Statistical Analysis Plan

Official Title: Personalized Mobile Phone App Intervention: Challenging Alcohol Expectancies to Reduce High-risk Alcohol Use and Consequences

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The primary aim of this paper is to examine the efficacy of the intervention on short-term (1-month versus baseline) and long-term (6- and 12-months versus baseline) alcohol outcomes using planned contrasts. Given the repeated measures design and that all outcome variables will be non-normally distributed, generalized linear mixed models (GLMMs) will be used to test intervention effects and logistic, Poisson, negative binomial, and/or gamma error distributions may be used (Hox et al., 2017; Raudenbush & Bryk, 2002). Models will be estimated using the *glmmTMB* (Brooks et al., 2017) package in R 4.2.1 (R Core Team, 2022) using maximum likelihood estimation based on the Laplace Approximation. Four models will test for intervention effects on primary alcohol outcomes. The primary outcomes will be (1) number of typical drinks per week in the past month, (2) number of HED days in the past two weeks, (3) peak eBAC in the past month, and (4) total number of negative alcohol consequences experienced in the past month. Models use data from assessments at four timepoints (screening/baseline, 1-, 6-, and 12-month follow-ups), yielding up to 1,632 Level 1 observations across 408 Level 2 cases. All models will control for sex and college type (enrollment at 2-year versus 4-year college) at Level 2. This model serves as the basis for testing intervention effects on primary alcohol outcomes: Level 1:

$$\text{Level 1:} \quad \text{Outcome}_{ti} = \pi_{0i} + \pi_{1i}(\text{1-month})_{ti} + \pi_{2i}(\text{6-month})_{ti} + \pi_{3i}(\text{12-month})_{ti}$$

$$\text{Level 2:} \quad \pi_{0i} = \beta_{00} + \beta_{01}(\text{Intervention})_i + \beta_{02}(\text{Sex})_i + \beta_{03}(\text{College})_i + r_{00i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11}(\text{Intervention})_i + r_{10i}$$

$$\pi_{2i} = \beta_{20} + \beta_{21}(\text{Intervention})_i + r_{20i}$$

$$\pi_{3i} = \beta_{30} + \beta_{31}(\text{Intervention})_i + r_{30i}$$

where t indexes study wave and i indexes individual participants. Outcome_{ti} represents the value of the outcome variable for a given individual at a given study wave. To test for intervention effects, time will be coded with a set of binary indicator variables (1-month, 6-month, 12-month) that compare each follow-up wave to screening/baseline (reference category). Intervention is a binary variable comparing the intervention condition to the assessment-only control condition. Of particular interest are parameters that reflect the interaction between intervention group and study wave (e.g., β_{11} at 1-month). The outcome will be connected to predictor variables through a link function, which will vary based on the type of error distribution used (e.g., log link function for Poisson error distribution). Sensitivity analyses will include linear or non-linear growth models testing average monthly changes in alcohol outcomes between the control and intervention conditions rather than the planned contrasts described above.

A secondary aim will test whether the intervention resulted in long-term (12 month) reductions in level of hazardous/harmful drinking, as indicated by AUDIT scores, as compared to the control condition. This will be tested using a negative binomial regression in which AUDIT scores at the 12-month follow-up will be regressed on condition, sex, college type, and baseline AUDIT scores.