EVOLUTIONARY THEORY AND PARENT-CHILD CONFLICT:
THE UTILITY OF PARENT-OFFSPRING CONFLICT THEORY

by

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DEDICATION

I would like to dedicate this dissertation to my family. To my mother and father, my brother and sisters, your support and understanding throughout the years has been indescribable. Thank you for always being there for me!
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ABSTRACT

Parent-offspring conflict theory (POCT) has been underutilized by researchers interested in family relationships. The goal of these three manuscripts is to help remedy this problem.

Manuscript one presents POCT in its original formulation and more recent developments. The theory is described and explained and four topical areas of human development are discussed in terms of how POCT has been applied and how the theory can help inform future research.

Manuscript two tests hypotheses derived from POCT about mother-adolescent conflict. This study showed that coresidence with a younger half sibling significantly incremented conflict between mothers and their children. This effect was not explained by SES, maternal depression, number of children in the household, or stepfather presence. In addition, children in younger half sibling households demonstrate elevated levels of conflict compared to families with a younger full sibling indicating that this effect is not an artifact of coresidence with a younger sibling. Presence of a younger half sibling also partially mediated the relationship between biological parental disruption and mother-child conflict.

Manuscript three sought to extend on the findings from manuscript two by examining how different family contexts affect trajectories of mother-child conflict across adolescence. A piecewise growth model was implemented to estimate linear conflict trajectories from early to mid and from mid to late adolescence. Results indicated that conflict tends to increase from early to mid adolescence but remain constant from mid to late adolescence, that biological parental disruption did not differentiate trajectories of conflict, nor did living with a stepfather. In addition,
despite a large difference in regression coefficients between families with and without a younger half sibling, younger half sibling status did not differentiate conflict trajectories from early to mid adolescence. Families did differ in their trajectories from mid to late adolescence with younger half sibling families showing a reduction in conflict over this time period. Inclusion of family level covariates effectively nullified all significant results. Results are discussed in the context of parent-offspring conflict theory. It is concluded that a larger sample with more diverse family types is needed to achieve sufficient power for additional analyses and future research.
CHAPTER I. INTRODUCTION

Introduction to Parent-Offspring Conflict Theory

Much research implicates the quality of parent-child relationships as an important determinant of an array of child and adolescent outcomes such as academic achievement, pregnancy risk, substance use, and various other indicators of child functioning (e.g. Amato & Keith, 1991; Ellis et al., 2003; Gutman & Eccles, 1999; Hetherington, Henderson, & Reiss, 1999; Maguen & Armistead, 2006). One well-replicated finding within this literature is that adolescents growing up in acrimonious family contexts, marked by high levels of parent-child conflict, have more behavioral adjustment problems (internalizing and externalizing), more difficulties in school, and generally feel more distressed than their peers from more harmonious families (El-Sheikh & Elmore-Staton, 2004; El-Sheikh & Flanagan, 2001; Flinn, 2006). Such family conflict can be both a cause and consequence of parental divorce (White & Booth, 1985) and increases the likelihood that children will experience multiple parental changes while growing up. Given the potentially harmful effects of negative family relationships, understanding the contexts and events within families that regulate parent-child conflict is important and may have implications for designing interventions aimed at reducing these effects.

One important framework for analyzing the causes of variation in parent-child conflict is parent-offspring conflict theory (POCT; Trivers, 1974; see also Parker, Royle, & Hartley, 2002), which is derived from inclusive fitness theory (Hamilton, 1964). POCT focuses on genetic asymmetries within families (i.e., different coefficients of relatedness between family members). Parents are equally genetically related (50%) to each of their biological offspring. All else being equal, therefore,
parents can maximize their inclusive fitness by investing equally in each of their offspring. By contrast, children are 100% related to themselves but only 50% related to each of their full biological siblings. Consequently, the developing child has a greater genetic stake (fitness interest) in themself than in any given sibling. POCT thus posits that children have been selected to demand a greater (disproportionate) share of parental investment than parents have been selected to give (Trivers, 1974), and that conflict between parents and children over parental investment will occur to the extent that the genetic interests of the parents and children diverge.

For over thirty years, biologists have employed and extended Trivers’ seminal model to better understand what factors affect the intensity and outcomes of within-family conflict. However, POCT has guided theory and research in evolutionary biology but has only rarely been applied to human families (though see Andrews, 2006; Buunk, Park, & Dubbs, 2008; Fouts, Hewlett, & Lamb, 2005; Quinlan, Quinlan, & Flinn, 2003; Soltis, 2004). The purpose of this dissertation is three fold: 1) to present POCT as a viable theoretical framework for understanding parent-child conflict in humans, 2) to test the hypothesis derived from POCT that the presence of younger half siblings uniquely predicts overall levels of parent-child conflict, and 3) to test the prediction that the presence of younger half siblings uniquely predicts conflict trajectories during adolescence.

Overview of Manuscripts

In line with these three goals this dissertation consists of three studies of human parent-child conflict. The first study is a theoretical review of the current state of POCT that provides an overview of how POCT can be applied to understand parent-child conflict at different life stages. In addition the theoretical review poses
several hypotheses at each life stage that can be tested using POCT. The second and third paper utilize one of these hypotheses, that the presence of younger half siblings in the household will effect parent-child conflict, by examining a) how younger half siblings contribute to parent-child conflict in adolescence net of well established indicators of conflict and b) how younger half siblings contribute to parent-child conflict trajectories across adolescence.
CHAPTER II. MANUSCRIPT I.

THE UTILITY OF PARENT-OFFSPRING CONFLICT THEORY IN UNDERSTANDING PARENT-CHILD CONFLICT IN HUMANS

Gabriel L. Schlomer
Marco Del Giudice
Bruce J. Ellis

Introduction

Conflict between parents and their children is a socially important phenomenon that has generated much theorizing and empirical research among academics as well as a crop of popular parenting and self-help books marketed for the general public. In this paper we seek to introduce developmental scientists to a powerful meta-theoretical perspective on parent-child conflict: Parent-offspring conflict theory (POCT: Trivers, 1974; Parker, Royle, & Hartley, 2002). Although POCT has stimulated empirical research and theoretical refinements within the field of evolutionary biology for over 35 years, it is barely known within the social sciences and has only rarely been applied to the analysis of human parent-child conflict (though see Andrews, 2006; Buunk, Park, & Dubbs, 2008; Fouts, Hewlett, & Lamb, 2005; Quinlan, Quinlan, & Flinn, 2003; Soltis, 2004). Perhaps one reason for the lack of utilization of POCT in the social sciences is lack of exposure to the theory. This article aims to remedy this problem. A second factor may be the relative complexity of the theory itself. Many factors operate both additively and interactively to produce conflict between a parent and child. In this paper we seek to elucidate these dynamic factors. The relative dearth of research in the social sciences derived from POCT is
unfortunate since applying the theory has the potential to revolutionize the social sciences as much as it has the biological sciences.

We present in this paper the theoretical tenets of POCT both in its original formulation as well as its more recent developments. We suggest that POCT can serve as a meta-theoretical framework for understanding conflict between parents and their children. A metatheory operates like a map of a challenging conceptual terrain; it “provides a guide and prevents certain kinds of errors, raises suspicions of certain explanations or observations, suggests lines of research to be followed, and provides a sound criterion for recognizing significant observations on natural phenomena” (Lloyd, 1979, p. 18). Toward this end, we apply POCT to a set of topics in the human developmental literature, ranging from prenatal to adolescent parent-child conflict that can be usefully illuminated by the theory. Our goal is to provide a conceptual map of conflictual relationships between parents and children from an evolutionary-developmental perspective—a map that both helps to explain what we know and guides future research to better understand conflictual family relationships.

Overview of the Paper

We begin our review by summarizing the logic of POCT in a non-mathematical way. We present Trivers’ seminal contribution alongside with its more recent elaborations and refinements and discuss in general terms how the theory can be applied to the human family. In section 3, we place POCT in a broader ecological perspective by reviewing the main contextual and individual factors that modulate parents’ degree of investment in their offspring and offspring’s demand for investment by their parents. Having laid out our theoretical background, we proceed to illustrate the application of POCT to humans in two instances of mother-offspring
interaction: Prenatal conflict between pregnant mothers and fetuses (section 4) and weaning conflict between lactating mothers and infants (section 5). We then discuss the effects of genetic relatedness on behavioral conflict between parents, children and their siblings (section 6). In section 7 we examine the small but growing literature on parent-offspring conflict over mating. Finally, in section 8 we look at parent-offspring conflict from the perspective of maternal and paternal genes by introducing the reader to the fascinating topic of genomic imprinting and its psychological implications. We conclude with an overall assessment of the utility of POCT for developmental psychology and a review of the main opportunities and challenges for future research.

The Logic of Parent-Offspring Conflict

The insight that led Trivers (1974) to realize the inevitability of within-family conflict of interest was nothing short of revolutionary, yet it can be explained in very simple terms. The starting point is Hamilton’s rule, the basic formulation of kin selection theory (Hamilton, 1964): Altruistic behavior (i.e., behavior that benefits another individual at a cost for the individual performing it) will evolve by natural selection only if

\[ rB > C \]

that is, if net fitness benefit gained by the recipient \( B \), discounted by the relatedness between actor and recipient \( r \), exceeds the fitness cost to the actor \( C \). The relatedness coefficient \( r \) ranges from 0 to 1 and represents the probability that, through common descent, two individuals share the same allele at any given locus; for example, in diploid species the relatedness between a parent and an offspring is \( r = 0.5 \), since (with Mendelian transmission) an allele present in one of the parents has a 50% probability of ending up in a given offspring. In total, across all genetic loci,
parents and offspring can be expected to share the same alleles by descent 50% of the times\(^1\).

The higher the relatedness coefficient \(r\) between two organisms, the more they will be selected to behave altruistically toward one another (i.e., to pay higher costs in order to benefit the other individual). Imagine that a mother is able to invest a certain quantity of resources in her offspring (for simplicity, we can assume offspring to be all full siblings). Resources may include food, time, active protection, and in general anything that imposes a net fitness cost on the mother by reducing her future reproductive success (e.g., because of energy expenditure, nutrient depletion, injury risk, and so on). How should she distribute these resources among the offspring? The relatedness between the mother and each of her offspring is exactly the same \((r = 0.5)\); it follows, therefore, that all else being equal, the mother should distribute her parental investment \textit{equally} among her offspring, with each offspring receiving the same amount of resources. The underlying logic is quite different, however, if one looks at the same decision from the perspective of a given offspring. While that offspring’s relatedness with each of its siblings is \(r = 0.5\), the same offspring is perfectly related to \textit{itself} \((r = 1.0)\). It follows that each offspring is selected to demand a greater (disproportionate) share of parental investment for itself, relative to its siblings, than parents have been selected to give, thus setting the stage for parent-child

\[^1\text{Classically defined, the relatedness coefficient } r \text{ is the probability that two individuals share the same allele at any given locus by (recent) common descent. As a probability, } r \text{ ranges between 0 and 1. For example, in diploid species the parent-offspring relatedness is } r = 0.5, \text{ since (with Mendelian transmission) an allele present in one of the parents has a 50\% probability of ending up in any given offspring. Relatedness can be defined more generally (and rigidously) as the genetic similarity between two individuals A and B, relative to the average genetic difference between A and a randomly chosen member of the population. In this version, } r \text{ can be treated as a regression coefficient and can take negative values (see Grafen, 1985).}\]
conflict and child-child competition over distribution of parental investment. It is important to note that conflict in the POCT sense does not necessarily refer to observable behavioral conflict between parent and child. Rather, conflict is defined more generally in terms of a conflict of interest between parent and child. From a POCT perspective parents and their children have opposing views regarding the optimal level of investment in children. This does not imply that conflict is always an observable event but rather that there are diverging interests between two organisms that share only a portion of their genome. Conceptualizing conflict in this way broadens the extent to which POCT can be applied to parent-child relations and provides a more flexible view of ecological and individual factors regulate optimal investment. The essence of POCT lies precisely in the difference between (1) the optimal parental investment from the parent’s perspective and (2) the optimal parental investment from the perspective of the offspring. Trivers’ model thus predicts that natural selection will maintain a conflictual tension within families concerning the allocation of parental investment. In fact, the theory can be easily extended beyond direct parental investment; indeed, as noted by Trivers (1974), any behavior that results in a cost to the parent and a benefit to an offspring (e.g., the offspring’s decisions concerning mating and reproduction, provided they can affect the parent in some way) has the potential to became an arena of within-family conflict. Clearly, POCT has deep and wide-ranging implications for the study of social behavior.

The Analysis of Parent-Offspring Conflict

For over thirty years, biologists have employed and extended Trivers’ seminal model to better understand what factors affect the intensity and outcomes of within-family conflict in animals. In this section we provide the reader with a concise
overview of the current state of the theory (for extended discussion see Godfray, 1995; Parker, Royle & Hartley, 2002; Royle, Hartley & Parker, 2004). There are two main kinds of POC models. The simplest (and oldest) models are called battleground models; they seek to quantify the extent of conflicts of interest and explain how potential conflict intensity varies as a function of the ecological characteristics of a given species or population. Resolution models go one step further, and seek to predict how the conflict will in fact be resolved: Will the parent “win”, or will a compromise be reached? And if so, how much will the outcome deviate from the parent’s and the offspring’s respective optima?

Conflict Battleground

Although Trivers’ original model demonstrates that parents and offspring will generally disagree about the optimal level of parental investment, the intensity of conflict at the behavioral and physiological level should depend on how much they disagree (i.e., on the gap between the parental and the offspring optima). Further, battleground models (e.g., Parker, 1985; Trivers, 1974) can be used to characterize the ecological factors that increase (or decrease) the extent of POC. In order to determine the conflict battleground, however, it is crucial to distinguish two forms of competition between siblings: intra-brood and inter-brood competition.

Intra-brood competition occurs between multiple young that are dependent at the same time (e.g., pups in the same litter), when parental investment is a fixed amount that has to be distributed among siblings. In this case, the extent of conflict is expected to depend on the available level of resources (less resources, more conflict), on the number of offspring competing for those resources (more offspring, more conflict) and, crucially, on the relatedness between siblings. Conflict is minimized
when siblings are always full siblings ($r = 0.5$); however, under any degree of multiple paternity (due, for example, to polygamy or cuckoldry) the average relatedness decreases, up to the point where all of one’s siblings can be expected to be half-siblings ($r = 0.25$), which maximizes conflict. For example, in a comprehensive study of passerine birds, Briskie, Naugler, and Leech (1994) found a negative correlation between begging intensity and genetic relatedness among siblings: In species where the genetic relatedness between siblings was generally low, offspring begged louder. This finding persisted even after controlling for the potential confounding effects of nestling size, nestling number, and variation in paternal care. In total, by straightforward application of Hamilton’s rule, decreasing relatedness between siblings tends to increase the extent of parent-offspring conflict.

**Inter-brood competition.** Even if a parent only has one dependent offspring at a time (and thus there is no intra-brood competition), the offspring is still competing for increased investment, only this time with its future siblings. Increased parental investment in the present offspring inevitably decreases the amount of investment that the parent will be able to provide to future offspring. The extent of POC resulting from inter-brood competition does not depend directly on the relatedness between siblings (Parker, 1985; Lessells & Parker, 1999), but on a more complex parameter that is determined by the organism’s mating system: The *interdependence* between the mother’s and the father’s reproductive success.

To the extent that the fitness opportunities and costs experienced by one parent are linked to the fitness opportunities and costs experienced by the other parent, the two are *interdependent* (constrained). This may happen, for example, in a mating system where mates are scarce, and if one partner dies the other will have trouble
finding another mate (thus incurring a fitness cost). More generally, interdependence is increased when investment by one of the parents translates into a fitness cost for the other parent (e.g., in species where males protect nursing females from predators and experience fitness costs as a consequence). The lowest levels of inter-brood competition are predicted in mating systems where individuals have only one mate over the course of their lifespan, with no replacement even if one of the partners dies (so-called “true monogamy”). In this context, the parents are maximally interdependent.

In the simplest case when only the mother provides parental investment, an individual offspring can maximize its fitness by extracting a higher amount of investment from the mother. If the costs paid by the mother do not affect the future reproductive success of the father (independence), the offspring will be selected to extract more maternal investment—as it can “offset” the increased cost paid by the mother through the father’s reproduction with other females. If, however, the father itself pays a cost associated with increased maternal investment (interdependence), the offspring cannot compensate for the fitness cost paid by the mother through its father’s reproduction. As a result, it will settle for a lower level of maternal investment, thus reducing the gap between parental and offspring optima. Thus, conflict intensity is predicted to increase when the reproductive success of fathers is independent from that of mothers, and vice versa; this will happen more frequently in polygynous or promiscuous mating systems, but reproductive independence can coexist with monogamy if parents can easily “replace” their current mate without paying additional costs (see Lessells & Parker, 1999; Parker et al., 2002). Finally, the dynamics of inter-brood competition may depend on specific patterns of genetic
expression in the offspring – a case in point is that of imprinted genes, i.e., genes whose pattern of expression depends on their parent of origin (see section 8).

While intra-brood and inter-brood competition are conceptually distinct and can be discussed separately for clarity, they are not mutually exclusive, and a reproductive system can involve a combination of both. This is the case for humans, whose families typically include multiple dependent children of different ages. In human families, each child is competing for investment with his/her future siblings (inter-brood). True monogamy is virtually nonexistent in human societies (Barash & Lipton, 2001), and most mating systems allow for multiple partners (especially for men); thus, the interdependence between mothers and fathers is expected to be variable but far from complete, and inter-brood competition can be expected to be a significant source of parent-offspring conflict in humans. In addition, older children are competing with their younger siblings for the parents’ attention and resources (intra-brood). It is important to note that, because of the extended period of immaturity in humans, intra-brood competition will often concern different resources for the two competing siblings. For example, a 4-years-old boy is not directly competing with his 6-months brother for the mother’s milk; however, the time spent lactating and the energy devoted to milk production do reduce the mother’s capacity to take care of the older child, protect him, prepare food for him, and so on.

Conflict Resolution

Whereas the extent of potential conflict is predicated on relatively general family and ecological factors (e.g., between-sibling relatedness, family size, resource availability, mating systems), predicting the outcome of conflict requires more detailed assumptions about the actual mechanisms that regulate parental investment.
This is extremely valuable because, in contrast to simple battleground models, resolution models permit (at least in principle) formulation of precise quantitative predictions (Godfray, 1995). Early models focused on who (parent or offspring) gets to control the allocation of resources. At one extreme of the power continuum are sibling competition models (e.g., Parker & Macnair, 1979; Parker, 1985). These models assume that offspring totally control the allocation of parental investment among siblings (e.g., by fighting for access to the best feeding position); accordingly, asymmetries in competitive ability between siblings determine the distribution of investment. But even sibling competition models do not assume that the more competitively advantaged sibling will try to monopolize all of the parental investment. Indeed, all else being equal, Sibling A can maximize her fitness by monopolizing parental investment only until her marginal gains fall to half that of Sibling B (presuming B is a full sibling with whom A has a relatedness of .50; see Parker et al., 2002). In family contexts in which there are multiple dependent siblings of different ages, as is commonly the case in human families, the marginal gains of the older sibling may quickly fall to below 50% of that of the younger sibling, given that the fitness return on parental investment may be much higher for relatively helpless young children. Indeed, older siblings must eventually be weaned of parental support and may even become “helpers at the nest,” promoting the fitness of their younger siblings.

In sibling competition models, parent-offspring conflict (reflecting both intra- and inter-brood competition) is ultimately resolved by a compromise between parental and offspring optima (i.e., parents invest more than their optimal amount, but still less than the offspring optimum). At the other extreme, “honest signaling”
models assume that parents have complete control over investment, and offspring merely signal their current level of need by some kind of costly signals. Allocation is then determined by siblings’ relative need. Fitness costs associated with signaling (e.g., loud begging may be costly because metabolically expensive, or because it attracts predators) permit a reliable communication system to evolve, by offsetting the potential benefits of exaggerated or deceptive signals (Zahavi & Zahavi, 1997). In some signaling models (e.g., Godfray, 1991, 1995) the conflict is resolved at the parental optimum, while in others (Johnstone, 1996) a compromise is reached between parental and offspring optima, depending on the specific assumptions made in the models. A great deal of empirical research in various animal species has been conducted with the aim of discriminating between these competing models (see Royle et al., 2004 for review).

Another way to approach conflict resolution is to focus not on who controls resource allocation, but rather on the empirical functions that describe the reciprocal influence between parent and offspring: the Effect of Demand on Supply (EDS: how the parent adjusts investment levels in relation to changes in offspring demand) and the Effect of Supply on Demand (ESD: how offspring solicitation is affected by changes in parental investment). Parker and colleagues (2002; Royle et al., 2004) showed that the critical parameter predicting the conflict outcome is the ESD. If changes in parental investment do not affect solicitation level (i.e., the ESD has a slope equal to zero), the conflict is resolved at the parental optimum; if instead offspring solicitation diminishes when parental investment increases (i.e., the ESD has a negative slope), the conflict is resolved at a compromise level. In some cases, increased parental investment may elicit increased demands from offspring (i.e., the
ESD has a positive slope); mathematical models then predict that conflict should be resolved at an investment level even lower than the parental optimum. All three mechanisms have been documented empirically, although ESDs with a negative slope appear to be more common than the other two types (Royle et al, 2004; see Kölliker [2003] for an example of how ESD and EDS functions can be mapped by means of systematic experimentation).

There has been surprisingly little research on how POC resolution models apply to human families. It is likely, however, that different types of investment can give rise to different conflict scenarios. For example, humans typically breastfeed only one infant at a time: thus, signalling models are more relevant to conflicts about lactation and weaning (section 5). By contrast, older children can fight over food shares, making sibling competition for food a more plausible scenario, at least in some ecological contexts. No systematic attempts have been made to map the ESD function of human children; again, it is quite possible that the shape of the function depends on the specific type of investment concerned. Even in absence of targeted data, we can use the findings of developmental psychology to derive some plausible hypotheses about the shape of the ESD. A good example is attachment theory, which deals with rather general dimensions of parental investment, operationalized as sensitivity, availability and emotional warmth (Ainsworth, Blehar, Waters & Wall, 1978; Cassidy & Shaver, 2008). The lowest demands on parents are those of avoidant children, who experience rejecting and insensitive parents (i.e., low investment) and go on to develop a distancing, self-reliant coping style. Securely attached children (who experience the highest levels of investment) demand more than avoidant ones. But the strongest demands for investment come from ambivalent children, who experience
inconsistently sensitive caregivers (i.e., intermediate parental investment) and display clinging, attention-seeking, and overly dependent behavior. This points to a nonlinear, inverted-U shape of the ESD; the outcome of conflict resolution would then vary along the investment continuum, depending on the local slope of the curve. Of course, this example does not prove that the ESD of human children has this specific shape; rather, it is meant to illustrate how extant psychological data can be brought to bear on POC models, and how POCT can orient researchers toward new types of empirical questions.

Determinants of Parental Investment and Offspring Demand

As we saw in the previous section, POCT describes the conflict of interest between parents and offspring in general and abstract terms, and points to a limited number of factors (such as relatedness between siblings, or the total amount of resources available to parents) that can influence conflict intensity. However, many ecological and individual factors converge to influence parental strategies for allocating resources, on the one hand, and offspring’s solicitation strategies and demand for parental investment, on the other. In this section we provide an overview of these factors and their interplay in setting the stage for conflict dynamics.

Parental Reproductive Strategy

From the parent’s perspective, the critical decision concerns the amount of resources that will be devoted to a given offspring. As shown in Figure 1, for a number of reasons—species-typical mating systems and availability of mates, impact of parental investment on offspring fitness, paternity certainty, harshness and unpredictability of local environments, parental age, parental condition/resources, genetic variation—parents differ in their reproductive strategies (e.g., Ellis,
Figueredo, Brumbach, & Schlomer, 2009; Nettle, 2010; Quinlan, 2007). These differences occur on two dimensions that directly affect offspring: current versus future reproduction and quantity versus quality of offspring (see Figure 1).

According to life history theory (Chisholm, 1999; Roff, 1992; Stearns, 1992), the most fundamental trade-off faced by parents is between current and future reproduction. Effort put into reproducing now will use energy or resources that cannot be used or saved for future reproduction. The organism therefore faces the risk of crossing an investment threshold, above which resources consumed in support of current reproduction would have produced better fitness returns if they had instead been allocated to future reproduction (Chisholm, 1999). The costs of current reproduction may be paid in terms of reduced number, quality, or survival of future offspring, as well as reduced growth and survival of the parent. The greater the parent’s probability of breeding again in the future, the more parents can be expected to withhold resources from current reproduction, and thus the greater the potential for conflict with extant offspring (in Figure 1, see the mediated path from “parental reproductive strategy”  \(\rightarrow\) “total parental investment in current offspring”  \(\rightarrow\) “parental investment in individual offspring”  \(\rightarrow\) “offspring solicitation/demand for investment”). Further, conflict should increase as a function of reduced interdependence between maternal and paternal reproductive success and reduced relatedness between siblings (section 2), both of which depend on parental reproductive strategies and on the current mating system. These relations are shown in Figure 1 in the mediated paths from “mating system/mate availability” and “parental reproductive strategy” to “offspring solicitation/demand for parental investment” through “parental interdependence” and “sibling relatedness.”
At the most basic level, trade-offs between current versus future reproduction are influenced by energetic conditions—caloric intake, energy expenditures, and related health conditions—which set a baseline for many developmental and reproductive processes, including amount and duration of parental investment. As reviewed in Kuzawa (2005) and Ellison (2001), poor energetic conditions translate into development of a more energy-sparing phenotype: slower growth, delayed sexual maturation, low gonadal steroid production, small adult body size, reduced fecundity, and lower maternal milk production in mammals. Along these lines, small body size, wide birth spacing, monogamous marriage, and father-present social systems are more likely to be found among human hunter-gatherers inhabiting harsh ecologies where biparental care (male provisioning) is substantial and important for offspring survival and reproductive success (Draper & Harpending, 1988; Geary, 2000; Kaplan & Lancaster, 2003: Table 7-1; Marlowe, 2003).

Prolonged and intensive investment in current offspring occurs at the expense of investment in future offspring. When resources are scarce, parents may sacrifice future reproduction by extending investment in current offspring for longer than under ideal conditions (Bateson, 1994) (Figure 1: “parental reproductive strategy” → “total parental investment in current offspring”). For example, under normal conditions spotted hyena mothers wean their offspring at approximately 12 months of age but often delay weaning until 18 months of age in habitats characterized by low or fluctuating availability of prey (Hofer & East, 1995). In total, mothers tend to monitor and strategically respond (depending on their own resources/condition) to the progress and condition of their current offspring (Bateson, 1994; see Figure 1: effects of “offspring need” and “offspring fitness” on “parental investment in individual
offspring,” as moderated by “parental condition/resources”). This complex web of parental investment decisions is discussed in more detail below. A key factor regulating parental investment in any given child is the likely impact of that investment on the child’s fitness (Ellis et al., 2009; Quinlan, 2007).

Closely related to current-future trade-offs are quality-quantity trade-offs. Constraints on resources and energy, both developmentally and over evolutionary time, bias organisms toward investing in either a relatively small number of “high quality” offspring or a relatively large number of “low quality” offspring (Stearns, 1992). In humans, allocation of resources toward high offspring quality is often associated with monogamy and biparental investment, which lead to increased interdependence between parents. Higher quality offspring tend to have better health, survival, and developmental outcomes. To the extent that parents favor offspring quantity over quality, thus reducing investment per child, the potential for conflict with any given offspring increases. In Figure 1, this principle is illustrated by the negative effect of “offspring number” on “parental investment in individual offspring,” which in turn affects “offspring fitness,” “offspring need,” and “offspring solicitation/demand for investment.”

“Total parental investment” (maternal investment plus paternal investment) is divided among offspring to generate the level of “parental investment in individual offspring.” The effects of resource division among offspring can be demonstrated in species that produce litters. Provision of food is a critical aspect of parental investment. It follows that as litter size increases, investment in each offspring decreases, resulting in smaller and less nourished offspring. This trend has been found in many different species ranging from invertebrates to birds to mammals (see Klomp,
The quality-quantity trade-off is also pervasive among humans in Western societies, where larger family size is associated with less direct parental involvement in key childcare activities (Lawson & Mace, 2009), and preindustrial societies, where larger family size has been linked to poorer growth and survival outcomes of offspring (e.g., Borgerhoff Mulder, 2000; Hagen, Barrett, & Price 2006; Strassmann and Gillespie, 2002). On the other hand, when parents are faced with unusually small litters, they may invest heavily to increase offspring quality (Mendl, 1994). Either way, the more that parents divide resources among offspring, the greater the potential for parent-offspring conflict.

Animals often inhabit environments that afford enough bioenergetic resources to support basic somatic functions and provisioning of offspring but are dangerous and unpredictable in other ways. Environments may be characterized by external sources of disability and death (e.g. predation, warfare, weather cycles, infectious disease) that are relatively insensitive to the adaptive decisions of the organism and/or vary unpredictably over time or space (Ellis et al., 2009). These conditions result in diminishing fitness returns on parental investment in any given offspring (above a basic level) and thus favor shifts toward offspring quantity over quality. This is captured by the arrow in Figure 1 from “environmental harshness/unpredictability” to “parental reproductive strategies”. The shift toward offspring quantity involves limiting parental investment in given offspring and is indexed empirically by such constructs as harsh, neglectful, rejecting, and insensitive parenting. As predicted by life history theory, this type of low-investment parenting is disproportionately found in dangerous and/or unpredictable environments (Ellis et al., 2009).

Offspring’s Fitness and Need
Equal division of resources among offspring rests on the assumption that all offspring are equal in their potential to survive and reproduce. This is often not the case, however, and models of parent-offspring conflict suggest that parents may discriminate among offspring according to their fitness and need. Fitness refers to the reproductive value of offspring (i.e., their expected future reproductive success); it is signaled by such characteristics as age, size, health, and competitive ability. Need refers to the increase in fitness of offspring as a result of receiving a unit of parental investment (Royle, Hartley, & Parker, 2002). In parent-offspring conflict models, need and fitness are assumed to be negatively related (Figure 1), whereby offspring that display higher fitness have less need for parental provisioning than do their younger, weaker, or less healthy siblings. As shown in Figure 1, “offspring fitness” has a bidirectional relation with parental investment. On the one hand, parental investment tends to reduce the offspring’s need and increase their fitness. On the other hand, offspring fitness influences the resource allocation decisions of parents. In particular, parental investment in any given offspring should only continue until the fitness gains achieved through continued investment become less than the potential gains that could be realized through investment in other (current or future) offspring (Roff, 1992; Stearns, 1992). Further, parents should be selected to cease investment altogether when offspring are in a very poor state (and thus unlikely to survive) and conditions are sufficiently variable that they can be expected to improve for future reproduction (Bateson, 1994).

This prediction has been supported by cross-cultural data demonstrating that parent-inflicted infanticide in humans occurs overwhelmingly when the child is unlikely to survive due to poor health or unfavorable circumstances external to the
child (Daly & Wilson, 1988; reviewed in Soltis, 2004). A powerful external circumstance that regulates parental investment is resource availability: lack of nutritional and economic resources restricts investment in any given child (Figure 1: “parental condition/resources” → “total parental investment in current offspring”). Above and beyond the effects of resource availability, however, children who are mentally, physically, or behaviorally atypical—and thus are unlikely to achieve reproductive success—suffer dramatically elevated rates of child abuse and neglect (Daly & Wilson, 1980; reviewed in Bugental & Happaney, 2004; Soltis, 2004). These effects, which are pervasive across time and culture, are captured by the arrow in Figure 1 from “offspring fitness” to “parental investment in individual offspring.”

Available evidence suggests that humans follow a similar pattern, particularly in ecological contexts that force parents to make tough reproductive choices. Across a sample of traditional societies in the Human Relations Area Files, either having too
many children or births spaced too closely together were common motives for infanticide; when this occurred, it was always the younger child who was killed rather than an older, more reproductively valuable sibling (Daly & Wilson, 1988).

Likewise, under extreme socioeconomic conditions, such as in Brazilian shantytowns where child mortality rates are very high, mothers have been found to treat their offspring differentially on the basis of their perceived survival prospects, investing in vigorous, healthy infants while selectively neglecting others (Scheper-Hughes, 1992; see Hrdy, 1999, for extensive discussion of these issues).

By contrast, in stable and well-resourced environments, parents can afford to invest in needier offspring in a “compensatory” fashion (e.g., Stamps, et al., 1985). In humans, parents may devote extra time and attention to needier children—when they can afford to do so. Among the Karo Batak of North Sumatra, for example, children with greater need and/or lower fitness (indexed by younger age and higher propensity to illness) tend to cry and whimper more often (Kushnick, 2008); in turn, this observed fussiness predicts a greater frequency of nursing (Figure 1: “offspring solicitation/demand for parental investment” → “parental investment in individual offspring”), a pattern consistent with a positive EDS function (the default assumption of POC models). Interestingly, longer feeding periods were followed by increased fussiness, suggesting a positive ESD function whereby increasing investment increases solicitation (Figure 1, “investment in individual offspring” → “offspring solicitation/demand for investment”). As the authors note, this is a rather crude assessment of the ESD function, which can only be elucidated through systematic experimental work; however, these results provide a useful starting point for future
research and show how POCT can be used to inform both research design and data interpretation.

In general, the dilemma faced by parents is whether to invest heavily in high-risk children to improve their chances of survival and reproduction or to focus resources on current (or future) offspring with the highest reproductive value (Mann, 1992). Mothers in Western societies from higher socioeconomic backgrounds—who have less to lose from investing in high-risk offspring—do not necessarily provide less care for high-risk children (such as low birthweight or premature infants); however, mothers do show behavioral preferences for healthier children (e.g., more holding, touching, soothing, and smiling), nurse them for longer periods of time, and wait longer before having their next child (Barratt, Roach, & Leavitt, 1996; Bereczaki & Csanaky, 2001; Goldberg, Perrotta, Minde, & Corter, 1986; Mann, 1992; Robson & Cline, 1998). In total, mothers are more likely to enhance the fitness of current healthy offspring, compared with high-risk offspring, at a cost to future reproduction. However, the effect of “offspring fitness” on “parental investment in individual offspring” may be moderated by “parental condition/resources” (as shown in Figure 1). This hypothesis has been tested on predominantly Latina samples in the US. As predicted, mothers in better condition or with more interpersonal resources (i.e., absence of depression, participation in a parenting skills program) disproportionately invested in high-risk versus low-risk infants and young children, whereas mothers in worse condition or with fewer interpersonal resources (i.e., presence of depression, no experimental enhancement of parenting skills) showed the opposite pattern (Beaulieu & Bugental, 2008; Bugental, Beaulieu, & Silbert-Geiger, 2010).

*Parent’s Age*
According to the *terminal investment hypothesis* (Fisher, 1930; Williams, 1966), when future reproductive potential is low, and thus conserving resources for future reproduction is likely to result in wasted effort, organisms should invest heavily in already-born offspring (current reproduction). Such an increase in investment should reduce parent-offspring conflict by leading to greater convergence between parental and offspring optima and eliminating inter-brood competition. This series of relations is represented in Figure 1 by the mediated path from “parental age” to “parental reproductive strategy” (reflecting the current-future trade-off) \( \rightarrow \) “total parental investment in current offspring” \( \rightarrow \) “parent investment in individual offspring” \( \rightarrow \) “offspring solicitation/demand for investment.” In females, the likelihood of successful future reproduction depends strongly on age, leading to the hypothesis that investment in current offspring should be relatively low among young mothers and increase with age.

Empirical tests of this hypothesis in the animal literature have yielded mixed results, in part because many studies do not consider the increasing costs associated with parental investment as an organism ages (Clutton-Brock, 1984). In addition, some debate exists regarding the effects of age versus parity (number of births)—two confounded aspects of female development—on parental investment (Fessler, Navarrete, Hopkins, & Izard, 2005; though see Braza, 2004). The relationship between age and investment has been extensively studied in the California gull (*Larus californicus*; Pugesek, 1990, 1995; Pugesek & Diem, 1990). This corpus of research shows that older gull mothers withhold food from nestlings less, have longer periods of investment, and that increased investment is not a product of increased foraging efficiency with age. This relationship between age and investment is not linear,
however; Pugeske & Diem (1990) found that indicators of investment peaked among gulls 16-19 years and then declined among gulls 20-23 years old.

The human literature shows both curvilinear and linear effects of maternal age on investment in offspring. Prenatally, these effects appear to be curvilinear. Specifically, maternal investment in fetal development (as measured by infant birth weight) peaks among women 25-29 and then declines thereafter (Braza, 2004). This effect was not explained by the parity of the mothers. Postnatally, however, maternal investment appears to increase linearly with maternal age. On the one hand, young mothers are most likely to neglect, abuse, or kill their young children (Brown, Cohen, Johnson, & Salzinger, 1998; Luke & Brown, 2007; Mersky, Berger, Reynolds, & Gromoske, 2009; Overpeck, Brenner, Trumble, Trifiletti, & Berendes, 1998). On the other hand, positive forms of investment in offspring tend to increase as mothers age. For example, in a study of 4 month old infants, older mothers (range = 16-38 years, $M$ ~ 24 years) tended to be more satisfied in their role as a parent and spent less time away from their child (Ragozin, Basham, Cnic, Greenberg, & Robinson, 1982). These effects were not explained by maternal education, parity, gestational age, or income. Furthermore, older mothers tended to be more sensitive to infant cues compared to younger mothers, particularly for primiparous mothers (Ragozin, et al., 1982). Even after controlling for socioeconomic status, maternal education, ethnicity, intelligence, social desirability of responding, and child age and language competence, older mothers provided more praise and physical affection towards their toddlers compared to younger mothers (Bornstien & Putnick, 2007). Finally, older mothers are especially likely to tolerate and invest in needy offspring (Beaulieu & Bugental, 2008).
From the perspective of POCT, this higher level of parental investment among older mothers should result in less parent-child conflict. To our knowledge, however, this prediction has not been tested. Thus, an important direction for future research will be to examine the moderating influence of parental age on parent-child conflict.

**Child-Specific Influences on Offspring Solicitation/Demand for Investment**

Several additional factors are expected to influence the amount of investment demanded by a given offspring. At the most basic level, POCT predicts that “offspring solicitation/demand for parental investment” will increase as biological relatedness between siblings decreases (Section 2). Specifically, within families, Sibling A can maximize her fitness by monopolizing parental investment until her marginal gains fall to half that of Sibling B (if Sibling B is a full sibling with whom she has a relatedness of .50) or to one-fourth that of Sibling B (if Sibling B is a full sibling with whom she has a relatedness of .25; Parker et al., 2002). This effect, as depicted in Figure 1 (“sibling relatedness” → “offspring solicitation/demand for investment”), is reviewed in detail in Section 6.

At the same time, offspring need to modulate their demands for parental investment in relation to parental condition/resources. As discussed by Bateson (1994), whereas increased levels of “offspring solicitation/demand for investment” among very young offspring generally increases offspring survival in the short-term, the strength of this relation decreases as offspring get older. Further, depending on parental condition/resources, too much “offspring solicitation/demand for investment” early in childhood may reduce the capacity of parents to provide necessary investment in the future. Thus, offspring should monitor parental condition/resources and adjust demands accordingly (Bateson, 1994), so as not to seriously endanger the health of
the nursing mother; see Figure 1: “parental condition/resources” → “offspring solicitation/demand for investment.” This is especially relevant for species such as humans with extensive post-weaning parental investment.

In addition, “offspring solicitation/demand for investment” should be modulated by “parental condition/resources” relative to the “need” and “fitness” of different siblings. Just as parents tend to favor larger, more competitive offspring when energetic resources are scarce (reviewed above), more competitively-advantaged (dominant) siblings tend to monopolize parental investment under conditions of resource scarcity but not under conditions of resource abundance (see Figure 1, “offspring fitness” → “offspring solicitation/ demand for parental investment,” as moderated by “parental condition/resources”). This discriminative pattern of sibling competition and demand has been documented across ecologically and taxonomically diverse species (including a wide range of avian species [reviewed in Drummond, 2001]), spotted hyenas [Hofer & East, 2008; White, 2008], and Galápagos fur seals and sea lions [Trillmich & Wolf, 2008]). Although this pattern of competitively-advantaged siblings monopolizing scarce parental resources often inflicts extreme costs, including death, on competitively-disadvantaged siblings, mathematical models have demonstrated that this behavior could still evolve if the fitness benefits accrued by the dominant sibling exceed the costs incurred by loss of a sibling (with that cost discounted by the coefficient of relatedness, r) (Parker, Mock, & Lamey, 1989). Such behavior should be conditionally expressed, however, developing when resources are so scarce that parents cannot adequately feed all members of a brood. In this context, the dominant sibling, to ensure its own growth and survival, can benefit from selfishly consuming a disproportionate share of the
food; by contrast, given sufficient energetic resources, the small gain in growth and
survival obtained by eliminating or devaluing siblings is outweighed by the cost to
inclusive fitness (Hofer & East, 2008). These documented effects of resource scarcity
on sibling competition for parental investment suggest an important direction for
future research on sibling rivalry in humans.

Summary

In summary, the amount of investment that parents allocate toward a given
offspring, on the one hand, and the levels of offspring solicitation and demand for
parental investment, on the other, is multiply determined. Parental investment
depends on the parents’ reproductive strategy, parental age, parental
condition/resources, number of offspring, and on parental assessments of the need and
fitness of different offspring. Offspring solicitation/demand depends fundamentally
on the level of parental investment they are receiving together with offspring fitness,
offspring need, number of siblings, genetic relatedness among siblings,
interdependence between parents, and parental condition/resources. These factors
regulating parental investment and offspring demand interact to modulate the
intensity of parent-child conflict, which ultimately reflects the gap between parent’s
and offspring’s optimal levels of parental investment.

Prenatal Conflict

In humans, the most extensive applications of POCT have been to parent-child
conflict before birth. The fetal stage is increasingly recognized as an important phase
in the human life cycle. The processes that unfold before birth set the stage for later
development and have far-reaching implications for physical and psychological health
in childhood and even adulthood (Bateson et al., 2004; Kuzawa, 2007). During
prenatal development, the interaction between fetal and maternal physiology affects fetal growth rate and birth weight (with their many consequences for physical and cognitive development; see Kuzawa, 2007; McCarton, Wallace, Divon & Vaughan, 1996; Wilcox, 2001). Even more importantly, maternal hormones can exert powerful effects on the calibration of the child’s metabolism (e.g., Gluckman, Hanson & Beedle, 2007) and temperamental reactivity (e.g., Huizink, de Medina, Mulder, Visser, & Buitelaar., 2002; Möhler, Parzer, Brunner, Weibel, & Resch., 2006). Despite the growing attention to fetal development, most researchers still adopt an outdated view of pregnancy as an essentially harmonious and cooperative enterprise, quite unlike the rewarding but often conflictual relationships that later take place between parents and their infants/children. However, parent-offspring conflict is already present (and arguably quite intense) well before birth. As Trivers (1974) stated: “Since parental investment begins before eggs are laid or young are born … I assume that parent-offspring conflict may in theory begin as early as meiosis.” (p. 252). In fact, later research has uncovered a world of strategic parent-offspring relations before birth involving a complex mixture of cooperation and competition (Haig, 1993). In this section we focus on the main conflicts that take place during human pregnancy and explore their implications for psychological research.

Fetal Nutrition and Growth

Human pregnancy involves a long, sustained period of maternal investment, and puts a remarkable physiological burden on the woman (Ellison, 2001). The most obvious form of maternal investment is the provision of nutrients to the fetus, which in humans takes place through the placental circulatory system. Maternal blood enters the placenta through spiral arteries and exchanges nutrients and oxygen with fetal
blood through the placental barrier. This mechanism implies two possible conflicts between the mother and the fetus: the conflict about blood flow (the more blood enters the placenta, the more nutrients are transferred to the fetus) and the conflict about nutrient concentration, in particular that of blood glucose.

One of the most puzzling aspects of gestation is the marked inefficiency in how circulation is regulated. Cardiac output rises dramatically early in pregnancy and remains elevated until the third trimester; at the same time, vasodilation occurs, lowering arterial resistance during the first and second trimester. The net effect is a drop in blood pressure in early and mid-pregnancy, with pressure typically rising again during the third trimester (Easterling, Benedetti, Schmucker, & Millard, 1990). Vasodilation appears to put an unnecessary strain on the mother’s heart, since an effective system would increase blood supply to the placenta by increasing arterial resistance (vasoconstriction), thus elevating blood pressure with only a modest amount of increase in cardiac output. In fact, maternal vasodilation can be explained as a defense of mothers against fetal release of factors that induce constriction of maternal vessels. Since placental arteries have extremely low resistance, increasing maternal blood pressure benefits the fetus by directly increasing placental flow (Haig, 1993). The side effects of this physiological tug-of-war are (1) the apparent inefficiency of the system and (2) the occasional risk of fetal-induced maternal hypertension. In accord with the conflict model, gestational hypertension can be harmful to the mother but predicts lower perinatal mortality in the fetus and higher birthweight (Langer, Yogev, Most, & Xenakis, 2005). This is especially true when hypertension is not associated with proteinuria, also known as pre-eclampsia, and is considerably more dangerous for the fetus as well as for the mother (Lindheimer,
Glucose and insulin levels in mothers are altered during pregnancy. Glucose concentration at baseline drops early in pregnancy, stabilizing to the new lower level by the end of the first trimester (Lind & Aspillaga, 1988). Maternal insulin levels and insulin response after meals remain low until mid-gestation, but rise dramatically during the third trimester. At the same time, insulin resistance develops, leading to longer elevation of blood sugar after meals. The combination of high insulin levels and insulin resistance is another apparent paradox, which again can be explained by underlying parent-offspring conflict (Haig, 1993). The most abundant hormone produced by the placenta is human placental lactogen (hPL). Through hPL secretion, the fetus is able to induce insulin resistance in the mother, most likely by activating prolactin receptors. The rise in maternal insulin levels during the third trimester can be interpreted as a countermeasure against fetal manipulation, and the same is true for the reduction in circulating sugar at the beginning of pregnancy.

As with the regulation of blood pressure, conflict about blood glucose involves potentially dangerous side effects: insulin resistance during pregnancy increases the mother’s risk of developing diabetes later in life (Feig, Zinman, Wang, & Hux, 2008) and, when blood glucose levels are elevated for long periods, the mother may contract gestational diabetes mellitus (GDM)—a condition occurring in 7% of pregnancies in developed countries (ADA, 2004). Mothers with GDM have larger babies than healthy mothers, supporting the theory that insulin resistance is a means for the fetus to obtain resources from the mother (Langer, et al., 2005). The effects of prenatal conflict can have long-lasting consequences on metabolism and health: Maternal
GDM in pregnancy increases the newborn’s risk of developing insulin resistance and obesity in childhood (Boney, Verma, Tucker & Vohr, 2005). Women over the age of 35 are at high risk for GDM (Ross, 2006). It could be hypothesized that older women are shifting their threshold for parental investment, allowing current offspring to get more resources in view of their decreasing fertility.

_Pregnancy Sickness_

Pregnancy sickness or NVP (nausea and vomiting of pregnancy) is a common pattern of food aversion, nausea and vomiting experienced by most women during the first trimester of pregnancy. NVP peaks around weeks 9-14 and typically ends by the fourth month of gestation. From the evolutionary point of view, there is strong support for the hypothesis that NVP has the adaptive function of protecting the fetus from ingestion of toxins and teratogens during the most sensitive phase of organogenesis (Profet, 1992); in addition, Flaxman & Sherman (2000) proposed that the especially strong aversion for meat, fish, poultry and eggs displayed by pregnant women is designed to protect both the developing fetus and the mother (who undergoes physiological immunosuppression during pregnancy) from food-borne pathogens such as bacteria and fungi. Consistent with this hypothesis, stronger NVP symptoms are associated with better pregnancy outcomes, such as lowered risk of miscarriage and stillbirth (reviewed in Flaxman & Sherman, 2000; Forbes, 2002).

The protection hypothesis was challenged by Forbes (2002), who put forth the alternative evolutionary hypothesis that NVP is a nonadaptive outcome of maternal-fetal conflict. The most likely endocrine basis for NVP is the placental hormone hCG (human chorionic gonadotropin), which is abundantly produced by the embryo during the first trimester. The primary function of hCG is to maintain pregnancy by
preventing degeneration of the corpus luteum, and there is consistent evidence that it behaves as a “honest signal” of fetal vigor and genetic quality (e.g., absence of chromosomal abnormalities; Forbes, 1997, 2002). Forbes argued that viable fetuses produce higher hCG levels and, incidentally, higher NVP symptoms in mothers; thus, the observed relation between NVP severity and good pregnancy outcomes could be due to higher fetal quality and not to the protective effects of NVP. The conflict hypothesis would also explain why extremely strong NVP (known as hyperemesis gravidarum) can be highly debilitating for the mother, and sometimes fatal for both mother and fetus (e.g., Abell & Riely, 1994). If NVP is the outcome of a conflict between mother and fetus, the mother is expected to suffer an excessive cost (from her point of view) if the fetus “wins”; also, the conflict may occasionally escalate and get out of hand, killing one or both parties as an unintended side effect.

Whereas the two hypotheses are presented and discussed as mutually exclusive (e.g., Flaxman & Sherman, 2008), they are probably compatible at a deeper level: The key is to consider NVP as a form of parental investment, with protective benefits for the fetus and nutritional costs for the mother (Del Giudice, 2007). Parent-offspring conflict theory then predicts that mother and fetus should disagree about the optimal severity of NVP, with the fetus favoring more severe symptoms than the mother. In this perspective, NVP would be an adaptation, but a costly one, especially for the mother. Although hCG could have evolved as a signal of viability, it may have taken on an additional role as a regulator of maternal investment during pregnancy. This hypothesis is consistent with the paternally biased expression of hCG, since paternally expressed genes often evolve so as to increase the level of maternal investment (see section 7).
Future Directions

The range of potential conflicts between mothers and fetuses extends beyond nutrition and growth. One important arena of conflict that has been relatively neglected is that of spontaneous abortion. Spontaneous abortion in the first trimester often occurs because of genetic or chromosomal anomalies in the embryo (Forbes, 2002), and can be seen as a “quality filter” mechanism that interrupts pregnancy before substantial investment is made (see Forbes, 1997). As with every type of maternal investment, mother and fetus are expected to disagree about the exact threshold for abortion, with the fetus favoring a less stringent filter than the mother. Importantly, maternal stress has been shown to increase the likelihood of miscarriage (e.g., Arck et al., 2001), so that the conflict outcome may be partly regulated by the psychological state of the mother.

Another puzzling phenomenon that might be illuminated by a parent-offspring conflict perspective is that of so-called “denied pregnancy” or, more aptly, “cryptic pregnancy” (Del Giudice, 2007). A startling number of human pregnancies go unrecognized by the mother and her relatives until the end of the second trimester (about 1 pregnancy in 475), and in some cases until delivery (about 1 in 2,500; Wessel, Endrikat & Büscher, 2002). This phenomenon has been traditionally interpreted in a psychodynamic framework, as involving psychotic-like defenses against deeply conflictual unconscious feelings. However, women experiencing cryptic pregnancy typically lack NVP symptoms, may show pseudo-menstrual bleedings, report reduced abdominal swelling, and often deliver underweight babies (reviewed in Del Giudice, 2007). Del Giudice argued that this constellation of features reflects an unusually low level of maternal investment, and can mislead
women into believing they are not pregnant; intriguingly, both NVP and menstruation cessation are likely regulated by fetal hGC, suggesting a key role of this hormone in the etiology of cryptic pregnancy. At the functional level, Del Giudice (2007) proposed three explanatory hypotheses for the occurrence of cryptic pregnancy: This condition may arise as a nonadaptive by-product of mother-fetus conflict; as a result of low fetal quality, when hCG levels are just above the abortion threshold; and as an “emergency strategy” triggered by social stressors—a strategy aimed at reducing investment in order to maximize the likelihood of successful delivery in a threatening environment. Future research on this fascinating topic could afford new insight into the mechanisms that regulate the allocation of maternal investment during pregnancy and, most importantly, the role played by psychological and social factors.

Finally, framing human pregnancy in the perspective of parent-offspring conflict will help researchers generate new hypotheses on how social and ecological factors may affect important outcomes such as spontaneous abortions, pregnancy sickness, hypertension, diabetes and high/low birthweight. For example, a comparative study by Long (2005) showed that fetal development is faster in primate species with more promiscuous mating systems compared to monogamous species, even controlling for phylogenetic confounds. Moreover, fetal growth is fastest in species where the fetus (by virtue of placental structure) has more direct access to maternal nutrients. These data are consistent with battleground models (see above) which predict a higher level of parent-offspring conflict in mating systems where interdependence between mothers and fathers is low. It is possible that cultural variation in human mating systems (or even in individual reproductive strategies) may be associated with more or less intense mother-fetus conflict and, consequently, with
differences in the incidence of pregnancy-related outcomes such as NVP, hypertension, and low birthweight. Even more detailed predictions could be made by applying conflict resolution models to human pregnancy. Unfortunately, current data do not permit precise characterization of the ESD functions involved in mother-fetal exchanges; for this reason, the quantitative description of how mother and fetus respond to each other during pregnancy would be a valuable topic for future research, ripe with potential clinical implications.

Weaning Conflict

After birth, the primary focus of mother-child conflict shifts to the intensity and duration of breast-feeding. Beyond direct nutritional benefits, breast-feeding in human mothers confers health benefits to their children (Cunningham, Jelliffe, & Jelliffe, 1991; McDade & Worthman, 1998), including reduced risk of gastrointestinal infections, respiratory infections, middle ear infections, meningitis, and immune system disorders in infants. The decision to breast-feed, including the duration of breast-feeding and the timing of weaning, therefore has significant relevance to the health of the child. To provide a foundation for understanding weaning conflict in humans, we first describe weaning in other mammals and primates, articulating the principals that underlie weaning conflict in general, and then apply these principals to understanding weaning conflict in humans.

Weaning Conflict in Primates and Other Mammals

Conflict during weaning in mammals has been well studied and is considered the prototypical case of parent-child conflict over a limited resource (Fouts, et al., 2005). Trivers (1974) used the case of mammalian weaning to illustrate the principals of POCT. According to POCT, parents and their children are expected to disagree
over the duration of nursing. Because resources invested in breast feeding cannot be used for future reproduction, the optimal duration of nursing should differ from the perspectives of parents and children, with children selected to seek a longer duration of breastfeeding than mothers are selected to provide. Although it is in the interests of both mothers and children to achieve some balance between maternal investment in current versus future offspring, the optimal tipping point—i.e., when to shift investment away from current offspring—can differ sharply for mothers and offspring (section 2).

Among primates, the weaning process typically coincides with maternal resumption of mating (Maestripieri, 2002). A prediction of POCT is that weaning conflict should increase around transition points when mothers reallocate investment away from nursing and toward the production of new offspring. It is at such transition points when competition between current and future offspring is most salient. For example, a well-established phenomena in the primate literature on weaning is the tendency for nipple solicitation to increase markedly when their mothers resume estrus (i.e., fertile ovulatory cycles), as has been clearly demonstrated in rhesus macaques (Macaca mulatta; Gomendio, 1991). Studies of nursing have shown that the energetic stress of lactation reduces fertility by suppressing the activity of the hypothalamic-pituitary-ovarian (HPO) axis (e.g., Ellison, 2001). The increase in breast-feeding attempts by offspring that coincides with estrus, therefore, may function to delay or prevent the mothers from reproducing. Indeed, Gomendio (1991) compared rhesus mothers who did and did not conceive during the next breeding season and found that the offspring of non-conceiving mothers were more successful in their attempts to gain access to the nipple. Significant differences were also found
between conceiving and non-conceiving mothers in their rates of rejecting nursing offspring: conceiving mothers rebuffed their infant’s nursing attempts more often than did non-conceiving mothers. Nonetheless, no differences were found in begging intensity between offspring of conceiving and non-conceiving mothers during estrus (Gomendio, 1991). These data suggest that the resolution of weaning conflict and the attendant likelihood of future conception was mediated by maternal behavior (i.e., mothers maintained control over allocation of investment). Although infants engaged in tactics to solicit additional investment from mothers, additional investment did not appear to affect solicitation (no effect of supply on demand).

Finally, offspring solicitation/demand for parental investment, and associated levels of parent-child conflict, depend on resource availability, with conflict decreasing as a function of greater availability of weaning foods (Section 3). Among chacma baboons, for example, infants only have tantrums during weaning when alternative forms of food are unavailable; these tantrums are followed by an increase in the amount of investment received from the mothers (Barrett & Henzi, 2000), demonstrating a positive effect of demand on supply.

Weaning Conflict in Humans

Humans are largely unique in the animal world in raising multiple dependent offspring of different ages. Offspring in almost all other species need to be able to feed themselves after they are weaned, as parents generally do not provision older offspring after they have produced new offspring. Humans neither bear and raise only one offspring at a time (as the other great apes do, creating “pure” inter-brood competition) nor produce litters (as many other mammalian species do, generating “pure” intra-brood competition). The battleground of weaning conflict in humans,
therefore, does not conform to a strictly inter-brood or intra-brood model. Because humans generally do not produce litters, multiple births excepted (though in hunting- and-gathering societies, only one twin usually is raised and the other sacrificed; Daly & Wilson, 1984, 1988), the degree of intra-brood competition over mother’s milk is essentially zero. Nonetheless, nursing may still be a focus of sibling competition because it takes considerable time and energy away from the mother—time and energy that could have been devoted to older siblings. For example, one reported barrier to infant breastfeeding is maternal workload, including caring for other children (Ogbanu, Probst, Laditka, Liu, Baek, & Glover, 2009; Ahluwalia, Morrow, & Hsia 2005). This barrier suggests that mothers may make trade-offs in their time allocation, devoting energy and resources to either nursing or caring for their older children. In general, the time and resources of mothers, of which energetic expenditures on nursing is one component, should be a central point of contention among siblings.

Because potential conflicts over weaning in modern societies are mitigated by the widespread availability of alternative food sources for infants (e.g., formula, mashed baby foods), traditional societies—where decisions over duration of lactation present mothers with real energetic and reproductive trade-offs—provide a more valid context for studying weaning conflict. Anthropological data on weaning processes in such societies are abundant and provide a solid basis for testing principals of POCT. The most detailed data come from a series of studies on the weaning patterns of Bofi foragers and farmers of Central Africa. The Bofi foragers are a patrilocal group that hunt primarily with nets and subside on small to medium sized game together with
plant foods and insects gathered from the local environment. Bofi farmers are slash-and-burn horticulturalists. Both the foragers and farmers are largely monogamous.

Fouts and colleagues (Fouts, Hewlett, & Lamb, 2000; Fouts, 2004; Fouts, Hewlett, & Lamb, 2005) found that, in both the farmers and foragers, conflict between parent and child was initially low post partum but gradually increased over time as nursing frequency was reduced and the weaning process began (see also Pryce, 1995). Farmer children were weaned at earlier ages than foraging children, and this may partly explain why they displayed more weaning distress (Fouts et al., 2005). In addition to child age, low overall levels of nursing and the mother becoming pregnant each predicted increased levels of fussing and crying by children during nursing/weaning. Each of these factors influences or reflects the amount of investment that mothers allocate toward offspring and, therefore, contributes to parent-child conflict. For example, pregnancy usually coincides with a decrease in nursing. Among the Bofi, pregnancy was most strongly associated with fussiness and crying when weaning was abrupt rather than gradual.

The tendency for weaning to occur at pregnancy is not unique to the Bofi; cross-culturally, pregnancy is a common reason for initiating weaning (McDade & Worthman, 1998). For example, among the !Kung, weaning typically occurs when the mother becomes pregnant (Konner, 2005) and is completed well before the birth of the new child. Likewise, among the Turkana pastoralists of Kenya, conflict tends to be high when mothers resume sexual relations with their husbands. Resumption of sexual relations represents a transition point where reproductive effort is being diverted away from parental investment and towards mating effort. Indeed, the most frequently cited reason for weaning among the Turkana was pregnancy (Gray, 1996).
Thus, consistent with POCT, conflict between human mothers and their children tracks maternal resource allocation decisions between investment in current versus future offspring.

Control of investment (e.g. nursing) in non-industrial societies generally lies in the hands of the mother. Weaning practices among the Bofi and Turkana, for example, involve the application of substances to the mother’s nipples to discourage nursing (e.g., Fouts, et. al. 2000; Gray, 1995). An additional tactic used by the Turkana is to simply leave the child in the care of alloparents for durations from a few hours to a few days, with the mother often leaving the camp entirely. Although the effect of supply on demand (ESD) was not measured among the Turkana, evidence from the Bofi and from the Karo Batak of Indonesia (Kushnick, 2008) suggest that two ESD mechanisms can occur. Among the Bofi, infant fussiness was greater when weaning was more abrupt, suggesting that reduction in supply leads to increased demand. Among the Karo Batak, however, a positive relationship was found between provisioning and infant fussiness, where longer periods of suckling were followed by longer periods of fussing. Thus, the ESD associated with human lactation may show a complex pattern, and possibly change depending on the phase of weaning.

Finally, ecological and social contexts influence the timing of weaning and subsequent parent-child conflict. The availability of non-breast-milk foods and their cost, maternal workload, social support, and ideology are all related to weaning in pre-industrial societies (McDade and Worthman, 1998). In total, socioecological factors such as workload and social support influence the benefit-cost ratio of nursing from the mother’s perspective and, through it, weaning processes and parent-child conflict.
Future Directions

An important avenue for future research will be applying POCT to predict individual and cultural variation in the initiation and termination of weaning. Nursing can be highly valuable to infants but, at the same time, has the potential to become highly stressful for both mother and child. It is then important to understand the factors that contribute to variation in nursing behavior (Pickler, 2009). To be certain, applying discoveries about weaning conflict in pre-industrial societies to industrial societies may be complicated. For example, nearly all mothers in pre-industrial societies breastfeed their newborn infants to some degree, due at least in part to the lack of alternatives food sources. In industrial societies however, formula has been marketed as a viable alternative to breastfeeding, and up to 60% of women do not breastfeed at all (Ogbuanu, et al., 2009). Nonetheless, we suggest that some of the same factors that influence the timing of weaning in traditional societies can be fruitfully studied in industrial societies as well. For example, several studies have shown that maternal workload (such as household responsibilities) and caring for other children are predictive of maternal decisions to breastfeed (e.g. Ogbuanu, et al., 2009; Ahluwalia, et al., 2005; Guttman & Zimmerman, 2000). In a POCT perspective, these factors influence the costs of nursing and shift mothers’ allocation decisions between different facets of life history strategies. Thus, applying POCT to this research field can prompt researchers to ask novel questions about the decision to breastfeed. For example, how does the need and fitness of extant children contribute to the decision to breastfeed a new infant?

Another interesting line of future study would be to examine how variance in mating strategies is related to parent-child conflict both across cultures and between
individuals. For example, one could compare the level of conflict in primarily monogamous societies such as the Bofi (Fouts, 2004) with other hunter-gather societies with more promiscuous mating systems. On the one hand, parents are faced with a trade-off between finding mates and investing in their children, as time and energy devoted to finding and maintaining a mate comes at a cost to investing in existing offspring. On the other hand, from the child’s perspective, high promiscuity indicates low parental reproductive interdependence and a higher probability of having half-siblings; thus, children should be selected to solicit more investment and to raise the level of conflict with parents. Fascinating questions arise from this hypothesis. For example, what may be the cues used by children to gain information about their parents’ mating strategies? At which stages of development could parental mating strategy become an important factor in the modulation of parent-offspring conflict? And so on.

**Genetic Relatedness and Family Conflict**

Although weaning can be a time of stress and conflict, human children (unlike many other primates) remain dependent on their parents for many years after their mother stops breastfeeding them. Indeed, parents and other family members fully provide for children at least until the beginning of middle childhood (see Bogin, 1997; Del Giudice, Angeleri & Manera, 2009), and parental investment often continues through adolescence and early adulthood. During childhood, conflict over parental investment takes new forms, extending beyond the dyadic relationship with the mother, and ultimately involves all the members of the family—including siblings. This is why genetic relatedness becomes a major influence on the intensity and resolution of parent-child conflict. Despite the importance of relatedness, very few
studies have used POCT as a framework to investigate its effects in human families (though see Schlomer, Ellis, & Garber, 2010). This is a very promising area of research, and one where major discoveries are probably waiting to be made.

*Step-families*

Generally speaking, conflict within families should be negatively associated with genetic relatedness. Lower genetic relatedness is predicted to increase conflict, and the most dramatic example (though not one directly derived from POCT) is provided by research on step-families. Qualitative differences in the parent-child relationship can be drawn along lines of biological relatedness. For example, parents tend be more warm and engage in more caretaking toward their biological children compared to stepchildren (Hetherington, Henderson, & Reiss, 1999; O’Connor, Dunn, Jenkins, & Rasbash, 2006). Indeed, in a comprehensive study of adolescent family relationships in step-families, Hetherington, et al (1999) report that “A notable finding relating to parent-adolescent relationships in this study was the relative lack of differences in parenting related to being in a stepfamily or a non-stepfamily. Instead, biological relatedness between parent and adolescent was stronger in determining differences in parenting than family type” (p. 83).

Low genetic relatedness between adults and children in the family is associated not only with colder and less involved parenting, but also with a higher probability of neglect, abuse, and homicide toward children. Indeed, a consistent finding in the child abuse literature is that children in stepparent families are at considerably greater risk for neglect and abuse compared to families with two biological parents (e.g., Daly & Wilson, 1988, 2007; Wilson, Daly, & Weghorst, 1980). In addition, young children who live with at least one non-biological parent
(e.g. step, adopted, etc.) are at greater risk for fatal injury (Schnitzer & Ewigman, 2005), regardless of the injury being intentional or not (Tooley, Karakis, Stokes, Ozanne-Smith, 2006) (see Daly & Wilson, 2007, for a detailed review of the “Cinderella effect”). In total, these data indicate that lack of genetic relatedness is associated with dramatically elevated levels of conflict among family members.

**Sibling Competition**

Sibling competition is another domain in which genetic relatedness should substantially affect behavior. From an evolutionary perspective, competition between siblings functions to extract a disproportionate share of investment from parents, and offspring that are better competitors are able to secure more resources. This pattern of sibling rivalry can be expected to emerge most strongly under conditions of resource scarcity (section 3). Because sibling competition is often a zero-sum game, garnering of additional parental resources by more dominant siblings typically results diminished resources for other siblings. Factors such as sibling number, individual offspring’s competitive ability, parental condition and resources, and offspring need influence parental investment in current offspring (see Figure 1) and, through it, the degree of competition between siblings and its outcomes.

As discussed in section 2, in the context of intra-brood competition, greater sibling relatedness can be expected to (1) reduce the intensity of parent-offspring conflict and (2) reduce competition between siblings for parental investment. The basis of these predictions is that convergence versus divergence of sibling interests and parent and offspring optima ultimately depends on shared genes. Consistent with this theorizing, Pollet (2007) reported that adult half siblings showed less social investment in one another (concern for the other, face to face contact) than did full
siblings. In this study, maternal half siblings, who were also likely to be raised together, showed more social investment compared to paternal half siblings, suggesting that both coresidence while growing up and genetic relatedness influence sibling relationships. Another study by Smith (2007) found that monozygotic twins reported more sympathy and compassion and less rivalry, avoidance, and aggression with each other than did dizygotic twins. This result suggests that siblings may possess some (likely unconscious) mechanism allowing them to estimate the genetic relatedness with one another, possibly based on the degree of physical and/or psychological similarity. Finally, in another study conducted in a Mormon polygynist community, sibling solidarity was higher between full biological siblings than half siblings (Jankowiak & Diderich, 2000). This finding was particularly compelling because of the prolonged coresidence of half siblings and the ethos of the community, whose members intentionally sought to downplay genetic differences between children.

More recently, Schlomer et al. (2010) tested the hypothesis that reduced genetic relatedness between siblings would increase conflictual relationships between mothers and their adolescent children. In their study, levels of mother-child conflict were compared between families with and without a half sibling. Children who co-resided with a younger half sibling reported higher levels of conflict with their mothers compared to children without a younger half sibling. This effect persisted net of several family-level control variables, including socioeconomic status, number of co-residing children, parental divorce, and presence of a stepfather. Although these results must be considered tentative pending replication, this is the first human research to document a phenomenon, clearly predicted by POCT, that has been
previously demonstrated in cross-species comparisons of birds (Briskie, et al., 1994): That decreasing offspring relatedness increases offspring solicitation/demand for parental investment.

**Future Directions**

There is still a lot to learn about the effects of relatedness on family conflict. POCT could be fruitfully adopted by developmental researchers, both as a tool to generate new predictions and as a general framework for interpreting and connecting the empirical findings. Although the effects of sibling relatedness have been investigated in a number of recent studies (see above), it is still unknown how children estimate relatedness and what cues they use. Potentially, relatedness cues could come from parents’ behavior, as well as from other, less explicit sources such as physical similarity and olfactory cues. These factors have been shown to influence fathers’ behavior toward their children (e.g., Apicella & Marlowe, 2004, 2007; Burch & Gallup, 2000; Volk & Quinsey, 2007), but may be just as relevant to sibling relationships. Lastly, while studies of genetic relatedness between siblings suggest that half-sibling relationships are less cohesive than full sibling relationships, there is dearth of research trying to unpack the processes underlying these relationships. For example, much research has been conducted regarding sibling rivalry (e.g. Buhrmester, 1992; Buhrmester & Furman, 1992; Cicirelli, 1995; Dunn, Slomkowski, & Beardsall, 1994); however, POCT is not about rivalry *per se* but rather about competition for parental investment. So, in addition to overt rivalry, half-siblings may compete more for parental attention as well as being more sensitive to asymmetries in investment and parental favoritism.
While relatedness between siblings should mainly affect intra-brood competition, competition between present and future siblings (inter-brood) is expected to depend on the interdependence between parents. However, this parameter has been so far neglected in POCT-inspired research. Many interesting research questions may arise from consideration of parent interdependence, both at the level of cultural or social groups (e.g., how do different mating systems and/or different levels of partner availability affect parent-child conflict?) and at the level of individual families. Do parents adjust their behavior according to their perceived interdependence? Do children make (conscious or unconscious) estimates of the interdependence between their own parents, and if so, what cues do they use to that end? Does overt conflict between parents modulate parent-child conflict by providing children with cues of low interdependence? And so on.

**Parent-Offspring Conflict over Mating**

In many hunter-gatherer societies parents play a major role in choosing mates for their children. In many societies parents arrange marriages (or other close kin do) and in others children choose their own mate but must gain their parents approval before they are allowed to wed (Apostolou, 2007a). Thus, parental influence on their children’s mate choice has long been a part of the evolutionary history of our species. Because parents exert control over their children’s mate choice, it is expected that parents will value characteristics in an in-law that benefit their own inclusive fitness rather than the inclusive fitness of their children. Since parents choose in-laws based on their own inclusive fitness interests, disagreements over the importance of characteristics of a potential long-term mate are expected to manifest between parents and their children (Apostolou, 2007b). Consider the following scenario: a parent (A)
has a child (B) who in turn has her own children (C) she had with a partner that she chose. Because parent (A) is only 25% related to any children (C; i.e. their grandchildren) the importance of specific characteristics of their child’s (B) partner will be less than that of their child (B). This is because child (B) is related to her children (C) by 50% compared to 25% (Apostolou, 2008b). It is important to note however that overall the parent and child preferred characteristics are highly correlated, but it is the relative value of some characteristics that differ between parents and children. Indeed, children tend to value characteristics indicative of heritable genetic quality while parents value characteristics that indicate investment, cooperation with the in-group, and family background (Apostolou, 2008a; Buunk, 2008a). In research on parental mate preferences Apostolou (2008b) found that parents are more willing to trade-off physical attractiveness (a marker of genetic quality; Thornhill & Gangestad 1993; Thornhill & Møller, 1997) in a partner for their children compared to a partner for themselves. This is because genetic quality of their child’s partner has no direct inclusive fitness benefit to the parent. In addition, when choosing a mate for their child, parents are less willing to trade-off quality family background and social status compared to choosing a mate for themselves (Apostolou, 2008a). Parents tend to prefer family background and social status of an in-law because of the potential to gain resources as a result of their child’s union. These resources may then use to invest in relatives that are more closely related to them than their grandchildren would be, and thus enhance their own inclusive fitness.

Among hunter-gatherers, when choosing a son-in-law, parents typically choose someone who is hard working, a good provider, a good hunter, and/or comes from a good family. When choosing a daughter-in-law parents look for a hard worker
and one from a good family. Generally, physical attractiveness is not a part of parental preferences of in-law children in these societies (Apostolou, 2007a). Parental preferences for characteristics in an in-law are also moderated by the gender of the in-law. For example, in the case of a son-in-law parents prefer characteristics such as industry, ambition, education, intelligence, and financial prospects more so than for a daughter-in-law. Conversely, preferred characteristics of a daughter-in-law include housekeeping, cooking, chastity, and attractiveness. Interestingly, wealth for a son-in-law ranks low in the hierarchy of preferred characteristics suggesting that the wealth of a son-in-law is not as important as his capacity to generate resources (Apostolou, 2007b). This small but developing area of research suggests that parents prefer characteristics in their in-laws that differ somewhat from the preferred characteristics of the child.

Future Directions

One critique of this literature is that it is all based on self-report of one individual. That is, the typical research design employs a questionnaire format and participants are asked to compare the suitableness of marriage partner characteristics for the participant themselves versus the participant’s child. Additional research is needed to independently compare the preferences of children and their parents. In addition, ratings were based on an artificial scenario given to the parents where they were instructed to imagine that they lived in a society with arranged marriages. Additional research examining the characteristics of actual long-term mates of children would be compelling. Furthermore, parental preference for family background and social status is based on the logic that parents can use resources gained from their child’s marriage to enhance their own inclusive fitness. Differences
in preferences may be observed when investment in other closely related individuals cannot impact their fitness, such as in unpredictable environments (Ellis, et al., 2009). Additional research should examine the instances and extent of conflict that parents and their children experience over the mating choices of the children, the tactics that parents employ to influence their children’s mating decisions, and the counter tactics that children employ to buffer their parents’ influence.

Genomic Imprinting

So far, we have discussed how the logic of parent-offspring conflict has been applied to individuals such as mothers, offspring, and siblings. David Haig (1997) was the first to realize that conflicts about parental investment can arise not only between parents and offspring, but also between different genes within the same offspring—specifically, between genes inherited from the mother and genes inherited from the father. This form of intragenomic conflict (i.e., conflict between different genes in the same individual’s genome) derives from the special characteristics of imprinted genes, and its evolutionary implications are spelled out in the “kinship theory” of genomic imprinting (Haig, 1997, 2004; Wilkins & Haig, 2003).

The Kinship Theory of Imprinting

A gene is said to be imprinted if its expression depends on its parent of origin, i.e., on whether it was contained in an ovum or a sperm. For example, the IGF2 gene (coding an important growth factor; see below) is paternally expressed in humans, and its homologues are paternally expressed in various mammals including rats, mice and sheep (see Haig, 2004). This means that although every individual inherits two copies of the gene (one from each parent), only the paternally derived copy is actually expressed, while the maternally derived one is silenced and has no effect on the
organism’s development. Gene silencing is accomplished through reversible epigenetic mechanisms, usually by DNA methylation and histone modification; complex imprinting patterns can be observed as, for example, some genes show parent-specific expression only in specific cell types or only during certain phases of development. To date, imprinted genes have been found only in mammals and angiosperm plants; according to current estimates, less than 1% of the mammalian genome is imprinted (see Bartolomei & Tilghman, 1997; Wilkins, 2008).

Let us consider parent-offspring conflict from the perspective of imprinted genes. A maternally derived allele in the offspring has a 50% probability of ending up in a future sibling. But if there is any degree of multiple paternity, the same probability for a paternally derived allele will be lower than 50% (possibly much lower). In other words, the relatedness between siblings is asymmetric when one looks at the maternal and paternal halves of the genome. For non-imprinted autosomal genes, this hardly matters because they carry no information whatsoever about their parent of origin. For imprinted genes, however, this phenomenon has remarkable implications: Because a paternally expressed gene is (on average) less strongly related to future siblings than its maternally expressed counterparts, it can be expected to discount the well-being of future siblings at the benefit of the individual offspring. Thus, paternally expressed genes are expected to “side” with the offspring in the regulation of maternal investment, and to evolve so as to increase the transfer of maternal resources to the offspring (for example, by increasing its fetal growth rate). Maternally expressed genes are expected to evolve in the opposite direction, thus inhibiting the transfer of maternal resources to the offspring. The intensity of conflict between maternally and paternally expressed genes is expected to increase with
increasing likelihood of multiple paternity, and can be completely avoided only in truly monogamous mating systems (which are exceedingly rare)\(^2\).

In its original formulation, the kinship theory of imprinting was essentially concerned with inter-brood sibling competition. Haig and Wilkins (2000) extended the model to cover intra-brood competition. They showed that paternally expressed genes should increase offspring solicitation/demand for parental investment if increased demand reduces the amount of resources to be divided between siblings but increases the share received by those offspring that are more demanding. In contrast, maternally expressed genes should evolve in the opposite direction and tend to reduce offspring solicitation/demand for parental investment if this reduction causes all siblings to be better off. In summary, the kinship theory of imprinting predicts that paternally expressed genes will evolve as “resource enhancers,” increasing maternal investment toward the individual offspring; they are also expected to increase the severity of sibling competition for parental investment. On the contrary, maternally expressed genes should become “resource inhibitors” and reduce the individual offspring’s demands in order to favor siblings as a group. The tug-of-war between maternally and paternally imprinted genes is expected to lead to costly manifestations of conflict, either at the physiological or behavioral level.

While the kinship theory of imprinting can be easily applied to parent-offspring conflict, its scope is not limited to interactions with parents and siblings; indeed, the effects of asymmetric relatedness potentially extend to any interaction with patrilineal

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\(^2\) For the purposes of the present paper we focus on the “weak” version of the kinship theory of imprinting, concerning the effects of selection on genes that (for whatever reason) show parent-specific expression. The “strong” version of the theory goes further and maintains that kinship relations actually explain the evolution of parent-specific expression, with imprinting evolving as an adaptive strategy in presence of asymmetric relatedness (see Haig, 2004).
versus matrilineal kin (e.g., to relations with paternal vs. maternal grandparents). For example, in a species where males disperse and juveniles live together with their matrilineal (female) relatives until maturity, maternal genes can be expected to evolve as to favor highly cooperative and altruistic behaviors in juveniles. To date, however, most empirical applications have focused on mother-offspring interactions and, in particular, with the conflicts involved in the regulation of maternal investment during pregnancy.

Imprinted Genes and Prenatal Conflicts

In the previous section we reviewed some of the mechanisms involved in maternal-fetal conflict over investment and discussed how the fetus can attempt to manipulate maternal physiology in order to increase resource transfer beyond the maternal optimum. Not surprisingly, many imprinted genes are critically involved in the regulation of fetal growth. In humans, the insulin-like growth factor II gene (IGF2) is paternally expressed and promotes fetal growth; IGF2 over-expression results in overgrowth symptoms and is associated with the Beckwith-Wiedemann syndrome, a pathological condition involving prenatal overgrowth and enlarged placenta. Another gene, H19, is maternally expressed and has opposite growth-inhibitory effects. H19 produces a noncoding RNA that apparently acts by suppressing IGF2 expression, thus providing an example of direct antagonism between a paternally and a maternally expressed gene. In mice (but not in humans), the IGF-II receptor gene (Igf2r) is maternally expressed and behaves in a similarly antagonistic way: The IGF-II receptor promotes the degradation of paternally expressed IGF-II. Another growth-related gene in humans (and mice) is the maternally expressed IPL, which is highly expressed in the placenta and, if
inactivated, results in placental overgrowth. Several other imprinted genes are expressed during fetal development, although their function (and their possible relationship to the kinship theory) is presently less clear (reviewed in Haig, 2004).

As discussed in the previous section, maternal hypertension and pre-eclampsia can sometimes be interpreted as the result of mother-fetus conflict over blood supply. A gene associated with pre-eclampsia, \textit{STOX1}, has been suspected for some time to be imprinted and maternally expressed (e.g., Arngrimsson, 2005; Úbeda & Wilkins, 2008). Recent analyses have cast doubts on the possibility that \textit{STOX1} itself is imprinted, but \textit{STOX1} is a transcription factor that regulates several other genes, at least one of which (\textit{CTNNA3}) is known to be imprinted (see Oudejans & van Dijk, 2008). Thus, parent-specific expression may be involved in the physiological regulation of fetal blood supply.

Finally, placental hormones probably constitute the main channels for fetal manipulation (see above). Formal modeling by Haig (1996) indicates that if hormones can be used by the fetus as a way of manipulating maternal physiology, and if there is some degree of multiple paternity between successive offspring, we should sometimes expect fetal hormones to be produced (or up-regulated) by paternally expressed genes. This is especially true when species give birth to singletons (as humans typically do), so that all the relevant conflict is inter-brood and the benefits of hormonal manipulation do not have to be shared with siblings. In addition, multiple paternity \textit{within} litters should reduce fetal manipulation and render the evolution of paternally-biased expression less likely. While there is still little research on the imprinting status of placental hormones, there is indirect evidence that the gene coding for the \(\beta\)-subunit of hCG may be imprinted and paternally expressed (Goshen, Gonik, de Groot,
& Hochberg, 1994). This is an important finding, given that hCG participates in several physiological pathways potentially related to prenatal conflict (e.g., spontaneous abortion, pregnancy sickness), and seems to act as a maximizer of maternal investment during pregnancy.

*Genomic Imprinting After Birth*

While several imprinted genes are involved in fetal and placental development, many of them are active after birth, with a substantial subset being expressed in the brain (Davies, Isles & Wilkinson, 2005; Isles, Davies & Wilkinson, 2006). This suggests that imprinted genes may continue to participate in the regulation of parent-offspring conflict by affecting infant and child behavior. Likely targets of genetic action are hunger and food preferences, but several other behaviors can potentially act as resource enhancers/inhibitors, including crying, attention-seeking, emotional dysregulation, dependency, and so on (Brown & Consedine, 2004; Isles et al., 2006). Indirect evidence suggests that imprinted genes are probably involved in the regulation of critical neurotransmitter systems such as dopamine, serotonin, and GABA. Even more intriguingly, there are cues that imprinted genes may exert an impact on the oxytocin and vasopressin systems, which are crucially involved in the neurobiology of parent-child attachment and adult couple formation (Davies, Lynn, Relkovic & Wilkinson, 2008) At present, most of the empirical evidence for behavioral effects of imprinted genes in humans comes from the study of two imprinting-related syndromes caused by mutations or deletions on the long arm of chromosome 15, Angelman Syndrome (AS) and Prader-Willi Syndrome (PWS). These syndromes result from opposite patterns of genetic disruption and, as predicted by the kinship theory, show largely opposite phenotypes that relate to different levels
of infant demand. AS (due to paternal over-expression and/or maternal under-expression) is associated with enhanced activity, prolonged suckling, bouts of laughter and sleeping problems; on the contrary, PWS (due to maternal over-expression and/or paternal under-expression) includes reduced activity, poor suckling, undergrowth, weak crying and sleepiness (all traits that reduce demands on the mother). In PWS, hunger regulation changes dramatically after infancy, with PWS-affected children developing insatiable appetite and often becoming obese (see Brown & Consedine, 2004; Crespi & Badcock, 2008; Haig & Warthon, 2003; Úbeda, 2008). A possible evolutionary explanation for this phenotypic inversion is that the child’s growing appetite for other kinds of food reduces consumption of breast milk, thus lowering the metabolic burden on the mother (Haig & Wharton, 2003). Another interpretation comes from the “generalized kinship theory” developed by Úbeda (2008), which extends the predictions of the kinship theory to mating systems where fathers provide parental investment in addition to mothers. In such species (humans included), the effects associated to imprinted genes can be expected to reverse after weaning, with paternally expressed genes reducing offspring demands and maternally expressed genes increasing them.

The psychological implications of imprinting could be even more wide-ranging than suggested by the above sketch. Recently, Crespi and Badcock (2008; Badcock, 2009) argued that genomic imprinting can help explain the evolution of the human brain and the origin of some important psychological disorders. They reviewed a large body of evidence linking imprinted genes to the etiology of autism and psychosis, and proposed that autistic-spectrum conditions are associated with a “paternally biased” pattern of brain development (i.e., over-expression of paternal genes and/or under-
expression of maternal genes), while psychotic-spectrum syndromes would be associated to a “maternally biased” development. Although Crespi and Badcock’s model is still speculative in some respects, it holds considerable promise for an integrated evolutionary theory of psychopathology, and may be useful to understand normal variation in personality as well (see Del Giudice, Angeleri, Brizio & Elena, 2010, for an extended version of the model). A better understanding of the genetic and epigenetic basis of autism and psychosis may also permit the development of improved methods for the early diagnosis and treatment of these conditions.

Future Directions

The idea that infant and child behavior is shaped by the action of imprinted genes opens up exciting avenues for research at the interface of developmental psychology, developmental neurobiology, and behavior genetics. First, understanding the mechanisms and function of imprinting will likely shed light on the genetic basis of parent-offspring conflict and on its regulation at the neural and physiological level. Second, the study of genomic imprinting could grant researchers a deeper understanding of the dynamics of gene-environment interactions in development (see Meaney, 2010). Genomic imprinting is a kind of epigenetic modification (i.e., a reversible modification that affects genetic expression without altering the DNA sequence); for this reason, imprinted genes can – in principle – evolve the ability to respond to environmental factors and could participate in the regulation of individual plasticity and in the inter-generational transmission of information about local environmental conditions. One can speculate that specific environmental and social cues (relating for example to mating systems, resource levels, or parental conflict) might affect the imprinting status of some genes during development, thus increasing
or reducing the intensity of conflict between the paternal and maternal genome. At the same time, individual variation in the sequence of imprinted genes (and/or in the genes coding for the imprinting machinery) may shift the balance between maternal and paternal expression, thus contributing to the development of individual differences personality and social behavior.

Human family life is complex, and parental investment in our species can extend for very long periods of time (in the order of decades) and even through multiple generations. For this reason, it is reasonable to anticipate that imprinted genes will be found to be involved in a wide range of key areas of development including parent-child attachment, adolescent conflict, and even the development of sexual and mating behavior (Del Giudice et al., 2010; Úbeda & Gardner, 2010). Haig (2010) recently proposed that imprinted genes could have been conspicuously involved in the evolution of several key features of human life history, such as early weaning and slow childhood growth. Clearly, the study of family conflict within the genome holds considerable promise for the future of developmental psychology and for its further integration with the biological sciences.

Conclusions

Parent-offspring conflict theory provides a powerful framework for understanding conflict between parents and their children. The utility of the theory is not only in its evolutionary-developmental focus, but in its ability to tie together many different findings across developmental periods. In biology, the utility of the theory has been well recognized and has even been referred to as one of the crown jewels in sociobiology (Bateson, 1994). Unfortunately, this theory has received little attention in the social sciences. We suggest that this may be due, in part, to two possible
reasons: 1) lack of exposure to the theory and 2) the relative complexity of the theory. In this article we have attempted to expose social scientists to this theory by providing a clear description of the theory and how it has and can be used to understand human parent-child conflict.

To summarize, POCT models come in two main varieties: 1) battleground models and 2) resolution models. Battleground models describe the conflict landscape by quantifying within-family conflict and identifying ecological characteristics that predict conflict. Central to battleground models are intrabrood and interbrood sibling competition. Intrabrood competition refers to competition between existing siblings. With intrabrood competition the parameter predictive of conflict is the relatedness between siblings with greater conflict at lower relatedness. In interbrood competition, siblings are competing with yet unborn or future offspring. In this situation the predictive parameter is not genetic relatedness between siblings but rather the interdependence between parents. When interdependence is low, the probability of future siblings being full siblings is low, thus conflict is high. In addition, when interdependence is low, greater intersexual competition exists between parents and thus overall investment levels in offspring may be low. Conflict is expected to be particularly intense when interdependence is low due to the confluence of these two factors.

Resolution models on the other hand deal with the expected outcome of conflict between parents and depend primarily on the empirical functions of the parent-child relationship. These functions are the effect of demand on supply (EDS) and the effect of supply on demand (ESD). The critical parameter in resolutions
models is ESD and all three functions (positive, negative, and neutral) have been found in nature.

In addition to these general models of parent-child conflict, models of parent-child co-adaptation will provide improvements and updates regarding these mathematical models as we begin to understand more about the genetics behind parental investment and offspring solicitation.

The models of parent-offspring conflict described are limited in the number of factors that are theoretically relevant when predicting conflict between parents and their children. In this paper we more fully describe the factors that converge to predict parental investment in offspring as well as expected conflict as a result of this variation (Figure 1). It is our hope that future researchers will apply this model to better understand different aspects of the parent child relationship.

Nonetheless, POCT models have already been applied in a variety of topics including prenatal conflict, weaning conflict, family composition, parent-offspring conflict over mating and genomic imprinting. Parent-offspring conflict models provide integrative explanation for sets of seemingly unrelated findings as well as provides a framework for deriving additional novel hypothesis about the parent-child relationship across developmental epochs. This theory has already provided significant advancements in some areas of social research, and has the potential to impact human social science research in a way characteristic of the biological sciences.

In conclusion, we have sought in this paper to accomplish several goals: 1) to introduce POCT to an audience with limited exposure to the theory, 2) to clearly elucidate the principals and theoretical tenets of POCT, 3) provide examples of areas
where POCT has been successfully applied, and 4) convince readers that much can yet be discovered by applying POCT to human families. In addition, we have put forth specific hypotheses about conflict between parents and their children derived from POCT as well as provided a model for which additional hypothesis can be derived. It is our hope that social science researchers interested in studying parent-child dynamics will see the value of the evolutionary developmental perspective that POCT provides and incorporate this perspective into their own research.
Figure 1. Factors regulating parental investment and offspring demand. Dotted lines indicate moderator effects. The pattern of relations depicted in this figure is explicated in section 3. EDS: Effect of demand on supply; ESD: Effect of supply on demand.
CHAPTER III. MANSCRIPT II.

MOTHER-CHILD CONFLICT AND SIBLING RELATEDNESS:
A TEST OF HYPOTHESES FROM PARENT-OFFSPRING CONFLICT THEORY

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Introduction

Parents are equally genetically related (50%) to each of their biological offspring. All else being equal, therefore, parents can maximize their inclusive fitness by investing equally in each of their offspring. By contrast, children are 100% related to themselves but only 50% related to each of their full biological siblings. Consequently, the developing child has a greater genetic stake (fitness interest) in themselves than in any given sibling. POCT thus posits that children have been selected to demand a greater (disproportionate) share of parental investment than parents have been selected to give (Trivers, 1974), and that conflict between parents and children over parental investment will occur to the extent that the genetic interests of the parents and children diverge.

One implication of this theory is that, in multiple sibling families, parents and children will conflict over the amounts of investment allocated to each child. Consider the case of a two sibling family. Presuming that Siblings A and B are of equal reproductive value, parents can maximize their fitness by distributing investment equally between them. By contrast, Sibling A can maximize her fitness by monopolizing parental investment until her marginal gains fall to half that of Sibling B (if Sibling B is a full
sibling with whom she shares 50% of her genes) or to one-fourth that of Sibling B (if Sibling B is a half sibling with whom she shares 25% of her genes) (Parker, Royle, & Hartley, 2002). Thus, in multiple sibling families, the amount of parental investment per child that maximizes parental fitness (the parental optimum) is always less than the amount that maximizes a given child’s fitness (the offspring optimum), resulting in parent-child conflict.

Because parental and offspring optima diverge more in relation to half siblings than full siblings, there are greater conflicts of interest over parental investment in half than full siblings. A derivation of POCT, therefore, is that the introduction of younger half siblings into the home will generate higher levels of conflict between extant children and their custodial biological parents than will the introduction of younger full siblings. This theorizing is consistent with past research documenting greater feelings of solidarity among full than half siblings, even in families where maternal half siblings are raised together like full siblings (Pollet, 2007), and even in polygamous communities where cultural norms downplay genetic differences and actively promote solidarity between full and half siblings (Jankowiak & Diderich, 2000).

It is important to note that POCT concerns selective forces that operated over evolutionary time on parental and child motives and behavior. Genetic asymmetries within families (i.e., differences in biological relatedness) are not a proximate causal factor in the theory, magically inducing different levels of POC. Rather, such differences should only occur to the degree that (1) the full sibling/half sibling contrast was selectively significant in human evolution (which is mathematically inevitable), (2) this
contrast was signaled by reliable cues or family events, which ancestral children evolved to detect and respond to (e.g., birth of new child to mother and stepfather; heavy investment of mother and stepfather in new child to detriment of the incumbent child), and (3) those cues persist in modern environments.

**Parental Disruption**

From the perspective of POCT, an important distinction is between *parentally intact* and *parentally disrupted* families. Children born and raised in a home with both of their biological parents are defined as parentally intact. By contrast, children who spend some or all of their childhood in a home without both biological parents are parentally disrupted. According to this definition, parentally intact families can include older half siblings from a previous marriage.

Parentally disrupted families encompass both children who are born into single-mother families and children who experience the divorce/separation of their biological parents. In parentally disrupted families, a number of processes operate to reduce the ability and/or willingness of parents to invest time, energy, and resources in their children. (Parental death also results in loss of parental investment, but the extent of this loss and the intervening mechanisms through which parental death affects investment in children have been less adequately studied). Divorce frequently results in greatly diminished contact between children and noncustodial parents (usually the fathers) (e.g., Fox & Kelly, 1995; Furstenberg, Nord, & Peterson, 1983). At the same time, divorced custodial parents (usually mothers), as well as never-married mothers, tend to provide lower quality parental investment compared with married parents (i.e., they spend less
time with their children, provide less emotional support, have fewer rules, dispense harsher discipline, engage in less parental monitoring and supervision, and have more conflict with their children; e.g., Amato, 2000; Astone & McLanahan, 1991; Chilcoat, Breslau, & Anthony, 1996; Hetherington & Clingempeel, 1992; McLanahan & Sandefur, 1994). Further, many children experience a decline in economic and community resources following divorce (e.g., Amato, 2000; McLanahan & Teitler, 1999). This may include economic hardship, movement into poorer neighborhoods, enrollment of children in inferior schools, decreases in the quality and availability of after-school programs, and so forth.

In summary, from the child’s perspective, parental disruption may translate into substantial reductions in levels and quality of maternal investment and associated economic and community resources. According to POCT, therefore, children in parentally disrupted families should report higher levels of conflict with their custodial mothers than will children in parentally intact families. Although this prediction is not unique to POCT (e.g., it is also consistent with Family Systems Theory) and has been tested and supported in past research (i.e., conflict between parents and their children tends to be more frequent and intense in divorced families; e.g., Baer, 1999; Hetherington & Clingempeel, 1992; Hetherington et al., 1999; Laursen, 2005), POCT provides a different explanation for this phenomenon that has unique implications for mediating mechanisms.

As a requisite first step in the current study, we attempted to replicate the well-established effect of parental disruption on parent-child conflict. The primary purpose of
the present study, however, is to attempt to explain this finding in terms of a newly proposed mediating mechanism unique to POCT: entrance of younger half siblings into the family.

Mediating Effects of Younger Half Siblings

As discussed above, POCT posits that the entry of younger half siblings into the family will be a major source of conflict between extant children and custodial biological parents. POCT thus generates the following novel prediction: The effects of parental disruption on levels of conflict between the custodial biological parent and his/her extant children (i.e., children who preceded the parental disruption) will be mediated by the custodial biological parent subsequently having new children (i.e., by the entry of younger half siblings into the home). This specific prediction has not been generated or tested in past research.

POCT does not posit full mediation, however. Because parental disruption generally results in substantial loss of parental investment, parental disruption should elevate parent-child conflict, regardless of whether new half siblings come into the family. In total, the theory predicts partial mediation: some of the effects of parental disruption on parent-child conflict should be accounted for by the entrance of younger half siblings into the home.

Stepfathers

As discussed above, parental disruption increases conflict between custodial mothers and their biological children for several reasons. A relevant question is whether the entry of a stepfather increases this conflict above and beyond the effects of parental
disruption. According to POCT, to the extent that the presence of a stepfather causes additional loss of maternal investment, over and above the loss sustained as a result of parental disruption, stepfather presence should increase conflict between custodial mothers and their biological children. Stated differently, if children living in biological-mother/stepfather homes tend to receive less maternal investment than do children living in single-biological-mother homes, then stepfather presence should increment the prediction of mother-child conflict.

We do not expect this net loss to occur, however. Remarriage generally increases the financial well-being of single mothers and their children (Amato & Sobolewski, 2004). For example, the median income of stepfather families is more than double that of single-mother families (McLanahan & Sandefur, 1994). This increased financial capital not only increases the ability of mothers to provide their children with such tangible resources as better food and medical care, residence in safer neighborhoods, and access to higher quality schools, but also may reduce the number of hours that mothers need to work outside of the home, thereby making them more available to their children. Nonetheless, this economically-based increase in the quality and quantity of maternal investment may be offset by reallocation of the mother’s time and energy away from parenting toward maintenance of her new marital relationship. Because the child is genetically unrelated to the stepfather, the child and stepfather are in direct competition for the time, energy, and resources of the mother/wife, and this competition is a zero-sum game. The result is a trade-off between allocation of the mother’s effort to the stepfather and her parental investments in the child.
In total, the effects of stepfathers on the quality and quantity of maternal investment in biological offspring may be a net wash. This perspective is consistent with past research indicating that children in stepfamilies do not differ from children in divorced, single-mother families in internalizing or externalizing problems, academic achievement, self-esteem, or overall adjustment (Amato, 1987; Ganong & Coleman, 1993; Jeynes, 2006). Accordingly, we do not expect the entry of a stepfather into the home to mediate the effects of parental disruption on levels of conflict between custodial mothers and their extant offspring, unless the entry of the stepfather is followed by the subsequent birth of a half sibling.

Overview of Study

The current study tested hypotheses derived from POCT concerning the effects of younger siblings and family composition on parent-child conflict. Children’s perceptions of conflict with their biological mothers were prospectively assessed over the middle school years (6th, 7th, and 8th grades) in a community sample of families participating in a longitudinal study of adjustment in young adolescents who varied in risk for psychopathology (based on maternal histories of depression). We focused on children’s perceptions of conflict because the theory specifies that the introduction of younger half siblings into a family presents special issues for extant children (i.e., conflicts over allocations of parental investment). All children lived with their biological mothers; some lived in parentally intact families, whereas others lived in parentally disrupted families. Of those in parentally disrupted families, some experienced the entry of younger half siblings and/or stepfathers/mothers’ boyfriends into their home. (Unfortunately, there
were not enough children with stepsiblings to also test for their effects). Potential confounding factors that covary with family composition and may influence parent-child conflict—family socioeconomic status, maternal history of mood disorders (i.e., risk), and family size—were controlled in the analyses. Family size was especially important to adjust for because it enabled us to test the effects of half siblings independent of the effects of sibling number.

Method

Participants

Participants were enrolled in a longitudinal study of young adolescents. A high-risk research design, similar to that of Beardslee et al. (1988), Hammen (1991), and Radke-Yarrow (1998), was used in which mothers with histories of depressive disorders were over-sampled in order to obtain greater variability in the constructs of interest (i.e., mother-child conflict, marital disruption). The sample consisted of 240 children and their mothers. Four target children were excluded from the analyses because they lived in a home with either only stepsiblings, adoptive siblings, or other unrelated children. The analytic sample used in this study thus consisted of 236 children and their biological mothers. Of the 236 children, 110 (46.6%) were male and 126 (53.4%) were female with a mean age at first assessment of 11.86 years ($SD = .56$, $range = 11-14$). Approximately 82% were European American, 14% were African American, and 4% were classified as other (Hispanic, Asian, Native American).

Procedure
Parents of fifth grade children from metropolitan public schools were invited to participate in a study about parents and children. A brief health history questionnaire was sent with a letter describing the project to over 3,500 families. Of the 1,495 mothers who indicated an interest in participating, the 587 who had endorsed either a history of depression, use of antidepressants, or no history of psychopathology were screened further by telephone. The remaining families were excluded because the mother did not indicate depression, reported only nonaffective psychiatric disorders, or indicated other kinds of serious health problems (e.g., cancer, multiple sclerosis). On the basis of the screening calls of the 587 families, 349 had mothers who reported either a history of depression or no history of psychiatric problems. The 238 families not further screened were excluded because they did not indicate sufficient symptoms to meet criteria for a depressive disorder (38%), had other psychiatric disorders that did not also include a depressive disorder (19%), they or the target child had a serious medical condition (14%), were no longer interested (21%), the target child was in the wrong grade or class (6%), or the family had moved out of the area (2%). The Structured Clinical Interview for DSM diagnoses (SCID; Spitzer, Williams, Gibbon, & First, 1990) then was conducted with the 349 mothers who had indicated that they had had a history of some depression or had had no psychiatric problems. Based on the SCID, 185 mothers (high risk) indicating a history of a mood disorder (e.g., Major Depressive Disorder, Dysthymia) and 55 reporting no lifetime history of a psychiatric disorder (low-risk) were retained in the study. The final analytic sample employed in the current analyses included 181 mothers from the high risk group and the 55 mothers in the low risk group.
A research assistant who was unaware of the mothers’ psychiatric history individually administered a battery of questionnaires to mothers and adolescents separately. Adolescents were first assessed when they were in 6th grade and re-evaluated annually in grades 7 and 8. All predictor variables in the analyses were taken from the 6th grade (Time 1) evaluation. Data from all three waves were used to construct the main outcome variable: mother-child conflict. Only those measures relevant to the current study are described here.

*Measures of Mother-Child Conflict.*

The Conflict Behavior Questionnaire (CBQ; Prinz, Foster, Kent, & O’Leary, 1979) was used to assess children’s perceived levels of conflict with their mothers. The CBQ contains 20 items answered using a true-false response format. It is designed to tap two sources of conflict between children and their mothers: (1) dissatisfaction with the mother’s behavior and (2) evaluations of interactions between the mother and child. Example items include “My mom seems to be always complaining about me” and “At least once a day we get angry at each other.” The CBQ has demonstrated high internal consistency, reliability, and good predictive validity (see Foster & Robin, 1988; Maguen & Armistead, 2006; Prinz et al., 1979).

For the evaluations in grades 7 and 8, 14.3% and 19.6%, respectively, of the Time 1 participants were missing data for the CBQ due to attrition. The missing and retained families did not significantly differ in child gender, child race, family size, rates of family disruption, or frequency of half siblings or stepfathers, but missing families were more likely to have a depressed mother (86.8% vs. 73.7%; $\chi^2 [1] = 3.90, p < .05$) and be lower
SES (Hollingshead Index: $M = 39.17$ vs. $43.23$; $t [222] = 1.99, p < .05$) at baseline. In order to utilize the full sample of 236 children for the subsequent analyses, missing data for the CBQ were imputed using the expectation maximization (EM) algorithm. EM takes into account the total structure of the data and has been shown to be superior to other single imputation methods (such as regression or mean substitution) (see Gold & Bentler, 2000). Imputation did not notably alter means or standard deviations for these measures and had little impact on correlations between these and other measures used in the analyses (see Table 1).

A latent measure of child-reported conflict with the mother in the middle school years was derived through confirmatory factor analysis (CFA) of the three CBQ scores ($\alpha = .74$). CFA reduces the likelihood of capitalizing on chance relations based on shared error variance between mother-child conflict and other variables. The three CBQ scores loaded highly on the latent construct (.80, .87, and .77). A repeated measures ANOVA using the three CBQ scores as a within subjects factor yielded a marginally significant linear trend of increasing conflict over the three time points, $F(1, 235) = 3.77, p < .06$ ($T1: M = 2.78; T2: M = 2.98; T3: M = 3.35$). Despite this linear trend, the three CBQ scores were moderately to strongly correlated with each other ($T1$ and $T2$: $r = .56$; $T2$ and $T3$: $r = .52$; $T1$ and $T3$: $r = .39$; all $ps < .001$). Therefore, although the mean levels of mother-child conflict showed some increase over time, the latent variable consisted of a high degree of extracted common variance for each case across the three years.

*Measures of Family Composition*
Parental disruption. During the initial interview (Time 1), mothers reported on the target child’s immediate family including the number and relationship of individuals co-residing with the child. In all families, the female head of household was the target child’s biological mother.

Children were coded as 0 (parentally intact) if the biological father was reported as the male head of household and 1 (parentally disrupted) if there was no male head of household or if the male head was not the target child’s biological father. Based on these criteria, 127 of the 236 families (53.8%) were coded as parentally disrupted.

Entry of a stepfather into the home. During the Time 1 evaluation, mothers reported on the relation of the male head of household to the target child. Families were coded as having experienced the entry of a stepfather into the home if the mother reported that the male head was the target child’s stepfather or a friend of the target child’s mother (i.e. the mother’s boyfriend); 49/236 families (20.8%) had a stepfather residing in the family with the target child. Entry of a stepfather was coded as a dummy variable.

Entry of a younger half sibling into the home. Based on information about the family constellation obtained at Time 1, families were coded as having experienced the entry of a younger half sibling into the home if the target child was living with at least one younger half sibling. Two target children reported living with both a younger half sibling and a younger full sibling. These cases were classified as younger half sibling families; 26/236 families (11.0%) had younger half siblings. All half siblings were related maternally. Entry of a younger half sibling was coded as a dummy variable.
Younger sibling status. To distinguish between different types of younger siblings, a 3-level variable was created. The categories included: 0 = participants had no younger siblings: 104/236 (44.1%); 1 = participants had younger full siblings only: 106/236 (44.9%); 2 = participants had younger half siblings: 26/236 (11.0%).

Family Control Variables.

Socioeconomic status (SES). Household SES was assessed by the widely used Hollingshead four factor index of social status (Edwards-Hewitt & Gray, 1995; Hollingshead, 1975). To calculate the SES score of a household, scale values for occupation (range from one to nine) and for education (range from one to seven) were multiplied by factor weights of five and three, respectively. These two products then were summed. SES scores were calculated based on information obtained at Time 1. The sample was predominantly lower-middle to middle class with a mean SES score of 41.89 (SD = 13.30) and a range that included the upper and lower bounds of the Hollingshead index (i.e., range = 8-66).

Risk. The Structured Clinical Interview for DSM diagnoses (SCID; Spitzer, Williams, Gibbon, & First, 1990) was used to assess mother’s history of mood disorders. Interviews were audio taped, and inter-rater reliability was calculated on a random subset of 20% of these interviews. Agreement was 94% (kappa=.88) for diagnoses of mood disorders. Following the work of Keller et al. (1986) and Sameroff, Seifer, and Barocas (1983), we created a chronicity/severity index based on the number, duration, and severity of mothers’ depressive episodes. Children’s “risk” was defined in terms of the extent of mother’s history of mood disorders. Using information from the SCID, mothers
were categorized into the following groups: (a) no depression (n = 55) consisted of mothers who had experienced no episodes of depression; (b) mild (n = 47) consisted of mothers who had experienced no more than two episodes of a depressive disorder and had been depressed for no more than 1 year during their child’s life. Depressive episodes for mothers in this group also could not have been associated with psychiatric hospitalization, a suicide attempt, or psychotic features. (c) Moderate (n = 84) included mothers who had one to three depressive episodes and between 1 and 4 years of depression during the child’s life. Also included in this group were mothers who had been depressed less than 1 year but had been hospitalized, made a suicide attempt, or had psychotic features. (d) The severe group (n = 50) consisted of mothers who had more than four episodes or had been depressed more than 4 years during their child’s life. (For more information about these groups, see Frye & Garber, 2005).

*Family size.* Family size was computed to reflect the number of children (including the target child) living in the household at Time 1. Although some of the target children had siblings who lived outside their home, family size was calculated in this way because siblings living in the home of the child were in direct competition for parental investment. Mean family size was 2.36 (SD = 1.05).

**Results**

*Bivariate Relations*

Table 1 presents correlations between the variables in the study. The overall pattern of bivariate relations conforms to expectations and past research; e.g., families with histories of maternal mood disorders (risk) were more likely to have experienced
parental disruption and stepfather presence, evinced higher levels of mother-child conflict, and were lower in SES.

Consistent with POCT, significant zero-order correlations were found between the family composition variables (family disruption, half-sibling presence, stepfather presence) and mother-child conflict (see Table 1). These effects of family composition are systematically evaluated below.

Mother-Child Conflict in Different Family Contexts

Table 2 provides frequencies of the number of target children living in different types of parentally intact and disrupted families, and the means and standard errors for mother-child conflict for each family type, after adjusting for the control variables (i.e., SES, risk, and family size). The mother-child conflict variable was standardized, such that the mean for the sample was 0, and higher scores indicated greater conflict. Of particular interest for the current study are levels of mother-child conflict in parentally disrupted families that include the presence of stepfathers and/or younger half siblings.

Parentally disrupted families without younger half siblings had about average levels of mother-child conflict, regardless of whether a stepfather was present or not. In contrast, parentally disrupted families that included younger half siblings had above average levels of mother-child conflict, regardless of whether a stepfather was present or not. In comparison with all types of parentally disrupted families, parentally intact families had below average levels of mother-child conflict (Table 2).

Half Siblings versus Full Siblings
To test the hypothesis that the entry of younger half siblings into the home predicts greater mother-child conflict than does the entry of younger full siblings, an ANCOVA was conducted. Younger sibling status was employed as the independent variable and the latent measure of mother-child conflict was the dependent variable. The analysis tested for mean differences in mother-child conflict across family types while controlling for appropriate covariates. Specifically, because half and full sibling families are likely to differ in more ways than just the genetic relatedness of offspring, the family control variables (SES, risk, and family size) and parental disruption were entered as covariates. As expected, there was a significant main effect of younger sibling status, $F(2, 229) = 6.23, p < .01$. After adjusting for the covariates, estimated mean levels of mother-child conflict were .01 ($SE = .11$) in families with no younger siblings, -.24 ($SE = .11$) in families with younger full siblings only, and .63 ($SE = .22$) in families with younger half siblings. Planned comparisons based on one-tailed tests indicated that in families with a younger half sibling, adolescents reported significantly higher levels of mother-child conflict compared to families with either no younger siblings ($t = 1.88, p < .05$) or younger full siblings only ($t = 4.04, p < .001$). In total, after adjusting for covariates, mean levels of mother-child conflict were nearly 1 standard deviation higher in families with younger half siblings than in families with younger full siblings.

Tests of the Mediational Model

To test the hypothesis that the effect of parental disruption on mother-child conflict is partially mediated by entry of younger half siblings into the family, a hierarchical regression analysis was conducted. The latent measure of mother-child
conflict was the dependent variable. The three family control variables (SES, risk, and family size) were entered in the first step and parental disruption was entered in the second step. At the first step, only risk significantly predicted mother-child conflict ($\beta = .16, SE = .07; t = 2.32, p < .05$). At the second step, over and above the effects of the family control variables, parental disruption significantly incremented the prediction of mother-child conflict ($\beta = .23, SE = .16; t = 3.15, p < .01; \Delta R^2 = .040$). These data are consistent with the hypothesis that conflict between children and their mothers is elevated in parentally disrupted families.

The presence of younger half siblings was entered in the 3rd step of the hierarchical regression. As shown in step 3 (Table 3), the presence of younger half siblings in the home significantly incremented the prediction of mother-child conflict above and beyond the effects of family size, SES, risk, and parental disruption ($\beta = .22, SE = .24; t = 3.20, p < .01; \Delta R^2 = .040$). Moreover, when the half sibling variable was added to the model, the beta-weight for parental disruption dropped from .23 to .16, resulting in more than a 50% reduction in the squared semipartial correlation, from .040 to .017, which indicates the proportion of variance uniquely accounted for by a single predictor variable in a multiple regression model. Nonetheless, parental disruption remained a significant predictor of mother-child conflict in the multivariate model. These data are consistent with the hypothesis that the presence of half siblings partially mediates the relation between parental disruption and mother-child conflict. However, formal tests of mediation (including tests of the statistical significance of the indirect
effect) could not be conducted because the path between parental disruption and the presence of half siblings could not be estimated (due to the zero cell value problem).

According to Baron and Kenny (1986), four conditions must be satisfied to establish mediation. First, the predictor variable (i.e., parental disruption) must be related to the mediator (younger half siblings). Because parental disruption is a necessary precondition for the presence of younger half siblings (and therefore must predict it), the first condition was satisfied. The second criterion, that the predictor variable is associated with the outcome variable (mother-child conflict) also was satisfied ($\beta = .23, p < .01$). The third criterion is that the mediator predict the outcome variable, and the final criterion is that the inclusion of the mediator in the regression equation reduces the relation between the predictor and outcome variables. These conditions were demonstrated in the final step of the regression analysis (Table 3), wherein half-sibling presence uniquely predicted mother-child conflict and reduced the effect of parental disruption on mother-child conflict. In sum, despite the inability to directly specify a regression coefficient for the path between parental disruption and half-sibling presence (i.e., the first criterion), all of Baron and Kenny’s (1986) conditions for mediation were in fact met.

To explore the potential of stepfather presence as a mediator between parental disruption and mother-child conflict, we conducted a second hierarchical regression analysis. The steps of this hierarchical regression were exactly the same as the steps of the preceding hierarchical regression, except that presence of stepfathers (instead of the presence of younger half siblings) was entered in the 3rd step. As expected, the result of
this analysis showed that stepfather presence did not significantly increment the prediction of mother-child conflict above and beyond the effects of the family control variables and parental disruption ($\beta = .002, SE = .20; t = .03, p = ns$). Moreover, parental disruption remained a significant predictor of mother-child conflict after including stepfather presence in the model. In fact, the beta-weight for parental disruption remained unchanged at $\beta = .23, SE = .18, t = 2.84, p < .01$, with or without inclusion of stepfather presence in the model. Thus, stepfather presence did not mediate the relation between parental disruption and mother-child conflict.

Finally, a standard multiple regression analysis was conducted in which the family control variables, parental disruption, stepfather presence, and younger half sibling presence were entered simultaneously into the equation. As expected, both parental disruption ($\beta = .18, SE = .18, t = 2.32, p < .05$) and younger half sibling presence ($\beta = .24, SE = .25, t = 3.33, p < .001$) continued to significantly predict mother-child conflict, above and beyond the effects of stepfather presence ($\beta = -.07, SE = .20, t = .92, p = ns$) and the family control variables.

Discussion

Parent-offspring conflict theory (POCT; Trivers, 1974) highlights the entrance of half siblings into the family as a special source of conflict between custodial biological parents and their extant children. Several findings from the current study are consistent with this core hypothesis. First, the presence of younger maternal half siblings was associated with substantially higher levels of mother-child conflict than was the presence of younger full siblings; indeed, levels of mother-child conflict were nearly a full
standard deviation higher in the younger half sibling homes, even after controlling for parental disruption, SES, risk, and family size. This finding suggests that younger half siblings in particular, rather than younger siblings in general, are linked with higher levels of mother-child conflict. Second, the presence of younger maternal half siblings partially mediated the effect of parental disruption on mother-child conflict. Controlling for maternal depression, SES, risk, and family size, the presence of younger half siblings accounted for more than half of the covariation between parental disruption and mother-child conflict. Third, the presence of younger half siblings predicted high levels of mother-child conflict, regardless of whether or not a stepfather was present in the home. Thus, the half sibling finding likely was not an artifact of the entrance of an unrelated adult male into the home following parental disruption. In fact, after adjusting for the family control variables and parental disruption, stepfather presence did not further predict mother-child conflict. Thus, consistent with POCT, these findings suggest that the entrance of younger half siblings into the family is a robust source of mother-child conflict in parentally disrupted families.

Because POCT has rarely been tested in human family research, and because no other theoretical framework underscores the effects of half siblings on family relationships, little research has been conducted in this area. A small literature has examined levels of closeness and conflict in full sibling versus half sibling versus stepsibling relationships (Deater-Deckard, Dunn, & Lussier, 2002; Ganong & Coleman, 1993; Jankowiak & Diderich, 2000; Pollet, 2007). Only one published study to our
knowledge, however, has meaningful parallels with the current study. Specifically, Stewart (2005) examined family systems that were initially characterized by a biological parent, a stepparent, and an extant child from the biological parent’s prior relationship, followed by the birth of a half sibling. This research examined the effects of the half sibling on the stepparent-stepchild relationship. The entrance of a half sibling did not have a positive effect on this relationship. Taken together, Stewart’s (2005) results and the present findings suggest that the birth of a younger half sibling challenges relationships between extant older siblings and both residential biological parents and stepparents. Despite the complementarity of these findings, the current study is the first to specifically examine the effects of younger half siblings on the quality of relationships between extant children and custodial biological parents.

Although links between family disruption and parent-child conflict are well-documented in the literature (e.g., Baer, 1999; Hetherington & Clingempeel, 1992; Hetherington et al., 1999; Laursen, 2005), less is known about the mechanisms through which these links occur. In the current study, the presence of younger half siblings in the household partially mediated the effect of parental disruption on children’s reported levels of conflict with their mothers. A possible implication of these results is that it may not be the dissolution of the parental union per se that contributes to the persistence of conflict between mothers and their children in disrupted homes, but rather the tendency for marital dissolution to be followed by the introduction of half siblings into the family. Half siblings are a source of parent-child conflict in parentally disrupted families.
that often emerges years after a divorce has occurred, and thus may account for elevated levels of parent-child conflict long after the new family structure has stabilized.

**POCT versus Family Systems Theory**

From the perspective of POCT, genetic asymmetries within families generate systematic conflicts between parents and their children over allocation of parental investment. The prediction that the introduction of new half siblings will cause greater parent-child conflict than the introduction of new full siblings is a straightforward derivation of POCT (see Trivers, 1974). In contrast, family systems theory (FST; Doherty, & Bambtiste, 1993; Minuchin & Fishman, 1981) does not include biological relatedness in its theoretical tenets. Rather, FST views the family as a collection of integrated subsystems (e.g., marital subsystem, the parent-child subsystem), whereby changes in one subsystem reverberate to affect the family system as a whole. The focus of FST is on how perturbations of the family system create problems within families, how different family subsystems operate and interact, and how alliances across subsystems can affect the system as a whole.

Although FST has never been used to generate hypotheses about specific effects of half siblings, an important question is whether the reach of FST can be extended to accommodate the current half sibling hypothesis? The FST perspective might argue that the introduction of a younger half sibling would create a perturbation in the family system, which then accounts for heightened mother-child conflict. By this logic, the introduction of a younger sibling, irrespective of biological relatedness, should create conflict between mothers and their existing children. But that was not the case in the
current study. The fact that levels of mother-child conflict— independent of parental
disruption, socioeconomic conditions, maternal depression, and family size—were nearly
a full standard deviation higher in homes with younger half versus full siblings is not
consistent with a FST perspective.

Strengths and Limitations

The current study had notable strengths and limitations. An important conceptual
strength of this paper is the introduction of POCT to the field of social development. In
the present context, this theory afforded a unique, a priori prediction about the effects of
half siblings on mother-child conflict. Further applications of POCT could potentially
advance our understanding of systematic patterns of conflict and cooperation within
families—a potential that has already been realized in animal research (e.g. Briskie,
Naughler, & Leech, 1994; Long, 2005; Maestripieri, 2002). In addition, a methodological
strength of the current study was the prospective, longitudinal assessment of parent-child
conflict from the child’s perspective using the well-validated Conflict Behavior
Questionnaire. This enabled us to construct a latent measure of child-reported conflict
that extracted the shared variance across three measurement periods and minimized
measurement error. Moreover, the measure did not share method variance with the other
measures used in the study, which were all based on mother-report. Finally, the
perspective of middle-school aged children on conflict with their mothers is ideal for
testing hypotheses from POCT.

An obvious limitation of the present study is that it was not explicitly designed to
test hypotheses from POCT. Thus, certain important constructs—mating effort by the
mothers following parental disruption, changes in maternal investment in extant offspring following the birth of new offspring (half siblings), levels of conflict between the siblings—were not measured. These omissions provide important directions for future research.

A second limitation was the relatively small number of children living with younger half siblings. Of the 236 children in the sample, only 26 co-resided with at least one younger half sibling, 9 co-resided with multiple half siblings, and 13 co-resided with an older half sibling. Thus, we lacked the power to examine the effects of single versus multiple half siblings, older versus younger half siblings, same-sex versus opposite-sex half siblings, or other various combinations. Larger studies with more half siblings are needed to study these effects. Further, due to a paucity of co-residing stepsiblings in the current study, we could not examine the effects of half siblings versus stepsiblings on family conflict.

A third limitation was the absence of information about time since parental disruption. POCT and FST generate competing predictions about the persistence of conflict in disrupted families. From the perspective of FST, conflict in biologically disrupted households should subside over time as the family reaches a new homeostatic state. In contrast, POCT predicts that elevated levels of conflict between children and their custodial parent in disrupted families will persist over time because the factors that cause loss of parental investment persist (e.g., reallocation of maternal investment to mating relationships; redistribution of resources to half siblings). Consistent with POCT, there is some evidence that conflict remains elevated in divorced families long after the
initial disruption and past the point where homeostasis should have occurred (Bray & Berger, 1993; Hetherington, 1989; Hetherington et al., 1999; Hetherington & Jodl, 1994).

Additional research is needed, however, to adequately test competing predictions from POCT and FST about the time course of parent-child conflict.

Finally, although these results suggest possible causes of mother-child conflict in different family contexts, the overall model only accounted for 11% of the variance. Many other possible sources of parent-child conflict were not addressed in this study. More work is needed to provide a complete picture of the causes of conflict between mothers and their early adolescent offspring.

In conclusion, although much research has examined dyadic relationships between family members, few studies have examined how particular types of dyadic relationships affect other family members. The present findings suggest that the introduction of half siblings into the home following parental dissolution provide unique challenges to mother-child relationships.
Footnotes

1Note that in Table 1, some of the bivariate correlations are between dichotomous variables (e.g. phi correlations). Interpretation of these coefficients is similar to Pearson correlations, although caution is warranted in interpreting their values. Because phi coefficients are especially sensitive to distributional properties, some bivariate relations may be limited in their maximum possible value (see Cohen, Cohen, West, & Aiken, 2003). In addition, the way in which some dichotomous variables were coded created zero cell values if examined in a 2 x 2 table (e.g., parental disruption and younger half-sibling presence; by definition, parentally intact families do not include younger half siblings). Such zero cell values preclude accurate regression estimates of relations between these variables (Cohen et al., 2003).
Table 1

Means, Standard Deviations, and Correlations among Measures before and after Imputation.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mean(SD)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before Imputation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Mother-Child Conflict</td>
<td>0.00 (1.00)</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Parental Disruption</td>
<td>---</td>
<td>.28***</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Stepfather Presence</td>
<td>---</td>
<td>.14*</td>
<td>.46***</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Younger Half Sibling Presence</td>
<td>---</td>
<td>.30***</td>
<td>.30***</td>
<td>.36***</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Risk</td>
<td>---</td>
<td>.19**</td>
<td>.45***</td>
<td>.29***</td>
<td>.15**</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. SES</td>
<td>41.74 (13.26)</td>
<td>-.08</td>
<td>-.35***</td>
<td>-.14*</td>
<td>-.21**</td>
<td>-.33***</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>7. Family Size</td>
<td>2.36 (1.06)</td>
<td>-.02</td>
<td>-.08</td>
<td>.11</td>
<td>.17*</td>
<td>.01</td>
<td>-.02</td>
<td>---</td>
</tr>
<tr>
<td><strong>After Imputation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother-Child Conflict</td>
<td>0.00 (1.00)</td>
<td>1.00</td>
<td>.26***</td>
<td>.12*</td>
<td>.25*</td>
<td>.16*</td>
<td>-.07</td>
<td>-.06</td>
</tr>
</tbody>
</table>

* Note. The mother child-conflict variable is based on latent factor scores. Correlations with mother-child conflict before imputation: N = 182; all other correlations: N = 236.

* p < .05, ** p ≤ .01, *** p ≤ .001
Table 2.

Means, Standard Errors, and Cell Sizes for Mother-Child Conflict in Different Family Contexts.

<table>
<thead>
<tr>
<th>Birth Parent Relationship</th>
<th>Younger Sibling: Type and Presence</th>
<th>Stepfather Presence</th>
<th>$M$ (SE)</th>
<th>$n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disrupted</td>
<td>No Half-Sib</td>
<td>No</td>
<td>.04 (.13)</td>
<td>70</td>
</tr>
<tr>
<td>Disrupted</td>
<td>No Half-Sib</td>
<td>Yes</td>
<td>.05 (.19)</td>
<td>31</td>
</tr>
<tr>
<td>Disrupted</td>
<td>Half-Sib</td>
<td>No</td>
<td>1.49 (.37)</td>
<td>8</td>
</tr>
<tr>
<td>Disrupted</td>
<td>Half-Sib</td>
<td>Yes</td>
<td>.46 (.26)</td>
<td>18</td>
</tr>
<tr>
<td>Intact</td>
<td>Full-Sib</td>
<td>------------</td>
<td>-.38 (.15)</td>
<td>63</td>
</tr>
<tr>
<td>Intact</td>
<td>No Full-Sib</td>
<td>------------</td>
<td>-.23 (.16)</td>
<td>46</td>
</tr>
</tbody>
</table>

*Note.* Means and standard errors are based on post-imputation factor scores for mother-child conflict after adjustment for family size, SES, and risk (i.e., maternal depression). Participants with both younger full-sibs and half-sibs were classified as residing in half-sib families.
Table 3.

**Hierarchical Multiple Regression: Younger Half-Sibling Presence as a Mediator of Mother-Child Conflict in Disrupted Households**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$\beta$ (SE)</th>
<th>$t$</th>
<th>$R^2$</th>
<th>$R^2$ change</th>
<th>$F$ change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Control Variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Size</td>
<td>-.10 (.07)</td>
<td>1.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td>.04 (.01)</td>
<td>.55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk</td>
<td>.07 (.07)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parental Disruption</td>
<td>.16 (.16)</td>
<td>2.13*</td>
<td>.071</td>
<td>.040</td>
<td>9.90**</td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half-Sibling Presence</td>
<td>.22 (.24)</td>
<td>3.20**</td>
<td>.111</td>
<td>.040</td>
<td>10.23***</td>
</tr>
</tbody>
</table>

*Note. All significance tests are two-tailed. Regression coefficients were taken from the final (full) model. $R^2$ is shown at each step. * $p < .05$, ** $p < .01$, *** $p < .001$
CHAPTER IV. MANUSCRIPT III.
LINEAR GROWTH IN MOTHER-CHILD CONFLICT TRAJECTORIES ACROSS ADOLESCENCE:
PREDICTORS OF DIFFERENCES BETWEEN FAMILY TYPES FROM PARENT-OFFPSRING CONFLICT THEORY.
Gabriel L. Schlomer
Bruce J. Ellis
Judy Garber

Introduction

Adolescence was once described as a period of inevitable storm and stress (e.g., Hall, 1904). More recently this view of adolescence as an inevitably difficult period of development has been replaced by a more refined view that considers additional elements such as culture and other individual differences (e.g., Arnett, 1999). The conclusion that storm and stress is not a ubiquitous feature of adolescence is based on the finding that difficulties during this period are simply more likely than at other developmental periods, but not par for the course. Nonetheless, it is generally accepted that adolescence as a developmental period consists of major psychosocial changes for children that, among other things, consists of dramatic changes in family relationships (e.g. Collins & Laursen, 2004). Often it is the case that during these transitions relations between parents and their children become more strained, as children and parents renegotiate their roles and other aspects of their relationship. Indeed, while some studies have shown the “storm and stress” model is not inevitable, many families do experience heightened conflict between
parents and children during this period (Laursen & Collins, 1994). Several cross sectional studies suggest that adolescence is characterized by elevated levels of parent-child conflict particularly during early adolescence. For example, Kim, Conger, Lorenz, and Elder (2001) found that adolescent negative affect toward parents tended to increase between ages 12 and 15 and then decrease thereafter. In a meta-analysis of the parent-child conflict literature, Laursen, Coy, and Collins (1998) concluded that parent-child conflict negativity tended to increase from early to mid adolescence and then settle back to a level less than mid adolescence but greater than early adolescence thereafter. Generally speaking the consensus among parent-child conflict researchers is that conflict tends to increase from early to mid adolescence and then become less intense during middle and late adolescent periods (DeGoede, Branje, & Meeus, 2009).

Despite the large body of cross sectional evidence regarding the developmental trajectory of parent-child conflict during adolescence, few longitudinal studies have been conducted that model the course of conflict over this developmental period. For example, only two longitudinal studies were identified in the Laursen, et al. (1998) meta-analysis. Since that time few additional longitudinal studies of parent-child conflict have been conducted. However, there are two studies in particular that provide significant insight into the development of parent-child conflict during adolescence. The first study was conducted by McGue, Elkins, Walden, & Iacono (2005). In this study the authors examined change in parent-child relationship between ages 11 and 14 using a simple two measure intake and follow-up design. Results of their analysis were consistent with cross sectional research: conflict tended to increase from early to mid adolescence. While this
study provides a useful addition to the longitudinal research on parent-child conflict it suffers from a few key limitations. First, only conflict from early to mid adolescence was examined, thus the full trajectory of conflict over the course of adolescence was not encompassed in this study. Second, only two time points were measured, once in early adolescence and once in middle adolescence, three years apart. Additional measures between these two time points would provide better information about the shape of the conflict trajectory from early to mid adolescence.

In an improvement upon the McGue et al. (2005) study, DeGoede, et. al. (2009) examined trajectories of conflict among two cohorts of adolescences. Within each cohort, four waves of data were collected at approximately one year intervals. At the initial wave, the mean age of participants in the first cohort was 12.4 years while the mean age of the second cohort was 16.7 years. Thus, the first cohort captured change from early to mid adolescence while the second cohort captured change from mid to late adolescence. Because the two cohorts represent two distinct samples, trajectories of parent-child relationships were modeled separately for each cohort. Results regarding parent-child conflict were generally consistent with McGue et al., (2005). Overall, parent-child conflict tended to increase sharply from early to mid adolescence as evidenced by the strong positive slope of conflict over time within the first cohort. In contrast, a strong negative slope was observed within the second cohort, indicating that parent-child conflict declined from mid to late adolescence. While this research provides an important advancement with regard modeling trajectories of parent-child conflict over time, this study suffers from two main limitations. First, because the age ranges in the cohorts were
non-overlapping, no information was available about changes between the ages of 15 and 16. Secondly, and perhaps more importantly, the dual cohort design, while useful, is not ideal for modeling trajectories of conflict over adolescence. A study in which the same children were followed across the entire adolescent period would be more desirable (DeGoede, et al., 2009).

The current study provides an advance on previous studies regarding the trajectory of conflict across adolescence. In this study, mother-child conflict is measured from early adolescence to late adolescence in six waves of data collection separated by approximately one year. The complete longitudinal data regarding conflict over the duration of adolescence is ideal for modeling parent-adolescent conflict trajectories. In addition to being the first study to longitudinally model parent-child conflict across adolescence, a second goal of this study to test hypotheses derived from parent-offspring conflict theory regarding differences between different family structures in terms of conflict trajectories.

*Parent-Offspring Conflict Theory*

Parent-offspring conflict theory (Trivers, 1974; POCT) focuses on genetic asymmetries within the family, that is, differences in genetic relatedness between family members. For example, parents are equally genetically related to each of their offspring (50%) but a given child however is 100% related to themselves but only 50% (on average) related to any given full biological sibling. From a POCT perspective, any given sibling should value investment from parents in themselves twice as much as investment in a full biological sibling. On the other hand, because parents are equally genetically
related to each of the biological children, parents have been selected to divide their resources evenly among their children (assuming that each child is of equal reproductive value). As a result POCT posits children have been selected to respond to such genetic asymmetries by demanding a greater (disproportionate) amount of parental investment than the parent has been selected to give. Conflict between parent and child is determined (in part) by the extent that the genetic interests of parents and children diverge.

Consider for example a two sibling family. Assuming that sibling A and sibling B are of equal reproductive value, because a parent is equally genetically related to each offspring a parent can maximize their marginal fitness gains by investing equally in each child. However, because sibling A shares only 50% her genes with sibling B, sibling A could maximize her fitness by monopolizing parental investment until her marginal gains fall to half that of sibling B (if sibling B is a full sibling and shares 50% of her genes) or to one fourth that of sibling B (if sibling B is a half sibling and shares 25% of her genes). Thus, in the traditional Triversian model, the optimal investment for the parent will always be less than that of an offspring. The degree of this difference is directly influenced by the genetic relatedness between siblings.

In a previous study, Schlomer, Ellis, & Garber (2010) used POCT to generate hypotheses about parent-child conflict in different family contexts. The researchers found that presence of younger half siblings in multiple sibling households was associated with substantially higher mean levels of mother-child conflict compared to households without a younger half sibling. Furthermore, this result persisted after controlling for parental disruption (non two biological parent household), stepfather presence, socioeconomic
status, maternal depression, and family size. In addition, families with a younger half sibling demonstrated higher levels of mother-child conflict compared to families with a younger full sibling, indicating that the younger half sibling effect was not an artifact of a younger sibling *per se*. These results support the hypotheses derived from POCT that conflict between mothers and their children will be sensitive to the genetic relatedness between siblings. The present study seeks to expand upon this previous research by examining how different family contexts affect the trajectories of mother-child conflict over the course of adolescence.

*The Current Study*

The aim of this study is to model trajectories of conflict between mothers and their children over the entire course of adolescence; to the author’s knowledge, this is the first study to do so. The form of the growth trajectory is expected to be curvilinear. Specifically, given previous longitudinal and cross sectional research, conflict is predicted to increase markedly from early to mid adolescence and decrease thereafter. Thus the conflict curve is expected to take an inverted U-shape function across adolescence.

In addition, several hypotheses are tested regarding family structure influences on trajectories of conflict. Building on Schlomer, et al. (2010), it is hypothesized that: 1) both biologically intact and biologically disrupted families will show an inverted U-shaped growth function across adolescence; however, the conflict slope of disrupted families will be more positive from early to mid adolescence than intact families (indicating greater acceleration of conflict); 2) among biologically disrupted families,
both families with and without a stepfather will show an inverted U shaped-growth function across adolescence; however, the conflict slope in stepfather families will be more positive from early to mid adolescence than in families without a stepfather; 3) among biologically disrupted families, both families with and without a younger half sibling will show an inverted U-shape function across adolescence; however, the conflict slope of younger half sibling families will be more positive from early to mid adolescence than in families without younger half siblings; 4) the presence of stepfathers will not account for the effects of younger half sibling presence on mother-child conflict (that is, there will be a unique effect of younger half siblings on the trajectory of conflict, above and beyond any effects of stepfathers). Lastly, to test the robustness of the younger half sibling effect, several covariates will be added to control for family level confounds (family size, socioeconomic status, risk, and presence of younger full siblings). In addition to these hypotheses about differences in trajectories from early to mid adolescence, based on previous research (e.g. Laursen, et al. 1998) it is expect that steepness of the positive slope of conflict from early to mid adolescence to be greater in magnitude than the declination from mid to late adolescence, resulting in a higher level of parent-child conflict at the end than at the beginning of adolescence. A major strength of the current study is that it is the first to systematically explore differences in conflict trajectories across different family contexts.

Method

Participants
Participants were enrolled in a longitudinal study of young adolescents. A high-risk research design, similar to that of Beardslee et al. (1988), Hammen (1991), and Radke-Yarrow (1998), was used in which mothers with histories of depressive disorders were over-sampled in order to obtain greater variability in the constructs of interest (i.e., mother-child conflict, marital disruption). The sample consisted of 240 children and their mothers who were assessed when the children were in 6th, 7th, 8th, 9th, 11th, and 12th grade resulting in six data collection periods approximately one year apart. Data for the main outcome (parent-child conflict) was not collected when children were in 10th grade (due to a lapse in funding). Four target children were excluded from the analyses because they lived in a home with either only stepsiblings, adoptive siblings, or other unrelated children. The analytic sample used in this study thus consisted of 236 children and their biological mothers. Of the 236 children, 110 (46.6%) were male and 126 (53.4%) were female. The mean age of the children at each wave of data collection was 11.86 (SD = .56), 12.71 (SD = .61), 13.56 (SD = .60), 14.57 (SD = .65), 16.55 (SD = .60), and 18.06 years (SD = .55), respectively. Approximately 82% were European American, 14% were African American, and 4% were classified as other (Hispanic, Asian, Native American).

Procedure

Parents of fifth grade children from metropolitan public schools were invited to participate in a study about parents and children. A brief health history questionnaire was sent with a letter describing the project to over 3,500 families. Of the 1,495 mothers who indicated an interest in participating, the 587 who had endorsed either a history of depression, use of antidepressants, or no history of psychopathology were screened
further by telephone. The remaining families were excluded because the mother did not indicate depression, reported only nonaffective psychiatric disorders, or indicated other kinds of serious health problems (e.g., cancer, multiple sclerosis). On the basis of the screening calls of the 587 families, 349 had mothers who reported either a history of depression or no history of psychiatric problems. The 238 families not further screened were excluded because they did not indicate sufficient symptoms to meet criteria for a depressive disorder (38%), had other psychiatric disorders that did not also include a depressive disorder (19%), they or the target child had a serious medical condition (14%), were no longer interested (21%), the target child was in the wrong grade or class (6%), or the family had moved out of the area (2%). The Structured Clinical Interview for DSM diagnoses (SCID; Spitzer, Williams, Gibbon, & First, 1990) then was conducted with the 349 mothers who had indicated that they had had a history of some depression or had had no psychiatric problems. Based on the SCID, 185 mothers (high risk) indicating a history of a mood disorder (e.g., Major Depressive Disorder, Dysthymia) and 55 reporting no lifetime history of a psychiatric disorder (low-risk) were retained in the study. The final analytic sample employed in the current analyses included 181 mothers from the high risk group and the 55 mothers in the low risk group.

A research assistant who was unaware of the mothers’ psychiatric history individually administered a battery of questionnaires to mothers and adolescents separately. All predictor variables in the analyses were taken from the 6th grade evaluation. Data from all six waves were used to construct the mother-child conflict growth trajectories.
Measure of Mother-Child Conflict.

The Conflict Behavior Questionnaire (CBQ; Prinz, Foster, Kent, & O’Leary, 1979) was used to assess children’s perceived levels of conflict with their mothers. The CBQ contains 20 items answered using a true-false response format. It is designed to tap two sources of conflict between children and their mothers: (1) dissatisfaction with the mother’s behavior and (2) evaluations of interactions between the mother and child. Example items include “My mom seems to be always complaining about me” and “At least once a day we get angry at each other.” The CBQ has demonstrated high internal consistency, reliability, and good predictive validity (see Foster & Robin, 1988; Maguen & Armistead, 2006; Prinz et al., 1979). Mean level of mother-child conflict were 2.78 ($SD = 3.68$), 3.00 ($SD = 3.97$), 3.50 ($SD = 4.42$), 3.73 ($SD = 4.44$), 4.00 ($SD = 4.70$), and 3.90 ($SD = 5.06$) for the 6th, 7th, 8th, 9th, 11th, and 12th grade intakes, respectively.

After the initial intake in the 6th grade, participants were missing data for the CBQ due to attrition. The amount of missing data across the six time points ranged from 14.3% to 25.8% with a mean of 21.9% ($SD = 4.9$%). The missing and retained families did not significantly differ in child gender, child race, family size, rates of parental disruption, or frequency of half siblings or stepfathers, but missing families were more likely to have a depressed mother (86.8% vs. 73.7%; $\chi^2 [1] = 3.90, p < .05$) and be lower SES (Hollingshead Index: $M = 39.17$ vs. 43.23; $t [222] = 1.99, p < .05$) at baseline.

Measures of Family Composition

Parental disruption. During the initial interview (Time 1), mothers reported on the target child’s immediate family including the number and relationship of individuals
co-residing with the child. In all families, the female head of household was the target child’s biological mother. Children were coded as 0 (parentally intact) if the biological father was reported as the male head of household and 1 (parentally disrupted) if there was no male head of household or if the male head was not the target child’s biological father. Based on these criteria, 127 of the 236 families (53.8%) were coded as parentally disrupted.

Entry of a stepfather into the home. During the Time 1 evaluation, mothers reported on the relation of the male head of household to the target child. Families were coded as having experienced the entry of a stepfather into the home if the mother reported that the male head was the target child’s stepfather or a friend of the target child’s mother (i.e. the mother’s boyfriend); 49/236 families (20.8%) had a stepfather residing in the family with the target child. Entry of a stepfather was coded as a dummy variable.

Entry of a younger half sibling into the home. Based on information about the family constellation obtained at Time 1, families were coded as having experienced the entry of a younger half sibling into the home if the target child was living with at least one younger half sibling. Two target children reported living with both a younger half sibling and a younger full sibling. These cases were classified as younger half sibling families; 26/236 families (11.0%) had younger half siblings. All half siblings were related maternally. Entry of a younger half sibling was coded as a dummy variable.

Family Control Variables.
Socioeconomic status (SES). Household SES was assessed by the widely used Hollingshead four factor index of social status (Edwards-Hewitt & Gray, 1995; Hollingshead, 1975). To calculate the SES score of a household, scale values for occupation (range from one to nine) and for education (range from one to seven) were multiplied by factor weights of five and three, respectively. These two products then were summed. SES scores were calculated based on information obtained at Time 1. The sample was predominantly lower-middle to middle class with a mean SES score of 41.89 (SD = 13.30) and a range that included the upper and lower bounds of the Hollingshead index (i.e., range = 8-66).

Risk. The Structured Clinical Interview for DSM diagnoses (SCID; Spitzer, Williams, Gibbon, & First, 1990) was used to assess mother’s history of mood disorders. Interviews were audio taped, and inter-rater reliability was calculated on a random subset of 20% of these interviews. Agreement was 94% (kappa=.88) for diagnoses of mood disorders. Following the work of Keller et al. (1986) and Sameroff, Seifer, and Barocas (1983), we created a chronicity/severity index based on the number, duration, and severity of mothers’ depressive episodes. Children’s “risk” was defined in terms of the extent of mother’s history of mood disorders. Using information from the SCID, mothers were categorized into the following groups: (a) no depression (n = 55) consisted of mothers who had experienced no episodes of depression; (b) mild (n = 47) consisted of mothers who had experienced no more than two episodes of a depressive disorder and had been depressed for no more than 1 year during their child’s life. Depressive episodes for mothers in this group also could not have been associated with psychiatric
hospitalization, a suicide attempt, or psychotic features. (c) Moderate (n = 84) included mothers who had one to three depressive episodes and between 1 and 4 years of depression during the child’s life. Also included in this group were mothers who had been depressed less than 1 year but had been hospitalized, made a suicide attempt, or had psychotic features. (d) The severe group (n = 50) consisted of mothers who had more than four episodes or had been depressed more than 4 years during their child’s life. (For more information about these groups, see Frye & Garber, 2005).

*Family size.* Family size was computed to reflect the number of children (including the target child) living in the household at Time 1. Although some of the target children had siblings who lived outside their home, family size was calculated in this way because siblings living in the home of the child were in direct competition for parental investment. Mean family size was 2.36 (SD = 1.05).

*Younger sibling status.* To help control for the presence of a younger sibling, a dummy variable coding for younger sibling status was created. This variable was coded 1 if the participant lived with a younger full sibling and 0 if they did not live with a younger full sibling. Of the 236 participants in this sample 106 (44.9%) reported co-residing with a younger full sibling.

**Analysis**

To model trajectories of change in conflict over early to mid adolescence multilevel modeling was employed to model growth trajectories over time using SAS PROC MIXED (SAS Institute Inc., 2002). Multilevel modeling was chosen over other analytical approaches (e.g. repeated measure ANOVA) so that different forms of the
conflict trajectory can be fitted (e.g. linear and various curvilinear functions) and tested for how well they describe the actual conflict trajectory. In addition, longitudinal data are often correlated in ways not explained by their temporal ordering; multilevel modeling allows for tests of correlations among these residuals and allows structure to be placed on these correlations. Furthermore, in multilevel modeling structure can be added to the variance/covariances of the random effects. Adding a structure to the random effects allows correlations to be estimated in specific ways between variance components of the model (e.g. variance in the intercept and slope). Lastly, due to attrition, missing data were present for the main outcome variable, mother-child conflict. Multilevel modeling has an advantage over other modeling techniques (e.g. latent growth curve modeling) in that the multilevel model is robust against unbalanced data, that is the missing data need not be imputed to obtain accurate parameter estimates (Singer & Willett, 2003).

To determine the most appropriate growth trajectory for conflict over time, several unconditional growth models were tested using various growth trajectories. These included a linear model, two models that contained a linear term plus a curvilinear term (logarithmic and quadratic function of time), two models that contained only a curvilinear term, and a piecewise (two part) analysis. In the piecewise model two slopes are specified with a single intercept. The initial slope represented conflict from initial intake at 6th grade ($M = 11.86$ years) through age 14, the subsequent slope represented conflict after age 14 to the final data collection when participants where in the 12th grade ($M = 18.06$ years). These trajectories were chosen because previous research suggests that conflict tends to peak around 14 years of age and then decrease thereafter (e.g. De Goede et al.,
In addition, the lack of a 10th grade data collection period (when the average age of the children would have been approximately 15 years) made this point a natural break between the conflict trajectories.

The results of these models showed that the logarithmic only model and the piecewise model showed approximately equivalent fit to the data (as indicated by the -2 Res Log Likelihood, AIC and BIC). Since the difference between these two models is small, the results of the piecewise model will be presented. The choice to adopt the piecewise model was based on three main advantages that a piecewise model has over other curvilinear models. First, each slope in a piecewise analysis is linear, which makes them highly interpretable. Second, the strength of the initial and subsequent slopes can be empirically tested to determine if they significantly differ from zero. Third, difference in growth trajectories between family types can be tested for the initial slope and subsequent slope separately (instead of a single difference between curves) providing a more fine grained analysis of differences in parent-child conflict over time.

Results

The results of this analysis are presented in a series of models that build in complexity, starting with the unconditional means model and building to the final model that includes all relevant predictors and control variables. For each model, mother-child conflict from 6th to 12th grade was used as the dependent variable. To model trajectories of conflict over time, a piecewise model was used (see above). Each model is presented below.

*Model 1: Unconditional Means Model*
The first model was the unconditional means model, a model that effectively has no predictors in the model. The form of the first model can be seen in Equation 1:

\begin{align*}
\text{Level 1: } Y_{ij} &= \pi_{0i} + e_{ij} \\
\text{Level 2: } \pi_{0i} &= \gamma_{00} + \zeta_{0i}
\end{align*}

where $Y_{ij}$ represents the outcome conflict, $\pi_{0i}$ represents the mean of conflict for each individual, $e_{ij}$ represents each individual’s deviation from their mean at a given occasion, $\gamma_{00}$ represents the grand mean of conflict, and $\zeta_{0i}$ represents the deviation of each individual mean from the grand mean. The utility of specifying an unconditional means model is in partitioning variance. In the equation above there are two variance components, $e_{ij}$ and $\zeta_{0i}$ corresponding to within person variation and between person variation, respectively. Results of the unconditional means model showed that there was significant within person variation ($\sigma^2 = .60, SE = .03, p < .001$) as well as significant between person variation ($\sigma^2 = .39, SE = .05, p < .001$). These variance components where used to calculate an interclass correlation ($\rho = .39$) demonstrating that approximately 40% of the variance in mother-child conflict resided between individuals. Thus, there is sufficient amount of variance to be accounted for to test hypotheses about differences between adolescents in different family contexts in their conflict trajectories.

**Model 2: Unconditional Growth Models**

The second model estimated was an unconditional growth model using participant age prior to age 14 as the initial slope (IntS) and participant age after age 14 as the subsequent slope (SubS) as the only level 1 predictors in the model. These variables are constructed so that the initial slope captures change in conflict to age 14 while the
subsequent slope captures change after age 14. The intercept in the model represents mean level conflict at age 14. The form of the first model can be seen in Equation 2:

Level 1: \( Y_{ij} = \pi_{0i} + \pi_{1i}(\text{IntS}_i) + \pi_{2i}(\text{SubS}_i) + e_{ij} \)  

Level 2: \( \pi_{0i} = \gamma_{00} + \zeta_{0i} \)
\( \pi_{1i} = \gamma_{10} + \zeta_{1i} \)
\( \pi_{2i} = \gamma_{20} + \zeta_{2i} \)

where \( Y_{ij} \) represents the outcome conflict, \( \pi_{0i} \), represents the intercept of conflict or in this case the mean level of conflict when participants were 14 years old, \( \pi_{1i}(\text{IntS}_i) \) represents the slope or trajectory of growth in conflict for the initial slope (prior to age 14), \( \pi_{2i}(\text{SubS}_i) \) represents the slope of conflict for the subsequent slope (after age 14), and \( e_{ij} \) represents the residual variance in conflict for each person at each time point after accounting for the predictors. In addition, the intercept \( (\pi_{0i}) \) is a function of \( \gamma_{00} \) or the grand mean plus each individual’s deviation from the grand mean \( (\zeta_{0i}) \). Similarly, the initial slope \( (\pi_{1i}) \) is a function of \( \gamma_{10} \) or the mean initial slope plus each individual’s deviation from the mean initial slope \( (\zeta_{1i}) \). Lastly, the subsequent slope \( (\pi_{2i}) \) is a function of \( \gamma_{20} \) or the mean subsequent slope plus each individual’s deviation from the mean subsequent slope \( (\zeta_{2i}) \).

To determine the best fitting variance/covariance structure for the random effects, a series of unconditional growth models that possess the above described form were conducted using different variations of the variance/covariance of the G matrix. These variations included unstructured, autoregressive (AR1), compound symmetric and heterogeneous compound symmetric. The results of these models showed that the
unstructured G matrix specification showed the best fit both in terms of the -2 Residual Log Likelihood (2917.2) as well as the AIC and the BIC (2931.2 and 2955.4, respectively). Placing additional restrictions on the G matrix (by virtue of alternative variance/covariance structures) only served to increase both the -2 Residual Log Likelihood, AIC, and BIC for all alternative models. In addition, an unstructured G matrix is conceptually the most appropriate structure for this model as it allows random effects to have unique variances and covariances. Results of this model showed that the intercept, initial slope, and subsequent slope each had significant between individual variances ($\sigma^2 = .66, .35, .22$, respectively; all $p$’s < .001). Furthermore, a positive covariance was observed between the intercept and the initial slope (COVAR = .33, $p < .001$) and a negative covariance was observed between the intercept and the subsequent slope (COVAR = -.16, $p < .05$). This means that individuals who tended to be high in conflict at age 14 tended to have steeper initial slopes and that individuals who were high in conflict at age 14 tended to have less steep slopes. There was however no significant covariance between the initial slope and the subsequent slope (COVAR = -.07, ns) suggesting that the initial slope and the subsequent slope were largely independent of one another.

With the best structure of the G matrix obtained was then prudent to determine if adding additional specifications to the residual variance/covariance matrix (R matrix) improved model fit. Model improvement was assessed via changes in the -2 Residual Log Likelihood, AIC and BIC statistics using a series of models that specified alternative structures for the R matrix. These models where then compared to the original model that
was agnostic to R matrix structure. Alternative R matrix structures included unstructured, autoregressive (AR1), compound symmetric, and heterogeneous compound symmetric. Results of these comparisons showed that only the autoregressive model improved the $-2$ Residual Log Likelihood (2915.2; all other specifications of the R matrix resulted in non-positive definite errors). The difference between the $-2$ Residual Log Likelihood’s between the original model and the autoregressive model is distributed as a chi square with one degree of freedom. Thus, model improvement can be assessed empirically. In this case, adding an autoregressive R matrix did not significantly improve model fit ($\chi^2(1) = 1.3, ns$). In addition, both the AIC (2931.9) and the BIC (2959.6) increased as a result of the autoregressive R matrix. Taken together, these results suggest that adding structure to the R matrix only serves to worsen model fit and thus, in subsequent models, no structure to the R matrix is specified.

The final unconditional growth model possessed the following properties: 1) random intercept, initial slope, subsequent slope, 2) unstructured random effects variance/covariance matrix (e.g. G matrix), 3) no specification of the residual variance/covariance (R matrix). Results of this unconditional growth model (Figure 1) showed that there was a non-significant intercept ($b = .05; t(223) = .77, ns$) indicating that at age 14 the mean level of conflict was not significantly different from zero. Since conflict was centered across the sample and across time points, this indicates that conflict at age 14 did not differ from the grand mean of conflict for the sample. There was however significant positive growth in mother-child conflict for the initial slope ($b = .23; t(198) = 3.13, p < .01$) and there was no growth in mother-child conflict for the
subsequent slope \( (b = .05; t(189) = 1.12, ns) \). These results are in contrast with previous empirical literature which suggests that parent-child conflict tends to increase in early adolescence and decrease there after (e.g. Laursen, et. al., 1998).

**Model 3: The Effect of Parental Disruption**

Model 3 built upon the final unconditional growth model by adding parental disruption (PntDis) to the model and its interaction with the initial slope and subsequent slope as level 2 predictors (fixed effects). The level 2 equation for this model is as follows (Equation 3):

\[
\pi_{0i} = \gamma_{00} + \gamma_{01}\text{PntDis}_i + \zeta_{0i}
\]

\[
\pi_{1i} = \gamma_{10} + \gamma_{11}\text{PntDis}_i + \zeta_{1i}
\]

\[
\pi_{2i} = \gamma_{20} + \gamma_{21}\text{PntDis}_i + \zeta_{2i}
\]

where \( \pi_{0i} \) represents the intercept of mother-child conflict, \( \gamma_{00} \) which represents the grand mean, \( \gamma_{01}\text{PntDis}_i \) refers to the fixed effect of parental disruption on the intercept, \( \zeta_{0i} \) refers to the residual variance left over after accounting for parental disruption. Similarly, \( \pi_{1i} \) refers to the initial slope or growth in conflict over time for each individual, \( \gamma_{10} \) refers to the mean initial slope for the sample, \( \gamma_{11}\text{PntDis}_i \) represents the effect of parental disruption on the initial slope, and \( \zeta_{1i} \) refers to the residual variance left over in the initial slope after accounting for the effect of parental disruption. Lastly, \( \pi_{2i} \) refers to the subsequent slope or growth in conflict over time for each individual, \( \gamma_{20} \) refers to the mean subsequent slope for the sample, \( \gamma_{21}\text{PntDis}_i \) represents the effect of parental disruption on the subsequent slope, and \( \zeta_{2i} \) refers to the residual variance left over in the subsequent slope after accounting for the effect of parental disruption.
Results of Model 3 (Figure 2) showed a nonsignificant intercept for intact families (b = -.16; t(218) = 1.68, ns) but a significant intercept for disrupted families (b = .24; t(223) = 2.66, p < .01). In addition, these two means were significantly different from each other (b = .40; t(220) = 3.05, p < .01). These results indicate that, at age 14, conflict tended to be significantly higher in disrupted families compared intact families.

Furthermore, mother-child conflict showed positive linear growth in both intact families (b = .21, t[194] = 1.98, p < .05) as well as disrupted families (b = .25, t[202] = 2.44, p < .05) for the initial slope. Conversely, neither intact (b = .07, t[193] = .94, ns) nor disrupted families (b = .05, t[186] = .73, ns) showed significant growth for the subsequent slope. Importantly, slopes for intact and disrupted families did not differ from each other for either the initial slope (t[198] = .29, ns) or their subsequent slope (t[190] = .16, ns) as evidenced by the non-significant interactions between parental disruption and initial slope and between parental disruption and subsequent slope. Thus, as can be seen in Figure 2 while intact and disrupted families did differ from each other in terms of mean level of mother-child conflict, they did not significantly differ from each other in terms of their trajectories over time. This result is contrary the hypothesis that acceleration in mother-child conflict from early to mid adolescence will be greater in disrupted families compared to intact families.

Model 4: The Effect of Stepfather Presence

Model 4 was identical to Model 3 except stepfather presence (StepFath) and its interaction with the initial slope and subsequent slope was added to the model. The following level 2 equations describe this model:
\[ \pi_{0i} = \gamma_{00} + \gamma_{01}\text{PntDis}_i + \gamma_{02}\text{StepFath} + \zeta_{0i} \]  
\[ \pi_{1i} = \gamma_{10} + \gamma_{11}\text{PntDis}_i + \gamma_{12}\text{StepFath} + \zeta_{1i} \]  
\[ \pi_{2i} = \gamma_{20} + \gamma_{21}\text{PntDis}_i + \gamma_{22}\text{StepFath} + \zeta_{2i} \]

Interpretation of these equations is similar to the set of equations found in equation 3 above. The unique feature of these equations is that additional parameters have been added to account for the addition of the stepfather predictor.

Results regarding differences in the intercept between family types showed that mean level of conflict at age 14 in disrupted families without a stepfather did not significantly differ from zero (\(b = .17; t(217) = 1.54, ns\)) while mean level of conflict at age 14 was significantly different from zero in disrupted families with a stepfather (\(b = .37, t(231) = 2.46, p < .05\)). These means were not significantly different from each other however (\(t(226) = 1.06, ns\)).

After controlling for the effect of parental disruption, the initial slope of mother-child conflict showed significant positive growth when a stepfather was present (\(b = .50, t[227] = 2.85, p < .01\)) but not when a stepfather was absent (\(b = .12, t[196] = .93, ns\)) (Figure 3). These two slopes were marginally statistically different from each other (\(t[216] = 1.77, p = .08\)). For the subsequent slope, neither stepfather present families (\(b = .06, t[202] = .52, ns\)) nor families without a stepfather (\(b = .04, t[178] = .50\)) showed significant growth. These slopes were not significantly different from each other (\(t[194] = .14, ns\)). These results suggest that the presence of a stepfather significantly contributes to growth in mother child conflict from early to middle adolescence. However, because the interaction between stepfather presence and the initial slope was not significant, it
cannot be concluded that families with and without stepfathers are significantly different from one another in terms of trajectories of conflict in early adolescence.

*Model 5: The Effect of Younger Half-Siblings*

Model 5 was identical to Model 4 except that instead of stepfather presence as the main predictor of interest, the presence of a younger half-sibling (YoungHalf) was substituted. The level 2 equation for this model is as follows:

\[
\begin{align*}
\pi_{0i} &= \gamma_{00} + \gamma_{01}\text{FamDis}_i + \gamma_{02}\text{YoungHalf}_i + \zeta_{0i} \\
\pi_{1i} &= \gamma_{10} + \gamma_{11}\text{FamDis}_i + \gamma_{12}\text{YoungHalf}_i + \zeta_{1i} \\
\pi_{2i} &= \gamma_{20} + \gamma_{21}\text{FamDis}_i + \gamma_{22}\text{YoungHalf}_i + \zeta_{2i}
\end{align*}
\] (5)

At age 14, mother-child conflict in disrupted families without a younger half sibling was not significantly different from zero \((b = .12; t(219) = 1.16, ns)\). Mother-child conflict in families with a younger half sibling did significantly differ from zero \((b = .76; t(230) = 3.77, p < .001)\). In addition, these two means were significantly different from each other \((t(228) = 2.89, p < .01)\). These results indicate disrupted families with a younger half sibling tended to have higher mother-child conflict at age 14 compared to disrupted families without a younger half sibling.

Results of the growth model (Figure 4) indicate that after controlling for the effect of parental disruption, children from disrupted families without a younger half-sibling did not show significant growth in mother-child conflict in their initial slope \((b = .17, t(197) = 1.52, ns)\) (Figure 4). However, children from disrupted families that lived with a younger half sibling did show positive growth in their initial slope \((b = .62, t[236] = 2.48, p < .05)\). These two slopes however were not significantly different from each other.
Interestingly, children from disrupted families without a younger half sibling no significant positive growth in their subsequent slope \((b = .14, \ t[185] = 1.96, \ ns)\) while children from disrupted families with a younger half sibling showed significant negative growth in conflict \((b = -.39, \ t[177] = 2.42, \ p < .05)\). These two slopes were significantly different from one another \((t[178] = 3.02, \ p < .01)\). Interestingly, as can be seen in Figure 4, the estimated level of conflict in families with a younger half sibling was lower at age 18 compared to families without a younger half sibling. To test the significance of this difference, the initial and subsequent slope variables were re-centered on age 18 and the analysis conducted again. The result of this analysis indicated that the intercepts (reflecting conflict at age 18) did not significantly differ between families with and without a younger half sibling \((t[327] = 1.49, \ ns)\).

These results suggest that while the presence of a younger half sibling contributes to growth in conflict during early adolescence, such families are not necessarily different from disrupted families without a younger half sibling. In addition, the presence of a younger half sibling may serve as a buffer against conflict during mid to late adolescence while other disrupted families show somewhat positive growth in conflict during this same period.

**Model 6: The Concurrent Effects of Stepfather Presence and Younger Half Sibling Presence.**

Because the presence of stepfathers and the presence of younger half siblings tend to be highly correlated, it was important to test the effects of younger half siblings while controlling for stepfather presence. To achieve this, a multilevel model was specified in
which stepfather presence/absence was used to predict mother-child conflict. The
standardized residuals were then saved from this analysis and used as the dependent
variable in the subsequent model.

After controlling for stepfather presence, conflict at age 14 among children in
disrupted families with a younger half sibling was significantly different from zero \( (b = .67, t(230) = 3.24, p < .01) \) while conflict among children in disrupted families without a
younger half sibling did not differ from zero \( (b = .09, t(219) = .93, ns) \). In addition, these
means were significantly different from one another \( (b = .57, t(228) = 2.51, p < .05) \).

Inspection of the simple slopes for this analysis showed that after controlling for
stepfather presence, disrupted families with a half sibling continued to show strong
positive growth in the initial slope \( (b = .63, t[235] = 2.54, p < .05) \) whereas disrupted
families without a younger half sibling showed no significant growth \( (b = .17; t(197) =
1.53, ns) \) (Figure 5). These two slopes however were not significantly different from one
another \( (b = .46; t(228) = 1.70, ns) \). In addition the subsequent slope for disrupted
families with a younger half sibling also remained significant and negative in its valence
\( (b = -.39, t[177] = 2.39, p < .05) \) while the subsequent slope for disrupted families
without a younger half sibling was not significant \( (b = .14; t(185) = 1.96, ns) \). These two
slopes were significantly different from one another \( (b = .53; t(178) = 2.99, p < .01) \).
These results suggest that for households with a younger half sibling the presence of a
stepfather does not account for the growth in conflict between adolescents and their
mothers over the course of adolescence.

*Model 7: Controlling for Family Level Covariates.*
To test the robustness of the previous model, several covariates were added to the previous model. To avoid potential problems with multicollinearity between these predictors (Cohen, Cohen, West, & Aiken, 2003) a multilevel model was specified where the following control variables where entered into the model: stepfather presence, risk, socioeconomic status, the number of children in the household of the TC, and younger sibling status. The standardized residuals of the mother-child conflict variable were saved and used as a dependent variable in the younger half sibling model.

Adding these covariates to the model had the effect of washing out all previously significant results. Neither families with \( b = .43, t(147) = 1.53, ns \) or without \( b = .09, t(191) = .67, ns \) younger half siblings evidence mean levels of conflict at age 14 that were significantly different from zero, nor were these two means significantly different from each other \( b = .34, t(150) = 1.10, ns \). As can be seen in Figure 6 the general pattern of results for the slopes remained the same, however none of the coefficients for the slopes where statistically significant. The initial slope for children from disrupted families with a younger half sibling was no longer significant after controlling for the covariates \( b = .35, t(203) = 1.05, ns \) nor was the initial slope significant for children in disrupted families without a younger half sibling \( b = .13, t(175) = .87, ns \). These two slopes where not significantly different from one another \( b = .23, t(198) = .60, ns \).

Similarly, neither subsequent slope for disrupted families with a younger half sibling \( b = -.34, t(82) = 1.23, ns \) or disrupted families without a younger half sibling where significant \( b = .25, t(93) = 1.87, ns \). Finally, these two subsequent slopes were not significantly different from one another \( b = .58, t(84) = 1.92, ns \).
Discussion

The goals of this study were twofold: 1) to model the trajectory of mother-child conflict across the adolescent developmental period and 2) to test hypotheses derived from POCT about differences in conflict trajectories between different family compositions. Because previous cross sectional and longitudinal studies suggested that the trajectory of conflict over the period of adolescence was non-linear, a piecewise growth model was adopted to model separate slopes within the same analysis context to determine the linear trajectories of mother-child conflict from early to mid adolescence and then from mid to late adolescence.

Results of the growth model suggest that, consistent with other research, mother-child conflict tends to increase between early and mid adolescence (Lausen, et al. 1998; De Goede, et al. 2009). Contrary to previous research however (e.g. De Goede, et. al 2009) conflict did not decrease from mid to late adolescence, and instead showed no growth, positive or negative, and remained at an elevated state. One reason for this contrasting difference may be the aspect of conflict that was measured by other researchers. For example, in the Laursen, et al. (1998) meta-analysis, an intentional distinction was made between the frequency and affective intensity of parent-child conflict. In sum, conflict frequency tends to decline with age however conflict intensity (affect) increases between early and middle adolescence and changes little thereafter. The measure used by De Goede, et al. (2009) conflated the frequency and intensity aspect of parent-child conflict and thus their results cannot be used to make the finer determination between these two components. It would seem however that their results are driven
primarily by frequency of conflict rather than affective intensity, given their results and the results found by Laursen et al (1998). In the current study the Conflict Behavior Questionnaire (Prinz, et. al., 1979; CBQ) was used as the measure of conflict between mothers and their children. Like the measure used by De Goede, et al. (2009) the CBQ conflates frequency and intensity of conflict. Considering these contrasting results given the similarities between the measure of conflict in this study and that used by De Goede, et al. more research is necessary that model conflict trajectories across adolescence that separates these two aspects of conflict.

An additional reason to expect conflict to decline between parents and their older children is the correlation between age and reproductive value. Among hunter-gatherer societies, the probability of child survival declines sharply until around reproductive age then declines less sharply thereafter (Kaplan, 1997). Thus children who have reached the age of reproduction have two distinct advantages over younger children: 1) they have demonstrated the ability to survive and 2) they are reproductively viable organisms. The reproductive value of older children is thus higher than children who are younger because they have demonstrated the ability to survive and (potentially) reproduce. One implication of this difference in reproductive value is that parental investment may be higher among older children compared to younger children. Because investment in older children is less likely to result in wasted effort, parents may allocate additional investment in children that are older and in turn reduce conflict. A future avenue of research may be to explore the relationship between parental investment and child age as it relates to child reproductive value.
Hypotheses derived from POCT generally received mixed support. Of consideration though is the difference between significance testing and effect sizes. The goal of significance testing is to determine if a coefficient is large enough, given its standard error, to be considered a product of a systematic process rather than chance alone. Significance tests are by their nature bound to sample sizes as the calculation of a standard error for a coefficient is determined, in part, by sample size. In this study there were very few half sibling and stepfather families. Indeed, one limitation of this study is its limited sample size. For example of the 236 children in the sample, only 26 co-resided with at least one younger half sibling. In addition, only 49 children co-resided with a stepfather. Thus, many of the analyses involving younger half siblings and stepfathers may be vastly underpowered in this study. As a consequence, in addition to discussion of results in terms of significance, results will also be discussed in terms of their effect size. That is, the size of their regression coefficient.

Both intact and disrupted families showed significant positive growth in their initial slope. The coefficients for intact and disrupted families were .21 and .25, respectively. These two coefficients were quite similar and indicate that for both intact and disrupted families, a change in one year of age resulted in a .21 to .25 standard deviation increase in conflict from early to mid adolescence. This result also suggests that the change observed in mother-child conflict from across adolescence is not an artifact of parental disruption but represents a more general trend among adolescents for conflict to change during this time period. In addition, no growth in conflict was found for the subsequent slope as evidenced by near zero coefficients for both intact and disrupted
families. Contrary to predictions however, the initial slopes for intact and disrupted families and subsequent slopes for intact and disrupted families were not significantly different from each other precluding any definitive distinctions between these two family types. These results suggest that the trajectory of conflict during adolescence is not exasperated by biological parental disruption even though children in disrupted families experience higher mean levels of mother-child conflict. In addition, there is no difference between intact and disrupted families in terms of how much they decrease in conflict from mid to late adolescence.

Consistent with Schlomer, et al., (2010) mean levels of conflict (at age 14) did not differ between stepfather present and stepfather absent families. Interestingly, after controlling for parental disruption families that had a stepfather showed strong positive growth (.50) in mother-child conflict in their initial slope while families without a stepfather did not (.12) Having a stepfather in the home was associated with a half of a standard deviation increase in mother-child conflict for every one year of age from early to mid adolescence. Surprisingly and contrary to predictions, however, these slopes did not significantly differ from one another despite the cross-over affect that are typically indicative of an interaction (see Figure 3). The interaction was near significant but failure to cross the statistical threshold in this case was likely due to low power to detect the effect. Perhaps other, larger datasets with more stepfather families would bear a distinction in conflict growth over this time period.

Stepfather present and stepfather absent families also did not differ in their subsequent slopes. Neither of the subsequent slopes for stepfather present or stepfather
absent families showed significant growth as would be expected by their near zero coefficients.

Mean levels of conflict between families with and without a younger half sibling significantly differed from one another at age 14. This finding suggests that average levels of conflict tend to be higher in younger half sibling families compared to families without a younger half sibling. In addition, similar to the stepfather findings, a strong positive initial slope (.62) was found for children living in a younger half sibling family while the slope for children without a younger half sibling was not significant and relatively small in its effect size (.17). Thus, within disrupted families coresiding with a half sibling resulted in an increase in conflict .62 standard deviations for every one year of age from early to mid adolescence. Including stepfather presence as a covariate had little effect on these coefficients and even slightly increased the coefficient for younger half sibling families. However, despite the large difference in coefficients between younger half sibling families and those without a younger half sibling, the initial slopes for families with and without a younger half sibling were not significantly different from one another. Thus, conclusive statements about differences between these two family types in terms of change in conflict from early adolescence to late adolescence cannot be made. As noted above, the reason for the lack of significant difference between these two slopes may be the result of a low sample size among families with a younger half sibling. One surprising finding was the tendency for children with a younger half sibling to actually decrease in mother-child conflict from middle to late adolescence. Indeed, not only was this slope significantly negative and moderately strong in its effect, but also
significantly different from families without a younger half sibling. Some research suggests that the entry of a common child between a mother and stepfather can have the effect of solidifying family relationships (Gagnon & Coleman, 1994). However, more research is needed to fully understand why half sibling presence increases mother-child conflict from early to mid adolescence and decreases conflict from mid to late adolescence. One possible explanation may be the resources for which the siblings are competing. An intra-brood model of parent-child conflict suggests that offspring are in direct competition with each other for the time, energy, and resources of their parent (Parker, Royal, & Hartley, 2002). In this model, the primary determinant of conflict between parents and their children is genetic relatedness between siblings. Often is the case that a large age difference exists between extant children and their younger half siblings as the extant children experience the dissolution, repartnering of their mother, and subsequent birth of a younger half sibling. In this study, the average age difference between the target child and their closest age younger half sibling was $6.07 \pm 2.91$ years compared to $3.23 \pm 2.24$ for the closest age sibling of non-half sibling families. Early in adolescence half siblings may be in more direct competition for the time and affection of their mothers, however as time goes on and adolescent children become more autonomous (Eisenberg & Morris, 2004; Steinberg, 1990) the competition between half siblings decreases. It may be the case that when the siblings are no longer in competition with each other for maternal investment, and the effects of competition of half siblings are no longer present. In such cases the solidifying effect of a common child between the mother and stepfather may be able to manifest. However, not all half sibling
families in this sample had a stepfather, thus more research is needed to fully explore this phenomena.

Lastly, inclusion of the family control variables effectively nullified all of the significant findings from the half sibling analysis. Follow-up analysis (not shown) revealed that none of the covariates included in the analysis were effective at mitigating the half sibling effect except for socioeconomic status. SES as a sole covariate was responsible for washing out the half sibling effects. In this study, socioeconomic status was measured via the Hollingshead index of social status (Hollingshead, 1975) which is based on indicators of parental occupation and education. The Hollingshead index has been shown to be highly correlated with other measures of SES as well as income (Cirino, et al., 2002). The large impact that SES had in this study is likely to due its correlation with income. From a POCT point of view, income is a critical factor predicting conflict between parents and their children as it is an indicator of the resources that parents have to invest in their children. In families with few resources, conflict is expected to be high between parents and their children since there are fewer resources to distribute among children. The optimal investment level from the point of view of the child may not be met in low income households and thus conflict is expected to be high. Additional investigation is needed to more fully explore the additive and potential interactive effects of SES and genetic relatedness on conflict within families. Nonetheless, despite the null results after controlling for SES, the coefficient for younger half sibling present families remained relatively large. Replication of this finding with a larger sample is needed to more accurately demonstrate this effect (or lack thereof).
This study was not without its strengths however. For the first time mother-child conflict trajectory has been modeled over the entire course of adolescence. This provides a significant advance in our knowledge about the transitions that occur during adolescent. In addition, the use of POCT has allowed for novel hypotheses to be posited in this study, providing preliminary insight into how different family structures effect conflict during adolescence. Much more research on larger samples is needed however to fully elucidate these effects.
Figure 1. Unconditional Growth Model.
Figure 2. Differences in Growth Trajectories between Intact and Disrupted Families.
Figure 3. Differences in Growth Trajectories in Disrupted Families With and Without a Stepfather.
Figure 4. Differences in Growth Trajectories in Disrupted Families With and Without a Younger Half Sibling.
Figure 5. Differences in Growth Trajectories in Disrupted Families With and Without a Younger Half Sibling Controlling for Stepfather Presence.
Figure 6. Differences in Growth Trajectories in Disrupted Families With and Without a Younger Half Sibling Controlling for Stepfather Presence and the Family Control Variables.
CHAPTER V. CONCLUSIONS

Summary of Results

The set of three manuscripts presented in this dissertation center on explaining and testing hypotheses derived from parent-offspring conflict theory (Trivers, 1974; POCT). Long has it been that researchers have been interested in familial conflict (e.g. Hall, 1904) however only rarely has a biosocial approach been applied to make predictions and describe the origins of conflict within human families. Since Trivers (1974) first published his seminal paper on parent-child conflict many biologists have used POCT to understand acrimonious parent-offspring relations in a variety of species and particularly in mammals and birds. The study of one mammal however has for too long been neglected: humans. The papers in this dissertation are an attempt to remedy this situation by first, detailing POCT in an accessible way and demonstrating its utility; second, by applying POCT to conflictual relations between parents and their adolescents; and lastly extending this model of parent-child conflict not only to mean levels of conflict but also growth in conflict over the duration of adolescence.

The first manuscript in this dissertation was a theoretical synthesis of the literature on POCT. The goal of this manuscript was to describe parent-offspring conflict theory both in its original formulation (Trivers, 1974) and in terms of more recent theoretical developments and extensions (e.g. Parker, Royle, & Hartley, 2002; Royle, Hartley, & Parker, 2004). In addition, the manuscript described four areas of research where the theory has been applied and where the theory could be applied more thoroughly: prenatal conflict, weaning conflict, family conflict, and mating conflict. These are but a few of the
areas that POCT could be applied and the potential for the theory to be more influential within research on human conflictual relations is great.

In the second manuscript POCT was applied to human parent-child conflict during early adolescence. Results of this study showed that following parental disruption, the entry of younger maternal half siblings into the home was uniquely associated with elevated conflict between mothers and their biological children, independent of the effects of family size, socioeconomic status, maternal depression and stepfather presence. In addition, presence of a younger full biological sibling was not associated with higher levels of conflict and thus the presence of a younger half sibling was not an artifact of having a younger sibling per se. Lastly, the effect of parental disruption on mother-child conflict was partially mediated by the entry of half siblings (but not stepfathers) into the home.

The third manuscript sought to extend the findings of the second by examining how trajectories of conflict over the course of adolescence differed across different family contexts (e.g. biologically disrupted, stepfather present, younger half sibling present). In addition, this study modeled the trajectory of conflict over the entire course of adolescence, which is the first time this has been done. A piecewise growth model was used to accurately reflect the expected curvilinear trajectory of conflict over adolescence. Using a piecewise growth model also had the advantage of estimating two linear slopes within the same model which allowed independent assessment of individual differences in growth trajectories of conflict in different epochs of adolescence.
Results showed that, consistent with previous longitudinal research (DeGoede, Branje, & Meeus, 2009; McGue, Elkins, Walden, & Iacono, 2005), conflict tended to increase from early to mid adolescence. Contrary to previous research however, it was found that conflict from mid adolescence to late adolescence showed no growth, neither positive nor negative. Tests of family context effects showed that while mean levels of conflict in biologically disrupted and intact families may differ, they do not differ in their growth trajectories. Growth in stepfather families also showed this same pattern as disrupted families, however there was only a trend for stepfather present families to accelerate growth in mother-child conflict to a greater degree than non-stepfather families from early to mid adolescence. Within younger half sibling families, strong positive growth was found when a younger half sibling was present from early to mid adolescence, but not when a younger half sibling was absent. However, despite the strong growth in conflict from early to mid adolescence for younger half sibling families, no difference was found between the growth trajectories of younger half sibling present and non-younger half sibling families. Surprisingly, growth in conflict actually decreased in younger half sibling present families from mid to late adolescence while non-younger half sibling families showed no significant growth, and these two slopes were significantly different from one another. The presence of a stepfather did not mitigate this effect. These results suggest that while presence of a younger half sibling may exacerbate conflict from early to mid adolescence there may be a buffering effect of younger half siblings on conflict from mid to late adolescence. More research is needed however to fully explore this finding. Lastly, and perhaps unfortunately, inclusion of
socioeconomic status effectively nullified all of the previous results found in the younger half sibling model. More research is needed to examine the confounding effects of socioeconomic status and the presence of younger half siblings.

Contributions and Implications

This set of manuscripts provides several important contributions that have implications for family relationships. First, parent-offspring conflict theory is being introduced to scholars who may not be familiar with the theory. Indeed, one reason for the underutilization of the theory by family researchers may simply be lack of exposure to the ideas, predictions, and tenets of parent-offspring conflict theory. In addition, applications of POCT are spelled out. Parent-offspring conflict theory has the potential to have a large impact on the way in which we think about family relationships and the utility of the theory for understanding family dynamics are far reaching.

In addition, for the first time POCT has been used to directly test hypotheses about how family structure affects conflict within families. To the author’s knowledge this is the first study to examine how the presence of a younger half sibling influences conflictual relations between children and their biological mothers. The implication of this research is that it is necessary for conflict researchers to consider genetic asymmetries in the family when conducting research on parent-child conflict. Some research has implicated genetic asymmetries in the family as a major contributor to variation in family processes (e.g. Hetherington, Henderson, & Reiss, 1999) however much of the research on parent-child relations fail to consider this aspect of family life. Lastly, this was the first study to model trajectories of conflict over the course of
adolescence. Furthermore, this is the first study to examine how family composition effects trajectories of conflict over time. Too few longitudinal studies exist that examine change in parent-child conflict over time, and this study provides a unique addition to that literature.

Limitations and Future Directions

Several limitations about this set of manuscripts warrant mentioning and provide insight into future directions for research. First, it is not feasible to describe all of the areas that parent-offspring conflict theory may be applied to, and only four areas were discussed in the first manuscript. No doubt future research on parent-child relations will reveal additional areas in which the theory can be applied. Third, manuscripts two and three were both based on the same sample, future research is needed to replicate these findings outside of this sample. Fourth was the relatively small number of children living with younger half siblings. Of the 236 children in the sample, only 26 co-resided with at least one younger half sibling, 9 co-resided with multiple half siblings, and 13 co-resided with an older half sibling. Thus, power was insufficient to examine the effects of single versus multiple half siblings, older versus younger half siblings, same-sex versus opposite-sex half siblings, or other various combinations. Future research with larger samples could help to illuminate such potential differences in conflict between family types. Despite these limitations this set of manuscripts provide an important advance in our way of thinking about conflictual family relations and the nature of conflict within diverse family contexts.
REFERENCES


