SUBTYPES OF AGGRESSION IN HUMANS AND ANIMALS.

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From the elementary fencing behavior of fruit flies to the lunging attack of mice or rats, and from the biting of dogs to the more subtle form of indirect aggression in humans, the expression of aggressive behavior becomes increasingly sophisticated and diversified as animals increase in neural complexity. Comparable transformation is observed during the course of human ontogeny. Children first bite, hit, push, and kick (Tremblay et al., 1999); then gradually, they may come to choose more indirect, socially-oriented forms of aggression such as spreading negative rumors about a classmate or attempting to alter relationships (Björkqvist, Lagerspetz, & Kaukiainen, 1992). The expression of aggression undoubtedly reaches a peak of complexity in adulthood, not only in terms of expression but also with regard to its multiple causes and consequences (Loeber & Hay, 1997).

The fact that aggression is not a unitary or homogeneous phenomenon is clearly not in dispute among scientists. More challenging, however, is the need to provide a definition of aggression that would satisfy researchers from most, hopefully all, spheres of expertise (Archer & Browne, 1989). Some authors have argued that this was an impossible mission because the concept of aggression involves too many variables and determinants, and – more particularly – a significant part of social and moral judgment (e.g., Johnson, 1972). Others avoid using the term aggression because of its diffuse meaning (e.g., Patterson & Cobb, 1973), or declare that reaching a consensus on a definition is not necessary to perform a meticulous analysis of aggression (e.g., Cairns, 1979). Finally, some researchers maintained that aggression is essentially an inadequate concept that ought to be replaced by more precise terminology (e.g., coercive control, Tedeschi & Felson, 1994; Felson, 2002).

Before reaching a potential agreement about a definition, a first step is to describe and classify the different types of aggression. As Moyer (1968) argued, "progress in understanding the general phenomenon of aggressive behavior can only be made when the various aggressions are carefully and operationally defined" (p. 65). Hence, several attempts have been made to sort the different forms of aggression into discrete categories. Various taxonomies have been offered for both animal and human aggression, either based on similarity of behavioral expression, the contextual characteristics of the eliciting stimulus, functional significance, motivational underpinning, or underlying neurophysiological mechanisms.

In this chapter, we review the diverse forms of aggression in both animals and humans, in an attempt to integrate the current knowledge into a coherent theoretical and practical framework. We argue that a better understanding of the concept of aggression requires a systematic examination of the various proximal and distal forces that induce, facilitate, or maintain the development and expression of the different subtypes of aggression in both humans and animals. Comparing the similarity and dissimilarity of these multiple forces in a variety of species and among individuals within a given species represents the only possible strategy for formulating a universal taxonomy of aggression.

COMPARING DIFFERENT LEVELS OF PHYLOGENETIC AND ONTOGENETIC ORGANIZATION

The risk of anthropomorphism and zoomorphism

To recognize the phylogenetic sophistication of aggression, it is important to discriminate between subtypes of aggression that are unique to humans and those that are also present in other species. The ontogenetic sophistication of aggression will become manifest only by differentiating subtypes of aggression that are expressed during a specific developmental period from those that occur throughout ontogeny. Distinctions should be articulated behaviorally, functionally, and neurobiologically. At the behavioral level, a number of aggression-related behaviors are strikingly similar among species, even in those that are extremely distant in phylogenetic terms. For instance, "boxing", an upright posture observed during fighting, is shown by fruit flies, rats, and humans. Although the behavioral repertoire of flies and rodents is more complex than one would expect (Chen, Lee, Bowens, Huber, & Kravitz, 2002; Barnett & Marples, 1981; Gendreau, Gariépy, Petitto, & Lewis, 1997), it does not reach the range of human behavioral expression. Nevertheless, one may ask how is it possible that such unrelated species exhibit similar forms of aggression. What do flies, rodents, and humans have in common besides possessing pairs of limbs and being able to display a similar motor-expressive pattern? At the functional level, fruit flies and rats do not fight for money or pride, but both can fight for sexual access and territoriality, as humans sometimes do. At the neurobiological level, the divergence is considerable. The rudimentary nervous system of a fruit fly is made up from a mere 250,000 neurons and the brain of an adult rat weighs more or less 2 g. With its 100 billion neurons, the 1.4 kg human brain is at a different level of complexity. Nevertheless, rats and humans share similar brain structures and pathways, and like fruit flies, they can develop addiction to cocaine, nicotine, and alcohol (Bainton, Tsai, Singh, Moore, Neckameyer, & Heberlein, 2000), suggesting a certain degree of neurobiological similarity.

Cross-species comparisons call for differentiating behavioral and neurophysiological characteristics that are homologous (i.e., having common evolutionary origin) from those that are simply analogous (i.e., likeness in function but not in evolutionary origin). When analyzing behavioral and/or physiological similarity between species we run the risk of *anthropomorphism*, that is, viewing animals as having human-like qualities, or *zoomorphism*, that is, mistakenly perceiving human behavior as the mirror image of animal behavior (Cairns, 1979). For instance, contrary to the controversial and sensationalist opinion of past authors (e.g., Ardrey, 1966), predatory behavior in animals should not be equated with hunting or warfare in humans. Although these behaviors may share some common neuroevolutionary processes, the function of predatory behavior is to supply food, thus enhancing the probability

of survival. Human hunting, at least in modern society, is often motivated only by the pleasure that the activity provides, and not by the necessity to gain food. Predation targets other species, whereas warfare is directed at other humans.

Likewise, matching children's and adult's behavior on the basis of their expressive similarity, something one could adventurously call "adultomorphism" or "pedomorphism" depending on the direction of the comparison, is not uncommon. A child hitting another child in kindergarten and an adult hitting a colleague at work are two events that — albeit similar in their expression and to some extent in their immediate consequences (i.e. physical hurt) — clearly differ in terms of antecedents and long-term consequences. In sum, any definition of aggression that does not address the issue of phylogenetic and ontogenetic similarity *and* contrast encourages a static or reified view of a complex phenomenon.

Early taxonomies of aggression

Animal models of aggression provide a strong conceptual base for approaching the study of human aggression. Moyer (1968) established seven categories of aggressive behavior based on their functional values and stimulus-bound characteristics. They were predatory aggression, intermale aggression, fear-induced aggression, irritable aggression, territorial defense, maternal aggression, and instrumental aggression. A possible eighth category, sex-related aggression was also suggested. As Moyer himself mentioned five years later, however, "definition of the kinds of aggression on that basis alone now appears too restrictive: the kinds of aggression vary on a number of different dimensions, and all of them must be considered in the definition of each kind" (Moyer, 1973, p.12). The dimensions that Moyer referred to were: the specificity of the eliciting stimulus, the presence or absence of an emotional display, the sex of the attacker, and the neurophysiological correlates. With these four "dimensions" in mind, Moyer (1973) finally rejected territorial defense as a subtype of aggression. Although Moyer's taxonomy was primarily targeting animal aggression, reference was also made to human behavior: however, the uniqueness and complexity of human aggression was not specifically addressed. The use of the categories to describe and differentiate human aggression undoubtedly leans toward zoomorphism.

A similar commentary can be made regarding Wilson's sociobiological taxonomy (Wilson, 1980). Although most of the subtypes of aggression (i.e., territorial, dominance, sexual, parental disciplinary, weaning, moralistic, predatory, and antipredatory aggression) were meant to be theoretically applicable to both animals and humans, there are obvious exceptions. Weaning aggression for example, that is, when parents "gently attack" their offspring to make them stop begging for food, is clearly more relevant to animal behavior. The opposite can be said of moralistic aggression, which for Wilson (1980) represents advanced forms of reciprocal altruism that reduce the manifestation of aggression via rules, codes of punishment, or enforced conformity.

In conjunction with the risk of zoomorphism and/or anthropomorphism, one major problem with Moyer's and Wilson's taxonomies is that they are based on an eclectic set of criteria. These involve a specific target (i.e., prey, predator, another male), a specific context (i.e., territorial, maternal, weaning), a specific function (i.e., to dominate, to obtain sexual access) or the concomitant occurrence of an emotional state (i.e., fear, anger), or a learning process (i.e., instrumental, moralistic). As argued by Archer and Browne (1989), one should try to be more explicit, and perhaps more restrictive, in terms of which criteria are used to divide aggression into distinct classes. Archer (1988) proposed a simpler classification on the basis of function by distinguishing forms of aggression that are "competitive", "protective", and "parental". Parental aggression can be viewed as an extension of protective aggression, involving protection of those recognized as genetically related and dependent**.** Predation was omitted from this scheme, because as argued in an earlier article (Archer, 1976), Moyer (1968) actually presented good evidence for the neural and motivational separation of the two forms of behavior. The argument was that the motivational systems underlying aggression and predation had evolved independently of one another: a good example is provided by cats, who show very different types of behavior and emotional states when fighting one another and when stalking prey. However, it is undoubtedly the case that the systems controlling predation and aggression are more related in some cases, for example in the case of mouse-killing by rats (e.g., Karli, 1956), and cannibalism in chimpanzees (Bygott, 1972), and more widely in the case of male infanticide. In humans, the link between hunting and aggression may be more complex.
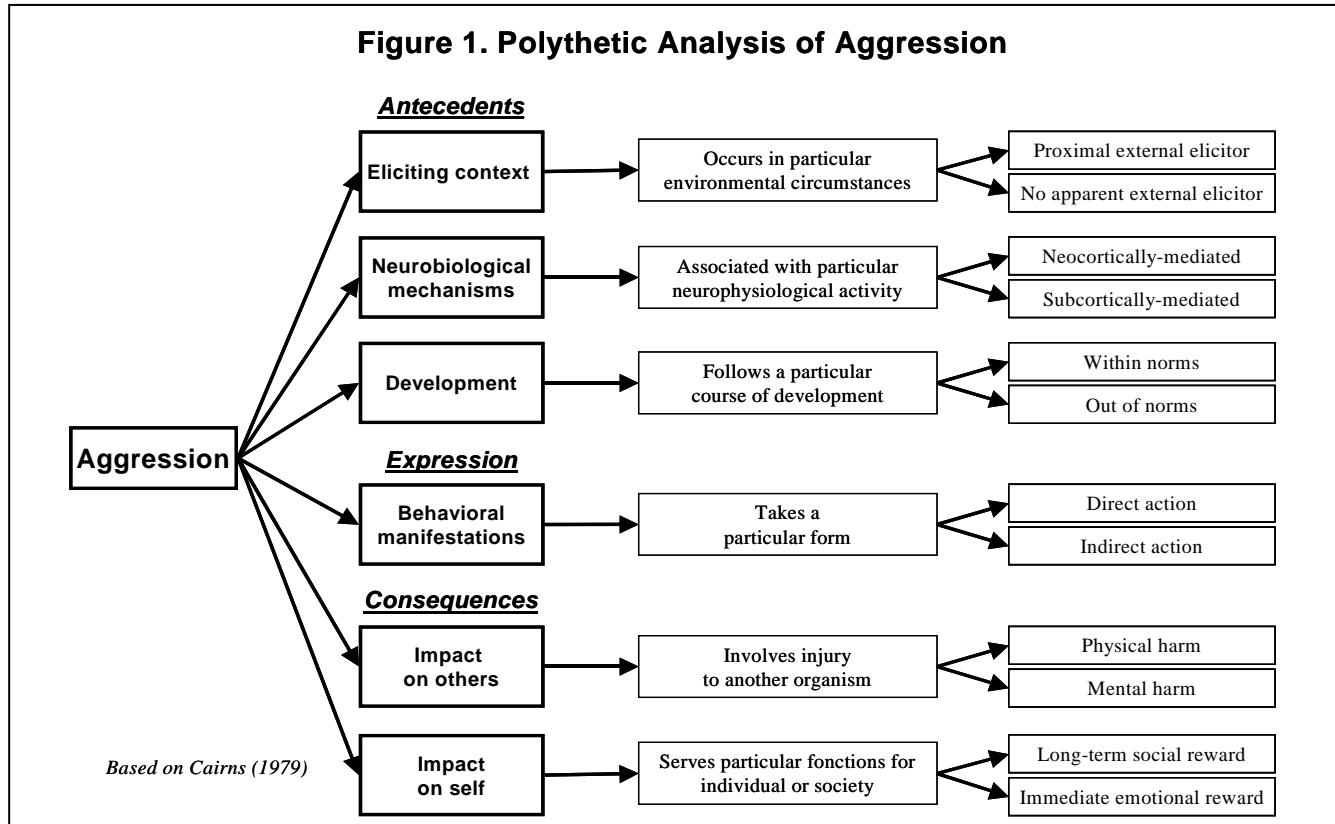
At about the same time that Moyer proposed his taxonomy and suggested four dimensional criteria to discriminate subtypes of aggression in animals, similar attempts were made to categorize the different forms of aggression in humans. Buss (1961) suggested that aggression be dichotomized along three behavioral dimensions: physical-verbal, active-passive, and direct-indirect. In 1969, Pulkkinen formulated a bi-dimensional (and bi-criteria) model characterizing human aggression (see Pulkkinen, 1987). A first dimension was related to the expression of aggression, ranging from indirect forms to more direct ones. A second dimension concerned the defensive-offensive dichotomy, which was determined by the presence or absence of proximal threatening stimuli. Although these models have the merit of being parsimonious, they are not truly pertinent to animal aggression, as indirect forms of aggression are exclusive to humans, and possibly nonhuman primates (Campbell, 1999). In addition, a model depicting behavioral or contextual features in terms of a continuum (poles or axis) may not be appropriate for some distinctions, since it postulates quantitative differences between the different forms of aggression. An aggressive act can fluctuate in intensity but it cannot be half direct and half indirect.

A MULTI-LEVEL ANALYSIS OF AGGRESSION IN ANIMALS AND HUMANS

Aggression is a dynamic, multifaceted social-emotional process that calls for a careful examination of its various *antecedents, expressions*, and *consequences* (or functions). The necessity to adopt a dynamic and multifactorial perspective when investigating the foundations of aggression and other types of social

behavior in humans and animals was ardently advocated by Cairns (1979). Cairns stressed the importance of using adequate criteria in order to generalize from one phylogenetic level to another and from one developmental stage to another. Observing a similar feature in two or more species (e.g., boxing) or in a child and an adult (e.g., hitting) is not enough to conclude that these behaviors

vs. mental harm may be more appropriate and applicable to human behavior than to rat or fruit fly aggression. It is also important to mention that even if most subtypes of aggression have been established on the basis of a single criterion, it is always possible to relate them to other criteria. Therefore, overlap between criteria is clearly the rule rather than the exception. For example, parental

Figure 1. Polythetic Analysis of Aggression

Antecedents

Eliciting context → Occurs in particular environmental circumstances → Proximal external elicitor / No apparent external elicitor

Neurobiological mechanisms → Associated with particular neurophysiological activity → Neocortically-mediated / Subcortically-mediated

Development → Follows a particular course of development → Within norms / Out of norms

Expression

Behavioral manifestations → Takes a particular form → Direct action / Indirect action

Consequences

Impact on others → Involves injury to another organism → Physical harm / Mental harm

Impact on self → Serves particular fonctions for individual or society → Long-term social reward / Immediate emotional reward

Based on Cairns (1979)

serve the same function and derive from the same proximal or distal antecedents. This principle has a significant impact on how aggression is ultimately defined and how the different forms of aggression can be grouped.

Figure 1 summarizes the major domains or themes of investigation in aggression research. This is an extended representation of Cairns' model of what he called "polythetic analysis", that is, the examination of aggression from multiple conceptual angles. The first three domains encompass the proximal (eliciting context and neurophysiological mechanisms) and the more distal antecedents of aggression, which are perceptible only through a longitudinal, developmental analysis. The fourth domain relates to the expression of aggression whereas the fifth and the sixth cover the consequences of aggression to others (harm) and to self and society (social-emotional function), respectively.

One must recognize that there are important differences between, as well as within, species in terms of variables that influence the development and expression of aggression. Nevertheless, this thematic framework probably covers most subtypes of aggression found in the scientific literature and can be generally applied to both animal and human research. Obviously, dichotomizing aggression as direct vs. indirect or as producing physical

aggression in animals serves an obvious long-term function (i.e., survival of offspring) but it also can be described in terms of antecedents, either proximal (i.e., perception of a prey, underlying neurophysiological mechanism) or more distal (i.e., genetic predisposition).

Commonsense would dictate that we follow the temporal sequence of aggression, beginning with its antecedents, then its expression, finishing off with its consequences on others and the self. We decided to go the opposite way, starting with the first and most obvious outcome of aggression (its consequences on others and self) to elements that necessitate a more thorough examination of the problem (e.g., distal antecedents and developmental issues). This upward presentation of the different components of aggression ends up with a provisional integrative representation of the most significant subtypes of aggression and their underlying processes.

SUBTYPING AGGRESSION ON THE BASIS ON ITS CONSEQUENCES ON OTHERS AND SELF

Based on harm and injury

Harm or injury to others is the foremost indicator that an aggressive act has occurred. This is perhaps why it has been a common criterion for qualifying aggression

(Berkowitz, 1981; Rule, 1974). In its most simplified form, aggression has been defined as the delivery of noxious or painful stimuli to another individual (Buss, 1961) or as a response resulting in injury (Rule, 1974) or as "damage or destruction of some goal entity" (Moyer, 1968). Some authors specified that the targeted individual ought to "be motivated to avoid such treatment", in order to exclude cases of sadomasochism (Baron, 1977). Research has traditionally focused on physical harm but it has been increasingly frequent to include mental or psychological harm as potential consequence of aggression, as in the case of indirect aggression or persistent bullying.

Issues have been raised concerning the validity of harm as a criterion for assessing or qualifying aggression. First, as potential harm, either physical or psychological, seems inherent to all forms of aggression, it has little discriminatory value. In addition, assessment of harm is not only contingent upon the nature of the aggressive action (a hit by a two year-old may not hurt an adult) but it is also conditional on the victim's sensibility. Some individuals may be hypersensitive to external stimulation and may be more prone to feel physically and/or mentally harmed. Assessment of harm is indeed a highly subjective matter. Even from a behaviorist perspective which targets the observable behavior of the aggressor (delivery of noxious stimuli), judgment has to be made to determine whether pain or harm has been inflicted or not. Furthermore, the harm criterion has little value for subtyping aggression in animals. Automated bite-recording devices to measure the intensity of noxious delivery by aggressive primates and rodents have been designed (Ulrich, Dulaney, Arnett, & Mueller, 1973) but this turned out to be too impractical and restrictive (Knutson, 1973).

Based on intent, motivation

Descriptive models of aggression have often emphasized the cognitive/motivational antecedent of aggression. An influential paper by Feshbach (1964) was critical in establishing two major types of aggression based on harm, or more specifically on the motivation to harm. If injury (to a person or object) was the primary goal of the action (pleasure or satisfaction following injury being the main reward), it was labeled as *hostile aggression*. If injury was not the main purpose and the action was executed for reward other than the pleasure of injuring, then it was termed *instrumental aggression*. More specifically, Feshbach (1964) defined instrumental aggression as any act that produces harm and that "is directed toward the achievement of nonaggressive goals". These "nonaggressive" goals include getting attention and acquiring an object or a resource.

Although differentiating aggression based on the presence of hostile intention has been a dominant and relatively valid conceptual dichotomy in aggression research (Atkins, Stoff, Osborne & Brown, 1993), it raises theoretical problems. First, aggression can be both hostile and instrumental (Bushman & Anderson, 2001; Hartup & De Wit, 1974). Second, labeling aggression as hostile is rather tautological. Are there nonhostile, friendly forms of aggression? This semantic glitch should not hinder the fact that some people may gain a considerable satisfaction or pleasure from hitting and injuring someone whereas others may benefit more from the social or materialistic consequences of their aggressive action. Importantly,

getting pleasure from producing harm to someone may not be the most common motivational antecedent of aggression. Indeed, for many explanatory models (e.g., Archer, 1976; Berkowitz, 1993; Dollard, Doob, Miller, Mowrer, & Sears, 1939) bringing an end to a situation that is annoying, or removing an irritant or a discrepancy from what is expected, are the frequent motivational precursors of aggression. Nonetheless, both pleasure-motivated aggression and relief-motivated aggression imply an emotional outcome or reward that is either pleasurable (positive reinforcement) or a release from a previously noxious state (negative reinforcement). Whether we call Feshbach's categories of aggression hostile vs. instrumental, annoyance-motivated vs. incentive-motivated (Zillman, 1978) or emotionally rewarding vs. materialistically/socially rewarding, does not really matter if an unambiguous definition is provided.

Researchers from the social-interactionist perspective (Tedeschi & Felson, 1994) view aggression (which they term "coercive power") as being motivated by interpersonal goals – to control others, to maintain justice or to defend social identity. From the perspective of the actor, all aggression is therefore instrumental in that it pursues one of these social goals. However these situations can just as readily be viewed as removing an irritant, i.e. negative reinforcement, and it may be confusing to regard such situations – which inevitably involve anger – as instrumental in nature. For the purposes of clarity, it is probably better to restrict the term instrumental to cases involving positive reinforcement of aggression by a reward unconnected with activation of the aggression system. This would highlight the parallels between such human cases as robbery and rape (Felson, 2002) and the use of conventional reinforcers such as food or water to facilitate animal aggression (e.g., Ulrich, Johnston, Richardson & Wolff, 1963).

Feshbach (1971) and Rule (1974) proposed a different taxonomy by subdividing instrumental aggression into *personally motivated* aggression and *socially motivated* aggression. Personally motivated aggression is different from hostile aggression since the primary goal is not to hurt but to obtain reward via injury. On the other hand, aggression is said to be socially motivated when the primary goal is to gain a social advantage. Even from the authors' views, however, the distinction between these subtypes of aggression was problematic, due to the difficulty in assessing motivation, intent, or feeling. Sears (1961) suggested the term *prosocial aggression* to distinguish aggressive behavior considered as socially and morally acceptable. However, to the same extent that the term hostile aggression is certainly a truism, the expression "prosocial aggression" appears to be an oxymoron. Naming an aggressive act as prosocial or antisocial depends too much on individual viewpoints to be a useful categorization criterion. Physically punishing a child for preventing the occurrence of life-threatening situations (e.g., crossing a high-traffic road) may have justifiable intention and long-term benefits. From the child perspective, however, the immediate consequence of being spanked by a parent or being slapped by a peer may not differ much. Also, any act of terrorism or war can be considered legitimate and morally acceptable from the aggressor's perspective. From the victim's point of view,

the immediate and harmful consequences do not depend on how good the intention was.

It has been claimed that behavior should be at once intentional (motivation to injure) and harmful to be classified as being aggressive (Berkowitz, 1993; Dollard et al., 1939). As with the nature and intensity of harm, however, intent is a concept that is difficult to prove and easy to deny (Loeber & Hay, 1997). It also brings about serious limitations when investigating aggression in children or animals (Tremblay, 2000). For these reasons, although intent is certainly central to the definition of aggression, it may not be an adequate criterion in practical terms for establishing a taxonomy of aggression applicable to both animals and humans (children and adults). Intention may be also problematic in cases of indirect aggression where the perpetrator seeks to cover up their actions.

SUBTYPING AGGRESSION ON THE BASIS ON ITS EXPRESSION

This has been a popular criterion for establishing categories of aggression. It circumvents the pitfalls of intrinsic notions such as instinct, motivation, drive, or intent to harm. Unfortunately, too many behavioral responses or observable facts that have essentially nothing in common, from infanticide and murdering to giving a verbal description of Rorschach inkblots, have been subsumed under the label of aggression. Display of aggressive behavior is species-typical and age-dependent as it is manifestly constrained by morphogenetic, neurophysiological, and maturational factors unique to each species and developmental stage. Topographical descriptions of aggressive interactions have been performed systematically in animals (Barnett & Marples, 1981; Grant & Mackintosh, 1963; see also chapter by Pellis). Although attempts have been made to extent the ethological approach in children (Blurton-Jones, 1967; McGrew, 1972) much less has been achieved regarding the operationalization of specific aggressive behavior in humans (Knutson, 1973; Tremblay, 2000). Buss (1961) was among the first to offer a behavioral taxonomy of human aggression by dichotomizing it along the physical-verbal, active-passive, and direct-indirect dimensions. The active-passive dimension is debatable, however, since it is difficult to determine whether behavioral inactivity (e.g., not helping someone in need) was intended or not. The physical-verbal and the direct-indirect dimensions are more defendable. They are more useful when applied to humans, although animals often begin aggressive encounters with threat displays, including vocalizations (Archer, 1988).

In animals, *direct aggression* is straightforward, involving bodily contact such as biting, hitting, or pushing. Some behavioral elements that do not involve any physical contact, such as threat and thrust (Grant & Mackintosh, 1963), are clearly direct and aggressive, as their objective is to intimidate and they are often precursors of genuine attack. In humans, Blurton-Jones (1972) also labeled as aggressive a number of nonphysical behaviors that were temporally related to other more obvious aggressive actions. In humans, however, the expression of aggression is far more complex and includes a broader assortment of direct and indirect actions. Direct forms of aggression comprise physical assault and a range of verbal behaviors that may be hostile in content or in tone. These verbal behaviors may occur with or without physical attack. In humans, direct aggression is somehow equivalent to *overt aggression* (Crick, 1996).

Indirect aggression is at the other end of the behavioral dichotomy, consisting of actions aiming at harming others that involve some kind of social intermediary between the aggressor and the victim. The course of action is often delayed and subtle as there is no physical contact. The psychological effects, however, may persist over a long period. This can be achieved through gossiping and ostracizing, which ultimately may damage peer relationships or social status or through actions aiming at reducing accessibility to resources. Research on indirect aggression has grown substantially in the last few years, as this may be the most prevalent form of aggression during adolescence and adulthood (Björkqvist et al., 1992). It is the only form of aggression that may be more prevalent in males than in females (Campbell, 1999). Indirect aggression overlaps with two further categories, *relational* (Crick, Grotpeter, & Bigbee, 2002) and *social* (Galen & Underwood, 1997) aggression. Relational aggression emphasizes damage to relationships as a way of harming the other, and therefore can include face-to-face statements such as "I'm not friend with you anymore" which are excluded from indirect aggression (Coyne & Archer, 2003). Social aggression is a wider category that includes both relational and indirect forms, along with expressions such as negative facial expressions or body movements.

SUBTYPING AGGRESSION ON THE BASIS ON ITS ANTECEDENTS

Proximal contextual and emotional elicitors

Proximal antecedents, either contextual or emotional are the most frequently used criteria for discriminating subtypes of aggression, particularly in animals. A wide range of social and nonsocial contextual-situational variables has been used to elicit aggressive behavior in animals (Archer, 1976, 1988). Social elicitors include the presence of a prey or exposure to a same-species, same-sex conspecific either in the home-cage (resident-intruder paradigm) or in a novel environment. These social encounters are often combined with prior or concomitant experimental manipulations (e.g., social isolation, food deprivation, electric shock) that alter the neurobehavioral state of the potential aggressor. These predisposing factors, which influence the potency of the elicitors (Hinde, 1974), represent an important issue in aggression research.

A decisive factor is the presence or absence of a threatening elicitor. When a situation is clearly threatening or *perceived* as threatening, an arsenal of behavioral responses is put in motion to protect the individual from pain, injury, and possibly from death. Responses to threat range from harmless reactions such as heightened immobility (i.e., freezing, crouching), escape, and holding off the threatening assailant with stretching of the upper limbs (boxing) to fierce attack and delivery of noxious stimuli. This constellation of responses has been traditionally subsumed under the label "agonistic behavior" (Scott & Fredericson, 1951).

The notion of aggression as a response to potential threat to the animal's welfare is central to theories that conceive of aggression as a aversion, where the animal is motivated to avoid a situation. This contrasts with an appetite, where the animal is motivated to approach or seek out a situation (Craig, 1928). Aversion-based theories seek to identify the mechanism through which animals or humans detect threats, and they include the frustration-aggression hypothesis (Dollard et al., 1939), the discrepancy model of animal aggression (Archer, 1976), and the theory of threatened egotism (Baumeister, Smart, & Boden, 1996).

Pain is another "emotional" antecedent of aggressive behavior. Animals exposed to painful stimulation (e.g., electrical shocks, sudden heat, bite) will start fighting against each other or will attack an inanimate object if tested alone (Archer, 1989/1990; Ulrich & Azrin, 1962). Blanchard and Blanchard (1981) have convincingly argued that such pain-induced aggression is analogous to fear-induced defensive aggression. Archer (1989/1989) suggested that, although this is the case in laboratory set-ups involving repeated painful shocks, an isolated single painful stimulus may under natural conditions evoke anger-induced offensive aggression. Overall, aggressive behavior can be generated by a variety of external stimuli that are threatening or painful, and these stimuli activate at different degrees both the peripheral and the central nervous system. In pain-induced aggression, activation of the nociceptors and/or thermal receptors sets in motion neural pathways that control the expression of aggressive behavior, and in this case, the threshold for fear is easily reached. Then, determining if aggression is mediated by fear or anger will depend on what brain regions are activated during attack.

Under threatening circumstances, aggression may be offensive or defensive (Blanchard & Blanchard, 1989), i.e. anger or fear motivated. In humans, responses to provocation, broadly similar to threats in animals, have been termed *reactive aggression*. Thus, reactive aggression is an impulsive, negatively valenced act displayed in response to a threat or provocation (Dodge, & Coie, 1987; Vitaro, Gendreau, Tremblay, & Oligny, 1998). It stems from the frustration-aggression hypothesis that viewed aggression as a "primordial reaction […] whenever pleasure seeking or pain-avoiding behavior is blocked" (Dollard et al., 1939, p.21). Interestingly, it is not so much contextual stimuli per se that determine whether aggression will be labeled as reactive but the perception that the individual has and what he or she makes out of it. Indeed, an interesting finding in human research is that reactively-aggressive children are characterized by a lower threshold for exhibiting aggression, that is, they more readily perceive an ambiguous situation as threatening or hostile (Dodge & Coie, 1987; Vitaro, Brendgen, & Tremblay, 2002). This attributional/perceptual bias and behavioral hypersensitivity to what typically should be mild, nonthreatening stimulation is reminiscent of what is observed in animals after prolonged social isolation (Gendreau, Gariépy, Petitto, & Lewis, 1998) or after successive defeat experiences (Keeney & Hogg, 1999). These animal paradigms may be more relevant to human reactive aggression than paradigms using clear life-threatening conditions. Conversely, *proactive aggression* occurs with more forethought and does not seem to be associated with any apparent proximal elicitor. It is more controlled, more premeditated, and less emotionally reactive. It can be understood in terms of social learning, as a result of previous external reinforcement (Bandura, 1973; Patterson & Cobb, 1973).

Discriminant and convergent validity of these subtypes of aggression has been provided by an increasing number of empirical reports (Dodge & Coie, 1987; Poulin & Boivin, 2000; Pulkkinen, 1996; Vitaro et al., 1998, 2002). Contrary to the dichotomy hostile-instrumental, which is determined by the nature of the motivation (goal is to hurt vs. goal is to gain), reactive and proactive forms of aggression are differentiated by the presence of a prior provocative event and the short delay before enactment. The distinction between reactive and proactive aggression, however, is problematic as it depends on no provocation being identified, when what is a provocation varies considerable between individuals. Looking at someone in the wrong way may be classed as a provocation in a subculture where everyone is on the lookout for signs of disrespect. Having said this, the category proactive aggression, i.e. aggression without obvious provocation or threat, may alert us to cases, primarily among young men, where fights are sought for no apparent reason than to inflict a physical defeat on another person.

Brain mechanisms

Neuroscientists have somehow bypassed the use of psychic or inner states in relation to aggression by examining the direct and observable effects of lesions and stimulations of specific areas of the brain. The brains of humans and other mammals share many structures, pathways, and neurochemical properties, reflecting the long and progressive transformation of the brain during evolution. In the last four decades, an increasing body of evidence has accumulated describing the role of specific neural circuits in the expression of different types of aggression. Numerous sites within the neocortex and subcortical structures have been identified as key neurophysiological processes. Moyer (1968; 1973) was among the first to relate specific neural circuitries and distinctive neuroendocrinological status to subtypes of aggression. Particular attention was given to the amygdaloid complex, the various hypothalamic nuclei, and other parts of the so-called limbic system (e.g., septum, cingulate cortex). Moyer (1973) argued that each of the subtypes of aggression that he had previously identified (except for instrumental aggression) had its own set of neural circuits. Functions associated with the expression of specific forms of aggressive behavior have indeed been localized in the brain (Valzelli, 1981; Panksepp, 1998). As Panksepp pointed out, however, there are more subtypes of aggression based on the proximal contextual antecedents than there are subtypes based on neural processes. In other words, similar brain circuitry may allow different types of aggression to be expressed; what differs are the eliciting circumstances and the perceptual processing. As we will see, this has a significant impact on our attempt to produce a parsimonious taxonomy of aggression.

Panksepp (1998) denoted distinct neural circuitry for no more than three subtypes of aggression in the brains of rats and cats: predatory aggression, which is not generally viewed as aggression (see above); affective or rage-like aggression (which may coincide with defensive aggression

identified by Blanchard & Blanchard, 1989); and intermale aggression (what the Blanchards called offensive aggression). So-called predatory aggression (or quiet-biting attack in the laboratory) can be generated by stimulation of the dorsolateral hypothalamus, and involves activation of the ventral part of the periaqueductal gray. It is believed to be primarily mediated by what Panksepp termed the SEEKING or the appetitive motivational system of the brain. If so, this contrasts with the emphasis on aversive motivation in most theories of aggression (see above). This system involves not only the lateral hypothalamus but also most structures that are innervated by dopamine and serotonin-releasing neurons, including the prefrontal cortex. Abnormal development of the prefrontal cortex has been associated with antisocial personality disorder (Raine, Lencz, Bihrle, LaCasse, & Colletti, 2000) and people diagnosed with this disorder have been shown to display more proactive forms of aggression (Chase, O'Leary, & Heyman, 2001). This would be consistent with their seeking out situations in which to display aggressive actions.

In contrast, the affective subtype of aggression is mediated by different and more primitive (Archer, 1988) interactive neural circuits, what Panksepp (1998) termed the FEAR system and the RAGE system. Affective aggression involves the ventrolateral-medial hypothalamus, several amygdaloid nuclei, the dorsal part of the periaqueductal gray to cite just a few (Gregg & Siegel, 2001). Importantly, this subcortical circuitry operates relatively independently of neocortical input. The neurophysiological basis of intermale (or intrasexual) aggression has not been well established. Panksepp (1998) mentioned that the brain circuitry of intermale aggression may interact with both the SEEKING and RAGE systems, but is somehow relatively independent. The evidence for this is clearly not overwhelming but Panksepp (1998) reported that brain lesions which impair predatory and affective aggression do not affect intermale aggression.

Obviously, this is an extremely simplified account of very complex brain mechanisms involving many more structures and neurotransmitter systems (see Gregg & Siegel, 2001). Although primitive forms of aggression such as those elicited by stimuli perceived as painful, threatening or annoying, may be processed through brain circuitry highly similar to others species, the sophistication and diversification of aggression in humans necessarily implies the existence of brain processes unique to our species. Our neocortex, which does not complete its maturation before adulthood (Giedd et al., 1999), plays an important inhibitory role on more primitive brain structures, therefore controlling the expression of social-emotional reactivity. The gradual transformation of the brain during development may explain the progressive shift in the expression of aggression from early childhood to adulthood, that is, direct, reactive and physical forms of aggressive behavior being gradually substituted by more indirect, controlled, and nonphysical forms (see chapter by Vaillancourt).

Distal influences (development)

What differentiates humans from animals is not only the increased complexity of the human brain, the advanced cognitive skills and social world, but the longer developmental period that is necessary for organizing behavior (Cairns, 1979; Hinde, 1974). As mentioned in the preceding section, the expression of aggression changes throughout ontogeny with physical aggression reaching its peak in early childhood (Tremblay et al., 1999) and relationally oriented forms of aggression gradually emerging in late childhood/early adolescence (Björkqvist et al., 1992). Hartup (1974) observed that aggression develops from being first object-oriented (instrumental) to more person-oriented (hostile) aggression (see also Caplan, Vespo, Pedersen, & Hay, 1991).

Hinde (1992) proposed one of the few categorization of aggression exclusive to childhood. He discriminated instrumental (or specific) aggression (aiming at gaining or retrieving an object or situation), teasing aggression (aggression unrelated to acquiring a specific object or situation), defensive aggression (in response to an attack), and game aggression (that results from rough-and-tumble play). Hinde suggested that childhood instrumental and defensive aggression were somehow equivalent to reactive-impulsive aggression as observed in adulthood. Teasing aggression had its adult counterpart under the label of "spontaneous aggression". No further distinction between impulsive and spontaneous aggression and no adult correspondence for game aggression were provided.

A social-developmental analysis of the functional and expressive characteristics of aggression from early childhood to adulthood is indispensable for our understanding of the different ontogenetic pathways to more sophisticated forms of aggression. Hinde's distinction between subtypes of aggression in childhood was clearly a step towards establishing a developmental topology of aggression. One may question, however, the need to use different taxonomical labels for children and adult aggression, especially when there is correspondence between the different subtypes. In addition, characterizing one form of aggression as impulsive and another as spontaneous is confusing. Finally, game aggression or rough-and-tumble play is clearly motivationally distinct from other forms of aggression (Blurton-Jones, 1972; Smith, 1989). In the end, we need to agree on a general taxonomy that is applicable throughout development, not only to a specific period. Once this is achieved, the developmental trajectory of the different subtypes of aggression can be investigated.

The onset and stability of aggression during ontogeny has been an important issue in developmental and clinical sciences. Moffitt (1993) proposed a developmental taxonomy of conduct disorders (CD) based on the onset and persistence of antisocial behavior (which relates to aggression). Specifically, CD could be described as life-course persistent (behavioral problems start during childhood and persist throughout childhood up to adolescence and adulthood) or as adolescence-limited (when problems emerge and end during adolescence) Discriminating between early vs. late onset CD has been a valuable clinical classification (American Psychiatric Association, 1994).

The relationships between individual development and the transformation of aggression over time in boys and girls, in both expression and function, are central to the science of aggression. We now recognize the gender-dependent development and use of physical aggression (Tremblay et al., 1999) and the gradual emergence of hostile (Caplan et

al., 1991; Hartup, 1974) and indirect (Björkqvist et al., 1992) aggression. Similarly, reactive aggression seems to appear first (as tantrums) or may be a more prevalent form of aggression early on (Loeber & Hay, 1997). On the other hand, children prone to display proactive forms of aggression may be more at risk of exhibiting delinquent

genes or a brain mechanism. It is a complex social phenomenon that conveys so many meanings, takes so many forms, results from so many proximal and distal antecedents, and has so many consequences that a universal taxonomy seems an unachievable puzzle. It has identifiable underlying brain processes but those are

Figure 2. A simplified taxonomical model of aggression based on context, neuroaffective processes, consequences on self, and learning
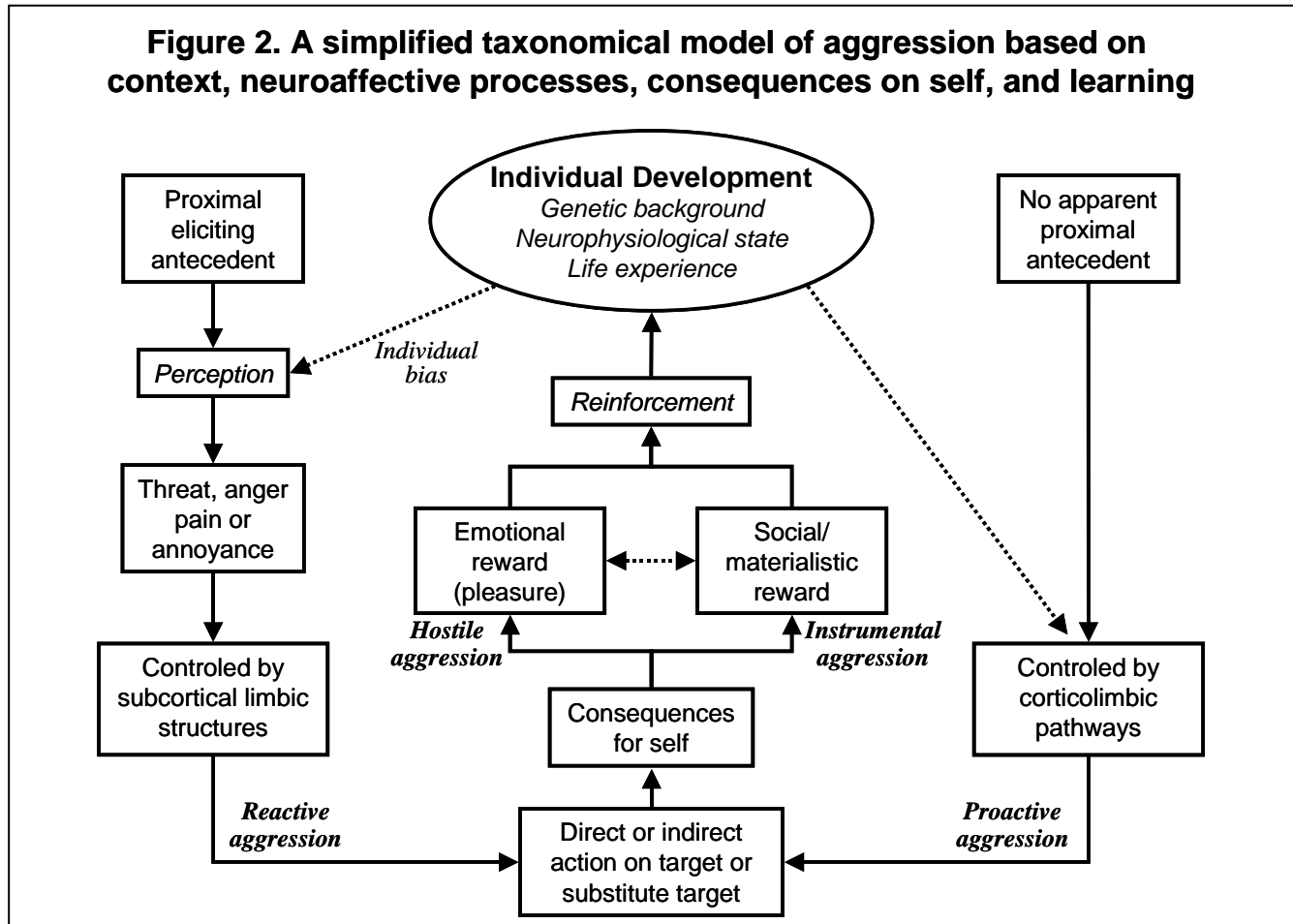
activities in adolescence (Vitaro et al., 2002). Finally, recent evidence suggests that reactive and proactive aggression in boys and girls may have different etiological antecedents (Connor, Steingard, Anderson, & Melloni, 2003). Many important issues remain to be investigated regarding the onset and developmental trajectory of the different forms of aggression across gender and sociocultural background.

AN INTEGRATIVE MODEL OF AGGRESSION

The goal of this chapter is to provide a summary of conceptual and theoretical issues related to the categorization of different subtypes of aggression in humans and animals. Finding an appropriate taxonomy seems to be a recurrent problem in aggression research. A taxonomy is by definition a classification based on similarities of a specified characteristic. Suggesting a taxonomy for subtypes of aggression based on a single criterion or for a single species is one thing but conceiving one that encompasses the multiple ontogenetic and phylogenetic aspects of this phenomenon is more challenging. Aggression is neither a behavior, nor a set of

dependent upon context, emotional state, and previous learning experience (reinforcement). Importantly, aggression is a phenomenon in constant transformation, both phylogenetically and ontogenetically. Hinde (1974) summarized well the challenge of elaborating a taxonomy for subtypes of aggression in both humans and animals: "The range validity of any generalizations we make is inversely related to their precision. As more diverse phenomena are included within our category of aggressive behavior, our generalizations inevitably become less precise" (p. 4).

The primary problem with respect to categorizing aggression into different subtypes is to select a parsimonious set of criteria that integrate most forms of aggression. In this regard, some criteria, despite being relevant to our better understanding of aggression do not appear to be essential for establishing a categorization. Harm to others, for instance, either physically or psychologically induced, may be the first, more expeditious consequence of aggression, but it has little taxonomic value. Therefore, we settled on a simplified taxonomic model that encompasses the most significant and

discriminative features of aggression (Figure 2). Those include the antecedent (to determine if aggression is proactive or reactive), the expression (to determine if aggression is direct or indirect), and the function (to determine whether aggression was produced only to hurt or to benefit socially). Other important elements of aggression such as distal antecedents (past experience, biological or genetic predisposition), aggressor's emotional-perceptual bias, basic neurobiological mechanisms, and learning were also integrated.

The first step in identifying the form of aggression should be to determine whether there is a proximal contextual elicitor. If there is no apparent proximal antecedent, then aggression is proactive. This form of aggression is primarily controlled by the neocortex, more particularly the prefrontal cortex and the descending corticolimbic pathways. When a proximal antecedent can be identified, then aggression is said to be reactive. This behavioral output involves various motivational/emotional states (e.g., fear, pain, anger or annoyance) that are under the control of subcortical, primarily limbic, structures. In reactive aggression, perception of the eliciting stimulus is the key for judging the pathological nature of the response. Hypersensitivity to certain contexts and stimulations may indicate heightened anxiety or heightened fearfulness (paranoia)**.** Both proactive and reactive aggression can be expressed directly or indirectly and they can target either the source of stimulation or a substitute person/object (displaced aggression). Then the aggressive action may provide a pleasurable reward from harming (hostile aggression), a social/materialistic reward, (instrumental aggression) or both. Following these consequences, learning (reinforcement) will take place and certainly influence individual development.

CONCLUDING REMARKS

Aggression is always a timely topic. The news media provide an incessant flow of information on the shocking nature of human behavior. We were just finishing this chapter as we hear the news that three teenage girls are facing attempted murder charges for allegedly trying to poison a classmate by adding copper sulfate, a highly toxic substance, to her drink. What aggressive category does poisoning fit into? It undoubtedly relates to physical harm but without a clear direct physical action. It is a physical action but with an indirect, concealed behavioral twist. Although it is a planned, proactive-like aggressive action, it is likely a retaliatory response to some prior event or situation. This is a good example of the difficulty in fitting every act of aggression into a definite category or model. Do we need more research to produce a better taxonomy? Reaching a consensus on this issue may not be as necessary as continuing our thorough analysis of the wide range of proximal and distal forces that influence the development and expression of aggression (Cairns, 1979). It is important to refine our knowledge on the many genetic, biological, and social factors that induce, facilitate, or maintain aggression throughout development. Eventually, a universally agreed-upon taxonomy, at once parsimonious and comprehensive, and integrating both animal and human aggression may emerge.

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