**Growth Mixture Model Write-up**

**FILE NAME: 6.11.10 Drinking GMM PDA 4 Class**

\*Files with the same name (1-5 class models) were used to create the top panel of table 1.

**Analysis Plan**

*Measures*

Drinking frequency was assessed using the Form 90 every other month for 1 year (6 assessments in 12 months) following admission to the treatment program. The Form 90 is a structured assessment interview for drinking and related behaviors (Miller, 1996) that gathers self-reported daily alcohol use between each assessment period. For ease of presentation of the analytic methods employed we chose to report on only one alcohol use variable namely, percent days abstinent (PDA). We selected PDA from a number of possible alcohol use outcomes because the alcohol use disorder (AUD) specialty treatment that clients in the RREP study received was abstinence focused. Patterns in PDA during each month of treatment were analyzed, providing 12 waves of data to be included in the data analyses. Because alcohol use was assessed on the daily level, aggregating the 6 assessments conducted over 12 months to monthly level data was possible (i.e., PDA = (number of days abstinent during each month/30) × 100).

*Data analysis plan*

This study used LGMM procedures to identify latent classes of individual’s percent days abstinent (PDA). A series of 5 LGMMs were conducted using Mplus version 6 (Muthèn and Muthèn, 1998–2010). The LGMMs were run to determine the number of distinct groups of individuals with similar PDA patterns across the 1- year study period.

*Growth mixture model class selection*

This sample of 549 AUD adult participants is medium-sized based on the standards for LGMMs (Nylund et al., 2007). The model fit indices used to determine the best fitting model were selected based on recommendations from Nylund and colleagues’ (2007) Monte Carlo study designed to determine the most appropriate fit indices for LGMMs across a range of sample sizes, and based on Muthen and Muthen’s (2000) recommendations for class selection for LGMMs. Thus, four criteria (i.e., bootstrapped parametric likelihood ratio test (BLRT), sample size adjusted Bayesian information criterion (saBIC), entropy, average latent class probabilities)

were used to determine the optimal number of latent growth classes (Muthèn and Muthèn, 2000).

First, the BLRT (McLachlan and Peel, 2000), tests for improvement over a model with one fewer class, designed for smaller samples by extrapolating the data to better represent the true distribution. Second, the saBIC (Sclove, 1987) is a comparative fit index that rewards parsimony while maximizing the model’s likelihood ratio statistic. Better model fit is indicated by a lower value; therefore, the value for a single model cannot be interpreted without another model with a known adjustment for comparison. The saBIC helps identify the best in a series of models (Muthèn and Muthèn, 2000) and is well-suited for smaller samples (Lubke and Neale, 2006). Third, model classification quality was assessed using the entropy statistic. Entropy ranges from 0 to 1, with higher values suggesting better classification quality (Celeux and Soromenho, 1996; Ramaswamy et al., 1993) and values greater than 0.80 typically considered to have adequate classification quality (Jung and Wickrama, 2008). Fourth, average latent class probabilities for the most likely latent class membership by latent class discrimination values were evaluated, with good model fit being represented by values close to 1 in the primary diagonal and values close to 0 in all other cells.

**Results**

*Sample characteristics*

Participants considered as a single group maintained a steady and infrequent drinking pattern across the study period (Fig. 1; M = 84.30, SD = 28.41). Close examination of the sample revealed extreme heterogeneity and significant variance of PDA at every time point (variance ranged from a minimum at month 1 of 111.48 to a maximum of 289.17 at month 8). As noted in the Method section, we then conducted a series of 5 latent growth mixture models (LGMMs) to determine the number of latent classes of individuals that shared common trajectories of drinking frequency across the study period. Final model selection was based on model fit and interpretability.

*Growth mixture model selection and interpretation*

Overall model fit indices for the series of five LGMMs, and the estimated means for each time point along with the intercept, linear and quadratic slopes for the best fitting model are presented

in Table 1. The growth factors presented in Table 1 all had significant variances constrained to be equal across classes (intercept variance = 30.39, linear slope variance = 47.96, quadratic slope variance = 0.40, p’s < .05). The 4-class model was the best fitting model based on model fit indices and interpretability. Specifically, there was a substantial improvement in saBIC from the 3- to 4-class model (decrease of 184 points), but the saBIC did not continue to improve from the 4- to 5-class model (decrease of 4 points). Additionally, the 3 participants in the first class of the 5-class model are likely to be a subset of the 4th class of the 4-class model (n = 67) and the 5th class of the 5-class model (n = 64). In comparison to the 5-class model, the 4-class model had similar saBIC and entropy values. In addition, although the BLRT suggests that the 5-class model is an improvement over the 4-class model, the 5-class model included a class with only 3 participants (i.e., 0.54% of the total sample), which is not substantively interpretable. Moreover, the 4-class model showed near-perfect average latent class probability for the most likely latent class membership by latent class discrimination, indicating that the 4-class model was a good representation of participant reports.

Qualitatively, the 4-class model had two classes that increased in PDA across the 12-month study period. We named these classes slightly decreasing frequency drinkers (SDFD) and greatly decreasing frequency drinkers (GDFD) based on the magnitude of the improvement across the study period. One class, which contained the majority of the sample maintained steady and infrequent drinking levels throughout the study period, and were named stable occasional drinkers (SOD). The final class steadily and rapidly deteriorated throughout the 12-month study period and was named increasing frequency drinkers (IFD). Thus, the best-fitting LGMM model for PDA had 4 latent classes and is presented in Fig. 2a panels A–D. LGMM analysis estimates linear and quadratic trends for individual subclasses, in conjunction with the intercept for each class. In Fig. 2a panels A–D the dashed lines represent the estimated quadratic trajectories for each latent class, and the solid lines represent the estimated linear trends for each latent class based on the parameter estimates produced from the LGMM. These lines extend beyond the data and beyond the limits of percent days abstinent (i.e.,0–100%) because the calculated trend lines begin at the intercept and then change according to the following equations (linear: predicted value = intercept + (linear trend parameter × month); quadratic: predicted value = intercept + (quadratic trend parameter × month2)) across the study period. This estimation procedure produces increasingly less accurate predictions across time if the true data points do not follow a pure linear or quadratic trend. In this case, because the actual PDA trends are best described by abrupt changes throughout the study period, the LGMM linear and quadratic trend lines become increasingly inaccurate at the later time points. Specifically, in Fig. 2a, it is clear that the projected trends exaggerate the observed changes by assuming constant linear or quadratic change across the study period. If we juxtapose Fig. 2a with Fig. 2b, which presents the same LGMM trajectories with JPA trend lines, it is clear that the JPA regression lines fit much more closely to the data points of the LGMM linear and quadratic trend lines.

*Description of the final model.*

The majority of the sample was in the stable occasional drinkers group (SOD; N = 416, 76% of the total sample, mean PDA 93.57), which was characterized by a stable pattern of infrequent drinking. The intercept, linear slope, and quadratic slope for the SOD group all significantly differed from 0 (intercept = 98.63, p < 0.001; linear slope = −2.37, p < 0.001; quadratic slope = 0.19, p < 0.001). The negative linear slope implies that over time the SOD group increased their drinking frequency, and the positive quadratic slope implies that at some point the trend in drinking frequency either increased more rapidly than would be expected from a linear trend or changed from increasing to decreasing during the study period. Fig. 2 panel A suggests that the latter interpretation is more accurate. The next most common group was the increasing frequency

drinkers group (IFD; N = 67, 12% of the total sample, mean PDA 52.21), which was characterized by a rapid increase in drinking frequency across the study period. The intercept, linear slope, and quadratic slope for the IFD group all differed from 0 (intercept = 97.23, p < 0.001; linear slope = −12.16, p < 0.001; quadratic slope = 0.50, p < 0.004). The negative linear slope implies that the IFD group started with a high percentage of abstinent days and ended with a low percentage of abstinent days, and the positive quadratic slope suggests that this trend is more rapid than would be expected from a linear trend. The third most common group was the slightly decreasing frequency drinkers (SDFD; N = 44, 8% of the total sample, mean PDA

63.32), which was characterized by a mild decrease in drinking across the study period. The SDFD group had an intercept that significantly differed from 0 (intercept = 59.91, p < 0.001), but neither the linear nor quadratic slopes differed from 0. This implies that the SDFD group maintained a stable level of moderately frequent drinking throughout the study period. The least common group was the greatly decreasing frequency drinkers (GDFD; N = 22, 4% of the total sample, mean PDA 39.10), which was characterized by a rapid decrease in drinking frequency

over the 12-month study period. The intercept, linear slope, and quadratic slope for the GDFD group all differed from 0 (intercept = 13.13, p < 0.001; linear slope = 8.23, p = 0.001; quadratic

slope = −0.47, p = 0.046). The positive linear slope implies that the GDFD group decreased its drinking frequency (had more abstinent days) across the study period, and the negative quadratic slope in this case implies that at some point in the study period the drinking pattern of participants in this group changed from decreasing drinking frequency to increasing drinking frequency as seen in Fig. 2 panel A.





