Cover Page

Title: Analytic Plan-- Addressing Intersectional Stigma: Testing THRIVE 365 for Black Sexual Minority Men (On The Daily)

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Analytic Plan

To examine the feasibility and acceptability of iTHRIVE 365, will evaluate daily self-report engagement data and page access paradata (feasibility) and whether they found it useful, user-friendly, and whether they would recommend it to others (acceptability). To examine the impact of iTHRIVE 365 engagement, we will run a chi-square to test for differences in ART use between days in which participants did and did not engage with iTHRIVE 365. This is better than a day-level approach given there is high ART use in the sample, which limits analytic options given small within- and between-level variance. For psychological outcomes, we will estimate dynamic structural equation models (DSEM) for the intensive longitudinal data (ILD) produced by the daily surveys. DSEM is an analytic approach that combines time-series analysis, multilevel modeling, and structural equation modeling as it can model: within-person lagged associations across many repeated measures, between-person differences in individual-level processes, and multiple latent and outcome variables, respectively. Our models will follow best practices in two-level DSEM for ILD in M*plus* 8.4, with analyses as multilevel models that specify within-person variance (i.e., change in outcome for a single person from day to day) and between-person variance (i.e., differences between participants' overall outcomes). The standard DSEM approach within M*plus* uses Bayesian Markov Chain Monte Carlo estimation to aid in convergence and flexibility. For those unfamiliar with Bayesian statistics, there are no *p*-values associated with effects; however, typical frequentist inference can be approximated by calculating a 95% credible interval for each parameter and testing whether 0 is within the interval. Intervals that do not contain 0 are analogous to "significant" in a traditional frequentist analysis.

Specifically, we will examine associations between iTHRIVE 365 engagement and next day outcomes with a multilevel vector autoregressive models (VAR (1)) in the DSEM framework.[42] All models will adjust the effects of engagement for app availability since app registration occurred starting on day 8 of the study. As an example, the models examining the association between iTHRIVE 365 engagement (T365) and depressive symptoms (Dep) can be written in statistically as

$$
\begin{aligned}
&\underline{\text{Within-Person}} \\
&Dep_{ti} = \alpha_{1i} + \varphi_{1i} Dep^{C}_{(t-1)i} + \beta_{1i} T365_{(t-1)i} + e_{1ti} \\
&T365_{ti} = \nu_{1} + \varphi_{2} T365_{(t-1)i} + \beta_{2} Access_{ti} \\
&\underline{\text{Between-Person}} \\
&\alpha_{1i} = \gamma_{00} + u_{0i} \\
&\beta_{1i} = \gamma_{10} + u_{1i} \\
&\varphi_{1i} = \gamma_{20} + u_{2i}
\end{aligned}
\tag{1}
$$

With distributional assumptions,

$$
\begin{aligned}
&\mathbf{e}_{i} \sim N\ \left(\mathbf{0}, diag\left[\sigma_{1}^{2}, \sigma_{2}^{2}\right]\right) \\
&\mathbf{u}_{i} \sim N\ \left(\mathbf{0}, \begin{bmatrix} \tau_{00} & & \\ \tau_{21} & \tau_{11} & \\ 0 & 0 & \tau_{22} \end{bmatrix}\right)
\end{aligned}
\tag{2}
$$

In the first expression in the within-person equation, Dep is the depressive symptoms outcome, *t* indexes time (in days, *t* = 1, …, 14), *i* indexes individuals (*i* = 1, … *N*), α_{1i} is a person-specific intercept for depressive symptoms, φ_{1i} is the autoregressive effect capturing the carryover of depressive symptoms from the previous day to the current day, Dep^{C} is latent-centered depressive symptoms such that $Dep^{C}_{i} = Dep_{i} - \alpha_{1i}$ (latent centering helps alleviate Ludkte's and Nickell's bias in time-series models),[43] β_{1i} is a time-varying covariate effect of T365 access the previous day on depressive

symptoms during the current day, and e_1 is a normally distributed within-person error with variance σ_1^2. The second expression in the within-person equation is a probit model because T365 use is dichotomous such that ν_1 is the threshold for T365 use, φ_2 is the carryover effect of T365 use the previous day onto T365 use during the current day, and β_2 accounts for whether person *i* had access to the intervention at time *t* .

In the between-person model, γ are fixed effects that capture the average effect of the parameter across all persons, and *u* are normally distributed random effects capturing person-specific deviations from the fixed effects. The variances of the random effects are captured by the diagonal elements of the tau-matrix; one random effect covariance between depressive symptoms intercepts and the lagged T365 effect is also estimated as denoted by the τ_{10} element in the off-diagonal. Figure 1 features a path diagram for this model.

In line with best practice recommendations for DSEM with small sample sizes,[44] we will use range restricted priors of $Uniform[0,1]$ for the random effect variances $\tau_{00}, \tau_{11}, \text{ and } \tau_{22}$ to stabilize the sampling in the MCMC optimization. This approach does not encode subjective prior beliefs but rather just limits the prior's support to range of values that the outcome can take. M*plus* default priors were used for other parameters that are minimally influenced by sample size including improper $N\ (0,\infty)$ for regression paths or random effect covariances and improper $\text{InvGamma}(-1,0)$ for within-person error variances. Parameters will be estimated via Markov Chain Monte Carlo with a Gibbs sampler using two chains thinned by 10 iterations with a minimum of 20,000 iterations. Convergence after 20,000 iterations was evaluated using the potential scale

reduction method using a threshold of $\hat{R} \leq 1.10$. We will compute credible intervals with the highest posterior density method.