Published in final edited form as:

Infant Behav Dev. 2019 May ; 55: 100–111. doi:10.1016/j.infbeh.2019.03.009.

Mother-Infant Interactions with Firstborns and Secondborns: A Within-Family Study of European Americans

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Abstract

Given the large numbers of families with more than one child, understanding similarities and differences in siblings' behaviors and in parents' interactions with their sibling infants is an important goal for advancing more representative developmental science. This study employed a within-family design to examine mean-level consistency and individual-order agreement in 5-month-old sibling behaviors and maternal parenting practices with their firstborns and secondborns ($n_s=61$ mothers and 122 infants). Each infant was seen independently with mother. Firstborn infants were more social with their mothers and engaged in more exploration with objects than secondborn infants; firstborn and secondborn infants' behaviors were correlated for smiling, distress communication, and efficiency of exploration. Mothers engaged in more physical encouragement, social exchange, didactic interaction, material provisioning, and language with their firstborns than with their secondborns. Notably, only maternal nurturing (e.g., feeding, holding) did not differ in mean level when mothers were with their two infants, but mean differences in mothers' social exchange and material provisioning with their two children attenuated to nonsignificance when controlling for differences in siblings' behaviors. Individual-order agreement of mothers' behaviors with firstborn and secondborn infants (across an average of almost 3 years) was only moderate. These findings suggest that mother-firstborn interactions may differ from mother-secondborn interactions. Future research should move beyond studying mother-firstborn dyads to understand broader family and developmental processes.

Keywords

parenting practices; infant behaviors; birth order; mother-infant interaction; siblings

1. Introduction

A substantial proportion of developmental science concerned with infant development, parenting, and family life has been constructed on mother-firstborn interactions (Hoffman, 1991), but roughly 80% of families in the United States will have more than one child (Monte & Ellis, 2014). Better understanding of similarities and differences in siblings'

behaviors and in parents' interactions with their sibling infants is therefore an important goal in advancing a more representative developmental science. Child birth order and parent parity play important roles in the development and expression of individual differences in child development and parenting. Parental differential treatment has short and lasting consequences for children's development (Buist, Dekovi, & Prinzie, 2013). Unfortunately, the majority of birth-order and parity research has followed between-family designs that may be valuable for some purposes, but also often confound birth order and parity with other family or child factors (discussed below). Holden and Miller's (1999, p. 247) summary judgment over a decade ago still holds true: "There is substantially more information about how child rearing changes over time than across children or situations. Consequently, there is a greater need for investigations into the latter two domains." Here, we investigated interactions of infant siblings with their same mother when each infant was the same age (5 months) in a within-family design.

The extant literature is divided on whether parents treat siblings similarly or differently, and whether siblings are similar or different, as well as the causes of each. The literature is also unclear whether interactions are consistent across different dyads in the same family unit. Do mothers parent their sibling infants similarly or dissimilarly? Are differences in parenting attributable to differences in sibling behaviors? To begin to answer these fundamental questions, this study quantified and compared sibling infants' behaviors and mothers' parenting practices between mothers and their firstborn and secondborn infants in the same family, using both micro- and macro-analytic variables. The sibling comparison literature is large, but the within-family subset of studies is much smaller. Within-family studies are needed because between-family studies cannot assess whether mothers behave similarly with their own two children or whether siblings are similar to one another. Between-family studies allow only group-mean differences between unrelated families. As a consequence, we restrict the following review to within-family studies of relevant interactions.

1.1 Sibling Similarities and Differences and their Implications for Parenting and Parity

Siblings differ from one another on a range of biological, psychological, experiential, and environmental factors (Bouchard & McGue, 2003; Pluess & Belsky, 2013) that contribute to making them distinctive individuals. Children's rearing experiences may differ depending on whether they are an older or younger sibling in a family, a daughter or a son, or have a brother or sister. Each child engenders idiosyncratic interactions with parents (Bornstein, 2015; Lerner, Hershberg, Hilliard, & Johnson, 2015), and even within the same family and home setting, given the transactional nature of the parent-child relationship, no parent could be expected to treat different children in exactly the same manner (Sameroff, 2010). Structurally, parents with two children have to divide their resources and energy between the two; psychologically, parents may feel closer to or more effective with one child than another (Feinberg, McHale, & Whiteman, 2019). Parenting also affects different children differently, at minimum because parenting is not always perceived or interpreted by different children in the same way (Lerner et al., 2015; Sutor et al., 2009; Turkheimer & Waldron, 2000).

Still, siblings can and often do resemble one another in many ways. They are biologically similar, sharing an average of 50% of their genetic makeup (Plomin, DeFries, McClearn, & McGuffin, 2008). Studying a sample of 5-month-old infant twins (identical and fraternal), Boivin and colleagues (2005) found that children's genes explained significant amounts of variance in certain maternal behaviors (see also Button, Lau, Maughan, & Eley, 2008; McGuire, Segal, & Hersherberger, 2012). Research also points to some homogenizing shared experiential and environmental effects in siblings (Burt, 2014; Else-Quest, Clark, & Owen, 2011; Holden & Miller, 1999; Klahr & Burt, 2014; Reiss, Neiderhiser, Hetherington, & Plomin, 2000). Studies of shared environmental variation in parenting show that a second child, when reaching a given age, may be treated much the same as her/his older sibling was at that age (even though the older sibling may now be the recipient of different age-appropriate parenting). In such a sibling age-held-constant design, Dunn, Plomin, and Nettles (1985, p. 1192) observed that "mothers were strikingly consistent in their behavior toward their two children." Similarly, in their meta-analysis of parenting Holden and Miller (1999) concluded that parenting is to a degree "enduring" as their analysis revealed substantial shared environmental variation between siblings. This perspective is consistent with a socialization model in which parenting is driven by consistent individual-level parent characteristics (e.g., personality, internal working model) and family-level contextual factors (e.g., neighborhoods) rather than by diverging characteristics of children or situations.

1.2 Consistency and Agreement across Siblings

Psychological science is centrally concerned with assessing average performance as well as individual variation around the average (Bornstein, Putnick, & Esposito, 2017). Similarity and difference in interactions can be assessed in two different and complementary ways, as mean-level consistency and individual-order (relative standing) agreement, using mean difference tests and correlations, respectively. Mean-level consistency assesses average differences between firstborns and secondborns, or mothers with their firstborn and secondborn children. Individual-order agreement assesses agreement in the rank-ordering of firstborns and secondborns in the group, or the rank-ordering of mothers with their firstborns and secondborns. These two types of analyses require within-family designs and are rarely reported in the same study, as we do here.

1.3 Interactions in Mothers, Firstborns, and Secondborns in the Same Family

The literature that has examined interactions in mothers with siblings in the same family is methodologically diverse. Some studies observe siblings at different ages, combine laterborns of various ordinal positions in a single group, observe mothers and firstborns alone but observe secondborns with firstborns present (in triads), employ the same (nonblind) coders or raters for the two siblings, and use brief (e.g., 5-min) observations. Other studies rely on maternal reports (that are subject to shared method and source variance across parity), restrict samples to families with medical or social risk, group biological and adopted children in the same sample, and include mothers with some special circumstances (suffering from depression) with one sibling but not (remitted) with the other. Of course, legitimate scientific reasons could motivate each of these methodological choices, but each choice may induce variation in parent-child interactions separate from that strictly associated with the siblings or rearing siblings. Divergent findings in this literature have been rightly

criticized for reflecting this scientific and methodological variation (Michalski & Shackelford, 2001).

Moreover, most studies of sibling similarities and differences have used toddlers and school-aged children. Only a handful has studied infants, which is important toward understanding the origins of mother-child relationships. Jacobs and Moss (1976) studied 3-month-old infant siblings' interactions with their mother over 6 hours of naturalistic interaction. When mean-differences were found, they almost always favored the firstborn child. Mothers spent similar amounts of time in basic nurturing behaviors like feeding with their two children, but spent more time in social, verbal, and didactic (e.g., tactile and visual stimulation) behaviors with firstborns than secondborns. Infants were largely similar in the mean levels of their behaviors, but firstborns vocalized and smiled more than secondborns. Individual-order agreement in mothers' and siblings' behaviors ranged in size, but most relations were small to medium. Dunn, Plomin, and Nettle (1985) also studied mothers' behaviors with their two children, each at the age of 12 months. Individual-order agreement was medium to large for most parenting measures (mean-level consistency was not reported). In another study, individual-order agreement of maternal sensitivity and attachment security with two 1-year-old sibling children also fell in the large range, but mothers displayed greater sensitivity with their firstborns than with their secondborns (van IJzendoorn et al., 2000). Finally, in a study with 2-month-olds secondborn infants displayed more positive affect (but similar amounts of negative and neutral affect) than firstborns, and siblings' affect scores were uncorrelated; mothers displayed more positive and less neutral affect to their secondborns than their firstborns, but mothers' affect scores were moderately correlated across siblings (Moore, Cohn, & Campbell, 1997). Taken together, these studies point to some advantages of being firstborn infant (e.g., additional time and attention), but also some advantages of being a secondborn (e.g., positive affect). Individual-order agreement of mothers' behaviors with their first- and secondborns seems to fall in the medium range, and siblings' behaviors tend to share little variance.

1.4 The Present Study

The present study was designed to examine and compare mother-firstborn and mother-secondborn infant interactions and siblings. To operationalize interactions, we microcoded multiple individual behaviors of infants and parenting practices of mothers and examined both microcoded individual behavioral indicators as well as macro-aggregated behavioral domains. Microanalytic codes focus on single events, such as behaviors, and produce detailed descriptive information regarding dependent measures (e.g., frequency and duration). Macroanalytic assessments offer a more holistic impression of mothers and children by aggregating micro-codes into higher-order domains. These different approaches to coding interactions yield nonredundant insights and complementary windows on sibling behaviors and the parent-infant relationship, and research methodology in parent-child interaction has emphasized the differential insights afforded by each (Hartmann, Abbott, & Pelzel, 2015). To provide a complete picture of mothers and their first- and secondborn infants, we therefore coded behaviors at a microanalytic level and then aggregated conceptually linked behaviors into macroanalytic domains.

We report consistency of group means as well as agreement of individual variation across mother-infant sibling dyads in interactions when the siblings were the same age. Certainly, children of different ages require different parenting. Young infants may require more nurturing and physical contact, and older toddlers may require more play and discipline. Holding infant age constant eliminates age as an explanation for differences in infant and parent behaviors.

We also chose to observe mother-firstborn and mother-secondborn dyads under the same conditions. At 5 months, all firstborns were the only children in their families, and all secondborns lived in homes with the older siblings. Had we observed firstborns in dyads and secondborns in triads with the older child present, we could not attribute differences in infant or mother behavior to the dyad. Under these conditions, differences in treatment or behavior could simply arise because the mother and secondborn infant were dividing their attention with the firstborn. By observing the secondborn interacting only with the mother, we eliminated divided attention as a cause of differences, which provides a conservative test of the conditions experienced by first and second children in the family.

Infant behaviors and maternal parenting practices vary with child gender (Jenkins, Rasbash, & O'Connor, 2003), so we balanced the samples to have equal representation of older and younger girls and boys, and we analyzed main effects of gender and interactions between parity/birth order and gender to determine if parity and birth order effects differed for girls and boys.

Finally, to localize tested effects to sibling birth order and maternal parity per se, we took several possible covariates into account including maternal age and family SES as well as infant birth weight, age, the age difference between siblings (as longitudinal assessments spaced close together result in greater consistency than those spaced at longer intervals; Lasko, 1954; van IJzendoorn et al., 2000), maternal hours of employment, and mother and researcher evaluations of the typicality of observed mother-infant interactions (see Appendix). As mother-infant interactions were obtained for the two members of the dyad interacting, we also controlled significant mean differences and correlations for conceptually corresponding partner behaviors. For example, individual-order agreement in mother behaviors across siblings could occur in response to similarity of siblings' behaviors. Controlling for partner behaviors allowed us to localize effects to the infant or mother more precisely.

Based on the admittedly scant research on these behaviors in infancy, we had the following expectations.

1. Following Moore, Cohn, and Campbell (1997), we expected a secondborn advantage in infant social behavior. However, given the limited research on other domains of infant behavior, we had no directional hypotheses about them and consider the analyses exploratory.
2. Following Jacobs and Moss (1976), we expected mothers to nurture their first- and secondborn children similarly, but engage in more physical, social, didactic, material, and language behaviors with firstborns than secondborns.

3. We expected agreement in relative standing of firstborn and secondborn infant behaviors to fall in the small range (e.g., $r_s \approx .10$) for all domains.
4. We expected agreement in relative standing of maternal parenting practices with her two infants to fall in the medium range (e.g., $r_s \approx .30$) for all domains.

2. Method

2.1 Participants

Sixty-one families with firstborn children were recruited through mass mailings and newspaper advertisements as part of a larger study of child development, and observed when the first and then the second infant in the same family was 5 months old. Therefore, a total of 183 individuals provided data, including 61 firstborn and 61 secondborn infants and their 61 mothers. Sample demographic statistics are presented in Table 1. Infant-mother dyads were observed once when the family's firstborn infant was 5 months of age and again an average of 2.94 years later ($SD = 1.10$, $range = 1.33 - 6.37$) when the family's secondborn infant was 5 months of age. At birth, 97% of children were term, and all were healthy at the time of their study (none of 4 preterm infants emerged as a univariate or multivariate outlier, so all were retained). Siblings' ages, gender composition (51% were same gender and 49% were opposite gender), and birth weights were similar. By design, mothers were older and slightly more educated (as measured by the 7-point Hollingshead, 1975, Four-Factor Index of Social Status education scale) at the second visit than the first visit, but mothers' employment was consistent across visits. Families were all European American, intact, and middle socioeconomic status at both visits (see Appendix).

2.2 Procedures

Families ($N = 375$) were originally recruited to participate in a longitudinal study of child development when their first child was born. A subset of these families that had a second biological child ($n = 207$) was invited to participate in the study again with their second child, and 61 families completed some or all of the protocol. Eligible families who participated with their second child ($n = 61$) and who did not ($n = 146$) were similar in maternal age at the birth of the first child, $t(128.87) = -1.15$, $p = .253$, maternal education, $t(199) = -.61$, $p = .545$, family socioeconomic status, $t(199) = -.99$, $p = .325$, and firstborn gender, $\chi^2(1, n=207) = .02$, $p = .886$.

In the 2 weeks before each home visit, mothers completed a demographic questionnaire. When infants were 5 months of age, each infant-mother dyad was visited in their home by a single female researcher (different at the two visits), and an hour-long video/audiorecord of the dyad's naturalistic behavior was made (an optimal recording duration according to Holden & Miller's, 1999, meta-analysis). Mothers made alternative care arrangements for their older child during visits with secondborns, or a second researcher came to the home and cared for the older child away from the mother and secondborn infant. Mothers and infants were seen when infants were expected to be awake for the observation; on average, infants were awake 99.64% of the recorded time. The mother was told that the researcher was interested in recording the infant's usual activities at a time when the mother was at home and solely responsible for infant care. Mothers were not instructed to remain with their

infants and were free to move around their homes. No other people were present in the home during the visit.

The mother was urged to act as she ordinarily would, to go about her normal routine, and to disregard the researcher insofar as possible. After a prescribed and recommended period of acclimation to the camera and the presence of the researcher (Stevenson, Leavitt, Roach, Chapman, & Miller, 1986), filming commenced. The researcher resisted talking to the mother or making eye contact with, interacting with, or otherwise reacting to the infant during the filming. During the course of their respective visits, mothers were similarly in view of their firstborns ($M = 93.61\%$, $SD = 8.05$) and secondborns ($M = 93.55\%$, $SD = 8.85$), $t(60) = .05$, $p = .964$.

2.3 Infant Behaviors and Mother Parent Practices

In infants, we focused on physical development (hereafter called infant physical, including promotion of balance and movement), social interaction (hereafter called infant social, including looking at mother, smiling, alert expression), exploration of the environment (hereafter called infant exploration, including looking, touching, and mouthing objects, as well as the extent and efficiency of exploration), nondistress vocalization, and distress communication (including distress vocalization and negative facial expression). These five theoretically based macroanalytic domains (operationalized in 13 microanalytic behavior indicators) represent key developmental tasks and performance competencies that are critical to successful adaptation of a human infant around the middle of the first year of life.

In mothers, we focused on nurturance (hereafter called mother nurture, including feeding, bathing, holding), promotion of physical development (hereafter called mother physical, including balance and movement), social interaction (hereafter called mother social, including encouraging attention to mother, expressing affection, social play), didactic exchange (hereafter called mother didactic, including encouraging attention to properties, objects, or events in the environment), materially outfitting the infant's surround (hereafter called mother material, including providing the infant with a quantity and quality of objects), and speech to infant (hereafter called mother language). These six theoretically based macroanalytic parenting practice domains (operationalized in 12 microanalytic behaviors) assessed the primary parenting tasks and performance competencies required of the caregiver of a young infant. Domain scores were calculated as the mean of the (usually standardized) infant behaviors and maternal practices that related conceptually to the domain (Streiner, 2003). Standardized scores were computed across firstborns and secondborns so that mean levels could be compared. (Operational definitions of all behaviors and practices and computation of domain scores appear in the Appendix.)

2.4 Coding

Data were coded from the first 50 min of the videorecords using mutually exclusive and exhaustive coding systems and real-time observation coding procedures yielding unbiased estimates of frequency and duration. This microanalytic strategy allowed us to examine mother and infant activities at the level of in-the-moment lived experiences. Coders who were blind to infant birth order were first trained to reliability on consensus coding, and

between 17% and 24% of the sample (depending on the domain) was coded independently to obtain coder reliability. (Additional details about the coding and reliability appear in the Appendix.)

2.5 Analytic Plan

A post-hoc power analysis was computed prior to data analysis to determine whether the sample size of 61 families provided sufficient power to detect a medium-sized effect in a 2×2 (Birth order by Infant gender) GLMM design. With an effect size of .15 for within-subjects effects and .25 for between-subjects effects (Faul, Erdfelder, Lang, & Buchner, 2007), $\alpha = .05$, a correlation of .30 between repeated measurements, and $N = 122$ mother-infant dyads, the power estimates ranged from .92 – .99 for main effects and interactions, indicating sufficient power to detect medium and large effects. Power to detect a correlation of .30 was .77, and power to detect a correlation of .50 was .99 for $\alpha = .05$ and $N = 61$, indicating marginal power to detect a medium-sized correlation and strong power to detect a large correlation.

Prior to formal analysis, univariate and multivariate distributions of the dependent variables and potential covariates were examined for normality, homogeneity of variance, outliers, and influential cases, and transformations were applied to resolve any problems with non-normality (Tabachnick & Fidell, 2012).

2.5.1 Mean-level consistency.—First, mean levels between infant siblings' behaviors and between mothers' parenting practices with her two children were explored using general linear mixed modeling (GLMM). Sibling birth order/parity was treated as a repeated effect within families, and the covariance structure was modeled as heterogeneous compound symmetry, accounting for the likelihood that siblings' behaviors and mother's parenting with her two children would be correlated. Birth order and gender effects as well as the interaction of Birth order and Gender were explored as fixed effects. When a significant mean-level difference was found on a domain or indicator for birth order, gender, or their interaction, fixed-effect covariates were included in the model (see below).

2.5.2 Individual-order agreement.—Second, individual-order agreement between infant siblings' behaviors and mothers' parenting practices across the two children were examined with zero-order correlations. Partial correlations were then computed by residualizing the firstborn and/or secondborn scores (as necessary) for statistically and conceptually significant covariates. In describing effect sizes of correlations, we follow Cohen's (1988, pp. 79–80) terminology: small effect size $r = .10$, medium effect size $r = .30$, large effect size $r = .50$.

2.5.3 Covariates.—Because demographic variables may be important in explaining behavioral variation and mean level, several infant and maternal sociodemographic variables were investigated as potential covariates. Furthermore, because infant and maternal activities may influence each another (Maccoby & Martin, 1983), conceptually corresponding partner activities were investigated as potential covariates. Potential covariates were grouped into three clusters on the basis of conceptual similarity and used individually or as a block: (1)

infant and maternal sociodemographic variables: infant age and birth weight, and the age difference between the siblings, and maternal age, education, and hours of employment; (2) context covariates: the mother's and observer's evaluations of the visit (see the Appendix) and the percentage of time the mother spent in view of the infant; and (3) corresponding maternal practices for analyses of infant behaviors and corresponding infant behaviors for analyses for maternal practices. Based on previous work (Bornstein, Putnick, Park, Suwalsky, & Haynes, 2017), we defined the following six pairs of infant and mother domains as conceptually corresponding: (1) infant physical and maternal physical, (2) infant social and maternal social, (3) infant social and maternal language, (4) infant exploration and maternal didactic, (5) infant exploration and maternal materially outfitting the infant's surround, and (6) infant vocalization and maternal language. If a conceptually corresponding behavior was significantly different in mean level between siblings and/or significantly correlated with the partner's behavior (see Appendix Tables A4 and A5), it was controlled. When using these covariates, we tested scores only at comparable levels: macroanalytic domain to domain or microanalytic indicator to indicator.

3. Results

3.1 Descriptive Statistics

Tables 2 and 3 present descriptive statistics of the domains and indicators for infants and mothers, respectively. An overview of the significance of mean difference tests detailed below is also presented in Tables 2 and 3 before and after controlling for significant covariates.

3.2 Mean-level Consistency in Infant Sibling Behaviors by Birth Order and Infant Gender

3.2.1 Infant physical domain.—The Birth order by Gender interaction was significant, $F(1, 110.53) = 4.81, p = .030$. Main effects of birth order and gender were not significant. Controlling for the maternal physical domain, the Birth order by Gender interaction was still significant, $F(1, 110.58) = 4.13, p = .044$. Among girls, firstborns proved more physically developed than secondborns, $F(1, 28.93) = 4.72, p = .038$, but this difference was not significant among boys, $F(1, 40.80) = 1.49, p = .229$ (Figure 1). At the indicator level, pre-locomotion exhibited the significant Birth order by Gender interaction, $F(1, 113.13) = 4.73, p = .032$, but this effect attenuated to nonsignificance when controlling for maternal encouragement to roll/crawl/step, $F(1, 109.24) = 3.72, p = .056$. Infant sitting did not exhibit the Birth order by Gender interaction, $F(1, 104.02) = .41, p = .523$, but a main effect of birth order, $F(1, 56.20) = 4.11, p = .047$, with firstborns more developed than secondborns. However, this main effect attenuated to nonsignificance when controlling for maternal encouragement of infants to sit or stand, $F(1, 68.60) = .08, p = .781$.

3.2.2 Infant social domain.—A significant main effect of birth order emerged, $F(1, 59.29) = 19.84, p < .001$, which maintained when controlling for infant alertness and the maternal social and language domains, $F(1, 65.38) = 10.05, p = .002$. Firstborns were more social than secondborns. The interaction between Birth order and Gender and the main effect of gender were not significant. At the indicator level, firstborns looked at their mothers more than secondborns, $F(1, 58.93) = 13.18, p = .001$, and when controlling for mothers'

encouraging infants' attention to themselves, social play, and language, $F(1, 69.64) = 4.95, p = .029$. Firstborns also smiled more than secondborns, $F(1, 59.20) = 9.39, p = .003$. There were no significant covariates of infant smiling. Finally, firstborns displayed alert expressions more than secondborns, $F(1, 59.05) = 8.86, p = .004$, but this difference attenuated to nonsignificance when controlling for maternal age, $F(1, 76.60) = 3.67, p = .059$.

3.2.3 Infant exploration domain.—A main effect of birth order emerged, $F(1, 57.05) = 4.46, p = .039$, but this effect attenuated to nonsignificance when controlling for maternal didactic and material domains, $F(1, 76.60) = .00, p = .975$. At the indicator level, firstborns looked at objects more than secondborns, $F(1, 57.79) = 10.21, p = .002$, but not after controlling for maternal didactic behavior and the quality and quantity of objects available to the infant, $F(1, 79.13) = .04, p = .839$. Firstborns also explored to a greater extent than secondborns, $F(1, 57.08) = 11.26, p = .001$, and this effect held when controlling for maternal age, maternal didactic behavior, and the quantity of objects available to the infant, $F(1, 92.61) = 9.29, p = .003$. Infant touching objects, mouthing objects, and the efficiency of exploration did not differ by birth order or gender.

3.2.4 Infant nondistress vocalization domain.—A significant main effect of gender emerged, $F(1, 117.74) = 6.69, p = .011$, with boys vocalizing more than girls. None of the potential covariates was related to infant nondistress vocalization, and there were no indicators of this domain.

3.2.5 Infant distress communication domain.—No effects were significant for the domain or its indicators.

3.3 Mean-level Consistency in Maternal Parenting Practices by Parity and Infant Gender

3.3.1 Mother nurture domain.—No effects were significant for the domain. At the indicator level, mothers were more likely to bathe, diaper, or dress their firstborn than their secondborn infants, $F(1, 57.95) = 5.58, p = .022$. There were no significant covariates for bathe/diaper/dress.

3.3.2 Mother physical domain.—At the domain level, mothers encouraged more physical behavior in firstborns than in secondborns, $F(1, 59.11) = 48.71, p < .001$, and this effect held when controlling for maternal hours of employment and sibling infants' physical domain scores, $F(1, 54.58) = 31.54, p < .001$. At the indicator level, mothers encouraged sitting/standing more in their firstborns than their secondborns, $F(1, 59.16) = 39.83, p < .001$, and this effect held when controlling for siblings' sitting, $F(1, 59.51) = 29.15, p < .001$. Maternal encouragement of rolling, crawling, or stepping did not differ by birth order or gender.

3.3.3 Mother social domain.—At the domain level, mothers engaged in more social behaviors with firstborns than secondborns, $F(1, 58.65) = 5.59, p = .021$, but this effect attenuated when controlling for siblings' social domain scores, $F(1, 66.86) = 1.05, p = .309$. At the indicator level, mothers were more likely to encourage attention to themselves when

with their firstborns than with their secondborns, $F(1, 58.49) = 10.66, p = .002$, but this effect attenuated to nonsignificance when controlling for siblings' looking at their mother, $F(1, 61.85) = 1.28, p = .263$. Maternal expressions of affection and social play did not differ between firstborns and secondborns or between girls and boys.

3.3.4 Mother didactic domain.—Mothers engaged in more didactic parenting with firstborns than secondborns, $F(1, 53.76) = 49.15, p < .001$, and this effect held when controlling for sibling infants' exploration, $F(1, 56.53) = 39.57, p < .001$.

3.3.5 Mother material domain.—Mothers afforded more material provisions to firstborns than secondborns, $F(1, 58.74) = 6.15, p = .016$, but this effect attenuated to nonsignificance when controlling for sibling infants' exploration domain scores, $F(1, 59.59) = 2.20, p = .143$. At the indicator level, mothers provided a larger quantity of objects to firstborns than to secondborns, $F(1, 58.45) = 19.72, p < .001$, and this effect maintained significance when controlling for maternal age and siblings' looking, touching, and mouthing objects, and the extent of infants' exploration, $F(1, 73.86) = 11.19, p = .001$. The quality of objects was similar across parity and infant gender.

3.3.6 Mother language domain.—Mothers spoke more to their firstborns than to their secondborns, $F(1, 56.96) = 31.95, p < .001$, and this effect maintained significance when controlling for the percentage of time mothers were in view of their infants and sibling infants' social domain scores, $F(1, 60.16) = 20.44, p < .001$.

3.4 Individual-Order Agreement between Infant Siblings' Behaviors

Table 2 displays zero-order correlations between firstborns' and secondborns' domain scores and their indicators. Sibling behaviors were largely uncorrelated with few exceptions: Firstborns' and secondborns' smiling, crying, negative facial expressions, and efficiency of exploration had medium-sized correlations. Controlling for covariates did not attenuate these few relations.

3.5 Individual-Order Agreement between Maternal Parenting Practices with Firstborns and Secondborns

Table 3 displays zero-order correlations between mothers' parenting practices with their firstborns and secondborns. All domains had medium-sized individual-order agreement across interactions with firstborns and secondborns (over an average of almost 3 years). However, the nurture domain and physical domain correlations attenuated to nonsignificance when controlling for the percentage of time mothers spent in view of their children and firstborn infants' physical domain scores, respectively. At the indicator level, feed/burp/wipe, encourage attention to mother, express affection, social play, and quality of objects had medium-sized stabilities across infant siblings, but feed/burp/wipe attenuated to nonsignificance when controlling for the percentage of time mothers spent in view of their secondborn infants, and quality of objects attenuated when controlling the mothers' behaviors with their firstborn infants for firstborns' looking at objects.

4. Discussion

This study addressed four basic developmental science questions in families observed with their first- and their secondborn infants. The first two questions concerned the consistency in mean levels of infant siblings' behaviors and mothers' parenting practices with her two infants even though separated by approximately 3 years.

Sibling infants scored similarly in mean levels with a few exceptions. Contrary to expectations, once sociodemographic, context, and partner effects were controlled, firstborn infants were more social with their mothers than secondborn infants. Specifically, firstborns looked at their mothers and smiled more than secondborns. Firstborns also explored the objects around them more than secondborns. Moore, Cohn, and Campbell (1997) noted a secondborn advantage at 2 months in positive affectivity, defined as the proportion of time spent in a positive affective state. It should be noted that only 3 min of face-to-face play was used for that study, as compared to 50 mins of naturalistic interaction in the current study. As in the current study, in over 6 hours of interaction, Jacobs and Moss (1976) found that firstborns smiled more than secondborns. The social interaction advantage for firstborns in the current infant sample was found again when the children were 20-months-old (Bornstein, Putnick, & Suwalsky, 2019) – firstborn children were observed to be more sociable and responsive to their mothers, and mothers rated their firstborns higher in adaptive social skills than secondborns. Perhaps having the mother's undivided attention in the first 5 months of life promotes the development of sociability because it allows for greater contingent responsiveness in the dyad, which promotes the infant's social skills.

As expected, mothers' parenting practices were similar with their two infant siblings in requisite nurturant behaviors, but mothers were more active in optional physical encouragement, social exchange, didactic interaction, material provisioning, and language with their firstborns than with their secondborns even though the interaction situations were equivalent for the two babies (that is mothers and babies were alone together for an hour, etc.). This mean-level finding points to systematic, if incipient, maternal differential treatment of infant siblings. When controlling for infant sibling behaviors, differences in the treatment of firstborns and secondborns attenuated for social exchange and material provision (but not in the quantity of objects provided), suggesting that for these two domains, mothers may have been responding to the differential behaviors of their infants. (Of course, causation cannot be determined from a cross-sectional observational study design such as this one.) Differential treatment in physical encouragement, didactic behavior, and language were not attributable to differences in infant behaviors. Price (2008) estimated that secondborn school-aged children are the recipients of 20–30 minutes less quality time from their parents (time spent as the focus of an activity) than firstborn children were at the same age. Our findings suggest that these differences may begin very early in development.

The third and fourth questions which we addressed in this within-family design concerned individual variation that complements mean-level comparisons. As expected, the behaviors of firstborn and secondborn infant siblings in the same family were largely uncorrelated, with medium-sized relations only for smiling, distress communication, and efficiency of

exploration. However, mothers showed rather consistent medium-sized agreement when interacting with their two infants; that is, mothers who were relatively more social, for example, with their firstborn infants were also relatively more social with their secondborn infants. When controlling for covariates and infant siblings' behaviors, stabilities for maternal nurturing and physical encouragement attenuated to nonsignificance, but the effect sizes remained in the medium range, suggesting that power of the partial correlations may have been an issue. Individual-order agreement in parenting across siblings likely reflects the general tendency of mothers to interact in a certain way, where variability would reflect temporal variation, the influence of children's idiosyncrasies, or other causes (McHale & Pawletko, 1992). Many reports (both individual studies and meta-analysis) support a reasonable degree of individual-order agreement in parenting practices across siblings.

Combined, the consistency and agreement results have implications for infant development and parenting. We found a fairly consistent difference in mothers' parenting their infant siblings, where mothers are doing more with their firstborn than secondborn infants, even when in a one-on-one setting. Considering that secondborn infants are unlikely to receive their mothers' undivided attention in the typical course of their day, these findings likely underestimate differences in the lived experiences of firstborns and secondborns. In daily life, mothers with a second infant have two children to caregive. Between the birth of their firstborn and secondborn infants, mothers hone their skills and learn to balance their own needs with those of their children. Primiparous mothers may begin parenting by trying to stimulate their child in all ways, and "calm down" as they accumulate more parenting experience and a second child. That said, our findings do not imply that it is better to engage in more of each of these domains. Simply doing more could also be overstimulating or intrusive. These findings are quantitative, rather than qualitative. Perhaps mothers do less overall with their secondborns, but the quality of their interactions matters. Previous research with this sample suggests that this may be the case. We coded the emotional quality of mother-infant interactions and found no mean differences between mother-firstborn and mother-secondborn interactions (Bornstein, Putnick, & Suwalsky, 2016). Even though mothers are engaging in more physical encouragement, social exchange, didactic interaction, material provisioning, and language with firstborns than secondborns, firstborns and secondborns may experience similar overall quality of emotional interactions. Conversely, although we observed medium-sized correlations between mothers' parenting practices with their two infants across domains, the overall quality of emotional interactions was unrelated in sibling pairs in (Bornstein et al., 2016). In this case, more interaction does not reflect better quality interaction.

Differential treatment of siblings is consequential when it is perceived by the child, and different children may perceive it differently. The infants in this study are not yet able to quantify differences in parental behavior. Still, a pattern of differential treatment that is established this early may persist (as has been found in other studies, e.g., Hallers-Haalboom et al., 2014), and persistent differences in amount of attention, teaching, provision of objects, and speech can feel quite consequential to one or another child. As siblings age, they become concerned with the fairness of behaviors toward them and their siblings (Loeser, Whiteman, & McHale, 2016). Younger siblings may be more vulnerable to negative effects

of differential treatment (McHale, Crouter, McGuire, & Updegraff, 1995), so perceived slights could compound into larger problems.

Overall, this study suggests that two infants being reared in the same family have different experiences, even when other conditions are held constant (one-on-one time with mother in the household at the same age). Emphasizing that parents are not the same with each of their children, Plomin (1994), Dunn (1995), and their colleagues (Hetherington, Reiss, & Plomin, 1994) drew attention to the importance of variations in parent-child interactions within families for understanding (nonshared) environmental influences on child development. The distinction between shared and nonshared environmental effects is based, in part, on whether such environmental influences make siblings more or less alike. The concept of the nonshared child-rearing environment acknowledges that parents interact with or structure one child's physical and social worlds differently from that of his or her sibling(s). For example, secondborns are exposed to interactions between their parents and their older sibling which never occur with firstborns (Dunn, 1993); multiparas also report higher self-efficacy and know more about child development than primiparas, as experiences with their firstborns increase mothers' efficiency and knowledge in meeting the needs and demands of their secondborn (Bornstein et al., 2019; Fish & Stifter, 1993). Dunn and Plomin opined that growing up within the same family makes siblings no more similar than two children selected at random from the population (Dunn & Plomin, 1990; Plomin, 2011). Combined with variation in siblings' biological makeup, within-family variation in parental beliefs and behaviors is a potent factor in accounting for why children in the same family can differ from one another (Bornstein et al., 2019; Caspi et al., 2004).

4.1 Limitations

Due to the paucity of prior research on infant sibling mean differences, we were unable to make directional hypotheses about most domains of infant behavior. Consequently, these findings should be interpreted as preliminary. Because our estimates of agreement are derived from associations between observations that are not perfectly reliable, it is possible that true estimates of agreement are slightly higher than those obtained here. We also cannot rule out the possibility that the mean differences we found in the parenting of firstborns and secondborns are a result of practice effects or demand characteristics. The firstborn visit was the first time the mother was observed with her child, and she may have been motivated to engage her infant more because of the novelty of participating in a research study. By the time of the secondborn visit, the research process was more familiar to the family. However, offsetting this concern, we assured mothers that we were interested in their typical behaviors, and we evaluated mothers' comfort and the typicality of their own and their infants' behaviors at both visits and found no significant differences between visits (see the Appendix).

Only the parenting practices of mothers were assessed. Future research should extend these findings by examining fathers' parenting practices across siblings. When a second child is added to the family, fathers may step in more to provide caregiving and stimulation to the older or younger child (Kreppner, 1988), so what appears to be a deficit in time devoted to secondborns may simply be a readjustment of caregiving from one parent to another. Our

observations were also conducted in a restricted sample and during a selected period of infant development; thus, the generalizability of these findings may not extend to other groups or developmental periods (but see Bornstein et al., 2019).

4.2 Implications

Nonetheless, several implications emerge from these results. First, examining maternal behaviors with siblings is critical to developing a more complete picture of child rearing. Changes in maternal behaviors are expectable over time, as mothers adapt to the ever-changing developmental needs of children through their progression away from infancy (Bornstein, 2015). We utilized the same situation and observational coding measures at both time points in the current study. Despite this methodological consistency, our findings suggest considerable variability in maternal parenting over time. Mothers appear to adapt their parenting to suit their different children, but they also may change their parenting based on their experience with their firstborn child (Whiteman, McHale, & Crouter, 2003) and the ever-changing needs of their families. The large observed variability in maternal parenting over time has implications for understanding developmental outcomes associated with maternal behavior. Consistency in caregiving is meaningfully related to children's outcomes (NICHD Early Child Care Research Network, 2004), and consideration of only stable components of maternal behavior may neglect important information about maternal parenting practices and children's experiences of them across the developmental spectrum. Boyle et al. (2004) reported that high variability in parenting across all siblings in the family (the within-family standard deviation) was associated with an increased risk to *all* children in the family, over and above the child-specific effect of an individual child being disfavored as compared to their siblings. Meunier, Bisceglia, and Jenkins (2012) further demonstrated the way in which this family-level influence of high variability in parenting across all siblings may operate at a child level. They reported significant curvilinear effects of differential parenting. In the moderate range of differential parenting, the relation between differential parenting and children's adjustment is weak. At the ends of the distribution, however, when children are highly favored and highly disfavored, children show increased behavioral problems. The child who is disfavored by a parent in a sibling dyad shows a greater (and more negative) divergence from a sibling in behavior problems over time (Burt, McGue, Iacono, & Krueger, 2006; Turkheimer & Waldron, 2000), and favored siblings also experience increased problems when differential treatment is larger (Singer & Weinstein, 2000).

4.3 Conclusion

Research to date on family influences in child development has primarily centered on single-dyad studies (one mother, one child). In the current study, maternal parenting practices expressed toward one child were not necessarily deterministic of that mother's parenting of her other child. The extent of dissimilarity of maternal parenting practices towards two children in the same family should prompt researchers to move beyond studying mother-firstborn child dyads to understand broader family and developmental processes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This research was supported by the Intramural Research Program of the NIH/NICHD, USA, and an International Research Fellowship in collaboration with the Centre for the Evaluation of Development Policies (EDePo) at the Institute for Fiscal Studies (IFS), London, UK, funded by the European Research Council (ERC) under the Horizon 2020 research and innovation programme (grant agreement No 695300-HKADeC-ERC-2015-AdG).

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Figure 1.
Birth order by gender interaction for the infant physical domain.

Table 1

Demographic Statistics for Siblings and their Mothers at the Firstborn and Secondborn Home Visits

	Firstborn		Secondborn		<i>t</i> (60)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Infant					
Age in months	5.35	.18	5.34	.23	.27
Gender (% female)	47.54%		50.82%		.13 ^d
Birth weight	3551.08	374.06	3525.22	496.51	.43
Mother					
Age in years	29.69	4.45	32.63	4.51	-20.93 ^{***}
Education ^a	5.79	1.14	5.95	1.01	-3.08 ^{**}
Employment status ^b	59.02%		54.10%		.47 ^d
Hours of employment ^c	37.85	8.55	34.48	11.02	1.38
Family SES	52.02	12.73	52.85	12.25	-1.12

Note:^aHollingshead 7-point education scale.^bPercent employed.^cBased on mothers who were employed at both timepoints (*n*=24; *df*=23).^dCochran's Q.^{*}*p* .05.^{**}*p* .01.^{***}*p* .001.

Table 2

Descriptive Statistics for Infant Domains and Indicators by Child Birth Order

Infant Domains and Indicators		Firstborn		Secondborn		Significance of birth order mean differences		$r_{(1,2)}$
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	No controls	Controlling covariates	
Physical	Domain	5.25	.95	5.13	.77	^a <i>ns</i>	--	.15
	Pre-locomotion	5.59	1.34	5.65	1.24	^a <i>ns</i>	--	.21
Social	Sitting	4.97	1.23	4.63	1.00	*	<i>ns</i>	.23
	Domain	.24	.65	-.24	.61	***	**	.09
	Look at mother	.30	1.01	-.30	.77	***	*	-.04
	Smile	.17	1.07	-.17	.82	**	n/a	.30*
Exploration	Alert expression	2150.25	316.63	1930.83	495.09	**	<i>ns</i>	.20
	Domain	.12	.63	-.12	.68	*	<i>ns</i>	.19
	Look at objects	.21	.71	-.21	.88	**	<i>ns</i>	.14
	Touch objects	.12	.90	-.12	.88	<i>ns</i>	--	.16
	Mouth objects	.09	.91	-.09	.88	<i>ns</i>	--	-.18
	Extent of exploration	.23	.95	-.23	.78	***	**	.25
	Efficiency of exploration	-.07	.79	.07	.92	<i>ns</i>	--	.35**
	Domain	-.00	.94	.00	.85	<i>ns</i>	--	.03
Distress Communication	Domain	.02	.87	-.02	1.03	<i>ns</i>	--	.40**
	Distress vocalization	.04	.91	-.04	1.05	<i>ns</i>	--	.35**
	Negative facial expression	-.00	.90	.00	1.04	<i>ns</i>	--	.37**

Note. $N = 61$ pairs of siblings except for the physical domain ($N = 55$). Six infants were not observed in positions that allowed the physical domain indicators to be coded. All domains and indicators are standardized ($M = 0$, $SD = 1$) except the Physical Domain and indicators, which are developmental equivalents, and alert expression, which is a duration in seconds.

ns = nonsignificant, $p > .05$.

*
 $p < .05$.

**
 $p < .01$.

 $p < .001$ (two-tailed).

-- = covariate analysis not tested.

n/a = not applicable, no significant covariates.

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There was a significant Birth order X Gender interaction (see text and Figure 1).

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Table 3

Descriptive Statistics for Mother Domains and Indicators by Child Birth Order

Mother Domains and Indicators		Firstborn		Secondborn		Significance of birth order mean differences		$r_{(1,2)}$
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	No controls	Controlling covariates	
Nurture	Domain	.06	.57	-.06	.67	<i>ns</i>	--	.31 ^a /.24 ^a
	Feed/burp/wipe	469.23	417.28	528.92	484.95	<i>ns</i>	--	.36 ^{**} /.28 ^b
	Bathe/diaper/dress	242.35	288.26	144.14	204.40	*	n/a	.19
	Hold	991.33	515.65	944.51	700.90	<i>ns</i>	--	.15
Physical	Domain	.13	.09	.06	.05	***	***	.31 ^a /.24 ^c
	Physical & verbal encouragement to sit/stand	.24	.16	.10	.10	***	***	.17
	Physical & verbal encouragement to roll/crawl/step	.03	.04	.02	.03	<i>ns</i>	--	.09
Social	Domain	.11	.63	-.11	.68	*	<i>ns</i>	.28 [*]
	Encourage attention to mother	.18	.86	-.18	.95	**	<i>ns</i>	.36 ^{**}
	Express affection	.05	.94	-.05	.93	<i>ns</i>	--	.30 [*]
	Social play	.09	1.01	-.09	.81	<i>ns</i>	--	.30 [*]
Didactic	Domain	.42	.99	-.42	.61	***	***	.40 ^{**}
Material	Domain	.11	.67	-.11	.62	*	<i>ns</i>	.39 ^{**}
	Quantity of objects	.29	.90	-.29	.72	***	***	.13
	Quality of objects	-.07	.83	.07	.92	<i>ns</i>	--	.30 ^a /.23 ^d
Language	Domain	.33	.89	-.33	.77	***	***	.42 ^{***}

Note. $N = 61$ mothers with two sibling children. All domains and indicators are standardized ($M = 0$, $SD = 1$) except the Nurturing Domain indicators which are durations in seconds, and the Physical Domain and indicators, which are proportions. There was no significant infant gender difference on any domain or indicator.

^aCorrelation attenuated to nonsignificance when controlling the percentage of time the mother spent in view of both siblings.

^bCorrelation attenuated to nonsignificance when controlling the mother's behavior with the secondborn for the percentage of time the mother spent in view of the secondborn.

^cCorrelation attenuated to nonsignificance when controlling the mother's behavior with the firstborn infant for maternal education and the mother's rating of her comfort.

^dCorrelation attenuated to nonsignificance when controlling the mother's behavior with the firstborn infant for look at objects.

ns = nonsignificant, $p > .05$.

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p .05.
*
p .01.
**
p .001. (two-tailed).

-- = covariate analysis not tested.
n/a = not applicable, no significant covariates.