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# Acceptability and Co-Development of an Online Cognitive Bias Modification Intervention for Emerging Adults With Hazardous Alcohol Use and Social Anxiety: A Mixed Methods Study

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**Background:** Approach bias modification (ApBM) and interpretation bias modification (IBM) are two promising adjunct treatments for alcohol use and social anxiety, respectively. However, the acceptability of combining ApBM and IBM into one program for people who experience both of these disorders is unknown. The present study describes the codevelopment of a new, hybrid ApBM + IBM program and provides insight into the perceptions of acceptability from service providers and emerging adults.

**Methods:** Service providers ( $n = 14$ ) and emerging adults aged 18 to 25 years with lived experience of hazardous alcohol use and heightened social anxiety ( $n = 15$ ) were recruited via online advertisements and through existing networks. All participants were shown a beta version of the program and asked to complete qualitative and quantitative questions to ascertain feedback on the program's acceptability and suggestions for improvement.

**Results:** Themes emerged relating to the ApBM + IBM program's quality and usefulness, appropriateness, motivation and engagement, and potential clinical value. The program was well received and deemed acceptable for the target age group. It was rated particularly highly with regard to the overall quality and ease of use. Emerging adults had fewer suggestions for how the intervention might be revised; however, there were suggestions from both groups regarding the need for a compelling rationale at the outset of treatment and a suggestion to include a motivational interviewing and psychoeducational-based module prior to the first training session, to increase user buy-in and engagement.

**Conclusions:** The current findings reflect positively on the acceptability of a hybrid ApBM + IBM for emerging adults with co-occurring hazardous alcohol use and social anxiety. Service providers and emerging adults identified a number of ways to improve the design and implementation of the program, which will likely improve adherence to, and outcomes of, the intervention when added as an adjunct to treatment as usual.

**Key Words:** Alcohol, Anxiety, Cognitive Bias Modification, Internet Intervention, Young People.

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**A**LCOHOL USE AND anxiety disorders are two of the most prevalent and debilitating psychiatric conditions experienced worldwide, affecting up to 1 in 6 people and 1 in 4 in their lifetime, respectively (Kessler et al., 2005). When alcohol use and anxiety disorders co-occur, there are ongoing interactions between the disorders that may maintain or exacerbate each other in a vicious perpetuating cycle (Baillie et al., 2010; Stewart and Conrod, 2008). This complex, mutually exacerbating relationship commonly leads to greater severity and impairment, as well as a poorer response to treatment than for either disorder in isolation (Farris et al., 2012; McEvoy and Shand, 2008).

Arguably, one of the greatest challenges for treating alcohol use and anxiety disorders are the high rates of relapse. For instance, up to 60% of people treated for an alcohol use disorder relapse to heavy drinking within a year following treatment (National Institute on Drug Abuse, 2009), and these rates are even higher for people with co-occurring

anxiety (Kushner et al., 2005). Recent evidence suggests that high relapse rates may in part be attributable to the effects that implicit or automatically activated cognitive processes have on anxious thoughts and the tendency to drink; factors not adequately addressed in current treatments. For instance, some problem drinkers exhibit an “approach bias,” where they are drawn to approach alcohol rather than avoid it (Braunstein et al., 2016; Wiers et al., 2009). This approach bias has been implicated in the development of heavy drinking, has been shown to predict future alcohol use among adults with an alcohol use disorder (Braunstein et al., 2016), and has been associated with relapse to alcohol after receiving treatment for alcohol dependence (Schlauch et al., 2012). People with anxiety, on the other hand, commonly exhibit an “interpretation bias,” which is a tendency to automatically interpret ambiguous information in a negative manner (e.g., that a yawn from a conversation partner indicates boredom; Amir et al., 2005; Murphy et al., 2007). Interpretation biases have been shown to contribute to the development of anxiety symptoms and disorders, as well as to the maintenance and severity of these conditions (Beard, 2011; Muris et al., 2008). These implicit biases, which are measured indirectly, can be triggered very quickly and are often below the threshold of conscious awareness. As people are often not fully aware that they are being influenced by them, they are difficult to override through conscious effort.

In recent years, new innovative training procedures, known as cognitive bias modification (CBM), have been developed to tackle these implicit processes. CBM has been proposed as a complementary treatment approach that can effectively work side-by-side with cognitive behavioral therapy (CBT) and other psychotherapies, by targeting different aspects of negative thinking and responding. Alongside working to reduce negative thinking styles and behavioral responses in a conscious, deliberate, and explicit way during CBT, CBM can help reduce these processes at a subconscious, habitual, and implicit level (via repeated practice on a cognitive task), which may further aid the effectiveness of treatment (Baert et al., 2011; Bowler et al., 2012; White et al., 2017). While CBM’s efficacy among nonclinical samples is inconsistent (Boffo et al., 2019; Cristea et al., 2015; Wiers et al., 2018), there are particularly promising findings in clinical contexts as clients are motivated to change their thoughts and behavior (Wiers et al., 2018).

There are a wide variety of implicit biases seen across a range of disorders. One of the most common types of CBM programs for alcohol use disorders is approach bias modification (ApBM). ApBM seeks to train an action tendency to avoid alcohol, by repeatedly pushing away images of alcohol shown on a computer screen. Although the evidence for the efficacy of ApBM for nonclinical samples is inconclusive (Boffo et al., 2019; Cristea et al., 2015; Wiers et al., 2018), several randomized controlled trials (RCT) have provided evidence in support of the efficacy of ApBM when delivered to clinical samples in conjunction with standard treatments (Wiers et al., 2011; Eberl et al., 2013; Manning et al., 2016;

Rinck et al., 2018, for reviews see: Kakoschke et al., 2017, Wiers et al., 2018, Batschelet et al., 2020). The first RCT conducted in Germany found that provision of 4 ApBM sessions to alcohol-dependent adults (preceding inpatient alcohol use treatment) resulted in lower alcohol consumption and 13% reduced relapse rates 1 year after treatment discharge, compared with patients who received no training or sham placebo training (in addition to inpatient treatment; Wiers et al., 2011). These findings were later replicated by Eberl and colleagues (2013), who found that inpatients who received 12 sessions of ApBM plus treatment as usual (primarily abstinence-oriented CBT) experienced 9% lower relapse 1 year following treatment, relative to those who received treatment as usual only. Change in alcohol approach biases was found to mediate the change in relapse rates, and a stronger approach bias at baseline moderated ApBM effects. A further 2 RCTs have since demonstrated equivalent clinical improvements among patients receiving ApBM as an adjunct treatment for alcohol use disorders, in comparison with patients who did not receive ApBM or received a placebo control version or no training, with 6.7 to 21.4% reduced relapse rates (Manning et al., 2016; Rinck et al., 2018). Recent research has also shown that ApBM can effectively be delivered via the Internet; however, as motivation to change drinking behavior appears to be a prerequisite for ApBM to be effective (Wiers et al., 2018), the technique is most likely to be effective when delivered alongside standard treatments, rather than as a stand-alone intervention (Wiers et al., 2015).

Over the past two decades, there has also been growing interest in interpretation bias modification (IBM) for ameliorating anxiety symptoms, particularly social anxiety. IBM directly targets negative interpretation biases by repeatedly presenting individuals with emotionally ambiguous social scenarios and training respondents to disambiguate the scenarios in a positive/neutral (vs. threatening) way (Mathews and Mackintosh, 2000). A recent review of meta-analyses on CBM training paradigms showed that single- or multi-session IBM can successfully modify negative interpretations of ambiguity (Jones and Sharpe, 2017), which can lead to a subsequent shift in social anxiety levels (Bowler et al., 2012; Murphy et al., 2007; Salemink et al., 2009). Further support for the efficacy of IBM in reducing anxiety symptoms compared to a waitlist or sham control training condition has since been provided in a systematic review and network meta-analysis (Fodor et al., 2020). While the effect on social anxiety symptoms has not always been greater than control conditions, a greater number of training sessions and instructions for participants to imagine themselves in the social scenarios have been shown to produce larger effects on social anxiety disorder symptoms (Menne-Lothmann et al., 2014). IBM has also been shown to be equally effective in reducing social anxiety as computerized CBT among highly anxious individuals (Bowler et al., 2012).

Unlike research on ApBM, relatively few studies have tested the clinical utility of IBM in reducing social anxiety

among clinical samples (Amir and Taylor, 2012; Brettschneider et al., 2015; Brosan et al., 2011; Salemink and Wiers, 2014). Notably, Amir and Taylor (2012) examined the impact of 12 sessions of IBM among clients with generalized social anxiety disorder. IBM training was associated with significantly greater reductions in negative interpretations of ambiguous scenarios, social anxiety symptoms, and rates of social anxiety disorder diagnosis from pre- to postassessment, as well as significant decreases in clinician-rated social anxiety symptoms, relative to a sham control training condition. Effects on social anxiety were maintained at 3-month follow-up, and changes in negative interpretation were shown to mediate the relationship between training group and improvement in social anxiety symptoms. Similarly, Brosnan and colleagues (2011) found that a 4-session program that combined IBM with CBM for attentional biases led to reductions in both cognitive biases and state and trait anxiety among a diagnosed, clinical sample of individuals with social/generalized anxiety disorder. However, unlike Amir and Taylor (2012), no mediational analyses were conducted to determine whether change in cognitive biases mediated the relationship between IBM + CBM training and change in state and trait anxiety (Brosan et al., 2011). Several studies among clinical samples in Europe have additionally shown that Internet-delivered IBM training sessions can significantly shift interpretations from negative to positive (Brettschneider et al., 2015; Salemink et al., 2014), with some showing clinically significant improvement in social anxiety symptoms (e.g., 48% of participants no longer met criteria for social anxiety disorder after 8 IBM sessions; Brettschneider et al., 2015) and others finding equivalent reductions in anxiety, depression, and subjective distress between an active IBM and control groups (Salemink and Wiers, 2014).

Taken together, these results suggest that both types of CBM show promising effects on cognitive biases and social anxiety/alcohol symptoms among clinical samples. To-date however, ApBM and IBM have largely been examined separately. A promising avenue that has not been explored is the potential of combining these effective cognitive re-training protocols to optimize standard treatments among comorbid samples. Given the feed-forward cycle between alcohol use and anxiety, whereby each disorder fuels and impedes recovery from the other (Baillie et al., 2010; Stewart and Conrod, 2008), it is possible that combining these programs will have multiplicative effects on treatment outcomes.

Furthermore, most studies examining the efficacy of ApBM and IBM in clinical populations have done so among adults. Although emerging adulthood, commonly referred to as the developmental period between 18 and 25 years (Arnett, 2000), is a critical period of increased vulnerability for the onset of both alcohol use and anxiety disorders (de Lijster et al., 2017; Degenhardt et al., 2016; Kessler et al., 2005; Teesson et al., 2010), there is an absence of research examining whether these training paradigms can be equally efficacious when delivered to treatment-seeking emerging adults. Use of a hybrid ApBM + IBM intervention may

interrupt the vicious cycle between alcohol use and anxiety, and prevent the development of chronic and entrenched disorder-level problems in adulthood.

Finally, numerous studies have shown that existing CBM programs are generally deemed acceptable and feasible add-on treatments by clients and clinicians alike (Beard et al., 2012; Leung et al., 2019; Rozenman et al., 2011). IBM studies in particular have been reported as acceptable with regard to their perceived helpfulness, personal relevance, user-friendliness, credibility, ease of use, simplicity, and esthetic appearance (Beard, 2011; Beard et al., 2020; Beard et al., 2019). Despite this, CBM programs are not without their critiques. Some end-users have criticized the duration of the training, the content of training stimuli, and lack of customized features, for instance (Beard et al., 2020). Additionally, current CBM protocols require repeated repetitions on cognitive tasks and have low face validity compared to other treatments. As such, attrition can be high and tasks are sometimes considered “boring” in nature (Brosan et al., 2011). It is important to overcome these challenges regarding adherence and engagement, as attitudes toward a treatment can fundamentally improve adherence to, and outcomes of, an intervention (Koffel et al., 2018). This points to the need to assess attitudes toward this new treatment, and to apply a user-centered design process to collaboratively develop CBM programs that may better meet user needs, especially for complex groups like those experiencing co-occurring alcohol use and social anxiety problems.

### *The Current Study*

The current study reports on the acceptability and co-development of the *Re-Train Your Brain* intervention; an evidence-based, age-appropriate hybrid ApBM + IBM program for emerging adults with co-occurring hazardous alcohol use and social anxiety. A beta version of the program was created in order to gain feedback and suggestions for improvement.

### *Aims*

1. To evaluate the acceptability of a beta version of the *Re-Train Your Brain* intervention by service providers and emerging adults with co-occurring hazardous alcohol use and social anxiety.
2. To develop and refine a full *Re-Train Your Brain* program, using feedback from these two key groups.

## MATERIAL AND METHODS

### *Program Development*

The *Re-Train Your Brain* program is Internet-delivered for convenience and flexibility, and will be provided alongside face-to-face treatment. A co-development process with service providers and emerging adults who currently experience hazardous alcohol use and social anxiety was undertaken to ensure the content and design

of a fully developed program is deemed relevant, acceptable, and maximizes engagement of emerging adults with this comorbidity.

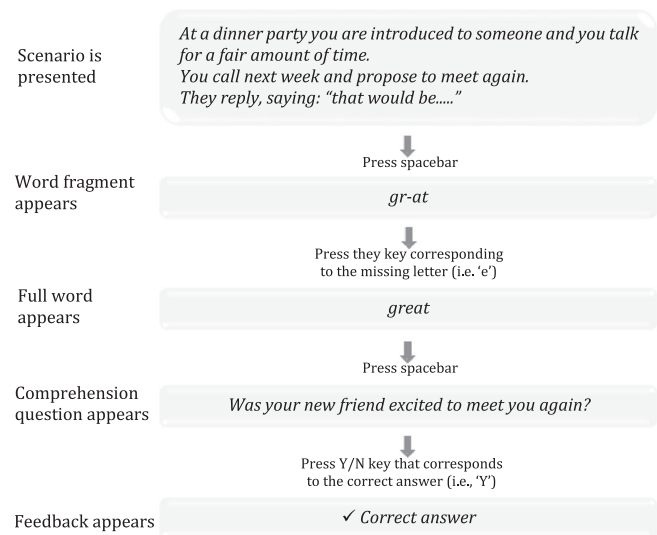
**Alcohol ApBM Component.** ApBM is used to reduce maladaptive alcohol approach behaviors and increase alcohol avoidance behaviors in response to alcohol-related stimuli (Wiers et al., 2009). Participants are instructed to pull or push a computer mouse toward or away from their body in response to an irrelevant feature of images (i.e., the orientation as portrait or landscape) shown on a computer screen, while ignoring the picture content. Two categories of pictures are used: alcoholic and nonalcoholic beverages. Contingent upon a pull or push movement, the picture zooms in (becomes larger on the screen to generate the subjective experience of moving toward the images' content, i.e., an approach behavior) or zooms out (becomes smaller on the screen to give a sense of avoidance behavior). An incorrect response is followed with error feedback (a red "X" on the screen). All alcoholic drink images are presented in the format aligned with training avoidance (e.g., landscape, push), while nonalcohol images are trained with approach (e.g., portrait, pull). Format movement assignments are counterbalanced. To familiarize participants with the task requirements, they are asked to complete a brief practice round involving empty rectangular frames in landscape or portrait format. The ApBM training procedures used in the beta version were based on existing effective programs (Wiers et al., 2011; Wiers et al., 2009), with adapted stimuli that were likely to be relevant and salient to Australian emerging adults (Onie et al., 2020). Six empty frames were used for the practice and 10 alcoholic and 10 nonalcoholic images that were matched for color and shape were shown for the training.

**Anxiety IBM Program Component.** IBM seeks to reduce negative threat interpretations that are commonly associated with social anxiety. Participants are trained to resolve ambiguous social scenarios with either positive or neutral outcomes, through completion of a word fragment (Mathews and Mackintosh, 2000). Each scenario consists of 3 lines that are ambiguous in terms of valence or emotional interpretation. Participants are instructed to imagine/visualize themselves in each situation described. One word of the story is presented as a word fragment and disambiguates the story in a positive or neutral way. Participants are asked to complete the fragment as quickly as possible by pressing the spacebar when they know what the word is, and then to press the key corresponding to the missing letter. Reaction times are recorded. After this, a comprehension question appears. Participants answer the question by pressing "Y" (yes) and "N" (no) on their keyboard. They subsequently receive feedback (correct/wrong answer) to reinforce the interpretation imposed by the word fragment. An example scenario is provided in Fig. 1:

For the beta version, social scenarios were translated versions of those used in previous research (Mathews and Mackintosh, 2000; Salemink et al., 2014; Salemink et al., 2009), adapted to be made more suitable for the developmental context of the study's target age range (18 to 25 years; e.g., changing a scenario that suggested a person had children) and the Australian context (e.g., changing the season at Christmas time from winter to summer). Scenarios were translated through a two-part process; initially, Google Translate+ was used to translate scenarios from Dutch into English, and then, scenarios were subsequently reviewed and edited by two native English speakers (KP and MP) to improve English phrasing while maintaining the intent, style, and neutral tone of the scenarios. Participants were provided 6 scenarios to complete.

#### Recruitment and Procedure

**Ethics Approval.** Ethical approval was granted by the University of Sydney's Human Research Ethics Committee (#2019/566).



**Fig. 1.** Example IBM scenario to illustrate the training procedures.

**Phase 1: Service Providers.** Service providers with experience treating emerging adults with alcohol use and anxiety disorders were recruited via personalized email invitations. Interested individuals provided consent, reviewed the beta program, and completed a baseline survey. Service providers were included if they: (i) provide alcohol or mental health treatment for emerging adults, (ii) had at least 6 months of work experience, (iii) were literate in English, (iv) had access to the Internet via a mouse-operable computer (i.e., a laptop or desktop but not a smartphone/tablet), and (v) had capacity to participate. Reimbursement with an AUD\$50 e-voucher was provided.

**Phase 2: Emerging Adults.** Feedback was also provided by Australians aged 18 to 25 years who reported social anxiety symptoms and hazardous alcohol consumption and were currently receiving treatment for anxiety and/or alcohol use. Participants were recruited via paid online advertisements and posts on Facebook and Twitter. All advertisements directed emerging adults to the study website. After providing consent, interested participants completed an eligibility survey. Inclusion criteria required participants to be: (i) Australians aged 18 to 25 years, (ii) currently reporting hazardous or harmful levels of alcohol use (AUDIT  $\geq$  8; Babor et al., 2001), (iii) experiencing at least mild symptoms of social anxiety (Social Interaction Anxiety Scale [SIAS-6]  $\geq$  7 or Social Phobia Scale [SPS-6]  $\geq$  2; Peters et al., 2012), (iv) currently receiving treatment from a mental health professional for anxiety and/or alcohol use, to resemble the end-users of the final program (as assessed by the following self-report question "Are you currently seeing a mental health professional for anxiety or alcohol use?"), and (v) have access to the Internet and a mouse-operable computer. Exclusion criteria included: (i) inability to provide contact information and (ii) insufficient English literacy. Eligible participants received access to a beta version of the program and an online baseline survey. Emerging adults received an AUD\$30 e-voucher for their time.

#### Measures

**Sociodemographic Characteristics.** All participants were asked to provide information on their gender, and emerging adults were additionally asked to specify their age, country of birth, education, and employment status.

**Acceptability.** All participants were asked questions about the perceived acceptability of the beta ApBM + IBM program,

**Table 1.** Summary of the Validated Scales Used in the Current Study

Measure	Assessment purpose	Scoring and interpretation	Psychometric properties
Usability System Usability Scale (SUS; Brooke, 1996)	Program usability	The SUS contains 10 items that are rated on a 5-point Likert scale from 1 “strongly disagree” to 5 “strongly agree.” A total score is computed by summing item scores (0 to 4) and multiplying by 2.5, giving a range of 0 to 100. Higher values denote greater usability and higher satisfaction with the program. Cut-off scores using a “school grade analogue” have recently been suggested for interpreting the SUS (0 to 51.7 = F, 51.8 to 62.6 = D, 62.7 to 72.5 = C, 72.6 to 78.8 = B, and 78.9 to 100 = A), with a score over 68 being considered above average (Sauro and Lewis, 2012).	The SUS is reported to be a highly robust and versatile tool with excellent psychometric properties. The literature shows that the internal reliability is high, with Cronbach’s alphas at or > 0.9 (Bangor et al., 2008; Lewis et al., 2015) and concurrent validity with other measures of perceived and objective usability (Lewis, 2018).
Alcohol use Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001)	Hazardous alcohol use	Total scores for the AUDIT range from 0 to 40, with cut-off scores of 8 to 15, 16 to 25, and $\geq 26$ indicating risky/hazardous alcohol use, high risk/harmful use, and high risk/possible dependency.	The AUDIT has demonstrated good validity and reliability in the identification of harmful use, abuse, and dependence of alcohol among a wide range of patient populations, in different countries and in diverse health and community contexts, involving adolescent, adult, and elderly samples (for a systematic review, see de Meneses-Gaya et al., 2009).
Timeline Follow-back Procedure (TLFB; Pedersen et al., 2012; Rueger et al., 2012; Sobell and Sobell, 1995).	Alcohol consumption and frequency of binge drinking (>5 standard drinks per drinking day)	The TLFB is a drinking assessment method that obtains participants’ retrospective estimates of daily drinking over the past month. The traditional TLFB involves a structured face-to-face interview with the use of a calendar to allow participants to indicate the occasions when they drank alcohol over this time period. Self-administered, computer/Web-based versions of the TLFB have also been utilized.	The traditional TLFB has been shown to be psychometrically sound across a range of populations (see Sobell and Sobell, 1992 for a review), including social drinkers and persons with a diagnosis of alcohol abuse or dependence. Computer/Web-based versions of the TLFB demonstrate strong psychometric properties that are comparable to the traditional version (Pedersen et al., 2012; Rueger et al., 2012).
Anxiety Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987)	Symptoms of social anxiety	The LSAS is an instrument that assesses fear/anxiety and avoidance of specific social situations (e.g., parties). Respondents are asked to indicate how much they fear (0 “none” to 3 “severe”) and how often they avoid (0 “none” to 3 “usually”) 24 social situations that. Cut-off scores of $\geq 30$ and $\geq 60$ are indicative of social anxiety and generalized social anxiety, respectively (Mennin et al., 2002; Rytwinski et al., 2009).	The LSAS has been shown to be a reliable and valid measures of social anxiety (Rytwinski et al., 2009), and evidence suggests the self-report version of the LSAS compares well to the clinician-administered version (Dos Santos et al., 2013; Fresco et al., 2001)
Generalised Anxiety Disorder scale (GAD-7; Spitzer et al., 2006)	Symptoms of anxiety	The 7-item GAD is a screening tool and severity indicator for GAD. The GAD-7 has also been found to index symptoms across multiple disorders, including GAD, panic, and social anxiety disorder (Johnston et al., 2014). Items are scored on a 4-point Likert scale, ranging from 0 “not at all” to 3 “nearly every day.” Total scores range from 0 to 21, with scores of $\geq 5$ , $\geq 10$ , and $\geq 15$ representing cut-off points for mild, moderate, and severe anxiety, respectively (Spitzer et al., 2006).	The GAD-7 has demonstrated good reliability (internal and test-re-test) and construct validity, with strong associations with other established measures of anxiety as well as diagnoses of GAD (Kroenke et al., 2007; Löwe et al., 2008; Spitzer et al., 2006)

measured on a 5-point Likert scale ranging from 0 “not at all” to 4 “very.” Items asked whether the program/tasks were user friendly, simple to use, logical, easy to do, comprehensible, credible and of good quality, motivating, engaging, enjoyable, utilized acceptable online/computerized delivery, and whether material and language

was relevant, relatable, and age appropriate. In addition, service providers were asked whether the program would be valuable and potentially effective, a good supplement to treatment as usual, likely to change cognitive biases/anxiety symptom/alcohol use, and whether they would recommend the program to others. They were

also asked what anxiety-provoking scenarios would be relevant to young Australians. Emerging adults were also asked their preferred location to complete training sessions (i.e., home, office/clinic, no preference), how many sessions they would be willing to complete, and their preferred delivery format (i.e., each session containing a 50:50 ratio of ApBM:IBM, or alternating ApBM and IBM between each session). To inform revisions, the survey also contained open-ended questions on the most/least helpful and enjoyable features of the program, any general comments, suggestions for making the IBM scenarios more age appropriate/relevant/relatable, as well as facilitators and barriers to participation. Emerging adults were also asked what alcoholic and nonalcoholic beverages are commonly consumed by young people. *The usability of the program* was also assessed using the 10-item System Usability Scale (SUS; Brooke, 1996; Table 1).

*Alcohol Use and Anxiety.* Emerging adults were asked about their alcohol use and anxiety symptoms (see Table 1). *Hazardous alcohol use* was assessed through the 10-item Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001), while *alcohol consumption* and frequency of *binge drinking* in the past month were assessed through the Timeline Follow-back Procedure (TLFB; Pedersen et al., 2012; Rueger et al., 2012; Sobell and Sobell, 1995). *Symptoms of social anxiety* were assessed using the Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987), and *symptoms of anxiety* more broadly were assessed by the 7-item Generalised Anxiety Disorder scale (GAD-7; Spitzer et al., 2006).

### Statistical Analysis

Descriptive analyses were performed on quantitative acceptability questions using IBM SPSS version 25. General inductive analysis (Thomas, 2006) was carried out for qualitative acceptability questions, using NVivo software. The two coders of the qualitative data (MP and KP) have no prior experience developing or trialing CBM interventions; however, KP was familiar with existing CBM acceptability studies which placed her in a better position to understand and discuss the content of participants' feedback, but may also have led her to perceive participants' responses less critically than someone independent to the project. As such, MP, a researcher with little knowledge of CBM interventions, assisted with coding. Specifically, KP and MP reviewed feedback from participants in each phase and identified text segments that related to the study objectives. After discussion, data were coded independently by MP and KP. A coding frame was developed, and categories were created from the text segments. Coding categories were then simplified and merged into overarching themes. The two coders discussed any inconsistencies and reached consensus on the major themes. Finally, a model was created that included the most important themes and subthemes. Direct quotations from the participants have been included to illustrate key themes and subthemes.

## RESULTS

### Participants

*Phase 1: Service Providers.* Sixteen service providers met inclusion criteria; however, 2 were excluded from analyses as they did not complete questions on the acceptability of the program, leaving a final sample of  $n = 14$ . The sample included 8 clinical psychologists, 4 registered psychologists, 1 psychiatrist, and 1 social worker. The majority ( $n = 10$ ) had 3 or more years' experience, focused on the treatment of

anxiety disorders ( $n = 5$ ), alcohol use disorders ( $n = 1$ ), or both disorders ( $n = 8$ ).

*Phase 2: Emerging Adults.* Fifteen emerging adults (66.7% female) aged  $M = 20.5$  years (range = 18 to 25) were eligible to participate. Characteristics of the sample are outlined in Table 2.

### Acceptability

Four key themes emerged from the qualitative data with regard to the acceptability of the program, which have been used to present the quantitative and qualitative findings below.

*Quality and Usability.* As evident in Fig. 2, the majority of service providers ( $n > 10$ ) found the program to be of high quality and easy to use. Specifically, service providers rated the program as "mostly" or "very" user friendly, simple to complete, logical, easy to do, easy to comprehend, credible and of good quality, and acceptable with regard to the online/computerized delivery. The mean SUS score was  $M = 68.4$  ( $SD = 8.0$ ) or a "C-grade," indicating that while the program is of acceptable quality (i.e., equivalent to the average of 68), it could still benefit from improvements. Ease of use of the program was a key theme brought up by almost all service providers, with particular mention of the program being quick, easy and straightforward (Table 3). No specific suggestions were given to improve the usability of the program. However, it was mentioned by several service providers that the program contained text-heavy instructions that were difficult to understand, small and hard to read font, and that some emerging adults with anxiety may experience difficulties and have trouble concentrating due to time pressures associated with the reaction time-based nature of the training (Table 3).

Emerging adults generally regarded the program as easy and straightforward to complete (Fig. 2). It was deemed "mostly" or "very" user friendly ( $n = 13$ ), simple to complete ( $n = 11$ ), logical ( $n = 8$ ), easy to do ( $n = 12$ ), easy to comprehend ( $n = 14$ ), of good quality ( $n = 10$ ), and had acceptable online delivery ( $n = 12$ ). The mean SUS score was  $M = 74.0$  ( $SD = 14.5$ ), indicating a "B-grade" (above average) rating of user experience. Similar to service providers, ease of use was noted as one of the key attributes of the program. Subthemes closely mirrored those of service providers with respects to time pressures and complex task instructions (Table 3).

*Appropriateness.* More than half of service providers reported that the program was "mostly" or "very" appropriate, with relevant and age appropriate stimuli ( $n = 8$  and  $n = 11$ , respectively) and relevant and relatable language for the target age group ( $n = 12$ ; Fig. 2). Service providers generally commended the appropriateness of IBM social scenarios, particularly their age appropriateness (Table 3). There

**Table 2.** Sociodemographic, Alcohol Use, and Anxiety Characteristics of Emerging Adults

	Statistic ( <i>n</i> = 15)
<b>Sociodemographics</b>	
<b>Gender</b>	
Female, % ( <i>n</i> )	66.7 (10)
Male, % ( <i>n</i> )	26.7 (4)
Nonbinary, % ( <i>n</i> )	6.7 (1)
Age (years), <i>M</i> ( <i>SD</i> )	20.5 (2.6)
Australian born, % ( <i>n</i> )	100 (15)
<b>Highest level of education</b>	
Secondary school, % ( <i>n</i> )	46.7 (7)
Bachelor's degree or higher, % ( <i>n</i> )	26.7 (4)
Trade certificate or apprenticeship, % ( <i>n</i> )	13.3 (2)
"Other" tertiary diploma or certificate, % ( <i>n</i> )	13.3 (2)
<b>Employment/education</b>	
Employed full-time, % ( <i>n</i> )	20.0 (3)
Employed part-time or casually, % ( <i>n</i> )	46.7 (7)
Studying full-time, % ( <i>n</i> )	33.3 (5)
<b>Alcohol use</b>	
Number of standard drinks in past month, <i>M</i> ( <i>SD</i> )	62.1 (24.5)
Number of binge drinking <sup>a</sup> episodes in past month, <i>M</i> ( <i>SD</i> )	4.4 (1.8)
AUDIT score, <i>M</i> ( <i>SD</i> )	18.8 (7.6)
<b>AUDIT drinking categories</b>	
Risky or hazardous use, % ( <i>n</i> )	33.3 (5)
High risk or harmful use, % ( <i>n</i> )	46.7 (7)
High risk or possible dependency, % ( <i>n</i> )	20.0 (3)
<b>Anxiety</b>	
LSAS score, <i>M</i> ( <i>SD</i> )	80.0 (30.8)
LSAS generalized social anxiety, % ( <i>n</i> )	73.3 (11)
GAD score, <i>M</i> ( <i>SD</i> )	12.7 (3.9)
<b>GAD severity categories</b>	
Mild, % ( <i>n</i> )	20.0 (3)
Moderate, % ( <i>n</i> )	53.3 (8)
Severe, % ( <i>n</i> )	26.7 (4)

<sup>a</sup>>5 standard drinks per drinking day.

were, however, divergent opinions about how relevant and relatable the scenarios were and whether the content should be more work or study focused. Only minor suggestions for revision were provided, including a recommendation that the language be made more conversational, and targeting scenarios at emerging adults in the lower end of the 18- to 25-year age range (Table 3). The top 5 responses regarding the types of anxiety-provoking scenarios that could be used in the IBM training included: going to parties, pubs or social events (*n* = 11), speaking in public (*n* = 11), having a job interview or starting a new job (*n* = 10), dating or starting a romantic relationship (*n* = 7), and talking to or meeting someone new (*n* = 5).

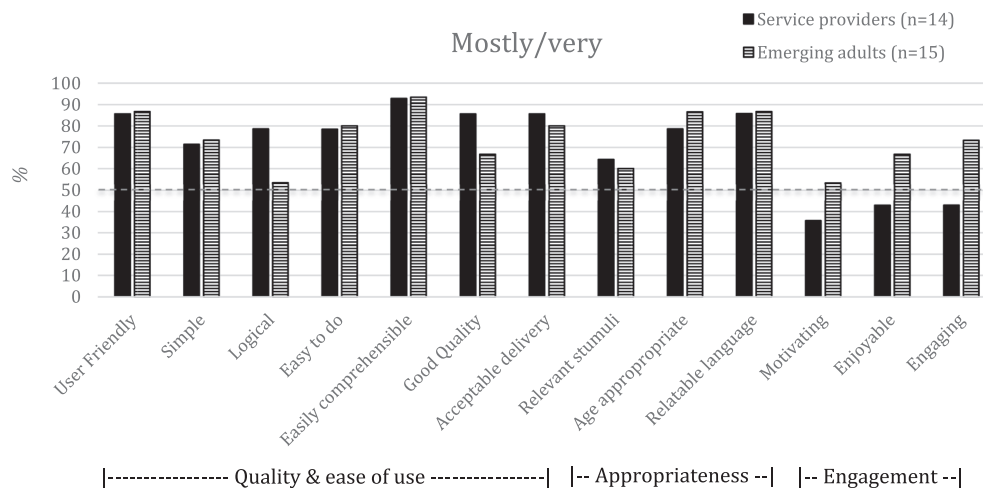
Emerging adults generally agreed that the program was "mostly" or "very" relevant (*n* = 9), age appropriate (*n* = 13) and contained relatable and appropriate language (*n* = 13). Appropriateness was a key theme brought up by all emerging adults. Corresponding with subthemes identified for service providers, there was evidence that the IBM scenarios were age appropriate and reflected the real-life experiences of some emerging adults (Table 3). However, to improve the relevance and relatability of scenarios to a broader range of participants, it was suggested that the

number of scenarios aimed at school-aged students (i.e., 18 years) and scenarios that are unlikely to occur prior to 25 years of age, such as getting married, should be reduced. All participants indicated that the 10 sample alcoholic beverage ApBM images (predominantly light spirits such as vodka/gin, as well as beer, cider, and wine) were "mostly" or "very" appropriate for their age group (*n* = 15). Confirming the appropriateness of these images, the most frequently reported alcohol beverage types consumed by people their age were vodka (*n* = 15), beer (*n* = 13), cider (*n* = 10), whisky (*n* = 7), wine (*n* = 6), and premixed drinks (*n* = 6).

*Engagement and Motivation.* Given the repetitive nature of the training tasks, the program was not perceived to be particularly exciting by service providers, with only a few participants indicating that the tasks were "mostly" or "very" engaging (*n* = 6), enjoyable (*n* = 6), and motivating (*n* = 5; Fig. 2). While some qualitative comments reiterated the quantitative data with respect to the design not being colorful or engaging compared to other online interventions, other comments indicated that there were game-like elements that may assist in treatment completion. When asked to specify the best methods to motivate clients to complete treatment sessions, all service providers emphasized the importance of financial reimbursement (for research purposes), as well as email and SMS reminders to complete sessions. Six service providers specified that encouragement from their clinician would be useful, and 3 highlighted that provision of a rationale for treatment would be necessary. Several service providers highlighted that provision of the program on a smartphone and including push notifications may help with engagement, as well as SMS reminders for training sessions. Given that "*the skill being taught is not obvious, and the practical application is not obvious,*" suggestions for improvement fairly consistently emphasized the need to provide a rationale for the training and to explore the client's reasons for (and readiness to) make a change. One service provider also suggested the program should incorporate metaphors to justify the need for repeated training sessions (Table 3).

Emerging adults had a slightly more positive perception regarding the appeal of the program, with at least half of respondents reporting that they found the program "mostly" or "very" motivating (*n* = 8), enjoyable (*n* = 10), and engaging (*n* = 11). Comments indicated that they enjoyed the interactive and game-like qualities, as well as the combination of tasks. Several subthemes regarding engagement matched the subthemes identified by service providers; especially the need for an evidence-based rationale for the program to improve understanding of how the training is intended to help reduce their symptoms. Responses also highlighted the importance of financial incentives to motivate participants to complete treatment sessions as part of the research study (*n* = 11), as well as SMS prompts and email reminders (*n* = 6). Clinician encouragement was only mentioned by two emerging





**Fig. 2.** Acceptability of the *Re-Train Your Brain* ApBM + IBM intervention, rated as “mostly” or “very”.

adults, and intrinsic motivation by one. Suggestions for making the program an app or available on a mobile device for convenience were mentioned by 2 participants. The majority of participants said they would be motivated to complete sessions at least once per week ( $n = 10$ ), with  $n = 6$  willing to complete more than 2 per week. When asked about their preferences for treatment setting, 10 participants (66.7%) preferred the idea of completing sessions at home, 3 (20.0%) preferred office/clinic delivery, and 2 (13.3%) had no preference. There was no consistent preference for the most enjoyable and engaging way to deliver the brain training sessions, with approximately half ( $n = 8$ ; 53.3%) preferring a 50:50 split of ApBM and IBM within each session, while the remaining half ( $n = 7$ ; 46.7%) preferring sessions that alternated between ApBM and IBM.

**Clinical Value.** While most service providers indicated that they would recommend the program to others ( $n = 10$ ), only half reported seeing the value and potential effectiveness of the program ( $n = 8$ ), and even fewer indicated that they could see the potential of the program in altering cognitive biases ( $n = 6$ ), anxiety symptoms ( $n = 4$ ), or alcohol use ( $n = 1$ ), and few thought it would be a valuable supplement to treatment as usual ( $n = 3$ ; Fig. 3). Contrary to these quantitative findings, a subtheme emerged which emphasized the benefit that CBM training may add to treatment as usual. To improve engagement, motivation, and clinical outcomes, 2 service providers suggested a psychoeducational and motivation enhancement-type session should be included at the outset of the program.

Emerging adults appeared to appreciate the clinical utility of the program, reporting that the program would be “mostly” or “very” useful in reducing symptoms of anxiety and/or alcohol use ( $n = 9$ ), useful in helping them practice what they learn in treatment as usual ( $n = 9$ ), and would be valuable and potentially effective ( $n = 10$ ) as an adjunct treatment.

### Program Development and Refinement

Key themes and subthemes that emerged are shown in Fig. 4, and a summary of revisions made to the program that map onto these themes and subthemes are provided in Table 3. To improve the perceived quality and ease of use, task instructions were simplified, font size was increased, and reassurance was provided that the tasks can be difficult to complete in the beginning but will likely get easier with repeated practice. Several changes were made to the program content to make it more appropriate, particularly the IBM scenarios, including the use of more colloquial language, replacement of terminology that was not deemed age appropriate, and integration of a broader range of anxiety-provoking situations faced by diverse groups. To enhance engagement and motivation, several service providers and one emerging adult indicated a need to incorporate a rationale for treatment at the outset of the program and a need to enhance intrinsic motivation for change. This was addressed by including a motivational interviewing and psychoeducational-based module at the outset of training. Other revisions included adding color to the program, SMS and email notifications, and adding a “muscle metaphor” within the treatment rationale and SMS/email reminders to emphasize the importance of completing multiple, repeated training sessions (i.e., just like building a muscle, training the brain requires regular, repeated exercise to make it stronger).

## DISCUSSION

The present study describes the development process for an Internet-delivered, hybrid ApBM + IBM program (“*Re-Train Your Brain*”) for emerging adults with alcohol use problems and social anxiety, to augment face-to-face treatment. The primary aim was to assess the acceptability of a beta version of the *Re-Train Your Brain* program based on feedback from service providers and emerging adults with

**Table 3.** Themes and Subthemes that Emerged Regarding the Acceptability of the Beta Program and Program Revisions Based on Feedback

	Service provider comments (n = 14)	Emerging adult comments (n = 15)	Program revisions
Ease of use			
Quick and easy	"[The program was] easy to use, relatively quick"	"Easy. Maybe too simple"	
Task instructions	". . . Reading a lot of text/instructions pre-task."	"The instructions prior to starting the task are somewhat difficult to interpret"	Task instructions were simplified, and imagery was added to help people understand the tasks and get a sense of the program interface.
Task time pressures	"Young people who are very anxious may have trouble concentrating under pressure"	"I felt pressure in relation to time"	Text was added to explain that participants should try to complete the task as quickly as possible and that it is normal to find this a bit stressful. They are advised to do their best and training may get easier with repeated practice.
Font size	"The font is quite small and hard to read"		Font size was increased.
Appropriateness			
Age-appropriate scenarios	"Appropriate, no changes" "I thought that the scenarios were relevant and would work with this age group".	"The scenarios are age-appropriate, as most people my age are working and studying"	
Relevant and relatable scenarios	"Perhaps some of the scenarios may be unfamiliar, but I think that most of my clients could imagine themselves in a similar sort of scenario" "Perhaps more examples targeting younger people would be useful" "Some youth accessing our service may not relate to the kind family member, study, or stable family home aspects so ensuring that there is a breadth of examples can assist further with that"	"Some of them seem more relevant in a high school setting and almost all are aimed at students" "I am 18, so some of the scenarios regarding wedding speeches, and mother in laws, aren't relevant for me, however the student-based ones are more relevant, so I think it just depends on how old the participant is" "Yes, they are [age-appropriate], but I usually think less positively."	Inclusion of social situations more relevant to younger individuals, that are not school or study-focused, for example, going to the movies, the pool, or a picnic. Inclusion of a range of scenarios to cover a breath of social, financial, and family situations.
Language	"[The language seemed a bit formal (i.e., not conversational). I wondered if a more casual, conversational style would be useful" "'Lecture' could be 'class'. . . anniversary dinner' could be 'party'"	". . .excessive use of kind of robot sounding words i.e., agreeable >enjoyable (or just good?) preoccupied >distracted" "Some information was way too exaggerated"	Language was made more informal and conversational. Words identified as not age appropriate were replaced with vernacular with a similar meaning.
Engagement and motivation			
General engagement	"The design is not that engaging just thinking how colourful/ engaging a lot of online sites are for young people and they are really used to things being interactive." "Both [tasks were] engaging—good stuff!"	"I found it all engaging"	More color incorporated into the design of the program.
Game-like features	"The game-like quality of the first task may help participants engage with it" "Bit more colour and animation might help!"	"Interactive/game-like" "[The program is] unique and has varied tasks"	
Mobile friendly	"Would be good if it were an app or able to be done on a smart phone."	"If it was mobile friendly and I could get a push reminder so I could remember to do on my commute"	Making the intervention mobile friendly was outside the scope for this project.
Financial reimbursement	"Reimbursement for their time would be a good motivator for session completion (during research phase), or otherwise a good rationale for how the sessions could be of benefit to them (as part of treatment)"	"For research purposes financial reimbursement. For personal gain, self-motivated"	
SMS reminders	"SMS reminders always help" "Perhaps a prompt that they could use the PC at library, TAFE etc would get them thinking?"	"SMS reminders would help me to remember"	SMS push notifications added to remind of sessions, and that they may be completed wherever is most convenient for Internet access (e.g., home, clinic, university/TAFE, library).
Clinician encouragement	"Being encouraged by clinician would be most important, after giving rationale for how it could be of benefit, and after going through motivational interviewing on readiness for change."	"Financial reimbursement or clinician encouragement"	

Continued.

Table 3. (Continued)

	Service provider comments (n = 14)	Emerging adult comments (n = 15)	Program revisions
Rationale behind the intervention	“more info needs to be given as to how the task might help. Anxious people like knowing what they’re doing to keep in control”	“Don’t really understand how it’s meant to help. . . Would be nice if science behind it explained at the start” “ . . . understanding how the research could help me manage my symptoms”	Inclusion of a rationale at the outset of treatment for how the sessions could be of benefit to participants.
Metaphors	“ . . .convincing clients that this is a suitable treatment given that there isn’t a lot of face validity i.e., clients might struggle to see the relevance of the task and how it addresses their struggles” “The repetitive nature of the task would likely discourage participation. . . I could imagine using metaphors (like practicing a musical instrument or going to soccer training before a big game) would be useful”		Inclusion of a “muscle metaphor” into SMS/email notifications and program rationale, to remind clients of the importance of completing multiple, repeated training sessions (i.e., just like a muscle, training the brain requires regular, repeated exercise to make it stronger). Also included research team contact details to enable troubleshooting.
Motivation and readiness for change	“Understanding a client’s motivation for wanting to change would also help to set up the rationale”. “Being encouraged by clinician would be most important, after giving rationale for how it could be of benefit, and after going through motivational interviewing on readiness for change.”		Inclusion of a psychoeducational/ motivational interviewing module prior to CBM training to build intrinsic motivation for change. This will assess readiness for change, set training goals, and identify reasons for making a change.
Clinical value Adjunct treatment Psychoeducation	“The implicit nature of the task may nicely compliment the explicit nature of TAU”. “ . . .integrating psychoed into a therapy session would be imperative, and translating to practice in real life outside session”		A psychoeducational/ motivational interviewing module has been included at the outset of the program.

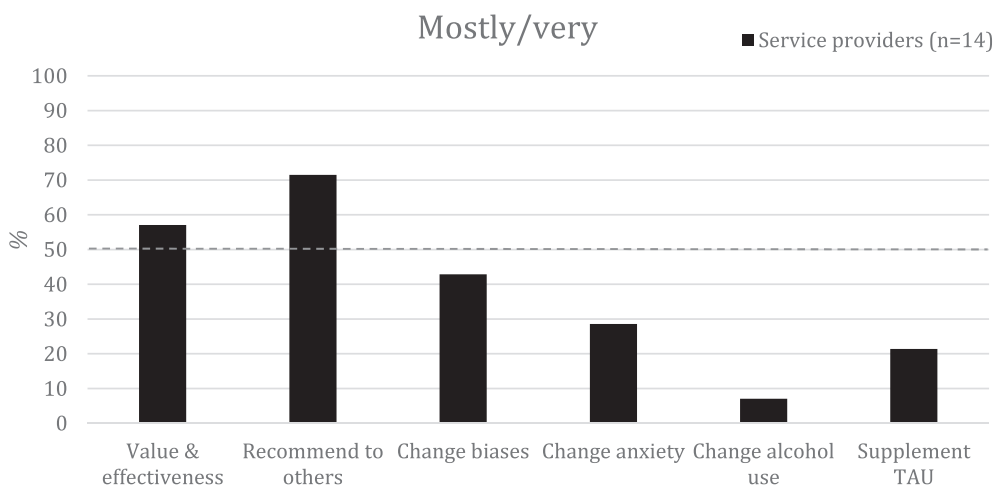


Fig. 3. Clinical value of the *Re-Train Your Brain* ApBM + IBM intervention, rated as “mostly” or “very”.

hazardous alcohol use and social anxiety, and then refine (co-design) the intervention according to suggestions from these two groups.

*Principal Findings*

The current study indicates that the *Re-Train Your Brain* intervention is an acceptable treatment program and may

have potential utility for service providers and emerging adults alike. Consistent with prior research on the acceptability of CBM (Beard et al., 2019; Leung et al., 2019), responses from both groups were generally positive, with most participants describing the beta intervention as easy to complete and straightforward. Emerging adults rated the usability of the program more positively than did the service providers, with ratings equivalent to “B-grade” ( $M = 74.0$ ) and “C-grade” ( $M = 68.4$ ), respectively. This is consistent with prior research investigating the usability of online and app-based interventions for mental health conditions using the SUS, whereby user groups typically rate higher on the usability of a program/app than researchers and clinicians (Fuller-Tyszkiewicz et al., 2018). This may be because end-users evaluate the program in its own right (i.e., with regard to its functionality and technical attributes), while service providers rate its functionality and technical attributes relative to what they imagine could be provided to patients through in-person care, and thereby find the program more difficult to use. These usability ratings are equivalent to, if not greater than, usability ratings of other technology-based interventions and are above average scores ( $M \geq 68$ ; Fuller-Tyszkiewicz et al., 2018; Kooistra et al., 2016), indicating that the program is of acceptable quality.

The program was reported to contain appropriate language and stimuli by most participants in both groups, although it was recommended to use more conversational and colloquial language in the IBM scenarios. Somewhat conflicting feedback was provided with respects to the content of the IBM scenarios (e.g., whether content should be study or work-focused), indicating some degree of relevance to personal circumstances, rather than overall age-specific

concerns with the program content. Future iterations of the program may benefit from implementing personalized content, relevant to each participant specifically, as has been incorporated in recent app-based IBM programs (Beard et al., 2020) and other cognitive bias assessment and modification programs (Glashouwer et al., 2020; Köpetz et al., 2017; McNally et al., 1994; Wiers et al., In Press). However, although personalizing CBM to the individual has resulted in positive feedback regarding stimuli relevance (Beard et al., 2020), its impact on the efficacy of these training paradigms is yet to be firmly established.

The dominant alcoholic beverage types consumed by our sample of 18- to 25-year olds were vodka, beer, and cider. In contrast to our findings, data from the 2016 Australian National Drug Strategy Household Survey indicates that among the Australian general population aged 14 years or older, bottled wine was the most frequently consumed alcoholic beverage type (34.5% among recent drinkers), while cider was rarely consumed (4.5%; Australian Institute of Health and Welfare, 2017). The current data build on extant knowledge regarding emerging adult drink preferences and were used to inform the stimuli included in the ApBM training to maximize the potential efficacy of the intervention.

Program engagement, enjoyment, and motivation to complete the training sessions were a main concern raised by service providers. While they perceived the program to be fairly laborious and repetitive, this view was not shared by emerging adults. Rather, a large proportion of emerging adults said they would engage with the program, suggesting it is a worthwhile investment for future research. Given CBMs low face validity, both groups expressed a desire to better understand how CBM training works and how doing the training

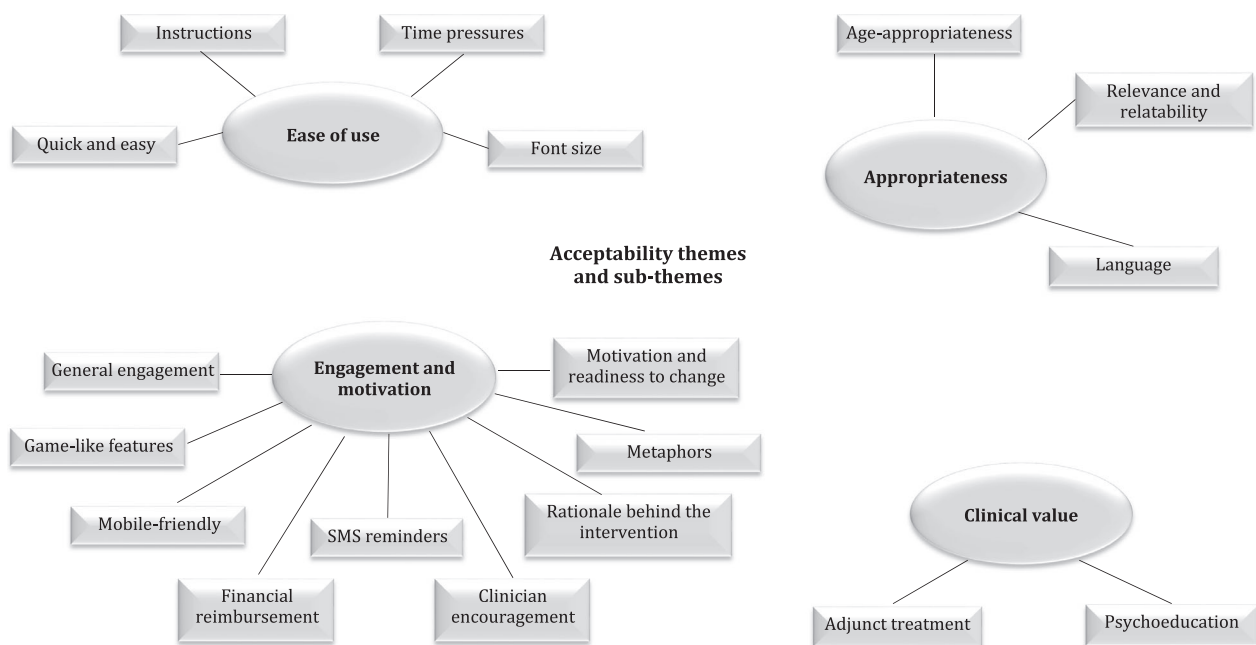


Fig. 4. Key themes and subthemes that emerged regarding the acceptability of the beta *Re-Train Your Brain* ApBM + IBM program.

may help reduce alcohol use and improve social anxiety. This echoes the feedback provided in previous CBM acceptability studies (Beard et al., 2012; Leung et al., 2019). Provision of a compelling rationale at the outset of the program is important for initial buy-in and setting expectations about the purpose and nature of the intervention (e.g., computerized, repetitive training; Beard and Peckham, 2020). This rationale will likely enhance motivation to train, and thus may result in increased adherence and lower attrition. In terms of program delivery, emerging adults had a clear preference for completing the program at home, presumably due to greater flexibility in completing training at an inconvenient time and location. This reiterates findings from previous studies (Beard et al., 2011).

Trial repetition, boredom, and disengagement are serious concerns for CBM training (Beard et al., 2011). As full gamification of the program is beyond the scope of this study, it was important to establish the most acceptable and engaging format for delivering the brain training sessions (i.e., either 50:50 ApBM and IBM in each session, or alternating ApBM and IBM between sessions). Although there was no consistent preference for the program format, the majority of emerging adults generally reported that they were willing to complete 1 to 2 training sessions per week. This level of training in either ApBM or IBM is feasible to provide and has been associated with significant improvements in alcohol use and anxiety in extant literature, respectively (Amir and Taylor, 2012; Beard and Amir, 2008; Beard et al., 2011; Eberl et al., 2013; Eberl et al., 2014).

The potential clinical value of the program was reflected in the qualitative feedback from both groups. Quantitative responses from service providers indicated that the program shows promise as an adjunct treatment; however, they had reservations regarding the program's potential effects on cognitive biases, anxiety symptoms, and alcohol use. This may have been partially the result of a lack of understanding of the rationale for treatment. Emerging adults were more optimistic about the program's value and potential effectiveness. Consistent with recent CBM programs, to increase clinical utility of the intervention, a psychoeducational and motivational interviewing-based module was developed and will be delivered prior to the first training session (Boffo et al., 2015; Boffo et al., 2017). This module discusses the interrelationship between alcohol use and anxiety, and aims to increase intrinsic motivation for change and decrease ambivalence about change. It will also inform participants about the existence of automatically activated processes and the importance of changing them.

### *Strengths and Limitations*

Involving end-users in every stage of the research processes helps ensure the relevance and usefulness of the research for the community (Greenhalgh et al., 2016). Thus, co-designing the *Re-Train Your Brain* program with emerging adults who are "experts of their experiences" of alcohol use and anxiety

was critical to ensuring the program is age appropriate, engaging and useful for their peers. Additionally, by actively engaging, consulting, and collaborating with service providers, this study will help to ensure the program can be feasibly implemented, is scalable, and is responsive to the needs of service providers. The study was also conducted solely online, providing participants a sense of anonymity and confidentiality, and reducing the impact of bias that can result from a researcher's presence during data collection. However, it should be acknowledged that interviews would have allowed more in-depth data collection and opportunities for clarifying.

Conclusions drawn from the present study should, however, be viewed in light of the following limitations. First, feedback was sought from a modest number of participants. While relatively small in number, this sample size is in line with those used in previous CBM acceptability studies (Beard et al., 2012; Lisk et al., 2018) and the data collected provides sufficient insight from key stakeholder groups for refinement of the program. Given the intervention is targeted at emerging adults with hazardous alcohol use and social anxiety, the current results may not generalize to younger or older populations with these concerns, or other disorders targeted by CBM. Additionally, acceptability questions were also not asked separately for ApBM and IBM, and the qualitative data analysis did not include any systematic checks of interrater reliability for trustworthiness. Thus, it is unclear whether one aspect of the hybrid program was more acceptable than the other, and whether the themes derived are trustworthy and reliable. In addition, the study does not contain an evaluation of acceptability after participant feedback was incorporated to ensure the changes met with their approval. While this study focused on alcohol approach biases and anxiety interpretation biases due to the relatively strong evidence base for their modification in clinical samples via CBM (see Fodor et al., 2020, regarding data on training interpretations for anxiety), it would also be interesting to test how intervening on the same cognitive processes across disorders impacts outcomes (for instance, Chow et al., 2018 provided initial evidence that comorbid alcohol use and social anxiety are strongly associated with comorbid interpretation and expectancy biases). One could imagine synergistic effects when interpretations, for example, are trained in both the anxiety and alcohol domains, but one could also imagine more generalizability when multiple cognitive processes are targeted. This will be an intriguing area for future research given interpretive biases are also evident in alcohol use disorders (Salemink et al., 2019) and automatic avoidance biases are also evident in anxiety disorders (Rinck et al., 2013). Future research may benefit from addressing common cognitive process across disorders in a combined CBM intervention (see Wiers et al., In Press for a way to potentially combine these elements). Finally, while beyond the scope of this paper, future research should examine the feasibility and acceptability of the intervention when delivered via different treatment modalities such as smartphone apps.

## CONCLUSIONS AND IMPLICATIONS

*Re-Train Your Brain* is a hybrid ApBM + IBM training program that combines efficacious CBM programs for alcohol use and social anxiety into one program to help emerging adults who experience both of these conditions. Importantly, the program can be self-administered, requires no specific skills or knowledge, and can be effectively delivered online (Wiers et al., 2015), thereby maximizing efficiency and scarce resources, and creating great potential for easy and large-scale dissemination. The program holds potential to enhance clinical outcomes at a minimum cost in terms of time and effort for both patients and service providers.

Given the positive comments regarding the program and the revisions made based on feedback from service providers and emerging adults, the *Re-Train Your Brain* program has the potential to improve outcomes in those for whom standard treatments alone are not sufficient (Deady et al., 2013; Kushner et al., 2005). The next step will be to conduct a pilot trial to evaluate the program's feasibility (i.e., compliance and delivery) to ascertain whether further changes to the program are required, followed by a larger randomized controlled trial to evaluate the efficacy of the *Re-Train Your Brain* program in reducing biases, alcohol use, and social anxiety in emerging adults.

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## CONFLICTS OF INTEREST

None declared.

## REFERENCES

- Amir N, Beard C, Bower E (2005) Interpretation bias and social anxiety. *Cogn Ther Res* 29:433–443.
- Amir N, Taylor CT (2012) Interpretation training in individuals with generalized social anxiety disorder: a randomized controlled trial. *J Consult Clin Psychol* 80:497–511.
- Arnett JJ (2000) Emerging adulthood. A theory of development from the late teens through the twenties. *Am Psychol* 55:469–480.
- Australian Institute of Health and Welfare (2017) National Drug Strategy Household Survey 2016: Detailed Findings. Australian Institute of Health and Welfare, Canberra, ACT, Australia.
- Babor T, Higgins-Biddle J, Saunders J, Monteiro M (2001) The Alcohol Use Disorders Identification Test, Guidelines for Use in Primary Care, 2nd edn. World Health Organization, Geneva.
- Baert S, Koster EW, De Raedt R (2011) Modification of information-processing biases in emotional disorders: clinically relevant developments in experimental psychopathology. *Int J Cogn Ther* 4:208–222.
- Baillie AJ, Stapinski L, Crome E, Morley K, Sannibale C, Haber P, Teesson M (2010) Some new directions for research on psychological interventions for comorbid anxiety and substance use disorders. *Drug Alcohol Rev* 29:518–524.
- Bangor A, Kortum PT, Miller JT (2008) An Empirical Evaluation of the System Usability Scale. *Int J Hum Comp Interact* 24:574–594.
- Batschelet HM, Stein M, Tschuempferlin RM, Soravia LM, Moggi F (2020) Alcohol-specific computerized interventions to alter cognitive biases: a systematic review of effects on experimental tasks, drinking behavior, and neuronal activation. *Front Psychiatry* 10:871.
- Beard C (2011) Cognitive bias modification for anxiety: current evidence and future directions. *Expert Rev Neurother* 11:299–311.
- Beard C, Amir N (2008) A multi-session interpretation modification program: changes in interpretation and social anxiety symptoms. *Behav Res Ther* 46:1135–1141.
- Beard C, Mchugh RK, Björgvinsson T, Ramadurai R, Pollak JP (2020) HabitWorks: development of a CBM-I smartphone app to augment and extend acute treatment. *Behav Ther*. <https://doi.org/10.1016/j.beth.2020.04.013>
- Beard C, Peckham AD (2020) Interpretation bias modification, in *Clinical Handbook of Fear and Anxiety: Maintenance Processes and Treatment Mechanisms* (Abramowitz, J. & Blakey, S. M. eds). American Psychological Association, Washington, DC.
- Beard C, Rifkin LS, Silverman AL, Björgvinsson T (2019) Translating CBM-I into real-world settings: augmenting a CBT-Based Psychiatric Hospital Program. *Behav Ther* 50:515–530.
- Beard C, Weisberg RB, Amir N (2011) Combined cognitive bias modification treatment for social anxiety disorder: a pilot trial. *Depress Anxiety* 28:981–988.
- Beard C, Weisberg RB, Primack J (2012) Socially anxious primary care patients' attitudes toward cognitive bias modification (CBM): a qualitative study. *Behav Cogn Psychother* 40:618–633.
- Boffo M, Pronk T, Wiers RW, Mannarini S (2015) Combining cognitive bias modification training with motivational support in alcohol dependent outpatients: study protocol for a randomised controlled trial. *Trials* 16:63.
- Boffo M, Willemen R, Pronk T, Wiers RW, Dom G (2017) Effectiveness of two web-based cognitive bias modification interventions targeting approach and attentional bias in gambling problems: study protocol for a pilot randomised controlled trial. *Trials* 18:452.
- Boffo M, Zerhouni O, Gronau QF, Van Beek RJJ, Nikolaou K, Marsman M, Wiers RW (2019) Cognitive bias modification for behavior change in alcohol and smoking addiction: bayesian meta-analysis of individual participant data. *Neuropsychol Rev* 29:52–78.
- Bowler JO, Mackintosh B, Dunn BD, Mathews A, Dalgleish T, Hoppitt L (2012) A comparison of cognitive bias modification for interpretation and computerized cognitive behavior therapy: effects on anxiety, depression, attentional control, and interpretive bias. *J Consult Clin Psychol* 80:1021–1033.
- Braunstein M, Kuerbis A, Ochsner K, Morgenstern J (2016) Implicit alcohol approach and avoidance tendencies predict future drinking in problem drinkers. *Alcohol Clin Exp Res* 40:1945–1952.
- Brettschneider M, Neumann P, Berger T, Renneberg B, Boettcher J (2015) Internet-based interpretation bias modification for social anxiety: a pilot study. *J Behav Ther Exp Psychiatry* 49:21–29.
- Brooke J (1996) SUS: a quick and dirty usability scale. *Usability Evaluation in Industry* 189:4–10.
- Brosan L, Hoppitt L, Sheller L, Sillence A, Mackintosh B (2011) Cognitive bias modification for attention and interpretation reduces trait and state anxiety in anxious patients referred to an out-patient service: results from a pilot study. *J Behav Ther Exp Psychiatry* 42:258–264.
- Chow PI, Portnow S, Zhang D, Saleminck E, Wiers RW, Teachman BA (2018) Comorbid interpretation and expectancy bias in social anxiety and alcohol use. *Anxiety Stress Coping* 31:669–685.

- Cristea IA, Kok RN, Cuijpers P (2015) Efficacy of cognitive bias modification interventions in anxiety and depression: meta-analysis. *Br J Psychiatry* 206:7–16.
- De Lijster JM, Dierckx B, Utens EMWJ, Verhulst FC, Zieldorff C, Dieleman GC, Legerstee JS (2017) The age of onset of anxiety disorders: a meta-analysis. *Can J Psychiatry* 62:237–246.
- De Meneses-Gaya C, Zuairi AW, Loureiro SR, Crippa JAS (2009) Alcohol Use Disorders Identification Test (AUDIT): an updated systematic review of psychometric properties. *Psychol Neurosci* 2:83–97.
- Deady M, Teeson M, Mills K, Kay-Lambkin F, Baker A, Baillie A (2013) One Person, Diverse Needs: Living With Mental Health and Alcohol and Drug Difficulties. A Review of Best Practice. NHMRC Centre of Research Excellence in Mental Health and Substance Use, Sydney, NSW, Australia.
- Degenhardt L, Stockings E, Patton G, Hall WD, Lynskey M (2016) The increasing global health priority of substance use in young people. *Lancet Psychiatry* 3:251–264.
- Dos Santos LF, Loureiro SR, Crippa JA, De Lima Osório F (2013) Adaptation and initial psychometric study of the self-report version of Liebowitz Social Anxiety Scale (LSAS-SR). *Int J Psychiatry Clin Pract* 17:139–143.
- Eberl C, Wiers RW, Pawelczack S, Rinck M, Becker ES, Lindenmeyer J (2013) Approach bias modification in alcohol dependence: do clinical effects replicate and for whom does it work best? *Dev Cogn Neurosci* 4:38–51.
- Eberl C, Wiers RW, Pawelczack S, Rinck M, Becker ES, Lindenmeyer J (2014) Implementation of approach bias re-training in alcoholism—how many sessions are needed? *Alcohol Clin Exp Res* 38:587–594.
- Farris SG, Epstein EE, McCrady BS, Hunter-Reel D (2012) Do co-morbid anxiety disorders predict drinking outcomes in women with alcohol use disorders? *Alcohol Alcohol* 47:143–148.
- Fodor LA, Georgescu R, Cuijpers P, Szamoskozi S, David D, Furukawa TA, Cristea IA (2020) Efficacy of cognitive bias modification interventions in anxiety and depressive disorders: a systematic review and network meta-analysis. *Lancet Psychiatry* 7:506–514.
- Fresco DM, Coles ME, Heimberg RG, Liebowitz MR, Hami S, Stein MB, Goetz D (2001) The Liebowitz Social Anxiety Scale: a comparison of the psychometric properties of self-report and clinician-administered formats. *Psychol Med* 31:1025–1035.
- Fuller-Tyszkiewicz M, Richardson B, Klein B, Skouteris H, Christensen H, Austin D, Castle D, Mihalopoulos C, O'Donnell R, Arulkadacham L, Shatte A, Ware A (2018) A mobile app-based intervention for depression: end-user and expert usability testing study. *JMIR Ment Health* 5:e54.
- Glashouwer KA, Timmerman J, De Jong PJ (2020) A personalized approach-avoidance modification intervention to reduce negative body image. A placebo-controlled pilot study. *J Behav Ther Exp Psychiatry* 68:101544.
- Greenhalgh T, Jackson C, Shaw S, Janamian T (2016) Achieving research impact through co-creation in community-based health services: literature review and case study. *Milbank Q* 94:392–429.
- Johnston L, Dear BF, Gandy M, Fogliati VJ, Kayrouz R, Sheehan J, Rapee RM, Titov N (2014) Exploring the efficacy and acceptability of Internet-delivered cognitive behavioural therapy for young adults with anxiety and depression: an open trial. *Aust N Z J Psychiatry* 48:819–827.
- Jones EB, Sharpe L (2017) Cognitive bias modification: a review of meta-analyses. *J Affect Disord* 223:175–183.
- Kakoschke N, Kemps E, Tiggemann M (2017) Approach bias modification training and consumption: a review of the literature. *Addict Behav* 64:21–28.
- Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE (2005) Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry* 62:593–602.
- Koffel E, Vitiello MV, McCurry SM, Rybarczyk B, Von Korff M (2018) Predictors of adherence to psychological treatment for insomnia and pain: analysis from a randomized trial. *Clin J Pain* 34:375–382.
- Kooistra LC, Ruwaard J, Wiersma JE, Van Oppen P, Van Der Vaart R, Van Gemert-Pijnen JEW, Riper H (2016) Development and initial evaluation of blended cognitive behavioural treatment for major depression in routine specialized mental health care. *Internet Intervent* 4:61–71.
- Köpetz C, Macpherson L, Mitchell AD, Houston-Ludlam AN, Wiers RW (2017) A novel training approach to activate alternative behaviors for smoking in depressed smokers. *Exp Clin Psychopharmacol* 25:50–60.
- Kroenke K, Spitzer RL, Williams JB, Monahan PO, Löwe B (2007) Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann Intern Med* 146:317–325.
- Kushner MG, Abrams K, Thuras P, Hanson KL, Brekke M, Sletten S (2005) Follow-up study of anxiety disorder and alcohol dependence in comorbid alcoholism treatment patients. *Alcohol Clin Exp Res* 29:1432–1443.
- Leung CJ, Fosuaah A, Frerichs J, Heslin M, Kabir T, Lee TMC, Mcguire P, Meek C, Mouchlianitis E, Nath AS, Peters E, Shergill S, Stahl D, Trotta A, Yiend J (2019) A qualitative study of the acceptability of cognitive bias modification for paranoia (CBM-pa) in patients with psychosis. *BMC Psychiatry* 19:225.
- Lewis JR (2018) The System Usability Scale: past, present, and future. *Int J Human Comp Interact* 34:577–590.
- Lewis JR, Brown J, Mayes DK (2015) Psychometric Evaluation of the EMO and the SUS in the Context of a Large-Sample Unmoderated Usability Study. *Int J Human Comp Interact* 31:545–553.
- Liebowitz MR (1987) Social phobia. *Mod Probl Pharmacopsychiatry* 22:141–173.
- Lisk SC, Pile V, Haller SPW, Kumari V, Lau JYF (2018) Multisession cognitive bias modification targeting multiple biases in adolescents with elevated social anxiety. *Cogn Ther Res* 42:581–597.
- Löwe B, Decker O, Müller S, Brähler E, Schellberg D, Herzog W, Herzberg PY (2008) Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. *Med Care* 46:266–274.
- Manning V, Staiger PK, Hall K, Garfield JB, Flaks G, Leung D, Hughes LK, Lum JA, Lubman DI, Verdejo-Garcia A (2016) Cognitive bias modification training during inpatient alcohol detoxification reduces early relapse: a randomized controlled trial. *Alcohol Clin Exp Res* 40:2011–2019.
- Mathews A, Mackintosh B (2000) Induced emotional interpretation bias and anxiety. *J Abnorm Psychol* 109:602–615.
- Mcevoy P, Shand F (2008) The effect of comorbid substance use disorders on treatment outcome for anxiety disorders. *J Anxiety Disord* 22:1087–1098.
- McNally RJ, Amir N, Louro CE, Lukach BM, Riemann BC, Calamari JE (1994) Cognitive processing of idiographic emotional information in panic disorder. *Behav Res Ther* 32:119–122.
- Menne-Lothmann C, Viechtbauer W, Höhn P, Kasanova Z, Haller SP, Drukker M, Van Os J, Wichers M, Lau JYF (2014) How to Boost Positive Interpretations? A Meta-Analysis of the Effectiveness of Cognitive Bias Modification for Interpretation. *PLoS One* 9:e100925.
- Mennin DS, Fresco DM, Heimberg RG, Schneier FR, Davies SO, Liebowitz MR (2002) Screening for social anxiety disorder in the clinical setting: Using the Liebowitz Social Anxiety Scale. *J Anxiety Disord* 16:661–673.
- Muris P, Huijding J, Mayer B, Hameetman M (2008) A space odyssey: experimental manipulation of threat perception and anxiety-related interpretation bias in children. *Child Psychiatry Hum Dev* 39:469–480.
- Murphy R, Hirsch CR, Mathews A, Smith K, Clark DM (2007) Facilitating a benign interpretation bias in a high socially anxious population. *Behav Res Ther* 45:1517–1529.
- National Institute on Drug Abuse (2009) Principles of Drug Addiction Treatment: A Research-based Guide. National Institute on Drug Abuse, U.S. Department of Health and Human Services, NIH.
- Onie S, Gong S, Manwaring E, Grageda D, Webb K, Yuen WS, Most SB (2020) Validation of the Australian beverage picture set: a controlled picture set for cognitive bias measurement and modification paradigms. *Aust J Psychol* 72:223–232.
- Pedersen ER, Grow J, Duncan S, Neighbors C, Larimer ME (2012) Concurrent validity of an online version of the Timeline Followback assessment. *Psychol Addict Behav* 26:672–677.

- Peters L, Sunderland M, Andrews G, Rapee RM, Mattick RP (2012) Development of a short form Social Interaction Anxiety (SIAS) and Social Phobia Scale (SPS) using nonparametric item response theory: the SIAS-6 and the SPS-6. *Psychol Assess* 24:66–76.
- Rinck M, Telli S, Kampmann IL, Woud ML, Kerstholt M, Te Velthuis S, Wittkowski M, Becker ES (2013) Training approach-avoidance of smiling faces affects emotional vulnerability in socially anxious individuals. *Front Hum Neurosci* 7:481.
- Rinck M, Wiers RW, Becker E, Lindenmeyer J (2018) Relapse prevention in abstinent alcoholics by cognitive bias modification: clinical effects of combining approach bias modification and attention bias modification. *J Consult Clin Psychol* 86:1005–1016.
- Rozenman M, Weersing VR, Amir N (2011) A case series of attention modification in clinically anxious youths. *Behav Res Ther* 49:324–330.
- Rueger SY, Trela CJ, Palmeri M, King AC (2012) Self-Administered web-based timeline followback procedure for drinking and smoking behaviors in young adults. *J Stud Alcohol Drugs* 73:829–833.
- Rytwinski NK, Fresco DM, Heimberg RG, Coles ME, Liebowitz MR, Cisell S, Stein MB, Hofmann SG (2009) Screening for social anxiety disorder with the self-report version of the Liebowitz Social Anxiety Scale. *Depress Anxiety* 26:34–38.
- Salemink E, Kindt M, Rienties H, Van Den Hout M (2014) Internet-based cognitive bias modification of interpretations in patients with anxiety disorders: a randomised controlled trial. *J Behav Ther Exp Psychiatry* 45:186–195.
- Salemink E, Van Den Hout M, Kindt M (2009) Effects of positive interpretive bias modification in highly anxious individuals. *J Anxiety Disord* 23:676–683.
- Salemink E, Wiers RW (2014) Alcohol-related memory associations in positive and negative affect situations: drinking motives, working memory capacity, and prospective drinking. *Psychol Addict Behav* 28:105–113.
- Salemink E, Woud ML, Roos M, Wiers R, Lindgren KP (2019) Reducing alcohol-related interpretive bias in negative affect situations: Using a scenario-based Cognitive Bias Modification training paradigm. *Addict Behav* 88:106–113.
- Sauro J, Lewis JR (2012) Quantifying the User Experience: Practical Statistics for User Research. Morgan Kaufman, San Francisco, CA.
- Schlauch RC, Stasiewicz PR, Bradizza CM, Coffey SF, Gulliver SB, Gudleski GD (2012) Relationship between approach and avoidance inclinations to use alcohol and treatment outcomes. *Addict Behav* 37:824–830.
- Sobell LC, Sobell MB (1992) Timeline follow-back: A technique for assessing self-reported ethanol consumption, in *Measuring Alcohol Consumption: Psychosocial and Biological Methods* (Allen J & Litten RZ eds), pp 41–72. Humana Press, Totowa, NJ.
- Sobell LC, Sobell MB (1995) Alcohol Time-Line Follow-Back User's Manual. Addiction Research Foundation, Toronto, ON, Canada.
- Spitzer RL, Kroenke K, Williams JW, Löwe B (2006) A brief measure for assessing generalized anxiety disorder: The GAD-7. *Arch Intern Med* 166:1092–1097.
- Stewart SH, Conrod PJ (2008) Anxiety disorder and substance use disorder co-morbidity: common themes and future directions, in *Anxiety and Substance Use Disorders: The Vicious Cycle of Comorbidity* (Stewart SH & Conrod PJ eds), pp 239–257. Springer, New York, NY.
- Teesson M, Hall W, Slade T, Mills K, Grove R, Mewton L, Baillie A, Haber P (2010) Prevalence and correlates of DSM-IV alcohol abuse and dependence in Australia: findings of the 2007 National Survey of Mental Health and Wellbeing. *Addiction* 105:2085–2094.
- Thomas DR (2006) A general inductive approach for analyzing qualitative evaluation data. *Am J Eval* 27:237–246.
- White LK, Sequeira S, Britton JC, Brotman MA, Gold AL, Berman E, Towbin K, Abend R, Fox NA, Bar-Haim Y, Leibenluft E, Pine DS (2017) Complementary features of attention bias modification therapy and cognitive-behavioral therapy in pediatric anxiety disorders. *Am J Psychiatry* 174:775–784.
- Wiers RW, Boffo M, Field M (2018) What's in a trial? On the importance of distinguishing between experimental lab studies and randomized controlled trials: the case of cognitive bias modification and alcohol use disorders. *J Stud Alcohol Drugs* 79:333–343.
- Wiers RW, Eberl C, Rinck M, Becker ES, Lindenmeyer J (2011) Retraining automatic action tendencies changes alcoholic patients' approach bias for alcohol and improves treatment outcome. *Psychol Sci* 22:490–497.
- Wiers RW, Houben K, Fadardi JS, Van Beek P, Rhemtulla M, Cox WM (2015) Alcohol Cognitive Bias Modification training for problem drinkers over the web. *Addict Behav* 40:21–26.
- Wiers RW, Rinck M, Dictus M, Van Den Wildenberg E (2009) Relatively strong automatic appetitive action-tendencies in male carriers of the OPRM1 G-allele. *Genes Brain Behav* 8:101–106.
- Wiers RW, Van Dessel P, Köpetz C (in press) ABC-training: A new theory-based form of cognitive bias modification to foster automatization of alternative choices in the treatment of addiction and related disorders. *Curr Direct Psychol Sci*.