Play and the Regulation of Aggression

Introduction: Aggression is Innate, but so is Empathy and Social Being

"With what simplicity would I have demonstrated that man is naturally good and that it is through these institutions alone that men become bad." Rousseau, Discourse on the Arts and Sciences, 1750

"Hereby it is manifest, that during the time men live without a common Power to keep them all in awe, they are in that condition which is called War; and such a war, as is of every man, against every man." Hobbes, The Leviathan, 1651

Since the 1960's, our culture has leaned powerfully towards the developmental philosophy of Rousseau: children are naturally self-regulating, creative, positive and good. Only the arbitrary forces of culture make them bad. Carl Rogers (1989, p. x), a psychologist perhaps more responsible than any other for the promotion of Rousseau's viewpoint, makes the following observation: Man is a "basically trustworthy member of the human species, whose deepest characteristics tend toward development, differentiation, cooperative relationships… whose impulses tend naturally to harmonize into a complex and changing pattern of self-regulation; whose total character is such as to tend to preserve and enhance himself and his species, and perhaps to move it towards its further evolution." But is it really true that in our more aggressive moments we are all merely innocent victims of our cultures? Hobbes (1651) believed very much the opposite: in his state of nature, "there is no place for industry, because the fruit thereof is uncertain: and consequently no culture of the earth; no navigation, nor use of the commodities that may be imported by sea; no commodious building; no instruments of moving and removing such things as require much force; …no account of time; no arts; no letters; no society; and which is worst of all, continual fear, and danger of violent death; and the life of man, solitary, poor, nasty, brutish, and short." Many cultures tilt strongly towards Hobbes: the child is a force of nature, wilful, destructive, capable of self-harm, in dire need of careful, cautious and intense socialization, and damned in the absence of social order (Fischer, 1989).

What might a modern psychologist say about this debate, given the progress in the behavioral sciences over the last century? Is the human being a noble savage, corrupted by the stresses of civilized social being, or a beast of prey, selfish and cruel? To answer this question, it is necessary to consider evidence derived from a diverse sampling of the behavioral sciences, and to reframe the argument: what tendencies to aggression, if any, characterize the human species, and what mechanisms, individual and social, regulate and constrain those tendencies?

It should first be noted that the psychoanalytic viewpoint is not a simple derivative of the Hobbesian perspective, in the same way that the humanistic view is of Rousseau's. Freud proposed that aggression was innate, part of the id, noting that aggression emerged as a consequence of socially-induced frustration, in the form of conflict between the pleasure and reality principles. In the

psychoanalytic world, the id (nature), the ego (the individual and his subjectivity) and the superego (culture) are all good and bad, simultaneously. In keeping with this conceptualization, it appears that aggression is a natural component of our behavioral repertoire, emerging far back in the sequence of development, and not something added secondarily to an essentially peaceful temperament. Young children appear fundamentally egocentric (Piaget, 1932). They hold their own intrinsic desires paramount, and exist in a world where those desires are bounded only by their immediate consequences. They reliably begin to manifest aggressive behaviors such as pushing, hitting, kicking and throwing around eighteen months of age, although there is wide individual variability in the frequency with which these behaviours are manifested (Nagin & Tremblay, 1999). Such aggression, manifested in defensive or instrumental form (Vitiello & Stoff, 1997), appears dependent upon the operation of very low-level, early-maturing brain structures, such as the hypothalamus or periaqueductal grey (reviewed in Peterson & Shane, in press). The incidence of aggressive behavior peaks, surprisingly, in kindergarten, and then declines over time (Nagin & Tremblay, 1999). By four, most children have become social. The small number who have not (Nagin & Tremblay, 1999) tend to be aggressive for the rest of their lives (Coie & Dodge, 1998). Chronically aggressive children, then adults, lack empathy, are suspicious, narcissistic and self-centered, (Coie & Dodge, 1998) and are characterized by inappropriate and brittle high self-esteem (Olweus, 1994, Bushman & Baumeister, 1998). Few interventions appear helpful.

Chimpanzees, our surprisingly close cousins (Sibley & Ahlquist, 1984), appear primally aggressive, within their social groups, in the same manner as children. Most of their within-group aggression appears related to dominance-hierarchy manoeuvring, as it does in the human case (Wilson & Daly, 1997). Such manoeuvring appears to initially manifest itself in the innocuous and easily overlooked form of teasing. De Waal (1996, p. 114) states: "[Chimp youngsters] throw handfuls of dirt or pebbles at their elders, hit them with sticks, splash them with water, jump on their heads when they are dozing, and so on. Much of the time, the individual thus bothered takes it remarkably well, tickles the youngster, or makes a mock chase that turns the whole incident into a game." Teasing techniques transform with age, becoming less frequent, but more severe. The infant engages in little pushes from behind, jumping away when the adult turns around. The adolescent male, by contrast, manifests full-fledged charging displays, seeking to dominate his peers, the adult females that surround him and, eventually, higher-ranking adult males. As adults, chimps form sophisticated coalitions, jockeying for position and, upon occasion, physically engage and dominate or subordinate themselves to other individuals, in conflicts that can become violent (De Waal, 1996).

Dominance hierarchy position appears to be a vital determinant of survival and reproductive success. In consequence, little is more important to a social animal than accurate representation of who rules and who is subordinate under what circumstances (Abbott et al., 2003; Virgin & Sapolosky, 1997). The establishment and maintenance of a predictable dominance hierarchy allows for the emergence of orderly access to desirable resources, so that every attempt at consummation

within the social environment does not immediately escalate into an aggressive encounter. Tracking dominance and other social information is so important that group size appears as an important correlate of neocortical size, in primates, particularly with regards to brain systems devoted to analysis of complex relationships (Joffe & Dunbar, 1997). This all means, of course, that advancement is frequently worth fighting for.

The fact of innate dominance striving, buttressed by the mechanisms of aggression, does not mean that chimps or humans lack social feeling, and simply learn to inhibit their aggression through fear or through cognitively-mediated calculation of the potential consequences of aggressive behavior. Primates are as gregarious as they are aggressive – even in the immediate aftermath of intense agonistic encounters (De Waal, 1989b). It appears, therefore, that agonistic and cooperative behaviors are not necessarily opposed to one another, at least in any simple manner. First, more innately aggressive social creatures may also have to be more innately affiliative (De Waal, 1989b), in order to find and maintain social support, which is more important to them even than the objective safety of their environment (Abbott et al., 2003). Second, at any given time or place, individual action and social interaction can be characterized by cooperation at one level, and competition at another. Among intensely social animals, the social group, the dominance hierarchy, the superordinate level, clearly constitutes a form of extended cooperation. Within that group, however, that cooperative space, the subordinate level, dominance striving takes place. It appears, therefore, that the essentially aggressive instincts appear complexly counterbalanced by the interplay of two equally powerful domains of regulation, one internal and innate; the other, social and emergent.

The internal process that regulates aggression (in addition to simple fear) seems to be empathy or, perhaps, identification – the ability to feel the experiences or to adopt the viewpoint of another, respectively. Whether such ability emerges as a consequence of conditioning, emotional contagion, or cognitively-mediated understanding, the evidence for its existence is strong (Preston & De Waal, 2002). The circuitry that governs empathy – or its close variants, love, affiliation and nurturance – is arguably as archaic and deeply rooted as that motivating aggression (De Waal & Preston, 2002; Panksepp, 1998a), and appears to play a modulatory role, regulating the intensity of response to those deemed kin. A wide range of animals exhibit sophisticated reactions to the distress of a conspecific: rats appear visibly upset by the sight of another rat receiving electric shocks (Rice & Gainer, 1962; Rice, 1964); hyenas can be primed to eat and drink by the sight of their group mates doing the same, even when they are not visibly attending (Yoerg, 1991); and rhesus monkeys will starve themselves if they learn that their food gathering efforts culminate in the shock of a conspecific (Masserman et al., 1964). Human infants respond with crying to the crying of other infants (Zahn-Waxler, Radke-Yarrow and King, 1979) and, after the first year, imitate the distress behaviors of others and spontaneously manifest helping behaviors (Zahn-Waxler, Radke-Yarrow & Brady-Smith, 1977). Furthermore, Miller, Eisenberg, Fabes & Shell (1996) have noted that older children who manifest expressions of facial concern when exposed to the suffering of others are

characterized by higher levels of moral reasoning and increased prosocial behaviour.

The social process that regulates aggression appears more integrally associated, to say it again, with dominance hierarchy structure. Chimps are perfectly capable of killing, while hunting and during raiding parties conducted on foreign conspecifics (Wrangham & Peterson, 1996), so there is clearly no necessary internal limit on their aggressive behavior. It appears, as well, that the tendency towards dominance-striving among chimps can at least temporarily override any innate tendency towards empathy, during intense agonistic within-troupe disputes. De Waal (1989a) has suggested that under such conditions it is the whole chimp troupe which constrains the "ambition" of the individual, becoming agitated *en masse* and interfering, actively, with any dominance battle that goes too far. Preston and De Waal (2002) have taken pains to outline the nature of those factors that modulate the expression of empathy: familiarity and perceived similarity, as well as factors such as learning, past experience with the cause of suffering, and the salience of the suffering all affect empathic responding. What this means is that social forces can alter the probability that empathy will inhibit aggression, by altering the salience of factors modulating both. The consequences of extended social being, however, are more indirectly associated with aggression regulation, and appear related to the function of neural circuits that mature later, in a predictable, regulated and orderly social environment. If human children are socialized, within such an environment, they learn socially-acceptable but more complex alternatives to violence. They begin to integrate their own proximate desires with distal wishes, and consider and allow for the wants and needs of others.

The human child appears to face the world with a basic set of functional motivational states, mediated by low-level but sophisticated brain circuits governing action, setting the frame for perception, emotion, and cognition (Gregg & Siegel, 2000; Peterson & Flanders, 2002; Swanson, 2000). The operation of these circuits enables the child to identify and pursue valuable goals such as food, water, warmth, social affiliation, self-protection, and the exploring of new territory (Swanson, 2000, Gregg & Siegel, 2000). Each primary motivational circuit sets a unidimensional goal for behavior (Swanson, 2000), so that the child's first developmental requirement is to learn how to attain that goal. Secondly, however, he or she must learn how to balance all the primary goals, and to determine how they can find their fulfillment within a complex interpersonal environment. The emergence of the emotional circuits, one stage above those governing motivation, helps fulfill this second set of requirements, as does the development of prefrontal circuitry, designed to modulate motivation and emotion and to extend comprehension of the consequences of action across broad spans of time and place (Oatley & Johnson-Laird, 1987; Oatley, 1999; Peterson, 1999).

Initially, the child's mother provides what is needed, with minimal demands for reciprocation. However, as the child grows, expectations for reciprocity grow. He or she enters a world characterized by long term considerations, and by the

presence of other people, who have goals and feelings of their own. These goals and feelings have to be taken into account, as they manifest themselves in the same environment providing opportunity for the developing child. This means that the child must not only solve the problem of his own instincts and their interactions, but the problem of the instincts of others, in combination with his own. The movement towards such solution appears to be mediated, at least in part, by empathy, and then by play. The child appears intrinsically able to experience the motivations and emotions of others. He or she is capable of affiliative instincts, and is prepared to be a social animal, cooperative and supportive, as well as competitive and agonistic. The development of social understanding appears to take place from the bottom up, in a kind of bootstrapping process. Rough and tumble (R&T) play, mediating and regulating direct physical contact, allows the child to attune his or her body to the embodied presence of others. More abstract forms of play allow for the attuning of motivational states, emotional reactions, and the contents of consciousness, over increasingly large spans of space and time. Role-play and fantasy mediate abstract forms of identification, and consequent extension of empathy to those beyond the immediately familiar. Finally, the adoption of a role, part fiction and part genuine being, comprises the establishment of a functional position within a real-world hierarchy of cooperation and dominance.

Numerous researchers have sketched the developmental effects of childhood play. These include enhanced physical fitness and improved cognitive, emotional and social function (Pellegrini & Smith, 1998). Less attention has been paid to the manner in which play cultivates self-regulation. Play, however, might be regarded as early social cognition: if I can play with you, I can adapt my actions and reactions to yours. I can allow your motivational and emotional states, your reference frame, to modulate mine. I can start to act out your frame, to understand and to embody it. Eventually, perhaps, we can share the same perspective, and use the fact of that sharing to work cooperatively towards a common goal. This means that we can start to share identity, predicated on voluntary compliance with the same set of values, and benefit mutually from the consequent control of aggression – not so much because of inhibition, but because of the alignment of mutual desire. This ability unfolds, over time, in a lengthy developmental process – one that appears to start not so much with the mind, as might be initially predicted, but with the body, in direct, physical contact with the body of others.

Rough and Tumble Play and the Embodied Negotiation of Dominance and Cooperation

Pellis & Iwaniuk (2000, p. 136) state that "species with a greater proportion of their growth occurring postnatally play more and have more complex play than do species with more of their growth occurring prenatally," in keeping with Bruner's (1976) suggestion that the prolonged infancy of humans provides more time for play and more time to develop sophisticated cognitive abilities. Panksepp (1998a) has argued, specifically, that the mammal brain is hard-wired for play – at least for rough and tumble (R&T) play. Juvenile rats will exhibit R&T play, beginning at 17 days of age, even when prevented from engaging in any prior play experiences, and will play more vigorously, if intermittently deprived of the opportunity to do so. These early play impulses appear to manifest themselves only under the appropriate conditions, however. Fear and hunger and associated states of deprivation quickly eliminate play. Young rats must also have a secure home environment, with abundant parental involvement, to play.

R&T play is different from exploratory activity and from aggression – two forms of behavior with which it can easily be confused. R&T play and exploratory activity share the fact that both are enjoyable. Habitual R&T play winners and losers will learn instrumental tasks to gain an opportunity to play, for example, indicating that play episodes are reinforcing, and both will run toward the play arena at equal speeds. (The winners enter confidently, however, while the losers move in more timidly and slowly.) Such enjoyment appears mediated in part by the same dopaminergic incentive reward circuits underlying exploratory behavior, although play also activates widespread release of opiates, especially in those areas characterized by circuits for sexual, maternal and other affiliative behaviors (Panksepp, 1998a). However, DA agonists such as amphetamines invigorate exploratory activity, but markedly reduce play. Finally, formal behavioral analysis clearly discriminates R&T play from genuine aggression. A playful rat chases his partner around in a "flurry of dynamic, carefree rambunctiousness" (Panksepp, 1998a, p. 284), pouncing on him, pinning him, in the consummatory stage of each play episode. Such pinning is clearly a gesture of dominance, but not one that breaks the rules of play. In a real fight, rats box, and prance sideways, postures and gestures accompanied by piloerection. Furthermore, in genuine dominance bouts, the resident animal consistently wins, if the activity occurs in one of the animal's home territory. This is not the case in play fighting (Panksepp, 1998a). Finally, pins during a real battle are more sustained and menacing then they are in playful contexts.

Play fighting and genuine aggression appear as distinguishable within the context of human behavior, as they are among rats. Blurton Jones (1972), for example – taking a cue from Harlow and Harlow's (1965) observations of play fighting in young rhesus monkeys – clearly differentiated R&T play from physical aggression among preschool children. Children involved in a play fight wrestle, grapple, jump, tumble, and run, while laughing and exhibiting facial expression of enjoyment. In play fighting contexts, children spend most of the time in close

proximity, whereas they come together briefly for a genuinely aggressive act, and then pull away, rapidly. Positive emotional expressions are also markedly absent on such an occasion. Despite these relatively subtle differences, children are highly adept at distinguishing playful from aggressive fighting (Smith & Boulton, 1990; Boulton & Smith, 1992), regardless of their culture (Costabile et al., 1991), and play fighting gestures exchanged between experienced children seldomly elicit a hostile response (Boulton, 1991). Children who become skilled at R&T play learn directly what forms of agonistic interaction will be tolerated by others, and carefully and judiciously limit the social expression of their aggression.

Mothers are the first to initiate R&T play cycles with their infants, through tickling bouts and mocked acts of aggression. As motor coordination develops, and children become more active, fathers, who play more robustly, become the play partner of choice (Roopnarine, Hooper, Ahmeduzzaman, & Pollack, 1993). Mother depression and father absence are therefore associated with childhood externalizing behavior problems (Bates, Bayles, Bennett, Ridge, & Brown, 1991; Pagani, Boulerice, Tremblay, & Vitaro, 1997; Patterson, Reid & Dishion, 1992). Depressed mothers are less likely to tickle and play peek-a-boo with their infants (Field, 1998). Older children of single mothers have fewer opportunities to learn to regulate aggressive behavior, since fathers tend to engage in play fighting after the end of the first year. Such children appear awkward when invited to engage in R&T play. Accidentally, or motivated by frustration, they hurt their play partners. The victims respond with rejection. Aggression emerges in response to this rejection (Asher & Coie, 1990; Smith, Hunter, Carvalho, & Costabile, 1992), and a detrimental positive feedback cycle establishes itself.

The broader nature and significance of R&T play, as well as its role as a scaffold for more sophisticated social cognition, may best be revealed within a broader conceptual framework, including both Piagetian and neuropsychological components. As the child develops, he or she experiments, stage by stage, with the construction of small-scale motor patterns, designed to attain small-scale, motivated ends. Piaget (1932, p. 16-18) points out, for example, that in the initial, primary stages of play, a child handles objects at the dictates of his "desires and motor habits." Since "play is purely individual," at this stage, "ritualized schemas" develop – skilled play habits – but no collective patterns, much less rules. The child first plays by him or herself, constructing a repertoire of functional actions, then conceptions, from the bottom up. Swanson (2000, p. 115) describes the physiology underlying the construction of such a functional hierarchy: "the lowest or first level of the locomotor system is formed … by a subset of motoneuron pools in the spinal cord ventral horn that innervates the limb muscles responsible for locomotor behavior. The second major level is referred to as the locomotor pattern generator, which lies entirely within the spinal cord, near the motoneuron pools that it regulates. In fact, it is itself a hierarchy of increasingly complex motor pattern generators that coordinate and time muscle contractions across individual joints, then across multiple joints within a particular limb, and finally amongst all four limbs."

Swanson continues: "a third major level is represented, at least in part, by an ill-defined region of the dorsal tegmentum known as the mesencephalic locomotor region, and rostroventral to this is a fourth major level in an ill-defined region of the caudal hypothalamus/rostral midbrain – the so called subthalamic or hypothalamic locomotor region." This hypothalamic locomotor region, a "locomotor pattern controller," (p. 116) which generates downward outputs to the spinal locomotor pattern generator, is the next control system to develop, as the individual constructs increasingly complex hierarchies of motor behavior. It is of interest to note, in this regard, (1) that tactile stimulation during infancy – an important aspect of R&T play, and one linked to it through the specialized skin receptors involved in such play (Panksepp, 1998a) – has an important organizing and stabilizing effect on different brain structures, including the HPA axis (Lande, Scarr, & Gunzenhauser, 1989; Meaney et al., 1988) and (2) that that children with chronic aggression problems are frequently characterized by dysregulated hypothalamic-pituitary-adrenal (HPA) activity (McBurnett, Lahey, Rathouz, & Loeber, 2000; van Goozen, Matthys, Cohen-Kettenis, Thijssen, & van Engeland, 1998). Traumatic experience during infancy can apparently cause permanent alterations to the HPA axis, by detrimentally affecting steroid receptor function in the hippocampus and the prefrontal cortex.

Piaget's emphasis on embodiment and procedural knowledge, given physiological grounding by Swanson, is particularly clear in his description of the earliest play stages. Before there are stateable rules, there are behavioral patterns. These emerge first under the control of internal motivation, and then as a consequence of social interaction. As the child progresses towards Piaget's second stage – the first point at which the social world has any major impact – more complex understanding emerges. First, the child starts to copy himself, using procedure to map procedure, at the initial but still embodied stage of genuine representation. He experiments, initially, using trial and error to attain his goals. Any successful action is immediately imitated and practiced. In this manner, the child builds a repertoire of voluntarily accessible and automatized motor schema (Piaget, 1932). The imitative process then extends itself to interpersonal action, so that the child becomes capable of imitating others. It should be noted, however, that even at this second, imitative stage, the child is still not genuinely *playing* with others. He or she engages in socially-constructed and possibly sanctioned means of playing, but is neither trying to win, nor attempting to unify the various modes of playing individually developed or imitated. Nonetheless, at this stage, patterned social interactions can emerge, spontaneously, as a consequence of the interaction of motivated and emotionally-driven participants, who are constantly exchanging information about which actions and reactions are acceptable. Although such primary social interaction may look "rule-governed" to an observer, because of its regularity, it is still instantiated at a purely procedural, implicit level.

It is possible, nonetheless, to see the emergence of a *procedural morality* at this level. Panksepp (1998a) describes the manner in which rats learn to govern their pinning behavior: Stable patterns of play dominance, corresponding to the establishment of complex, socially-modified motor behaviors, rapidly emerge

during R&T play. One rat ends up on top more often during pinning, in repeatedly matched play pairs. However, if the dominant rat pins its playmate more than 70% of the time, then the subordinate, who typically initiates the play sequence, begins to ignore the victor, and playful activity gradually diminishes (Panksepp, 1998a). This means that the dominant rat must learn to respond carefully to the behavioral cues of the subordinate. If the subordinate breaks the shared play frame by escaping, or biting, as a consequence of undue frustration or anxiety, then its value as a playmate decreases. Whether this is morality, or merely conditioning, is beside the point. Such modulation still constitutes the beginning of social behavior, laying the basis for the development of the higher-order morality that keeps aggression properly regulated.

The child is alone, at the first stage of play, constructing the basic elements of motor competence – grasping, letting go, extending and contracting limbs – adapting himself to his or her own motivations and their interactions, in an increasingly complex world of objects. Then he or she starts to combine those actions, sequencing multiple motivated patterns of action, under the guidance of higher-order control systems. His isolated manner of being takes on a social aspect, with the onset of R&T play, and he begins to establish socially-modulated behavioral patterns. R&T play, in turn, shades into dramatic play, laid down in its most fundamental aspects over the sensorimotor substructure constructed first by the individual and then modified by R&T play. As play becomes increasingly dramatic, increasingly abstract, the substructure for the highest stages of social cognition begins to establish itself.

Abstract Play and the Cooperative Establishment of Joint Fictional Worlds

During R&T play, children use their bodies in playful dominance interactions, modifying and constructing motor schemas that take the other's qualities into account, learning to control anxiety, frustration and the thrill of victory. Some of this control is best understood as inhibition. Whalen & Henker (1991) reported, for example, that theories of impaired behavioral control appeared more relevant to understanding the interpersonal problems of young ADHD children than theories of impaired social cognition. Hughes, White, Sharpen & Dunn (2000) noted that conduct disorder in four-year-olds was associated with problems in executive function (associated with inhibitory control), but not with problems in performance on higher-order theory of mind tasks. Séguin, Zelazo & Tremblay (1999) associated physical aggression among preschoolers with deficits in self-regulatory cognitive skills, while Séguin et al. (1995) associated aggression among older children with impaired executive or prefrontal function. However, theories of inhibition appear insufficient to account for more complex forms of aggression regulation, because they do not take into account the emergence of cooperative behaviours and conceptions, designed to maximize the utility of social being. These are better understood, perhaps, as sophisticated alternatives to aggression, instead of mechanisms that inhibit, govern or regulate aggression. To cooperate means to establish a mode of occupying the same space as other individuals, in a manner that makes aggression positively counterproductive. The groundwork for this ability appears to be scaffolded at the sensorimotor level –

mediated, perhaps, by R&T play – but the ability itself is something different: something more akin to the understanding of narrative, drama and fiction; something more like the development of explicit theory of mind.

Higher-order, more explicit, cooperative morality appears to emerge around Piaget's (1932) third developmental stage, appearing around age 7. At this stage, each child playing a given game starts to try to win – tries to dominate the narrow hierarchy of achievement specified by the rules of the game. At first glance, this appears as something essentially competitive. However, for individual victory to occur, the modes of playing between children have to be unified, so that all players share the same goal. This means that any disagreements about the game have to be resolved, and that aggression emerging as a consequence of those disagreements must be rendered unnecessary, before any attempt to play, let alone win, can begin. Piaget notes that even this more complex form of play appears to emerge procedurally, rather than explicitly. Within the confines of a given group game, where each child can check him or herself against the behavior of the others, conflict-free stable patterned playing quickly emerges. However, if the playing children are separated, and interviewed individually, they give disparate or even contradictory accounts of the emergent game's formal "rules." At the third stage, children are just beginning to map the contours of their structured social behavior into truly representational linguistic patterns. They still need the information provided by the presence of the others to maintain adherence to the predictable pattern of the game.

Once a joint social ritual or game is firmly established, however, its nature, as a regular occurrence, can be explicitly described and codified. As a consequence of emerging cognitive ability, and because the child can test his explicit verbalizable hypotheses against those of others, the patterns that actually constitute the game and the explicit description of the game come into alignment. At this point, the child has successfully "mapped" his own socially-modified sensorimotor output, and becomes a conscious player (Piaget, 1932). This convergence means that children playing the same game come to inhabit the same, fantasy-predicated, fictional or dramatic world. It is the ability to establish such joint, fictional habitation – more than alignment of motor patterning, more than inhibition of aggressive responding – that constitutes cooperation, and that allows for the modulation of motivation and emotion, towards some shared end. In a good game, everyone has fun. There is no need to be defensive. There are many opportunities for joint gain. In consequence, there is little need for violence.

To understand the organization characterizing complex social play, it is important to note that innate motivational systems are not simple deterministic systems of drive. Nor do these systems merely set goals, although they do that as well (Swanson, 2000). Instead, states of motivation serve as axioms or predicates of experience, providing a delimited, bounded but flexible frame for perception, emotion, cognition and action (Barsalou, 1983; Peterson & Flanders, 2002). With the establishment of such a frame, the more sophisticated goal-oriented individual can strive towards necessary goals in multiple, non-reflexive manners, instead of mindlessly heading in a single, familiar but potentially

counterproductive direction. These frames appear governed by low-level brain circuitry, primarily within the hypothalamus, but also depend upon the extended processing resources of the limbic system and cortex.

Motivationally bounded states or frames are manifold in number, as there are qualitatively different states of motivation (Rolls, 1999; Swanson, 2000), and they manifest themselves singly and sequentially, as processes of perception, emotion, cognition and action must be directed towards specified, limited targets (Miller, 1956; Cowan, in press). Each frame appears to contain particularized conceptualizations of the current state of affairs, as well as the desired end (Peterson, 1999; Peterson & Flanders, 2002). The individual or individuals operating within the confines of a given story move from present to future, in a linear track. Two points define such a track, or line. A present position cannot be defined, without a point of future contrast. Likewise, a potential future cannot be evaluated – judged affectively as better – except in terms of a present position. A verbal description of such a conceptualization can be regarded as the most basic form of fiction – drama, narrative and, not infrequently, game (Peterson, 1999).

The construction of a fiction-like frame, simplified by the momentary domination of a single motivational state, helps specify what ends action should pursue, and what phenomena might be considered as objects in that pursuit (Hacking, 1999; Lakoff, 1987; Tranel, Logan, Frank & Damasio, 1997; Wittgenstein, 1968). The immature individual or child, pursuing his or her purely individual goals, acts and perceives in a solipsistic world, established in accordance with those goals. As the developing individual becomes more complex, however, control over the contents of the goal-framework starts to become more differentiated, so that although fundamental underlying motivational states still have access to it (in cases of mounting hunger or thirst, etc.), so do emergent systems of even more complex control. The hippocampus, for example, allows for determination by context or situation (LeDoux, 1996) and the orbitofrontal prefrontal cortex allows previously unvalued goals to attain the status of true value (Krawczyk, 2002). The dorsolateral prefrontal cortex, finally, allows complex, abstracted frameworks to govern behaviour, removing the developing individual from the incessant short-term demands of basic motivational states (Pochon, Levy, Fossati, Lehericy, Poline, Pillon, Le Bihan & Dubois, 2002). This sequentially emergent access by higher-order systems to motivational framing allows the individual to formulate goals that take multiple states of motivation and the vagaries of external context into account. This "external context" also constitutes social being: the fact of motivated others, singly and in groups, who are also rank-ordering their values hierarchically, and implementing their motivational worlds, while constantly exchanging motivational and emotional information with one another.

The individual construction of a motivationally-predicated frame or story allows an individual to specify starting place, goal, objects of perception, and implication for emotion, and to therefore deal with those bits of the world relevant to a particular need or desire. The joint construction of such a frame, such a story, integrates perception across individuals, placing them in the same

world of objects, at the same time it places their emotions in alignment. This allows more than one individual to inhabit the same experiential goal-directed space, and to thereby cooperate, voluntarily, to reach the goal and to maintain the integrity of the space. This is the process by which fundamental agreements, nullifying the very necessity of aggression (rather than merely inhibiting its expression), come into being.

The specific circuitry mediating the establishment of such agreement has been recently outlined, provisionally, at the prefrontal cortical level. Rizzolatti, Fogassi and Gallese (2001) describe a localized class of visuomotor neurons comprising the "mirror neuron system." First described in monkeys, mirror neurons are located in area F5 of the ventral premotor cortex. This area contains neurons that code "goal-related" motor acts, such as grasping by hand and by mouth. Rizzolatti et al. (2001) state, with regards to these neurons: "some of these cells are motor neurons, others also respond to visual stimuli. Some of them are activated by the presentation of three dimensional objects, whereas others – mirror neurons – require action observation for their activation" (p. 661). Mirror neurons, part of the system that uses motor output patterning as part of what occurs during an act of "perception," have a number of remarkable properties. First, they do not respond to the presence of a motivationally significant object (say, an apple) in isolation. Nor do they respond to the sight of a conspecific engaged in a context-independent action (making a grasping action). But they do respond to the sight of a conspecific making a grasping action in the presence of a motivationally significant object. More to the point, their pattern of action when observing such a motivated sequence precisely matches their pattern of action when that sequence is undertaken by the observer. Rizzolatti et al. (2001, p. 662) note that this neural "congruence is sometimes extremely strict. In such cases, the effective motor action and the effective observed action coincide both in terms of goal (for example, grasping) and in terms of how the goal is achieved (for example, precision grip)." In other cases, however, the congruence is broader, matched more to the broad goal of the action. The action of these less specific neurons is of even greater interest, because their broader response pattern is not a sign of inaccuracy, but of increased sophistication: they are capable of "imitating" more approximate patterns of motor output – those that "generalize the goal of the observed action across many instances of it…. [T]he novelty of these findings is the fact that, for the first time, a neural mechanism that allows a direct matching between the visual description of an action and its execution has been identified. Such a matching system constitutes a parsimonious solution to the problem of translating the results of the visual analysis of an observed action… into an account that the individual is able to understand" (p. 662).

This understanding appears complete and comprehensive, stretching from the abstract, through the emotional, to the physical. The motor system underlying mirroring accepts neural inputs from systems governing sensation, cognition, and circadian state, and has three primary divisions of output: somatic, endocrine, and neuroendocrine (Swanson, 2000). Descending control systems from higher-order, "limbic" structures such as the amygdala governing affective response

have also been well described (LeDoux, 1996). Furthermore, area F5, which contains the mirror neurons, shares connectivity to inferior parietal lobe with area "a" of the superior temporal sulcus – a brain area that is part of a circuit including the amygdala and orbitofrontal cortex (Amaral et al., 1992). This combination of facts implies that the matching described by Rizzolatti extends past action patterns, to the associated emotional, motivational, cognitive and neuroendocrine consequences and concomitants of those action patterns. To understand someone therefore begins to appear more and more like walking a mile in his or her skin, rather than in his or her shoes.

Such a hypothesis appears even more compelling, once careful attention is paid to the additional neuroanatomical and functional significance of area F5, the monkey homologue of Broca's area in humans – the prefrontal area governing voluntary speech. This anatomical equivalence suggests that the primary purpose of verbal communication could well be the exchange of motivated patterns of action, instead of the description of the objective world (Peterson, 1999). Furthermore, it appears to be the association between the mirror neuron system and speech that allows verbal communication to take on its embodied, imitation-provoking meaning. These ideas are very important with regards to understanding and considering the importance of dramatic social play and associated forms of narrative. Imagine that the developmental elaboration of the mirror neuron system allows a maturing child to embody the action and motivational states of those he observes first, directly, with more or less faithful and precise mimicry. Then imagine that the inter-relationship between the linguistic abilities of Broca's area and the mirror neuron circuitry allow communicating children to verbally instantiate shared motivated or goal-oriented states, not at the level of precise imitation, but at a higher, generalized state. This means that cooperating and communicating children, engaging in pretend play, can jointly establish fictional worlds and then coordinate their motivations, their actions, their emotions – their very object-perceptions – within those worlds. Finally, imagine that this process of coordination within the confines of a fictional world constitutes the process of scaffolding that underlies (1) the understanding of narrative and fiction, in their verbal forms; (2) the capacity to engage in large-scale, cooperative social enterprises (which have a pronounced fiction-like aspect, prior to their manifestation as "completed projects" within the world) and (3) the ability to engage in understanding abstract and even more disembodied semantic thought. A plan, after all – including a shared plan – is nothing but the projection of a compelling fiction onto extant and agreed upon objects and contexts. The joint establishment of such a plan, motivationally significant to all, emotionally gripping, eliminates the very necessity for conflict.

Sophisticated mother-child conversations about emotions appear to lay the groundwork for children's discussions of affective states and the emergence of ability to adopt the perspective of another (reviewed briefly in Oppenheim, Nir, Warren & Emde, 1997). Oppenheim et al. (1997) have demonstrated, as well, that preschool children able to engage in less emotionally disrupted and more coherent pretend play representations of a hypothetical parent-child separation event with their mothers were also able to produce sentence-stem completion

narratives that were more prosocial, less aggressive and more coherent, and were rated by their mothers as characterized by fewer behavior problems concurrently and one year later. Wolf (1990) has suggested, likewise, that the development of narrative ability increases children's ability to view interpersonal situations from multiple perspectives, including those of their potential selves (their individual selves, in a different motivational state) and those of others. Hughes & Dunn (1997) provide direct support for the notion of social collaboration in pretend play, by (1) noting a strong positive relationship between mental state talk and turn-taking and (2) noting that the relationship between mental state talk on the part of one child is as strongly affected by mental state talk on the part of his or her partner as it is by individual variability in verbal ability. Seja and Russell (1999) have demonstrated, similarly, that fantasy play ability is significantly related to emotional understanding, over and above individual variation in verbal ability, while Taylor & Carlson (1997) have demonstrated that children whose fantasy and pretend play abilities was more sophisticated also did better on theory of mind tasks, independently of their verbal intelligence. Finally, Hughes & Dunn (1997) note that theory of mind task performance is positively associated with references to mental state, independently of age.

Brown, Donelan-McCall & Dunn (1996, p. 847) note, in this regard, that the maintenance of interactive games and the construction of fantasy worlds "must surely provide multiple opportunities for the fledgling theorist to appreciate the workings of the mind" (from Hughes and Dunn, 1997). Eckler & Weininger (1989) have paid particular attention to the elaboration of such pretence worlds, pointing out that younger children tend towards "pre-episodic" and older children toward "episodic play," which is very much dramatic and story-like. Furthermore, these authors also clearly distinguish two aspects of pretense, "setting-up" and "play" – processes that appear to correspond very much to the establishment of a shared frame and action within that frame, respectively. Children setting up a pretend play episode appear to be constructing a joint fictional frame, a delimited subsection of the "real world," too complex to fully model. This delimited subsection has a consummatory element, which is the complex goal of the fictional world (Rumelhart, 1977), and also contains shared objects of perception – objects which, in the case of pretense, may not even be there (as a child is perfectly capable of acting "as if" something is there, and "as if" an object that is there is in fact something else). Children who are "setting up" a play episode therefore appear not only to be negotiating the nature of the actions that will occur in that space, but mutually regulating each other's perception (as suggested previously). Pretend play thus logically appears associated with talk about mental state (that is, talk directed at establishing or inquiring about a subjective state of being, i.e., "I mean," or "you think") at rates much higher than chance (Hughes & Dunn, 1997) and, more specifically, with mental state talk directed at another's inferred mental state, desired (that is, directed) or actual.

Children with autism, characterized by fundamental deficits in the substructural elements of social cognition, also fail to use social gaze, which serves to specify the target of joint motivation and perception, in empathy and joint attention

tasks (Charman, Swettenham, Baron-Cohen, Cox, Baird & Drew, 1997). This observation adds to the knowledge base already established demonstrating similar impairments among such children in empathy, pretend play and joint attention (reviewed briefly in Charman et al., 1997; Baron-Cohen, Allen & Gillberg, 1992). The gaze dysfunction is particularly interesting, given that gaze monitoring constitutes a procedural technique for determining intent, or goal-orientation, on the part of another, and is clearly part of the social-cognitive system that enables human beings to establish shared goal-oriented conceptual frames and associated behaviors and emotions (Adolphs, 2001; Hobson, 1990). Autistic children also appear delayed, if not fundamentally impaired, in imitation (Charman et al., 1997).

The fact that individuals who have sustained left or right prefrontal damage in adulthood appear impaired on theory of mind tasks, even when their deficits on classic executive cognitive tests have been controlled statistically, may also be relevant to understanding the emergent neuropsychological control over shared motivation (Rowe, Bullock, Polkey & Morris, 2001), and helps elucidate, physiologically, the distinction between pure inhibition of aggression and voluntary cooperation. Similar patterns of deficits appear to characterize non-Alzheimer's frontal variant frontotemporal dementia, which may be characterized by emergent suspiciousness, dysregulation of formerly socialized behavior, and antisociality (Lough & Hodges, 2002; Lough, Gregory & Hodges, 2001). In the latter case, emergent antisociality appears associated specifically with a breakdown of social cognition, but not classic executive function (Lough et al., 2001), perhaps as a consequence of deterioration in orbitofrontal/ ventromedial circuitry, which appears specifically activated during social cooperation (McCabe, Houser, Ryan, Smith and Trouard, 2001; Rilling, Gutman, Zeh, Pagnoni, Berns & Kilts, 2002).

Dunn & Hughes (2001) demonstrated a clear distinction between hard-to-manage children and normal children with regards to violent fantasy play, with a clearly higher proportion of the former group, both boys and girls, consistently engaging in pretend games that involved killing, fighting or beating, despite the fact that no overall difference in frequency of pretend play as such emerged. Such interest in violent fantasy was itself related to poor executive control and language ability, impaired theory of mind (related as well to language ability), frequent antisocial behavior, displays of anger and refusal to help a friend, poor communication and coordination of play, more conflict within friendships, and decreases in empathetic moral sensibility two years later. Hughes, Cutting and Dunn (2001) then attempted to determine if conduct-disordered children were more likely to respond negatively to the threat of losing a game because (1) they were preoccupied with aggression, in general, as indexed by violent themes in their pretend play, (2) they were delayed or deviant with regards to reading the intentions of others (potentially manifesting a hostile attribution bias) or (3) were characterized by a problem with executive function, resulting in difficulties inhibiting inappropriate behaviors. Age four violent pretend play theme frequency, theory of mind performance, and executive function all appeared significantly associated with negative behavior to threat of loss at age five at the

zero-order correlation level of analysis, and all appeared of significant or near-significant statistical import when entered simultaneously in a regression analysis. The picture of multidimensional causality portrayed by this study was marred somewhat in its clarity by the results of longer term follow-up: by age seven, only age-4 violent pretend play theme measure remained as a significant predictor (accounting for 25% of the variance). Nonetheless, there is suggestive evidence that many different forms of regulation of aggression exist, at very different levels of neurological instantiation.

Perhaps the effects of various pathologies, heightening the probability of aggression, might be additive, or even interactive: particularly aggressive children might lack basic inhibition (perhaps first instantiated as a consequence of R&T play, governing motor output in the presence of others), might be impaired with regards to theory of mind and capacity to cooperate and, finally, as Crick and Dodge (1996) and Happe and Frith (1996) have suggested, might actively infer hostile intent on the part of others necessitating revenge, thus rendering even their limited capacity for social understanding counterproductive. Jenkins & Greenbaum (1999) have argued, in this regard, that disruptive children develop an overt "adversarial goal structure" that leads to frequent anger and aggression. Such a structure could be a generalized hypothesis such as "cooperation is impossible," a theme that makes antisociality more or less logically inevitable, or "individual victory trumps cooperative action," a theme logically associated with narcissism, which is characterized by high levels of extraversion (social dominance striving) and low levels of agreeableness (warmth, empathy). Rose & Asher (1999) have also noted that children who pursue the explicit goal of revenge towards a friend consequent to conflict within a friendship were (1) more likely to use aggressive strategies, such as self-interest assertion, and hostility (2) less likely to use prosocial strategies, such as relationship maintenance and accommodation-compromise (3) more likely to lack friends and (4) more likely to have poor quality friendships.

It is interesting to note in this regard first that over the long term, strike back once, then forgive and forget strategies are much more likely to win iterative repetitive tit-for-tat cooperative exchange games such as Prisoner's Dilemma than are any other strategies (Wedekind & Milinski, 1996) and second that the combination of yoked goal-and-strategy implementation sounds very much like a social game (not least because of the emergence of constant reciprocity). It is also very relevant with regards to the potential developmental origins of an essentially adversarial game that maltreated children are more likely than their non-maltreated peers to develop more negative and constricted and less coherent narrative or story-like representations of their caregivers, and that these more negative representations, while potentially accurate in the circumstances in which they emerged, generalize poorly, and are associated with emotion dysregulation, aggression and peer rejection. Positive and coherent representations of caregivers, by contrast, are related both to prosocial behavior and to preference by peers (Shields, Ryan and Cicchetti, 2001). Maltreated children appear to see the social surround as "angry, malevolent, punitive, exploitative, and conflictual" (reviewed briefly in Shields et al., 2001). It is

particularly interesting, therefore, to note that R&T play initiated with popular, pro-social young school age children generally turns into play-with-rules, or more advanced pretend play, while such play initiated with aggressive children, degenerates rapidly into violence (Pellegrini & Smith, 1998). Given the aggressive child's vengeful and mistrustful view of the world, it is not unreasonable to suppose that exploratory R&T play forays on the part of one child with regard to another for assessment of the basic social strategies employed – or not employed – by that. Finally it is useful to note that violent video game play – a form of scaffolded pretend play that highlights themes of revenge and destruction – does in fact appear causally associated with aggressive behavior, thoughts and feelings, and with a decrease in prosociality (Bushman & Anderson, 2002).

Kochanska and colleagues (Murray & Kochanska, 2002) have recently developed a statistically coherent and longitudinally stable battery of "effortful control tasks," which include capacity to delay gratification and to voluntarily suppress or initiate actions – performance on which can be assessed as early as 2.5 years – and showed some relationship between lesser performance on this task battery and aspects of conduct disordered behavior such as impaired attentional control. Forman & Kochanska (2001) have also demonstrated that children who were more imitative and responsive during pretend-play sequences modeled by mothers were also more positively responsive to maternal control and less likely to manifest noncompliance in a typical discipline context. This appears to mean that children who are more capable of adopting a shared frame of reference in a play-like context are also those who are more willing to "play the right game" when attention is called to their transgressions or rule-breaking behaviors. Stipek, Recchia and McClintic (1992) note, in this regard, that young children do not really distinguish between teaching and disciplinary contexts, reacting with pride to doing well and with shame to doing badly in both contexts. Kochanska, Aksan & Koenig (1995) and Kochanska, Tjebkes & Forman (1998) have therefore proposed the concept of committed compliance, something opposite to that of "the adversarial goal structure," distinguished from externally-imposed obedience by its "enthusiastic and self-sustaining quality, unmediated by ongoing parental control" (Forman & Kochanska, 2001, p. 199), and described further as "visible embracing of the parent's agenda" and as "a behavioral tendency consistent across situations… shown by the child's continued restraint when the [parent] is no longer present". This sounds very much like the adoption of a shared motivational frame of reference or micro-world, constructed on the basis of true social cooperation, and not merely the inhibition of aggression.

Conclusion

First, it is clear that both Hobbes and Rousseau were correct. The individual brings to the world a set of inborn motivations, including those that underlie aggression, and these motivations are brought under control – or not – as a consequence of socialization. This control appears at least two-fold. The direct inhibition and regulation of aggression appears established as a consequence of R&T pay, and appears associated in principle with the development of some forms of executive control. The formal adoption of a prosocial stance on the world, by contrast, mediated by emergent trust in the trustworthiness of self and other, culminates not so much in the capacity to obey rules and to stay on track (associated perhaps with inhibitory and executive control) but in willingness to voluntarily enter into complex, cooperative social games with others (mediated by shared, goal-directed frames of reference) (Peterson, 1999; Peterson & Flanders, 2002). However, the tendency towards the social good seems as predicated on innate capability and interest – on inborn empathy – as the tendency towards aggression. There is therefore no shortage of evidence for innate human good, and much suggestion that it is in fact even reasonably considered the norm. Furthermore, it is clear that pathological socialization experiences, first in the context of the family and second in the context of early peer experiences – that is, a variant of the institutional sickness described by Rousseau – can produce and then reinforce in a child the conviction that the world is a cruel and sadistic place, fit only for interpretation through lenses colored by the desire for revenge.

Next, it is clear that complex processes of play, beginning with R&T play and culminating in the production of sophisticated, abstract socially-shared frames of reference, play an important role in the modulation of aggression, both with regards to its inhibition, and with regards to its integration into fully functional individual and social identities. The first problem that life presents, so to speak, is the necessity of satisfying basic motivational states. The next, emergent problem is the necessity to construct and integrate techniques designed to satisfy these motivational states across different states, across different time-frames and in a wide variety of contexts. Given the intensely social nature of the natural human environment, this problem of integration must eventually expand to include the other, the motivated other.

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