

Neural Correlates and Symptoms of ADHD as Predictors of Cannabis Use

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BACKGROUND

Cannabis and other substance misuse is common among individuals with symptoms of attention deficit hyperactivity disorder (ADHD), particularly in young adults. Despite the growing perception that cannabis can be used as a therapeutic for ADHD, cannabis use among individuals with ADHD symptoms can also lead to cannabis use disorder and potential exacerbation of ADHD symptoms. We hypothesize that brain regions associated with ADHD symptoms are associated with cannabinoid receptor expression, leading to higher rates of cannabis use.

- Objective:** The current analysis prospectively explored the relationship between ADHD symptomology and longitudinal cannabis use frequency.

METHODS & MEASURES

Longitudinal Impulsivity & Alcohol (LIA) Study 1:

- Participants:** 144 first-year college students (ages 18-19) at UNC
 - Subjects at risk for AUD oversampled
 - Exclusion Criteria (baseline): SUDs (including AUD), psychoactive drugs, psychiatric and neurologic disorders
- Study Design:**
 - Baseline (In-person): Self-Report Questionnaires paired with an fMRI scan including a stop-signal task to probe brain function related to attention and impulsivity
 - Three yearly longitudinal follow-ups: Self-Report Questionnaires

LIA Study 2:

- Participants:** 301 first-year college students (ages 18-19)
 - Recruited online, nationwide with no exclusion criteria beyond age and student status
- Study Design:** Similar longitudinal paradigm without fMRI scan

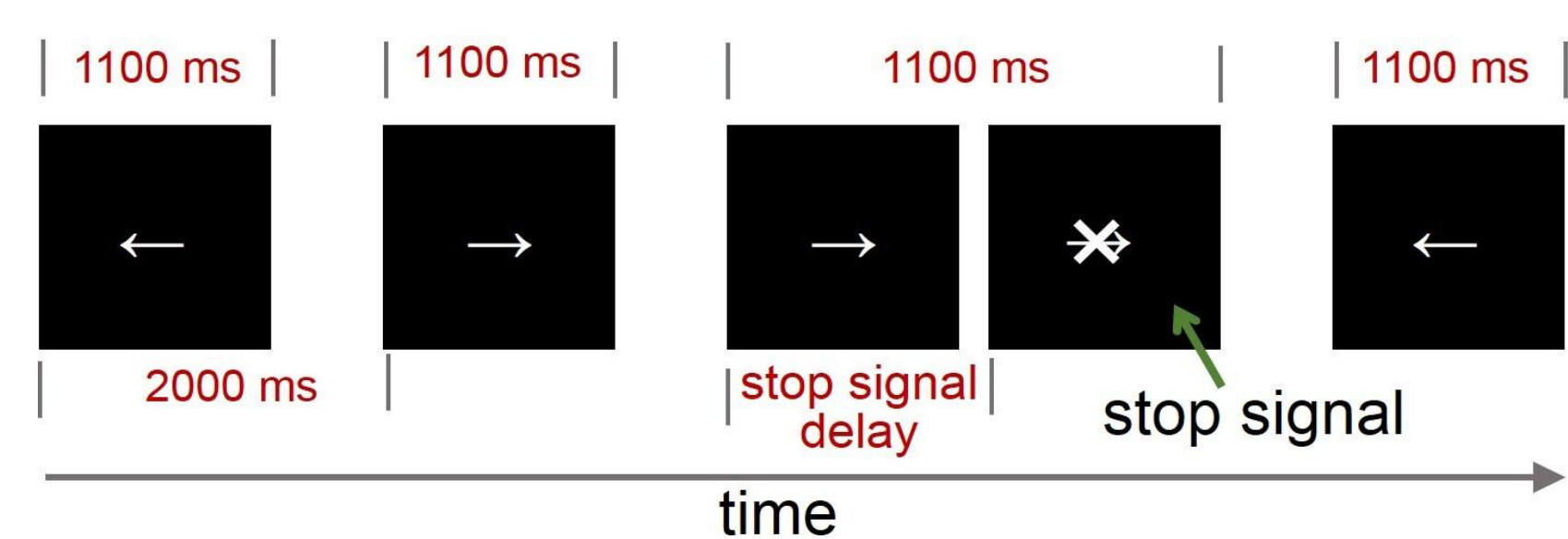


Figure 1: LIA Study 1 Stop Signal Task Design

Analysis:

- ADHD Symptoms:** Quantified via the DSM-IV Total Symptoms Subscale calculated on the Conners Adult ADHD Rating Scale (CAARS) at baseline for every participant.
- Cannabis Use Frequency:** Quantified as times used in the past year via self report on the Customary Drinking and Drug Use Record (CDDR) at baseline and each yearly follow up.
- Link between ADHD symptoms and cannabis use analyzed using **Mplus Version 8.11** (Muthen & Muthen)

RESULTS

LIA 1: Longitudinal Time Series by ADHD Symptom Severity

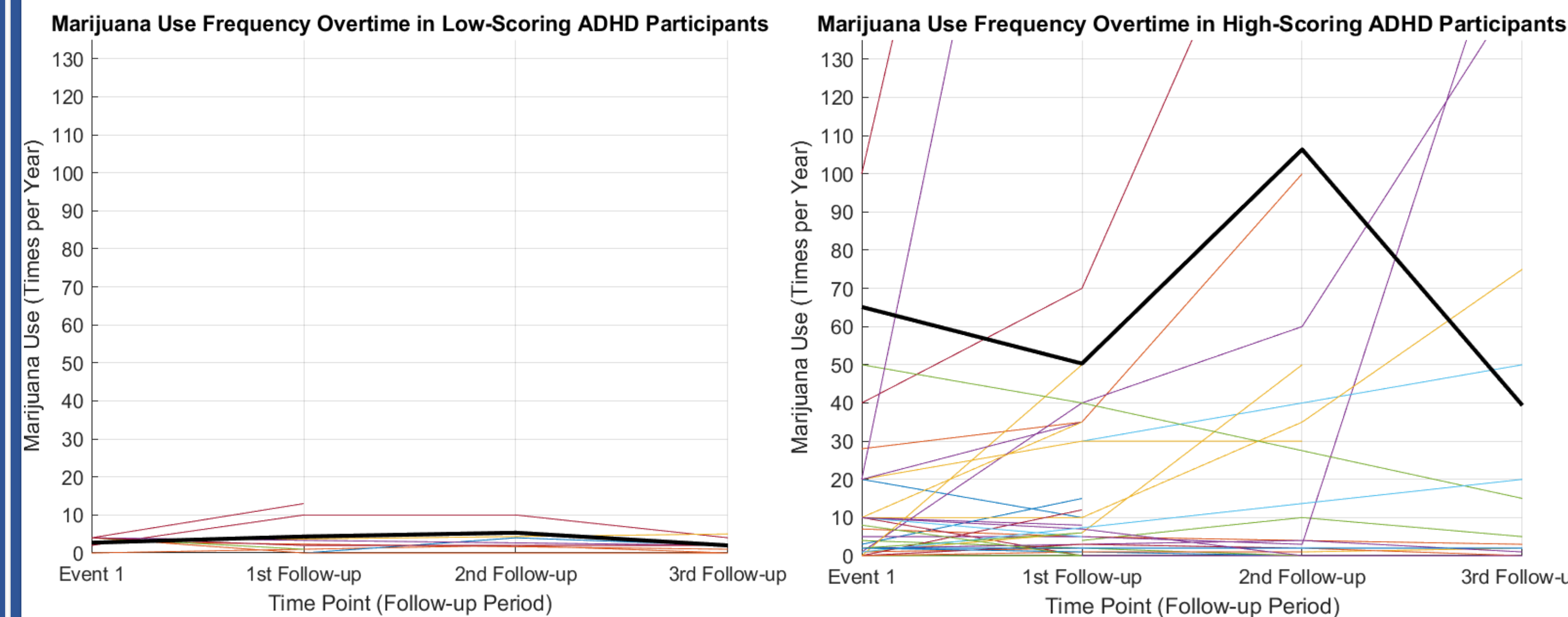


Figure 2: LIA 1 Participants with CAARS Total Symptom Score ≤11

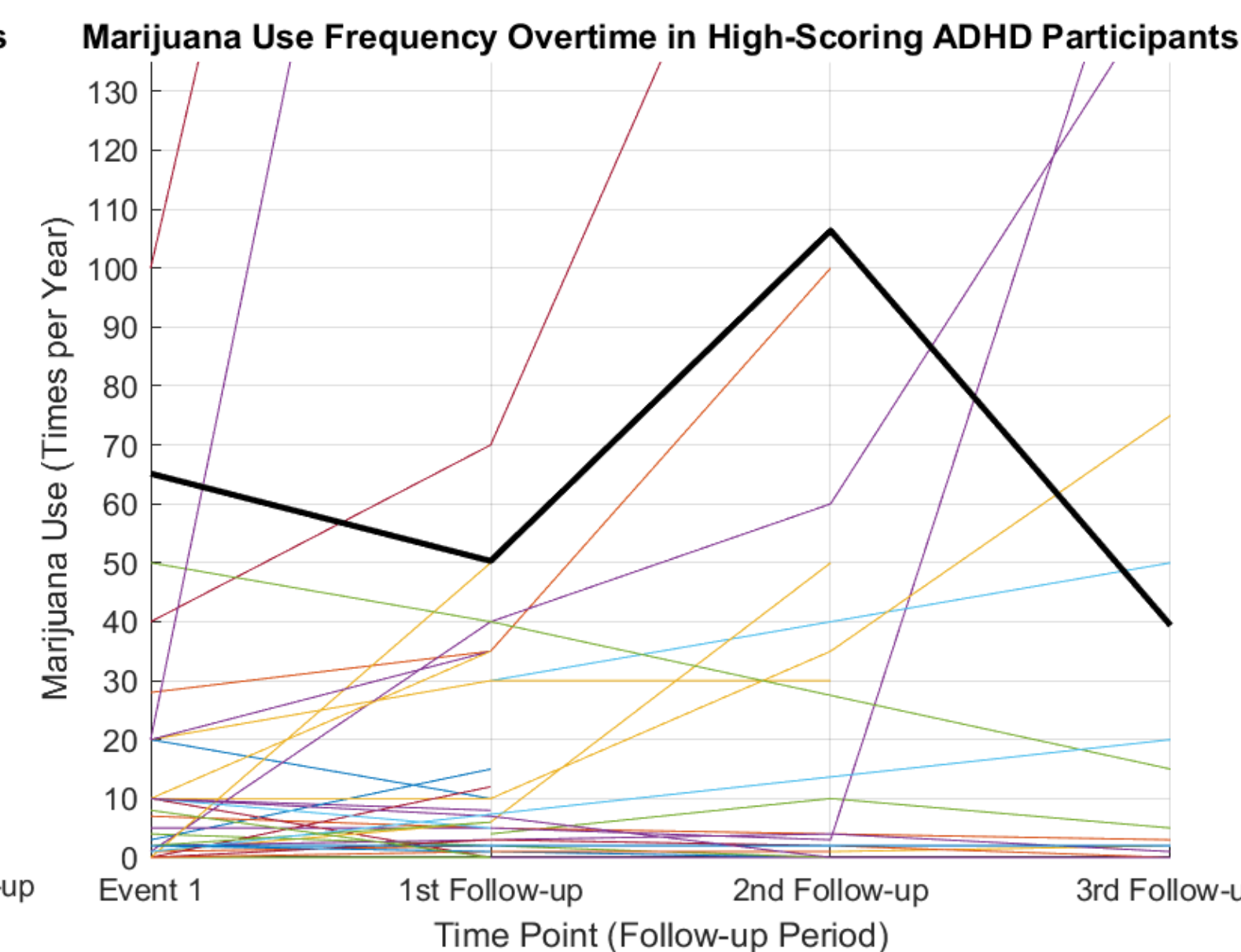


Figure 3: MJ Use Freq for LIA 1 Participants with CAARS Total Symptom Score 12-44

LIA 2: Longitudinal Time Series by ADHD Symptom Severity

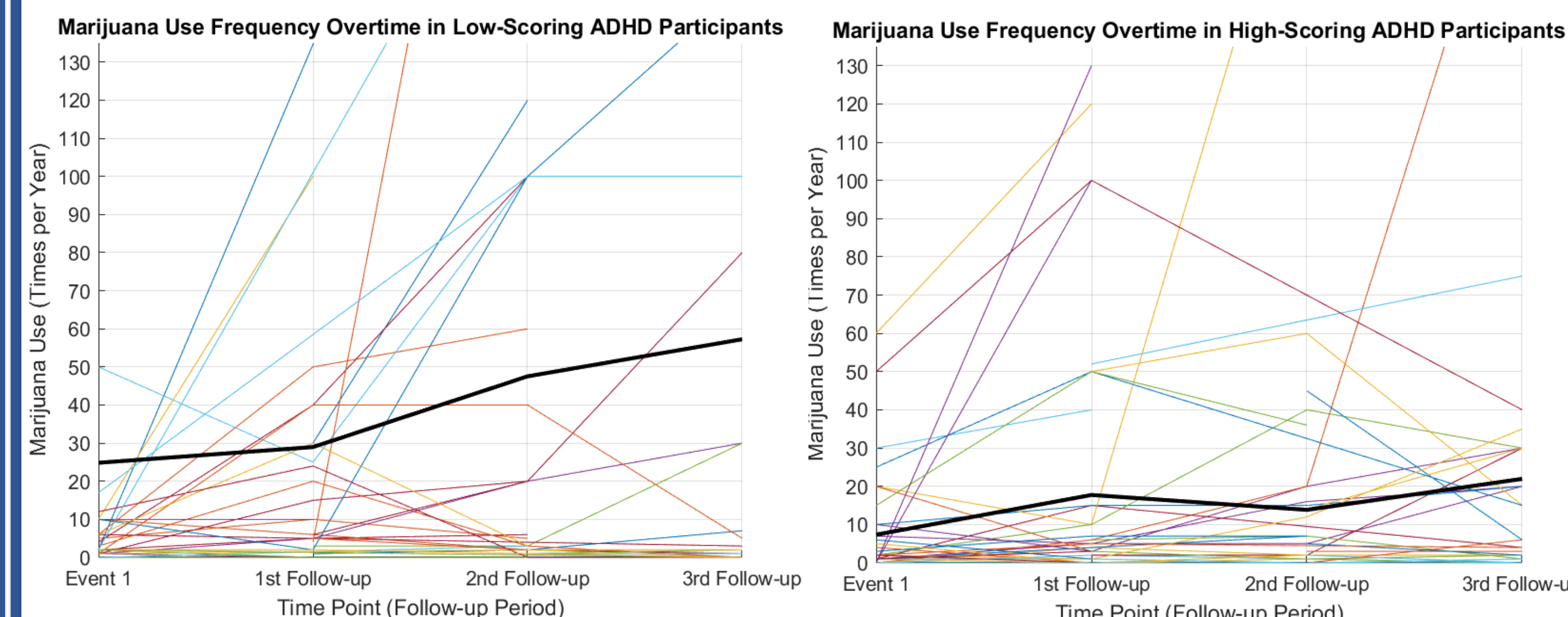


Figure 4: MJ Use Freq for LIA 2 Participants with CAARS Total Symptom Score ≤15

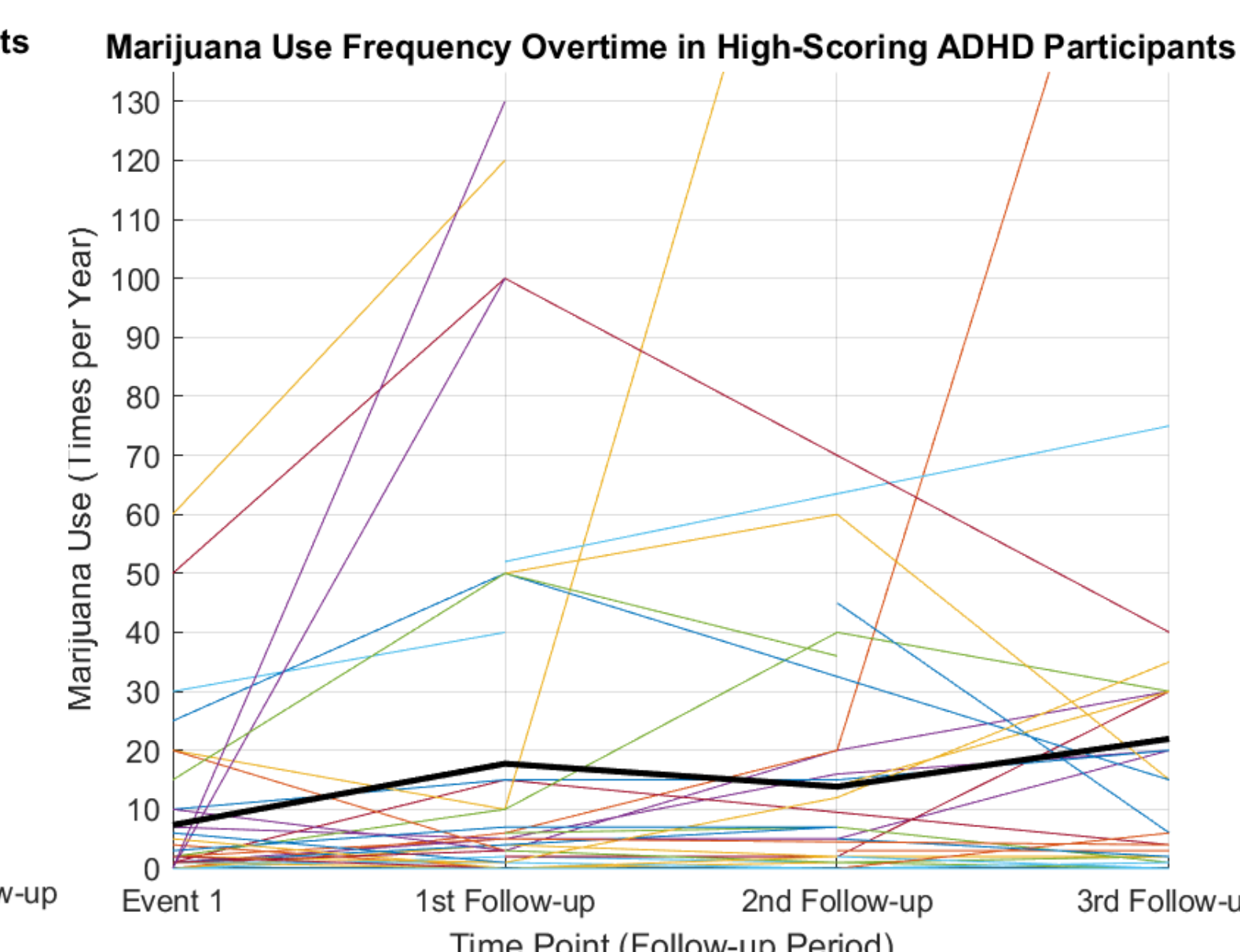


Figure 5: MJ Use Freq for LIA 2 Participants with CAARS Total Symptom Score 16-44

Latent Growth Model of Cannabis Use Trajectories predicted by ADHD Symptom Severity

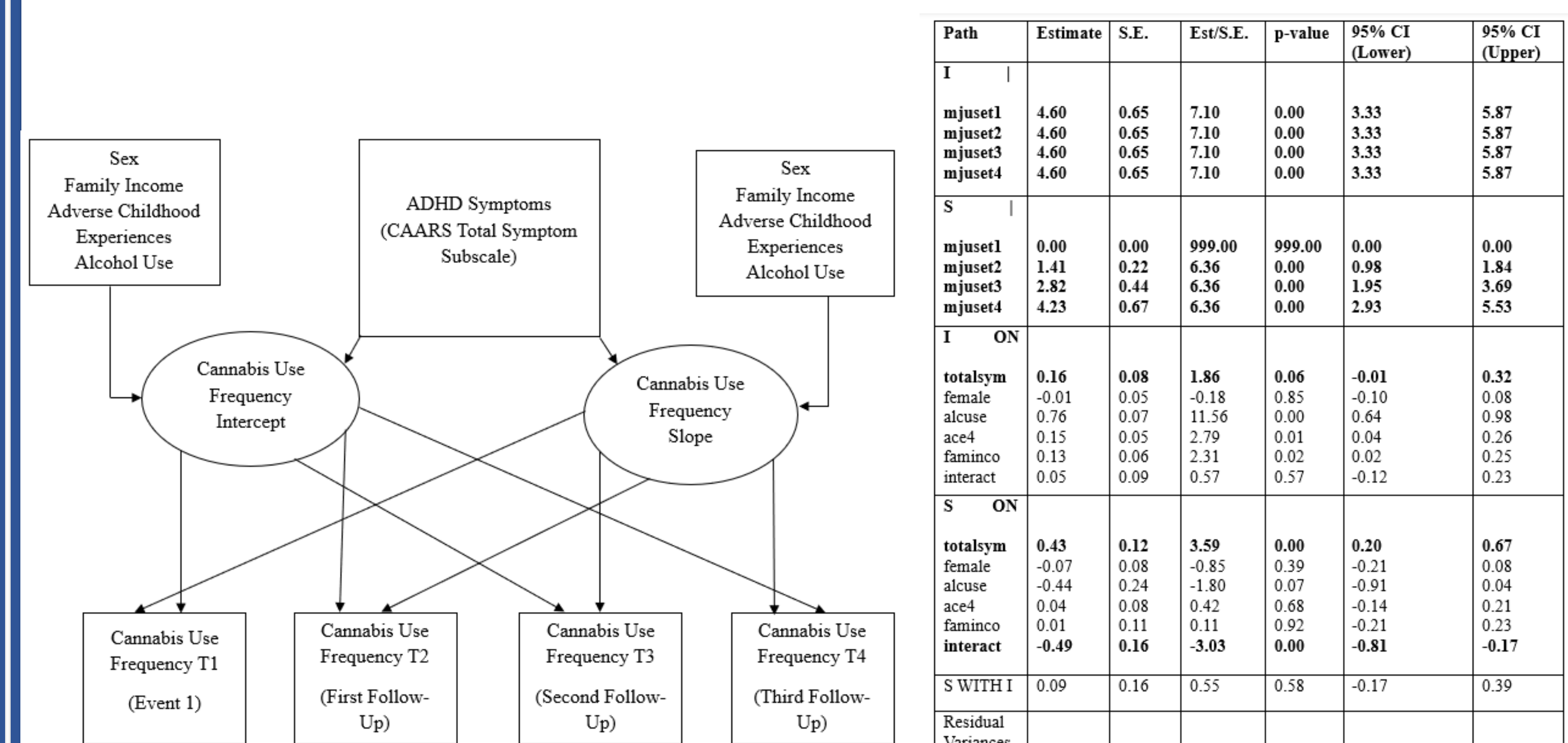


Figure 6: Conceptual Model of Latent Conditional Trajectory Analysis

Path	Estimate	S.E.	Est/S.E.	p-value	95% CI (Lower)	95% CI (Upper)
I						
mjuset1	4.60	0.65	7.10	0.00	3.33	5.87
mjuset2	4.60	0.65	7.10	0.00	3.33	5.87
mjuset3	4.60	0.65	7.10	0.00	3.33	5.87
mjuset4	4.60	0.65	7.10	0.00	3.33	5.87
S						
totalym	0.00	0.00	999.00	0.00	0.00	0.00
female	1.41	0.22	6.36	0.00	0.98	1.84
alouse	2.82	0.44	6.36	0.00	1.95	3.69
acet	4.23	0.67	6.36	0.00	2.93	5.53
flaminc	0.00	0.00	999.00	0.00	0.00	0.00
interact	0.00	0.00	999.00	0.00	0.00	0.00
S ON						
totalym	0.16	0.08	1.86	0.06	-0.01	0.32
female	-0.07	0.08	-0.85	0.39	-0.21	0.08
alouse	0.76	0.24	3.15	0.00	0.29	1.23
acet	0.15	0.05	2.79	0.01	0.04	0.26
flaminc	0.13	0.06	2.31	0.02	0.02	0.25
interact	0.05	0.09	0.57	0.57	-0.12	0.23
S WITH I						
totalym	0.43	0.12	3.59	0.00	0.20	0.67
female	-0.07	0.08	-0.85	0.39	-0.21	0.08
alouse	0.76	0.24	3.15	0.00	0.29	1.23
acet	0.04	0.08	0.42	0.68	-0.14	0.21
flaminc	0.01	0.11	0.11	0.92	-0.21	0.23
interact	-0.49	0.16	-3.03	0.00	-0.81	-0.17
Residual Variances						
I	0.32	0.08	3.89	0.00	0.16	0.49
S	0.34	0.10	3.28	0.00	0.14	0.54
R-Square						
I	0.68	0.08	8.10	0.00	0.16	
S	0.66	0.10	6.43	0.00	0.14	

Table 1: Standardized Model Results and Confidence Intervals

CONCLUSIONS

- Standardized results for the latent growth model indicate significant effects of total ADHD symptoms and cannabis use at each yearly timepoint on latent intercept and slope.
- The interaction between sex and total ADHD symptoms had a significant effect on the latent slope, with the association stronger amongst females than males.
- Ultimately, it appears as though elevated ADHD-related symptoms predict increase cannabis use frequency in young adults, informing potential treatment approaches.

FUTURE DIRECTIONS

Future analyses will leverage growth mixture models to explore the role of brain regions and sex in the relationship between ADHD symptoms and cannabis use during the fMRI stop-signal task.

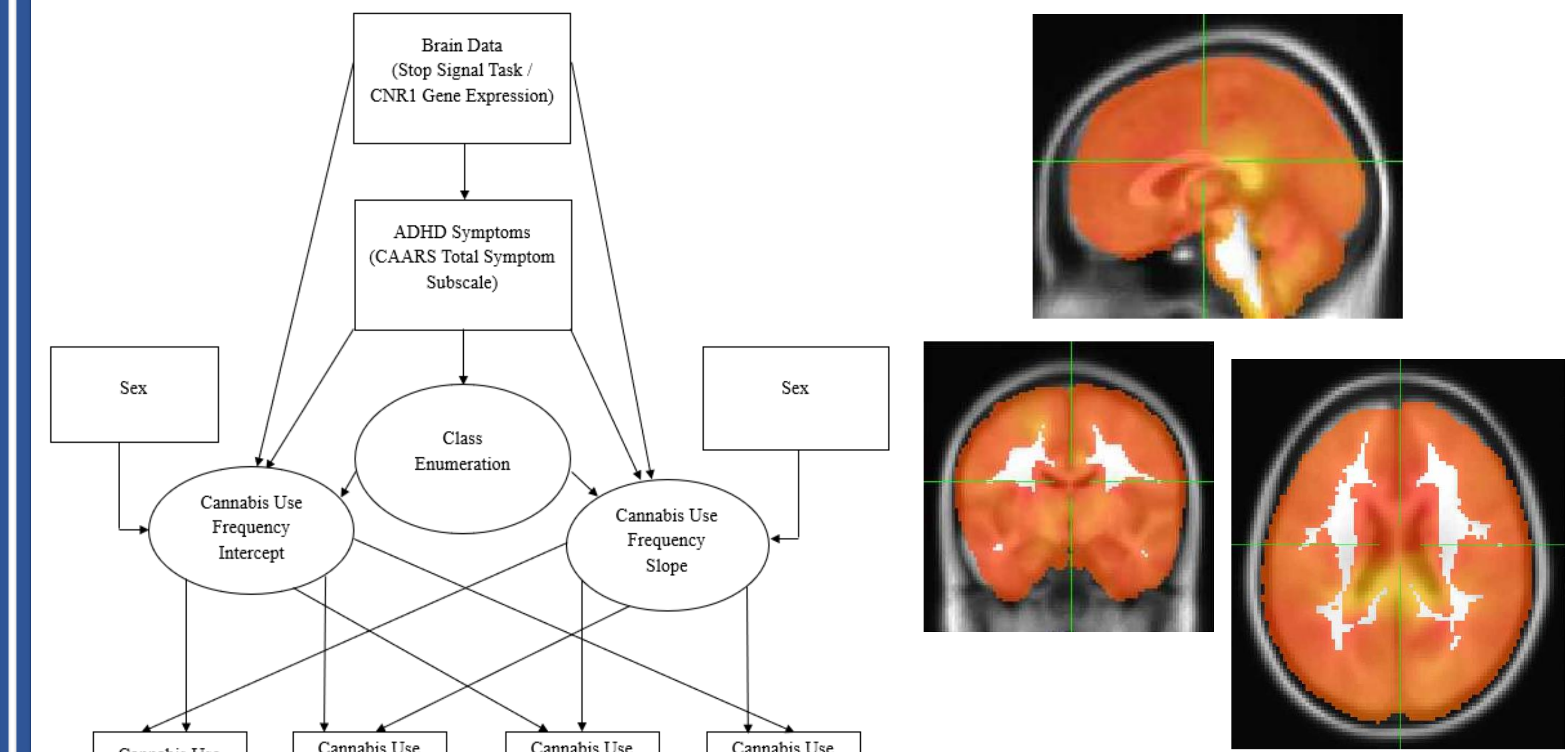


Figure 7: Potential Conceptual Growth Mixture Model to analyze the effect of ADHD Symptoms on Cannabis Use Frequency including Brain Data. Using GMM class enumeration, Gene Expression-Neuroimaging Covariance Analysis will be conducted to indicate the associations between brain regions activated in the fMRI Stop Signal Task and Cannabinoid Receptor 1 (CNR1) gene expression.

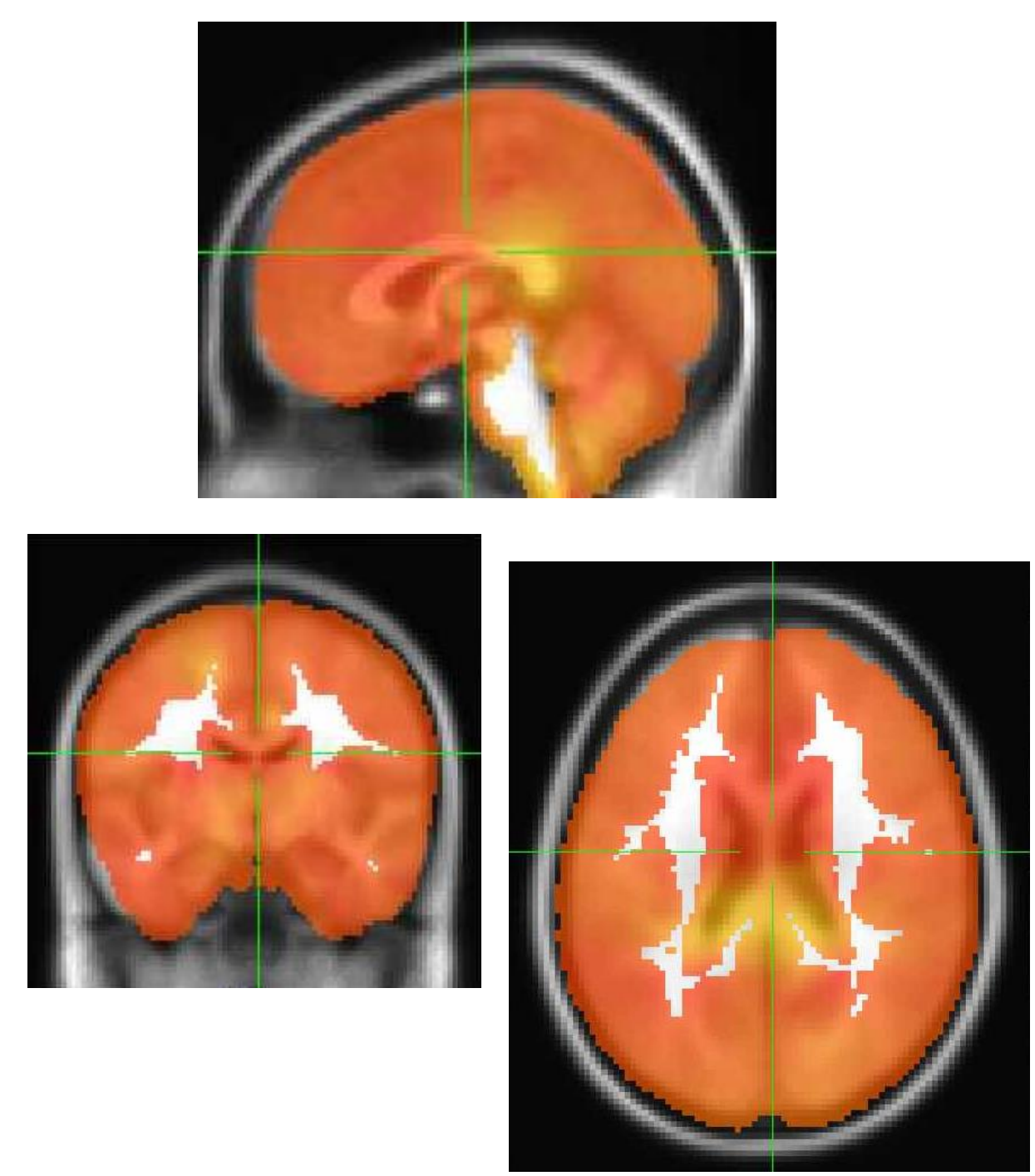


Figure 8: Preliminary Cannabinoid Receptor 1 (CNR1) Gene Expression Map created utilizing Allen Brain Atlas brain donor probe data. Future analyses will examine whether individual differences in fMRI stop signal task activation in regions associated with CNR1 gene expression data predict longitudinal cannabis use.

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