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HOW THE SOCIAL ENVIRONMENT SHAPED THE EVOLUTION OF MIND

ABSTRACT. Dominance hierarchies are ubiquitous in the societies of human and non-human animals. Evidence from comparative, developmental, and cognitive psychological investigations is presented that show how social dominance hierarchies shaped the evolution of the human mind, and hence, human social institutions. It is argued that the pressures that arise from living in hierarchical social groups laid a foundation of fundamental concepts and cognitive strategies that are crucial to surviving in social dominance hierarchies. These include recognizing and reasoning transitively about dominance relations, fast-track learning of social norms (permissions, prohibitions, and obligations), detecting violations of social norms (cheating), monitoring reciprocal obligations, and reading the intentions of others.

1. INTRODUCTION

The problem of social coordination is one that any social species must solve. Dominance hierarchies are the simplest and, by their very definition, least equitable solution. In functional terms, dominance means that certain individuals have priority of access to resources in competitive situations (Clutton-Brock and Harvey 1976). In human socio-economic and socio political systems, instances of dominance hierarchies include monopolies, monarchies, social stratification, caste and class systems, sexism, and racism. In each case, social, political, and economic power falls disproportionately into the hands of some members of a society at the expense of others.

Inequitable distribution of resources leads inevitably to social strife and disharmony. Various attempts have been made throughout history to redistribute wealth and power (e.g., the Bolshevik Revolution, the Magna Carta, legal codes, graduated tax laws, and even affirmative action) with varying degrees of success. This striving for dominance and power plays itself out not just in the global arena, but in everyday human relationships as well, creating strife and conflict between parent and child, wife and husband, colleagues, siblings, and friends.

It would be easy to dismiss dominance (and the conflict it produces) in our social relationships and socio-political institutions as the inevitable

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outcome of mixing individual differences with conflicts of interest. But the ubiquity of this characteristic on local and global levels suggests otherwise. It suggests instead that dominance as a social reasoning strategy has its fundamental roots in our cognitive architecture. Our social interactions and institutions are shot through with dominance and the striving against dominance because *social dominance hierarchies constituted a crucible in which cognitive and emotional functions were forged*. These functions include (but are not restricted to) a (sometimes regrettable) tendency to conform and obey, and a (sometimes Machiavellian) capacity to forecast the feelings, thoughts, plans, and actions of others.

In this paper, I will endeavor to demonstrate how social dominance hierarchies shaped the evolution of the human mind, and, consequently, human societies. I will show how survival pressures exerted by living with conspecifics shaped a cognitive architecture imbued with the primitive deontic concepts of permission, prohibition, and obligation, the capacity for violation (cheater) detection, and the capacity for hierarchically embedded mental representations that enable outwitting and evasion of dominance and social strictures through the use of deception and cooperative effort.

2. HOW NATURAL SELECTION WORKS

The cornerstone of evolutionary theory is natural selection, a theoretical mechanism that works in the following way: Variation exists in the traits of the members of most species, and some of this variation is heritable. Because of their particular heritable attributes, some individuals will be better able to cope with survival pressures than others within the same environmental niche. These individuals will survive better or longer and hence leave more living offspring than others in their species. The differential reproductive success of individuals based on their genetic differences is called *natural selection*. The outcome of this process is that *organisms will evolve behavioral or other traits that promote individual reproductive success within a particular environmental niche*, which is defined in terms of *the number of one's offspring that live to reproduce themselves.* From an evolutionary standpoint, therefore, the fundamental problem that an organism must solve is *maximizing reproductive success*.

In most species, there is a direct relationship between dominance rank and reproductive success, with higher ranking members being less likely to die of predation or starvation (Cheney and Seyfarth 1990, 33–4), and more likely to leave living offspring (e.g., Bertram 1976; Bygott et al. 1979; Dewsbury 1982; Clutton-Brock 1988; Ellis 1995; Fedigan 1983; Hausfater 1975; McCann 1981; Nishida 1983; Robinson 1982; Silk 1987; Tutin

1979; de Waal 1982; Watts and Stokes 1971). Among species in which dominance rank is unstable, the level of reproductive success achieved by any individual is directly related to the length of time during which the individual is high ranking (Altmann et al. 1996). Maximizing reproductive success, therefore, is intimately connected to maximizing one's rank.

3. COGNITION IN NONHUMAN PRIMATES

Higher rank is not a simple matter of greater size. *Dominance rank does not correlate with size in many species* (Smuts 1985; Walters and Seyfarth 1987). Instead, the evidence from primatology indicates that attaining and maintaining a high-ranking position in a primate dominance hierarchy depends on a collection of *cognitive* traits. These include:

- Recognizing dominance relations
- Fast track learning of social norms (i.e., permissions, prohibitions)
- Detecting violations of social norms (cheaters)
- Monitoring reciprocal obligations
- Reading the intentions of others.

3.1. *Dominance, Social Norms, and Violation Detection*

To appreciate why these cognitive traits are crucial, one must first appreciate that, from a cognitive standpoint, a dominance hierarchy is a set of implicit *social norms*. Social norms are prescriptive rules: They are rules (implicit or explicit) that dictate which behaviors are *permitted*, *obligated*, or *prohibited*. In dominance hierarchies, these social norms are reflected in virtually every activity, including who is allowed to sit next to, play with, share food with, groom, or mate with whom (Hall 1964; Aruguete 1994). In order to avoid conflict in a social dominance hierarchy, individuals must quickly learn *what is permitted and what is forbidden them given their rank*.

Flouting these implicit social norms can have dire consequences. Indeed, Hall (1964) designated perceived violations of the "social code" as the single most common cause of aggression in primate groups. Dominant individuals typically take on the role of protecting this implicit "social code", aggressing against those who violate social norms and breaking up disputes between lower-ranking individuals (see, e.g., Boehm 1992). For example, high-ranking individuals often punish violations of social norms as benign as grooming or sharing food with forbidden individuals (de Waal 1992, 246–9). In order to preserve the social code, members of a

dominance hierarchy must be capable of *detecting violations of the social code*. In other words, one must have the cognitive wherewithal to recognize when someone is violating a social norm. This is particularly true if one is to maintain a high-ranking position since violation detection is crucial to ensuring that one maintains priority of access to resources (particularly reproductive resources).

3.2. *Dominance Status and Reciprocal Obligations*

High-ranking positions are acquired and defended through the formation of alliances, alliances that are based on reciprocal obligations (Chapais 1988 and 1992; Datta 1983a-b; Goodall 1986; Harcourt 1988; Harcourt and Stewart 1987; Harcourt and de Waal 1992; Riss and Goodall 1977; Seyfarth and Cheney 1984; Smuts 1985; Uehara et al. 1994; de Waal 1989; 1992). During contests of rank, individuals typically call for help, and *non-kin allies are most likely to supply that help if the individual in question has groomed them, shared food with them, or assisted them in agonistic encounters in the past* (Chapais 1992; Cheney and Seyfarth 1990, 67–9; Prud'Homme and Chapais 1993; Seyfarth 1976; Seyfarth and Cheney 1984). These are reciprocal relationships in that the rate of intervention by individual A on behalf of B is proportional to the rate of intervention of B on behalf of A (de Waal 1989; 1992). Furthermore, there is a preference for forming alliances with high-ranking individuals, and high-ranking individuals (given the greater potential benefits that derive from their interventions) need not reciprocate as often as subordinates in order to maintain an alliance (Chapais 1992; Cheney 1983; Prud'Homme and Chapais 1993).

3.3. *Dominance Striving and the Problem of Other Minds*

So far, we've seen that living within a social dominance hierarchy requires recognizing what is permitted and forbidden given one's rank, staying out of trouble by conforming to social norms, forming strategic alliances based on reciprocal obligations in order to improve and maintain one's rank, and maintaining social harmony and priority of access to resources by detecting and reacting to violations of social norms. These cognitive functions produce dynamic societies in which there is a good deal of jockeying for position, fission and fusion of coalitions and alliances, competition and cooperative effort for mutual benefit. But among primates, at any rate, the complexity of social life doesn't end there because low-ranking individuals use deception to improve their access to resources (Byrne 1995; Mitchell 1986; Whiten and Byrne 1988). For example, they conceal objects or behaviors from others by hiding them from view, acting quietly so as not

to attract attention, avoiding looking at a desirable object themselves, or distracting attention away from the desired object or forbidden behaviors. For example:

> The unit was resting. An adult female (Hamadryas baboon) spent twenty minutes in gradually shifting in a seating position over a distance of about 2 metres to a place behind a rock about 50 cm high where she began to groom a subadult follower of the unit – an interaction not tolerated by the adult male. As I was observing from a cliff slightly above the unit, I could judge that the adult male leader could, from his resting position, see the tail, back and crown of the female's head, but not her front, arms and face; the subadult male sat in a bent position while being groomed and was also invisible to the leader. (Observed by Kummer, reported by Whiten and Byrne 1988)

> Often a low-ranking male (chimpanzee) will sit with his upper arm resting on his knee and his hand loosely hanging down so that a female in front of him can see his erect penis, but apes on the side cannot see it. This inconspicuous form of concealment occurs together with quick glances at dominant males. Needless to say, the subordinate always uses the hand on the body side which is tuned towards the dominants. (Observed by de Waal, reported by Whiten and Byrne 1988.)

> One day, some time after the group (of chimpanzees) had been fed, Figan suddenly spotted a banana that had been overlooked – but Goliath was resting directly underneath it. After no more than a quick glance from the fruit to Goliath, Figan moved away and sat on the other side of the tent so that he could no longer see the fruit. Fifteen minutes later, when Goliath got up and left, Figan, without a moment's hesitation, went over and collected the banana. (Observed by Goodall, reported by Whiten and Byrne 1988.)

> S (gorilla) looks up into Hypericum tree and spies a nearly obscured clump of Lanranthus vine. Without looking at those behind her, she sits down by the side of the trail and begins to intently self-groom until the others have passed her and all are out of sight some 15 foot [sic] ahead. Only then did S stop 'selfgrooming' to rapidly climb into the tree, break off the vine clump and descend with it to the trail to hastily feed on it before running to catch up with the group. (Observed by Fossey, reported by White and Byrne 1988).

As is apparent, most of these deceptions allow lower-ranking individuals to flout social norms without getting caught. This can have enormous beneficial consequences for the deceiver. Through deception, subordinates garner a larger share of resources through deception, and form alliances with forbidden individuals through surreptitious food sharing or grooming, alliances that can be called upon during contests of rank. More importantly, deception can be used to improve one's access to reproductive opportunities, and hence, reproductive success. Gagneux et al. (1997) report that over 50% of the offspring born to female chimpanzees in their study group were fathered by males from *other troops*. The females in question had surreptitiously disappeared around the times of their estrus and reappeared a few days later. During these times, they had apparently engaged in clandestine matings. Not surprisingly, then, dominants are ever vigilant to potential deceptions, and develop strategies for counteracting them:

One chimp was alone in the feeding area and was going to be fed bananas. A metal box was opened from a distance. Just at the moment when the box was opened, another chimp approached at the border of the clearing. The first chimp quickly closed the metal box and walked away several metres, sat down and looked around as if nothing happened. The second chimp left the feeding area again, *but as soon as he was out of sight, he hid behind a tree and peered at the individual in the feeding area.* As soon as that individual approached and opened the metal box again, the hiding individual approached, replaced the other, and ate the bananas. (Observed by Plooij, reported by Whiten and Byrne 1988.)

Belle, accordingly stopped uncovering the food if Rock was close. She sat on it until Rock left. Rock, however, soon learned this, and when she sat in one place for more than a few seconds, he came over, shoved her aside, searched her sitting place, and got the food. Belle next stopped going all the way (to the food). Rock, however, countered by steadily expanding the area of his search through the grass near where Belle had sat. Eventually, Belle sat farther and farther away, waiting until Rock looked in the opposite direction before she moved toward the food at all, and Rock in turn seemed to look away until Belle started to move somewhere. On some occasions Rock started to wander off, only to wheel around suddenly precisely as Belle was about to uncover some food . . . on a few trials, she actually started off a trial by leading the group in the opposite direction from the food, and then, while Rock was engaged in his search, she doubled back rapidly and got some food. (Menzel 1974)

That deception occurs in the daily interactions of primate societies is uncontroversial. Its interpretation, however, is not. The controversy concerns whether or not deceptions like these require mental representation on the part of the participants, and if so, the minimum complexity of the mental representation required to execute them. More to the point, the crucial question is: To what extent are other species capable of reflecting on their own internal states and the internal states of others?

Nature is replete with instances of deception, and most require no mental representation at all (e.g., the hawk moth flicks open its hind wings in response to looming objects displaying spots on its hind wings that look like the eyes of a large hawk). Some deception, however, is more difficult to explain without appealing to a capacity for mental representation. Consider, for example, the cases of misdirected attention, which are difficult to explain unless the deceiver were capable of higher-order intentional states such as

I *want* (you to *believe* (that I stopped to groom myself))

or

I *want* (you to *believe* (that I *know* (the food is over there))

Krebs and Dawkins (1984) referred to the capacity to forecast the behavior of others (as in the case of Belle and Rock) as *mind reading* (although

they meant this in strictly behavioral terms and made no commitment to mental representation). The competitive advantage conferred by such a capacity is obviously enormous – unless those you compete with also possess the same capacity. Achieving dominance in such a society is extremely difficult, and it is probably because of this "mindreading" capability that hierarchies in some species can be notoriously unstable.

But the capacity to reflect on your own mental states and to appreciate (however minimally) the internal states of others confers other, less malevolent advantages as well. The ability to anticipate others' actions also enables coordinated cooperative effort, such as seen in the cooperative hunting of lionesses and chimpanzees. In laboratory studies, common chimpanzees have been shown capable of taking either role in a cooperative task when they've only been explicitly taught one of the roles, suggesting that they appreciate what a partner needs to know in order for both to succeed in a joint task (Povinelli 1994). They also deliberately teach their offspring skills, such as nut cracking and (in the case of signing chimps) sign language, exaggerating their movements to allow their offspring ample time to observe, and ensuring that their offspring are in fact watching their actions while they are being demonstrated (Boesch 1991; also see Caro and Hauser 1992). There is also evidence of compassion, distress, and caring toward others, suggesting a capacity to appreciate the feelings of others (see de Waal 1996 for numerous examples).

To summarize, primate social interactions are far more complex than simple contests of strength. Instead, these interactions depend on a cluster of important and primitive cognitive functions. The most primitive and fundamental of these are (a) recognizing individuals and (b) making rank and kinship discriminations through transitive inference. Without these functions, one cannot monitor one's history with other individuals, form alliances, avoid conflict, and so on. Just as important, however, are (c) recognizing/learning what is permitted and what is forbidden given one's rank, (d) forming reciprocal obligations based on resource sharing, (e) monitoring reciprocity, (f) detecting violations of social norms (i.e., cheating), and (g) reading the intentions of others. Without a cognitive function that allows one to quickly learn what is *forbidden* and what is *permitted* given one's rank, subordinates risk incurring the wrath of their higher-ranking conspecifics, a situation that can (and does) result in ostracism and even death. Without a cognitive function that allows one to grasp the structure of an *obligation*, fruitful alliances cannot be formed and maintained that allow one to move up in rank. Without a *violation detection* function, highranking individuals cannot monopolize resources, cannot maintain fruitful alliances, and cannot preserve the peace. In this basic mix, there is

also a capacity, however rudimentary, for reading the intentions of others through an appreciation of their internal mental and emotional states. Unlike the basic cognitive functions required for dominance and social norm reasoning, the interpretation of the data on this capacity is extremely controversial. Without the capacity to read the intentions of others, however, the cooperative effort and higher-order deception seen among some social mammals (particularly the great apes) would be virtually impossible.

These, I argue, constitute basic and early emerging cognitive functions in social mammals, and they are shot through with the dynamics of dominance. What one is permitted or forbidden to do depends on one's rank. The rate at which one must reciprocate (and, hence, what counts as reciprocity) depends on one's rank. And whether or not one must be vigilant in detecting social norm violations depends on one's rank.

Why should dominance play such a large role? Essentially, because it was there first. Dominance is ubiquitous among social species, and in many, size does matter. But if wit can out-maneuver brawn, then there is an evolutionary pressure to be brainy. Dominance hierarchies constituted the social context for the evolution of these basic cognitive functions, functions that are crucial for out-competing brawn in contests of rank, and for maintaining a stable social environment.

4. SOCIAL COGNITION IN HUMAN PRIMATES

Pope Edwards (1982, 276) described the social order in preliterate human societies as "cooperation and reciprocal obligations within a hierarchical structure of authority relationships". It is as good a description of most human societies and social institutions as any. Human cognition, then, was (and still is) subject to the same types of selective pressures as other social mammals during evolution, bigger brains notwithstanding. And so it is not surprising to find evidence of a human biological preparedness to develop cognitive functions for classes of problems that are critical to survival in a social dominance hierarchy. As we saw earlier, these functions include

- Recognizing dominance relations
- Fast track learning of social norms (permissions and prohibitions)
- Detecting violations of social norms (cheaters)
- Monitoring reciprocal obligations (social exchange reasoning)
- Reading the intentions of others (theory of mind reasoning).

4.1. *Dominance Effects in Human Social, Emotional, and Cognitive Functions*

Dominance hierarchies are apparent in the play groups of preschool children (Hold-Cavell and Borsutsky 1986; Keating and Heltman 1994; LaFreniere and Charlesworth 1980; Rubin and Caplan 1992; Smith 1988), even among children as young as two years of age (Frankel and Arbel 1980). In fact, social dominance is the earliest stable dimension of peer group social organization (Strayer and Trudel 1984). Children as young as four years of age can reliably report the hierarchical structure of dominance relations in their play groups, a task that depends at least implicitly on the use of transitive inference; in contrast, content-free transitive reasoning does not reliably emerge until the 6th or 7th year of life, suggesting a distinction between domain-specific and general reasoning versions of this type of reasoning competence that emerge at different developmental rates (Smith 1988).

Consideration of relative rank also modifies physiological stress indices., such as blood pressure, heart-rate, and cortisol levels. Retaliating against an aggressor causes these indices to return to normal – but only when retaliating against a lower-status target; if a victim retaliates against a higher-status aggressor, his or her stress indices remain at their frustration-induced elevated levels. (Hokanson 1961; Hokanson and Shetler 1961).

Countless studies in social psychology have also revealed a distressing human tendency to conform, comply, and submit to authority (dominant individuals) – even malevolent authority. Perhaps the most famous examples of this are the Milgram experiments (Milgram 1974). Sixtyfive percent of the subjects participating in these studies obeyed a malevolent authority's orders to deliver a potentially fatal electric shock to an innocent victim. (In fact, no shocks were delivered and the "victim" was a confederate of the experimenter, but the subjects were not made aware of these facts until after they agreed or refused to obey the order.)

Dominance appears to be written deeply into our physiological, social, and cognitive functions. It emerges early as a defining trait of individuals (personality) and hence produces a propensity for human social groups to organize themselves hierarchically, and for the majority of individuals to displace responsibility for their actions by obeying authority. So large a part does it play in our social lives that it also shapes and modifies our cognitive strategies and physiological responses.

4.2. *Social Norm Reasoning*

Philosophical treatments of reasoning have long appreciated the need to distinguish between practical reasoning and theoretical reasoning, a need that has recently also emerged in psychological models of reasoning (e.g., Manktelow and Over 1991; 1995; Cummins 1996b–c; 1997; 1998a, b; 1999, in press; Oaksford and Chater 1992). The goal of practical reasoning is determining a prudent course of action. Typically, this means determining what one is *permitted*, *obligated*, or *forbidden* to do. Deontic logics have been proposed to aid in developing normative models of this type of reasoning, logics that have as their primitive operators permission, obligation, and (in some cases) prohibition (Hilpinen 1971; 1981). These are the core operators that are needed to do the job. Practical, or deontic, reasoning is distinct from discursive or theoretical reasoning in which the reasoner is required to determine the epistemic status (truth) of a description of a state of affairs. Here, one is not concerned with choosing a prudent course of action. Instead, one is concerned with what is entailed by given facts.

This distinction appears not just in normative models of reasoning, but in everyday reasoning as well. For nearly three decades, psychologists have noted that when reasoning about prescriptive rules (social norms), we spontaneously look for possible violations of the rule, that is, we look to see who might be breaking the rule (Cheng and Holyoak 1985; 1989; Cosmides 1989; Griggs and Cox, 1982; Cummins 1996a, b; Johnson-Laird, et al. 1972; Manktelow and Over 1991; 1995). This extremely cogent and crucial reasoning strategy seems to be triggered almost exclusively by problems with deontic content, particularly permissions, obligations, prohibitions, promises, and warnings. Violation detection is rarely found in everyday theoretical reasoning.

The most striking examples of this effect have been reported using the Wason Card Selection Task. As a simple example, imagine someone tells you something odd about a mutual friend of yours, namely:

> If John stays overnight at his cabin, then he always comes home with a sack of garbage. (If $< p >$, then $< q >$)

As proof, your friend has kept tabs on John, writing down his activities everyday for the past three months and storing the information in a computer file. The file contains *information about where John went and what he had with him when he returned*. These include

- Information about what John brought home when *he stayed overnight at his cabin* (p)
- Information about what John brought home when *he stayed overnight elsewhere* ($\sim p$)

- Information about where John had gone when *he returned with a sack of garbage* (q)
- Information about where John had gone when *he returned without a sack of garbage* ($\sim q$).

Which occasions would you like to inspect in *order to make sure your friend is right*? The typical choices on theoretical (or truth-testing) problems like this is p and q, that is, "stayed overnight at his cabin" and "came home with a sack of garbage".

Now imagine that John's cabin is in a wildlife preserve, and it is required that all overnight visitors take their garbage out with them in order protect the environment and discourage scavenging. Which occasions would you like to inspect *in order to make sure John obeyed the rule*?

The typical answer on *deontic* problems like this is p and $\sim q$ ("stayed overnight at his cabin" and "returned without a sack of garbage").

When reasoning about the *truth* of a conditional statement, people spontaneously seek to confirm that the antecedent (p) and the consequent (q) did in fact occur together. When reasoning about obedience to prescriptive rules (*social norms*), people instead spontaneously look for possible rule violations. This is true whether the final query biases search in favor of verification (as in the example above) or violation detection (e.g., "...in order to find out whether your friend was wrong" and "...in order to make sure John isn't breaking the rule"). But consider this: In the truth-testing case, had you inspected the occasions in which John came home without a bag of garbage and discovered that he'd been to his cabin, this would have provided incontrovertible proof that the statement was false. Yet it does not occur to us to look for potential violations of the statement in the truth-testing case. The need only seems apparent in the deontic case. This is what I refer to as the *deontic effect* (Cummins, 1994b, c; 1998a, b; 1999 in press).

The *deontic effect* does not appear just in the reasoning of adults. It has been observed in children as young as three years of age, making it one of the earliest emerging reasoning functions (Cummins 1996a). Children spontaneously adopt a violation detection strategy when attempting to determine whether or not a social rule is being followed, but not when attempting to determine whether a conditional utterance is true or false. The magnitude of this effect is equivalent to the magnitude found in the adult literature. Furthermore, children also find it easier to recognize instances of cheating than instances that prove a rule false (Harris and Nuñez 1996).

Although the deontic effect has been observed in numerous experiments over the course of thirty years (see Cummins (1996b) for a review), its interpretation is not without controversy. Some have argued that the de-

ontic effect simply shows that embedding reasoning problems in contents with which people are reasonably familiar improves performance (e.g., Griggs and Cox 1982; Johnson-Laird et al. 1972). Others have argued that we induce reasoning schemas for frequently occurring, highly important classes of situations (such as permissions), and the deontic effect reflects evocation of these class-specific schemas (Cheng and Holyoak 1985; 1989; Holyoak and Cheng 1995). Still others have argued that the deontic effect reflects the evocation of innate, genetic algorithms for cheater detection that evolved in response to pressure to reason about social exchange, which is defined as cooperative effort for mutual benefit (Cosmides 1989; Cosmides and Tooby 1992; 1994; Gigerenzer and Hug 1992). The deontic effect also has been explained as the inevitable outcome of a search for counterexamples to reasoner-constructed mental models, a process that is sensitive to subjective utility (Manktelow and Over 1991; 1995). And, finally, some researchers have argued that the shift in selection patterns on the truth-testing and deontic versions of the Wason task indicates that people view these tasks in terms of optimal data selection, and shift their strategies from maximizing expected information gain on the truth-testing version to maximizing expected utility on the deontic version (Oaksford and Chater 1992).

In all of this controversy, two things remain uncontroversial. The first is that when reasoning about prescriptive social rules, people adopt a violation detection strategy. The second is that what counts as an efficacious and rational strategy when reasoning about social rules is perfectly obvious: It's clear even to three-year-olds. In contrast, what one ought to do when testing a statement's truth is the subject of controversy even among scientists and philosophers of science (e.g., Duhem 1954; Earman 1992; Horwich 1982; Lakatos 1970; Putnam 1974). One might ask, 'Why?' Why is the deontic version of the task so much clearer and easier for human primates to reason about while the truth-testing version is not? Why, in fact, do people perform well on the deontic version of the task regardless of general intellectual ability or level of education while performance on the truth-testing version correlates positively with intelligence (Stanovich and West in press)?

Even more crucial is the observation that consideration of relative social rank strongly influences the likelihood that a violation detection strategy will be evoked. Reasoners are far more likely to look for cheaters when *checking on individuals who are lower ranking than themselves* (65%) than when checking on individuals of equally high (20%), equally low (18%) or higher rank (20%) than themselves (Cummins 1999). Social rank had no effect on the likelihood of adopting a violation detection strategy in a

lie detection condition. (The percentage "*p* and not-*q*" responses ranged from 15% to 18% across the rank manipulations in the lie detection task). Similarly, Mealey and her colleagues found that subjects were far better at remembering low-status cheaters than high-status cheaters or non-cheaters of any rank (Mealey et al. 1996).

These seemingly disparate and confusing results can be readily understood from the perspective offered here: Violation detection is a basic cognitive function that facilitates social regulation. It is a crucial function for ensuring that implicit (or explicit) social norms are honored, and, more particularly, that higher-ranking individuals can protect the status quo by regulating the behavior of those over whom they have power or authority.

4.3. *Monitoring Reciprocity*

Reciprocity appears to be a primitive component of human cognitive architecture, at least in the social realm. Infants engage in turn-taking games with caretakers within the first year of life (Vandell and Wilson 1987). Preschoolers typically choose to help playmates who have helped them in the past, and are more likely to share resources with those who have shared with them in the past (Smith 1988).

Research on decision-making among adults also shows that reneging on a promise to cooperate is reacted to more strongly and more negatively than competitive loss alone (Rabbie 1992; Weg and Smith 1993). For example, Weg and Smith (1993) gave subjects the opportunity to win money in transactions based on the Prisoner's Dilemma. The subject's task was to decide whether to betray his or her collaborators and win a fixed amount of money, or to trust them and possibly win more or less than the fixed amount. Subjects showed a greater willingness to trust, and a greater unwillingness to forgive betrayals of that trust, than would have been predicted by rational choice theory.

These results are better accounted for by assuming that people are predisposed to engage in reciprocal obligation transactions, or, as Cosmides and Tooby call it *social exchange* (Cosmides 1989; Cosmides and Tooby 1992; 1994). According to Social Exchange Theory, cheater detection is part of a domain-specific mental algorithm – a mental module – that evolved in humans in the Pleistocene in response to pressure to reason about social exchange. Social exchange is defined in terms of reciprocal altruism, that is, cooperative effort for mutual benefit. Cheater detection is a crucial element of this theory because modeling in evolutionary biology has repeatedly shown that reciprocal altruism cannot emerge as an evolutionarily stable strategy unless the participants are capable of detecting and excluding cheaters (e.g., Axelrod and Hamilton 1981). Curiously

cheating is defined in Social Exchange Theory not as failure to reciprocate but instead as taking a benefit without paying a cost. Further, most of the research done testing the theory has focused on detecting violations of social norms (such as wearing a tattoo or eating a certain type of food when one is not entitled to according to social conventions), which we already know people are very good at. Other results have shown that cost manipulations have little effect on cheater detection (Cheng and Holyoak 1989) but benefit manipulations do (Cosmides and Tooby 1992), and that which violations are detected depends on whose perspective the reasoner adopts during the reasoning process. For example, consider the promise "If you mow my lawn, I'll give you $5". From the promisor's perspective, it is important to ensure that the lawn was mowed before the $5 was paid. In the standard Wason task, this corresponds to selecting not-p and q, that is, "didn't mow the lawn" and "paid $5'. From the promisee's perspective, it is important to ensure that the $5 was paid once the lawn was mowed. This corresponds to selecting p and not-q, that is, "mowed the lawn", and "didn't pay $5". Several studies have now reported that a switch in perspective on reciprocal obligation tasks results in just this type of switch in selection patterns, suggesting that people are indeed very good at defecting violations of reciprocal obligations (Gigerenzer and Hug 1992; Manktelow and Over 1991; 1995; Politzer and Nguyan-Xuan 1991).

Cross-cultural work on reasoning shows similar results. An example cited by Scribner (1975, 155) on syllogistic reasoning among the Kpelle of West Africa amply illustrates the type of responses observed when using categorical syllogisms to test theoretical reasoning:

(E:) All Kpelle men are rice farmers. Mr Smith (this is a Western name) is not a rice farmer. Is he a Kpelle man?

(S:) I don't know the man in person. I have not laid eyes on the man himself.

(E:) Just think about the statement.

(S:) If I know him in person, I can answer that question, but since I do not know him in person I cannot answer that question.

(E:) Try and answer from your Kpelle sense.

(S:) If you know a person, if a question comes up about him, you are able to answer. But if you do not know a person, if a question comes up about him, it's hard for you to answer it.

As this excerpt shows, the reasoner does not seem to grasp the fact that the dilemma can be resolved via reasoning. Instead, he is concerned with

retrieving and verifying facts, a strategy that does not fare well in this type of task.

A very different picture emerges, however, when members of preliterate cultures are asked to reason about moral dilemmas. One oft-cited study by Harkness et al. (1981) on rural Kenyans (Kipsigis community) illustrates the typical result observed in these studies. The dilemma in this excerpt concerned whether a boy should obey his father and give him some money he had earned himself when the father had promised the boy he could keep it.

> A child has to give you what you ask for just in the same way as when he asks for anything you give it to him. Why then should he be selfish with what he has? A parent loves his child and maybe ⟨the son⟩ refused without knowing the need of helping his father. By showing respect to one another, friendship between us is assured and as a result this will increase the prosperity of our family.

As is apparent, the reasoner has little difficulty understanding what this reasoning problem is all about. Furthermore, this protocol is full of references to reciprocity, and particularly reciprocal obligations. Interestingly, however, just as in primate societies, what counts as reciprocal depends on social status. In this study, when determining what was right or fair, all subjects settled dilemmas in favor of the person with higher rank or status, regardless of the merits of the case.

In short, there is ample evidence that reciprocity emerges early in human development and is a universal characteristic of spontaneous, untutored reasoning.

4.4. *Human Reasoning and the Problem of Other Minds*

As we saw in the section on nonhuman primates, detecting violations of social norms and reading the intentions of others differ significantly in terms of the computational commitments they require. Learning the social norms of one's group and detecting violations of them does not require appreciating the internal states of others. Social norms and violation detection traffic in the realm of readily observable overt behavior. Reading the intentions of others, however, can and often does require crossing the line into the realm of the unobserved and private internal states of others. As we saw, it can in fact require constructing hierarchically embedded mental representations of the mental states of others. "Mind reading", therefore, requires greater representational and computational complexity than does inducing social norms and detecting norm violations.

It should come as no surprise, then, that "mind reading" – a skill at which humans excel compared to other species – emerges later during development than does cheater detection – a skill we seem to have in

common with other social animals. In the developmental and comparative literatures, "mind reading" is called *theory of mind reasoning*, and it comprises a number of separate subskills which develop at different ages. For example, infants as young as 10 weeks can distinguish among various facial expressions (Haviland and Lelwica 1987), and even two year olds can succeed at tasks that require them to grasp another's goals, desires, or preferences (e.g., Bartsch and Wellman 1989; Flavell et al. 1990; Melztoff 1995).

Reasoning about the content and truth values of others' belief states, however, proves more troubling to young children. For example, children younger than about age 4 fail to take into account a speaker's knowledge when evaluating utterances, and simply label inaccurate statements as lies. For example, if puppet A watches an event, then lies about it to puppet B, who then innocently passes the inaccurate information on to puppet C, children in this age group will call both A and B liars (Strichartz and Burton 1990; Wimmer et al. 1984). It is not until about the 7th or 8th year of life that consideration of what a speaker believed or knew reliably appears in their judgments. (See Haugaard and Reppucci 1992; Bussey 1992 for reviews of this literature.)

Prior to about age 4, children also perform inconsistently on tasks that require attributing false beliefs to others. In the standard false belief task, children watch while a puppet hides a toy in location A and then leaves. A second puppet then appears, finds the toy, and hides it in location B. The child is then asked where the first puppet left the toy, where the toy is now, and where the first puppet thinks the toy is. Prior to about age 4, children answer the first two questions correctly, yet believe the first puppet thinks the toy is in the current location (location B). Their behavior is typically explained as a failure or inability to attribute false beliefs to others (see Gopnik 1993; Leslie 1994; Perner 1991 for reviews of this literature.)

Although these tasks are seemingly very different, they share one very important feature: They require appreciating the knowledge/belief states of others. In the deception task, puppet A is guilty of lying because it knew one thing but reported something inconsistent with that knowledge. In contrast, puppet B wasn't guilty of lying because it reported accurately what it knew, but what it knew was contrary to fact. In the false belief task, the first puppet can't know that the toy was moved because it didn't see the toy get moved, so it believes something contrary to reality. In order to perform these tasks, one must maintain several conflicting pieces of knowledge – what is true, what puppet A believes to be true, and what puppet B believes to be true. But in both tasks, young children seem to focus almost exclusively on the first of these – what is currently true. They

find it difficult to reason well if they must take into account what others saw, knew, or believe, particularly if that knowledge or belief is contrary to fact.

Two broad classes of explanations have been offered to explain these results. The first class includes discontinuity theories: They attribute the change in performance in the third year of life to a radical change in the nature of the child's understanding of mental states, that is, a change in competence, from a non-representational to a representational "theory of mind" (Gopnik 1993; Perner 1991; Wellman 1990). Prior to this shift, the child lacks a concept of false belief. The second class of explanations include continuity theories: These theories frame false belief reasoning in terms of conceptual competence. They propose that the concept of false belief is part of an early emerging, domain-specific representational system, that becomes functional through the period from approximately 18 to 36 months. The shift that occurs from ages 3 to 4 is one of a change in performance, not competence (Leslie 1994).

There are three additional facts about theory of mind reasoning that need to be brought into this discussion. The first is that it is not until about ages 5 to 7 that children can reliably perform tasks that require understanding statements that express second-order intentionality such as "John wants his mother to think that . . . " (Perner and Wimmer 1985). The second is that children begin to pass the false belief task at the same time they begin to pass counterfactual reasoning talks (Riggs et al. 1998). These results suggest that it is not until children can construct and manipulate hierarchically embedded mental representations that they can reliably succeed in cognitive tasks that depend on them. And as we saw earlier, creatures that are capable of constructing such representations are also highly capable of thwarting social norms and dominance through dint of guile. Which brings us to the second fact: *Theory of mind reasoning emerges earlier in later borns than first borns* (Jenkins and Astington 1996; Lewis et al. 1996; Perrier et al. 1994; Ruffman et al. 1998), which is readily predicted by the theory of dominance presented here. One of the primary purposes of deception is outwitting those who have power to constrain or inhibit your behavior.

The capacity to represent others' internal states, however, has other, less Machiavellian, uses. It also allows for greater compassion, and social codes based on something other than social norms. In short, it sets the stage for the development (or evolution) of a code of morality, particularly one based on harm to others. The capacity to appreciate others' internal states allows one to ground social codes in concepts such as suffering. Without

it, social codes must be grounded in rules that forbid, permit, or obligate certain kinds of behavior.

This distinction between a social code grounded in prescriptive rules and one grounded in appreciation of others' internal states emerges early in human development, and it is universally (cross-culturally) recognized. Children as young as $2\frac{1}{2}$ years of age distinguish between social conventions and moral prescriptions (Hollos et al. 1986; Nucci et al. 1983). Children treat moral rules as unconditional obligations toward others and social conventions as context-specific rules based on authority and consensus. They judge moral transgressions in terms of harm done to others and fairness (e.g., pain or injury incurred), and judge social rule violations in terms of social coordination factors (e.g., social sanctions against breaking the rules). In one study, over 80% of preschoolers stated that conventional transgressions would be right if there were no rule pertaining to the act (e.g., adopting a different form of dress, greeting, use of toys, etc), but that moral transgressions would *not* be right even if there were no rule pertaining to the behavior (e.g., hitting another child, stealing property). This distinction appears to be universal, having been observed in a variety of cultures both developmentally and in adult legal/social codes (Snarey 1985).

Moral dilemmas often arise when socially acceptable behavior is seen by large enough segments of a society to violate basic moral rules. This division lies at the foundation of classic as well as contemporary disputes over slavery and animal rights, as these excerpts show:

> In our opinion, if monkeys could read and otherwise use language properly, we could not ethically use them as laboratory animals. A major justification for experimenting on (or eating, or otherwise using) animals, at least as we see it, rests on a basic conception of ethics: Rights only exist because there are complementary duties (e.g., see Frankena 1963). For example, if you have a right to live, the rest of us have a duty not to kill you. Thus, ethics is embedded in a community of responsible citizens who can perform the necessary duties that allow rights to be conferred. If a monkey, or anything else, could understand necessary duties, it would become a member of the community to which the rights apply. However, monkeys cannot participate in such social contracts. (Kosslyn and Koenig 1995, 501)

Here, the justification for animal experimentation (and consequent suffering) rests on the deontic concepts of rights and duties, that is, on *permissions* and *obligations* that are conferred upon members of a group. This contrasts sharply with the following argument that appeals instead to an appreciation of the internal states of others, particularly to their capacity for suffering::

> But is there any reason why we should be suffered to torment them? Not any that I can see. Are there reasons why we should be suffered *not* to torment them? Yes, several. The

day has been, I grieve to say in many places it is not yet past, in which the greater part of the species, under the denomination of slaves, have been treated by the law exactly upon the same footing as, in England, for example, the inferior races of animals are still. The day may come, when the rest of the animal creation may acquire those rights which never could have been withholden from them but by the hand of tyranny. The French have already discovered that the blackness of the skin is no reason why a human being should be abandoned without redress to the caprice of a tormentor. It may come one day to be recognized, that the number of the legs, the villosity of the skin, or the termination of the *os sacrum*, are reasons equally insufficient for abandoning a sensitive being to the same fate. What else is it that should trace the insuperable line? Is it the faculty of reason, or, perhaps, the faculty of discourse? ….the question is not, Can they *reason*, nor Can they *talk*?, but can they *suffer*? (Bentham 1789; Chap.: 17, section 1, part 4, fn)

While the former argument appealed to rights, obligations, and social norms, this argument appeals to victims' internal states, particularly their capacity for suffering. The developmental, comparative, and cognitive research presented here suggests that these two types of reasoning are fundamentally different because they rely on different concepts, and, perhaps, engage different reasoning strategies. The former depends on the deontic concepts of permissions, prohibitions, and obligations and relates to distinctly observable behavior. The second depends on internally representing, considering and perhaps even experiencing to some degree, the mental and emotional states of others. Working out how to bridge these two domains has been the goal of philosophers and legal scholars for millennia, and the difficulty of this task is apparent in the many disparate schools of thought that have emerged as a result (e.g., deontology and consequentialism). Perhaps these issues are so thorny not only because of the social ramifications they carry but because they require the blending of two fundamentally different types of cognition.

In summary, five cognitive functions that are crucial to survival in social dominance hierarchies are apparent in human reasoning performance. These include recognizing dominance relations, cogent reasoning about permissions, obligations, and prohibitions (social norms), violation detection, reciprocity, and "mind-reading". All but the last of these emerge early in development and color reasoning performance throughout the lifespan. "Mind-reading" emerges later in development, and seems to depend on a complexity of mental representation that distinguishes humans from many other species. The nature of this complexity seems to be a capacity for forming deeply-embedded representations (of the type readily seen in human communicative signals, i.e., language), and has as its consequence enabling an organism to distinguish between true representations and counterfactuals that can serve as goals, suppositions, or representations of the internal states of others.

5. WHY DOMINANCE IS NOT AN INEVITABLE SOCIAL OUTCOME

The theory of dominance presented here is NOT a theory of innate modules. Instead, it is a theory about cognitive functions jointly shaped by innate predispositions and environmental inputs. When it comes to nativist theses about cognition, there is a temptation to ask which information (rules, theories, etc.) is innate, and which is learned. An alternative explanation is that complex social animals do not inherit modules fully formed but instead have a *biological preparedness* to develop them very quickly for classes of problems that are critical to survival (Cummins and Cummins, in press). Biological preparedness as an explanans is more consistent with contemporary neuroscience than are innate modules. The picture of the brain that is emerging from decades of neuroscience research is one in which precious little is fixed at birth. Instead, innate processing "biases" are elicited or modified through interactions with the environment. Furthermore, biological preparedness comes in degrees, and is probably best explained in terms of *canalization* (Ariew 1996; McKenzie and O'Farrell 1993; Waddington 1975). A trait is said to be more or less canalized as its expression is more or less independent of environmental influence. A combination of genetic and environmental factors cause development to follow a particular pathway, and once begun, development is bound to achieve a particular end-state.

This means that biology often puts strong constraints on what types of knowledge or skills can or will be learned, but that *the environment plays a very large role in how and whether certain biological predispositions get expressed*. I have argued here that humans (like most other social mammals) have a propensity to form dominance hierarchies and to use dominance-centered strategies for controlling social interactions. I've also argued this is so because many of our basic cognitive functions were forged in the crucible of dominance hierarchies and were crucial to survival in these environments. Our evolutionary environment is reflected in our cognitive architecture, and that architecture in turn shapes the nature of our social institutions. In their most benign form, hierarchies reflect nothing more than leadership qualities among a few individuals. In their more malevolent form, such hierarchies can constitute rigid and profound socioeconomic stratification. From a socio-political perspective, perhaps the most important contribution that cognitive psychologists can make is to investigate which environmental contingencies trigger or hinder the expression of these potentially destructive biological predispositions.

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