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Chapter II. Methods and Procedures for the Family Transitions Study

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Participants

Participants included 241 families, including mothers, fathers, and their firstborn children. Families were initially recruited through flyers posted in local obstetric clinics, hospitals, pediatricians' offices, child care centers, child-birth education classes, and local newspaper advertisements. The majority of participants (64%) were recruited through obstetric clinics; local media provided 30% of our participants, and word of mouth accounted for 6%. To be eligible for the study, families had to meet the following criteria: (1) the mother was pregnant with her second child; (2) the father was the biological father of the second child (98% were also the biological father of the firstborn); (3) the mother and the father were living together (99% were married); (3) the older sibling was between the ages of 1 and 5 years at the time of the infant's birth; and (4) the older sibling did not have chronic and severe physical, mental, or developmental problems. Upon birth, infants with chronic health problems or identifiable disabilities/anomalies, prematurity (< 37 weeks) or a birth weight less than 2500 grams were not included. All births were singleton. Of the 408 families who contacted the project office and met study criteria, 241 (59.1%) agreed to participate. Most families cited the time commitment as the major reason for not participating. During the first prenatal home visit, research staff explained the study in greater detail during which parents had the opportunity to ask questions before they signed consent forms for the study, which was approved by the Institutional Review Board of the Medical School at the University of Michigan. Families were compensated \$300 for participating in all phases of the study. The attrition rate was 15.8% across the 12 months of the study. The final sample of 241 families was chosen to account for a 15% attrition rate across the study period with the goal of having at least 200 families available for planned analyses. We chose 200 families in order to have an .80 power to detect small-to-medium effects using two-tailed $\alpha = .05$ (e.g., $r = .19$, two group $d = .4$, two times $d = .2$, an ANOVA effect size $f = .23$ with 4 groups). At 12 months, 203 families remained in the study.

Characteristics of Family Households

During the prenatal home visit, parents provided demographic information on their education, occupations, family income, age and race/ethnicity. Parents' length of marriage ranged from .58 – 20 years ($M = 5.77$, $SD = 2.74$). Families were primarily middle- to upper-middle class. The mode of household income was \$60,000 – \$99,999 (37.8%); 32.8% of families had a household income greater than \$100,000, 27.8% of families earned \$20,000 – \$59,999; and 1.7% of families earned less than \$20,000.

Parent Characteristics

At the prenatal timepoint, the mean age of mothers was 31.6 years ($SD = 4.22$) and the mean age of fathers was 33.2 years ($SD = 4.78$). The sample was well-educated, with the majority of parents earning a Bachelor's degree or higher (83.9% of mothers; 79.2% of fathers).

The racial breakdown of the sample was primarily European American (89.6% of mothers, 89.2% of fathers), followed by African American (5.4% of mothers, 5.0% of fathers), Asian/Asian-American (2.9% of mothers, 3.7% of fathers), and other (2.1% of mothers, 2.1% of fathers). Of the total sample, 3.7% of mothers and 2.9% of fathers were Hispanic. The sample was recruited from four counties in southeastern Michigan. According to the U.S. Census Bureau, families across these counties were, on average, 77% Caucasian/White (range: 52% – 97%), 10% African American (range: 0.4% – 40.5%), 4% Asian (range: 1% – 8%) and 1% other (range: 0.4% – 1%); 4% (2% – 5%) of the population in these counties identified as Hispanic or Latino. Therefore, the racial and ethnic background of the sample was fairly representative of the counties from which they were recruited.

The majority of fathers were employed full-time (92.1%), with 7.8% of fathers being employed part-time, staying home full-time, or unemployed. Nearly a third of the mothers were employed full-time at the prenatal time point (35.7%); 29.9% of mothers were employed part-time ($M = 18.65$ hours/week, $SD = 9.02$ hours/week), 32.8% were staying home full-time, and 1.7% were unemployed.

Parents' occupational prestige was coded according to the National Compensation Survey from the U.S. Department of Labor (Chao & Utgoff, 2003). Mothers who reported they were stay-at-home mothers or unemployed were not asked for a job title. Parents who reported that being a student was their occupation were assigned a code of "student" (2.5% of mothers, 7.8% of fathers). Four mothers and two fathers reported an occupation that was uncodeable (e.g., fundraising, tutor). Most parents (58% of mothers, 47% of fathers) had professional, specialty, or technical careers followed by executive, administrative, and managerial positions (17.2% of mothers, 25.4% of fathers), administrative support positions (10.8% mothers, 2.6% of fathers), service occupations (7.0% of mothers, 4.3 % of fathers), sales (2.5% of mothers, 6.0% of fathers), and precision production and repair (0% of mothers and 4.7% of fathers) with less than 1% in occupations classified as handlers, cleaners and laborers.

Firstborn Children

Of the recruited sample, 54.4 % ($n = 131$) of firstborns were girls. On average, firstborns were 2.5 years old at the time of the infant's birth ($M = 31.17$ months; $SD = 10.13$ months). At the prenatal time point, 149 (62%) parents reported their firstborn children were in childcare. Of these families, 87 (58.4%) utilized school-based childcare (e.g., preschool, kindergarten), 7 (4.7%) utilized an in-home care provider, 16 (10.7%) utilized an out of home private provider, 17 (11.4%) utilized a relative, and 22 (14.8%) used a combination of two or more forms of childcare. Of the firstborns in childcare, 72.5% ($n = 108$) were in part-time care (fewer than 40 hours per week) and 27.5% ($n = 41$) were in full-time care (more

than or equal to 40 hours per week). The average amount of time per week in childcare was 24.16 hours ($SD = 15.18$).

One month after the birth, parents were asked open-ended questions about how they prepared the firstborn for the birth of the second child, which ranged from sibling preparation classes at the local hospital to showing the child his or her own baby pictures. Table 1 provides detailed information on the different types of activities families used to prepare firstborns for the birth of their siblings. Most parents (88%) relied on different forms of media (i.e., books, videos, websites) or discussion (72%). Very few families (21%) actually went to hospital-based classes designed to prepare children for the arrival of an infant sibling.

Infant Siblings

Of the 225 families remaining at 1-month, 55% of the infant siblings born were boys ($n = 124$). The gender constellation of sibling dyads (child-infant) consisted of 56 girl-girl, 45 boy-girl, 66 girl-boy, and 58 boy-boy dyads. Gender constellation of the sibling dyad was unrelated to any of the classes identified in our group-based trajectory analyses (all χ^2 nonsignificant), so is not discussed further.

Characteristics of Pregnancy and Birth

The majority of parents reported that both parents wanted and planned for the second child (85.5%), and 11.2% of parents reported that both parents wanted the second child but not right now. Only 3.2% of parents reported that one or both parents had not wanted the second child. Nearly all of the fathers (98%) attended the birth whereas only 3% of the children attended. Most (96.4%) infants were born at a hospital, 3.1% were born at home, and one infant was born at a birthing center. Mothers were away from home for a mean of 2.28 days ($SD = 1.13$) for the birth. Most of the children (91.5%) visited their mother and the infant in the hospital at least once. Most infants were born vaginally (75%), and the remainder were born through Caesarean section (25%). All infants were born full-term, were singleton births, and at a healthy weight ($M = 7.96$ lbs, $SD = 1.13$ lbs) and length ($M = 20.38$ inches, $SD = 1.07$ inches).

Study Design and Procedures

Participation in the study began during the last trimester of the mother's pregnancy with the second child ($M = 33.8$ gestation weeks, $SD = 3.3$ weeks) and continued throughout the first year after the infant's birth. Data were collected at five time points (prenatal, 1 month, 4 months, 8 months, and 12 months postpartum) using multiple methods, including behavioral observations of parent-child and family interaction, couple interviews, assessments of children's social-cognitive understanding, and parental self-reports.

These timepoints were chosen to coincide with significant developmental milestones in infant development and to correspond with different phases of the family adjustment and adaptation response based on theories of family stress and resilience (see also Stewart, 1990). These were also the 5 timepoints used by Stewart (1990) in one of the only

longitudinal investigations on the transition with more than two timepoints, which allowed us to compare findings across studies. The prenatal timepoint provided a pre-birth (i.e., baseline) assessment point. The period between prenatal and 1 month corresponded to an immediate post-birth period or adjustment phase, whereas the period from 1 month to 4 months corresponded with a restructuring and adaptation period. Further, significant developmental changes occur in infant social behavior and motor development at both 4 and 8 months of age; (e.g., smiling at 4 months and stranger wariness and infant locomotion at 8 months). These social and motoric changes typical of infant development from 4 to 8 months provided more opportunities for infants to engage in family interactions than was possible at 1 month. Finally, the 12-month timepoint marked 1 year after the birth and is also significant for the development of infant-parent attachment relationships (Ainsworth, Blehar, Waters, & Wall, 1978).

Home visits were conducted at each timepoint to collect interview data, observations of family interaction, and child assessments of children's social understanding. A set of questionnaires was left for both mothers and fathers to complete after home visits. An additional home visit was conducted at the prenatal, 4- and 12-month timepoints to conduct the Attachment Q-Sort in relation to the older child (Waters & Deane, 1985) with mothers and fathers, and a second social understanding assessment with children. Each home visit lasted approximately two hours.

In the first set of analyses, parent reports of children's problem behavior across the five time-points were used to identify developmental trajectories of problematic behavior before and after the sibling's birth. In the second set of analyses, prenatally-collected mothers' and fathers' reports of child, parent, and family factors and observations of mother-child, father-child, coparenting and marital interaction during the prenatal home visit were used to predict the different trajectory patterns. In the third set of analyses, trajectory patterns were used to predict children's relationship with their infant sibling at 12 months based on parent reports.

Children's Behavioral and Emotional Adjustment

Both mothers and fathers completed the Child Behavior Checklist (CBCL/1½-5; Achenbach & Rescorla, 2000) for their firstborn children before and after the sibling's birth (i.e., at prenatal, 1-, 4-, 8-, and 12-month timepoints). The CBCL/1½-5 is one of the most widely-used standardized measures in child psychology for evaluating maladaptive behavioral and emotional problems in preschool children between the ages of 1½ and 5 years (the age of most children in our study), with dedicated clinical cut-off scores at the 97.5th percentile and borderline clinical at the 92.5th percentile. We chose this measure intentionally to capture the extent and severity of maladaptive behavior after the sibling birth and whether there was evidence to suggest that children were reaching clinical or borderline clinical levels of problem behavior in response to the birth, in contrast to earlier studies using measures with no known standardized norms.

Parents rated 99 items about their children's problem behavior on a 3-point Likert scale from 0 = *not true* to 2 = *very true*. The CBCL/1½-5 yields seven syndromes scales: (1) *emotionally reactive* (e.g., sudden changes in mood or feelings; $\alpha = .51 - .69$, $M = .62$); (2) *anxious/depressed* (e.g., get too upset when separated from parents; $\alpha = .52 - .68$, $M = .59$);

(3) *somatic complaints* (e.g., aches or pains without medical cause; $\alpha = .35 - .52$, $M = .47$); (4) *withdrawn* (e.g., avoids looking others in the eye; $\alpha = .48 - .54$, $M = .53$); (5) *sleep problems* (e.g., has trouble getting to sleep; $\alpha = .70 - .80$, $M = .74$); (6) *attention problems* (e.g., quickly shifts from one activity to another; $\alpha = .62 - .70$, $M = .66$); and (7) *aggressive behavior* (e.g., gets in many fights; $\alpha = .85 - .89$, $M = .87$). In addition, the CBCL yields two broad band scores: *Internalizing problems* including emotionally reactive, anxious/depressed, somatic complaints, and withdrawn; and *externalizing problems* including attention problems and aggressive behavior. For the current report, though, we examined the individual syndrome scores rather than the broadband emotional and behavioral dimensions because they closely represented problematic behaviors described by parents in prior studies of the transition (e.g., sleep problems, anxiety and clinginess, aggression and opposition) and provided a better means of attempting to replicate these earlier findings. Ivanova et al. (2010) provided further psychometric support for the configural invariance of the factor structure of the seven syndrome scales for 19,106 children aged 1.5 – 5 years across 23 societies, as well as mean item loadings (.43 – .72) comparable to the magnitude of the mean alphas reported here across the five timepoints of this study. Further, prior studies examining the emergence of psychopathology in toddlerhood have also relied on many of the individual syndrome scales such as aggression, anxiety, sleep problems and somatic complaints (e.g., Shaw, Keenan, Vondra, Delliquardi, & Giovannelli, 1997; Shaw, Owens, Giovannelli, & Winslow, 2001; Weinraub et al., 2012; Wolff et al., 2009).

Correlations between mothers' and fathers' reports on the CBCL syndrome scales revealed consistent, significant correlations in the low to moderate range across the five timepoints: (1) Emotionally reactive, $r = .20 - .39$, $M = .29$, all p 's $< .01$; (2) anxious/depressed, $r = .27 - .38$, $M = .32$, all p 's $< .001$; (3) somatic complaints, $r = .39 - .53$, $M = .46$, all p 's $< .001$; (4) withdrawal, $r = .26 - .35$, $M = .31$, all p 's $< .001$; (5) sleep problems, $r = .57 - .67$, $M = .63$, all p 's $< .001$; (6) attention problems, $r = .38 - .46$, $M = .41$, all p 's $< .001$; and (7) aggressive behavior, $r = .34 - .48$, $M = .42$, all p 's $< .001$. Because mothers' and fathers' reports were significantly correlated across all timepoints and because we wanted to create robust composites that were not based on a single-reporter, mothers' and fathers' scores were averaged to create one composite score for each child at each timepoint in order to increase construct validity (Rushton, Brainerd, & Pressley, 1983). These composites are subsequently referred to as the CBCL subscales.

Child, Parent, and Family Predictors at the Prenatal Time Point

All antecedent variables used to predict the trajectories of problematic behavior were measured at the prenatal timepoint. In line with the developmental ecological systems perspective, prenatal predictors were child, parent, and family contextual characteristics that were potential risk and protective factors that could explain children's adjustment after the birth of a sibling. We used the following conventions when creating child, parent, and family composites. We averaged across mothers' and fathers' reports for child characteristics in order to create more robust composites that were not based on a single-informant. We also averaged mother and father reports and behavioral observations for dyadic, couple-level, relationship constructs such as coparenting and marital relationships. Because of our interest in family systems and the role of fathers in supporting children's adjustment across the

transition to siblinghood, we kept each of the measures of parenting and parent characteristics separate for mothers and fathers.

Child Characteristics

Children's temperament—The Child Behavior Questionnaire (CBQ; (Mary K. Rothbart, Ahadi, Hershey, & Fisher, 2001) was used to assess children's temperament. Mothers and fathers completed the anger/frustration and shyness subscales of the CBQ. Each item used a 7-point Likert scale (1 = *extremely untrue* to 7 = *extremely true*). Composite scores were created by averaging mothers' and father's reports on 13 items for 'anger/frustration' ($\alpha = .77$ for mother, $\alpha = .73$ for father) and 13 items of 'shyness' ($\alpha = .92$ for mother, $\alpha = .89$ for father). A higher score on 'anger/frustration' reflected more negative affectivity related to interruption of ongoing tasks or goal blocking (e.g., has temper tantrums when s/he does not get what s/he wants; gets quite frustrated when prevented from doing something s/he wants to do). A higher score on 'shyness' reflected slower or more inhibited speed of approach and discomfort in social situations (e.g., sometimes prefer to watch rather than join other children playing; get embarrassed when strangers pay a lot of attention to her/him). We refer to anger/frustration as *negative emotionality* and shyness as *behavioral inhibition* throughout the remainder of the monograph.

Theory of mind (ToM; Wellman & Liu, 2004)—At the prenatal timepoint, children completed the theory of mind scale to assess children's ability to understand another person's mental states. This scale consists of six subscales that are arranged in developmental sequence (a) *Not-Own Desire*: child judges that two people (the child vs. someone else) have different desires about the same objects; (b) *Not-Own Belief*: child judges that two people (the child vs. someone else) have different beliefs about the same object, when the child does not know which belief is true or false; (c) *Knowledge Access*: child sees what is in a box and judges the knowledge of another person who does not see what is in a box; (d) *Explicit False-Belief*: child judges how someone will search, given that person's mistaken belief; (e) *Contents False-Belief*: child judges another person's false belief about what is in a distinctive container when child knows that it contained something unexpected; and (f) *Hidden Emotion*: child judges that a person can feel one thing but display a different emotion. A composite score summed the number of the tasks for which children provided the correct answer (0–6).

Emotion understanding—Children's understanding of emotions was assessed at the prenatal timepoint using a series of established tasks to assess nine areas that increased in difficulty level to capture the range of emotional understanding for 1- to 5-year-old children (see (Pons, Harris, & de Rosnay, 2004), for a similar strategy for older children): (1) Denham's (1986) *affective labeling* (4 expressive-items: e.g., "Can you show me the happy face?" and four receptive items; e.g., "How does Jenny/Johnny feel when she/he wears this face?"; (2) Denham's (1986) *affective-perspective taking* (stereotypical reactions; 4 stories); (3) Wellman and Woolley's (1990) *desire-based emotion task* (3 stories); (4) Denham's *non-stereotypical reactions* (4 stories); (5) Vinden's (1999) *belief-based emotion tasks*; (6) false-belief explanation; (7) false-belief prediction; (8) *emotion display rules knowledge* (3 stories from Jones, Abbey, & Cumberland, 1998); and (9) Gordis' (1989) *mixed emotions task* (3

stories). These tasks were administered and coded according to Denham (1986) and Wellman and Woolley's schemes (1990). The Gordis' task was coded following a scoring system used by Maguire and Dunn (1997). A composite score was created by summing across the nine tasks for a total emotional understanding score. Higher scores reflected greater emotion understanding.

Parenting and Parent Characteristics

Attitudes toward physical punishment—Mothers and fathers completed the 10-item Attitudes toward Physical Punishment Scale (Holden & Zambarano, 1992) to assess parents' attitudes toward spanking their children. Parents rated how strongly they agreed or disagreed with each statement using a 7-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*; e.g., "Spanking is a normal part of my parenting"). Composite scores were created by averaging the items for mothers and fathers separately, (α for mothers and fathers = .71)

Parenting self-efficacy—To measure mothers' and fathers' parental self-efficacy with regard to their firstborn children, the Parental Locus of Control Scale was used (PLOC; Campis, Lyman, & Prentice-Dunn, 1986). Higher scores indicated that parents felt *less* confident in controlling their child's behavior, whereas lower scores indicated that parents felt efficacious in control of their child's behavior. Mothers and fathers completed the PLOC using a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree* on the firstborn child (e.g., "what I do has little effect on my older child's behavior"). Composite scores for parental efficacy were created by averaging the subscales 'Parental Efficacy (10 items)', 'Child Control of Parents' Life (7 items)', and 'Parental Control of Child's Life ((10 items)', for mothers and fathers separately (α for mothers and fathers = .74 and .70, respectively).

Depression—Mothers and fathers completed the 21-item Beck Depression Inventory at the prenatal visit (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). The BDI has high internal reliability, well-documented concurrent and discriminate validity, and has been used in many studies of pregnant and postpartum women, as well as with men (Beck, Steer, & Carbin, 1988). Items were summed to create separate composite scores for mothers and fathers (α = .85 and .79 for mothers and fathers, respectively).

Attachment security—At the second home visit of the prenatal timepoint, mothers and fathers completed the Attachment Q-sort (AQS; Waters & Deane, 1985) to assess the security of the mother-firstborn and father-firstborn relationship. The AQS can be used with a wide age range of children with items appropriate for home observation. The AQS consists of 90 cards, each of which contains a statement about child behavior (e.g., when child returns to mother after playing, he is sometimes fussy for no clear reason). Parents had been left the list of the 90 behaviors two weeks earlier at the first home visit with instructions to observe their children over the next few weeks with these behaviors in mind. Using a sorting board designed for this purpose, a trained research assistant sat with each parent while they separately sorted the 90 cards into nine piles (10 cards each) ranging from "least characteristic of your child" to "most characteristic of your child." Attachment security scores were calculated by correlating mothers' and fathers' sorts with a criterion sort

representing the hypothetically “most secure” child. Higher scores indicate a closer fit to the criterion sort for a securely-attached child; correlations were transformed into Fisher’s z coefficients. Parent-completed AQS’s are a valid measure of attachment in early childhood when conducted according to the criteria established in earlier studies, which were adopted for this study (Moss, Bureau, Cyr, & Dubois-Comtois, 2006; Tarabulsky et al., 2008; Teti & McGourty, 1996).

Family and Social Context

Marital relationship quality—At the prenatal timepoint, both parents completed the 25-item Intimate Relations Scale to assess marital quality (Braiker & Kelley, 1979). The measure yields four subscales: (a) *love* - the degree to which spouses feel a sense of love and belonging (10 items, “To what extent do you have a sense of belonging to your spouse/partner?”, $\alpha = .83$ and $.80$ for mothers and fathers, respectively); (b) *maintenance* - the extent to which spouses attempted to enrich, improve, and maintain their relationship (5 items, “How much do you and your spouse/partner talk about the quality of your relationship?”, $\alpha = .69$ and $.64$ for mothers and fathers, respectively); (c) *conflict* - the extent to which couples engaged in marital disputes (5 items, “How often do you feel angry or resentful toward your partner?”, $\alpha = .78$ and $.68$ for mothers and fathers, respectively); and (d) *ambivalence* - the extent to which spouses reported confusion and were unsure about the future of the relationship (5 items, “How confused are you about your feelings toward your spouse/partner?”, $\alpha = .75$ and $.68$ for mothers and fathers, respectively). Each item was answered on a 9-point Likert scale (1 = *very little or not at all*; 9 = *very much or extremely*). As in prior research, we composited love and maintenance into *positive marital relations* and ambivalence and conflict into *negative marital relations* for mothers and fathers, and then averaged across parents to create dyadic composites of *positive* and *negative marital relationship quality* (Volling, Oh, Gonzalez, Kuo, & Yu, 2015).

Home observations of marital interaction—Husbands and wives engaged in a 10-minute, video-taped, marital interaction during which they were instructed to discuss their day. Husbands’ and wives’ affect and behaviors were coded by trained independent coders using the Interactional Dimensions Coding System (Kline et al., 2004). Each 10-minute interaction was separated into three equal segments of three minutes and 20 seconds. Within each segment, each spouse was coded for *positive affect* - the positivity of tone of voice, facial expressions, and body language; *negative affect* - the negativity of tone of voice, facial expressions, and body language; *dominance* - one spouse’s control over the other; *support validation* - positive listening and speaking skills that demonstrated support of the other spouse; *conflict* - expressed struggle between the two partners; *withdrawal* - avoiding interaction with spouse; and *communication skills* - one person’s ability to convey thoughts and feelings in a clear, constructive manner. Each code was rated on a 9-point scale from 1 (*extremely uncharacteristic*) to 9 (*extremely characteristic*). Inter-rater reliability, measured via intra-class correlations, ranged from $.88 - .95$ ($M = .91$) for wives and $.78 - .92$ ($M = .88$) for husbands. Means across segments were calculated for each code ($\alpha = .76$ to $.88$ for husbands; $.77$ to $.84$ for wives). Two composites were then created from these individual mean codes to reflect positive marital interaction (*positive affect + support validation + communication skills*; $\alpha = .71$ for husbands, $.59$ for wives) and negative marital interaction

(*negative affect + dominance + conflict + withdrawal*; $\alpha = .73$ for husbands, $.71$ for wives), which were then averaged across spouses to create a dyadic, relationship composite of *negative* and *positive marital interaction*.

Division of household labor—During a couple interview at the prenatal timepoint, both parents jointly reported division of household labor using the Household Task Checklist (HTC; (Baruch & Barnett, 1986). Parents had to agree on who did what for each of the nine items of the HTC. Each item was measured on a scale ranging from 1 = *almost always wife* to 3 = *both equally* to 5 = *almost always husband*. Items included meal preparation, cleaning house, laundry, grocery shopping, meal cleanup, household repairs, yard work, car repairs, and paying bills and were averaged ($\alpha = .56$).

Division of childcare—During a joint couple interview at the prenatal timepoint, both parents jointly reported on who did what for 11 child care tasks using the *Checklist of Child Care Tasks* (CCCT; (Baruch & Barnett, 1986; Ehrenberg, Gearing-Small, Hunter, & Small, 2001). Each item was rated on a scale from 1 = *almost always wife*, 3 = *both equally*, 5 = *almost always husband* and averaged (e.g., making snack for child, taking child to the doctor, cleaning up child's room, and supervising child's morning routine; $\alpha = .73$).

Coparenting—Mothers and fathers completed the 14-item Coparenting Questionnaire (CQ; (Margolin, Gordis, & John, 2001) to assess perceptions of their spouse's coparenting *cooperation* (e.g., "My spouse says nice things to me about our child"; 5 items), *triangulation* (e.g., "My spouse tries to get our child to take sides when we argue"; 4 items), and *conflict* (e.g., "My spouse argues with me about our child"; 5 items). Each item was rated on a 5-point Likert scale ranging from 1 = *never* to 5 = *always*. Dyadic composite scores were created by averaging parents' reports for cooperation ($\alpha = .79$ for mothers and $.66$ for fathers), triangulation ($\alpha = .50$ for mothers and $.63$ for fathers), and conflict ($\alpha = .74$ for mothers and fathers).

Home observations of coparenting behavior—The 15 minutes of videotaped family freeplay were divided into three equal 5-minute intervals coded for coparenting behavior. Trained coders rated couple interaction on a 5-point rating scale (1 = *very low* to 5 = *very high*) according to six dimensions of coparenting behavior which included cooperation, pleasure, interactiveness, displeasure, coldness, and competition developed by Schoppe-Sullivan and colleagues (Schoppe, Mangelsdorf, & Frosch, 2001; Schoppe-Sullivan, Mangelsdorf, Frosch, & McHale, 2004). Each member of the coding team was randomly assigned to rate positive or negative dimensions of behavior. Based on 20% of the sample, intraclass correlation coefficients that assessed interrater reliability ranged from $.72$ to $.90$. Ratings were then summed across the three videotaped segments, and means were calculated for each code. Two composites were created to reflect supportive coparenting and undermining coparenting. *Supportive coparenting* ($M = 8.09$) was generated from the sum of interactiveness ($\alpha = .73$), pleasure ($\alpha = .74$), and cooperation ($\alpha = .78$), and *undermining coparenting* ($M = 6.68$) was calculated from displeasure ($\alpha = .76$), coldness ($\alpha = .79$), and competition ($\alpha = .78$).

Daily hassles and stress—At the prenatal timepoint, mothers and fathers reported the extent to which they felt hassled while completing daily tasks of parenting, using the Daily Hassles Scale (Crnic & Greenberg, 1990). Each item was rated on a 5-point Likert scale (1 = *no hassles* to 5 = *huge hassles*). Example items included: “You continually have to clean up after your child’s messes,” “your child is constantly under foot or in the way,” and “having to run extra errands just for your child.” Composite scores were created by averaging the 14 items for mothers ($\alpha = .84$) and for fathers ($\alpha = .83$).

Family support—Mothers and fathers reported on the 12 items of the Parenting Support Scale (PSS; (Bonds, Gondoli, Sturge-Apple, & Salem, 2002) to assess the extent to which parents perceived support with regard to parenting (e.g., “Someone to talk to about things that worry you” and “someone to help you take care of your child”). Each item used a 5-point Likert scale (1 = *never* to 5 = *quite often*). An overall composite score for family support was created by averaging mothers’ and fathers’ reports ($\alpha = .86$).

Social support—Both parents jointly reported on the 9 items of the Family Support Scale (FSS; (Dunst, Tivette, & Hamby, 1996) to assess the helpfulness of people and groups in caring for their firstborn child (e.g., own/partner’s parents, friends, parent groups). Each item was or rated on a 5-point Likert scale (1 = *not at all helpful*; 5 = *extremely helpful*; $\alpha = .77$) or given a “not available” option if it was not applicable. A composite was created by using the mean of all items.

Work-family conflict—Fathers reported on their work-family conflict using the 22 items of the Work-Family Conflict scale (WFCS; (Kelloway, Gottlieb, & Barham, 1999). Each item was measured on a 4-point scale (1 = *never* to 4 = *almost always*). The WFCS assessed four dimensions of work and family conflict: strain-based work interference with family (e.g., “The demands of my job make it hard for me to enjoy the time I spend with my family”); time-based work interference with family (e.g., “To meet the demands of my job, I have to limit the number of things I do with family members”); strain-based family interference with work (e.g., “I spend time at work thinking about the things I have to get done at home”); and time-based family interference with work (e.g., “Family demands make it difficult for me to take on additional job responsibilities”). A composite was created from the average of all items ($\alpha = .72$). Mothers’ scores on work-family conflict were not used because most mothers were either not working full-time at the time of the prenatal visit (30%) or were stay-at-home caregivers (32.8%).

Sibling Relationship Quality at 12 Months

Parents reported on the children’s behavior toward their younger sibling at 12 months using the Sibling Relationships in Early Childhood scale (Volling & Elins, 1998). Three subscales were used: (a) positive involvement (7 items, “Shares play things with baby,” $\alpha = .87$ for mothers, $\alpha = .86$ for fathers); (b) conflict (5 items, “Is physically aggressive with baby,” $\alpha = .76$ for mothers, $\alpha = .73$ for fathers), and (c) avoidance (3 items, “Is happy when baby goes away (e.g., on outings, store with parent)”, $\alpha = .67$ for mothers, $\alpha = .69$ for fathers). Each item was rated from 1 = *never* to 5 = *always*; higher scores indicated more positive

involvement, conflict, or avoidance on each respective subscale. A composite score for each subscale was created by averaging mothers' and fathers' reports.

Data Analysis Overview

Recent advances in statistical modeling offer unique opportunities to model developmental trajectories of children's behavioral adjustment over time, and to identify both predictors of those trajectories and their outcomes. A latent growth approach models trajectories through parameters such as slope and intercept, and estimates parameter values for individuals (known as random effects) as well as the sample as a whole (known as a fixed effect). Thus, latent growth models simultaneously provide information about the common pattern in a sample and the individual heterogeneity around that common pattern. Other techniques, such as group-based trajectory analysis (e.g., Nagin, 1999), model heterogeneity by identifying clusters, commonly called classes, of individuals who share common values on the growth parameters (i.e., similar slope and intercept) of the trajectories. Latent growth models and group-based trajectory analysis can be combined (1) to partition the sample into smaller classes that share common parameter values within their class and (2) to allow for heterogeneity within the class by introducing random effect terms. In other words, individuals in the same class share a fixed effect value for each parameter (i.e., common to all individuals in the same class) and also have random effect terms to model individual differences within a class. This combined technique is known as growth mixture modeling (GMM). The benefit of growth mixture modeling is that it combines two approaches to data analysis and theory testing (i.e., individual differences in trajectories and clustering of trajectories), and allows testing of trajectory parameters across classes, as well as individual differences within those classes.

Modeling Developmental Changes across the Transition

Examination of the linear slope from a latent growth model informs us whether children show steady or dramatic increases in behavior problems over the year. These models can be extended beyond linear trajectories. For example, it is possible to model curvilinear trajectories by testing global quadratic change across the five timepoints (Prenatal, 1, 4, 8 and 12 months) that might reflect changes across the first year of siblinghood where children show a gradual increase in behavior problems with an eventual gradual decline.

Dunn and Kendrick (1982) claimed that most children showed an initial disturbance shortly after the birth, but that this disturbance was short-lived and by 8 months, most children had adapted. This pattern, which we call an "adjustment and adaptation response" (AAR), suggests there may be an initial burst in behavioral problems immediately following the birth of the sibling (i.e., from prenatal to 1 month post-birth), but children would adapt quickly to the new sibling and return to pre-birth levels of behavioral functioning by 4 months, with no additional change throughout the remaining year (i.e., at 8 and 12 months). This pattern indicates that the initial period is stressful for the child with rapid increases in adjustment difficulties. Neither the linear nor global quadratic term capture this adjustment and adaptation response pattern of rapid increase and rapid decline because they are typically defined over all available time points. One might conclude erroneously by

examining statistical significance of linear or quadratic terms in a GMM that there was no change even though there was an increase at 1 month and a corresponding decrease by 4 months. In the current modeling framework, we tested linear, quadratic, and adjustment and adaptation response patterns in children's emotional and behavioral adjustment by including a local quadratic contrast that tested change specifically from prenatal to 1 month to 4 months.

Growth mixture models—The primary research question in this monograph deals with developmental trajectories of children across the first year following the birth of a sibling. We used GMMs to examine individual developmental trajectories with the goal of identifying intra-personal growth for each individual by estimating latent variables (i.e., the intercept, linear slope, quadratic parameter and AAR parameter) based on multiple repeated indicators, and determining classes of individuals exhibiting similar patterns.

Using Mplus Version 7.0 (Muthén & Muthén, 1998–2013), we first tested unconditional models using the entire sample with full information maximum likelihood (FIML) for each of the seven CBCL subscales to determine which of the developmental patterns. We tested three models at the unconditional stage of model testing. The first model was the standard *linear latent growth* model, which served as the baseline model. This model included random effects for both the intercept and slope to model heterogeneity. The second model added an extra term for the fixed effect quadratic defined across all five time points to test the *quadratic latent growth* model. The quadratic model across the first year is flexible and assesses several potential curvilinear patterns depicted in Figure. For example, the quadratic effect can estimate change describing a *sudden and persistent pattern of maladjustment*, which would reflect a sudden increase in problematic behaviors immediately following the birth that persisted across the first year or a pattern of gradual increase that would subside over the course of the year. The quadratic model could also capture change describing the *delayed impact model*, in which there is minimal evidence of disruption in the early months, but more evidence of increases in problematic behavior later in the year that coincides with significant changes in infant development and increasing sibling confrontations. The third model, the *adjustment and adaptation response (AAR)* model, assessed a pattern of immediate change (i.e., increase in problem behaviors from prenatal to 1 month) that subsided by 4 months. Essentially, the AAR effect is a local quadratic term limited to the first three time points; the AAR model does not examine change at 8 or 12 months. This model added an extra fixed effect term to the baseline (linear) growth model involving the AAR contrast. Each of the unconditional models reflecting change for the sample overall is reported in Chapter III.

Once a best fitting unconditional model was selected for each subscale, we then estimated classes within each of the CBCL subscales for the best fitting model using GMM (Muthén, 2004) with FIML using MPlus Version 7.0 (Muthén & Muthén, 1998–2013). This allowed us to identify classes with distinct trajectories of the firstborn child's behavioral adjustment from prenatal throughout the first year after the sibling's birth. This strategy follows the recommendation of Muthén and Muthén (2000) who suggested that GMM should use the best fitting unconditional model as the base model. Across all GMMs, the fixed effects of the latent growth model (i.e., the intercept, linear slope, and when applicable, the quadratic

slope and the AAR contrast) were freely estimated for each class and the random variance of growth parameters (slope and intercept) were constrained to be equal across classes. The residual variance was constrained to be equal across time points with the single residual variance estimated freely. When estimating the maximum likelihood mixture models, we followed the recommendation of Nylund, Asparouhov, & Muthén, (2007) to increase the number of random start values to ensure confidence in finding a global maximum solution.

To decide on the number of classes for a particular GMM, we estimated fit indices for 1 (unconditional model) to $k+1$ class-solution models. Models with different numbers of latent classes were evaluated to determine which model provided the best fit to the data. Because models with different numbers of classes were not nested, model comparisons were conducted using a set of multiple fit indices, including the Bayesian Information Criterion, the sample size adjusted *BIC*, and the Akaike Information Criterion; lower scores represent better fitting models. We also used the Lo-Mendell-Rubin (*LMR*) likelihood ratio test of model fit and the entropy measure, which refers to the average classification accuracy in assigning individuals to classes; values range from zero to 1, with higher scores reflecting better accuracy in classification of class membership. The optimal models were chosen based on goodness-of-fit, parsimony, and avoiding degenerate solutions with a class consisting of only one participant. For simplicity of subsequent analyses, we used the class with the modal posterior probability.

To demonstrate the face validity of the resulting classes, we examined the individual trajectories for each child in the sample (i.e., spaghetti plots) by class membership using standard CBCL cutoffs at the mean, 92.5% (borderline-clinical) and 97.5% (clinical) levels as described in the CBCL1.5-5 manual (Achenbach & Rescorla, 2000) to determine whether resulting classes fell within normative, borderline, or clinical ranges and were thus descriptively meaningful. We present the spaghetti plots in Chapter IV on aggression for each of the classes to demonstrate this approach, but all figures for the remaining chapters can be found in the supplemental materials.

Missing Data—Where possible we used FIML to estimate models and their parameters operating under the assumption that data are missing at random (Little & Rubin, 2014; Schafer & Graham, 2002). The pattern of missing for the five time points on the CBCL subscales involve the following: 184 families provided observations at all five time points, 16 families provided observations at the first four time points, 3 families provide observations at the first three time points, 7 families provided observations at the first two time points, and 10 families provided observations at only the first time point. The other patterns of missingness on the longitudinal design on the CBCL scale were not systematic (e.g., 3 families missing only the 8 month timepoint, 4 families missing only the 4 month timepoint). We fail to reject the missing completely at random (MCAR) assumption across all seven subscales using the nonparametric test of Jamshidian and Jalal (2010) as implemented in the MissMech package in R.

Using Prenatal Child, Parent, and Family Characteristics to Predict Change Trajectories

Once the trajectory classes were established, the next step in our analysis strategy was to predict the trajectory classes from child, parent, and family predictors obtained at the prenatal time point. One problem that can occur when adding predictors to a GMM where one simultaneously (1) assesses predictors of class membership and (2) estimates class membership is that the composition of class membership may change as predictors are added to or deleted from the model. We wanted membership in the trajectory classes to remain fixed as we tested for predictors rather than have class membership vary as each predictor was added to or removed from the model. As such, we fixed class membership after conducting the GMM and deciding on the number of classes. In this way, we could guarantee that the trajectory classes were not moving targets as we tested different predictors (see also Petras & Masyn, 2010).

Our analyses were further complicated because we had many potential predictors collected at the prenatal time point based on the developmental ecological systems model where several child, parent, and family variables were the focus. Further, predictors could very well differ across the seven CBCL subscales, so we needed to ensure that we were not using a variable selection procedure that would place constraints on which predictor variables were relevant for each CBCL subscale, e.g., a predictor for the aggression scale may not have relevance to another subscale such as sleep problems. We also wanted to minimize multiple comparison issues when testing many potential predictors across the CBCL subscales.

To address these concerns, we relied on new procedures based on modern methods from the computer science and statistical learning fields for variable selection. We adopted two methods, classification and regression trees (CART, Breiman, Friedman, Stone, & Olshen, 1984) and random forests (Breiman, 2001) to select predictor variables. A detailed explanation of both CART and random forests written for the psychological audience is given in Strobl, Tutz, and Malley (2009) and we provide a brief description here. The first cross-validation criterion used the CART procedure as implemented in the recursive partitioning R package *rpart*. CART uses a recursive partitioning algorithm to estimate cut points on if-then statements (see Strobl et al., 2009) for a detailed description). For example, if mother's attachment score (i.e., the Q-sort) is greater than an estimated value X , then predict class membership i ; if mother's attachment score is less than or equal to value X , then predict class membership j and k . Both the predictor, in the example of mother's attachment Q-sort, and the cut-off value, in the example X , are estimated from data. The algorithm continues estimating such if-then statements with corresponding cut-off values until a convergence criterion is met. The algorithm can also find multiple "if" statements such as "if mother's attachment score is less than or equal to Y AND father's attachment score is less than or equal to Z , then predict class i ." In this way, the recursive partitioning algorithm can model complicated interaction patterns. We used default settings within the *rpart* program. This set of if-then statements was "pruned" using a 10-fold cross-validation procedure where estimation was conducted on 90% of the data and predictive validity was assessed on the remaining 10% (i.e., proportion of correct predicted class membership as assessed by out-of-sample prediction). A particular if-then statement is pruned from the model if it does not predict well as assessed in the cross-validation procedure. This recursive

partitioning algorithm with cross-validation criterion typically led to three or four candidate predictors of class membership among the entire set of available prenatal predictors.

The second cross-validation-based criterion emerged from the random forest procedure (see Strobl et al., 2009, for a detailed description). This procedure examines repeated random subsets of predictors, evaluates each variable's predictive validity within that subset and rank orders predictors on the basis of their predictive accuracy using the Gini coefficient. We considered a variable as a candidate predictor if it emerged as a top three variable in predictive validity based on the measures.

The key criterion we used to select variables was predictive validity, as assessed by cross-validation in both CART and random forests. We opted for estimating GMM and searching for class predictors in two separate steps rather than in one simultaneous procedure (McArdle & Ritschard, 2013). Once these candidate predictors were identified, we then used them in multinomial logistic regressions to assess their significance in predicting trajectory classes. Thus, our approach uses two criteria to select predictors: (1) cross-validation, also known as predictive accuracy, in a hold-out sample to identify predictors and (2) statistical significance in a multinomial regression. These two criteria may lead to different conclusions when applied individually. For example, cross-validation may find that a variable performs well in predicting membership in a relatively small class, say $N = 12$, but the statistical significance criterion in the multinomial regression may find that the same variable does not significantly identify this small class compared to the reference class. We required that a predictor pass both criteria: (1) emerge as a predictor of class membership in cross-validation in either CART or random forest, *and* (2) emerge as a statistically significant predictor of class membership in the multinomial regression.

Across the seven CBCL subscales there was often complete overlap between the variables selected by the random forest and CART procedures. After finding candidate predictor variables that passed the cross-validation criterion, we estimated multinomial logistic regressions to provide standard statistical testing of those candidate predictors. When conducting the multinomial logistic models, we used traditional maximum likelihood estimation and interpreted each beta coefficient as a unique predictor controlling for the other predictors in the model. The reference class in the multinomial logistic regressions for each CBCL subscale was the largest "normative" class; for some subscales we also report additional tests involving comparisons between pairs of classes that shared similar prenatal starting points, but different developmental outcomes (multifinality) or different prenatal starting points with similar outcomes (equifinality). Given the post-hoc and exploratory nature of these additional tests, we identify them in the relevant chapters and recommend that a more conservative Type I error rate be used for those tests (e.g., $\alpha = .01$). For all multinomial logistic regression models, we compared the baseline main effect model using candidate predictors that emerged from our selection process to a model that included all possible higher-order interactions between the candidate predictor variables. This allowed testing of potential interactions beyond main effects. Testing of higher order interactions would likely lead to overfitting of data and potentially spurious results, so we limited our analysis to an omnibus test of higher-order interactions using the standard difference in Chi-square test to compare nested models (i.e., the main effect model compared to the model that

includes all higher-order interactions). Only one of the seven subscales (somatic complaints) exhibited significant higher-order interaction effects in the multinomial logistic regression. Even though we tested for all higher-order interactions, we limited interpretation to statistically significant two-way interactions to minimize the chance of interpreting spurious interactions.

Using Class Membership to Predict Sibling Outcomes

To determine whether there were meaningful differences across the classes that would predict sibling relationship quality, we examined whether and how class membership predicted sibling relationship quality one year following the birth of a sibling. Here we used standard regression analyses (REML) on three dimensions of sibling relationship quality: positive engagement, antagonistic behavior, and avoidance. Because the classes are categorical variables, we used dummy coding designating the largest normative class as the reference class for each of the seven CBCL subscales. We report regression coefficients and standard errors for these analyses.

Across our analyses we used modal class membership in both the multinomial regressions and the outcome regressions. More advanced procedures for including uncertainty information about class membership (such as class membership probability) in the context of traditional distal outcome regression and multinomial regression to assess class predictors and variable selection methods are still in development so we thought it would be premature to use those fledging methods in this monograph. Some preliminary sensitivity analyses where class membership was sampled according to class membership probability as one preliminary attempt to address uncertainty in class membership in the context of regressions yielded similar conclusions so we felt reassured moving forward with using modal class membership throughout our predictor and outcome regressions.

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Figure.

Theorized curvilinear trajectory patterns reflecting sudden persistent change, delayed impact, and growth and maturity.

Table 1

Activities Parents Reported to Prepare the Firstborn for the Birth of a Sibling

<u>Activity</u>	<u>N</u>	<u>%</u>
Media	195	87.8
Books/Magazines	160	72.1
Discussion	160	72.1
Changes to the home	55	24.8
Sibling preparation class	47	20.9
Interacted with other infants	31	14.0
Movie/Television Show	26	11.7
Bought doll	24	11.0
Gifts for child or infant	20	9.0
Took child to prenatal doctor's visits	11	5.0
Tummy interaction	11	5.0
Websites	9	4.1
Arranged for social support	7	3.2
Showed pictures	7	3.2
Religious activity	5	2.3
Specified "nothing"	4	1.8