Chapter X:
Principles of Evolutionary Psychology

Introduction

In the previous chapter, we encountered a number of simple questions about human behavior. It was explained how evolutionary psychology answers these questions. Finally, the reader was admonished to maintain an attitude somewhere between skepticism and open-mindedness towards the answers of both the evolutionary psychologist and his/her critics.

If that chapter gave you some interesting questions to think about, then it succeeded in its purpose. But it could also give the misleading impression that evolutionary psychologists are a breed of armchair speculators. This is definitely not the case. There are well developed principles and theories of evolutionary psychology that have sparked considerable empirical research. In this chapter, four major theories are explored—(1) inclusive fitness and kin selection; (2) reciprocity and cooperation; (3) parental investment altruism; and (4) prepared learning. The chapter ends by examining how some of these theories are used to explain some aspects of human aggression.

Inclusive Fitness and Kin Selection

Sometimes, mothering ringneck pheasants perform a marvelous act of self-sacrifice. If a large animal trods too close to her nest, she will make a great deal of noise and run through the field flapping her wings. The safest course of action for her is to be silent, run a few steps to build up the momentum for flight and then soar away. Yet she makes herself deliberately conspicuous to a potential predator and is sometimes caught in the process. Prairie dogs also show similar behavior. When a raptor soars overhead or a land based predator approaches the colony, the prairie dogs who initially spot the threat stand upright on their hind legs and issue a series of loud barks that act as alarm codes for their colony mates to run post haste to their boroughs. This behavior assists the colony as a whole, but at the expense of making the signaler conspicuous to the predator.

These are examples of *altruism*, a behavior that can reduce the reproductive fitness of the altruist but increase the fitness of consepcifics. Ever since Darwin's time, altruism posed a problem for natural selection. Certainly any heritable behavior that reduced fitness should decrease over time. Just consider a prairie dog colony that 50% altruists and 50% cheats[1]. When a cheater spots a predator, he hightails it to the nearest borough. The odds that the predator eats an altruist are slightly increased because the cheater has just removed one of his own kind from the denominator of vulnerable prairie dogs. When the altruist spies the threat, she announces her position to the predator and places herself in danger. Both the other altruists and the cheaters benefit, but if anyone is to be devoured, it is once again more likely to be the altruist than the cheater.

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[1] Most people would use the word "selfish" as the appropriate antonym for altruism. In *The Selfish Gene*, however, Richard Dawkins points out that from a genes perceptive, altruism is actually a selfish action to help the genes own replication. Hence, most evolutionists use the word "cheat."

A solution for this had to wait until 1964, when W.D. Hamilton published a classic paper. Using mathematical models, Hamilton showed that altruism could evolve when altruistic genotypes preferentially benefit other altruistic genotypes over cheater genotypes. The clearest way for an altruistic genotype to do this is to have mechanisms that bias it to work altruistically for *close genetic relatives*. If I have an altruistic genotype, then the most likely individuals in the world to also share this genotype will be my parents, siblings, and children. When this concept was presented to the famous geneticist H.B.S. Haldane he quipped that he would he would never give his life for his brother, but he would for two brothers or eight first cousins[2].

Hamilton's work presented the twin ideas of *inclusive fitness* and *kin selection*. Inclusive fitness is defined as the *fitness of an individual along with the fitness of close relatives*[3]. Your inclusive fitness would be a weighted sum of your own reproductive fitness, that of your first degree relatives, second degree relatives, etc. Kin selection refers to implication of inclusive fitness that *natural selection can work on the close genetic relatives of the organism actually performing the behavior*. In a loose sense, fitness can be expressed in terms of kinships just as we have seen it being expressed in terms of genotypes, phenotypes, and individuals.

Inclusive fitness and kin selection have been used to explain many different human behaviors. The very fact that we humans recognize and pay close attention to genealogy may a cognitive mechanism developed through evolution that helps in kin recognition. The phrase "blood is thicker than water" has been interpreted as a realistic description of human emotions and behaviors that preferentially benefit kin over others Several aspects of altruistic parental behavior may have evolved through kin selection. Continual themes in fiction portray noble parents shielding their young children from potential harm, but evil step-parents threatening their step-children.

Daly and Wilson (19xx) have pointed out how familial homicide patterns agree quite well with kinship selection. Although rare, parents do murder a child, but the most likely perpetrator of such a heinous act is much more likely to be a step-parent than a biological parent. Despite the hyperbolic threat "do that again and I'll kill you" echoed by many a frustrated parent, very, very few parents ever even contemplate homicide when it comes to their offspring. The inhibition of homicide is not restricted to parents and their offspring. Ask yourself the following question, "In your whole lifetime, which person has shouted at you and hit kicked the most and which person have you yelled at and fought with the most?" If you respond like most people, then you will nominate a brother or sister. Yet fratricide (the killing of a sibling) is very rare. Humans are much more likely to kill a spouse than an offspring or sibling.

[2] I have found several different texts that quote Haldane, all differing slightly from one another. But the substance of his comment remains that given in this text.

[3] In terms of the concept of fitness given in the chapter on the five forces of evolution, inclusive fitness may be more broadly defined as *the fitness of an individual plus others with the same genotype*. In this case, it simply equals the fitness of genotypes irrespective of the individuals carrying those genotypes.

Reciprocity and Cooperation

A close cousin to inclusive fitness is the concept of reciprocity and cooperation, sometimes called reciprocal altruism. Traditionally, inclusive fitness and kin selection have been used to refer to altruism towards genetic relatives. Reciprocity and cooperation deal with *behavior that requires some "sacrifice" but also has beneficial consequences between conspecifics who are not necessarily genetic relatives*. The concept was developed in a seminal paper by Robert Trivers (1971).

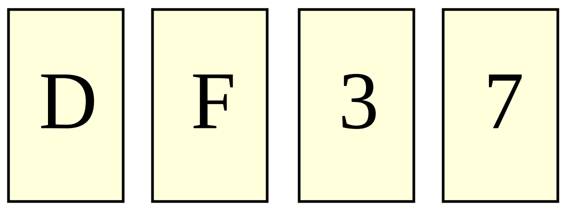
To understand reciprocity and the problem it posed for evolutionists, we must once again consider cheaters. Lions and wolves hunt large prey cooperatively. Although it is mentioned infrequently on the nature shows, chasing, grabbing, and killing large prey is not a safe enterprise. Zebras kick and bite, wildebeast have horns, and caribou have antlers, so predators can be hurt, sometimes even mortally so, in the hunt. Imagine a cheating lioness who approaches the prey only after it is dead. Would not her behavior be advantageous? She can participate in the feast but avoids the risk of injury. If cheating has a selective advantage, then would it not eventually result in the extinction of cooperative hunting? Another problem is how cooperative hunting ever got started in the first place. Most feline predators like the lynx, tiger, cheetah, leopard, and jaguar, make a perfectly fine living at solitary hunting. Why did lions ever develop cooperation?

According to Trivers and to others like John Mayard Smith and Axelrod who developed mathematical models of the evolution of reciprocity, cooperation cannot evolve alone. It must be accompanied with mechanisms that detect and reward mutual cooperators and detect and punish cheaters. Consider grooming in primates. It serves the very useful function of riding a hairy monkey or ape from large parasites like fleas and lice. Imagine that you are a chimp and that a fellow chimp, Clyde, is continually presenting himself to you to be groomed. Being the nice chimp that you are, you groom Clyde every time that he requests it. After a while, however, you notice something peculiar. Whenever you present yourself to Clyde for grooming, he refuses. Ask yourself how you truly feel about this situation and how you are likely to respond to Clyde's future presentations. Again, if you are like most people, when Clyde presents to you, you would feel some form of negative emotion that could range from mild exasperation to downright contempt, depending on the type of chimp you are. At some point, you are also likely to refuse to groom Clyde. Evolutionary psychologists would say that this is your "cheat detection and punishment" mechanism in action.

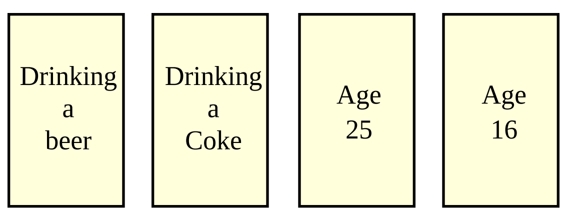
Reciprocity evolves when reciprocity and cheating can be recognized or anticipated and then acted upon. If your roommate, Mary, is cramming for her physics exam, you are likely to bake some banana bread for her when you suspect that Mary will do something nice for you on the eve of your big chemistry exam next week. But if Mary were the type of roommate who clutters and trashes the place leaving you to do all the cleaning up, then you are likely to feel irritated and aggravated at her. No banana bread tonight! We feel that it is right and just that everyone do their fair share, and as parents, we spend considerable time and effort inculcating this ethos into our children[4].

One of the strengths of the modern evolutionists is their ability to uncover subtle and non obvious phenomenon that fit better with evolutionary theory than other theory. You were correct to express skepticism of the Mary example—after all, there is really no way to determine the relative influences of a biologically softwired “cheat detector” and your upbringing on the behavior. But consider the following example, taken from Pinker (1998) who apparently took it from Ridley (1993).

Below are four cards that have a letter on one side and a number on the other side. Which cards would you turn over to test whether you could falsify the following statement: “If a card had a D, then it must have a 3 on the other side?”

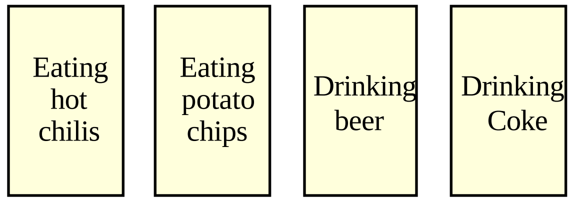


Now suppose that you have a job checking on whether bars are obeying the state law and serving alcohol to people age 21 and over. You go into Jack’s bar and there are four patrons represented by the cards below. The patron’s age is on one side and their beverage is on the other. Which cards would you turn over to check if Jack’s bar is following the law?



Finally, suppose that you are in Jill’s deli chatting with one of the servers. The server says that everyone who eats hot chili peppers here always drinks a cold beer. Again, there are four patrons, their food being on one side and their beverage on the other side of the cards below. Which cards would you turn over to check out the server’s statement?

[4] Because biological tendencies and learning are not mutually exclusive, parental reminders and admonitions can serve to reinforce behavioral patterns to which we are already genetically predisposed.



All three of these problems have the *same* logical form. Pinker points out, however, that most people get the letter/number and the chili problem *wrong* but get the bar problem *correct*! If we humans were really using the formal rules of logic to solve these problems, we should solve each problem equally well.

Consider the bar problem. The correct solution is to turn over the "Drinking a beer" and the "Age 16 cards." If the "Drinking a beer" card has someone under age 21, then Jack's bar is not obeying the law. Similarly, if the "Age 16" card reveals that the person is drinking alcohol, then Jack's bar in not obeying the law. Turning over the "Drinking a Coke" and the "Age 25" cards do help to solve the problem. Someone drinking a coke can be any age, and a 25 year old can drink anything.

In the letter/number problem, the correct solution is the D and the 7 card. Pinker states that most people pick either the D card or the D and the 3 card. If the proposition holds, then D card *must* have a 3 on the other side and the 7 card *must not* have a D on the other side. Turning over the 3 card does not help solve the problem because 3 could be paired with any letter. A similar logic holds for the chili problem where the correct solution is turning over the "Eating hot chilis" card (which, if the proposition holds, should have a "Drinking beer" on the other side) and the "Drinking Coke" card (which must *not* have "Eating hot chilis" on the other side).

This example is based on a number of studies by Cosmides (XXX) who conclude that our cheater detector is elicited in the bar problem but not in the letter/number problem or the chili problem[5]. Jack's bar is disobeying the rules ("cheating") if alcohol is being served to someone under 21. There is no morality associated with a D card or with the beverage one drinks while eating chili peppers. These data to not agree with the idea that the mind is that learns formal rules and then applies these rules to specific cases. It does agree with the evolutionary theory of reciprocity. We humans are biologically sensitized to detect cheating, so a logical problem with a content based on cheating is easier to solve that identical logical problems with arbitrary content.

Parental Investment

Robert Trivers, who first explicated reciprocity and cooperation, also gave us parental investment theory (Trivers, R. L. (1972). Parental investment and natural selection. In B. Campbell, Ed., Sexual Selection and the Descent of Man. Chicago:

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[5] Technically, Cosmides and Gigerenzer conclude that the logical problem is easier to solve whenever it involves a social "contract."

Atherton, pp. 136-179). This theory states that *in any species the parent (male or female) that invests the most time, energy, and resources on its offspring will be the choosier mate.* The theory begins by asking the fundamental question of why many species act finicky in choosing mates. Most evolutionists explain mate preferences as mechanisms that genes have developed in organisms to assist in their own (i.e., the genes own) replication. If I am a gene in an organism of a sexual species, not only do I want "my" organism to reproduce but I also want "my" organism to reproduce with a mate who has good genes. Hence, if mechanisms develop to recognize good mates, then natural selection will favor these mechanisms.

Triver's theory maintains that the fastidiousness of mate preferences will be stronger in the sex that expends the most resources in producing offspring. Ordinarily, this will be the female because biologists define a female as the sex of a species that produces the larger gamete. (Hence, women are females because eggs are many, many times the size of sperm). The sex that produces the larger gamete produces fewer of those gametes. Hence, each gamete is more "precious" in a reproductive sense[6].

In mammals, the female expends more resources on offspring than the male. Fertilization in mammals is internal to the female, offspring development takes place in the female's uterus, and the female must suckle the infant for a significant period of time. Hence, female mammals should be choosier mates than the males. Indeed, this is always the case. In species where one sex competes for mating, males compete with other males for the opportunity of having sex with females. Females do not butt heads with each other for the opportunity of mating with any random guy in the herd. Even in chimps and bonobos where mating is largely promiscuous, every male in a troop tries quite hard to have a go at any female in estrus. Whenever one sex shuns a mating attempt, it is the female shunning a male and not a male shunning a female[7].

Parental investment theory, along with the concept of certainty of parenthood, has been used to explain many different types of human mate preferences. Females must commit nine months to pregnancy and then, before the advent of manufactured baby formula, more than a year to feeding a single offspring. Even if a woman conceived after her first menstruation, she could bear one child per year until menopause, and the most likely number of offspring for a female during most of human evolution was probably no more than five (Nesse and Williams, 1994). A human male, on the other hand, has the potential of fathering a baby every single day after puberty. Female humans are

[6] Even in insects, the female is almost always the choosier of the sexes. In several insect species, the males present "nuptial gifts" to the female by offering her another dead insect (usually killed by the male) to consume. When the gift is small, stale, or unpalatable, the female effectively says "Goodbye, Charlie" and flitters away in search of a better offer. Once she finds a satisfactory present, she begins consuming the carcass. The male moves behind her and copulates while she is munching away in gustatory delight.

[7] Advocates of parental investment theory are fond of pointing out discrepancies to the "female is choosier" rule, although to my knowledge, the rule has no contradiction among mammals. In the seahorse and the jacuna bird, the male invests more in offspring than the female. In the seahorse, the female deposits her eggs into a males pouch where they are fertilized, incubated, and cared for after hatching by their father. The female jacuna bird maintains a large territory containing several males. She is fertilized by one male, lays her eggs, and leaves the male to tend the nest and feed the chicks while she moves on to another male and conceives. In both case, the male is apparently more choosier than the female in mating.

biologically constrained to devote considerable resources to a single offspring; human males lack such constraints[8]. Hence, human females should have more discriminating mate preferences than males.

A litany of empirical observations is used to support of this conclusion. Certainly in our Western cultures, anecdotal observations agree with it. Males are more ready than females to engage in anonymous sex, even to the point of paying for it. Women report more sexual advances made on them by men than men report sexual advances initiated by women. Personal ads written by women request males for relationships more often that those authored by men; men's personal ads stress sex (Deaux,K.& Hanna,R. (1984), Courtship in the personal column: The influence of gender and sexual orientation. *Sex Roles*, *11*, 363-375.) Consider the following questions—how long would you have to know someone before feeling comfortable going out on a date with that person, and how long would you have to know someone before getting married? Both males and females have similar time frames—a short time frame for dating and a longer one for matrimony. Now consider this question—how long would you have to know someone before have sex? The average woman picks a time frame somewhere between dating and marriage. Males pick a time frame *shorter* than dating. (Buss, D.M. & Schmitt, D.P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review*, *100*, 204-232.)

This account of human parental investment, however, faces a real problem—why should men ever stick around at all? If the reproductive fitness of the genes in a male organism are maximized by sleeping around with as many women as possible, why would these genes ever develop mechanisms that predispose a man to settle down with a woman? The evolutionists answer to this is that it effectively "takes two to tango." Just like the peacock's tail, men's behavior is influenced by women's mate preferences. If mutations arose that influenced women to prefer men who stuck around, and if there were men who actually did stick around, and if the pairing between this type of woman and this type of man had high reproductive fitness, then females who prefer stabile males would increase in frequency as will males who actually remain stabile.

Prepared Learning

Several decades ago, American psychology held several laws of learning as sacred. One law was *equipotentiality* and it stated that an organism could learn to associate any stimulus to any response with equal ease. The classic example is Pavlov's dog who, according to this law could have learned to associate a bright light to the food as easily as it learned to associate the bell with food. The two stimuli, light and bell, are equipotent in the sense that given the same learning parameters, both could eventually lead the dog to salivate. A second law was temporal contiguity. This law stated that the presentation of a novel stimulus with a learned stimulus must occur quickly in time. In Pavlov's case, the food has to be presented shortly after the bell was rung in order for learning to occur. The

[8] The constraints referred to here are the purely physical. Human males may have *behavioral* constraints that are also biologically influenced and may limit their reproductive potential.

dog never would learn to salivate to the bell if the food were presented three days after the bell. Finally, a third law was practice—it took many trials before the behavior was fully learned.

These laws begin to crumble after a series of fortuitous studies in the 1950s and 1960s by Garcia and his colleagues. In one study (), rats were divided into two groups. The first group was trained to drink brightly colored, bubbly while the second received water sweetened with saccharine. After training, the rats were administered an aversive stimulus associated with drinking. Half of the rats in each group received an electric shock when they tried to drink. The other half received low doses of X rays that would, in several hours, make the rats sick.

According to the laws of learning postulated at that time, the rats who received shock should quickly learn to avoid drinking.[9] Because the onset of sickness was delayed and the time span violated the law of temporal contiguity, the X-rayed rats should not learn to avoid drinking the water. The actual results of the study are given in Table XX.

Results of the Garcia and Koelling (1996) study on conditioned avoidance.

		Aversive Stimulus:	
		Shock	X-Ray
Type of Water:	Bright, bubbly	High Avoidance	Low Avoidance
	Sweetened	Low Avoidance	High Avoidance

Clearly, the results did not agree with the widely held laws. When rats where shocked, the "bright, bubbly" water group learned to avoid while the sweetened water group failed to learn. Bright, bubbly water and sweetened water were not equipotent stimuli as they should have been. Similarly, rats learned to avoid when they were made sick with X-rays but only with sweetened water. Once again, the two types of water were not equipotent, but more importantly, the learning violated the law of temporal contiguity because the onset of sickness was an hour or two after drinking. Moreover, rats in the sweetened water/X-ray condition learned their avoidance in only one or two trials, a clear violation of the law of practice. It took many trials to condition the avoidance of rats in the bright, bubbly/shock condition.

What could explain these results? Today, a favored explanation is that of *prepared learning* or *preparedness*, a phenomenon that, ironically, was developed by Thorndike in 1911 and then ignored. A certain type of preparedness, *biological preparedness*, holds that genes and other biological influences shape an organism so that is very easy to learn certain things (i.e., a biological predisposition) but quite hard to learn other things (i.e., a biological constraint).

Let us reexamine the Garcia and Koelling results in light of this. The rat has evolved into a highly oflactory creature that perceives the world in terms of smell and

[9] This is the tradiational conditioned avoidance paradigm.

taste. Indeed, rat colonies develop a characteristic smell that is used to recognize colony mates and identify intruders[10]. Rats are also scavengers who dine on a surprisingly wide variety of organic material. Because they locate food though smell, they are especially attracted to rotting fruit, vegetable, and animal matter because of its pungent odor. Rotting food, however, poses a problem for digestion because it can create sickness when it is too far gone.

Rats react to their food in a peculiar way. When a rat locates a novel food source, he seldom gobbles it all up. Instead, he will nibble a little bit of it, go way for several hours, and then return. The rat may repeat his several times—a quick taste, a lengthy departure, and then a return—but soon he will return and gorge on the food. Interestingly, if an experimenter laces the original food source with enough poison to make the rat sick but not enough to kill him, the rat may return but will not eat the food any more. It is usually a quick, one trial learning experience.

Evolutionary psychologists speculate that rats evolved a biological predisposition and a behavioral repertoire to avoid rotting foods that may make them ill. At some point rats who nibbled at a novel food source outreproduced those who gobbled the whole thing down, presumably because the gobbling strategy had a high probability of incapacitation or even death through sickness. Similarly, rats who nibbled and learned quickly outreproduced those who nibbled but took a long time to learn. And what sensory cues would the rat use to bad food from good food? Most likely they would be olfactory cues.

In this way, rats in the Garcia and Koelling study would easily learn to associate an olfactory cue (water sweetness) with eventual sickness but would have a harder time associating a visual cue (colored, bubbly water) with sickness. Rats who learned to avoid sweetened water when they became sick were biologically predisposed to learn this and to learn it quickly. Were a rat drinking the bright, bubbly water able to cogitate about his situation, he might think, “Every time that guy puts me into this box I get sick but it can’t be the water because it tastes perfectly ok.” Rats are not biologically prepared to associate a visual cue with sickness.

Similarly, electric shock is a not a natural event in the ecology of the rat. The cogitating rodent given sweetened water would be quite perplexed—“The water tastes good and did not make me sick. Nothing wrong with that stuff.” Again, this is a biological constraint. Finally, the rats given two stimuli that are quite arbitrary from the perspective of their natural habitats—bright, bubbly water and shock—followed all the rules of learning that had been established using arbitrary stimuli.

Preparedness has also been invoked to explain the development of certain human fears and phobias. Children sometimes develop strong fears and phobias of darkness, but few, if any, develop fears of all the other stimuli associated with going to sleep—pillows, pajamas, sheets, bedtime stories, or even the light bulb. A large proportion of humans has been shocked at some point, but toaster phobias and phobias of electric outlets are surprisingly rare. People seriously injured in a car crash in a red Volkswagon may

[10] If an adult male rat is taken from his colony and given a sufficient bath to remove the colony smell, he will be attacked and sometimes killed when he is reintroduced to the group. Even his littermates will attack him.

develop strong fears of driving or riding in a car, but hardly any of them panic at the sight of a red Volkswagon parked along a curb. Most of us are acquainted with someone who is phobic of a certain type of animal (snakes, spiders, or bees are frequent ones). But how many of us know someone who panics at the sight of a bowl of chili even though the person may have had a quite noxious experience eating chili that was too hot for his taste?

Aggression (incomplete)

Aggression or agonistic behavior (a term prefered by many biologists) is defined an overt action or a threat of overt action that can physically injure another organism. A sense of deliberation is implied—accidentally tramping on an ant is not aggressive, but walking a few feet out of one's way to squish a caterpillar is aggressive. The term does not include the English language meaning of aggression as a forceful, vigorous, energetic actions—e.g., the aggressive entrepeneur. Far from being pathological, physical aggression and the threat of it are adaptive behaviors for many species. Aggression and threat are used in the establishment and defense of territory, to change and to maintain dominance, to gain access to mates, and as a countermeasure to protect oneself and others, especially genetic relatives, from harm.

Most people are surprised to learn that we humans can be a very nonaggressive species in terms of our day to day actions. Troops of chimps, baboons, and many other monkeys and apes show aggression on almost a daily basis. If you spend an evening watching ducks or geese during breeding season, you will see multiple instances of quacking, honking, chasing, pecking, and biting. Spend the same amount of time in a park, shopping mall, or other place where people congregate. If you do witness aggression, it be only a few times and is likely to occur among younger children. Walk for a while in a strange neighborhood with single family homes. While passing one or two homes, the family dog may run to the fence and bark, warning you against trespassing and portending dire consequences if you do. How many owners act would this way towards you? If you do make eye contact with someone sitting on the porch or working in yard, you are likely to experience a nod of the head and a small smile.

In urban and suburban areas, people observe other people on a daily basis. Most people work with other people, so beginning with the morning commute, urbanites are likely to spend something over 8 to 10 hours a day as observers of other humans. (Not that they are consciously staring at others to record their behavior, but as passive observers who would note any extreme departure from normative behavior.) Even if we account for solitary weekends and holidays, most people would average over 6 hours a day in person observation. That is equivalent to over 2,000 observational hours per year. In a class of 50 college students, ask who has witness a murder or an attempt to commit a murder in the past year. Combined, 50 students give around 100,000 observational hours. That is much longer than it ever took to document homicide in chimpanzees. If you asked the students about witnessing homicides over the past 10 years, you are still likely to draw a blank, even though the observations hours are well over 1,000,000. Murder is, thankfully, a rare event. That is why it is a newsworthy event and why we hear about it all the time.