

# Chapter 8

## The Evolutionary Psychology of Sibling Conflict and Siblicide

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*There is a little boy inside the man who is my brother...Oh, how I hated that little boy. And how I love him too.*

—Anna Quindlan

*When brothers agree, no fortress is so strong as their common life.*

—Antisthenes

*The Rule of Sibs: If your sibling gets something you want, you (1) try to take it; (2) break it; or (3) say it's no good*

—Patricia Fleming

### Introduction

Our brothers and sisters are often our closest allies, but they can also be our greatest competitors. Some of the time we adore them; some of the time they can drive us to despair if not violence. What factors influence the course of sibling rivalry, whether brothers band together against all others or become deadly enemies as in the biblical story of Cain and Abel? This chapter focuses on the evolutionary roots of sibling solidarity and conflict not just in humans but in nonhumans as well, as there is a long and rich history of studying sibling conflict in many other species that can inform our understanding of the human case. Siblicide is an excellent example of a topic much better studied in nonhuman species, due to the fact that it is much

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more frequent in nonhumans and yet shares many of the same root causes. Siblicide is rare in humans, not surprisingly as it is the most extreme expression of sibling competition.

Siblicide can be defined as the killing of one sibling by another and includes both fratricide (the killing of a brother) and sororicide (the killing of a sister). As will be discussed later, sibling violence is the most frequent type of nonlethal familial violence (Wiehe 1997). With siblicide being relatively rare in humans, there is scant research on the topic. The majority of research on familial violence has focused on spousal abuse/homicide and child abuse/infanticide in which deaths are much more common (Statistics Canada 2004; Underwood and Patch 1999).

Despite its current low rate, historical data, biographies, and fictional stories tell the story of siblicidal conflict. In the Bible, Cain slew his brother Abel (a version of conflict over parental favoritism) after God showed a preference for Abel and his animal offerings over Cain's crops. Sultan Mehmet II of the Ottoman Empire imprisoned his brothers and killed them all once he had produced an heir to protect his "territory" and offspring. The fact that such events and tales of events keep cropping up across time and cultures suggests that siblicidal conflict has been a concern and that not all sibling rivalries end peacefully during or after childhood. Of course, when sibling rivalry is examined in humans, it is typically of the nonlethal variety. Even if conflict between human children escalates beyond the verbal to punching and shoving, parents have an emotional and fitness interest in quickly intervening. But the fact is that such conflict does occur despite the shared genetic interests of siblings, even if human siblings are less likely to cause their siblings' deaths, as is seen in many other animal sibships.

Evolutionary perspectives have been productively applied to the study of familial conflict across a number of contexts including spousal homicide (Daly and Wilson 1988; Wilson and Daly 2004), infanticide (Daly and Wilson 1984, 1994a), child abuse (Daly and Wilson 1986, 1994b), parent-offspring conflict (Salmon 2007; Schlomer et al. 2011), and sibling relationships in general (Pollet 2007; Salmon 2003; Salmon and Daly 1998), as well as siblicide (Daly et al. 2001; Michalski et al. 2007).

## Sibling Conflict Theory

Sibling relationships are the most enduring relationships of the life span (Cicirelli 1995). Within those relationships, there is potential for conflict as well as cooperation. Explaining motivation for cooperation and altruism (even that directed toward one's kin) from an evolutionary perspective presented a problem, until Hamilton (1964) proposed *kin selection theory*. With this theory, Hamilton redefined classic Darwinian fitness (i.e., survival and successful reproduction, hence the transmission of one's own genes into subsequent generations) into the concept of *inclusive fitness* (i.e., encompassing not only one's own survival and reproduction, but also that of genetically related individuals in whom one has invested). According

to ‘Hamilton’s rule’ (1964), the likelihood an individual will behave altruistically toward another depends on whether the degree of relatedness and the potential fitness benefit to the other person outweigh the potential fitness cost to oneself (i.e.,  $r * b > c$ ). Thus, altruistic behavior directed toward kin serves as an indirect way to increase one’s own inclusive fitness. In addition, kin selection theory predicts that genetic relatedness should influence the likelihood of conflict and cooperation between individuals. Specifically, according to this theory, we expect to see more cooperation (and less conflict) between genetically related individuals, with greater relatedness leading to greater cooperation (and even less conflict) when all other things are equal. These predictions have been supported by numerous studies investigating feelings of subjective closeness and received support across adult relationships as a function of degree of relatedness, with higher levels directed to kin versus nonkin and to more closely related kin (e.g., a sibling) than more distantly related kin (e.g., a cousin) (Neyer and Lang 2003).

Genetic relatedness, however, does not guarantee that those that are related will share the same interests or be motivated to behave altruistically toward each other. A clear example of this comes from *parent–offspring conflict theory* (Trivers 1974). The genetic interests of parents and their offspring are not identical. Offspring will be selected to manipulate their parents in order to ensure higher investment, and parents will be selected to manipulate their offspring to suit their own (i.e., the parents’) genetic interests. When two parties have differing interests, there is a possibility of conflict. From an offspring’s perspective, the more parental investment (e.g., resources such as time, energy, food, etc.), the better. From a parent’s point of view, the more he/she invests in any one offspring, the less he/she can invest in other current or future offspring (Trivers 1972). According to *parental investment theory*, the amount and allocation of parental investment depends on the amount of resources available to parents, the quality of the offspring, and the potential for future offspring (Trivers 1972). Assuming availability of resources and equal quality of offspring, it would be expected that parents value each offspring equally and would encourage them to value their siblings more than they would be naturally inclined to do. Each offspring, however, being more closely genetically related to itself than to its sibling, values itself over its siblings. This brings about the possibility for sibling conflict as siblings compete for parental resources. Therefore, it could be expected that each sibling would try to receive more than their “fair share” of parental investment. An extreme outcome of this conflict is siblicide, which, although rare in humans, is not uncommon in nonhuman animals.

## Sibling Competition in Nonhuman Animals

Sibling conflict in nonhumans shares many features with such a conflict in humans. Its intensity is influenced by the sex of siblings, their birth order (which often translates into size and strength differences), the number of siblings, and the available resources. Inclusive fitness theory also suggests greater conflict between nonkin

(as in human step-siblings) than between kin over food or territory, and the greater the levels of conflict, the lesser the degree of relatedness (half siblings experiencing greater conflict than full biological siblings, for example). The Holmes and Sherman (1982) well-known studies of the role of kinship in reducing territorial aggression examined its impact on the social behavior of Belding's ground squirrels (*Spermophilus beldings*). In this species of ground squirrel, females tend not to disperse, staying in close proximity to their natal burrow. As a result, sisters are likely to occupy adjacent territories. Holmes and Sherman found half-sisters to exhibit greater aggression toward each other than full sisters and to be less likely to band together to defend each other's burrow from nonkin invaders even though they grew up in the same natal nest. Full sisters engaged in more cooperation and less antagonism than half-sisters.

More familiar to some than adult conflicts over territory, scramble competition among young siblings occurs in many mammals over access to milk. Typically, the number of offspring influences the intensity of this competition. In guinea pigs (*Cavia aperea f. porcellus*), for example, when litters are experimentally manipulated such that they have more or less offspring than available teats to nurse (Fey and Trillmich 2008), the pups from larger litters experience slower growth rates due to competition for milk and the resulting longer wait for access to teats. Aggression toward siblings in this study was only seen among the larger litters.

Competition for maternal milk can also be seen in domestic pigs. Sows may not have enough milk to feed all their piglets, especially when litters are very large. The teats nearest to the front of the sow's body have the best supply of milk. Competition for access to the best teats is direct and piglet dentition (sharp incisors) is specialized to facilitate aggressive attacks on siblings. As a result of such direct competition, some low birth weight piglets do not survive. Piglets also compete indirectly by stimulating milk production at the teats most used, with the remaining teats producing less milk (Drake et al. 2008). The more restricted the supply of food, the more intense the sibling aggression to the point where some piglets die of sibling-induced starvation (Andersen et al. 2011).

Competition for food provided by parents can also be intense in a variety of avian species. Competition between barn swallow (*Hirundo rustica*) chicks is influenced by offspring sex, sex of competing siblings, and hatching order. Chicks engage in vocalizations, gaping, and posturing such that parents provide more food to the chicks that beg more intensely (Lotem 1998). Studies examining how factors influence the outcome of such sibling competition indicate that junior chicks and males beg more vigorously (perhaps signally greater need) and, as a result, receive more feedings (Bonisoli-Alquati et al. 2011). In this case, the parents appear to be compensating male junior chicks for the disadvantage of asynchronous hatching.

One mammalian species (familiar to many from zoos and television shows) with nontrivial sibling rivalry is the cooperatively breeding meerkat. Meerkats (*Suricata suricatta*) commonly engage in aggression between littermates that can be fierce, though rarely resulting in serious injury and never lethal (Hodge et al. 2007).

In a meerkat group, one female monopolizes reproduction with an average of three to four litters per year with a typical litter size of four pups, though there can

be as few as one and as many as seven (Hodge et al. 2008). While in the beginning, pups are fed in the burrow, as they mature they travel with the adults in the group, begging for food from helpers. As cooperative breeders, meerkat groups contain nonreproductive helpers who feed and protect pups. There are benefits to being the only pup around a helper because helpers tend to feed whichever begging pup is closest to them. Pups, therefore, try to deny other pups' access to a specific helper that they are shadowing by attacking any littermate who comes close to the helper. Such attacks mainly consist of snaps and lunges and the other pup is usually quickly driven off. Fights do sometimes occur, with the loser retreating in search of another helper. Most meerkat sibling aggression occurs between juveniles and dissipates as they become adults.

Unsurprisingly, meerkat pup littermate aggression increases when food availability decreases, usually due to a lack of rain or a low number of helpers. Hodge et al. (2009) tested the impact of food availability on levels of sibling aggression with short-term feeding experiments. Researchers decreased a pup's hunger by provisioning with a small amount of food before a foraging excursion. Pups that had been fed exhibited less aggression during foraging/begging than the unfed control pups.

As the above examples might suggest, siblicide in many species is often a result of substantial resource shortages that produce extreme sibling competition. This final outcome can be influenced by the degree of relatedness between offspring and the impact of such aggression on parental fitness. It is important, as well, to distinguish between cases in which competition between siblings is always fatal to the subordinate (obligate siblicide) and cases in which the consequences of competition are highly variable, influenced largely by environmental conditions (facultative siblicide).

Why do parents produce more offspring than they are able to successfully raise? There are several possibilities or ways in which overproduction of offspring can lead to greater parental fitness. "Overproduction allows: (1) efficient 'resource-tracking' (where the extra offspring actually turn out to be affordable because of an unpredictable upswing in ecological conditions); (2) the possibility of 'sibling facilitation' (e.g. some offspring serving as helpers or critical meals for others); and/or (3) the use of extras as 'replacement offspring' when one or more members of the core brood proves defective or happens to die" (Mock and Parker 1998, p. 2). There are also circumstances in which parents may be able to provide enough resources for all their offspring but chose not to, instead keeping some portion of resources in reserve for other uses, including opportunities for future reproduction (Williams 1966). Parents may, rather than prevent competition and possible siblicide, encourage brood reduction through asynchronous hatching, selective care of offspring, or infanticide (St. Clair et al. 1995). When considering whether siblicide is more likely to be obligate or facultative, evidence suggests that we should expect obligate siblicide or aggression to evolve where resources are most often limited and siblings can present a serious drain on scarce resources. Facultative siblicide is more likely to be found in circumstances in which resources are not always limited (Mock et al. 1990). In the obligate species, the extra sibling can serve as a replacement if the first

offspring dies. In the facultative species, the extra sibling will survive and contribute to both parental and sibling fitness when conditions are favorable.

## **Siblicide in Nonhuman Animals**

There is an extensive literature on siblicide in nonhuman species, particularly avian ones. Many organisms regularly produce more offspring than they can afford to raise to maturity, from insects with massive broods in which only one or two survive to marsupials who produce more young than they have teats to feed them with (Mock and Parker 1998). In a majority of such species, the reduction in offspring occurs through differential starvation. But in other cases, brood reduction occurs via siblicide, the elder offspring (the “A” chick, for example) killing its younger sibling (the “B” chick) directly or by forcing it from the nest. As previously mentioned, food availability is a driving factor in the intensity of sibling competition, the one that moves the competition to a deadly level. A great deal of research on sibling competition for food has focused on birds as they tend to lend themselves well to such observations. Siblings are confined to the close proximity of a nest. They are dependent on their parents for small packets of food that are easily quantified, and their nests are often easily observable (in trees, ground nests, etc., as opposed to underground burrows).

### ***Avian Siblicide***

*Boobies.* Siblicidal behavior has been examined in a number of booby species. The Nazca booby (*Sula granli*) fledges just one nestling regardless of clutch size and the elder “A” chick always eliminates its younger rival. This species therefore practices obligate siblicide (Anderson 1990). Despite the fact that only one nestling survives to fledge, two eggs are typically laid. This surplus production of offspring is sometimes explained with the insurance egg hypothesis, which suggests that the second egg can serve as a replacement or backup egg in case the first egg fails to hatch or the chick dies soon after hatching. As a result of such insurance, booby parents who produce two eggs will have greater reproductive success than those that lay one egg (as one-egg nests would be more likely to fail to fledge).

Clifford and Anderson (2000) tested this insurance hypothesis experimentally by manipulating clutch sizes. Natural one-egg clutches were increased to two-egg ones and natural two-egg clutches were reduced to one-egg ones. In both cases, parents with two-egg clutches produced more hatchlings and fledglings than the one-egg clutches. The insurance benefit of the extra egg was clear—those booby parents with two eggs experienced greater reproductive success. Why do all natural clutches not consist of two eggs? The most reasonable answer is that parents who are strongly limited by their own resource condition (or food availability as the time of laying) are only able to produce one egg.

Possible proximate mechanisms that enable obligate or facultative siblicide have also been examined, with particular regard to androgen levels. An examination was conducted of perinatal androgen levels in two species of booby, the previously mentioned obligate Nazca and the facultative blue-footed booby (*Sula nebouxii*) which, unlike the Nazca, often raises more than one chick (Muller et al. 2008). Blue-footed booby parents do favor the eldest chick in terms of their own feeding behavior when food is scarce.

But patterns of chick aggression are quite different between the two species. The Nazca elder chick unconditionally attacks its younger sibling, when possible ejecting it from the nest. Blue-footed chicks exhibit aggression but it is conditional on food availability, and is highly focused on getting access to, or monopolizing, whatever food is available. When androgen levels were examined, obligate Nazca chicks were found to hatch with higher circulating androgen levels than the facultative blue-footed chicks. The role of high levels of androgens in facilitating sibling aggression is revisited in the section on mammalian siblicide.

However, in the obligate brown booby (*Sula leucogaster*), there is no evidence of the role of androgens in facilitating sibling aggression (Drummond et al. 2008). Rather, in this case it appears that brown booby mothers make their junior chicks vulnerable to siblicide by hatching them 5 days after their nestmates, not by differential allocation of egg androgens or nutrients. Drummond and colleagues (2008) also found that facultative blue-footed booby mothers hatched their subordinate chicks 4 days after their nestmates and with 10% less yolk to ensure their low status.

*Kittiwakes*. The food amount hypothesis (FAH) proposes that sibling aggression is negatively correlated with the amount of food parents provide to the aggressor (Mock 1987). Evidence that supports the FAH has been found in a number of species including cattle egrets and osprey (both discussed below) and the black-legged kittiwake.

White et al. (2010) tested the FAH in a colony of black-legged kittiwakes in the Gulf of Alaska that had been experiencing long-term food shortages. As part of a large-scale food supplementation project examining the impact of food supply on kittiwake breeding, the amount of food available to parents was manipulated. Breeding pairs raising two chicks were split into two groups: one was given supplemental fish and the other was not. The supplementation was started approximately 1 month before hatching and was ended once the majority of chicks had fledged.

“A” chicks received substantially more food when their parents were supplemented than those with unsupplemented parents such that they gained more weight. There was no difference in the amount fed to “B” chicks between groups. While the aggression exhibited by “A” chicks in both groups decreased over time, the “A” chicks in the supplemented group were less aggressive (in terms of frequency of attacks and intensity of them) than those in the unsupplemented group. This corresponds to field-study reports that chick aggression is greater during seasons of food shortage (Irons 1992), supporting the adaptive view of sibling aggression.



*Cattle egrets.* The cattle egret (*Bubulcus ibis*), unlike most herons, is typically found feeding in fields and other dry grassy habitats. They seem to follow the insurance chick model to a certain extent, with a clutch size that ranges from one to five eggs but is typically three. Frequently, the third (and fourth or fifth) chicks do not survive and the nestlings exhibit intense sibling rivalry. If we consider a brood of three, the “A”, “B”, and “C” chicks hatch asynchronously, giving the “A” chick the size advantage, as usual. After winning some early skirmishes, the “A” chick is usually free to enjoy the dominant position with its first dibs on food delivered by parents. The “C” chick gets about half the food the older siblings do and loses the majority of fights to the “B” chick. When the nestlings are very young, attacks do not do serious damage but as they get larger, they will raise their heads up and drive down on their opponents, often drawing blood, and fighting is most intense when food is arriving. The “C” chick inevitably surrenders by lowering its head (making access to food brought from above by a parent difficult). With food being monopolized by the “A” and “B” chicks, the “C” chick loses weight and strength so that by their third week, one-third to one-half of all “C” chicks would have died (Mock 2004). If a senior chick is lost to defect, disease, or predation, the “C” chick is more likely to survive to fledge.

*Ospreys.* The osprey (*Pandion haliaetus*) is a large fish-eating raptor found worldwide, typically nesting on lakeshores and in coastal areas. They typically lay two to four eggs asynchronously and appear to experience facultative brood reduction during food shortages (Jamieson et al. 1983; McLean and Byrd 1991). An experimental study designed to test the FAH in ospreys was conducted in southwest British Columbia in which the researchers removed broods from their nests, exposed them to a starvation period, and then either fed them or did not (sham feeding) in order to manipulate the hunger level of the nestlings (Machmer and Ydenberg 1998). They were then placed in a nest with food and their behavior was observed. Broods were more aggressive when food was introduced after sham feeding, with senior siblings being the most aggressive and claiming the larger share of the food. It appears that the competitive asymmetries established through sibling aggression facilitate brood reduction in ospreys to a level matching the prevailing food supply.

*Black eagles.* Unlike most of the avian species previously discussed, the black eagle (*Aquila verreauxi*) is a species with obligate siblicide. Rather than exhibiting support for the FAH, they are an example of the extra offspring as insurance model. Their range includes the mountains of southern and northeastern Africa and parts of the Middle East. Black eagles nest on cliff ledges, laying two eggs which hatch asynchronously, typically 3 days apart. The resulting “A” chick is larger, typically attacking the “B” chick from the day it hatches with its very sharp beak. The older chick usually prevents the younger one from gaining access to parentally provided food until it finally dies of starvation. It is unusual for more than one chick to fledge from a black eagle nest (Simmons 1988).

*Laughing kookaburras.* The laughing kookaburra (*Dacelo novaeguineae*) is a cooperatively breeding member of the kingfisher family. Being carnivorous, they live in forested areas of Australia, in family groups with a monogamous pair breeding between September and January supported by older offspring. Three eggs are



laid at 2-day intervals which then hatch asynchronously, giving an advantage, as usual, to the larger, older “A” chick. Laughing kookaburra chicks have a hooked bill specialized for sibling competition which is used to grasp and shake their victim. Such an aggressive competition is common when the food supply is limited. There is typically a bump in “C” chick deaths in the first week as a result of physical injuries. A week or two later, there will be another increase in mortality with less visible causes, mainly due to starvation (Legge 2000; Legge and Cockburn 2000). The hooked bill seen in nestlings disappears by the time they fledge.

Legge (2002) examined the extra offspring as insurance model and the resource-tracking model in a population of laughing kookaburras in the Canberra Nature Park. While she found that nests with no mortality resulted in more independent fledglings, those nests that experienced brood reduction by siblicide had higher-quality surviving siblings (as measured by weight and feather development) than nests where brood reduction occurred by starvation. If there is an inability to raise all three offspring, early siblicide seems to produce the best result from the perspective of parental fitness.

### ***Mammalian Siblicide***

*Spotted hyenas.* Siblicide is relatively rare among mammals. The spotted hyena (*Crocuta crocuta*) has received a great deal of attention with regard to its intense sibling competition; much of it focused on whether siblicide in this species is obligate or facultative.

Observational evidence suggests that siblings kill approximately one-quarter of cubs, half of those born to same-sex litters in which sibling competition is increased compared to opposite-sex litters (Frank et al. 1991).

Spotted hyenas are found in sub-Saharan Africa and their cubs are born in underground dens. In addition to their siblicidal behavior, the species is also well known for the strong degree to which females are masculinized, anatomically and behaviorally, by exposure to high levels of androgens during development. Neonates also show high levels of androgens. Cubs also experience precocial motor development. At birth, their eyes are open and they have fully erupted front teeth. These teeth are used to bite and shake their sibling rivals. Spotted hyenas usually give birth to a pair of cubs. Aggressive fighting peaks in the 48 hours immediately after birth (Frank et al. 1991; Smale et al. 1995). By this time, dominance has been clearly established. In same-sex litters, the subordinate sibling may die, but in mixed-sex litters, both usually survive. When three cubs are born, the third almost always perishes. While some researchers thought this might be an example of obligate siblicide, recent evidence from wild and captive populations indicates that facultative siblicide is the more likely explanation (Smale et al. 1999; Wahaj et al. 2007). When food resources are insufficient to raise two cubs, the early aggression to establish dominance can be deadly to the subordinate cub, if not by direct siblicide, then indirectly by starvation when the dominant cub monopolizes the food supply.

A long-term study of maternal provisioning and cub survival in the Serengeti (Hofer and East 2008) found an increase in the incidence of siblicide as the average cohort growth rate declined (due to fluctuations in prey abundance). In siblicidal litters, the dominant cub's growth rate increased substantially once their other cub died. The result was a siblicidal-cub growth rate similar to that of a singleton cub with a corresponding increase in expected survival. It was a clear example of a facultative response to fluctuating nutritional resources.

*Galapagos fur seals.* Like the hyena, the Galapagos fur seal (*Arctocephalus galapagoensis*) experiences high resource uncertainty. In addition, they take a long time to wean and, as a result, can often have overlapping successive young with 5–23% of pups born while an older sibling is still being nursed. Such younger siblings have a lower birth weight, grow less, and suffer higher early mortality than those without a currently nursing older sibling. Many of these sibling pairs are also half-siblings, sharing a mother but with different fathers and about half of the older siblings will harass the younger ones, biting them and/or chasing them away from the mother (Trillmich and Wolf 2008). Mothers frequently interfere in such disputes, using threats or biting the older sibling to discourage attacks on the younger one. However, even without direct attacks, scramble competition for a limited milk supply can sometimes be lethal, with the older pup leaving insufficient milk for the younger one.

## Sibling Conflict in Humans

As illustrated by the quotes at the beginning of this chapter, sibling relationships in humans are often complicated. Indeed, most sibling relationships can be characterized as treading a fine line between love and hate, especially during childhood and adolescence. Animosity and conflict among siblings, although it can be quite intense at times, is thought to be a normal part of development (Cicirelli 1995). As such, this conflict has been shown to hold both potential benefits as well as potential costs for psychosocial and cognitive development. Potential benefits of sibling conflict may include greater empathy and perspective taking (Dunn and Brown 1994; Dunn and Slomkowski 1992) as well as valuable practice in social negotiation, producing greater problem-solving and conflict-resolution skills (Azmitia and Montgomery 1993; Campione-Barr and Smetana 2010). Especially coercive, unresolved, and intense sibling conflict may lead to psychological, behavioral, and academic problems by early and middle adolescence including peer rejection and delinquent behavior (Bank et al. 2004; Cohen 2004). Also, in extreme cases, sibling conflict can lead to siblicide, although this is rare in human siblings, as discussed later.

From an evolutionary perspective, sibling conflict (among human and other non-human species) stems from rivalry over limited resources. Specifically, for human siblings, this means competition over limited parental resources (e.g., attention, time, and money in modern societies versus limited food and basic resources such as shelter across our evolutionary past). As such, more conflict would be expected

in families that have more limited parental resources as well as larger numbers of siblings. In relation to family size, evidence suggests that while fewer siblings are associated with more severe acts of violence, more siblings are associated with more overall incidents of violence (Straus et al. 2006). Investigations of proximate explanations have found the most common sources of sibling conflict to involve issues of relative power, self-interest (e.g., sharing of personal items), violation of rules (e.g., perceived immaturity and inappropriate behavior), and interests outside the family (McGuire et al. 2000). The most commonly cited source of conflict by both older and younger siblings has been the sharing of personal possessions, and the least commonly cited source has been competition over parental attention. This has been a consistent finding in studies conducted with toddlers and preschool-aged siblings (Dunn and Munn 1987; Stenimetz 1977), school-aged siblings (McGuire et al. 2000), as well as adolescent siblings who noted conflict over personal space and possessions as not only the most frequent source of conflict, but also the most intense one (Campion-Barr and Smetana 2010). Given the consistency of these findings, it has been suggested that sibling conflict may be a process by which children learn their place in the world, learn how to set personal boundaries, and (especially for young adolescents) learn to assert their independence and claim autonomy over their personal choices (McGuire et al. 2000).

In a recent study conducted in our lab, participants were asked to describe the times when they fantasized about aggressive encounters with a sibling. Many reported conflicts over personal possessions and a sense that they were treated differently, or rather that their sibling got special treatment. For example:

When she becomes violent, I sometimes wish that I could retaliate. If I come away with a broken nose, obviously it was my fault because I provoked her but if she comes away with so much as a scratch it becomes assault and I'm the villain for not being the bigger person.

I also imagined myself beating him up...unrealistic since he was so much bigger in size than me.

My sister has been so frustrated with my sarcasm and back-sass that she claimed she wanted to kill me with several different details involving weapons blood and gore.

...there were so many revenge thoughts going through my head...I wished that he didn't exist.

Relative to other types (e.g., parent-child and spousal violence), sibling violence is the most common form of family violence. Interestingly, since it is considered to be a normal part of family life, sibling violence seems to be acceptable, whereas violence between nonrelated individuals is not. Indeed, many accounts of sibling violence would likely be considered criminal assault if they had occurred outside the sibling relationship, while within the sibling relationship the acts of violence are often considered to be minor offenses. A national study of family violence in two-parent households found that approximately 80% of American children between the ages of 3 and 17 years reported at least one act of violence against a sibling in a typical year (Straus et al. 2006). Within this sample, 74% of siblings reported pushing or shoving a sibling, 48% reported slapping a sibling, 42% reported kicking, biting, or punching a sibling, 40% reported hitting a sibling with an object, and 16% reported beating up

a sibling. The only act of violence that was shown to be more prevalent in parent-child and spousal relationships was the use of weapons (e.g., a gun or knife), which is consistent with siblicide rates being the lowest of family homicides. Although the rates of physical violence decline across development (i.e., with age of the children), it is estimated that nearly two-thirds of teenagers aged 15–17 years still engage in physical aggression with their siblings (Straus et al. 2006).

### *Factors that Influence the Intensity of Sibling Conflict*

The prevalence as well as the intensity of sibling conflict is influenced by many factors. Some proximate influences include temperament and differential parental treatment, while some ultimate or evolutionary influences include relatedness, gender, birth order, and birth spacing. We discuss both sets of factors.

*Temperament.* Personality differences—or differences in temperament of younger children—have been associated with sibling conflict (Brody et al. 1987). In female sibling pairs, both older and younger sisters with higher activity and emotional intensity levels were found to direct more aggressive (and less prosocial) behavior toward their sibling. In male sibling pairs, however, high activity levels of the younger brother and high emotional intensity of the older brother predicted more conflictual interaction between the siblings. In the male sibling pairs, any aggressive behavior from the younger brother resulted in reciprocation of aggression by the older brother. While the difference in temperament predicted sibling conflict, it should also be noted that the sibling pairs in which both children exhibited high levels of activity and/or emotional intensity exhibited even greater conflict than those pairs in which only one sibling had those temperament traits.

*Differential parental treatment.* Given that sibling conflict can be construed as rivalry over limited parental resources, it makes sense that (1) siblings would be conscious of differential treatment, and (2) noticeable differences in parental treatment between siblings would lead to an increase in sibling conflict. By the age of 3 years, children are sensitive to differences in parental treatment between themselves and their siblings and actively monitor their siblings' relationships with their parents relative to their own (Dunn and Munn 1985). Not only are children sensitive to these differences from a young age, but this differential treatment has also been associated with higher levels of negativity in sibling relationships (Brody et al. 1992a, 1992b). The effect of differential parental treatment on the sibling relationship is moderated by birth order (Shanahan et al. 2008). Specifically, firstborns who recognize differential maternal treatment in favor of their sibling exhibit withdrawal from the relationship. That is, instead of directing aggression at the younger sibling, they tend to decrease levels of warmth and emotional closeness directed to the sibling. Secondborn children, however, respond to differences in maternal treatment in favor of the older sibling by directing more aggression toward that sibling.

*Relatedness.* Hamilton's kin selection theory (1964) predicts that greater genetic similarity should lead to increased levels of cooperation and altruism, whereas less genetic similarity would lead to increased competition. Consistent

with the kin selection theory, findings from twin studies have shown that monozygotic (i.e., identical) twins have higher levels of cooperation across different tasks as well as closer relationships throughout childhood and into adulthood relative to dizygotic (i.e., fraternal) twins (for review, see Segal 2005). Although relatively few studies have investigated the effect of relatedness on sibling relationships, the results of studies that have been conducted are also consistent with the finding of kin selection theory that there is less conflict in full-sibling relationships relative to half-sibling and step-sibling relationships (Hetherington 1988; Pollet 2007).

*Gender.* Boys have more conflict with siblings than do girls (Brody et al. 1985) and opposite-sex siblings have more conflict (although not physical violence) than same-sex siblings (Dunn and Kendrick 1982; Campione-Barr and Smetana 2010). Older female siblings are more likely to help take care of younger siblings, and as a result have less conflictual relationships with younger siblings than do older male siblings (Cicirelli 1994; Hrdy 2005). Gender differences in closeness of sibling pairs continue into adulthood with sister–sister pairs having closer and stronger relationships relative to brother–brother and brother–sister pairs (Campione-Barr and Smetana 2010; Pollet 2007). Investigations of sibling violence have found that boys are more violent toward siblings than are girls and the highest level of violence occurs between brothers (Straus et al. 2006). Across all ages, girls are less likely to use physical violence than are boys, regardless of the sex of their siblings. Boys, however, are less violent with sisters relative to brothers or brother–sister mixes, and girls with brothers tend to be more violent than girls with sisters.

*Birth order.* Evidence suggests that middleborn children perceive their parents in a less positive light than do first- and lastborns, preferring to have a close relationship with a friend over kin (Salmon 2003; Salmon and Daly 1998). Firstborns are more likely to maintain a close contact with siblings and invest more in siblings relative to laterborns (Pollet and Nettle 2009). There are also birth-order differences in terms of sources of sibling conflict. Older siblings report issues centering around the younger sibling's immaturity, whereas younger siblings report issues centering around rejection by (and aggression from) the older sibling (Buhrmester and Furman 1990; Ross et al. 1994).

*Birth spacing.* The effects related to birth-order effects are of birth spacing. During childhood, greater birth spacing leads to a reduction in conflict; however, in adulthood, greater birth spacing is associated with less contact and less close relationships between siblings (Pollet 2007). Close birth spacing has been associated with not only increased conflict over parental resources, but also detrimental effects on development and health (Miller et al. 1992; Powell and Steelman 1993; Rustein 2005). It has been noted that most sibling conflict occurs between siblings who are within two years of age, presumably because they have similar need of parental resources (Cicirelli 1995).

## **Siblicide in Humans**

The most extreme form of sibling conflict is siblicide, in which one sibling kills another. While siblicide is much more common in many other animal species, as discussed previously (Mock and Parker 1998), it is rare in humans. In fact, family homicides (e.g., intimate partner homicides, filicides—parents killing their offspring, parricide—children killing their parents, and siblicides) in general are not common, and siblicide is the rarest form of family homicide (Diem and Pizarro 2010). Siblicides have been estimated to make up only 1.4–2% of all homicides in Detroit and Canada (Daly and Wilson 1988; Bourget and Gagne 2006) with the majority (over 70%) of siblicides being brother-killing-brother (Gebo 2002; Underwood and Patch 1999). Consistent with these focused samples, national studies on homicide rates in the USA have estimated that approximately 1.5% of all homicides are siblicides (Sussman and Steinmetz 1987). Evidence from investigations of siblicide has indicated that when they do occur, siblicides are typically due to competition over very limited resources (Daly and Wilson 1988; Pollet and Hoben 2011). Some cultures (e.g., some Islamic societies) condone “honor killings” of females by male family members, most commonly committed by her brother, which center around protecting a family’s honor by ridding itself of a female whose sexual reputation is not chaste and pure. Overall, consistent with predictions from Hamilton’s kin selection theory (1964), it is more likely that siblings will form alliances to protect their common interests from nonkin rather than kill each other.

While the developmental literature indicates that most siblings grow out of intense conflict and rivalry when they reach adulthood and leave their parents’ home (Buhrmester and Furman 1990), siblicide is most likely to occur when this is not the case. Therefore, although rare, siblicides do occur and have been proposed to be a result of sibling rivalry, stress, unresolved conflicts, mental illness, and substance abuse (Ewing 1997). The majority of siblicides are committed by adult siblings who are still living together in intense competition for parental resources, status, and power. Furthermore, there is an increased risk of siblicide occurring with unemployment and/or substance abuse of the adult siblings. Based on homicide data from 1988 covering 33 counties across the USA, it was found that alcohol was involved in approximately 50% of siblicides and mental illness was involved in approximately 20% of the incidents (Dawson and Langan 1994).

### ***Factors that Influence the Likelihood of Siblicide***

There are several factors that may influence the likelihood that one sibling would kill another. Some proximate influences (a few of which were mentioned above) include poverty, mental illness, substance abuse, and social disorganization (Diem and Pizarro 2010; Ewing 1997). From an evolutionary perspective, ultimate influences include age (or birth order), gender, and degree of relatedness, which we focus on in this section.



*Age and Birth Order.* Siblicide is most likely to occur in early and middle adulthood, not in adolescence as might be expected (Underwood and Patch 1999). Indeed, according to United States Federal Bureau of Investigation Supplementary Homicide Reports from 1976 to 1994, 78% of siblicides that occurred in the USA involved adult victims and perpetrators (Gebo 2002). Analysis of siblicide data from 1993 to 1995 found the mean age of siblicide victims to be 33.3 years and the mean age of perpetrators to be 34.4 years (Underwood and Patch 1999). Other analyses have indicated that 86% of victims of siblicide are between the ages of 20 and 59 years (Dawson and Langan 1994).

There is also a convergence of evidence indicating that, consistent with the majority of all homicides, the perpetrators of siblicide tend to be younger than their victims. That is, younger siblings tend to murder older siblings (Daly et al. 2001; Gebo 2002; Marleau and Saucier 1998; Underwood and Patch 1999). Siblicides are most likely to occur when the victim and perpetrator are within 5 years of age of each other. This pattern is reversed, however, for juvenile siblicides in which both the victim and perpetrator are under the age of 18. In juvenile siblicides, older siblings are more likely to murder their younger sibling, a pattern that emerged in 65% of juvenile siblicides in one study (Daly et al. 2001; Gebo 2002).

What could account for a younger sibling being more likely to kill an older sibling? A cross-cultural investigation of siblicide found the most common sources of conflict leading to siblicide included arguments over familial property, money, authority (i.e., specifically an older adult sibling asserting authority over a younger adult sibling), and entitlement (Daly et al. 2001). These findings were consistent across Japanese, American, British, Canadian, and tribal society samples in which the older sibling has privileged status over the younger sibling. Therefore, siblicides in which a younger sibling kills an older sibling appear to revolve around a power struggle, with the younger sibling defying the presumed authority of the older sibling and asserting his own dominance in the relationship.

*Gender.* Male-on-male homicide is most common, overall, and the same is true for siblicide. Males are more likely to kill their brother and are, therefore, much more likely to be both the perpetrators and victims of siblicide than are females (Daly et al. 2001; Gebo 2002; Underwood and Patch 1999). Females are more likely to be the victims of siblicide than they are perpetrators. Indeed, it has been found that 76.1% of siblicides were brother killing brother, 11.9% were brother killing sister, 8.2% were sister killing brother, and 3.9% were sister killing sister (Underwood and Patch 1999). This same distribution in frequency of gender-dyad siblicides has been found across several studies (Daly et al. 2001; Gebo 2002; Marleau and Saucier 1998). This is consistent with the expectation that same-sex sibling rivalry would be more intense than opposite-sex sibling rivalry, as there would likely be more direct competition over the same parental resources and attention, especially when the siblings are closer in age.

*Relatedness.* Although the predictions for the role of relatedness in siblicide are clear from an evolutionary perspective, the existing literature on the relationship is somewhat unclear. This is due to two main reasons: (1) the relationship has been greatly understudied (i.e., there have only been a couple studies on this issue) and (2)



the lack of clear relatedness information in the available homicide data sets. An evolutionary perspective would suggest that degree of genetic relatedness would moderate sibling relationships such that higher relatedness would lead to less conflict (and hence less incidence of siblicide). That is, siblicides involving full siblings would be expected to be less prevalent than siblicides involving half-siblings and step-siblings. The existing data to date, however, do not seem to support this prediction.

In the first investigation of the relationship between relatedness and siblicide, approximately 93% of siblicides were found to involve full siblings, approximately 4% involved half-siblings, and approximately 3% involved step-siblings (Russell et al. 2007). Although this finding was contrary to what would be expected, there was a trend in the data suggesting that siblicides among full siblings were less brutal than those among half-siblings and step-siblings. Specifically, it was found that 6% of full-sibling siblicides involved brutal beating murders relative to 12.5% of the half-sibling and step-sibling siblicides. This trend is consistent with findings that stepparents (acting out of anger and resentment) typically use more brutal methods to murder children than do genetic parents (Daly and Wilson 1994a). It would be expected that half-siblings and step-siblings would not experience the same level of closeness that full siblings would and therefore would be more likely to act out of anger and resentment of the half/step-sibling receiving parental resources they feel should be directed more toward themselves.

In an attempt to increase the sample size, a second follow-up study investigated the relationship between relatedness and siblicide in a 60-year period in Chicago (Michalski et al. 2007). This study, however, did not really address relatedness of siblings but rather looked at homicides committed by full siblings versus siblings-in-law (no genetic relatedness at all, but rather affinal kin). Again due to a small sample size, the result did not reach significance, but the authors did find a trend of more accidental deaths among full siblings and more deliberate, intentional siblicides among siblings-in-law.

Therefore, the question of the relationship between genetic relatedness and siblicide remains largely unanswered, and more studies are desperately needed in this area (also pointed out by Gebo 2002). One major problem (and obstacle) leading to the apparent lack of support for the evolutionary prediction of fewer siblicides occurring among full siblings is the lack of clear relatedness information in the homicide records. For example, analysis of this topic would require information not only about degree of relatedness, but also about how long the children lived together in the same household, the history and degree of their interactions, as well as information about the population of full-sibling households versus half-sibling and step-sibling households overall. Without detailed information, we are unlikely to be able to get a clear answer regarding the role of relatedness on siblicide.

## Conclusion

In this chapter, we discussed factors that influence sibling conflict and (in its most extreme form) siblicide among human and nonhuman animals. Although siblicide is much more rare in humans than in many nonhuman animals, to some extent

they share the same underlying cause—that is, availability of resources. Whereas siblicide among nonhuman animals is more likely to occur at younger ages with the older sibling killing the younger sibling, siblicide among humans is more likely to occur in adulthood with the younger sibling killing the older sibling. Proximate factors that contribute to intensified conflict among human siblings include temperament (with more conflict among siblings when at least one has high activity and/or high emotional intensity levels) and differential parental treatment (with recognition of more favorable parental treatment toward one's sibling leading to greater conflict). Ultimate factors that contribute to intensified conflict among human siblings include gender (with males being more aggressive toward siblings and brother–brother pairs experiencing the greatest conflict), birth spacing (with more conflict between siblings close in age as they compete over similar parental resources), and relatedness (with greater conflict and competition among half- and step-siblings relative to full siblings). Although available research on this topic seems consistent with predictions from the evolutionary theories of parent–offspring conflict and kin selection, conflict within human sibling relationships (especially siblicide) is still understudied and not fully understood. One key area that requires further investigation is the influence of genetic relatedness on human siblicide as a main effect, as well as potential interactions between degree of relatedness and other factors known to lead to greater conflict among siblings.

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