**Early Development of Negative and Positive Affect: Implications for ADHD Symptomatology Across Three Birth Cohorts**

**Online Supplement**

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*Primary Analysis, Research Question One:*

Results from the LCMs that considered change in each dimension of affect separately are depicted in the main text, in Figure 1. Fit statistics associated with the LCGAs for Research Question 1 are presented in Table S1 and results are depicted in the main text, in Figure 2. Mean child SDQ hyperactivity scores are presented for resultant classes in Table S2.

**Negative Affect: Distress to Limitation.** Results from the linear unconditional LCM that considered infant distress to limitation fit the data well, χ2 = 8.12, df = 5, *p* = .15, CFI = .97, TLI = .96, RMSEA = .057. The intercept (average score at three months of child age) was 3.46 and this score, on average, increased .26 every three months (*p* < .001). There was significant variability in the intercept of distress to limitation (*p* < .001), but not in the slope (*p* = .78). The LCM that also included a quadratic term did not fit the data adequately, χ2 = 3.71, df = 1, *p* = .05, CFI = .97, TLI = .82, RMSEA = .12. Neither the slope nor intercept of distress to limitation from the linear model were associated with the SDQ hyperactivity scores (*p*s > .67).

Results from the LCGAs suggest that there were no subgroups of children who differ from one another in their intercepts and/or slopes of distress to limitation, as evidenced by non-significant VLMR likelihood ratio tests in all models (*p*s > .10).

**Negative Affect: Fear.** Both the linear (χ2 = 7.70, df = 6, *p* = .26, CFI = .98, TLI = .98, RMSEA = .04) and quadratic models (χ2 = 2.03, df = 5, *p* = .85, CFI = 1.00, TLI = 1.00, RMSEA = .00) fit the data adequately, though of note, the variance of 12 month fear was set to zero in order to have the model run without error (this variance was originally estimated in both models to be a very small negative number). However, the quadratic model fit significantly better than the linear model (adjusted chi square difference = 8.89, *p* = .003). The intercept (average three month IBQ-R score) for infant fear was 2.25, the linear slope = .57 (*p* < .001), and quadratic slope = -.07, *p* = .018. The variance of the intercept and linear slope, but not quadratic slope, were statistically significantly different than zero (*p*s < .001). However, neither the slope nor intercept were associated with SDQ hyperactivity scores (*p*s > .58).

 Results from LCGAs that considered trajectories of fear pointed to a 3-Class solution. Though the BIC values for the 4-Class and 5-Class solutions were lower, the VLMR LRTs for these solutions were not statistically significant (*p*s > 0.11). Class 1 (49%), “low, stable,” began with low levels of fear (intercept = 1.85) and did not change significantly over time (linear slope = 0.21, *p* = 0.11; quadratic slope = 0.01, *p* = 0.84). Class 2 (46%), “low, increasing” had an intercept of 2.40 and increased over time, linear slope = 0.97 (*p* < 0.001), quadratic slope = -0.16 (*p* = .006). Class 3 (5%), “high, stable,” began with high fear (intercept = 4.60) that did not change significantly over time (linear slope = 0.42, *p* = 0.40; quadratic slope = -0.10, *p* = 0.45). These classes did not differ significantly on SDQ hyperactivity scores when controlling for child sex, age, maternal depressive symptoms, and the data collection site, *p*s > 0.80.

**Negative Affect: Sadness.** Both the LCM that included a linear slope term (χ2 = 5.53, df = 5, *p* = .35, CFI = .99, TLI = .99, RMSEA = .02) and the LCM that included both a linear and a quadratic slope term (χ2 = 0.43, df = 1, *p* = .51, CFI = 1.00, TLI = 1.00, RMSEA = .00) fit the data well. The change in chi square value between these models was not significant (adjusted chi square difference = 4.94, *p* = 0.29), suggesting that they did not differ significantly in their fit to the data. For this reason, the more parsimonious (linear term only) model was selected. The intercept for infant sadness was 3.35 and infants on average increased 0.11 every three months (*p* < 0.001). There was significant variability in the intercept (*p* = 0.002) but not in the slope (*p* = 0.57). The intercept (B = 1.44, *p* = 0.01) but not slope (*p* = 0.87) of sadness predicted greater SDQ hyperactivity scores, again controlling for child sex, age, maternal depressive symptoms, and data collection site.

Results from the LCGAs suggest that a 2-class solution fit the data best. Though the 3-Class-Solution had a slightly lower BIC value, the VLMR LRT for the 3 vs. 2-Class solution was not significant *p* = .37, suggesting that the 2-Class solution is preferable. Class 1 (48%), “high, stable,” began with higher sadness scores (intercept = 4.01) that remained stable over time (slope = .10, *p* = .09). Class 2 (52%), “lower, increasing,” began with lower sadness scores (intercept = 2.73) that increased over time (slope = .13, *p* = .002). These groups did not differ significantly on SDQ hyperactivity scores (*p* =0.35) after controlling for child age, sex, maternal depressive symptoms, and data collection site.

To confirm that our selection of the model that included only a linear slope only (over the model that included both the linear and quadratic slope) did not result in loss of information, we also ran LCGAs using the model that also included a quadratic term. The results were nearly identical: they suggested a 2-class solution, with a “high, stable” class (47%) (intercept = 3.96; linear slope = .32, p = .07; quadratic slope = -.07, *p* = .16) and a “lower, increasing” class (53%) (intercept = 2.64; linear slope = .40, *p* = .03; quadratic slope = -.09, *p* = .13). Interestingly, the quadratic slope term for both of these classes was not statistically significant, confirming our selection of the best class solution.

**Positive Affect: Smiling/Laughter.**The LCM that included a linear slope did not fit the data adequately (χ2 = 23.25, df = 5, *p* = 0.00, CFI = 0.85, TLI = 0.82, RMSEA = 0.14. The LCM that included both a linear and quadratic term did fit the data adequately, (χ2 = 2.36, df = 4, *p* = 0.67, CFI = 1.00, TLI = 1.00, RMSEA = 0.00), however, the variance of the quadratic slope term was set to zero in order to have the model run without error (this variance was originally estimated to be a very small negative number). The intercept for smiling/laughter was 4.70, the linear slope = 0.64, *p* < 0.001, quadratic slope = -0.14, *p* < .001. There was significant variability in the intercept of smiling (*p* < 0.001), but not in the slopes (*p*s > 0.44). Neither the slope nor intercept were associated with the SDQ hyperactivity scores (*p*s > 0.68), controlling for child sex, age, maternal depressive symptoms, and data collection site.

Results from LCGAs point to a 3-Class solution. Class 1 (12%) “low, stable” had an intercept of 3.59, and did not change significantly over time (linear slope = -0.09, *p* = 0.82; quadratic slope = 0.11, *p* = 0.35). Class 2 (46%) “high, increasing” began with a value of 5.57 and increased over time (linear slope = 0.74, *p* < 0.001; quadratic slope = -0.20, *p* < .001). Class 3 (43%) “moderate, increasing” began with moderate smiling/laughter (intercept = 4.13) that increased over time (linear slope = 0.84, *p* < 0.001; quadratic slope = -0.18, *p* = 0.004). These classes did not differ significantly on SDQ hyperactivity scores when controlling for child sex, age, maternal depressive symptoms, and the data collection site, *ps* > 0.42.

**Positive Affect: High Intensity Pleasure.** The LCM that included only a linear slope did not fit the data adequately, χ2 = 44.13, df = 7, *p* = 0.00, CFI = 0.30, TLI = 0.40, RMSEA = 0.17. The model that included both a linear and quadratic slope did fit the data adequately (χ2 = 5.96, df = 6, *p* = 0.43, CFI = 1.00, TLI = 1.00, RMSEA = 0.00), however the variance of the linear and quadratic slopes needed to be set to zero in order for the model to run without error (both variances were estimated to be very small negative numbers in the initial model). The intercept for high intensity pleasure was 5.43 and children typically increased over time (linear slope = 0.82, *p* < 0.001, quadratic slope = -0.19, *p* < 0.001). There was significant variability in intercept values (*p* < 0.001). The intercept of high intensity pleasures was not related to child SDQ hyperactivity scores (*p*s < 0.28), controlling for child sex, age, maternal depressive symptoms, and data collection site.

Results from LCGAs suggested that a 3-Class solution fit the data best (based on the lowest BIC value and a significant VLMR LRT for the k vs. k-1 solution), however one of the resulting classes was very small (1%). This would typically suggest that the k-1 class (2-Class) solution is preferable, however the VLMR LRT for the 2 vs. 1-Class solution was not significant, which suggests that there are not significant subgroups of children who differ in the intercept and/or slope.

1. **Online Supplemental Results: Research Question Two**

**Primary Analyses, Research Question 2: LCGAs that Considered Both Positive and Negative Affect**

Fit statistics associated with the LCGAs for Research Question 2 are presented in Table S3. Mean child SDQ hyperactivity scores are presented for resultant classes in the main text, in Table 3.

**Distress to Limitation.** The LCGAs that considered trajectories of distress to limitation and smiling/laughter in the same model yielded a 4-Class solution. Class 1 (41%) “moderate, increasing distress/high, increasing smiling” began with a distress score of 3.66 that increased over time (0.26, *p* < 0.001). This class began with high smiling/laughter (intercept = 5.42) that increased over time (linear slope = 0.77, *p*  < .001, quadratic slope = -0.21, *p* < 0.01). Class 2 (17%) “high, increasing distress/moderate, stable smiling” began with high distress to limitation (intercept = 4.40) that increased over time (slope = 0.23, *p* < 0.001). They also began with moderate smiling/laughter (intercept = 3.82) that remained stable over time (linear slope = 0.76, *p* = .06, quadratic slope = -0.14, *p* = 0.24). Notably, Class 2 is the only class where children’s distress to limitation scores were higher than their smiling/laughter scores. Class 3 (12%) “low, increasing distress/high, increasing smiling” exhibited low initial levels of distress to limitation (intercept = 2.40) that increased over time (slope = 0.28, *p* < .001) and high smiling/laughter (intercept = 5.66) that also increased over time (linear slope = 0.68, *p* = .02, quadratic slope = -0.18, *p* = 0.02). Class 4 (30%) “moderate, increasing distress/moderate, stable smiling“ began with a distress score of 3.15 that increased over time (0.24, *p* < 0.001), and with high smiling/laughter (intercept = 4.02) that remained stable over time (linear = 0.42, *p*  = 0.11, quadratic = -0.06, *p* = 0.48).

 The LCGAs that considered trajectories of distress to limitation and high intensity pleasure did not yield meaningful subgroups, as evidenced by non-significant VLMR LRTs for all models (*p*s > 0.14).

**Fear.** Results from the LCGA that considered trajectories of fear and smiling/laughter yielded a 2-Class solution. Class 1 (47%) “low, increasing fear/moderate, increasing smiling” began with low initial fear (intercept = 2.06) that increased over time (linear slope = 0.64, *p* < .001, quadratic slope = -.09, *p* = 0.08). They began with moderate smiling/laughter (intercept = 3.93) that increased over time (linear slope = 0.57, *p* = 0.004, quadratic slope = -0.09, *p* = 0.11). Class 2 (53%) “moderate, increasing feat/high, increasing smiling” began with moderate fear (intercept = 2.44) that increased over time (linear slope = 0.63, *p* < 0.001, quadratic slope = -0.11, *p* = 0.05)**.** They also began with high (intercept = 5.45) smiling that increased over time (linear slope = 0.74, *p* < .001, quadratic slope = -0.20, *p* < .001). These groups did not differ significantly on SDQ hyperactivity scores (*p* = 0.70), after controlling for child age, sex, maternal depressive symptoms, and data collection site.

The LCGA that considered trajectories of fear and high-intensity pleasure initially pointed to a 5-class solution (based on the lowest BIC and a significant LRT comparing the 5- vs. 4-Class solution), however two of the resultant classes were very small (1% and 3%), which suggests that the 5-class solution should be rejected in favor of a smaller-class solution. However, none of the other VLMR LRTs were significant, *p*s > 0.13, which suggests that there are not meaningful subgroups.

**Sadness.** For the LCGAs that considered sadness and smiling/laughter together in a single model, a 4-Class solution appeared to fit the data best, as evidenced by the lowest BIC value and a significant VLMR LRT comparing the 4- vs. 3-Class solutions. The VLMR LRT comparing the 2- vs. 1-Class solution was also significant (*p* < 0.0001) but the BIC for that model was larger (2817.64 for the 2-Class solution vs. 2784.57 for the 4-Class solution). Class 1 (40%) “moderate, stable sadness/moderate, increasing smiling” began with moderate sadness (intercept = 3.17) that was stable over time (slope = 0.06, *p* = 0.31), and with moderate smiling/laughter (intercept = 3.97) that increased over time (linear slope = 0.50, *p* = 0.04, quadratic slope = -0.09, *p* = 0.23). Class 2 (25%) “high, stable sadness/high, increasing smiling” began with high sadness (intercept = 3.91) that remained stable over time (slope = 0.14, *p* = 0.14), and with high levels of smiling/laughter (intercept = 5.50) that increased over time (linear slope = 0.80, quadratic slope = -0.20). Class 3 (25%) “low, increasing sadness, high, increasing smiling” exhibited low sadness (intercept = 2.61) that increased over time (slope = 0.14, *p* = 0.009) and high smiling/laughing (intercept = 5.50) that increased over time (linear slope = 0.76, *p* < 0.001, quadratic slope = -0.20, *p* < 0.001). Class 4 (10%) “high, stable sadness, moderate, increasing smiling” began with high sadness scores (4.36) that remained stable over time (slope = 0.14, *p* = 0.08). This class began with moderate smiling/laughter (intercept = 3.84) that increased over time (linear slope = 0.86, *p* = 0.008, quadratic slope = -0.14, *p* = 0.15). These classes did not differ from one another on ADHD symptoms (*p*s > 0.09).

The LCGA that considered sadness and high intensity pleasure suggested that the 2-Class solution appeared to fit the data best. Though the 4-Class solution also had a significant VLMR LRT (*p* = 0.007), one of the resultant classes was very small (1% of the sample), which suggests that this solution should be rejected in favor of a lower-class solution. The VLMR LRT for the 3- vs. 2-Class solution was not significant, *p* = 0.56, suggesting that the 2-Class solution was preferable (it’s VLMR was significant, *p* = 0.03). Class 1 (45%) “high, stable sadness/high, increasing pleasure” began with high sadness (intercept = 4.02) that did not change significantly over time (slope = 0.11, *p* = 0.11). They also began with high levels of high intensity pleasure (intercept = 5.24) that increased over time (linear slope = 1.02, *p <* .001). Class 2 (55%), “low, increasing sadness/high, increasing pleasure” started with low sadness scores (intercept = 2.75) that increased over time (slope = 0.12, *p* = 0.01), as well as high levels of high intensity pleasure (intercept = 5.56) that increased over time (linear slope = 0.74, *p* < 0.001, quadratic slope = -0.17, *p* = .001). These classes did not differ from one another on their average SDQ hyperactivity scores (*p* = 0.49).

1. **Supplemental tables and figures**

**Supplemental Table S1**

*Primary Analysis, Research Question One: Fit Statistics for Latent Class Growth Analysis Models*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Distress to Limitation | Fear | Sadness | Smiling/Laughter | High Intensity Pleasure |
|   | BIC | VLMR LRT | BIC | VLMR LRT | BIC | VLMR LRT | BIC | VLMR LRT | BIC | VLMR LRT |
| 1-Class | 1371.53 | -- | 1471.85 | -- | 1469.49 | -- | 1480.36 | -- | 1163.83 | -- |
| 2-Class | 1305.71 | 0.10 | 1375.76 | 0.03 | **1396.19** | **0.0003** | 1339.26 | <0.0001 | 1118.51 | 0.36 |
| 3-Class | 1274.09 | 0.14 | **1350.80** | **0.01** | 1394.83 | 0.37 | **1327.23** | **0.01** | 1093.26 | 0.001 |
| 4-Class | 1277.57 | 0.33 | 1323.95 | 0.11 | 1394.84 | 0.07 | 1336.98 | 0.17 | 1099.38 | 0.23 |
| 5-Class | 1225.86 | 0.21 | 1318.50 | 0.25 | 1400.07 | 0.22 | 1348.24 | 0.37 | 1102.78 | 0.06 |
| *Note:* BIC = Bayesian Information Criterion. VLMR LRT = Vuong-Lo-Mendell-Rubin Likelihood Ratio Test for the *k* vs k-1 class solution. The bolded values represent the solution that was selected as the best class solution.  |

**Supplemental Table S2**

*Primary Analysis, Research Question 1: Raw ADHD symptom means presented by subgroup for latent class growth analysis that considered a single dimension of affect*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Fear | Sadness | Smiling/Laughing |
|   | Mean | SD | Mean | SD | Mean | SD |
| Class 1 | 3.33 | 2.65 | 3.12 | 2.52 | 2.73 | 3.13 |
| Class 2 | 3.53 | 3.08 | 3.83 | 3.22 | 3.26 | 2.67 |
| Class 3 | 3.00 | 4.24 | -- | -- | 3.75 | 2.94 |
| Class 4 | -- | -- | -- | -- | -- | -- |

*Note:* SDQ = Strengths and Difficulties Questionnaire.

**Supplemental Table S3**

*Primary Analysis, Research Question Two: Fit Statistics for Latent Class Growth Analyses that Included Both Negative and Positive Affect*

|  |  |  |  |
| --- | --- | --- | --- |
|  | Distress to Limitation | Fear | Sadness |
|  | Smiling/Laughter | High Intensity Pleasure | Smiling/Laughter | High Intensity Pleasure | Smiling/Laughter | High Intensity Pleasure |
|   | BIC | VLMR LRT | BIC | VLMR LRT | BIC | VLMR LRT | BIC | VLMR LRT | BIC | VLMR LRT | BIC | VLMR LRT |
| 1-Class | 2851.90 | -- | 2535.36 | -- | 2952.25 | -- | 2635.71 | -- | 2949.85 | -- | 2633.31 | -- |
| 2-Class | 2711.80 | <0.0001 | 2484.30 | 0.18 | **2749.35** | **0.0001** | 2554.84 | 0.13 | 2817.64 | < 0.0001 | **2572.02** | **0.03** |
| 3-Class | 2617.84 | 0.43 | 2459.53 | 0.46 | 2755.29 | 0.11 | 2529.37 | 0.35 | 2794.23 | 0.15 | 2550.54 | 0.56 |
| 4-Class | **2670.65** | **0.046** | 2436.90 | 0.16 | 2751.81 | 0.35 | 2501.60 | 0.43 | **2784.56** | **0.04** | 2535.47 | 0.01 |
| 5-Class | 2663.57 | 0.38 | 2431.32 | 0.14 | 2748.84 | 0.39 | 2496.28 | 0.002 | 2776.87 | 0.45 | 2527.34 | 0.20 |
| *Note:* BIC = Bayesian Information Criterion. VLMR LRT = Vuong-Lo-Mendell-Rubin Likelihood Ratio Test for the *k* vs *k*-1 class solution. The bolded values represent the solution that was selected as the best class solution. |