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Cheater Detection is Modified by Social Rank: The Impact of Dominance on the Evolution of Cognitive Functions

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Cheater detection plays a crucial role in biologial and psychological theories of the evolution of cooperation and reciprocity. Here it is argued that cheater detection plays a broader role in social coordination as a fundamental, primitive cognitive adaptation to dominance hierarchies. In functional terms, dominance means that certain individuals have priority of access to resources in competitive situations. In cognitive terms, dominance hierarchies constitute a set of social norms that reflect which behaviors are permitted, prohibited, or obligated given one's rank. In order to maintain priority of access to resources, dominant individuals monitor the behavior of subordinates and aggress against those who "cheat" (violate social norms). An implication of this analysis is that higher-ranking individuals should be more likely to detect cheating in lower-ranking individuals than vice versa. Two experiments are described that support this prediction. In the first experiment, people were far more likely to look for cheaters when monitoring compliance of lower-ranking individuals on a social norm reasoning task than higher- or equal-ranking individuals. In the second, the same result obtained when reasoners were required to switch perspectives: More cheater detection was observed when reasoners adopted a high-ranking than a low-ranking perspective.

KEY WORDS: Dominance; Social norms; Cheater detection; Violation detection; Cognition.

Studies of human reasoning performance have repeatedly shown that people reason more efficiently about some domains than others (Cheng and Holyoak 1985; Cummins 1995, 1996a, 1996b; Cummins et al. 1991; Evans 1989; Gigerenzer 1998; Gigerenzer and Hug 1992; Griggs and Cox 1982). Domain-specific effects prove troublesome to cognitive scientists who embrace the prevailing view that human reasoning architecture is best characterized as a general

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problem-solver. One particular content effect whose explanation has been the source of considerable controversy is the *deontic effect.* When reasoning about problems with deontic content (such as permissions, obligations, promises, prohibitions, etc.), people spontaneously adopt a *violation-detection strategy*, looking for instances of rule-breaking or *cheating* (Cheng and Holyoak 1985; Griggs and Cox 1982; Johnson-Laird et al. 1972). Violation-detection is appropriate for other cognitive tasks of seemingly equivalent complexity, such as truth-testing and hypothesis-testing, yet is rarely observed; instead, people spontaneously adopt a strategy of seeking confirming evidence when testing truth, often ignoring potentially useful disconfirming evidence (Oaksford and Chater 1994; Reich and Ruth 1982; Wason 1960; Wason and Johnson-Laird 1972; also see Cummins 1996a for a review of this literature). This social reasoning advantage emerges early in life, having been observed in children as young as 3 years of age (Cummins 1996b; Harris and Nuñez 1996).

There is no accepted explanation for this robust effect. Initially, content-based reasoning performances differences like these were attributed to error or bias in human reasoning (Evans 1989; Rumain et al. 1983; Wason and Johnson-Laird 1972). Cheng and Holyoak challenged that interpretation by offering Pragmatic Reasoning Schema Theory, a theory in which content effects in human reasoning reflected the operation of domain-specific schemas induced through experience with frequently occurring classes of problems such as permissions and causations (Cheng and Holyoak 1985, 1989; Holyoak and Cheng 1995). Recently, several researchers have all separately argued that the key factor in triggering violation detection is the presence of deontic content in a problem, that is, content of a social nature dictating what one may, must, or must not do in a given socially defined set of circumstances (Cosmides 1989; Cosmides and Tooby 1992, 1994; Cummins 1996a, 1996b, 1996c, 1996d; Manktelow and Over 1991, 1995; Oaksford and Chater 1994, 1996). The dividing line among these theories is whether the deontic effect is thought to reflect nothing more than statistical or logical properties of the problems that are detected and exploited by a "general problem-solver" (Manktelow and Over 1991, 1995; Oaksford and Chater 1994, 1996) or whether it is taken to reflect properties of human reasoning architecture (Cosmides 1989; Cosmides and Tooby 1992, 1994; Cummins 1996a, 1996b, 1996c, 1996d, 1997, 1998, in press-a, in press-b).

Seeing a connection between violation detection in the psychology literature and cheater detection in evolutionary biology, Cosmides and Tooby argued that deontic content effects reflect the evocation of innate, Darwinian algorithms for cheater detection that evolved in humans in response to pressure to reason about *social exchange*, which they define as cooperative effort for mutual benefit (Cosmides 1989; Cosmides and Tooby 1992, 1994). Their theory, called Social Exchange Theory, is based on modeling research in evolutionary biology showing that reciprocity cannot evolve as an evolutionary stable strategy unless individuals can recognize cheaters and exclude them from future transactions (Axelrod 1984; Maynard Smith 1982; Trivers 1971). Cheating is defined as *taking a benefit without paying a cost. According to Social Exchange Theory, then, cheater detection is a species-specific cognitive adaptation for social exchange.*

In contrast, Cummins has argued that *cheater detection constitutes a primitive cognitive adaptation for classes of problems that are critical to the evolution of sociality in many species*, including detection of dishonest or unreliable signaling, deception, and compliance with implicit social norms, as well as monitoring reciprocity. Accordingly, the "cheater detection effect" that is so apparent in human reasoning performance reflects a biological preparedness on the part of social animals to acquire or develop cognitive functions that allow them to monitor the behavior of conspecifics and extract the rules that constrain behavior within one's social group. In particular, Cummins has proposed a theory, called Dominance Theory, that is based on an analysis of *the problems associated with living in social dominance hierarchies and the minimum cognitive functions that are required to solve them* (Cummins 1996a, 1996b, 1996c, 1996d, 1997, 1998, in press-a, in press-b). Violation-detection constitutes one of these functions in that it is implicated in the acquisition and maintenance of dominance rank. Low-ranking individuals attempt to improve their access to competitive resources through acts of *cheating* and *deception.* Dominant individuals attempt to maintain priority of access to resources by *detecting and thwarting acts of cheating and deception.* Further, high-ranking positions are acquired and maintained through the formation of alliances based on *reciprocal obligations*, alliances that are discontinued if one party repeatedly fails to reciprocate (i.e., *cheats on the implicit reciprocal agreement*).

DOMINANCE THEORY

The fundamental tenet of Dominance Theory is that, from a cognitive standpoint, a social dominance hierarchy constitutes a set of *implicit social norms* that reflect which behaviors are *permitted, prohibited*, or *obligated given one's rank.* Among social primates, 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 (Aruguete 1994; Hall 1964). In functional terms, dominance means that certain individuals have *priority of access* to resources in competitive situations (Clutton-Brock and Harvey 1976). 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: 33–34), and more likely to leave living offspring (Clutton-Brock 1988; Dewsbury 1982; Ellis 1995; Fedigan 1983; Hausfater 1975; McCann (1981) Tutin 1979; Watts and Stokes 1971). Among primate 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.

Low-ranking individuals attempt to improve their access to resources through *cheating* and *deception.* For example, they maintain possession of desirable objects or engage in forbidden behaviors 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 (Byrne 1995; Mitchell 1986; Whiten and Byrne 1988). They also move forbidden trysts out of line of sight of dominant individuals and suppress copulation cries to avoid detection (de Waal 1988; Kummer 1988).

As is apparent, most of these acts of cheating and deception allow lower-ranking individuals to *violate social norms* without getting caught. This can have enormous beneficial consequences for the cheater or deceiver. First, subordinates who use these tactics improve their access to resources, particularly reproductive resources. Gagneux et al. (1997) report that more than 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 estrous and reappeared a few days later. During these times, they had apparently engaged in clandestine matings. Second, through surreptitious food sharing or grooming, alliances are formed with forbidden individuals that can be called on during contests of rank (Chapais 1992; Cheney and Seyfarth 1990: 67–69; de Waal 1989, 1992; Prud'homme and Chapais 1993; Seyfarth 1976; Seyfarth and Cheney 1984).

The costs associated with cheating can be quite high, because dominant individuals maintain priority of access to resources by *detecting and punishing cheaters*, that is, those who attempt to access resources that are forbidden them. For example, high-ranking individuals often punish acts of cheating as benign as grooming or sharing food with forbidden individuals (de Waal 1992: 246–249) as well as more serious transgressions such as attempting to mate with estrous females (de Waal 1992). Indeed, Hall (1964) designated perceived violations of the "social code" as the single most common cause of aggression in primate groups.

Cheater detection is therefore crucial to *maintaining* priority of access to resources, and what constitutes cheating is simply *violating implicit social norms.* The benefits that accrue to individuals for compliance are continued acceptance within the social group (i.e., avoiding ostracism) and avoidance of agonistic encounters with dominants who preserve the status quo. The costs that accrue for compliance include lost opportunities to form alliances or garner a larger share of resources.

Cheater detection is also crucial to *attaining* a high-ranking position. Contrary to common wisdom, dominance ranking does *not* correlate with size in many species of primates (Smuts 1985; Walters and Seyfarth 1987). Instead, one's rank in the hierarchy depends crucially on forming and maintaining alliances based on kinship relations or *reciprocal obligations* (Chapais 1988, 1992; Datta 1983a, 1983b; de Waal 1989; Harcourt 1988; Harcourt and Stewart 1987; Seyfarth and Cheney 1984; Smuts 1985; Uehara et al. 1994). 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: 67–69; 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. Further, *failure to reciprocate (i.e., cheating) results in termination of the alliance* (de Waal 1989, 1992). *What*

counts as reciprocity, however, depends on one's rank. High-ranking individuals need not reciprocate as often as subordinates in order to maintain an alliance, presumably because of the greater benefits that derive from their interventions (Chapais 1992; Cheney 1983; Prud'homme and Chapais 1993).

A dramatic example of the relationship among dominance, alliances, and reproductive success was reported by Hall and DeVore (1965), who recorded 53 complete copulations with estrous females by six adult baboon males, including one male who, individually, was the most dominant animal in the troop. Despite his greater individual dominance, this male only achieved eight copulations. His access to estrous females was effectively blocked by a coalition of three males, who, together, achieved more than twice the number of copulations of the other three males. The dominant male in this alliance achieved the majority of these copulations. The alliance this male formed, therefore, resulted in his having a higher rank than his major competitor when in the company of his allies.

To summarize, a social dominance hierarchy is a set of implicit social norms that constrain the behavior of individuals within a social group, with the result that some individuals have priority of access to resources in competitive situations. Low-ranking individuals attempt to increase their share of resources through deception and cheating, which constitute violations of implicit social norms. Dominant individuals attempt to maintain priority of access by detecting violations of social norms and punishing errant individuals. Social interactions within dominance hierachies are therefore shot through with cheating, deception, and violation detection. Further, both cheating/deception and cheater detection are fitness-enhancing in that they have direct impact on access to resources and, hence, survival and reproductive success.

Specific Predictions of Dominance Theory

Applying Dominance Theory to human cognition yields two specific predictions: First, cheater detection should be modified by social rank. Specifically, *higher-ranking individuals should be more likely to detect violations of social rules on the part of lower-ranking individuals than vice versa.* This is because no advantage accrues to detecting higher-ranking cheaters to the extent that lower-ranking individuals are not in a position to enforce social norms on higher-ranking individuals. Furthermore,this advantage of rank is predicted to be observed only on social reasoning tasks; dominance rank should have no effect on nonsocial reasoning tasks such as truth-testing. In contrast, no competing theory predicts differential reasoning performance as a function of perceived social rank.

The second implication is that a social content effect should be observed as long as the reasoning scenario describes a socially prescriptive rule; there is no need for the situation to describe a reciprocal obligation based on cooperative effort for mutual benefit, as predicted by Social Exchange Theory.

To test these predictions, two experiments were conducted in which relative rank was manipulated on the Wason Card Selection Task (Wason 1968). Reasoners were given a conditional statement (if *p*, then *q*). In one version of the task, the con-

ditional was described as a statement someone made, and *the reasoner's task was to test the truth of the statement* (Truth-Testing Task). In another version of the task, the conditional was described as a socially prescriptive rule, and *the reasoner's task was to test compliance with the rule* (Cheater-Detection Task). No explicit costs or benefits were associated with compliance, and no reciprocity was stated or implied. The crucial manipulation was social rank: *The reasoner was required to adopt the perspective of someone who was higher ranking, equal ranking, or lower ranking than the individuals whose behavior they were required to monitor.* The first experiment was a completely between-subject design; subjects either saw the truth-testing or cheater-detection version, and adopted a single perspective. In the second experiment, rank was manipulated within-subject on cheater-detection tasks, with subjects adopting either a high-ranking or low-ranking perspective first, and then switching perspective on a second problem.

EXPERIMENT 1

Method

Subjects. One-hundred sixty students enrolled in Introductory Psychology courses at California State University-Sacramento and the University of California-Davis served as subjects in the experiment. Subjects received credit toward satisfying a research participation requirement for participating.

Materials and procedure. The materials used in this experiment are included in the Appendix. In Experiment 1, the reasoning problems described a situation in a college dormitory. In the cheater-detection version of the task, reasoners were told that there was an important rule in the dormitory, namely, that *if someone is assigned to tutor a study session, that person is required to tape record the session.* People who weren't assigned to tutor the session were not required to tape record the session but could do so if they desired. The reasoners were then shown four cards. One side of each card indicated whether or not the person in question had been assigned to tutor a particular study session and the other side indicated whether or not the person had in fact tape recorded the session. The faces of each card showed, respectively, "Assigned to tutor the session," "NOT assigned to tutor the session," "Taped the session," and "Did NOT tape the session." With respect to the conditional statement, these cards represent *p*, *not-p*, *q*, and *not-q*, respectively. The order in which the cards appeared on the protocol was counterbalanced in a Latin-square design. In contrast to other studies (Cosmides 1989; Gigerenzer and Hug 1992), subjects were NOT explicitly cued to look for cheaters. Instead, they were simply instructed to *select the card or cards that need to be turned over to determine whether or not the person followed the rule.*

In the truth-testing version of the task, reasoners were told that study sessions took place in the dorm, but no mention was made of a rule concerning them. Instead, they were asked to imagine that they had overheard someone say, "*If I'm assigned to tutor a session, I always tape record the session.*" They were then shown the

same four cards described earlier and were asked to *select the card or cards that need to be turned over to determine whether or not the person told the truth.*

Half of the subjects were assigned to the cheater-detection and half to the truth-testing reasoning condition. These two groups were then further subdivided into four conditions, as follows:

- High ranking: The reasoner adopted the perspective of a high-ranking individual (Resident Assistant) checking on low-ranking individuals (Students).
- Low ranking: The reasoner adopted the perspective of a Student checking on Resident Assistants.
- Equally high ranking: The reasoner adopted the perspective of a Resident Assistant checking on other Resident Assistants.
- Equally low ranking: The reasoner adopted the perspective of a Student checking on other Students.

Results and Discussion

Protocols were scored as evidencing a cheater (or violation) detection strategy if the reasoner selected *p* and *not-q*, that is, if they selected the cards labeled *"Assigned to tutor the session"* and *"Did NOT tape the session."* Note that this selection pattern is appropriate for the truth-testing version of the task as well as the cheater-detection version of the task: If the *not-q* card was turned over in the truth-testing case and *"Assigned to tape the session"* appeared on the back, this would constitute decisive proof that the reasoner did not tell the truth.

The results, depicted in Figure 1, were quite clear: Status had a profound effect on the likelihood of adopting a violation detection strategy on the cheater-detection version of the task $\chi^2_{(3)} = 14.91$, $p < .001$, but *not* on the truth-testing version of the task $\chi^2_{(3)} < 1$. The percentage of subjects who adopted a violation detection strategy ranged from 15–20% in every cell except the high-ranking cell in the cheater-detection task. This percentage is comparable to the percent typically reported on truth-testing versions of the Wason task (see Cummins 1996a for a review of this literature). When subjects adopted the perspective of a high-ranking individual checking on lower-status individuals, however, this percentage more than tripled to 65%. As predicted, *reasoners were far more likely to look for cheaters on the cheater-detection version of the task when checking on individuals who were lower-ranking than themselves.* Recall that subjects were NOT explicitly instructed to look for cheaters as they sometimes are in other studies (Cosmides 1989; Gigerenzer and Hug 1992). One might argue that if there were a module (or any other sort of domain-specific strategy) for cheater-detection, it would work whether you instruct it to work or not. But this is a fallacious argument; it would work *if it is triggered.* Explicitly telling people to look for cheaters will surely trigger it. But the point of decades of research has been which problem configurations trigger it in the absence of explicit instruction, and why do some configurations work but not others? These results provide an unbiased estimate of the degree to which social norms and social rank *by themselves*

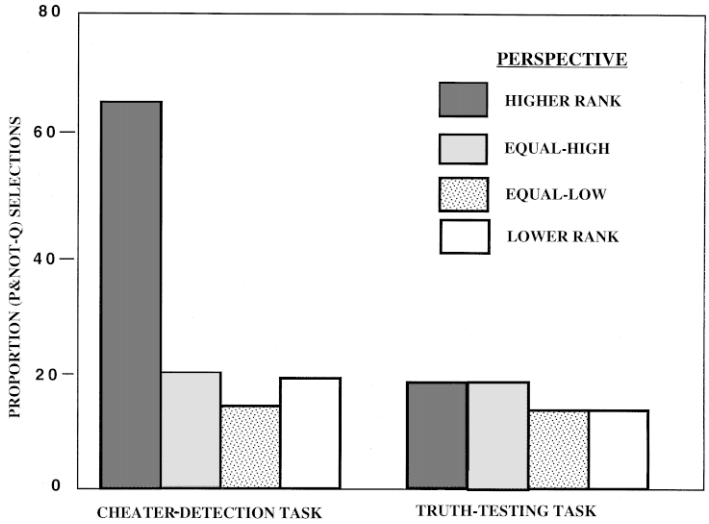

FIGURE 1. Percent violation detection (*p* and *not-q*) responses when reasoners were asked to test compliance with a social norm (Cheater-Detection Task) or the truth of an utterance (Truth-Testing Task) from a higher-ranking, equally high ranking, equally low ranking, lower-ranking perspective (n = 20).

are capable of evoking cheater detection in naive reasoners, and they are consistent with and predicted by Dominance Theory.

EXPERIMENT 2

Experiment 2 replicated the high-ranking and low-ranking cheater-detection task with one important modification: Each subject solved one problem from a high-ranking perspective and one from a low-ranking perspective. Only Dominance Theory predicts greater incidence of cheater detection when reasoners adopt a high-ranking position relative to their targets.

Method

Subjects. One-hundred sixteen students enrolled in Introductory Psychology courses at California State University-Sacramento and the University of California-Davis served as subjects in the experiment. Subjects received credit toward a research participation requirement for serving as participants.

Materials and procedure. Half of the subjects adopted the perspective of a high-ranking individual for the first problem and a low-ranking individual for the second. This order was reversed for the remaining half of the subjects. In order to minimize carry-over effects, two story scenarios were used and a 10-minute map-reading distractor task was interpolated between the two reasoning problems. The two story scenarios were the dormitory story from Experiment 1 and a business story (see Ap-

pendix). The business story required the reasoner to check whether people were obeying the rule *"If it is someone's turn to put a shipment of merchandise away, that person must put the merchandise away immediately."* The four cards consisted of *"It is Smith's turn to put the merchandise away," "It is NOT Jones' turn to put the merchandise away," "Anderson is putting a shipment of merchandise away," and "Johnson is NOT putting the shipment of merchandise away."* When adopting a high-ranking perspective, subjects either read the dormitory story from the perspective of a resident assistant checking on students, or the business story from the perspective of a store supervisor checking on employees. When adopting the low-ranking perspective, subjects either read the dormitory story from the perspective of a student checking on resident assistants, or the business story from the perspective of an employee checking on store supervisors. Story scenario and perspective were counterbalanced so that those who solved the dormitory problem first were given the business problem as their second problem and vice versa.

Results and Discussion

The protocols were scored as evidencing violation detection if the *p* and *not-q* cards were selected. In the dormitory story, this meant selecting "Assigned to tutor the session" and "Did not tape the session." In the business story, this meant selecting "It is Smith's turn to put the merchandise away" and "Johnson is NOT putting the shipment of merchandise away."

The results, depicted in Figure 2, were again quite clear: When subjects adopted a low-ranking perspective first, 41% adopted a cheater-detection strategy. This percentage increased to 65% when subjects switched to a high-ranking perspective on the second problem, a 24% increase (Cochran's $Q = 6.76$, $p < .025$). This means that cheater detection was more likely to be evoked in *the same reasoner* when that reasoner adopted a high-ranking perspective. When subjects adopted a high-ranking perspective first, 50% adopted a cheater-detection strategy, and 40% maintained that strategy when going on to solve the problem from a low-status perspective. This difference was not statistically significant (Cochran's $Q < 2.40$, $p > .05$), suggesting that once cheater detection is primed through adopting a high-ranking perspective, the strategy is maintained. These results are consistent with other studies showing that once cheater detection is primed, it remains active for subsequent problems regardless of content (Cheng and Holyoak 1985). This is sometimes called carry-over effects. Only Dominance Theory, however, predicts that cheater-detection priming or carry-over effects will be triggered by adopting a high-ranking perspective.

DISCUSSION

In each experiment, the incidence of cheater detection varied as a function of the perspective adopted by the reasoner. Adopting a high-ranking perspective relative to targets primed cheater detection. These results are predicted by Dominance Theory.

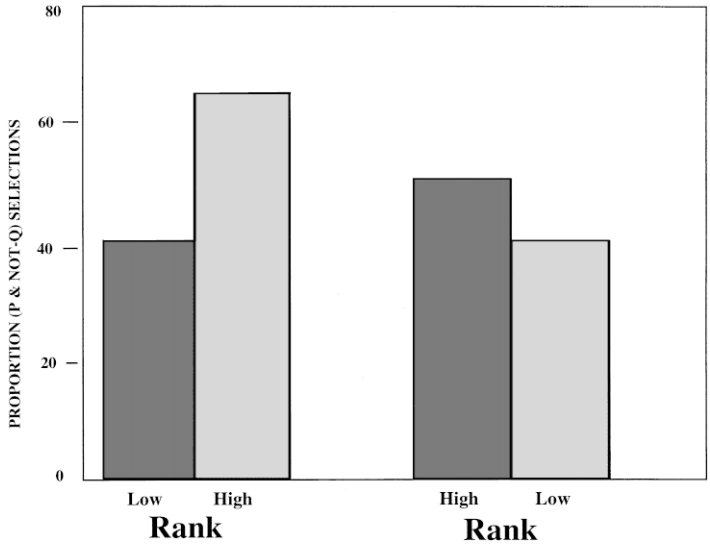

FIGURE 2. Percent violation detection (*p* and *not-q*) responses when reasoners were asked to test compliance with a social norm from a high-ranking or low-ranking perspective. Reasoners either adopted a low-ranking perspective first and than switched to a high-ranking perspective, or vice versa (n = 58).

In contrast, they are not well explained by any of the theories proposed so far—at least as they are currently formulated.

Social Exchange Theory cannot account for the effects reported here for two reasons. First, there is no mechanism in the theory as it is currently stated for taking relative status into account when computing costs and benefits. Second, robust effects were observed here even though there are *no* costs or benefits associated with the prescriptive social rules used, nor is there any hint of reciprocity. The theory could account for the effects reported here by including a social rank parameter that influenced the evocation of cheater detection. But there is a more important relation between Dominance Theory and Social Exchange Theory that must be appreciated.

Reciprocity—particularly reciprocal obligations—are a crucial component in Dominance Theory. As mentioned earlier, high-ranking positions are acquired and maintained through the formation of alliances with non-kin based on reciprocal obligations, such as assisting an individual in an agonistic encounter if that individual has groomed or shared food with you in the past. This is the essence of Social Exchange Theory—cooperative effort for mutual benefit. Social Exchange Theory is therefore a theory about cheater detection used in service of monitoring reciprocity and, therefore, is not wrong in its essentials. Indeed, research with chimpanzees and other nonhuman primates strongly suggest that at least some species of social animals monitor reciprocal obligations and respond to imbalances (cheating) by terminating the alliance (de Waal 1989, 1992), although what constitutes too large an imbalance depends on the relative rank of the participants (Chapais 1992; Cheney 1983; Prud'homme and Chapais 1993). Further, Dominance Theory holds that

higher-ranking individuals should be more likely to detect cheating in lower-ranking individuals than vice versa *only insofar as no advantage accrues to detecting higher-ranking cheaters.* This situation occurs when lower-ranking individuals are not in a position to enforce social norms on higher-ranking individuals. In social contracts, advantages accrue to both parties for detecting cheating, regardless of rank. If the contract is supported by other institutions (legal, etc.) that wield *coercive power*, then subordinates are in fact in a position to enforce social norms on higher-ranking individuals. Under these conditions, one would expect the status effects reported here to be significantly attenuated.

In order to accommodate these results, theories based on a "general problem-solver" view of cognition must include parameters sensitive to social rank that suppress or elicit violation detection strategies. Although such a modification would bring these theories in line with the data reported here, there is no *a priori* reason to justify their inclusion in these systems. By including such parameters, these theorists concede the point that human reasoning performance cannot be explained entirely in terms of general reasoning processes. Cognition is shot through with domain specificity, and the domains that must be accommodated are those that are fitness enhancing.

Schema induction or learning theories, such as Pragmatic Reasoning Schema Theory (Cheng and Holyoak 1985, 1989; Holyoak and Cheng 1995), could accommodate these results through appeal to learned social roles: If people in a particular society believe that the role of authorities is to ensure that others follow the rules, then taking on the role of an authority would activate or prioritize cheater detection in people assigned those roles. There is evidence that having power over people influences decision-making through stereotype activation (Fiske 1995; Goodwin, Operario, & Fiske, 1998; Wegner and Bargh 1998). Such an explanation precludes a need to posit involvement of evolutionary or other biological processes to account for the results other than the evolution of neurological plasticity (i.e., the capacity of brain tissue to acquire/develop complex functions through experience with environmental input). This explanation appears particularly compelling when one considers that the social order in preliterate human societies is often described as "cooperation and reciprocal obligations within a hierarchical structure of authority relationships"–in other words, a dominance hierarchy (Pope Edwards 1982: 276). This is particularly true in human societies with economic surplus (Lenski 1984). Dominance hierarchies are ubiquitous in human societies, and the inequitable distribution of resources that characterizes them leads inevitably to social strife and disharmony. For this reason, humans have ample opportunity to learn about social roles, social status, and the problems that must be solved in socially stratified societies.

These learning explanations, however, beg the question of *why* dominance hierarchies are so ubiquitous in human societies. Nor do they sort well with other data that tip the scales in favor of biological and evolutionary explanations. First, social reasoning is neurologically separable from other types of reasoning (Baron-Cohen 1995; Damasio 1994; McGuffin and Scourfield 1997). Second, cheater detection emerges earlier than lie detection in human development (Cummins 1996b; Haugaard and Reppucci 1992; Wimmer et al. 1984) even though instances of each

type of transgression are abundant, and it is equally important to learn to identify instances of lying as it is to identify instances of cheating. Third, social dominance hierarchies emerge early in human development, having been observed in the play groups of children as young as 2 years of age (Frankel and Arbel 1980; Hold-Cavell and Borsutzky 1986; La Freniere and Charlesworth 1983; Rubin and Caplan 1992; Smith 1988). In fact, social dominance is the earliest stable dimension of peer group social organization and seems to arise more from differences in personality and behavioral predispositions among the children themselves than from social role modelling (Strayer and Trudel 1984). Fourth, dominance effects are seen in basic human cognitive and emotional functions. For example, Hokanson (1961) and Hokanson and Shetler (1961) found that retaliating against an aggressor causes blood pressure 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. Mealey et al. (1996) found better memory on a picture recognition task for low-status cheaters than for high-status cheaters or noncheaters, indicating that status effects influence even this basic cognitive function.

The neurological separability of social reasoning from other types of reasoning (particularly neurodevelopmentally, as in autism and Turner's syndrome), the early emergence of cheater detection during development, and the ubiquity of cheating and cheater detection in the societies of nonhuman primates implicate biological and evolutionary processes in the explanation of the deontic effect beyond the obvious explanation that the brain has an evolved, biological capacity to learn. It suggests, instead, a biological preparedness to acquire certain cognitive functions that were (and are) critical to survival during a species evolutionary history (see following). Further, the ubiquity of social dominance hierarchies in human and nonhuman societies, their early emergence in human development, and the impact of dominance and status on basic cognitive and emotional functions all seem to implicate social dominance hierarchies as a major force in the evolution of higher cognitive functions.

Does this mean that there are "dominance detection" and "cheater detection" modules in human reasoning architecture? The majority of evidence from developmental psychology, ethology, and neuroscience seems to indicate that we neither inherit social reasoning schemas intact nor do we simply induce them from life experiences, but instead we are biologically predisposed to develop cognitive functions that were critical to survival during our evolutionary history. These functions not only develop early, but exert the greatest influence throughout the lifespan. 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. For highly canalized traits, 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 biological predispositions get expressed. For these reasons, the terms "innate module" or "cognitive adaptation" as used by evolutionary psychologists should not be taken to mean "intact at birth" but rather to describe how genes transact with the environment to yield domain specificity in cognitive functions.

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APPENDIX

Materials Used in Experiment 1

Cheater Detection: High Rank

Imagine you have been given the job of **resident assistant** in a college dormitory. Resident assistants are in charge of the dormitory. They are chosen by the administration and essentially run the dormitory. Your most important task is to make sure the university rules are obeyed and applied fairly.

One of the most important rules concerns tutoring. As resident assistant, you must choose tutors for study sessions held in the dormitory on Thursday evenings. The role of tutor is taken very seriously, and only mature, responsible students should be given the job.

The university rule is **IF A STUDENT IS ASSIGNED TO TUTOR A SESSION, THE STUDENT MUST TAPE RECORD THE SESSION.** The administration provides tapes and machines for this purpose.

To make sure the sessions are run properly, records are kept of each study session. This is done by writing information on cards every time a session is conducted. **The front side of the cards indicates whether or not a particular student was assigned to tutor the session, and the back side indicates whether or not the stu-**

dent tape recorded the session. (Sometimes the tutors will show up for sessions other than the ones they are assigned in order to compare teaching methods, and will tape record the session to listen to later. This is perfectly acceptable.)

Below are four records for students in your dormitory. Two of the cards are shown front-side up and the other two are shown back-side up. **Your job is to make sure everyone follows the rule. Look at each card and decide which one(s) needs to be turned over to make sure the students are following the rule. Place an X below your choice(s).**

IF A STUDENT IS ASSIGNED TO TUTOR A SESSION, THE STUDENT MUST TAPE RECORD THE SESSION.

Smith was assigned to tutor the session	Jones was NOT assigned to tutor the session	Anderson tape recorded the session	Johnson did NOT tape record the session

The following modifications were made to produce three additional versions of the Cheater-Detection task:

Equally High Rank: The sentence beginning "As resident assistant" was replaced with "Resident assistants are assigned as tutors for study sessions held in the dormitory on Thursday evenings."

The university rule was changed to **"IF A RESIDENT ASSISTANT IS ASSIGNED TO TUTOR A SESSION, THE RESIDENT ASSISTANT MUST TAPE RECORD THE SESSION."**

All subsequent references to "student" were replaced with "resident assistant."

Equally Low Rank: The opening paragraph was replaced with "Imagine you are a **student** and you live in a dormitory."

The sentence beginning "As resident assistant" was replaced with "Students are assigned to serve as tutors for study sessions held in the dormitory on Thursday evenings."

Low Rank: The opening sentence was replaced with "Imagine you are a **student** living in a dormitory. Each dormitory has several resident assistants."

The sentence beginning "As resident assistant" was replaced with "Every Thursday evening, a study session is held in the dormitory, and the administration assigns a resident assistant to tutor the session."

The university rule was replaced with **"IF A RESIDENT ASSISTANT IS ASSIGNED TO TUTOR A SESSION, THE RESIDENT ASSISTANT MUST TAPE RECORD THE SESSION."**

All remaining references to "student" were replaced with "resident assistant".

Truth-Testing: High Rank

Imagine you have been given the job of **resident assistant** at your dormitory. Resident assistants are in charge of the dormitory. They are chosen by the administration and essentially run the dormitory.

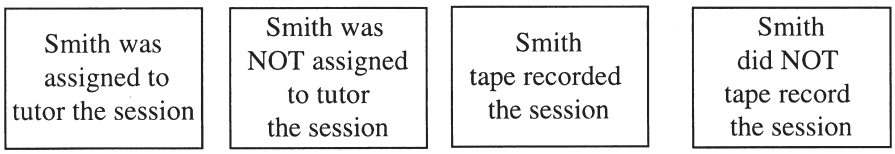
As resident assistant, you choose tutors for study sessions held in the dormitory on Thursday evenings. The administration provides tapes and machines in case anyone wants to record a session.

Records are kept of each study session. This is done be writing information on cards every time a session is conducted. **The front side of the cards indicates whether or not a particular student was assigned to tutor the session, and the back side indicates whether or not the student tape recorded the session.** (Sometimes the tutors will show up for sessions other than the ones they are assigned in order to compare teaching methods, and will tape record the session to listen to later. This is perfectly acceptable.)

One day, you overhear two students who live in your dormitory talking to each other. One says to the other **IF I AM ASSIGNED TO TUTOR A SESSION, I ALWAYS TAPE RECORD THE SESSION.**

Below are four records for the student you overheard. Two of the cards are shown front-side up and the other two are shown back-side up. **You're curious about whether the student was telling the truth. Look at each card and decide which one(s) needs to be turned over to find out whether or not the student was telling the truth. Place an X below your choice(s).**

IF I AM ASSIGNED TO TUTOR A SESSION, I ALWAYS TAPE RECORD THE SESSION.



The following modifications were made to create three additional versions of the Truth-Testing Task.

Equally High Rank: The sentence beginning "As resident assistant" was replaced with "The dormitory resident assistants are assigned on a random basis to tutor study sessions held in the dormitory on Thursday evenings."

All subsequent references to "student" were changed to "resident assistant."

Equally Low Rank: The opening paragraph was replaced with "Imagine you are a **student** and you live in a dormitory."

The paragraph beginning "As resident assistant" was replaced with "One of the most important rules in the dormitory concerns tutoring. Students are assigned as tu-

tors for study sessions held in the dormitory on Thursday evenings. The administration provides tapes and machines in case anyone wants to record a session."

Low Rank: The opening paragraph was replaced with "Imagine you are a **student** and you live in a dormitory. Each dormitory has several resident assistants who are in charge of the dormitory. They are chosen by the administration and essentially run the dormitory."

The sentence beginning "As resident assistant" was replaced with "The dormitory resident assistants are graduate students who are assigned on a random basis to tutor study sessions held in the dormitory on Thursday evenings."

All subsequent references to "student" were replaced with "resident assistant."

Materials Used in Experiment 2

[Note: Cheater-detection materials from Experiment 1 were also used in this experiment]

Cheater Detection: High Rank

Imagine you are a **supervisor** in a large store that sells CDs, tapes, and records. Shipments of merchandise come in every day and must be put on the shelves as quickly as possible. Employees are assigned to do this task. This is so important that a store rule is posted behind the counter that says:

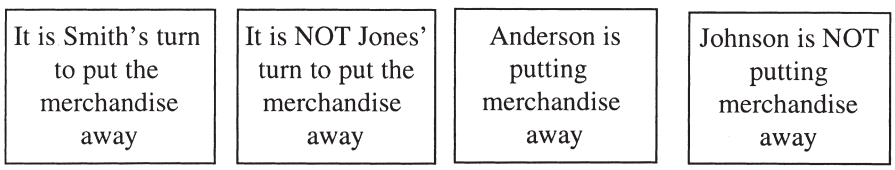
IF IT IS AN EMPLOYEE'S TURN TO PUT A NEW SHIPMENT OF MERCHANDISE AWAY, THE EMPLOYEE MUST PUT THE NEW SHIPMENT AWAY IMMEDIATELY.

Sometimes employees will put shipments away when it's not their turn just to help out. That's OK, but they don't get special credit for it.

Records are kept of merchandise handling by writing information on cards every time a shipment arrives. **One side of the card indicates whose turn it was to put merchandise away, and the other side indicates whether that person put merchandise away.**

Below are four cards. Two of the cards are shown face-side up and the other two are shown back-side up. **Look at each card and decide which one(s) needs to be turned over to make sure the employees are following the rule. Place an X below your choice(s).**

IF IT IS AN EMPLOYEE'S TURN TO PUT A NEW SHIPMENT OF MERCHANDISE AWAY, THE EMPLOYEE MUST PUT THE NEW SHIPMENT AWAY IMMEDIATLEY.



Cheater Detection: Low Rank

The opening sentence was replaced with “Imagine you are an **employee** in a large store that sells CDs, tapes, and records. The store is so large that there are always four supervisors on the floor at all times.”

The store rule was changed to **“IF IT IS A SUPERVISOR’S TURN TO PUT A NEW SHIPMENT OF MERCHANDISE AWAY, THE SUPERVISOR MUST PUT THE NEW SHIPMENT AWAY IMMEDIATELY.”**

All subsequent references to “supervisor” were changed to “employee.”