# Statistical Design and Power

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## STATISTICAL DESIGN AND POWER

### Data Analyses

General modeling. Data will be screened for accuracy, missing values, and fit between the data and assumptions as well as internal consistencies, variability, and distributions. Some outcomes, such as number alcoholic drinks per week (DDQ) or depression (QIDS-SR-16*),* will have distributions that are relatively continuous and normal. Generalized linear models (GzLMs) will be used for outcomes that are not normally distributed. We will specify the appropriate distributions (e.g., gamma, Poisson, etc.) and link functions (e.g., inverse, log, etc.). Based on our prior longitudinal studies with similar samples, completion rates through the 6-month follow-up should be over 75%, with little missing data due to refusal to answer particular survey items. Pattern-mixture models will examine whether missingness can be ignorable. For non-ignorable missing data, values will be multiply imputed and data recombined using Rubin's[214] rules. *All analysis will be intent-to-treat (ITT), based on all available data, regardless of whether they complete the assigned interventions.*

Analysis of Specific Aims.

***Specific Aim 1:*** *Evaluate fear vs reward pathways to address PTSD and alcohol misuse following sexual assault by comparing: imaginal exposure alone; alcohol skills training alone; or supportive telehealth.*

*Hypothesis 1a:* Individuals in imaginal exposure or alcohol skills training will show greater decreases in alcohol use behavior and PTSD symptoms than individuals in *supportive telehealth* at the 1-month follow-up.

*Hypothesis 1b*: Imaginal exposure will produce larger decreases in PTSD symptoms *and fear behavior (PABQ)* and alcohol skills training will produce greater decreases in alcohol use *and increases in reward behavior (SHAPS)* at 1-month follow-up.

In testing intervention effects through *the 1-month follow-up*, we will use regression models to test for condition differences. Intervention conditions will be the primary predictors and other salient covariates (e.g., age, education). A dummy variable coding with the *supportive telehealth* treated as the reference category will allow for assessing the effects of each intervention on PTSD symptoms and alcohol use behavior (Hypothesis 1). Using a model predicting 1-month outcomes, orthogonal contrast code of condition[215] will yield: (i) an estimate of the difference between any intervention vs. *supportive telehealth*, and (ii) an estimate of imaginal exposure vs. skills training and thus address Hypothesis 1b.

Weekly self-report measures of PTSD symptoms, daily drinking, alcohol cravings, *fear behavior (PABQ), and reward behavior (SHAPS)* will be analyzed using latent growth modeling (LGM).[216,217] Each measure will be specified as indicators of level and change. We will first establish the form of the growth model and then regress growth factors on intervention condition. A likely specification of this model would be a simple linear growth model in which the intercept growth factor represents level of the given outcome at baseline and the linear slope factor represents weekly rate of change. Linear growth would then be regressed on intervention condition (either dummy or orthogonal coded) to assess whether rates of change differ across condition.

***Specific Aim 2****: Evaluate the need to target both fear and reward pathways following sexual assault by comparing participants who receive: one intervention alone (imaginal exposure or alcohol skills training); both; or supportive telehealth.*

*Hypothesis 2:* Individuals who receive both imaginal exposure and alcohol skills training will demonstrate greater decreases in alcohol use behavior, PTSD symptoms *and fear (PABQ), greater increases in reward (SHAPS),* and better overall functioning than individuals who receive only one intervention or receive *supportive telehealth* at the 2- and 6-month follow-ups.

A similar approach as used for Aim 1 will be implemented to examine outcomes at the 2- and 6-month follow-up time points. Use of orthogonal coding will allow for estimating the effects of getting any intervention vs none and for the added value of getting both interventions vs getting only one intervention. Secondary analyses will be conducted that will also contrast the imaginal exposure only and skills training only conditions and, among those who receive both, the imaginal exposure first versus alcohol skills training first conditions.

For analyses of Aim 2, we will *use growth models for repeated measures collected at baseline, 1-, 2- and 6-month assessments.* Using an LGM approach, we will again establish the form of growth models (e.g., linear growth, piecewise function) and then assess effects of condition assignment on level and change across 6-months. A possible specification of this type of model is shown in Figure 2 below, where condition predicts linear change in PTSD across the first 2 months and PTSD symptoms at the final two time points.

Growth models of weekly data will be extended through the 2-month follow-up *to capture changes occurring through the intervention periods*. For these models, a piecewise specification of growth may be used, with separate linear slope terms for weeks 1-4 (1st intervention) and weeks 4-8 (2nd intervention). Differences in rates of change could thus be assessed for these two periods separately.

***Exploratory Aim 3:*** *Evaluate individualized prediction of intervention response, examining baseline performance on fear and reward tasks, time since assault, and history of alcohol use severity as moderators of effects of imaginal exposure vs alcohol skills.*

*Hypothesis 3a:* Baseline impairment in fear processing will predict greater PTSD at follow-up. *Hypothesis 3b*: Baseline impairments in reward processing will predict greater alcohol use at follow-up. *Hypothesis 3c*: Effects of impairments in fear and reward processing will be mitigated at 1-, 2-, and 6 month follow-ups for individuals who receive imaginal exposure or alcohol skills training, respectively. *Hypothesis 3d:* Briefer time since assault will predict greater response to receiving only one intervention (imaginal exposure or alcohol skills). *Hypothesis 3e*: A history of more severe alcohol use will predict greater response to receiving the alcohol skills intervention (either alone or in combination with imaginal exposure) compared to receiving imaginal exposure alone.

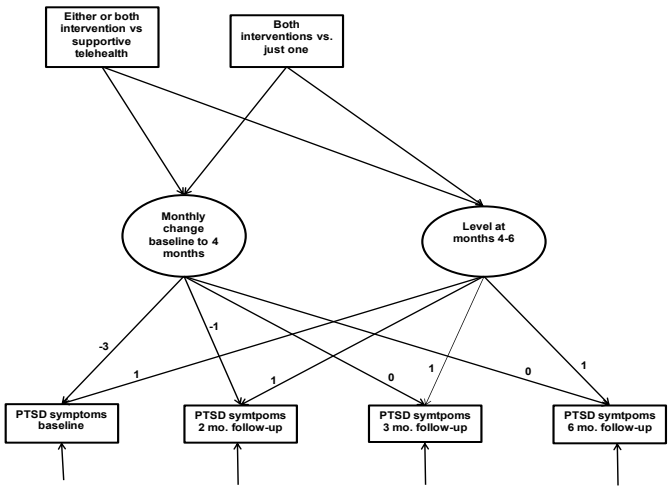


Figure 2: Latent growth model specification of interventions effects

This aim will explore predictors of PTSD symptoms and alcohol use and intervention responsiveness. Scores on fear (AX+/BX-) and reward tasks (PRT), *as well as time since assault*, will be added as main effects and as interaction terms with intervention condition to the models specified in Aims 1 and 2. The main effects of fear and reward tasks *and of time since assault on* PTSD symptoms and alcohol use at follow-up will be a test Hypothesis 3a & 3b. *The interaction terms between scores on the fear task and receiving imaginal exposure will test whether benefits of this particular intervention are particularly strong for the people with impairments in fear processing. The interaction term between scores on the rewards task and receiving alcohol skill training will test whether this intervention is particularly suited for people with impaired reward processing. The interaction term between time since assault and receiving one vs both interventio[illegible] associated with larger beneficial treatment effects from only one intervention approach.*

Power Analyses. Prior research shows medium to large effects of brief interventions on PTSD and related health behaviors following sexual assault. For example, Rothbaum et al.[106] reported a large effect ($d$ = .70) on sexual assault-related PTSD using brief imaginal exposure compared to a control condition. Accordingly, this study was powered to detect medium effect sizes for Aims 1 and 2. Estimating 25% attrition at follow-up time points, we calculated power based on a size of 135 ($N$ = 180), power = .8, and a Type-I error at .05, two-sided. We also calculated power in terms of simple ANOVA, difference of means, and difference of proportions tests as a frame of reference using common effect size conventions. For Aims 1 and 2, the design involves comparisons among three arms with equal numbers, with power to detect a moderate size effect of $f$ = .27 for an ANOVA model comparing three groups of equal size. For comparing two groups of 45 each, we will have power to detect $d$ = .60 and differences of proportions of .50 vs. .22 and .30 vs. .07. For analyses comparing two interventions combined against the *supportive* condition, there is power to detect $d$ = .52 and differences of proportions of .5 vs. .25 and .3 vs. .09.

Covariates will be included in models to increase precisions of model estimates and reduce attenuation of measured effect sizes. The longitudinal design allows for using baseline measures as covariates when examining differences by condition at follow-up. As an illustration, in a comparison of two groups of 45 where the difference of means at follow-up is $d$ = .48, power is .65; adding a baseline measure of the outcome variable that is correlated $r$ = .5 across time points and explains 25% of the variance at follow-up, power is increased to .77. Analyses for Aim 2 involving data from baseline through 6-month follow-up will take advantage of four time points of repeated measures data, which will yield more precise estimates of intervention effects for outcomes that fluctuate from time to time, but reflect more general patterns of change (e.g., linear monthly decreases in PTSD symptoms). *Similarly, modeling of weekly data on PTSD symptoms, drinking, alcohol cravings, and fear and reward responses as part of Aims 1 and 2 will benefit from multiple assessments that allow for more precise assessment of intervention effects.*

For Aim 3 exploratory analyses, to detect moderation, adequate power will require large effects ($f$ > .4). We will exercise caution due to testing multiple contrasts with respect to multiple outcomes. We will heed concerns about over-reliance on significance testing[218,219] and emphasize providing a clear representation of estimated effects and uncertainty. Results will be expressed in effect sizes such as relative risk of heavy drinking or PTSD

diagnosis. Uncertainty of model estimates will be described with confidence or credibility intervals.