



Adaptations to avoid victimization

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ABSTRACT

From an evolutionary perspective, victims are individuals who incur fitness costs as the result of the actions of external agents. The external agents that inflict the costs are often other humans. In the evolutionary past, there were recurrent contexts of conflict in the fitness interests of different individuals. Evidence suggests that many instances of the infliction of costs on conspecifics are the evolved products of adaptations that function to acquire and control fitness-enhancing resources and goals. We propose that an antagonistic, co-evolutionary arms race that has churned through the deep time of human evolutionary history has produced adaptations to strategically exploit others and defenses to avoid the costs of victimization.

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Contents

1. What is a victim?	60
2. Why are some behaviors considered crimes?	60
3. Ancestral contexts selecting for criminal behavior	60
3.1. Conflict over status	60
3.2. Conflict over resources	61
3.3. Conflict over mating	61
4. Dangers of inflicting costs on conspecifics	61
5. Coevolution of cost-infliction and victim defenses	61
6. Three temporal contexts of victim defenses	62
6.1. Pre-victimization adaptations	62
6.2. In flagrante victimization adaptations	62
6.3. Post-victimization adaptations	62
7. Adaptations to damage status	62
8. Victim defenses against status damage	63
9. Adaptations for theft and cheating	63
10. Victim defenses against theft and cheating	63
11. Adaptations for violence	63
12. Victim defenses against violence	63
13. Adaptations that produce rape	64
14. Victim defenses against rape	64
15. Adaptations that produce homicide	64
16. Homicide as a byproduct of other evolved mechanisms	64
17. Fitness costs of being killed	64
18. Victim defenses against homicide	65
19. The nature of selection for homicide defense adaptations	65
20. Avoiding contexts where homicide is likely	65

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21. Defending against a would-be killer	66
22. Stanching the costs of homicide of genetic relatives	67
23. Evidence of adaptations for homicide and homicide defenses	67
24. Managing errors to avoid homicide	68
25. Secrecy as a defense against homicide	69
26. Killing in self-defense: preemptive homicide to prevent being killed	69
27. Concluding comments	70
References	70

1. What is a victim?

For forensic psychologists who work within the legal system, victims represent a restricted class of individuals—people who have costs defined by legislators to be criminal inflicted on them by others. An evolutionary exploration of victimization demands a more inclusive definition. We argue that the genetic relatives, romantic partners, and close allies of the primary victims of exploitative or violent strategies also can incur substantial costs, making them secondary victims of the exploitation or violence. Because natural selection operates through the differential replication of genes (Hamilton, 1963), costs to genetic fitness resulting from the victimization of one family member are shared across the person's genetic relatives. Closer genetic relatives share more copies of the victim's genes, making the costs inflicted on close relatives greater than those incurred by more distant genetic relatives. Spouses and close social allies can also be secondary victims, incurring costs as a result of loss of investment, protection, and perhaps gaining a reputation of being vulnerable to exploitation (Buss & Duntley, 2008; Duntley, 2005). We hypothesize that selection operated to produce adaptations in both primary and secondary victims of cost-inflicting behaviors generates strategies to eliminate or decrease the costs of victimization.

2. Why are some behaviors considered crimes?

Of all the human behaviors that inflict costs on others, only a subset is considered criminal. How do individuals and societies decide whether a behavior should be legally vilified? We propose that many of the behaviors that societies criminalize share one and usually more of the following characteristics: (1) they lead to a substantial negative impact on the inclusive fitness of the victim; (2) they are motivated by the perpetrators pursuit of personal gain rather than a desire to avoid being the victim of others' cost-inflicting strategies; (3) the specific cost-inflicting behaviors used or the contexts in which they were used are predictive of an increased likelihood of re-offending; (4) the victims are having something done to them against their will; (5) the victims have limited or no ability to effectively avoid, deter, or address the cost-inflicting behavior themselves; and (6) the cost-inflicting behavior, if not addressed, could negatively impact the fitness of members of the broader social group. This evolutionary conception of criminality clearly does not capture all behaviors that legislatures have deemed criminal and likely includes other behaviors that are not criminal. However, we suggest that, for the most part, behaviors that are cross-culturally agreed upon to be criminal do intuitively resonate with evolved social emotions that form the foundation of our sense of fairness (see Krebs, 2008; Petersen, Sell, Tooby, & Cosmides, 2010; Tooby & Cosmides, 2010).

Many of the laws prohibiting cost-inflicting behaviors and the enforcement of those laws are argued to be outcomes of evolved psychological mechanisms. Individuals with psychological predispositions to prevent being victimized and to punish those who inflict costs would have had an evolutionary advantage over competitors lacking them. Because every individual in a group would benefit from preventing others from victimizing them, it is likely that selection favored cooperation among members of the same social group for the prevention and punishment of cost-inflicting behaviors against other members of the in-

group (Cosmides & Tooby, 2005, 2006; Petersen et al., 2010; Tooby & Cosmides, 2010).

3. Ancestral contexts selecting for criminal behavior

Evolutionary processes favor the context-specific expression of behavioral strategies that produce better inclusive fitness outcomes than those produced by competing alternatives. For some contexts, such as big-game hunting, cooperation between hunters would have produced the greatest inclusive fitness benefits for the individual hunters given that their individual contributions were proportional to the amount of benefits they received. Certain other ancestral contexts, however, lead to conflict in the fitness interests of the parties involved. A strategy that ancestrally enhanced the inclusive fitness of one individual would have simultaneously decreased the fitness of another. In mating relationships, for example, the optimal timing and frequency of intercourse for the sexes differ. Men benefit from sex earlier in a relationship and more frequent sex to produce a greater number of offspring. Women benefit from delaying sex until later in a relationship and less frequent sex so that they may acquire more information to evaluate a male partner's potential as a long-term mate and maintain a safer inter-birth interval (Buss, 2003a, b). Research has demonstrated that men employ strategies to get women to mate beyond their optimum, which benefitted the average fitness of ancestral men at a cost to women, and women employ strategies to get men to mate below their optimum, which benefitted the fitness of ancestral women at a cost to men.

Criminal cost-inflicting strategies come in many guises, including robbery, assault, rape, and murder. Many of these have been proposed to result from the operation of psychological adaptations. Researchers have found evidence that psychological adaptations contribute to the production of spousal violence (Buss & Shackelford, 1997a), stalking (Duntley & Buss, in press), aggression (Buss & Shackelford, 1997b; Campbell, 1993; Daly & Wilson, 1988), rape (Thornhill & Palmer, 2000), and homicide (Daly & Wilson, 1988). Victims of these crimes incur costs ranging from strategic interference with evolved goals to death. Perpetrators, however, can reap significant benefits from their cost-inflicting behaviors. Like conflict between the sexes in the optimal timing and frequency of mating, significant conflicts in the fitness interests of perpetrators and victims are inherent in behavioral contexts considered to be criminal.

The conflict that exists between individuals is tempered by genetic relatedness (Hamilton, 1963). Because selection operates by differential replication of genes, individuals should have evolved predispositions to favor genetic relatives over non-relatives. Closer genetic relatives should experience less conflict over resources than more distant relatives or unrelated individuals. To identify which individuals experience the greatest conflicts in their respective fitness interests, it is necessary to explore the adaptive problems leading to conflict between individuals.

3.1. Conflict over status

One broad context of ancestral conflict was over position in status hierarchies. All available evidence indicates that high-status men have sexual access to a larger number of women (Perusse, 1993).

Men who are high in status also seek younger and more fertile women (Grammer, 1992), and marry women who are more attractive (Taylor & Glenn, 1976; Udry & Eckland, 1984) than their low-status rivals. Although no comprehensive evolutionary theory of the importance of status over human evolutionary history has yet been proposed (Buss, 2004), the potential for large fitness gains associated with increases in status would have created selection pressure for cognitive adaptations that produce desires and behaviors that lead to hierarchy ascension and prevent large status falls.

3.2. Conflict over resources

A second context of ancestrally recurrent conflict was conflict over material resources that helped to solve recurrent adaptive problems. Such resources included territory, food, weapons, and tools. There was also conflict over individuals who were the suppliers of material resources, such as conflict between siblings for investment from their parents and elder kin (Parker, Royle, & Hartley, 2002) and conflict between women for men with resources (Buss, Larsen, & Westen, 1996; Buss, Larsen, Westen, & Semmelroth, 1992). The scarcer and more valuable the resource in terms of its contribution to an individual's reproductive success, the greater the conflict between individuals over access to the resource.

3.3. Conflict over mating

Men and women face different adaptive problems of mating in some domains. For example, women's typical minimum obligatory investment in reproduction is nine months, longer if time spent breast feeding is included. Men, in contrast, can invest as little as a few hours or a few minutes to produce the same child that requires months or years of investment from women. Because women's minimum obligatory investment in reproduction is greater, the costs of a poor mate choice are greater for women than for men (Trivers, 1972). As a result, women tend to be choosier when selecting mates in short-term mating contexts where the discrepancy in parental investment between the sexes is great. There is also conflict between the sexes about the timing of sexual activity, or indeed whether sex occurs at all with a particular partner. Because sex is less costly for men than for women, men tend to desire sex earlier in romantic relationships, and with less investment, than do women (Werner-Wilson, 1998). Men also desire a greater number of sexual partners than do women (Schmitt, Shackelford, Duntley, Tooke, & Buss, 2001) and are more inclined to short-term, uncommitted sex (Buss, 2003a). The differences in men's and women's sexual desires are a clear source of evolutionarily recurrent conflict between the fitness interests of the sexes (Buss, 1989; Buss, 2000; Buss & Shackelford, 1997b), and central to understanding the evolution of the psychology of victims of crime.

Women are biologically limited in the number of offspring they can bear in their lifetime. Once a woman is pregnant, additional sex partners will not lead her to have additional offspring. For men, however, short-term sex with multiple partners can lead to additional offspring. Men's rate of reproduction is limited primarily by the number of females they can impregnate. Given an equal sex ratio in the mating pool, men who impregnate more than one woman or who have more than one long-term partner at any time effectively deprive other men of mates. Competition between men over mating opportunities with women is a central source of conflict in the fitness interests of male rivals.

Human polygynous mating systems, in which some males may have more than one mate at a time, lead to greater reproductive success for the polygynous men and zero reproductive success for many of their competitors. Over evolutionary time, the greater reproductive variance among men selected for more extreme and risky male strategies to acquire and retain mates. Daly and Wilson (1988) argue that sex differences in the use of risky strategies, such as violence and

homicide, are an outcome of this unique selection pressure on men. Over evolutionary time, men who failed to take risks would have been at a disadvantage in competition for mates and, therefore, less likely to leave descendants (Daly & Wilson, 1988; Kruger & Nesse, 2004; Wilson & Daly, 1985).

Fitness conflicts between the sexes also result from the fact that fertilization occurs internally within women. As a result, women are always certain that the offspring that they bear are genetically related to them. Men, however, are always less than certain of their paternity (Buss, 2003a, b; Symons, 1979). Men's paternity uncertainty has been proposed to be the primary selective impetus for the finding that men's jealousy, more than women's jealousy, centers on the sexual aspects of a partner's infidelity (Buss & Haselton, 2005; Buss et al., 1992).

In the ancestral past, men and women also differed in the greatest threats to their long-term romantic relationships. A partner's sexual infidelity was more costly for men who might subsequently invest their limited resources in another man's child rather than their own. A partner's emotional infidelity was more costly for women who could suffer a decrease or loss of their male partner's investment that could be critical for the women's survival and that of their dependent children. Sex differences in the costs of threats to long-term romantic relationships are hypothesized to have selected for more cost-inflicting behaviors perpetrated by men in response to contexts of sexual infidelity and more cost-inflicting behaviors perpetrated by women in response to contexts of emotional infidelity. Both men and women may use cost-inflicting behaviors to address each of the fitness conflicts discussed. However, across contexts in which women utilize cost-inflicting behaviors, we hypothesize that they will be less risky than those used by men.

4. Dangers of inflicting costs on conspecifics

There can be dangers associated with adopting a strategy of cost-infliction against competitors. Individuals who inflict costs on others may gain unfavorable reputations, become injured, or may die as a result of carrying out their attacks. Because of the potential dangers, the use of cost-inflicting strategies to best competitors should be most likely when the contested resources are rare and have a great potential to enhance fitness. For example, men who hold high positions in status hierarchies have greater success in attracting mates than do lower status men (Buss et al., 1990). High status positions in social hierarchies are thus rare and valuable for the reproductive success of men, and would have created selection pressure for deploying strategies capable of increasing status, including tactics of cost-infliction on rivals. In contrast, there would not have been selection pressure to compete against others for plentiful, easily obtainable resources (or to struggle to control items or entities that contributed little to human reproductive success).

5. Coevolution of cost-infliction and victim defenses

Coevolutionary arms races are part of the evolutionary history of all species. They can occur between species, as with predators and prey (Barbosa & Castellanos, 2005), or within species between competing adaptations in contexts of social conflict (Buss, 1988, 1996). Coevolutionary arms races can create massive selection pressures, capable of producing rapid evolutionary change (Phillips, Brown, & Shine, 2004). Any recurrent context of conflict between individuals that has a large fitness impact can lead to the coevolution of competing strategies to best a competitor or to defend against being exploited.

We propose that the evolution of adaptations to inflict costs created selection pressures for the coevolution of counter-adaptations in victims to avoid or prevent incurring the costs. The strength of the selection pressure for victim adaptations is a function of the amount of costs inflicted, the frequency of such costs over evolutionary time,

and the certainty that the costs will be incurred by victims. The evolution of adaptations to prevent victimization subsequently creates new selection pressures for refinements of adaptations designed to inflict costs. These refined adaptations for cost-infliction, in turn, create new selection pressures for refined victim adaptations capable of defending against the new cost-inflicting strategies. Antagonistic, co-evolutionary arms races like this are hypothesized to have recurred over human evolutionary history.

Victim adaptations to competitors' cost-inflicting strategies can only evolve when the strategies have been recurrent in predictable contexts over evolutionary time. Adaptations are more likely than byproducts of adaptations or noise to produce evolutionarily recurrent, contextually predictable behaviors. Moreover, many evolved counter-adaptations function by making a competitor's cost-inflicting behavior too costly to perform. This would create selection pressure against the cost-inflicting strategy. If a cost-inflicting strategy persists over evolutionary time despite the costs perpetrators incur from victim defenses, then the cost-inflicting strategy may be functional in producing a net benefit in a particular context. Evidence of such functionality and corresponding complexity of design in adaptations and defenses are evidence of adaptation.

6. Three temporal contexts of victim defenses

There are important differences between the form and function of victim defenses depending on when they are enacted. Victims can defend themselves from the cost-inflicting strategies of others: (1) before the victimization occurs, (2) while the cost-inflicting event is occurring, or (3) after being victimized. Each of these categories of victim defenses was selected for by the outcomes of victimization. We hypothesize that the strength of selection pressures operating to design adaptations to address each temporal context varies as a function of the nature of the costs inflicted. For example, there would be selection pressures on victim adaptations against rape in all three temporal contexts. Women should have adaptations to avoid victimization, to minimize costs during victimization, and to take steps to prevent future victimization in the aftermath of rape. However, there would not be selection pressures on all three temporal contexts of primary victims' adaptations against being murdered. The primary victims of homicide are incapable of directly influencing events after their deaths.

6.1. Pre-victimization adaptations

The best defense against being victimized is to never become a victim. To the extent that strategies of cost-infliction were perpetrated by predictable conspecifics in predictable contexts there would have been selection pressures for the evolution of defensive adaptations to avoid them. Individuals with psychological mechanisms that led them to recognize situations and competitors associated with a higher likelihood of incurring the costs and avoiding those situations and competitors would have had a large fitness advantage over others who lacked such mechanisms. Fear while walking through dark alleys at night, of people who seem "shifty," and stranger anxiety in infants are examples of the hypothesized outcomes of adaptations to prevent falling victim to the cost-inflicting strategies of others.

6.2. In flagrante victimization adaptations

Selection also shaped adaptations to minimize the costs of victimization while it is occurring. Defensive postures, verbal attempts at manipulation, and seeking or creating opportunities to flee an attacker are defensive strategies hypothesized to have been selected because they decreased the costs of victimization. Curling into a fetal position may help to deflect the blows from an attacker away from a victim's head and internal organs. The use of language to activate sympathy or empathy in an attacker, or to frighten an attacker

away, may be effective in decreasing the duration or severity of the cost infliction. Creating or waiting for an event that distracts an attacker, or temporarily incapacitating an attacker, might give victims an opportunity to escape or to hide and seek protection, decreasing the magnitude of costs they might otherwise have incurred.

6.3. Post-victimization adaptations

Finally, we hypothesize that selection shaped victim adaptations activated after the occurrence of the cost-inflicting event that function to minimize the impact of the victimization and to prevent future victimization. For example, acting as though the injuries sustained during a fight are not as debilitating as they actually are, or verbal assaults on an attacker that impugn the effectiveness of the person's attack, such as "you punch like a 3 year-old," may decrease the status loss associated with being beaten in a fight.

There are numerous avenues for the prevention of future occurrences of victimization. One is the learning of cues to danger. By recognizing and subsequently avoiding dangerous contexts and individuals, victims will be less likely to incur costs in similar contexts in the future. A person victimized in a certain part of a city, for example, subsequently may be motivated to avoid that part of the city. Similarly, a victim may avoid future interactions with an attacker. Victims also may be proactive in avoiding conflicts by fortifying defenses against future attacks by conspecifics. For example, carrying a weapon for self-defense may decrease the likelihood of incurring serious costs in future confrontations.

Another avenue for the prevention of future victimization is to retaliate against an attacker. Demonstrating an effective ability to retaliate may decrease the likelihood of future victimization by sending a message to the perpetrator and others that attacks or exploitation will be punished. Revenge has been suggested to be wired into our psychology by natural selection (Buss & Duntley, 2006). fMRI research has demonstrated that pleasure centers of men's brains become activated upon succeeding in contexts of revenge against someone perceived to have perpetrated a wrong (Singer et al., 2006). This suggests that the motivation for men to seek revenge may have evolutionary underpinning and supports the contention that maintaining status in social competition was important for the reproductive success of ancestral men.

Selection pressures for each temporal category of victim adaptations were unlikely to be equal. Because avoiding victimization entirely was ancestrally associated with the lowest costs, we hypothesize that there was proportionally more selection pressure for the evolution of pre-victimization adaptations than for victim adaptations that function during or after victims have incurred costs. As a result, pre-victimization adaptations are hypothesized to be larger in number than the other temporal categories of victim adaptations.

In sum, it is useful to consider three temporal categories of victim adaptations: those aimed at avoiding victimization, those that minimize the costs of victimization while it is occurring, and those that function after victimization to minimize its costs and to prevent its recurrence. The nature of the victimization will determine the degree of selection pressure for adaptations in each of these contexts.

7. Adaptations to damage status

Damaging the reputations of rivals is a cost-inflicting strategy that can lead to fitness benefits. Damage to social reputations leads social allies to value an individual less, making the person less likely to receive social support. A variety of tactics can be effective in damaging the social reputation of rivals, including physical domination, strategic derogation, and public humiliation.

An individual in a group cannot ascend in a status hierarchy without displacing someone above, bumping that person to a lower position than they occupied previously and inflicting costs associated with status loss. Higher status men have greater access to resources and more mating opportunities than lower status men (Betzig,

1993; Buss, 1994; Hill & Hurtado, 1996; Perusse, 1993). Because a larger number of mating opportunities enhances the reproductive success of men more than of women, it is hypothesized that there should be greater status striving among men than among women. Research across the lifespan has found this to be the case, with men placing greater importance on coming out ahead and women more focused on maintaining social harmony (Maccoby, 1990; Pratto, 1996; Whiting & Edwards, 1988).

8. Victim defenses against status damage

A number of victim defenses may have evolved to combat the danger of status loss caused by the cost-inflicting tactics of competitors. First, individuals should be armed with the ability to constantly track their own position in a status hierarchy, while also keeping track of their closest competitors (Buss, 2011, 2008). Individuals should be motivated to gather information about the strengths and weaknesses of their closest status rivals to inform strategies of status defense that may be required in the future. Mechanisms should also exist for tracking one's own social and trait weaknesses that could be exploited by others. A range of social fears, such as fear of public speaking, fear of sexual rejection, fear of nudity, and fear of being cuckolded, could be produced, in part, by proactive victim defenses against having one's weaknesses exploited and being publicly humiliated.

The strategic formation of alliances that will strengthen one's hold on a position in a status hierarchy also can help defend against status assaults from others. Offensive tactics, such as competitor derogation (Buss & Dedden, 1990) can assault the status of those most likely to challenge one's position in the future, forestalling a status conflict. Competitor derogation also may be an effective strategy after a status loss has occurred. Recouping status that has been lost, however, can be a more formidable task than maintaining one's position in a status hierarchy, and may require more drastic measures.

Social status is likely to have been so important to the reproductive success of ancestral men that modern men may resort to violence and even murder in response to public humiliation or challenges to status and social reputation. This made sense in the contexts of small group living in which we evolved (Tooby & DeVore, 1987), where a loss of status could have had devastating effects on survival and reproduction (Buss, 2011, 2008). The outcome of selection for victim adaptations to defend status in the small group living conditions of our ancestors is evidenced today in research conducted on homicidal ideation that finds the most frequent triggers of homicidal fantasies are status-related (Buss & Duntley, 1999), and in research on actual murders, which suggests that reputational damage is part of the motivation for a substantial number of homicides (Daly & Wilson, 1988).

9. Adaptations for theft and cheating

A second strategy of cost-infliction that may be used to gain an advantage in fitness conflicts is to steal resources (see Cohen & Machalek, 1988; Kanazawa, 2008) or to cheat rivals out of their resources. A valuable weapon can be stolen and used against its owner. Valuable territory can be encroached upon and its vegetation, water, shelter, and wildlife exploited (Chagnon, 1996). Mates can be poached from an existing relationship (Buss, 2000, 2003a, b; Schmitt & Buss, 2001). Public knowledge that an individual has been cheated or had valuables stolen also can affect the person's reputation. The person may gain a reputation as one who is easy to exploit, perhaps increasing the likelihood that others will attempt to cheat or steal from the person. An easily exploitable person will likely be less attractive to members of the opposite sex. Cheating or the theft of resources, in short, can be effective strategies of cost-infliction for individual gain.

10. Victim defenses against theft and cheating

To prevent the threat of material resource theft, individuals may have evolved adaptations to defend against theft and being cheated. These mechanisms are hypothesized to motivate people to keep valuable items under protection, to conceal them, or to make valuable commodities seem less desirable to rivals. Humans also may have evolved adaptations to detect those who would cheat them. Deceiving rivals is not the exclusive province of humans and does not require a conscious, deliberate, or intentional component. Deception about the location of a valuable resource, such as food, has been shown to occur in other primates, including tufted capuchin monkeys (*Cebus apella*) (Fujita, Kuroshima, & Masuda, 2002), in pigs (Held, Mendl, Devereux, & Byrne, 2002), and in ravens (*Corvus corax*) (Bugnyar & Kotrscha, 2004).

The ability to detect cheaters in contexts of social exchange is another strategy to prevent the loss of resources to rivals. Sugiyama, Tooby, and Cosmides (2002) found evidence that the ability to detect violations of conditional rules in contexts of social exchange (cheater-detection) is likely a cross-cultural universal. In their research, the Shiwiari hunter-horticulturalists of the Ecuadorian Amazon performed similarly to Harvard undergraduates. Both groups, however, performed poorly when asked to detect violations of conditional rules in contexts other than social exchange.

When the resource that is threatened is a mate rather than a material commodity, Buss and Shackelford (1997a) found that men and women engage in tactics that range from vigilance to violence to defend their relationships. Fueled by jealousy, an emotion absent from contexts of material resource theft, men's tactics of defending against mate poachers were found to be different from women's. Men are more likely to conceal their partners, to display resources, and to resort to threats and violence, especially against rivals. Women are more likely to enhance their appearance and to induce jealousy in their partners, demonstrating their desirability by showing they have other mating options.

11. Adaptations for violence

A third strategy for inflicting costs on rivals is to injure them physically. Individuals should disengage from competition for a contested resource when the inclusive fitness costs of competing become greater than the benefits of controlling the resource. The direct infliction of costs on competitors in the form of violence can help tip the outcome of competition in favor of the individuals who inflict the greater costs, increasing the likelihood that these individuals will control the contested resources. Healthy individuals can compete more effectively than their injured rivals. Rivals may be more likely to avoid or to drop out of competitions with individuals who have injured them in the past. Individuals capable of inflicting greater injuries on competitors than are inflicted on them may gain a reputation as being difficult to exploit. This reputation may protect those successful in the use of violence against violent confrontations and grant easier access to resources with less resistance from competitors.

12. Victim defenses against violence

The most effective strategy for dealing with violence capable of producing injuries is to avoid it altogether. Human adaptations to form alliances may provide one form of deterrence against violent rivals, as it is easier to attack an individual than a group. Adaptations that lead to the avoidance of contexts likely to make one the target of violence may provide another kind of protection against being injured in a violent confrontation. Humans also may possess adaptations designed to attempt to reason with an attacker, describing the possible costs of the person's violent behavior or suggesting other resolutions to the conflict. Finally,

if an attack cannot be avoided, individuals may resort to violence or even murder to defend against an attack (Daly & Wilson, 1988).

13. Adaptations that produce rape

A fourth cost-inflicting strategy aimed directly at obtaining reproductive resources is rape. A rapist may benefit from the behavior by siring offspring that he may not have otherwise produced. Not only does rape inflict terrible emotional costs (Block, 1990; Burgess & Holmstrom, 1974) and physical costs (Geist, 1988) on women, it also inflicts fitness costs by bypassing female mechanisms of mate choice (Buss, 2004). Although some scholars have concluded that there is not enough evidence to determine whether men have adaptations to rape (Buss, 2003a, b, 2004; Symons, 1979), historical records and ethnographies suggest that rape occurs cross-culturally and was recurrent over human evolutionary history (Buss, 2003a, b).

14. Victim defenses against rape

A number of researchers have proposed the existence of anti-rape adaptations. The formation of alliances with groups of other women and with men for protection has been argued to represent evolved counterstrategies to rapists' tactics (Smuts, 1992). The "bodyguard hypothesis" proposes that women's preference for mates who are physically formidable and high in social dominance is, in part, an adaptation to prevent rape (Wilson & Mesnick, 1997). Specialized fears that motivate women to avoid situations ancestrally predictive of an increased likelihood of being raped have been proposed to help preemptively defend against rape. To prevent conception resulting from rape, women may have evolved to avoid risky activities during ovulation (Chavanne & Gallup, 1998). The psychological pain of rape has been argued to motivate women to avoid being raped in the future (Thornhill & Palmer, 2000). In addition, women may possess adaptations to minimize the costs of rape after it has occurred. To avoid the reputational damage that can be associated with rape or to avoid losing their romantic partner, women may feel motivated to keep their ordeal a secret. They may even feel a strong urge to bathe themselves after the event, washing physical evidence of the forced encounter away so it cannot be detected, especially by their romantic partner. Women may seek revenge against their attacker by marshaling male relatives and allies to attack him, especially if the rapist represents a persistent threat to the women or their female relatives. Spontaneous abortion, premature delivery, and infanticide may also represent female defenses to avoid investing in a rapist's child.

15. Adaptations that produce homicide

Buss and Duntley (1998, 1999, 2003, 2004) proposed that humans possess adaptations for murder. According to their Homicide Adaptation Theory, over the long expanse of human evolutionary history, there were recurrent sources of conflict between individuals, such as conflict over reputation and social status, conflict over resources, and conflict over romantic partners. Homicide is unique from non-lethal solutions to conflict because it represents an absolute end to the competition between two individuals. Death is an absorbing state from which no individual organism can escape. It inflicts damage that cannot be repaired or regenerated, terminating the individual phenotype. More specifically, once dead, a person can no longer damage your reputation, steal your resources, prevent you from attracting a romantic partner, or have sex with your spouse.

Homicide is hypothesized to be the designed output of evolved psychological mechanisms. In other words, inflicting an ultimately lethal injury on a rival is the goal of homicide adaptations. Inflicting an unrecoverable injury without immediately killing the victim may sometimes be a better strategy than the outright instant homicide of a rival. The infliction of an unrecoverable injury that slowly kills a

victim through infection or other gradual debilitation is more subtle and may motivate less vengeance in the victim's kin and social allies. With the help of time, age, starvation, pathogens, parasites, and poor wound healing, killers could achieve the evolved goal of eliminating a rival while maintaining some plausible deniability about their intentions to kill.

Killing conspecifics is hypothesized to solve a variety of adaptive problems. Specifically, the killing of a conspecific could have contributed to: (1) preventing the exploitation, injury, rape, or killing of self, kin, mates, and coalitional allies by conspecifics in the present and future; (2) reputation management against being perceived as easily exploited, injured, raped, or killed by conspecifics; (3) protecting resources, territory, shelter, and food from competitors; (4) eliminating resource-absorbing or costly individuals who are not genetically related (e.g., stepchildren); and (5) eliminating genetic relatives who interfere with investment in other vehicles better able to translate resource investment into genetic fitness (e.g., deformed infants, the chronically ill or infirm).

16. Homicide as a byproduct of other evolved mechanisms

Adaptations for homicide need not be involved in the production of all homicidal behavior. Another evolutionary explanation of killing was proposed by Daly and Wilson in their book *Homicide* (1988). According to Daly and Wilson, homicide may be an over-reactive mistake, the byproduct of adaptations designed for non-lethal outcomes. They argue that homicide can be used "as a sort of 'assay' of the evolved psychology of interpersonal conflict and does not presuppose that killing per se is or ever was adaptive" (Wilson, Daly, & Daniele, 1995, p. 276). For example, the behavior of a teenage mother who abandons her newborn in a dumpster to die may be explained by the failure of her psychological mechanisms for parenting to engage. Similarly, in the case of a husband who kills his wife for being sexually unfaithful, Daly and Wilson have argued that male mechanisms for sexual jealousy and evolved desires for the coercion and control of their mates may mistakenly overreact, leading the man to kill his wife. Despite their contention that conspecific killing in humans is a maladaptive byproduct of psychological adaptations, Daly and Wilson (1990) do emphasize that an evolutionary account of homicide is important: "... what is needed is a Darwinian psychology that uses evolutionary ideas as a metatheory for the postulation of cognitive/emotional/motivational mechanisms and strategies" (pp. 108–109).

17. Fitness costs of being killed

Whether or not there are adaptations specifically for homicide, conspecific killing was a recurrent feature of human evolutionary history (Chagnon, 1988; Trinkaus & Shipman, 1993). Examining the costs of homicide through an evolutionary lens elucidates the nature and magnitude of the costs incurred by victims of homicide, and gives us a better understanding of how other humans were significant dangers over our evolutionary history. A victim's death has a much larger impact on his or her inclusive fitness than just the loss of the genes housed in the person's body. The inclusive fitness costs of dying at the hands of another human can cascade to the victim's children, spouse, kin, and coalitional allies. The specific costs include:

Loss of future reproduction. A victim of homicide cannot reproduce in the future with a current mate or with other possible mates. On average, this cost would have been greater for younger individuals than for older individuals.

Damage to existing children. The child of a murdered parent receives fewer resources, is more susceptible to being exploited by others, and may have more difficulty ascending status hierarchies or negotiating mating relationships, which will likely lead to poorer fitness outcomes. Children of a murdered parent may see their surviving parent's investment diverted away from them to

a new mating relationship and to the children who are the product of that relationship. A single parent, who can invest less than what two parents can invest, might abandon his or her children in favor of better mating prospects in the future. And the children of a murdered parent risk becoming stepchildren, a condition that brings with it physical abuse and homicide rates 40 to 100 times greater than those found for children who reside with two genetic parents (Daly & Wilson, 1988).

Damage to extended kin group. A homicide victim cannot protect or invest in kin. A victim's entire kin network can gain the reputation of being vulnerable to exploitation as a result of the person's death. A homicide victim cannot influence the status trajectories or mating relationships of family members. And the open position left by the victim in a kin network's status hierarchy could create a struggle for power among the surviving family members.

Homicide victim's fitness losses can be rival's fitness gains. Killers can benefit from the residual reproductive value and parenting value of the surviving mate of their victim, sometimes at the expense of the victim's children with that mate. A killer can ascend into the vacancy in a status hierarchy left by his victim. The children of killers would thrive relative to the children of homicide victims, who would be deprived of the investment, protection, and influence of a genetic parent. Many family members who would have survived if the person was not killed will die before they can reproduce. And many children who would have been born to members of the family will never be born.

The magnitude of rivals' fitness gains will be heavily dependent on group size. In smaller groups, a slight local increase in resources or mates, following a murder, can bring a substantial benefit to the murderer. In larger groups, however, the fitness benefits could be diluted because the newly available resources could be harder to keep from the hands of a greater number of competitors.

18. Victim defenses against homicide

If homicide recurred in predictable contexts over our evolutionary history, it would have created selection pressures to avoid being killed in precisely those contexts. We propose that the selection pressures created by the costs of being killed were powerful enough to shape distinct adaptations to defend against homicide (Buss & Duntley, under review; Duntley & Buss, 1998, 1999, 2000, 2001, 2002).

The strength of selection for any adaptation, including defenses against being killed, is a function of the *frequency* of the event and the *fitness costs* of the event. Low base-rate events that impose heavy fitness costs, like homicide, can create intense selection pressures for adaptations to prevent or to avoid them. Ancestral homicides, however, may not have been as infrequent as they are in many modern societies. Homicide rates in hunter-gatherer societies, which more closely resemble the conditions in which humans evolved, are far higher than those in modern nations with organized judicial systems (Ghiglieri, 1999; Marshall & Block, 2004).

19. The nature of selection for homicide defense adaptations

Homicide defense adaptations would have been selected for only one function: to avoid the massive fitness costs of being killed. This could have been accomplished by: (1) avoiding contexts that present a high risk of becoming a homicide victim or manipulating the contexts so they were no longer dangerous, (2) effectively defending against conspecific killers who were attacking, and (3) stanching the costs of homicide among genetic relatives of the victim after it occurred.

20. Avoiding contexts where homicide is likely

One of the design features of homicide avoidance mechanisms is sensitivity to cues of high-risk contexts. Cues to the presence of such contexts include:

Who controls the territory one occupies. Who controls the territory an individual is occupying is an important cue that was reliably correlated with the ancestral likelihood of being killed by hostile conspecifics. Individuals are more vulnerable to attack when away from their home territory. Being in a rival's territory or even a neutral territory would be a cue to an increased risk of attack. Chagnon (1996) reports that the Yanomamo sometimes lure members of a rival group to their territory under the auspices of having a celebratory feast. Away from their home territory, the rival group is at a strategic disadvantage. The Yanomamo attempt to lull their rivals into a false sense of security only to ambush them. Individuals should experience more fear of being killed in the presence of cues indicative of being in hostile territory.

Characteristics of the surroundings. Characteristics of the physical surroundings are another source of ancestrally-relevant cues to the likelihood of being killed. It is easier for a competitor to hide in the shadows than in the light. Individuals are more likely to be ambushed in areas where there are visual obstacles than in areas that afford unobstructed visual scanning. An individual is more vulnerable to attack when his back is to an open room than against a wall. Individuals should experience more fear of homicide and ideation that their life may be in danger in the presence of such cues to their vulnerability. Evidence supporting this hypothesis comes from investigations of the Savanna Hypothesis. Kaplan (1992) argued that the process of evaluating landscape involves information-gathering about places for surveillance, places for hiding, refuges from predators, and possible routes of escape.

Characteristics of the rival. Certain personality and life history characteristics of rivals have been recurrently correlated over our evolutionary history with the likelihood that a rival will kill: high levels of narcissism, an anti-social personality, high impulsivity, low conscientiousness, high levels of hostility, and a history of committing acts of violence or homicide against others. A history of violent behavior is one of the strongest predictors of future violence (Douglas & Webster, 1999). The importance of the reputations of rivals in identifying conspecifics who pose an increased threat of killing cannot be underestimated. It is clear from many ethnographies, for example, that some men develop reputations as killers or thugs. The people who live in the same communities as these men give them a wide berth, trying to avoid doing anything that might antagonize them (Chagnon, 1996; Ghiglieri, 1999).

Characteristics of the situation. Specific adaptations have evolved to be sensitive to circumstances ancestrally indicative of an increased probability of being killed. These situations correspond to contexts solvable by homicide and include: injuring, raping, killing, or inflicting other serious costs on a rival, his kin, his mates, or his coalitional allies; damaging a rival's reputation, leading others to perceive him or his genetic relatives as easily exploited, injured, raped, or killed; poaching the resources, mates, territory, shelter, or food that belongs to a rival; absorbing the resources of a non-genetic relative (e.g., stepchildren); interfering with parents' or kin's investment in vehicles who are less able to translate resource investment into genetic fitness (e.g., deformed infants, the chronically ill).

Perhaps the most effective defense against being killed is to avoid situations associated with an increased risk of being a victim of homicide. The experience of fear may be one adaptive mechanism that helps us to avoid them. In his book *The Gift of Fear* (1997), Gavin De Becker argues that fear, when applied appropriately, is a signal that exists to aid in our survival, protecting us from violent situations. It is adaptive to experience fear, he argues, when the fear is enabling—allowing an individual to effectively address the danger he or she faces. Real fear, according to De Becker, “occurs in the presence of danger and will always easily link to pain or death” (p. 285).

Marks (1987) has argued that fear and anxiety can be protective in four primary ways. First, it can lead a person to become immobile. This could help to conceal an individual from a predator or hostile conspecific, allow him time to assess the situation, and perhaps decrease the likelihood of being attacked. This is a valuable strategy when there is uncertainty about whether one has been spotted or cannot determine its exact location of the threat. Second, fear can motivate an individual to escape or to avoid danger in the environment. This can help move one out of harm's way and find a location that provides protection from future interactions with the source of the danger. Third, a person may adopt a strategy of aggression in self-defense. A dangerous conspecific or predator can be frightened away or killed through the successful employment of an aggressive strategy. Finally, an individual can adopt a strategy of submission to appease the source of the hostility, usually a member of the same species. Such strategies of submission are common among social mammals, including humans (Buss, 2004).

Because homicide has unique fitness consequences, we hypothesize that the fear of being killed is a distinct emotional state. We propose that it is accompanied by specific decision rules that function to help individuals defend against being killed by a conspecific. Specifically, we propose that selection fashioned homicide defense adaptations that lead to the avoidance of: (1) unfamiliar surroundings, particularly those controlled by rivals; (2) traveling through locations where one could be ambushed; (3) traveling at night; (4) interacting with individuals who are more likely to kill; and (5) inflicting costs likely to motivate a conspecific to kill you. Rather than consisting of a single, consistent emotional experience, fear is proposed to be expressed in a range of discreet states. As a victim defense, a variety of fears may be experienced, which include, for example: mild anxiety about groups of unknown strangers in the distance; terror that motivates curling into a fetal position if an attacker has knocked one down and is kicking one in the head; battle-numbness that makes one ignore moderate injuries (e.g., a hand having been cut off) if there is still imminent danger from an attacking horde; a specific aversion to sharp incoming projectile weapons that would be likely to inflict unhealable infections if they pierced one's torso.

It is interesting that people in modern environments so willingly expose themselves to experiences that they evolved to fear. More than half of the programs at the top of Nielsen Ratings in a typical week (when the NFL playoffs are not occurring) are homicide dramas or documentaries. Murder mystery novels, monster movies, TV “thriller” series, haunted houses, and Halloween masks all embody perceptual cues that activate victim psychology effectively. Why people—especially teenagers—voluntarily subject themselves to such “aversive” stimuli is an interesting question, and perhaps one that concerns calibration and practice of victim defenses.

21. Defending against a would-be killer

Another protection against homicide is defending against the attacks of another individual. Such strategies can take three primary forms:

1. *Fleeing the potentially homicidal confrontation with the person.* An individual who is successful in fleeing from someone who tried to kill him may then attempt to change the situation in ways that will decrease the likelihood of being killed. One such strategy may be to leave the area he shares with the intended killer. A proposed explanation for human migration out of Africa, across Europe and Asia, and into the Americas was to avoid hostile confrontations with conspecifics (Diamond, 1997; Richerson & Boyd, 1998). Fleeing homicidal rivals can be an effective strategy if the intended victims can move out of their reach. But fleeing often represents only a temporary solution. If nothing about the context of conflict between the would-be killer and intended victim changes, it is likely that a homicidal person will attempt to kill their intended victim again.
2. *Manipulating the situation to make killing less beneficial and more costly.* A person who believes he might be killed may be able to alter aspects of the situation to increase the costs or decrease the benefits of a homicidal strategy, making homicide less attractive than alternatives. Examples include: forging alliances with powerful conspecifics; staying in the vicinity of coalitional allies who may serve as bodyguards; turning members of a group against the person who may intend to kill you; resolving the conflict with the conspecific, such as by some form of payment; helping the rival to salvage or restore his reputation; bargaining or begging for one's life; threatening retaliation by one's kin and coalitional allies; and performing preemptive, perhaps homicidal, attacks against the would-be killer, his kin, or his coalitional allies.

Some of these strategies may be implemented up to the moment that a homicidal behavior is enacted upon a victim. The implementation of these defensive strategies may not always be enough to derail a homicidal strategy in favor of a non-lethal alternative. If not, the person targeted by a killer would have no recourse but to defend against the attack.

3. *Defending against homicidal attacks.* At the point at which a rival is engaging in behaviors capable of killing, it may be too late to flee or derail the homicidal strategy. In such a face-to-face confrontation with a killer, the options are to defend oneself or to die. There are two strategies of self-defense: call for help or physically incapacitate the would-be killer so the intended victim can flee. Screams for help may be uniquely identifiable from other calls for assistance. Selection could have fashioned this kind of honest signal if fitness gains flowed to rescuers, such as the victim's kin or coalitional allies who might benefit from reciprocal exchange with the intended victim or the victim's kin. “Death screams” or screams in terror (Buss, personal communication) may represent alarms that function as a call for help or to warn kin and mates to the presence of a dangerous killer as the victim dies. The screams may solicit aid and protection from friends and family, or else warn them away. Death screams may be construed as costly, hard-to-fake, credible calls for help. References to “blood curling screams” and “screaming bloody murder” may refer to such uniquely identifiable screams for help by people battling off a rival's attempts to kill them.

Physically incapacitating the killer is another strategy a victim can use in self-defense. Recent research suggests that one of the functions of our ancestors' domestication of dogs was to act as bodyguards and watchdogs (Clutton-Brock, 1999; Shipman, 2010). Invariably, this strategy involves physically attacking the would-be killer. At a minimum, the victim of a homicidal strategy must incapacitate the attacker enough so that the victim can flee or buy

enough time for help to arrive. In some confrontations, the most practical strategy of physically incapacitating the killer may be to kill him in self-defense. Contexts leading victims to kill in self-defense are likely to include features such as: a lack of kin or allies in close enough proximity to help; the failure of non-lethal strategies to incapacitate the attacker; and a lack of other options.

One of the key differences between a would-be killer and victim in hostile confrontations is that the killer is more often prepared to carry out his homicidal strategy than the victim is to defend against being killed. The killer can select the time and place when it is best to kill. Selection would have favored adaptive design that led killers to catch victims alone and by surprise, reducing the possible costs of killing (e.g., being injured or killed by a victim or the victim's kin). Because the genetic relatives of a homicide victim suffer fitness costs, we propose that adaptations to defend against being killed are also found in victims' kin.

22. Stanching the costs of homicide of genetic relatives

At least two forces may have selected for adaptations in kin that function to stanch the negative consequences of a family member being killed. First, damage to a homicide victim's family reputation may be repaired by inflicting reciprocal costs on the killer. A family that is capable of striking back against the killer may be able to demonstrate that it is not or is no longer exploitable. Second, the killer may be a persistent threat if he were to continue to live. Avenging the death of a family member by killing the killer may eliminate a source of recurrent fitness costs.

All of the proposed adaptations for defending against homicide function by derailing or thwarting homicidal strategies, or by inflicting heavy costs on killers. Homicide defense adaptations are costly for killers. The evolution of adaptations to defend against being killed would have created selection pressures for the evolution of refined adaptations for homicide that were capable of circumventing the evolved homicide defenses. The presence of refined homicide adaptations, in turn, would have selected for further refinements homicide defenses, and so on, setting up an antagonistic coevolutionary arms race between adaptations to kill and adaptations to defend against being killed.

23. Evidence of adaptations for homicide and homicide defenses

Several sources of evidence suggest that mechanisms dedicated to conspecific killing have evolved. The first source of evidence is comparative. A large number of species regularly commit conspecific killings in such predictable contexts that it is reasonable to advance the hypothesis that such species have adaptations designed to kill. Some insect and arachnid species, for example, engage in mate-killings. Where mate-killing and cannibalism is known to increase the number or viability of offspring (including in mantids, black widow spiders, jumping spiders, and scorpions), males approach females cautiously and retreat quickly after copulation. Breene and Sweet (1985) showed that in the sexually cannibalistic black widow spider *Latrodectus mactans*, when males survive copulation, they can often fertilize multiple females. Males of sexually cannibalistic species (Elgar & Crespi, 1992) use diverse strategies to decrease their chances of being cannibalized: male scorpions sometimes sting the female after deposition of the spermatophore (Polis & Farley, 1979); male black widows (Gould, 1984) and crab spiders (Bristowe, 1958) often restrain females in silk prior to copulation. Conspecific killing, as well as mechanisms to prevent getting killed, appear to be common among insects and arachnids.

Among the 4000 species of mammals, many also have well-documented patterns of conspecific killing. Male tigers, lions, wolves, hyenas, cougars, and cheetahs have been observed to kill the infants of rival males (Ghiglieri, 1999). These killings often have the effect of hastening the estrus of the mothers of those infants, at which point they

often mate with the killers. Among primate species, conspecific killings have been well documented among langur monkeys (Hrdy, 1977), chacma baboons (Busse & Hamilton, 1981), red howler monkeys (Crockett & Sekulic, 1984), savanna baboons (Collins, Busse, & Goodall, 1984), mountain gorillas (Fossey, 1984), chimpanzees (Bygott, 1972; Suzuki, 1971), blue monkeys (Butynski, 1982), and others (Hausfater & Hrdy, 1984). The killing of conspecific rival males has also been well-documented among the chimpanzees of Gombe (Wrangham, 1999), as well as in mountain gorillas (Fossey, 1984).

Conspecific killing is widespread, although by no means universal, in the animal world. The circumstances in which many of these conspecific killings occur, such as males killing rivals or the offspring of rivals, provides evidence that some, perhaps many, primate species have evolved adaptations for killing. The cumulative existence pointing to adaptations for within-species killing among primates and other mammals does not imply that such adaptations necessarily exist in humans. But it does suggest that there is no reason to be skeptical a priori about the possibility that adaptations for homicide have evolved in humans, either de novo or through modification of prior designs of ancestral species, or both.

Conspecific killing among humans has the potential to occur wherever there are humans interacting with other humans. This is as true of mother and child as it is of enemy nations. It is even true of the relationship between a pregnant mother and her developing fetus. For a woman, the fetus she carries likely does not represent her last opportunity to reproduce. Women were selected to invest more in those offspring who will yield the greater reproductive benefit, even in utero. If a fetus is not viable, for example, it would make more sense for a pregnant woman to forgo her investment in its development in favor of investing in a subsequent pregnancy. Most fertilized eggs do not result in a full-term pregnancy. Up to 78% fail to implant or are spontaneously aborted (Nesse & Williams, 1994). Most often, these outcomes occur because the mother detects chromosomal abnormalities in the fetus. The mother's ability to detect such abnormalities is the result of adaptations that function to prevent the mother from investing in offspring that will likely die young. Most miscarriages occur during the first 12 weeks after conception (Haig, 1993), at a point when the mother has not yet invested heavily in a costly pregnancy and the spontaneously aborted fetus is less likely to lead to infection (Saraiya et al., 1999). The fetus, however, is not a passive pawn in its mother's evolved reproductive strategy. The fetus has only one chance to live. Selection would have favored fetal genes to resist its mother's attempt to abort it. The production and release of human chorionic gonadotropin (hCG) by the fetus into the mother's bloodstream, which is normally an honest signal of fetal viability, may be one adaptation against being spontaneously aborted. This hormone prevents the mother from menstruating, allowing the fetus to remain implanted. Maternal physiology reacts to the production of hCG as a sign that the developing fetus is viable (Haig, 1993). Other humans do not cease to be dangerous after a child is born. For additional evidence, we focus on child-killing by a parent or parent-substitute.

The contested resource that leads to infanticide is often parental investment, leading to parent-offspring conflict (Trivers, 1974). There is conflict between the mother and her infant over how much she invests in the child. The infant may desire greater investment than would be optimal from the mother's perspective. Additionally, the reproductive value of children is lowest at birth and increases as they age, a function of the likelihood they will survive to reproductive age.

A newborn infant has few options for defending itself from homicidal attacks perpetrated by adults. To defend against maternal infanticide, a newborn's best strategy may be to display cues that it is a vehicle worthy of investment. Immediately after birth, an infant should display cues to its health and vigor, cues capable of satisfying maternal adaptations that evolved to judge the probability of fitness payoffs for investing in the infant (Soltis, 2004). Newborns who

nurse in the first hour after birth stimulate a surge in maternal oxytocin levels, strengthening the bond between mother and newborn. Nursing mothers' priorities become shifted. They become less motivated to self-groom for the purposes of attracting a mate and more motivated to groom their infants (Insel, 1992). By contrast, new mothers who do not nurse are more likely to suffer from postpartum depression (Papinczak & Turner, 2000; Taveras et al., 2003), a condition associated with higher rates of maternal infanticide (Hagen, 1999; Knopps, 1993; Spinelli, 2004) and maternal thoughts of harming their babies (Jennings, Ross, Popper, & Elmore, 1999; Kendall-Tackett, 1994). More active newborns, as evaluated by APGAR scores, are less likely to die (Chong & Karlberg, 2004; Morales & Vazquez, 1994), and would be a wiser object of maternal investment than newborns that are less active. Selection may have favored early nursing, the production of loud cries, and robust movements in newborns as defenses against maternal infanticide.

As they develop, infants are increasingly aware of their environment and able to move about on their own. As a result, they are increasingly likely to encounter dangers while outside the range of their caregivers' protection. Infants who possess some ability to recognize potential dangers in the environment would have a significant advantage over infants with no such ability. Selection would have favored knowledge in advance, in the form of specific fears, to steer infants away from threats to their survival. The developmental timing of the emergence of fears provides evidence that selection played a part in shaping them. Many fears do not emerge in development until individuals first encounter adaptive problems. For example, the fear of heights emerges when children begin to crawl. The emergence of this fear corresponds with infants' greater risk of falling. Fear of strangers emerges at about the same time (Scarr & Salapatek, 1970), corresponding with a greater risk of encountering hostile conspecifics. Stranger anxiety provides powerful protection against dangerous conspecifics. It prevents children from approaching individuals they do not know, and motivates them to seek parental protection. Stranger anxiety has been documented in many different countries and cultures, from Guatemala and Zambia, to the !Kung and the Hopi Indians (Smith, 1979). Infant deaths at the hands of unrelated conspecifics have been documented among non-human primates (Ghiglieri, 1999; Hrdy, 1977; Wrangham & Peterson, 1996) and in humans (Daly & Wilson, 1988; Hrdy, 2000). Human children are more fearful of male strangers than female strangers, corresponding to the greater danger posed by male strangers over evolutionary history (Heerwagen & Orians, 2002). Even though most strangers do not intend to inflict harm on children, if a fear of strangers prevented even a tiny fraction of children from being killed in the evolutionary past, stranger anxiety would have been favored by selection.

Strangers are not the only threat to the lives of children. Children raised with a stepparent in the home are between 40 and 100 times more likely to be killed than children raised by two genetic parents (Daly & Wilson, 1988). Stepfamilies were likely a recurrent feature of ancestral environments. Without modern medical treatments, disease killed many adults. Fathers sometimes died in battles or on hunts. Mothers sometimes died during childbirth. After their partner's death, it was probably not uncommon for a surviving parent to find a new mate. Along with the benefits that come from a new long-term relationship is the potential for significant costs to existing children. Because the risk of being killed is so much greater for children with a stepparent in the home, one risk that may have affected single parents' preferences in a new mate was the risk of their existing children being killed. There would have been selection pressure for the evolution of adaptations in single parents to prefer partners who presented lesser risk to their existing children. Single parents' preferences for new partners might reflect, in part, evolved defenses against the homicide of their existing children (Buss, 2005).

Stepchildren also may possess adaptations to help defend against potentially homicidal stepparents. These adaptations would have been shaped to recognize characteristics of potential stepparents predictive

of their likelihood of inflicting costs on the children, including killing them. Children's evolved intuitions about potential stepparents may lead them to influence their surviving parent's mate choice, decreasing the children's future risk of being killed.

Selection also would have favored adaptations to guide the behavior of children living with a stepparent. Stepchildren should take steps to minimize their costliness to their stepparent, such as keeping a low profile and demanding few resources. Stepchildren also should recognize opportunities to make themselves valuable to their stepparent, such as contributing to the care of children that result from the relationship between their genetic parent and stepparent. The best strategy for stepchildren who feel their life is in danger, however, may be to sabotage the relationship between their genetic parent and stepparent. This may involve stepchildren inflicting costs on their stepparents in an attempt to get the stepparents to abandon the romantic relationship. It also may involve stepchildren inflicting costs on themselves to influence their genetic parent to curb investment away from a new mateship and toward their children. Engaging in delinquent behaviors may be one strategy children use to inflict costs on themselves. Living in a stepfamily compared to living with two genetic parents more than doubles a child's risk of engaging in juvenile delinquent behavior (Coughlin & Vuchinich, 1996).

The presence of a stepparent is a good example of a recurrent context of increased risk of homicide that may have selected for anti-homicide defenses in stepchildren and their kin. These adaptations become activated in stepchildren, but remain dormant in children who reside with both of their genetic parents. We propose that specialized adaptations to defend against homicide exist for all contextual domains where there was a recurrent risk of being killed. Many situations, however, do not provide complete information about the probability that a person may fall victim to homicide. Because being killed is so costly, selection may have fashioned adaptively patterned biases that lead people to systematically overestimate the likelihood that they will be killed in conditions of uncertainty, a topic to which we turn next.

24. Managing errors to avoid homicide

Goleman (1995) argued that most of what people worry about has a low probability of happening. However, a cognitive system that "irrationally" overestimated the likelihood of violence, thus reliably leading an individual to avoid its costs would be favored by selection over an unbiased, "rational" cognitive system that led an individual to rarely incur heavy costs. Because many inferences about whether one will be targeted by a killer are obfuscated by uncertainty, contexts of homicide can be considered compatible with the logic of Error Management Theory (Haselton, 2003; Haselton & Buss, 2000). In situations involving uncertainty, making an erroneous inference about the intentions of others can carry high fitness costs. There are two types of errors one can make when inferring the intentions of others: Inferring an intention that is not present or inferring the absence of an intention that is present. In the case of avoiding homicide, selection pressures would have shaped cognitive biases that lead people to overestimate homicidal intent in others. In contexts ancestrally predictive of homicide, it would be better, on average, to infer that a rival might want to kill you when they really do not, than to infer that the rival does not want to kill you when he actually does. In this way, people would avoid making the more costly of the two errors. In sum, a design feature of the psychology of homicide avoidance is a cognitive bias that leads people to overestimate homicidal intent in the presence of cues to adaptive problems historically solvable by homicide.

The amount of uncertainty surrounding a potentially high-cost situation is also likely to have an effect. Imagine a man walking home from a bar late on a rainy night. He decides to take a shortcut through a dark alley to shorten the distance he must walk in the rain. As he is walking, he notices another man in the alley and immediately identifies the man as his brother. Assuming the two had a good relationship, there would

be little reason for the man to infer that his brother might want to kill him. Indeed, no fear of being killed should be triggered in this situation. Now imagine that the same man takes a shortcut through an alley and sees another man who he does not know. Greater uncertainty about the intentions of the unknown man, in addition to the other features of the context, may lead to an overestimate of the likelihood that this man might harm or kill him. In conditions of uncertainty about the identity of another person, in vague situations, and in the absence of information to the contrary, the safer error would be to overestimate a conspecific's hostile intentions. In fact, the safest error may be to assume that the other person intended to kill you. Selection would have shaped adaptations to defend against the most costly possibility first. When facing uncertainty from environmental cues, selection should mold psychological design to assume that the worst possible fitness event is going to occur, so its heavy costs can be avoided. The strategies people employ to defend against homicide (e.g., avoiding the context, fleeing, or killing one's attacker) would simultaneously defend against a number of non-lethal, cost-inflicting strategies. As a result, homicide defense strategies may represent a compromise between a pure defense against homicide and a defense against other significant fitness-related events.

In summary, we propose that uncertainty about the nature of situations, including uncertainty about the identity or history of an individual, provided selection pressures that influenced the adapted design of human error management psychology. Adaptations to minimize costly errors evolved in the form of cognitive biases that overestimate the likelihood that another individual intends to inflict costs proportional to the uncertainty surrounding the individual and the context. The bias toward inferring that another individual intends to inflict costs should increase as uncertainty about the individual and the context increases. This is not to say that such an error management bias will be applied equally to different individuals. The bias should be proportional to the ancestral threat that different individuals posed. It should be especially strong for those who posed the greatest threat, such as young adult males, and less strong or absent for others (e.g., infants, young children, the elderly).

There is evidence that people's perceptions are biased in the direction predicted by Error Management Theory (Haselton & Buss, 2001). Experiments using schematic facial stimuli demonstrates that different facial expressions are not processed the same way (Öhman, Lundqvist, & Esteves, 2001). Participants in this research viewed stimuli of threatening and friendly faces that were constructed from identical physical features. The threatening face was identified more quickly than the happy face from among neutral distracters. Additionally, faces with V-shaped eyebrows of a schematic angry facial display were more quickly and accurately identified than were faces with inverted V-shaped eyebrows (friendly faces), among both neutral and emotional distracters. These results are consistent with a perceptual bias predicted by Error Management Theory that leads individuals to be especially sensitive to the presence of potentially hostile conspecifics. Natural selection would have favored a greater sensitivity to angry faces over friendly faces, as those with hostile intentions would have posed an adaptive problem often requiring immediate action to avoid incurring potentially heavy costs (See also Ackermann, Shapiro, Neuberg, Kenrick, Vaughn Beeker, Griskevicius, et al., 2006).

Many people still willingly enter into situations that could get them killed. People have extramarital affairs. People derogate others to ascend status hierarchies. People poach the material and mating resources of others. What makes them think they can get away with their lives?

25. Secrecy as a defense against homicide

The answer may lie in the use of secrecy as a defense against being killed by a conspecific. People only become homicidal if they are aware that they are being wronged. Ignorance can provide them

bliss and provide those who sneak behind their backs some measure of protection from being killed. A sexual relationship behind the back of one's partner, for example, has the potential to confer fitness benefits to men in the form of additional offspring. It can confer benefits to women as well, such as access to superior or different genes, and access to additional resources from an affair partner (Greiling & Buss, 2000). Selection should have favored the use of secrecy to defend against the costs of discovered infidelity, which includes being killed by a jealous partner, whenever possible. This logic also applies to other behaviors that benefit one individual at a cost to another. In the case of sexual infidelity, there is a clear pattern in the risks of being killed. Men are more likely than women to kill their partner for a sexual infidelity. As a result, selection pressures may have been stronger on women than on men to adopt clandestine tactics to conduct their affairs. Women may have evolved to be more motivated to hide and to be better at hiding their infidelities from their partners. This may help to explain why men indicate a greater amount of uncertainty about whether their romantic partner is having an affair than women do (Buss, 2000): men encounter fewer cues to their partner's infidelity. Clandestine strategies, however, are not always successful. Sometimes men discover their partner's infidelity. As homicide statistics demonstrate (Buss, 2005; Daly & Wilson, 1988; Ghiglieri, 1999), perhaps the most dangerous human a woman will encounter in her lifetime is her romantic partner.

26. Killing in self-defense: preemptive homicide to prevent being killed

In a review of 223 appellate opinions of the cases of battered women who killed their partners in Pennsylvania, 75% of the homicides occurred while the woman was being assaulted by her romantic partner (Maguigan, 1991). In a study of mate homicides in North Carolina between 1991 and 1993, violence perpetrated by men preceded 75% of cases in which women killed their romantic partners. In contrast, there is no evidence that violence perpetrated by women preceded any of the homicides committed by men (Smith, Moracco, & Butts, 1998). It can be argued that the majority of women who kill their romantic partners do so in self-defense. The example provided by these female-perpetrated mate homicides is illustrative of the ultimate anti-homicide defense: killing an attacker before the attacker kills you.

We propose that the costs of being murdered were substantial enough to select for adaptations designed to eliminate the threat of homicidal conspecifics by killing them. Selection for homicide defenses was unlike selection for the psychology of homicide. Whereas adaptations for homicide were selected to favor non-lethal alternatives to solve adaptive problems, selection may have favored psychological design to prefer homicide as a strategy of self-defense in face-to-face confrontations with a would-be killer. Killing someone to prevent them from killing you would have had distinct evolutionary advantages over strategies of non-lethal violence. By killing a homicidal conspecific, you eliminate any future threat the person may pose. Whereas an injured rival can recuperate and attempt to kill you again, a dead rival cannot. By killing the person who would kill you, one also demonstrates a willingness and ability to kill, sending a powerful signal to others that attempts on your life will be met with the ultimate cost.

Most legal systems do not treat homicides committed in self-defense the same as other homicides. The law considers killing in self-defense to be a form of justifiable homicide if the person who kills "reasonably believes that killing is a necessary response to a physical attack that is likely to cause serious injury or death" (Costanzo, 2004, p. 83). In the evolutionary history of adaptations to produce preemptive homicides, however, the management of errors in conditions of uncertainty would have played a pivotal role in determining what a person reasonably believes. Individuals in the past who erred on the side of preemptively killing those perceived to be a credible threat to their lives or

the lives of their kin would have had an advantage over others who erred in the opposite direction. The consequence of this overestimation is the preemptive killing of some people who would not have become killers. In the calculus of selection, however, it is better to be safe and alive than dead.

27. Concluding comments

In conclusion, the evolution of adaptations to inflict costs created selection pressures for the coevolution of victim adaptations to avoid or prevent incurring the costs. These coevolved victim adaptations, in turn, created selection pressures for the evolution of refined adaptations and new adaptations for cost-infliction, setting up antagonistic, coevolutionary arms races between strategies to inflict costs and victim strategies to defend against them. Coevolutionary arms races can be extremely powerful. They can exert selection pressure on numerous physiological and psychological systems simultaneously, leading to rapid evolutionary change and great complexity of adaptive design. Adaptations for homicide and adaptations to defend against homicide may be results of an antagonistic coevolutionary arms race. The costs of being killed are among the greatest an individual can incur at the hands of a conspecific. These tremendous costs created unique and powerful selection pressures for the evolution of victim adaptations to defend against being killed. The available evidence is consistent with the theory that coevolved adaptations for homicide and victim defenses against being killed exist.

References

- Ackerman, J. M., Shapiro, J. R., Neuberger, S. L., Kenrick, D. T., Vaughn Becker, D., Griskevicius, V., et al. (2006). They all look the same to me (unless they're angry): from out-group homogeneity to out-group heterogeneity. *Psychological Science*, *17*, 836–840.
- Barbosa, P., & Castellanos, I. (2005). *Ecology of predator–prey interactions*. New York: Oxford University Press.
- Betzig, L. L. (1993). Sex, succession, and stratification in the first six civilizations. In L. Ellis (Ed.), *Social stratification and socioeconomic inequality* (pp. 37–74). Westport, CT: Praeger.
- Block, A. P. (1990). Rape trauma syndrome as scientific expert testimony. *Archives of Sexual Behavior*, *19*, 309–323.
- Breene, R. G., & Sweet, M. H. (1985). Evidence of insemination of multiple females by the male black widow spider, *Latrodectus mactans* [Araneae, Theridiidae]. *The Journal of Arachnology*, *13*, 331–336.
- Bristowe, W. S. (1958). *The world of spiders*. London: Collins.
- Bugnyar, T., & Kotrscha, K. (2004). Leading a conspecific away from food in ravens (*Corvus corax*)? *Animal Cognition*, *7*, 69–76.
- Burgess, A. W., & Holmstrom, L. L. (1974). Rape trauma syndrome. *The American Journal of Psychiatry*, *131*, 981–986.
- Buss, D. M. (1988). The evolution of human intrasexual competition: Tactics of mate attraction. *Journal of Personality and Social Psychology*, *54*, 616–628.
- Buss, D. M. (1989). Conflict between the sexes: Strategic interference and the evocation of anger and upset. *Journal of Personality & Social Psychology*, *56*, 735–747.
- Buss, D. M. (1994). *The Evolution of Desire*. New York: Basic Books.
- Buss, D. M. (1996). Sexual conflict: Evolutionary insights into feminist and the “battle of the sexes”. In D. M. Buss & N. M. Malamuth (Eds.), *Sex, power, conflict* (pp. 296–318). New York: Oxford University Press.
- Buss, D. M. (2000). *The dangerous passion*. New York: Free Press.
- Buss, D. M. (2003a). *The evolution of desire* (rev. ed.). New York: Free Press.
- Buss, D. M. (2003b, June). Sexual conflict. *Paper presented at the Annual Meeting of the Human Behavior and Evolution Society, The University of Nebraska*.
- Buss, D. M. (2004). *Evolutionary psychology* (2nd ed.). New York: Allyn & Bacon.
- Buss, D. M. (2005). *The murderer next door*. New York: Penguin.
- Buss, D. M. (2011). *Evolutionary psychology: The new science of the mind* (4th Edition). New York: Allyn & Bacon.
- Buss, D. M., Abbott, M., Angleitner, A., Asherian, A., Biaggio, A., et al. (1990). International preferences in selecting mates: A study of 37 cultures. *Journal of Cross-Cultural Psychology*, *21*, 5–47.
- Buss, D. M., & Dedden, L. A. (1990). Derogation of competitors. *Journal of Social and Personal Relationships*, *7*, 395–422.
- Buss, D. M., & Duntley, J. D. (1998, July). Evolved homicide modules. *Paper presented to the Annual Meeting of the Human Behavior and Evolution Society, Davis, CA*.
- Buss, D. M., & Duntley, J. D. (1999, June). Killer psychology: The evolution of intrasexual homicide. *Paper presented to the Annual Meeting of the Human Behavior and Evolution Society, Salt Lake City, UT*.
- Buss, D. M., & Duntley, J. D. (2003). Homicide: An evolutionary perspective and implications for public policy. In N. Dess (Ed.), *Violence and public policy*. Westport, CT: Greenwood Publishing Group.
- Buss, D. M., & Duntley, J. D. (2004). The evolution of gender differences in aggression. In S. Fein (Ed.), *Gender and aggression* (pp. XX). New York: Guilford.
- Buss, D. M., & Duntley, J. D. (2006). The evolution of aggression. In M. Schaller, J. A. Simpson & D. T. Kenrick (Eds.), *Evolution and Social Psychology* (pp. 263–286). New York: Psychology Press.
- Buss, D. M., & Duntley, J. D. (2008). Adaptations for exploitation. *Group dynamics: Theory, Research, and Practice*, *12*, 53–62.
- Buss, D. M., & Duntley, J. D. (under review). Homicide adaptation theory.
- Buss, D. M., & Haselton, M. G. (2005). The evolution of jealousy: A response to Buller. *Trends in Cognitive Sciences*, *9*, 506–507.
- Buss, D. M., Larsen, R. R., & Westen, D. (1996). Sex differences in jealousy: Not gone, not forgotten, and not explained by alternative hypotheses. *Psychological Science*, *7*, 373–375.
- Buss, D. M., Larsen, R. R., Westen, D., & Semmelroth, J. (1992). Sex differences in jealousy: Evolution, physiology, and psychology. *Psychological Science*, *3*, 251–255.
- Buss, D. M., & Shackelford, T. K. (1997a). From vigilance to violence: Mate retention tactics in married couples. *Journal of Personality and Social Psychology*, *72*, 346–361.
- Buss, D. M., & Shackelford, T. K. (1997b). Human aggression in evolutionary psychological perspective. *Clinical Psychology Review*, *17*, 605–619.
- Busse, C., & Hamilton, W. J., III (1981). Infant carrying by adult male chacma baboons. *Science*, *212*, 1281–1283.
- Butynski, T. M. (1982). Harem male replacement and infanticide in the blue monkey (*Cercopithecus mitis* Stuhlmann) in the Kibale Forest, Uganda. *American Journal of Primatology*, *3*, 1–22.
- Bygott, J. D. (1972). Cannibalism among wild chimpanzees. *Nature*, *238*, 410–411.
- Campbell, A. (1993). *Men, women, and aggression*. New York: Basic Books.
- Chagnon, N. (1988). Life histories, blood revenge, and warfare in a tribal population. *Science*, *239*, 985–992.
- Chagnon, N. (1996). *Yanomamo* (5th ed.). New York: Holt, Rinehart, & Winston.
- Chavanne, T. J., & Gallup, G. G., Jr. (1998). Variation in risk taking behavior among female college students as a function of the menstrual cycle. *Evolution and Human Behavior*, *19*, 27–32.
- Chong, D. S., & Karlberg, J. (2004). Refining the Apgar score cut-off point for newborns at risk. *Acta Paediatrica*, *93*, 53–59.
- Clutton-Brock, J. (1999). *A natural history of domesticated mammals* (2nd edition). Cambridge: Cambridge University Press.
- Cohen, L. E., & Machalek, R. (1988). A general theory of expropriative crime: An evolutionary ecological approach. *The American Journal of Sociology*, *94*, 465–501.
- Collins, D. A., Busse, C. D., & Goodall, J. (1984). Infanticide in two populations of savanna baboons. In G. Hausfater & S. B. Hrdy (Eds.), *Infanticide: Comparative and evolutionary perspectives* (pp. 193–216). New York: Aldine.
- Cosmides, L., & Tooby, J. (2005). Neurocognitive adaptations designed for social exchange. In D. M. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 584–627). Hoboken, NJ: Wiley.
- Cosmides, L., & Tooby, J. (2006). Evolutionary psychology, moral heuristics, and the law. In G. Gigerenzer & Christoph Engel (Eds.), *Heuristics and the law (Dahlem workshop report 94)*. Cambridge, MA: MIT Press.
- Costanzo, M. (2004). *Psychology applied to law*. New York: ThomsonWadsworth.
- Coughlin, C., & Vuchinich, S. (1996). Family experience in preadolescence and the development of male delinquency. *Journal of Marriage and the Family*, *58*, 491–501.
- Crockett, C. M., & Sekulic, R. (1984). Infanticide in red howler monkeys. In G. Hausfater & S. B. Hrdy (Eds.), *Infanticide: Comparative and evolutionary perspectives* (pp. 173–192). New York: Aldine.
- Daly, M., & Wilson, M. (1988). *Homicide*. Hawthorne, NY: Aldine.
- Daly, M., & Wilson, M. (1990). Killing the competition. *Human Nature*, *1*, 83–109.
- De Becker, G. (1997). *The gift of fear*. New York: Little, Brown, and Company.
- Diamond, J. (1997). *Guns, germs, and steel*. New York: W. W. Norton.
- Douglas, K. S., & Webster, C. D. (1999). Predicting violence in mentally and personality disordered individuals. In R. Roesch, S. D. Hart, & J. R. P. Ogloff (Eds.), *Psychology and law: The state of the discipline* (pp. 175–239). New York: Kluwer/Plenum.
- Duntley, J. D. (2005). Adaptations to dangers from other humans. In D. Buss (Ed.), *The handbook of evolutionary psychology* (pp. 224–249). New York: Wiley.
- Duntley, J. D., & Buss, D. M. (1998, July). Evolved anti-homicide modules. *Paper presented to the Annual Meeting of the Human Behavior and Evolution Society, Davis, CA*.
- Duntley, J. D., & Buss, D. M. (1999, June). Killer psychology: The evolution of mate homicide. *Paper presented to the Annual Meeting of the Human Behavior and Evolution Society, Salt Lake City, UT*.
- Duntley, J. D., & Buss, D. M. (2000, June). The killers among us: A co-evolutionary theory of homicide. *Invited paper presented at a special symposium organized by the Society for Evolution and the Law at the Annual Meeting of the Human Behavior and Evolution Society, Amherst, MA*.
- Duntley, J. D., & Buss, D. M. (2001, June). Anti-homicide design: Adaptations to prevent homicide victimization. *Paper presented to the Annual Meeting of the Human Behavior and Evolution Society, London*.
- Duntley, J. D., & Buss, D. M. (2002, July). Homicide by design: On the plausibility of psychological adaptations for homicide. *Invited presentation for the First Annual AHRB Conference on Innateness and the Structure of the Mind, University of Sheffield, England*.
- Duntley, J. D., & Buss, D. M. (in press). The evolution of stalking. *Sex Roles*.
- Elgar, M., & Crespi, B. J. (Eds.). (1992). *Cannibalism: Ecology and evolution among diverse taxa*. Oxford, U.K.: Oxford University Press.
- Fossey, D. (1984). *Gorillas in the mist*. Boston: Houghton Mifflin.
- Fujita, K., Kuroshima, H., & Masuda, T. (2002). Do tufted capuchin monkeys (*Cebus apella*) spontaneously deceive opponents? A preliminary analysis of an experimental food-competition contest between monkeys. *Animal Cognition*, *5*, 19–25.
- Geist, R. F. (1988). Sexually related trauma. *Emergency Medicine Clinics of North America*, *6*, 439–466.

- Ghiglieri, M. P. (1999). *The dark side of man*. Reading, MA: Perseus Books.
- Goleman, D. (1995). *Emotional intelligence*. New York: Bantam.
- Gould, S. J. (1984). Only his wings remained. *Natural History*, 93, 10–18.
- Grammer, K. (1992). Variations on a theme: Age dependent mate selection in humans. *The Behavioral and Brain Sciences*, 15, 100–102.
- Greiling, H., & Buss, D. M. (2000). Women's sexual strategies: The hidden dimension of extra pair mating. *Personality and Individual Differences*, 28, 929–963.
- Hagen, E. H. (1999). The functions of postpartum depression. *Evolution and Human Behavior*, 20, 325–359.
- Haig, D. (1993). Genetic conflicts in human pregnancy. *The Quarterly Review of Biology*, 4, 495–532.
- Hamilton, W. D. (1963). The evolution of altruistic behavior. *The American Naturalist*, 97, 354–356.
- Haselton, M. G. (2003). The sexual overperception bias: Evidence of systematic bias in men from a survey of naturally occurring events. *Journal of Research in Personality*, 37, 34–47.
- Haselton, M. G., & Buss, D. M. (2000). Error management theory: A new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology*, 78, 81–91.
- Haselton, M. G., & Buss, D. M. (2001). The affective shift hypothesis: The functions of emotional changes following sexual intercourse. *Personal Relationships*, 8, 357–369.
- Hausfater, G., & Hrdy, S. B. (Eds.). (1984). *Infanticide: Comparative and evolutionary perspectives*. New York: Aldine.
- Heerwagen, J. H., & Orians, G. H. (2002). The ecological world of children. In P. H. Kahn Jr. & S. R. Kellert (Eds.), *Children and nature* (pp. 29–64). Cambridge, MA: MIT Press.
- Held, S., Mendl, M., Devereux, C., & Byrne, R. W. (2002). Foraging pigs alter their behavior in response to exploitation. *Animal Behavior*, 64, 157–166.
- Hill, K., & Hurtado, A. M. (1996). *Ache Life History: The Ecology and Demography of a Foraging People*. Hawthorne, New York: Aldine de Gruyter.
- Hrdy, S. B. (1977). Infanticide as a primate reproductive strategy. *American Scientist*, 65, 40–49.
- Hrdy, S. B. (2000). *Mother Nature: Maternal instincts and the shaping of the species*. London: Vintage.
- Insel, T. R. (1992). Oxytocin – A neuropeptide for affiliation: evidence from behavioral, receptor autoradiographic, and comparative studies. *Psychoneuroendocrinology*, 17, 3–35.
- Jennings, K. D., Ross, S., Popper, S., & Elmore, M. (1999). Thoughts of harming infants in depressed and nondepressed mothers. *Journal of Affective Disorders*, 54, 21–28.
- Kanazawa, S. (2008). Theft. In Joshua Duntley, & Todd K. Shackelford (Eds.), *Evolutionary forensic psychology* (pp. 160–175). New York: Oxford University Press.
- Kaplan, S. (1992). Environmental preference in a knowledge-seeking, knowledge-using organism. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 581–598). New York: Oxford University Press.
- Kendall-Tackett, K. A. (1994). Postpartum depression. *Illness, Crisis, and Loss*, 4, 80–86.
- Knopps, G. (1993). Postpartum mood disorders: A startling contrast to the joy of birth. *Postgraduate Medicine*, 103, 103–116.
- Krebs, D. L. (2008). The evolution of a sense of justice. In J. Duntley & T. K. Shackelford (Eds.), *Evolutionary forensic psychology* (pp. 230–248). New York: Oxford University Press.
- Kruger, D. J., & Nesse, R. M. (2004). Sexual selection and the male:female mortality ratio. *Evolutionary Psychology*, 2, 66–77.
- Maccoby, E. (1990). Gender and relationships: A developmental account. *American Psychologist*, 45, 513–520.
- Maguigan, H. (1991). Myths and misconceptions in current reform proposals. *University of Pennsylvania Law Review*, 140, 379–486.
- Marks, I. M. (1987). *Fears, Phobias, and Rituals*. New York: Oxford University Press.
- Marshall, I. H., & Block, C. R. (2004). Maximizing the availability of cross-national data on homicide. *Homicide Studies*, 8, 267–310.
- Morales, V. Z., & Vazquez, C. (1994). Apgar score and infant mortality in Puerto Rico. *Puerto Rico Health Science Journal*, 13, 175–181.
- Nesse, R. M., & Williams, G. C. (1994). *Why we get sick*. New York: Times Books Random House.
- Öhman, A., Lundqvist, D., & Esteves, F. (2001). The face in the crowd revisited: A threat advantage with schematic stimuli. *Journal of Personality and Social Psychology*, 80, 381–396.
- Papinczak, T. A., & Turner, C. T. (2000). An analysis of personal and social factors influencing initiation and duration of breastfeeding in a large Queensland maternity hospital. *Breastfeeding Review*, 8, 25–33.
- Parker, G. A., Royle, M. J., & Hartley, I. R. (2002). Intrafamilial conflict and parental investment: A synthesis. *Philosophical Transactions of the Royal Society of London B*, 357, 295–307.
- Perusse, D. (1993). Cultural and reproductive success in industrial societies: Testing the relationship at proximate and ultimate levels. *The Behavioral and Brain Sciences*, 16, 267–322.
- Petersen, M., Sell, A., Tooby, J., & Cosmides, L. (2010). Evolutionary psychology and criminal justice: A recalibrational theory of punishment and reconciliation. In Henrik Høgh-Olesen (Ed.), *Human morality & sociality: Evolutionary & comparative perspectives*. New York: Palgrave MacMillan.
- Phillips, B., Brown, G. P., & Shine, R. (2004). Assessing the potential for an evolutionary response to rapid environmental change: Invasive toads and an Australian snake. *Evolutionary Ecology Research*, 6, 799–811.
- Polis, G. A., & Farley, R. D. (1979). Behavior and ecology of mating in the cannibalistic scorpion *Paruroctonus mesaensis* Stahnke (Scorpionida: Vaejovidae). *Journal of Arachnology*, 7, 33–46.
- Pratto, F. (1996). Sexual politics: The gender gap in the bedroom, the cupboard, and the cabinet. In D. M. Buss & N. M. Malamuth (Eds.), *Sex, power, conflict* (pp. 179–230). New York: Oxford University Press.
- Richerson, P. J., & Boyd, R. (1998). The evolution of human ultra-sociality. In I. Eibl-Eibesfeldt & F. K. Salter (Eds.), *Indoctrinability, warfare, and ideology*. New York: Berghahn Books.
- Saraiya, M., Green, C. A., Berg, C. J., Hopkins, F. W., Koonin, L. M., & Atrash, H. K. (1999). Spontaneous abortion-related deaths among women in the United States – 1981–1991. *Obstetrics and Gynecology*, 94, 172–176.
- Scarr, S., & Salapatek, P. (1970). Patterns of fear development during infancy. *Merrill-Palmer Quarterly*, 16, 53–90.
- Schmitt, D. P., & Buss, D. M. (2001). Human mate poaching: Tactics and temptations for infiltrating existing mateships. *Journal of Personality and Social Psychology*, 80, 894–917.
- Schmitt, D. P., Shackelford, T. K., Duntley, J. D., Tooke, W., & Buss, D. M. (2001). The desire for sexual variety as a tool for understanding basic human mating strategies. *Personal Relationships*, 8, 425–455.
- Shipman, Pat (2010). The animal connection and human evolution. *Current Anthropology*, 51, 519–538.
- Singer, T., Seymour, B., O'Doerty, J., Stephan, K. E., Dolan, R. J., & Frith, C. D. (2006). Empathic neural responses are modulated by the perceived fairness of others. *Nature*, 439, 466–469.
- Smith, P. K. (1979). The ontogeny of fear in children. In W. Sluckin (Ed.), *Fear in animals and man* (pp. 164–168). London: Van Nostrand.
- Smith, P. H., Moracco, K. E., & Butts, J. D. (1998). Partner homicide in context: A population-based perspective. *Homicide Studies*, 2, 400–421.
- Smuts, B. B. (1992). Men's aggression against women. *Human Nature*, 6, 1–32.
- Soltis, J. (2004). The signal functions of early infant crying. *The Behavioral and Brain Sciences*, 27, 443–490.
- Spinelli, M. G. (2004). Maternal infanticide associated with mental illness: Prevention and the promise of saved lives. *The American Journal of Psychiatry*, 161, 1548–1557.
- Sugiyama, L. S., Tooby, J., & Cosmides, L. (2002). Cross-cultural evidence of cognitive adaptations for social exchange among the Shiwiari of Ecuadorian Amazonia. *Proceedings of the National Academy of Sciences of the United States of America*, 99, 11537–11542.
- Suzuki, A. (1971). Carnivory and cannibalism observed in forest-living chimpanzees. *Journal of the Anthropological Society of Nippon*, 74, 30–48.
- Symons, D. (1979). *The evolution of human sexuality*. New York: Oxford University Press.
- Taveras, E. M., Capra, A. M., Braveman, P. A., Jensvold, N. G., Escobar, G. J., & Lieu, T. A. (2003). Clinician support and psychosocial risk factors associated with breastfeeding discontinuation. *Pediatrics*, 112, 108–115.
- Taylor, P. A., & Glenn, N. D. (1976). The utility of education and attractiveness for females' status attainment through marriage. *American Sociological Review*, 41, 484–498.
- Thornhill, R., & Palmer, C. (2000). *A natural history of rape*. Cambridge, MA: MIT Press.
- Tooby, J., & Cosmides, L. (2010). Groups in mind: The coalitional roots of war and morality. In Henrik Høgh-Olesen (Ed.), *Human morality & sociality: Evolutionary & comparative perspectives*. New York: Palgrave MacMillan.
- Tooby, J., & DeVore, I. (1987). The reconstruction of hominid behavioral evolution through strategic modeling. In W. G. Kinzey (Ed.), *The evolution of human behavior* (pp. 183–237). New York: State University of New York Press.
- Trinkaus, E., & Shipman, P. (1993). *The Neanderthals*. New York: Alfred A. Knopf.
- Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man: 1871–1971* (pp. 136–179). Chicago: Aldine.
- Trivers, R. L. (1974). Parent-offspring conflict. *American Zoologist*, 14, 249–264.
- Udry, R. R., & Eckland, B. K. (1984). Benefits of being attractive: Differential payoffs for men and women. *Psychological Reports*, 54, 47–56.
- Werner-Wilson, R. J. (1998). Gender differences in adolescent sexual attitudes: The influence of individual and family factors. *Adolescence*, 33, 519–531.
- Whiting, B., & Edwards, C. P. (1988). *Children of different worlds*. Cambridge, MA: Harvard University Press.
- Wilson, M., & Daly, M. (1985). Competitiveness, risk-taking and violence: the young male syndrome. *Ethology and Sociobiology*, 6, 59–73.
- Wilson, M. I., Daly, M., & Daniele, A. (1995). Familicide: The killing of spouse and children. *Aggressive Behavior*, 2, 275–291.
- Wilson, M., & Mesnick, S. L. (1997). An empirical test of the bodyguard hypothesis. In P. A. Gowaty (Ed.), *Feminism and evolutionary biology*. New York: Chapman & Hall.
- Wrangham, R. W. (1999). The evolution of coalitional killing. *Yearbook of Physical Anthropology*, 42, 1–30.
- Wrangham, R. W., & Peterson, D. (1996). *Demonic males*. Boston: Houghton Mifflin.