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Alcohol Cue Reactivity Task Development

Carmen Pulido, Ph.D.^a, Sandra A. Brown, Ph.D.^{a,b}, Kevin Cummins, M.S.^a, Martin P. Paulus, M.D.^{a,b}, and Susan F. Tapert, Ph.D.^{a,b}

^a University of California San Diego

^b VA San Diego Healthcare System

Abstract

Background—The physiological and cognitive reactions provoked by alcohol cues, as compared to non-alcohol cues, can predict future drinking. Alcohol cue reactivity tasks have been developed; however, most were created for use with alcohol use disordered individuals and utilize limited or only partially standardized stimuli. This project systematically created an alcohol cue reactivity task for studies with non-drinkers, using well-characterized stimuli.

Objectives—We comprehensively standardized 60 alcohol and 60 non-alcohol beverage pictures using ratings from young non-drinkers ($N=82$) on affective and perceptual features.

Results—A statistical matching approach yielded 26 matched alcohol - non-alcohol picture pairs matched on valence, arousal, image complexity, brightness, and hue. The task was piloted and further refined to 22 picture pairs. An 8-minute, 32-second event-related task was created using a random stimulus function for optimized condition timing and systematic presentation of the images.

Conclusions—The long-term objectives of this project are to utilize this task with non-drinking youth to investigate how reactivity to alcohol stimuli may predict alcohol use initiation and escalation, to help identify the role of exposure to alcohol stimuli on the subsequent development of alcohol-related problems.

Keywords

Alcohol cue reactivity; Task development; Standardization; Affective ratings; Adolescence; College students

1. Introduction

Subjective alcohol craving and responses to alcohol-specific cues (e.g., pictures of alcoholic beverages) have been shown to produce different physiological and cognitive interference responses in contrast with exposure to non-alcohol cues (e.g., delayed reaction times on attentional tasks) (Bruce & Jones, 2004). Specifically, prior investigations have shown that alcoholics report higher subjective reactions (e.g., craving) to alcohol stimuli (e.g., pictures) when compared to non-alcoholic stimuli (Drobes, 2002) and social drinkers (George et al., 2001). Similarly, adults (Monti et al., 1987) and adolescents (Thomas & Deas, 2005; Thomas, Drobes, & Deas, 2005) with alcohol dependence have demonstrated differential physiological

Corresponding author: Carmen Pulido, Ph.D., University of California San Diego, Department of Psychiatry, 3350 La Jolla Village Drive (151B), San Diego, CA 92161, (858) 642-1480, (858) 642-6340 fax, cpulido@ucsd.edu.

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responses, such as increased salivation, to the sight and smell of alcoholic beverages as compared to non-alcoholic beverages. This population has also evidenced cognitive interference (e.g., delayed reaction times) when presented with alcohol cues (e.g., alcoholic beverages or alcohol-related words) (Bauer & Cox, 1998; Sayette et al., 1994). Social drinkers also show delayed reaction times (Bruce & Jones, 2004) or alcohol bias (Townshend & Duka, 2001) when presented with alcohol stimuli, which often correlated with the level of alcohol involvement. Cue reactivity paradigms have been used for tailoring alcohol interventions (Drummond & Glautier, 1994; Rohsenow et al., 2001), evaluating the efficacy of alcohol treatment programs (Hutchison et al., 2006; Schneider et al., 2001), and examining degree of reactivity in relation to duration of abstinence (Monti et al., 1993).

In brief, from the concentration of studies with alcohol using individuals, alcohol cue reactivity appears to develop through personal alcohol use. Only a few studies have examined alcohol cue reactivity among individuals *at risk* for alcohol use disorders (AUD) (Tapert et al., 2003). In the present study, an alcohol cue reactivity task was developed using stimuli ratings of non-drinkers, who have previously been shown to have different subjective affective responses to alcohol beverage images as compared to drinkers (Pulido, Mok, Brown, & Tapert, 2009). This alcohol cue reactivity task was developed for future use with non-drinkers at risk for AUD, to help determine whether attentional bias is developed only through personal alcohol use experiences, or if it can also be learned through modeling, and whether cue reactivity can predict subsequent drinking behavior. Ultimately, these findings can help in the development of effective AUD prevention programming.

1.2 Alcohol Cue Reactivity Studies and Limitations

Prior to assessing alcohol cue reactivity, a task for such purpose needs to be developed. Stimuli standardization and implementation into a task is time consuming, and several research groups have substantially advanced our understanding of stimulus characteristics important to consider when creating an alcohol cue reactivity task (Braus et al., 2001; Grusser, Heinz, & Flor, 2000; Grusser et al., 2004; Wrase et al., 2002; Wrase et al., 2007).

First, stimulus affective and perceptual characteristics are important to consider. Fortunately, some investigators have highlighted the importance of stimulus standardization and reported efforts to standardize task materials prior to task creation (e.g., Grusser et al., 2000; Wrase et al., 2002). However, standardization procedures have typically explored only one dimension such as valence (e.g., Bauer & Cox, 1998) or the visual complexity of the stimuli (e.g., Bruce & Jones, 2004). A task simultaneously considering multiple task-relevant stimulus parameters is yet to be developed. Second, the standardization of a limited quantity of stimuli (e.g., Grusser et al., 2000) restricts its utility for creating an alcohol cue reactivity task since stimuli repetition can reduce statistical power or even confound results (Schwartz et al., 2003). For instance, a modest quantity of items has been managed in some studies by supplementing the task with stimuli standardized with divergent procedures (e.g., George et al., 2001; Hermann et al., 2006; Myrick et al., 2004). Third, in cases where alcohol visual stimuli standardization has been undertaken with small (Grusser et al., 2000; Lang, 1999) and large (Stritzke, Breiner, Curtin, & Lang, 2004; Wrase et al., 2002) item pools, participants' alcohol use characteristics are often unknown, despite this being an important correlate of alcohol stimulus ratings (Pulido, Mok et al., 2009). Finally, although various tasks are currently available to assess alcohol cue reactivity among AUD individuals, no task has been developed to specifically examine alcohol cue reactivity among non-drinking individuals at risk for AUD.

This study utilized a database of affective (i.e., valence and arousal) and perceptual (i.e., familiarity and image complexity) ratings from 82 non-drinking individuals and objective brightness and color measures to statistically match 120 alcohol and non-alcohol beverage pictures for an alcohol cue reactivity task. The task developed here will improve upon existing

alcohol cue reactivity paradigms in that it was developed by means of a novel and stringent procedure, simultaneously taking into consideration multiple recommended task development procedures. These included using a large item pool, collecting ratings from non-drinkers and covering relevant parameters, using an objective matching approach, optimizing task design for fMRI, including an active control condition, and conducting a pilot study. The careful creation of the task will allow for more accurate neural assessment of alcohol cue reactivity and comparison of results across samples.

2. Methods

This study had two objectives: a) to statistically match a set of alcohol and non alcohol picture pairs on affective and perceptual features, and b) to systematically present these cues with a time course conducive to evaluating behavioral reactions as well as blood oxygen level dependent response during functional magnetic resonance imaging studies.

2.1 Methods for Stimuli Matching

The first objective was to generate a set of alcohol and non-alcohol beverage pictures that would be recognizable to non-drinkers, then to match alcohol to non-alcohol pictures on valence, arousal, and perceptual complexity ratings, and on objective measures of brightness level and net color. These aims were accomplished by (1) collecting ratings on familiarity, valence, arousal, and complexity ratings for 120 alcohol and non-alcohol beverage pictures from a sample of 245 adolescents and young adults, including 82 non-drinkers; and (2) obtaining objective measurement of pictures' brightness and color using the GNU Image Manipulation Program (GIMP; Berkeley, CA), a photo editing software program. Test construction theory was used to ensure the proper development of the task.

2.1.1 Participants—Participants ($N=82$) were ages 13 to 23 ($M = 18.1$, $SD=2.2$), 52% female, 41% Caucasian, 10% with paternal AUD (all denied maternal AUD), and reportedly minimal depressive symptomatology (BDI-II score $M=5.9$, $SD=7.1$). Participants ages 18 and older ($n=67$) were college students recruited from local universities (Pulido, Mok et al., 2009). Participants under age 18 ($n=15$) were recruited from local middle schools through an ongoing adolescent brain imaging study (Pulido, Anderson, Armstead, Brown, & Tapert, 2009; Spadoni, Norman, Schweinsburg, & Tapert, 2008). The inclusionary criterion for the present study was having had 10 or less lifetime alcohol drinking experiences, as determined by the Customary Drinking and Drug Use Record (see below, Brown et al., 1998); those reporting drinking more were excluded. An alcohol drinking experience was defined as a 24-hour period when one or more standardized alcoholic beverages (i.e., 12oz. beer, 8 oz. malt liquor, 4 oz. wine, or 1.25 oz. of hard liquor) were consumed. This criterion was based on the future objective of using this task with non-drinkers, and our previous findings of differences in affective responses to alcohol pictures between individuals above and below this threshold (Pulido, Mok et al., 2009).

2.1.2. Measures

2.1.2.1. General Interview (Brown, Vik, & Creamer, 1989): A general interview was administered to gather demographic information.

2.1.2.2. Customary Drinking and Substance Use Record (Brown et al., 1998): An abbreviated form of the CDDR gathered frequency, quantity, and recency of personal alcohol and other drug use.

2.1.2.3. The Short Michigan Alcoholism Screening Test versions M and F (Sher & Descutner, 1986): The Short Michigan Alcoholism Screening Test versions M and F (Sher &

Descutner, 1986), which are adapted forms of the SMAST, were administered to participants to report on their Mothers (SMAST-M) and Fathers (SMAST-F) history of AUD. The SMAST-M and SMAST-F have shown good reliability and validity (Crews & Sher, 1992).

2.1.2.4. The Beck Depression Inventory-Second Edition (Beck, Steer, & Brown, 1996) and Beck Depression Inventory (Beck, 1978): The Beck Depression Inventory-Second Edition (Beck, Steer, & Brown, 1996) and Beck Depression Inventory (Beck, 1978) were used to assess college student's and adolescents' current level of depression (respectively).

2.1.2.5. The Beverage Pictures: The Beverage Pictures stimuli consisted of 120 color pictures: 60 of alcoholic beverages and 60 of non-alcoholic beverages. Pictures were obtained from popular magazine advertisements, amateur photographs, the Normative Appetitive Picture System (Stritzke et al., 2004), the International Affective Picture System ([CSEA-NIMH], 1999), and the internet, then scanned at a similar resolution and image size. The pictures were displayed via an E-Prime (Pittsburgh, PA) program for systematic presentation (see sample picture in Figure 1). Each subject rated 60 pictures instead of all 120 to minimize fatigue. Thus, four picture presentation programs were created with 30 alcohol and 30 non-alcohol pictures in each. Within each program, pictures were randomized to control for order effects.

2.1.2.6. The Self-Assessment Manikin (SAM): The Self-Assessment Manikin (SAM) picture rating system (Lang, 1999) includes two nine-point scales for rating valence (i.e., pleasure/displeasure) and arousal (i.e., excitement/calm) perceived while viewing each picture.

2.1.2.7. The Perceptual Ratings Booklet: The Perceptual Ratings Booklet was used to rate familiarity with the beverage depicted and each picture's complexity according to guidelines in Snodgrass and Vanderwart (1980). Familiarity was measured with a five-point scale with 1 ("very unfamiliar," i.e., the participant was uncertain as to what kind of beverage was depicted) to 5 ("very familiar," i.e., the participant recognized the beverage and knew what type of beverage it was). Visual complexity (e.g., "How detailed is the picture? If you had to describe the picture in detail or draw it, how simple or complicated would it be?") was measured with a five-point scale, with 1 for "very simple" to 5 for "very complex."

2.1.3. Procedures—College participants were tested in groups of 1 to 5 individuals, and 13 to 17 year olds were tested individually to ensure attention to the task. There were four parts to the study. First, informed consent was obtained (for minors, informed consent was obtained from the parent and assent from the adolescent) in accordance with University of California San Diego and San Diego State University Human Research Protections Program guidelines, and questionnaires covering demographic information, alcohol and drug use history, and mood were administered.

Second, participants completed valence and arousal ratings of the alcohol and non-alcohol beverage pictures. Detailed instructions and practice trials were provided, then each subject rated 60 pictures, using the Self-Assessment Manikin booklets (Lang, 1999). Stimuli were presented via E-Prime running on a laptop computer, and each trial included three components: 1) the preparation slide presented for 3 seconds ("Please be ready for the next slide"); 2) a stimulus picture presented for 6 seconds, and participants were asked to attend to it during its entire presentation; and 3) a rating slide presented for 11 seconds asking participants to rate how the picture made them feel while viewing it.

Third, subjects rated perceptual features (i.e., familiarity and complexity) of the pictures. For this, the same pictures presented for affective ratings were shown again but in randomized order. Each trial included three components: 1) the preparation slide presented for 3 seconds ("Please be ready for the next slide"); 2) a stimulus picture presented for 2.5 seconds with

participants asked to attend to it during its entire presentation; and 3) a rating slide presented for 9 seconds asking participants to rate the picture in terms of their personal familiarity with the beverage and the picture's level of visual complexity.

Fourth, subjects responded to questionnaires regarding their family history of alcohol use, followed by the debriefing of the study. Completing these procedures took approximately 2 hours for each participant.

2.1.4. Statistical Procedures for Stimulus Matching—First, a visual inspection of the 120 beverage pictures revealed that 8 were not fit for matching consideration because of poor image quality. Next, pictures were screened for familiarity ratings (scale: 1 “not familiar” to 5 “very familiar”). Mean familiarity ratings were higher for non-alcoholic beverage pictures (i.e., range from 2.5 to 4.8; $M = 4.2$, $SD = 0.5$) than for alcohol pictures (i.e., range 1.7 to 4.0; $M = 2.8$, $SD = 0.6$) on average, among these non-drinking participants. Alcohol pictures with mean familiarity ratings equal or below 2.3 (below “neutral”) were excluded from further analysis (approximately 10% of the picture pool). In summary, 17 alcohol and 6 non-alcohol pictures were eliminated from further analysis based on image quality, or low familiarity rating in this population.

Next, alcohol and non-alcohol pictures' valence, arousal, and complexity absolute difference scores were computed for each subject. An absolute difference score reflects the difference between two stimuli in a parameter of interest. For this, participants' booklets with ratings data were coded and double checked for accuracy, entered into Microsoft Excel 4.0 and checked for entry accuracy, and exported into SPSS 14.0. All data were examined for outliers, normality of distribution, and homoscedasticity. Then, within each subject and within one parameter (e.g., valence) an absolute difference score was calculated by subtracting a valence rating to each alcohol picture from the subject's valence rating to each non-alcohol picture (i.e., each alcohol picture rating was contrasted against all available non-alcohol picture ratings within a subject). The same procedure was completed for arousal and complexity ratings for each participant. Mean absolute distances were computed for each picture pair on these 3 dimensions. For this, within one parameter, the distance score for one picture pair was averaged across all subjects. Mood scores (i.e., BDI-II and BDI totals) were not significant predictors of valence, arousal, or complexity ratings for alcohol and non-alcohol beverage pictures.

To consider the brightness and color constituents of each image in the matching procedure, GIMP photo editing software was used to objectively measure these parameters for each picture. Four values were ascertained for each picture to characterize the overall brightness, as well as red, blue, and green content. Absolute difference scores were calculated for each alcohol picture in contrast to every available non-alcohol picture for the matching procedure.

To consider all the above-mentioned parameters during picture matching, values were standardized (i.e., ranging from 0 to 8), and composite summary scores were computed for each possible picture pair, with larger scores indicating a poorer match. As valence was considered to be more important for matching (Drobes, 2002; Wrase et al., 2002) than complexity (Braus et al., 2001; Wrase et al., 2007), brightness (Levin et al., 1998), or color (Braus et al., 2001; Wrase et al., 2007) based on reported attempts to control these parameters in the alcohol cue reactivity literature, it was assigned greater weight. The following formula was used to compute the composite summary score:

$$\text{Score} = (\text{valence} \times 2) + (\text{arousal} \times 1) + (\text{complexity} \times 1) + (\text{brightness} \times 0.5) + (\text{red} \times 0.167) + (\text{green} \times 0.167) + (\text{blue} \times 0.167)$$

Thus, for each picture-picture difference, a single value was computed (range was 4.1 to 21.1 across all possible alcohol – non-alcohol picture pairs). Matching was accomplished by selecting the minimum possible composite distance score for each alcohol picture to find its best non-alcohol picture match. Twenty-six picture pairs were thus determined; with composite difference scores ranging from 4.1 to 7.9 (see Table 1).

2.2. Methods for Stimuli Presentation for Future Task Administration

In addition to the two primary conditions (i.e., alcohol and non-alcohol) of this cue reactivity task, an active control condition consisting of degraded images of the alcohol and non-alcohol stimuli was created (for an example see Figure 1) using an Image Shuffle program (San Diego, CA) to facilitate controlling for responses to perceptual features (e.g., color) during future neuroimaging data analysis.

The task design was optimized using the Analysis of Functional NeuroImages (AFNI) RSFgen program (Cox, 1996), which generates random stimulus functions to inform optimal duration and timing of each trial to maximize the number of trials of interest (Liu, 2004; Liu & Frank, 2004). The stimulus function calculates the number of presentations required given the number of stimulus types, number of stimuli per type, and task duration, and timing considers hemodynamic response temporal characteristics so that this task can be used in functional magnetic resonance imaging studies (Cohen, 1997).

The pairs of alcohol – non-alcohol pictures were programmed into E-Prime for systematic presentation. A practice version of the task and task instructions were developed for standard administration, asking participants to press a key in response to whether they like (left arrow), feel neutral (down arrow), or dislike (right arrow) the beverage picture.

3. Results

In summary, 120 beverage pictures were subjected to a statistical matching process, involving exclusion on the basis of visual inspection and ratings of familiarity in a sample of 82 non-drinking youth. This yielded 26 alcohol and 26 non-alcohol beverage pictures that were optimally matched in terms of affective and perceptual ratings as well as objective indices of brightness and hue content. Ratings and other image parameters averaged across the 26 alcohol and 26 non-alcohol pictures are shown in Table 2. In this sample of non-drinkers, the non-alcohol pictures tended to be rated more favorably (i.e., positive valence) while, on average, the alcohol pictures were rated as neutral. Arousal, complexity, brightness, and color content indices were not statistically different between the two picture types.

The 26 picture pairs and respective active control condition were administered to a new adolescent sample ($N=21$) for further evaluation of behavioral responses. Based on responses of these adolescents to the 26 picture pairs, poor matching and item recognition was observed for some stimuli, resulting in the removal of 4 of the 26 picture pairs. Parameter ratings and objective indices of brightness and hue content for the 22 alcohol and non-alcohol picture pairs, according to this non-drinking sample ($N=82$), remained significant for valence and non significant for arousal, complexity, brightness and color.

Mood, age, gender, ethnicity, and paternal AUD were explored as predictors for the 22 pictures pairs' valence, arousal, and complexity ratings. Participant's mood, age, ethnicity, and paternal AUD were not significant predictors of picture ratings. However, gender was significant at predicting non-alcohol pictures valence (Females $M = 3.7$, $SD = 1.2$, Males $M = 4.2$, $SD = 0.7$; $t_{(65)} = -2.2$, $p = 0.03$) and alcohol pictures complexity ratings (Females $M = 3.6$, $SD = 0.6$, Males $M = 3.1$, $SD = 0.7$; $t_{(80)} = 2.9$, $p < 0.01$). Specifically, females, when compared to males, rated

non-alcohol pictures as being more pleasant and alcohol pictures as being more perceptually complex.

RSFgen was used again to generate a random stimulus function for the 22 alcohol and non-alcohol picture pairs and active control conditions (see Figure 2); they were then programmed into E-Prime. A final task was created as an event related task with 4 conditions (i.e., alcohol, non alcohol, and alcohol and non alcohol active controls) each with 22 stimuli. The task begins with a 12-second fixation (rest) period. The alcohol and non alcohol stimuli are each presented 4 times (i.e., 88 trials per condition) while the active control stimuli are presented once (i.e., 22 trials per condition) to result in 220 trials. Each trial is presented for 750 ms (Heinz et al., 2007) with a 1250 ms inter-stimulus interval (i.e., blank screen), and 15 intermittent fixation periods (i.e., screen with a centered cross-hair) of 2, 4, or 6 seconds (i.e., for a total of 60 seconds of fixation throughout the task). During future functional magnetic resonance imaging data analysis, the fixation and active control conditions provide the opportunity to contrast activation to alcohol and non-alcohol pictures to a rest (i.e., fixation) and visual (i.e., active control) baselines. The alcohol cue reactivity task is 8 minutes and 32 seconds in duration. Task instructions are to press a key within 2000 ms of stimuli presentation in response to whether participants *Like* (left button), feel *Neutral* (down button), or *Dislike* (right button) seeing the beverage picture. Ratings and reaction times are logged for statistical analysis. A practice task with non-beverage pictures was created for establishing task demands outside the scanner.

4. Discussion

This novel matching procedure provided a more objective and rigorous method (i.e., objective comparison of multiple parameters), as compared to previous alcohol cue reactivity tasks, to contrast stimuli (i.e., alcohol and non-alcohol) on relevant affective and perceptual characteristics for task inclusion. This in turn, will eliminate potential confounds of future alcohol cue reactivity studies by minimizing the extent to which the stimuli of interest (i.e., alcohol) varies from the control (i.e., non alcohol and active control) conditions.

Studies with alcohol dependent individuals have shown that behavioral, physiological, and neural reactivity to alcohol stimuli influences subjective craving and drinking behavior. As most extant alcohol cue reactivity tasks were not rigorously constructed, we created an event-related neuroimaging task starting with a set of 120 (i.e., 60 alcohol and 60 non-alcohol) beverage pictures. Pictures were screened for visual quality and familiarity ratings of non-drinkers. Then, a novel approach objectively matched alcohol and non-alcohol pictures on valence, arousal, and complexity ratings of non-drinking young people, as well as objective measures of brightness and color (i.e., red, green, and blue). In addition, an active control condition was created to further manage pictures' perceptual characteristics, during future neuroimaging data analysis. Task presentation sequence and timing were optimized using a random stimulus function approach, which provided as many trials as possible in a reasonable period of time. Matched stimuli were programmed into a widely used presentation software program for systematic delivery, and a practice task was created. This alcohol cue reactivity task improves upon existing tasks in that it was developed by means of a novel and stringent procedure, since for the first time various recommended cue reactivity task development measures were simultaneously taken into consideration for the careful creation of the task.

Some may argue that matching these stimuli on affective characteristics could potentially remove the very alcohol reactivity we are interested in. However, by matching alcohol to non-alcohol stimuli on affective ratings and presenting it as a neuroimaging cue reactivity task, any differential response (i.e., neuronal activation) subjects may show between conditions (i.e., alcohol vs. non alcohol) can more precisely be attributable to the alcohol-specific content of

the cue as compared to the affective significance of the stimuli. Thus, this task can be used to investigate alcohol cue reactivity above and beyond reactivity to affectively charged stimuli.

The task here developed will help determine if alcohol cue reactivity is inherent among individuals at risk for developing AUD. In addition, the task could potentially be used as an indicator of risk for heavy alcohol involvement and alcohol related problems, and to determine differences in alcohol cue reactivity as a function of risk and protective factors (e.g., OPRM1 genotype variants, Anton et al., 2008; Myrick et al., 2008).

4.1. Limitations

The task was developed based on ratings of non-drinking college students and adolescents; as such, its use may be limited to non-drinkers. The inclusion of a college sample, rather than only adolescents, may be a limitation. A non-drinking adolescent sample may have been a better fit for this study's purposes. However, when comparing young adolescents and college students' pictures ratings, only one of four ratings significantly differed. In addition, the inclusion of a college sample broadened the utility of this task for use with youth, including late adolescent college freshman.

The alcohol and non alcohol stimuli included in the task were matched on multiple variables; still, significant differences in the subjective valence ratings of alcohol images were found, which may be a characteristic of the population included (i.e., non-drinkers) and a limitation of this task. Specifically, females rated non-alcohol pictures as being more pleasant and alcohol pictures as being more perceptually complex when compared to males. Previous alcohol cue reactivity picture standardization studies have not reported recruiting non-drinkers and no gender differences in picture ratings have been reported among controls, thus there is no precedent to these findings (Grusser et al., 2000; Wrase et al., 2002).

Stimuli updates will be needed to keep current with alcohol advertisement trends in coming years. The stimuli here are limited to pictures, although moving images or olfactory cues may further enhance cue-related responses. However, for studies of non-drinkers, it is unclear if olfactory or gustatory stimuli could enhance reactivity to alcohol cues given this population's limited personal use experiences. Alcohol cue reactivity among non-drinking youth is conceptualized as resulting from a variety of factors, including parental and peer modeling and the media (e.g., magazine advertisements, billboards), which supports the adequacy of pictorial stimuli for the initial investigation of alcohol cue reactivity among non drinkers.

4.2 Clinical Implications

Cue reactivity research with non-drinking youth could be used to ascertain which populations might be at particularly high risk for AUD. This information could be valuable for determining who might be at greater need for preventive services. In addition, determination of heightened risk for AUD on the basis of alcohol cue reactivity would point to potential interventions targeting the extinction of the cue response.

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Figure 1.
Sample Shuffled Picture and Matched Picture Pair (Non-Alcohol44 and Beer11).

Figure 2.

Portion of Alcohol Cue Reactivity Task reference function generated by AFNI RSFgen. Task is 8 minutes, 32 seconds in duration, with 2-second trials. The x-axis represents the first 101 seconds of the task; the y-axis represents the task conditions (alcohol and non-alcohol active control conditions were collapsed into one category). The horizontal lines of the blue graph represent the condition and its duration during the time course of the task.

Table 1

Composite Distance Scores for the 26 Pictures Pairs Retained

Alcohol Picture	Non-Alcohol Picture	Composite Distance
Beer11	Non-Alcohol44	4.1
Beer10	Non-Alcohol53	4.5
Beer21	Non-Alcohol32	5.5
Beer17	Non-Alcohol41	5.8
Beer16	Non-Alcohol51	6.1
Beer15	Non-Alcohol47	6.7
Beer6	Non-Alcohol50	6.8
Beer8	Non-Alcohol39	6.8
Beer14	Non-Alcohol8	7.4
Beer4	Non-Alcohol9	7.8
HardLiquor15	Non-Alcohol55	6.0
HardLiquor6	Non-Alcohol40	6.0
HardLiquor10	Non-Alcohol18	6.5
HardLiquor9	Non-Alcohol23	6.5
HardLiquor2	Non-Alcohol38	6.7
HardLiquor12	Non-Alcohol49	7.2
HardLiquor3	Non-Alcohol46	7.2
HardLiquor1	Non-Alcohol24	7.9
Wine13	Non-Alcohol5	4.7
Wine10	Non-Alcohol26	5.1
Wine1	Non-Alcohol56	5.6
Wine15	Non-Alcohol31	5.7
Wine12	Non-Alcohol43	6.0
Wine17	Non-Alcohol54	6.0
Wine9	Non-Alcohol58	6.4
Wine4	Non-Alcohol48	6.5

Table 2Mean Parameter Ratings by Picture Type for the 26 Picture Pairs ($N=82$)

	Alcohol <i>M</i> (SD)	Non Alcohol <i>M</i> (SD)
Valence ^{a*}	5.0 (1.2)	3.9 (0.9)
Arousal ^a	5.2 (1.4)	4.9 (1.1)
Complexity	3.2 (0.6)	3.2 (0.7)
Brightness	140.6 (51.5)	135.5 (47.6)
Red	134.7 (49.4)	124.4 (47.0)
Green	100.8 (50.5)	110.0 (49.0)
Blue	88.7 (56.1)	106.0 (52.7)

^a For valence and arousal, a rating of 5 represents neutral while smaller ratings indicate more pleasantness and arousal while viewing the picture (range 1 to 9)

* $p \leq .001$