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On July 7, 2003, three teenaged boys dressed like characters from the Matrix movies were charged with murder conspiracy, car jacking, and illegal weapons possession. Their plan was to steal a car, kill three middle school classmates, then carry out random attacks on as many people as possible through their hometown of Oaklyn, New Jersey. Their plans bore a striking resemblance to the shootings that took place in schools across the country in 1999, beginning with the Colorado's Columbine high school in which two teens killed 13 people before taking their own lives. It was as though the Columbine students' actions had ignited a rage that had been simmering just below the collective surface of American teenage consciousness.

In the aftermath of these tragedies, schools responded in predictable ways. Collective action was taken to deter violence and make us feel safe once again. Surveillance cameras were installed in classrooms. Weapon checkpoints were setup in school entrances. Security guards were posted. Dress codes were instituted. Attempts were made to pass legislation allowing parents to access a list of books their children check out of the school library. Political pundits and social commentators filled the airwaves and print media with analyses the tragedies. We wanted to know how something like this could happen, and how it could have been prevented. The usual suspects were trotted out and held up for scrutiny: TV violence, the ready availability of guns, and the presumed "break down" of the American family values. The makers of violent video games were sued by crusading lawyers who sought to hold them accountable given that many of these violent teens spent hours playing (and in some cases, designing) such games.

Pundits and wise men aside, the most telling insights came from the students themselves. They pointed the finger not at the "usual suspects" but instead squarely and directly at the source of so much teeming rage: the status hierarchies that completely define their lives in and out of school¹. As one student put it "It's a rat race inside the school to see who's going to be more popular. Everybody's thinking: Am I going to look cool to the popular kids? Are they going to accept me?" In the words of another "The jocks rule the school, and they kind of get a big head and think they own the world." (The term "jock", as it turns out, is used freely to refer to high-status, popular students.) And yet another "It just makes you not want to go to school, you don't want to deal with those people." According to classmates, the ringleader of the Oaklyn teens was constantly tormented for a speech impediment caused by a cleft, his bow-legged and stooped gait, and even his clothes. As one student put it, he "was an easy target, but he never lashed out. He just took it." And still another, "Everybody picked on him." In the words of the Columbine shooters "This is for all the people who made fun of us all these years!"

According to students, the popular—or high status—kids make life hell for those they believe to be less popular and therefore lower status than themselves. They freely

¹ Philadelphia Inquirer Online Tue, Jul. 08, 2003 Frontpage, *Oaklyn plot investigators seize suspects' computers*; ABCNEWS.com April, 23, 1999, *High School Hell: Shooters were ostracized by school cliques*.

inflict verbal abuse (usually under the guise of “teasing”), cut in front of less popular kids in food lines or push them out of line and take their place, or deliberately bump into them in the halls and smirk while walking away. They act as though they have and deserve “priority of access to resources”, including teacher’s attention, best places to sit on the bus or in the lunchroom, and the most attractive mates. The methods they use to assert these “entitlements” usually avoid detection by supervising adults because, as researcher Rachel Simmons (2002) puts it, high status kids (particularly girls) have learned how to operate “below the radar”. They know how to completely dominate and suppress those outside their own popular cliques in ways that are either difficult to detect or socially acceptable.

The students’ analyses, however, were dismissed out of hand by school officials, social commentators and political pundits, because, after all, how could things so trivial as *status* and *popularity* possibly lead to such violent tragedies? The connection is not so incredible, however, when viewed against the backdrop of human evolutionary psychology.

1. Social Hierarchies: Ultimate Causes

The key to understanding the impact of status lies in appreciating its relation to *survival and reproductive success* both during our evolutionary past and in our present lives. Status (or rank) is most frequently defined *as priority of access to resources in competitive situations*. Natural selection is a straightforward process: The genes of those who live long enough to reproduce remain in the gene pool. The genes of those who don’t don’t. In most species, there is a direct relationship between social status and reproductive success, with higher status individuals being less likely to die of predation or starvation, and more likely to leave living offspring (Clutton-Brock, 1988; Clutton-Brock & Harvey, 1976; Dewsbury, 1982; Ellis, 1995). Among species in which status 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, Alberts, Haines et al., 1996). There is a direct relationship between status and *inclusive fitness*, where fitness is defined as the number of living offspring one has that go on to reproduce themselves, and inclusive fitness is defined as the reproductive success of individuals and their closely related kin—or to put it more precisely, personal fitness plus the effects of actions on the reproduction of genetic relatives, degraded by relatedness (see e.g., Dawkins (1982). Your status is directly tied to your ability to survive, to reproduce, and to take care of yourself, your offspring, and your kin.

2. Social Hierarchies: Proximate Causes

2.1 Social status and neuroendocrine responses. Given the intimate and direct relationship between status, survival, and reproductive success, it should come as no surprise that a loss in status (however trivial its manifestation may seem to our modern sensibilities) should send an alarm signal directly to our physiology. A loss in status can mean the difference between life and death—or between merely surviving and having a life worth living. These “alarm signals” manifest themselves as changes in our physiology which motivate us to act in ways that either keep them the way they are (in the case of pleasant-feeling changes) or make them go away (in the case of unpleasant-feeling changes). These changes take place in the neuroendocrine system, a sort of dialog

between the nervous system and the endocrine system in which certain cells release hormones into the blood in response to stimulation of the nervous system. When the individual is challenged in some way, the brain activates the autonomic nervous system which stimulates the output of two hormones, cortisol from the adrenal cortex and adrenalin from the adrenal medulla. Adrenalin affects us immediately by increasing heart rate and blood pressure, and mobilizing stored energy reserves. Cortisol works more slowly, replenishing energy supplies through fat storage. Collectively, the cascade of events that occur in the neuroendocrine system is referred to as “stress”. If the stress is temporary, then these responses help to put the body back into balance (or allostasis). If instead the stress is chronic, these responses can have deleterious effects on the individual’s mental and physical health (McEwen & Wingfield, 2002). These deleterious effects manifest as altered fat storage and mobilization, hormonal imbalances, sleep disturbances, cardiovascular disease, altered mood, and altered neuroendocrine reactivity. A frequently used measure of stress level is circulating cortisol.

The direct connection between status effects and neuroendocrine response is plainly evident in research based on animal models, particularly research on individuals living in naturalistic ecologies in intact social groups. Hormones play a large role in the development and expression of social status. Status correlates with androgen and serotonin levels in many species of primates in that those with higher levels are also higher-ranking (Ellis, 1995; Sapolsky, 1990; Sapolsky & Ray, 1989). This relationship is also bidirectional: Changes in social status produce marked changes in levels of these hormones. Following contests of rank, defeated males exhibit a drop in androgen levels while winners' levels rises; serotonin levels rise in subordinates who improve their social status (Sapolsky, 1990, 1999; Sapolsky & Ray, 1989; Niehoff, 1999). Subordinates who receive frequent beatings from dominants suffer persistently elevated cortisol (stress hormone) levels, and impaired endocrine feedback responses to stress (Blanchard, Sakai, & McEwen, 1993). And cortisol levels of all members of a social group soar during periods of social instability resulting from upheavals in the dominance hierarchy, such as when unfamiliar individuals are introduced into a group or an alpha male is ousted (McEwen & Wingfield, 2002; Niehoff, 1999).

Are these effects seen in humans? The answer appears to be decidedly, yes. The intimate relationship between social status and neuroendocrine responses is plainly evident in modern humans. You may believe you don’t think much about status, but your endocrine system shows otherwise. Changes in status produce large changes in hormone levels. For example, following competitive games, male winners typically show elevated testosterone levels relative to losers (Booth, Shelly, Mazur, Tharp, & Kittok, 1989; Elias, 1981). This is true even when the competition involves little physical action, as in chess competitions (Mazur, Booth, & Dabbs, 1992) or contests in reaction time (Gladue, Boechler, & McCaul, 1989). Female winners have lower levels of cortisol (a hormone secreted by the adrenal glands in response to physical or social stressors) than female losers (Bateup, Booth, Shirtcliff, & Granger, 2001). One need not even participate in the game to show the effects; hormone levels in fans who watch the game mirror those of the team they support (Bernhardt, Dabbs, Fielden, & Lutter, 1989). The neuroendocrine responses that are evoked by human competitive games are therefore essentially the same as the responses seen in contests of rank in other species. In fact, it is often difficult for competitors and fans to remember that these contests are, after all, just games.

Physiologically, they feel like the real thing: A competitive contest between rivals that will determine where we stand in the hierarchy and hence what our chances of long-term survival are likely to be.

A number of studies have demonstrated a reliable relationship between socio-economic status and neuroendocrine reactivity. For example, adults and children of low socio-economic status typically show higher cortisol levels than those of higher socio-economic status (Kapuka, Treiber, & Davis, 2002; Lupien, King, Meaney, & McEwen, 2001). Several health indices reliably correlate with socio-economic status, and these correlations cannot be explained simply in terms of differences in access to health care, smoking, or other objective factors (Adler, Boyce, Chesney, Cohen, Folkman, Kahn, & Syme, 1994; Adler, Boyce, Chesney, Folkman, & Syme, 1993; McEwen & Wingfield, 2002). One might be tempted to conclude that these results simply show that poverty is more stressful than wealth, but the picture emerging from this branch of research suggests the story is far more complex. What seems to matter instead is *perceived* social status vis a vis others. For example, among healthy white women, *perceived* social status is consistently and strongly related to a wide constellation of hormone-dependent health indices, including heart rate, sleep latency, body fat distribution, and cortisol habituation to repeated stress; this is true even after the contribution of *objective* socio-economic status is partialled out (Adler, Epel, Casellazzo, & Ickovics, 2000). Compared to socially dominant individuals, subordinate or submissive individuals have higher baseline cortisol levels, display greater changes in physiological stress indices during conflict, and slower recovery from conflict-induced changes in cardiovascular activity measures (Newton, Blane, Flores, & Greenfield, 1999; Rejeski, Gagne, Parker, & Koritnik, 1989). This is true even among married couples; perception of spouse dominance correlates with blood pressure reactivity during marital interactions (Brown, Smith, & Benjamin, 1998). Moreover, when frustrated by antagonists, stress indices (such as blood pressure and cortisol levels) can be made to return to baseline levels if the frustrated individuals are given the opportunity to aggress against their antagonists—but only if they believe their antagonists to be of lower status than themselves; when retaliating against antagonists they believe to be of higher status, these indices remain at their frustration-induced levels (Hokanson, 1961; Hokanson & Shetler, 1961).

Finally, the relationship between status and neuroendocrine responses appears to be bidirectional: Not only does perceived social status influence hormone levels, but changes in hormone levels can change one's perceived social status and thereby one's manner of interacting with the world. For example, in one double-blind study (Tse & Bondy, 2002), citalopram (a selective serotonin-reuptake inhibitor) or a placebo was administered to ten volunteers while their roommates received no treatment. While on the drug, these volunteers were rated by their roommates as significantly less submissive and more cooperative. They also spontaneously adopted a dominant pattern of eye contact when interacting with strangers.

Neuroendocrine reactivity, therefore, is more than a simple correlative response to events in the social and physical environments. It comprises a signaling system that informs one (and others) of one's current relative status: How you feel tells you where you are in the social hierarchy, and how you react to social stressors informs others of your status as well (e.g., dominant eye patterns signal higher status than submissive eye patterns). And where you are in the hierarchy is a pretty good predictor of your chances

of long term survival and quality of life. As the Columbine and related tragedies show, life at the bottom of the hierarchy can be pretty grim emotionally, and, as this section shows, the constant emotional turmoil that those at the bottom suffer put them at high risk for illness, depression, or violence.

2.2 Social Status and Cognitive/Behavioral Strategies. At this point, we might ask what determines one's place in a social hierarchy, that is, what makes some people higher status than others? It is plain that status hierarchies emerge early in development, and with little assistance from caretakers. Status hierarchies are apparent in the play groups of preschool children as young as two years of age (Frankel & Arbel, 1980; Strayer & Trudel, 1984). Children in this age group differ among themselves on measures of social dominance. In fact, social dominance is the earliest stable dimension of peer group social organization, and one of the earliest emerging and most enduring observable personality traits (Frankel & Arbel, 1980, Hold-Cavell & Boursutzky, 1986; Lemerise, Harper, & Howes, 1998). Even toddlers seem to be acutely aware of these differences in that they prefer to associate with and imitate high-status as opposed to low-status individuals (Boulton & Smith, 1990; LaFreniere & Charlesworth, 1983; Russon & Waite, 1991).

To explore this question, let's again look at status striving in Darwin's laboratory—the natural world. Common wisdom has it that higher rank among animals means greater size, and indeed, size and dominance rank are correlated in many species (Ellis, 1995). But even in those showing such a correlation, size constitutes only one contributing to social rank. Investigations of social interactions in a variety of species suggests that dominance hierarchies are supported by a collection of specific *cognitive* functions, and that those who achieve dominance are those who are particularly adept at them. To put it more baldly, ***selection favors those who have social and political intelligence.*** This turns out to mean (a) *being adept at learning the implicit rules that constrain behavior in one's social group and monitoring compliance with them,* (b) *forecasting and influencing the behavior of others,* and (c) *forming powerful alliances based on reciprocal obligations.*

2.2.1 Social status, “mind-reading”, and deception. Social living confers both costs and benefits to individuals. The costs are increased competition for food, shelter, mates, and the like. The benefits are increased access to mates, and increased opportunities for cooperative action, including predator defense, caring for the young, and (in the case of humans, at any rate) collectively manipulating the physical environment to better suit one's needs. In hierarchical social groups, how these costs and benefits cash out depend a good deal on one's status. To appreciate this, consider that from a cognitive standpoint, a social hierarchy is, essentially, a set “*social norms*”, that is, *rules that constrain the behavior of individuals depending on their rank* (Cummins, 2000). In human societies, these may be implicit or explicitly codified as regulations or laws. In animal societies, these “social norms” are implicit yet reflected in virtually every activity, including who is allowed to sit next to, play with, share food with, groom, or mate with whom. Animal societies often resemble human feudal societies in that high status individuals typically take on the role of enforcing these implicit “social norms”, aggressing against those who violate them and breaking up disputes between lower-ranking individuals (Boehm, 1992). For example, high-ranking individuals often punish

violations of social norms as benign as grooming or sharing food with forbidden individuals. In fact, perceived violation of the "social code" has been designated by many researchers as the single most common cause of aggression in primate societies (Hall, 1964).

Also as in feudal societies, animal societies that are characterized by rigid social hierarchies are more stable than those that lack them, and disruptions in social rankings (such as the ousting of an alpha male—or, in the case of humans, a local baron or king) constitute periods of intense social tension and conflict (Coates-Markel, 1997; de Waal, 1982). The social stability conferred by strict social hierarchies, however, carries a cost in terms of individual freedom. In order to avoid punishment (or ostracism, which can mean death due to predation or starvation), individuals must learn what is *permitted*, what is *forbidden*, and what is *obligated given their place in the hierarchy, and they must comply with these norms* (see Cummins, 1996a, 1998, and 2000 for a more complete discussion of this). Individual behavior must be monitored with respect to them, and violations responded to effectively.

While non-hierarchical societies (such as those of some aboriginal societies) can also be rigidly defined in terms of social norms that constrain behavior, the difference is that in social hierarchies, what one may, must, or must not do depends in large part on one's status. In many cases, this is because the norms typically concern access to resources. *To be of high status means to have priority of access to resources in competitive*. If high status individuals fail to monitor the behavior of subordinates vis a vis available resources, then they cannot maintain priority of access to resources.

Among humans, this phenomenon is perhaps most clearly manifested in political-orientation scales that measure social dominance. People who score high on measures of social dominance tend to prefer hierarchical relationships in society, distribution of resources based on merit, conservative ideology, military programs, and punitive justice policies (Pratto, Tartar, & Conway-Lanz, 1999). These are all consistent with maintaining priority of access to resources. Those scoring low on social dominance measures tend to favor social equality, distribution of resources based on need, and social programs (Pratto, Tartar, & Conway-Lanz, 1999). In fact, social dominance measures have been found to account for much of the sex-linked variability in political attitudes (Pratto, Stallworth, & Sidanius, 1997).

Effects like these can also be produced in contrived laboratory settings using simple but straightforward cognitive tasks. Participants are presented scenarios that describe arbitrary social rules, and are required to monitor compliance of fictitious individuals. Under these circumstances, adults are far more likely to look for violators of the rules when they believe they are monitoring individuals who are *lower* status than themselves than when monitoring individuals of equally high, equally low, or higher status than themselves (Cummins, 1999a). Adults also exhibit better face recognition memory for low-status cheaters than high-status cheaters or non-cheaters of any rank (Mealey, Daood, & Krage, 1996).

Because agents (as opposed to objects) move of their own volition and have internal states (physical, emotional, and mental), negotiating the demands of the social environment several orders of magnitude more computationally complex than negotiating the demands of the physical environment. Imagine, if you will, a computerized robot that must learn to negotiate a complex but stable physical environment vs one that must learn

to negotiate an environment populated by other robots that move of their own accord and are motivated to seek goals based on internal states that are unobservable but presumably similar to it's own (e.g., finding food, and shelter). The computational demands of keeping track of events and objects in the former are trivial compared to keeping track of events and objects in the latter. If you encounter a rock in the former and move around it, you can be pretty sure that it will remain in the same place while your back is turned. If you encounter an agent in the latter and move around it, you can't be sure of where it will be a few seconds later. Nor can you be sure that it will not show up again in the place you are headed, with much the same goal in mind as yourself. Engaging in competitive or cooperative action requires, at the very least, keeping track of what the other is doing as well as keeping track of your own actions and their outcomes.

These characteristics of the social environment constitute evolutionary "pressure" for solving certain kinds of social problems, problems that are directly related to *fitness and are best solved through cognitive effort*, particularly cognitive effort involved in the forecasting and influencing of others' behavior. Social dominance has been found to correlate with deceptive ability and enhanced ability to decode nonverbal cues. Individuals who are perceived and rated as socially dominant are better at deceiving others, persuading others, and interpreting others' intentions (Hall, Halberstadt, & O'Brien, 1997; Keating & Heltman, 1994).

There is a large literature on deception among primates that suggests "Machiavellian" intent in some primate social interactions (Whiten & Byrne, 1988a; Byrne, 1995). The major outcome of most of these deceptions is *flouting social norms without getting caught*, a singularly effective strategy by which low-ranking individuals improve their access to resources (see Cummins, 2000 for examples). For example, dominant males monopolize reproduction opportunities by aggressing against or threatening to aggress against females and subordinate males who are caught socializing or consorting (Cheney & Seyfarth, 1990, p. 227). Because of the high risks involved in such forbidden liaisons, females and subordinate males often engage in deception, such as concealing their trysts behind obstacles and suppressing their copulation cries (Kummer, 1988; de Waal, 1988). Deceptions of this kind have also been observed for hiding other forbidden behaviors, such as stealing food, failing to share food, or grooming forbidden individuals (see Whiten & Byrne, 1988b for numerous examples.) 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 (Whiten & Byrne, 1988a; Byrne, 1995). 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. Gagneux, Woodruff, & Boesch (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. This observation perhaps offers the clearest testament to the impact greater intelligence can have on reproductive success. Variation in intelligence is a trait upon which natural selection can operate. This situation seems to produce a kind of evolutionary "arms race" in that species that show the greatest capacity for this type of

deception (such as chimpanzees) also have the most unstable dominance hierarchies relative to those that have stable hierarchies (such as macaques) (Whiten & Byrne, 1988a, 1988b). It is difficult to dominate individuals who have the cognitive wherewithal to outwit you.

The impact of strategic deception on relative status has also been demonstrated in human cognitive experimental studies. These studies often themselves rely on deception. A group of participants are gathered into a room, and given a hypothetical problem, such as determining how they would survive following a plane crash in a remote mountain area with only rope, matches, and 3 ounces of water. In reality, the solution they come up with is not of particular interest. What is of interest is how the decision-making unfolds. Inevitably, one or more individuals will come to dominate the group, steering the discussion down particular paths and emphasizing some offered solutions over others. These dominant individuals also turn out to be those who are best at deception. For example, when asked to take a sip of a truly foul tasting liquid and then tell others that the liquid tastes great, dominant individuals are more convincing than subordinate individuals. It is on the whole more difficult to tell when they are lying or when they are telling the truth compared to subordinate individuals. Apparently, dominant individuals have (by nature or by learning) an arsenal of methods for leading, persuading, deceiving, or otherwise influencing others.

2.2.2 Social status and reciprocity. Outwitting the competition is only part of the story. In order to acquire and maintain a favorable position in the hierarchy, it is also necessary to form strong alliances with others. This is best accomplished through the formation of reciprocal obligations.

The study of reciprocity has a long and venerable history in evolutionary biology. The idea is that individuals cooperate for mutual benefit—I'll help you if you help me. According to "selfish gene" theories (Dawkins, 1976), reciprocity shouldn't exist. Natural selection operates at the level of the individual, or to be more precise, natural selection is differential gene replication, but operates through differential reproductive success of individuals. There appears to be little benefit to cooperating with another individual if that means enhancing that individual's reproductive benefits at your expense, such as spending time grooming another individual rather than foraging or hunting to enhance your own survival, or investing effort in caring for another's offspring instead of or in addition to your own. Yet such cooperation does exist in nature in abundance. In his seminal paper on reciprocal altruism, Trivers (1971) cited cleaning symbioses (seen in over forty-five species of fish and six species of shrimp), bird calls (which often warn the entire flock of approaching predators), and extensive cooperative efforts among humans, as examples of evolved reciprocity. Weighing heavily in this literature, evolutionary biologists Axelrod and Hamilton point out in the opening paragraph of their much-cited paper on models of reciprocity (1981, p. 1390): "The theory of evolution is based on the struggle for life and the survival of the fittest. Yet cooperation is common between members of the same species and even between members of different species."

Of the various explanations offered for this phenomenon, four have perhaps had the greatest impact. They are Hamilton's rule (Hamilton, 1964), communalism, mutualism, and reciprocal altruism. Hamilton's rule (sometime referred to as kin selection) shows that fitness benefits can accrue to those who preferentially aid

individuals with whom they share genes (relatives or kin). Fitness is measured in terms of the number of copies of a gene passed on to subsequent generations (rather than simply number of offspring produced). When modeled in this way (by tracking genes), it can be shown that individuals can increase their fitness either by producing their own offspring OR by aiding the reproduction of genetic relatives--as long as the degree of relatedness (number of genes shared) is high enough so that the benefits that accrue to the recipient are greater than the costs that accrue to the actor. In communalism, the interaction is beneficial for one and harmless to the other (i.e., birds eating insects off giraffes). In mutualism, both organisms benefit from the interactions (i.e., bees and flowers, clown fish and anemones).

Reciprocal altruism is a bit more complicated. Each individual helps another individual while also helping himself or herself (Trivers, 1971, p. 39). Conferring a benefit on the partner usually involves incurring a cost to oneself. The problem is that while a given individual can benefit from cooperating, he or she can usually do better by exploiting the cooperative efforts of others, that is, by accepting the benefits of the cooperative venture without reciprocating. In that case, the defector reaps the biggest reward, having gotten the offered benefit without reciprocating, while the cooperator suffers the costs involved in cooperating while reaping none of the benefits. The latter outcome is disadvantageous to survival. Failure to reciprocate is termed “cheating” (Trivers, 1971, p. 39), and in single-shot cooperative ventures, cheating (defection) is indeed an evolutionarily stable strategy (Axelrod & Hamilton, 1981). The situation changes dramatically, however, if (a) participants will have future opportunities to cooperate (as would be the case in a stable social group), and (b) participants can recognize each other. Under these conditions, reciprocity can evolve as an evolutionarily stable strategy *only if* those who fail to reciprocate are punished through exclusion from subsequent cooperative ventures. One of the most robust strategies to emerge in modeling research under these conditions is “Tit for Tat” in which a party chooses to cooperate on the first round, and then matches whatever the other player did on the preceding move in subsequent rounds.

Cooperation can have a marked impact on reproductive success by influencing the status of the cooperators. Changes in status typically occur when lower-ranking individuals challenge higher-ranking ones. Among male primates, rank within the dominance hierarchy is acquired and maintained through dyadic aggression, and alliances determine the fate of outranked individuals, including alpha males whose rank is usurped (Chapais, 1988 and 1992; Harcourt & de Waal, 1992; Riss & Goodall, 1977; Uehara, Hiraiwa-Hasegawa, Hosaka, & Hamai, 1994). Alpha males who form or already possess strong alliances with other males maintain a relatively high, stable position within the group, while those who have no alliances or weak alliances are ostracized, maintaining a solitary existence outside the group (Goodall, 1986; Uehara, Hiraiwa-Hasegawa, Hosaka, & Hamai, 1994). Importantly, these alliances are formed and maintained through cooperative effort, or more precisely, through the formation of reciprocal obligations. During agonistic encounters, individuals typically call for help, and *non-kin* allies are more 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 (Seyfarth & Cheney, 1984; de Waal, 1989). Similarly, they punish non-cooperators by directly aggressing against them when they themselves request help (de Waal, 1989), failing to come to their

aid, or by misinforming or failing to inform them about the location of food (Woodruff & Premack, 1979).

Not all alliances are equally effective, and, like human children, non-human primates often seem to focus their alliance-building efforts on higher-status individuals. For example baboons, macaques, and vervet monkeys form matrilineal hierarchies in which any female is dominant to all the females that are subordinate to her mother, and she is subordinate to all the females that are dominant to her mother (Cheney & Seyfarth, 1990). During agonistic encounters, support is typically given to the higher-ranking females who in turn intervene in conflicts when they themselves are dominant to the target of the aggression. By aiding higher-ranking females, lower-ranking females form strong alliances based on reciprocal obligations that enable them to move up in rank. As any eighth grader or high-schooler can tell you, survival in a hierarchical social environment depends on having loyal and powerful friends, and acquiring such friends is facilitated by doing them favors.

What counts as sufficient reciprocation also depends on the relative status of the individuals involved. Among those close in rank, 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, 1992). But high-ranking individuals need not reciprocate as often as subordinates in order to maintain an alliance (Chapais, 1988; Chapais, 1992; Seyfarth & Cheney 1984). The most frequent explanation given for this is that greater benefits derive from their interventions due to their priority of access to physical and social resources.

Among humans, the majority of research on reciprocity has come from experimental economics in which partners are given the opportunity to cooperate or defect in Prison Dilemma-like scenarios. With few exceptions, these studies have tended to analyze reciprocity as though it existed in a social vacuum in which two anonymous agents with equal exogenous status and no prior social history reach a fair outcome. The striking thing about many of these studies is how frequently people's decisions appear inconsistent with rational choice theory. For example, Weg and Smith (1993) gave subjects the opportunity to win money in transactions based on repeated 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. The subjects' choices perhaps appear more rational when viewed through the lens of evolutionary biology models of reciprocity. These subjects seem to come to the task biased toward cooperation, then (as in Tit for Tat), respond in ways that reward fellow cooperators and punish defectors (through exclusion or retaliation). Indeed, studies by Fehr and his colleagues suggest that the ability to detect and punish cheaters has a large influence in producing cooperative outcomes that deviate from standard game-theoretic predictions (Fehr & Gächter, 2000; Fehr, Gächter, & Kirchsteiger 1997; see also Güth & van Damme, 1998).

Even more striking are results of studies that employ the *dictator* game in which two people are jointly assigned a provisional sum of money. One person, the *dictator*, then decides how the money is to be split between the two. Standard self-interested economic analyses predict that dictators should award themselves the full amount, and many do; but a significant number of dictators and in many cases the majority will give

the other person a nontrivial amount of the money (e.g., Forsythe, et al., 1994; Hoffman, Hoffman, McCabe, Shachat, & Smith, 1994; Hoffman, McCabe, & Smith, 1996; Johannesson & Persson, 2000). In a variation of this game, called the *ultimatum* game, the other person is given the opportunity to either accept the proposed split or turn it down causing both players to walk away with nothing. In these studies, significantly more *proposers* (equivalent to dictators in the dictator game) offer the responder a nontrivial amount of the money with the modal offer usually being a 50:50 split. According to standard game-theoretic analyses, the addition of this second phase of play should make little difference to the proposed divisions. Given that the proposer has all the goods up front, responders should favor a single penny over nothing at all (which is what they'll each get if the responder declines), and the proposers knowing this should offer the responders as little as possible.

These results suggest that individuals come to these tasks with normative standards of fairness, and behavior that departs significantly from these norms elicit retaliatory, spiteful, or other apparently “irrational” responses. In the case of strangers of presumably equal status but demonstrably unequal power (as in the dictator and ultimatum games), the normative expectation seems to be a 50:50 split. Proposers and dictators appear to take these implicit norms into consideration when making decisions, and *their decisions are guided in large part by distance from the expected normative division*. Use of this metric results in decisions that depart significantly from predictions based on simple self-interest.

The workings of this “implicit normative metric” is perhaps most apparent in a series of studies by van Dijk and Vermunt (2000). These researchers had people play the dictator and ultimatum game with a special twist: Proposers and dictators received twice the value of each token being divided, while their partners received the stated value of the tokens. In one version of the games, both players knew about the arrangement (symmetric information). In a second version, only the proposers/dictators knew that they would receive twice as much money for each token (asymmetric information). This manipulation had no effect in the dictator game; dictators made a modal offer of two thirds of the tokens for their opponents under both information conditions. But it had a large impact in the ultimatum game; proposers made modal offers of two thirds of the tokens (an equal monetary value distribution) for their opponents in the symmetric information condition, but they exploited their opponents' ignorance in the asymmetric information condition by making a seemingly fair offer to split the tokens in half (with more of the actual monetary surplus going to the proposers). Van Dijk and Vermunt interpreted these results to mean that differences in the distribution of power between these two games were responsible for participants acting more generously in the dictator game than in the ultimatum game. They suggested that in situations involving strong power asymmetries (as in the dictator game), normative considerations will predominate, whereas in situations involving more equal power relations (as in the ultimatum game), strategic considerations will predominate.

Perhaps the most interesting aspect of these results is that they suggest priority of access to resources (as in the dictator game) may sometimes elicit a sense of “pastoral responsibility” toward the other, more powerless party. Using a different methodological approach, Fiddick and Cummins (2002) explored the impact of differential status, economic resources, and social relationship on tolerance toward cheating. Subjects were

asked to consider a carpooling arrangement in which one party agrees to pay for gasoline if the other party does all the driving. They were shown hypothetical ledgers showing gas payments that indicated varying degrees of compliance on the part of the gas-paying partner (from 100% compliance to as little as 25%), and were asked to indicate (a) their willingness to continue the arrangement and (b) their perception of how fairly they'd been treated. In some scenarios, the two parties were of equal status (both employees) and in some they were of unequal status in that one was an employee and the other a boss. Participants were found to be far more tolerant of cheating when they adopted the perspective of the higher-status person (which the authors referred to as a "noblesse oblige effect"). These results could not be interpreted simply in terms of asymmetrical costs and benefits. Participants judged the employee to derive more of a benefit from the carpooling arrangement than the boss, and there was no difference in the perceived costs paid by the employee and his boss (Fiddick, et al., in prep.). Further, the results obtained even when the employee was described as making more money than the boss (due to other income sources for the employee). Only two factors seemed to attenuate this effect. The first was removal of the social relationship between the parties. If the parties were described as having met through a classified ad rather than one being the other's employee, noblesse oblige disappeared; equivalent levels of intolerance for cheating was found regardless of whether the reasoner took the perspective of employee or boss. This strongly suggested that it was asymmetries in the social relation and not asymmetries in costs and benefits that underlie the effect. The second factor was culture. European subjects (Germans and Britons) showed the effect more strongly than North American subjects (Americans and Canadians), presumably due to differences in political histories (e.g., a history of feudalism in Europe). Instead of asymmetrical costs and benefits, these results suggest that status impacts *expectations concerning appropriate behavior*. Cheating a person of lower-status appears to be more unacceptable than cheating a person of higher-status. Together with the results of Cummins (1999a) and Mealey et al., (1996), these results suggest that high-status carries with it an expectation of pastoral responsibility; high status individuals are expected to monitor compliance with laws and contracts, yet show tolerance during enforcement if the miscreant is of lower status than the cheated individual. It is too soon, however, to draw any definitive conclusions about the role played by status with this data base. More research on this topic is needed, particularly research based on Prisoner Dilemma studies which allow actual (as opposed to imaginary) money to change hands.

3. How Development Informs Evolutionary Explanations of Social Dominance Effects

The thesis of this chapter is that the necessity of surviving and thriving in a social environment yields evolutionary pressure that shapes the physiological systems involved in neuroendocrine reactivity, cognition, and emotion. With respect to the first and second of these, we have seen how subtle changes in perceived relative status can produce large neuroendocrine and emotional responses. These responses are (in the long run) predictive of overall health and mortality.

With respect to the cognition, the evolutionary effects of sociality is plainly evident in cognitive development. We are intensely social beings from the moment of birth. Newborns (no more than a few minutes old) show a distinct bias for looking at

faces as compared to other equally complex stimuli (Goren, Sarty, & Wu, 1975). Ten-week-old infants have been found to distinguish among emotional facial expressions (d'Entremont & Muir, 1997). Within the first year of life, infants also engage in social referencing, looking at their caregivers' reactions to novel stimuli (e.g. Stenberg & Hagekull, 1997). And by two years of age, they can succeed at tasks that require them to grasp another's goals, desires, or preferences (e.g., Bartsch & Wellman, 1989). But, as we saw, becoming a fully-functioning social agent involves more than preferring social stimuli. It also requires inducing the rules that constrain behavior in one's social group, monitoring the behavior of oneself and others with respect to them, and developing the skills necessary to compete and cooperate effectively with others in order to achieve one's social goals--even if that entails the use of deception.

Developmental research has shown that, like language acquisition, very young children show a marked *precocity* for acquiring social rules and monitoring compliance with them. Children as young as 16 months of age look longer at visual displays depicting violations of arbitrary social rules than at similar displays that do not constitute violations of social rules (Cummins, 1999b). Reference to social rules appear in children's justifications of their behavior as early as 24 months of age (Dunn, 1988), and by 2 1/2 years of age, children distinguish between social conventions and moral rules, using these distinctions to discipline their inferences concerning acceptable behavior (Hollós & Turiel, 1986; Nucci, Turiel, & Encarnacion-Gawrych, 1983). When asked to test compliance with social rules, 3-year-olds have been found to spontaneously seek out potential rule-violations just as adults do (Cummins, 1996c), readily distinguish rule-violating behavior from compliant behavior (Harris & Nuñez, 1996), and give cogent explanations as to why violating instances constitute violations of the rule (Harris & Nuñez, 1996). In fact, their performance is equivalent to adults on these social reasoning tasks (Cummins, 1996c). In contrast, when asked to perform a non-social task of apparent equal complexity (test the truth of a rule rather than monitor compliance), children in this age group not only fail to seek out potentially falsifying evidence (Cummins, 1996b), they also fail to distinguish confirming from falsifying instances and cannot give coherent justifications for their decisions (Harris & Nuñez, 1996). And with respect to deception, dominant preschoolers (like their adult counterparts) not only are more successful at directing the play activities of their peers but at deceiving them (and adults) as well.

These striking differences in performance are important because, unlike other characteristics of cognitive development, they don't go away with maturity. For nearly three decades, psychologists have noted that adults reason more effectively about some domains than others. One of the most robust domain-specific effects is seen in the realm of social reasoning. When reasoning about prescriptive rules (social norms), adults spontaneously look for possible violations of the rule, that is, they look to see who might be breaking the rule (Cheng & Holyoak, 1985, Cosmides, 1989; Cummins, 1996c, Gigerenzer & Hug, 1992; Manktelow & Over, 1991 and 1995). Violation detection is appropriate for other types of reasoning tasks, such as evaluating the truth of a statement or rule, yet is rarely observed. This reasoning strategy seems to be triggered almost exclusively by problems with social content, particularly permissions, obligations, prohibitions, promises, and warnings. The magnitude of the difference in performance on truth-testing and violation-detection versions of these tasks in the adult literature is identical to that in the developmental literature (10-30% correct on truth testing vs 60-

90% correct on social versions of the same tasks). This means that the advantage for social reasoning emerges early in development and continues to color reasoning performance throughout the lifespan. The average three year old appears to have as firm a grasp on the implications of socially prescriptive rules as the average adult. As any parent knows, unfortunately, this hardly guarantees compliance; indeed, the ability to flout social rules increases as the ability to deceive emerges. For example, two-year-old toddlers can appreciate other's intentions and goals, and can effectively thwart them from reaching those goals through sabotage (such as locking a box or erasing footprints), it is not until later in development (after the emergence of a "theory of mind" at about 4-5 years of age) that they can effectively thwart others by manipulating their beliefs or other means of deception (Sodian, 1991). As their ability to manipulate beliefs develops, so does their ability to flout social rules and influence others.

4. Sex differences in status striving

Among mammals, there is a significant difference between potential reproductive success of males and females, namely, that the ceiling for male reproduction is much higher for males than females. This is because sperm are plentiful compared to eggs, and females necessarily invest more energy in reproduction than do males (e.g., pregnancy and lactation), and are typically more involved in the care of very young offspring (i.e., infants and toddlers). Male mammals, on the other hand, are not obligated to invest heavily in their offspring. They can, in a sense, drop their genes and go.

Comparatively speaking, therefore, female reproduction is limited by access to resources while male reproduction is limited by access to mates. Once a pregnancy has occurred, females cannot increase their reproductive success by engaging in further matings. Because of the greater cost to females in producing young, they instead can increase their lifelong reproductive success by investing in their offspring to ensure their survival. In contrast, males can increase their reproductive success by maximizing the number of fertile females with whom they mate. If the number of males in a population is approximately equal to that of females, then there exists enormous pressure for competition among males for access to fertile females, and there will exist greater variability among male reproductive success: For every male who gains reproductive access to a disproportionate share of females, other males lose opportunities to reproduce. It is here that status differences begin to have major impact. Generally speaking, the higher the status a male enjoys, the greater access to potential mates he also enjoys.

This point is perhaps most clearly demonstrated by the results of a large historical study of six early civilizations that spanned four continents and four thousand years (Betzig, 1993). Despite numerous differences among the cultures, there existed a remarkably consistent pattern with respect to status-based differential sexual access among men. Rich nobles maintained harems that included dozens—sometimes hundreds—of women. In India, for example, Bhupinder Singh maintained 332 women in his harem, while many commoners were so poor they could not afford wives at all. Similar disproportionate mating systems were observed in China, where princes maintained harems of hundreds of women, generals had thirty or more, upper-class men housed six to twelve, and middle class men kept three or four. Sometimes the number of women who could be “distributed” among the male populace was regulated by law. According to Incan law and custom, “principal persons” were given fifty young women,

leaders of vassal nations thirty, heads of provinces of more than 100,000 people were given twenty, governors of at least 100 people were given eight, petty chiefs seven, smaller chiefs five, and so on. Women, in short, were distributed like property strictly according to the status of men.

Status appears to improve male sexual access even when women are given (relatively speaking) more choice in the matter. By definition, higher status men have access and control of greater resources than do lower status men, and, as was pointed out earlier, female reproduction is limited by access to resources necessary to support pregnancy, lactation, and caring for the young. This makes high status men more desirable to females than low status men (Buss, 1994; Hill & Hurtado, 1996). This is most starkly demonstrated by the fact that women in polygynous societies that restrict the avenues women may pursue to obtain resources typically prefer to be one of many co-wives of a prosperous man than the only wife of a poor one (Betzig, 1986). In western cultures that have legally enforced monogamy and relatively greater financial opportunities available to women, high status men are nonetheless still preferred as mates, and as partners in extramarital affairs (Baker & Bellis, 1995; Perusse, 1993). The key factor here seems to be differential distribution of resources between the sexes. In their study in Hungary, Bereczkei, Vorgos, Gal, and Bernath (1997) found that females did not seek mates with resources as frequently as females in other nations. Since the collapse of communism in Hungary, there are still relatively few men with an income sufficient enough to maintain a family. The researchers speculate that, because of this, females in this culture have shifted their attention to cues other than those referring to resources when seeking mates (Bereczkei et al. 1997). Related research indicates which cues women attend to depends in large part on what their goals are in the dating game.

Kelly and Dunbar (2001) had 120 subjects (aged 18-55 yrs) rate eight profiles of imaginary male personalities designed to portray the presence or absence of the qualities of altruism or bravery. They found that altruistic males were preferred for long-term relationships and friendships. But for short-term liaisons (i.e., flings or affairs) females preferred non-altruistic, risk-prone, and brave males to altruistic, risk-averse, or non-brave males, and that men were aware of these preferences. Not surprisingly, then, men tend to engage in "display behavior" that signals these qualities. Sadalla, Kenrick & Vershure (1987) found that dominant behavior in males increased female's sexual attraction to them, but such behavior in females was not related to sexual attraction in males. This was true despite the fact that male dominance was not related to general likability. In other words, females in these studies found dominant males more sexually attractive even though they didn't like them much. Following up on this, Graziano, Jensen-Campbell, Todd, & Finch (1997) (using structural equation modeling) found that men who were not likeable were not attractive regardless of their dominance status. For men who were perceived to be likeable, however, dominance enhanced their physical attractiveness significantly. In another set of studies, researchers employed computer graphic techniques to manipulate the "masculinity" or "femininity" of a composite male face (Penton-Voak, Perrett, Castles, Kobayashi, Burt, Murray, & Minamisawa, 1999). The same results obtained: Females found highly masculinized faces more attractive when they were in the most fertile segment of their menstrual cycles.

Given that women apparently reward men for these dominant personality traits, it should come as no surprise that men score higher in social dominance orientation than do

women (Pratto, 1996): They tend to prefer social hierarchies, endorse an ideology that sanctions domination of one group over another, and the allocation of more perks to one group than another. This sex difference has been observed in numerous cultures, including Sweden, which is one of the most egalitarian cultures in the world (Buss, 1994).

Intra-sexual competition among females has received less attention from researchers than has intra-sexual competition among males. This seems partly due to the fact that females compete in far subtler ways than do males, ways that are opaque to those who don't know the game. These differences are perhaps most starkly apparent in the results of studies of female middle- and high-school cliques (Simmons, 2002; Crick, 1996; Crick & Grotpeter, 1995). The overall profile of sex differences that is emerging from this body of research shows that males tend to use direct confrontation to dominant and subdue potential threats and rivals. Females, on the other hand, prefer to use indirect means that can easily go undetected by teachers and others not involved in the devious attack, such as spreading rumors aimed at ruining a potential rival's reputation, excluding, ignoring, and isolating her socially, staring in order to intimidate her into silence, and derogating the rival when "popular" boys are nearby. This is referred to as "relational aggression." The effectiveness of these strategies lie in the fact that they hit the opponent "where they live": When threatened, males attempt to fight or flee, while females attempt to "tend and befriend", that is, engage in caretaking of their loved ones and strengthen social ties (Taylor, Klein, Lewis, Gruenewald, & Updegraff, 2002). To disable a rival, therefore, males tend to attack while females attempt to socially isolate her through exclusion, malicious gossip, and reputation damage. Females describe such strategies as "destroying" a rival.

5. Emotional, psychological, and strategic responses to loss of status. Losses in status can have devastating consequences for social agents. Some are readily perceived and measured, such as demotion at work yielding a reduction in pay and the concomitant negative impact on one's family. Others are more subtle yet still profound.

A loss of status can produce a deep sense of shame in the individual which is communicated tacitly by avoiding eye contact with others, lowering one's chin, hunching one's body posture, and avoiding social encounters (Wicker, Payne, & Morgan, 1983). In some circumstances, loss of status can evoke feelings of rage and depression (Gilbert, 1990). While rage may motivate the individual to retaliate, depression may prompt submissive behavior to appease others or to prevent further humiliation (Forrest & Hokanson, 1975).

Envy is perhaps the most frequent and most destructive—yet least studied—emotional response to perceived losses or inequalities in status. People experience envy when someone else has something they desire for themselves. The things that evoke envy may be tangible object (such as more money, a better house, a more desirable mate, more or better friends) or intangible qualities (such as being better looking, smarter, taller, or more popular). Such individuals are sometimes referred to as "tall poppies", or "one whose distinction, rank, or wealth attracts envious notice or hostility (Ramson, 1988). As such, they are obvious targets for envy, and for the destructive behavior that envy can unleash. For example, Feather (1994) found that the most common emotional reaction to tall poppies was envy, especially if the tall poppy's success was in a domain that was

important to the individual. Moreover, the negative reaction respondents felt toward tall poppies depended in part on their own degree of satisfaction with themselves in that people with low self-esteem reported more envy and more delight at the apparent fall of tall poppies than did people with high self-esteem. Similarly, Salovey and Rodin (1984) conducted a study in which participants were told that their standing on a self-relevant characteristic was worse than that of a successful peer. After receiving this information, participants were found to verbally derogate the successful peer, were less likely to seek friendship with that person, and reported feeling more depressed and anxious about interacting with that person. Another way to put it is that people like other people to the extent that they feel good about themselves when they're with them. Tall poppies make others feel diminished, and the dislike they attract is proportional to the discomfort others feel in their presence. This discomfort can provoke "retaliatory" behavior on the part of the "diminished" person, such as destroying the tall poppy's reputation through malicious gossip, social ostracism, or loss of job or other forms of income.

6. Conclusions

Does this mean that social hierarchies are a biological imperative? On the contrary, few aspects of human behavior are so rigidly determined. The breadth and depth of human cognitive functions enable us to reflect on the outcomes of our choices even before we make them. As Richard Dawkins (1976, p. 215) put it,

"We have the power to defy the selfish genes of our birth.."

And as philosopher Dan Dennett (1984, p. 45) further elaborates

So although we arrive on this planet with a built-in, biologically endorsed set of biases...we can nevertheless build lives from this base that overthrow those innate preferences. We can tame and rescind and (if need be) repress those preferences in favor of "higher" preferences...

The point of this chapter was to show how Darwinian processes have produced a complex network of cognitive, emotional, and physiological systems that bias us toward producing this kind of social structure, how we are wired from higher cognition right on down to our neuroendocrinology to detect minute changes in our status vis a vis others. From this perspective, the Columbine tragedy and its more recent counterparts should come as no surprise. When Darwinian processes are allowed full play--that is, when human beings are placed in competitive circumstances with very little oversight from benign governing bodies--there is a very high degree of risk that social dominance hierarchies will emerge in their ugliest incarnation. Human history and current newspapers are clear testaments to this on a grander scale than our high schools. In its most benign form, social dominance means nothing more than the fact that some individuals are more adept at influencing and therefore leading others. In its most malignant form, social dominance can mean despotism--the monopolization of resources by a privileged few who use their social advantages to oppress others. Ironically, the direction human societies take (including micro-societies such as corporate businesses, universities, and even human families) depends in large part on the beliefs and

personalities of the dominant individuals within them. It has been effectively argued by historians that the major reason the American revolution and French revolutions played out so immensely differently despite taking place during the same historical time period can be directly traced to the philosophical readings that influenced the architects of those revolutions (*Wall Street Journal*, July 14, 1989). The American revolution was grounded in ideas of the Anglo-Scottish Enlightenment, particularly the writings of John Locke, David Hume, and Adam Smith. In this tradition, a person is a political creature some of the time but is primarily a private individual—a parent, spouse, worshiper, or worker. Accordingly, the American revolution sought to weaken and fracture political power in favor of individual right to privacy. In contrast, the French revolution took its crucial ideas from the French Enlightenment, led by Jean Jacques Rousseau. This tradition sought to transform the human condition by strengthening the power of the central government into a single indivisible unit. All individual acts were seen in a broader political context.

If the analysis of social dominance, social hierarchies, and social power offer here is on track, then the steps that should be taken to avoid the malevolence that can erupt from unbridled Darwinian processes, such as the nation saw in the Columbine tragedy, are clear: It is the dominant individuals who must be identified and influenced to create a "kinder, gentler" social environment because it is they who wield the kind of social power that can effect true and lasting changes.

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