

NEGATIVE EMOTIONALITY, ACTIVITY LEVEL AND EXTERNALIZING PROBLEMS IN
PRESCHOOLERS: THE INFLUENCE OF MATERNAL MENTAL HEALTH AND EDUCATION

by

OGECHI K. NWADINOBİ

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Abstract

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Ogechi Nwadinobi, M.S.

The University of Texas at Arlington, 2017

Supervising Professor: Dr. Jeffrey Gagne

Early childhood temperament has been extensively linked to child externalizing behavioral problems such as aggression, violence, disobedience and antisocial behaviors. Individuals with such behavioral patterns are at greater risk for psychopathologies including oppositional defiant disorder, attention deficit hyperactivity disorder and conduct disorder (Caspi, Henry, McGee, Moffitt & Silva, 1995). The current investigation examined whether the child temperament factors of negative emotionality and activity level predict externalizing problems in preschool. In addition, the study assessed whether maternal mental health and education moderate the relationship between child temperament and externalizing behavior problems. The sample consisted of 201 typically developing children (males = 104, mean age = 3.86, $SD = 1.04$) and their mothers (mean age = 34.13, $SD = 5.13$) in the Dallas Fort-Worth area. Measures included laboratory-assessed negative emotionality and activity level in addition to parent-rated negative emotionality, activity level, maternal depression and maternal trait anxiety. Principal components analyses were used to construct lab-based negative emotionality and activity level measures. Using MLM regression, the study found that maternal anxiety moderated the relationship between child activity level and externalizing problems. Additionally, maternal education moderated the relationship between activity level and externalizing problems.

Keywords: Externalizing problems; anger; sadness; negative emotionality; activity level; maternal anxiety; maternal depression; maternal education

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Chapter 1 Introduction

Temperament is defined as individual differences in innate aspects of personality that are stable over time, yet are subject to a predictable developmental trajectory (Rothbart & Jones, 1998). Temperament has been conceptualized as both behavioral and emotional dispositions that are partly determined by biology and influence both self-regulation and reactivity across the lifespan (Gagne, Van Hulle, Aksan, Essex & Goldsmith, 2011; Eisenberg, 2006). Early childhood temperament has been shown to predict numerous social, cognitive and health outcomes including academic achievement, criminality, obesity and stability of peer relationships (Bussing, Mason, Bell, Porter & Garvan, 2010). Furthermore, early childhood temperament has been extensively linked to child externalizing behavioral problems such as aggression, violence, disobedience and antisocial behaviors. Individuals with such behavioral patterns are at greater risk for psychopathologies including oppositional defiant disorder (ODD), attention deficit hyperactivity disorder (ADHD) and conduct disorder (CD; Caspi, Henry, McGee, Moffitt & Silva, 1995).

Negative emotionality, defined as the tendency to experience frequent and intense episodes of emotional arousal and difficulty of return to a stable baseline (Rothbart, 1981), is a risk factor for both externalizing and internalizing disorders and socioemotional difficulties (Lengua, 2013). Investigations on the early development of negative emotionality will help us to better understand factors that influence the development of childhood psychopathology. The current study will examine whether child negative emotionality and activity level predict externalizing problems in preschool. The study will then assess whether the relationship between child temperament factors and externalizing problems is moderated by maternal mental health and education. There is a paucity of research on the broad construct of negative emotionality in comparison to other aspects of temperament. The current investigation aims to contribute to this literature while employing a multimethod approach.

1.1 Child Temperament

Contemporary temperament theorist Mary Rothbart organizes childhood temperament into two sets of broad domains, namely reactivity and self-regulation (Rothbart, 2007). Reactivity is conceptualized as emotional, motor and attentional reactions to stimuli (Rothbart, 2007). This domain includes behaviors varying from observable negative emotional expression to the more physiological measure of heart rate.

Self-regulation is defined as mechanisms to attenuate reactivity, including processes such as effortful control, fearful inhibition and extraverted approach (Rothbart, 2007). Alternately, Rothbart also conceptualizes temperament as reflecting the three broad domains of surgency/extraversion, negative emotionality and effortful control (Rothbart & Bates, 2006). Each of these is comprised of more specific dimensions. For example, effortful control is comprised of the inhibitory control, attentional focusing and persistence dimensions whereas negative emotionality is comprised of anger, sadness fear, shyness and soothability (Eisenberg, 2006; Rothbart & Jones, 1998). The present study examines aspects of the broad domain of negative emotionality while also assessing the more specific dimension of child activity level.

Hence, reactivity refers to emotional responding via emotions such as fear but can also refer to general negative emotionality or intensity (Rothbart & Bates, 2006). Individual differences in dispositional emotionality have been shown to predict development of socioemotional skills such as social adjustment and competence, and are associated with both internalizing and externalizing problems (Lengua, 2013; Eisenberg, 2006). Lengua and Rothbart define negative emotionality as a general term referring to the frequency and intensity of anger, sadness, fear and falling reactivity (Eisenberg, 2006). Negative emotionality as defined in this paper will only refer to the frequency and intensity of anger and sadness.

Anger and sadness are integral components of negative emotionality (Eisenberg, 2006; Rothbart & Jones, 1998). Previous research on childhood anger finds that it is negatively correlated with inhibitory control, thus as the child's ability to self-regulate over time increases, observable anger decreases (Gagne & Goldsmith, 2011). Inability to inhibit anger expressions leads to greater susceptibility to negative life outcomes such as criminality and is positively associated with childhood externalizing problems and psychopathology (Shaw et al., 2003). Sadness and fear have been linked with internalizing disorders and socioemotional difficulties, and highly sad and fearful children are at increased risk of anxiety, depression and other mood disorders (Roza, Hofstra, van der Ende, & Verhulst, 2003). Few investigators have researched negative emotionality as a broad domain therefore the current investigation will assist in bridging gaps in extant literature.

In addition to negative emotionality, research has also examined the temperament trait of activity level – conceptualized as the amount of gross motor activity a child typically displays (Rothbart, 1981). The active child is highly energetic and often in motion (Buss & Plomin, 1981). Interestingly, Goldsmith et

al. (1987) describes motor activity level as a potential indicator of emotional arousal that is not differentiated into the primary emotions. According to Rothbart (1998), both activity level and negative emotionality are aspects of temperament that are predicated on neural systems that underlie children's reactivity and self-regulation. Because activity level and negative emotionality are related as Goldsmith and Rothbart indicate, we are interested in studying both these traits in the context of externalizing problems.

1.2 Links between Temperament and Behavior Problems

Behavior problems (BP) broadly refer to emotional or interpersonal maladjustment in expression and conduct (Campbell, 1995). Encompassed under this general term are both externalizing and internalizing problems. Externalizing problem behaviors include aggression, hostility, hyperactivity, antisocial actions and conduct problems (Eisenberg et al., 1996). Early emerging externalizing problems influence later development of behavioral problems and increases likelihood of psychopathology (Caspi, Henry, McGee, Moffitt & Silva, 1995; Eisenberg et al., 1996; 2000; 2006). Internalizing problems have been defined as dysfunction in the intro-punitive emotions including guilt, fear and worry and often manifest outwardly as withdrawal, sad affect, and the development of anxiety and depression (Gilliom & Shaw, 2004). Internalizing and externalizing behavior problems in early childhood frequently co-occur, which increases risk for psychopathology (Mesman, Bongers & Koot, 2001).

Negative emotionality has been shown to be intimately linked with externalizing problems because much problem behavior is exemplified by uninhibited behavior and negative emotion (Eisenberg et al., 1996). Researchers have found that emotionality and emotional intensity predict problem behaviors as reported by teachers and parents and persist longitudinally (Cole, Zahn-Waxler, Fox, Usher & Welsh, 1996; Eisenberg et al., 1996). Laboratory studies utilizing mood induction revealed that differences in emotion expressivity predicted externalizing symptoms at preschool and 1st grade (Cole et al., 1996).

Child activity level has been extensively associated with early externalizing problems as well. Denham et al. (2000) report that high child activity level at age three predicts child externalizing problems at age five. Additional research has found that children with early hyperactivity are likely to experience the most problems upon starting school, in large part due to maladaptive behavioral problems including aggression and noncompliance (Campbell, Shaw and Gilliom, 2000). This finding was compounded when

the children also had the risk factors of negative parenting and family stress (Campbell, Shaw and Gilliom, 2000). Although many investigations of child temperament examine links to child behavior problems, parent factors also play a role in this area of child development.

1.3 Child Temperament and Behavior Problems: The Role of Maternal Factors

The literature is rich with research linking maternal affect and psychopathology with child temperament, behavioral problems and psychopathology (Van den Bergh & Marcoen, 2004; Fernald, Jones-Smith, Ozer, Neufeld, & DiGirolamo, 2008; O'Connor, Heron, Golding, Beveridge & Glover, 2002; Cummings & Davies, 1994). Children of mothers with maternal negative affect have been shown to exhibit significantly higher activity level from infancy to adolescence (DiPietro et al., 2002; 2006; Van den Bergh & Marcoen, 2004) and exhibit decreased ability to self-regulate emotions and impulsive behavior (Henrichs et al., 2009). Research from our lab found that child behavioral inhibition mediated the relationship between maternal negative affect and child internalizing problems (Fang & Gagne, 2017). Poor maternal mental health has been associated with a two to five-fold increase in the likelihood of developing behavioral problems according to Cummings and Davies (1994) and such behavioral maladjustment increases the likelihood of future psychopathology (Cummings & Davies, 1994). Maternal depression has been associated with a host of child temperamental factors including social adjustment, fear regulation and regulation of stress reactivity (Feldman, Granat, Pariente, Kanety, Kuint, & Gilboa-Schechtman, 2009; Webster-Stratton, Hammond, 1988).

Studies lend support to the hypothesis that child activity level, negative emotionality, behavior problems and maternal factors may interact, finding that high activity level at age two predicts externalizing problems at age four, and this effect was strongest for toddlers whose mothers scored high on maternal negativity (Van den Bergh & Marcoen, 2004; Rubin, Burgess, Dwyer & Hastings, 2003). In addition, children who tend towards high negative emotionality were found to be more likely to exhibit behavioral dysregulation and more problem behaviors (Eisenberg et al., 2000).

Maternal anxiety has been associated with increased likelihood of child and adolescent emotional and behavioral problems, including susceptibility to mood and externalizing disorders (Achenbach, McConaughy & Howell, 1987). Researchers have linked maternal antenatal anxiety in particular to ADHD symptomology, externalizing behavior problems and anxiety in children at eight years of age (Van den

Bergh & Marcoen, 2004) and another study reports that maternal anxiety was associated with child behavioral and emotional problems at age four (O'Connor, Heron, Golding, Beveridge & Glover, 2002). Positive correlations between maternal anxiety and clinical levels of hyperactivity have been observed (DiPietro et al, 2002; 2006). A comprehensive review of the adverse effects of postnatal maternal anxiety finds that maternal anxiety disrupts mother-child attachment formation, further increasing child risk of psychiatric illness (Glasheen, Richardson & Fabio, 2010). Additional studies assert that maternal prenatal anxiety explained up to 22% of the variance in childhood disorders (Van den Bergh & Marcoen, 2004).

Children with depressed mothers show dramatically increased risk of psychopathology, behavioral and emotional problems (Cummings & Davies, 1995; Gotlib & Goodman, 1999). Maternal depression has been associated with increased behavioral reactivity as early as infancy (Davis, Snidman, Wadhwa, Glynn, Schetter & Sandman, 2004). This trend remains relatively stable across childhood and into adolescence (Oberlander et al., 2007; Dawson et al., 2003), with significantly increased externalizing problems observable during adolescence in children of depressed mothers (Raposa, Hammen, Brennan & Najman, 2014). Fernald et al. found that maternal depression was linked to child hyperactivity in preschool (Fernald, Jones-Smith, Ozer, Neufeld, & DiGirolamo, 2008). One study reports that maternal depression and child behavioral problems appear to have an interdependent relationship, with maternal depressive symptomology predicting child behavior problems the following year and vice versa (Bagner, Pettit, Lewinsohn, Seeley & Jaccard, 2012).

1.4 Child Temperament and Behavior Problems: Other Important Moderators

Demographic characteristics such as child age and gender and parent education and socioeconomic status may also moderate the relationship between child temperament and behavior problems. These demographic moderators may also be relevant to the maternal traits under study. In studies of early childhood, age is often an important consideration. For example, problem behaviors decrease as children age because executive control functions including inhibitory control improve, resulting in enhanced regulation of behavioral and emotional expression (Hughes & Ensor, 2009). Carlson asserts that before three years of age, children have difficulty regulating their behavioral impulses but by age four they improve greatly (Carlson, 2007). Thus we would expect that as age increases, children's ability to regulate their own emotions and activity level increase (Carlson, 2007).

Gender is another variable that affects the development of child activity level and negative emotionality. Studies show a consensus in the finding that boys generally exhibit higher motor activity than girls (Sallis, Alcaraz, McKenzie & Hovell, 1999; Pate, Mclver, Dowda, Brown & Addy, 2008) and more boys exhibit clinical levels of hyperactivity as evidenced by ADHD diagnoses (Gaub & Carlson, 1997; Gershon & Gershon, 2002). In addition, boys are more likely to exhibit outward expressions of anger whereas girls are more likely to exhibit sadness (Cassano, Perry-Parrish & Zeman, 2007; Chaplin & Aldao, 2013). Negative emotionality is more common in boys before the age of four, likely as a result of inability to self-regulate before the development of adequate executive control (Chaplin & Aldao, 2013).

Socioeconomic status (SES) and maternal education are potential environmental and parental factors that have been shown to moderate the relationship between child temperament and externalizing behavior problems (Bradley & Corwyn, 2002). SES has been implicated in a host of childhood physical and psychological health outcomes, including cognitive and socioemotional development (Bradley & Corwyn, 2002). According to Van den Bergh and Marcoen, exposure to maternal depressive symptoms in late infancy is a risk factor for *low* activity level in later childhood for individuals in low-income countries. However, in high-income countries the pattern is the opposite; maternal depression is associated with increased activity level at 4-6 years of age (Van den Bergh and Marcoen, 2004). Lengua et al. (2013) report that effortful control is consistently observed to be lower in children growing up in low SES families. Gallo et al. (2005) find that SES moderates emotional response to psychosocial experiences, such that low SES is correlated with stronger emotional responses to psychosocial experience. The reserve capacity model as mentioned by Gallo et al. (2015) asserts that individuals from low SES backgrounds have greater emotional and physiological responses to stressors due to a deficit in psychosocial resources.

Parent education has also been associated with child behavioral difficulties. Parent education has been shown to be predictive of child behavior problems and previous analyses of our sample have indicated a moderating role of maternal education on the relationship between maternal depression and child aggression (Spann & Gagne, 2015). Extant literature has found that maternal education is associated with externalizing problems via negative discipline (Boe et al., 2014) and ethnic differences in externalizing problems are eliminated once parental education is controlled for (Anton, 2015) supporting

the assertion that maternal education is a critical factor in child development of externalizing behavior problems.

1.5 Multi-method Approach to Temperament Assessment

Child temperament research often relies on parental report, however this can be problematic since parents are susceptible to bias which contributes to a frequent lack of significant correlations between parent-ratings and laboratory assessment of child temperament (Saudino, Wertz, Gagne & Chawla, 2004). Of particular relevance for sibling research is parental tendency to be susceptible to contrast effects - that is the tendency to conceptualize one child's behavior as the opposite of that of the other child when in fact objective observations reveal significant similarity in behavior (Saudino, Wertz, Gagne & Chawla, 2004). Typically parents are prone to contrast effects in the case of dizygotic twins but at least one study has shown the same effect for non-twin siblings (Saudino et al., 2004). In addition, mothers who report anxious and depressive symptomology are more likely to perceive their children's temperament and behavior as difficult (Henrichs, 2009), thus parental measures may introduce additional bias. However parent ratings are valuable in that they provide the perspective of caregivers who are familiar with the complexities of their child's temperament and personality in numerous natural contexts.

Laboratory ratings of temperament are based on strict definitions of discrete behaviors in a controlled environment (Gagne, Van Hulle, Aksan, Essex & Goldsmith, 2011). Laboratory assessments involve the usage of strictly scripted scenarios administered to the child participant by a trained experimenter. Each temperament-evoking episode is recorded on video then coded for specific temperament variables across 10-30 second increments for the duration of the entire episode (Goldsmith & Rothbart, 1996). Each episode is rated by trained coders and a standard of reliability is achieved before all data is analyzed (Gagne, Van Hulle, Aksan, Essex & Goldsmith, 2011). Therefore, lab ratings do not reflect a comprehensive view of child behavior cross-contextually, though they do allow for greater controllability. Utilization of a multi-method approach (that combines both parent-ratings and laboratory assessments) in this study protects against bias and confounds while conferring both ecological and external validity to the current study (Saudino & Micalizzi, 2015).

1.6 The Current Study

There is a dearth of research investigating both child activity level and negative emotionality as predictors of behavior problems in the context of maternal factors and from a multimethod assessment perspective. To fill in the gaps in the extant literature, this investigation will include the maternal factors of depression and anxiety and the demographic factor of maternal education level to examine potential moderators. I examined activity level and negative emotionality using a parent-rated scale and a comprehensive laboratory assessment. The present study has four specific aims:

Aim 1. To construct objective composite measures of child negative emotionality and activity level using a standardized laboratory-based temperament assessment protocol. Factor analyses were used to combine anger, sadness and latency to resume positive affect variables from lab-based episodes of a negative emotionality episode. The activity level composite was derived in a similar manner using variables that relate to the frequency and vigor of child activity level.

Aim 2. To determine whether study variables predict externalizing behavior problems in pre-school using MLM regression. Hypothesis 1 predicts that maternal mental health symptoms and education, child negative emotionality, activity level, gender and age will significantly predict externalizing problems. Hypothesis 1.1 states that child AL will moderate the relationship between NE and EP.

Aim 3. To assess whether maternal anxiety and depression will moderate the relationship between child temperament factors and child externalizing behavior problems. Hypothesis 2.1 states that maternal anxiety will moderate the relationship between child negative emotionality and externalizing problems. Hypothesis 2.2 will test whether maternal anxiety moderates the relationship between child activity level and externalizing problems. Hypothesis 2.3 states that maternal depression will moderate the relationship between child negative emotionality and externalizing problems. Hypothesis 2.4 will explore whether maternal depression moderates the relationship between child activity level and externalizing problems.

Aim 4. To investigate whether maternal education level will moderate the relationship between child temperament factors and child externalizing behavior problems. Gender and age will be controlled for in these analyses. Hypothesis 3.1 predicts that maternal education would moderate the relationship

between child negative emotionality and externalizing problems. Hypothesis 3.2 predicts that maternal education would moderate the relationship between child activity level and externalizing problems.

As preliminary analyses, we will examine the relationship between laboratory and parent ratings of activity level and negative emotionality using Pearson's R correlation. I expect that laboratory and parent ratings will not be highly correlated which will be in line with previous findings. It is also hypothesized that lab-based and parent-rated child negative emotionality and child activity level will interact to uniquely predict child externalizing problems. Specifically, we hypothesize that negative emotionality will be a significant positive predictor of externalizing problems when child activity level is high. When both negative emotionality and activity level are low, child externalizing problems are predicted to be low.

It is predicted that high maternal anxiety/depression will amplify the relationship between child factors and externalizing problems. I hypothesize that maternal anxiety will moderate the relationship between child activity level and externalizing problems, such that children with mothers high on maternal anxiety will have greater externalizing problems than those whose mothers are low on anxiety. I also hypothesize that maternal anxiety will moderate the relationship between child negative emotionality and externalizing problems, such that children with mothers high on maternal anxiety will have greater externalizing problems than those whose mothers are low on anxiety. The same pattern of findings are predicted with maternal depression as a moderator of the relationship between child temperament factors and externalizing problems.

Finally, it is predicted that maternal education will moderate the effect of child negative emotionality on externalizing problems and also moderate the relationship between child activity level and externalizing problems. Children of mothers with less education will have the most externalizing problems whereas those whose mothers have more education will show less externalizing problems across combinations of low and high child negative emotionality and activity level.

Chapter 2 Methods

2.1 Participants

Two hundred and one typically developing children (males = 104, mean age = 3.86, SD = 1.04) and their mothers (mean age = 34.13, SD = 5.13) in the Dallas Fort-Worth area participated in the current

study. The sample is derived from the TEXAS Family Study which examined the temperament of twin and non-twin siblings at the University of Texas at Arlington under the direction of Dr. Jeffrey Gagne. Our families were predominantly Caucasian, as 84% of our sample identified as white, 11% multiracial, 4% black and 3% Asian/other. Most were considered above average in socioeconomic status with a mean annual income of \$70,000. Participants were compensated \$25 for participation in the survey portion our study and an additional \$50 for the laboratory portion of the study. All data were de-identified and stored securely prior to analysis and up to three years afterward.

2.2 Measures

2.2.1 Parent-rated Assessments of Child Temperament

2.2.1.1 Toddler Behavior Assessment Questionnaire.

To obtain measures of child activity level and negative emotionality, we utilized the Toddler Behavior Assessment Questionnaire (TBAQ). The TBAQ presents parents with questions such as “When playing on a moveable toy such as a tricycle, how often did your child attempt to go as fast as s/he could?” to be rated on a scale of 1 (Never) to 7 (Always). The responses were recoded and averaged, and higher scores indicated higher activity level. Internal reliability for the activity level subscale is approximately .78 (Goldsmith, 1996). To obtain measures of child negative emotionality, we utilized the soothability, anger, sadness, smile and social fear subscales of the TBAQ. The responses were recoded and averaged, and higher scores indicated higher soothability, anger, sadness, smile and social fear. Internal reliability for the anger subscale is approximately .82 and social fear is .83 (Goldsmith, 1996).

2.2.1.2 Emotional-Activity-Sociability-Shyness Scale

The Emotional-Activity-Sociability-Shyness Scale (EAS) was utilized to obtain parent ratings of child activity level and negative emotionality. This widely used instrument examines activity level and emotionality with ratings of statements such as “Child often fusses and cries” on a scale from 1 (strongly disagree) to 5 (strongly agree). The EAS has a reliability alpha coefficient ranging from .62 to .70 when used to assess 18-month-olds and 50 month-olds (Mathiesen & Tambs, 1999).

2.2.2 Laboratory-based Assessments of Temperament

2.2.2.1 Laboratory Temperament Assessment Battery

The Laboratory Temperament Assessment Battery (Lab-TAB) is a standardized manual of emotion-eliciting episodes for assessment of early childhood temperament. Constructed by Goldsmith and Rothbart (1996), the manual provides detailed instruction on the administration of episodes that reliably elicit observable behaviors in children. The Lab-TAB manual has versions tailored to pre-locomotor, locomotor and pre-school aged children and has been widely validated (Goldsmith & Rothbart, 1996).

2.2.2.2 Lab-TAB Corral of Balls episode

This lab-based episode assesses activity level in children. Children are presented with an inflatable pool filled with colorful plastic balls and allowed to play in the corral of balls unrestricted for 3-5 minutes. This episode is recorded and variables such as latency to play, number of balls manipulated and vigor are coded to generate measures of hyperactivity (Gagne et al., 2011; Goldsmith & Rothbart, 1999). This episode is ideal for measuring motor activity because it provides a non-social, non-threatening situation with abundant opportunity for uninhibited play. Coders were trained and inter-rater reliability of .85 was achieved.

2.2.2.3 Lab-TAB End of the Line episode

Observer-rated child anger, sadness and smile were derived from the Lab-TAB End of the Line episode from the Preschool Laboratory Temperament Assessment Battery (Goldsmith et al., 1995). This emotion-evoking episode involved allowing a child to play with an attractive toy for one minute, then removing the toy from his or her grasp and inexplicably refusing to allow continued play. After one minute, the experimenter or parent returns the toy to the child and play resumes. The episode was recorded and rated by trained coders on variables such as facial and bodily anger, sadness, latency to resume play and presence of smile or laughter. Inter-rater reliability of .85 was achieved.

2.2.3 Parent-rated Assessments of Child Externalizing Problems

2.2.3.1 Child Behavior Check List

To obtain parent ratings of child externalizing problems, the Child Behavior Check List (CBCL) was utilized. This parent report measures a range of behavioral problems in preschool-aged children with

items such as “Gets in many fights” to be rated on a scale of 0 (Not true at all) to 2 (Very true). We will create an externalizing problems variable by combining ratings from the attention problems subscale (Cronbach’s alpha = .75) and the aggressive behavior subscale (Cronbach’s alpha = .89) as outlined by the CBCL scoring procedures (Achenbach, 2011). Higher scores indicate greater externalizing problems.

2.2.4 Assessment of Maternal Affect & Mental Health

2.2.4.1 Spielberger State-Trait Anxiety

The Spielberger State-Trait Anxiety Inventory (STAI) is a commonly used questionnaire that assesses both current states of anxiety (A-State) and a general tendency towards anxiety (A-Trait). The present study uses the trait scale in order to measure a general, persistent tendency to anxiety symptoms. The items distinguish anxiety symptoms from depressive symptoms, using items such as “I am a steady person” for participants to rate on a scale of 1 (almost never) to 4 (almost always). All 40 item responses are summed to produce a measure of anxiety symptoms. Scores greater than 43 are identified as indicative of substantial risk for anxiety disorders (Spielberger, 1983). The STAI has a reliability estimate of .86 and satisfactory validity (Spielberger, 1983).

2.2.4.2 Center for Epidemiological Studies Depression Scale

The Center for Epidemiological Studies Depression Scale (CES-D) will be used to assess the mothers’ depression symptoms. This 20-item questionnaire refers to feelings and behaviors experienced in the past week. Statements such as “I felt that everything I did was an effort” were rated on a scale from 1 (Rarely or none of the time) to 4 (Most or all of the time). The CES-D has a reliability estimate of .88 and satisfactory validity (Orme, Reis & Herz, 1986).

2.3 Procedure

As part of the TEXAS Family Study, parents (typically mothers) were recruited and instructed to complete a series of online questionnaires. Mothers were given consent forms before commencement of three questionnaires via SurveyMonkey. These included the EAS, TBAQ and CES-D. The mothers were instructed to complete the questionnaires honestly and without significant rumination. Upon completion of the surveys, the mothers were debriefed, provided compensation in the form of \$25 gift cards and the session was concluded. Each session had a duration of approximately 30 minutes. The completed questionnaire data was de-identified and stored on a password-encrypted computer.

After completion of online questionnaires, families were invited to the Temperament and Development Lab of the University of Texas at Arlington Department of Psychology in order to complete the laboratory-based phase of the study. The STAI and CBCL were administered to the parent in person because these were copyrighted assessments. Siblings were separated into two rooms and completed laboratory independently. The End of the Line episode was typically administered by the parent (who was instructed on appropriate administration of the procedure beforehand). A trained experimenter administered the Corral of Balls episode. The duration of the laboratory visit was approximately 2 hours and families received compensation in the form of \$50 gift cards.

Chapter 3 Results

3.1 Data Analysis

Preliminary analyses included examination of descriptive statistics in order to assess measures of central tendency and observe whether gender and age differences exist. Next, correlational analyses were conducted to examine the relationship between study variables. It was predicted that child variables would correlate with other child variables. Specifically, parent-rated child negative emotionality and parent-rated child activity level was positively correlated and lab-based negative emotionality and lab-based activity level was positively correlated. It was predicted that maternal anxiety would correlate positively with maternal depression, and both were positively correlated with child negative emotionality and child activity level (both lab and parent-rated). It was predicted that lab-based and parent-rated activity level were not correlated highly, as the two measures assess different contextual scenarios and parent report is susceptible to bias (Saudino, 2004; Saudino & Micalizzi, 2015). The same was predicted for lab-based and parent-rated child negative emotionality.

Aim 1. The first aim was to construct a lab-based measure of child negative emotionality by combining anger, sadness and smile variables from the Lab-TAB End of the Line episode. This was executed by following factor analysis procedures outlined by Gagne, Van Hulle, Aksan, Essex and Goldsmith (2011). A composite score of child negative emotionality was derived from peak and mean intensities of child anger, sadness and smile across four time intervals in addition to the latency to resume play variable. These variables were screened to ensure normality and then entered into a confirmatory

factor analysis to measure the latent construct of negative emotionality. Factor scores were used as the objective NE scores.

The same procedure was used to construct a composite score of child activity level. Peak and mean intensities of number of balls manipulated, vigor and presence in the corral enclosure were calculated across three intervals. Along with latency to begin play, the mean and peaks were entered into a confirmatory factor analysis to derive factor loadings. Two factors were derived and accounted for 49% of the variance. Figure 1 illustrates this process.

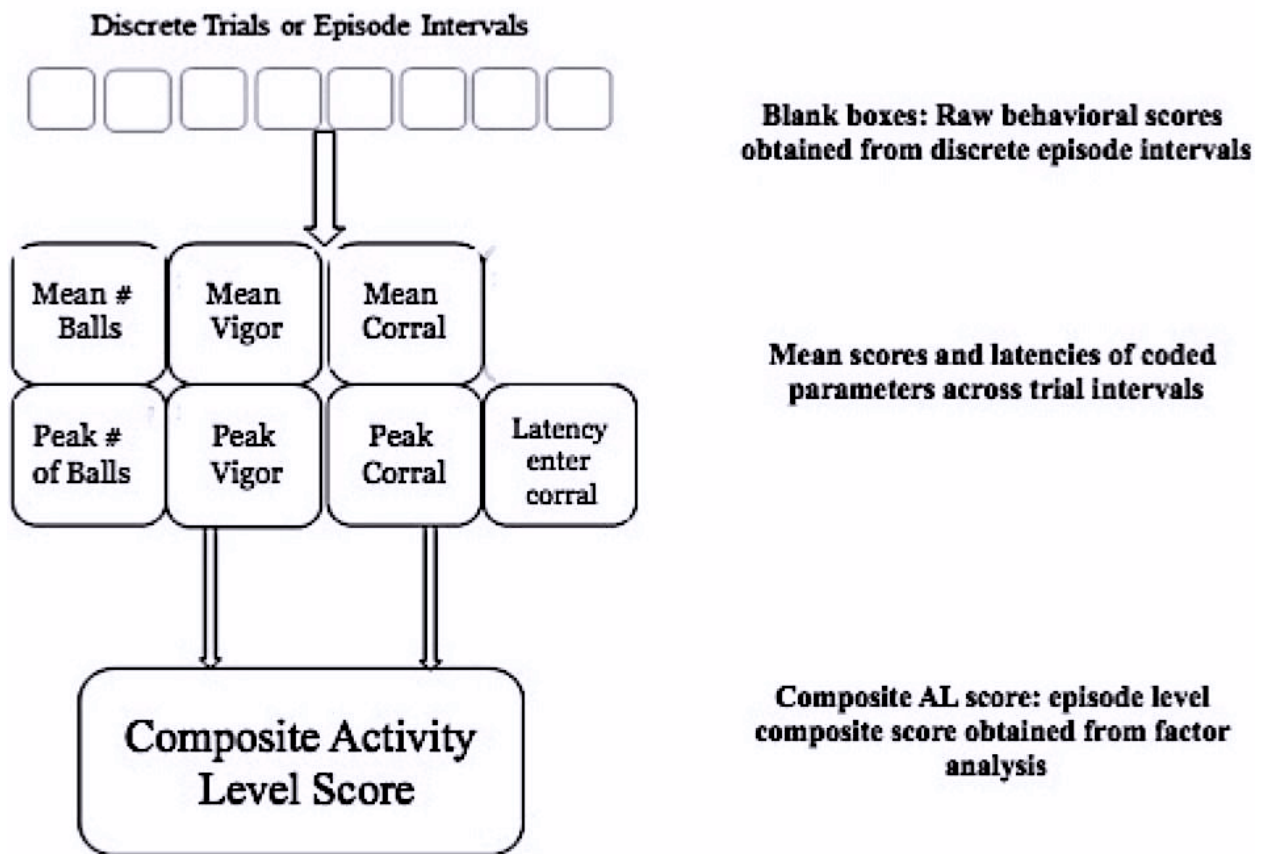


Figure 1. Illustration of the procedures used to derive the composite activity level score of the Lab-TAB "Corral of balls" episode.

Aim 2. The second aim was to determine whether child negative emotionality and activity level would predict externalizing behavior problems in pre-school. Given the nested nature of our sample due to sibling and twin data, the assumption of independent observations was violated and usage of a common OLS regression model would result in increased risk of Type I error (Cohen, Cohen, West &

Aiken, 2003). To account for nested data, restricted maximum likelihood estimation multilevel modeling (MLM) was utilized. Restricted maximum likelihood estimation MLM reduces the risk of Type I error by allowing intercepts to vary within dyads while holding the slopes constant (Kenny et al., 2016).

Hypothesis 1 assessed first whether maternal mental health symptoms and education, child negative emotionality, activity level, gender and age would significantly predict externalizing problems. Hypothesis 1 also predicted that child activity level would moderate the relationship between child negative emotionality and externalizing problems. It was expected that children with high negative emotionality and high activity level will show significantly greater levels of externalizing problems whereas children with low activity level and low negative emotionality will have significantly lower externalizing problems. I also expected high negative emotionality and low activity level to positively predict EP whereas low negative emotionality and high activity level will not predict EP.

Aim 3. The third aim was to examine whether maternal anxiety and depression would moderate the relationship between child temperament factors and externalizing problems (hypothesis 2). A MLM moderated-multiple regression was conducted to assess the two-way interactions. It was predicted that high maternal anxiety would amplify the relationship between child factors and externalizing problems such that when maternal anxiety is high, child negative emotionality will positively predict child-externalizing problems. When maternal anxiety is low, it was hypothesized that child negative emotionality would not predict child-externalizing problems as strongly. In other words, the effect of NE will occur strongly for those with high maternal anxiety while those whose mothers exhibit low maternal anxiety symptoms will have more similar EP across levels of negative emotionality.

Similarly when maternal anxiety is high, child activity level will positively predict child externalizing problems. When maternal anxiety is low, it is hypothesized that child activity level will not predict child externalizing problems as strongly. The simple effect of AL will occur strongly for those with high maternal anxiety while those whose mothers exhibit low maternal anxiety symptoms will have more similar EP across levels of AL. The same pattern of results is predicted for maternal depression as a moderator of child temperament factors (AL and NE) and externalizing problems.

Aim 4. The final objective is to determine if mother's education level will moderate the relationship between child negative emotionality and externalizing problems, and also child activity level and

externalizing problems (hypothesis 3). I hypothesized a main effect of child negative emotionality on externalizing problems, such that children who score high on negative emotionality will exhibit greater EP than those who score low on negative emotionality. This relationship will be moderated by maternal education. Children with high NE and mothers with less education will have the most externalizing problems whereas those whose mothers have more education will have lower externalizing problems across levels of NE. The relationship will not be significant for children who score low on negative emotionality. The same pattern was predicted for maternal education level as a moderator of the relationship between child activity level and externalizing problems.

3.2 Data Screening

Prior to analyses, data were screened for outliers and missing values. Outlying values 3.29 standard deviations above or below the mean were deleted from the externalizing, trait anxiety, TBAQ negative emotionality and Lab-TAB negative emotionality variables. SPSS Missing Values Analysis was run in order to screen for missing values. Two variables indicated greater than 2% missing values: externalizing (4.6%) and Lab-TAB activity level (5.1%). Little's MCAR test was run and missing values were assumed to be missing completely at random, $\chi^2(85) = 92.720, p = .266$. The expectation-maximization algorithm was used to impute missing values and these data were used for ensuing analyses.

To assess whether the data met the assumption of normality, histograms, skewness and kurtosis statistics were observed. Depression was positively skewed and underwent a square root transformation. All variables then met the assumption of normality and were used in subsequent analyses. The data met the assumptions of homoscedasticity, lack of multicollinearity among predictors and the multilevel assumption of homogeneity of level 1 variance for externalizing problems. Predictors were grand mean centered before use in multilevel models.

3.3 Associations amongst Variables

Correlational analyses were conducted to examine the relationship between study variables (Table 1). Child externalizing problems were positively associated with TBAQ negative emotionality, TBAQ activity level, EAS negative emotionality, EAS activity level, maternal depression and maternal anxiety, and EP were negatively associated with maternal education and child age. It was predicted that

parent-rated child negative emotionality and parent-rated child activity level would be positively correlated, which proved to be accurate for the TBAQ but not for the EAS.

Lab-based negative emotionality and lab-based activity level were negatively correlated. Maternal anxiety was positively correlated with maternal depression as hypothesized. Maternal depression was also positively associated with TBAQ child negative emotionality and child activity level and EAS negative emotionality. However maternal depression did not correlate with the lab-based assessments of NE or AL, nor did it correlate with EAS activity level. Maternal anxiety was positively related with EAS and TBAQ negative emotionality and activity level and child age, but not associated with lab-rated NE or AL. Maternal education was negatively correlated with EAS activity level and depression. Child age was negatively correlated with externalizing problems; both TBAQ and EAS negative emotionality and activity level, and Lab-TAB NE but positively correlated with Lab-TAB AL.

As predicted, lab-based and parent-rated activity level were not associated, as was the case for lab-based and parent-rated child negative emotionality. Notably, lab-assessed negative emotionality was only significantly linked positively with EAS negative emotionality and negatively with lab-assessed activity level and child age but not externalizing problems. Also, lab-rated activity level correlated negatively with TBAQ NE and lab-rated NE and positively with child age but not externalizing problems.

Table 1. Intercorrelations Amongst Study Variables

Measure	1	2	3	4	5	6	7	8	9	10	11
	Children (N = 196)										
1. Externalizing	—	.437**	.486**	.330**	.249**	.053	-.038	.242**	.285**	-.159	-.190**
2. TBAQ_NE		—	.428**	.600**	.004	.055	-.219**	.377**	.320**	-.049	-.149*
3. TBAQ_AL			—	.310**	.417**	.135	-.083	.308**	.423**	-.028	-.261**
4. EAS_NE				—	.032	.146*	-.133	.227**	.224**	.056	.008
5. EAS_AL					—	.044	.005	.026	.080	-.142*	-.143*
6. LabTAB_NE						—	-.214*	.028	.013	.019	-.344**
7. LabTAB_AL							—	-.002	-.054	-.024	.472*
8. STAI								—	.587**	-.051	.040
9. CES-D									—	-.253**	.006
10. EDU										—	.018
11. Child Age											—
Mean	12.804	-0.006	3.960	3.028	-0.163	-0.163	2.047	32.757	2.541	15.550	43.289
Standard Dev	7.451	0.970	0.770	0.796	1.072	1.072	0.706	7.347	1.272	2.275	12.564

Note. NE = Negative Emotionality, AL = Activity Level, EDU = Maternal Education * $p < .05$, ** $p < .01$, *** $p < .001$

Table 2. Gender Differences Amongst Study Variables

Variable	Girls (<i>n</i> = 93)		Boys (<i>n</i> = 103)		<i>t</i> -value	df	<i>p</i> -value	Effect size
	Mean(SD)	Mean(SD)	Mean(SD)	Mean(SD)				
Externalizing	12.45(7.55)	13.16(7.41)	.67	193	0.51	.09		
TBAQ_NE	.03(.97)	-.04(.98)	-.46	194	.65	.07		
TBAQ_AL	3.84(.78)	4.06(.75)	1.99	194	.048	.29		
EAS_NE	3.02(.82)	3.03(.78)	.186	194	.85	.01		
EAS_AL	3.98(.65)	4.12(.67)	1.53	194	.13	.21		
LabTAB_NE	-.21(1.00)	-.11(1.14)	.67	194	.50	.09		
LabTAB_AL	2.06(.66)	2.04(.75)	-.21	194	.84	.03		
STAI	33.82(7.49)	31.84(7.14)	-1.89	194	.06	.27		
CES-D	2.63(1.27)	2.46(1.28)	-.93	194	.35	.13		
EDU	15.75(2.31)	15.33(2.20)	-1.31	194	.19	.19		
Child Age	44.48(13.03)	42.14(12.13)	-1.31	194	.19	.19		

Note. STAI represents square-root transformed values.

Descriptive statistics and measures of central tendency were examined in order to assess whether gender differences exist (Table 2). Boys showed higher parent-rated (TBAQ) activity level than girls. There were no gender differences in externalizing problems, TBAQ negative emotionality, EAS negative emotionality and activity level, Lab-TAB negative emotionality and activity level, maternal anxiety, maternal depression, maternal education or child age. Further analyses solely utilized the TBAQ (rather than the EAS) as a measure of parent-rated child temperament in order to test hypotheses.

3.4 Hypotheses

Multilevel linear regression was conducted in order to assess the predictors of externalizing problems using R software (version 3.4.1). MLM regression accounts for our nested sample by dropping the assumption of independence in favor of estimations that consider family-level clustering of the data. Clustered data are favorable when individuals are assumed to be more similar to one another than randomly selected participants (Kenny et al., 2006). The null model was run in order to test whether the family effect was the sole predictor of externalizing problems. Level 1 and level 2 variances produced an intraclass correlation of .403. Therefore, 40.3% of the variance in child externalizing problems was accounted for at the family level. The family effect was significant, $\chi^2(1) = 23.87, p < .001$, thus justifying the decision to use MLM rather than ordinary least squares regression to determine predictors of externalizing problems. In order to test whether further analyses required controlling for child age and gender, an additional two level model was run that included family number, age and gender as random effects. This model was not significantly different from the model including only family effects, $\chi^2(2) = .312, p = .856$, therefore age and gender were not modeled in further analyses.

Hypothesis 1 stated that child negative emotionality, activity level, gender, age and maternal factors would predict externalizing behavior problems in pre-school. Using a two-level random intercept model employing restricted maximum likelihood estimation, I tested hypothesis 1 with TBAQ negative emotionality, TBAQ activity level, Lab-TAB negative emotionality and Lab-TAB activity level as predictors. As predicted, TBAQ activity level positively predicted externalizing problems, $b = 4.14, SE = 0.69, t(93) = 6.00, p < .001$, as did TBAQ negative emotionality, $b = 1.92, SE = 0.54, t(93) = 3.59, p = .002$. Unexpectedly, neither lab rated activity level, $b = .49, SE = .61, t(93) = .80, p = .43$, nor negative

emotionality, $b = -.21$, $SE = .38$, $t(93) = -.57$, $p = .59$, predicted externalizing problems. Child age and gender were not significant, nor were maternal factors of education, depression and anxiety. This full model had a deviance score significantly less than that of the null model, indicating a better fit, $\chi^2(1) = 76.04$, $p < .001$. Table 3 provides statistics for the multilevel regression.

Table 3. MLM Regression of Child and Maternal Factors Predicting Externalizing Problems

Fixed Effect	<i>b</i>	<i>SE</i>	<i>t</i> -value	df	<i>p</i> -value
Intercept	13.00	.53	24.34	96	.000***
Maternal Predictors					
Anxiety	.01	.09	-.003	96	.97
Depression	.17	.56	.31	96	.85
Education	-.36	.25	-1.43	96	.13
Child Predictors					
Gender	-.36	.88	-.40	90	.69
Age	-.08	.04	-1.90	90	.06
TBAQ Neg Emo	1.92	.54	3.59	90	.002**
TBAQ Activity	4.14	.69	6.00	90	.000***
Lab-TAB Neg Emo	-.21	.38	-.55	90	.59
Lab-TAB Activity	.49	.61	.80	90	.43

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Hypothesis 1.1 predicted that child activity level would moderate the relationship between child negative emotionality and externalizing problems. In order to test this hypothesis using only parent-rated NE and AL, TBAQ negative emotionality, TBAQ activity level and the interaction were entered into a two-level random intercepts model. Contrary to my predictions, the interaction was not significant, $b = -0.80$, $SE = 0.62$, $t(94) = -1.28$, $p = .20$. The hypothesis was also tested using only laboratory-rated NE and AL, therefore Lab-TAB negative emotionality, Lab-TAB activity level and the interaction were entered into a two-level random intercepts model. The interaction was not significant, $b = .58$, $SE = 0.56$, $t(94) = 1.05$, $p = .30$.

Hypothesis 2 stated that both maternal anxiety and maternal depression would moderate the relationship between child temperament factors and externalizing problems. To assess hypothesis 2.1, TBAQ negative emotionality, Lab-TAB negative emotionality, maternal trait anxiety and interaction terms were entered into the model. The interaction between lab-rated negative emotionality and maternal anxiety was not significant, $b = .09$, $SE = 0.62$, $t(92) = 1.40$, $p = .16$. The interaction between TBAQ negative emotionality and anxiety predicted externalizing problems, $b = -0.14$, $SE = 0.07$, $t(92) = -2.06$, $p = .04$. In order to probe the nature of the interaction, simple slopes analysis was conducted. At low levels of anxiety, TBAQ emotionality positively predicted externalizing problems, $b = 1.94$, $SE = .70$, $t(94) = 2.77$, $p = .007$. At high levels of anxiety, emotionality again positively predicted externalizing problems, $b = 3.68$, $SE = .0.74$, $t(94) = 4.99$, $p < .001$ (Figure 2).

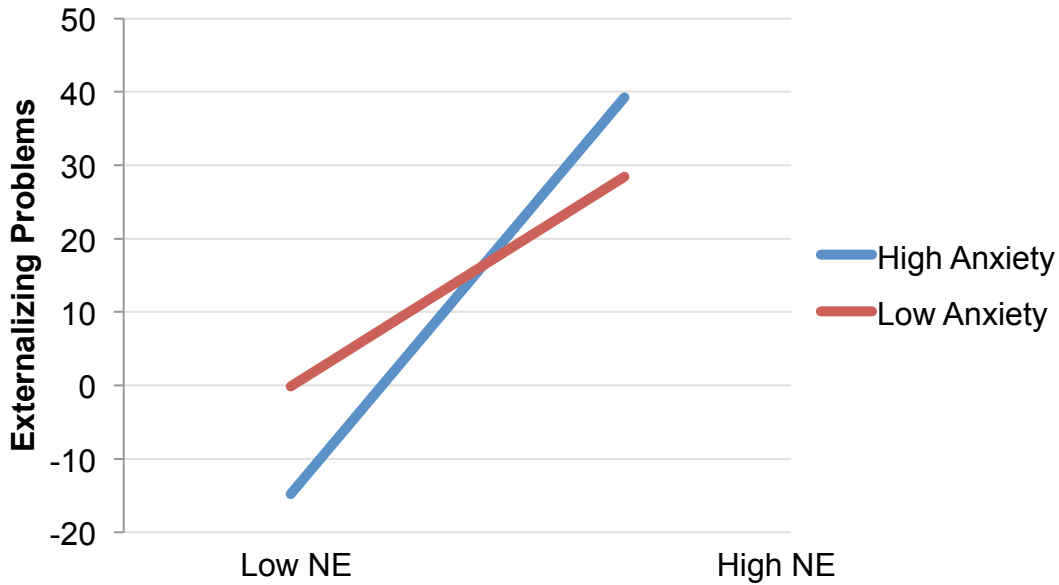


Figure 2. The interaction described in hypothesis 2.1 between TBAQ negative emotionality (NE) and maternal anxiety predicting externalizing problems.

To test hypothesis 2.2, TBAQ activity level, Lab-TAB activity level, maternal trait anxiety and interaction terms were entered into the model. Neither the interaction between TBAQ activity level and maternal anxiety, $b = .02$, $SE = .09$, $t(92) = .22$, $p = .83$, nor the interaction between lab-rated activity level and anxiety, $b = .01$, $SE = .07$, $t(92) = .13$, $p = .90$, were significant.

Parallel analyses were conducted in order to determine if maternal depression moderated the relationship between child temperament factors and externalizing problems. To assess hypothesis 2.3, TBAQ negative emotionality, Lab-TAB negative emotionality, maternal depression and interaction terms were entered into the model. The interaction between Lab-TAB negative emotionality and depression was not significant, $b = .58$, $SE = .38$, $t(93) = 1.54$, $p = .13$, and the interaction between TBAQ negative emotionality and maternal depression likewise did not predict externalizing problems, $b = -.49$, $SE = .39$, $t(93) = -1.26$, $p = .21$.

To test hypothesis 2.4, TBAQ activity level, Lab-TAB activity level, maternal depression and interaction terms were entered into the model. The TBAQ activity level x depression interaction did not predict externalizing problems, $b = .34$, $SE = .52$, $t(93) = .66$, $p = .51$. Similarly, the Lab-TAB activity level x depression interaction was not significant, $b = -.20$, $SE = .45$, $t(93) = -.43$, $p = .67$.

Hypothesis 3 stated that maternal education would moderate the relationship between child temperament factors and externalizing problems. To test hypothesis 3.1, TBAQ negative emotionality, Lab-TAB negative emotionality, maternal education and the activity level x education interaction terms were entered into the model. The TBAQ negative emotionality x education interaction was not predictive of externalizing problems, $b = .08$, $SE = .24$, $t(93) = .36$, $p = .72$. Likewise, the Lab-TAB negative emotionality x education interaction was not significant, $b = -.17$, $SE = .20$, $t(93) = -.89$, $p = .38$.

Finally, to test hypothesis 3.2, TBAQ activity level, Lab-TAB activity level, maternal education and activity level x education interaction terms were entered into the model. The TBAQ activity level x education interaction was not significant, $b = 0.12$, $SE = .26$, $t(93) = .47$, $p = .64$. However, the Lab-TAB activity level x education interaction was significantly predictive of externalizing problems, $b = 0.66$, $SE = .28$, $t(93) = 2.32$, $p = .02$. In order to probe the nature of the interaction, simple slopes analysis was conducted but yielded non-significant results at ± 1 SD of education. Johnson-Neyman floodlight analysis was conducted in order to determine regions of significance. Maternal education moderated the effect of lab-rated activity level on externalizing problems between the values of -3.51 and -1.86 on the lower bound and 4.44 to 5.75 on the upper bound (Figure 3). On the low end of education, Lab-TAB AL positively predicted EP. Similarly on the high end of education, Lab-TAB AL positively predicted EP.

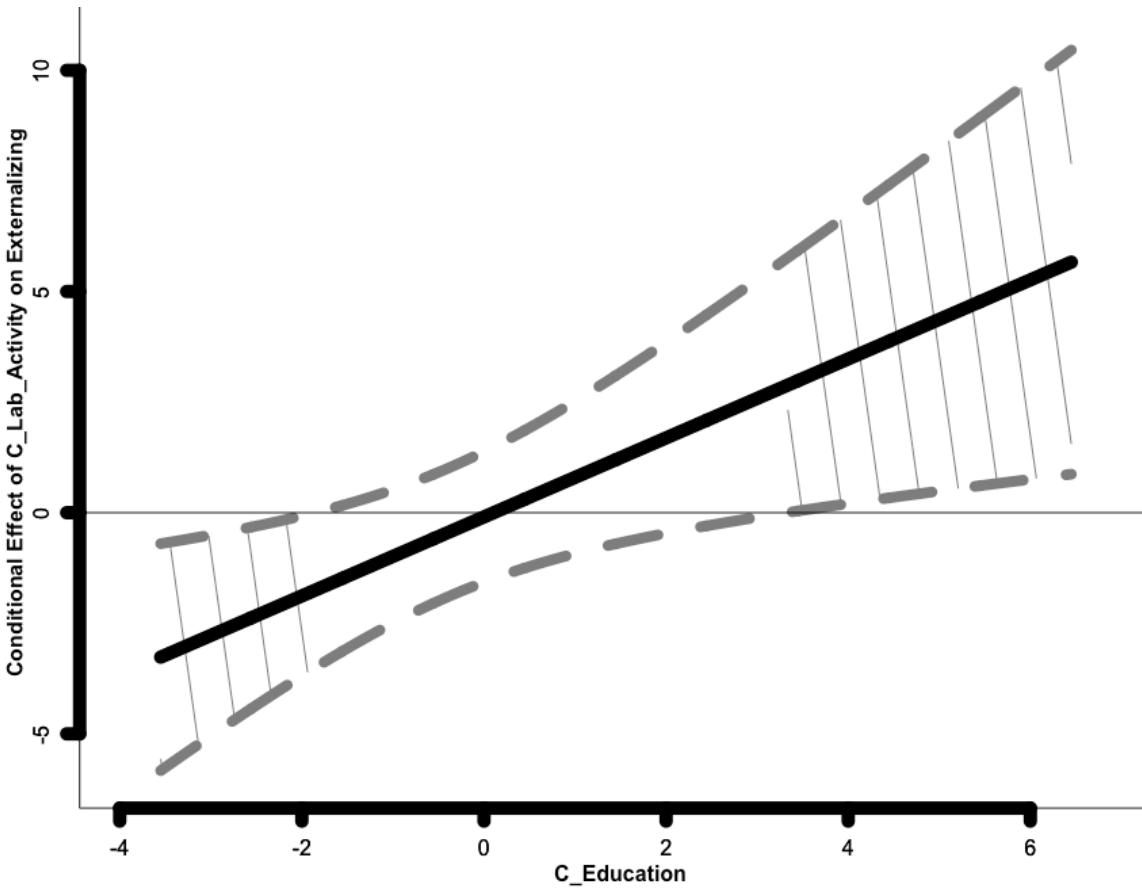


Figure 3. Moderation described in hypothesis 3.2. Maternal education (C_Education) moderates the relationship between child AL and EP. Shaded regions represent regions of significance.

Chapter 4 Discussion

The purpose of the current study was to determine predictors of externalizing problems in children of preschool age. Use of maternal and child predictors allowed for a family study design, with an emphasis on child emotionality, child activity level and maternal mental health symptoms. Extant research has shown a relationship between child temperament, maternal mental health and externalizing problems (Cummings & Davies, 1994; DiPietro et al., 2002; 2006; Van den Bergh & Marcoen, 2004; Henrichs et al., 2009) but the current study aimed to contribute to the literature by examining these relationships amongst preschoolers from a multi-method perspective. The current study found parent-rated child negative emotionality and activity level to be significant predictors of child externalizing problems. In addition,

maternal anxiety interacted with parent-rated negative emotionality to significantly predict externalizing problems, as did lab-assessed child activity level and maternal education.

4.1 Maternal x Child Effects on Externalizing Problems

Preliminary analyses revealed that externalizing problems correlated with all study variables except for Lab-TAB negative emotionality, Lab-TAB activity level and maternal education, contrary to my hypothesis. In addition, Lab-TAB negative emotionality and activity level were associated only with each other, child age and parent-rated negative emotionality (Table 1). This is potentially a result of the well-documented divergence between parent and observer-rated child temperament (Stifter, Willoughby & Towe-Goodman, 2009). This trend is particularly evident in the case of sibling or twin studies (Saudino, 2003; Saudino, Wertz, Gagne, & Chawla, 2004). Parent assessments of child temperament may be susceptible to bias (Saudino, 2003; Saudino, Wertz, Gagne, & Chawla, 2004), however parental report has the advantage of encompassing assessments of children cross-contextually. Since externalizing problems were also assessed via parental report, it follows that parent-rated child temperament is more likely to be associated with externalizing problems than lab-rated temperament.

Hypothesis 1 predicted that maternal mental health symptoms and education, child negative emotionality, activity level, gender and age would significantly predict externalizing problems. Contrary to predictions, only parent-rated child negative emotionality and activity level predicted externalizing problems. Although maternal anxiety and depression were correlated with parent-rated child temperament and externalizing problems (Table 1), neither predicted externalizing problems in the full model (Table 3). This finding contradicts existing literature that asserts a strong relationship between maternal anxiety (Achenbach, McConaughy & Howell, 1987; DiPietro et al, 2002; 2006) and maternal depression (Cummings & Davies, 1995; (Gotlib & Goodman, 1999) with a range of psychopathologies but externalizing problems in particular (Raposa, Hammen, Brennan & Najman, 2014; Van den Bergh & Marcoen, 2004).

Hypothesis 1 also stated that child activity level would moderate the relationship between child negative emotionality and externalizing problems. Contrary to my hypothesis, the interaction was not significant. Since Lab-TAB activity level and negative emotionality were not predictors of externalizing problems and interactions typically possess less power than main effects (Aiken & West, 2003), it

followed that interaction terms formed with lab-rated temperament did not produce significant results. The interaction was also tested with parent-rated activity level and negative emotionality, and this too produced non-significant results. This finding is incongruous with literature that suggests hyperactivity and negative emotionality to be linked, however most literature finds that both child temperament factors are associated with maternal mental health symptoms rather than directly with each other (DiPietro et al., 2002; 2006; Van den Bergh & Marcoen, 2004; Henrichs et al., 2009).

Hypothesis 2.1 stated that maternal anxiety would moderate the relationship between child negative emotionality and externalizing problems. The interaction between lab-rated negative emotionality and maternal anxiety was not significant. However, the interaction between TBAQ negative emotionality and anxiety predicted externalizing problems as hypothesized. At low and high levels of anxiety, TBAQ emotionality positively predicted externalizing problems, however the relationship was stronger for children whose mothers reported high trait anxiety symptoms. This is consistent with literature that shows that maternal anxiety is associated with child behavioral and emotional problems, (O'Connor et al., 2002) and high prenatal anxiety is associated with emotional dysregulation in children (Fagundes, Glaser & Kiecolt-Glaser, 2012).

Hypothesis 2.2 tested whether maternal anxiety moderated the relationship between child activity level and externalizing problems. Surprisingly, neither the interaction between TBAQ activity level and maternal anxiety nor the interaction between lab-rated activity level and maternal anxiety were significant. Research strongly supports a direct link between pre and postnatal anxiety and child hyperactivity (O'Connor et al., 2002), and highly active 3-year-olds are more likely to exhibit externalizing problems at age 5 (Denham et al., 2000). Thus it is unclear why neither interaction proved significant.

Analogous analyses were conducted in order to examine whether maternal depression moderated the relationship between child temperament factors and externalizing problems. Neither the interaction between Lab-TAB negative emotionality and depression nor the interaction between TBAQ negative emotionality and maternal depression predicted externalizing problems. Hypothesis 2.4 explored whether maternal depression moderated the relationship between child activity level and externalizing problems. The TBAQ activity level x depression interaction did not predict externalizing problems. Similarly, the Lab-TAB activity level x depression interaction was not significant. These findings are

contrary to literature that asserts a strong association between depression and child behavioral reactivity (Davis et al., 2004; Cummings & Davies, 1995) in both the domains of hyperactivity (Fernald et al., 2008) and emotional problems (Gotlib & Goodman, 1999).

Hypothesis 3 stated generally that maternal education would moderate the relationship between child temperament factors and externalizing problems. Testing hypothesis 3.1 revealed that the parent-rated child negative emotionality x education interaction was not predictive of externalizing problems and neither was the lab-assessed negative emotionality x education interaction. This finding was unexpected as it runs counter to studies that show that parental education is linked with child behavioral problems such as aggression (Dubow, Boxer & Huesmann, 2009; Boe et al., 2014).

Finally, hypothesis 3.2 determined that the TBAQ activity level x education interaction was not significant. However, the Lab-TAB activity level x education interaction was significantly predictive of externalizing problems, supporting my hypothesis. Johnson-Neyman floodlight analysis determined that education moderated the relationship between lab-assessed activity level and externalizing problems at very low and very high values of education. Studies typically link externalizing problems with low education (Dubow, Boxer & Huesmann, 2009; Boe et al., 2014; Anton, 2015), however previous research from our lab utilizing the same sample indicated that high maternal education strengthened the relationship between maternal depression and aggression whereas there was no effect at low levels of education (Spann & Gagne, 2015). Our unique findings may potentially be mediated by time spent employed outside of the home or parenting styles characteristic of mothers who report low and high levels of education. Studies have shown that authoritarian and permissive parenting styles lead to worse child outcomes (Radziszewska, Richardson, Dent & Flay, 1996; Tunde-Ayinmode & Adegunloye, 2011). Low family SES and parental education have been linked with authoritarian parenting style while high SES and parental education have been associated with permissive parenting style (Anton, 2015; Querido, Warner & Eyberg 2002; Chang, Schwartz, Dodge & McBride-Chang).

4.2 Limitations and Implications

Interpretation of this study should be tempered by consideration of limitations. Firstly, Lab-TAB variables failed to predict externalizing problems (save for the Lab-TAB AL x anxiety interaction). One possible explanation for this is systematic errors in coding of the episodes or statistical construction of the

variables, therefore the variables will be re-assessed for accuracy. Though Lab-TAB's emotion-eliciting episodes have high validity and reliability (Gagne et al., 2011), the negative emotionality-evoking End of the Line Lab-TAB episode was administered by an experimenter in a small percentage of cases, which may have had influence on children's comfort exhibiting their natural range of emotion. Studies have suggested that children exhibit more emotion to familiar individuals, especially parents (Grolnick, Brisges & Connell, 1996). A study in child emotion-regulation utilized mothers as administrators of the emotion-eliciting episodes and produced robust findings in variation levels of anger and sadness exhibited (Morris et al., 2011). Future assessments of child negative emotionality will utilize only parents as experimenters in order to ensure construct validity.

In order to circumvent the problem with our Lab-TAB variables, future study of my research questions will utilize objective global ratings of child temperament derived from trained experimenters at the conclusion of the laboratory visit in place of Lab-TAB ratings. These post-visit ratings should provide enough variability and construct validity to reveal significant findings where they exist.

An additional limitation of this study is the lack of measures of effect size to determine the strength of significant relationships due to my use of MLM. In order to gain an impression of the extent of my significant findings, I ran an ordinary least squares regression analysis. The results show that TBAQ NE accounted for 6.5% of the variance in externalizing problems, TBAQ AL accounted for 10.17%, the interaction between TBAQ NE and maternal anxiety accounted for .08% and the interaction between Lab-TAB AL and maternal education accounted for 1.96% of the variance in externalizing problems. These numbers represent small effect sizes. However, these estimates are likely positively biased due to the violation of the assumption of independent observations characteristic of nested data.

Despite the aforementioned shortcomings, the current study adds to the literature by taking a multi-method approach to studying early childhood predictors of externalizing problems. Few studies have considered child activity level and negative emotionality in concert, though Goldsmith et al. (1987) described both these elements of child temperament as factors underlying emotional arousal that is undifferentiated into the primary emotions. The current study also revealed a potential curvilinear effect of education on externalizing problems and a unique interaction between lab-rated activity level and maternal anxiety on EP. Maternal trait anxiety's moderating role between child AL and EP lend support to

a possible biological influence of anxiety on child hyperactivity (O'Connor et al., 2002; DiPietro et al., 2002; 2006). Approaching the study of predictors of externalizing problems from a family design perspective allows for conclusions of the unique effect of family-level characteristics. My findings that parent-rated child activity level and negative emotionality are predictive of externalizing problems serve to reinforce the existing literature (Eisenberg et al., 1996; Cole et al., 1996; Denham et al., 2000) while my novel finding in regards to the effect of high and low maternal education qualify common conceptualizations.

4.3 Future directions

Future studies of predictors of child externalizing problems should examine inhibitory control as a mediator between negative emotionality on EP and activity level on EP. It is well studied that inhibitory control increases with age (Gagne & Goldsmith, 2011; Spann & Gagne, 2016) as does the ability to self-regulate emotions and behavior. It then follows that development of inhibitory control could function as a mediator between these two aspects of temperament and externalizing problems.

In addition, genetic predictors of child externalizing problems should be examined. Of particular interest is the impact of the serotonin transporter 5-HTTP short form allele, which has been shown to be associated with susceptibility to mood and externalizing problems. Serotonin has mood regulation properties, thus adequate serotonin receptors as conferred by possession of the 5-HTTP long form allele are protective against stressful early life stressors (Feder et al., 2009). In addition, gene x environment interactions utilizing this allele could be explored. In particular the interaction of serotonin transporter genotype with parenting style and SES/education can be examined.

4.4 Conclusion

Self-regulation and reactivity are two domains of temperament that continue to show links to adulthood trajectories in areas including social adjustment, cognition and health (Bussing et al., 2010; Eisenberg, 2006). Predictors of externalizing problems as studied in the current paper have implications for school readiness, academic achievement, stability of peer relationships and criminality (Blair & Raver, 2015; Bussing et al., 2010). In fact, studies find that emotional regulation in particular may be the mediator between poverty and school readiness outcomes (Blair & Raver, 2015). Identifying risk factors associated with child externalizing problems, namely maternal trait anxiety symptoms, low and high

education, high child activity level and high child negative emotionality, allow for future studies to target these factors for interventions in order to attenuate negative outcomes including child psychopathology, low academic achievement, poor health and poor relationship quality (Caspi et al., 1995).

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Biographical Information

Ogechi Nwadinobi is concluding her second year as a graduate student at the University of Texas at Arlington. She received her Bachelors of Arts in Anthropology with a certificate in Neuroscience from Princeton University in 2014. Ogechi's prior research investigated the relationship between poverty and parental psychiatric history on psychopathology amongst adolescents. Ogechi has also researched long-term psychiatric effects of poverty, disease and political violence on a population in Nigeria.

Ogechi will continue her education at Texas A&M University in the department of Educational Psychology. She plans to study child temperament and environmental predictors of child learning outcomes and psychopathology. In addition, Ogechi also plans to investigate links between culture, biology and childhood temperament.