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THE GENETIC AND ENVIRONMENTAL INFLUENCES ON CHILD ANXIETY AND SCHOOL PERFORMANCE

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ABSTRACT

Background: Childhood anxiety has both genetic and environmental influences. The presence of anxiety in early childhood is of interest in the present report because of its potential impact on early childhood school performance. This report utilizes data from a longitudinal adoption study including adopted infants, their birth parents, and adoptive parents (N = 361). The report examined the relationship between birth mother anxiety symptoms, child anxiety symptoms, and subsequent child school performance. School performance was studied under three categories: reading, arithmetic/math, and language arts/writing. In addition, this study examined how parenting style may moderate the effects of inherited risk for anxiety symptoms on child school performance during childhood using adoptive parenting variables: involvement and positive parenting. **Results:** Through correlation analysis as well as linear and ordinal regression modeling no significant relationship was found between birth mother anxiety, child anxiety, and school performance in any of the three categories investigated (reading, math, writing). Additionally, both adoptive parent positive parenting and involvement were not shown to moderate inherited influences on anxiety and school performance. The lack of significant results in this study can be explained in part by the presence of missing data and the age of the participants for each variable.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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I would first like to thank the Early Growth and Development Study team for allowing me to utilize the data they have collected for use in this thesis. I would like to thank Dr. Jenae Neiderhiser for her constant guidance and support. Additionally, I would like to thank Dr. Diane Henderson for her advise as my honors advisor as well as her input on my thesis. Finally, I would like to thank my friends and family who have supported me through the thesis writing process and my four years at Penn State.

Chapter 1

Introduction

Genetic and environmental factors have been shown to have an effect on the development of anxiety in children. It is important to understand the development of childhood anxiety and study potential child outcomes to understand the disorder and its effects. In the present study, the development of anxiety is of interest because of how it may impact early childhood success in school. Previous research has linked lower school achievement, IQ scores, and school records with higher levels of anxiety (Cowen et. al 1965). This thesis will examine the correlations between birth parent anxiety symptoms, childhood anxiety symptoms and child school performance at an early age. To potentially moderate this effect we also study the style of parenting in an effort to determine if positive parenting and involvement impact the school performance outcome given the presence of early childhood anxiety symptoms.

Anxiety

Anxiety is among the most prevalent psychological disorders experienced by adolescents, and without treatment can cause impairments in school and in social situations (Waite et al. 2014). The development of anxiety symptoms has been shown to be at least moderately heritable (Hettema, Neale & Kendler, 2001; Torgersen, 1983; Eley, Bolton, O'Connor, Perrin, Smith & Plomin, 2003) with some differences depending on the type of anxiety. Anxiety diagnostic categories such as general distress, separation anxiety, fears, obsessive-compulsive behaviors,

and shyness/inhibition were all found to have genetic influences (Eley et al. 2003). Through univariate genetic analyses three patterns of genetic and environmental influences were found for the five categories of anxiety (Eley et al. 2003). Shared and non-shared environmental influences contributed moderately to general distress, separation anxiety, and fears (Eley et al. 2003). In the categories of obsessive-compulsive behaviors and shyness/inhibition, genetic influences accounted for 2/3 of the variance, the highest levels seen in all the variables analyzed, with the remaining variance due entirely to non-shared environmental influences (Eley et al. 2003). The findings in this study show the shared genetic and environmental influences on the development of anxiety in children.

Studies have reported that rearing environmental influences, independent of genetic influences, such as parent-child interaction and parenting behaviors, have an effect on child anxiety. Nine-month-old children with genetic risk for anxiety, indicated by presence of social phobia in birth mothers, had the least social inhibition when their adoptive parents were considered non-anxious (Brooker et al., 2011). This indicates the possible positive impact parenting behavior had on the child given he/she was genetically at risk for high social inhibition.

Additional studies using the same sample as used in the current thesis have examined the influences of parental anxiety on children during early childhood. For example, one of these studies showed only weak influences of both inherited (birth parent anxiety) and rearing environmental (adoptive parent anxiety) influences on child anxiety symptoms at 18 months (Field et al. 2017). Similarly, using the same sample, adoptive father anxiety at child age 6 was associated with child anxiety symptoms at child age 8, although this association was not found for adoptive mothers and there was no evidence of inherited influences (Ahmadzadeh et al., in

press). Thus, previous research has found both genetic and environmental influences on child anxiety. The genetic influences can also be interpreted as an increased susceptibility to environmental factors, meaning heritable factors together with environmental factors lead to the development of anxiety symptoms.

Anxiety and School Performance

Anxiety symptoms in early childhood are of interest in this study specifically due to their relationship with school performance and academic achievement. Anxiety has been associated with school achievement for 9-year-old children with a negative relationship found between high anxiety and IQ scores and achievement scores (Cowen et al. 1965). Children with anxiety disorders were found to have lower IQ scores than those without an anxiety disorder (Davis et al. 2008). Similarly, school performance has been linked to anxiety in children. In a study of anxiety and school performance, children between the ages of 6 and 13 with high anxiety were tested in three waves. Through cognitive-behavioral therapy intervention programs of two variations, family-focused and child-focused, the study participants worked on reducing their anxiety levels. At each of the three stages, the child's school performance was investigated to see if there was any change in relation to the change in anxiety level they experienced (Wood 2006). Decreased anxiety levels were found to be predictive of the child's improvement in school performance. These findings suggest that the presence of anxiety symptoms has a negative impact on a child's academic achievement (Wood 2006). The associations found in these two studies present a link between anxiety and various measures of academic achievement.

Adoptive Parenting Moderation

Parenting has been shown to moderate heritable influences for a wide variety of child outcomes. Typically, this is referred to as gene x environment interaction (GxE). This thesis examines how parenting may moderate the effects of inherited risk for anxiety problems on child school performance during middle childhood. Other studies using data from the Early Growth and Development Study (EGDS) investigated the moderation of adoptive parents' parenting on child anxiety symptoms and internalizing behaviors. For example, one such study found that infants whose birth parents showed elevated levels of anxiety symptoms showed the lowest levels of internalizing symptoms in environments in which adoptive parents had low levels of anxiety (Brooker et al. 2014). Alternatively, when birth parents reported low or mean levels of anxiety symptoms, there was no relationship found between attention control and internalizing problems for child age 18 months (Brooker et al. 2014). It is also important to note that greater adoptive parent anxiety symptoms were predictive of greater internalizing problems in the child for all levels of the birth parent anxiety (Brooker et al. 2014). These results indicate that children raised by non-anxious parents saw the most benefit from increased attention control as compared to other children. It suggests adoptive parents are able to moderate inherited influences of anxiety with respect to child internalizing, but the study is limited in that a relationship was only seen in the context of low adoptive parent anxiety. A previous report from the EGDS found the correlation for high adoptive parent anxiety at an earlier age point (9-months). It was observed that when the adoptive parent experienced high levels of anxiety symptoms, increased anxious behavior at 9 months of age was predicted by the infant exhibiting greater attention control (Booker et al. 2011). This disparity in results may be due in part to the varying ages of interest. A second study aimed to understand the bidirectional association between infants' negative affect

and parent anxiety (Brooker et al. 2015) and found that negative affect in 9-month-old infants was positively associated with anxiety symptoms in adoptive parents at child age 27 months (Brooker et al. 2015).

The presence of child anxiety in early life has also been shown to impact parenting behavior. Dadds and Roth (2001) proposed that anxious children might require more reassurance and comfort, which over time may exhaust the parent. This reassurance seeking needs of the child can result in the parent changing his/her behavior (Dadds and Roth, 2001) and parents may then attempt to push the child towards independence (Fox & Calkins, 1993). In turn, according to Fox and Calkins (1993), this increases the child's anxiety level further and requires more reassurance from the parent. This study indicates the alternative effects a child's behavior can have on the parent. It is important to note that the interaction between parent and child can be difficult to interpret. The adoptive parent may change his/her parenting behavior based on the behaviors of the child, and subsequently have an impact on the child's anxiety levels.

Chapter 2

Present Study

The present analysis aimed to test the environmental and heritable influences on a child's school performance given their anxiety level. The effects of birth parent anxiety (heritable) and adoptive parent anxiety (environmental) were examined within the context of adoptive parents' parenting behaviors. There were two aims of this research outlined as follows:

First we sought to study the relationship between anxiety in the birth mother and anxiety symptoms in the child at 4.5 years old and subsequently the child's school performance at age 7. Second we sought to investigate the effect of 4.5-year-old anxiety symptoms of the adoptive child on adoptive parenting style when the child was age 6. We then analyzed the effect parenting has on age 7 school performance. This was done in an effort to understand how adoptive parenting may moderate the heritable influences of birth parent anxiety symptoms on child anxiety and performance in school.

Hypothesis

I. Birth parent anxiety at child age 4.5 years will be negatively associated with child's school performance at age 7 years.

II. Parenting at child age 6, as measured under both the positive parenting and involvement subscales, will moderate the relationship between birth parent anxiety and child performance in school.

Chapter 3

Method

Participants

This analysis was made possible by the longitudinal adoption Early Growth and Development Study (EGDS). The sample includes 561 linked sets of birth parents, adoptive parents and adopted children. Participants were recruited through adoption agencies across the United States. Adoption placement mean age was 3 days with a standard deviation of 5 days. A majority (57%) of the adopted children were male (Leve et al 2013). The sample for this analysis was drawn from the first of two cohorts in the study, which included 361 linked sets. Table 1 provides demographic information of the parent participants of interest. Adoptive parent (AP) 1 and 2 refer to the adoptive mother and father respectively (can also refer to two adoptive mothers or two adoptive fathers). The child's age in months at AP Wave D (age 4.5 years) interview had a mean of 55.49 months and standard deviation 1.91. At AP Wave E (age 6 years) interview, the child age had a mean of 72.00 months and standard deviation 2.12. Finally, at AP Wave F (age 7 years) interview the mean child age was 84.45 months with a standard deviation of 2.16.

Table 1: Demographic Information for Cohort 1

Variable	Birth Mother	Adoptive Parent 1	Adoptive Parent 2
Age:			
Mean & SD	24.12 (SD = 5.89)	37.78 (SD = 5.50)	38.39 (SD = 5.77)
Range	14.63 – 43.39	24.78 – 54.05	25.50 – 59.48
Race (%):			
Caucasian	71.1	91.4	90.2
African –American	11.4	3.6	5.0
Asian	1.9	0.6	0.6
Multi-ethnic	5.0	1.1	1.1

Other	10.6	3.3	3.1
Median Annual Income	< $20K	$40K+	$100k+
Mean Highest Completed Education Level	High school	4 – year college degree	4 – year college degree

Measures

Birth parent anxiety symptoms at child age 4-5 years

Birth parents completed the Beck Anxiety Inventory at multiple assessments but in this paper the report from when the child was 4.5 years of age was utilized (Beck et al. 1988). Given it is a genetic risk variable the age of assessment is less of concern because there is little direct contact between the child and the birth parents. The responses were on a 4-point scale indicating the degree to which they experienced anxiety symptoms. The range was ascending in terms of severity of anxiety as follows: 1 = not at all, 2 = slightly, 3 = moderately, 4 = severely. The total BAI score was a sum of all question answers. The scores on the BAI are interpreted as follows: 0 - 7 minimal anxiety, 8 - 15 mild anxiety, 16 - 25 moderate anxiety, and 26 - 63 severe anxiety. For the purpose of this analysis, the BAI score of the birth mother was utilized due to the magnitude of missing values for the birth father (only 94 out of 361 were available). Prior reports from the EGDS found that the anxiety effects in one parent do not necessarily negate that of the other parent meaning the findings had no differences when the birth father was excluded or included in the analyses (Brooker et. al. 2014).

Child anxiety symptoms age 4.5 years

The measure of child anxiety came from the Parent Report Forms of the Child Behavior Checklist-Long (CBCL) anxiety subscale (Achenbach & Rescorla 2001). The CBCL is

comprised of 100 questions in which the parent chose one of three options in accordance with the true behaviors of their child. The range is as follows: 1 = not true, 2 = sometimes true, 3 = very true. The items were then re-coded to range from 0 - 2 to match the official CBCL raw coding system.

The focus for this analysis was anxiety so we looked only at the CBCL Anxious and Depressed (A/D) subscale. The CBCL-A/D consists of 8 items relating to symptoms of anxiety and depression. The questions contained in this subscale are 10, 33, 37, 43, 47, 68, 87, and 90. With the recoded variables there is a range of potential overall scores on this assessment from 0 - 16. A higher score indicates more symptoms.

Parenting at child age 6 years

Adoptive mothers and fathers each completed the Alabama Parenting Questionnaire (APQ; Frick, 1991) at child age 6 years. The APQ is comprised of 42 items. The positive parenting subscale consists of 6 items (02, 05, 13, 16, 18, 27). The range of scores for each item is 1 - 5. The subscale description is as follows: "parent provides positive feedback or rewards for the child." An example statement is: "You let your child know when he/she is doing a good job with something" (APQ; Frick, 1991). Respondents choose from 5 rates for each question as follows: 1 = never, 2 = almost never, 3 = sometimes, 4 = often, 5 = always.

The subscale of involvement is comprised of 7 questions (decreased from 10 questions at Waves D & E due to missing values). This subscale is described as "parent involvement in child's daily routine and activities" (APQ; Frick, 1991). An example statement under this subscale is: "You play games or do other fun things with your child" (APQ; Frick, 1991). The responses follow the same range as positive parenting outlined above.

School Records at child age 7 years

To study school performance, school records from when children were 7-year-old were utilized. These records include three scores, one for each the following: reading, arithmetic/math and language arts/writing. Each overall score is measured on a 6-point scale as follows: 1 = Far below grade level, 2 = Somewhat below grade level, 3 = At grade level, 4 = Somewhat above grade level, 5 = Far above grade level, 9 = Unable to judge.

Descriptive Statistics

Prior to conducting any modeling of the data, descriptive statistics were computed to obtain information regarding missing values, outliers and overall distribution of each of the variables of interest. Table 2 shows the sample size and mean for each of the variables. Given the size of the sample, I chose to leave the outliers in the analysis. Had they been removed the sample size would significantly decrease and it may incorrectly bias the results of our analysis. It is also important to note the number of missing values in the data. Given the nature of the analysis, there will be a loss of many subjects due to one or more missing values for each of the variables.

Table 2: Descriptive Statistics including sample size, mean and range for study variables

Variable	Sample Size (N)	Mean	Range
Birth Mother Anxiety	322	6.8570	0 - 47
Adoptive Parent 1 Report of Child Anxiety	267	1.8614	0 - 12
Adoptive Parent 2 Report of Child Anxiety	239	1.8075	0 - 10

Positive Parenting:			
AP1	307	4.3806	3.17 – 5.00
AP2	286	4.2710	3.00 - 5.00
Involvement:			
AP1	306	4.0965	2.86 – 5.00
AP2	286	3.8612	2.711 – 5.00
Reading	262	3.42	1 - 5
Arithmetic/Math	258	3.29	1 - 5
Language Arts, Writing	262	3.18	1 - 5

Statistical Analysis

In an effort to examine genetic (birth parent anxiety), environmental (positive parenting & involvement), and gene x environment (GxE) interactions on a child's success in early education (reading, math, and writing proficiency) a statistical analysis was also performed. First, correlation analysis amongst all study variables was conducted to gain a sense of relationships present as well as detect possible covariates. Next, linear and ordinal regression analyses were performed in R-studio. The ordinal regression was conducted by converting the school performance variable. Since it was the response variable of interest it was converted from a continuous variable to an ordinal variable. The new variable was sub-divided into its 5 pre-determined categories as outlined in the Measures section of this report. All the explanatory variables were kept as continuous.

Chapter 4

Results

Preliminary Analysis

Prior to any statistical analysis, a correlation matrix was examined for each of the variables of interest in the present study. Little correlation was found between birth mother anxiety, child anxiety, and school performance. Table 3 outlines all correlations for the variables analyzed in this report.

Table 3: Pearson Correlations for Variables of Interest

	1	2	3	4	5	6	7	8	9	10
1. Birth Mother Anxiety	1									
2. Child Anxiety AP1	-.072	1								
3. Child Anxiety AP2	-.062	0.386**	1							
4. Involvement AP1	0.053	-.102	-.029	1						
5. Involvement AP2	-.027	-0.046	-.029	0.183**	1					
6. Positive Parenting AP1	0.017	-0.021	-.045	0.558**	0.065	1				
7. Positive Parenting AP2	0.029	-0.040	-.012	0.193**	0.564**	0.173**	1			
8. Reading	0.1	-0.112	-.043	0.043	0.071	-0.024	0.028	1		
9. Math	0.091	-0.116	-.033	0.054	0.067	0.060	-.009	0.684**	1	
10. Language Arts/Writing	0.048	-0.091	0.037	0.048	-.002	0.017	-.049	0.726**	.740**	1

** - Correlation is significant at the 0.01 level (2-tailed)

As expected, it was observed that adoptive parent (AP) 1 & 2 involvement (R=0.183, p = 0.002) and positive parenting (R=0.173, p = 0.003) were correlated. These correlations lead to

the decision to use the maximum score for each of positive parenting and involvement in our regression analysis, meaning the max score for involvement between AP1 and AP2 was used instead of each score separately. The same can be said for the positive parenting variable. Also of note is the correlation between AP1 involvement and AP1 positive parenting (R=0.558, p=0.000), indicating that the two styles of parenting go hand in hand. The same correlation can be seen in AP2 (R=0.564, p=0.000). Finally, the school variables were significantly correlated with one another. Reading levels and arithmetic/math levels were positively correlated with one another (R=0.684, p = 0.000). Reading was also correlated with language arts/writing (R=0.726, p =0.000). Math and language arts/writing held the highest positive correlation (R=0.740, p= 0.000). These results indicate that if a child is successful in one of these three subcategories of school performance, they are likely to find success in all three.

Statistical Regression

Although preliminary analysis indicated a weak relationship between the variables of interest in the study, a regression analysis was still performed to further solidify the findings and to examine possible hidden associations. A linear regression model was fit first with the predictors and interaction terms as follows: $Y = \beta_0 + \beta_1 BMAnxiety + \beta_2 ChildAnxiety + \beta_3 PositiveParenting + \beta_4 Involvement + \beta_5 BMAnxiety * PositiveParenting + \beta_6 BMAnxiety * Involvement + \beta_7 ChildAnxiety * PositiveParenting + \beta_8 ChildAnxiety * Involvement + \beta_9 BMAnxiety * ChildAnxiety * PositiveParenting + \beta_9 BMAnxiety * ChildAnxiety * Involvement$

The model, however, was a poor fit for the data given the failure of the LINE assumptions necessary to conduct a linear model. To address these issues a second model was attempted. Ordinal regression is a type of logistic regression that allows for natural ordering in

the response variable. Since the response of school performance naturally increases in terms of skill level, this regression style offered potential to more accurately fit the data. It was also necessary to conduct ordinal regression because the response variable did not meet the linear regression assumption of normally distributed residuals. Initial solutions to this issue would be variable transformations but each transformation attempted (squared, square root, cube) failed to fix the distribution of residuals. Thus, logistic regression became the best alternative for analysis. The equation for ordinal regression follows the following format: $\text{Ln}\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$.

Three separate ordinal regression analyses were conducted. One for each of the following as the response variable: reading, arithmetic/math, and language arts/writing. Given the number of missing values and loss of power in the analysis, the ordinal regression was only performed on the main effects, not accounting for the interaction terms. Thus it can only be used to offer insight into the first hypothesis. As suspected by the weak correlations found in the preliminary analysis and the poor results of the linear model, the ordinal regression produced no significant findings for the first hypothesis. The regression output can be found in Appendix A. All p-values were insignificant which indicates that the values of the estimates do not produce an accurate model of the data.

Chapter 5

Discussion

The first aim of this study was to investigate the relationship between anxiety symptoms in the birth mother and child anxiety symptoms and subsequently the child's school performance under the subcategories of reading, arithmetic/math, and language arts/writing. In opposition with my initial hypothesis, no significant relationship was found between birth mother anxiety symptoms, child anxiety symptoms, and any of the three school performance scores.

The second aim of this study was to examine the moderating effect of parenting on the child's school performance. Two parenting variables were examined, positive parenting and involvement. Given the lack of correlation found through the first aim of the analysis it is understandable that the addition of this variable also did not lead to a significant result. Contrary to the predictions under the hypothesis, we did not find significant results for positive parenting or involvement as moderators on birth mother anxiety and child school performance.

Several factors may have lead to the conclusions found in this analysis. One potential reason for the results was the prevalence of anxiety at young age points. Past research has had difficulty identifying anxiety in children at such a young age. Given the children are only 4.5 years of age, information about the child's psychopathy is collected from the parents. Although this is necessary given the child's lack of vocabulary and limited understanding of the questions, there was little agreement found between the child and parent about symptomatology (Achenbach et al., 1987). It was also found that children report their anxiety symptoms at a higher rate than their parents (e.g. Herjanic & Reich, 1997, Kolko & Kazdin, 1993). Although it

is unclear whether the report by the child is more accurate than that of the parent in terms of assessing true levels of anxiety, it is important to note that a difference lies between the two.

If the link between birth parent anxiety and child anxiety was investigated at a later age it is possible that the findings would be consistent with our expectations. Additionally, school records were only available for children at age 7, equivalent to first grade, which may also explain the lack of correlation. Specifically, such associations may not be present during first grade. Consistent with this, previous research examining child anxiety effects on child school performance and IQ found associations for older children more consistently (Wood 2006; Cowen et al. 1965).

Additionally, an issue that arose in the analysis was that of missing data. Given the number of missing values for each of the variables, the final analysis was limited in sample size. By combining all variables into one regression analysis, any cases that had at least one missing value posed a problem in the analysis. The second regression analysis conducted also used the variables as ordinal variables, meaning they had to be manipulated prior to analysis. These variable cut-offs were chosen by the guidelines of the test but were converted from continuous to ordinal.

A take-away from an examination of the school performance variables showed a greater prevalence of higher scores (at or above grade level) for each of the sub-categories of school performance.

Figure 1: Scatterplots of Response Variables: Reading, Arithmetic/Math & Language Arts/Writing

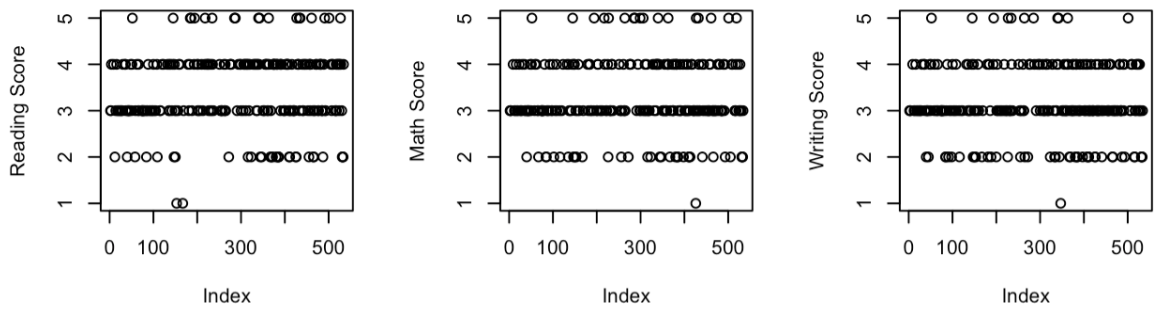

Figure 1 shows the distributions of each response studied: reading, arithmetic/math, and language arts/writing. The normality and linearity issues associated with this variable were one reason creating an ordinal variable instead of a continuous variable was necessary. As can also be noted, all three sub-categories (reading, math, language arts/writing) follow almost identical patterns.

Chapter 6

Limitations & Further Research

To better understand the relationships studied in this paper several additional analyses could be considered. As a first step, improving the size of the sample would allow for less difficulty interpreting and extending the results of the analysis. A potential downfall of this analysis was the prevalence of missing data. To account for this a method of missing data imputation would be highly beneficial. It would allow for the inclusion of more data points and thus increase the power of the statistical analysis conducted. The best route based on my analysis of the type of data would be multiple imputation. This method fills in estimates for missing values, but does so multiple times to account for uncertainty and variability. These estimates would likely be similar to the true estimates but of course not identical. Regression can then be performed on each of the new data sets and a result found through a combination of all models. This is beneficial given that it works for linear and non-linear data sets alike. Additionally, there may be more covariates in the data that were overlooked and would be interesting to investigate in an additional analysis. Finally, this research could be extended beyond just the variables included. More interesting results may be found for children's school performance at later age points or for varying measurements of parenting style, family home environment, or birth parent anxiety symptoms.

Chapter 7 Appendix A

Regression Output

Reading:

```
Call:
lm(formula = DataNEW$SFF18010A ~ BMAnxiety + ChildAnxietyMax + 
    APpositiveMax + APinvolveMax + APpositiveMax * BMAnxiety + 
    APinvolveMax * BMAnxiety + APpositiveMax * ChildAnxietyMax + 
    APinvolveMax * ChildAnxietyMax + BMAnxiety * ChildAnxietyMax * 
    APpositiveMax + BMAnxiety * ChildAnxietyMax * APinvolveMax, 
    data = DataNEW)

Residuals:
    Min      1Q  Median      3Q     Max 
-2.3825 -0.4873  0.1168  0.5533  1.7658 

Coefficients:
                                      Estimate Std. Error t value Pr(>|t|)
(Intercept)                           8.130282   2.673808   3.041  0.00279 **
BMAnxiety                            -0.226821   0.395533  -0.573  0.56720
ChildAnxietyMax                      -0.897140   0.707749  -1.268  0.20692
APpositiveMax                        -1.077992   0.762428  -1.414  0.15948
APinvolveMax                          0.096315   0.518815   0.186  0.85298
BMAnxiety:APpositiveMax               0.015032   0.112192   0.134  0.89360
BMAnxiety:APinvolveMax                0.032452   0.060252   0.539  0.59097
ChildAnxietyMax:APpositiveMax         0.232282   0.258785   0.898  0.37085
ChildAnxietyMax:APinvolveMax         -0.052033   0.178245  -0.292  0.77076
BMAnxiety:ChildAnxietyMax            -0.010913   0.114464  -0.095  0.92418
BMAnxiety:ChildAnxietyMax:APpositiveMax  0.010293   0.038740   0.266  0.79084
BMAnxiety:ChildAnxietyMax:APinvolveMax  -0.006611   0.020744  -0.319  0.75040
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.8194 on 149 degrees of freedom


Call:
polr(formula = as.ordered(DataNEW$SFF18010A) ~ BMAnxiety + ChildAnxietyMax + 
    APpositiveMax + APinvolveMax, data = DataNEW)

Coefficients:
                   Value Std. Error  t value
BMAnxiety       -0.0002048    0.01906 -0.01075
ChildAnxietyMax -0.0559720    0.07935 -0.70537
APpositiveMax   -0.5048942    0.58464 -0.86359
APinvolveMax     0.2422809    0.42942  0.56420

Intercepts:
    Value   Std. Error t value
1|2 -6.5001  2.5989    -2.5011
2|3 -3.4962  2.4105    -1.4504
3|4 -1.4451  2.3959    -0.6032
4|5  1.0390  2.3974     0.4334

Residual Deviance: 386.0384
AIC: 402.0384
```

Arithmetic/Math:

```
Call:
lm(formula = DataNEW$SFF18010B ~ BMAnxiety + ChildAnxietyMax +
    APpositiveMax + APinvolveMax + APpositiveMax * BMAnxiety +
    APinvolveMax * BMAnxiety + APpositiveMax * ChildAnxietyMax +
    APinvolveMax * ChildAnxietyMax + BMAnxiety * ChildAnxietyMax *
    APpositiveMax + BMAnxiety * ChildAnxietyMax * APinvolveMax,
    data = DataNEW)

Residuals:
    Min      1Q  Median      3Q     Max
-1.4940 -0.3585 -0.1809  0.5629  1.7847

Coefficients:
                                       Estimate Std. Error t value Pr(>|t|)
(Intercept)                             6.00358    2.44093   2.460   0.0151 *
BMAnxiety                              -0.33375    0.36187  -0.922   0.3579
ChildAnxietyMax                        -0.11562    0.64296  -0.180   0.8575
APpositiveMax                           0.12604    0.69860   0.180   0.8571
APinvolveMax                           -0.69167    0.49194  -1.406   0.1619
BMAnxiety:APpositiveMax                -0.04320    0.10306  -0.419   0.6758
BMAnxiety:APinvolveMax                  0.11627    0.06096   1.907   0.0585 .
ChildAnxietyMax:APpositiveMax          -0.22881    0.23562  -0.971   0.3331
ChildAnxietyMax:APinvolveMax            0.24621    0.16388   1.502   0.1352
BMAnxiety:ChildAnxietyMax              -0.05184    0.10418  -0.498   0.6195
BMAnxiety:ChildAnxietyMax:APpositiveMax  0.04890    0.03543   1.380   0.1697
BMAnxiety:ChildAnxietyMax:APinvolveMax  -0.03752    0.01969  -1.906   0.0587 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7425 on 145 degrees of freedom


Call:
polr(formula = as.ordered(DataNEW$SFF18010B) ~ BMAnxiety + ChildAnxietyMax +
    APpositiveMax + APinvolveMax, data = DataNEW)

Coefficients:
                    Value Std. Error  t value
BMAnxiety       -0.008302    0.02050 -0.40501
ChildAnxietyMax -0.123422    0.08219 -1.50160
APpositiveMax   -0.009765    0.59395 -0.01644
APinvolveMax     0.178786    0.45613  0.39196

Intercepts:
    Value    Std. Error t value
1|2 -11.0554  20.9605    -0.5274
2|3  -1.8225   2.3821    -0.7651
3|4   0.9487   2.3760     0.3993
4|5   3.0400   2.3949     1.2693

Residual Deviance: 344.5974
AIC: 360.5974
```

Language Arts/Writing:

```
Call:
lm(formula = DataNEW$SFF18010C ~ BMAnxiety + ChildAnxietyMax +
    APpositiveMax + APinvolveMax + APpositiveMax * BMAnxiety +
    APinvolveMax * BMAnxiety + APpositiveMax * ChildAnxietyMax +
    APinvolveMax * ChildAnxietyMax + BMAnxiety * ChildAnxietyMax *
    APpositiveMax + BMAnxiety * ChildAnxietyMax * APinvolveMax,
    data = DataNEW)

Residuals:
    Min      1Q  Median      3Q     Max
-1.4366 -0.2869 -0.1320  0.6353  1.9177

Coefficients:
                                      Estimate Std. Error t value Pr(>|t|)
(Intercept)                            5.73115    2.49981   2.293   0.0233 *
BMAnxiety                             -0.02117    0.37087  -0.057   0.9546
ChildAnxietyMax                        0.02128    0.66167   0.032   0.9744
APpositiveMax                          0.08302    0.71289   0.116   0.9075
APinvolveMax                          -0.65066    0.48524  -1.341   0.1820
BMAnxiety:APpositiveMax               -0.08163    0.10528  -0.775   0.4394
BMAnxiety:APinvolveMax                 0.08538    0.05642   1.513   0.1323
ChildAnxietyMax:APpositiveMax         -0.27034    0.24176  -1.118   0.2653
ChildAnxietyMax:APinvolveMax           0.27319    0.16652   1.641   0.1030
BMAnxiety:ChildAnxietyMax             -0.12073    0.10724  -1.126   0.2620
BMAnxiety:ChildAnxietyMax:APpositiveMax  0.06305    0.03630   1.737   0.0844 .
BMAnxiety:ChildAnxietyMax:APinvolveMax  -0.03696    0.01942  -1.904   0.0589 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7661 on 149 degrees of freedom


Call:
polr(formula = as.ordered(DataNEW$SFF18010C) ~ BMAnxiety + ChildAnxietyMax +
    APpositiveMax + APinvolveMax, data = DataNEW)

Coefficients:
                  Value Std. Error  t value
BMAnxiety       -0.02095    0.01904 -1.10051
ChildAnxietyMax -0.00116    0.08152 -0.01423
APpositiveMax   -0.40641    0.58995 -0.68888
APinvolveMax     0.03405    0.44730  0.07612

Intercepts:
    Value    Std. Error t value
1|2 -12.2509  14.6301    -0.8374
2|3  -3.4701   2.3828    -1.4563
3|4  -0.9849   2.3638    -0.4167
4|5   1.1209   2.3784     0.4713

Residual Deviance: 361.9624
AIC: 377.9624
```

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ACADEMIC VITA

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EDUCATION:

The Pennsylvania State University, Schreyer Honors College
Bachelors of Science in Mathematics & Statistics
Minor in Economics
Graduation Date: Spring 2019

International Studies Institute, Florence, Italy Summer 2018

WORK EXPERIENCE:

Johnson & Johnson, Janssen Pharmaceutical Companies, PA Summer 2017
Statistical Data Analyst - Intern

- Worked with statisticians to enable optimization of the clinical trial response process in order to facilitate continued development of the Janssen R&D pipeline
- Developed R programs to evaluate pharmaceutical data
- Utilized statistical methodology including principal component analysis and multi-dimensional scaling

Johnson & Johnson, Janssen Pharmaceutical Companies, PA Summer 2016
Statistical Data Analyst - Intern

- Programmed in SAS to analyze data sets from ongoing clinical trials
- Presented results of summer project to management
- Worked on project designed to determine if the statistical power of various studies was impacted by the use of on-site monitoring. Specific data point changes that resulted from those monitoring visits were analyzed.

MSI International, Valley Forge, PA Summer 2015
Data Analyst - Intern

- Utilized SPSS statistical software to analyze market studies data
- Developed presentations (PowerPoint) for clients based on data collected from customized market studies
- Edited and revised visual presentations to ensure accuracy and maximize impact

RESEARCH:

Early Growth & Development Study, State College, PA Jan. 2018 - Present
Undergraduate – Medical Records

- Work up to ten hours per week in the lab entering medical records and preparing data for SAS programming

AWARDS & ACTIVITIES:

Evan Johnson Memorial Award – Outstanding Achievement in Mathematics
Statistics Department Undergraduate Teaching Assistant
Undergraduate Grader for Intermediate Macroeconomics Course
Penn State Dance Marathon (THON): Finance Committee – Secretary