Protocol and Statistical Analysis Plan

Official Title: **Brief Online Interventions for Alcohol Use (Mechanical Turk 10)**
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RESEARCH PROCEDURES

This experiment will consist of a battery of self-report questionnaires about health behaviors and alcohol use. Subjects will be told that the purpose of the study is to learn about the effects of cognitive training. Other than this general explanation of purpose, subjects will not be given any information concerning what outcomes might be expected.

Screening Questions (Appendix B). To determine whether subjects qualify, a short screening questionnaire will be used in which subjects answer questions about their age, sex, and drug use behaviors. Namely, subjects will be asked if they used alcohol, cigarettes, and marijuana in the past week to conceal the specific drug use qualifications. Subjects will also complete a questionnaire evaluating DSM-V criteria for alcohol use disorder. If a subject fails to qualify based on the inclusion criteria stipulated above (see Study Population), he or she will be thanked for his or her time and provided $0.05 compensation for completing this screener.

Phase 1: Baseline Survey. Subjects will first complete a baseline phase in which a health and drug use history is collected. Approximately half of subjects will also be randomized to receive normative feedback on alcohol use as a part of the baseline survey (see Normative Feedback below).

Alcohol Use History. Subjects will complete a battery of standardized assessments of alcohol use, such as the Alcohol Use Disorder Identification Test (AUDIT), Drinker Inventory of Consequences (DrInC), and timeline follow back for the past two weeks of alcohol use (TLFB). These measures are designed to capture past and current alcohol use behaviors and severity (e.g., drinks consumed per week, past month binge alcohol use). The Readiness for Change questionnaire evaluating desire and readiness to change alcohol use behaviors will also be collected (Rollnick et al., 1992). However, no exclusion criteria based on desire or readiness to change alcohol consumption will be used.

Behavioral Economic Measures (Appendix C-E). Subjects will complete a battery of behavioral economic measures, including a delay discounting task (Koffarnus & Bickel, 2014; Appendix C), commodity purchase task (Murphy and MacKillop, 2006; Appendix D), and a Reinforcement Survey Schedule-Alcohol Use Version (Murphy et al., 2005; Appendix E). These measures have been extensively applied in the behavioral science literature to evaluate aspects of alcohol valuation and reinforcement (Amlung et al., 2015; Murphy and MacKillop, 2006; Cox and Dallery, 2016; Koffarnus and Bickel, 2014; Morris et al., 2017). We have also effectively used these measures on the mTurk platform in previous research (Strickland & Stoops, under review; Strickland & Stoops, 2017; Strickland et al., 2017).

Normative Feedback (Appendix F). Half of subjects will be randomly assigned to a normative feedback condition. Subjects assigned to this condition will be directed to a statement standardized based on subjects' reported average number of standard drinks per week, age, and gender. This statement will provide a normative comparison of alcohol consumption to individuals of the same age and gender (see Appendix F for example). Percentile ranks for the normative comparisons will be made using data from the 2016 National Survey on Drug Use and Health (Center for Behavioral Health Statistics, 2017). After receiving feedback, subjects will report perceptions of this feedback (e.g., was it surprising, helpful, expected) as well as motivation to change alcohol use in response to the feedback. Previous studies have shown the feasibility and acceptability of delivering this type of normative feedback through mTurk (Kuerbis et al., 2016; 2017). Control participants will receive feedback on time spent doing a non-alcohol related activity as an attention/informational control (e.g., time spent watching television; LaBrie et al., 2013). Control subjects will complete feedback perception questions for the provided information, similar to the alcohol normative feedback group.

Demographic and Other Drug Use Variables: A battery of standardized questionnaires will assess other drug use and health behavior (e.g., DAST for substance use severity; FTND for cigarette use severity). Demographics will be also collected for each subject, including items such as age, sex, race, and education.

Phase 2: Cognitive Training Phase. Following completion of the baseline phase, subjects will be contacted through mTurk's interface to complete a 2-week cognitive training study. Subjects will be asked to complete daily cognitive training surveys and told that they will receive $0.50 for each 5-8 minute survey completed. Additionally, subjects will be told that completion of 10 or more assessments will result in entry into a raffle for one of five $50 bonuses.

Subjects will be randomly assigned to one of three training conditions using stratified sampling. Sampling will be stratified based on alcohol use disorder status (e.g., moderate, severe) to ensure equal representation in each condition. All training conditions will be completed daily and will take ~5-8 minutes to complete. Tasks will be programmed in PsyToolkit, an open-source web-based platform that provides reliable reaction time data for online delivery (Stoet, 2017). Recent research in our laboratory has effectively used PsyToolkit for

completing cognitive-behavioral research and demonstrates the feasibility of using the resource for conducting research through mTurk (Lile et al., in preparation).

Inhibitory Control Training (Appendix G). The inhibitory control training task is a modified version of the Cued Go/No-Go tasks (Weafer and Fillmore, 2012; Miller et al. 1991) and is based on a task currently used in our laboratory targeting cocaine inhibitory control. The task will take approximately 5 minutes to complete and will consist of 2 blocks of 50 trials. A trial will involve a sequence of events during which a fixation point (+) will be presented for 800 ms, followed by a blank white screen for 500 ms, a cue image (alcohol or neutral) will be presented for one of five stimulus onset asynchronies (SOA; i.e., 100, 200, 300, 400, 500 ms), and finally a go or no-go target, which will be displayed until a response occurs or 1000 ms elapses. There will be a 700 ms interval between all trials. Alcohol images will serve as no-go cues and visually matched neutral images will serve as go cues. Cues will predict which target will be presented 100% of the time. After a SOA, the cue will either turn solid green (go target) or solid blue (no-go target). Subjects will be instructed to press the SPACE bar on the keyboard as soon as a green (go) target appears. Subjects will be instructed to withhold responses when a blue (no-go) target appears.

Working Memory Training (Appendix H for example). A battery of working memory tasks will be used during the intervention period. These tasks were selected from previous research evaluating working memory training in substance use disorder (Bickel et al., 2011b; Houben et al., 2011b). Tasks will include visuospatial working memory task, digit span task, letter span task, and the n-back task. Broadly speaking, these tasks require information recall and/or categorization of that information based on short-term retention. Task difficulty varies within each task and increases or decreases based on task performance. Subjects will complete one task randomly selected from the possible tasks during each session. Expected time of completion is 5 minutes.

Control Training Tasks. Control training tasks will include completion of basic arithmetic problems for approximately 5 minutes. These problems will include simple one digit arithmetic and are intended to control for engagement with the training session, but with a task that is unrelated to response inhibition or working memory training.

Alcohol Use Measures (Appendix J). All subjects will also report on the previous day's alcohol use and alcohol craving during each training session.

Phase 3: Follow Up Phase.

Post-Training Follow Up. Subjects will be asked to complete a post-training follow up survey. This survey will be identical to the baseline survey and will evaluate changes in the alcohol use, behavioral economic, and other cognitive-behavioral measures over the course of the 2-week training period.

The post-training follow up will also contain acceptability measures. The Treatment Acceptability Questionnaire will be administered and subjects will rate their response to statements on a 100-point visual analog scale (0 = Low; 100 = High) (e.g., ease of completion, helpful instructions, enjoyability). Multiple choice questions will also be used to evaluate how much subjects would pay to participate in the tasks completed in the study, if they would participate again, and motives related to study participation (e.g., to make money, to reduce alcohol use). Qualitative measures will also be included to collect features not captured by these quantitative measures (e.g., "What did you like most/least about the study?"). These measures were derived from prior research delivering behavioral interventions through online platforms (e.g., Raiff et al., 2013)

Two-Week Follow Up. Subjects will be asked to complete a 2-week follow up survey. This survey will include alcohol use and severity measures as well as 2-week timeline follow back from the end of the intervention period.

Data Analysis (Statistical Analysis Plan)

All statistical analyses will be conducted in R programming using two-tailed tests and an alpha rate of 0.05.

Feasibility. Descriptive statistics will first be used to express study attrition (i.e., the primary measure of feasibility). Feasibility will be supported by average completion rates during the intervention period greater than 80%. This value was selected given the general target of greater than 80% when evaluating adherence to pharmacological interventions (see Brown & Bussell, 2011). Predictors of attrition will also be evaluated using multiple regression (% completed assessments) or time-hazard models (time to first missed assessment).

Acceptability. Descriptive statistics will first be used to express acceptability measures. The primary outcome will be percentage of subjects reporting they would participate again. Success will be defined greater than 80% subjects reporting they would participate again in each active intervention condition. This value was selected for consistency with the feasibility benchmark selected. Other measures will be compared between cognitive-training conditions (e.g., enjoyability) using a one-way between-subjects ANOVA. Other predictors of acceptability will be evaluated using multiple regression (continuous outcomes) or logistic regression (dichotomous outcomes).

Initial Efficacy and Moderating Variables. Mixed-effect modeling (i.e., multilevel modeling) will be used to evaluate intervention effects on alcohol use. The primary outcome will be subjects with no heavy drinking days (dichotomous). This criterion was recently selected by the FDA as an acceptable clinical trial endpoint for FDA-approval of medications. Secondary outcomes will include changes in behavioral economic measures and other alcohol use variables by treatment condition. Secondary analyses will also be conducted evaluating baseline measures as prognostic variables predicting changes in alcohol consumption.

Appendix A

DSM-V Alcohol Use Disorder Questionnaire (from Hagman, 2017)

Below are questions related to your experiences from alcohol use within the past year. Please select your best answer to each question as to whether each experience occurred more than once in the prior year in response to your alcohol use. REMEMBER TO SELECT YOUR BEST ANSWER.

1. During the past year, were you unable to or failed to fulfill major role obligations at work, school or home because of alcohol use?

   YES

   NO

2. During the past year, did you consume alcohol in situations in which it was physically hazardous (e.g., driving while intoxicated)?

   YES

   NO

3. During the past year, did you continue to drink alcohol despite persistent or recurrent social or interpersonal problems caused by the effects of the alcohol (e.g., arguments with a significant other or family member, physical fight)?

   YES

   NO

4. During the past year, as a result of your drinking, did you have a need to drink more to become intoxicated or get the desired effect?

   YES

   NO

5. During the past year, as a result of your drinking, did you notice a diminished effect with continued use of the same amount of alcohol?

   YES

   NO

6. During the past year, as a result of your drinking, did you experience any withdrawal symptoms from not drinking (e.g., shakes, tremors, sleeplessness, anxiety, sweating, flushing)?

   YES

   NO

7. During the past year, as a result of your drinking, did you drink to relieve or avoid withdrawal symptoms?

   YES

NO

8. During the past year, did you drink alcohol in larger amounts or over a longer period than intended?

YES

NO

9. During the past year, as a result of alcohol use, did you have a persistent desire or have unsuccessful efforts to cut down or control alcohol use?

YES

NO

10. During the past year, as a result of alcohol use, did you spend a great deal of time in activities necessary to obtain alcohol or recover from its effects?

YES

NO

11. During the past year, as a result of alcohol use, were important social, occupational, or recreational activities given up or reduced because of alcohol use?

YES

NO

12. During the past year, as a result of alcohol use, did you continue to drink alcohol, despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by drinking?

YES

NO

13. During the past year, as a result of alcohol use, did you have a strong desire or craving to drink?

YES

NO

APPENDIX B

Screening Questionnaire

1. What is your age?

2. What is your sex?
Male
Female

3. Have you drunk an alcoholic beverage in the past week?
Yes
No

4. Have you smoked a cigarette in the past week?
Yes
No

5. Have you used marijuana in the past week?
Yes
No

6. Would you be interested in participating in a 2-week study where you complete daily cognitive training tasks. You will be paid for each daily training survey ($0.50/survey, approximately 5-8 minutes/survey). You will also be entered to win one of five $50 bonuses based on active participation (e.g., completing > 70% of surveys).
Yes
No
I do not know

7. DSM-V Alcohol Use Disorder Questionnaire (See Appendix A)

Appendix C

5-Trial Adjusting Delay Discounting Task (Table from Koffarnus & Bickel, 2014)

The below table describes the outcomes for the 5-trial task. For each of the 5 choices (i.e., No.), the subject is asked if the would prefer the immediate or delayed reinforcer. The delay to the delayed choice is systematically increased or decreased based on previous trial choice (i.e., Delay Choice; increases if delay is chosen, decreases if immediate is chosen). The primary outcome is k as labeled in the table below.

Table 1
Parameters of the Possible Individual Choice Trials in the 5-Trial Adjusting Delay Task

Index	Delay choice	No.	ED_{50} (days) if last choice is:		k if last choice is:	
			Immediate	Delayed	Immediate	Delayed
1	1 hr	5	0.04167	0.05893	24.0	17.0
2	2 hr	4				
3	3 hr	5	0.1021	0.1444	9.79	6.93
4	4 hr	3				
5	6 hr	5	0.2041	0.3062	4.90	3.27
6	9 hr	4				
7	12 hr	5	0.4330	0.7071	2.31	1.41
8	1 day	2				
9	1.5 days	5	1.225	1.732	0.816	0.577
10	2 days	4				
11	3 days	5	2.450	3.464	0.408	0.289
12	4 days	3				
13	1 week	5	5.292	8.573	0.189	0.117
14	1.5 weeks	4				
15	2 weeks	5	12.12	17.15	0.0825	0.0583
16	3 weeks	1				
17	1 month	5	25.28	43.05	0.0396	0.0232
18	2 months	4				
19	3 months	5	74.56	105.4	0.0134	0.00949
20	4 months	3				
21	6 months	5	149.1	210.9	0.00671	0.004741
22	8 months	4				
23	1 year	5	298.2	516.5	0.00335	0.00194
24	2 years	2				
25	3 years	5	894.7	1265.	0.00112	0.000791
26	4 years	4				
27	5 years	5	1633.	2310.	0.000612	0.000433
28	8 years	3				
29	12 years	5	3579.	5368.	0.000279	0.000186
30	18 years	4				
31	25 years	5	7748.	9131.	0.000129	0.000110

Note. ED_{50} = Effective Delay 50%.

Appendix D

Commodity Purchase Task

Example Instructions for Subjects

This is a series of questions designed to assess choices for alcohol across changes in price. This information is entirely for research purposes. All questions about purchasing are completely hypothetical (pretend).

Imagine a TYPICAL DAY during which you drink alcohol. The following questions ask how much alcohol you would consume if it cost various amounts of money. The alcohol is your preferred brand and type (e.g., beer, wine, liquor). Assume that each drink is a standard drink (i.e., 12 oz. beer, 5 oz. wine, 1.5 oz. shot alone or in mixed drink). Assume that you have the same income that you have now and NO ACCESS to any alcohol products than those offered at these prices. In addiction, assume that you would consume all the alcohol you purchase on that day; that is you cannot save or stockpile any for a later date.

Example Questions for Subjects (for the Alcohol Purchase Task)

Price/Drink	# Drinks Purchased
Free	
$0.02	
$0.05	
$0.13	
$0.25	
$0.50	
$1.00	
$2.00	
$3.00	
$4.00	
$5.00	
$6.00	
$7.00	
$8.00	
$9.00	
$10.00	
$11.00	
$12.00	
$13.00	
$14.00	
$15.00	

Appendix E

Reinforcement Survey Schedule-Alcohol Use Version

The following is a list of activities, events, and experiences. For the time frame of the last 30 days, please rate how often you have engaged in each activity, and how much you enjoyed each activity when you were not drinking alcohol or using drugs. Then, rate how often you have engaged in each activity and how much you enjoyed each activity when you were drinking alcohol or using drugs. If you have experienced an activity more than once in the past month, try to rate how enjoyable it was on average. Please fill in a frequency response for each item.

Rate the frequency and enjoyability of each item over the past 30 days. Only report an enjoyment rating for items that you engaged in at least once in the past month.

Frequency	Enjoyability
0 = 0 times	*1= unpleasant or neutral etc.*
1 = once a week or less	*2 = mildly pleasant*
2 = 2-4 times per week	*3 = moderately pleasant*
3 = about once a day	*4 = very pleasant*
4 = more than once day	*5 = extremely pleasant*

1. Go places with other people
2. Have conversations about daily life
3. Go out to eat
4. Flirt with significant others or potential romantic partners
5. Get compliments from significant others or potential romantic partners
6. Interact with significant others or potential romantic partners
7. Kiss significant others or potential romantic partners
8. Dine out
9. Go for walks
10. Talk on phone (for fun)
11. Go to parties
12. Get compliments
13. Go for drives (for fun)
14. Meet new people
15. Hang out with friends
16. Read email, text messages, or letters (for fun)
17. Write email, text messages, or letters (for fun)
18. Non-sexual intimacy with a romantic partner (e.g., hugging, holding hands)
19. Sexual intimacy with a romantic partner
20. Going on weekends trips or vacations
21. Attending school
22. Studying
23. Doing housework or chores at home
24. Reading a book, magazine, newspaper, or on the Internet
25. Go to plays
26. Exercise (e.g., run, bicycle ride, lift weight, yoga, play sports)
27. Work
28. Relax at home
29. Go to a movie or play
30. Play a musical instrument
31. Play video/electronic games (all kinds)
32. Watch television
33. Engage in any other hobbies not mentioned previously

Appendix F

Normative Feedback

Questions for Subject:

Q1 How many standard alcoholic drinks do you consume in an average week?

Q2 How many standard alcoholic drinks do you think the average person that is your age and gender consumes in an average week?

Normative Feedback:

"You reported drinking [Q1 Answer] standard alcoholic drink(s) per week. You told us that you believe that the average person that is [subject age range] years old and [subject gender] consumes [Q2 Answer] drinks per week.

The actual drinking norm for individuals that are [subject age range] and [subject gender] is [drinking norm] standard alcoholic drinks per week (50th percentile). Your percentile rank is [percentile]%, which means that you drink more than [percentile]% of individuals that are [subject age range] and [subject gender]."

Example Feedback:

"You reported drinking 4 standard alcoholic drink(s) per week. You told us that you believe that the average person that is 30-35 years old and male consumes 2 drinks per week.

The actual drinking norm for individuals that are 30-35 years old and male is 2 standard alcoholic drinks per week (50th percentile). Your percentile rank is 76%, which means that you drink more than 76% of individuals that are 30-35 years old and male."

Appendix G
Inhibitory Control Training Task Instructions

This is a reaction time task that we would like you to perform. While you are performing the task, please place your dominant hand (i.e., writing hand) index finger on the SPACE bar.

Presented on the screen will be squares that are green or blue in color. If the color GREEN appears on the screen, you are to press the SPACE bar as quickly as possible. If the color BLUE appears on the screen, then no response is required.

Now, before the green or blue color appears, you will see a plus sign in the middle of the screen. It serves as a fixation point so that you know where to focus your attention on the computer screen. After the plus sign disappears, a picture or a rectangle will appear on the screen. The pictures are of various objects. Do not respond to any of the pictures or empty rectangles. They are just there to get you ready to respond to the target colors of GREEN and BLUE when they appear. Again, if the color GREEN appears, respond as quickly as possible by pressing the SPACE bar. If the color BLUE appears, then no response is required.

To help you to respond quickly, the computer will display how fast you are pressing the key when the target appears. Once you respond to a green target, the screen will show you the amount of time it took for you to make that response, in milliseconds. The fewer the milliseconds, the faster the response. So, lower numbers are better. If you accidentally respond to a blue target, the screen will say 'Incorrect Response'.

The time to complete this test is about 5 minutes including 1 break. Please pay attention to the task throughout the entire session and try not to become distracted. Press the SPACE bar to start the task.

Appendix H

Working Memory Task Example

n-Back Trial Diagram (Figure from Borgwardt et al. 2012)

In this task, subjects are presented with a sequence of numbers and asked to indicate when the current stimulus matches the one from "n" steps earlier. Two settings will be used in this study, the 1-back and the 2-back (i.e., matching 1 and 2 stimuli back, respectively). The primary outcome of this task is the percentage of correct responses.
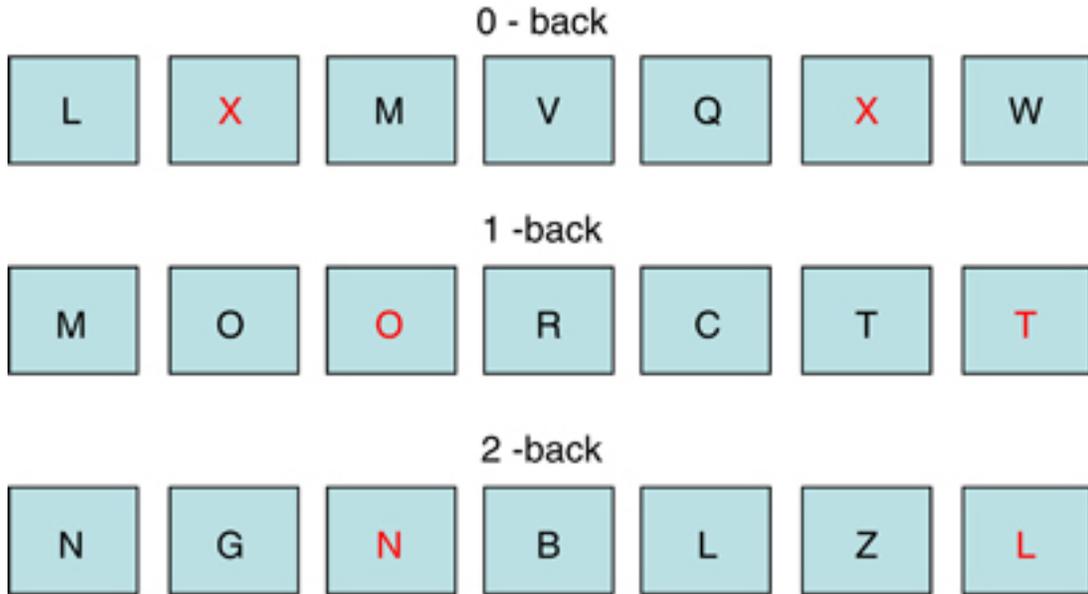
Appendix I

Daily Alcohol Use Follow Up Questions

Alcohol Recall
Please enter the approximate number of each type of standard alcoholic drinks you consumed on "Monday 9/5/17*"
*Note that the date will be individualized for each survey

12 oz beer (Less than 6% ABV)
(e.g., most American beer, Budweiser, Miller)

12 oz beer (6% ABV or greater)
(e.g., most craft beer, IPA)

4 oz wine or champagne

12 oz alcopop
(e.g., wine cooler, hard lemonade, cider)

1 shot of hard liquor
(e.g., whisky, tequila)

12 oz malt liquor
(e.g., Colt 45, Steel Reserve)

1 mixed drink with 1 shot of hard liquor
(e.g., martini, margarita)

Other alcoholic beverage

Alcohol Craving (Modified version of the Penn Alcohol Craving Scale-PACS; Flannery et al., 1999)

All items measured on a 10-point scale (0 = Not at All; 10 = Constantly)

How often did these things happen over the past DAY regarding your alcohol use:

1. How often did you have a strong urge to drink alcohol?
2. How often did you picture drinking alcohol?
3. How often did you imagine what alcohol would task like?
4. How often did you imagine how your body would feel if you had alcohol?
5. How often were the thoughts of alcohol intrusive?