

Aggressiveness and violence – An issue

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Abstract

Frequently, aggressiveness and violence are used as synonymous. However, these are two complex and different phenomena that scientists and philosophers have studied. In this paper, we make a difference between aggressiveness and violence. Aggressiveness must be considered utilitarian behavior that harms or destroys objects or subjects. Aggressiveness is a primitive way to conduct, and here, we discuss anatomic and functional encephalic systems. This involuntary and instinctive behavior is triggered when the animal is required to hunt a prey, defend its territory when young, or compete for a mate for reproductive purposes. The aggressiveness will be violence when it pursues a social, political, economic, or criminal goal. A violent or aggressive act is not distinguished by the outcome but by intentionality. Indeed, a violent action could have the same material consequences as an aggressive act with a different goal. Aggression-violence is a biological phenomenon and the result of culture, societal life, political relations, and current moral conditions. We often tend to simplify the phenomena, and we have discussed aggressiveness-violence, but there are also other phenomena, such as empathy and mirror behavior. Empathy, compassion, and affection should be studied alongside the aggressive-violent process.

Keywords: Aggressiveness. Violence. Psychosurgery. Stereotaxis. Biological evolution.

Introduction

Frequently, aggressiveness and violence are used as synonymous. However, these are two complex and different phenomena that scientists and philosophers have studied widely. The evolutionary premise is to survive as individuals, as a group, and as a species and maintain our lineage. From an evolutionary point of view, the life of a human being was in danger because he was a link in the food chain. This circumstance has changed, and nowadays, the main predator of man is another man. In addition, today, the deterioration of the environment and depletion of natural resources is one of the main risks for our species.

Aggressiveness could be considered utilitarian behavior that harms or destroys objects or subjects. Aggressiveness is a primitive conduct. This involuntary and

instinctive behavior is triggered when the animal is required to hunt a prey, defend its territory when young, or compete for a mate for reproductive purposes. Nevertheless, aggressiveness and violence can be considered parallel conduct. The aggressiveness will be violence when it pursues a social, political, economic, or criminal goal. Indeed, a violent or aggressive act is not distinguished by the outcome but by intentionality. A violent action could have the same material consequences as an aggressive act with a different goal.

Today, the anatomic substrate of aggressiveness behavior is the limbic system^{1,2}. The limbic system has consistent and congruent evidence about anatomical connections and physiological functions related to emotions². This system is a transition between the primitive brain and the telencephalon. In 1937, Papez published a particular neural loop involved in emotional

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Date of reception: 24-07-2023

Date of acceptance: 10-11-2023

DOI: 10.24875/HGMX.23000056

Available online: 23-04-2024

Rev Med Hosp Gen Mex. 2024;87(2):72-79

www.hospitalgeneral.mx

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behavior; Papez's circuit was considered a loop between moderator centers of mood^{1,3}. Later, in the middle of the 20th century, Mac Lean proposed a more prominent and more extensive neuronal circuitry related to excited and aggressive behavior named the limbic system^{1,4}. Evidence has been accumulated about the areas involved in psychiatric disorders. In 1986, Yudofsky proposed the term neuroaggressive disorder as the presence of organic damage to brain structures involved in developing or containing aggressive behavior⁵.

Aggressive behavior has been studied for many centuries. In 2017⁶, Wrangham published the point of view of Jean-Jacques Rousseau and Peter Kropotkin; they state that the behavior of human beings is initially peaceful and becomes violent due to the influence of a hierarchical society. In that same paper, in the opposite sense, it is analyzed the thoughts of Thomas Hobbes and Thomas Henry Huxley. They establish that the behavior of the human being is initially aggressive and is modulated and limited by the influence of civilization. According to prior declarations, aggressiveness-violence could be understood as equivalent phenomena originated or regulated by natural conditions and social rules.

Two fundamental types of aggressive behavior are proposed: reactive and proactive^{6,7}. Reactive aggression includes several conditions, such as being innate; it always involves vegetative responses of a sympathetic autonomic type (tachycardia, arterial hypertension, pupillary dilation, and others that depend on adrenaline secretion), and it depends on brain structures grouped in the limbic system that we will analyze. Reactive aggressiveness includes an emotion such as fear or anger; it could be considered primitive and directed to different "objectives," such as defense against a predator, the fight during the mating period, or the defense of the territory. This type of aggressiveness in its acme can attack without measuring the consequences or who is attacked; its goal is mainly to survive, and it manifests as an impulse, so it is uncontrolled.

On the other hand, proactive aggression is learned; it almost does not involve vegetative responses, it depends more on the frontal lobe than on the limbic system, it does not understand emotion for what is considered cold, it could be considered evolved, it always has a specific "directed target" for what his goal is a reward that can be of different kinds, not only to survive but to obtain satisfaction or power. Ultimately, it is instrumental, planned, and always controlled.

Biological behavior

Biologically, invertebrate animals (*arthropods*, *mollusks*, *nematodes*, echinoderms, cnidarians, and *Porifera*) can exhibit aggressive behavior if we define this as destructive behavior. However, in these groups of animals, no structure in their nervous system gives an emotional tone to this action. Consequently, this behavior is more a reaction than aggressive behavior. In mammals, the nervous system is transformed into a dorsal cord, the spinal cord protected within the vertebral column. Encephalization occurs as the nervous system evolves, which means that the anterior portion expands and predominates, forming the brain inside the skull^{8,9}. The limbic system is a set of anatomical structures shaped like a ring around the diencephalon. The limbic system includes the "limbic cortices" (amygdala, hippocampus, cingulate cortex, and orbitofrontal cortex) (Fig. 1).

Specifically, the cerebral cortex has specific zones related to generating and controlling emotions. They are the amygdala complex, hippocampal cortex, cingulate gyrus, and orbitofrontal cortex. In this sense, in 1952, Mac Lean proposed a strong connection between the frontal and temporal cortex, and he included interaction with the hypothalamus, septal cortex, and rhinencephalon^{1,10}. Mac Lean postulated the concept of the triune brain, which is integrated into three parts:

- The reptilian brain (ventral striatum and basal ganglia)
- The visceral brain (limbic system)
- The evolutionary neocortical brain (predominately cortex of frontal lobes).

This idea has been kept for many years. There has been an increment of anatomical structures in mood control, particularly in the vegetative response and aggressive behavior. The amygdala and the hypothalamus are the most critical neural nuclei for causing aggressive conduct, reproductive behavior, and anxiety or fear. The hypothalamus can trigger the visceral and autonomic functions of the subject (sympathetic and parasympathetic systems). The stimulus that triggers these responses produces a memory trace through the hippocampal formation of the temporal lobe. In this way, an aggressive or fearful response can be integrated. Hence, the edge between the reptilian brain, limbic system, and neocortex could be more precise. Parallel loops could be a better model of study.

On the other hand, despite controversial opinions on brain surgical treatment of psychiatric illness, neurosurgery has been used as a medical proposition to reduce aggressive conduct in these patients. These surgeries were hardly questioned in the last century, causing ethical

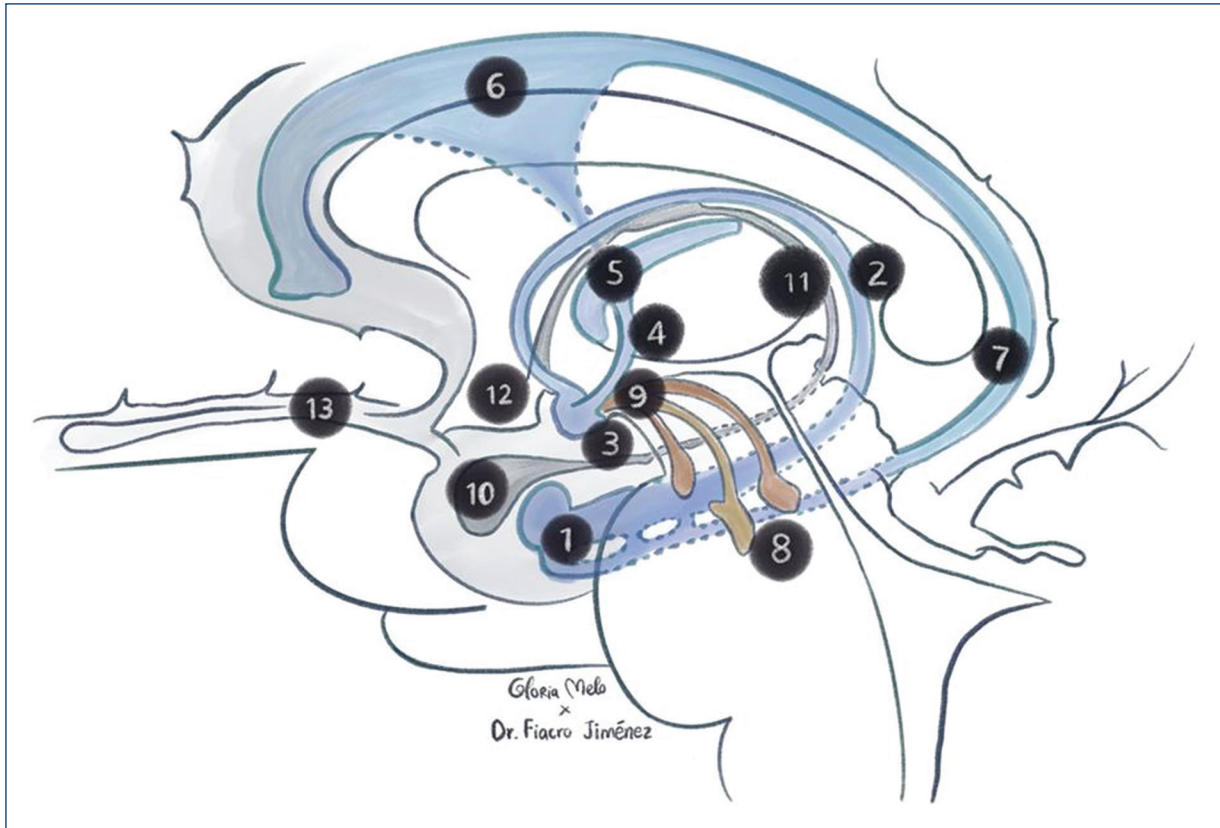


Figure 1. Diagram of the limbic and paralimbic system. (1) Hippocampus, (2) fornix, (3) mamillary body, (4) mammillothalamic bundle, (5) anterior nucleus of the thalamus, (6) cingulate cortex, (7) hippocampal connections, (8) medial forebrain bundle, (9) medial forebrain tract, (10) amygdaloid nucleus, (11) stria terminalis, (12) septal area-ventral striatum, and (13) rhinencephalon and orbitofrontal cortex.

issues, side effects, and unsteady outcomes. However, some well-established neurosurgical procedures have decreased aggressive behavior safely. Several authors have reported that ablative surgery or deep brain stimulation could reduce neuroaggressive disorder (Fig. 2)¹¹⁻²⁴.

Personality: for two decades, we have performed a bilateral surgical procedure to control neuroaggressive states involving an anterior capsulotomy and a bilateral supragenual cingulotomy²². The results have shown a sustained reduction between 60 and 80% of the aggressive behavior of the patients. Recently, in other communication, we have been able to observe that the combined lesion of the lateral hypothalamus and the lateral and central nuclei of the amygdala on the “dominant” side can reduce aggressive behavior very efficiently compared to other more extensive procedures such as the one previously mentioned^{25,26}. The left hemisphere is “dominant” for language, and the control of the right hemibody performs fine movements such as writing. We could conceptualize aggressive behavior

as “a tool” under the control of the left fronto-parieto-temporal cortex. This proposal could explain the co-existence of reactive and proactive aggression. Both behaviors occur in humans, but proactive aggressiveness would seem to be the substrate for violence.

Seven hundred thousand years of evolution of primates allowed the frontal and parietal lobes of the brain to act on the limbic system and their parallel loops²⁷. However, from an evolutive point of view, there is only a 1.23% difference between the genome of *Homo sapiens* and the two phylogenetically closest species, such as *Pan paniscus* (Bonobo) and *Pan troglodytes* (chimpanzee)²⁸. Despite this, the phenotypic and cultural difference is enormous. Genetic or epigenetic aspects of primates could partially explain the control of reactive and proactive aggressiveness²⁷.

Developing the cerebral cortex is essential in understanding the behavior of vertebrates in general and humans (allocortex and isocortex)²⁸⁻³⁰. However, social environment and cultural development can make isocortex or allocortex

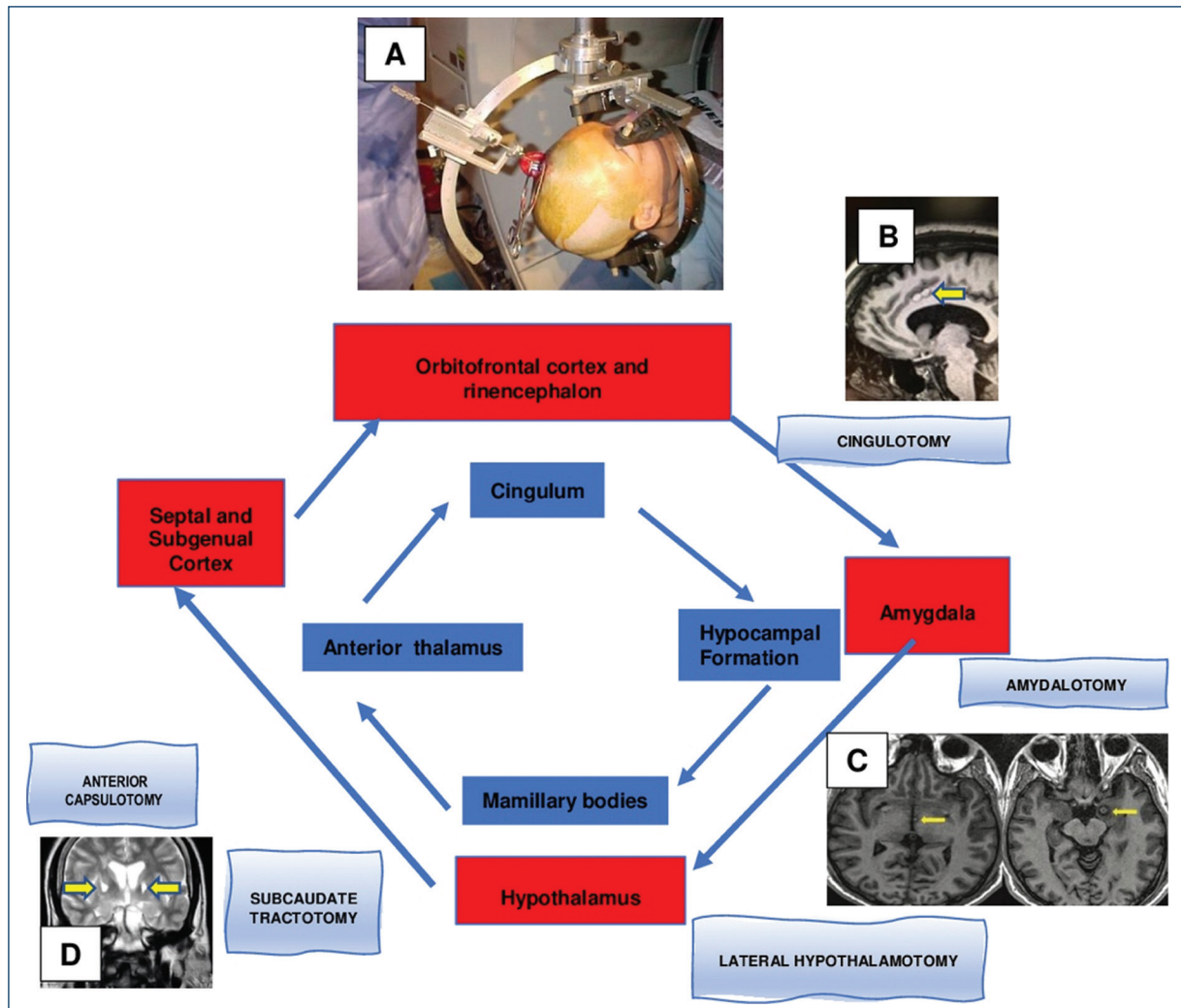


Figure 2. This figure shows the two primary circuits that make up the limbic system. In the center (in blue boxes), you can see the four main structures that Papez described at the beginning of the 20th century. Outside, a paralimbic circuit (in red boxes) constitutes a fundamental part of the control of emotions, and Mac Lean later described that. **A:** stereotactic surgery to control aggression. This procedure has demonstrated its efficacy and safety for over 50 years. **B-D:** different magnetic resonance images with the lesions resulting from surgery for aggressiveness, respectively cingulotomy, amygdalotomy, hypothalamotomy, and anterior capsulotomy.

circuits prevail to specific stimuli, such as aggression-violence in conflict resolution³⁰⁻³². The growth in the volume of the human brain depended fundamentally on the parietal, frontal, temporal, and occipital neocortex and particularly on areas known as associations that are responsible for interrelating the specific functions of the primary sensory and motor cortices (Fig. 3).

Social behavior

In 2005, Baños established that aggressiveness is a biological-adaptive behavior and that violence is a cultural behavior, understanding culture as part of the

environment that human beings have created³³. He adds that violence is an intentional, premeditated, and conscious process of the individual and society.

The manufacture of weapons would be an example of how society establishes a culture of violence. Neolithic stone tools later became weapons for hunting, defense, and attack. Aggressive-adaptive behavior evolves as a behavior to exert discretionary force to harm and control.

Prehistoric society already set inter and intra-group violence. In the first circumstance, it would be due to the competition of the sources of resources, and in the second, it establishes a hierarchy and a social order.

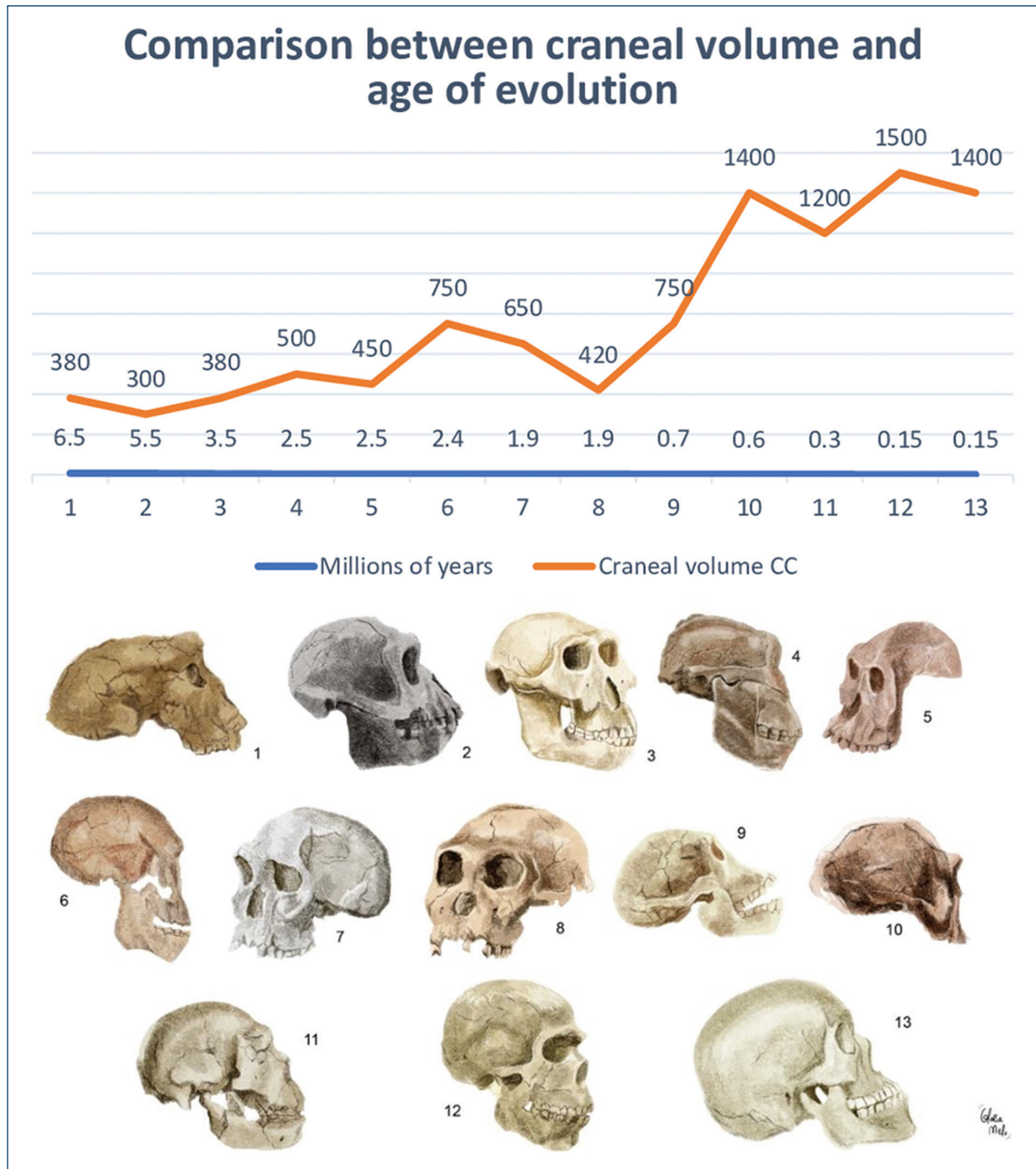


Figure 3. Comparison of brain volume from 6.5 million years of evolution to 150 thousand years in different skulls of 13 species of primitive human ancestors. (1) *Sahelanthropus tchadensis*, (2) *Ardipithecus*, (3) *Australopithecus afarensis*, (4) *Paranthropus*, (5) *Australopithecus garhi*, (6) *Homo rudolfensis*, (7) *Homo habilis*, (8) *Australopithecus sediba*, (9) *Homo georgicus*, (10) *Homo ergaster*, (11) *Homo heidelbergensis*, (12) *Homo neanderthal*, and (13) *Homo sapiens*.

A culture of violence is established. Fight with other clans for hunting sites, to defend their young, or to expand their territory. From one point of view, it could even be thought that the primitive family established

patriarchal and chieftainship control of the clan. Violence is institutionalized and individuals act culturally following it. Baños notes, "Institutions are the way by which culture has to be reproduced since they are built

as a mechanism that shapes identities.” He adds: “Violence, like any cultural pattern, is reproduced through institutions. Therefore, each culture will have a characteristic type of violence”³³. He says that there is no linearity between aggressiveness and violence, but they are coherent. Although human behavior depends partly on social and economic conditions, human biology also plays a very important role. Their interrelationship is very complex and on many levels. Baños points out that violence is linked to a process of intentionality, premeditation, and conscience, and it is the culture and institutions of a society that allows or does not allow violent expressions.

Cultural behavior

Cultural violence is a special construct. Johan Galtung defined it in 1990 as “those aspects of culture, of the symbolic sphere of our existence (exemplified by religion and ideology, language and art, empirical science and formal science) that can be used to justify or legitimize direct or structural violence”³⁴. He also mentions that the culture of violence makes structural and direct violence be seen as correct in the same way that the use of power is legitimized in politics. It even points out different types of violence for the four basic needs of a social group: the need to survive, the need for well-being, the need for identity, and the need for freedom. The sum of the five satisfactions produces conditions of peace³⁴.

Cavanaugh, in 2012, means that violence has usually been studied as a social and psychological phenomenon. However, it is a multifactorial problem, and consequently, it must be studied from different points of view: biological, anthropological, psychological, social, economic, and political³⁵.

Willem Schinkel proposes³⁶ that violence is hardly understood and poorly recognized in our society, immersed in several study perspectives, and points out a series of antinomies that would allow a better understanding of it, particularly the last one:

- Violence breaks the social order—violence is constitutive of the social order.
- Violence is a social problem—violence is a standard solution to social problems.
- Violence is only destructive of forms of socialization—violence is a positive form of socialization, leading people to come together.
- Violence is a coping mechanism—violence is a primary form and source of contingency.

- Violence breaks norms—violence strengthens norms.
- Violence is a visible phenomenon—violence is a hidden process.
- State violence is reactive toward illegitimate violence—state violence is already active in distinguishing between legitimacy and illegitimacy.
- Violence is an important social process in terms of an external referent—violence is a social process characterized exclusively by self-reference.
- Violence is a repellent—violence is an attractant.
- Violence is a means to an end—violence is an end.

Earlier, in 2004, Schinkel wrote an essay on what he refers to as the will to violence, where he discusses the possibility that violence has no other cause or sociological motivation than itself³⁷. He describes it as self-referenced violence and that sociological science has tried to study or explain within a deterministic current and its causes without including the will to be violent.

Another explanation of violence comes from political science. Valentino, in 2014, established that since 1900, 100 million people have been murdered for political purposes, mostly civilians, and considers this circumstance as an action directed, instrumented, and orchestrated by the actors of power to achieve military and political objectives rather than the result of irrational and random violence from old ethnic feuds³⁸.

Discussion

Violence as a cultural outcome could be a part of the human condition. Aggressiveness behavior is a natural tool that is processed, optimized, and converted into violence. Violence as social behavior should be originated in the isocortex as proactive aggression. Too many situations in our complex society can elicit violence, but limbic and paralimbic systems uphold the physiologic substrate of aggressiveness.

In addition, Stevenson analyzed an evolutionary point of view raised by Charles Darwin, where violence could be understood as a consequent instrument³⁹:

- There is a variation of the individual traits of a species, which makes each subject different in their biological conditions.
- The parents’ traits are inherited by the children which allows the selection of the best phenotypic traits for changing environmental conditions by competition.
- Populations tend to have a geometric growth rate. Consequently, competition between individuals

becomes more acute if a species predominates for its best phenotypic traits.

- The environment’s resources will eventually not support this growth, so insufficient satisfiers increase the struggle between subjects.

Here is the basis of competition for survival. The environment’s limited resources will be controlled and used by the individuals with the best attributes. Natural selection allows different individuals to compete for resources, and those who best adapt and use their physical, mental, or social strengths will obtain power over the satisfiers.

In his essay on Anthropology of the Brain, Roger Bartra proposes the existence of social networks that enhance brain neural networks⁴⁰. Bartra explains that the mutations that gave rise to brain volume and structure could not have been sufficient for the degree of human brain development. The language and the existence of specific social structures made it possible to non-specific cortical neural networks of the human primate.

Porcelli et al. have raised. That evolution has exerted a social pressure that has specialized areas of the cerebral cortex for processing stimuli and regulating neurotransmitter systems to the point of forming social networks that are now called the “social brain”⁴¹. Not only the cerebral cortex is involved in this interrelationship with culture and codes of social conduct, but extensive neural networks have also already been explored as myelinated structures in very diverse socialization processes⁴². The growing evidence on the direct relationship between brain function and structure with the social and cultural system is clear and has given rise to a growing area of social and neural sciences.

Thus, Porcelli’s social brain (or the exobrain proposed by Bartra) requires its counterpart in the family structure or the clan to establish the basic codes of conduct. Linguistic or body communication establishes the primary habits that will be reinforced or modified at school, peer groups, or work.

The multiplicity of approaches tends to bias the perspective. Aggression-violence is a biological phenomenon resulting from culture, societal life, political relations, and current moral conditions (Fig. 4). We often tend to simplify the phenomena and we have discussed aggressiveness-violence, but there are also other phenomena, such as empathy and mirror behavior. Empathy, compassion, and affection should be studied alongside the aggressive-violent process.

Finally, violence for pleasure is a very serious and challenging issue that has been analyzed as a poorly understood behavior. Another circumstance about

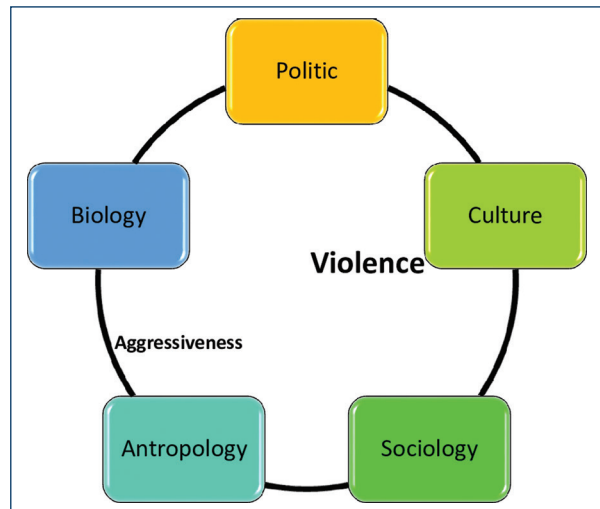


Figure 4. The participation of different aspects of the environment, the organization, and the biology of the human being that intervenes in aggressive and violent behavior.

violent behavior due to “evil” is indolence as a way of ignoring an extremely violent system or is it a proactive action toward the possibility of exercising our power to obtain pleasure? Gil-Verona et al.⁴³ have analyzed the consequences of a lack of attachment to the mother that a primate can suffer, turning the individual into an irritable, aggressive, and stressed subject. The consequence is predictable if this subject continues developing in a society with a violent culture.

Funding

The authors declare that they have not received funding.

Conflicts of interest

The authors declare no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this

manuscript nor for the creation of images, graphics, tables, or their corresponding captions.

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