continue to consume alcohol (Wiers & Stacy, 2006). Several studies researching cognitive processes and addictive behaviour provide further insights into this paradox. Addictive behaviour can be explained by the dual process model of Strack and Deutsch (2004). In this model, addictive behaviour is generally directed by two different cognitive systems, namely the associative, "impulsive" system, and the reflective system. These two systems both influence in what way an individual will respond to certain stimuli that are associated with addictive substances. The associative system is the faster of the two; it almost automatically evaluates the stimuli on their emotional and motivational impact. Positive or negative associations with addictive substances are elicited in this fast associative system. On the other hand, the slower reflective system decides consciously whether or not using addictive substances is beneficial by rationalizing the advantages and disadvantages. However, to be able to counter the urge to use addictive substances, enough motivation and resources need to be present in this reflective system (Wiers et al., 2007).

Addictive behaviour is developed as a consequence of the imbalance between the associative and reflective system (Wiers et al., 2007). Thus, when the reflective system predominates the associative system, the automatic impulses to consume alcohol will not be strong enough to overwrite the reasoning of the reflective system. With appropriate treatment, one can change the influence of either system. Treating the reflective system requires the altering of conscious processes. An example of a treatment that is focused on the alteration of conscious processes is Cognitive Behavioural Therapy (CBT). The core idea of CBT is that cognition has an influence on behaviour and that cognitive processes can be altered (Dozois, Dobson, & Rnic, 2019). In the treatment for addictive alcohol consumption, this means that

CBT helps changing individual's thoughts on alcohol consumption with the result of consuming less alcohol. Because CBT influences the conscious thought processes concerning a particular set of behaviours, it means that CBT does not have enough direct influence on the processes in the impulsive system to effectively be applicable on the impulsive system in a treatment. This requires the associative system to be treated by using another type of intervention that is specifically aimed at the impulsive processes.

Cognitive Bias Modification (CBM) is a type of intervention that directly aims to alter the automatic cognitive processes that are influencing addiction (Eberl et al., 2013). One form of these automatic processes is the approach bias, which is an automatic action tendency to approach appetitive cues rather than to avoid them (Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013). The approach bias can be examined by the approach avoidance task (AAT). The AAT is originally a task developed by Rinck and Becker (2007) for anxiety disorders. In this task, participants were presented with different stimuli (i.e., images) on the computer screen that they had to pull closer or push away by the use of a joystick. The AAT consisted of two parts: (a) an approach part in which the to be measured variable had to be pulled towards and the control variable had to be pushed away; and (b) an avoidance part that was the same as the approach part, except that the pull and push activities were reversed. The pulling and pushing of the joystick was measured in reaction times (RTs), whereby the difference in reaction times (i.e., avoidance of the to be measured variable minus approach of the to be measured variable) indicated either an approach (i.e., positive difference) or an avoidance (i.e., negative difference) bias. Zenko and Ekkekakis (2019) have compared the validity of nine implicit process measures. Of these nine, they showed that "only the AAT was significantly and meaningfully related to validation criteria" (p. 11). They also suggested that, in order to indicate behavioural approach avoidance tendencies, the AAT could be especially effective in comparison to the other measures. Based on the AAT, a study by Wiers, Rinck, Dictus, and van den Wildenberg (2009) showed that approach biases also exist for alcohol consumption. Furthermore, it was demonstrated that approach biases are associated with an increase in alcohol consumption (Wiers, Rinck, Kordts, Houben, & Strack, 2010). Therefore, alcohol consumption can significantly be influenced by the automatic approach bias.

Based on the AAT of Wiers et al. (2009), Wiers et al. (2010) developed an approach avoidance task-training (AAT-T) with the aim of altering the automatic action tendencies that excessive alcohol users have, instead of assessing the automatic action tendencies related to the approach or avoidance of alcohol. Several studies have shown the AAT-T's effectiveness

in the alteration of automatic processes concerning alcohol approach bias (e.g., Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011; Wiers et al., 2010). Besides this result, Wiers et al. (2010) also found a noticeable effect of the AAT-T on the consumption of alcohol. Heavy drinkers who had been successfully trained using the avoidance part drank less beer in a following test, compared to the group who had been successfully trained using the approach part. Also, in the literature review by Kakoschke, Kemps, and Tiggemann (2017), which also includes the studies of Wiers et al. (2011) and Wiers et al. (2010), positive results regarding the effects of the AAT-T were found. Of the eight studies focusing on alcohol consumption, five showed a successful retraining of the approach bias. The successfully retrained participants in these five studies also showed a significant group difference in either alcohol consumption or relapse rates.

Over the past few years, the AAT and the AAT-T have been offered to participants on computers. However, because new technologies are constantly being introduced, the use of the computers has been becoming less prevalent, and the use of new means such as smartphones and tablets has been increasing. These new mobile technologies provided a platform for the creation of applications (apps). One app that is developed as an AAT-T for the reduction of alcohol consumption is the *Breindebaas* app (Tactus Holding B.V., 2016). The Breindebaas app has been developed for adults who would like to reduce or stop alcohol consumption by changing the automatic responses they have with drinking. A pilot study of the Breindebaas app, based on problem drinkers, showed that a reduction of weekly alcohol consumption of approximately eight standard glasses of alcohol was found as a result of using the app for three weeks (Somsen, 2017). Although the effect of the training was measured, a limitation of this study was that the approach bias towards alcohol was not measured. However, because the computer version of the AAT showed that it was able to measure an alcohol approach bias (Wiers et al., 2009), it was assumed that the Breindebaas app was also capable of measuring the alcohol approach bias.

The Breindebaas app made use of a standardized set of both alcoholic and non-alcoholic stimuli. However, participants in the pilot study of Somsen (2017) suggested to personalize the alcoholic and non-alcoholic stimuli, whereby participants themselves are able to choose from a standard set of stimuli, which stimuli will be shown during the training. Although the participants talked about personalization, in the field of information systems this would be called customization, because the users of the app themselves are able to tailor the system to their preferences. In the field of information system, the term personalization is used when the system would modify itself by the information it gathers from the user

(Treiblmaier, Madlberger, Knotzer, & Pollach, 2004). However, in psychological practices all types of care that are tailored to an individual are called personalization. For this reason, the term personalization is used in the present study.

Because the participants in the pilot study of Somsen (2017) suggested a personalized training, it would be interesting to first investigate the personalized alcohol approach bias measurement. This investigation would be in order to find out what the best course of action would be regarding the alcohol approach bias training; the question considering the alcohol approach bias measurement would then be whether or not personalization provides added value to measure the alcohol approach bias. Although studies have shown that the AAT is able to measure the alcohol approach bias, there are to my best knowledge no previous studies that specifically have addressed a mobile and a personalized alcohol approach bias measurement. In order to make an appropriate decision regarding the question, the differences between the standardized and personalized alcohol approach bias measurements should first be investigated. Therefore, the present study aims to compare the psychometric properties of the standardized alcohol approach bias measurement of the Breindebaas app with the personalized alcohol approach bias measurement of the Breindebaas app. Specifically, the construct validity, the convergent validity, and the mean difference in alcohol approach bias scores between the standardized and personalized alcohol approach bias measurements will be examined. The self-report constructs for alcohol consumption, the Alcohol Use Disorders Identification Test (AUDIT), and a craving Visual Analogue Scale (craving VAS) are going to be used to test the convergent validity of the two alcohol approach bias measurements. It is respectively hypothesized that (a) the correlation between the two alcohol approach bias measurements is significant, (b) the two alcohol approach bias measurements significantly positively correlate with the three self-report constructs, and (c) the mean alcohol approach bias score of the personalized alcohol approach bias measurement is significantly higher than the mean alcohol approach bias score of the standardized alcohol approach bias measurement. Lastly, there are to my best knowledge also no previous studies that specifically have researched whether the number of personalized alcoholic stimuli is associated with several demographic characteristics; this will be exploratively researched in the present study, in order to investigate whether it is advisable to use the personalized instead of the standardized version of the Breindebaas app for specific types of individuals.

Method

Design

This study was a cross-sectional validity study. Participants filled in an online questionnaire and performed two alcohol approach bias measurements in the Breindebaas app (these measurements will for the remainder of the article be referred to as the *(two) bias measurement(s)*). The order in which participants performed the two bias measurements was randomized, whereby participants were randomly distributed over two generally equally sized groups. Furthermore, the study was approved by the Ethics Committee of the Faculty of Behavioural, Management, and Social sciences of the University of Twente (request number 190373).

Participants

The participants who were recruited had to match three inclusion criteria: (a) participants had to be Dutch and Dutch speaking, (b) participants had to be 18 years or older, and (c) male participants had to consume at least seven standard glasses of alcohol per week and female participants had to consume at least four standard glasses of alcohol per week. The last criterion was based on one third of the number of standard glasses of alcohol that excessive users drink; this criterion was chosen in deliberation with the supervisors.

Participants were recruited from the general public, among acquaintances, and on the campus of the University of Twente. From the general public, participants were recruited via posters and flyers (see Appendix A). The posters and flyers were posted in the Dutch municipalities Almelo and Hengelo at various spots, ranging from the library to the supermarket, and from the general practitioner to the town hall. Furthermore, by applying to a local television program in the municipality of Almelo, an invitation to participate in the study was broadcasted. Next to this, participants were recruited among near acquaintances, such as family members and friends of the researchers. The digital version of the poster/flyer was also posted on different social media platforms of the researchers, namely Facebook, Instagram, Snapchat, and WhatsApp. Moreover, participants were also recruited on the campus of the University of Twente, both through proactively approaching individuals, and through the use of the SONA system, which is a test subject pool system for Communication Studies and Psychology students of the University of Twente. Lastly, all participants participated voluntarily in this study in return for a chance to win one of the gift vouchers of €20.

Material

Breindebaas. Breindebaas is a Dutch app developed by Tactus Holding B.V. (2016). In this study, a new version of the app, that was still under development, was used. This new

app had two features, namely a measurement and a training feature. With the measurement feature an individual's alcohol approach bias could be measured. The purpose of the training was to reduce an individual's alcohol approach bias. In this study the focus was only on the measurement feature of the app.

The alcohol approach bias in the measurement feature could be examined for two measurements, namely for a standardized and a personalized alcohol approach bias measurement (these measurements will for the remainder of the article be referred to as the *standardized bias measurement* and the *personalized bias measurement*, respectively). A bias measurement, which was assigned by the researchers based on a randomization tool, consisted out of two parts, namely an approach and an avoidance alcohol part. These parts were randomized by the Breindebaas app and therefore the order of the parts could not be assigned by the researchers. In a bias measurement, a total of 100 stimuli were presented. In the alcohol approach part, 25 stimuli were alcoholic stimuli that had to be swiped towards oneself and 25 stimuli were non-alcoholic stimuli that had to be swiped away from oneself; these stimuli were randomly displayed whereby the parts (i.e., approach or avoidance) could only be displayed after each other for a maximum of three times. In the alcohol avoidance part this was the same, except that the swiping activities were reversed. The swiping of the stimuli was measured in RTs. Lastly, only individuals in the personalized bias measurement were asked to select alcoholic and non-alcoholic stimuli of their preferences.

The swipe movement of the Breindebaas app was based on the idea that evaluating a stimulus as good usually results in pulling an object towards oneself, and the evaluation of a stimulus as bad usually results in pushing an object away (Chen & Bargh, 1999). Likewise, when participants swiped the stimuli towards them, the stimuli on the screen became larger, so that it seemed as if the stimuli were moving towards the participants. When participants swiped the stimuli away from them, the stimuli on the screen became smaller and thus seemed to disappear. This was based on the zooming effect, whereby swiping towards and swiping away from oneself respectively creates a feeling of approach and avoidance (Neumann & Strack, 2000).

Measures

All participants completed an online questionnaire before they performed the two bias measurements of the Breindebaas app. Due to the study being group work, only the questions that were used in this study were discussed. The online questionnaire was created in Qualtrics and the language of the questionnaire was Dutch.

Demographic characteristics. Participants reported their gender, age, most important daily activity, and highest current or completed education.

Alcohol consumption. A self-report questionnaire, based on the Dutch version (Wiers, Hoogeveen, Sergeant, & Gunning, 1997) of the self-report Timeline Follow-Back method (Sobell & Sobell, 1992), was used to measure the amount of alcohol consumption of the participants. The participants indicated for every day of the past week, the number of standard glasses of alcohol that they had consumed. The total score was determined by the sum of the number of standard glasses of alcohol consumed each day. Retrospective estimates of data on daily alcohol consumption can reliably be collected by this self-report measure (Sobell, Brown, Leo, & Sobell, 1996). However, this self-report measure tends only to be valid when the report is made in a clinical or research setting, when participants are sober, and when a guarantee for confidentiality is provided (Sobell & Sobell, 1990, 1995).

Binge drinking. Participants indicated how many times in the past 2 weeks they had consumed six or more standard glasses of alcohol on a single occasion. This amount was based on the definition of binge drinking, whereby individuals drink at least 60 grams of pure alcohol on a single occasion (World Health Organization, 2018). In the Netherlands, a standard glass of alcohol contains 10 grams of pure alcohol (Mongan & Long, 2015), hence the minimum number of six standard glasses of alcohol.

AUDIT. The Dutch version (Schippers & Broekman, 2010) of the validated (self-report) questionnaire the AUDIT (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) was used to identify participants who excessively drink alcohol. The AUDIT consisted of 10 questions; within each question a certain set of possible responses could be chosen of which each response had a score ranging from 0 to 4. By adding up the scores of all the questions, the total score was calculated. A total score of 8 or more could indicate injurious and risky alcohol use, just as possible alcohol dependence. According to Babor et al. (2001), several studies have reported the reliability of the AUDIT of which the results indicated high internal consistency. Also, many studies evaluating the validity of the AUDIT, using diverse samples, provided satisfactory results and thereby proved its efficiency (de Meneses-Gaya, Zuardi, Loureiro, & Crippa, 2009).

Craving VAS. Participants were asked to indicate on a single item VAS, ranging from 1 (*not at all*) to 10 (*a lot*), how much they currently craved alcohol. However, single item scales that measure alcohol craving have limited reliability and validity (Tiffany, Carter, & Singleton, 2000).

Type of alcohol. Participants were asked what type of alcohol they usually drink when they drink alcohol. They could choose one or more of the several available options of beer, wine, and liquor.

Procedure

All participants individually completed an online questionnaire, and a standardized and a personalized bias measurement in the Breindebaas app. Prior to the study, the order of the two bias measurements was randomly determined. A random team generator tool was used (Baum, n.d.) to assign participants to the standardized or personalized bias measurement group, which resembled what bias measurement the participants would start with.

At the start of the study the participants were thanked for their interest in participation. After this, the participants were asked to fill in the online questionnaire on a mobile phone that was supplied by the researcher. The online questionnaire started with an informed consent, which the participants had to agree with before they could continue with the questionnaire and take part in the two bias measurements of the Breindebaas app (see Appendix B1.1).

After finishing the questionnaire, the two bias measurements of the Breindebaas app were performed on the mobile phone that was supplied by the researcher. First, the participants had to register themselves. Then, the participants were asked to log into the app with their account details (see Appendix B1.2). After logging in, a screen popped up that showed a multitude of options. Here, the researcher made sure to only activate the options “Activate measures” and “Play a sound with right or wrong answers”. Participants who started with the standardized bias measurement were told to use the standardized set of stimuli and to follow the instructions provided by the app (see Appendix B2.1). When participants started with the personalized bias measurement, the set of stimuli had to be chosen. After the selection of stimuli, the participants were also told to follow the instructions provided by the app (see Appendix B2.2). A bias measurement consisted of two parts. During the bias measurement, the researcher wrote down which part the participants received first (i.e., alcohol approach or alcohol avoidance), possible comments regarding the malfunctioning of the app (e.g., the app froze during the bias measurement), and possible external negative influences on the performance of the bias measurement (e.g., distractions during the bias measurement).

After the first bias measurement was finished, the researcher logged out of the account and closed the app fully to secure the data. Then, the break started (see Appendix B2.3).

The second bias measurement was performed after the break. The participants were asked to log into the app and to continue with the second bias measurement. Now, the participants had to conduct either the standardized or personalized bias measurement, based on which bias measurement remained. The instructions for the participants and the notes of the researcher were repeated conform to the first bias measurement.

The study came to an end after the second bias measurement was finished; the researcher again made sure to log out of the account and to close the app completely. The researcher thanked the participants again for their participation and asked about the experiences of the participants during the study (see Appendix B3).

Data Analysis

The data of the online questionnaire was linked to the data of the two bias measurements of the Breindebaas app through the e-mail addresses of the participants. For the statistical analyses, IBM SPSS Statistics version 25 was used.

Preliminary analyses. Firstly, preliminary analyses were performed in the order stated below.

Data cleaning. Participants that did not have both bias measurement data available were listwise (i.e., completely) removed from the data set (n = 9). Also, participants that made more than 25% mistakes (i.e., wrong swipe directions) in at least one bias measurement were listwise removed from the data set (n = 1).

Alcohol approach bias scores. The alcohol approach bias scores (these scores will for the remainder of the article be referred to as the *bias score(s)*) for the two bias measurements were calculated for each participant. For the calculation of this bias score, the formula of the *D*-score, based on Greenwald, Nosek, and Banaji (2003), was used. For the calculation of the *D*-score, at first the mean and standard deviation of the RTs of the alcoholic stimuli in both parts (i.e., alcohol approach and alcohol avoidance) were calculated for each participant. The first 10 RTs of both parts were deleted, because the first 10 stimuli of each part were meant as practice. Also, RTs of less than 200 or more than 2000 ms were not included in the calculations. Then, the *D*-score was calculated by subtracting the mean RT of the alcoholic stimuli in the approach part from the mean RT of the alcoholic stimuli in the avoidance part. This resulting outcome was then divided by the pooled standard deviation (Cohen, 1988), $SD_{pooled} = [(SD_1^2 + SD_2^2) / 2]^{1/2}$, whereby SD_1 is the standard deviation RT of the alcoholic stimuli in the avoidance part and SD_2 is the standard deviation RT of the alcoholic stimuli in the approach part. A positive *D*-score indicated an alcohol approach bias and a negative *D*-score indicated an alcohol avoidance bias.

Outliers. Possible outliers on the three self-report constructs and the two bias measurements were identified by the use of a boxplot. Extreme outliers, which were defined by having a quartile distance of at least 150% below Q1 or above Q3, were listwise removed from the data set. Only in the standardized bias measurement there were outliers (n = 3). After removing these outliers listwise from the data set, there were no remaining outliers in the data set.

Normality. To test whether the scores on the three self-report constructs and the two bias measurements were normally distributed, five Shapiro-Wilk tests were performed in which participants were pairwise excluded (i.e., removed only in an analysis if they missed data of the particular variable). The distribution was normal (p > .05) for all three self-report constructs and the two bias measurements. However, for the correlations with the self-report constructs the AUDIT and the craving VAS, the Spearman's rank correlation coefficient was calculated, because these variables were measured on a ranked scale. For the correlations with the self-report construct for alcohol consumption and for the correlation between the two bias measurements, Pearson's correlation coefficient was calculated, because these variables were measured on a continuous scale.

Descriptive statistics. Descriptive statistics were performed on the data of the questionnaire and the bias scores. In the descriptive statistics, the participants were excluded pairwise.

Psychometric properties. Secondly, the psychometric properties of the two bias measurements were examined. Also here, the participants were excluded pairwise. Furthermore, when determining the effect size, the formula of Hedges' g was used. Hedges' g could be calculated in four steps: (a) $M_1 - M_2$, whereby M_x is the mean of the corresponding variable; (b) $\{[(n_1 - 1) \times SD_1^2] + [(n_2 - 1) \times SD_2^2]\}$, whereby n_x is the number of participants of the corresponding variable and SD_x is the standard deviation of the corresponding variable; (c) $n_1 + n_2 - 2$, whereby n_x is again the number of participants in the corresponding variable; and (d) lastly the three previous steps were then put in one equation, namely $\{a / [(b / c)^{1/2}]\}$.

Construct and convergent validity. To test the construct validity, a correlation analysis between the bias scores of the two bias measurements was performed. To test the convergent validity of the two bias measurements, six correlation analyses were performed, namely between the bias scores of the standardized bias measurement and the three self-report constructs, and between the bias scores of the personalized bias measurement and the three self-report constructs. By comparing these two sets of three correlations, it could be determined whether the personalized bias measurement had stronger positive correlations

with the three self-report constructs, thus a higher validity, compared to the standardized bias measurement.

Standardized versus personalized alcohol approach bias. The difference in the mean bias scores between the two bias measurements was examined through a paired samples t-test.

Amount of personalization. The associations between the number of personalized alcoholic stimuli and several participants' demographic characteristics were explored through four Chi-Square Tests. Before performing these analyses, the amount of personalization was firstly calculated by counting the number of stimuli that did not appear in the standardized set of stimuli.

For the Chi-Square Tests, the variable of the number of personalized alcoholic stimuli was collapsed in dichotomous groups through visual binning based on equal percentiles based on scanned cases. This was done in order to be able to make a difference between participants that personalized the alcoholic stimuli a little or a lot. Then, an independent samples t-test was performed to confirm whether these two created groups were significantly different from each other. Furthermore, the variables age, most important daily activity, and highest current or completed education were also collapsed into dichotomous groups through recoding the variables. The variable gender was already dichotomous and represented (a) males (n = 10), and (b) females (n = 4). The variable age was collapsed in two groups, because the age distribution showed two clear categories: (a) participants that were 32 years old or younger (n = 6), and (b) participants that were 49 years old or older (n = 8). The variable most important daily activity was collapsed in (a) participants that were pupil or student (n = 2), and (b) participants that were no pupil or student (i.e., paid work or other; n = 12). The variable highest current or completed education was collapsed in (a) participants of which the highest current or completed education was primary school, LBO, MAVO, VMBO, HAVO, VWO, or MBO (low; n = 9); and (b) participants of which the highest current or completed education was HBO or WO (high; n = 5).

Evaluation of the two bias measurements. Lastly, the experiences (i.e., comments) that participants expressed at the end of the study were also analysed. Experiences that participants gave were not literally documented, but clustered in self-made groups by the researcher, based on the participants' general intentions.

Results

Participants' Characteristics

Twenty-seven participants who matched the inclusion criteria participated in the study. All participants participated both in the online questionnaire as well as in the two bias

measurements of the Breindebaas app. After removing participants with incomplete or erroneous bias data, and after removing the outliers, the data of 14 participants was used in the descriptive statistics (see Table 1) and in the analyses. Participants were mainly male (*n* = 10, 71.4%), and had a mean age of 42.93 years (*SD* = 13.82). For the most important daily activity, the most commonly mentioned activity was paid work or other (*n* = 12, 85.7%), and the most common highest current or completed education was low (*n* = 9, 64.3%). On the question of binge drinking, the results were as follows: (a) I have never drunk more than six glasses on one occasion in the last 2 weeks (*n* = 4, 28.6%), (b) one time in the last 2 weeks (*n* = 7, 50%), (c) two times in the last 2 weeks (*n* = 2, 14.3%), and (d) three times in the last 2 weeks (*n* = 1, 7.1%). Moreover, 50% of the participants scored 8 or more on the AUDIT. Furthermore, participants drank mostly only beer (*n* = 8, 57.1%), followed by two or three types of alcohol (*n* = 3, 21.4%), only wine (*n* = 2, 14.3%), or only liquor (*n* = 1, 7.1%). Lastly, six participants started with the standardized bias measurement and eight participants started with the personalized bias measurement.

Table 1
Descriptive Statistics (*N* = 14)

Variable	*n*	%	*M*	*SD*
Gender				
Male	10	71.4		
Female	4	28.6		
Age			42.93	13.82
32 years or younger	6	42.9	28.50	3.08
49 years or older	8	57.1	53.75	5.95
Most important daily activity				
Pupil or student	2	14.3		
Paid work or other[a]	12	85.7		
Highest current or completed education				
Low[b]	9	64.3		
High[c]	5	35.7		
Alcohol consumption			10.71	4.87
Male	10	71.4	9.70	4.85
Female	4	28.6	13.25	4.50
Alcohol Use Disorders Identification Test	10	71.4	8.90	4.31
Craving Visual Analogue Scale	8	57.1	4.50	2.67
Bias scores				
Standardized bias measurement			0.12	0.27
Personalized bias measurement			0.12	0.50

Note. [a]Other (*n* = 1) = Invalidity insurance act. [b]Low = Elementary school, LBO, MAVO, VMBO, HAVO, VWO, and MBO (education levels based on the Dutch school system). [c]High = HBO and WO (education levels based on the Dutch school system).

Construct and Convergent Validity

A Pearson correlation between the bias scores of the standardized bias measurement and the bias scores of the personalized bias measurement was performed to determine the relationship between the two bias measurements (see Figure 2). The result showed that there was no significant relationship between the two bias measurements, $r = .19$, $n = 14$, $p = .52$ (two-tailed).

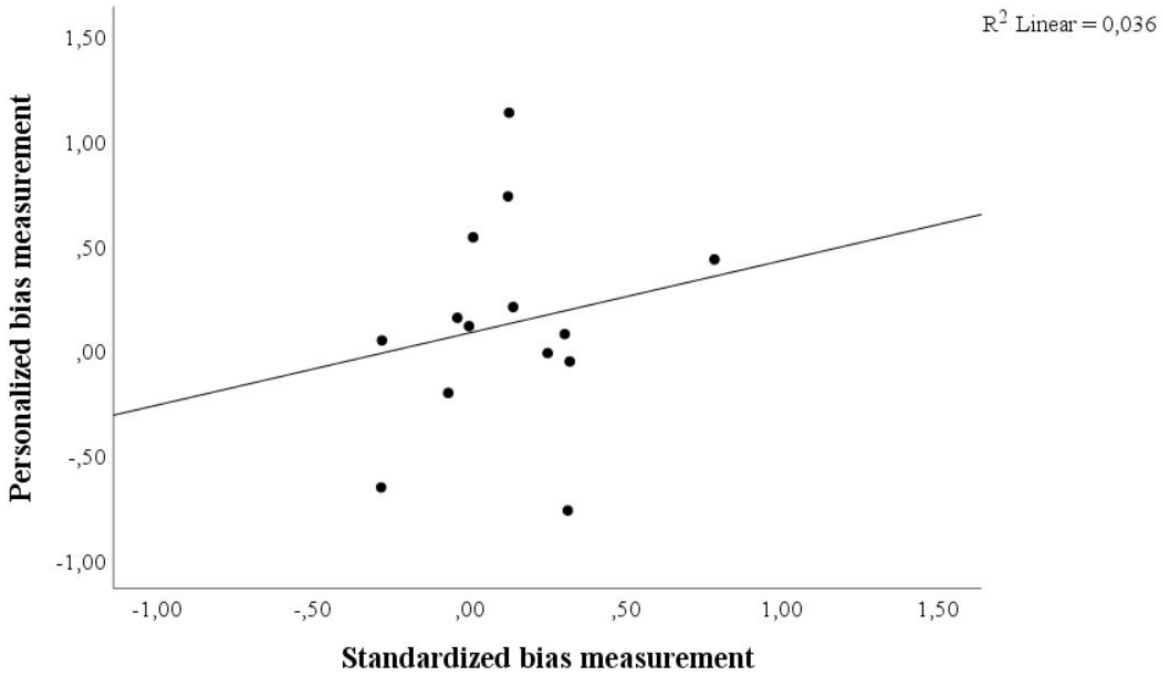

Figure 2. Relationship between the bias scores on the personalized bias measurement and the bias scores on the standardized bias measurement.

Next, two Pearson correlations between the bias scores of the two bias measurements and the total scores of the self-report construct for alcohol consumption were run to examine their relationships (see Table 2). Furthermore, four Spearman correlations were run to examine the relationships between the bias scores of the two bias measurements, and the total scores of the self-report construct the AUDIT and the scores of the self-report construct craving VAS (see Table 2). These results showed that only the bias scores of the standardized bias measurement significantly correlated with the scores of the self-report construct craving VAS; this indicated a strong, negative relationship, $r_s = -.74$, $n = 8$, $p = .038$ (two-tailed). Because this relationship was negative, it meant that the more participants craved, the lower their bias score was. This lower bias score indicated a weaker alcohol approach bias and a

negative bias score even indicated an alcohol avoidance bias. This is in contrast with the hypothesis, because it was expected that participants that had higher craving scores would also be faster to swipe the alcoholic stimuli to themselves and slower to swipe the alcoholic stimuli away from themselves, and therefore would have had higher bias scores.

Table 2
Correlations Between Bias Measurements and Self-Report Constructs

Bias scores	Alcohol consumption (n = 14)	AUDIT (n = 10)	Craving VAS (n = 8)
Standardized bias measurement	−.36	.044	−.74*
Personalized bias measurement	.15	−.37	−.16

Note. AUDIT = Alcohol Use Disorders Identification Test; Craving VAS = craving Visual Analogue Scale.
* $p < .05$ (two-tailed).

Standardized Versus Personalized Alcohol Approach Bias

A paired samples t-test was performed to test whether there was a mean difference between the bias scores of the standardized bias measurement and the bias scores of the personalized bias measurement. The result showed no significant mean difference between the bias scores of the two bias measurements, $t(13) = .008$, $p = .99$ (two-tailed).

Amount of Personalization

Firstly, the amount of personalization was determined (see Table 3). Here, a particular finding was that on average participants personalized alcoholic stimuli more ($M = 20.71$, $SD = 3.85$) than non-alcoholic stimuli ($M = 13.07$, $SD = 6.57$). A paired samples t-test showed that this mean difference, 7.64, 95% CI [2.92, 12.37], was significant, $t(13) = 3.49$, $p = .004$ (two-tailed), and represented a very large-sized effect, Hedges' $g = 1.42$.

Secondly, the participants were collapsed in two groups: (a) participants who had 20 or less personalized alcoholic stimuli ($n = 8$), and (b) participants who had 21 or more personalized alcoholic stimuli ($n = 6$). An independent samples t-test was performed to confirm whether these two groups were significantly different from each other. Participants in the second group (b) personalized the set of alcoholic stimuli more ($M = 23.67$, $SD = 3.67$) than participants in the first group (a; $M = 18.5$, $SD = 2.20$). This mean difference, 5.17, 95% CI [−8.59, −1.75], was significant, $t(12) = -3.29$, $p = .006$ (two-tailed), and represented a very large-sized effect, Hedges' $g = 1.78$.

Lastly, four Chi-Square Tests were performed to test the associations between the number of personalized alcoholic stimuli and several participants' demographic

characteristics (see Appendix C). Due to a small sample size and because in all tests the Chi-Square Test assumption was violated, Fisher's Exact Test was used. Fisher's Exact Test indicated a non-significant association between the amount of personalized alcoholic stimuli and (a) gender (p = .58, two-sided), (b) age (p = 1.00, two-sided), (c) most important daily activity (p = 1.00, two-sided), and (d) highest current or completed education (p = .30, two-sided).

Table 3
Number of Personalized Stimuli in the Personalized Bias Measurement

Personalized stimuli	Minimum	Maximum	*M*	*SD*
Alcoholic	15	30	20.71	3.85
Non-alcoholic	0	21	13.07	6.57
Total	21	43	33.79	7.00

Evaluation of the Two Bias Measurements

After finishing the online questionnaire and the two bias measurements of the Breindebaas app, the participants were asked about their experiences during the study, which resulted in the following comments about the two bias measurements. In the undermentioned comments, the comments of all participants were included.

Considering positive comments on the two bias measurements, the fact that the game element was enjoyable was mentioned (n = 3). The participants defined this game element to be the action of the swiping of the stimuli.

Neutral comments on the two bias measurements were (a) that participants were not sure whether there were tricky stimuli, such as alcohol-free beer (n = 7); the suggestion to swipe text instead of stimuli during the two bias measurements (n = 2); and (c) the suggestion to add the alcoholic drink sambuca (n = 1). The first neutral comment (a) could indicate that the participants were on one's guard to have as much correct swipe directions as possible, because they took part in a study. The second neutral comment (b) was related to the negative comment that not all stimuli were clear. Because not all stimuli were clear, a few participants were curious whether swiping text (i.e., drink names) instead of stimuli would also work.

Negative comments on the two bias measurements were (a) the fact that participants in the personalized bias measurement had to choose at least 50 stimuli for both alcoholic and non-alcoholic drinks, made their personalized set of stimuli a lot less personalized (n = 10); (b) that there were too many stimuli to choose from (n = 9); (c) that stimuli were insufficiently categorized by brand or type of drink (n = 8); (d) that the stimuli to choose from

were double (n = 6); (e) that a few participants got thirsty for alcohol during the two bias measurements (n = 4); (f) that participants wanted to be able to perform the personalized bias measurement with multiple stimuli of one drink (n = 3); (g) that not all stimuli were clear (n = 3); (h) that the stimuli were small (n = 3); (i) that the Breindebaas app stated before a measurement that "soft drinks" had to be swiped, but that it was left unclear what to do with drinks like coffee and tea (n = 2); (j) that the select button of the stimuli was sometimes unresponsive and sometimes too responsive (n = 2); and (k) to remove the coloured background during the two bias measurements, because it was distracting (n = 1). A suggestion for the first and sixth negative comments (a and f, respectively) was to be able to choose as many stimuli as the participants wanted, and only to perform the personalized bias measurement with these stimuli, even if this would mean that the participants needed to play with double stimuli. Two participants stated that this could make the personalized bias measurement boring, but that it at least would make it personalized.

Lastly, because two older adult participants (65 and 79 years old) specifically gave comments regarding older adults, these comments were taken separately. However, because these comments were mainly based on one participant, no firm conclusion should be drawn from these comments. The specific comments of the older adults were (a) that the game element was enjoyable (n = 1), (b) that the game was easy to do (n = 2), (c) that the sounds supported the memory (n = 1) , (d) to play with multiple stimuli of one drink for older adults (n = 1), (e) that there were too many stimuli to choose from for older adults (n = 1), and (f) that it was unsure whether older adults needed personalization (n = 1). Here too, what was meant with "game" in the first two comments (a and b) of the older adults, was the action of the swiping of the stimuli. The fourth, fifth, and sixth comments (d, e, and f, respectively) of the older adults were linked together. Because these participants stated that older adults mostly only drink a few types of alcohol, they wanted to be able to play with only those drinks. Because of this reason, one of these participants was also unsure whether older adults needed personalization, because he had the feeling that his set of stimuli was not personalized at all.

Discussion

Main Results

This study compared the psychometric properties of the standardized bias measurement of the Breindebaas app with the personalized bias measurement of the Breindebaas app. This study showed that a personalized approach to measure the alcohol approach bias did not provide an added value to measure the alcohol approach bias. More

specifically, it was found that (a) the correlation between the two bias measurements was not significant; (b) the two bias measurements did not significantly positively correlate with the three self-report constructs, however, there was a significant negative correlation between the standardized bias measurement and the self-report construct craving VAS; and (c) there was no significant mean bias score difference between the two bias measurements. This shows that all three hypotheses were falsified. Additionally, the associations with the number of personalized alcoholic stimuli were exploratively researched and participants were asked for their experiences, which showed that (d) the participants personalized the alcoholic stimuli significantly more than the non-alcoholic stimuli; (e) there were no significant associations between the number of personalized alcoholic stimuli and several participants' demographic characteristics; and (f) the most prevalent comment that the participants gave, was that they had the feeling that their set of personalized stimuli was not truly personalized, because they had to choose at least 50 stimuli for both alcoholic and non-alcoholic drinks.

The first finding, which showed that the personalized bias measurement was not significantly correlated with the standardized bias measurement, can be assumed from previous research. The relationship between the personalized bias measurement and the standardized bias measurement of the Breindebaas app was analysed in the present study, because it was assumed that the mobile standardized bias measurement of the Breindebaas app was capable of measuring the alcohol approach bias. However, whether the mobile standardized bias measurement was able to measure the alcohol approach bias was not tested before; it was only assumed of being capable to measure the alcohol approach bias, because it was an equivalent to the computer AAT (Wiers et al., 2009) that was able to measure an alcohol approach bias. Meule, Lender, Richard, Dinic, and Blechert (2019) also tested a touchscreen-based interface AAT, but on chocolate-containing foods and non-edible object. They showed that the touchscreen-based AAT was unable to reproduce an approach bias that the joystick-based variant yielded. Despite that Meule et al. (2019) did not explain this effect in their study, their research showed that an AAT that works properly on one device will not necessarily work just as well on a different device.

The second finding was that the two bias measurements did not significantly positively correlate with the three self-report constructs, however, there was a significant negative correlation between the standardized bias measurement and the self-report construct craving VAS. Both parts of this finding are partly in line with previous research. Because there are to my best knowledge no previous studies done on a personalized bias measurement, the findings about personalization cannot be compared. For the standardized bias measurement

however, the results of this present study indicated that the self-report constructs for alcohol consumption and the AUDIT did not have a significant relationship with the two bias measurements. In contrast, Field, Kiernan, Eastwood, and Child (2008) demonstrated in a different implicit task that weekly alcohol consumption and the AUDIT were significantly correlated with the bias score. However, their bias score was calculated by subtracting the RTs of the alcoholic stimuli of the approach part from the RTs of the alcoholic stimuli of the avoid part. Besides this, the weekly alcohol consumption was log transformed to decrease the skewness. Also, Kersbergen, Woud, and Field (2015) found that higher scores on the relevant feature version of the AAT, which is similar to the standardized bias measurement of the Breindebaas app, predicted higher scores on alcohol consumption and the AUDIT. However, their prediction only occurred when bias scores based on raw RTs, which are the mean differences between the alcohol approach and alcohol avoidance parts, were used in the analyses. Analyses in which the *D*-measure was used, which was calculated in the same manner as the bias score in this present study, also did not result in a significant model. Thus, these previous studies showed that the way in which the bias scores were calculated do matter. The calculation does matter, because the AAT that was used in the study of Krieglmeyer and Deutsch (2010) showed to be very sensitive to the correction of outliers. This present study has calculated the bias score based on the formula of Greenwald et al. (2003), which corrects for outliers, consequently making the bias score less accurate. The results of this present study furthermore showed that the self-report construct craving VAS did have a strong, significant, negative relationship with the standardized bias measurement. That craving is an indicator of addiction has long been clear (Minervini, Palandri, Bianchi, Bastiani, & Paffi, 2011). Field et al. (2008) also demonstrated that the bias score was associated with self-reported alcohol craving. However, as already noted, they used a different calculation for the bias score and besides this, they also used a different craving self-report construct. Though, the result of this present study meant that the more participants craved, the lower their bias score was. This contradicts each other, because it would be expected that individuals that had higher craving scores would also be faster to swipe the alcoholic stimuli to themselves and slower to swipe the alcoholic stimuli away from themselves, and therefore would have had higher bias scores. A reason for this result in this present study could be that the self-report construct craving VAS was not a valid measure. Namely, one-dimensional measures of craving have difficulty to hold other dimensions that theoretical models of craving presume and thus are often incompetent to use (Minervini et al., 2011). Furthermore, what was notable in this present study, is that there was a significant relationship between the

self-report construct craving VAS and the standardized bias measurement, but not between the self-report construct craving VAS and the personalized bias measurement, while there was no significant difference between the mean bias scores of the two bias measurements. Further research should investigate this difference.

The third finding, namely that there was no significant mean bias score difference between the two bias measurements, can also not be compared with other studies, because there are to my best knowledge no previous studies done on the personalization of an approach bias measurement. However, there are for example an app and a few interventions that have researched a personalized approach. A study based on weight loss using a commercial app suggested that personalization of the app was linked to a greater chance of success in losing weight (Serrano, Yu, Coa, Collins, & Atienza, 2016). Furthermore, Ludden, van Rompay, Kelders, and van Gemert-Pijnen (2015) discussed that in web-based interventions, user-controlled personalization gives users a feeling of control or dominance that can produce well-being. They also stated that control can change passive patients into active citizens responsible for their own well-being. On the other hand, Andersson, Estling, Jakobsson, Cuijpers, and Carlbring (2011) found in their study of internet treatment (CBT) for anxiety disorders, that giving participants a possibility to choose their own training modules had a minimal effect on the outcome. Although the personalized bias measurement in this present study had no added value to measure the alcohol approach bias, it is still interesting to compare a standardized alcohol approach bias training with a personalized alcohol approach bias training, in order to decide which training version will more successfully retrain the alcohol approach bias, because these previous studies provided different conclusions about the effect of personalization on outcomes.

The fourth and fifth findings showed that although it was interesting to inspect whether the number of personalized alcoholic stimuli was linked to several demographic characteristics of the participants, in order to investigate whether it is advisable to use the personalized version of the Breindebaas app instead of the standardized version of the Breindebaas app for specific types of individuals, the results showed no significant associations. To my best knowledge, there are also no previous studies that had tested whether the amount of personalization in a health app is associated with participants' demographic characteristics. What is notable from this present study however, is that participants mostly commented that they had the feeling that their personalized set of stimuli was not truly personalized due to the minimum number of stimuli that had to be chosen. This could have led to distorted results and therefore it is advisable to not draw firm conclusions from these

results. Another remarkable result from this study is that participants personalized the alcoholic stimuli significantly more than the non-alcoholic stimuli. This could either mean that participants are less picky on non-alcoholic drinks, or that the standardized set of stimuli that was already prechecked gave a good representation of what Dutch individuals generally drink.

The sixth finding, regarding the comments of the participants about the two bias measurements, is specifically worth noting, because this could be the reason behind the obtained results in this study. Therefore, the Breindebaas app should be changed in accordance to the following recommendations. Regarding the stimuli, it is advisable to (a) delete the double stimuli, which also directly reduces the number of stimuli individuals can choose from; (b) categorize the stimuli in a more convenient way; (c) make the stimuli clearer and larger; and (d) add the alcoholic drink sambuca. Regarding the measurement and training itself, it is advisable to (a) let individuals choose the number of stimuli they want to play with in the personalized bias measurement, with a minimum of one and a maximum of 50 stimuli for both alcoholic and non-alcoholic drinks; (b) make sure that individuals know that there are no tricky stimuli (i.e., alcohol-free alcoholic stimuli); (c) let individuals play with multiple stimuli of one drink in the personalized bias measurement; and (d) use the word *non-alcoholic drinks* instead of *soft drinks*. Regarding the Breindebaas app, it is advisable to develop the app in such a way that (a) the select button of the stimuli is not unresponsive and not too responsive, (b) the app will not freeze during the measurement or training, and (c) the checkboxes are not prechecked when participants have to choose their personalized set of stimuli. The second comment (b) regarding the Breindebaas app was not explicitly mentioned by the participants, but all participants experienced this issue to some extent, because the app was still under development. The last comment (c) regarding the Breindebaas app was also not specifically mentioned by the participants. However, when the participants had to choose their personalized set of stimuli, the checkboxes of the stimuli were already prechecked according to the standardized bias measurement, which could have influenced the participants to some extent, because they were not able to choose from an unchecked set of stimuli. Furthermore, the most mentioned comment of the participants was that they did not have the feeling that their personalized set of stimuli was truly personalized. This probably played a big role in all of the results.

Strengths and Limitations

A number of strengths about this study should be mentioned. Firstly, the study was highly controlled due to the standardization of the instructions that every participant received

from the researcher during the study. Secondly, counterbalancing was performed in order to compensate for a possible learning effect. This learning effect was a possibility, because participants taking part in the first bias measurement could get used to the task. Lastly, after the study, experiences of the participants were gathered that could be used for the improvement of the measurement and even the training feature of the Breindebaas app.

The study also had some limitations. Firstly, it should be noted that the Breindebaas app still had technical issues and therefore did not work optimally during the study. Namely, during the measurements the app often froze, which caused distorted RTs and consequently caused an inaccurate alcohol approach bias measure. Although these RTs have been removed from the analysis, the freezing of the app was probably distracting for the rest of the participants' bias measurements. Secondly, the design of the Breindebaas app was somewhat flawed, as the evaluation comments displayed. The comment that was most prevalently mentioned, was that participants felt that their personalized set of stimuli was not truly personalized. Therefore, for future research it is of big importance that participants are able to choose as many stimuli as they want. Thirdly, the overall number of participants was low, both because of recruitment difficulties and because of unusable bias data; therefore, the analyses could not be performed on a larger general Dutch population. Fourthly, the removal of the three bias score outliers of the standardized bias measurement was retrospectively unnecessary, because the RTs below 200 and above 2000 ms (i.e., RT outliers) were already removed from the calculations of the bias scores. Lastly, the participants performed the two bias measurements on an assigned device, namely the mobile phone of the researcher. While this was a device the participants might not be familiar with, this could also have had a negative effect on the RTs due to participants being careful with the mobile phone and not being used to the workings of the mobile phone. Because of all these limitations, the results of this study should be interpreted with caution.

Future Research

Firstly, it should be noted that for the calculation of the bias score, the bias score based on raw RTs should be used in order to avoid the correction of outliers. Secondly, because the computer version of the AAT was able to measure an alcohol approach bias, it is interesting to test the difference between a standardized and a personalized bias measurement on the computer with the use of a joystick. The results of this computer-based study could then be compared to a new study; this new study would be similar to the study conducted in this present study, though with a larger sample size and after improvements have been applied to the Breindebaas app according to the aforementioned recommendations. This comparison

would be useful in order to find out whether personalization has an added value to measure the alcohol approach bias, or possibly only when using a specific type of device. To find a larger sample size than in this study, a possible solution could be to increase the effectiveness of using social media to reach a larger audience, and to offer a small compensation to all participants instead of offering a possibility of a prize. Also, another way of increasing the sample size is through changing the criterion of the minimal amount of alcohol consumption in this present study, by including all adults that want to change (i.e., reduce or stop) their drinking behaviour, because the Breindebaas app is aimed at those individuals. Thirdly, after the measurements have been tested, it is advisable to still test both a standardized and a personalized training conform to the pilot study of Somsen (2017). However, a change that should be mentioned is that participants should either test a standardized or a personalized bias training. The participants cannot test both trainings, because the learning effect would otherwise be too large.

Furthermore, because participants also reported getting thirsty for alcohol during the bias measurements, it is good to further investigate this finding, as this is the opposite effect of what should occur after playing the Breindebaas app. However, because the measurement consisted of two parts, participants also had to swipe alcoholic stimuli to themselves, which could have caused participants to associate alcohol as appetitive. Therefore, only in the training study this effect should be investigated; this can be done by asking the participants before and after every training session how much they crave alcohol. Lastly, because some participants suggested to swipe text instead of stimuli, it is interesting to test the alcohol approach bias with drink names instead of stimuli.

Conclusions

The results of this study indicated that a personalized approach to measure the alcohol approach bias did not provide an added value to measure the alcohol approach bias. Also, the amount of personalization was not associated with relevant results. However, due to a small study sample size, a flawed Breindebaas app, and most importantly the feeling that participants' personalized set of stimuli was not truly personalized, no firm conclusions can be drawn from this study.

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Appendix A

Poster and Flyer

Figure 1. Poster/flyer that was used for the recruitment of participants for the study. Vector image reprinted from "Illustration of people having a party," by rawpixel.com, 2018 (https://www.freepik.com/free-vector/illustration-people-having-party_2921084.htm). *CC* 2018 by rawpixel.com.

Appendix B

Standardized Instructions Regarding the Study Procedure

1. Prebias Measurements

1.1 Informed Consent and Questionnaire

"Bedankt voor uw deelname aan dit onderzoek. U gaat zometeen beginnen met het invullen van de vragenlijst. Aan het begin van de vragenlijst staat een toestemmingsformulier; hierin worden zaken uitgelegd over privacy (het gebruik van de data), en de behandeling van opmerkingen of klachten. Ik vraag u dit zorgvuldig door te lezen voordat u toestemming geeft. Mocht u nog verdere opmerkingen of vragen hebben (betreffende het toestemmingsformulier), dan beantwoord ik ze graag."

English translation. "Thank you for your participation in this study. In a moment you will start with filling in the questionnaire. At the beginning of the questionnaire there is a consent form; herein things will be explained about privacy (the use of the data), and the handling of comments or complaints. I ask you to read this carefully before you give consent. May you have further comments or questions (regarding the consent form), then I will gladly answer them."

1.2 Logging In

"Nu gaat u aan de slag met de Breindebaas app. Voordat u begint, wil ik u graag vragen om het geluid van de mobiele telefoon aan te zetten op 50%."

"Nu kunt u beginnen met het aanmaken van een account. Om een account aan te maken, mag u klikken op de tekst onderaan het (start)scherm en de gevraagde informatie invullen."

"U mag zich nu aanmelden."

English translation. "Now you will work with the Breindebaas app. Before you start, I would like to ask you to turn the mobile phone's sound on to 50%."

"Now you can start with creating an account. To create an account, you may click on the text at the bottom of the (start)screen and fill in the requested information."

"You may now log in."

2. Bias Measurements

2.1 Standardized Bias Measurement

"Gedurende deze ronde gebruikt u de standaard afbeeldingen. Er hoeven dus geen afbeeldingen geselecteerd te worden. De app zal vóór het begin van de meting aangeven wat er van u verwacht wordt. Veel succes!"

English translation. “During this round you will use the standard images. So, no images have to be selected. Before the start of the measurement, the app will indicate what is expected from you. Good luck!”

2.2 Personalized Bias Measurement

“Voor de start van deze ronde vraag ik u de drankjes te selecteren, uit de verschillende categorieën, die u mogelijk wel zou drinken. Ik raad u aan om, wanneer u een afbeelding selecteert, een andere te verwijderen. Dit komt omdat de meting werkt met een minimum- en maximumaantal afbeeldingen.”

“Dan gaat u nu beginnen met de meting. De app zal vóór het begin van de meting aangeven wat er van u verwacht wordt. Veel succes!”

English translation. “Before the start of this round I would like to ask you to select the drinks, from the different categories, which you would be likely to drink. I recommend you, if you select an image, to subsequently remove another one. This is because the measurement works with a minimum and maximum number of images.”

“Now you will start with the measurement. Before the start of the measurement, the app will indicate what is expected from you. Good luck!”

2.3 Break

“De eerste meting is nu voltooid. Voordat u met de volgende meting begint, zullen we 10 minuten pauze houden. U heeft de mogelijkheid om in deze 10 minuten met een puzzel aan de slag te gaan. Als u liever iets anders doet, mag u ook met u mobiel bezig of kunnen we een gesprekje hebben.”

English translation. “The first measurement is now finished. Before you start with the next measurement, we will have a 10-minute break. In these 10 minutes you have the opportunity to solve a puzzle. If you prefer to do something else, you can also check your mobile phone or we can have a conversation.”

3. Postbias Measurements

“U bent nu aangekomen aan het einde van het onderzoek. Ik wil u nogmaals bedanken voor uw deelname aan dit onderzoek. Tot slot wil ik u vragen hoe u het onderzoek heeft ervaren.”

English Translation

“You have now reached the end of the study. I want to thank you again for your participation in this study. Finally, I want to ask you how you have experienced the study.”

Appendix C

Chi-Square Test Crosstabulations

Table C1
Number of Personalized Alcoholic Stimuli and Gender

Number of personalized alcoholic stimuli	Gender		Total
	Male	Female	
20 or less	5	3	8
21 or more	5	1	6
Total	10	4	14

Note. The table consists of counts.
p = .58 (two-sided; Fisher's Exact Test).

Table C2
Number of Personalized Alcoholic Stimuli and Age

Number of personalized alcoholic stimuli	Age		Total
	32 years or younger	49 years or older	
20 or less	3	5	8
21 or more	3	3	6
Total	6	8	14

Note. The table consists of counts.
p = 1.00 (two-sided; Fisher's Exact Test).

Table C3
Number of Personalized Alcoholic Stimuli and Most Important Daily Activity

Number of personalized alcoholic stimuli	Most important daily activity		Total
	Pupil or student	Paid work or other[a]	
20 or less	1	7	8
21 or more	1	5	6
Total	2	12	14

Note. The table consists of counts.
[a]Other = Invalidity insurance act.
p = 1.00 (two-sided; Fisher's Exact Test).

Table C4
Number of Personalized Alcoholic Stimuli, and Highest Current or Completed Education

Number of personalized alcoholic stimuli	Highest current or completed education		Total
	Low[a]	High[b]	
20 or less	4	4	8
21 or more	5	1	6
Total	9	5	14

Note. The table consists of counts.
[a]Low = Elementary school, LBO, MAVO, VMBO, HAVO, VWO, and MBO (education levels based on the Dutch school system). [b]High = HBO and WO (education levels based on the Dutch school system).
p = .30 (two-sided; Fisher's Exact Test).