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MINDLESS VIOLENCE? THE NATURE AND BIOLOGY OF AGGRESSION

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MINDLESS VIOLENCE?

THE NATURE AND BIOLOGY OF AGGRESSION

INAUGURAL LECTURE

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by

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MINDLESS VIOLENCE?

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An inaugural lecture provides one with a real piece of academic freedom. One can decide to inflict upon the captive audience the minutae of laboriously-accumulated research or one can opt to range widely across a broad area of personal interest. There are dangers for the speaker in both approaches. The first may bore and the second may appear superficial or self-indulgent. I have decided to risk the latter approach, examining some views gained during my cross disciplinary studies at the interface between biology and psychology. The title is intended to focus on the difficulties often encountered in attempts to explain aggression. This is an area of immense topical interest with daily accounts of violent acts in war, crime, sport and even domestic life. It is a topic on which everyone is an expert! 'Mindless' is the description used when referring to activities one can't understand.

I will start at a fairly basic level by outlining some of the difficulties of saying what aggression is. I will than go on to examine some of the claims made about the biology of aggression - i.e. the potential impact of genes, hormones, brain circuits and neurotransmitters on such phenomena. I hope that my comments will, at least partially, redress some of the rather sloppy writing in this area by populists and sections of the media.

I thought I would commence with what is surely the most pessimistic definition of aggression currently available. This is Barnett's (1975) claim that aggression is "A word with many meanings, and a source of much confusion". I think you will agree that this is not a very helpful statement for people who wish to make sense of such phenomena. The definition does, however, make a serious point. Barnett clearly felt that the term 'aggression', as used by a wide range of writers (artists, biologists, journalists, politicians, psychologists, and sociologists) was employed in too diverse a fashion to be scientifically useful. He could see no sense in retaining it.

We seem, however, to be stuck with 'aggression'. Accepting this, a perhaps more useful scientific definition is that provided by Arnold Buss (1971) who described it as "the attempt to deliver noxious stimuli, whether or not that attempt is successful". Use of the word 'attempt' implies that the action is intentional rather than accidental but one must warn of the difficulty of establish intent in human actions and the almost impossibility of according such an attribute to animals. The term 'noxious stimuli' is also vague - does this term include verbal as well as physical responses? The qualifying phrase 'whether or not that attempt is successful' is included to bring actions involving failed attempts to deliver noxious stimuli (e.g. a sniper who misses) into the description.

Let us look at the individual features which are used to specify aggression. The one attribute that everyone agrees on is that the action must, at least, have the <u>potential for harm or damage</u>. But what do we mean by harm? Should harm include only physical effects or can it be extended to include emotional damage or reduced breeding potential? There <u>are</u> behavioural responses which clearly involve harm or potential harm that receive labels other than aggression. For example, harm is definitely

involved in predation (see figure 1, over) an activity which is generally distinguished from aggression by ethologists (students of behaviour within the organism's natural environment). Predation is often, but not exclusively, an activity involving members of different species and generally does <u>not</u> involve marked arousal (see below). Harm is also a potential consequence of <u>defensive</u> responses by animals (see figure 2, next page but 1). Consequently, the potential for harm alone is insufficient cause for an action to receive the label 'aggression'.

<u>Intentionality</u> is another feature necessary in some accounts for identifying aggression but we have already noted that it is often difficult to establish whether responses are deliberate or not. Some authorities maintain that the motives of the 'aggressor' are actually unimportant - what matters is whether the 'victim' regards the action as intentional or not. Others go one stage further and maintain that an "impassionate observer" (i.e. an individual outside the encounter) is a better judge of aggression. Although the best way of distinguishing between intentional and accidental acts may be to consider the probability of occurrence, one must note that different individuals may vary in their willingness to see particular responses as intentional. There are examples of animal behaviour which have been described as 'aggression' where intentionality is highly improbable. Figure 3 (see next page but 1) shows an example of "colonial aggression" between two groups of Australian bryozoa. It is very unlikely that this response (where one colony pushes the other off the sea bed) involves collective motivation by these simple zooids!

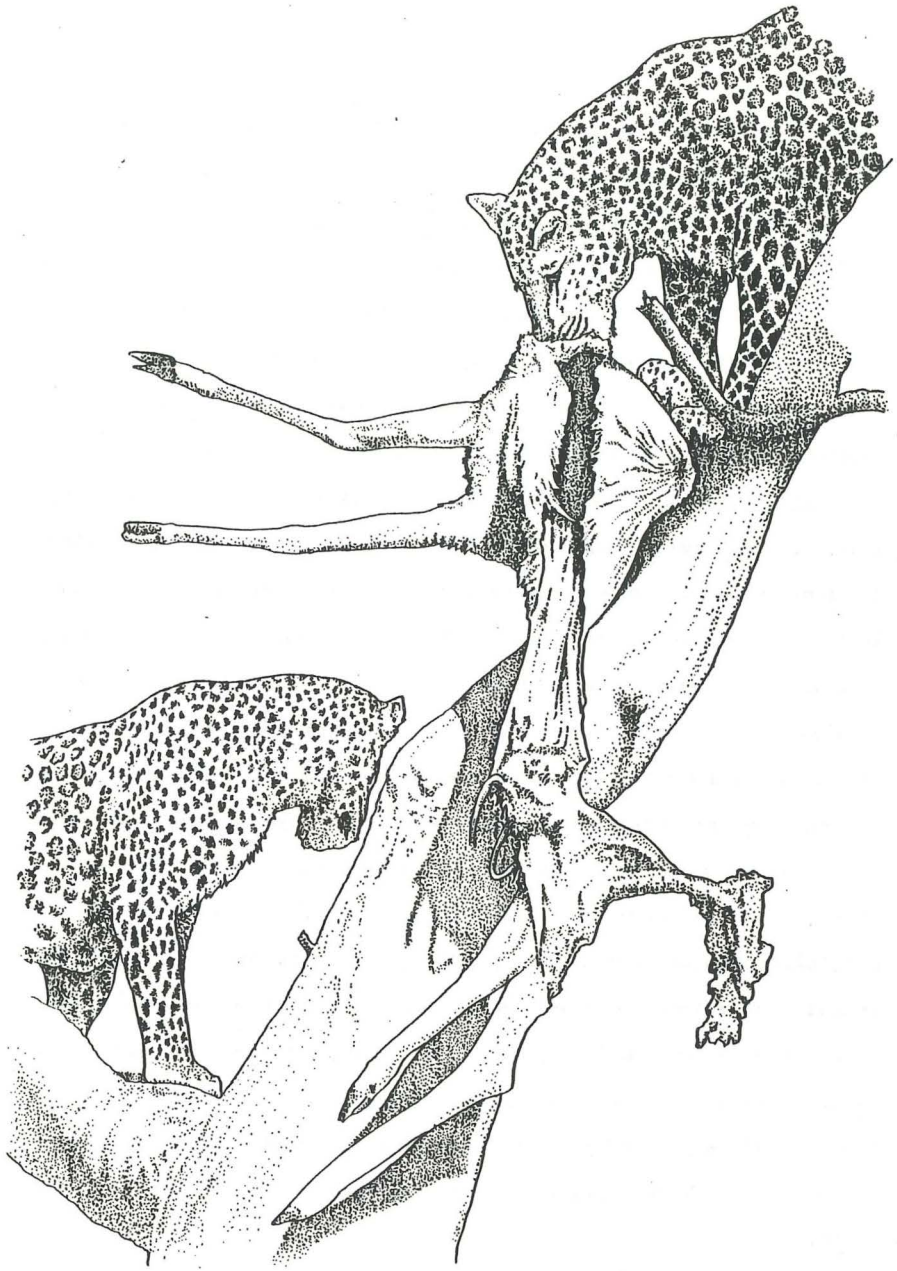


Figure 1 A predatory attack on an antelope by two leopards. From P.F. Brain (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford.

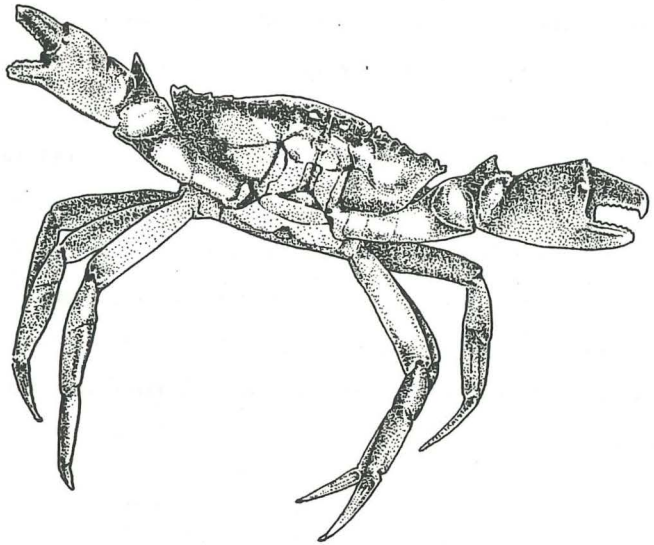


Figure 2. A defensive response in a common shore crab directed towards the camera-holding author of this article. from P.F. Brain, (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford).

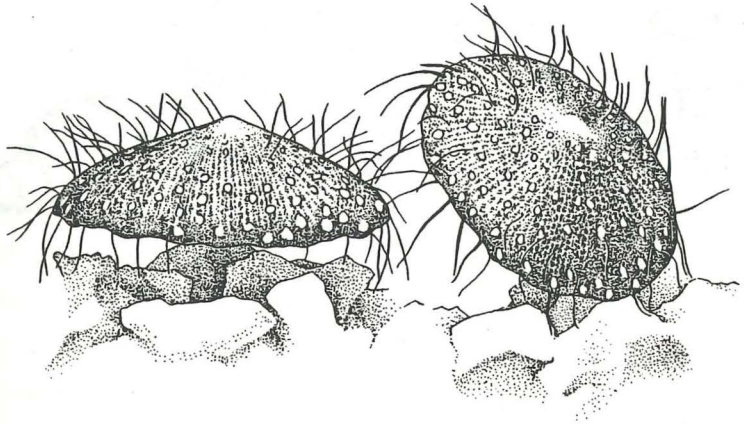


Figure 3. A 'colonial aggressive' encounter between two colonies of the bryozoan Selenaria maculata from P.F. Brain (1989). The Nature and control of Aggression, Oxford Project for Peace Studies, Oxford.

It is also often maintained that aggression has to involve arousal. Arousal is a psychological term applied to evidence of internal changes including alterations in heart-rate, respiration and the distribution of blood in the tissues. Charles Darwin (1872), advocated that one could deduce the arousal state of animals by looking at postures, the position of hairs, feathers or combs and recording the production of sounds (e.g. spitting and snarling). There are, for example, obvious differences in the postures of cats when countering another cat in a territorial dispute and when confronting a threat such as a dog (see Figures 4 (below) and 5 (over)).

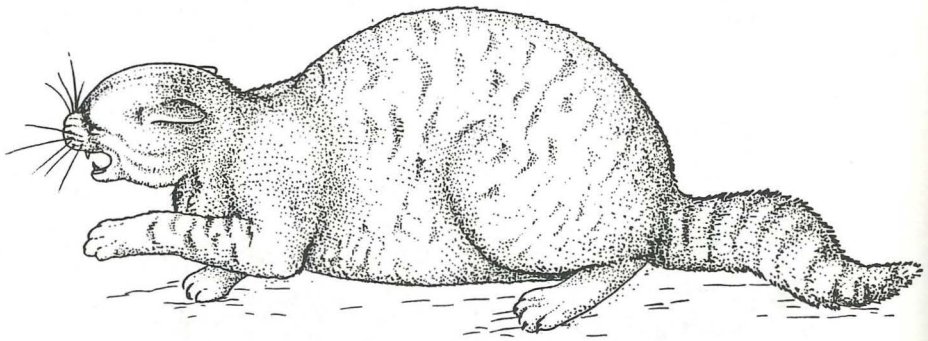


Figure 4 Cat confronting a rival on a territorial boundary - After C. Darwin (1872). The Expression of the Emotions in Man and Animals, D. Appleton and Co., London.

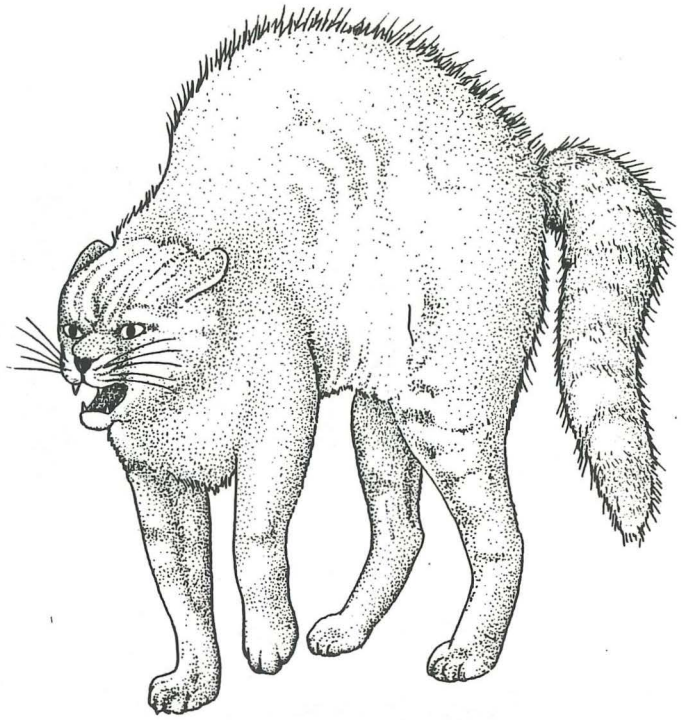


Figure 5 Cat threatened by a dog. After C. Darwin (1872). The Expression of the Emotions in Man and Animals, D. Appleton & Co., London

As one can sometimes see animals (e.g. 'cornered' subordinate dogs) which are simultaneously fearful and likely to attack, some authorities have expressed a preference for the term agonistic behaviour to describe the range of activities evident in social conflict. Reliance on these external indicators of arousal introduces the problem of anthropomorphism (judging animal behaviour in human terms). Figure 6 (see over) shows expressions in a camel and an eagle which can be interpreted by humans as 'arrogant, turning away' and 'proud decisiveness', respectively. The animals are, of course, not showing these human attributes. Such misidentification is also possible in our own species. Figure 7 (see next page but 1) is said to show a range of individuals all expressing 'anger'. The fact that actors can simulate emotions should be sufficient warning

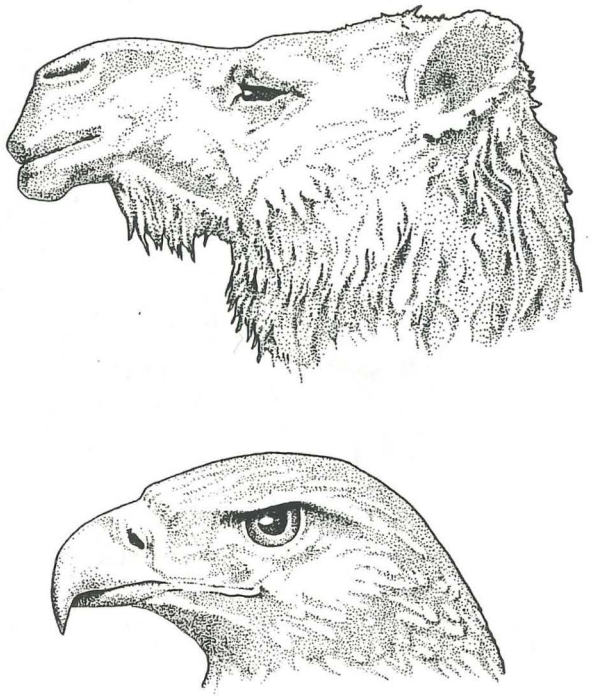


Figure 6. Facial expressions of a camel (above) and an eagle (below). After K. Lorenz (1965) Uber tierisches und menschliches Verhalten: Aus dem Werdegang der Verhaltenslehre 1 and 2, Piper, Munich.

against relying too heavily on this 'body language'. A similar message is provided by figure 8 (over) which reveals how the use of dental lip retractors distorts the features of a child into an apparently aggressive 'snarl'. Figure 9 (next page but 1) shows the physiological changes and external expression used in a man that are said to accompany rage. Although the figure looks impressive and 'scientific', one must reiterate that aggressive individuals do not always show the illustrated changes. For example, psychopaths show few of these external or internal signs of

Figure 7. Similar facial expressions in (left to right) a mandrill, a Japanese kubuki actor and a child that have been interpreted as 'aggression'. Redrawn after Eibl-Eibesfeldt, I (1971) Love and Hate, Methuen and Co. Ltd., London.

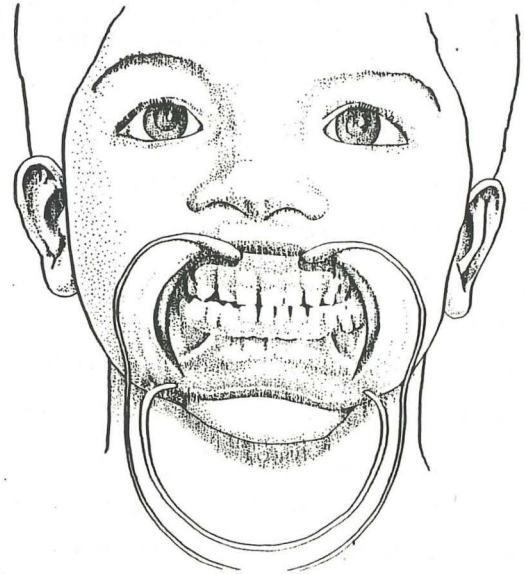


Figure 8. Child with dental lip retractors fitted, producing baring of the teeth and gums.

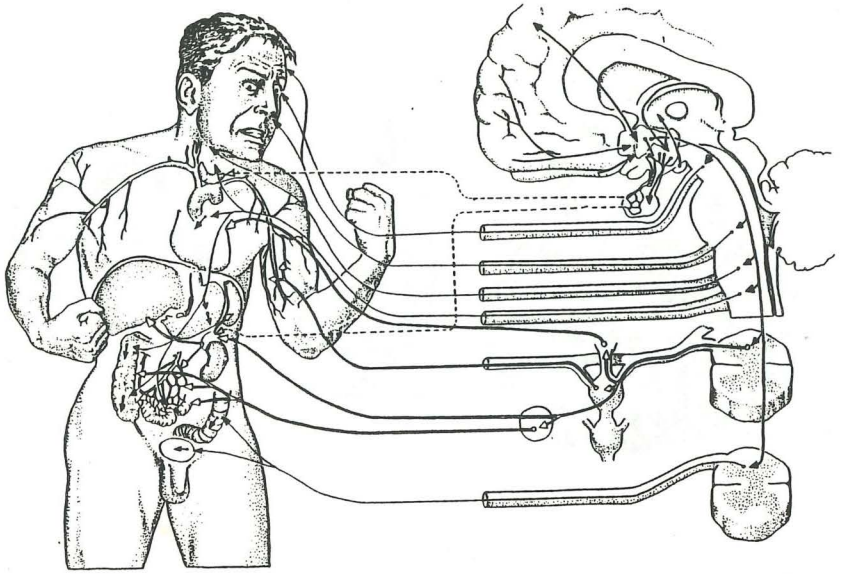


Figure 9. A simplified and redrawn version of Frank Netter's (1965) illustration showing in physiological consequences of rage in a human. N.B. the facial expression and the effects of the condition on the blood distribution, heart-rate and evacuation of the bladder and bowels. After, The Ciba Collection of Medical Illustrations Volume 4 Endocrine and Selected Metabolic Disorders, Ciba Pharmaceutical Company, Summit, New Jersey.

aggression. Further, several recent studies have challenged the view that baring of the teeth is most clearly associated with aggression - in some investigations, aggression was more closely associated with the "small mouth" response.

A final proviso needed before some authorities will accept that an act is aggressive, is that the 'victim' must find the action aversive. This requirement is to get around the difficulties of sado-masochism in humans and the use of 'love darts' by snails which cause slight tissue damage but appear to facilitate courtship in these hermaphrodite animals.

A basic problem with everyday use of the term 'aggression' is that people think that they are discussing an entity ('thing') rather than using a concept. Figure 10 provides a slight modification of Robert Hinde's (1966) schema for how concepts are generated. We humans essentially have to deal with a complex world where a vast array of so-called independent variables (potential causes) may be related to an equally large collection of dependent variables (potential consequences). As we are not computers, we attempt to make sense of our world by creating intervening variables which link together groups of independent and dependent variables. The concept of 'aggression' is one of these intervening constructs. The trouble with concepts is that they are

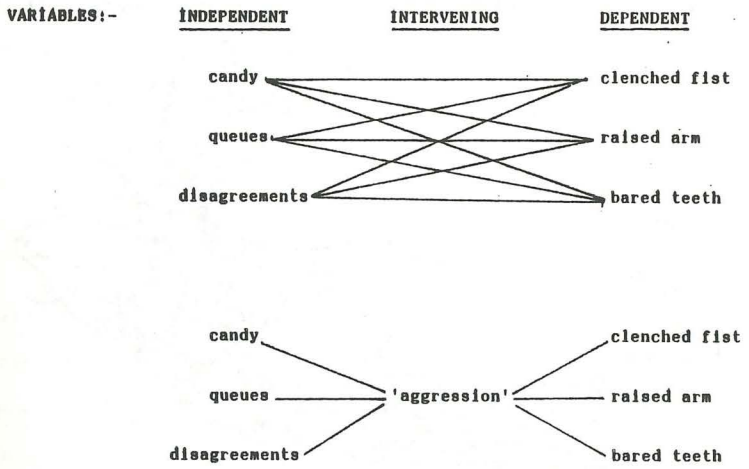


Figure 10. Modified version of R.A. Hinde's Schema (1966) as presented in Animal Behaviour: A Synthesis of Ethology and Comparative Psychology, McGraw-Hill, London.

theoretically definable in many ways - one does not assess a concept by its accuracy but by its usefulness as an explanatory device.

Perhaps of lesser importance to humans (but certainly of great relevance to animals), is recognition of the fact that animals can employ a wide range of senses in their 'aggressive' displays. Figure 11 (see below)shows a stag signalling visually by displaying his antlers and mane, audibly by bellowing and olfactorially (via the sense of smell) by using secretions from his pre-orbital gland. Figure 12 (over) shows the audible tail rattle threat in mice. This species also uses odour communication producing so-called "pheromones" which are often transmitted in the urine. Figure 13 (next page but 1) shows a 'stink fight' between two groups of ring-tailed lemurs. Here, these prosimians ('primitive' primates) are said to waft odours at the other group in an attempt to convince it to

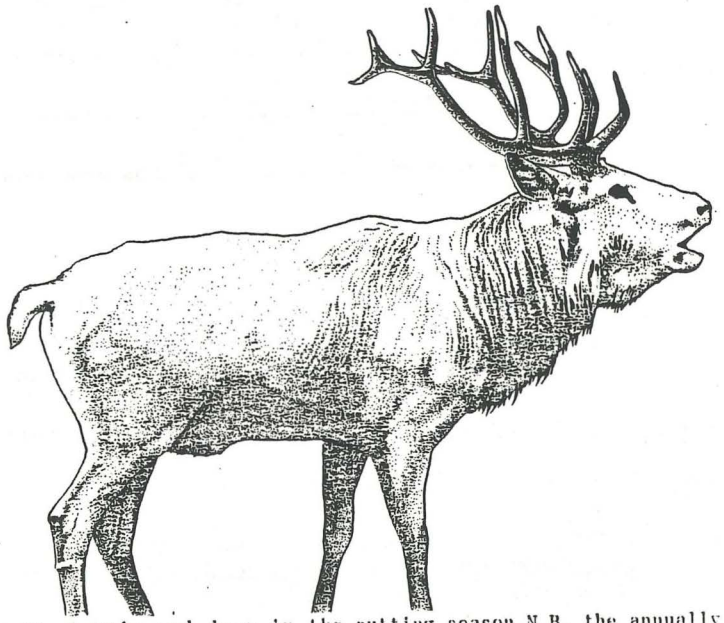


Figure 11. A male red deer in the rutting season N.B. the annually grown antlers and mane, the bellowing challenge behaviour and the pre-orbital gland near the eye. From a photograph by Ludek Bartos (Prague).

Figure 12. Male laboratory mice fighting N.B. the tail rattle response by the left hand animal. From a photograph by the author.

move away. It is not unfair to say that humans generally tend to consciously concentrate on visual cues rather than other sensory inputs.

Another feature which is certainly important in animals and may have parallels in humans, is the fact that in different contexts or at different times of the year, individuals may use qualitatively different responses. Figure 14 (see over) shows the relatively rare aggressive encounters of deer outside the rutting season which can involve potentially deadly kicking. Figure 15 (see next page but 1) shows the 'ritualised' (usually less damaging, as it involves much 'display') encounters between males in the rutting season which are essentially trials of strength. Animals often employ such displays which minimise potential damage to members of their own species (and to themselves).

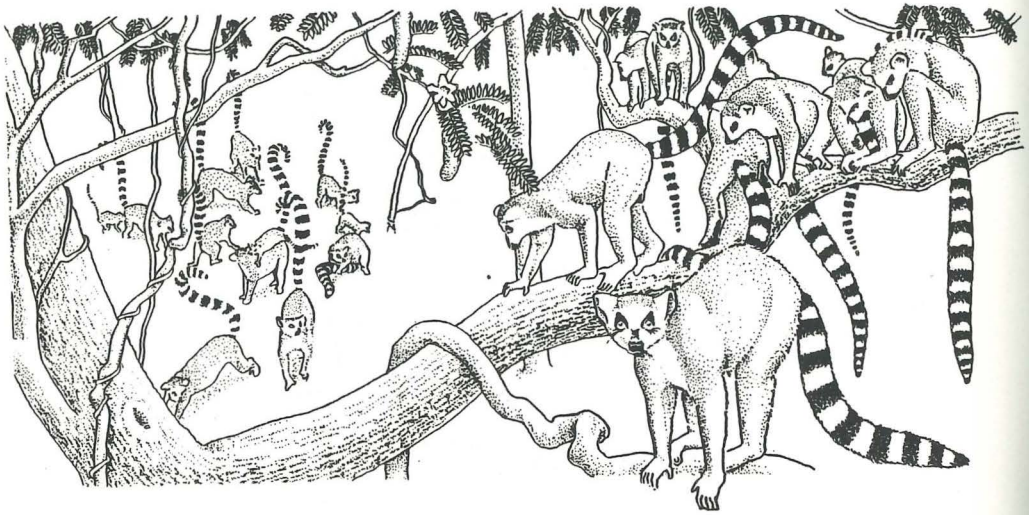


Figure 13. Ring-tailed lemurs in a "stink fight" - after E.O. Wilson (1975). Sociobiology, The Belknap Press of Harvard University Press, Cambridge.

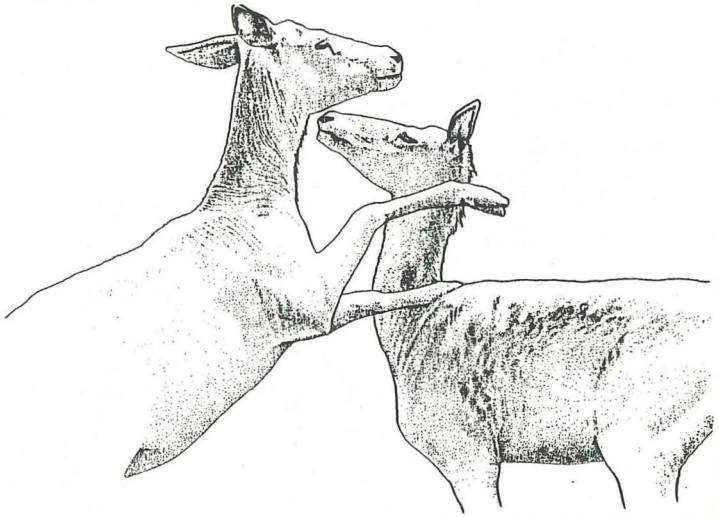


Figure 14. Red deer outside the rutting season (N.B. no antlers) using the fore-hooves in 'aggressive' encounters. From P.F. Brain (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford.

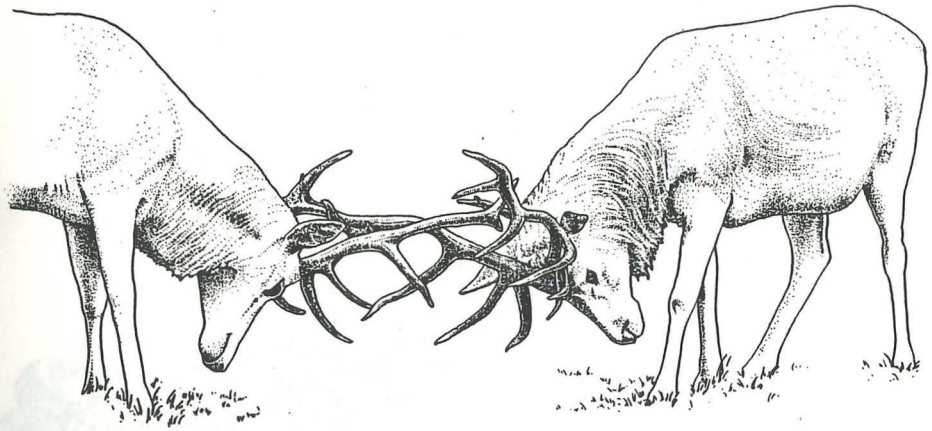


Figure 15. Use of antlers in contests between Red deer stags in the rutting season. From P.F. Brain (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford.

Why do animals fight? Figure 16 (see next page) shows male vipers (Vipera berus) encountering each other in the basking sites where females are located. They become involved in wrestling matches, attempting to pin the head of their opponent to the floor. Such animals never bite using their venom, and the larger and/or more vigorous male generally "wins" the contest and remains in close proximity to the females. Animal aggression is clearly used here in mate selection. Other animals, such as the European robin and the freshwater stickleback use their aggression to gain exclusive access to an area or territory. Possession of the territory is often an essential prerequisite for breeding activity of an individual or

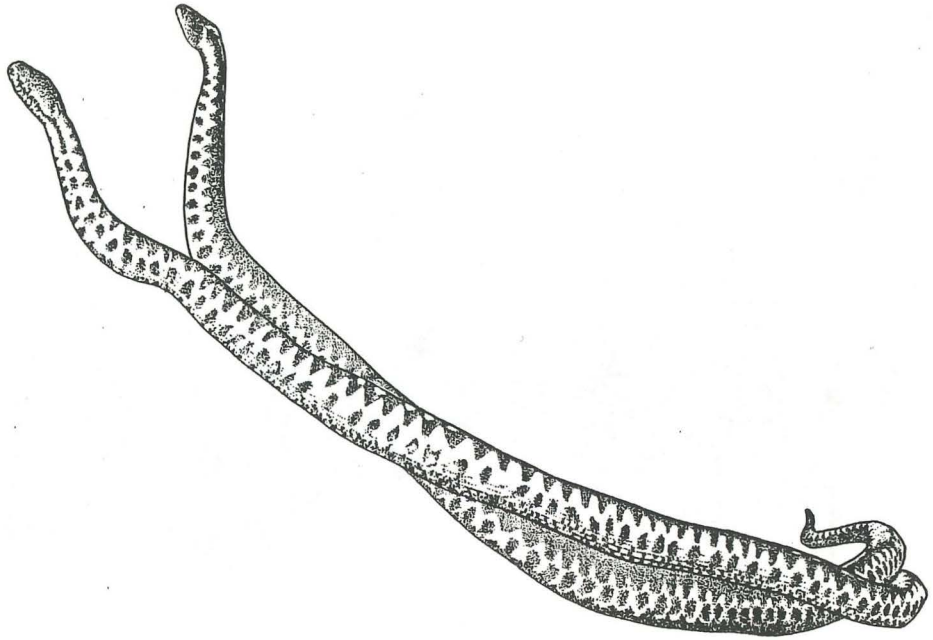


Figure 16. Wrestling in male vipers in spring encounters. From P.F. Brain (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford.

pair. Figure 17 (see over) shows the use of fighting and threat to determine social status in domestic chickens. Status may determine the animal's ease of access to a mate, food, water or nest sites.

One misconception that should be immediately dismissed is the view that, because particular animals employ aggression to obtain a mate, territory or elevated social status, behaviours receiving the same label in humans necessarily serve one or more of these functions. There is little evidence that humans are intrinsically territorial, always obtain their mates by crude physical competition or attain high social status by physically attacking other individuals. The serious dangers of simplistic extrapolations from animals to humans are evident to informed opinion.

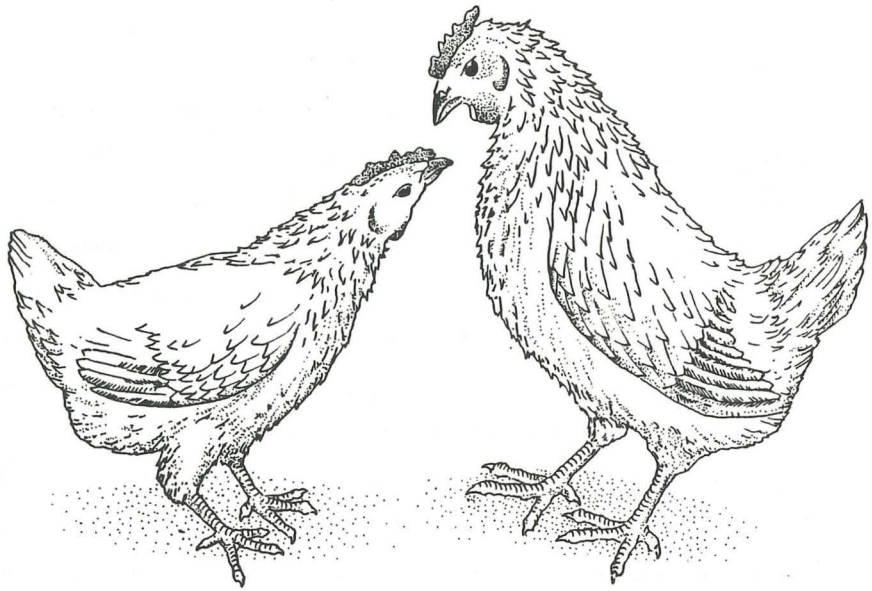


Figure. 17. Peck order in domestic chickens N.B. the animal on the right is dominating the bird on the left. From P.F. Brain (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford.

Another complicating feature of dealing with 'animal' aggression, is the recent recognition that there are strikingly diverse tests said to measure this attribute for a single species. For example, in my 'own' species, the laboratory mouse, 'aggression' is said to be generated (Brain, 1981) by pairing pre-isolated males (intermale aggression, see figure 18 over), by exposure of paired males or females to unavoidable foot or tail shock (shock-elicited aggression), by arranging for an unfamiliar intruder to enter the nest area of a lactating female with her offspring (maternal aggression see Figure 19, next page but 1), by placing a lactating female (or an animal marked with her urine) into an established group of females or castrated males, by giving the subject the opportunity to kill a locust or a cricket (predatory aggression) and by

confining subjects in a narrow tube where they may bite a target suspended in front of them thus activating a telegraph key (instrumental aggression, see Figure 20 over). Thus even in the 'simple' mouse, the tests used to generate 'aggression' are so varied (and the responses generated so qualitatively different) that it is highly improbable they all measure the same motivation. Certainly, housing conditions, genes, hormones and drugs to <u>not</u> have consistent influences across these different tests. I have argued (Brain, 1984) that it is highly probable that these diverse harm-directed activities tap offensive, defensive or even predatory motivations. In some cases, mixtures of motivations appear involved. Support for this view is provided by the use of detailed video-analysis which reveals that, in some 'ritualised' responses, vulnerable areas (i.e.

Figure 18. Intermale aggression in pre-isolated laboratory mice (drawn from photograph)

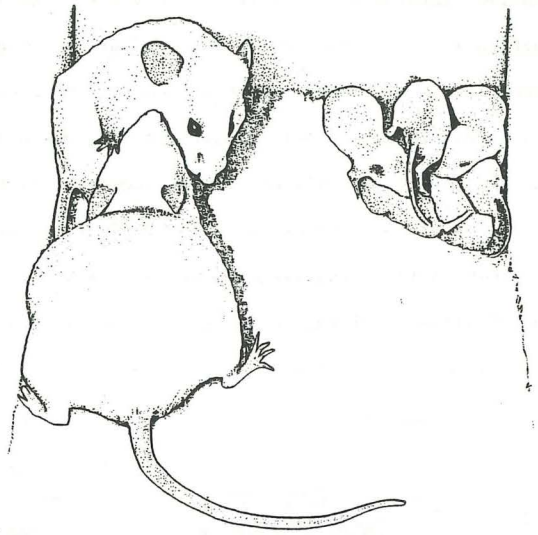


Figure 19. Maternal aggression by a lactating female mouse (foreground) on a strange male intruder (drawn from photograph).

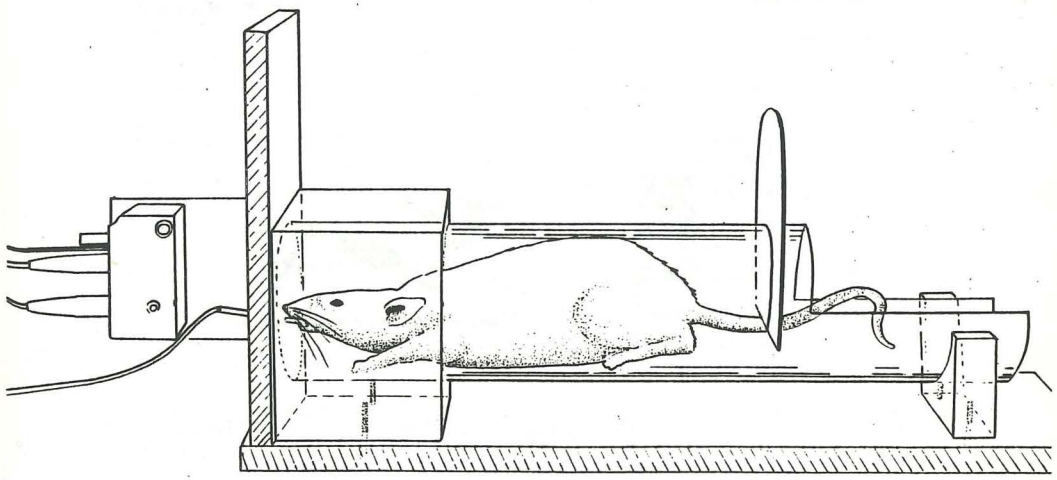
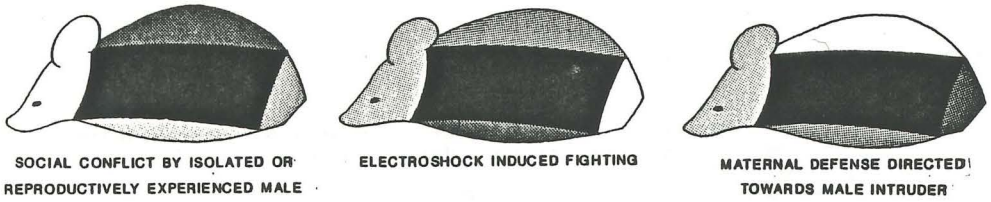


Figure 20. Instrumental aggression by a laboratory mouse - biting a metal target - to left of illustration (drawn from photograph)..

the head and ventral surface of the opponent's body are rarely bitten (in so-called 'offensive' intermale aggression). In others, vulnerable areas are frequently bitten (e.g. 'defensive' maternal attack on a potentially cannibalistic male intruder) and a third category are directed killing strategies (e.g. predatory aggression). Figure 21 (see below) shows the relative frequencies of using particular bite targets in different types of 'aggression' test involving laboratory mice. Perhaps one should limit the term 'aggression to the offensive displays and thus clearly separate these utilities of attack and threat from defensive and predatory functions?



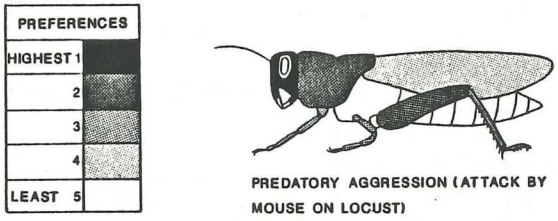


Figure 21. Patterns of bite targets used by mice in different test situations. N.B. the pattern in the top left situation reflects 'ritualised' offense with little or no biting of the vulnerable head and abdominal regions, the top right situation shows no such inhibition and is classed as 'defensive' and the bottom situation with the locust is clearly a 'killing' response.

What does all this mean to humans? Durant (1981) emphasized that in Victorian England there was a perception that "The legacy from man's brutish past was held to be revealed in the behaviour of children, criminals, idiots, savages and rioting mobs". This view has been remarkably persistent in some circles i.e. it seems generally accepted that cultivated and intelligent humans use their intellects to hold their animal past in check. Parallelling the earlier discussed variation in mouse 'aggression', there are many behaviours in humans which are candidates for the epithet 'aggression'. Although many people might naturally think of human aggression being most obvious in wars (see figure 22 over) reputable authorities believe that war has little to do with what most biologists view as aggression. In such situations, there is often no real evidence for what one might call aggressive motivation - many soldiers, airmen and sailors may act more out of a sense of duty (obligation to their group) and follow their training rather than display real antagonism to the enemy. One can, however, often see attempts to "dehumanise" the enemy and to whip up collective fervour to make the troops more enthusiastic. Group aggression in humans may be a very different phenomenon from individual aggression in our species.

Figure 23 (see over) illustrates the hostility machine used to study human 'aggression'. The buttons are said to deliver electric shock, graded from very mild to very severe. The subject is told by the experimenter that he/she is assisting in a learning task in which there is an intercom link to a second subject (actually the experimenter's assistant). When the assistant fails to respond correctly, the experimenter instructs the subject to deliver a punishment by pressing a

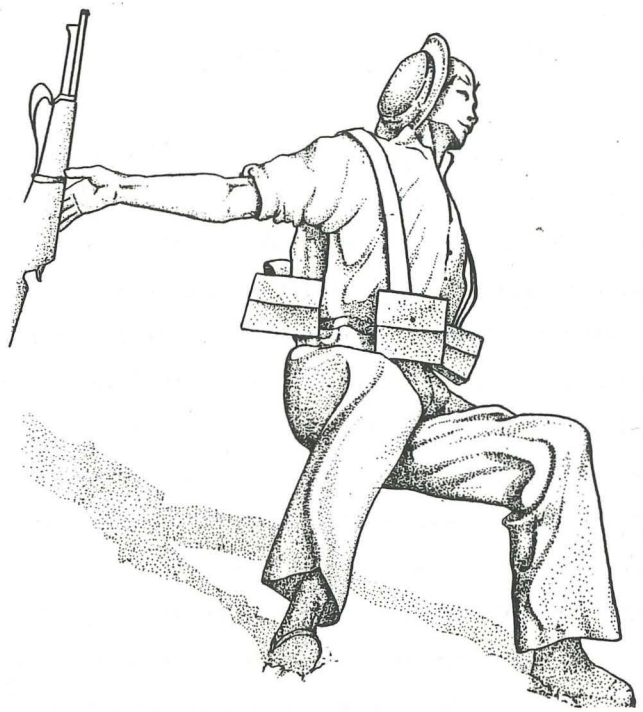


Figure 22. A republican soldier at the moment of being hit by a bullet in the Spanish Civil War. Redrawn from a newspaper photograph of the time by Frank Capa.

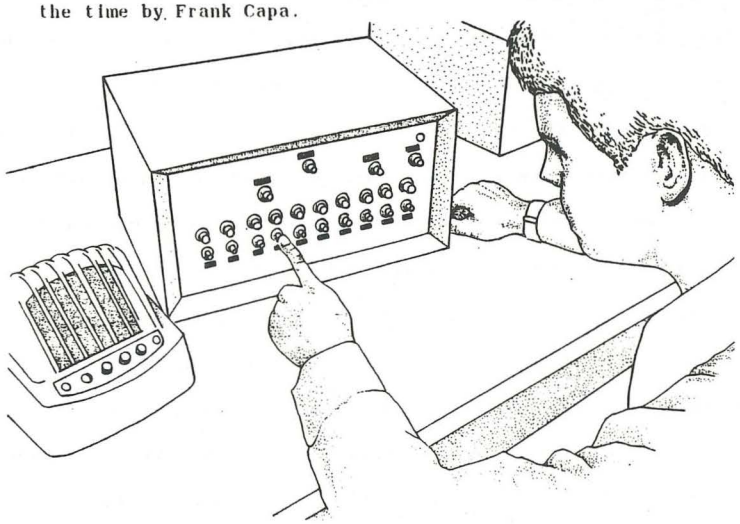


Figure 23. Buss' hostility machine - the seated subject is instructed to 'deliver' graded electroshocks to a confederate of the experimenter in a neighbouring cubical. This confederate communicates with the subject via the intercom arrangement. From P.F. Brain (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford.

button (actually there is no shock). The selected 'level' of shock is said to be a measure of hostility or aggressiveness. Remarkably, more than 90% of subjects will 'deliver' very severe shocks to their 'partner' even if the latter pleads that they have a heart condition. 'Normal' undergraduates are not too different from psychopaths in this respect and females are more 'aggressive' on this measure than male counterparts. It seems very likely that this test actually measures conformity to authority rather than hostility.

Buss' (1971) classification based on three dichotomies, provides a clear indication of the diversity of human 'aggression' as viewed through the eyes of a social psychologist. 'Aggression', according to Buss, may be physical or verbal, active or passive and direct or indirect. For example, physical, active, direct aggression includes activities such as punching, stabbing or shooting another individual. Verbal, active, direct aggression includes insulting or derrogating another person. Verbal, passive, indirect aggression is failure to make specific verbal comments e.g. not speaking up in another's defence when he/she is unfairly critisized. Although it is easy to think of animal analogies for punching, stabbing or shooting, it is much harder to think of animal parallels for "failing to carry out a necessary task" (perhaps refusal to move in a 'sit in'). Obviously, the social psychologist includes a much wider range of activities under the heading 'human aggression' than does the biologist.

Numerous hypotheses have been advanced to 'explain' human aggression. Although many have been subsequently largely discounted by scientific authorities, some persist in specialist fields and/or in popular writing and colour how the 'man in the street' thinks of aggression. One of Freud's psychoanalytical claims about aggression was that such behaviour

was a consequence of redirected thanatos ("deathwish") that could otherwise lead to suicide. Lorenz, who was certainly much influenced by Freud, developed the view that there was an instinctive drive for aggression which was part of the genetic endowment. Eibl-Eibesfeldt (a student of Lorenz) postulated that aggression was a spacing strategy concerned with territoriality and personal space. Maynard Smith and Parker have used the game-theoretic approach to explain animal (and by extension human) behaviour. They suggest that animals unconsciously select behavioural strategies in which the costs (in terms of injury, death or lost time) are weighed against potential gains (in terms of mates or territories etc.). Naturally, the success of a strategy depends on what other individuals are doing. Dollard and his colleagues developed the influential frustration-aggression hypothesis, maintaining that aggression is the result of 'frustrating' primary drives (those related to food, personal survival and sex). The social psychologist Bandura advocated a social learning view of human aggression in which individuals (especially children) acquired aggression by modelling their behaviour on conspecifics (especially adults) around them. There are also other views including such as Gurr's opinion that aggression results from relative deprivation. Felson's view that 'aggression' has attributional power being used as a label to reflect normative (generally socially accepted) values by indicating behaviour which is socially disapproved. I would merely like to emphasize the diversity of the above views and state my opinion that none of them (because of the actual nature of aggression) is, in any sense, a complete explanation of human aggression.

This talk, reflecting my training and research, is also concerned with claims about the involvement of biological factors in aggression (see Brain and Benton, 1981). We will briefly examine some of this material

which cuts across the old sterile 'nature' versus 'nurture' debate. People used to assume that nature or nuture controlled particular behaviours. Later they talked of the 'contributions' of genes and experience. Now it is clear that these factors are intertwined in complex ways (see below).

It is necessary to initially note, however, that what we call 'aggression' is (like any other behavioural concept) influenced by diverse factors which are difficult (impossible?) to disentangle. These include:-

(1) Biological items i.e. genes, neural systems, neurotransmitters and hormones;

(2) Situational determinants i.e. the environment or social context.

and

(3) The accumulated experiences of individuals.

Having said that, it is still worth looking at some claimed biological correlates in detail.

Genes

There are people who believe that genes have a profound effect on aggression. Certainly, one can derive lines of highly aggressive and relatively passive male mice from a basic stock by about 7 generations of selective breeding. The highly aggressive mice may, however, be made docile by subjecting them to defeats and the passive individuals rendered hostile by carefully providing them with positive fighting experiences. Obviously, experience can greatly modify the impact of genes on aggression. Indeed, if one looks at the varied tests for mouse aggression (described earlier), one does not get consistent rankings with different

inbred strains of mice across the tests, confirming that they do not measure the same attribute (Jones and Brain, 1987)

There have been some superficially convincing claims concerning the association between genes and aggression in humans. For example, human males having an extra 'Y' chromosome (the so-called 47 XYY karyotype) were said to be found at a higher than expected frequency in maximal security institutions. It was maintained that these generally excessively tall individuals were hyperaggressive as a result of their double dose of the 'male' sex chromosome. The argument was extended to claim that possession of a single 'Y' chromosome accounted for the presumedly greater aggressiveness of normal males when compared to females. In addition, however, to being tall, 47 XYY men are often (but not always) of sub-normal intelligence. A scenario that now seems more likely is that when prominent and rather unintelligent people do something hostile (recent data suggests this is no more likely than in typical 46 XY men), they are likely to be caught and treated as potentially dangerous by the judiciary and the prison authorities. This is just as likely to result in such men being over-represented maximal security prisons as an 'aggressive gene'.

Neural Circuits

There has been considerable interest concerning the potential involvement of parts of the brain in aggression. If, for example, one places a stimulatory electrode into certain (hypothalamic) areas of the brain of a cat, one can electrically elicit the "sham-rage" response. This response involves piloerection, spitting and striking towards another cat or another object (even a block of wood can be used). The same response can be produced by lesioning (creating a small area of damage) in an adjacent hypothalamic region. The initial view, therefore, was that

there were 'on' and 'off' centres in the central nervous systems of higher vertebrates for certain kinds of behaviour (including aggression). It followed that some kinds of clinical hyperaggressiveness might be consequences of neural abnormalities (whether congenital or as a consequence of injury) and could be relieved by psychosurgery. There are problems even here. Plotnik et al (1971) showed that rhesus monkeys implanted with radio-controlled stimulatory electrodes in particular neural regions would produce an aggressive response to a social subordinate but would give a fear response to a social dominant (see figures 24A below and 24B over page). This was true when the animal was stimulated in precisely the same region by exactly the same current. This means that social context at least partially determines the outcome of central activation. There have also been claims that the electroencephalograms (EEG's) 'or brain waves' of hostile individuals can show abnormal features. There are difficulties here in that slight neural

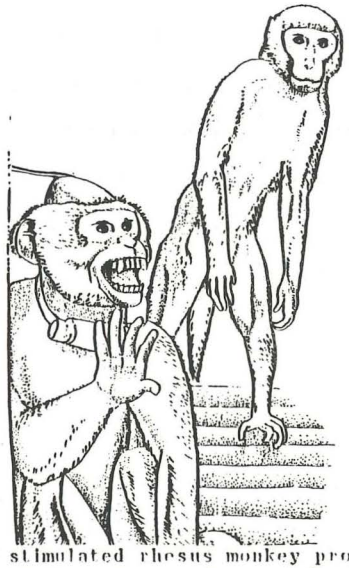


Figure 24A. Neurally stimulated rhesus monkey producing an aggressive response in the presence of a social subordinate - Drawn from a photograph by Plotnik et al., 1971.

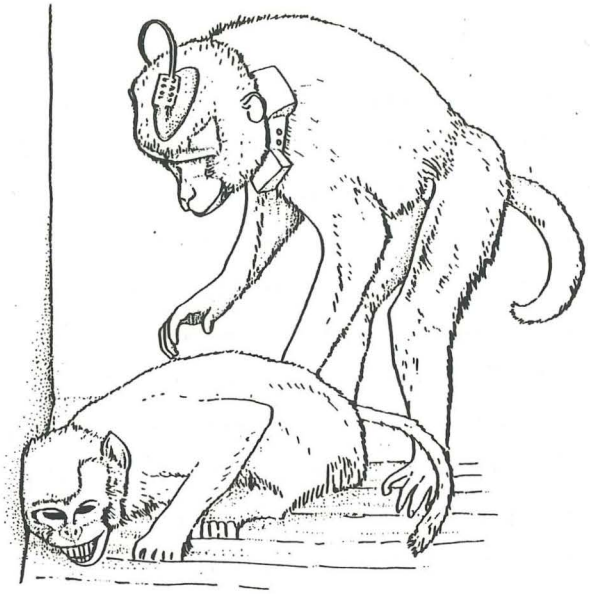


Figure 25B. Neurally stimulated rhesus monkey showing 'fear face' in presence of social dominant. Drawn from a photograph from Plotnik et al., 1971.

damage might change an individual's living circumstances and epileptics can show both abnormal EEG's and are likely (on occasions) to produce uncoordinated behaviour which may be interpreted as aggression. It is now generally accepted that there are no simple centres 'controlling' aggression and that all behaviour is modulated by complex, highly-integrated "constellations" of neural elements, involving processing and interpretation of information, as well as "motivation" and motor output.

Drugs

There are repeated claims that drugs can be used to control aggression. Certainly, a variety of compounds have been used in clinical and penal situations for this expressed purpose. Drugs can certainly

change the probability of seeing behaviour that could be termed aggressive but the effects can be produced in varied ways. Chemical treatment could theoretically reduce aggressiveness directly by acting on central brain structures, stimulate an incompatable 'fear' response thus indirectly reducing aggression or cause simple sedation. Detailed ethoexperimental analysis (a new approach combining techniques from ethology and comparative psychology - see Blanchard et al., 1989) of drug effects is currently producing a more complete picture of the actions of particular compounds. The so-called 'Serenic' drugs have been developed for their potential as specific anti-hostility agents. Detailed analysis of one (Fluprazine manufactured by Duphar b.v., Holland) confirms that it abolishes fighting and threat in rodents but not without subtly changing the remaining behaviour. Indeed, social behaviour and 'fear' elements seem to become infermingled in treated subjects. It appears (for a variety of reasons) increasingly unlikely that one can devise a "magic bullet" for aggression. This is not to deny that the properties of recently studied compounds seem considerably more specific and potentially useful than the "chemical strait-jackets" of yesteryear which simply sedated.

Hormones

Hormones, as 'natural' products, have been much studied in relation to aggression. It is currently clear that these secretions have complex effects on behaviour, changing motivation, social signalling and even the detection of social cues. The old fashioned idea that all aggression is caused by 'male' sex hormones (androgens) now seems untenable. Some forms of aggression in humans and animals are much influenced by these gonadal secretions (sometimes after conversion in the brain to 'female' sex

hormones or oestrogens) and others not (Brain et al., 1983). Female aggression is actually more prevailent in the Animal Kingdom than was previously maintained and many such activities are necessarily unrelated to androgens (see Figure 25 below).

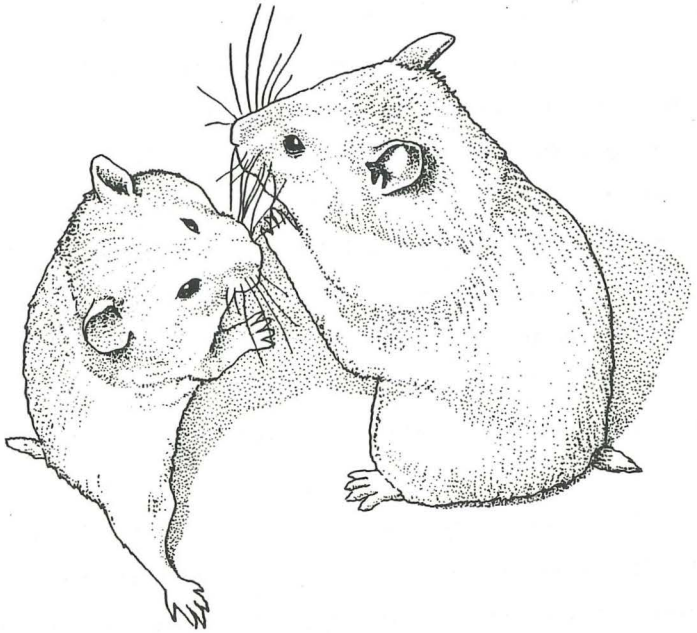


Figure 25. Threat display in two female hamsters. N.B. The animals use the dark patches on their 'chests' in intimidatory displays.

The earlier clinical claims concerning relationships between androgens and aggression in humans have not generally stood up to attempts at replication. For example, the finding of higher testosterone levels in the blood of hostile as opposed to non-aggressive male prisoners was based on a single measure of testosterone, relied on the behavioural assessments of prison guards and failed to control for the possible effects of homosexual activity on this index. It is consequently difficult to claim

that there is any evidence of a 'simple' relationship between testosterone and human aggression.

Figure 26 (see below) shows my current ideas concerning the actual relationship between biology and behaviour, namely that, if one looks at inter-individual forms of aggression, one is really dealing with some quite complex interactions between biology and experience. Some of these effects are mediated by changes in aggressive motivation, some by influencing other behaviours which compete with the aggression, others by changing the social signals that animals direct towards each other and yet others actually involve how they perceive those social signals. There are

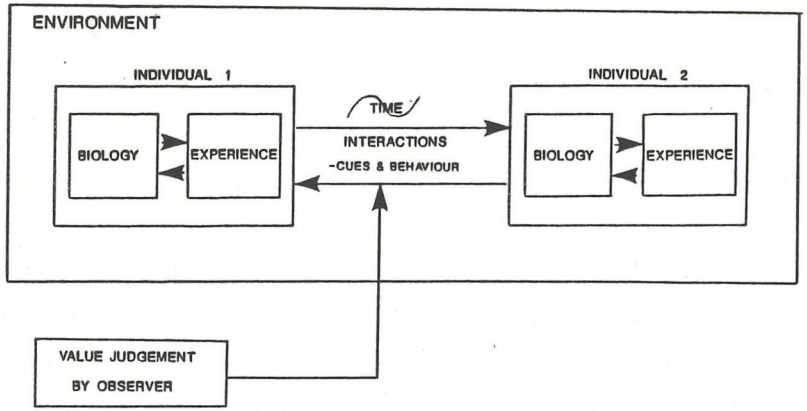


Figure 26. A Schema showing the relationship(s) between biology and aggression. From P.F. Brain (1989). The Nature and Control of Aggression, Oxford Project for Peace Studies, Oxford.

also changes over time and the impact of the particular environment to consider. One has to add to this complex mix, the fact that whether one chooses to call a behaviour aggression or not, is based the observer's value-judgement. It is consequently highly improbable that one will find simple relationships between any one biological factor and expressed behaviour. This is not to say that one should not attempt to understand the complex relationships.

One must also add, however, that investigations of complex social interactions in animals can be beneficial in other ways. My recent research has involved devising new laboratory measures of behaviour based on "ethoexperimental" principles. This looks at responses which seem to tap more basic ('hard-wired') attributes of animal behaviour by creating environments which reflect the natural lifestyles of wild animals (such behaviour is more obviously functional than many current psychologically-inspired tests) and attempts (by combining videotape and computer technologies) to provide a much more detailed analysis of interactions. Such studies are obviously of great utility in animal welfare investigations and in conservation (behaviour is the most sensitive indicator of whether of an environment is appropriate). Using such techniques, detailed re-investigations are being carried out on the impact of genes, drugs (especially those related to endogenous opioids - the bodies' own morphine-like pain relievers, benzodiazepines and alcohol) and hormones on behaviour. The techniques can be used to re-evaluate contentious claims (e.g. the relation between hostility and alcohol ingestion) or to provide exquisitely sensitive indices of drug side effects (e.g. in teratological investigations to assess the potential impact of exposing the foetus to drugs by treatment/self-application of/by the mother). These are exciting times in the behavioural sciences with

new applications becoming obvious daily. I hope to continue in my efforts to develop this blend of pure and applied research.

I would like to conclude with what is, I feel, the basic "take home" message. One of the major difficulties besetting us today is that most popular writing on human aggression involves a rerunning of the old (and inherently sterile) nature versus nurture debate. Konrad Lorenz, who died last year, made the claim in his 1966 book "On Aggression" that:-

"In man's case too, intraspecific aggression has not only regretable consequences but also quite positive social functions which make it seem inadvisable to dispense with it completely".

His view was that aggression was part of our animal inheritance and that the activities involved helped to make social groups more cohesive. Lorenz also suggested that formalised competition (e.g. the Olympic Games) could be a means of containing the negative consequences of these activities.

Taking a completely different tack, the social psychologist Leonard Berkowitz (1969) claimed that:-

"Aggression is all too likely to lead to still more aggression".

His view emphasises the social learning view of aggression and suggests that removal of overtly competitive situations (including vigorous team sports) is necessary to reduce the probability of violent behaviour.

Both are, of course, extreme viewpoints and neither encapsulates an absolute truth. Our current meagre state of knowledge is still best expressed, for me, in a quotation from Frank Buckland's "Animal Life" (1887):-

"N.B. The best way to stop tigers, cats, dogs, monkeys or even men and women fighting is to squirt water strongly into their faces. The effect is marvellous. Try it".

I am strongly convinced that we need to understand more about the nature of aggression and that this requires cross-disciplinary effort. Hopefully, my own studies have at least contributed to an improved understanding of the situation.

ACKNOWLEDGEMENT

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