Children's Internalizing Symptoms in Anticipation of the Transition to Middle School: Causal Inferences in the Context of a Natural Experiment

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Hadas Eidelman

Dr. Stephanie M. Jones

Dr. John B. Willett

Dr. Matthew K. Nock

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Abstract

The middle-school transition has long been linked with poor social-emotional and academic outcomes for children. However to date, research on the middle-school transition has been predominantly observational, not experimental, and has not addressed whether the transition itself – or unobserved factors – cause children's outcomes. In my dissertation, therefore, I explored the causal impact of a policy that foreshortened by one year the timing of the middle-school transition on children's developmental trajectories of anxiety and depressive symptoms.

In the summer of 2006, five of the 18 schools participating in the *New York City Study of Social and Literacy Development* (Jones, Brown, Hoglund, & Aber, 2010) shifted from a pK-6 to a pK-5 structure. Students entering fifth grade in these schools in the fall of 2006, therefore, faced the new knowledge that it would be their final elementary-school year. With no evidence of advance warning to families, I argue that this shift provided an exogenous disruption to children's trajectories and therefore supported the unbiased estimation of causal impact.

I employed an analytic strategy that combined, in a single analysis, elements of three statistical approaches: the multilevel modeling of change, to estimate children's symptom trajectories over a two-year period; an interrupted time-series design, to estimate the immediate causal impact of the change in policy on children's symptoms at the discontinuity among children who experienced the policy disruption; and a difference-in-differences correction, to subtract from the estimated impact of the

disruptive policy any secular differences estimated using data from children in the non-affected schools. I found that the foreshortening of the time to middle-school transition caused a rise in children's depressive symptoms, but not in their anxiety symptoms. In addition to the causal impact of the policy, I observed developmental and gender-based patterns in trajectories of children's anxiety and depressive symptoms during the important middle-childhood period.

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Introduction

Many children experience symptoms of anxiety and depression in their pre-adolescent years, and these symptoms entail emotional suffering and physical discomfort and can lead to impaired social, emotional, and academic development (Caspi, Elder, & Bem, 1988). Although there is much still to learn about the origins, developmental course, and consequences of internalizing symptomology, we know that a mix of genetic and environmental factors are the root causes of internalizing symptoms in children (Rapee, Schneiering, & Hudson, 2009). We also know that symptoms of anxiety and depression tend to play out differently for boys and girls within, and over, time (Lewinsohn, Gotlib, Lewinsohn, Seeley, & Allen, 1998), and that life transitions produce stress that may cause increases in symptoms of anxiety and depression (Skar, 2004).

One particular transition that has been linked to poor outcomes for children is the transition from elementary school to middle school, where researchers have observed drops in students' self-esteem and competence beliefs (Wigfield & Eccles, 1994), motivation (Eccles, Wigfield, Midgley, Reuman, Mac Iver, & Feldlaufer, 1993), and academic achievement (West & Schwerdt, 2012). This transition also carries important policy implications, as there have been substantial changes to the grade-configuration structure in American public schools over time, and these changes continue to take place (Rockoff & Lockwood, 2010). In my view, such grade-reconfiguration decisions should be driven by firm knowledge of their effects on children. Despite the importance of the topic, however, much of the existing research on the impact of the middle-school transition has been observational, not experimental, and therefore this leaves questions as to whether it is the transition itself – or unobserved factors that are both linked to the transition and to developmental outcomes – that have caused the negative effects on children that have been observed.

The best way to estimate the true causal impact of the middle-school transition on children's social-emotional outcomes would be to assign children randomly to conditions of transition and non-transition. However, randomizing children into groups that do, or do not, transition from elementary school at any particular age would be both inappropriate ethically and challenging logistically. This dilemma is not uncommon in developmental research. It often arises with questions of causal impact of programs and policies on children's developmental outcomes in real-world settings. Fortunately, from a research perspective, sometimes abrupt and arguably exogenous policy shifts occur naturally, and they consequently provide analytic opportunities for the assessment of causal impacts that would, under normal circumstances, not be possible (Murnane & Willett, 2011). In my dissertation, I capitalized on one such policy shift that occurred in a small population of New York City public schools in order to estimate the causal effect of the impending transition to middle school on trajectories of children's anxiety and depressive symptoms.

Specifically, I used longitudinal data from the *New York City Study of Social and Literacy Development* (Jones, Brown, Hoglund, & Aber, 2010; Jones, Brown, & Aber, 2011) to fit multilevel models for change (Singer & Willett, 2003) that map developmental trajectories of anxiety and depressive symptoms over a two-year period –

from fourth through fifth grade – for 1,119 children in 18 urban schools[1]. In addition, I incorporated an interrupted time-series (ITS) approach to estimate the causal effect on child anxiety and depressive symptom trajectories of an unexpected shift in the impending transition to middle school from the end of sixth grade to the end of fifth grade. This shift in transition affected 246 of the children in my sample, and these children were nested in 5 of the 18 study schools. I argue that, under reasonable assumptions, this permits me to estimate the causal impact of the policy shift on children's internalizing symptom trajectories. Because children in the remaining 13 schools in the study were unaffected by the shift, I was able to incorporate into the same analysis elements of a difference-in-differences (DiD) approach (Murnane & Willett, 2011) to remove any bias due to unrelated events that occurred concurrently with the policy shift and to improve the precision of my estimate of causal impact. I expect my research to contribute to knowledge about the development of internalizing symptoms throughout middle childhood as well as provide more definitive evidence regarding the causal impact of the middle-school transition on critical aspects of children's development.

Below, I review the literature on anxiety and depressive symptoms in school-age children, and on the effects of the middle-school transition on children's developmental outcomes. I then state my research questions and hypotheses, and describe my research design and analytic strategy. Finally, I present the results of my analyses and discuss the implications and limitations of my work.

[1] These children represent a subset of the full study sample, which comprises data from 1,304 children followed over three years (beginning in third grade and ending in fifth grade). The 1,119 children in my sample are those with valid data on at least one measurement occasion in fourth or fifth grade for either anxiety or depressive symptoms.

Background and Context

Anxiety and Depression in Childhood: Context, Co-occurrence, and Epidemiology

Anxiety and depressive symptoms, often referred to as internalizing symptoms (Achenbach, 1966), represent an important component of children's mental health in middle childhood. Worry and sadness are typical features of children's emotional development, but there are some children who worry or feel sadness more intensely than others (Thompson & Lagattuta, 2006). Researchers estimate that the cumulative prevalence of clinical anxiety or depressive disorder in children is about 10% by the age of sixteen (Costello, Mustillo, Erkanli, Keeler, & Angold, 2003). For children with extreme levels of internalizing symptoms, the experience and persistence of these emotions can obstruct their healthy development (Rapee, Schneiering, & Hudson, 2009). The negative effects of high internalizing symptomology in childhood can be persistent, and many anxious or depressed children go on to become anxious or depressed adults (Roza, Hofstra, van der Ende, & Verhulst, 2003). Further, both anxiety and depressive disorders are associated with future suicidal ideation and, in some cases, suicide attempts (Nock, Hwang, Sampson, & Kessler, 2010). Unfortunately, despite the relatively common, and treatable, nature of anxiety and depressive disorders, many children and adults who experience them do not receive appropriate mental health services (Farmer, Burns, Angold, & Costello, 1997; Mojtabai et al., 2011). Taken together, these factors suggest that a better understanding of children's experiences of internalizing symptoms and their causes will help guide efforts not only to reduce the incidence of internalizing symptoms in children, but also to decrease the persistence of those symptoms and contribute to the overall well-being of future adult populations.

Anxiety in childhood is characterized by substantial worrying, agitation, and distress, and children who experience anxiety often face emotional suffering as well as physical discomfort (APA, 2000; Panichelli-Mindel, Flannery-Schroeder, Kendall, & Angelosante, 2005; Rapee, Schniering, & Hudson, 2009). Anxiety disorders are relatively common, representing one of the most prevalent categories of childhood psychopathology (Merikangas et al., 2010; Rapee et al., 2009). Further, as children mature and assume more adult responsibilities, their experiences with anxiety, and the ensuing ramifications, can become more severe (Caspi, Elder, & Bem, 1988; Last, Hansen, & Franco, 1997). Because the factors that are associated with children's development of anxiety disorders are both temperamental and environmental (Mian, Wainwright, Briggs-Gowan, & Carter, 2011), studying the impacts of school-based policies on children's anxiety symptoms holds potential implications for mental-health interventions.

Depression in childhood entails sadness or irritability, a lack of interest in activities, and a variety of other symptoms such as weight gain or loss, sleep troubles, or feelings of worthlessness (APA, 2000). Angold, Weissman, John, Wickramaratne, and Prusoff (1991) group the symptoms of childhood depression into five conceptual categories: cognitive symptoms, such as guilt or feelings of worthlessness; vegetative symptoms, including changes in weight, insomnia, or hypersomnia; attentional symptoms, such as fatigue and trouble concentrating; suicidal symptoms, including suicidal ideation and attempts, as well as thoughts of death; and melancholic symptoms, such as agitation, moodiness, and loss of pleasure or interest in activities. Beyond the distress that children with depression feel, their mental-health status can be accompanied by negative impacts on other family members, such as parents experiencing marital conflict or feeling worried or incompetent, and siblings having difficulties in their relationships (Farmer, Burns, Angold, & Costello, 1997). As with anxiety, the examination of impacts of school-related phenomena on children's depressive symptoms is relevant for children, families, and schools.

Anxiety and depression often co-occur in children and adolescents. Avenevoli, Stolar, Li, Dierker, and Merikangas (2001) observed anxiety and depression disorders in a sample of 203 children who were assessed on 3 measurement occasions over a several-year period and whose ages at baseline ranged from 7 to 17 years old. They found that the majority (74%) of children who had experienced depression had also experienced an anxiety disorder. In their sample, it was indeed more common for children to have experienced both depression and anxiety disorder at any point during the years of the study (either separately, with a lag between disorders, or at the same time) than for children to have experienced only one disorder or the other. Similarly, Costello et al. (2003) used longitudinal data on 1,420 children, whose ages ranged from 9 to 13 at the beginning of the study, to examine the prevalence of different psychiatric disorders over time. They found a high level of concurrent comorbidity between anxiety and depression, meaning children had experienced both disorders within a three-month period over the course of the study. Consistent with Avenevoli et al. (2001), their findings showed that children with current depression were likely to have experienced prior anxiety, and vice versa, over the 8-year study period. This finding was especially strong for girls, for whom the relationship between prior (or current) anxiety and current (or prior) depression remained even after controlling for concurrent comorbidity between the two (Costello et al., 2003).

Despite their co-occurrence, however, there are important differences in the developmental timing of anxiety and depression in children. Recent epidemiologic evidence suggests that although both depression and anxiety are known to rise in adolescence, there is evidence that the rise in the prevalence of anxiety disorders occurs earlier in children's development than any rise in depression. Merikangas et al. (2010) used data from the National Comorbidity Survey – Adolescent Supplement (NCS-A; Kessler et al., 2009) to examine the lifetime prevalence of mental-health disorders in a nationally representative sample of 10,123 U.S. adolescents between the ages of 13 and 19. They found that anxiety disorders began in early childhood, with around 8% of children experiencing anxiety disorder at some point in their lives by the age of 4. This rate rose steeply throughout middle childhood and continued to rise, although less steeply, after age 12, when the cumulative lifetime prevalence of anxiety disorder was around 27%. In contrast, the prevalence of mood disorders (including depression) was relatively low in childhood and reached 10% only when children were around 13 or 14 years old, at which point the cumulative lifetime prevalence began to rise. In fact, the authors found that the median age at which children first experienced anxiety disorder was 6 years, whereas the corresponding age for mood disorders was 13 (Merikangas et al., 2010).

Similarly, Roza, Hofstra, van der Ende, and Verhulst (2003) followed a random sample of 1,580 Dutch children, who were 4 to16 years old at baseline, over several measurement occasions across fourteen years. The authors examined lifetime prevalence of mood and anxiety disorders among these children, and they too found that the rise in prevalence of mood disorders did not occur until children were 13, while the increase in anxiety disorders was evident for children starting around age 5 (Roza et al., 2003). In this dissertation, I estimated developmental trajectories separately for anxiety and depressive symptoms at a crucial point in children's development, as they approached adolescence. By examining the two separately, I was able to highlight potentially-important differences in their developmental timing.

Anxiety and Depression in Childhood: Differences by Gender

There are important differences in the prevalence of anxiety and depression between males and females that begin in childhood and persist throughout the lifespan. In adults, women experience both depression and anxiety disproportionately more than men (Costello et al., 2003; Kessler, Berglund, Demler, Jin, Merikangas, & Walters, 2005; Roza et al., 2003). There is evidence that the gender difference in anxiety disorders begins earlier in children's development than the gender difference in depressive disorders. Lewinsohn, Gotlib, Lewinsohn, Seeley, and Allen (1998) conducted diagnostic interviews to establish retrospectively the lifetime prevalence of anxiety disorders in 1,507 adolescents and found that girls displayed higher rates of anxiety relative to boys as early as age 6. In a meta-analysis that integrated the results of 26 studies and therefore included almost 60,000 children, Costello, Erkanli, and Angold (2006) found that for depressive disorders, the higher prevalence rates in girls seemed to happen later, as children entered adolescence.

Consistent with these findings, Roza et al. (2003) found that the rise in cumulative incidence for both depressive and anxiety disorders was accompanied by a divergence of the prevalence rates between females and males; meaning, the point at which girls' rates of prevalence became notably higher than boys' occurred during childhood for anxiety disorders and during adolescence for mood disorders. These gender differences in anxiety and mood disorders persisted, and continued to grow, into adulthood (Roza et al., 2003). Given the importance of gender in children's experiences of internalizing disorders, I tested explicit hypotheses about sex differences in trajectories of children's anxiety and depressive symptoms as an important part of my dissertation work.

Transition to Middle School: History and Effects on Children's Developmental and Academic Outcomes

In their 2004 book, "Focus on the Wonder Years: Challenges Facing the American Middle School," Juvonen, Le, Kaganoff, Augustine, and Constant cover, among other topics, the history of the formation of middle schools in the United States. Prior to 1900, American school children tended to be educated first in primary schools (up through eighth grade) and then in secondary schools (ninth through twelfth grades). Around the turn of the century, however, separate schools for the middle grades began to be incorporated into the public-school system, a movement that continued, in various iterations, throughout the twentieth century. The arguments for establishing middle-grade schools were several, including the changing developmental needs of children approaching adolescence, the need to accommodate growing numbers of immigrants entering public schools, increasing school enrollments in general, and the educational needs and goals specific to students who were expected to later transition into high schools and join the labor force.

Despite the developmental focus of some of the calls to action that supported middle-school formation throughout the 1900's, however, Juvonen et al. (2004) contend that the primary catalysts for the creation of middle schools were in reality more practical in nature (for example, overcrowding in elementary schools, etc.). Thus, the processes through which middle schools emerged onto the American public-educational landscape and the implementation of this restructuring resulted in middle-school settings that have not consistently met the educational and developmental needs of their students historically. The authors, through careful review of the literature on the middle-school transition, argue that one main reason for the poor effectiveness of such schools is that the time when children enter puberty is simply an inappropriate time to also make a school transition (Juvonen et al., 2004).

The transition to middle school has been shown to be linked with negative developmental outcomes for children. A wealth of observational research in the late 1980's and 1990's suggested that the middle-school transition had negative effects on children's self-esteem, feelings of competence, and their ratings of the importance of school (e.g., Wigfield & Eccles, 1994). Researchers also found that middle-school students experienced lower levels of academic motivation post-transition (Eccles, Wigfield, Midgley, Reuman, Mac Iver, & Feldlaufer, 1993). The broadly accepted rationale for why many of the negative outcomes in students at the transition to middle school occurred was that the fit between the developmental and academic needs of early adolescents and the environmental and contextual features of middle schools (from individual relationships with teachers to federal middle-school policies) was often poor and mismatched (Eccles & Roeser, 2009).

More recent research has employed an interesting comparison strategy to detect demonstrable negative impacts of the middle-school transition on children's academic performance. Rockoff and Lockwood (2010) compared the standardized test scores of New York City public-school students who transitioned to middle school to the scores of those who, by virtue of being enrolled in K-8 schools, did not[2]. They found that middle-school students earned lower test scores in their transition year than their K-8 counterparts, on tests of both mathematics and English. West and Schwerdt (2012) used a similar approach with data from the state of Florida to compare test scores between students who transitioned to middle school (either in sixth or seventh grade) and students who were enrolled in K-8 schools and therefore did not make a school transition until high school. They found similar transition-year drops in students' mathematics and reading achievement that the authors estimated as equivalent to 3.5 to 7 months of learning. Furthermore, West and Schwerdt found that students' achievement continued to drop, relative to the achievement of their K-8 peers, for the duration of their middle-school experiences (2012).

Despite the growing body of evidence that the middle-school transition presents challenges for pre-adolescent students, the literature is substantially less definitive about the mechanisms that are hypothesized to link the middle-school transition to negative student outcomes. Some scholars have suggested that negative outcomes for children may be attributed to lower classroom quality (Holas & Huston, 2012). Others implicate the structural differences between elementary and middle schools (e.g., Eccles et al., 1993;

[2] Rockoff and Lockwood use data from students in the NYC public school system from the academic years of 1998-1999 through 2007-2008. Although these years overlap with my dissertation sample, Rockoff and Lockwood, for analytical reasons, restrict their sample to children who entered third grade prior to the 2003-2004 school year. Despite the lack of overlap between their analytic sample and mine, it is reasonable to think that the generalizability of their results would extend to the students in my sample.

West & Schwerdt, 2012), including the larger social pool, increased academic demands, and more frequent transitions of teachers throughout the day. Some researchers have argued that these differences make it more difficult for middle-school students to form strong supportive relationships with teachers and peers, and that these factors account for the negative social-emotional and academic outcomes attributed to the middle-school transition (Eccles & Roeser, 2009; Barber & Olsen, 2004). These ideas represent a set of hypotheses that places the locus of the effects of this middle-school transition in contextual changes that occur in middle school.

It is also possible that the negative outcomes that children experience at the transition to middle school are simply developmental in nature. That is, the higher rates of internalizing symptoms in children as they approach adolescence may be about adolescence itself (e.g., Avenevoli et al., 2001), and therefore may be orthogonal to any structural changes in context associated with school transition. For instance, Cicchetti and Rogosch (2002) attribute some of the vulnerability to psychopathology present during adolescence to the organizational changes occurring internally for children during this phase of development. Arguably, the elevation in negative developmental outcomes that accompanies the middle-school transition is, in part, attributable to the transition itself and, in part, attributable to the normative developmental shifts that accompany adolescence.

Transition to Middle School: Might Negative Effects Begin Prior to Transition?

I hypothesize that the negative impacts of the middle-school transition on children's development may in part be the result of yet another phenomenon, the children's emotional state surrounding their anticipation of the forthcoming transition.

This possibility has been relatively unexplored in research to date. However, we can imagine a scenario where children's anticipation of the transition into middle school may impact their subsequent response to the transition itself. For example, a child who is scared of the unknown and not sure about what to expect from the move to a larger, unfamiliar middle-school setting may develop anxiety surrounding the upcoming move before she even leaves elementary school. Or perhaps another child, who knows he will be separated from his friends when they leave for different middle schools, may begin to get into fights with those very friends as a coping mechanism in response to the impending attenuation in those relationships. These types of pre-transition emotional responses could plausibly, either in and of themselves or through a chain of events they set in motion, affect children's subsequent responses to the transition itself.

Although I have not found research that explores this 'anticipatory' hypothesis directly, there is some research that provides indirect support for my hypotheses by showing that certain characteristics of children's social-emotional wellbeing just prior to the middle-school transition are predictive of their adjustment to the transition. For example, Lord, Eccles, and McCarthy (1994) found that positive factors in children's lives prior to the transition were protective against a negative response to the transition. Similarly, Roeser, Eccles, and Freedman-Doan (1999) found a general continuity of children's positive or negative profiles of adjustment from the late-elementary school years into the beginning of middle school. Although findings of this sort do not assess children's anticipation of the transition to middle school explicitly, they do suggest that understanding children's emotional states at the end of elementary school can help to illuminate the mechanisms that guide their transition into the middle-school grades. This core idea is one of the guiding principles of my dissertation work.

Given evidence of the negative impacts of the transition to middle school on children's emotional and academic adjustment, combined with research that supports the concept of continuity of children's outcomes from elementary to middle school, it is possible that children may respond to anticipation of the impending transition with elevated internalizing symptoms. These elevated symptoms, in turn, may begin a process that sets the stage for students' subsequent negative responses to the shift itself. In the natural experiment presented in my dissertation, the main "experimental" distinction is between the group of children who experience a policy shift that foreshortens the timing of their transition to middle school and the group of children whose timing to middle-school transition does not change. I believe therefore that my thesis provides an opportunity to explore the hypothesis that the negative outcomes children experience with the middle-school transition may begin prior to the transition itself, in its anticipation.

Conclusion: Research Questions

For my dissertation, I analyzed data collected on 1,119 children nested in 18 New York City elementary schools over their fourth and fifth-grade years. In the summer between fourth and fifth grade – for a subset of these children, embedded in only five of the study schools (n=246) – a policy shift occurred that foreshortened their transition to middle school by one year. This subset of students found out, therefore, that their schools – having previously enrolled students through sixth grade – would immediately shift to enrolling students only through fifth grade. As a direct result of the change in policy, the students in these five schools, having believed previously that they would transition to middle school after sixth grade, were now embarking on their fifth-grade year with the new knowledge that it would instead be their final year of elementary school. Because I have no evidence there was any reasonable advance warning to families that this policy change would occur, I argue that it is an exogenous source of potential influence on children's developmental trajectories that provides me with an appropriate basis for estimating a causal impact of the policy shift and testing hypotheses about the impact of the anticipated transition to middle school.

In my dissertation, I took advantage of this exogenous difference in children's anticipation of the middle-school transition to estimate the causal impact of the foreshortening of the timing to transition on children's trajectories of internalizing symptoms. To do this, I adopted an analytic approach that combined, in a single analysis, elements of the multilevel modeling of change (MLMC), the interrupted time-series (ITS) design, and a difference-in-differences (DiD) estimation strategy. In Figure 1, where I provide a visual depiction of the study design, I show that the overall MLMC design established children's hypothesized trajectories of internalizing symptoms over the fourth and fifth grade years. Into my specification of statistical models for these trajectories, I incorporated ITS-based parameters to represent the immediate causal impact of the unanticipated foreshortening of students' time to middle-school transition for the subset of students whose schools shifted from pK-6[3] to pK-5 enrollments. I then removed an important potential source of bias from my ITS-based estimate of the causal impact of the policy shift (a bias that would have been induced in the findings if other unobserved

[3] One school went from a K-6 to a pK-5 structure.

features of the children's experiences had changed discontinuously concurrent with the policy shift) by using a difference-in-differences (DiD) strategy to compare the trajectories of the affected students (*n*=246) with those of the remaining 873 students in the other 13 study schools, who would transition ultimately to middle school at the same time, but for whom the timing had always been clear and unchanging. Including all of these pieces in my analysis simultaneously provided me with an unparalleled opportunity to parse the unique contributions of development and anticipation of the transition toward children's internalizing-symptom trajectories in middle childhood.

I addressed three specific research questions in my study, beginning with a question that simply sought to describe, and document potential gender differences in, children's trajectories of anxiety and depressive symptoms in fourth grade, as follows:

RQ1: Do trajectories of children's anxiety and depressive symptoms rise over the fourth-grade year, and are these trajectories steeper and more elevated, on average, for girls than for boys?

In addressing this question, I hypothesized that children's anxiety and depressive symptoms would indeed rise over the fourth-grade year. Further, I hypothesized that symptoms would be elevated, on average, for girls over boys. In addition to the hypothesized difference in elevation, I predicted that the rate of change in the rise of anxiety symptoms in fourth grade would be steeper for girls than for boys, while I did not expect to see differences in slope between boys and girls for depressive symptoms. I based this last hypothesis on prior research showing that the accelerated rise in girls' anxiety disorders as they approach adolescence, when their rates begin to diverge from those of boys, seems to occur earlier for anxiety, as compared to depressive, disorders (i.e., Lewinsohn et al., 1998).

My second specific research question concerned the immediate impact of the policy shift on children's trajectories of anxiety and depressive symptoms, as follows:

> RQ2: Does an arguably exogenous policy shift, occurring between fourth and fifth grade, that resulted in a foreshortening of the transition to middle school (to fifth-grade graduation from the previous policy of sixth-grade graduation) cause elevations in children's anxiety and depressive symptoms at the point of the shift, and are these elevations more pronounced for girls than boys?

Under this question, for each of my internalizing symptom outcomes, I held competing hypotheses. For trajectories of anxiety symptoms, one hypothesis was that if children were indeed surprised by the policy shift and overwhelmed by the impending transition, then the policy, possibly through the mechanism of worrying about the unknowns the middle-school future holds for children or the stress of the administrative process of finding, applying for, and getting into a middle school one year earlier than expected, would cause sudden discontinuous jumps in the elevation of children's anxiety symptoms at the point of the policy shift. For the reasons I presented above, I hypothesized that this discontinuous shift in elevation would be higher for girls than for boys. However, in my competing hypothesis, if the anticipation of the transition, and not the transition itself, were not a salient enough trigger for children's worries, then the policy may have caused no discernable disruption in the trajectories of children's symptoms. Similarly, for trajectories of depressive symptoms, I hypothesized that there could be an effect of the policy, plausibly driven by children's anticipation of the loss of relationships and familiarity with surroundings that accompany the middle-school transition. Again, I hypothesized that this effect would be larger for girls than for boys. On the other hand, because these losses would have not yet occurred, I held a competing hypothesis that there may have been no detectible effect of the policy on the trajectories of children's depressive symptoms.

My third, and final, research question concerned the rate of change in the children's trajectories of anxiety and depression after the policy shift, as follows:

RQ3: Are children's trajectories of anxiety and depressive symptoms *after the policy shift* steeper during fifth grade for students who experienced a foreshortening of the transition to middle school, and is the steepness of trajectories more pronounced for girls than for boys?

For this question, I hypothesized that if there were an immediate effect of the policy on children's internalizing symptoms, then that effect would persist and potentially intensify throughout fifth grade. For example, if the policy shift caused an increase in children's anxiety symptoms, I hypothesized that the slopes of their anxiety trajectories would be steeper in fifth grade than they were in fourth, as children approached the actual transition to middle school. Further, I hypothesized that this effect would be magnified for girls such that the change in their fifth-grade anxiety symptom trajectories would be larger than for boys. For depressive symptoms, I also hypothesized that children's fifth-grade trajectories would be steeper than their fourth-grade trajectories, if there were an effect of the policy. However, in the case of depressive symptoms, I hypothesized that girls' trajectories would remain at a higher elevation than boys', but I did not anticipate that the increase in the rate of change would be more pronounced for girls than for boys.

Research Design

Dataset

I used data drawn from the *New York City Study of Social and Literacy Development* (one of seven evaluations of Social and Character Development initiatives embedded in the Social and Character Development research network (NCER, 2010)), in which rich longitudinal data were collected over three years on children in third, fourth, and fifth-grade classrooms in 18 public elementary schools in New York City. The dataset contains values of a variety of demographic, social-emotional, behavioral, and academic measures, collected at the beginning of fall and end of spring semesters in each grade. Data collection started in the fall of the 2004-2005 academic year, when children in the sample entered the third grade and ended in the spring of the 2006-2007 academic year, when children completed the fifth grade. Because the instrument that was used to measure children's anxiety and depressive symptoms changed between the first and second years of the study (and therefore measures of these symptoms were not vertically equatable across the modification in instrument), I limited the sample for analysis in my dissertation to the final two years of data collection, which provided me therefore with a total of four waves of vertically-equated outcome data on each child.

Sample

I analyzed panel data on the 1,119 students who contributed at least one wave of data over the four measurement occasions. In Table 1, I display descriptive statistics for sample children on selected characteristics, by wave of the study. Notice that the average age of students at the first wave of data collection (fall of fourth grade) was 9 years and 6 months. The sample comprises 539 boys (48.2%) and 580 girls (51.8%). Children in the sample had an average score of 1.52 on a sociodemographic risk index and an average score of 2.01 on an index of community risk factors. Children exhibited average anxiety-symptom ratings of 0.46 and average depressive-symptom ratings of 0.30, across all four waves of data collection. I define these risk indices and symptom scales in greater detail in the *Measures* section, below.

On average, each student contributed just over three (3.14) waves of data. Of these 1,119 students, 246 (123 boys and 123 girls) were enrolled in schools whose policy about the timing of transition to middle school changed between children's fourth and fifth-grade years. These students contributed to the estimation of parameters describing the interrupted time-series (ITS) portion of my analysis. The remaining 873 students (416 boys and 457 girls) contributed to parameters describing the estimation of a secular trend in children's internalizing symptoms, which then played a role in the difference-in-differences (DiD) portion of my analysis. Meanwhile, data from all students in the sample contributed to the estimation of parameters describing the trajectories of the internalizing symptoms in fourth and fifth grade, thereby making up the multilevel modeling of change (MLMC) portion of my analysis.

Measures

For my analysis, I formatted my longitudinal data as a person-period dataset (Singer & Willett, 2003), in which each row contained information on each child at each measurement occasion, including values for the following variables:

Outcomes.

Anxiety symptoms: ANX. One of my two main outcomes, *ANX*, recorded children's time-varying level of anxiety symptoms. On each of four measurement occasions (fall of fourth grade, spring of fourth grade, fall of fifth grade, and spring of fifth grade), participating children responded to 13 items that assessed their anxiety symptomology using the Behavioral Assessment System for Children (BASC: Reynolds & Kamphaus, 1998). On each item, children rated whether or not the particular statement applied to them (where 0=*no*; and 1=*yes*). Items included statements such as "I worry about little things," "I worry but I don't know why," "I get nervous when things do not go the right way," and "I worry about what is going to happen." Study team members then summed the children's ratings across the 13 items and divided by 13 to average them; producing an aggregate child-anxiety score that could range from 0 to 1 (estimated Cronbach's α reliabilities of the composite measure were 0.817, 0.822, 0.835, and 0.839, respectively, for the four time points).

Depressive symptoms: DEP. My second main outcome, *DEP*, recorded children's time-varying level of depressive symptoms. On the same four measurement occasions (fall and spring of fourth and fifth grades), participating children responded to 13 items that assessed their depressive symptomology, also using the BASC (Reynolds & Kamphaus, 1998). On each item, children rated whether or not the given statement applied to them (where 0=*no*; and 1=*yes*). Items on the depressive-symptoms scale included statements such as, "I used to be happier," "Nobody ever listens to me," "I feel like my life is getting worse," and "I don't seem to do anything right." Study team members then summed and averaged children's ratings across the 13 items, resulting in an aggregate depressive-symptom score that could range from 0 to 1 (estimated Cronbach's α reliabilities of the composite measure were 0.824, 0.860, 0.860, and 0.873, respectively, for the four measurement occasions).

Question Predictors.

Time: TIME. To provide a key predictor for the individual growth model and a forcing variable for the interrupted time-series portion of my research design, I recorded the values of *TIME*, measured in number of years and centered at zero at the point of discontinuity. However, to also account for heterogeneity in children's development while accommodating the ITS design, I retained for each child their chronological age at the point of discontinuity and incorporated this individual-specific value for age in all my statistical models as a time-invariant covariate – see *AGE*, below. Because I cannot know with certainty when children found out about the foreshortening of their timing to the middle-school transition, I set the point of discontinuity at July 15, 2006, an arbitrary point during the summer prior to children's entry into fifth grade (in subsequent sensitivity analyses, I tested the robustness of my findings to reasonable redefinitions of the July 15 date)[4]. This meant that the value of *TIME* was equal to 0 for each child at the point of disruption, as is standard for a forcing variable (Murnane & Willett, 2011).

Timing of policy shift: SHIFT. To incorporate the exogenous policy shift into children's developmental trajectories, I defined a time-varying dichotomous variable, *SHIFT*, to indicate whether children's data at each measurement occasion were collected

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[4] I included in my work sensitivity analyses where I fit two additional models using different dates for the discontinuity, one set at the last day of the 2005-2006 school year (when children completed the fourth grade) and the other at the first day of the 2006-2007 school year (when children entered fifth grade) to provide a lower and upper bound, of sorts, for the impact of the policy. I report on these sensitivity analyses in the results section of this dissertation.

before, or after, the policy shift (set at July 15, 2006, as described above). Following standard practice (Murnane & Willett, 2011), I set values of *SHIFT* equal to zero for occasions prior to the policy shift (fall and spring of fourth grade) and equal to one on occasions after the policy shift (fall and spring of fifth grade).

Membership in the group experiencing discontinuity: ITSGROUP. To account for the difference-in-differences portion of my design, I defined a time-invariant dichotomous variable, *ITSGROUP*, to indicate whether students were enrolled in one of the five schools that experienced the policy shift (*ITSGROUP* =1) or in one of the other thirteen schools in the study (*ITSGROUP* =0).

Child gender: GIRL. Detection of gender differences in children's anxiety and depressive-symptom trajectories in fourth and fifth grades, and in the response of those trajectories to the policy shift, was an important part of my analysis. I distinguished girls from boys by values of a time-invariant covariate, *GIRL* (where 0=*boy* and 1=*girl*).

Covariates. In all my statistical models, I controlled for the values of socioeconomic status and neighborhood risk indices that were related plausibly to children's anxiety and depressive symptoms, in order to improve the precision of my estimates. The inclusion of these covariates is standard for this literature. I also included as a covariate the child's chronological age (in years) at the point of discontinuity, as referenced above.

Socioeconomic risk index: SRISK. *SRISK* was an ordinal variable whose values summed the presence (or absence) of four key socioeconomic risk factors: (1) whether or not the child lived in a single-parent household; (2) whether or not family income was below 185% of the Federal Poverty Line; (3) whether or not a parent had less than a high school degree; and (4) whether or not there was a parent in the home who was unemployed. For each risk factor, its presence was coded as a score of 1, and its absence was coded as 0. Therefore, *SRISK* could take on integer values from 0 (indicating that *none* of the four risk factors were present) to 4 (indicating that *all* four risk factors were present). Although *SRISK* was measured at multiple time points, in my models I included each child's first-available valid measurement of *SRISK* as a time-invariant covariate. For details about the implications of this choice of specification, see *Appendix A*. Because the time point at which children first had valid values for *SRISK* differed across children, I included dummy variables in my models to distinguish the time point at which each child's first *SRISK* value was measured.

Community factor risk index: CRISK. To represent community-level risk, I used a composite variable that represented an average of parent ratings on 7 items in a questionnaire that asked them to rate whether the given statement applied to their neighborhood either *not at all* (=1); *a little* (=2); *somewhat* (=3); or *a lot* (=4). Examples of items were that litter/trash pickup was a problem in the neighborhood, that drugs were sold or used by people in the neighborhood, that there were overpopulated houses or apartments in the neighborhood, and that people were injured or killed with guns or knives in the neighborhood. Research assistants summed and then averaged parents' ratings across the 7 items, resulting in an aggregate community-risk score that could range from 1 to 4. Although *CRISK* was measured at multiple time points, in my models I included each child's first-available valid measurement of *CRISK* as a time-invariant covariate. For details about the implications of this choice of specification, see *Appendix*

A. To control for heterogeneity in the timing of children's first-available *CRISK* measurement, in my models I included also dummy variables to distinguish the time point at which each child's first value for *CRISK* originated.

Child age: AGE. In my statistical models, I accounted for potential developmental differences in children's levels of internalizing symptoms by including each child's age (in years) at the point of discontinuity. I used *AGE* as time-invariant, as the passage of time itself was already accounted for by *TIME*.

School fixed effects. In order to account for the nesting of children in particular schools, in all my statistical models I included indicator variables to distinguish the schools in the sample, with one school omitted to act as the reference category.

In the section that follows, in which I describe my data-analyses and present the specification of my principal statistical models, I refer to *SRISK*, *CRISK*, *AGE*, and their relevant interactions as the vector of covariates, ***Z***. I also included in vector ***Z*** the school-level fixed effects[5].

Data-Analytic Strategy

I addressed my research questions by fitting multilevel models for change that incorporated elements of the interrupted time-series (ITS) and difference-in-differences (DiD) designs. In Figure 2, I present histograms of the sample distributions of anxiety and depressive symptoms, my two outcome measures, at each time point. Because the

[5] These fixed effects of school also accounted for the experimental design of the original data collection, a study evaluating the effectiveness of a literacy-based social-emotional intervention to reduce children's aggression, which is irrelevant to my research. Full details of the intervention goals and randomization process can be found in Brown, Jones, LaRusso, & Aber (2010). Although I did not expect to find treatment effects of the intervention in my study, the inclusion of the school fixed effects accounted for potential confounds associated with treatment status, which was assigned at the school level.

histograms revealed floor effects for each outcome, where children's scores were stacked at the low end of the scale, I used a tobit regression approach to fit my hypothesized models in order to account for the left-censoring in my outcomes (Singer & Willett, 2003). I addressed all three of my research questions, for each respective outcome, within a single final fitted multilevel model. This included: (a) estimating the elevation and rates of change of internalizing symptom trajectories for students over their fourth and fifth-grade years, before and after the policy shift; and (b) estimating the causal impact of the policy that foreshortened the transition to middle school on the elevations of trajectories for the subset of affected children. In addition, from the fitted final model, I obtained estimates that contrasted the levels of internalizing symptoms as well as the policy impact between boys and girls. By incorporating a second-difference from the DiD component of my design directly into the statistical model, I was able to enhance the causal interpretation and precision of my estimate of the impact of the policy shift beyond what would be possible with an ITS design alone.

Thus, to address all of my questions simultaneously, I assumed that my outcomes were linear functions of time[6] and fitted the following fully-interacted 2-level model for each outcome, shown here in its composite form:

[6] This choice of functional form was necessary here, given the limited number of time points in the data (two prior to and two after the policy shift).

$$
\begin{aligned}
INT_{ij} = \gamma_{00} &+ \gamma_{01}GIRL_i + \gamma_{02}(GIRL_i \times ITSGROUP_i) + \gamma_{10}TIME_{ij} \\
&+ \gamma_{11}(TIME_{ij} \times GIRL_i) + \gamma_{12}(TIME_{ij} \times ITSGROUP_i) \\
&+ \gamma_{13}(TIME_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{20}SHIFT_{ij} \\
&+ \gamma_{21}(SHIFT_{ij} \times GIRL_i) + \gamma_{22}(SHIFT_{ij} \times ITSGROUP_i) \\
&+ \gamma_{23}(SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{30}(TIME_{ij} \times SHIFT_{ij}) \\
&+ \gamma_{31}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i) + \gamma_{32}(TIME_{ij} \times SHIFT_{ij} \times ITSGROUP_i) \\
&+ \gamma_{33}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \delta \boldsymbol{Z}_i + \varepsilon_{ij} + u_i
\end{aligned}
$$

where $\varepsilon_{ij} \sim N(0, \sigma_\varepsilon^2)$ and $u_i \sim N(0, \sigma_u^2)$

where ε_{ij} is the level-1 residual for child *i* on occasion *j*, and u_i is the time-invariant level-2 residual for child *i*[7].

In Figure 3, where I depict the geometry of this hypothesized model, the outcome averages labeled (a) and (b) represent the population average levels of anxiety (or depressive) symptoms for children who experienced the policy shift (the *ITS* group) at the point of discontinuity, serving as "controls" prior to the shift and "treated children" afterward. These values are the projections of the population average trajectories following and prior to the policy shift, respectively. The difference in elevation between (a) and (b), or parameter Δ_1, represents the *ITS*-based immediate causal impact of the foreshortening of children's middle-school transition on their internalizing symptoms. Meanwhile, the outcome averages labeled (c) and (d) represent the corresponding

[7] There is no term in this model for the main effect of *ITSGROUP*. The reason for this is that because *ITSGROUP* is a school-level variable, it is collinear with the school fixed effects that are present in the model as covariates. Therefore, I include *ITSGROUP* in these models only in its interactions with other variables (Singer & Willett, 2003).

population average levels of internalizing symptoms at the point of discontinuity for the group of children who did *not* experience the shift (the *non-ITS* group). The difference between (c) and (d), or parameter Δ_2, represents any secular disruption that all children in the population might have experienced between fourth and fifth grade, in the absence of a foreshortening policy. It is then the subtraction of parameter Δ_2 from parameter Δ_1 (the difference-in-differences portion of the analysis, in which any potential secular-trend bias is removed from the ITS estimate alone) that produced my final estimate of the causal impact of the policy on children's internalizing symptoms in the population. After I fitted the model above, I was able to recover an estimate of this population difference by combining model-estimated parameters and conducting corresponding tests using a post-hoc general-linear hypothesis (GLH) testing strategy. Below, I unpack this general strategy for each of my research questions, although it is important to stress that after I trimmed terms that were not statistically significant from my models to achieve parsimony, I made adjustments to this strategy, as appropriate. I discuss this further in my results section.

RQ1: Do trajectories of children's anxiety and depressive symptoms rise over the fourth-grade year, and are these trajectories steeper and more elevated, on average, for girls than for boys?

To answer my first research question, I examined parameter estimates from the fitted final model that described the trajectories of change in the outcome, prior to the discontinuity. I estimated these parameter combinations and tested that they differed from zero, in the population, using the corresponding post-hoc GLH tests, whose specification I present in *Appendix B*. As I show in *Appendix B*, to answer the first part of my first research question, which asks whether children's trajectories of internalizing symptoms rose during fourth grade, I required an estimate of parameter γ_{10} to be positive and statistically significant, to indicate that the average internalizing trajectory (anxiety or depression) of boys in the non-policy-shift group rose during their fourth-grade year. For girls in the non-policy-shift group, I required a positive and statistically significant estimate of parameter sum $(\gamma_{10} + \gamma_{11})$. For boys in the policy-shift group, the corresponding parameter sum was $(\gamma_{10} + \gamma_{12})$, and for girls in the policy-shift group it was $(\gamma_{10} + \gamma_{11} + \gamma_{12} + \gamma_{13})$.

To address the second part of my first research question, which asked whether girls' trajectories of anxiety or depressive symptoms were higher and/or steeper than boys', for children in the non-policy-shift group, I required a positive and statistically significant estimate of γ_{01} to indicate that internalizing trajectories were higher for girls than boys in this group, and a positive and statistically significant estimate of γ_{11} to indicate that they were steeper. Similarly, for children in the policy-shift group, I used the parameter sum $(\gamma_{01} + \gamma_{03})$ to test whether internalizing-symptom trajectories were elevated for girls; and parameter sum $(\gamma_{11} + \gamma_{13})$ to test whether girls exhibited steeper trajectories than their male counterparts.

RQ2: Does an arguably exogenous policy shift, occurring between fourth and fifth grade, that resulted in a foreshortening of the transition to middle school (to fifth-grade graduation from the previous policy of sixth-grade graduation) cause elevations in children's anxiety and depressive symptoms at the point of discontinuity, and are these elevations more pronounced for girls than boys?

As I show in *Appendix C*, I required a positive and statistically significant estimate of parameter γ_{22} to indicate that the policy shift had caused boys' internalizing symptoms to increase at the point of discontinuity. Similarly, I required a positive and statistically significant estimate of the parameter sum $(\gamma_{22} + \gamma_{23})$ to indicate that the policy shift had caused girls' internalizing symptoms to increase at the discontinuity. Lastly, I required a positive and statistically significant estimate of γ_{23} to indicate that the effect of the policy on children's internalizing symptoms was greater for girls than for boys.

RQ3: Are children's trajectories of anxiety and depressive symptoms after the policy shift steeper during fifth grade for students who experienced a foreshortening of the transition to middle school, and is steepness of trajectories more pronounced for girls than for boys?

To address this question, I compared children's rate of change in internalizing trajectories between fifth and fourth grades. Although I cannot infer causality at time points after the discontinuity, I followed the same ITS and DiD process that I highlight in *Appendix C*, where I subtracted the effect of interest for the non-policy-shift group from the effect for the policy-shift group, to produce what I refer to as a 'pseudo-causal' estimate here. As I show in *Appendix D*, I required a positive and statistically significant estimate of parameter γ_{32} to indicate that boys' internalizing symptom trajectories were steeper in fifth grade than in fourth, and a positive and statistically significant estimate of the parameter sum $(\gamma_{32} + \gamma_{33})$ to indicate the same for girls. Meanwhile, parameter γ_{33} indicated whether the 'pseudo-causal' post-discontinuity slope effect was more pronounced for girls than for boys.

Results

When Anxiety Symptoms Were the Outcome

In Table 2, I display a judicious selection of statistical models that I fitted in the process of arriving at my final model for the anxiety-symptoms outcome. In column 2 of the table, I display *Model A1*, the fully-interacted model that corresponds to the model I described in the previous section, with the addition of covariates and a statistically significant interaction between predictors *AGE* and *GIRL*, the only relevant interaction that I did not specify in my study design model and that I found made a statistically significant contribution to children's anxiety symptoms[8]. In addition to this model, I present *Model A2*, a parsimonious version of *Model A1* that retains the indicator variables representing children's first valid measurement of the risk indexes. The effect of this set of indicator variables, jointly, was not distinguishable from zero in the population (p=0.134), so I omitted them from *Model A3*, my final parsimonious fitted model for trajectories of children's anxiety symptoms.

In *Model A3*, I have included predictors describing the relationship between children's anxiety symptoms and time, age, gender, community risks, socioeconomic risks, and policy-shift group membership. Crucially, I also included the important *SHIFT×ITS* statistical interaction. The inclusion of this interaction term allowed me to produce an estimate of the causal impact of the policy that foreshortened the timing of children's transition to middle school on children's anxiety-symptom trajectories, as described above, using the interrupted-time-series estimate enhanced by subtracting from

[8] I tested the statistical significance of a host of substantively-meaningful interactions throughout my model fitting process. After I trimmed certain non-significant terms out of my models in the interest of parsimony, I re-tested all of these interactions to confirm that they remained non-significant in the new parsimonious model.

it the secular disruption in non-treated children's anxiety symptoms between fourth and fifth grades. In order to arrive at the results I present here, I performed judiciously selected post-hoc General Linear Hypothesis (GLH) tests on specific combinations of parameters in my final model. I describe the logic behind these tests in *Appendices E* through *G*, to which I refer in my reporting of results below. In what follows, I break down the results for models that treat anxiety symptoms as the outcome, by specific research question.

RQ1: Do trajectories of children's anxiety symptoms rise over the 4th-grade year, and are these trajectories steeper and more elevated, on average, for girls than for boys?

In *Model A3* in Table 2, the estimated parameter associated with the linear effect of time indicates that boys' anxiety symptoms decreased linearly by 0.133 points per year during fourth grade, on average in the population (p<0.001)[9]. As I explain in *Appendix E*, for girls, the fourth-grade change in anxiety symptoms was represented by the sum of the parameters representing linear time and the interaction of linear time and *GIRL*. In *Appendix F*, in which I present the results of the single-parameter and GLH tests on the relevant parameters and combinations of parameters, respectively, from my final model for anxiety symptoms, I show that girls' anxiety symptoms decreased linearly by 0.005 points per year during fourth grade, and that this rate of change was not distinguishable from zero (p=0.886). The parameter estimate associated with the *TIME×GIRL* interaction indicated that the fitted rate of change in anxiety symptoms for girls in fourth grade was,

[9] In *Model A3*, I have trimmed from the model several non-significant interaction terms that included *ITSGROUP* because I did not find any meaningful differences in anxiety trajectories over time between children in the policy-shift and non-policy-shift groups. Therefore, the findings that I report here apply to children in schools that experienced the policy change and to children in schools that did not.

while indistinguishable from zero, steeper than that of boys by 0.128 points per year ($p<0.05$).

To address the question of whether girls' anxiety trajectories were more elevated than boys' in fourth grade, as I describe in *Appendix E*, the statistically significant linear combination of the parameter associated with the main effect of *GIRL* plus 10.24 (the median age of sample children at the point of discontinuity) times the parameter associated with the interaction of *AGE*×*GIRL* indicated that for children of median age, girls' anxiety symptoms were, on average, higher than boys' symptoms in fourth grade ($p<0.001$), controlling for the other variables in the model. Because girls' fourth-grade anxiety trajectories were steeper than boys' trajectories (as a result of the statistically significant interaction between *TIME* and *GIRL*), the extent to which girls' anxiety levels were higher than those of boys increased throughout the school year. This makes it difficult to interpret this coefficient sum ($\hat{\gamma}_{01} + 10.24 \times \hat{\gamma}_{03} = 0.186$) in words alone. Therefore, in Figure 4, I plot the fitted fourth-grade anxiety trajectories versus time for prototypical boys and girls of median age, whose sociodemographic and community risk factors have also been set at their median values for the sample. I present girls' trajectories in green and boys' in blue, and consequently the vertical distance between the green and blue lines represents the fitted difference in elevation of anxiety symptoms between these prototypical boys and girls. Notice that the fourth-grade gender differential in anxiety symptoms was smallest, at 0.078 points, at the beginning of the school year (when *TIME*=-0.85) and largest, at 0.180 points, at the end of the school year (when *TIME*=-0.05).

Finally, the statistically significant two-way interaction between *AGE* and *GIRL* present in the final model indicated that the relationship between trajectories of anxiety symptoms and gender differed for children of different ages such that the vertical gap between boys' and girls' anxiety symptoms was 0.068 points larger for every one-year difference in children's ages ($p<0.05$), after taking into account the effects of other variables in the model. I highlight this interaction in Figure 5, in which I add – to Figure 4 – fitted anxiety trajectories for prototypical children who were 11.36 years old at the point of discontinuity (90^{th} percentile, about one year older than the median age for the sample) and for prototypical children who were 9.68 years old at the discontinuity (10^{th} percentile, roughly 8.4 months younger than the median age for the sample). In the middle of fourth grade (when *TIME*=-0.45), the estimated difference in elevation of anxiety symptoms between boys and girls was 0.129 points for children of median age. However, this difference was larger, 0.205, for children who were at the 90^{th} percentile for age, and smaller, 0.091, for children who were at the 10^{th} percentile for age.

RQ2: Does an arguably exogenous policy shift, occurring between fourth and fifth grade, that resulted in a foreshortening of the transition to middle school (to fifth-grade graduation from the previous policy of sixth-grade graduation) cause concurrent elevations in children's anxiety symptoms, and are these elevations more pronounced for girls than boys?

In *Appendix G*, I show that the parameter of interest for evaluating the impact of the policy on children's anxiety symptom trajectories was the parameter associated with the interaction between *SHIFT* and *ITSGROUP*. In my final model, this coefficient was not statistically significant ($p=0.540$) and of very small magnitude (0.013 points), indicating that the policy that foreshortened children's time to middle-school transition did not cause elevations in children's anxiety symptoms at the point of discontinuity. Likewise, the impact of the policy shift was not more pronounced for girls than for boys, as evidenced by the non-statistically significant estimate of the three-way interaction *SHIFT×GIRL×ITSGROUP* in prior modeling. Due to the non-statistically significant estimate of *SHIFT×GIRL×ITSGROUP*, I did not include it as part of my final model. In Figure 6, I add fifth-grade fitted trajectories of anxiety symptoms to the plot with the fitted fourth-grade trajectories for prototypical children that I presented in Figure 4. Placing the vertical axis at *TIME*=0 identifies the point of discontinuity, as is customary for studies using interrupted-time series designs (Murnane & Willett, 2011). This is the point at which we would expect to see an immediate effect of the policy if there was one, in the form of a vertical break in children's trajectories between the left and right halves of the plot. Although, in Figure 6, there is a visible vertical jig in boys' anxiety trajectories at the point of discontinuity, this difference in elevation (the sum of the coefficients on predictors *SHIFT* and *SHIFT×ITS*) was not distinguishable from zero in the population (p=0.368, as exhibited in *Appendix H*, where I display the results of additional GLH tests I performed during the process of addressing my research questions).

RQ3: Are children's trajectories of anxiety symptoms after the policy shift steeper during fifth grade for students who experienced a foreshortening of the transition to middle school, and is the steepness of trajectories more pronounced for girls than for boys?

The policy shift did not have a pseudo-causal impact on children's rate of change in anxiety symptoms after the shift (i.e., in fifth grade), as indicated by the non-statistically significant estimate of the slope parameter associated with the *TIME×SHIFT×ITSGROUP* interaction, the parameter that would have indicated post-discontinuity slope differences for children who experienced the policy shift, in *Model A1* in Table 2. Because the slope estimate for the *TIME×SHIFT×ITSGROUP* interaction in *Model A1*, as well as in subsequent models, was not distinguishable from zero, I did not retain this parameter in my final model. Similarly, the non-statistically significant estimate of the slope parameter associated with the four-way *TIME×SHIFT×GIRL×ITSGROUP* interaction in the same model indicated that there was no gender difference in pseudo-causal impact on children's anxiety trajectory slopes in fifth grade.

However, though not associated with policy-group membership (i.e., not pseudo-causal), there were nonetheless differences in boys' and girls' anxiety trajectories in fifth versus fourth grade. The estimated slope parameter associated with the *TIME×SHIFT* interaction term indicated that the rate of change in boys' anxiety symptoms was 0.107 points per year higher during fifth grade than it was in fourth, on average in the population ($p<0.05$). The sum of the fitted rate of change of boys' trajectories in fourth grade and the difference in slope in fifth grade (-0.133 points per year, as I reported in the results for RQ1 above, plus 0.107 points per year) was -0.026, indicating that in fifth grade, boy's anxiety symptoms decreased linearly by 0.026 points annually. I performed a post-hoc GLH test on this sum (the sum of the slope parameters associated with the *TIME* and *TIME×SHIFT* predictors), the results of which I display in *Appendix H*. This

GLH test indicated that boys' fifth grade rate of change in anxiety symptoms was not distinguishable from zero (p=0.489), in the population, and this is shown in the almost-flat blue line on the right half of Figure 6.

Meanwhile, the estimated slope parameter associated with the three-way *TIME*×*SHIFT*×*GIRL* interaction term indicated that for girls, the fifth-grade slope difference in anxiety symptoms was 0.191 points per year lower than the slope difference for boys (p<0.01). Added together (the slope parameters associated with the *TIME*×*SHIFT* and *TIME*×*SHIFT*×*GIRL* interactions), I found that the estimated rate of change in girls' anxiety symptoms was 0.084 points per year lower during fifth grade than fourth. Added to girls' estimated rate of change in anxiety symptoms in fourth grade (-0.005, as reported for RQ1), this means that in fifth grade, girls' anxiety symptoms, represented by the green line on the right half of Figure 6, decreased linearly at a rate of 0.089 points per year[10], on average in the population (p<0.05).

Finally, the *AGE* by *GIRL* interaction on which I reported in the results for my first research question also applied to children's fifth-grade trajectories of anxiety symptoms. In Figure 7, I add to Figure 6 fitted trajectories for prototypical children in the 90^{th} and 10^{th} percentiles for age, using the same visual conventions that I used in Figure 5. As in fourth grade, girls who were older had higher levels of anxiety symptoms, and girls who were younger had lower levels. For boys, however, the opposite was the case, with older boys demonstrating lower anxiety levels and younger boys demonstrating higher levels.

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[10] This is the sum of the estimated slope parameters associated with *TIME*, *TIME*×*GIRL*, *TIME*×*SHIFT*, and *TIME*×*SHIFT*×*GIRL*, on which I also performed a post-hoc GLH test.

When Depressive Symptoms Were the Outcome

In Table 3, I display a judicious selection of statistical models that I fitted in the process of arriving at my final model for the depressive-symptoms outcome. In column 2 of the table I display *Model D1*, the fully interacted model for depressive symptoms, which corresponds to *Model A1* that I presented in Table 2 for anxiety symptoms. In Table 3, I also include *Model D3*, which was a parsimonious version of *Model D1* that included indicator variables for children's first measurement of the risk variables as well as the marginally statistically significant interaction between *AGE* and *GIRL*. I retained neither the risk measurement indicators nor the *AGE*×*GIRL* interaction in my final model, *Model D4*, which I present in column 5 of the table, though I present *Model D3* to draw attention to a potential age by gender interaction, as this interaction was statistically significant at the 0.05 level for anxiety symptoms. In my final model for children's depressive symptoms, *Model D4*, I have included predictors describing the relationship between children's depressive symptoms and time, age, gender, community risks, socioeconomic risks, and policy-shift-group membership, as well as the critical *SHIFT*×*ITS* statistical interaction. Below, I present the results for models with depressive symptoms as the outcome, which I have broken down by research question.

RQ1: Do trajectories of children's depressive symptoms rise over the fourth-grade year, and are these trajectories steeper and more elevated, on average, for girls than for boys?

As I show in *Model D4* in Table 3, the estimated parameter associated with the linear effect of time indicated that children's depressive symptoms decreased linearly by 0.065 points per year during fourth grade, on average in the population, taking into account the effects of other variables in the model ($p<0.01$). In this final model, I did not retain the term for the statistical interaction between time and gender because it was not statistically significant in the fully-interacted model, *Model D1*, ($\beta=0.0006$, $p=0.992$) or in subsequent models. The omission of this interaction term from my final model indicated that girls' trajectories of depressive symptoms in fourth grade were neither distinguishably steeper, nor shallower, than the trajectories for boys. The parameter estimate associated with the main effect of *GIRL* indicated that girls' fourth-grade trajectories of depressive symptoms were 0.036 points higher in elevation than boys', on average in the population, although this difference in elevation was statistically significant only at the 0.10 α-level ($p=0.062$). Lastly, the parameter estimate associated with *AGE* indicated that older children had depressive-symptom trajectories that were higher in elevation than trajectories for younger children, such that a one-year difference in child age was positively associated with an estimated elevation of 0.050 points in depressive-symptom trajectories ($p<0.01$).

RQ2: Does an arguably exogenous policy shift, occurring between fourth and fifth grade, that resulted in a foreshortening of the transition to middle school (to fifth-grade graduation from the previous policy of sixth-grade graduation) cause concurrent elevations in children's depressive symptoms, and are these elevations more pronounced for girls than boys?

The parameter estimate associated with the *SHIFT×ITSGROUP* interaction indicated that the change in policy that foreshortened the timing of children's middle-school transition caused an increase in elevation of 0.054 points in children's depressive-symptom trajectories at the point of discontinuity ($p<0.05$), representing an effect size of

0.193 standard deviations[11]. This impact was not more pronounced for girls than for boys, as I established in prior modeling (see *Model D1* in Table 3) through the non-statistically significant estimate of the slope associated with the three-way interaction *SHIFT*×*GIRL*×*ITSGROUP*, the parameter that would have indicated such an effect. I therefore did not retain the *SHIFT*×*GIRL*×*ITSGROUP* term in my trimmed final model.

I display this effect in Figure 8, where I plot the fitted depressive-symptom trajectories versus time for prototypical girls of median age, whose sociodemographic and community risk factors have been set at their median values for the sample. I present the fitted trajectories for girls in the policy-shift group in green, and the dotted gray line represents the fitted depressive-symptom trajectory for girls in the non-policy-shift group. On the left half of Figure 8 only the green line is visible, though this is only because the estimated fourth-grade depression-symptom trajectories did not differ between girls in the policy-shift versus non-policy-shift groups. The vertical distance between the green lines at the Y-axis represents the ITS estimate of the effect of the policy. The subtraction of the (downward) secular disruption in depressive-symptom trajectories for girls in the non-policy-shift group from this ITS estimate, the DiD portion of my analysis, is what produced the 0.054 value. In Figure 9 I display side-by-side the fitted plots for girls and boys, with boys' fitted trajectories plotted in blue. Although the policy impact did not differ for boys as compared to girls, I present the side-by-side plots to show the (marginally statistically significant) difference in the elevation of depressive-symptom trajectories between boys and girls.

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[11] I calculated this effect size using the standard deviation in children's depressive symptoms for the spring of fourth grade, the most recent measure of depressive symptoms at the time of the discontinuity (SD=0.280).

RQ3: Are children's trajectories of depressive symptoms after the policy shift steeper during fifth grade for students who experienced a foreshortening of the transition to middle school, and is the steepness of trajectories more pronounced for girls than for boys?

The policy shift did not have a pseudo-causal impact on the slopes of children's fifth-grade depressive symptoms. I did not retain the term for the three-way interaction between *TIME*, *SHIFT*, and *ITSGROUP* in my final model, as the estimate of its associated slope parameter never reached statistical significance throughout the model-fitting process. Finally, I did not find that the rate of change in girls' fifth-grade depressive-symptom trajectories was steeper than boys', as the parameter estimate for the *TIME*×*SHIFT*×*GIRL* three-way interaction was non-statistically significant throughout the model-fitting. I therefore did not retain the *TIME*×*SHIFT*×*GIRL* interaction term in my final fitted model.

Sensitivity Analyses: Upper and Lower Bounds for Date of Discontinuity

I found no evidence that indicated that there was any advance warning to families of the shift in grade configuration, from a pK-6 to a pK-5 structure (providing the source of exogeneity upon which I designed this analysis), from the five schools that enacted this shift. Because I was not able to document the exact timing of when the entering fifth-grade students in these five schools learned that the 2006-2007 school year would be unexpectedly their final year in elementary school, I chose for my analysis to use July 15, 2006, an arbitrary point in the summer between these students' fourth and fifth-grade years, as the point of discontinuity. However, it is also possible that students learned of the change in policy that foreshortened their timing to middle-school transition by one year as early as the last day of the 2005-2006 school year or as late as the first day of the 2006-2007 school year. For this reason, I conducted sensitivity analyses, where I fitted a set of additional models that were identical to my final fitted models in all respects except that I used different dates for the discontinuity.

In Table 4, I present the results of these sensitivity analyses for each of my outcomes, children's anxiety symptoms and children's depressive symptoms. I present model results for anxiety symptoms in the left half of Table 4 and for depressive symptoms in the right half. For each outcome, I first present my final fitted model, from which I drew the results I reported earlier in this section. I then present parameter estimates and *p*-values from one model where the date of discontinuity was June 28, 2006, the last day of fourth grade for children in my sample (Klein, 2005); and one model where the date of discontinuity was September 5, 2006, the sample children's first day of fifth grade (Klein, 2007). As the results in Table 4 indicate, my findings for both outcomes were robust to these lower and upper bounds, of sorts, on the impact of the policy.

Discussion

In this dissertation, I evaluated the causal impact of a school-level policy shift that changed the timing of children's impending transition to middle school, essentially foreshortening their time to transition by one year, on children's anxiety and depressive symptom trajectories. Entering fifth-grade students in the affected schools, with no evidence of advance warning, found out that they would now graduate from elementary school after fifth grade, despite their schools' previous policy of graduating students after sixth grade. Meanwhile, children in the non-affected schools were also scheduled to graduate to middle school after fifth grade, but for them, this was the timing they had always expected. I used longitudinal data from the *New York City Study of Social and Literacy Development* (Jones, Brown, Hoglund, & Aber, 2010) to model separately children's trajectories of anxiety symptoms and depressive symptoms over the fourth and fifth-grade years. In a single final fitted statistical model for each outcome, I was able to incorporate both an interrupted-time-series design that included the children who experienced the policy shift, and a difference-in-differences design that used non-affected children to remove bias from the ITS estimate by subtracting the impact of any secular disruption in internalizing symptoms that may have occurred simultaneously with the policy shift but independent of it. Because the longitudinal data I analyzed included four waves over the two-year period, I was able not only to estimate the effect of the policy change but also to make observations about the developmental nature of children's trajectories of internalizing symptoms during these late elementary-school years.

Generally, I found that children's trajectories of both anxiety and depressive symptoms declined over the fourth and fifth-grade years. I also found that, despite the overall decline in symptoms, for anxiety, girls who were older had higher levels of anxiety symptoms, while the opposite was true for boys; older boys exhibited lower levels of anxiety symptoms than younger boys. Additionally, I found that girls, on average, had internalizing-symptom trajectories that were higher in elevation than boys', although this difference was more pronounced for anxiety than for depressive symptoms. As for the impact of the policy shift, I found that the foreshortening by one year of children's impending transition to middle school caused an increase in children's depressive symptoms, and that this increase was not more pronounced for girls than for boys. I did not find any causal impact of the change in policy on children's anxiety symptoms, and I did not observe differences in the steepness of children's trajectories in fifth grade that were associated with the policy change itself, for either anxiety or depressive symptoms.

From a developmental perspective, my findings are somewhat at odds with those of prior research. Past research indicates that children's internalizing symptoms increase as children approach adolescence (i.e., Avenevoli et al., 2001), especially for girls (i.e., Roza et al., 2003), but in my findings children's internalizing symptoms decreased consistently over a two-year period. One potential explanation for this discrepancy is that the literature tends to look at clinical levels of internalizing symptoms, tracking rates of disorder as opposed to levels of symptoms. This disorder-focused approach therefore, and for legitimate reasons, groups all children whose levels of internalizing symptoms are normative as non-pathological, ignoring variability in symptomology for this group. Because the data in my study included only self-reported symptoms, I did not have access to information about the incidence of diagnosable disorders in children in the sample, leaving open the possibility that clinical disorders did indeed rise among children in this sample, but that the increase was masked by the general decline in symptomology for the majority of non-disordered children. This theory for the discrepancy between my findings and past research is supported by findings from at least one study, where the authors found a decrease in children's depressive-symptom scale scores prior to age 11 (Angold, Erkanli, Silber, Eaves, & Costello, 2002).

My findings involving gender and internalizing symptoms were largely consistent with prior research. I found that girls had higher levels of both depressive and anxiety symptoms than boys, which is consistent with the literature (i.e., Lewinsohn et al., 1998). This finding was more convincing in my study for anxiety symptoms than for depressive symptoms, though the extent to which girls' symptoms were higher than boys' was more consistent over time for depressive symptoms than for anxiety symptoms. Although in my findings children's symptoms declined overall, for anxiety, the interaction between gender and age suggested that at each point in fourth and fifth grade, the disparity between girls' and boys' anxiety symptom levels was most pronounced for older children. This increasing disparity between girls' and boys' anxiety symptoms for older, as compared to younger, children supports the work of other researchers that indicates that girls' increased anxiety prevalence diverges from boys' relatively early in children's pre-adolescent development (e.g., Roza et al., 2003). It also raises the possibility that for anxiety symptoms at least, the decline that I found over time, which was inconsistent with prior work, was to some extent potentially an artifact of using school years, and not children's ages, to mark the passage of time. That older girls had higher anxiety symptoms and the opposite was true for boys may provide partial reconciliation between my findings of declining symptomology and those of past research.

My findings about the impact of the policy shift on children's internalizing symptoms as they anticipated the transition to middle school differed for anxiety versus depressive symptoms. I found an impact of the policy on children's depressive symptoms, whereby children demonstrated a substantial jump in depressive symptoms concurrent with the shift in policy, equivalent to around one-fifth of a standard deviation in children's depressive-symptom scores. However, I found no such impact of the change in timing to middle-school transition on children's anxiety symptoms. Although the data in my study did not lend themselves to explaining why there was an effect on depressive symptoms and not on anxiety symptoms directly, these results suggest that it was not worry about preparing for the many changes entailed in the transition to middle school (e.g., Eccles et al., 1993) that was the salient portion of children's responses to the change. Rather, it appears the sudden change in children's expectations about when they would leave elementary school affected them in a more somber manner. Perhaps children felt sad about how the impending move to middle school would affect their friendships; perhaps they felt upset at how the policy shift was handled. With these data, I cannot draw conclusions about the difference in impact of the policy between children's depressive and anxiety symptoms, though the potential explanations I present here represent plausible hypotheses for future study.

That there was any impact of the policy shift at all supports the work of other education researchers who have found a variety of negative outcomes associated with the transition to middle school (i.e., Theriot & Dupper, 2010; Wigfield & Eccles, 1994; West

& Schwerdt, 2012). Arguably, my work extends some of these earlier findings in that I used a quasi-experimental design, which could support limited conclusions of causality, whereas most of the previous studies about the middle-school transition have been observational in nature. Therefore, many of these past studies have been vulnerable to issues of conflation between the changes in children's outcomes associated with the transition to middle school, the changes associated simply with development and approaching adolescence, and potential underlying differences between students that guided their selection into K-8 or K-12 (versus middle) schools. In contrast, in my study, the ITS component provided some support for a causal claim, and the difference-in-differences component directly estimated the portion of changes in children's internalizing symptoms that was related to typical development, potentially teasing apart development from the response to the policy shift. On the other hand, my study only addressed children's immediate responses to the policy change, at a time while they were still in elementary school. Therefore, I can only draw conclusions about the impact of the sudden change in the timing of children's transition to middle school on their internalizing symptoms as they *anticipated* the move, not as a result of the move itself.

Lastly, my finding that there was no pseudo-causal impact of the policy shift on the rate of change in children's depressive symptoms post-discontinuity, when they were in fifth grade, resonates partially with prior studies that found persisting effects of the middle school transition on children's outcomes (e.g., West & Schwerdt, 2012). On the one hand, the consistency of the post-discontinuity slope of children's depressive symptoms with their fourth-grade slope supports the idea of persistent effects, as it indicates that the vertical shift in the affected children's depressive symptoms, on average, was maintained through fifth grade (compared to the elevation of depressive symptoms for children in the non-policy-shift group). On the other hand, if children's fifth-grade slopes for depressive symptoms had been steeper than their fourth-grade slopes, this would have been more convincing evidence that the rise in symptoms would remain with children into their middle school years.

On a final note as I discuss these findings, I found neither sociodemographic nor community risk factors to be related to variability in children's anxiety and depressive symptoms. This finding goes against prior literature (e.g., Evans, 2004) and could be explained by a couple of scenarios: either these factors were truly unrelated to children's internalizing symptoms, in this sample, and in the population to which it generalizes, or for some reason the operationalization of these variables failed to capture the meaningful variability contained in children's experiences of risk. In the case that the risk variables were unrelated truly to children's symptoms, it is possible that there was not enough variability in sociodemographic or community risk between children in this sample to predict their symptoms of anxiety and depression over time meaningfully. Another possible explanation for the null findings is that the risk index data were parent-reported, so perhaps they did not represent adequately the experiences of perceived risk from the perspective of the children in the study.

Limitations and Implications

There are several threats to the validity of my findings. Perhaps the largest threat is that the data I analyzed did not include observations of children beyond the transition to middle school; instead, I employed data that observed children's anxiety and depressive symptoms only in their final two years of elementary school. Therefore, interpretation of the causal impact of the policy foreshortening children's time to their middle-school transition must be limited to their internalizing symptoms in *anticipation* of the transition, neither through the transition nor after it.

Additionally, my measures of children's symptoms did not constitute diagnoses of anxiety or depressive disorder. I was therefore able only to estimate children's symptom trajectories over time without the ability to account for which children experienced clinical levels of anxiety or depression. This limitation makes it more difficult to place my findings in context with regard to past research. It also means that my findings do not generalize specifically to children in the population with the highest mental-health needs. However, the benefit of this limitation is that it strengthens the generalizability of my findings to a broader population, because the majority of children who experience anxiety and/or depressive symptoms in middle childhood do not qualify for clinical diagnoses. Due to the nature of the data I used, I was better able to explore the ecological characteristics of children's lives that were associated with variability in their internalizing symptoms than I would have been with data that measured only diagnoses of disorder versus non-disorder.

Another important limitation to my study was that my data did not include factors such as children's family functioning and parental history of anxiety and depression, which we have long known to be linked to children's own internalizing-symptom levels (e.g., Beardslee et al., 1996). The inclusion of such family-level variables would be an important addition to future exploration of this or related issues. Nonetheless, my research provided an opportunity to follow children's symptom trajectories over time in a meaningful and rigorous fashion during the important middle childhood developmental period, and my findings carry implications for children, policy makers, and education and mental-health practitioners.

My findings suggest that in situations where children are not prepared for the impending transition from elementary to middle school, their depressive symptoms, on average, may rise in anticipation of the change. On the face of it, children's experience of elevated depressive symptoms is reason enough for school-based intervention, but the case is even stronger if the rise in symptoms is the result of a school-based policy. Additionally, if children's mental health suffers in anticipation of the transition to middle school, then it is plausible that this decline in emotional wellness represents the beginning of the processes that result in the negative outcomes long known to accompany the middle-school transition. If this is indeed the case, then my findings open the door for potential mental-health intervention in elementary schools, as well as for a critique of policies that transition children out of elementary school. More controversially, my findings can also be interpreted to support the existing notion that perhaps a system that includes a middle-school transition at all (as opposed to primary and secondary schools only) may not be in the best interest of children, developmentally.

At the elementary-school level, the results from my study suggest that teachers, counselors, and administrators may have opportunities to help students by being watchful for signs of children's increasing depressive symptomology in the late-elementary-school years. Perhaps interventions that address the impending transition to middle school and what it entails would be beneficial to particularly vulnerable children at this important pre-adolescent phase of their development. Meanwhile, at the policy level, my findings imply that decision-makers may be able to better meet the holistic needs of children by evaluating the implementation of policies that change the timing of children's transition from elementary to middle school. To be very clear, it would be a mistake to interpret the findings I presented here as support for an argument that transitioning to middle school after sixth grade would be better for children's mental-health outcomes than transitioning to middle school after fifth grade. In fact, the children in this study who did not experience the policy shift – and therefore did not experience the resulting rise in depressive symptoms – were also transitioning out of elementary school after fifth grade. The distinction between these children and the children who experienced the policy shift was that the non-policy-shift children did not have their timing to transition changed. I interpret my findings as being more suggestive of the effects of impending school transition and of changes in elementary-to-middle-school policy than on effects of the specific timing of the transition itself.

Although it is reasonable to conclude here that children were indeed responding to the foreshortening of the timing to their impending middle-school transition, it is also possible that they were responding not to the substance of the change itself but rather to the scenario where they learned of such a meaningful change without advanced warning. It is possible that the handling of the change in policy is what produced the rise in children's depressive symptoms. In the case that it was the way that the policy change was presented to children, and not the substance of the change itself, that caused the increase in children's depressive symptoms, the implication for school practitioners and decision-makers would be to think about how quickly to roll out changes in policy; and in the case that such policies must be implemented without advance warning, schools and school systems may achieve better results for their students by putting in place supports to maintain and improve children's emotional health in the wake of sudden shifts.

Conclusion

In this dissertation, I examined the role of an unexpected foreshortening in the timing of students' impending middle-school transition on their developmental trajectories of anxiety and depressive symptoms. I found that this unexpected change led to an increase in children's depressive symptoms but not their anxiety symptoms. By using innovative statistical procedures, I was able to both assess the causal impacts of the policy shift and to examine developmental patterns in children's internalizing symptomology in middle childhood. I hope that my findings will be useful to education providers, mental health professionals, policy-makers, and families as they all strive to best meet the social, emotional, and academic needs of children as they approach adolescence.

Tables

Table 1. Sample means, (standard deviations), and *medians* for distributions of child age, anxiety and depressive symptoms, and sociodemographic and community risk factors, by wave of data-collection and overall (*n*=1,119 children).

Variable	Wave				
	1	2	3	4	Overall
Child Age in Years	9.68 (0.65) *median=9.54*	--	--	--	--
Anxiety Symptoms	0.50 (0.27) *median=0.54*	0.48 (0.28) *median=0.46*	0.45 (0.28) *median=0.46*	0.43 (0.28) *median=0.38*	0.46 (0.28) *median=0.46*
Depressive Symptoms	0.33 (0.26) *median=0.31*	0.32 (0.28) *median=0.23*	0.29 (0.27) *median=0.23*	0.27 (0.28) *median=0.15*	0.30 (0.28) *median=0.23*
Sociodemographic Risk	--	--	--	--	1.52 (1.04) *median=2.00*
Community Risk	--	--	--	--	2.01 (0.84) *median=1.86*

Table 2. Parameter estimates and approximate *p*-values for a select taxonomy of fitted **multilevel random-intercept tobit models, with anxiety symptoms as the outcome**. Estimated slopes for the fixed effects of school, although included in the models, are not displayed here (*n*=838 children in 18 schools over 2,507 total observations).

	Model A1	Model A2	Model A3
Fixed Effects:			
Initial status	0.708***	0.720***	0.737***
TIME	-0.135**	-0.135***	-0.133***
SHIFT	0.032	0.020	0.017
GIRL	-0.428	-0.446	-0.511~
TIME × *ITSGROUP*	0.001		
SHIFT × *ITSGROUP*	-0.041	0.013	0.013
TIME × *SHIFT* × *ITSGROUP*	0.111		
GIRL × *ITSGROUP*	0.107		
TIME × *GIRL* × *ITSGROUP*	0.094		
SHIFT × *GIRL* × *ITSGROUP*	0.023		
TIME × *SHIFT* × *GIRL* × *ITSGROUP*	-0.238		
TIME × *SHIFT*	0.075	0.100~	0.107*
TIME × *GIRL*	0.108~	0.127*	0.128*
SHIFT × *GIRL*	-0.042	-0.036	-0.038
TIME × *SHIFT* × *GIRL*	-0.143~	-0.195**	-0.191**
CRISKBL	0.008	0.007	0.006
SRISKBL	-0.004	-0.003	-0.003
AGE	-0.033~	-0.035~	-0.033~
AGE × *GIRL*	0.058*	0.062*	0.068*
CFRST2	0.000	0.001	
CFRST4	0.051	0.051	
SFRST2	0.041	0.055	
SFRST4	0.032	0.033	
Variance Components			
σ_e (Level 1)	0.204***	0.204***	0.204***
σ_u (Level 2)	0.203***	0.203***	0.204***
Goodness-of-fit			
-2LL	639.21	644.08	651.10

~ $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 3. Parameter estimates and approximate *p*-values for a select taxonomy of fitted **multilevel random-intercept tobit models, with depressive symptoms as the outcome**. Estimated slopes for the fixed effects of school, although included in the models, are not displayed here (*n*=837 children in 18 schools over 2,505 total observations).

	Model D1	Model D2	Model D3	Model D4
Fixed Effects:				
Initial status	0.037	-0.230	0.049	-0.232
TIME	-0.047	-0.070**	-0.070**	-0.065**
SHIFT	0.015	-0.008	-0.008	-0.010
GIRL	-0.512~	0.037*	-0.556~	0.036~
TIME × *ITSGROUP*	-0.110			
SHIFT × *ITSGROUP*	0.002	0.054*	0.054*	0.054*
TIME × *SHIFT* × *ITSGROUP*	0.235~			
GIRL × *ITSGROUP*	0.083			
TIME × *GIRL* × *ITSGROUP*	0.115			
SHIFT × *GIRL* × *ITSGROUP*	0.053			
TIME × *SHIFT* × *GIRL* × *ITSGROUP*	-0.179			
TIME × *SHIFT*	-0.073			
TIME × *GIRL*	0.001			
SHIFT × *GIRL*	-0.031			
TIME × *SHIFT* × *GIRL*	0.029			
CRISKBL	0.001	0.001	0.001	0.000
SRISKBL	0.006	0.007	0.006	0.007
AGE	0.025	0.049**	0.022	0.050**
AGE × *GIRL*	0.052~		0.057~	
CFRST2	0.045	0.051	0.050	
CFRST4	0.061	0.054	0.055	
SFRST2	-0.010	-0.007	-0.007	
SFRST4	-0.048	-0.035	-0.044	
Variance Components				
σ_e (Level 1)	0.217***	0.217***	0.218***	0.217***
σ_u (Level 2)	0.230***	0.231***	0.230***	0.232***
Goodness-of-fit				
-2LL	1389.37	1401.27	1397.79	1404.68

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 4. Parameter estimates and approximate *p*-values for fitted **multilevel random-intercept tobit models** with **anxiety and depressive symptoms as outcomes** including sensitivity analyses using differing dates of discontinuity. Estimated slopes for the fixed effects of school, although included in the models, are not displayed here (n_{ANX}=838 children; 2,507 observations; n_{DEP}=837 children; 2,505 observations).

	Anxiety Symptoms as Outcome			**Depressive Symptoms as Outcome**		
	Model A3	A3 Lower	A3 Upper	Model D4	D4 Lower	D4 Upper
Date of discontinuity	July 15, 2006	June 28, 2006	Sept. 5, 2006	July 15, 2006	June 28, 2006	Sept. 5, 2006
Fixed Effects:						
Initial status	0.737***	0.742***	0.723***	-0.232	-0.226	-0.249
TIME	-0.133***	-0.133***	-0.133***	-0.065**	-0.065**	-0.065**
SHIFT	0.017	0.012	0.032	-0.010	-0.010	-0.010
GIRL	-0.511~	-0.513~	-0.502~	0.036~	0.036~	0.036~
SHIFT × *ITSGROUP*	0.013	0.013	0.013	0.054*	0.054*	0.054*
TIME × *SHIFT*	0.107*	0.107*	0.107*			
TIME × *GIRL*	0.128*	0.128*	0.128*			
SHIFT × *GIRL*	-0.038	-0.029	-0.065			
TIME × *SHIFT* × *GIRL*	-0.191**	-0.191**	-0.191**			
CRISKBL	0.006	0.006	0.006	0.000	0.000	0.000
SRISKBL	-0.003	-0.003	-0.003	0.007	0.007	0.007
AGE	-0.033~	-0.035~	-0.035~	0.050**	0.050**	0.050**
AGE × *GIRL*	0.068*	0.068*	0.068*			
Variance Components						
σ_e (Level 1)	0.204***	0.204***	0.204***	0.217***	0.217***	0.217***
σ_u (Level 2)	0.204***	0.204***	0.204***	0.232***	0.232***	0.232***
Goodness-of-fit						
-2LL	651.10	651.10	651.10	1404.68	1404.68	1404.68

~$p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Figures

Figure 1. Timeline presenting sample children organized in two groups. The *policy-shift* group (top row), contains students, nested in 5 schools, who experienced the unexpected shift mandating that they transition out of elementary school after fifth (no longer sixth) grade. The *non-policy-shift* group (bottom row), contains students, nested in 13 schools, who did not experience the change in policy. The three analytic approaches applied in this study (MLMC: multilevel model for change; ITS: interrupted time-series; and DiD: difference-in-differences) are highlighted.

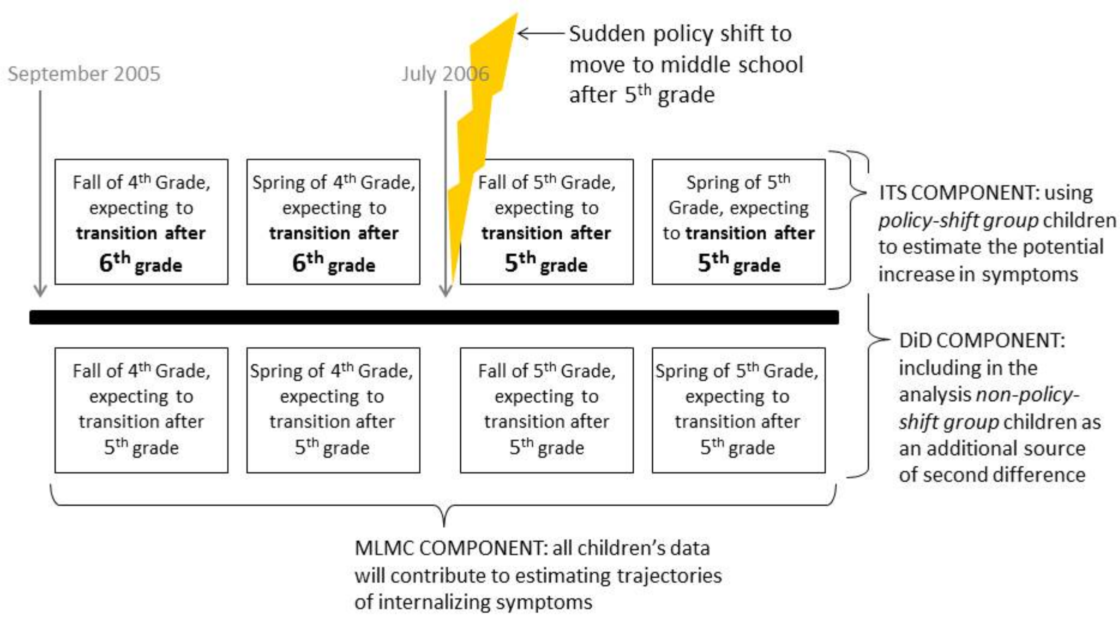


Figure 2. Histograms displaying the distributions of anxiety and depressive symptoms, by wave (W1 = wave 1, W2 = wave 2, etc.), demonstrating floor effects.

Figure 3. Hypothetical children's population internalizing-symptom trajectories, where population outcome values (a) through (d) represent children's population average level of anxiety (or depressive) symptoms at the point of discontinuity; Δ_1 represents the population interrupted time-series treatment effect; Δ_2 represents the population secular shift in children's internalizing symptoms between fourth and fifth grade; and Δ_1 - Δ_2 represents the population difference-in-differences treatment effect.

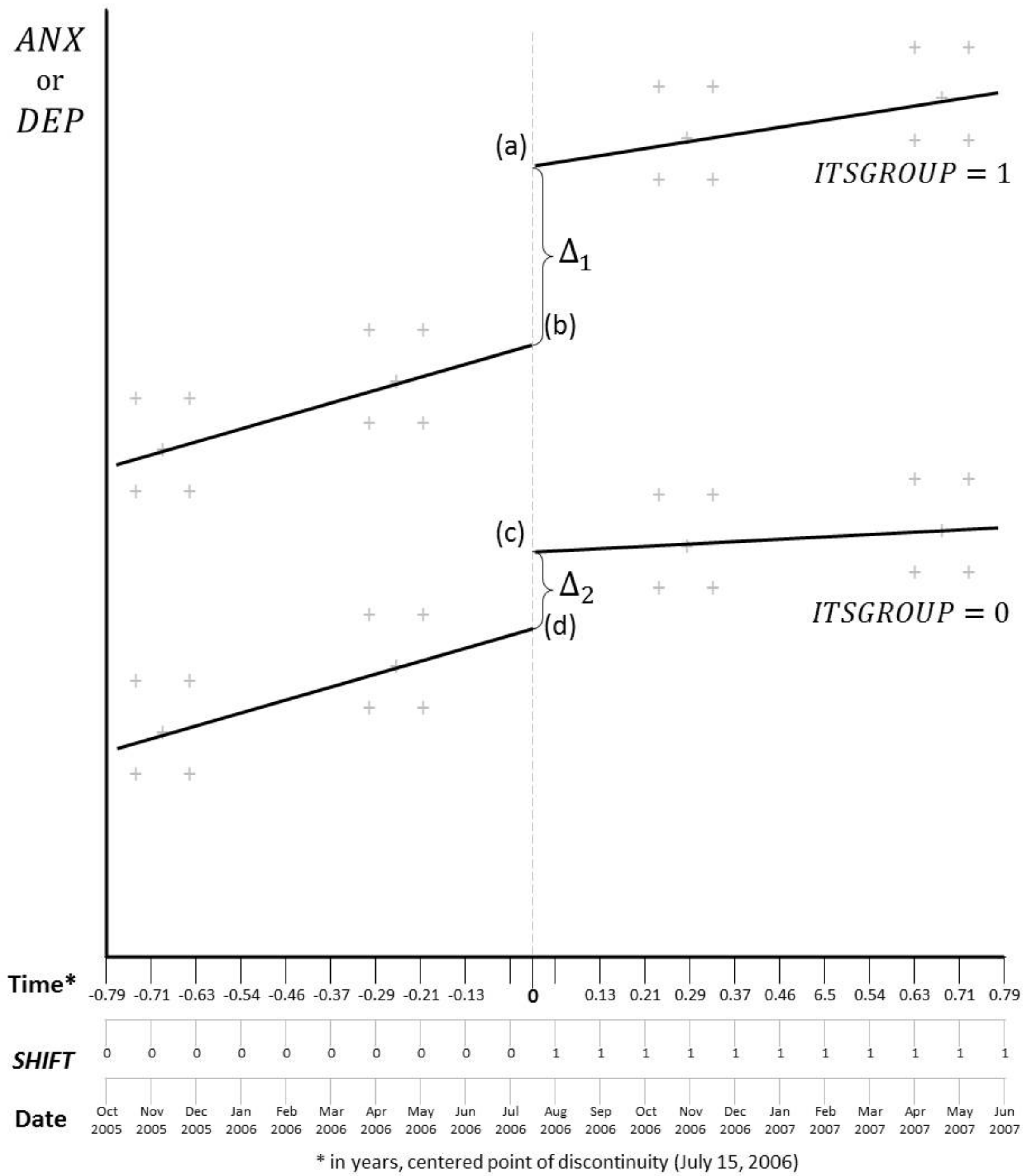


Figure 4. Fitted average anxiety-symptom trajectories over fourth grade for prototypical **girls** and **boys** of median age (10.38 years old at the point of discontinuity) whose levels of sociodemographic and community risk factors are set at their median values (2.00 and 1.86, respectively) (*n*=838 children in 18 schools over 2,507 total observations).

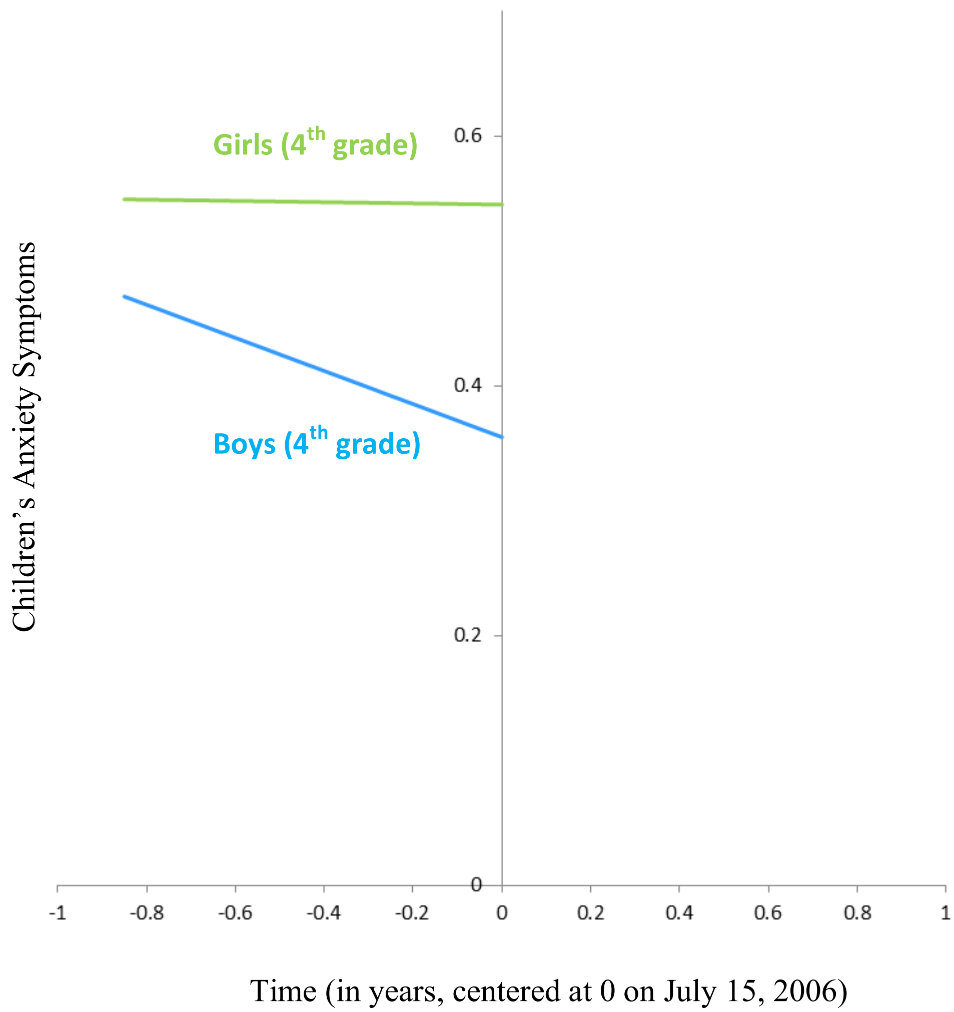


Figure 5. Fitted average anxiety-symptom trajectories over fourth grade for prototypical **girls** and **boys** of median age (solid lines; 10.38 years old at the point of discontinuity), above-median age (thick dashed lines; 11.36 years old at the point of discontinuity), and below-median age (thin dashed lines; 9.68 years old at the point of discontinuity) whose levels of sociodemographic and community risk factors are set at their median values (2.00 and 1.86, respectively); (*n*=838 children in 18 schools over 2,507 total observations).

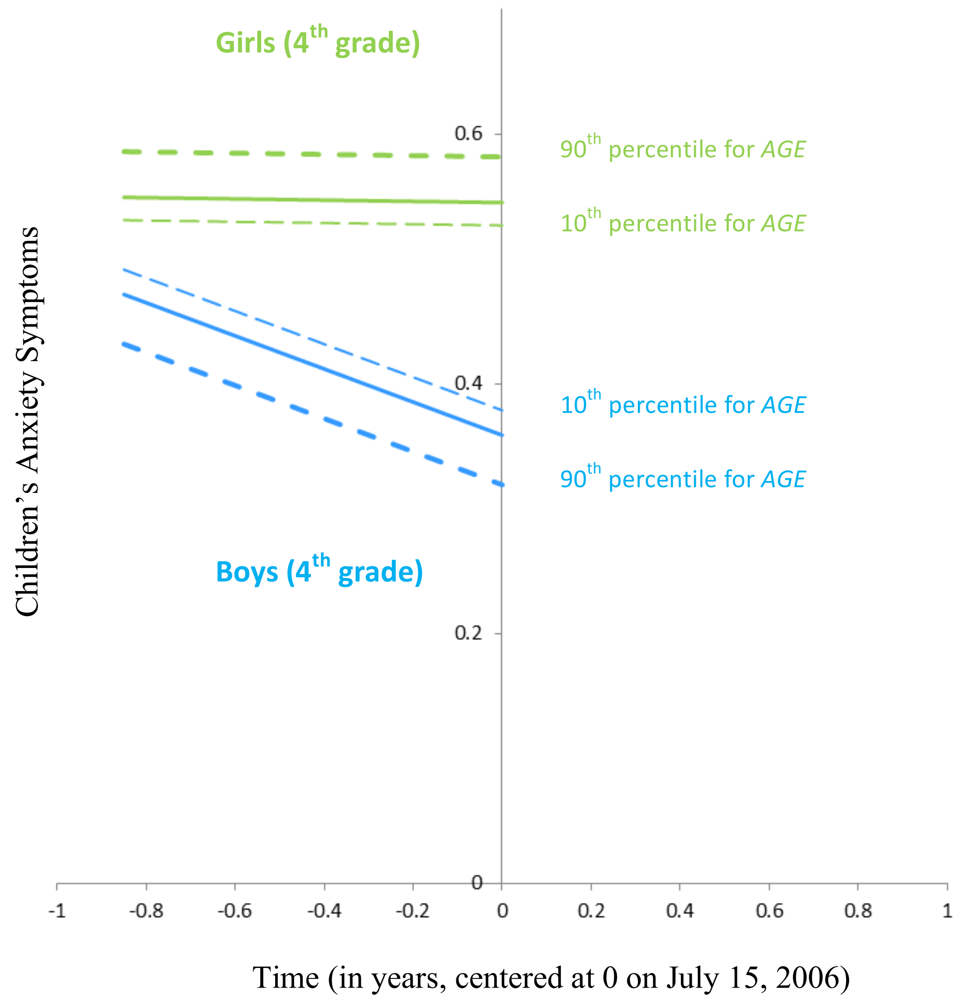


Figure 6. Fitted average anxiety-symptom trajectories over fourth and fifth grades for prototypical **girls** and **boys** of average age (10.38 years old at the point of discontinuity) whose levels of sociodemographic and community risk factors are set at their median values (2.00 and 1.86, respectively); (*n*=838 children in 18 schools over 2,507 total observations).

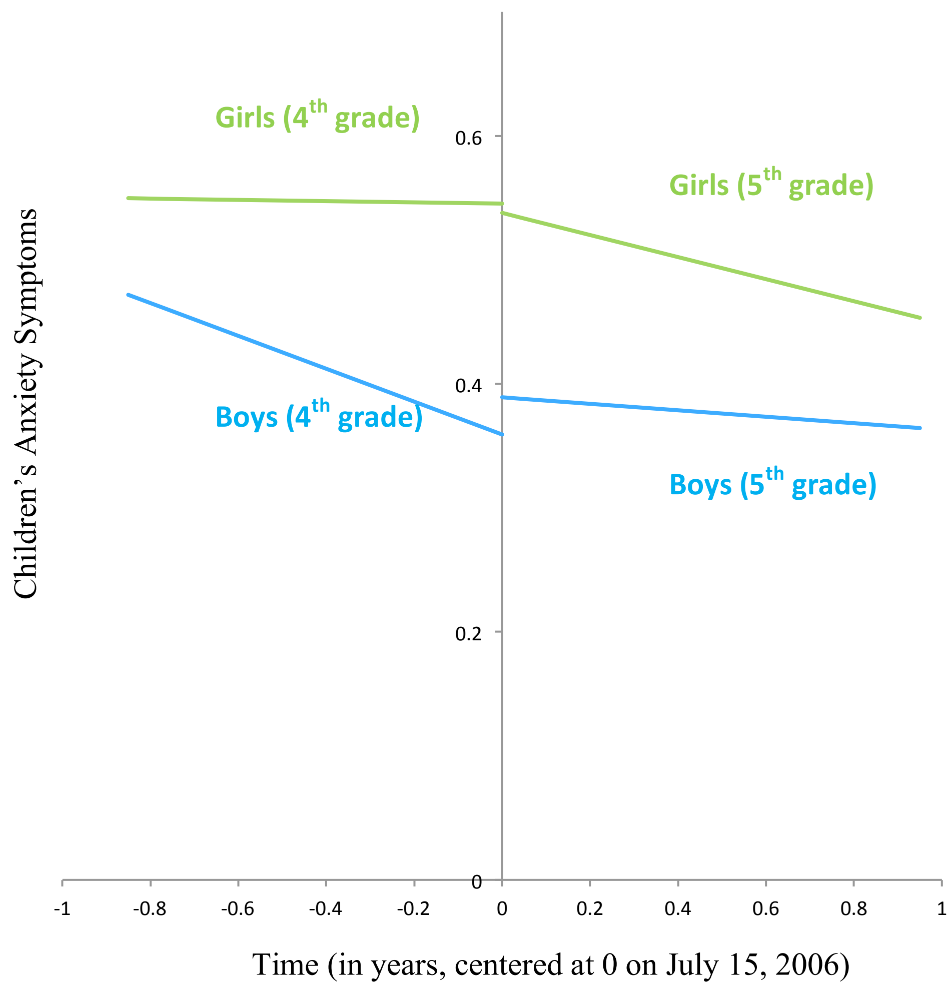


Figure 7. Fitted average anxiety-symptom trajectories over fourth and fifth grades for prototypical **girls** and **boys** of median age (solid lines; 10.38 years old at the point of discontinuity), above-median age (thick dashed lines; 11.36 years old at the point of discontinuity), and below-median age (thin dashed lines; 9.68 years old at the point of discontinuity) whose levels of sociodemographic and community risk factors are set at their median values (2.00 and 1.86, respectively); (*n*=838 children in 18 schools over 2,507 total observations).

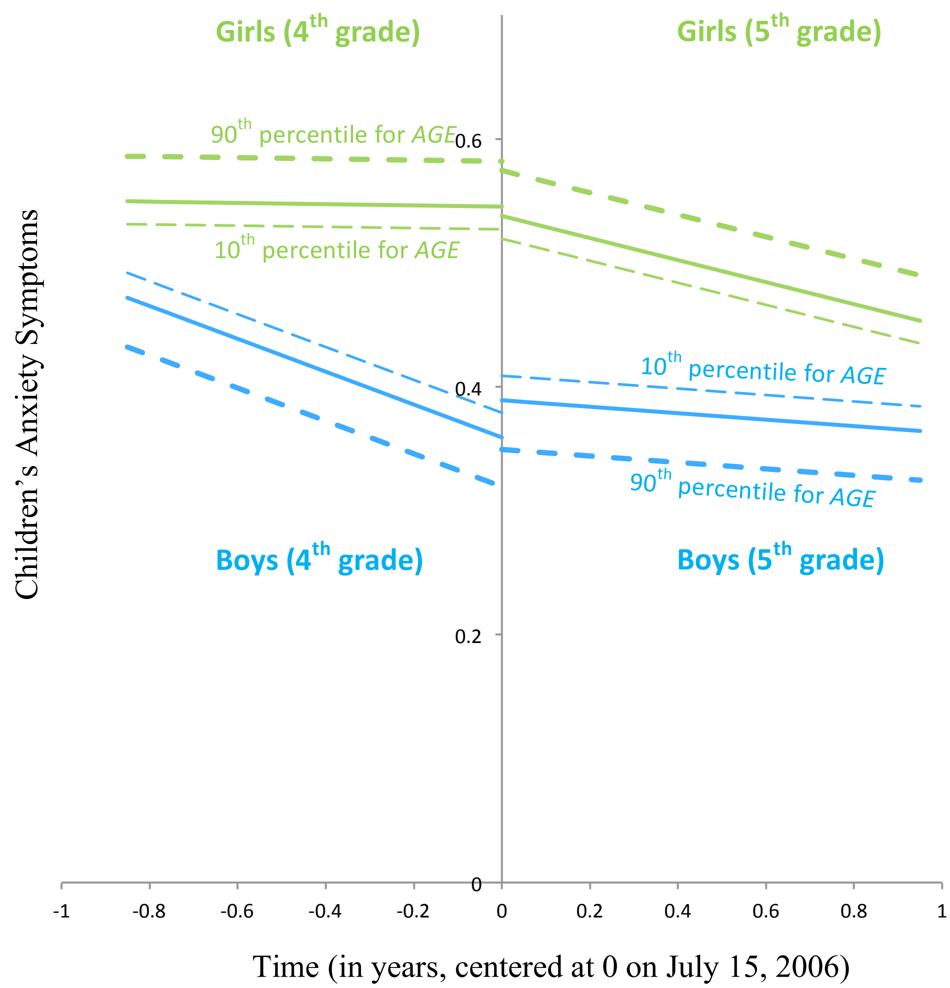


Figure 8. Fitted average depressive-symptom trajectories over fourth and fifth grades for prototypical girls of median age (10.38 years old at the point of discontinuity) whose levels of sociodemographic and community risk factors are set at their median values (2.00 and 1.86, respectively) in both **the policy-shift group** (solid lines) and the **non-policy-shift group** (dotted line); (*n*=837 children in 18 schools over 2,505 total observations).

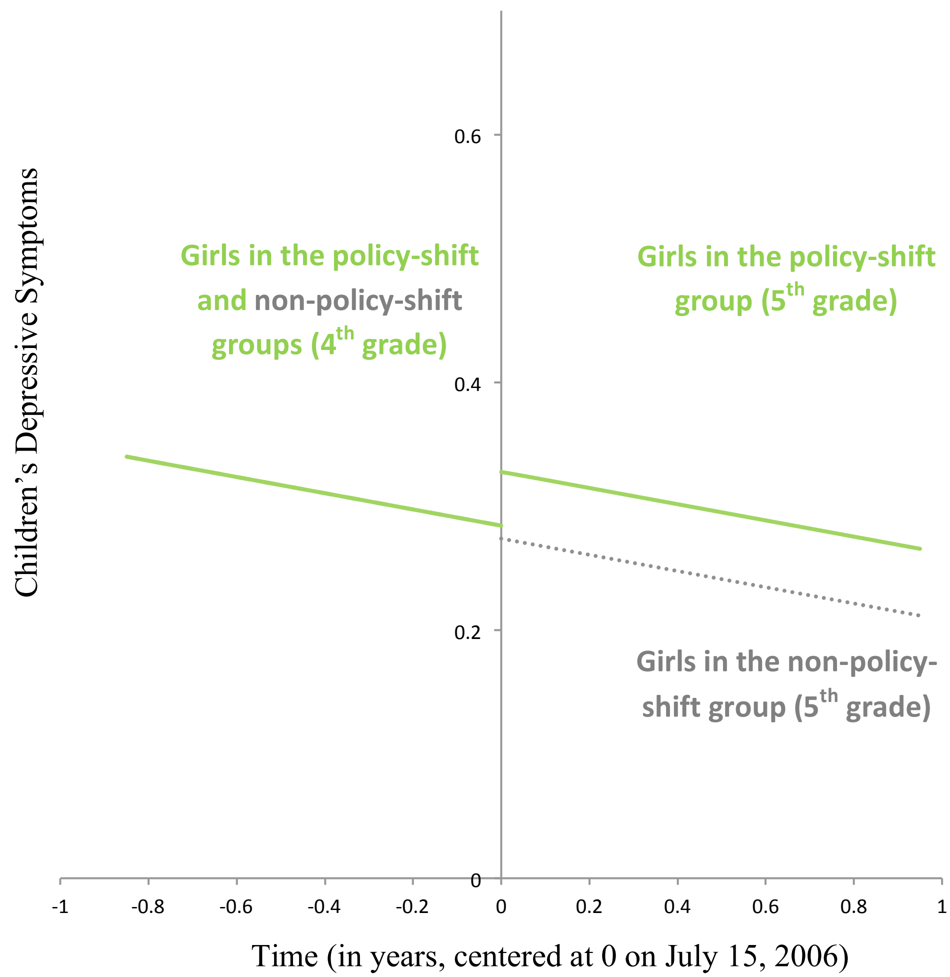
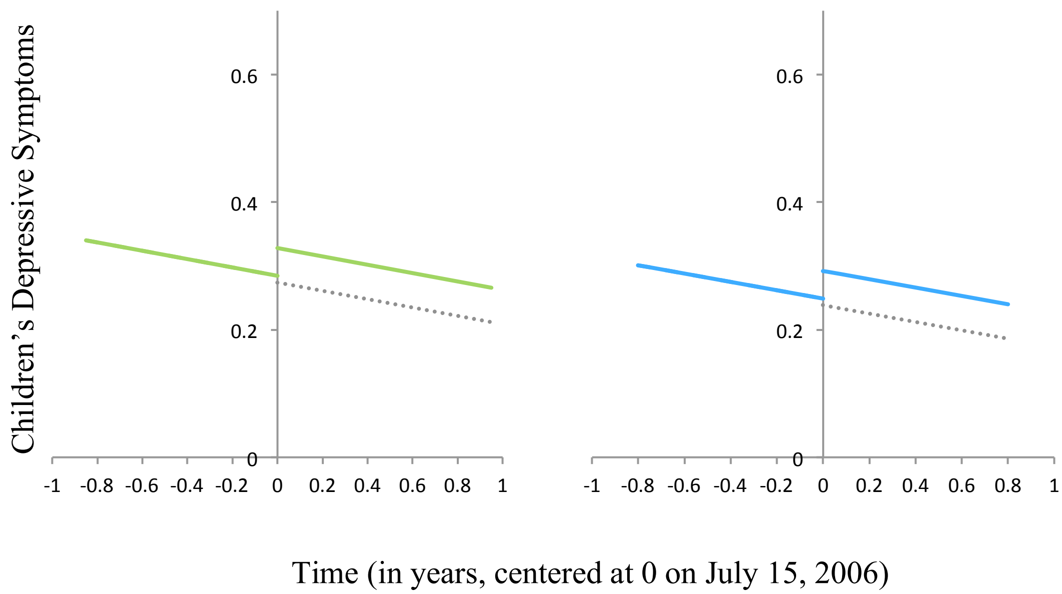


Figure 9. Side-by-side fitted average depressive-symptom trajectories over fourth and fifth grades for prototypical **girls** (left) and **boys** (right) of median age (10.38 years old at the point of discontinuity) whose levels of sociodemographic and community risk factors are set at their median values (2.00 and 1.86, respectively) in both the policy-shift group (solid lines) and the non-policy-shift group (dotted lines); (*n*=837 children in 18 schools over 2,505 total observations).



Appendices

Appendix A: Operationalization of *SRISK* and *CRISK* Variables

For funding reasons, the data from which I composited the values of the risk variables in my analyses were only collected at the first, second, and fourth waves of data collection, for my sample. As a result of the systematic missingness of these variables at the third wave, using them in their most authentic time-varying form would have deleted a wave of outcome data from my models. Thus, I created several different versions of these variables, shown in the table below, and adopted *Approach #3*, for two reasons:

(1) It is more defensible than *Approach #1*, where *later* RISK assessments are used to predict *prior* internalizing symptoms, thereby introducing potential bias due to endogeneity into the findings;

(2) Although *Approach #3* generates an identical number of observations as *Approach #5*, the latter approach is haphazard as it is un-systematic in terms of which missing values are imputed. In contrast, *Approach #3* is straightforward, not favoring any missing values over any others.

	Variable Names	Nature of Approach	Sample in Models
Approach #1	*CRISKAVE* *SRISKAVE*	Time-invariant (average)	842 children 2,684 observations (4 waves)
Approach #2	*CRISK* *SRISK*	Time-varying	836 children 1,630 observations (3 waves)
Approach #3	*CRISKBL* *SRISKBL*	Time-invariant (baseline)	838 children 2,507 observations (4 waves)
Approach #4	*CRISKFF* *SRISKFF*	Time-varying (fill from 1&2 to 3)	838 children 2,191 observations (4 waves)
Approach #5	*CRISKFFALL* *SRISKFFALL*	Time-varying (fill from 1&2 to 2,3&4)	838 children 2,507 observations (4 waves)

Appendix B: Derivation of Parameters of Interest for RQ1, *Fully-Interacted Model*

To address my first research question, I take my hypothesized population model and first solve for the population elevation and rate of change in boys' and girls' internalizing trajectories in both the *policy-shift* and *non-policy-shift* groups under the condition that *SHIFT*=0 (that is, at time points prior to the discontinuity):

Full hypothesized model:

$$\begin{aligned} INT_{ij} = \gamma_{00} &+ \gamma_{01}GIRL_i + \gamma_{02}(GIRL_i \times ITSGROUP_i) + \gamma_{10}TIME_{ij} \\ &+ \gamma_{11}(TIME_{ij} \times GIRL_i) + \gamma_{12}(TIME_{ij} \times ITSGROUP_i) \\ &+ \gamma_{13}(TIME_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{20}SHIFT_{ij} \\ &+ \gamma_{21}(SHIFT_{ij} \times GIRL_i) + \gamma_{22}(SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{23}(SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{30}(TIME_{ij} \times SHIFT_{ij}) \\ &+ \gamma_{31}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i) + \gamma_{32}(TIME_{ij} \times SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{33}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \delta\boldsymbol{Z}_i + \varepsilon_{ij} + u_i \end{aligned}$$

Expected population value of the outcome for boys in the *non-policy-shift* group:

(1a) $where\ GIRL = 0; TIME \neq 0;\ SHIFT = 0; ITSGROUP = 0$

$$\boldsymbol{E(INT_{RQ1})} = \gamma_{00} + \gamma_{10}TIME_{ij} + \delta\boldsymbol{Z}_i$$

Expected population value of the outcome for girls in the *non-policy-shift* group:

(1b) $where\ GIRL = 1; TIME \neq 0;\ SHIFT = 0; ITSGROUP = 0$

$$\boldsymbol{E(INT_{RQ1})} = \gamma_{00} + \gamma_{01} + (\gamma_{10} + \gamma_{11})TIME_{ij} + \delta\boldsymbol{Z}_i$$

Expected population value of the outcome for boys in the *policy-shift* group:

(1c) $where\ GIRL = 0; TIME \neq 0;\ SHIFT = 0; ITSGROUP = 1$

$$\boldsymbol{E(INT_{RQ1})} = \gamma_{00} + (\gamma_{10} + \gamma_{12})TIME_{ij} + \delta\boldsymbol{Z}_i$$

Expected population value of the outcome for girls in the *policy-shift* group:

(1d) $where\ GIRL = 1; TIME \neq 0;\ SHIFT = 0; ITSGROUP = 1$

$$\boldsymbol{E(INT_{RQ1})} = \gamma_{00} + \gamma_{01} + \gamma_{02} + (\gamma_{10} + \gamma_{11} + \gamma_{12} + \gamma_{13})TIME_{ij} + \delta\boldsymbol{Z}_i$$

For children in each of these groups, the parameter (or sum of parameters) in equations (1a) through (1d) that are multiplied by *TIME* represents those children's population average annual rate of change in internalizing symptoms, therefore addressing the first part of my first research question.

Next I solve for population differences in elevation and rate of change in internalizing trajectories between boys and girls in the *policy-shift* and *non-policy-shift* groups.

Expected population difference in outcome between boys and girls in the *non-policy-shift* group:

(2a) $(1b) - (1a) = \gamma_{01} + \gamma_{11} TIME_{ij}$

Expected population difference in outcome between boys and girls in the *policy-shift* group:

(2b) $(1d) - (1c) = \gamma_{01} + \gamma_{02} + (\gamma_{11} + \gamma_{13}) TIME_{ij}$

In each of these groups, the parameter (or sum of parameters) in equations (2a) and (2b) that **are not** multiplied by *TIME* represents the population average vertical difference in elevation between girls' and boys' trajectories; the parameter (or sum of parameters) that **are** multiplied by *TIME* represents gender differences in the steepness of children's trajectories. Therefore, these quantities address the second part of my first research question.

Appendix C: Derivation of Parameters of Interest for RQ2, *Fully-Interacted Model*

To address my second research question, I take my hypothesized population model and first solve for population outcome values (a) through (d) in Figure 3 for boys to calculate the quantities Δ_{1boy}, Δ_{2boy}, and $\Delta_{(1-2)boy}$:

Full hypothesized model:

$$\begin{aligned} INT_{ij} = \gamma_{00} &+ \gamma_{01}GIRL_i + \gamma_{02}(GIRL_i \times ITSGROUP_i) + \gamma_{10}TIME_{ij} \\ &+ \gamma_{11}(TIME_{ij} \times GIRL_i) + \gamma_{12}(TIME_{ij} \times ITSGROUP_i) \\ &+ \gamma_{13}(TIME_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{20}SHIFT_{ij} \\ &+ \gamma_{21}(SHIFT_{ij} \times GIRL_i) + \gamma_{22}(SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{23}(SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{30}(TIME_{ij} \times SHIFT_{ij}) \\ &+ \gamma_{31}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i) + \gamma_{32}(TIME_{ij} \times SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{33}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \delta \boldsymbol{Z}_i + \varepsilon_{ij} + u_i \end{aligned}$$

Expected population value of the outcome for boys in the *policy-shift* group:

(3a) $where\ GIRL = 0; TIME = 0; SHIFT = 1; ITSGROUP = 1$

$$\boldsymbol{E(INT_a)} = \gamma_{00} + \gamma_{20} + \gamma_{22} + \delta \boldsymbol{Z}_i$$

(3b) $where\ GIRL = 0; TIME = 0; SHIFT = 0; ITSGROUP = 1$

$$\boldsymbol{E(INT_b)} = \gamma_{00} + \delta \boldsymbol{Z}_i$$

Expected population value of the outcome for boys in the *non-policy-shift* group:

(3c) $where\ GIRL = 0; TIME = 0; SHIFT = 1; ITSGROUP = 0$

$$\boldsymbol{E(INT_c)} = \gamma_{00} + \gamma_{20} + \delta \boldsymbol{Z}_i$$

(3d) $where\ GIRL = 0; TIME = 0; SHIFT = 0; ITSGROUP = 0$

$$\boldsymbol{E(INT_d)} = \gamma_{00} + \delta \boldsymbol{Z}_i$$

Given equations (3a) through (3d) above:

$$\Delta_{1boy} = (3a) - (3b) = \gamma_{20} + \gamma_{22}$$

$$\Delta_{2boy} = (3c) - (3d) = \gamma_{20}$$

$$\Delta_{(1-2)boy} = \Delta_{1boy} - \Delta_{2boy} = \gamma_{22}$$

I then solve for population outcome values (a) through (d) in Figure 3 for girls to calculate the quantities Δ_{1girl}, Δ_{2girl}, and $\Delta_{(1-2)girl}$:

Expected population value of the outcome for girls in the *policy-shift* group:

(4a) $where\ GIRL = 1; TIME = 0; SHIFT = 1; ITSGROUP = 1$

$$\boldsymbol{E}(\boldsymbol{INT_a}) = \gamma_{00} + \gamma_{01} + \gamma_{02} + \gamma_{20} + \gamma_{21} + \gamma_{22} + \gamma_{23} + \delta\boldsymbol{Z}_i$$

(4b) $where\ GIRL = 1; TIME = 0; SHIFT = 0; ITSGROUP = 1$

$$\boldsymbol{E}(\boldsymbol{INT_b}) = \gamma_{00} + \gamma_{01} + \gamma_{02} + \delta\boldsymbol{Z}_i$$

Expected population value of the outcome for girls in the *non-policy-shift* group:

(4c) $where\ GIRL = 1; TIME = 0; SHIFT = 1; ITSGROUP = 0$

$$\boldsymbol{E}(\boldsymbol{INT_c}) = \gamma_{00} + \gamma_{01} + \gamma_{20} + \gamma_{21} + \delta\boldsymbol{Z}_i$$

(4d) $where\ GIRL = 1; TIME = 0; SHIFT = 0; ITSGROUP = 0$

$$\boldsymbol{E}(\boldsymbol{INT_d}) = \gamma_{00} + \gamma_{01} + \delta\boldsymbol{Z}_i$$

Given equations (4a) through (4d) above:

$$\Delta_{1girl} = (4a) - (4b) = \gamma_{20} + \gamma_{21} + \gamma_{22} + \gamma_{23}$$

$$\Delta_{2girl} = (4c) - (4d) = \gamma_{20} + \gamma_{21}$$

$$\Delta_{(1-2)girl} = \Delta_{1girl} - \Delta_{2girl} = \gamma_{22} + \gamma_{23}$$

Finally, I subtract $\Delta_{(1-2)boy}$ from $\Delta_{(1-2)girl}$ to define the parameter of interest that will indicate whether the causal impact for girls was more pronounced than the causal impact for boys.

$$\Delta_{(1-2)girl} - \Delta_{(1-2)boy} = \gamma_{22} + \gamma_{23} - \gamma_{22} = \gamma_{23}$$

Appendix D: Derivation of Parameters of Interest for RQ3, *Fully-Interacted Model*

To address my third research question, I take my hypothesized population model and first solve for the population elevation and rate of change in boys' and girls' internalizing trajectories in both the *policy-shift* and *non-policy-shift* groups under the condition that *SHIFT*=1 (that is, at time points after the discontinuity):

Full hypothesized model:

$$\begin{aligned} INT_{ij} = \gamma_{00} &+ \gamma_{01}GIRL_i + \gamma_{02}(GIRL_i \times ITSGROUP_i) + \gamma_{10}TIME_{ij} \\ &+ \gamma_{11}(TIME_{ij} \times GIRL_i) + \gamma_{12}(TIME_{ij} \times ITSGROUP_i) \\ &+ \gamma_{13}(TIME_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{20}SHIFT_{ij} \\ &+ \gamma_{21}(SHIFT_{ij} \times GIRL_i) + \gamma_{22}(SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{23}(SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \gamma_{30}(TIME_{ij} \times SHIFT_{ij}) \\ &+ \gamma_{31}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i) + \gamma_{32}(TIME_{ij} \times SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{33}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i \times ITSGROUP_i) + \delta\boldsymbol{Z}_i + \varepsilon_{ij} + u_i \end{aligned}$$

Expected population value of the outcome for boys in the *non-policy-shift* group:

(5a) $where\ GIRL = 0; TIME \neq 0;\ SHIFT = 1; ITSGROUP = 0$

$$\boldsymbol{E}(\boldsymbol{INT_{RQ3}}) = \gamma_{00} + \gamma_{20} + (\gamma_{10} + \gamma_{30})TIME_{ij} + \delta\boldsymbol{Z}_i$$

Expected population value of the outcome for girls in the *non-policy-shift* group:

(5b) $where\ GIRL = 1; TIME \neq 0;\ SHIFT = 1; ITSGROUP = 0$

$$\boldsymbol{E}(\boldsymbol{INT_{RQ3}}) = \gamma_{00} + \gamma_{01} + \gamma_{20} + \gamma_{21} + (\gamma_{10} + \gamma_{11} + \gamma_{30} + \gamma_{31})TIME_{ij} + \delta\boldsymbol{Z}_i$$

Expected population value of the outcome for boys in the *policy-shift* group:

(5c) $where\ GIRL = 0; TIME \neq 0;\ SHIFT = 1; ITSGROUP = 1$

$$\boldsymbol{E}(\boldsymbol{INT_{RQ3}}) = \gamma_{00} + \gamma_{20} + \gamma_{22} + (\gamma_{10} + \gamma_{12} + \gamma_{30} + \gamma_{32})TIME_{ij} + \delta\boldsymbol{Z}_i$$

Expected population value of the outcome for girls in the *policy-shift* group:

(5d) $where\ GIRL = 1; TIME \neq 0;\ SHIFT = 1; ITSGROUP = 1$

$$\begin{aligned} \boldsymbol{E}(\boldsymbol{INT_{RQ3}}) = \gamma_{00} + \gamma_{01} + \gamma_{02} + \gamma_{20} + \gamma_{21} + \gamma_{22} + \gamma_{23} + (\gamma_{10} + \gamma_{11} + \gamma_{12} + \\ \gamma_{13} + \gamma_{30} + \gamma_{31} + \gamma_{32} + \gamma_{33})TIME_{ij} + \delta\boldsymbol{Z}_i \end{aligned}$$

Next I solve for population differences in elevation and rate of change between children's fifth-grade internalizing trajectories and their trajectories in fourth grade. I do this for boys and girls in the *policy-shift* and *non-policy-shift* groups[12].

Expected population difference in outcome between fifth and fourth grade trajectories for boys in the *non-policy-shift* group:

(6a) $(5a) - (1a) = \gamma_{20} + \gamma_{30}TIME_{ij}$

Expected population difference in outcome between fifth and fourth grade trajectories for girls in the *non-policy-shift* group:

(6b) $(5b) - (1b) = \gamma_{20} + \gamma_{21} + (\gamma_{30}+\gamma_{31})TIME_{ij}$

Expected population difference in outcome between fifth and fourth grade trajectories for boys in the *policy-shift* group:

(6c) $(5c) - (1c) = \gamma_{20} + \gamma_{22} + (\gamma_{30} + \gamma_{32})TIME_{ij}$

Expected population difference in outcome between fifth and fourth grade trajectories for girls in the *policy-shift* group:

(6d) $(5d) - (1d) = \gamma_{20} + \gamma_{21} + \gamma_{22} + \gamma_{23} + (\gamma_{30}+\gamma_{31} + \gamma_{32} + \gamma_{33})TIME_{ij}$

Finally, to produce the pseudo-causal population values for the difference in rate of change in internalizing symptoms between fifth-grade and fourth-grade trajectories, I go through three steps. First I subtract the *non-policy-shift* group difference in trajectories from that of the *policy-shift* group, for boys and girls separately. Second, I subtract from these equations the causal differences in elevation ($\Delta_{(1-2)boy}$ and $\Delta_{(1-2)girl}$) that addressed RQ2, producing pseudo-causal post-discontinuity population values for the difference, in slope only, of internalizing trajectories between fifth and fourth grade. Finally, I subtract the pseudo-causal population value for boys from the pseudo-causal population value for girls to establish whether the pseudo-causal post-discontinuity slope effect was more pronounced for girls than for boys.

Subtraction of *non-policy-shift* group difference in trajectories between fifth and fourth grade for boys:

(7a) $(6c) - (6a) = \gamma_{22} + \gamma_{32}TIME_{ij}$

[12] Note that the differences in elevation here are identical to the causal parameters I produced in *Appendix C*, since they are precisely the vertical quantities that, by design, constitute the causal estimates at the discontinuity. I will subtract these out of equations (8a) and (8b) in the final set of solutions I present here in order to isolate the pseudo-causal post-discontinuity difference in slope of children's internalizing trajectories between fifth and fourth grade.

Subtraction of *non-policy-shift* group difference in trajectories between fifth and fourth grade for girls:

(7b) $(6d) - (6b) = \gamma_{22} + \gamma_{23} + (\gamma_{32} + \gamma_{33})TIME_{ij}$

Pseudo-causal slope effect for boys (subtraction of causal impact in elevation from RQ2):

(8a) $(7a) - \Delta_{(1-2)boy} = \gamma_{32}TIME_{ij}$

Pseudo-causal slope effect for girls (subtraction of causal impact in elevation from RQ2):

(8b) $(7b) - \Delta_{(1-2)girl} = (\gamma_{32} + \gamma_{33})TIME_{ij}$

Pseudo-causal gender effect for slope of trajectories between fifth and fourth grade:

(8c) $(8b) - (8a) = \gamma_{33}TIME_{ij}$

Appendix E: Derivation of Parameters of Interest for RQ1, *Trimmed Final Model*

In this appendix, I derive my parameters of interest for my first research question using my trimmed final model with anxiety symptoms as the outcome, *Model A3* from Table 1, as these differ somewhat from the parameters of interest I derived in *Appendix B* using my theoretical fully-interacted model.

To address my first research question using my final model, I first solve for population elevation and rate of change in boys' and girls' internalizing trajectories under the condition that *SHIFT*=0 (that is, at time points prior to the discontinuity) and, to accommodate the statistically significant *AGE*×*GIRL* interaction, that *AGE*=10.24 (the median age of children in the sample at the point of discontinuity):

<u>Final trimmed model</u>[13]:

$$\begin{aligned} ANX_{ij} = \gamma_{00} &+ \gamma_{01}GIRL_i + \gamma_{02}AGE_i + \gamma_{03}(AGE_i \times GIRL_i) + \gamma_{04}CRISKBL_i \\ &+ \gamma_{05}SRISKBL_i + \gamma_{10}TIME_{ij} + \gamma_{11}(TIME_{ij} \times GIRL_i) + \gamma_{20}SHIFT_{ij} \\ &+ \gamma_{21}(SHIFT_{ij} \times GIRL_i) + \gamma_{22}(SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{30}(TIME_{ij} \times SHIFT_{ij}) + \gamma_{31}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i) + \delta \boldsymbol{Z}_i + \varepsilon_{ij} \\ &+ u_i \end{aligned}$$

In this model, because I have removed several non-statistically significant interaction terms that included *ITSGROUP*, there is no difference between boys and girls in the policy-shift vs. non-policy-shift groups prior to the discontinuity. Therefore I do not need to derive the parameters of interest for my first research question separately for these two groups (as I did in *Appendix B*).

<u>Expected population value of the outcome for boys</u>:

(9a) $where\ GIRL = 0; TIME \neq 0;\ SHIFT = 0; AGE = 10.24$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ1}}) = \gamma_{00} + 10.24(\gamma_{02}) + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \gamma_{10}TIME_{ij} + \delta \boldsymbol{Z}_i$$

<u>Expected population value of the outcome for girls</u>:

(9b) $where\ GIRL = 1; TIME \neq 0;\ SHIFT = 0; AGE = 10.24$

$$\begin{aligned} \boldsymbol{E}(\boldsymbol{ANX_{RQ1}}) = \gamma_{00} + \gamma_{01} + 10.24(\gamma_{02} + \gamma_{03}) + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + (\gamma_{10} \\ + \gamma_{11})TIME_{ij} + \delta \boldsymbol{Z}_i \end{aligned}$$

Parameters of Interest: To address the first part of my first research question, whether trajectories of children's anxiety symptoms rise over the fourth-grade year, a positive and statistically significant estimate of parameter γ_{10} would indicate that boys' anxiety

[13] In this model specification, **Z** represents the fixed effects of school.

trajectories rose during fourth grade; meanwhile, a positive and statistically significant estimate of parameter sum $(\gamma_{10} + \gamma_{11})$ would indicate the same for girls.

Next I solve for population differences in elevation and rate of change in anxiety trajectories between boys and girls:

Expected population difference in outcome between boys and girls:

(10) $(1b) - (1a) = \gamma_{01} + 10.24(\gamma_{03}) + \gamma_{11}TIME_{ij}$

Parameters of Interest: To address the second part of my first research question, whether children's fourth-grade anxiety symptom trajectories are steeper and more elevated for girls than boys, a positive and statistically significant estimate of parameter sum$(\gamma_{01} + 10.24(\gamma_{03}))$ would indicate that anxiety trajectories were higher in elevation for girls than boys, and a positive and statistically significant estimate of parameter γ_{11}would indicate that they were steeper.

Appendix F: Single-Parameter and Post-Hoc-GLH Test Results on Parameters of Interest for RQ1

These results represent findings from my final model, *Model A3* in Table 1, for children's anxiety symptoms over time.

RQ1: Do trajectories of children's anxiety symptoms rise over the fourth-grade year, and are these trajectories steeper and more elevated, on average, for girls than for boys?

Variable whose Parameter is of Interest	Parameter or Parameter Sum	Substantive Meaning	Estimated Magnitude	*p*-value
TIME	γ_{10}	Did boys' anxiety symptoms change over the course of fourth grade?	-0.133	*p*=0.001
TIME + *TIME*×*GIRL*	$\gamma_{10} + \gamma_{11}$	Did girls' anxiety symptoms change over the course of fourth grade?	-0.005	*p*=0.886
GIRL + 10.24(*AGE*×*GIRL*)	$\gamma_{01} + 10.24(\gamma_{03})$	Did anxiety symptoms differ between girls and boys during fourth grade?	0.186	*p*=0.000
TIME×*GIRL*	γ_{11}	Did rate of change in anxiety symptoms differ between girls and boys during fourth grade?	0.128	*p*=0.011

Appendix G: Derivation of Parameters of Interest for RQ2, *Trimmed Final Model*

In this appendix, I derive the parameters of interest for my second research question using my trimmed final model, *Model A3* from Table 1. The parameters of interest differ somewhat from the parameters of interest that I derived in *Appendix C* using my theoretical fully-interacted model, namely in that the removal of the non-significant *GIRL×ITSGROUP*, *TIME×ITSGROUP*, *TIME×GIRL×ITSGROUP*, *SHIFT×GIRL×ITSGROUP*, *TIME×SHIFT×ITSGROUP*, and *TIME×SHIFT×GIRL×ITSGROUP* terms has already established null findings for most of my second research question[14].

To address my second research question using my final model, I first solve for population outcome values (a) through (d) in Figure 3 for boys to calculate the quantities Δ_{1boy}, Δ_{2boy}, and $\Delta_{(1-2)boy}$:

<u>Final trimmed model[15]</u>:

$$\begin{aligned} ANX_{ij} = \gamma_{00} &+ \gamma_{01}GIRL_i + \gamma_{02}AGE_i + \gamma_{03}(AGE_i \times GIRL_i) + \gamma_{04}CRISKBL_i \\ &+ \gamma_{05}SRISKBL_i + \gamma_{10}TIME_{ij} + \gamma_{11}(TIME_{ij} \times GIRL_i) + \gamma_{20}SHIFT_{ij} \\ &+ \gamma_{21}(SHIFT_{ij} \times GIRL_i) + \gamma_{22}(SHIFT_{ij} \times ITSGROUP_i) \\ &+ \gamma_{30}(TIME_{ij} \times SHIFT_{ij}) + \gamma_{31}(TIME_{ij} \times SHIFT_{ij} \times GIRL_i) + \delta\boldsymbol{Z}_i + \varepsilon_{ij} \\ &+ u_i \end{aligned}$$

<u>Expected population value of the outcome for boys in the *policy-shift* group</u>:

(11a) $where\ GIRL = 0; TIME = 0; SHIFT = 1; ITSGROUP = 1;\ AGE \neq 0$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{20} + \gamma_{22} + \gamma_{02}AGE_i + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

(11b) $where\ GIRL = 0; TIME = 0; SHIFT = 0; ITSGROUP = 1;\ AGE \neq 0$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{02}AGE_i + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

<u>Expected population value of the outcome for boys in the *non-policy-shift* group</u>:

(11c) $where\ GIRL = 0; TIME = 0; SHIFT = 1; ITSGROUP = 0;\ AGE \neq 0$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{20} + \gamma_{02}AGE_i + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

(11d) $where\ GIRL = 0; TIME = 0; SHIFT = 0; ITSGROUP = 0;\ AGE \neq 0$

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[14] I kept in my final model the *SHIFT×ITSGROUP* interaction, despite its non-significance statistically, to retain the core component of my initial analytic design.
[15] In this model specification, **Z** represents the fixed effects of school.

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{02}AGE_i + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

Given equations (11a) through (11d) above:

$$\Delta_{1boy} = (11a) - (11b) = \gamma_{20} + \gamma_{22}$$

$$\Delta_{2boy} = (11c) - (11d) = \gamma_{20}$$

$$\Delta_{(1-2)boy} = \Delta_{1boy} - \Delta_{2boy} = \gamma_{22}$$

I then solve for population outcome values (a) through (d) in Figure 3 for girls to calculate the quantities Δ_{1girl}, Δ_{2girl}, and $\Delta_{(1-2)girl}$:

<u>Expected population value of the outcome for girls in the *policy-shift* group</u>:

(12a) $where\ GIRL = 1; TIME = 0; SHIFT = 1; ITSGROUP = 1;\ AGE \neq 0$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{01} + \gamma_{20} + \gamma_{21} + \gamma_{22} + \gamma_{02}AGE_i + 10.38(\gamma_{03}) + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

(12b) $where\ GIRL = 1; TIME = 0; SHIFT = 0; ITSGROUP = 1;\ AGE \neq 0$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{01} + \gamma_{02}AGE_i + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

<u>Expected population value of the outcome for girls in the *non-policy-shift* group</u>:

(12c) $where\ GIRL = 1; TIME = 0; SHIFT = 1; ITSGROUP = 0;\ AGE \neq 0$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{01} + \gamma_{20} + \gamma_{21} + \gamma_{02}AGE_i + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

(12d) $where\ GIRL = 1; TIME = 0; SHIFT = 0; ITSGROUP = 0;\ AGE \neq 0$

$$\boldsymbol{E}(\boldsymbol{ANX_{RQ2}}) = \gamma_{00} + \gamma_{01} + \gamma_{02}AGE_i + \gamma_{04}CRISKBL_i + \gamma_{05}SRISKBL_i + \delta\boldsymbol{Z}_i$$

Given equations (12a) through (12d) above:

$$\Delta_{1girl} = (12a) - (12b) = \gamma_{20} + \gamma_{21} + \gamma_{22}$$

$$\Delta_{2girl} = (12c) - (12d) = \gamma_{20} + \gamma_{21}$$

$\Delta_{(1-2)girl} = \Delta_{1girl} - \Delta_{2girl} = \gamma_{22}$[16]

Appendix H: Additional Post-Hoc-GLH Test Results Reported in Findings for RQ2 and RQ3

These results represent findings from my final model, *Model A3* in Table 1, for children's anxiety symptoms over time.

RQ2: Does an arguably exogenous policy shift, occurring between fourth and fifth grade, that resulted in a foreshortening of the transition to middle school (to fifth-grade graduation from the previous policy of sixth-grade graduation) cause elevations in children's anxiety symptoms at the point of the shift, and are these elevations more pronounced for girls than boys?

RQ3: Are children's trajectories of anxiety symptoms after the policy shift steeper during fifth grade for students who experienced a foreshortening of the transition to middle school, and is the steepness of trajectories more pronounced for girls than for boys?

Variable whose Parameter is of Interest	Parameter or Parameter Sum	Substantive Meaning	Estimated Magnitude	*p*-value
SHIFT + SHIFT×ITS	$\gamma_{20} + \gamma_{22}$	Did boys' anxiety symptoms rise at the point of discontinuity?	0.030	*p*=0.368
TIME + TIME×SHIFT	$\gamma_{10} + \gamma_{30}$	Did boys' anxiety symptoms change over the course of fifth grade?	-0.026	*p*=0.489
TIME + TIME×GIRL+ TIME×SHIFT + TIME×SHIFT×GIRL	$\gamma_{10} + \gamma_{11} + \gamma_{30} + \gamma_{31}$	Did girls' anxiety symptoms change over the course of fifth grade?	-0.089	*p*=0.016

[16] Note that the parameter of interest to evaluate the impact of the policy is identical for girls and boys. This is to be expected, since the removal of all interaction terms involving *GIRL* and *ITSGROUP* has already established that the policy impact did not differ by gender.

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Vita

Hadas Eidelman

1994-1998	University of Virginia Charlottesville, Virginia	B.A. June 1998
1998-1999	Floor Manager, Madison Children's Museum Madison, Wisconsin	
1999-2002	Marketing Coordinator, Environmental Defense Washington, DC	
2002-2003	Assistant Director, JCC Preschool Washington, DC	
2003-2006	Teacher, JCC Preschool Washington, DC	
2006-2007	Graduate School of Education Harvard University	M.Ed. May 2007
2007-2014	Doctor of Education Candidate Graduate School of Education Harvard University	
2007-2011	Teaching Fellow Graduate School of Education Harvard University	
2008-2013	Research Assistant Graduate School of Education Harvard University	
2010-2013	Partner, Grindal Eidelman Research Cambridge, Massachusetts	