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*polyscience.net*  
January 31, 2010

Dr. John Holdren, Co-Chair and Members  
President's Council of Advisers on Science and Technology  
The White House  
Washington, DC 20500

## Re: Neuropsychology & Rapid Learning Systems about Social Problems

Dear Dr. Holdren and PCAST Members:

Neuropsychology allows us, by functional imaging and new measures, to explore hierarchical psychodrama models and unrecognized mechanisms that may underlie costly social problems. For example: followership-dependency-submission mechanisms, activated and sustained in the human brain by hierarchical images and the same inherited, non-rational, brain mechanisms that can be observed in primates, may adversely affect motivation and the economic, societal, and political participation of lower status groups. They also may inhibit educational attainment in inner-city public schools.

Although they could be uncomfortable, the exciting promise of these lines of scientific investigation is that they will allow us to see human behavior in a new light and invent better solutions. The growing and suggestive scientific evidence from several disciplines is illustrated in an appended background paper for NSF's Grand Challenges of Mind and Brain panel (2006), (pp. 10-13). Marmot was been knighted in England for his studies of brain mechanisms, endocrine changes, and health effects of status in a country with universal access to health care (e.g., The Status Syndrome, 2004); key causal (brain) pathways remain mysterious.<1> There also are strong theoretical grounds to believe that refined models of psychopatholo-

gy and better treatment methods can emerge from these investigations.<2>

### Fast Discovery: How Fast?

I bring these issues to PCAST's attention for two reasons. First, 1.) I believe that the Obama Administration should have a strategic plan designating how quickly to proceed, with what levels of funding, and with what leadership and organizational structure to assure rapid learning about both basic science and specific applications (e.g., to science education). Given the wide range of potential applications and societal benefits affecting the work of different agencies, there are theoretical grounds to believe that research, by any single agency, will be underfunded. It is a competing paradigm. The hypotheses may seem obvious or implausible. We are at the exciting, leading edge of science, and somebody needs to organize a critical mass of investment in new measures and exploratory data before we know what we have.

### The Need for Wisdom

Second, 2.) PCAST's leadership in the Obama Administration is needed because we need a thoughtful, civic decision about how to proceed:

As some of your members will know, there have been discussions for more than twenty-five years of the wide potential of hierarchical psychodrama models to improve social science theory. For example: to organize an evidence-based dialogue with some of the claims about the psychology of the citizen-government relationship that were used to set and justify Republican economic policy. After strong, behind-closed-door disagreements within agenda-setting science panels these disputes rose to the level of PCAST for adjudication fifteen years ago. PCAST's decision to defer this line of investigation and leave key economic and social policy variables unmeasured is described in the appended letter from PCAST's staff on October 26, 1995.

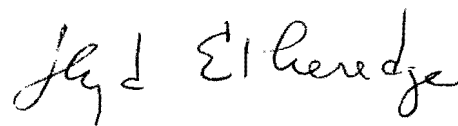
[At this point, I fear that we still will have many years of loud, simple, recycling ideological arguments ahead of us.<3> However, I believe that most Americans would be deeply grateful if PCAST will provide adult leadership and recommend an honest-broker test of ideological arguments, based on the model of the Michelson-Morley experiment in physics.]

I am not seeking to refight the scientific history of these years. However there is a remaining aura of private nervousness about testing these models and about the potential effects on the national science budget of resulting political attack or public controversy, that I think is healthier to address openly.<4> <5> I understand that

there may also have been behind-closed-doors worries over the years that new hierarchical psychodrama measures will be used to study residual effects of racism, link government-funded research to social and political advocacy, and erode bipartisan support for all government-funded social science.

As a scientist, I think there is extraordinary, exciting potential for human benefit if we create a rapid learning system to reconnect the dots in our thinking about social problems and thereby achieve a better connection to reality. However how we are to navigate these concerns, at this point in the 21st century, requires wisdom at your level.

Yours truly.

A handwritten signature in black ink that reads "Lloyd S. Etheredge". The signature is written in a cursive, flowing style.

Lloyd S. Etheredge, Director  
Government Learning Project; Fellow  
World Academy of Art & Science

<1> See the appended review by R. M. Sapolsky, "The Influence of Social Hierarchy on Primate Health," *Science*, (April 29, 2005), vol. 308, pp. 648 – 652. Implications of these new models and measures for upgrading reigning theories in several social science disciplines were identified in a draft discussion paper for a National Academy of Sciences panel in 1990: "A Proposal to Study Leadership, Motivation, and Economic Growth," online at [www.policyscience.net](http://www.policyscience.net) at II.C.

<2> "Grand Challenges . . ." pp. 5 – 10 (appended) for a map of psychodramas related to ideological psychodrama. In psychopathology (in the Bion-Klein tradition) the dramas may be intensified to the paranoid stance in relationship to hostile powers (I) and the depressive relationship to idealized, benevolent powers (II). Further discussions are available in papers online at [www.policyscience.net](http://www.policyscience.net) and published in the "Wisdom and Public Policy" chapter from Cambridge UP (*ibid.*). Talk therapy, engaging the neo-cortex and using language, may be less effective if the visual cortex and direct links to the limbic system and central nervous system are the physical location of the problem.

A hierarchical imagery/psychodrama model draws the causal arrows a bit differently than the earlier Kardiner and Ovesey research [the appended research diagram] that studied the effects of discrimination on motivation and cognitive functioning. The possibility of group psychology and linkages from the social and politi-

cal realm to individual personality were recognized in the pioneering work of Lasswell and others, although they have been difficult to nail-down empirically.

<3> These Republican ideas about national modal personality (discussed in the appended "President Reagan's Counseling (1984)"), whatever core and resonant truth they may contain for Americans about individual psychology, were used egregiously to justify deregulations of the banking industry. Just to disclose my politics: My intuitions are that the most important truths about key areas of social and economic policy remain to be discovered with the help of neuroscience and may not lie at a single point on the current Left-Right dimension in American politics, or along this dimension at all.

<4> As the appended summary from Ms. Dias indicates there were PCAST members during the Augustine era (1995) who privately questioned whether the American people were ready for evidence-based (v. belief-based) social, economic and foreign policy. My impression, as a political psychologist, is that only small minorities of American citizens are intensely ideological. If the same cautionary, behind-closed-doors arguments about the American people re-emerge, I hope that PCAST will ask for expert testimony and permit open public discussion and public knowledge of these judgments.

It also is true – as Thomas Wolfe's New Journalism illustrates – that status relations are outside the bounds of most news reporting and that hierarchical psychodrama models have a very uncomfortable fit with democratic civic and cultural assumptions. However, the reception of Marmot's work in the UK suggests that these lines of investigation are less socially disruptive than PCAST members may have imagined in 1995.

<5> Also, times change: Government leadership and funding for the rapid application of functional neuroimaging technology was recommended by the National Science and Technology Council in the recent Bush Administration: Social, Behavioral and Economic Research in the Federal Context (Washington, DC, 2009): *"with special attention to the influence of socioeconomic environments and policies on our brains . . ."* (p. 33). Italics added.

Appendices:

- Letter from Angela Phillips Diaz, President's Council of Advisers on Science and Technology, to the author (October 26, 1995).

- L. S. Etheredge, "Grand Challenges: Mapping the Brain-Mind Connection of Emotion and Politics." (2006).
- L. S. Etheredge, "President Reagan's Counseling," Political Psychology (1984)
- R. M. Sapolsky, "The Influence of Social Hierarchy on Primate Health," Science, (April 29, 2005), vol. 308, pp. 648 – 652.
- Early neuropsychology hypotheses: Diagram from Kardiner and Ovesey (1953)

EXECUTIVE OFFICE OF THE PRESIDENT  
PRESIDENT'S COMMITTEE OF ADVISORS ON SCIENCE AND TECHNOLOGY  
WASHINGTON, D.C. 20500

October 26, 1995

Dear Dr. Etheredge:

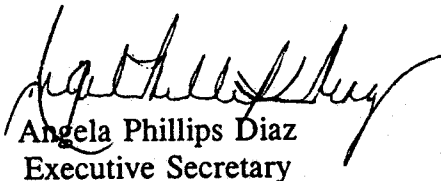
Mr. Norman Augustine forwarded your letter to this office for a response. Since we provide staff support for the President's Committee of Advisors on Science and Technology (PCAST), we stay in close communication with the members regarding their priorities and initiatives.

The points you raise in your letter to Mr. Augustine are certainly important for the policy sciences. The concern of the academic community regarding this potential for ideological bias in our policies and in our institutions is illustrated by the considerable body of literature that exists on this issue. The relative importance of these issues to the broader public is somewhat more difficult to gauge. During our recent PCAST meeting, however, the issue of using belief-based rather than empirically-based policies to drive budget choices was often raised.

Unfortunately, while many members might share some of your concerns, the PCAST as a whole has established its agenda for the coming year and is unable to take on new initiatives. PCAST did recently issue a set of Science and Technology Principles that might be of interest to you. I have enclosed a copy for your information.

We appreciate your interest in and recognition of PCAST as an important body for addressing national concerns about science and technology issues. We regret that PCAST cannot undertake the kind of report you have proposed but trust that you will pursue your concerns with others.

Sincerely,



Angela Phillips Diaz  
Executive Secretary

cc: PCAST Members  
Joyce Justus

Enclosure

Dr. Lloyd Etheredge  
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## ABSTRACT

### Grand Challenges: Mapping the Brain-Mind Connection of Emotion and Politics

by

Lloyd S. Etheredge

Advances in neuropsychology, including brain imaging, create a new set of research methods and challenges to map the connections between the mind and the brain in politics. This paper outlines a background model of the triune brain of homo politicus. Then it draws upon this model to discuss four research programs that can help to understand emotions in politics: 1.) To understand the odd, unique, and emotion-charged psychology of political ideologies and how ideological impasses can be addressed by science; 2.) To place several persistent social problems in a new light (as expressing previously unrecognized followership and submission mechanisms in the brain) and suggest more effective remedies; 3.) To provide further test of theories about the arousal and manipulation of fear for domestic political advantages and that may improve the conduct of international relations; and 4.) To improve the ability of people (including leaders and followers) to connect with one another (intellectually and emotionally) in democratic discussions and to achieve an emotional consensus behind a good idea.

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# Mapping the Brain-Mind Connection

Grand Challenges:

Mapping the Brain-Mind Connection of Emotion and Politics<sup>1</sup>

by

Lloyd S. Etheredge

Key terms: triune brain, brain imaging, hierarchical imagery, ideology, dominance/submission, aggression

Politics can be an arena of lifetime commitments motivated by inspired ideals. It also is an arena for brutality that has increased the percentage of the human race killed in political violence, each century, in recent centuries - with the 20<sup>th</sup> century being the most deadly on record.<sup>2</sup>

Between these extremes are the daily emotional lives of established democracies: altruism and selfishness; competition, drama and soap opera, spectator pleasures, humor, perpetual hopefulness and cynicism.

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<sup>1</sup> An earlier version of this paper was prepared for the NSF Grand Challenges of Mind and Brain (2006) project.

<sup>2</sup> The number of people killed as a result of political violence in the 20<sup>th</sup> century (including starvation) equaled about 10% of the world's population in 1900: (Emmott, 2003 p. 13).



## Mapping the Brain-Mind Connection

Continuing advances in neuropsychology, including brain imaging, create a new set of research methods and challenges to map the connections between the mind and the brain in politics (Martin, Brust, & Hilal, 1991 and the fifth edition, in press). I will outline a background model of the triune brain of homo politicus. Then I draw upon this model to discuss four research programs that can help: 1.) To understand the odd, unique, and emotion-charged psychology of political ideologies and how ideological impasses can be addressed by science; 2.) To place several persistent social problems in a new light (as expressing previously unrecognized followership and submission mechanisms in the brain) and suggest more effective remedies; 3.) To provide further test of theories about the arousal and manipulation of fear for domestic political advantages and that may improve the conduct of international relations; and 4.) To improve the ability of people (including leaders and followers) to connect with one another (intellectually and emotionally) in democratic discussions and to achieve an emotional consensus behind a good idea.

### I. The (Triune) Brain of *Homo Politicus*

Paul MacLean's model of a "triune" human brain is based on studies of the evolution of the brain across animal species (MacLean, 1990 (2003) (Sagan, 1977) (Cory Jr. & Gardner Jr., 2002). The brains of higher animals are based on the brains of lower animals and add new

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regions with new capacities. Thus, the human brain includes:

- 1.) The basic R-complex (the brain stem and cerebellum) of reptiles, dinosaurs, and other primitive species. This provides a powerful and primitive survival-oriented psychology: e.g., basic instincts and powerful drives such as eating (when the organism is hungry and attractive food is available) and mating, the fight/flight response to danger, etc.
  
- 2.) The limbic system. This adds the amygdala (involved in emotions and coordination of the autonomic and endocrine systems), the hippocampus (involved in memory storage) and the hypothalamus (Kelly & Dodd, 1991 p. 277). In shorthand, it adds the psychology of dogs, especially capacities for complex associational learning and stimulus response conditioning of behavior, and the linkage of emotion and physiological responses to images and sounds. Mammals at this level acquire a new and expanded range of emotions (and, for example, facial expression of these emotions, first studied by Darwin). The limbic system also creates a basic social and political psychology: Mammals with limbic systems usually live in social groups with established dominance hierarchies, kinship ties, etc.
  
- 3.) The neo-cortex adds uniquely human capacities for speech and rational/abstract reasoning. It also creates the potential for self-awareness and self-reflective thinking to

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affect emotions, improve coordination among elements of the triune brain, and other tasks.

Thus the mapping of brain connections involved in the behavior of *homo politicus* involves three major brain systems, each with a different psychology or set of operating principles. Two of the three parts, the primary locations of emotional life, lack the power of speech and reason, although they contribute knowledge, capacities, and operating principles that have proven useful for individual and species well-being and survival in earlier circumstances (Moore & Michel, 1998), (Timberlake & Hoffman, 1998). Thus, human political behavior and the emotional connections between the brain and mind can express three psychologies and types of mechanisms in ways that can vary with individuals and circumstances.

- The existence of three different psychological processes may be recognized by political professionals. In his recent memoir James Baker tells the story of warning President Gerald Ford against a press conference by Secretary of State Henry Kissinger, who wanted to discuss a diplomatic trip to Africa. There was a pending election primary in Texas and Baker feared that the President's enemies would use the trip [apparently, the fear-and-anger/R-complex-driven John Birch Society and campaign ads it would create for the public to associate President Ford with Kissinger's hated internationalism]: "President Ford puffed on his pipe and said, ' . . . You know, Jim, the *thinking* Republicans will understand my position on this.' Baker replies: 'Mr.

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President, with respect to this issue there *are* no thinking Republicans in Texas right now”  
(Baker III, 2006 p. 28).

### II. Mapping Connections: Four Research Challenges

The four theories (below) are, as perhaps they should be, ahead of persuasive scientific evidence. They connect several dots about important problems in new ways and suggest new lines of investigations and predictions about the findings. The research programs will push outward the frontiers of brain research methods.

#### A.) Why Ideologues are Passionate and Do Not Learn

The triune brain model suggests a fresh look at the passions of recycling ideological arguments.

Both politics and religion are forbidden subjects in the wardrooms of Navy ships. People get into unusually intense arguments and impasses about both subjects. Yet why, of all the important topics addressed by the human mind, should these two arouse so much passion and simple, perpetually recycling, ideas?

One possible answer is that, in both cases, there may be similar internal (hierarchical) psychodramas underlying the verbal arguments.

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Box 1 illustrates such psychodramas and emotional syndromes, based on post-Freudian investigations of the realm of the “Over- I” (a term that Freud’s English translators awkwardly called the “superego”) (Etheredge, 1982b).

For example, a higher image of government that vividly dramatizes potential hostility and control is associated with three syndromes:

- a.) Law-and-order authoritarians who closely identify with the government;
- b.) A step below this identification are rebels with a fight/flight reaction - radicals, libertarians, and conservatives who fear government and want to restrict, reduce, or weaken it. Or - in revolutionary response - overthrow it and seize its controlling power in the name of the people it now demeans, manipulates, and oppresses.
- c.) At a furthest remove are people whose subjective reality is an underground, with government a unitary and impersonal “They” or “It,” up there somewhere - hostile and to be avoided.

When it becomes an intense and total entrapment the clinical expression of this type of internal drama is paranoid psychosis.

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Box 1

In Plato's Cave:

Vivid Higher Images and Emotional/Ideological Systems

Vivid Higher Image

<u>Distance of self</u>	<u>Controlling &amp; Hostile</u>	<u>Benevolent</u>
Close	Authoritarian	Quiescent, blessed
	Rebellious opponent	Liberal activist
Distant	Underground	Despair, resignation

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If there is a vivid, established image of a benevolent government (or God) three different emotional reactions and policy imperatives may result:

- a.) Quiescent, blessed citizens trust their government and experience their leaders to be like Philosopher-Guardians, wise and working as hard as they can to bring a better world as quickly as possible. (This was an experience reported by more than 90% of the American adult population in the 1950s);
- b.) A step below are liberal activists who experience a partially benevolent government power above. Its further (idealized) potential has a zero-sum relationship to inhabitants of the world within its purview, whose needs exactly mirror the affirmative capabilities that liberal activists seek to realize - i.e., for the poor, underdeveloped countries, those without health insurance, the environment.
- c.) At furthest remove are citizens who have lost any hope for government. They are disillusioned, anomic, living lives of quiet desperation here on the barren windswept landscape of modernity.

When it becomes an intense and total entrapment the clinical expression of this type of internal drama is dependent depression or suicide.

## Mapping the Brain-Mind Connection

These psychodramas express mutually-defining images and emotional relationships of a higher government and a lower self. The model suggests why there can be so much self-assured ideological passion and preoccupation with selected themes, and why rational arguments do not connect across these systems: Like the play “Six Characters in Search of an Author” (Pirandello, 1998), people in passionate political arguments only seem to inhabit the same reality.

- In suggesting the emotional similarities of religion and politics, the model recalls an observation by the pollster John Zogby concerning the equivalent psychologies of religion and Republican/Democratic emotional syndromes in American political life: *"the vast majority of red state voters see God as one who punishes evil"* while *"a huge majority of blue state voters see their God as loving and tolerant"* (Zogby, 2004). [For other theories of ideology: (Lakoff, 2002) (Tomkins, 1963) (Smith, 1968) (Etheredge, 1982a). For implications of this model, if it is verified: (Etheredge, 2005 pp. 312-314, 319-321).]

A further application of this model is to test certain ideological assumptions, a task that now becomes possible. For example President Reagan (whose ideas are likely to return) imagined American economic and social problems to be caused by a growing welfare state, that misguided people erroneously believed was good for themselves, but that reduced their motivation and sense of responsibility for their own lives (Etheredge, 1984). Note that this imagines a type of world portrayed in the second column - i.e., yes, clinically, there *are* types of pathological dependency



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syndromes where people just sit around and merely complain about any problems that arise. And note, too, that this ideological argument now becomes *testable* because we can measure whether samples of American adults live inside such a strongly imagined reality. *But if they do not*, or if the statistical distributions show only a small fraction do so, the national theories/diagnoses and passionate social and economic policy agenda of these Republicans can be rejected on scientific grounds.

### B.) Followership/Submission Mechanisms

De Waal's Chimpanzee Politics presents compelling evidence that much of basic human political behavior, including the creation of dominance/subordination hierarchies, is based in the limbic system rather than the neo-cortex (De Waal, 2000). There are some differences across animal species (rhesus macaques tend to be fierce authoritarians and subordinates display a sickly “fear grin”; chimpanzees are inclined to be liberals) but the brain mechanisms appear to be universal.

A key finding is that a subordination/low status syndrome is a *package* (usually induced by fighting). Brain mechanisms trigger enduring motivational and postural changes and changes in the endocrine system. For example, chimpanzees who lose alpha male status automatically and universally shift their posture and walk in different - and easily recognized - ways. Testosterone levels increase and decrease, *both in chimpanzees and human males*, studied in experimental

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conditions of winning and losing. Similarly, the syndrome of posture and behavior changes back when there is a victory and alpha-male status is regained, and so does the testosterone (De Waal, 2000)(Goldstein, 2001).<sup>3</sup>

There is similar evidence (for what might be a universal syndrome) across dominated and lower-status human groups that exhibit emotional and motivational inhibitions and (somewhat unexpectedly) cognitive inhibitions. For example, in their classic psychiatric study of American Blacks, The Mark of Oppression, Kardiner and Ovesey (Kardiner & Ovesey, 1951 p. 303) reported such adverse effects on self-starting motivation, and also induced cognitive inhibitions that limited abilities for abstract reasoning and more executive abilities to plan and work for long-term futures. Blacks on the plantation, in America before the civil rights movement of the 1960s, women in traditional societies, and - today - minority/lower status populations in many nations of the world are often described in similar terms: They are passive, lack self-starting

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<sup>3</sup> Reviewing the scientific evidence in his *War and Gender* Goldstein quotes Secretary of State Henry Kissinger that “power is the great aphrodisiac” (Goldstein, 2001 p. 155). I.e., there is physiological evidence that this may be true and involved in the self-assurance of males in power. For many centuries the rhetoric of “regained manhood” has been used to rouse oppressed people to overthrow established hierarchies. Evidence may show that, for male Palestinian teenagers, throwing rocks at Israeli soldiers increases testosterone, an immediate feeling of well-being that they interpret as knowledge that they are doing a good and healthy activity.

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motivation, have limited capacities for learning, abstract reasoning, rationality and long-term planning, etc. [And these traits are often wrongly interpreted as inherent, rather than *induced*.]

- This theory makes a testable prediction, that enduring problems of labor force, political, and educational participation/attainment by Blacks in the US will reflect such unrecognized psychological mechanisms, that continue as an unintended residual (e.g., via mechanisms engaged by, and sustained by, hierarchical images in the brain) from an earlier era of discrimination and oppression.

[In this regard: the National Academy of Sciences (Shalala et al., 2006 in press) recently reported that more equal treatment of liberated women in America has virtually eliminated the gender difference in (lower) mathematical/analytical aptitude and attainment in public schools that was traditionally interpreted as a genetic deficit of women. If so, this may be dramatic evidence that unrecognized and reversible brain mechanisms - induced and sustained by vivid and established hierarchical imagery in the mind of the victim - play a wider inhibiting role than previously recognized.]

- A wider range of (measurable) physiological changes and health effects also may be part of the low status/submission syndrome. Even the relatively mild social/political/economic hierarchy in advanced, democratic, post-industrial countries apparently induces powerful neuroendocrine

## Mapping the Brain-Mind Connection

and related changes, with long-term effects on health and longevity. Several decades of pioneering work in Great Britain by Marmot (Marmot, 2004), for example, finds that even with universal government-provided access to health care, there is a gradual decline in longevity and health from the top to the bottom of the social spectrum. The “status gradient” does not merely affect people at the bottom: it even emerges in differences at the top - for example, Ph.D.’s enjoy better health and longer life than those with M.A. degrees or those with BA/BS degrees. One current theory is that the underlying mechanisms of such effects in primates are neurobiological changes associated with externally-induced social stress in dominance hierarchies (Sapolsky, 2005). A pathway of hierarchical images and the brain mechanism of the follower/submission response gains standing, for the triune brain of *homo politicus*, because hierarchical images partly bypass the neo-cortex and have direct hardwired links to parts of the brain responsible for emotion and motivation. Bales, who extensively investigated the psychology of hierarchical human relations, believed that the “up-down” dimension of social/political life is encoded via images (Bales, 2001) (Hare, 1985).

- Useful insights and solutions (for individuals, economies, and societies that would benefit from higher levels of self-starting motivation and the full use of cognitive abilities of all citizens) might be achieved by understanding the effects of internalized hierarchical images. There may be straightforward ways to solve the problem.

C. R-Complex Political Behavior

“The confrontation with wanton carnage, deception, and cruelty summons the Furies of revenge, who can convert peace-loving, liberal-minded elites into promoters of genocide. During World War II, J. Robert Oppenheimer, who frequently articulated ethical values that resonated with liberals, wanted to spray Strontium 90 (a baleful carcinogenic element) on Germany. . . . During John F. Kennedy’s presidency, the U.S. war plans for retaliation in the event of a Soviet nuclear attack provided for targeting millions of people in the hapless captive nations of Soviet-controlled Eastern Europe (which would have fiercely opposed the Soviet attack, given a chance). And the Kennedy era war plan would also have China instantly targeted, even though it might not have been involved in the Soviet attack.”

- Iklé (Iklé, 2006 p. 79)

In the autumn of 68 BC a surprise pirate attack set ablaze Rome’s port of Ostia, destroyed the Roman Empire’s consular war fleet, and kidnaped two Senators, their bodyguards, and staff. Rome’s leading soldier, Pompey (to be known as Pompey the Great), used the resulting fear to override opponents and push through the Lex Gabinia, by which he acquired an unprecedented broad dictatorship, with absolute and unchecked authority over everyone. Next, for Rome’s “war on terror,” he spent most of the Treasury, built 500 ships and raised an army of 120,000 infantry and 5,000 cavalry. He cleared the Mediterranean of pirates in three months. He then continued

## Mapping the Brain-Mind Connection

to spend six years expanding Rome's wealth (and, allegedly, its security) by conquering lands and establishing puppet regimes in the Middle East. Pompey never returned the power that he acquired. The panic reaction of Rome's political response to its terrorist event became part of the historical change from the early traditions of the Republic, with a complex system of checks and balances, to an age of imperial dictatorship. Harris (Harris, 2006), who tells the story, notes that since Pompey cleared the entire Mediterranean of pirates in only three months the pirates probably were not as grievous a threat in the first place. He calls Pompey's maneuver to seize and hold power "the oldest trick in the political book."

Testing a R-complex theory of fear-related behavior, by direct measures of the brain, can clarify our scientific understanding of this (allegedly) recurring story in domestic politics.

### 1.) The *Lord of the Flies* model and domestic politics

Two thousand years later, a modern statement of this model of fear manipulation and political behavior is the novel *The Lord of the Flies* (Golding, 1954 (1999)). The author (William Golding) also viewed it as an archetypal, universal model of political behavior. He thought that it described (in 1954) the recent tactics and psychological mechanisms in the rise of Hitler and of Communist totalitarian dictators and the resulting violence.<sup>4</sup>

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<sup>4</sup> Lasswell perceived a similar repeating psychological/political story, which he called the "garrison state" model: (Lasswell, 1941 (1997)).

## Mapping the Brain-Mind Connection

In Golding's novel a group of British schoolboys is stranded on a tropical island paradise. The fear of an elusive, lurking Beast grows in their minds. One boy, Jack, uses this fear to make himself the aggressive leader of a band of hunters. Soon, by the end of the book, he has expanded his control by the death of rivals, engaged in torture and intimidation of subordinates (without respect for their human rights), and he has launched a final hunt to kill his last rival.

The Lord of the Flies model suggests (in the language of the triune brain) that when the fight-flight response of the R-complex is activated, a set of primitive, rationality-independent, psychological mechanisms also is activated (e.g., search for a strong, confident, aggressive male leader for defense, an intensification of group bonding, an exclusion of deviants, etc.) (See also (Janis, 1982)).<sup>5</sup>

- Activation of the R-complex may be especially easy (although for unknown physiological reasons) among adherents of the political and religious Right. Recently, there has been widespread suspicion that President Bush's campaign adviser, Karl Rove, creates campaign tactics to engage and manipulate fear - for example, by placing gay marriage initiatives on a ballot, to frighten and anger core members of President Bush's Republican constituency, and thereby increase turnout.

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<sup>5</sup> These mechanisms did not affect Simon, Ralph or Piggy.

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It would be exciting to test the Lord of the Flies model, historically, in different countries, and with brain imaging and secure compelling textbook evidence, for students in all countries, to judge whether such fear manipulations (in major crises, and also normal election battles) are “the oldest trick in the book.”

### 2.) The R-Complex and World Politics

R-complex models also may be useful to understand international politics. And they make different predictions than popular rational-choice models. For example, during the Cold War, tough-minded “rational deterrence” theorists (e.g., Schelling (Schelling, 1960 (2006)), an economist) advocated the forthright use of threats to influence and deter the Soviet Union and other potential opponents. These theorists also advocated simple “rational calculation” policies to “raise the cost” of an opponent’s behavior, for example to cause North Vietnam to cease its “aggression” in the Vietnam War. Once the North Vietnamese calculated the rising costs, they would stop.

Alexander George at Stanford, initially associated with the RAND Corporation, was quietly alarmed by the danger of Schelling’s rational choice assumptions and forthright use of threats and “costs” (with the psychological assumption that being bombed by an enemy would be treated like a businessman reading numbers on a spreadsheet). He began a study of historical cases to test ideas about “coercive diplomacy” and crisis decision making (George, 2006 pp. 125-126)



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(Holsti, 1972). He found that a professional diplomatic framework was preferable to a military threat alone. Threats, if they crossed a threshold, could activate a powerful danger response (a fight/flight, R-complex syndrome, in MacLean's terms) and undermine rationality (perhaps dangerously) and the possibility of non-violent political settlements. In Cambridge, Pool (Pool, 1969 (1998)) wrote a similar alternative to Schelling's framework, an article about deterrence, attitude change, emotions, and the wisdom of a foreign policy that was "more rational than the rationality assumption." (See also (Etheredge, 1992)).

However Schelling's "rational choice" approach to international politics was never rejected scientifically. Tough-minded adherents of such theories are still around. It would be useful to establish, scientifically, whether R-complex activation has the wide ranging role and effects that George's early case studies implied.

- The quotation from Iklé, a leading arms control theorist, at the beginning of this section underscores evidence that, given the proper context, Americans also may exhibit R-complex international behavior. To forecast any American responses to new terrorist attacks, or to a growing nuclear threat from Iran or North Korea, it is worth recalling that the Japanese attack on Pearl Harbor (which produced fewer American deaths than the recent 9/11 and anthrax attacks) launched America into a world war on two continents, brought the fierce firebombing of civilian populations in cities across Japan, and the use of two nuclear bombs against Hiroshima and

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Nagasaki to achieve unconditional surrender.

The new triune brain/R-complex model of *homo politicus* also suggests a reinterpretation of the “domino theory” of American leaders during the Cold War. The “domino theory” seems to rationalize both parts of the R-complex fight-flight system - i.e., a vividly imagined threat to survival [even though Vietnam was on the other side of the planet] combined with the aggressive and powerful determination to fight the enemy and prevail, even at a very high cost. Thus, calling the domino theory a “theory” (as if it were solely a contingent neo-cortex phenomenon of words and ideas based on evidence and readily open to scientific debate) may be inaccurate and misleading.

- Are the powerful emotions of the R-complex, rather than neo-cortex calculations, also shaping current world politics? Vice President Cheney’s response to the 9/11 and anthrax attacks against America might fit the model: a worst-case imagining of attacks on American cities by terrorists with nuclear and biochemical weapons, and an aggressive global counterattack even if the imagined danger has only a “one percent chance” to occur (Suskind, 2006). Or consider the recent Iranian drive to acquire nuclear weapons: Could the fact that American conventional forces have recently destroyed three national governments (in Eastern Europe; and on two of its borders, Afghanistan and Iraq), declared de facto war on its fundamentalist clerics, and named it a target in the war on terrorism, activated a R-complex, and an Iranian *Lord of the Flies*

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syndrome, that will cause its elected leaders to pursue nuclear weapons, no matter what the risk?

It is unlikely that direct brain measures of current leaders can be obtained. Yet notably, even during the Cold War, a MIT political scientist (Lincoln Bloomfield) was able (quietly) to conduct crisis decision making simulations in the Soviet Union, at very high levels of its government and to discuss research issues. Political leaders often have an interest in the rationality of their subordinates, professional analysts, and staffs. And improved indirect measures of R-complex mechanisms may be possible (Hermann, 1979). Any progress to learn the emotions that lie behind the assured self-presentations of political leaders, by methods other than informed conjecture, is likely to have practical benefits.

### D. Mirror Neurons: Making Better Connections

A recent, exciting discovery is that portions of an observer's or audience member's brain can become activated by the behavior or emotion of another person, and in a pattern suggesting that the observer is experiencing what the other person is experiencing. Thus, the discovery of *mirror neurons* appears to provide a direct measurement of empathy and the effectiveness of communication that seeks to engage identification with the speaker's emotions and viewpoint (Rizzolatti, Fogassi, & Gallese, 2006).<sup>6</sup>

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<sup>7</sup> A classic hypothesis from Goethe concerning international politics also becomes easier to test (e.g., empathetic responses to television news of foreigners): "There comes a point where

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The ancient Greeks admired rhetoric, the capacity to appeal both to emotion and reason, and to achieve an emotional consensus behind a good idea (although they also feared the potential for demagoguery) (Kennedy, 2001)(Ober, 1989) (Worthington, 1994). An exciting line of research would be to analyze the (often, weak) ability of American political speakers, even in an age of mass communications, to arouse audiences - i.e., to foster identification with themselves and motivate political action.

Once, rhetoric was one of the seven parts of a classic liberal arts education, but it has disappeared from most schools (Bok, 2006). “Political rhetoric” is (with justification) a derisive term in America. Typically, the chambers of the two great deliberative bodies of American democracy, the House and the Senate, are almost empty: Members rise to deliver dull and uninspiring speeches to television cameras. The 2-3 sentence sound bite of American politicians is seldom memorable. Political campaigns have been captured by specialists in advertising; the television ads manage, at best, a 30-second message rather than a more sustained relationship.

To a degree, this American reduction of emotional arousal in political communication has been a choice of academic institutions. When the Kennedy School of Government was formed at

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one so to speak stands above the nations and where one experiences fortune or misfortune of a neighboring country as if it had happened to one’s own.”

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Harvard the faculty debated (briefly) whether to include a curriculum for public leadership and speaking. The vision was rejected in favor of analytical and management skills - writing briefing memos rather than arousing mass audiences. The academic faculty also shared memories of Hitler and his destructive use of the mass media, propaganda, and demagoguery. They were mistrustful of encouraging ambitious public policy graduates to prefer and use emotion (and perhaps sophist trickery) rather than analytic rationality. (Perhaps, facing current wars against terrorism, there *are* grounds to prefer managerial rhetoric to other, emotion-arousing possibilities.)

Today, it is possible that a good research program, aided by direct and objective measures of whether a political speaker has induced empathy (“gotten through,” “connected”) can improve the performance of leaders and the rate of innovation in many organizations. There might be many good ideas in the world that can benefit from achieving an emotional consensus behind them.

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PRESIDENT REAGAN'S COUNSELING

May, 1984

Lloyd S. Etheredge

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For decades, economic policy has been the territory of economists, governed by their idea that we are a nation of rational choices. President Reagan has changed the assumptions. He is using ideas familiar to psychoanalysts and clinical psychologists to diagnose the problems of the American economy and design a course of treatment. He has posed a set of problems which political psychologists can solve with great benefit to the intelligence of national policy.

The President's idea is simple. He says our economy's lack of vitality is produced because government has become a powerful, substantial presence "above" us here in America. Over the past thirty years as, in our national imagination, government became "bigger," we grew subjectively smaller to develop a national dependence. There was a "zero-sum" effect on each person's mind: as "it" (government) assumed more responsibility in national life, "we" (the people) took less. The work ethic disintegrated; productivity increases stopped; the economy stalled.

The President's economic policy follows logically. It is intellectually serious and urgent: he must provide national psychotherapy for a depressed, passive nation that expects its therapist to have a prompt and magical solution.

To effect the change he desires, our President-psychiatrist has designed a national psychodrama to inspire us, to create open space, and to reduce our idealized illusions. He is warm and supportive. He is cutting taxes and expenditures to make government above us "smaller." It may not be a cure we like, and there will be painful withdrawal symptoms, but we must again take responsibility for our own lives.

From personal experience, Dr. Reagan knows he is right. The dire predictions of his theory, made thirty years ago, appear correct to him. And in his autobiography, Where's the Rest of Me?, he sketches how he, too, was once dependent, in his case on the Hollywood studio system. He was well paid but unhappy, reading scripts written by others, never getting the leading dramatic roles he wanted to play. But then he became more

assertive, struck out on his own. Once he became his own man, life started to work for him. He made a successful

second marriage. Speaking his own ideas, he was elected Governor of California. Now, he has the leading role in the country.

Other aspects of the President's life and experience confirm the same intuitive truth. He enjoys exhilaration, and a sense of freedom, when he rides the open range on horseback, the experience of the open range for free entrepreneurship he has told us we will regain in our national psychology by cutting back that "big government" in the sky. When he escapes to California from Washington and clears brush on his ranch, he feels recharged. He knows we will feel that way too, as the American Congress "stays the course" to effect the psychological transformation he wants.

To be sure, this is a closed system of beliefs. Evidence is always interpreted in the light of what the President calls his "basic principles." If the economic recovery is slow, it only means problems of dependency and addiction to big government are deep in our national psyche. So he is under an even greater obligation to persevere until we regain our independence and self-confidence and restart the economy. He has no choice.

From the President's perspective there is likely a second cause of a slow recovery, a cause psychoanalysts and clinical psychologists often cite: we are resisting. To an unprecedented degree American news media refuse to discuss a national problem in the language a President uses. He has been stonewalled. CBS News runs nightly news stories about the sufferings imposed by Reaganomics but has not yet discussed the real national problem, our psychology of dependency. It is as though the Eastern liberal news media are so addicted to the drama of an activist government, so psychologically dependent, so accustomed to demand that the President do something, that they will never admit even the possibility he could be profoundly right.

If Reagan is right, these skeptics slow the cure. The President can cut taxes and expenditures; these are actions in physical reality. But the stakes are psychological reality. For the therapy to work we must agree - that the diagnosis of dependency is right, that big government is receding, that the therapist knows what he is doing.

It is also possible our actor-President is wrong. A powerful bond to government may be true of only 2% of the population: actors, intellectuals, reporters, the people who give money to political causes or end up in Washington. How can we tell?

The President has profoundly challenged the discipline of economics. His idea about how the economy works does not come from the hundreds of complex equations of their mathematical models. The basic problem, in his view, is simple: the economy is deeply political; we orient ourselves dependently toward government in a larger-than-life drama.

Lacking objective evidence, we now are adrift and debates about economic policy are decoupled, without intellectual integrity. Administration economists have given no evidence to support the intuitive psychological ideas about the economy the President uses to set policy. They have developed no national indicators for the substantiality of images of a "big" government in the sky, for changes in achievement motivation, for the alleged zero-sum allocations of responsibility.

Now, as we "stay the course," we navigate blind, on faith alone. Congress has applied no rules of evidence. The Report of the U.S. government's Council of Economic Advisers is intellectually irrelevant; it would be rejected as a test of the President's theories by any psychology department.

If the President is right, good national psychological indicators will tell us. And, refining our understanding, they might improve the President's policy. John F. Kennedy cut taxes and the economy leaped ahead - but Kennedy also talked about achievement - a New Frontier, a man on the moon by 1970. If psychodrama is needed, perhaps these are

the themes to emphasize.

The President is not speaking in metaphors. He believes he is talking about our reality: solid, strong constituents of individual's imagination so powerful in their effects as to destroy the health of a multi-trillion dollar economy and our national spirit. His theories reflect ideas many psychologists have voiced seriously in the past: psychoanalysts have told us that, via transference, many people related to government authority, in our "mass psychology," the way as children they regarded their magically powerful parents; David McClelland of Harvard explained the economic rise and fall of civilizations by changes in the imaginations of citizens.

Currently, empirical evidence bearing upon the President's fundamental assumption is indirect and inconsistent. Self-report measures seem to deny his model: Americans say they blame themselves for economic hardship. Yet macro-level studies of election results, and individual-difference measures of self-interested and "socio-tropic" voting suggest Reagan is correct and responsibility for management of the economy is assigned to the party in power.

Such measures of attitudes and voting are open to different interpretations as reflecting either rational and secular or psychodramatic processes. Alone, they cannot dispel the fog. The deeper question is the psychological nature of American government, and what is needed is that our public debates begin to be informed by evidence, from appropriate, clinically-derived measures, of the location and substance of citizens' experience of government.

# The Influence of Social Hierarchy on Primate Health

Robert M. Sapolsky

Dominance hierarchies occur in numerous social species, and rank within them can greatly influence the quality of life of an animal. In this review, I consider how rank can also influence physiology and health. I first consider whether it is high- or low-ranking animals that are most stressed in a dominance hierarchy; this turns out to vary as a function of the social organization in different species and populations. I then review how the stressful characteristics of social rank have adverse adrenocortical, cardiovascular, reproductive, immunological, and neurobiological consequences. Finally, I consider how these findings apply to the human realm of health, disease, and socioeconomic status.

One of the greatest challenges in public health is to understand the “socioeconomic gradient.” This refers to the fact that in numerous Westernized societies, stepwise descent in socioeconomic status (SES) predicts increased risks of cardiovascular, respiratory, rheumatoid, and psychiatric diseases; low birth weight; infant mortality; and mortality from all causes (1–4). This relation is predominately due to the influence of SES on health, rather than the converse, and the disease incidences can be several times greater at the lower extreme of the SES spectrum.

One set of questions raised by the gradient concern its external causes. Despite human aversion to inequity in some settings (5), many Westernized societies tolerate marked SES gradients in health care access. Is this the predominant cause of the health gradient, or is it more a function of differences in lifestyle risk factors or of the psychosocial milieu in which poverty occurs?

Another set of questions concern the physiological mediators of the SES-health relationship—how, in a frequently used phrase in the field, does poverty get under the skin? These physiological questions are difficult to study in humans, and an extensive literature has focused instead on nonhuman animals. Despite the demonstration that some nonhuman species can also be averse to inequity (6), groups of social animals often form dominance hierarchies, producing marked inequalities in access to resources. In such cases, an animal’s dominance rank can dramatically influence the quality of its life. Does rank also influence the health of an animal?

The study of rank-health relations in animals has often been framed in the context of stress

and the idea that animals of different ranks experience different patterns of stress (Fig. 1). A physical stressor is an external challenge to homeostasis. A psychosocial stressor is the anticipation, justified or not, that a challenge to homeostasis looms. Psychosocial stressors typically engender feelings of lack of control and predictability and a sense of lacking outlets for the frustration caused by the stressor. Both types of stressor activate an array of endocrine and neural adaptations (Fig. 2). When mobilized in response to an acute physical challenge to homeostasis (such as fleeing a predator), the stress response is adaptive, mobilizing energy to exercising muscle, increasing cardiovascular tone to facilitate the delivery of such energy, and inhibiting unessential anabolism, such as growth, repair, digestion, and reproduction. Chronic activation of the stress response by chronic psychosocial stressors (such as constant close proximity to an anxiety-provoking member of one’s own species) can increase the risk of numerous diseases or exacerbate such pre-existing diseases as hypertension, atherosclerosis, insulin-resistant diabetes, immune suppression, reproductive impairments, and affective disorders (7).

In most social species, dominance rank influences the extent to which an individual sustains physical and psychosocial stressors. Thus, dominance rank can potentially influence an individual animal’s vulnerability to stress-related disease. In this review, I first consider which social ranks are most stressful, with an emphasis on nonhuman primates; stress can be experienced by both high- and low-ranking animals, and it varies as a function of the social organization in different species and populations. I then review the pathology that occurs in animals suffering from the most rank-related social stress. Finally, I consider the relevance of these hierarchy/health relationships to humans.

## Which Ranks Are More Stressful?

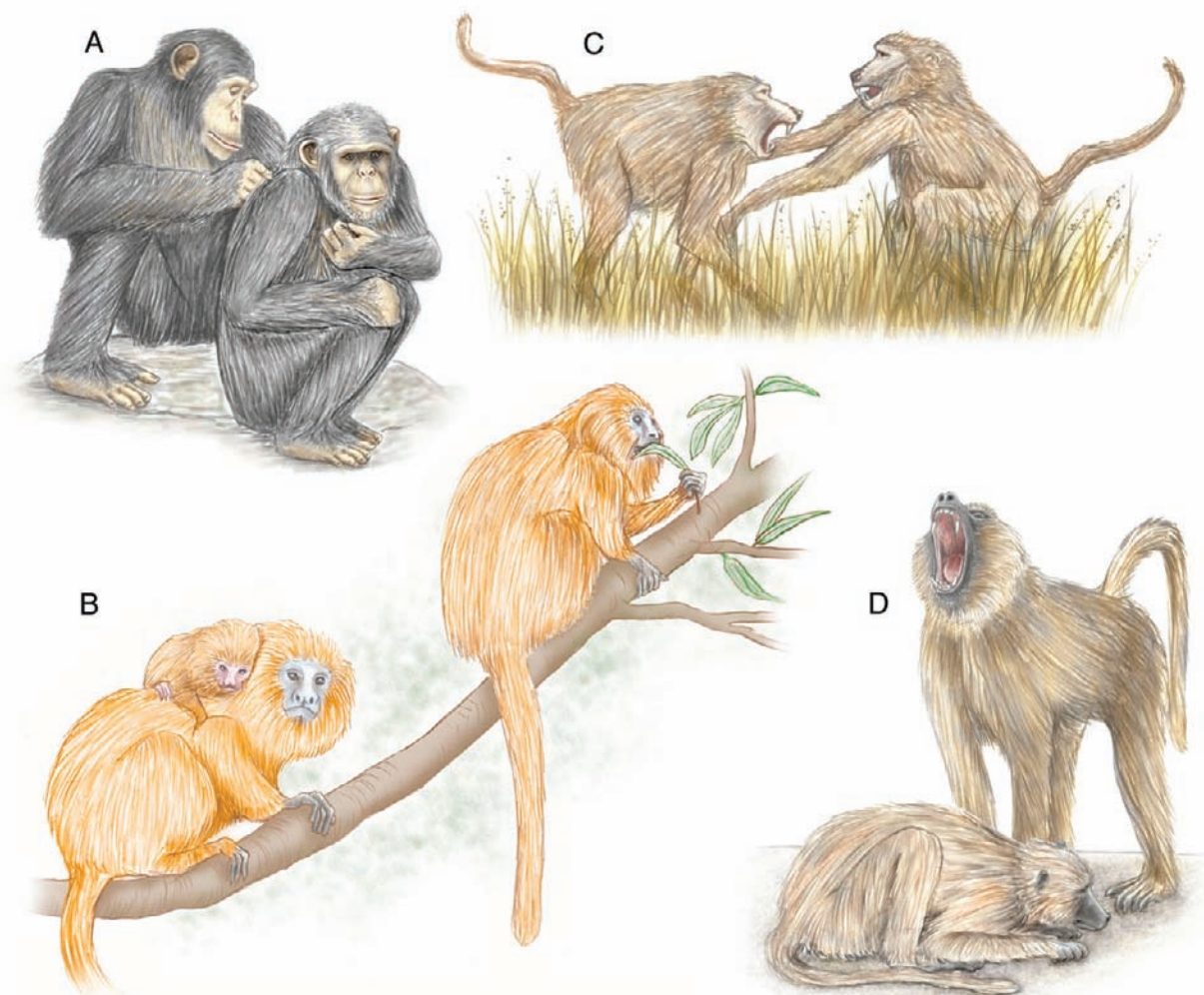
No consensus exists as to whether dominant or subordinate animals are more physiologically “stressed.” Research in the 1950s, since discredited, argued that high rank was more physiologically stressful (that is, the “executive stress syndrome,” which was purportedly valid for both humans and other primates) (8). By the 1960s, the prevailing view had become that lower dominance rank carries the greatest risk of stress-related disease (9). It has now become clear that this too is an incorrect generalization. The contemporary view reflects the heterogeneity that is the core of ethology: Rank means different things in different species and populations. Patterns that occur amid this heterogeneity help to resolve many inconsistencies in the data, showing that the rank that experiences the most physical and psychological stressors tends to display the most severe stress-related pathologies (Fig. 2).

*Resource inequity.* The extent to which resources are divided unequally among individuals varies as a function of the dominance style of different species. At one extreme are top-down “despotic” hierarchies in which resource access is skewed markedly and dominant positions are attained through aggression and intimidation. In contrast, bottom-up “egalitarian” hierarchies have more equal resource distribution, and dominance is attained with the support of subordinate individuals (10). As will be seen, social subordination in despotic species can be associated with the greatest physiological indices of stress. In contrast, this is not a feature of subordination in egalitarian species.

*Maintenance of dominance.* In some species, rank is lifelong and inherited (for example, in female rhesus monkeys); in others, it may fluctuate, reflecting what has been aptly termed shifts in group “politics” (11). In species where ranks shift, how does an individual, once attaining a high rank, maintain it? At one extreme among species with despotic hierarchies, high-ranking individuals frequently and aggressively reassert their domination over the subordinate cohort (even in the absence of an overt challenge). In such species, which include dwarf mongooses, African wild dogs, and ring-tailed lemurs, dominant individuals have the greatest physiological indices of stress, most plausibly reflecting the physical demands of frequent fighting (12, 13). In contrast, in other

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**Fig. 1.** (A and B) Affiliative behavior among subordinates can reduce the effects of stress. (A) Chimpanzees engage in social grooming. (B) A female tamarin monkey cares for another's young while the mother feeds. (C and D) Stressful dominance behavior may take physical or psychosocial forms. (C) Male savanna baboons may fight over a kill. (D) A dominant male baboon intimidates a subordinate. [Image credit: Carin Cain/Science]

despotic species, high-ranking individuals maintain dominance through psychological intimidation rather than aggression (where, for example, mere eye contact with the alpha individual might elicit subordination gestures). In such cases (e.g., savanna baboons, rhesus and squirrel monkeys, mice, rats, and white-throated sparrows), subordination is associated with the greatest physiological indices, plausibly reflecting the frequent psychological stressors for subordinates and the paucity of physical stressors for dominant individuals (12–18).

**Breeding style.** In many species, including some Old World primates, dominant alpha individuals of both genders monopolize breeding through aggression and intimidation. This can be sufficiently stressful to impair fertility in subordinates, producing “social contraception.” A different picture occurs in cooperative breeders, where one breeding female dominates other females, who are anovulatory. However, this subordination is minimally stressful, not involving aggression or harassment by the dominant female. Instead,

the anovulatory individuals are mostly younger sisters, waiting their turn to breed and helping to raise nieces and nephews (19). Among cooperative breeders such as marmosets, ring-tailed lemurs, marmots, wolves, and Florida scrub jays, subordinates show no more stress-related pathophysiology than do dominant individuals and may even have fewer indices (13, 19–21).

**Stability of social ranks.** When the hierarchy is stable in species where dominant individuals actively subjugate subordinates, it is the latter who are most socially stressed; this can particularly be the case in the most extreme example of a stable hierarchy, namely, one in which rank is hereditary. This reflects the high rates of physical and psychological harassment of subordinates, their relative lack of social control and predictability, their need to work harder to obtain food, and their lack of social outlets such as grooming or displacing aggression onto someone more subordinate. During major hierarchical reorganization, however, dominant individuals at the center of the social tensions typically experience the greatest amounts of physical and

psychological stress. As a result, during such reorganization among wild baboons or soon after group formation among species of captive primates, dominant individuals have the greatest physiological indices of stress; this has been shown in talapoin monkeys, squirrel monkeys, various macaque species, wild baboons, and chimpanzees. Once hierarchies stabilize, subordination becomes associated with the greatest physiological indices of stress (22).

**Subordinate coping strategies.** Stress-related physiological endpoints not only reflect the frequency and severity of stressors but also the availability and efficacy of coping outlets. Such outlets most commonly involve social support (such as grooming, physical contact, or coalition formation). Moreover, the occurrence in some species of reconciliative behaviors between two individuals shortly after a competitive interaction can be interpreted as a coping outlet for the loser of that interaction (23). The issue of coping outlets has been examined in a meta-analysis of rank-physiology relationships in both genders of an array of primate species.

Numerous variables related to social structure were considered, and three were collectively highly predictive of the occurrence of elevated stress hormone levels among subordinate animals: (i) high rates of being subjected to stressors; (ii) low availability of social support; and (iii) minimal presence of kin (24).

**Subordinate avoidance of dominants.** The inability to physically avoid dominant individuals is associated with stress, and the ease of avoidance varies by ecosystem. The spatial constraints of a two-dimensional terrestrial habitat differ from those of a three-dimensional arboreal or aquatic setting, and living in an open grassland differs from living in a plain dense with bushes. As an extreme example, subordinate animals in captivity have many fewer means to evade dominant individuals than they would in a natural setting (25). Thus, although dominant wolves have elevated stress hormone levels in the wild (21), subordinates demonstrate this trait in captivity (26).

**Subordinates' use of alternative strategies.** Implicit in being subordinate are the notions that one has reduced access to desirable resources and that this can translate into reduced Darwinian fitness. Sometimes, however, subordinate animals can pursue alternative behavioral strategies that, in effect, move them outside the hierarchy. For example, low rank among males of various Old World monkey species, as the result of male-male competition, has been thought to mean minimal reproductive access to females. However, females actually have considerable control over who they mate with. These are often low-ranking individuals with whom they have affiliative relationships (such as

frequent, nonsexual bouts of reciprocal grooming) (27). Such males not only have greater reproductive success than originally thought but also fewer physiological indices of stress than would be expected for their rank (28).

A different alternative strategy occurs among orangutans. Dominant males have pronounced secondary sexual characteristics, whereas subordinate individuals appear “juvenile.” This appearance is not merely a chronological stage. Instead, it is a state of arrested development in the presence of a dominant male and can persist for years. When the dominant male is removed, the apparently juvenile individual develops secondary sexual traits. This arrested state might seem to be a case of stress-induced social contraception. However, “juvenile” males are fertile, have some reproductive success (as they will force copulations when a dominant male is absent), and do not have elevated stress hormone levels or stress-related reproductive impairments. Rather than a stress-induced pathology, the arrest appears to be an alternative strategy. It is actually males in the process of the conspicuous, slow transition to the dominant form with the most marked physiological indices of stress (29).

**Stress of dominating mating.** In species with a sharply demarcated mating season, or where a few males disproportionately dominate mating, male-male competition for mating access can be fierce, dangerous, and at the cost of feeding and of affiliative behaviors. This raises the ironic possibility that dominant males may be sufficiently stressed by such competition that their testicular axes are suppressed. However, various endocrine mechanisms have evolved

that buffer reproductive physiology under that circumstance, either through blunting the release of stress hormones or blunting their ability to suppress the testicular system (30).

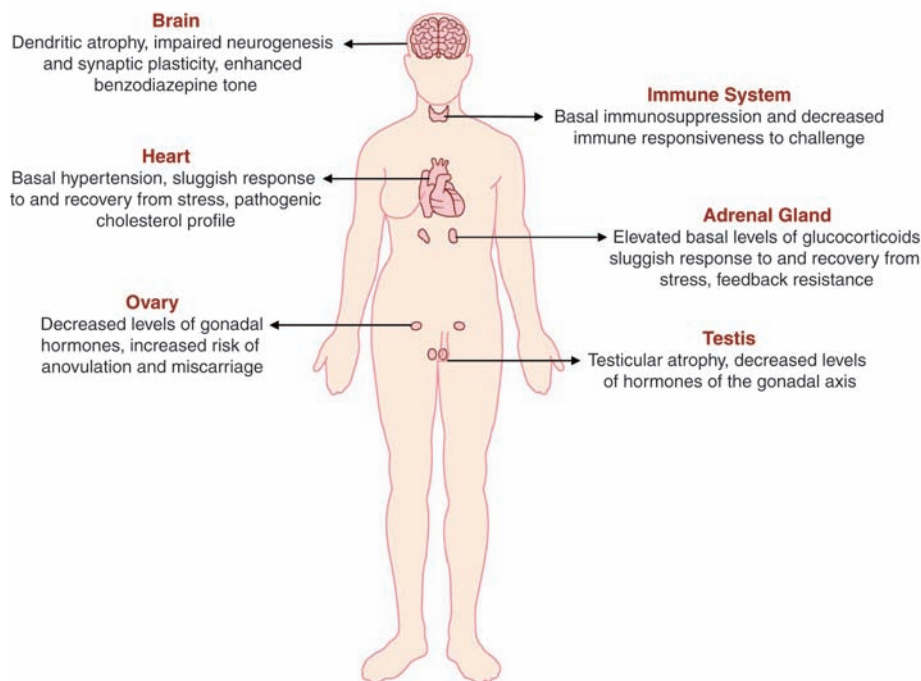
**Atmosphere and culture.** The nature of dominance varies with species and gender. Additionally, different populations of a species vary in their social milieu, and rank-physiology relationships can vary as well. For example, patterns of foraging by subordinate female spotted hyenas differ markedly between the enclosed Ngorongoro Crater and the open Serengeti Plains in East Africa, and only in the latter is subordination associated with elevated stress hormone levels (31). As another example, the elevated stress hormone levels observed among subordinate female macaques do not occur in a troop with atypically high rates of affiliative support (32, 33). In the realm of animal “culture,” multigenerational transmission of a culture of low aggression and high affiliation in a troop of wild baboons results in subordinate males that do not display the stress-related pathophysiology found in other troops (34).

**Personality.** Precedent exists for modulation of stress reactions by individuals' personalities. For example, independent of rank, primates who distinguish poorly between threatening and neutral stimuli, lack social outlets for support, and are hyperreactive to novelty have elevated stress hormone levels (35, 36) and increased rates of atherosclerosis (37).

Thus, under a variety of circumstances, social dominance can be associated with the most stress-related pathology, whereas in other situations, this is a trait of subordinate individuals. Are there common themes underlying this variability? Broadly and logically, adverse physiological profiles are most pronounced among animals of the rank exposed to the most physical and psychological stressors. This can arise from (i) low degrees of social control and predictability (as in dominant animals in unstable hierarchies and subordinate animals in small living spaces); (ii) a paucity of outlets after exposure to stressors (such as subordinate individuals in species lacking alternative strategies to hierarchical competition); (iii) a paucity of social support (for example, subordinate animals in settings with few kin and little access to social grooming); or (iv) high rates of physical stressors (such as dominant individuals who, as a function of their species or the instability of their hierarchy, must constantly reassert their dominance by physical means). Moreover, these links between rank and pathology can be made even more dramatic by the culture of a particular social group and by a personality prone toward interpreting ambiguous social circumstances as psychologically stressful.

### Negative Physiological Effects of Stressful Social Ranking

Studies of both feral and captive animal populations show that animals with specific



**Fig. 2.** Physiological correlates of the more stressful social rank. [Image credit: Bayard Colyear, Stanford Visual Arts Services]

dominance ranks tend to show characteristic stress-related physiological profiles (Table 1). We know that a particular rank gives rise to a particular physiological profile, rather than *visa versa*, because studies of individual captive animals before they are placed in social groups indicate that physiological profiles of singly-housed subjects do not predict their subsequent ranks in a social group (38).

Several stress-related physiological endpoints have been found to be sensitive to rank. The most frequently studied endpoint is the blood level of glucocorticoids (GCs), adrenal steroid hormones that are secreted during stress, such as cortisol or hydrocortisone in primates and corticosterone in many rodent species. GCs typify the double-edged nature of the stress response, as they help mediate adaptation to short-term physical stressors yet are pathogenic when secreted chronically.

Consistently, animals who are more socially stressed by the dominance hierarchy show indices of hyperactivity of the GC system. This includes elevated basal levels of GCs, the enlarged adrenal glands that accompany such increased secretion, a sluggish GC stress response in the face of a major homeostatic challenge, and impaired sensitivity of the system to negative feedback regulation.

In some cases, it is dominant individuals who show this profile. This includes species where dominant individuals have to repeatedly and physically reassert their rank (e.g., feral populations of dwarf mongooses, African wild dogs, female ring-tailed lemurs, and male chimpanzees) (12, 13, 39); those that are cooperative breeders (feral wolves and captive marmosets and tamarins) (16, 21); and those with transient periods of major rank instability (feral baboons and captive populations of talapoin, squirrel, and rhesus monkeys) (22).

In contrast, this profile is seen among subordinate individuals in species where high rank is maintained through nonphysical intimidation and the hierarchy is stable (feral male baboons and captive populations of squirrel and rhesus monkeys, tree shrews, rats, and mice) (22, 40, 41); where subordinates are exposed to frequent social stressors amid low availability of social support and minimal presence of kin (feral ring-tailed lemurs and captive populations of male rhesus or female talapoin monkeys) (13, 24); and when animals are in an enclosure too small to allow subordinate individuals to evade dominant ones (26).

A second prominent feature of the stress response is secretion of the catecholamine hormones (epinephrine and norepinephrine). These hormones of the sympathetic nervous system are secreted within seconds of the onset of a stressor (versus minutes for GCs) and have many of the same effects as GCs upon metabolism and cardiovascular tone. Thus, as with GCs, although the acute secretion of catecholamines is adaptive, prolonged secretion can be pathogenic. The

speed with which catecholamines are secreted typically precludes measuring basal circulating levels (because of the stress caused by the restraint of subjects for taking blood samples), and the hormones are poorly and variably preserved in urine and feces. Thus, little is known about rank-catecholamine relationships.

Prolonged stress adversely affects cardiovascular function, producing (i) hypertension and elevated heart rate; (ii) platelet aggregation and increased circulating levels of lipids and cholesterol, collectively promoting atherosclerotic plaque formation in injured blood vessels; (iii) decreased levels of protective high-density lipoprotein (HDL) cholesterol and/or elevated levels of endangering low-density lipoprotein (LDL) cholesterol; and (iv) vasoconstriction of damaged coronary arteries. A small literature demonstrates that animals who are more socially stressed by the dominance hierarchy demonstrate (i) basal hypertension; (ii) a sluggish activation of the cardiovascular stress response after a challenge and delayed recovery when it abates; (iii) a pathogenic cholesterol profile; and (iv) increased vulnerability to the atherogenic effects of a high-fat diet. These are traits of subordinate individuals when the dominance hierarchy is stable (among captive *fascicularis* macaques of both genders and among feral male savanna baboons) but of dominant individuals of the same populations when the hierarchy is unstable (37, 42, 43).

Chronic stress inhibits reproduction in both genders, a classic example of stress suppressing a costly anabolic process until more auspicious times. In females, this suppression can take the

form of delayed puberty, decreased levels of estrogen and progesterone, increased incidence of anovulatory cycles, impaired implantation, greater risk of miscarriage, prolonged interbirth intervals, and accelerated reproductive senescence. Primate studies show that the stress of subordination in a stable hierarchy (of cynomolgus monkeys) is associated with decreased gonadal hormone levels (42); there are conflicting data as to whether dominance or subordination in stable hierarchies of feral baboons is associated with higher rates of miscarriage (44, 45).

Among males, prolonged and major stress can suppress fertility; at an extreme in teleost fish, this includes atrophy of testes and of hypothalamic regions responsible for gonadotropin release (46). More commonly, stress can suppress circulating testosterone levels (9). However, there are many exceptions, as numerous species are resistant to this effect when the stressor is male-male competition during mating seasons; moreover, it is not clear how often these lower testosterone levels actually affect behavior or fertility. There is no consensus as to whether more socially stressed individuals have lower basal testosterone levels. However, such individuals (in this case, subordinate male baboons in a stable hierarchy) are more vulnerable to the suppressive effects of stress on basal testosterone levels (9).

Stress has complex time- and severity-dependent effects upon immunity. In general, mild to moderate transient stressors enhance immunity, particularly the first phase of the immune response, namely innate immunity. Later

**Table 1.** Influence of societal characteristics on stress experienced by high- and low-ranking individuals. An asterisk indicates no rank-related trend.

Societal characteristic	Individuals experiencing the most stress
<i>Dominance style and means of maintaining despotic dominance</i>	
Despotic hierarchy maintained through frequent physical reassertion of dominance	High-ranking
Despotic hierarchy maintained through intimidation	Low-ranking
Egalitarian hierarchy	*
<i>Style of breeding system</i>	
Cooperative	High-ranking
Competitive	*
<i>Stability of ranks</i>	
Unstable	High-ranking
Highly stable	Low-ranking
<i>Availability of coping outlets for subordinates</i>	
High availability	*
Low availability	Low-ranking
<i>Ease with which subordinates avoid dominant individuals</i>	
Easy avoidance	*
Difficult avoidance	Low-ranking
<i>Availability of alternative strategies to overt competition</i>	
Present	*
Lacking	Low-ranking
<i>Personality</i>	
Dominants perceive neutral interactions as challenging; subordinates take advantage of coping strategies	High-ranking
Dominants are adept at exerting social control and highly affiliative; subordinates are poor at exploiting opportunities for coping and support	Low-ranking

phases of the stress response are immunosuppressive, returning immune function to baseline. Should the later phase be prolonged by chronic stress, immunosuppression can be severe enough to compromise immune activation by infectious challenges (47, 48). In contrast, a failure of the later phase can increase the risk of the immune overactivity that constitutes autoimmunity. No studies have examined rank differences in the first immunostimulatory phase of the stress response or in the risk of autoimmunity if the later suppressive stage fails to occur. However, suppression of circulating lymphocyte numbers and blunted immune responsiveness to a challenge have been reported among animals socially stressed by a dominance hierarchy (subordinate rodents and pigs subject to high rates of attack and dominant chimpanzee males in an unstable captive population). Less clear is whether such rank effects are of sufficient magnitude to actually increase the risk of infectious disease (47, 49).

Animals who are socially stressed by the dominance hierarchy for prolonged periods undergo neurobiological changes as well. This can involve inhibition of neurogenesis, dendritic atrophy, and impairment of synaptic plasticity in the hippocampus (50, 51) and altered patterns of apoptotic cell death (increases in the cortex and decreases in the hippocampus) (52); these pathologies have been observed in socially subordinate rodents and tree shrews in stable hierarchies in captive populations.

Finally, a socially stressful position in a hierarchy is also associated with alterations in the neurochemistry of anxiety. Receptors exist in the nervous system for the anti-anxiety benzodiazepines (BDZs), which include the synthetic molecules diazepam and chlordiazepoxide hydrochloride as well as an as-yet uncharacterized endogenous BDZ. Pharmacological blockade of BDZ receptors caused the greatest disinhibition of anxiety-related behaviors in subordinate males in a stable hierarchy among feral baboons (34). This rank difference was interpreted as reflecting the demands for anxious vigilance among such individuals, necessitating a greater counteracting effect of endogenous BDZ tone.

### Human Hierarchies and Health

The literature reviewed raises the obvious question: Are these findings relevant to humans? Initially, they seem to be of minimal relevance. Humans are not hierarchical in the linear, unidimensional manner of many species. For example, humans belong to multiple hierarchies and tend to value most the one in which they rank highest (for example, a low-prestige employee who most values his role as a deacon in his church). Furthermore, the existence of internal standards makes humans less subject to the psychological consequences of rank. Finally, health-rank relations that are easy to study can be highly artificial (e.g., ex-

amining the physiological consequences of winning versus losing an athletic competition).

Despite these caveats, the SES gradient of health among Westernized humans is a robust example of social inequalities predicting patterns of disease. As mentioned earlier, stepwise descent in SES predicts a major increase in the incidence of an array of diseases and mortality (1–4).

These health effects of SES are not a result of poverty causing limited access to health care. Robust SES-health gradients exist in countries with universal health care and documented equality of access. In addition, gradients exist for diseases with incidences that are impervious to preventative health measures (e.g., juvenile diabetes) (2, 3).

Only a small portion of the SES-health relationship is due to SES-related life-style differences. In Westernized societies, lower SES is associated with higher rates of smoking and drinking to excess, less healthy diets, more sedentary life-styles, crime- and toxin-riddled communities, and fewer coping outlets (e.g., health club memberships and vacations). However, the most prominent of these factors collectively account for only a small part of the variability in the SES-health gradient (3).

Instead, increasing evidence suggests that the gradient arises from psychosocial factors. Subjective SES can be at least as predictive of health as is objective SES (1); in other words, feeling poor may be at the core of why being poor predicts poor health. In the United States, at the level of states or cities, the same low SES predicts poorer health in communities with greater income inequality (4). Whereas large inequalities decrease the availability of protective life-style factors for the poor in a community (what has been termed a “neomaterialist” explanation for the inequality-health relationship) (53), the disease consequences of feeling poor are often rooted in the psychosocial consequences of being made to feel poor by one’s surroundings (4). Increased income inequality typically decreases a community’s “social capital” (shown in decreased levels of trust and increased senses of alienation and disenfranchisement), and such decreased capital mediates the relationship between income inequality and health (2).

### Conclusions

Strong associations between social status and health thus occur in numerous species, including humans, with the poor health of those in the “wrong” rank related to their surfeit of physical and psychosocial stressors. In considering these issues in nonhuman species, the variability, qualifiers, and nuances of the rank-health relationship are frequently emphasized, a testament to the social complexity of other species. In contrast, in humans, there is a robust imperviousness of SES-health associations to differences in social and economic systems. It is not plausible that this human/nonhuman contrast re-

flects human sociality being less complex than in, say, baboons. Instead, it is a testimony to the power of humans, after inventing material technology and the unequal distribution of its spoils, to corrosively subordinate its have-nots.

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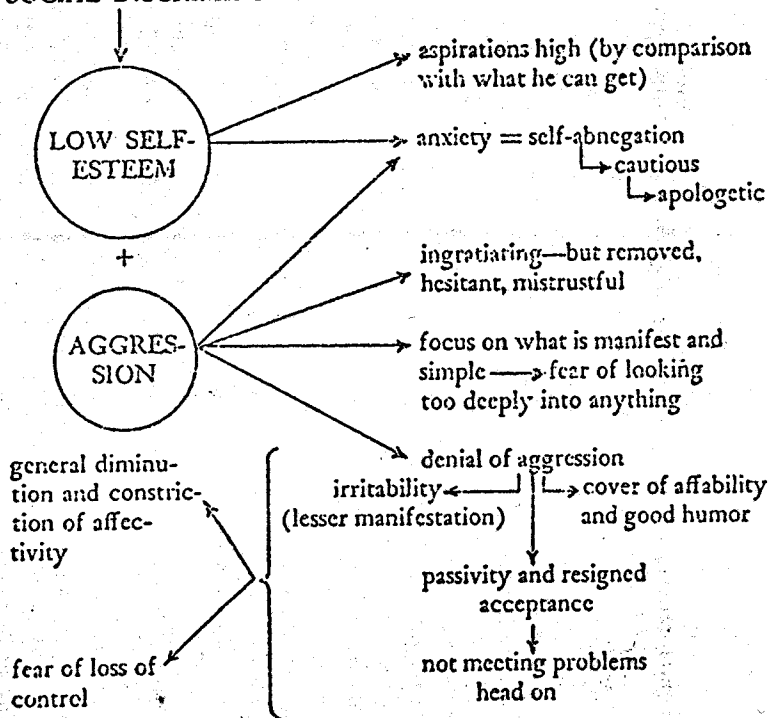
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from Abraham Kardiner &  
 Lionel Ovesy, The Mark of  
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because the individual, in order to maintain internal balance and to protect himself from being overwhelmed by it, must initiate restitutive maneuvers in order to keep functioning—all quite automatic and unconscious. In addition to maintaining an internal balance, the individual must continue to maintain a social façade and some kind of adaptation to the offending stimuli so that he can preserve some social effectiveness. All of this requires a constant preoccupation, notwithstanding the fact that these adaptational processes all take place on a low order of awareness. The following is a diagram of a typical parallelogram of forces:

SOCIAL DISCRIMINATION



In the center of this adaptational scheme stand the low self-esteem (the self-referential part) and the aggression (the reactive part). The rest are maneuvers with these main constellations, to prevent their manifestation, to deny them and the sources from which they