Aggression: Understanding the Roots of Human Behavior

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In psychology, as well as other social and behavioral sciences, aggression refers to behavior between members of the same species that is intended to cause pain or harm. Predatory or defensive behavior between members of different species is not normally considered "aggression." Aggression takes a variety of forms among humans and can be physical, mental, or verbal. Aggression should not be confused with assertiveness, although the terms are often used interchangeably among laypeople, e.g. an aggressive salesperson.

Varieties

There are two broad categories of aggression. These include hostile, affective, or retaliatory aggression and instrumental, predatory, or goal-oriented aggression. Empirical research indicates that there is a critical difference between the two, both psychologically and physiologically. Some research indicates that people with tendencies toward "affective" aggression, defined in this study as being "impulsive, unplanned, overt, or uncontrolled" have lower IQs than those with tendencies toward "predatory" aggression, defined here as being "goal-oriented, planned, hidden, or controlled".

In moral theories, such as argumentation ethics and the non-aggression principle, physical aggression is distinguished from violence. Aggression is considered the initiation of violence. Often, retaliatory violence and defensive violence is not considered aggression, because it is a responsive action.

Evolution

Like most behaviors, aggression can be examined in terms of its ability to help an animal reproduce and survive. Animals may use aggression to gain and secure territories, as well as other resources including food, water, and mating opportunities. Researchers have theorized that aggression and the capacity for murder are products of our evolutionary past.

Aggression against outsiders

The most apparent type of aggression is that seen in the interaction between a predator and its prey. An animal defending itself against a predator becomes aggressive in order to survive and to ensure the survival of its offspring. Because aggression against a much larger enemy or group of enemies would lead to the death of an animal, animals have developed a good sense of when they are outnumbered. This ability to gauge the strength of other animals gives animals a "fight or flight" response to predators; depending on how strong they gauge the predator to be, animals will either become aggressive or flee.

The need to survive and the viability of cooperative behavior as a survival strategy leads to a

phenomenon known as altruism. An example of an altruistic act is the alarm call that is given when a predator is approaching. While this call will inform the community of a predator's presence, it will also inform the predator of the whereabouts of the animal that gave the alarm call. While this would appear to give the alarm caller an evolutionary disadvantage, it would facilitate the continuation of this animal's genes because its relatives and progeny would be more able to avoid predators.

According to many researchers, predation is not aggression. Cats do not hiss or arch their backs when in pursuit of a rat, and the active areas in their hypothalamuses are more similar to those that reflect hunger than those that reflect aggression.

Aggression within a species

Aggression against conspecifics serves a number of purposes having to do with breeding. One of the most common of these purposes is the establishment of a dominance hierarchy. When certain types of animals are first placed in a common environment, the first thing they do is fight to assert their role in the dominance hierarchy. In general, the more dominant animals will be more aggressive than their subordinates. The majority of conspecific aggression ceases about 24 hours after the introduction of the animals being tested.

There are many different theories that try to explain how males and females developed these different aggressive tendencies. One theory states that in species where one sex makes a higher parental investment than the other, the higher investing sex is a resource for which the other sex competes: in the majority of species, females are the higher investing sex. It also holds that reproductive success is cardinal to the perpetuation of an organism's lineage and hereditary characteristics. For males, it is of crucial importance to establish dominance and resource holding to obtain reproductive opportunities in order to pass on their genetics. Unlike females, whose reproductive success is constrained by long gestation and lactation periods, male reproductive success is constrained by the number of partners they can mate with. As a result, males employ physical aggression more often than females; they take more risks in order to compete with other males and gain an elevation of status. Males even go as far as killing one another, although this is rare. Males demonstrate less concern for their physical welfare in such competitions. In contrast, females compete with one another for resources, which can be converted to offspring. The establishment of dominance is more costly for females than for males and females have less to gain from achieving status. The female presence is more critical to the offspring's survival and hence her reproductive success than is the father's. It is only logical then that the health and wellbeing of females would cause them to use less aggressive, low-risk, and indirect strategies to acquire resources. As a result, in the majority of female-female conflicts, females rarely inflict serious damage to one another over resources. When translated to human, these facts suggest that women should be expected to show less evidence of dominance hierarchies than men do. In society, aggression in boys becomes increasingly motivated by issues of social status and self-

esteem, which are usually decided by varying degrees of aggressive reactivity to personal challenge. Aggression in girls, focusing mainly on resource acquisition and not status, is more likely to take less physically dangerous and more covert forms of indirect aggression. There are, however, extensive critiques of the use of animal behavior to explain human behavior and the application of evolutionary explanations of contemporary human behavior.

In humans

Although humans share aspects of aggression with non-human animals, they differ from most of them in the complexity of their aggression because of factors such as culture, morals, and social situations. A wide variety of studies have been done on these situations. Agression in humans can be assessed by using aggression scales such as the MOAS (Modified Overt Agression Scale).

Culture

Culture is a distinctly human factor that plays a role in aggression. Kung Bushmen were described as the "harmless people" by Elizabeth Marshall Thomas (1958). Other researchers, however, have countered this point of view, calculating that the homicide rate among Bushmen is actually higher than that of developed societies (Keeley, 1996). Lawrence Keeley argues that the "peaceful savage" is a myth that is unsupported by the bulk of anthropological and archeological evidence. Hunter-gatherer societies do not have possessions to fight over, but they may still come to conflict over status and mating opportunities.

Empirical cross-cultural research has found differences in the level of aggression between cultures. In one study, American men resorted to physical aggression more readily than Japanese or Spanish men, whereas Japanese men preferred direct verbal conflict more than their American and Spanish counterparts (Andreu et al. 1998). Within American culture, southerners were shown to become more aroused and to respond more aggressively than northerners when affronted (Bowdle et al. 1996). There is also a higher homicide rate among young white southern men than among white northern men in the United States (Nisbett 1993). Changes in dominant behavior or in social status causes changes in testosterone levels. Reports of changes in testosterone of young men during athletic events, which involve face-to-face competition with a winner and a loser, reveal that testosterone rises shortly before their matches, as if in anticipation of the competition. Also, one to two hours after the competitive match, the testosterone levels of the winners are high relative to those levels of the losers. It is also important to take into account the type of conflict that is occurring when assessing aggression. Is the conflict between groups, within a group, within a family? The sex of those involved in the conflict is also critical. Male-male, male-female and female-female encounters should all be clearly distinguished from one another. Same sex encounters are more frequent than inter-sex encounters and this could affect the level of

aggression present.

A person's beliefs about the social acceptability of an aggressive act (termed "normative beliefs") are major predictors of their behavior. Today, some polls indicate that 63% of Jewish Israelis consider their country's Arab citizens a "security and demographic threat to the state." Roughly 18% said they felt hatred when they heard someone speaking Arabic, and 34% agreed with the statement that "Arab culture is inferior to Israeli culture." Various social scientists and political leaders suggest that increasing interpersonal aggression against Palestinians as well as Arabs in Israel is due to increasing tolerance for public racism against Arabs. Normative beliefs may partially explain cultural differences in aggression towards certain groups. As these beliefs are readily changeable through intervention, targeting normative beliefs may be a way to decrease aggression in certain individuals.

Media

Behaviors like aggression can be learned by watching and imitating the behavior of others. A considerable amount of evidence suggests that watching violence on television increases the likelihood of short-term aggression in children (Aronson, Wilson, & Akert, 2005, though for a dissenting viewpoint, see Freedman, 2002). Individuals may differ in how they respond to violence. The greatest impact is on those who are already prone to violent behavior. Adults may be influenced by violence in media as well. A long-term study of over 700 families found "a significant association" between the amount of time spent watching violent television as a teenager and the likelihood of committing acts of aggression later in life. The results remained the same in spite of factors such as family income, parental education and neighborhood violence (Aronson, Wilson, & Akert, 2005).

Although exposure to violence in media is associated with likelihood of short-term increases in aggression, none of these studies provide evidence for a definitive causal mechanism. Instead, violence in media may be one of many factors, or it may play a maintenance role since violent media tend to be selected by people who are prone to violence.

Situational factors

Alcohol impairs judgment, making people much less cautious than they usually are (MacDonald et al. 1996). It also disrupts the way information is processed (Bushman 1993, 1997; Bushman & Cooper 1990). A drunk person is much more likely to view an accidental event as a purposeful one, and therefore act more aggressively and that.

Pain and discomfort also increase aggression. Even the simple act of placing one's hands in warm water can cause an aggressive response. Hot temperatures have been implicated as a factor in a

number of studies. One study completed in the midst of the civil rights movement found that riots were more likely on hotter days than cooler ones (Carlsmith & Anderson 1979). Students were found to be more aggressive and irritable after taking a test in a hot classroom (Anderson et al. 1996, Rule, et al. 1987). Drivers in cars without air conditioning were also found to be more likely to honk their horns (Kenrick & MacFarlane 1986).

Frustration is another major cause of aggression. The Frustration aggression theory states that aggression increases if a person feels that he or she is being blocked from achieving a goal (Aronson et al. 2005). One study found that the closeness to the goal makes a difference. The study examined people waiting in line and concluded that the 2nd person was more aggressive than the 12th one when someone cut in line (Harris 1974). Unexpected frustration may be another factor. In a separate study, a group of students were collecting donations over the phone. Some of them were told that the people they would call would be generous and the collection would be very successful. The other group was given no expectations. The group with high expectations was much more upset and became more aggressive when no one was pledging (Kulik & Brown 1979).

There is some evidence to suggest that the presence of violent objects such as a gun can trigger aggression. In a study done by Leonard Berkowitz and Anthony Le Page (1967), college students were made angry and then left in the presence of a gun or badminton racket. They were then led to believe they were delivering electric shocks to another student, as in the Milgram experiment. Those who had been in the presence of the gun administered more shocks. It is possible that a violence-related stimulus increases the likelihood of aggressive cognitions by activating the semantic network.

A new proposal links military experience to anger and aggression, developing aggressive reactions and investigating these effects on those possessing the traits of a serial killer. Castle and Hensley state, "The military provides the social context where servicemen learn aggression, violence, and murder." Post-traumatic stress disorder (PTSD) is also a serious issue in the military, also believed to lead to aggression in soldiers who are suffering from what they witnessed in battle. They come back to the civilian world and are still haunted by flashbacks and nightmares, causing severe stress. In addition, those who are inclined toward serial killing find their violent impulses reinforced and refined, possibly creating more effective murderers. These controversial studies are far from definitive and require further investigation.

Gender

Gender is a factor that plays a role in both human and animal aggression. Males are historically believed to be generally more physically aggressive than females (Coie & Dodge 1997, Maccoby & Jacklin 1974), and men commit the vast majority of murders (Buss 2005). This is one of the most robust and reliable behavioral sex differences, and it has been found across many different age

groups and cultures. There is evidence that males are quicker to aggression (Frey et al. 2003) and more likely than females to express their aggression physically (Bjorkqvist et al. 1994). When considering indirect forms of non-violent aggression, such as relational aggression and social rejection, some scientists argue that females can be quite aggressive although female aggression is rarely expressed physically (Archer, 2004; Card, Stucky, Sawalani, & Little, 2008).

Although females are less likely to initiate physical violence, they can express aggression by using a variety of non-physical means. Exactly which method women use to express aggression is something that varies from culture to culture. On Bellona Island, a culture based on male dominance and physical violence, women tend to get into conflicts with other women more frequently than with men. When in conflict with males, instead of using physical means, they make up songs mocking the man, which spread across the island and humiliate him. If a woman wanted to kill a man, she would either convince her male relatives to kill him or hire an assassin. Although these two methods involve physical violence, both are forms of indirect aggression, since the aggressor herself avoids getting directly involved or putting herself in immediate physical danger.

In children

The frequency of physical aggression in humans peaks at around 2-3 years of age. It then declines gradually on average. These observations suggest that physical aggression is mostly not a learned behavior and that development provides opportunities for the learning of self-regulation. However, a small subset of children fails to acquire the necessary self-regulatory abilities and tends to show atypical levels of physical aggression across development. These may be at risk for later violent behavior.

What is typically expected of children?

Young children preparing to enter kindergarten need to develop the socially important skill of being assertive. Examples of assertiveness include asking others for information, initiating conversation, or being able to respond to peer pressure.
In contrast, some young children use aggressive behavior, such as hitting or biting, as a form of communication.
Aggressive behavior can impede learning as a skill deficit, while assertive behavior can facilitate learning. However, with young children, aggressive behavior is developmentally appropriate and can lead to opportunities of building conflict resolution and communication skills.
By school age, children should learn more socially appropriate forms of communicating such as expressing themselves through verbal or written language; if they have not, this behavior may signify a disability or developmental delay.

What triggers aggressive behavior in children?

Physical fear of others
Family difficulties
Learning, neurological, or conduct/behavior disorders
Psychological trauma

Corporal punishment such as spanking increases subsequent aggression in children.

The Bobo doll experiment was conducted by Albert Bandura in 1961. In this work, Bandura found that children exposed to an aggressive adult model acted more aggressively than those who were exposed to a nonaggressive adult model. This experiment suggests that anyone who comes in contact with and interacts with children can have an impact on the way they react and handle situations.

Summaries of best practice recommendations

American Academy of Pediatrics: "Set firm, consistent limits to help children self monitor emotions and behavior; make sure all care takers agree to the same limits. Provide examples of effective and socially acceptable ways of managing anger; be careful not to reinforce aggression with aggressive forms of punishment. Also, model acceptable behavior as a caretaker by managing your own temper. Remember that occasional outbursts are normal. If aggressive behavior continues for more than a few weeks, consult a pediatrician or mental health professional."
National Association of School Psychologists: "Overly aggressive behavior can signify a social skills deficit; direct instruction, modeling, and coaching can help children acquire the skill of assertion, which as a replacement behavior may help prevent aggressive behavior."

In female youth

In 1994 4,882 females aged 12-17 were charged with a violent crime, while this number rose to 5,652 in 1998. Similarly in the U.S., arrests of female youth for simple assault, aggravated assault, and offences included in the Violent Crime Index (homicide, forcible rape, robbery, aggravated assault) all increased from 1980 to 2000. More recent statistics are also concerning: in 2008 the U.S. National Survey on Drug Use and Health found that 18.6% of females aged 12-17 got into a serious fight at school or work, 14.1% participated in a group-against-group fight, and 5.7% attacked another with the intent to seriously harm. These statistics have increased research interest on this issue and on how best to prevent and intervene on girls' use of aggression and violence.

Aggressive and violent behavior not only harms the victim but is also associated with negative outcomes and other risky behaviors for the aggressive individual. Adolescent females who are not enrolled in or attending school are more likely to engage in violent behavior than those who are in

school. Moreover, there is an increase in violent behavior as school grades decrease, and violent adolescent females are also more likely to engage in binge drinking and illicit substance use than non-violent females.

There is some suggestion that the causes and correlates of aggression in female youth are different from those in males. Ellickson, Saner, and McGuigan (1997) found that violent female high school students were more likely to report poorer mental health than violent males. Violent females report engaging in self-harm, and unpopularity and depression may be more likely to be reported by aggressive female children than aggressive male children. Based on teacher reports, overtly aggressive females are perceived to be more maladjusted than overtly aggressive males. There is also evidence for differential gender effects of gender-neutral school-based violence prevention programs. A universal violence prevention program for seventh-graders resulted in stronger support of nonviolence and less acceptance of the use of violence in males but not in females. Similarly a program aimed at improving social competency reduced physical fighting in boys but not in girls.

Aggressive and violent female youth is a growing issue and warrants attention. Despite this there are very few school-based violence prevention or intervention programs for females specifically. Although there are numerous school-based unisex programs for a variety of ages, only one school-based female-targeted social aggression prevention program has been developed, and one group-counseling relational aggression intervention for female youth living in a residential home. Thus, there is a need for school-based female-specific violence prevention programs aimed at improving self-confidence, self-efficacy, and social skills. An effective program should also incorporate gender-specific content such as discussions about what it means to be a girl, societal expectations of being a girl and the roles girls are expected to play, and how girls communicate and interact with each other.

Biology

Aggression is directed to and often originates from outside stimuli, but has a very distinct internal character. Using various techniques and experiments, scientists have been able to explore the relationships between various parts of the body and aggression.

In the brain

Many researchers focus on the brain to explain aggression. The areas involved in aggression in mammals include the amygdala, hypothalamus, prefrontal cortex, cingulate cortex, hippocampus, septal nuclei, and periaqueductal grey of the midbrain. Because of the difficulties in determining the intentions of animals, aggression is defined in neuroscience research as behavior directed at an object or animal which results in damage or harm to that object or animal.

In many animals, aggression is controlled by pheromones. In mice, Major urinary proteins (Mups) have been demonstrated to promote innate aggressive in behavior males. Mups were demonstrated to activate olfactory sensory neurons in the vomeronasal organ (VNO), a subsystem of the nose known to detect pheromones via specific sensory receptors, of mice and rats.

The hypothalamus and periaqueductal gray of the midbrain are the most critical areas controlling aggression in mammals, as shown in studies on cats, rats, and monkeys. These brain areas control the expression of all the behavioral and autonomic components of aggression in these species, including vocalization. They have direct connections with both the brainstem nuclei controlling these functions and areas such as the amygdala and prefrontal cortex.

Electrical stimulation of the hypothalamus causes aggressive behavior the hypothalamus expresses receptors that help determine aggression levels based on their interactions with the neurotransmitters serotonin and vasopressin.

The amygdala is also critically involved in aggression. Stimulation of the amygdala results in augmented aggressive behavior in hamsters, while lesions of an evolutionarily homologous area in the lizard greatly reduce competitive drive and aggression (Bauman et al. 2006). Several experiments in attack-primed Syrian Golden Hamsters support the claim of the amygdala being involved in control of aggression. Using expression of c-fos as a neuroanatomically localized marker of activity, the neural circuitry involved in the state of "attack readiness" in attack-primed hamsters was studied. The results showed that certain structures of the amygdala were involved in aggressiveness: the medial nucleus and the cortical nuclei showed distinct differences in involvement as compared to other structures such as the lateral and basolateral nuclei and central nucleus of the amygdala, which were not associated with any substantial changes in aggressiveness. In addition, c-fos expression was found most clearly in the most dorsal and caudal aspects of the corticomedial amygdala (CMA). In the same study, it was also shown that lesions of the CMA significantly reduced the number of aggressive behaviors. Eight of eleven subjects failed to attack. Also a correlation between lesion site and attack latency was determined: the more anterior the lesion, the longer mean elapsed time to the aggressive behavior.

The prefrontal cortex (PFC) has been implicated in aggressive psychopathology. Reduced activity of the prefrontal cortex, in particular its medial and orbitofrontal portions, has been associated with violent/antisocial aggression. Specifically, regulation of the levels of the neurotransmitter serotonin in the PFC has been connected with a particular type of pathological aggression, induced by subjecting genetically predisposed, aggressive, wild-type mice to repeated winning experience; the male mice selected from aggressive lines had lower serotonin tissue levels in the PFC than the low-aggressive lines in this study.

Testosterone

Various neurotransmitters and hormones have been shown to correlate with aggressive behavior. The most often mentioned of these is the hormone testosterone. Scientists have for a long time been interested in the relationship between testosterone and aggressive behavior. In most species, males are more aggressive than females. Castration of males usually has a pacifying effect on aggressive behavior in males. In humans, males engage in crime and especially violent crime more than females. The involvement in crime usually rises in the early teens to mid teens which happen at the same time as testosterone levels rise. Research on the relationship between testosterone and aggression is difficult since the only reliable measurement of brain testosterone is by a lumbar puncture which is not done for research purposes. Studies therefore have often instead used more unreliable measurements from blood or saliva.

The Handbook of Crime Correlates, a review of crime studies, states most studies support a link between adult criminality and testosterone although the relationship is modest if examined separately for each sex. However, nearly all studies of juvenile delinquency and testosterone are not significant. Most studies have also found testosterone to be associated with behaviors or personality traits linked with criminality such as antisocial behavior and alcoholism. Many studies have also been done on the relationship between more general aggressive behavior/feelings and testosterone. About half the studies have found a relationship and about half no relationship.

In one source, it was noted that concentration of testosterone most clearly correlated with aggressive responses involving provocation. In adulthood, it is clear that testosterone is not related to any consistent methods of measuring aggression on personality scales, but several studies of the concentration of blood testosterone of convicted male criminals who committed violent crimes compared to males without a criminal record or who committed non-aggressive crimes revealed in most cases that men who were judged aggressive/dominant had higher blood concentrations of testosterone than controls. However, a correlation between testosterone levels and aggression does not prove a causal role for testosterone. Studies of testosterone levels of male athletes before and after a competition revealed that testosterone levels rise shortly before their matches, as if in anticipation of the competition, and are dependent on the outcome of the event: testosterone levels of winners are high relative to those of losers. Interestingly, testosterone levels in female criminals versus females without a criminal record mirror those of males: testosterone levels are higher in women who commit aggressive crimes or are deemed aggressive by their peers than non-aggressive females. However, no specific response of testosterone levels to competition was observed in female athletes, although a mood difference was noted. Testosterone has been shown to correlate with aggressive behavior in mice and in some humans, but some experiments have failed to find a relationship between testosterone levels and aggression in humans. The possible correlation between testosterone and aggression could explain the "roid rage" that can result from anabolic steroid use, although an effect of abnormally high levels of steroids does not prove an effect at physiological levels.

Another line of research has focused more on the effects of circulating testosterone on the nervous system mediated by local metabolism within the brain. Testosterone can be metabolized to 17b-estradiol by the enzyme aromatase or to 5a-dihydrotestosterone by 5a-reductase. Aromatase is highly expressed in regions involved in the regulation of aggressive behavior, such as the amygdala and hypothalamus. In studies using genetic knock-out techniques in inbred mice, male mice that lacked a functional aromatase enzyme displayed a marked reduction in aggression. Long-term treatment of these mice with estradiol partially restored aggressive behavior, suggesting that the neural conversion of circulating testosterone to estradiol and its effect on estrogen receptors affects inter-male aggression. Also, two different estrogen receptors, ERa and ERb, have been identified as having the ability to exert different effects on aggression. In studies using estrogen receptor knockout mice, individuals lacking a functional ERa displayed markedly reduced inter-male aggression while male mice that lacked a functional ERb exhibited normal or slightly elevated levels of aggressive behavior. These results imply that ERa facilitates male-male aggression, whereas ERb may inhibit aggression. However, different strains of mice show the opposite pattern in that aromatase activity is negatively correlated with aggressive behavior. Also, in a different strain of mice the behavioral effect of estradiol is dependent on daylength: under long days (16 h of light) estradiol reduces aggression, and under short days (8 h of light) estradiol rapidly increases aggression.

Other neurotransmitters and hormones

Glucocorticoids also play an important role in regulating aggressive behavior. In adult rats, acute injections of corticosterone promote aggressive behavior and acute reduction of corticosterone decreases aggression; however, a chronic reduction of corticosterone levels can produce abnormally aggressive behavior. In addition, glucocorticoids affect development of aggression and establishment of social hierarchies. Adult mice with low baseline levels of corticosterone are more likely to become dominant than are mice with high baseline corticosterone levels.

Dehydroepiandrosterone (DHEA) is the most abundant circulating androgen and can be rapidly metabolized within target tissues into potent androgens and estrogens. Gonadal steroids generally regulate aggression during the breeding season, but non-gonadal steroids may regulate aggression during the non-breeding season. Castration of various species in the non-breeding season has no effect on territorial aggression. In several avian studies, circulating DHEA has been found to be elevated in birds during the non-breeding season. These data support the idea that non-breeding birds combine adrenal and/or gonadal DHEA synthesis with neural DHEA metabolism to maintain territorial behavior when gonadal testosterone secretion is low. Similar results have been found in studies involving different strains of rats, mice, and hamsters. DHEA levels also have been studied in humans and may play a role in human aggression. Circulating DHEAS (its sulfated ester) levels rise during adrenarche (~7 years of age) while plasma testosterone levels are relatively low. This implies that aggression in pre-pubertal children with

aggressive conduct disorder might be correlated with plasma DHEAS rather than plasma testosterone, suggesting an important link between DHEAS and human aggressive behavior.

Another chemical messenger with implications for aggression is the neurotransmitter serotonin. In various experiments, serotonin action was shown to be negatively correlated with aggression (Delville et al. 1997). This correlation with aggression helps to explain the aggression-reducing effects of selective serotonin reuptake inhibitors such as fluoxetine (Delville et al. 1997), aka prozac.

While serotonin and testosterone have been the two most-researched chemical messengers with regards to aggression, other neurotransmitters and hormones have been shown to relate to aggressive behavior as well. The neurotransmitter vasopressin causes an increase in aggressive behavior when present in large amounts in the anterior hypothalamus (Delville et al. 1997). The effects of norepinephrine, cortisol, and other neurotransmitters are still being studied.

Genetics

In a nonmammilian example, the fruitless gene in Drosophila melanogaster is a critical determinant for how fruit flies fight. Patterns of aggression can be switched, with males using female patterns of aggression or females using male patterns, by manipulating either the fruitless or transformer genes in the brain. Candidate genes for differentiating aggression between the sexes are the Sry (sex determining region Y) gene, located on the Y chromosome and the Sts (steroid sulfatase) gene. The Sts gene encodes the steroid sulfatase enzyme, which is pivotal in the regulation of neurosteroid biosynthesis. It is expressed in both sexes, is correlated with levels of aggression among male mice, and increases dramatically in females after parturition and during lactation, corresponding to the onset of maternal aggression.

Alcohol

There has been some links between those prone to violence and their alcohol use. Those who are prone to violence and use alcohol are more likely to carry out violent acts. For example, Ted Bundy, an inherently violent individual, became more violent with his murders after much alcohol abuse.