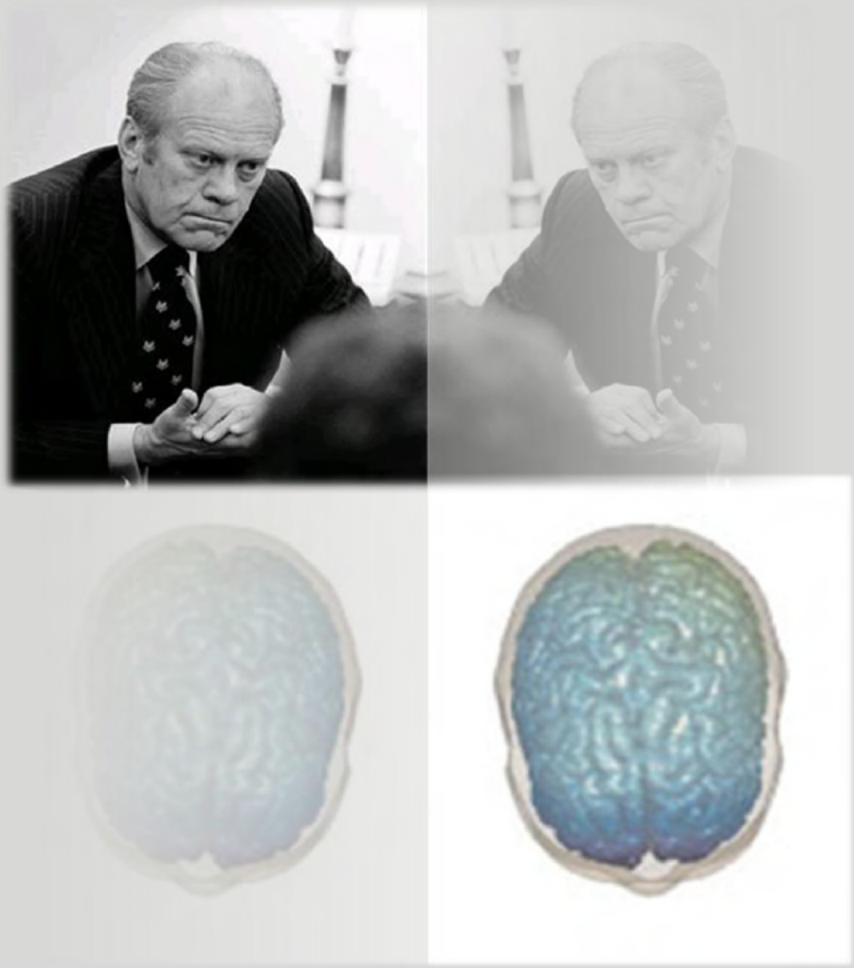
The Psychophysiological Effects of Stress: National Leadership

Produced for the Director, Net Assessment
Office of the Secretary of Defense



Prepared by:

(b) (7)(C) [redacted]

Revised Version
November 16, 2009
Contract Number
HQ0034-08-C-1049

Scitor Corporation

Contract Number
HQ0034-08-C-1049

Table of Contents

Executive Summary

There is little disagreement that stress affects how people function, but a lack of scientific data on the subject has long prevented specific conclusions as to *how* and *why*. However, the expanding horizons of the biological sciences now allow for somewhat greater insight. A large portion of the human physiological response to stress has been mapped, and the effects of these chemical changes on the brain and body are starting to be understood, the product of a field of science called psychophysiology, which studies the reciprocal interactions between psychology and physiology.

This paper leverages these advances to explore stress' effects on national leaders because presidents, prime ministers, and autocrats have enormous power to affect the wellbeing of their states (and others) and are frequently in potentially stressful situations. These leaders' importance and stress levels are often at their highest during crises. Consequently, this paper uses crisis events to focus its analysis. A framework is presented based on tasks that leaders may engage in during crises. From this, a set of seven traits that support the successful execution of these tasks is identified, and these traits are analyzed to better understand *how* and *why* stress affects leaders and the resulting implications, both cognitively and socio-emotionally (how leaders interact with others). The leadership traits examined in this report are: *drive, cognitive complexity, curiosity, creativity, objectivity, empathy, and dominance*.

The findings of this study are necessarily preliminary, as the field of psychophysiology is still developing and refining earlier paradigms. Nonetheless, patterns of effects have emerged that seem to be confirmed across several research paradigms and studies.

One of the earliest and most crucial findings of psychophysiology is that acute stress causes significantly different effects than long-term stress. Acute stress is characterized by intense, relatively brief periods – seconds to days – of uncontrollable stress; long-term stress is characterized by milder, albeit still uncontrollable stress applied over weeks to years. Hormone and neurotransmitter levels can be pushed in opposite directions under acute stress than they are under long-term stress. Moreover, some effects, such as the brain changing shape, only occur under sustained stress. Because of this, acute and long-term stress are analyzed separately in this study.

The Effects of Acute Stress

Acute stress typically leads to a release of epinephrine, norepinephrine, cortisol (often called the 'stress hormone'), dopamine, and other compounds. This flood of hormones and neurotransmitters pushes the body and brain into overdrive at the expense of higher cognitive abilities based in the prefrontal cortex (PFC) and hippocampus. As a result, individuals under

acute stress often focus more on relieving that stress quickly than thinking through the longer-term implications and ramifications of their actions.

- ***Drive*** – The increased dopamine levels from acute stress cause the individual to sense potential reward. The elevated epinephrine, norepinephrine, and cortisol levels increase energy levels by quickening the heart rate and liberating sugar for use by skeletal muscles and the brain. All of this leads to increased *drive*. In leaders, this increased drive can be expected to support interest in and focus on the crisis at hand and to increase their energy and desire to resolve it.
- ***Cognitive Complexity*** – The influx of norepinephrine, dopamine, and cortisol into the brain interrupts working memory and cognitive learning strategies. This leads to decreased capacity for *cognitive complexity*. As a result, leaders under acute stress may have an overly simple understanding of a crisis, develop less nuanced and appropriate options, and be restricted in the analysis that underlies their decisions and implementation strategies.
- ***Curiosity*** – Curiosity often results in acquiring conflicting information, but conflicting information can lead to cognitive dissonance, which can increase stress and levels of cortisol, epinephrine and/or norepinephrine. Since people under acute stress seek to decrease their stress levels, leaders are likely to have decreased *curiosity*, resulting in a less complete and potentially more biased conception of a crisis. Leaders under stress may also be motivated by dopamine-mediated reward patterns to punish dissent and by oxytocin's stress relieving effects to surround themselves with advisors with whom they are already in agreement to increase their feelings of support, which would increase their oxytocin levels.
- ***Creativity*** – The elevated norepinephrine, dopamine, and cortisol levels resulting from acute stress can impair the function of the prefrontal cortex, leading to decreased *creativity*. This may leave leaders less able to develop new, different, and potentially more effective strategies for dealing with a crisis.
- ***Objectivity*** – In men, high cortisol levels caused by acute stress result in increased risk tolerance and a bias towards action and certainty. In women however, stress appears to cause a relatively lower acceptance of risk. These effects may push men to make overly optimistic judgments and opt for higher-risk strategies with less consideration, while women might be less likely to act on opportunities.
- ***Empathy*** – The effects of acute stress on *empathy* are poorly understood. Increases in empathy should help leaders understand how to influence others to provide support and improve their ability to forecast reactions of allies and opponents to various choices, while decreases might leave them relatively aloof to others' motivations and intentions and, thus, less able to influence them. Women under stress appear to be better able to sense others' motivations and intentions than men under stress; however, individual variation plays a crucial role.
- ***Dominance*** – Release of cortisol in leaders under acute stress decreases anxiety and helps them deal decisively with a crisis. Moreover, individuals with higher testosterone levels – a marker for leaders – tend to experience lower levels of stress than others. (Although, the high testosterone levels need to be tempered by high serotonin levels; otherwise, the result

will be aggression rather than dominance.) This should give leaders a relative advantage in interactions with their more highly-stressed counterparts. These effects are likely to lead to increased *dominance* and a higher degree of cooperation from others, which would help leaders to elicit more information, garner additional help in generating solutions, and gather more support for implementing decisions.

The Effects of Long-Term Stress

In contrast with acute stress, sustained and chronic stress can cause leaders to become unmotivated, uncertain, and to turn inwards, potentially losing their ability and will to lead those around them. Prolonged stress tends to cause decreased dopamine and testosterone concentrations, increased levels of inflammatory factors, and a persistently elevated, but un-reactive, level of cortisol, which may cause anxiety in addition to dysfunction as well as atrophy of the PFC and the hippocampus (responsible for higher cognitive functions and for long-term memory).

- ***Drive*** – Decreased levels of dopamine in individuals under long-term stress interfere with motivation and reward pathways in the brain, and increases in inflammatory factors combine with down-regulation of the immune system to sap energy and health. All of this can result in decreased *drive* in individuals. In leaders, this can result in a lack of engagement in many facets involved in responding to a crisis, from gathering information to implementing a solution. The result could lead to situations where leaders settle for marginally acceptable solutions because they lack the motivation to seek better ones.
- **Cognitive Complexity** – Prolonged high cortisol levels in individuals under long-term stress may lead to a state whereby people turn inwards and focus solely on dissecting their problems, while turning off higher cognitive functions. The inability to abstract principles from this rumination (due to low-dopamine influenced PFC dysfunction and high-cortisol induced memory decline) leads to a functional decrease in *cognitive complexity*. As a result, leaders may have difficulty identifying and analyzing the true causes and consequences of crises, potentially leading to less appropriate responses.
- **Curiosity** – The inward focus due to high cortisol levels in individuals under long-term stress may also decrease interest in interacting with others and valuation of knowledge. When combined with potential memory dysfunction due to elevated cortisol levels, *curiosity* functionally decreases under prolonged stress. This could leave leaders acting based on only a subset of available information, leaving biases unchallenged and hampering their ability to select the best course of action. Leaders under long-term stress may also be more susceptible to seeking social support – surrounding themselves with advisors who agree and will not challenge their conclusions – in order to induce oxytocin release and garner its stress reducing effects.
- **Creativity** – Elevated cortisol levels and depleted dopamine and serotonin levels in individuals under long-term stress decrease the volume of information that passes between the subconscious and the conscious mind in addition to hampering PFC activity, resulting in

decreased *creativity*. As with acute stress, this may leave leaders less able to generate novel solutions and could force them to rely on past courses of action which are poorly tailored to the unique circumstances of a new crisis.

- **Objectivity** – Persistent activation of the hypothalamus-pituitary-adrenal (HPA) axis, which is responsible for cortisol production, is associated with uncertainty, fear, anxiety, and risk aversion. These effects are exacerbated by cortisol-induced down regulation of testosterone levels, which further increases anxiety and uncertainty, significantly affecting *objectivity*. As a result of these effects, leaders under long-term stress may miss opportunities during crises and end up ceding the initiative to their adversaries.
- **Empathy** – Long-term stress interferes with the ability of people to infer others' intentions and motivations, possibly through the detrimental effects of elevated cortisol and depleted dopamine levels on proper PFC function. This deficit of *empathy* may impair the ability of leaders to understand how to motivate allies and adversaries and to forecast their reactions to different courses of action.
- **Dominance** – Persistently elevated cortisol levels resulting from long-term stress decrease testosterone levels. Both of these changes increase uncertainty and anxiety and decrease *dominance*. The potential result is a relative loss of power and control by leaders, who might then be challenged by other, more dominant individuals.

Mitigation Strategies

Many of the effects of stress on leaders are detrimental, and as a result, some may seek mechanisms by which to ameliorate the effects of stress or the stress response itself. With the ongoing revolution in the biological sciences, new and targeted drugs, techniques, machines, such as those that interface with the brain, and genetic therapies will likely become available in the near future. However, a number of drugs and nutraceuticals that may mitigate the effects of stress have already been identified.

- **Propranolol** is a blood pressure drug developed in the 1960s that blocks some of the effects of norepinephrine and epinephrine in the brain and body. It has been used to prevent "stage fright" for several decades, and recent studies show that it can ameliorate some of the effects of acute stress on creativity and cognitive complexity with minimal side effects. The quick adoption of propranolol in parts of the performance art community (without FDA-approval for this specific indication) suggests that other drugs which are identified as effective will be adopted by communities with sufficiently high incentives.
- **Tamoxifen**, a breast cancer drug, has been shown to block a signaling pathway which can play an important role in certain types of PFC dysfunction. While it has not been tested on the effects of acute stress, it is effective in treating schizophrenia and could prove useful in mitigating some stress-induced effects. Drugs which selectively target 'deeper' pathways will allow for greater efficacy with fewer side-effects.
- **Selective serotonin reuptake inhibitors**, used to treat depression, are already some of the most prescribed drugs in the world. As depression is one of the possible consequences of

chronic stress, leaders suffering from this condition might be aided by this class of drugs to retain or regain engagement with their work.

- **Oxytocin**, a neuropeptide naturally released as a result of social support, raises the stress-response threshold and ameliorates existing stress, potentially helping leaders to perform at a higher level in crises. Oxytocin also increases trust, which depending on the characteristics of a crisis, could prove either helpful (enhancing empathy) or harmful (more susceptible to deception), although it would likely be beneficial if this effect could be engendered in opposing leaders.
- **Omega-3 fatty acids**, such as those found in fish oil, have anti-inflammatory properties, which could counteract some of the effects of long-term stress on energy and drive. Emerging research into nutraceuticals shows that traditional pharmaceutical development will not be the only pathway through which active compounds may be identified and suggests that holistic approaches including diet, drugs and supplements, and other techniques, such as training, may prove to be the most effective approach to mitigating the effects of stress.

Gaps

In addition to mapping the psychophysiological effects of stress on the leadership traits discussed above and identifying some mitigation strategies, this report identifies several major gaps in our current understanding of this area and shortcomings in the supporting research. First, the bulk of current studies are difficult to apply to national leaders. Many studies are performed on animals or clinical patients. While these can be valuable, they introduce significant uncertainty when trying to translate the results to healthy humans. Even studies in healthy humans are limited in their ecological validity to leaders because they are often conducted on college students. While national leaders cannot be expected to participate in studies, other groups of leaders from the business world, the military, and elsewhere should be recruited, where possible, as subjects for future studies. Studies of leaders who undergo similar types of stress and have been required to advance through similar selective pressures will greatly improve the ability to assess the likely effects of stress on national leaders. The current tests used for traits such as creativity also decrease the real-world validity of current research. While laboratory conditions and resource constraints restrict the complexity of tasks that subjects can perform, more realistic tests of traits will lead to a better understanding of the nuances of stress' effects.

Second, research on the effects of stress on social cognition is severely limited. This is problematic because leaders necessarily interact with people who bring them information, help to set their agenda, provide analytic support, and execute their decisions, and social cognition allows leaders to work well with others and guide them productively. As such, any detrimental or beneficial effects of stress on social cognition are important to understanding the overall stress phenotype.

Third, more research on otherwise healthy individuals under long-term stress is also needed. What research is done generally focuses on those individuals who have developed clinical conditions that can be caused by stress, such as depression and burnout, necessarily biasing the research against those who are more resilient. Those individuals enrolled in studies also have not necessarily developed their conditions due to long-term stress, further complicating extrapolation to a representative group of stressed people. Thus, to provide a more accurate view of the effects of long-term stress on national leaders, more studies on resilient individuals are required, although ethical and financial considerations make this relatively difficult.

Additional research in these areas can serve as a basis to refine our understanding of the effects of stress and open up new avenues of applicability for data on the psychophysiology of stress in leaders. Nonetheless, this report can provide insight to leaders looking to identify the effects of stress in themselves and to those who study leaders in an attempt to better understand events and predict future behavior.

Introduction

While people would like to view their leaders as uniformly rational and competent actors, scientific research shows that people's rationality and cognitive abilities are frequently compromised. Once one accepts the fact that these characteristics and traits are not immutable, the question of what factors affect them gains tremendous importance. Stress is one of the most important confounding factors when studying cognition. For decades, there has been little disagreement that stress affects how people function, but a lack of scientific data on the subject has long prevented specific conclusions as to *how* and *why*. Today, the advancing front of scientific research has opened up these questions to further inspection. Tying levels of a hormone in the body to the probability of war may seem rather far-fetched, but scientific research in the past 20 years has begun to open up the black box that is the human mind and decision-making and has made such analysis possible. For example, evidence shows that cortisol (the 'stress hormone') levels tend to affect the risk-tolerance of individuals by overtaxing a part of the brain involved in top-down mental control. The research identified herein shows that this finding is not unique. Stress affects nearly every fundamental aspect of leadership under crisis.

This report seeks to answer the question: What are the effects of stress on national leaders? This question falls principally in the field of psychophysiology. According to the Society for Psychophysiological Research, psychophysiology is concerned with the "interrelationships between the physiological and psychological aspects of behavior."[1] Here the word 'interrelationships' is key. The increasing scientific understanding of stress and the human response clearly shows that psychological states affect physiology which then affects ongoing and future psychological states. This paradigm serves as the basis for this study: stress affects human physiology which affects the way that humans think and act.

Because the field of psychophysiology is a relatively new field and this question is highly complex, this report does not seek to provide ***the*** answer. Rather, it seeks to give the reader an understanding of the human stress-response, develop a framework through which the question can be examined, and to fill out this framework based on the available scientific data to develop a better understanding of the psychophysiological effects of stress on leaders.

This report focuses on leaders in crisis situations in order to bound the scope of the report and because crises inherently involve important national goals and higher levels of stress. Leaders also tend to become more important and powerful in crises, making the effects of stress more significant.

[1] "About SPR," *Society for Psychophysiological Research*, http://www.sprweb.org/.

Studying this topic may be useful for several reasons. First, understanding the effects of stress may allow people to identify its effects on themselves and others and either change their own behavior or better anticipate and react to changes in others' thoughts and actions. Even more beneficial would be the ability to prevent or counter mechanisms of stress-induced ineffectiveness. This is the second potential reward of this study: documenting and understanding the physiological underpinnings of the effects of stress identifies potential targets for mitigation strategies, which might allow for the prevention of the detrimental effects of stress or amplification of its beneficial effects. Finally, the same understanding would allow for the identification of strategies to create or amplify the negative effects of stress and mute or eliminate its positive effects that adversaries might choose to employ against the United States or its allies.

Background

The impetus to look at the psychophysiological effects of stress came from Brown and May's study of the mechanisms of defeat in military units.[2] They identified defeat not in the traditional sense, as surrender, destruction, or withdrawal, but rather, as the breakdown in effectiveness in military units that resulted from a loss of internal group dynamics. A well coordinated withdrawal can preserve troops to fight another day, but troops still engaged in a battle can be hopelessly ineffective if they have lost their ability to react to the enemy or act as a cohesive unit. Brown and May's analysis that the breakdown of internal group processes under stress led to defeat raised the question: How does stress lead to the individual members of a unit or group becoming ineffective, both as individuals and as contributors to the group? Or in the terms of Brown and May, what are the mechanisms of defeat in individuals?

The first report in this project, *The Psychophysiology of Defeat Mechanisms: A Catalogue*, identified broad mechanisms by which stress contributes to individual defeat. It started by

[2] M. Brown, A. May, and M. Slater. Defeat Mechanisms: Military Organizations as Complex, Adaptive, Non-Linear Systems. Written for the Director, Office of Net Assessment, Office of the Secretary of Defense. Contract number DASW01-95-d-0060, D.0. 75

examining the human stress-response under acute, sustained, and chronic stress, which will be reviewed in Section 2. It then developed a framework to examine the different effects of stress on human functions, individually and within groups, during these different time periods. The *Catalogue* focused on the first of the three major goals of this project, especially on laying the groundwork for the rest of the project by synthesizing an understanding of the concept of stress, the human physiological response, and how this can lead to ineffectiveness.

Focus on Leaders

This report will apply the work done in the Catalogue to national leaders and identify what is currently known as well as accompanying gaps in knowledge about the second major goal of this project: to identify which parts of the brain stress affects and how these effects are mediated, whether by hormones, proteins, changes in signal transduction between cells, or gross physical changes in the structure of the brain. Identifying these specific mechanisms will provide a potential set of targets for mitigation and enhancement strategies.

The focus on leaders is due to their relative importance. While a good leader is neither necessary nor sufficient for the success of a nation, army, or group nor a bad leader for failure, no other person, on average, has so much ability to affect outcomes. Because of the power of states in today's international system, the most important group of leaders is national leaders. As long as nuclear weapons, highly effective biological weapons, and large numbers of major military systems stay under the control of states, no other group of people has as much ability to cause death, destruction, and misery, let alone through other forms of national power, such as economic means.

This focus certainly implies the point of view that individuals do matter. Some in the international relations community might argue that the forces at the systemic level govern the actions of nations, but a careful reading of history suggests that individuals have indeed played major roles in shaping the course of history.[3] Henry Kissinger summed up his view when he said, "As a professor, I tended to think of history as run by impersonal forces. But when you see it in practice, you see the difference personalities make."[4] If personalities make a difference, then the personalities that make the most difference will often be national leaders, and if there is any time that a national leader has the most potential sway over a situation, it is during a crisis. Even if a leader's style involves deferring to advisors at crucial points, his or her personality is still important because it is involved in deciding which advisor's advice to follow.

[3] D. L Byman and K. M Pollack, "Let us now praise great men: Bringing the statesman back in," *International Security* 25, no. 4 (2001): 107–146

[4] W. Isaacson, *Kissinger: A biography* (Simon & Schuster, 1992), 13.

While many everyday issues never reach the level of importance to be decided by a national leader, they often make decisions on a larger proportion of issues during a crisis. This is not meant to imply that leaders can control every detail of a crisis or its outcome. There are many factors out of a leader's control that could cause failure. A well-chosen course of action carried out under a watchful leader could still be botched by a military unit, diplomat, or anyone else carrying out the orders of the leader. A perfect decision making process (if such a thing exists) may nonetheless lead to a sub-optimal choice because of imperfect information, an adversary's response, or other intervening factors. Nonetheless, national leaders tend to have the most control over their nation's actions during crises, and even if leaders cannot *control* outcomes, this study posits that better performance by leaders will lead to better outcomes for their states on average. In contrast, cognitive biases and flaws are likely to lead to worse decisions on average. This should mean that, over time, they will lead to probabilistically worse outcomes. When the high stakes of geopolitics are at risk, even a slightly better average outcome may be highly significant.

The average outcome may not be what is important though, especially in crises. The failure of a leader even once under crisis has the potential for more far-reaching effects than people at lower-level positions. In the US system, the President also tends to have more power in crisis situations, especially foreign policy crises, for which the President is responsible and for which the President has the ability to be significantly more responsive than Congress, at least in the initial chapters. A common present-day paradigm for expressing the power of the President of the United States is captured by the image of the President being accompanied by the nuclear 'football,' the briefcase that carries nuclear launch codes. Indeed, as the Commander-in-Chief of the US armed forces, the President has the ability to launch hundreds or thousands of nuclear warheads in a very short amount of time. Understanding factors that affect the performance of someone with so much power is potentially very valuable. Leaders in crises also tend to be under significant amounts of stress, so specifically understanding and being able to modulate the stress response would provide a tool for affecting a leader's performance.


5

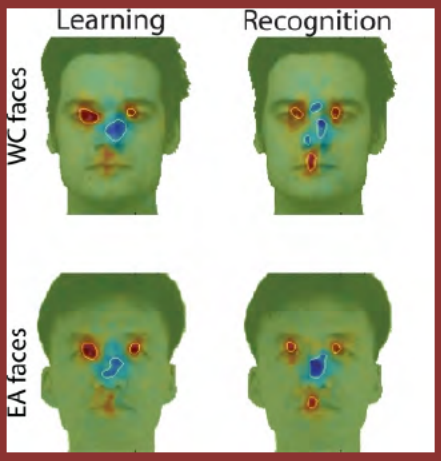
[5] Picture taken from http://mikecane.files.wordpress.com/2007/09/bigredbutton.jpg

Thus, we view crises as the most useful cases for this report because they emphasize both the significance of the leaders involved and high levels of stress, providing cases to illustrate the effects of stress on leaders, the goal of this report. This report will also focus on crises for practical reasons. More data is available about leaders' conduct in crises and the atmosphere in which they operate. The availability of cases and information has also informed the choice of subjects for case studies. This report will utilize cases of US Presidents to highlight the effects of stress. Presidents of the United States are some of the most often written about characters in history, and the power of the office and US societal values allow Presidents to exercise a great deal of control over US actions, minimizing some potentially confounding variables such as refused orders and potential coups.

The authors of this study acknowledge that this may limit the applicability of the analysis to Western leaders or to US Presidents. The majority of the leadership literature is also written from a Western point of view, and a large majority of the psychophysiological studies underlying the analysis have been carried out using Western, usually American, subjects. A number of studies have shown that different cultures process information in different ways when carrying out similar tasks, which strongly suggests that stress will affect individuals from different cultures differently (see the adjacent sidebar). Thus, a number of factors potentially limit the applicability of this report, but nonetheless, we believe that the analysis herein will still yield interesting and meaningful insights.

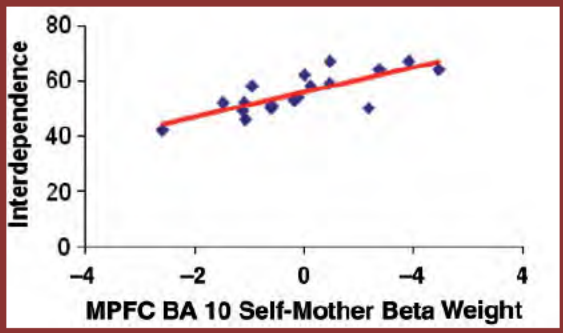
Cultural Differences in Information Processing

Studies of individuals from different cultures have shown that culture influences how people approach information and how it is processed at the neural level. When looking at faces, East Asians tend to focus on the center of the face, whereas Westerners tend to focus on the eyes and mouth, as seen in the picture below. The red represents locations where Western eyes focused, and the blue where Asian eyes focused. The race of the person viewed not affect the experiment.[6]



A similar pattern is witnessed when Asians and Westerners are shown pictures. Westerners tend to focus on prominent objects in the foreground, but Asians tend to focus on the background.

At a more fundamental level, Westerners and Asians also show differential activation of brain regions. When describing the self versus one's mother, people who identify more with Asian culture tend to have more activation in the medial-prefrontal cortex (mPFC) than those who identify with Western culture (interdependence vs. individuality). The mPFC is an area that is strongly affected by stress.[7]



[6] Caroline Blais et al., "Culture Shapes How We Look at Faces," *PLoS ONE* 3, no. 8 (2008): e3022.

[7] Rebecca D. Ray et al., "Interdependent self-construal and neural representations of self and mother," *Soc Cogn Affect Neurosci* (October 12, 2009): nsp039.

This is also not the first work to examine the effects of physiology on national leaders. Hugh L'Etang wrote three books on the subject from 1969-1995, with his final installment, *Ailing Leaders in Power*, examining specific leaders and how he viewed their medical conditions as impairing their ability to effectively carry out their work. While this method – what might be called the 'coincidence-of-nature approach' – could potentially provide insight into how physiology affects leaders, L'Etang relies on diagnoses such as 'brain failure' to explain what he perceives as the cognitive failings of certain leaders. This lack of specificity in the physiological aspects of his work means that the explanatory power of his book with respect to how physiology affects leadership is extremely low.[8]

Rose McDermott's book *Presidential Leadership, Illness, and Decision Making* utilizes the same coincidence-of-nature approach and identifies several leaders with major physiological impairments that could potentially shed light on the effect of physiology on leaders. John F. Kennedy becomes President despite his Addison's disease, which leads to an inability to produce cortisol. Eisenhower survives both a heart attack and a stroke while in office, leading to an apparent battle with depression. Unfortunately, the case of Kennedy can shed little light on the role cortisol plays in leadership because he is taking a host of other medicines, including amphetamines, during crucial times in his presidency. That Kennedy was the President of the United States while taking dozens of different medications makes his case interesting in and of itself, but even the conclusions McDermott draws about the effects of his medicines on his performance at the Vienna Conference with Khrushchev are difficult to support based on the available evidence. The Eisenhower case is instructive (and discussed herein), but without a number of other successful case studies, *Presidential Leadership* is unable to shed much light on the effects of stress on leaders.[9] It is our hope that this report, in contrast, provides a relatively holistic view of the topic based on an in-depth study of cutting edge research.

Structure

In order to give a preliminary answer to the question, "How does stress affect leaders?", this study will address different aspect of the question in the following sections:

- A discussion of the psychophysiology of stress;
- An overview of the first study in this project, *The Psychophysiology of Defeat Mechanisms: A Catalogue*;

[8] H. L'Etang, Ailing leaders in power, 1914-1994 (Royal Society of Medicine, 1995).

[9] R. McDermott, Presidential leadership, illness, and decision making (Cambridge Univ Pr, 2008).

- A framework for examining the effects of stress on leaders, how it was developed from the literature on the study of leadership and psychophysiology, and how it may shape this report;
- The population of this framework based on current psychophysiology data and how stress may affect leaders' actions;
- And finally, concluding remarks about the implications of this work and future directions for this project.

Stress[10]

The human stress-response system has evolved over thousands of years. This means that the bulk of the evolution that led to its current state occurred when an exceptionally dangerous, high stress event often meant a direct physical threat to one's safety or social rank, such as an attack by a wild animal or another human. The optimization of human systems to deal with something like a tiger attack, however, has led to a mix of compatibility and incompatibility with today's environment. Many contemporary situations in which the human stress-response is activated require remarkably similar effects to what was required thousands of years ago. Fighting off a wild animal requires the same quickened reflexes and decision-making that are useful in avoiding a car crash when driving 60 miles per hour.

However, the human stress-response system is relatively maladapted to the more complex problems facing people today, especially when considering executive leaders. Discerning the motives of an attacking animal is rarely a high and immediate priority, but identifying the reasons for a provocation in the realm of international affairs can be crucial, where the discussion of a "tiger" is more likely to refer to an economically developed Asian state. Stress can interfere with the higher cognitive abilities required in the latter case, hampering a leader's efforts to act correctly in a crisis.

Moreover, instead of a short encounter with a hostile force, executives may work under stress for days, months, or even years. Since the stress response appears to have evolved for dealing with brief, intense events, the long-term effects of high stress are less well adapted to the environment in which today's executives operate. However, neither acute nor long-term stress is completely maladapted to leaders' requirements. The energy and motivation that the onset of an acutely stressful event liberates can be tremendously useful. While chronic stress and the resulting depression that it may cause can make leaders ineffective due to their unwillingness or inability to stay engaged, take control, or act, it can also bring about a high level of rumination – focused dissection and analysis – which could be beneficial when dealing with some highly complex problems. On the other hand, rumination is rarely beneficial because it manifests alongside a host of detrimental effects associated with depression.

In order to provide background for understanding the physiology underlying these sometimes opposing effects, the remainder of this section will give a broad overview of types and levels of stress and the physiology of the stress response over different time frames.

[10] This section will cover some of the same issues discussed in the first report in this project, *The Psychophysiology of Defeat Mechanisms: A Catalogue*. However, it will also add to the discussion of stress in the first report and provide a more holistic background for the framework utilized herein.

Types of Stress

Not all potential challenges set off a stress response. Several factors are involved in the determination of the extent and magnitude of the stress response. First, there are different types of stress. These include:[11]

- *Physical stress*, such as running a long distance with an 80 lb pack
- *Cognitive stress*, such as trying to solve multiple math problems at the same time
- *Psychosocial stress*, such as judgment by others
- *Experiential stress*, such as expecting a punishment based on prior experience or identifying danger in a given situation

While soldiers are often under physical stress, most executive leaders are not forced to march long distances. As such, this report will primarily rely on studies that examine psychosocial, experiential, and cognitive stress. One type of stress that leaders do share with soldiers, however, is sleep deprivation. Sleep deprivation can be considered a co-factor to the other types of stress that leaders may experience, increasing the body's load in handling all its demands. While differences do exist between the types of mental stress, this report will generally consider them together under the broad use of the term 'stress' because data is lacking to distinguish between their effects.

Tipping the Scales

Closely related to the question of types of stress is the question of what factors cause an event to become sufficiently stressful to cause a physiological response. Below is a list of factors that contribute to the identification of a situation as relatively more or less stressful:

Factors increasing Perception of Stress	Factors Ameliorating Perception of Stress
Affect (mood) – Negative Outlook	Affect (mood) – Positive Outlook
Uncertainty	Sense of Control
Judgment of Social Status or Achievement	Sense of Purpose
Sleep Deprivation	Social Support

[11] Bruce S. McEwen, "The neurobiology of stress: from serendipity to clinical relevance," *Brain Research* 886, no. 1-2 (December 15, 2000): 172-189.

Often times, stress is referred to as controllable stress or uncontrollable stress. While 'sense of control' is one of the factors listed above, the question of whether stress is 'controllable' connotes a broader theme and takes into account all of the above factors. Thus, controllable stress is a potentially stressful situation that does not cross the threshold into a physiological response. This paper will focus on what is often referred to as 'uncontrollable stress,' which leads to the changes in hormone and neurotransmitter levels and their effects that will be the focus of this paper. 'Controllable stress' will only be discussed in situations where additional stressors may provide the proverbial 'straw that breaks the camel's back,' acting as a marginal addition that increases the total stress load past the breaking point.

The effects of sleep deprivation in an experimental setting illustrate the interplay of factors in the above table with stress. Two groups of healthy young adults were recruited, with one being sleep deprived for a night and the other allowed to sleep normally. By measuring the reactions of the subjects' pupils to negatively themed pictures, researchers could identify how strongly subjects reacted to negative emotional information. The sleep deprived group had larger and more anticipatory pupil-responses, suggesting that sleep deprivation increases people's reactivity to negative emotional information.[12] Thus, after sleep deprivation, a situation that would normally present as a 'controllable stressor' might cross the threshold into causing 'uncontrollable stress.' Any number of combinations of the increasing and ameliorating factors above may modulate whether a person perceives 'uncontrollable stress.'


13

A number of these factors will also be utilized in the research paradigms discussed in each trait section. For example, the Trier Social Stress Test (TSST) is an often used paradigm to cause a stress response in research subjects. An individual is brought before a group of evaluators in a mock job interview and must try to convince the evaluators that he or she should be hired. At the end of this speech, the subject is also made to do mental math (such as serial subtraction of 13 from 1000) in front of the evaluators. Thus, the TSST utilizes

[12] Peter L. Franzen et al., "Sleep deprivation alters pupillary reactivity to emotional stimuli in healthy young adults," *Biological Psychology* 80, no. 3 (March 2009): 300-305.

[13] D Picture of Trier Social Stress Test from http://www.jacobs-university.de/schools/jacobscenter/bkudielka/15533/index.php

social evaluation, achievement evaluation, a lack of social support, and a lack of control over the situation to produce a physiological stress-response in most individuals. This test has been validated over many years and in many trials.[14]

Low poll numbers may be a source of psychosocial stress for leaders, as it amounts to judgment of their abilities[15]

Leaders are likely to be affected by a number of these factors. Sleep deprivation is common because of the demands on the time of leaders, and during crises, this is bound to worsen. Crises also tend to be fraught with uncertainty, especially those of consequence, as both sides tend to have incentives (or think that they have incentives) to keep their intentions and "red-lines" hidden. National leaders are also constantly being judged on their achievements. In the West, this may occur through opinion polls, legislative actions, and discussion in the media. This can also be taken as judgment of social status depending on how the leader perceives criticism. Counterbalancing this, however, is the likelihood that leaders feel a sense of purpose. The rigors of becoming the leader of a country are sufficient that it does not often happen accidentally, and the people that achieve the highest position in a nation tend to believe that they should be there and for some reason. This also speaks to the likelihood of leaders feeling a sense of control. Although uncertainty created by an adversary may deprive leaders of a sense of total control, this group of people is likely to want to be at the top and thus wants to be in control. With stress, belief is often reality, so if a leader considers him or herself in control, he or she is less likely to perceive stress as uncontrollable. Finally, the degree to which leaders have social support and their valence – their general outlook and specific view on the current situation, such as whether it is improving or worsening – will vary by leader and by the circumstances, but they may be key factors in the extent to which a leader considers him or herself under stress.

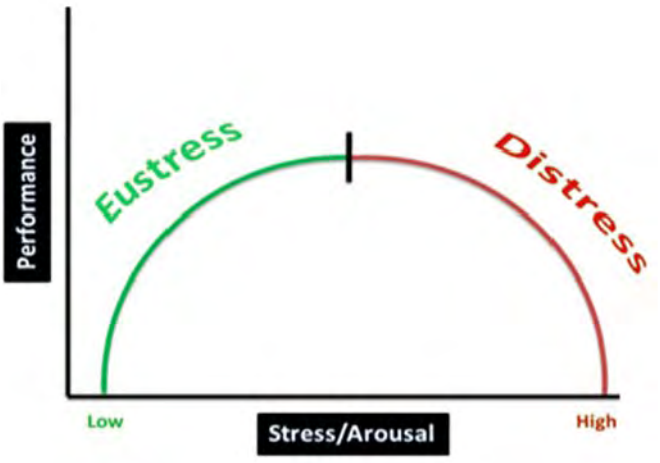
Magnitude of Stress

As discussed in the prior section, this report will focus on situations which engender a physiological stress-response. Within these cases however, some will lead to more or less of a response. While the word 'stress,' as used today, has acquired an almost universally negative

[14] L. Schwabe et al., "Stress modulates the use of spatial versus stimulus-response learning strategies in humans," *Learning & Memory* 14, no. 1-2 (2007): 109.

[15] Picture from http://www.healthpopuli.com/2008/12/were-officially-in-recession-momentum.html

meaning, some amounts of stress-response in some situations can be beneficial. As discussed above, the stress response which allows a driver to avoid an accident unfolding in front of them is beneficial. Without the faster reaction time and intense focus that stress can provide in such a situation, the driver might be hurt or killed, but if the driver is under high stress in his life and then experiences the additional stress of needing to avoid an accident, he or she might freeze-up. This phenomenon of 'good' stress vs. 'bad' stress – eustress and distress in the parlance of noted scientist Hans Selye – is described by his inverted 'U' model of stress and performance.[16] He described eustress and distress as 'good' and 'bad' stress, respectively, with increasing stress leading to improved performance up to a point, at which performance begins to decrease.



Selye's Proposed Relationship Between Stress and Performance

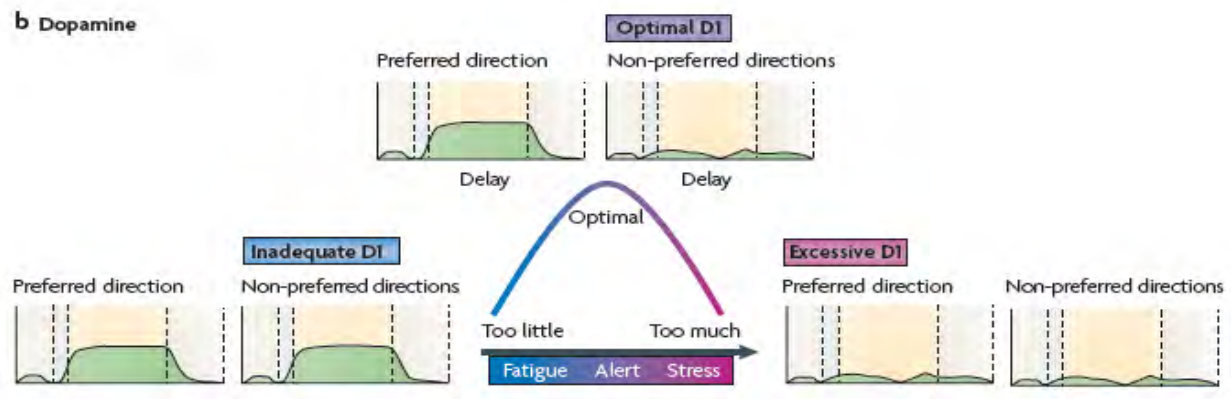
This model raises several questions: First, where do people begin on the curve when engaged in different activities? And second, does the shape of the curve vary depending on the characteristics of the given activity, situation, or person? This study posits that different situations do have either different starting points or different curves. The effects of stress on avoiding a car accident are significantly different than the effects of stress on managing a geopolitical crisis. Where a driver requires quick reflexes and quick decision making, a leader needs mental clarity and objectivity to perform significantly more challenging cognitive tasks where speed may be less crucial, including but not limited to identifying what is happening, why, motivations, the potential solution set, which solution is the best in terms of established goals, and how best to implement the chosen course of action. As such, someone attempting to avoid a car accident is aided much more by the stress response than a leader. It is outside of the scope of this project to develop a new Selye-like model or to adapt it to the complex tasks explored later. However, underlying much of the analysis in this report is the notion that the tasks that leaders perform are relatively complex and that this will lead to stress having different, and perhaps more severe, effects on leaders and leadership than on other groups and tasks, despite the fact that leaders share the same basic stress physiology as others.

[16] Incorporated into the inverted 'U' model of stress is Selyes' definition of eustress, or 'good stress', which allows for increased adaptability to overcome adversity. Over the last century, the original Yerkes & Dodson (1908) model has inspired other versions of the inverted 'U' model of stress and performance, including Selyes' (1975) and Hancock & Warms' (1989).

Even if the eustress/distress model is limited in its applicability, another U-shaped relationship is applicable. At the individual neurotransmitter level, some areas of the brain show increased performance with the addition of a neurotransmitter, but then reach a peak followed by decreasing performance. This is similar to adding salt or spices to food – too little and the food lacks taste, but too much and the taste is ruined. In regions of the brain, this effect can be seen through the cognitive functions in which they are involved.

Too little dopamine in reward centers of the brain can remove any sense of future reward from daily activities, leading to a lack of motivation, but too much can focus a person too highly on immediate rewards at the expense of future harm. Dopamine also exhibits an inverted-U relationship with working memory, which is the ability to temporarily hold and manipulate information in conscious thought. Both too much and too little dopamine decrease the signal-to-noise ratio that allows the brain to keep information in working memory, as demonstrated in the figure below. The figure refers to spatial working memory, or the ability to keep the location of objects in conscious thought when not observing them. The brain contains neurons which represent different directions, and to keep a location in working memory, those neurons representing the correct direction ('preferred direction') continue to fire while others ('non-preferred direction') are silent. With the optimal amount of dopamine stimulating the dopamine D1 receptor, the signal to noise ratio is high (top figure). However, with too little dopamine, all neurons begin to fire, degrading the signal-to-noise ratio (left figure). Too much dopamine (right figure) also degrades working memory performance, in this case by decreasing the firing of the correct neurons. This leads to a U-shaped relationship between dopamine levels and performance, which can also be seen with other neurotransmitters, including norepinephrine.[17]

The Effects of Dopamine Levels on Spatial Working Memory Performance



[17] A. F. T. Arnsten, "Stress signalling pathways that impair prefrontal cortex structure and function," *Nature Reviews Neuroscience* 10, no. 6 (2009): 410–422

Thus, acute stress, which often increases neurotransmitter levels, and sustained and chronic stress, which often decrease neurotransmitter levels, may both cause cognitive and socioemotional dysfunction. Sometimes, the negative effects will be in similar directions and sometimes they will be opposite, but it will be an important point going forward that just because some is good does not mean that more is better, and just because too much is bad doesn't mean that little is good.

Individual Variation


19

One of the key limitations to this report is that data on the psychophysiological effects of stress on high-level leaders is simply unavailable. While biographies and health records can provide some insight into the physiology and external thought processes of leaders – often though, the ones that they intend for their audience to perceive – this will only provide a very rough basis on which to proceed. The available research in the general public only highlights the potential difficulties that this may produce. Research data shows that levels of individual variation are high in the general population, in terms of how stress is perceived, the physiological responses to that stress, and the psychophysiological effects of the stress response on individuals. Factors that influence individual variation include: age, sex, genetic makeup, and life history.[18] The difficulty posed by this variation is only compounded by the fact that the vast majority of research is done in westerners, especially in Americans. Differences between cultures and nations will likely further increase the already understood variability.

Nonetheless, the authors of this study believe that it can still add value to the understanding of the psychophysiology of stress in leaders for the following reasons: This study will identify the physiological correlates of the traits that it describes and how they *can* be affected by stress. By

[18] Marian Joels and Tallie Z. Baram, "The neuro-symphony of stress," *Nat Rev Neurosci* 10, no. 6 (June 2009): 459-466

[19] Picture from http://www.sceniccityscoop.com/wp-content/uploads/2008/03/tall-and-short.jpg

avoiding the deterministic argument that certain types of stress *will always* cause certain effects, those borne out by future research or those demonstrated by specific leaders can be selected and those that are not applicable can be ignored without invalidating either the structure of the discussion or the analysis therein. If new research shows that certain effects are more likely or occur specifically in leaders as a subgroup, additions or changes can be made to the information and analysis in this report. Furthermore, by focusing on stress which causes a physiological response, in a sense equating stress with 'uncontrollable stress,' the variable thresholds for stress exhibited by different people and subgroups do not hinder the analysis. While these thresholds in leaders are an important object for future study, this report can be applied once leaders have crossed their own individual threshold into stress. The first study in this report also discusses a number of factors that may affect individual variability with respect to stress.

Thus, individual variability will not be a focus of this report because a comprehensive look could fill a report by itself without necessarily adding to the understanding of the elite group at the focus of this report since individual variation within national leaders and the differences between them as a group and other parts of the population are not well understood. As such, with the understanding that individual variation is important, we believe that the research discussed in this report presents a reasonable basis from which to analyze the psychophysiological effects of stress on leaders. While we posit that leaders will be different from the general population, leaders also share underlying anatomical and physiological systems as humans. It is highly unlikely that all the effects described in this report will affect any given leader, but we believe that it is similarly unlikely that none of the effects will be relevant, thus leaving, at a minimum, sections of this report that are applicable to any given leader, and hopefully, across a cross-section of leaders, much of this report will be valuable.

Physiology of Acute and Long-Term Stress

In addition to the magnitude of stress and individual variation, the time scale of stress is crucial to understanding its potential effects, as the physiological effects of acute stress can be the opposite of the effects of chronic or sustained stress. Even when the psychological effects are similar, they are usually the result of different mechanisms. This section will serve as foundation for the rest of the paper which will discuss individual systems in more specificity, but the understanding of the general trends of stress over different time periods discussed here will serve as important background for the rest of the report.

The Acute Response

The acute human stress-response begins and lasts over a period of seconds to days and seeks to mobilize the resources necessary to deal with a stressor, such as focus, oxygen and glucose,

which serve as fuel for cells, and to protect the body from potential damage that may come in the face of that stress, such as by tightening peripheral blood vessels, which would reduce bleeding after an injury.

The prototypical stress-response begins when a potential threat or stressor is identified. The amygdala, an 'older' portion of the brain, receives input from the senses – vision, hearing, touch, and others – via the limbic system and is alerted (see text box on the following page). It acts very much like an alarm. On a functional brain scan which can sense areas of the brain that are active, it 'lights up.' However, an initial alarm is not sufficient to set off a full-fledged stress-response. Instead, the prefrontal cortex (PFC), which is responsible for executive function (see the adjacent sidebar)[20] and the hippocampus, responsible for memory, can help quiet the amygdala if the threat is not considered worth mobilizing expensive flight-or-fight resources.

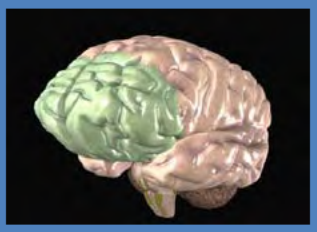
In the fastest portion of the response, the sympathetic nervous system, which is autonomic (not consciously controlled), stimulates the adrenal medulla, part of the adrenal glands located above the kidneys, to release epinephrine, often better

[20] This citation refers to the text box, Executive Function and the PFC: J. D. Cohen and E. K. Miller, "An integrative theory of prefrontal cortex function," *Annual Review of Neuroscience* 24 (2001): 167–202; A. F. T. Arnsten, "Stress signalling pathways that impair prefrontal cortex structure and function," *Nature Reviews Neuroscience* 10, no. 6 (2009): 410–422; Picture of PFC Location from: Bunge Lab, "Brain Glossary,"http://bungelab.berkeley.edu/KidsCorner/kidscorner/glossary.html. Picture of coliseum from http://www.hartransom.org/Hart_Ransom/7_wonders/7%20Wonders_Varni/roman_coliseum.htm

Executive Function & the PFC

As described by Miller and Cohen in their integrated theory of the prefrontal cortex function: "One of the fundamental mysteries of neuroscience is how coordinated, purposeful behavior arises from the distributed activity of billions of neurons and many different sub-systems in the brain. Simple behaviors can rely on relatively straightforward interactions between the brain's input and output systems. Animals with fewer than a hundred thousand neurons (in the human brain there are 100 billion or more neurons) can approach food and avoid predators. For animals with larger brains though, behavior is more flexible. But flexibility carries a cost: Although our elaborate sensory and motor systems provide detailed information about the external world and make available a large repertoire of actions, this introduces greater potential for interference and confusion. The richer information we have about the world and the greater number of options for behavior require appropriate attentional, decision-making, and coordinative functions, lest uncertainty prevail. For these reasons, humans have evolved mechanisms that coordinate lower-level sensory and motor processes along a common theme, an internal goal. This ability for cognitive control no doubt involves neural circuitry that extends over much of the brain, but it is commonly held that the prefrontal cortex (PFC) is particularly important." This control over lower level – and even higher level systems – is referred to as executive function and is one part of the brain that is strongly affected by stress.

LOCATION OF THE PREFRONTAL CORTEX



Goths, Visigoths, and the PFC?

How Important is the PFC?

The fact that many Romans suffered from severe lead poisoning has been clearly documented, and some have even hypothesized that the subsequent effects may have contributed to the downfall of the Roman Empire. A proposed mechanism for this effect is through PFC damage. Lead poisoning is associated with decreased grey matter in the PFC, which is in turn correlated with crime rates, poor decision making, and impulsive behavior. Additionally, analysis of bones from Roman times shows that lead poisoning was worse in wealthy Romans, who preserved wine and food in lead syrup and would have been likely to be involved in governance.

known as adrenaline, and norepinephrine.[21] These are responsible for increasing heart rate and shunting blood to essential areas for the fight or flight response, such as muscles, and away from non-essential areas, such as the digestive system. While both epinephrine and norepinephrine act peripherally, norepinephrine is also released by neurons in the brain and acts on the brain and central nervous system.

Following activation of the sympathetic nervous system, the hypothalamus-pituitary-adrenal (HPA) axis may be activated. The type of potential stressor and the psychological interpretation of the stressor can combine to affect whether the HPA axis will be activated. Factors involved with the discrimination between controllable and uncontrollable stress, again such as sense of control and social support, determine whether an HPA response occurs. If the stressor is psychologically assessed to be uncontrollable or sufficiently threatening, a cascade of hormones (see the adjacent sidebar)[22] ends in the release of cortisol.

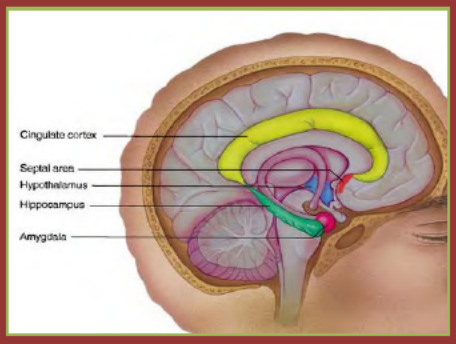
Cortisol acts to turn off the immune response, prevent swelling, and increases the availability of glucose to muscles – thus creating many of the physiological changes that prime the body for acute danger. It is also readily crosses the blood-brain barrier and exerts major effects on cognitive functions. A number of other hormones and neurotransmitters are also released under acute stress,

[21] Epinephrine and norepinephrine are also referred to as adrenaline and noradrenaline interchangeably. This report will utilize the epinephrine/norepinephrine terminology, although diagrams and figures may occasionally refer to adrenaline and noradrenaline or even by the chemical class in which they reside, catecholamines.

[22] Pictures in text box from:"The Limbic System," http://www.mhhe.com/socscience/intro/ibank/ibank/0014lll.jpg

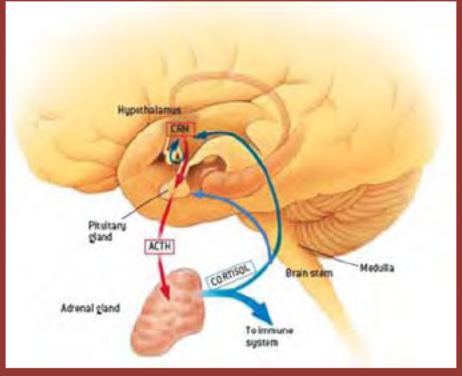
The Limbic System

The limbic system is a series of interconnected parts of the brain found in most mammals. Involved in monitoring and shaping an behavior in terms of needs, rewards, and expectations, the limbic system is sometimes referred to as an evolutionarily "earlier" part of the brain. This is because – unlike with the "later" cortex - humans share many parts and functions of the limbic system with other animals. The most prominent constituent of the system is the amygdala, which is most often blamed for emotional reactions. In fact, the amygdala, along with the thalamus, hippocampus, and cingulate cortex are intimately involved in basic, but important, behaviors like exploring the environment and then learning how to exploit it for survival as well as pleasure. As such the limbic system helps to carve up a complex world into manageable categories based, in part, on emotional salience.



HPA Axis & Cortisol Release

In response to an uncontrollable or sufficiently threatening stimulus, the hypothalamus releases Corticotrophin releasing hormone (CRH) and vasopressin. These in turn stimulate the pituitary gland to release adrenocorticotrophin hormone (ACTH) which acts on the adrenal cortex to release cortisol, which some have referred to as the 'stress hormone.' In a normal stress-response, the HPA axis works on a negative feedback loop whereby the cortisol shuts off the hypothalamus and pituitary glands' production of ACTH.



including dopamine, which is involved in reward processing.

The effects of acute stress tend to disrupt processing in the PFC and switch brain functions to more basic, evolutionarily older portions of the brain.

Sustained and Chronic Stress

The first report of this study, *The Psychophysiology of Defeat Mechanisms: A Catalogue* differentiated between sustained and chronic stress because their effects on the brain can vary both in magnitude and pathway. However, their psychophysiological effects tend to be similar, with differences being a matter of magnitude. As a result, separating them would lead to a large degree of repetition, and probably more importantly, the research available leaves very little data with which to do so. As such, this report will discuss them together, as the effects of long-term stress over weeks to years.

With the cessation of an acutely stressful situation, cortisol normally will act on the hypothalamus and pituitary glands to shut off further cortisol production through a process called feedback inhibition. However, if the stress continues or new stress begins in its place, the cortisol response may be sustained. The longer cortisol levels are raised, the more the hypothalamus and pituitary become immune to it and will support a continued stress-response. In the long term, the stress response loses much of its variability. Instead of a normal cortisol profile, which jumps to a maximum soon after waking up from sleep and then decreases for the rest of the day, a person under chronic stress may have a profile that stays elevated but flat or even inverted. This may be a factor in a number of diseases, such as hypertension and cardiovascular disease in addition to the cognitive and socioemotional effects that will be discussed later.

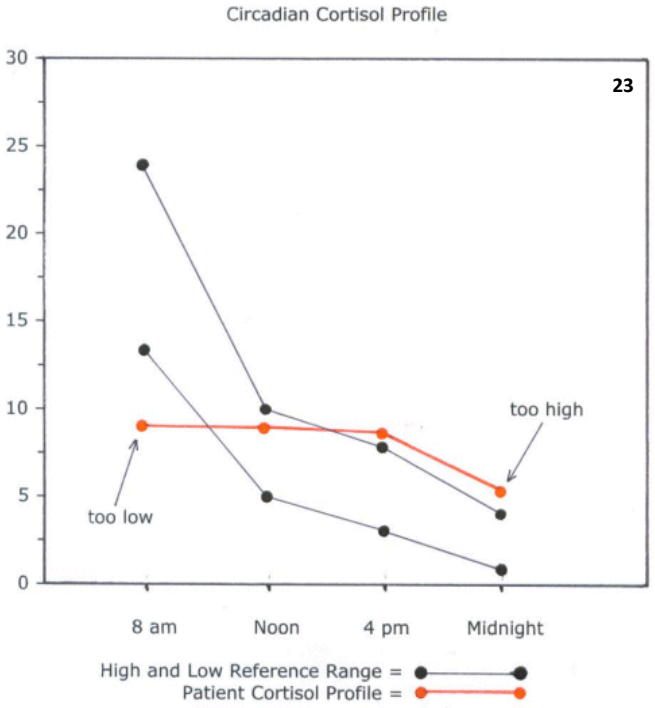


Chart demonstrating the "flat-line" effect on cortisol in burnout. The orange line reflects the loss of reactivity and variability which can result from sustained and chronic stress.

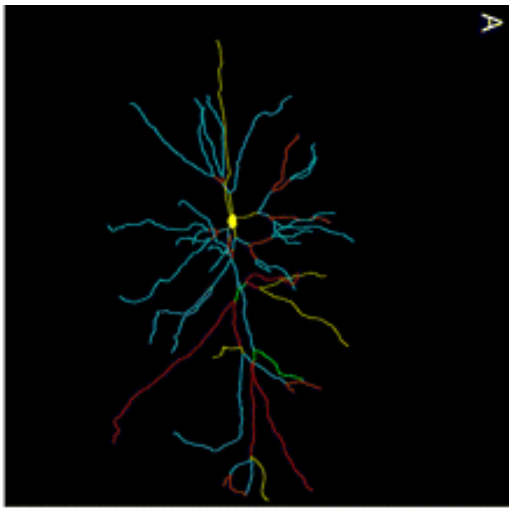
Long-term stress' effects on the integrity of the PFC and hippocampus are, perhaps, more concerning. While still under debate, strong evidence suggests that sustained and chronic stress

[23] *Picture from www.mind-wellness.net*

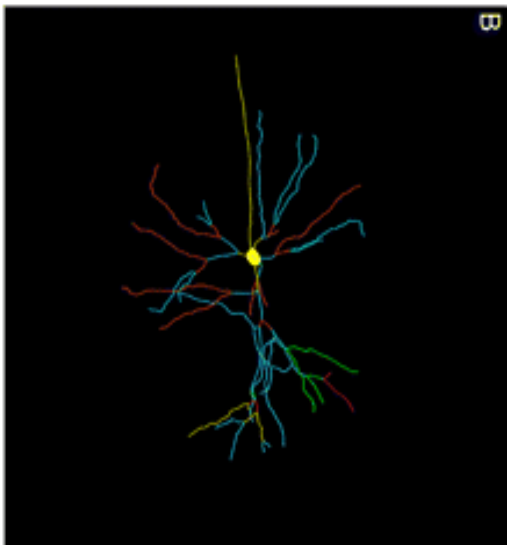
cause the size of the hippocampus and PFC to decrease while increasing the size of the amygdala. Cortisol decreases the amount of sugar available to neurons in the hippocampus and

PFC, and as a result, when they are stimulated to high levels of activity, they do not have enough energy to perform essential functions and may die. Long-term stress is especially harmful because it not only provides the elevated cortisol levels that deplete the neurons of fuel, but it also provides the external stimulation, such by repeated release of glutamate from other neurons.

While these effects would begin during acute stress, a longer time frame is required for enough neuronal death to accumulate to cause major atrophy and subsequent effects. In the long term, this can become a self-reinforcing cycle: As time passes, the hippocampus and the memories that it mediates are less available to help the individual in question learn and understand that a situation has changed or can be resolved.[24] PFC atrophy can decrease attention and executive function, both important for supporting actions to ameliorate stress, and the increased amygdala size can lead to increased fear, anxiety, and aggression, which will be less-effectively controlled by the degraded hippocampus and PFC.[25] Thus, the effects of long-term stress are especially pernicious and can build upon themselves. On a brighter note, however, once stress is resolved and a subject has several stress-free weeks to recuperate, the hippocampus and PFC will begin to re-grow. What is still



Reconstructed neurons from the rat PFC. The top neuron (A) is from a control animal and the bottom (B) is from an animal subjected to sustained stress. Longer and more numerous dendritic branching can be seen in the top image.[26]



[24] F. Ohl et al., "Effect of chronic psychosocial stress and long-term cortisol treatment on hippocampus-mediated memory and hippocampal volume: a pilot-study in tree shrews," *Psychoneuroendocrinology* 25, no. 4 (May 2000): 357-363

[25] McEwen, "The neurobiology of stress." *Brain Research* 886, no. 1-2 (Dec 2000):172-179.

[26] Pictures from: Jason J. Radley et al., "Repeated Stress Induces Dendritic Spine Loss in the Rat Medial Prefrontal Cortex," Cereb. Cortex (May 18, 2005): bhi104.

not well understood, however, is the difference between their pre- and post-stress function.[27]

[27] Robert M. Sapolsky, "Glucocorticoids and Hippocampal Atrophy in Neuropsychiatric Disorders," *Arch Gen Psychiatry* 57, no. 10 (October 1, 2000): 925-935.

The Psychophysiology of Defeat Mechanisms: A Catalogue

The first report in this series, *The Psychophysiology of Defeat Mechanisms: A Catalogue* sought to "identify some of the neurobiological bases for various [stress-induced] psychological conditions that could lead an individual to suffer defeat, where defeat is defined as "becoming militarily ineffective."[28] In order to identify these conditions, the authors examined the different effects of stress over time. They identified that the physiological effects of stress changed significantly over the acute (seconds to days), sustained (days to months), and chronic (months to years) time frames. Specifically, they found that:

- **Acute stress affects electrical and chemical substrates in the body, altering levels of stress hormones as well as activity of the nervous system, sometimes to the point of degrading important feedback loops.**
- **Sustained stress affects psychophysiological functions, such as the "explore/exploit" dynamic necessary for human adaptivity.**
- **Chronic stress affects the psychophysiological structure, resulting in such effects as protein misfolding, atrophy of the brain and musculature, and memory dysfunction.**

Within each time frame, the report identified different critical functions that were affected, both physiologically and psychologically, including the ability to sense and react, the capacity for internal communication, and feedback loops. Within the 3 x 3 matrix described by the time scale of the stress and the psychophysiological effects, the report identified nine stress-induced psychological conditions that resulted from the physiological effects of stress. These defeat mechanisms were then discussed in light of how they might lead to individual and group defeat – that is, how they could contribute to military ineffectiveness.

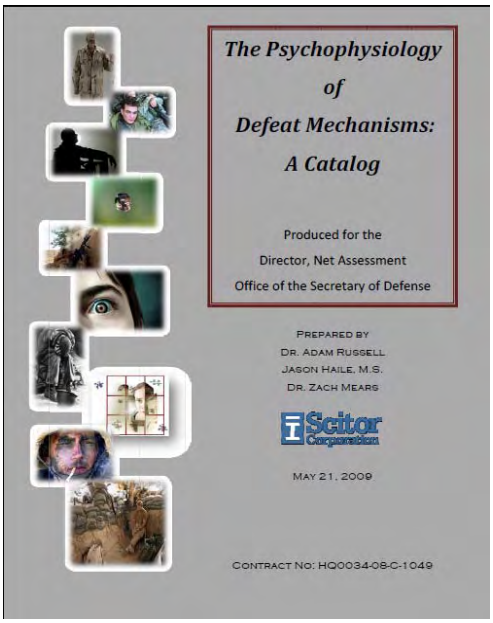
Psychophysiological Mechanisms of Defeat

Effects	Individual	Inability to sense/react	Loss of Psychophysiological communication	Loss of internal feedback loops
Stress	Acute	Myopia	Dissociation	Panic
	Sustained	Withdrawal	Debilitation	Burnout
	Chronic	Helplessness	Hopelessness	Depression

[28] Adam Russell, Jason Haile, and Zach Mears, "The Psychophysiology of Defeat Mechanisms: A Catalogue" (Written for the Director, Office of Net Assessment, Office of the Secretary of Defense. Contract Number HQ0034-08C-1049, May 2009). This study will sometime be referred to as the *Catalogue*.

The research, analysis, and framework of the *Catalogue* have informed the structure and content of this current work. Specifically, the crucial distinctions drawn between the effects of different time scales of stress factor prominently into the analysis herein. As discussed earlier, this report will group sustained and chronic stress together, not for any lack of a distinction, but because of the paucity of applicable research in humans. Some of the psychological conditions – the defeat mechanisms – will also be used as proxies for stress where data which speaks directly to the affects of stress is unavailable. Thus, *The Psychophysiology of Defeat Mechanisms: A Catalogue* provided a crucial first step into identifying the effects of stress on effectiveness, and this current study is indebted to it.

Where this study builds on the *Catalogue* will be first in its focus on leaders and second – and perhaps more importantly – in its attempt to add more specificity in answering the question: *How does stress lead to defeat?* While an excellent argument can be made for how a condition, such as burnout, can lead to defeat, the discussion necessarily begins very generally and does not inherently provide a structure. As a clinical syndrome, burnout is characterized by physical exhaustion, poor judgment, cynicism, guilt, feelings of ineffectiveness, and a sense of depersonalization in relationships.[29] As such, burnout is a condition that affects a wide number of attributes, skills, traits, and tasks that one might need to carry out. There is also significant overlap with other conditions, such as depression.



Thus, in an attempt to perform this analysis more clearly and with a higher degree of specificity, this report has developed and employed a new structure based on the tasks required of leaders and the traits that underlie those tasks. This should not be seen as a repudiation of the framework from the first report. This is especially the case because some of the defeat mechanisms identified in the first report be utilized as proxies for sustained and chronic stress where research directly on stress is lacking. Nonetheless, the authors of this report feel that this new framework gives the best basis from which to tackle a question that is infused with uncertainty from multiple angles – because of gaps in the emerging science of psychophysiology and because of disagreements over how to assess, model, and predict good leadership.

[29] Charles M. Balch, Julie A. Freischlag, and Tait D. Shanafelt, "Stress and Burnout Among Surgeons: Understanding and Managing the Syndrome and Avoiding the Adverse Consequences," *Arch Surg* 144, no. 4 (April 1, 2009): 371-376.

A Leadership Framework for Examining the Effects of Stress

Once the potential benefits of a new framework were identified, a brief survey of the leadership studies field was conducted. This survey identified a number of crosscurrents in the current debate that were taken into account in developing a framework for this study. The most important of these were: a distinction between leadership and management; disagreements over emphasis on leadership styles or leadership traits; and focus on leaders' individual cognitive characteristics versus their interaction with and within groups.

First, leadership is often conceived distinctly from management. According to Abraham Zaleznik in the Harvard Business Review on Leadership, "Managers and leaders are two very different types of people. Managers' goals arise out of necessities rather than desires; they excel at diffusing conflicts between individuals or departments, placating all sides while ensuring that an organization's day to day business gets done. Leaders, on the other hand, adopt personal, active attitudes towards goals. They look for the potential opportunities and rewards that lie around the corner, inspiring subordinates and firing up the creative process with their own energy. Their relationships with employees and coworkers are intense, and their working environment is often, consequently chaotic."[30] This distinction is problematic with respect to the current study because national leaders must be both leaders and managers, as the roles are conceived by Zaleznik and others who make the same distinction.

Research in the field also splits between groups of theories that focus on leadership styles and those that focus on leadership traits. Leadership styles look at the interaction between leaders and their followers/subordinates, how power is maintained, how leaders motivate, and other factors. Trait approaches focus on identifying traits, often cognitive, that are relied upon by leaders.

Two examples of theories of leadership style are transactional and transformational leadership. Built upon principles of behavioral psychology, the Transactional Model of leadership focuses on efforts of leaders to foster relationships with their followers to accomplish broader goals. These relationships are based on 'transactions' that allows for mutual satisfaction of goals and needs, with the transactions often described in terms of economics, such as reward and cost, profit and loss. Thus, the Transactional Model is sometimes referred to as the exchange theory of leadership, where leaders exchange assets with other individuals (leaders or followers) for mutual gain. Theorists backing this model leadership frequently highlight management skills necessary to build effective leader-follower working relationships.

[30] Harvard Business School Press, *Harvard Business Review on Leadership*, 1st ed. (Harvard Business Press, 1998).

In contrast, the Transformational Model of leadership primarily examines the use of charisma by leaders to gain power, followers, and achieve goals. The German Sociologist Max Weber first described the 'charismatic' leader as an individual who was recognized by followers as gifted and heroic while displaying exemplary character.[31] Leaders seek to leverage these characteristics to enact change using personality, behavior, and stressful situations, through which they guide followers, to attain power and achieve individual or societal goals.[32]

While some leaders might fit reasonably well into one mold or the other at a given time, relying on only one such model would leave significant gaps. More importantly, these models focus principally on the socioemotional aspect of leadership. Considering that national leaders are the ultimate decision makers in many governmental systems, cognitive aspects also underlie their performance. In contrast, many of the trait approaches to leadership focus mostly on cognitive traits, such as intelligence or cognitive complexity, sometimes to the exclusion of socioemotional traits. Because leaders constantly interact with others – to gather information, discuss options, and implement their decisions – the socioemotional aspects of their personae will also be crucial components of their overall performance. However, incorporating socioemotional traits into a trait framework is much simpler and more straightforward than attempting to integrate cognitive aspects into leadership styles. The psychophysiology literature also tends to study traits or mental functions that underlie traits, such as creativity, drive, and working memory, which allows for an easier transition between the scientific literature and a trait framework. As such, we elected to utilize a trait framework in this study.

In order to do so, however, we were required to select from a large universe of different traits. The wide variety identified and studied by various investigators is at least partially due to the effect of state-trait interactions, the concept that different traits will be employed in different situations and in different ways. However, we quickly identified that this could be ameliorated by focusing on leadership under specific circumstances. This also produced an analytic method by which traits could be identified. By identifying the tasks required of leaders in a given situation, the traits that are required to perform those tasks can be identified. While we recognize that leaders will not rely equally on traits, even under the same circumstances, we felt that a relatively limited set could be selected that would encompass a number of types of leaders.

As discussed earlier, we selected crises as the lens through which to study leaders for several reasons. First, crises, by their definition, involve important national goals. Second, leaders are

[31] Ibid, 79.

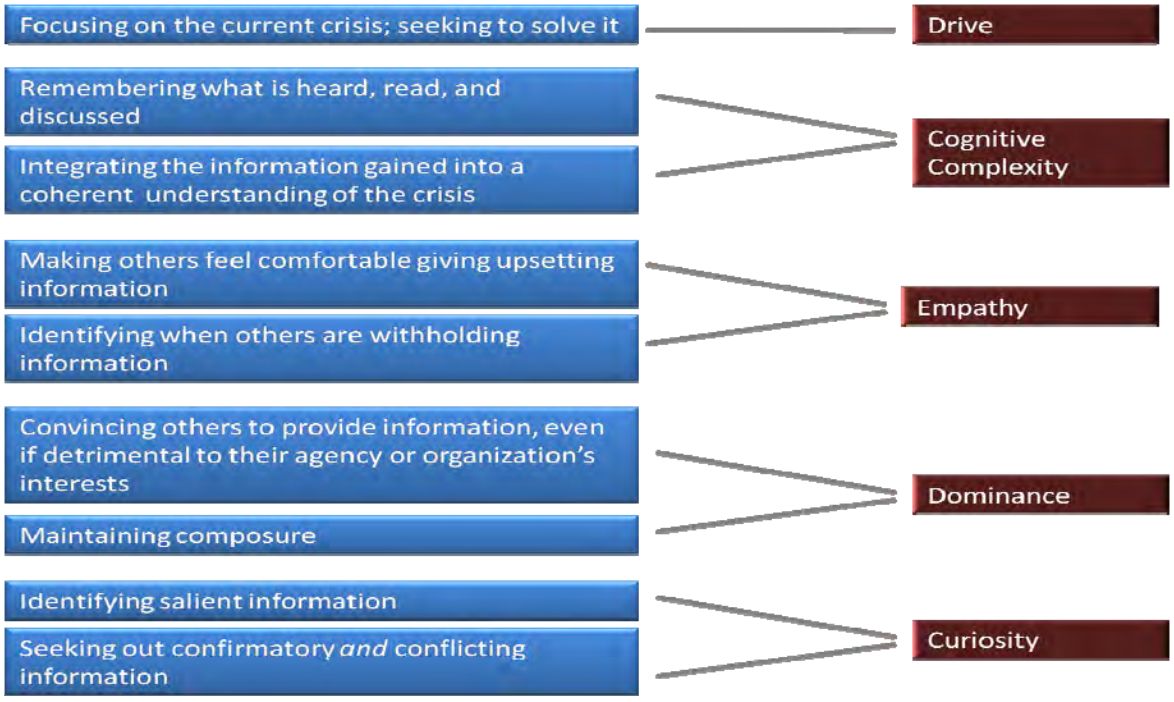
[32] R. J. House, A 1976 theory of charismatic leadership. In J.G. Hunt & L.L. Larson (Eds) Leadership: The cutting edge. Carbondale, IL: Southern Illinois University Press, 1977.

relatively more important during crises, and third, crises are inherently stressful situations. Thus, crises present an excellent set of circumstances to use in a study concerned with the effects of stress on leaders. They also provide a set of relatively well documented case studies to illustrate the effects of stress. Looking at crises, we identified four broad tasks that leaders may perform, consciously or unconsciously, during a crisis. Leaders, along with their subordinates, may perform the following tasks in crises:

1. Information gathering and sensemaking (see below for definition);[33]
2. Developing solution sets, including identification of costs and benefits;
3. Weighing options and deciding;
4. Implementing the chosen solution

Within each of these tasks, we identified sub-tasks that might help a leader successfully navigate through a crisis. For example, under the first task, information gathering and sensemaking, the following activities might contribute to success, which we have abstracted into a set of traits, boxed in red:

Sub-Tasks and Traits Associated with Information Gathering and Sensemaking



[33] Sensemaking is the process of creating situational awareness and understanding in situations of high complexity or uncertainty in order to make decisions. It is "a motivated, continuous effort to understand connections (which can be among people, places, and events) in order to anticipate their trajectories and act effectively." G. Klein, B. Moon, and R. R. Hoffman, "Making sense of sensemaking 1: Alternative perspectives," *IEEE Intelligent Systems* 21, no. 4 (2006): 70–73

In performing this same exercise for each of the other three categories of tasks, we came to the conclusion that the four tasks share similarities that make most of the traits we have identified applicable across each process (see Appendix 1 for breakdowns of each task). Drive, cognitive complexity, empathy, and dominance influence each task, as can be seen below:

Traits Underlying Crisis Tasks

Three factors help to explain this: First, the traits that we have chosen are broad. While we are interested in identifying the potential effects of stress with a degree of specificity, too microscopic a view will make assembling the full picture very difficult. The level of specificity has also been chosen because it is at approximately the level of traits investigated in psychophysiological studies, which helps to make the best use of an already limited data set. And third, the four sets of tasks that underlie leaders' actions in crises are not clearly delineated and sequential in real life. Leaders do not confer to gather information then go into isolation to make their decisions. Thus, we believe that it is appropriate that traits show up in multiple places and will add a better overall understanding of how traits may support successful leadership processes and provide a lens, through which to analyze the effects of stress on these processes.

This list of tasks and the supporting traits is not intended to be either necessary or sufficient for achieving a successful resolution of a crisis. No matter how persistently and curiously a leader attempts to gather information to understand a crisis, some information may simply be unavailable. Unforeseeable events may occur mid-crisis that change its character and the optimal decision, and despite the best oversight and attempts to cajole and guide those at the

"pointy end of the spear," implementation in or out of the leader's hands may be botched. Luck or chance will always be a factor. Nonetheless, we posit that the successful completion of the tasks listed above will increase the chances of a successful conclusion to a crisis probabilistically.

Additionally, the authors of this study are aware that the tasks discussed above comprise much that is subsumed within the rational decision making model. This is not meant to imply that leaders are rational decision makers, in fact this paper provides much evidence to the contrary. This framework allows for this, as it does not imply that leaders perform the tasks sequentially or, in some cases, even at all. Still, a leader that goes with his or her gut without considering the implications of his or her decision or even one who makes decisions by throwing darts at a board will be successful some percentage of the time, but we believe that, *on average*, the successful undertaking of the tasks described above will lead to better outcomes. Even a broken clock is correct twice a day, but when issues of global and national power are at stake, that is not very often.

Leadership Task-Trait Framework

The table below displays the traits that we have identified as potentially supporting leader tasks in crises. In effect, the different ways that these traits are degraded by stress are the defeat mechanisms of this paper, and the following sections will discuss how they can lead to leaders becoming ineffective. For the sake of concision, trait definitions will be presented with the discussion of the psychophysiology of the traits and the effects of stress in the following section. The discussion of how the traits are involved in the specific tasks will also be saved for the next section so that the each trait-specific section can contain a holistic discussion of the trait without significant repetition.

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	Drive	Drive	Drive	Drive
	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity
	Curiosity	Creativity	Objectivity	- - -
	Empathy	Empathy	Empathy	Empathy
	Dominance	Dominance	Dominance	Dominance

The Psychophysiological Effects of Stress on Leadership Traits and Tasks

In this section, the traits identified above will be analyzed both for how they support leaders and how they are affected by stress. Each section will begin with a definition of the trait and contain: a discussion of how it is involved in the leadership process; a brief discussion of the physiology of its function; and how stress affects it in the acute and the sustained/chronic time frame.

As mentioned earlier, the sustained and chronic time frames will be lumped together because their effects tend to be in the same direction and because of a paucity of psychophysiological data. Also as a result of this, proxies for the effects of sustained and chronic stress, such as burnout and depression will be utilized where no data on the specific effects of stress is available. This represents a biased data source from which to draw, as only some people under chronic or sustained stress will develop these conditions. This means that the effects discussed herein are those most likely to affect this sub-population, instead of more resilient people. Nonetheless, as this paper is seeking to identify potential effects of stress that can affect leaders, we believe that this is appropriate and leads to the fullest set of insights currently possible.

Drive

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	**Drive**	**Drive**	**Drive**	**Drive**
	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity
	Curiosity	Creativity	Objectivity	- - -
	Empathy	Empathy	Empathy	Empathy
	Dominance	Dominance	Dominance	Dominance

36

The trait *drive* is characterized by the energy and desire to exert effort in order to achieve an outcome or reward. Drive supports leaders in overcoming obstacles by giving them a "capacity to work with distant objects in view" and a degree of strength of will or perseverance.[34] A 'driven' person is traditionally thought of as someone who possesses a high degree of motivation and attention to remain actively engaged in a task and to achieve a desired goal. Motivation is a term that refers to processes which enable organisms to regulate their external and internal environment, characterized by vigor, persistence, and high levels of work output.[35] A short quip from Revolutionary War hero John Paul Jones nicely exhibits the trait drive. Despite major damage and fire aboard his ship, Jones responded to a British demand for surrender with his famous words, "I have not yet begun to fight!"

[34] S. A Kirkpatrick and E. A Locke, "Leadership: Do traits matter," *Academy of Management Executive* 5, no. 2 (1991): 48–60.

[35] J. Salamone et al., "Effort-related functions of nucleus accumbens dopamine and associated forebrain circuits," *Psychopharmacology* 191, no. 3 (April 1, 2007): 461-482.

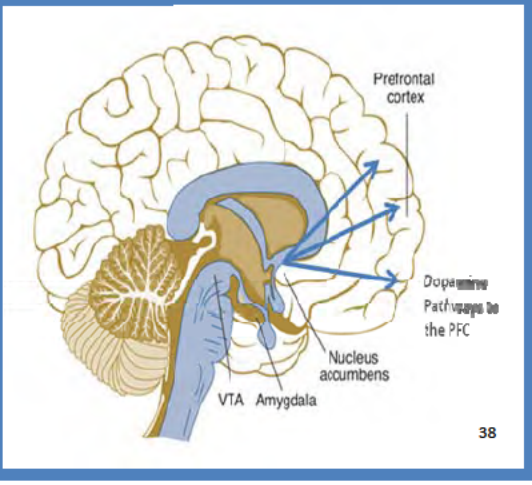
[36] Picture taken from: http://frogandprincess.wordpress.com/2009/08/10/how-to-do-business-in-asia/

In humans, drive is strongly associated with the reward pathways in the brain and the energy-liberating effects of various hormones. The potential for a reward incentivizes a person to invest time and energy in a challenge, especially one that may not pay off for days, months, or years. A reward can also keep a leader focused on a given task when they have many other potential demands on their time and energy, and perhaps most importantly, it can push a leader to try and achieve the best possible outcome, instead of satisficing – accepting an outcome that is 'good enough.' Importantly, a reward need not be a positive; it can also be the avoidance of a negative, such as not being killed. In the human brain, the reward circuitry is heavily reliant on the neurotransmitter dopamine. Dopamine supports not only the sense of reward, but also higher brain functions such as working memory.[37] Dopamine release can give humans 'a taste' of potential future rewards that can come from a given situation, such as by resolution of a crisis.

In addition to the pull of a potential reward, leaders need the energy to push through the enormous cognitive and physical demands of a crisis: long work hours, little sleep, and a barrage of information. Cells in the body rely principally on glucose – sugar – as fuel. Physical energy will decline with low blood sugar, but probably more importantly for leaders, studies show cognitive decline with acute low blood sugar. Thus, leaders require a sufficient supply to function at a high level.[39]

Reward Circuitry

Dopamine producing neurons project from the ventral tegmental area (VTA) into the nucleus accumbens, a collection of neurons which research has highlighted as instrumental in the processing of reward, including responsiveness to both positive and negative stimuli. It is also strongly implicated in effort-related processes associated with motivational drive. Dopamine producing neurons also project into the prefrontal cortex, where they are involved in positive and negative aspects of the stress-response.



Drive is strongly associated with the explore/exploit activity that is crucial to human interaction with the environment. In leaders, this involves their direct participation in managing a crisis. If a leader is content to sit-back and allow others to control the crisis, drive may not be particularly

[37] Susheel Vijayraghavan et al., "Inverted-U dopamine D1 receptor actions on prefrontal neurons engaged in working memory," *Nat Neurosci* 10, no. 3 (March 2007): 376-384

[38] Picture taken from http://pubs.niaaa.nih.gov/publications/arh312/images/thatcher.gif

[39] Louise Dye, Anne Lluch, and John E. Blundell, "Macronutrients and mental performance," *Nutrition* 16, no. 10 (October 2000): 1021-1034

important to them. However, this will also decrease their ability to affect the trajectory of the crisis, marginalizing their power as a leader.

Thus, drive sustains an engaged leader throughout the different aspects of the managing a crisis. The energy and interest that it generates support a leader's attempt to gather additional information about a crisis, which in turn helps in understanding that crisis. Leaders who are driven can be expected to generate more solutions instead of satisficing. This also carries over into the decision making process. Even if group members or supporters seek to gain an understanding of a crisis at hand and give the leader a comprehensive list of options, the leader will still be responsible for weighing the options and choosing. Just as stopping at 'enough' options can be detrimental if more time and energy could have led to better choices being considered, a lack of engagement, interest, and incentive to maximize the benefits and minimize the costs of the outcome of a crisis could lead to the selection of the easiest to implement, the simplest, or the first solution that is considered by the decision-maker. Finally, implementation can make or break even a good decision. Without drive, a leader may not have the energy or interest to convince people who initially oppose their idea or to mobilize the requisite interest groups. 'Giving up' on a good decision can have an even worse effect than choosing a lesser-option if the failure in implementation makes the choice itself appear to be faulty.

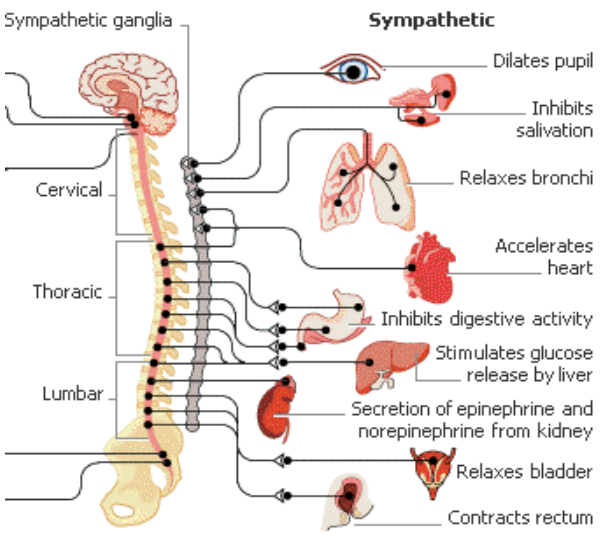
The Effects of Stress on Drive

Acute Stress

Under acute stress, drive tends to increase because of dopamine, cortisol, norepinephrine, and epinephrine release. Exposing rats to the scent of a predator leads to a prototypical stress-response: HPA axis-activation and a corticosterone (the rat analogue of cortisol) dump. In these same rats, dopamine release can be measured in the reward centers of the brain as well as into other parts. In humans, this dopamine release will serve as a cue that future rewards can be gained from the current situation, drawing the interest and engagement described above.

Acute stress will also liberate energy stores in the body. Cortisol opposes the effects of insulin, the hormone responsible for glucose storage in the liver as glycogen. As a result, glucose storage is ceased and stores are liberated. These effects lead to high blood glucose levels, supporting uptake for energy usage in the brain, active skeletal muscles, and the heart. Lipid (fat) creation is also slowed by cortisol release, and epinephrine and norepinephrine cause existing lipids to be broken down for energy use. They also divert blood flow from non-essential (in acutely stressful situations) parts of the body, such as the digestive tract, and increase heart

rate.[40] Thus, the acute stress-response acts in concert to produce and divert energy to critical body systems.



Effects of activation of the sympathetic nervous system and the release of epinephrine and norepinephrine, including energy conservation in non-essential systems and glucose liberation.[41]

The increased engagement and energy – the increased drive – caused by acute stress are positive when considered by themselves, but in concert with other effects of acute stress, can lead to self-defeating behavior. The goal directedness (usually, towards resolution of the crisis) of drive can interact with deficits in curiosity, creativity, objectivity, and empathy (all of which will be discussed in much greater detail later) to increase the probability of a negative outcome in a crisis. With persistent motivation to reach a goal (resolution of a crisis), it may be easier to miss deficits in information (caused by a lack of curiosity), an incomplete solution set (caused by decreased creativity), and such deficits in objectivity as over-weighting short term versus long-term gains. Similarly, if a leader is unable to recognize that their actions are ineffective, they may have the motivation to persist on that faulty course. Nonetheless, increased drive can support the search for information, the generation of solutions, the weighting of options, and implementation if these traits are intact, so increased drive is, by itself, a positive effect of acute stress, although it can further increase the damage of other effects of acute stress.

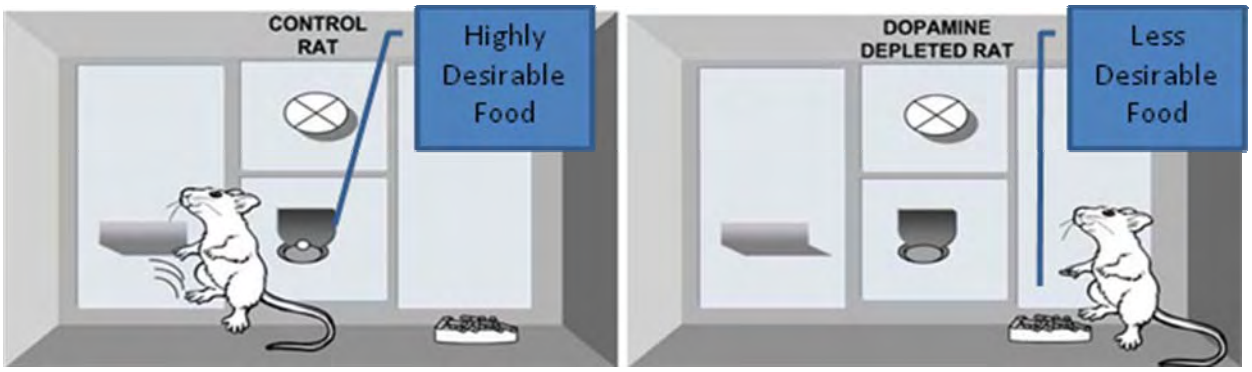
Sustained/Chronic Stress

Sustained and chronic stress cause the opposite effect of acute stress, leading to decreased drive. Rats exposed to chronic stress (hot and cold water baths for 2hrs per day for 4 weeks) display decreased dopamine levels. They also show decreased running activity on a rotating rod, analogous to behavioral symptoms of depression and loss of drive. In experiments where dopamine levels are experimentally decreased or where dopamine receptors are blocked, mice also show decreased motivation to seek rewards. For example, rats treated with dopamine receptor antagonists (compounds that turn off dopamine receptors) opt to eat readily

[40] "Effects of adrenal cortical hormones on carbohydrate, protein, and fat metabolism," January 1, 1973, http://0-www.ajcn.org.library.lausys.georgetown.edu/cgi/content/citation/26/1/113.

[41] Picture taken from http://theemtspot.com/wp-content/uploads/2009/05/autonomic.bmp

available, albeit less palatable 'chow,' rather than press a lever (requiring effort) to gain access to a more palatable food pellet.[42]



Left: Control rats show active exploration/exploitation behavior and press a lever for palatable food (high carbohydrate pellets). Right: Rats treated with low doses of DA antagonists and DA depleted rats display decreased lever pressing, instead increasing consumption of less palatable lab 'chow.'[43]

In the first report in this series, burnout and depression were identified as two conditions which can be caused by sustained and chronic stress, respectively. In chronically stressed people who have been diagnosed with burnout (see text box, following page), dopamine appears to play a role in their lack of motivation.[44,45,46] A subset of burnout individuals have high levels of a hormone, prolactin, which is inhibited by dopamine. When cortisol is administered to these people, their prolactin levels decrease, suggesting an increase in dopamine levels which could, in turn, explain the subsequent improvement in their other symptoms, including motivation.[47]

[42] M Koch, A Schmid, and H U Schnitzler, "Role of nucleus accumbens dopamine D1 and D2 receptors in instrumental and Pavlovian paradigms of conditioned reward," *Psychopharmacology* 152, no. 1 (September 2000): 67-73.

[43] Ibid.

[44] Balch, Freischlag, and Shanafelt, "Stress and Burnout Among Surgeons."

[45] Wilmar [1] Schaufeli et al., "Workaholism, burnout and well-being among junior doctors: The mediating role of role conflict," *Work & Stress* 23 (April 2009): 155-172.

[46] J Hakanen, A Bakker, and W Schaufeli, "Burnout and work engagement among teachers," *Journal of School Psychology* 43, no. 6 (1, 2006): 495-513.

[47] G Moorkens et al., "Characterization of pituitary function with emphasis on GH secretion in the chronic fatigue syndrome," *Clinical Endocrinology* 53, no. 1 (July 2000): 99-106.

Leaders' energy levels may also be significantly affected by prolonged stress. High levels of cortisol and norepinephrine can down-regulate the function of lymphocytes, dendritic cells, and macrophages, which are all key cellular elements of the immune system. These help individuals to fight off infections; more sickness and infections will leave a leader less fit to serve on a regular basis.[48] Long-term stress also is pro-inflammatory. Molecules, such as interleukin-6, are up-regulated, which can sap overall energy levels and health.

Burnout

As a clinical syndrome, burnout is characterized by physical exhaustion, poor judgment, cynicism, guilt, feelings of ineffectiveness, and a sense of depersonalization in relationships with coworkers. Depending on career choice, individuals working long hours and subjected to high work demands, such as teachers and physicians, may be prone to burnout more easily than the general population. Leaders certainly could fall into this category.[49]

Decreased drive can seriously affect leaders in crises because they may no longer have the energy or motivation to successfully manage a crisis. Without this push to succeed, leaders are more likely to avoid the cognitive load and the associated stress of attempting to understand a crisis and develop solutions. Even if their subordinates provide potential solutions, they will be less likely to persevere in weighing all possible options, as they will evade the stress from the cognitive dissonance caused by competing motivations of complex situations. The implementation phase might be the most seriously affected, as the energy and motivation required to win over opponents or assemble a coalition often require significant investments of time and energy before any rewards can be reaped. Without motivation and energy, leaders under sustained or chronic stress will not champion their ideas, and even good ones may die on the vine.

With the leader less engaged in governing, the effects of decreased drive also potentially open up the opportunity for others in positions of power to usurp the powers normally reserved for the leader, leading to unknown consequences. These effects of long-term stress are demonstrated by the following anecdote.

Calvin Coolidge, Chronic Stress, and the Effects of Decreased Drive

The case of Calvin Coolidge demonstrates the pernicious effects of a lack of drive. Coolidge's son died on 7 July 1924, and Coolidge was overwhelmed with grief. He appears to have been unable to move beyond his son's death. This constant fixation, present throughout the rest of his presidency, appears to have caused a highly stressful, but acute event to turn into a

[48] Black, P.H. Central Nervous System-Immune System Interactions: psychoneuroendocrinology of Stress and Its Immune Consequences. *Antimicrob Agents Chemother* 38:1-6, 1994.

[49] J Hakanen, A Bakker, and W Schaufeli, "Burnout and work engagement among teachers," *Journal of School Psychology* 43, no. 6 (1, 2006): 495-513.

sustained and then chronic stressor in Coolidge's life. This appears to have pushed Coolidge into a depressed state, with its negative effects on motivation and energy. [50]


51

Coolidge's changed sleep habits are one example of his increased listlessness. Earlier in his career, Coolidge customarily went to bed at 10 pm, woke at 6 or 7 am, and sometimes took a brief nap in the afternoon. After his son died, Coolidge continued going to bed at 10 pm but did not wake up until as late as 9 am. Moreover, he took a regular nap after lunch that lasted 2 to 4 hours. Following his son's death, Coolidge worked for approximately four and a half hours per day. [52]

Coolidge not only devoted less time to his presidential duties but also became less engaged. Before his son's death, Coolidge conducted regular cabinet meetings, conferred individually with cabinet members, and worked closely with them to resolve important matters. After his son died, Coolidge became more withdrawn, rarely consulted with his cabinet members, and delegated increasingly broad responsibility to them. When events in China sent Secretary of State Frank Kellogg to the White House to discuss the situation with the President and explore options for handling it, Coolidge told Kellogg to "use your own judgment." When Acting Secretary of State Joseph Grew later solicited Coolidge's views regarding another flare-up in US-China relations, Coolidge responded, "I don't know anything about this. You do…and you're in charge. You settle the problem and I'll back you up." When Coolidge sent former Secretary of War Henry Stimson to Nicaragua as the president's personal representative, Stimson asked the president what he wanted him to do. Coolidge replied, "If you can see a way to clean up that mess, I'd like to have you do it. I'll back you up whatever you think is right." [53]

Similarly, Coolidge virtually ceased his interaction with Congress. Before his son's death, Coolidge worked closely with Congress. He invited members to breakfast and dinner at the White House and for trips on the presidential yacht, solicited recommendations from members on appointments, and went out of his way to consult them on pending business. He delivered

[50] Robert E. Gilbert, *The Tormented President: Calvin Coolidge, Death, and Clinical Depression* (Praeger: Westport, CT: 2003), pp. 151-61, 170.

[51] Picture taken from wikimedia.org

[52] Jonathan R. T. Davidson and Kathryn M. Connor, "The Impairment of Presidents Pierce and Coolidge after Traumatic Bereavement," *Comprehensive Psychiatry* 49 (2008), p. 416.

[53] Gilbert, *Tormented President,* pp. 179-81.

his first annual message to Congress in person and laid out a series of legislative requests that were bold and innovative. [54]

After his son's death, Coolidge lost interest in working with Congress. He made no effort to influence committee assignments or intra-party squabbles. He ignored or met only infrequently with key members of Congress and made no real attempt to influence their votes. He even shunned strategy sessions with Congressional allies trying to pass administration measures and abstained from trying to help them. His annual messages were read to Congress by clerks and contained fewer and less important legislative proposals.[55]

Coolidge revealed a shocking unawareness on several key issues. When asked on 21 Nov. 1924 about Nicaragua, where American troops had been stationed since 1912, Coolidge replied: "I haven't any great detailed and precise information about [Nicaragua]. I know that there had been some trouble and it was my impression that we had sent some Marines in to guard the Legation, and that the difficulty was in relation to a presidential election. As I have heard nothing about it from the State Department for some time, I had taken it for granted that the situation was cleared up. I think this is the case, but I haven't any definite information." He expressed similar levels of uncertainty regarding the status of other key issues. [56]

Coolidge's lack of drive was also evident when dealing with important diplomatic and military issues. In 1925, factional military conflict in China threatened to shut down the road from Peking (Beijing) to the sea. After seeking and receiving Coolidge's consent, Acting Secretary of State Joseph Grew warned the opposing factions to keep the road open and threatened American naval intervention if the Taku Channel below the port of Tientsin was blockaded. It soon became clear, however, that Coolidge had not sought to understand the policy nor was he motivated to impact it. When the press asked questions about the extent of American involvement, Coolidge asked Grew, "What does all this mean?" After Grew recounted their previous conversation on the subject, the president gazed out the window of the White House for several minutes and then simply said, "All right, Mr. Secretary." [57]

Thus, Coolidge neither sought to understand nor solve problems for the rest of his presidency, including in political-military crises where US interests were at stake.

---

[54] Gilbert, *Tormented President,* p. 183; Davidson and Connor, "Impairment of Presidents," p. 417.

[55] Gilbert, *Tormented President,* pp. 184-87; Davidson and Connor, "Impairment of Presidents," pp. 416-17.

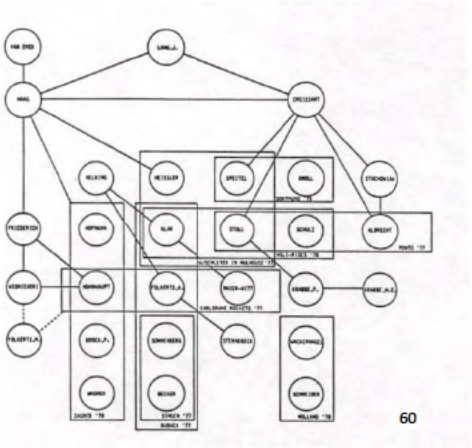
[56] Gilbert, *Tormented President,* p. 191.

[57] Gilbert, *Tormented President,* p. 205.

Cognitive Complexity

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	Drive	Drive	Drive	Drive
	Cognitive Complexity	**Cognitive Complexity**	**Cognitive Complexity**	**Cognitive Complexity**
	Curiosity	Creativity	Objectivity	- - -
	Empathy	Empathy	Empathy	Empathy
	Dominance	Dominance	Dominance	Dominance

Cognitive complexity is the ability to break down complex information into separate elements, to draw connections between these parts, and to abstract appropriate lessons from this information.[58] Cognitive complexity is crucial for leaders because it allows them to approach a crisis as a novel situation, to understand the usually multi-faceted nature of the problem, and to mentally represent it with higher fidelity. Low cognitive complexity is characterized by "simple responses, gross distinctions, rigidity, and restricted information usage," as opposed to high cognitive complexity, which results in "fine distinctions, flexibility, and extensive information usage."[59]


60

While a simple understanding of a crisis may sometimes be sufficient to choose a successful course of action, it may also increase the likelihood that leaders will utilize false analogies and

[58] S. Streufert and R. W Swezey, *Complexity, managers, and organizations* (Academic Pr, 1986)

[59] Peter Suedfeld and Philip Tetlock, "Integrative Complexity of Communications in International Crises," *The Journal of Conflict Resolution* 21, no. 1 (March 1977): 169-184

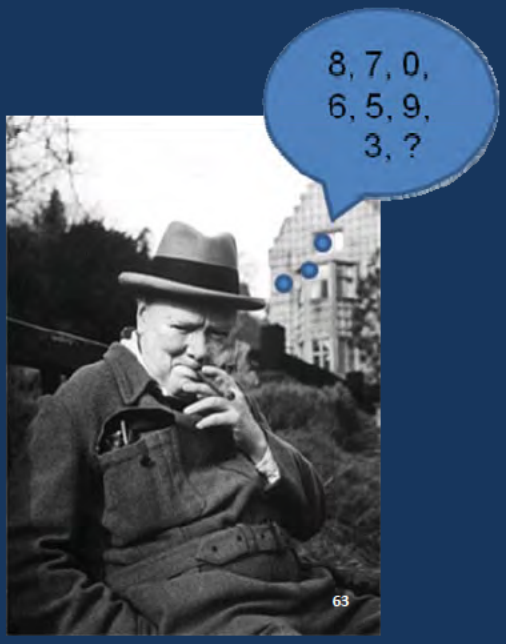
[60] Picture taken from http://www.globalsecurity.org/intell/library/policy/dod/images/ct_graphic_22.jpg

rely on incorrect inferences that could lead to poor outcomes. Research on past crises has suggested that lower levels of cognitive complexity have led to military conflict instead of negotiated conclusions to crises. By analyzing primary source documents, researchers rated the cognitive complexity of the participants in the crises that preceded World War I and the Korean War as significantly lower than in the 1911 Moroccan Crisis, the Berlin Blockade/Airlift, and the Cuban Missile Crisis.[61,62]

Cognitive complexity is supported by a number of 'higher' brain functions, including working memory, learning, and long-term memory. In order to analyze a situation, the ability to keep ideas in one's mind is crucial. This is called working memory, which is sometimes referred to as the 'buffer of consciousness.' By analyzing a situation, humans can Identify and abstract more complex mental representations – they can understand the properties of a situation. Humans and other animals possess both simpler and more complex cognitive learning strategies. While a simple strategy, such as associating a cue with a location – a McDonald's with a cross-street – may be useful in uncomplicated situations, more cognitive approaches, such as learning by spatial representation – understanding where one is in relation to the surroundings and a map – are likely to give a higher level of fidelity in truly understanding a complex situation. Finally, to benefit from newly learned paradigms, leaders must be able to maintain this information in long-term memory. Without this ability, not only will new inferences be lost, but leaders will be forced to rely on older memories which may no longer apply to present events.

Working Memory

The ability to keep multiple ideas in conscious thought at the same time while switching back and forth between them requires what is referred to as 'working memory.' It is often equated to the random access memory (RAM) of a computer that allows for faster manipulation of data without having to constantly re-access the hard drive, or long-term memory in people. While some have attempted to quantify the size of the average working memory, it depends on qualities of the information being remembered. However, with random digits, the average working memory appears to be around 7.



[63]

[61] Ibid.

[62] While there are a number of potentially confounding variables to any retrospective study such as this, the idea that more nuanced views will lead to probabilistically better outcomes is supported by the literature.

[63] Picture taken from www.anglotopia.net/tag/ww2/

Each of these functions supports leadership tasks in a crisis. The ability to keep information in working memory, to understand (learn about) a situation effectively, and to remember inferences is crucial when first approaching a crisis so that a barrage of information can be constructed into a coherent mental understanding. Cognitive complexity is also intertwined with creativity (which will be discussed at length in a later section). A complex understanding of a situation is crucial for the development of appropriate ideas to potentially solve it, as new ideas generated by leaders will be compared against the framework that they have developed to think about it. The existing understanding of a situation is also crucial because it provides the substrate from which unconscious ideas develop. Without a complex mental model of a given situation, new ideas are likely to be less well refined to the specifics of the situation. Once a solution set has been generated, making a decision requires that a leader have an understanding of his or her goals and how these may be served, an often complex and contradictory set of information that requires cognitive complexity to properly understand and analyze. Finally, implementation can require as much complexity as the other three tasks. If multiple actors or constituencies are involved, being able to fully understand their goals and the likely effects of different tactics will be critical.

The crucial function of cognitive complexity throughout the tasks discussed above is facilitated by the prefrontal cortex (PFC) and the hippocampus. The PFC is "the most evolved brain region," and it "subserves our highest-order cognitive abilities."[64] The PFC is involved in top-down mental control over older, more emotionally driven portions of the brain, such as the amygdala. The hippocampus is the center of spatial memory and is highly involved in complex learning. These higher abilities, however, are very sensitive to changes in the brain's physiological environment. As discussed in the neurotransmitter-level inverted-U model in the *Stress* section, too little or too much of a given neurotransmitter can impair neuronal function, and both acute and sustained/chronic stress can cause such imbalances.

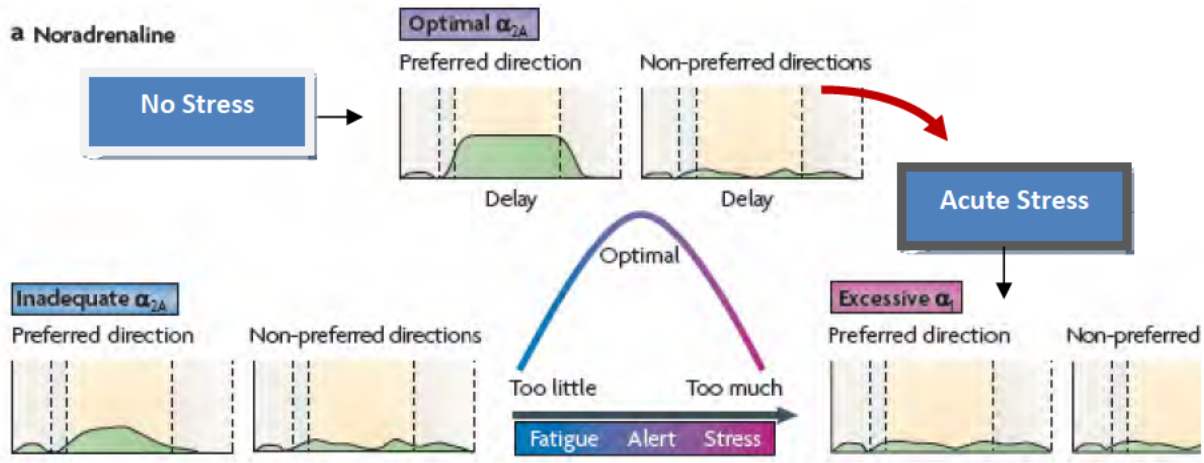
The Effects of Stress on Cognitive Complexity

Acute Stress

Acute stress leads to a loss of abilities supported by the PFC and the hippocampus, which decreases cognitive complexity. The effects of stress on working memory are some of the best studied mechanisms by which it can affect human performance. The release of cortisol, norepinephrine, and dopamine into the PFC following acute stress has been shown to seriously affect working memory by reducing optimal neuronal function. Using norepinephrine (referred

[64] A. F.T. Arnsten, "Stress signalling pathways that impair prefrontal cortex structure and function," *Nature Reviews Neuroscience* 10, no. 6 (2009): 410–422.

to as noradrenaline in the figure)[65] as an example, the figure below shows the effects of inadequate, optimal, and excessive norepinephrine on spatial working memory. Spatial working memory operates by having subsets of neurons that represent a given direction. When a spatial working memory task requires memory of that direction (preferred direction), the specific neurons continue to fire even when the cue is gone, while other subsets of neurons that represent different directions are quiet (non-preferred directions). As can be seen in the figure below, excessive norepinephrine leads to a quieting of the preferred direction firing, thus affecting the ability to keep that direction in working memory. This effect also occurs with dopamine, which is increased in the PFC under acute stress.



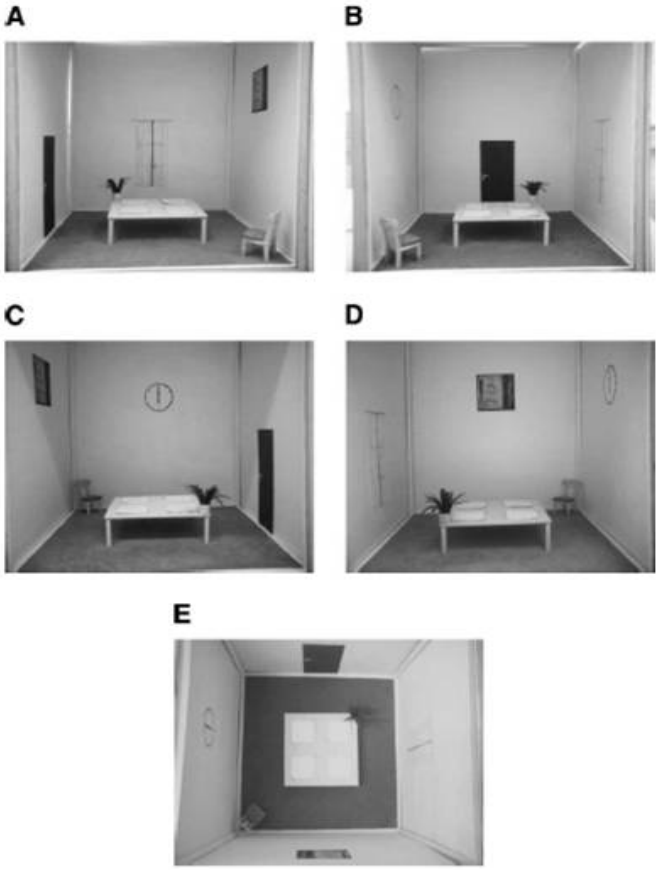
Another task for working memory that does not rely on spatial information requires participants to read a series of five sentences and to remember the last word of each sentence. In healthy adults, the recall of words under acute stress is significantly decreased. In one study, people under stress remembered 20% fewer words and experienced a 30% decrease in accuracy.[66] The crucial role of norepinephrine in stress-mediated effects on working memory is further confirmed by the effects of the drug propranolol, normally prescribed to control blood pressure in humans. Propranolol blocks beta-receptors for norepinephrine in the brain in both humans and rats, but it does not affect working memory without stress. Rats, like humans, normally have working memory deficits under stress, but when they are given propranolol,

[65] Ibid.

[66] Mathias Luethi, Beat Meier, and Carmen Sandi, "Stress Effects on Working Memory, Explicit Memory, and Implicit Memory for Neutral and Emotional Stimuli in Healthy Men," *Front Behav Neurosci* 2, no. 5 (January 2009): 1-9

these deficits are alleviated, and they perform like unstressed control rats.[67]

Learning strategies are also significantly affected by acute stress and shunted towards less cognitive, simpler stimulus-response strategies that would be expected to decrease cognitive complexity. In one such demonstration, participants were shown a model of the same room repeatedly, but from a different viewpoint (the four sides or the top) each time. The different walls of the room had characteristics (a door, a window, a mirror, and a clock) that allowed the participants to identify the layout of the room and from which angle they were viewing it (see adjacent figure). On the table in the center of the room, four cards were placed, with the same one being the 'winning card' each time.[68]



3D model of the room with removable walls: viewing angle (A) the clock, (B) the picture, (C) the window, (D) the door, and (E) from above. The cards are place upside down on the table and the plant is at the same location on the table for 12 trials and relocated in trial 13.[69]

For the first 12 trials, a plant was also placed next to the winning card. This allowed participants to choose the location of the winning card through a more cognitively complex spatial understanding of the room or by a stimulus-response option, choosing the card next to the plant. For the final trial, the plant was moved, but the card stayed in the same place. This allowed for the identification of which strategy was utilized by the participants. While almost 40% of control subjects utilized a spatial strategy, only 10% of subjects under acute stress utilized such a strategy. The difference was also significantly related to cortisol levels, which are involved in diminishing the control of the

[67] Benno Roozendaal, Jayme R. McReynolds, and James L. McGaugh, "The Basolateral Amygdala Interacts with the Medial Prefrontal Cortex in Regulating Glucocorticoid Effects on Working Memory Impairment," *J. Neurosci.* 24, no. 6 (February 11, 2004): 1385-1392

[68] L. Schwabe et al., "Stress modulates the use of spatial versus stimulus-response learning strategies in humans," *Learning & Memory* 14, no. 1-2 (2007): 109.

[69] Ibid.

PFC and promoting older, more primitive parts of the brain such as the amygdala. This shows the tendency of acute stress to push people towards less cognitively complex strategies. Interestingly, each person who utilized the spatial strategy also recognized that the plant was a cue, but none of those who relied on the plant's location described the possibility of using the spatial strategy. Thus, the spatial strategy is optimal because, at least in this case, it incorporated more information and an additional analytical strategy.

Acute stress causes difficulties in the ability to keep large amounts of information in working memory and to utilize more complex learning strategies. This can be expected to lower cognitive complexity, leading to probabilistically worse outcomes in crises. This effect is illustrated by Truman's analysis of Stalin at the Potsdam Conference.

Truman at Potsdam: Acute Stress and the Effects of Low Cognitive Complexity

Truman's first face-to-face meeting with Churchill and Stalin at the Potsdam conference certainly qualifies as a period of acute stress. Truman was concerned that his unfamiliarity with the substance of the many meetings Roosevelt had with Churchill and Stalin might cause problems, particularly as relations with the Soviet Union deteriorated.[71] The prospect of meeting the two Allied leaders for the first time at the Potsdam conference beginning in July 1945 thus filled Truman with worry. "How I hate this trip!" he confessed in his diary. He realized, however, that the trip was necessary and that the stakes were high. The agreements reached at Potsdam would lay the

Cultural Differences in Vision and Learning

As discussed in the introduction, Asians tend to focus more on background features, whereas Westerners focus more on objects in the foreground of pictures. This difference could potentially affect the probability of using stimulus-response vs. spatial learning strategies. Whereas Westerners tend towards their preference to focus on foreground objects under stress, Asians might tend more to focus on the background under stress, leading to different analytical biases. This might have an especially large effect in areas like imagery-intelligence analysis, where subtle hints can be crucially important.

When researchers look at peoples' ability to detect change in pictures, Westerners are superior at detecting change in foreground objects, while Asians score higher on background objects. In the top two pictures, the color of the semi-truck, the foreground object, changes. In the bottom two, the location of the sidewalk (in the background) moves down from the left picture to the right picture.[70]

[70] Takahiko Masuda and Richard Nisbett, "Culture and Change Blindness," *Cognitive Science: A Multidisciplinary Journal* 30, no. 2 (3, 2006): 381-399.

[71] Diary entry for 12 Apr. 1945, Robert H. Ferrell, ed., *Off the Record: The Private Papers of Harry S. Truman* (Harper & Row: New York, 1980), p. 16.

foundation for the post-war international order. He recognized, "But I have to make it – win, lose, or draw – and we must win."[72]


73

Truman's stress level only increased once he arrived in Potsdam. At the first plenary session, Stalin moved that Truman chair the conference. Truman was "scared" and found presiding "nerve-wracking."[74] Still, Truman pursued his primary objectives in his talks with Churchill and Stalin: Russian entry into the war against Japan; restoration of Germany's economy and its reintegration into the world trade, which required that German reparations be limited; and implementation of the Yalta Declaration, which pledged the three powers to assist the countries of liberated Europe to establish democratic governments through free elections.[75]

The stress of the conference, however, may have resulted in Truman being unable to correctly assess Stalin as a leader. After meeting Stalin for the first time the day before the plenary sessions began, Truman concluded, "I can deal with Stalin. He is honest – but smart as hell."[76] Near the end of the conference, he wrote to his wife, "I like Stalin. He is straightforward." Stalin was a fine man who wanted to do the right thing, Truman told Henry Wallace; he could be depended upon to keep his word, he told the White House staff.[77]

Stalin reminded Truman of his political benefactor, Thomas Pendergast, a political boss in Kansas City who eventually went to prison for tax evasion. Truman later commented to a biographer, "Stalin is as near like Tom Pendergast as any man I know." Although Pendergast

[72] Diary entry for 7 July 1945, Robert H. Ferrell, ed., *Off the Record,* p. 49.

[73] Picture taken from http://www.wtv-zone.com/Mary/GIFS/NAM1.JPG

[74] Truman quoted in Arnold A. Offner, *Another Such Victory: President Truman and the Cold War, 1945-1953* (Stanford University Press: Stanford, 2002),p. 81.

[75] James L. Gormly, *From Potsdam to the Cold War: Big Three Diplomacy, 1945-1947* (Scholarly Resources: Wilmington, DE, 1990), pp. 29-32.

[76] Diary entry for 17 July 1945, Robert H. Ferrell, ed., *Off the Record,* p. 53.

[77] David McCullough, *Truman* (Simon & Schuster: New York, 1992), p. 451.

had been involved in illegal activities, Truman always found him to be "a man of his word."[78] Moreover, Truman explained, "He was an able, clear thinker and understood political situations and how to handle them better than any man I have ever known."[79] Since Pendergast and other political bosses had permitted "free" elections in their bailiwicks, Truman expected Stalin to do the same in Poland. He also expected Stalin to "make some sort of gesture" to show Americans that he would keep the promises he made. "Any smart political boss will do that," Truman observed.[80]

When the Potsdam conference concluded, Truman and his advisors believed that their most important issues had been resolved. The Soviet Union had agreed to enter the war against Japan by 15 August 1945, a means for establishing peace treaties with Germany and its European allies had been established, and a general understanding had been reached on political and economic policies for Germany. The U.S. delegation had also made clear its opposition to the East European regimes and its demand for the creation of more representative governments.[81]

It soon became clear, however, that Stalin was not a man of his word. Stalin refused to permit the establishment of more open and representative governments in Bulgaria and Romania. The process established at Potsdam for drafting peace treaties (the Council of Foreign Ministers) collapsed. As relations between the United States and the Soviet Union deteriorated, Truman came to regret the faith he had placed in Stalin. Over a decade later, he recalled the Potsdam conference ruefully: "What a show that was! But a large number of agreements were reached in spite of the setup – only to be broken as soon as the unconscionable Russian Dictator returned to Moscow! And I liked the little son of a bitch."[82]

Under stress, Truman utilizes a cognitively simple method of understanding Stalin – he relies on an analogy to a known figure. However, Truman has not analyzed Stalin sufficiently well to understand that his analogy is false, and as a result, Truman fails in the initial implementation of his post-war strategy with regard to Eastern Europe and peace treaties, issues that cause significant problems for the US later in the Cold War.

---

[78] Margaret Truman, *Harry S. Truman* (Morrow: New York, 1973), p. 74.

[79] Robert H. Ferrell, ed. *The Autobiography of Harry S. Truman* (University of Missouri Press: Columbia, 2002), pp. 82-83.

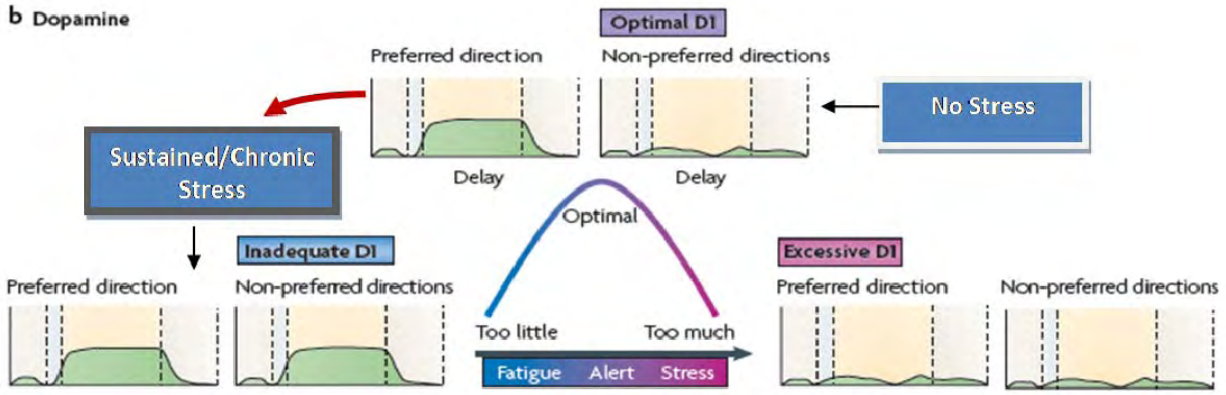
[80] Truman quoted in Arnold A. Offner, *Another Such Victory: President Truman and the Cold War, 1945-1953* (Stanford: Stanford University Press, 2002), p. 49.

[81] Gormly, *From Potsdam to the Cold War*, p. 64.

[82] Truman to Acheson [unsent], 15 Mar. 1957, Robert H. Ferrell, ed., *Off the Record,* p. 349.

Sustained/Chronic Stress

Sustained and chronic stress also tend to decrease cognitive complexity. Low dopamine levels caused by sustained and chronic stress (as discussed in *Drive*) impair working memory by increasing noise, with neurons firing at improper times.



[83]

In the example of spatial working memory, low dopamine levels increase the noise of the 'non-preferred direction' neurons (those not representing the location trying to be remembered), leading to the inability to distinguish directions and thus to decreased working memory function.[84] Various other types of working memory impairment are also seen in human depression cases, one of the models of the effects of chronic stress. Thus, people under long-term stress can be expected to have difficulty keeping multiple facets of their problems represented mentally at the same time. This may affect their ability to come up with the holistic solutions that complex problems often require.

Nonetheless, depressed individuals do have some capacity to break down their problems into small chunks, and they obsessively think about them. In fact, this is one of the hallmarks of depression, and some have suggested that this is the evolutionary purpose of depression – to shield out other stimuli while trying to solve an especially difficult problem. Nonetheless, the working memory deficits discussed above hamper the ability of depressed individuals to abstracting anything from this rumination.[85]

---

[83] Arnsten, "Stress signalling pathways that impair prefrontal cortex structure and function."

[84] Ibid.

[85] Paul W. Andrews and J. Anderson Thomson Jr., "The Bright Side of Being Blue: Depression as an Adaptation for Analyzing Complex Problems," *Psychological Review* 116, no. 3 (July 2009): 620-654

The effects of sustained and chronic stress on abstract thinking and long-term memory are also likely to play a crucial role in the degradation of cognitive complexity. The neuronal death in the PFC and hippocampal caused by cortisol sensitization of neurons will leave both crucial brain areas with diminished capacity. Even if a problem can be broken down into its constituent parts, the ability to abstract conclusions from this analysis will be impaired, as the PFC is involved in higher cognitive processes.[86] Conclusions which might be aided by information learned in the past will also be less accessible. Furthermore, if rumination, the compulsive analysis of a problem, does bring novel solutions to light, the decreased function of the hippocampus, where memories are stored, may mean that valuable insights will be lost.[87] Perhaps more importantly, memory dysfunction may decrease the ability of a leader under long-term stress to form memories of a new problem. Thus, in a crisis, a leader under chronic stress will have difficulty remembering points about the current problem, leaving them with, at best, a simplistic understanding of the full set of ongoing issues, which is likely to lead to simpler solutions, decisions, and implementation strategies.

Thus, sustained and chronic stress will tend to decrease cognitive complexity by interfering with working memory, with overall PFC cognitive abilities, and with long-term memory, leaving individuals unable to create or sustain a cognitively complex understanding of an ongoing crisis. These effects can be seen in the discussion of Coolidge and his chronic stress in the previous section. When asked for guidance on dealing with a new crisis in China, Coolidge turned to his acting Secretary of State Joseph Grew and asked, “What does all this mean?”

[86] J. J Radley et al., “Repeated stress induces dendritic spine loss in the rat medial prefrontal cortex,” *Cerebral cortex* 16, no. 3 (2006): 313–320

[87] Arnsten, “Stress signalling pathways that impair prefrontal cortex structure and function.”

Curiosity

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	Drive	Drive	Drive	Drive
	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity
	Curiosity	Creativity	Objectivity	- - -
	Empathy	Empathy	Empathy	Empathy
	Dominance	Dominance	Dominance	Dominance


[88]

The trait *curiosity* is often captured as an interest in gathering more information about different subjects. The earlier discussion of drive subsumes the push for more information, and as a result, this section will focus on gathering different types of information. More specifically, it will focus on leaders' interest in gathering dissenting information or information that conflicts with their beliefs about a topic. Curiosity, in this sense, supports leaders by giving them a fuller, less-biased information set from which to develop an understanding of a crisis. Thus, curiosity can support the construction of a more accurate understanding of a crisis and, in this way, may help to achieve a favorable outcome.

Very little direct research has been done on how stress affects curiosity, but a number of political science and sociological studies have suggested that it is adversely affected by stress.[89] An insight that may be helpful in understanding why people avoid conflicting information is that cognitive dissonance – the holding of opposing data or beliefs in one's mind at the same time – can act as a stressor itself. In fact, people experiencing cognitive dissonance have been shown

[88] Picture taken from http://www.cosmosmagazine.com/node/1890

[89] For example: Peter Suedfeld and Philip Tetlock, "Integrative Complexity of Communications in International Crises," *The Journal of Conflict Resolution* 21, no. 1 (March 1977): 169-184.

to be more susceptible to experimental infection with the cold virus.[90] This strongly implicates cortisol, epinephrine, or norepinephrine release in cases of cognitive dissonance – a physiological stress-response – as these chemicals depress the immune system.[91] This means that, in leaders already under stress, cognitive dissonance may increase their stress load, the opposite of the innate drive to reduce stress.

Chinese handling of US prisoners of war (POWs) during the Korean War shows the enormous power of the subconscious drive to resolve cognitive dissonance. After their capture, US soldiers were subjected to a program of self-criticism and introspective analysis of the faults of US society. At the same time, all social networks between the POWs were destroyed, and the fear of informants was kept high. The threat of physical violence was also ever-present, although, according to a report on the Chinese system, "During the period the camps were administered by the Chinese Communists, it was quite apparent that the enemy was far more concerned with indoctrination than with death or physical torture." In this highly stressful environment, the POWs' minds sought to remove cognitive dissonance. The constant forced repetition of information that criticized the US in discussions and writing sessions made the POWs begin to believe the propaganda. Something had to budge, and they could not change the information the Chinese were providing, but they could change their own pre-existing beliefs.[92]

The effects of the Chinese program were remarkable. According to one of the psychiatrists who evaluated the returning prisoners, "There was considerable confusion expressed as to who really started the Korean War. The majority believed that our forces had actually used germ warfare although most of the men felt "it was all right for us to do that in a war." Many expressed antipathy toward the Chinese Communists, but at the same time praised them for the "fine job they have done in China." Others stated that, "although Communism won't work in America I think it's a good thing for Asia." [...] None of the prisoners expressed any deep-seated hatred towards the Chinese Communists. Contrariwise, most felt that the "Chinese treated us the best they could."[93]

---

[90] R. Totman, S. E. Reed, and J. W. Craig, "Congnitive dissonance, stress and virus-induced common colds.," *Journal of psychosomatic research* 21, no. 1 (1977): 55

[91] Bruce S. McEwen, "The neurobiology of stress: from serendipity to clinical relevance," *Brain Research* 886, no. 1-2 (December 15, 2000): 172-189

[92] "We have ways of making you think « Kings of War," http://kingsofwar.wordpress.com/2009/07/28/we-have-ways-of-making-you-think/.

[93] HENRY A. SEGAL, "INITIAL PSYCHIATRIC FINDINGS OF RECENTLY REPATRIATED PRISONERS OF WAR," *Am J Psychiatry* 111, no. 5 (November 1, 1954): 358-363.

"The repatriates identified themselves as prisoners of war or former prisoners. They referred to "The Americans" or "American Forces." Many responded to the question, "What unit were you with?" with the reply, "Camp Number so-and-so." Thus, cognitive dissonance is an extremely powerful force, especially so when combined with stress.[94]

The Effects of Stress on Curiosity

Acute Stress

In experimental studies, people under stress tend to seek immediate gratification instead of future benefits.[95] While stress itself causes dopamine (the neurotransmitter highly implicated in reward) levels to rise, experimental results in animals suggest that the highest dopamine concentrations in the reward centers of the brain occur *after* the cessation of stress.[96] Thus, emerging from a stressful situation is itself a reward, and this provides some explanation for the phenomenon whereby people under stress often do whatever they think will remove the stressor, sometimes at the expense of other, especially longer-term consequences of their actions (as discussed in the *Myopia* section of the previous report).

97

As mentioned above, cognitive dissonance in the form of conflicting information creates additional stress for people. This suggests that the motivation to avoid or reduce stress may lead to a motivation to disregard such information. The reason that pre-existing stress would likely exacerbate an aversion to conflicting information is because people can be expected to avoid higher levels of stress more vigorously than lower levels. Thus, as cognitive dissonance would add to any pre-existing stress, people would be more motivated to avoid conflicting information when already

[94] Ibid.

[95] R. van den Bos, M. Harteveld, and H. Stoop, "Stress and decision-making in humans: Performance is related to cortisol reactivity, albeit differently in men and women," *Psychoneuroendocrinology* (2009)

[96] F. M Inglis and B. Moghaddam, "Dopaminergic innervation of the amygdala is highly responsive to stress.," *Journal of neurochemistry* 72, no. 3 (1999): 1088

[97] Picture taken from http://thestaffingadvisor.files.wordpress.com/2009/04/stress.jpg

under stress than in a period without stress, when cognitive dissonance might not cross the threshold into 'uncontrollable stress.' Another potential explanation is connected to the effects of stress on cognitive complexity. Under normal conditions, a person might be able to integrate conflicting information into their understanding of a situation, but under acute stress, cognitive complexity and learning are hampered. This suggests that people might have more difficulty integrating conflicting information under stress, leaving it to create cognitive dissonance and the avoidance thereof. Thus, in attempting to avoid stress, people may avoid conflicting information.

Just as relief of stress can be a reward, punishment of non-compliance can also act as a reward. This effect has been investigated in research paradigms such as the Prisoner's Dilemma Game. Non-cooperation by one partner leads to a worse outcome for the other, but if both can cooperate, mutual benefits can be reaped. This means that if one participant cooperates and the other defects, the former will feel cheated. In such cases, the ability to punish the non-cooperating partner leads to activation of brain areas that process reward.[98] This may be at work in stressful situations if a leader sees him or herself as cooperating by listening to a subordinate but the subordinate causes the leader additional stress by giving them conflicting information, something they are already trying to avoid. Punishing the subordinate would then give the leader a sense of reward and lead to a repetition of punishment, as rewarding actions tend to be learned and repeated.[99]

In addition to punishing people who disagree, perhaps by ignoring them or giving them less "face-time", leaders are more likely to spend time with those with whom they agree. Agreement can be seen as a source of social support, which is known to promote the release of the neuropeptide oxytocin, which decreases stress levels and promotes trust. This could lead to an insular environment because leaders would be seeking the decreased stress provided by the oxytocin response, trusting those who agree with them more, and avoiding the increased stress caused by dissenters providing conflicting information.[100]

[98] James K. Rilling et al., "The neural correlates of the affective response to unreciprocated cooperation," *Neuropsychologia* 46, no. 5 (2008): 1256-1266

[99] J. K Rilling, B. King-Casas, and A. G Sanfey, "The neurobiology of social decision-making," *Current Opinion in Neurobiology* 18, no. 2 (2008): 159–165

[100] M. Heinrichs et al., "Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress," *Biological Psychiatry* 54, no. 12 (2003): 1389–1398

Finally, when subjects are given exogenous cortisol, they tend to become less uncertain.[101] This suggests that the stress itself will also decrease a leader's sense that he or she needs conflicting information and also would likely make him or her quicker to disregard any such data.

While experimental evidence is lacking, the discussion above provides a mechanism by which acute stress can lead to decreased curiosity. This would result in leaders acting in a crisis without dissenting information, something which could significantly diminish their ability to make good decisions, especially if their initial conception of the crisis was flawed.

The discussion above also provides a potential psychophysiological underpinning for groupthink, as it shows how leaders are incentivized to punish those who dissent and to surround themselves with people who agree. Meanwhile, cortisol release decreases uncertainty, which would only exacerbate the problem by decreasing the feeling that additional information is required. At the same time, subordinates are incentivized not to disagree because of potential punishment and the lack of interest in dissenting information from the leader. Those same subordinates might also be feeling the same stress-induced effects, which could push them to reconcile their opinions with those of the leader in order to rid themselves of cognitive dissonance.

Lyndon Johnson's actions as he goes about making decisions regarding escalation in Vietnam demonstrate how leaders can lose their curiosity and build an insular decision-making environment.

LBJ, Vietnam, and a Lack of Curiosity

Lyndon Johnson felt pressure to prevent the "fall" of Vietnam to the Communists. He feared a divisive and destructive debate if that were to happen. He also feared the possibility of impeachment. More immediately, he thought that the Kennedy wing of the party would blame him for failure in Vietnam, laying the groundwork for a primary challenge by Robert Kennedy in 1968. These factors suggest that he would have been under considerable stress when making decisions about Vietnam.[102]

The day after President Kennedy's funeral, Johnson affirmed the U.S. commitment to helping South Vietnam defeat the "Communist conspiracy" it faced. Johnson made it clear that he

[101] Peter Putman, Erno J. Hermans, and Jack van Honk, "Exogenous cortisol shifts a motivated bias from fear to anger in spatial working memory for facial expressions," *Psychoneuroendocrinology* 32, no. 1 (January 2007): 14-21.

[102] H.R. McMaster, *Dereliction of Duty: Lyndon Johnson, Robert McNamara, the Joint Chiefs of Staff, and the Lies that Led to Vietnam* (HarperCollins: New York, 1997), p. 48; Richard M. Pious, *Why Presidents Fail: White House Decision Making from Eisenhower to Bush* (Rowman & Littlefield: Lanham, MD, 2008), p. 68.

expected all members of his administration to support established U.S. policy and ordered all government officials to avoid criticizing other departments and offices.[104] Later during deliberations about what strategy to pursue in Vietnam, Johnson sometimes invited an opposing viewpoint (such as from George Ball) but it is not clear if he was genuinely interested in opposing arguments or if he was simply doing so in order to later claim that he had listened to "all sides."


103

Johnson also demonstrated little interest in any advice that suggested the US position in Vietnam was deteriorating. He listened to advisers who were often wrong and ignored those who had a record of correctly predicting developments in Vietnam or who had knowledge of conditions in Southeast Asia.[105]

Johnson often distanced himself from those in his political inner-circle who gave him cautious advice. For example, when Vice President Hubert Humphrey sent a lengthy memo to Johnson in early 1965 outlining the political costs of escalation and urging him to cut US losses, Johnson froze him out of war councils. Johnson stopped holding formal NSC meetings at that point and would only discuss Vietnam in informal sessions with a small group of hand-picked advisers. These Tuesday lunches became the "heart" of the national security process, according to Walt Rostow, and "the only men present were those whose advice the president most wanted to hear." According to several reports, Johnson also staged "discussions" with his advisors for the sole purpose of legitimizing decisions he had already made.[106]

Johnson displays the adverse effects of acute stress on curiosity described above, and this leads him to escalate the war in Vietnam as he essentially ignores or silences most of the advice of those who disagreed. Of course, Johnson's deliberations and decisions occurred over an extended time period. However, it is not clear how 'controllable' Johnson's stress levels were throughout this time period, especially at critical decision points. If his stress levels were

[103] Picture taken from http://incogman.files.wordpress.com/2008/01/angry-lbj-wkennedy-2.jpg

[104] Mark White, "Going to War in Vietnam: George Ball's Dissent in the 1960s," AmericanDiplomacy.org, April 10, 2007, http://www.unc.edu/depts/diplomat/item/2007/0406/whit/white_ball.html; McMaster, *Dereliction of Duty,* p. 49.

[105] Pious, *Why Presidents Fail,* pp. 48-49; McMaster, *Dereliction of Duty, p. 61.*

[106] Pious, *Why Presidents Fail,* pp. 50, 59; McMaster, *Dereliction of Duty, p.* 88.

heightened only around the times he had to consider or make decisions about Vietnam, the acute stress lens is appropriate. Otherwise, this anecdote may better apply to the discussion of sustained/chronic stress. Because the effects on curiosity of acute and sustained/chronic stress are similar (even if the physiological effects are different), this distinction is difficult, and perhaps not critical, to make.

Sustained/Chronic Stress

While limited experimental evidence exists for the effects of acute stress on curiosity, even less is available to demonstrate the effects of sustained and chronic stress. This is partially the result of the effects of long-term stress on drive. If someone is less likely to actively participate in the first place, then they will also not be seeking conflicting information. Curiosity was investigated in one experimental model whereby investigators induced sadness in healthy adults, a method which is sometimes used as a simple proxy for depression. Compared to controls, subjects displayed decreased desire for and valuation of additional knowledge.[107] This is commensurate with a large body of evidence showing that, in depression, people turn inwards and become relatively uninterested in and unresponsive to external stimuli. Regardless of interest level however, leaders under long-term stress would be significantly less likely to benefit from dissenting information because of potential memory dysfunction.

Acute stress actually increases the strength of memories during the time that stress hormones are interacting with the brain. It has been suggested that this has evolved evolutionarily to aid people who survived stressful situations to remember how they succeeded in doing so. However, as discussed earlier, long-term stress can lead to hippocampal atrophy and other memory dysfunction due to heightened cortisol levels. Thus, if an acutely stressful situation turns into a sustained or chronic stressor, the initial conception of the situation will be seared into the leader's memory, and he or she will eventually be unable to generate new memories that counteract the initial impression.[108] This means that, even if others bring the leader new information that should change the way he or she understands a given problem or crisis, is the leader is less likely to gain a new understanding.

Finally, leaders under extended stress might also be susceptible to the allure of the stress relieving effects of social support, as mediated by oxytocin. This could drive them to surround themselves with only those who agree, as was described with acute stress.

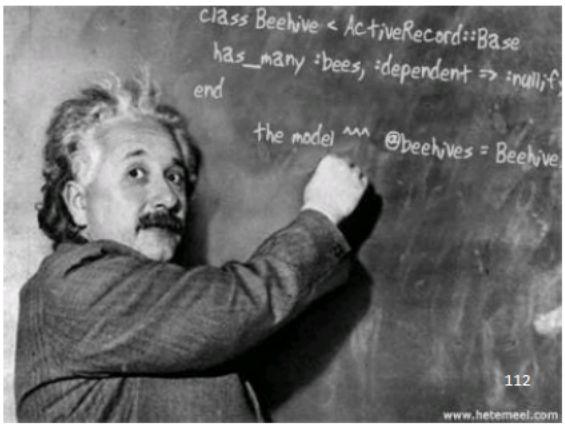
---

[107] James R. Rodrigue, Kenneth R. Olson, and Robert P. Markley, "Induced mood and curiosity," *Cognitive Therapy and Research* 11, no. 1 (February 1, 1987): 101-106

[108] M. Joëls et al., "Learning under stress: how does it work?," *Trends in Cognitive Sciences* 10, no. 4 (2006): 152–158

Creativity

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	Drive	Drive	Drive	Drive
	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity
	Curiosity	**Creativity**	Objectivity	- - -
	Empathy	Empathy	Empathy	Empathy
	Dominance	Dominance	Dominance	Dominance



Creativity involves the generation of novel concepts, ideas, or interpretations. It is commonly defined as the ability to produce work that is not only original, but also useful.[109] Creative individuals can be characterized by their ability to produce a large quantity of ideas or interpretations (ideational fluency), to produce novel output (unique ideas and interpretations), and to think flexibly (ability to produce different types of ideas and interpretations).[110] In today's geopolitical environment, leaders are often faced with novel, complex problems. This means that simple or off-the-shelf solutions are unlikely to lead to an optimal outcome because they will be unlikely to address the eccentricities of the crisis at hand. Thus, creativity may lead to the generation of better potential solutions, the selection of which may help to improve the outcome of a crisis.[111]

[109] Robert J. Sternberg and Todd I. Lubart, "Investing in creativity.," *American Psychologist* 51, no. 7 (1996): 677-688.

[110] JP Guilford, "Creativity," *Am Psychol*, no. 5: 444-454.

[111] This discussion is not intended to imply that leaders themselves will always be the one to generate solutions or that they must be, but rather, that their contribution to doing so can be valuable. This is especially the case if

Creativity appears to be the result of unconscious and conscious cognitive processes. The unconscious generation of new ideas is poorly understood (although it may be related to raw intelligence), but in order for these ideas to be developed, they must pass into the conscious mind. **The filter between the unconscious and conscious brain is referred to as latent inhibition, and the amount of information that passes through the filter appears to be proportional to dopamine, cortisol, and serotonin levels.**[113] Once an idea has passed through the latent inhibition filter, it must be represented in working memory and analyzed using higher brain functions attributed to the prefrontal cortex (PFC). This can be seen in the images of relative brain activity in creative tasks. The darker blue at the top of the image implies greater activity and is in the PFC.[114]

Creativity is associated with PFC activation

EEG data mapped onto a representation of a brain. The areas of highest activity during creative thought are represented by the darkest blue regions, in the prefrontal cortex. [115]

The Effects of Stress on Creativity

Acute Stress

Acute stress has opposing, but ultimately negative effects on creativity. Increased dopamine and cortisol levels lower latent inhibition, leading to increased attention to 'irrelevant' stimuli, some of which might be creative thoughts.[116] However in contrast, cortisol, norepinephrine, and excessive dopamine disrupt PFC activities, such as working memory (discussed in the

---

leaders are relatively unwilling to listen to advisors or are relatively megalomaniacal, but creativity is important in any situation where a leader is involved in developing solutions or in imagining their outcomes.

[112] Picture taken from http://aceonlineschools.com/einsteins-5-maxims-for-creative-excellence/

[113] U. Shalev, J. Feldon, and I. Weiner, "Latent Inhibition Is Disrupted by Acute and Repeated Administration of Corticosterone," *The International Journal of Neuropsychopharmacology* 1, no. 02 (1998): 103-113; A. W Flaherty, "Frontotemporal and dopaminergic control of idea generation and creative drive," *The Journal of comparative neurology* 493, no. 1 (2005): 147; L. M. McDonald et al., "Latent inhibition is attenuated by noise and partially restored by a 5-HT2A receptor antagonist.," *Behavioural Pharmacology* 13, no. 8 (2002): 663.

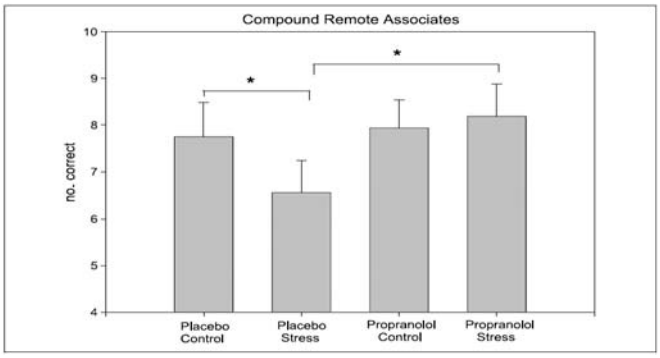
[114] A. Fink et al., "The creative brain: Investigation of brain activity during creative problem solving by means of EEG and FMRI," *Human Brain Mapping* 30, no. 3 (2009)

[115] Ibid.

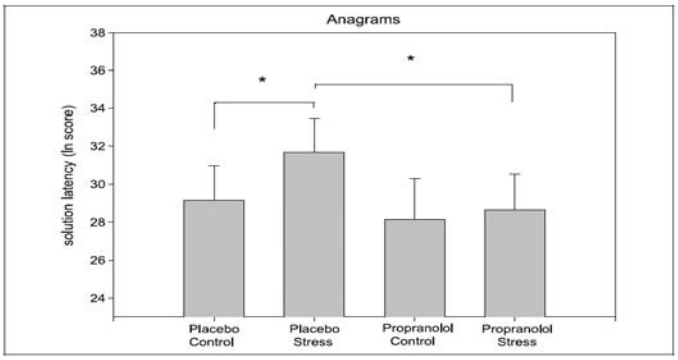
[116] Flaherty, "Frontotemporal and dopaminergic control of idea generation and creative drive"; Shalev, Feldon, and Weiner, "Latent Inhibition Is Disrupted by Acute and Repeated Administration of Corticosterone."

section *Cognitive Complexity*) and other analytical functions.[117] Paradigms that test creativity show that, despite these opposing effects, the PFC dysfunction dominates with the result that acute stress decreases creativity.

In the Compound Remote Associates Test, individuals are presented with three words and told to think of a word associated with the set. For instance, if the participant is shown the words FALLEN, ACTOR, and DUST, an associated word for all three could be STAR. Another test for cognitive flexibility and creativity utilizes a series of anagrams to test how long it takes for participants to come up with correct answers.[118] As can be seen in the figures on the right, participants under stress ('placebo stress') perform worse on both tests than participants not under stress ('placebo control'), correctly identifying fewer remote associates and requiring more time to solve the anagrams.



The number of remote associates trials successfully completed under control conditions; under stress; under control using the beta-blocker propranolol; and under stress using propranolol.[120]



The time required to solve anagrams under the same conditions as above.

These experiments also confirm that norepinephrine plays a key role in disrupting cognitive flexibility and creativity. When treated with propranolol, a drug which blocks some of the effects of norepinephrine, the deleterious effects of stress are removed, and participants under stress ('propranolol stress') score equally as well as non-stressed individuals.[119,120]

[117] A. F.T. Arnsten, "Stress signalling pathways that impair prefrontal cortex structure and function," *Nature Reviews Neuroscience* 10, no. 6 (2009): 410–422.

[118] These tests are clearly only simple proxies for high level creativity, but their ease of administration is crucial in a laboratory environment.

[119] J. K Alexander et al., "Beta-adrenergic modulation of cognitive flexibility during stress," *Journal of cognitive neuroscience* 19, no. 3 (2007): 468–478

[120] Ibid.

These results demonstrate that acute stress inhibits creativity. In leaders, this can be expected to lead to a smaller and less diverse solution set. Beyond the conceptualization of possible solutions, creativity is also important to understand the ways in which the possible solutions might affect the adversary. The generation of these ideas will allow for a deeper analysis of the pros and cons of potential solutions and would be expected to lead to the choice of a more appropriate course of action.

Sustained/Chronic Stress

Evidence suggests that sustained and chronic stress disrupt creativity. Latent inhibition will tend to be increased in individuals under sustained and chronic stress because of decreased dopamine levels. In depression, low serotonin levels are often a target for treatment, and serotonin is also inversely correlated with latent inhibition. This suggests that, during depression, fewer ideas will transit from the subconscious to conscious mind. This is commensurate with descriptions of the effects of depression, which highlight that it leads to highly focused introspective thought, during which other stimuli are not recognized.[121]

In addition to increased latent inhibition, depressed individuals show PFC dysfunction, including of working memory. The low dopamine levels exhibited in animals under chronic stress provide at least one mechanism by which this is likely to happen under long-term stress. This working memory dysfunction suggests that the limited number of ideas that do pass from unconscious to conscious thought will be less likely to be kept represented in a depressed person's working memory or correctly analyzed.[122] Finally, hippocampus-mediated long-term memory dysfunction that is caused by sustained and chronic stress would further prevent creative ideas from surviving to fruition because they would be less likely to be stored in long-term memory.[123]

Despite the deleterious effects of sustained and chronic stress on creativity, a number of studies have highlighted links between depressed individuals and creativity in the arts. While depressed individuals do appear to have periods of highly creative work, this work is carried out in bursts during periods of remission. Thus, although links do appear to exist between individuals susceptible to depression and creativity, creative thought is less likely during

[121] Paul W. Andrews and J. Anderson Thomson Jr., "The Bright Side of Being Blue: Depression as an Adaptation for Analyzing Complex Problems," *Psychological Review* 116, no. 3 (July 2009): 620-654

[122] P. O. Harvey et al., "Executive functions and updating of the contents of working memory in unipolar depression," *Journal of Psychiatric Research* 38, no. 6 (November): 567-576

[123] A. F. T. Arnsten, "Stress signalling pathways that impair prefrontal cortex structure and function," *Nature Reviews Neuroscience* 10, no. 6 (2009): 410–422.

depression. The potential effects of decreased creativity can be seen in the case of Jimmy Carter and the Iranian Hostage Crisis.

Carter, Chronic Stress, and the Iranian Hostage Crisis

On 4 November 1979, five hundred Iranian militants stormed the U.S. embassy in Tehran and took some sixty Americans hostage. The ensuing hostage crisis dominated the final year of the Carter presidency and was a significant source of stress for Carter and his advisors. Carter was constantly concerned for the safety of the prisoners. He worried about them during early-morning walks, passed sleepless nights trying to think of ways to rescue them, and met often with the hostages' families.[124]

The hostage crisis was in many ways unprecedented – a host government had never condoned or endorsed the seizure of an American embassy overseas. Although President Carter was not known as a historical thinker and his administration contained a number of officials with little or no experience in the federal government, Carter and his advisors made an early effort to collect possible precedents and then search for usable lessons that could be applied to the current case. As Carter explained at a press conference on 21 Apr. 1980, "I have studied all the previous occurrences in my lifetime where American hostages have been taken…to learn how they reacted and what the degree of success was."[125]

The availability of relevant, although not entirely accurate, analogies shaped how Carter and his advisors approached the hostage crisis. The decision-makers generated seven possible courses of action – ask the Shah to leave the United States, negotiate with Iran for the hostages' release, mount a naval blockade, launch an airstrike on the Abadan oil refinery, mine Iranian harbors, seize Iranian oil depots, and conduct a rescue mission. The only two options that received serious consideration – negotiation and a rescue mission – were also the only two that had historical precedents of

126

[124] Paul B. Ryan, *The Iranian Rescue Mission: Why It Failed* (Naval Institute Press: Annapolis, 1985), p. 10.

[125] David Patrick Houghton, *U.S. Foreign Policy and the Iran Hostage Crisis* (Cambridge: Cambridge University Press, 2001), pp. 15, 144, 145-46.

[126] Picture taken from http://www.thehtmldude.com/historyday/reaction.html

any kind as successful methods to resolve hostage disputes. Past hostage crises had been resolve either by protracted negotiation (the *Pueblo* crisis in 1968) or military rescue missions (the Entebbe rescue in 1976 and the Mogadishu rescue in 1977).[127]

The other options lacked historical precedents as ways to resolve a hostage crisis, and it appears that this lack of precedent – and the ensuing inability by Carter and his advisors to envision the success of these alternatives – significantly diminished the options they considered viable or open to them. Once Carter decided that action beyond negotiations had to be taken, he was left with only an unwieldy rescue attempt that required a series of exceptionally complex and interconnected operations, such as landing helicopters in a stadium to transport the hostages to a captured Iranian airbase, under tactical conditions that diverged widely from those in previous rescue attempts, ultimately ending in failure.[128] This discussion is not intended to imply that the other options would have been preferable. However, dismissing them without real consideration because they had not been successful in the past does not seem to be an optimal strategy when considering a situation with its own unique characteristics.

[127] Houghton, *U.S. Foreign Policy and the Iran Hostage Crisis,* pp. 80-81, 151.

[128] Houghton, *U.S. Foreign Policy and the Iran Hostage Crisis,* pp. 90, 147-48, 151.

Objectivity

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	Drive	Drive	Drive	Drive
	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity
	Curiosity	Creativity	**Objectivity**	- - -
	Empathy	Empathy	Empathy	Empathy
	Dominance	Dominance	Dominance	Dominance

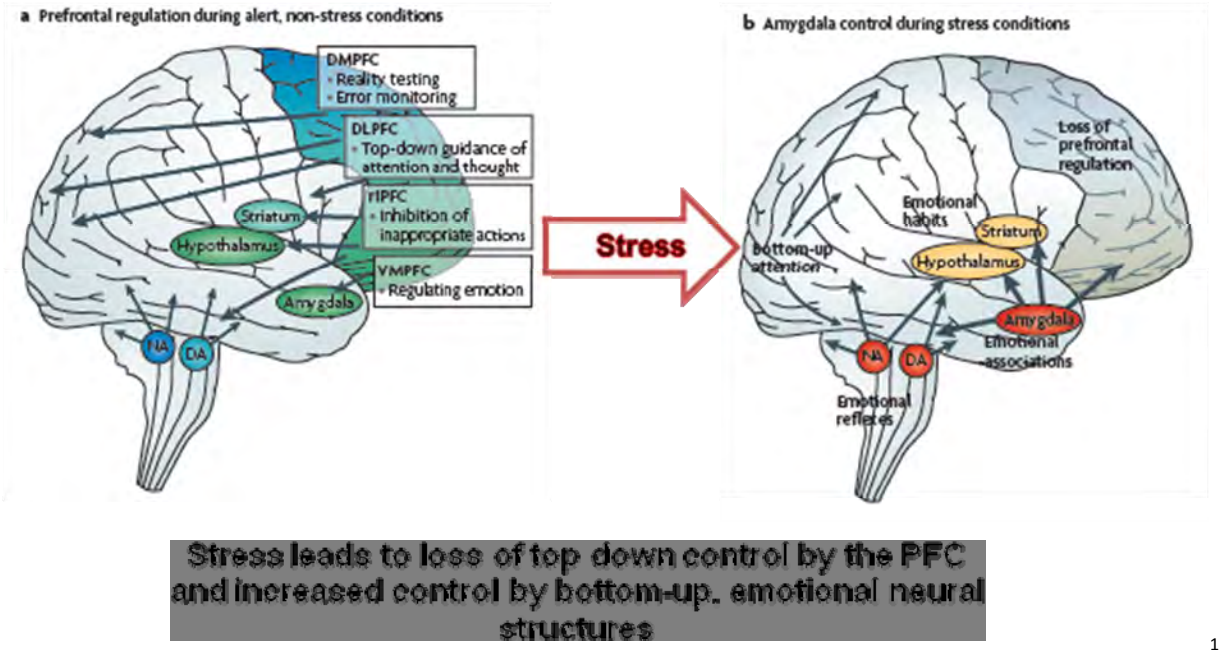

130

Objectivity is defined by the Merriam-Webster Dictionary as "expressing or dealing with facts or conditions as perceived without distortion by personal feelings, prejudices, or interpretations."[129] As a species, we pride ourselves on our relative objectivity, framed in the concept of *homo economicus*. The definition offered above seems to imply an inherent rationality in the unconscious human brain because it suggests that the perception of facts or conditions is what should be utilized before any addition of prejudice or interpretation, suggesting that these initial perceptions are themselves free of those filters. However, research in many different fields from economics to neuroscience shows that humans are far from objective, often applying emotional or other perceptual biases to information before, during, and after conscious perception. Thus, even if no conscious subjective filters are applied to judgments, humans are often not rational or objective, and stress tends to lead to specific types of bias, which will be discussed in this section.

[129] Merriam-Webster, "Objectivity," *Merriam-Webster Online Dictionary*, http://www.merriam-webster.com/dictionary/objectivity

[130] Picture taken from http://meshack737.files.wordpress.com/2009/01/king-solomon-baby.jpg

Objectivity is important to leaders because it can help them to choose their best option by weighing the costs, benefits, and risks of any potential solution through the lens of their interests. When objectivity is impaired, they may make decisions that are commensurate with a cognitive bias, but which lead to less favorable outcomes for their country. The degree of a person's objectivity will often relate to the performance of the prefrontal cortex (PFC). When PFC performance is degraded, more emotionally driven areas, such as the amygdala, may exert greater control. For example, the right ventromedial PFC (R vmPFC) is involved in weighing punishment vs. reward and present vs. future effects, and a loss of performance is likely to lead to a greater risk tolerance.[131]



[132]

The Effects of Stress on Objectivity

Acute Stress

Acute stress affects men and women in opposite ways. It tends to bias men towards rewards over punishment, making them risk acceptant; in contrast, women tend to improve their perception of reward vs. punishment. The Iowa Gambling Test (IGT) measures the tendency of participants to favor either high gains with higher losses or a better net payout of smaller gains with even smaller losses. Participants may choose cards from two sets of decks. The first set has

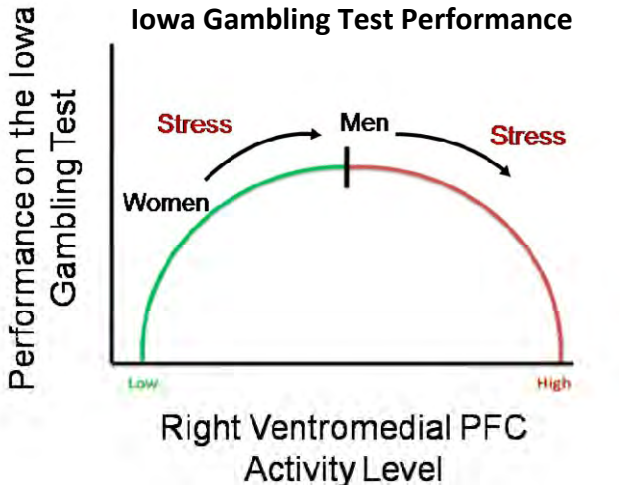
[131] R. van den Bos, M. Harteveld, and H. Stoop, "Stress and decision-making in humans: Performance is related to cortisol reactivity, albeit differently in men and women," *Psychoneuroendocrinology* (2009).

[132] A. F.T. Arnsten, "Stress signalling pathways that impair prefrontal cortex structure and function," *Nature Reviews Neuroscience* 10, no. 6 (2009): 410–422

cards that lead to large gains but also cards that lead to even larger losses. In contrast, the payout from cards in the second set is smaller, but the losses are even smaller than the gains. Thus, over time, the first has a net lower value than the second. After drawing a number of cards, most people can identify that the second set is superior.

Without stress, men tend to perform better than women on the IGT. However, when men and women are put under stress, as indicated by cortisol release, men perform worse, while women perform better; women under stress have similar average scores to unstressed men, while men under stress have similar scores to unstressed women.

The Effects of Stress on Male and Female Iowa Gambling Test Performance



Research suggests that this is related to differential brain activation in men and women. Imaging studies indicate that the effects of cortisol are mediated through the right ventromedial PFC (R vmPFC). Studies of people with brain damage show that this portion of the brain is responsible for the weighing of immediate vs. future effects and reward vs. punishment.[133] When not under stress, men have intrinsically higher levels of R vmPFC activation than women during the IGT, which appears to give men a better ability to discriminate between the IGT decks (without stress). However, under stress, cortisol released into the blood appears to be increasing the activation of the R vmPFC. The stress-induced performance decrement in men implies that the increased activation is moving it out of its optimal functioning range, while women's vmPFC activity is increasing towards improved function, as indicated by the above figure.[134]

Cortisol also appears to push people towards a preference for action. Rats given exogenous cortisol are more likely to approach and attack other rats put in their cages, even if those rats are docile or immobile.[135] The increased drive resulting from acute stress can only be expected to further this effect, as the mind seeks the dopamine reward of removing stress. The

[133] N. S Lawrence et al., "Distinct roles of prefrontal cortical subregions in the Iowa gambling task," *Cerebral Cortex* 19, no. 5 (2009): 1134

[134] van den Bos, Harteveld, and Stoop, "Stress and decision-making in humans."

[135] É Mikics, M. R Kruk, and J. Haller, "Genomic and non-genomic effects of glucocorticoids on aggressive behavior in male rats," *Psychoneuroendocrinology* 29, no. 5 (2004): 618–635

detrimental effects on the PFC of the release of norepinephrine and dopamine under acute stress may also play a role in affecting objectivity, but this has not been documented.

President Ford's actions in the Mayaguez Crisis show the potential deleterious effects of a lack of objectivity.

Ford, Acute Stress, and the Mayaguez Crisis


137

On 12 May 1975, the American merchant ship SS *Mayaguez*, sailing from Hong Kong to Thailand, was fired upon by Cambodian patrol boats in international waters, 50 miles from the Cambodian mainland. The Cambodians, however, had recently claimed their waters out to 90 miles and were seizing vessels that they believed were trespassing. Shortly after the *Mayaguez* radioed for help, Cambodian sailors boarded the ship and captured its crew.[136]

Fearing a repeat of the USS *Pueblo* incident that might further erode U.S. international standing already weakened by the recent Communist takeovers in Vietnam and Cambodia, President Gerald Ford was set on an expeditious resolution to the crisis. He ordered the aircraft carrier *USS Coral Sea* to the area and ground troops to the Philippines. Ford also instructed the Joint Chiefs to present a military plan later that day. Meanwhile, the White House issued a public statement threatening military measures if the ship and crew were not released, while the State Department warned the Khmer Rouge government to release the ship and crew immediately or it would face "the most serious consequences."[138]

In the middle of a late night NSC meeting on 13 May, Ford decided to use military force to liberate the ship and its crew. He ordered a simultaneous attack by marines on the *Mayaguez*

[136] John F. Guilmartin, Jr., *A Very Short War: The Mayaguez and the Battle of Koh Tang* (Texas A&M University Press: College Station, 1995), p. 26; Ralph Wetterhahn, *The Last Battle: The Mayaguez Incident and the End of the Vietnam War* (Carrol & Graf: New York, 2001), pp. 25-32.

[137] Picture taken from http://msnbcmedia2.msn.com/j/msnbc/Components/Photos/061227/061227_Gerald-Ford_vmed_730p.widec.jpg

[138] Wetterhahn, *The Last Battle,* pp. 36-41; Richard G. Head, Frisco W. Short, and Robert C. McFarlane, *Crisis Resolution: Presidential Decision Making in the Mayaguez and Korean Confrontations* (Westview: Boulder, CO, 1978), pp. 102, 108-11.

and Koh Tang Island, where the crew was thought to be held, combined with an aerial bombardment of selected shipping and industrial targets. The attack was scheduled for sunrise on May 15, Cambodian time (evening of May 14, Washington time). Ford asked the military to mount the operation even earlier, but too many of the ships, aircraft, and troops necessary to execute the operation were still too far away. Indeed, as the Joint Chiefs developed their operational plan, they reached a consensus that postponing the attack for another day would increase the operation's chances of success by enabling adequate forces to move into the area and command, control, and communications arrangements to be established.[139] Ford, however, refused to consider any delay and ordered the military to begin the operation.[140]

Less than 24 hours later, the operation to retake the *Mayaguez* and rescue the crew began. The ship was found abandoned and retaken by 8:25 am (Cambodian time). The landings on Koh Tang, which began at 6:00 am, were far less successful. Of the four helicopters in the first wave, one was shot down at sea, a second crash-landed, a third unloaded its troops before being hit and ditching at sea, and the fourth did not unload its Marines due to hostile fire. In the next hour, four more helicopters brought reinforcements, but three of them were heavily damaged. By 7:00 am, 109 Marines and 5 air force crewmen were pinned down in three separate locations.[141]

Meanwhile, the Cambodian Minister of Information and Propaganda had already made a radio address offering to release the "CIA spy ship." When Ford was informed of the message (approx. 2 ½ hours after the military operation had begun), he decided to continue the operation because the Cambodian message had not mentioned anything about the crew. Ford ordered punitive air strikes by planes from the *Coral Sea* against Cambodian airfields and refineries.[142]


[143]

[139] Wetterhahn, *The Last Battle,* p. 100; Head et al., *Crisis Resolution,* pp. 117-18, 120-22.

[140] Head et al., *Crisis Resolution,* pp. 122-23; Lamb, *Belief Systems and Decision Making,* pp.90-92; Wetterhahn, *The Last Battle,* pp. 123-24; Lucien S. Vandenbroucke, *Perilous Options: Special Operations as an Instrument of U.S. Foreign Policy* (Oxford University Press: New York, 1993), pp. 82-83.

[141] Guilmartin, *A Very Short War,* pp. 86-104; Wetterhahn, *The Last Battle,* pp.159-76.

[142] Head et al., *Crisis Resolution,* pp. 133, 138.

[143] Picture taken from http://www.iraqwarnews.net/2-29-08b.jpg

The crew of the Mayaguez was not on Koh Tang or on the Cambodian mainland. They were being held on Rong Som Len Island in Kompong Sam harbor and were released from custody at 6:20 am, shortly after the landing at Koh Tang began. They were put aboard a Thai fishing boat and headed back to the *Mayaguez*. They were picked up by 9:49 am by a US destroyer. The timing of the Cambodian actions indicates that the decision to release the crew was made before any U.S. military action wastaken.[144]

By 10:45 am Cambodian time, Ford directed the Joint Chiefs to order a disengagement. By 8:15 pm, all Marines were out. Fifteen Marines had been killed, three were missing in action, later believed captured and executed, and fifty were wounded.[145]

Thus, without considering negotiation or other strategies, Ford ordered a military assault before it could be properly prepared. His bias towards action led to the ill-fated *Mayaguez* rescue operation when the Cambodian Government was willing to release the sailors and the ship outright.

Sustained/Chronic Stress

Chronic stress tends to cause higher punishment sensitivity. Individuals with higher basal cortisol levels – a documented effect of chronic stress – tend to be more risk averse on tests such as the Iowa Gambling Test. Depressed individuals also perform better on the IGT than controls, likely because they are sensitive to the high punishments in the first deck.[146]

This is commensurate with the implications of the learned helplessness paradigm (see sidebar), which would suggest that

Learned Helplessness

The learned helplessness model of behavior is rooted in animal studies. Animals are divided into two groups. One group is given some sort of painful electric shock but can escape the shock by moving locations. The other group cannot escape the shock. Eventually, this second group stops moving entirely and no longer tries to escape the shock even when later given the opportunity. They have learned that they are helpless to prevent the shock, and in doing so, they stop trying.

CRH and cortisol are thought moderate learned helplessness by activating two receptors in the hippocampus (responsible for learning) that are involved in encoding information and experience, the NMDA receptor, which is used largely for short-term memories, and voltage-gated calcium channels, which are involved in the creation of long-term memories. When both are repeatedly activated, chronic stress results in an association of one's immediate experience of uncontrollable stress with the individual's long-term memories of how, over this period of time, they have been unable to actively effect a change. Functionally helpless, individuals stop trying to explore and exploit their environments.

---

[144] Head et al., *Crisis Resolution,* pp. 138-40.

[145] Head et al., *Crisis Resolution,* pp. 140-41.

[146] Moria J. Smoski et al., "Decision-making and risk aversion among depressive adults," *Journal of Behavior Therapy and Experimental Psychiatry* 39, no. 4 (December 2008): 567-576

individuals under chronic stress have a bias towards inaction.[147] This may be partially mediated by detrimental effects of long-term stress on drive, but the hormonal effects of long-term stress also appear to support a bias towards passivity.

Sustained and chronic stress lead to constant HPA-axis activation and down-regulation of testosterone levels. Constant HPA axis activation has been strongly linked to anxiety and fear through heightened cortisol and corticotrophin releasing hormone (CRH) levels, which act on the amygdala, through which fear is processed.[148] Fear tends to increase uncertainty and create a tendency towards inaction. Constant HPA-axis activation will also lead to decreased testosterone levels. Testosterone is anxiolytic – meaning that it is decreases anxiety – so people with lower levels are expected to experience increased anxiety. Experimental doses of testosterone also increase sensitivity to reward and decrease sensitivity to punishment, so the low levels expected in chronically stressed individuals should have the opposite effect.[149] In addition, research has demonstrated a positive relationship between basal cortisol levels and punishment sensitivity. Thus, people under long-term stress will tend to be more risk-averse and sensitive to punishment.[150]

Risk averse leaders would be more likely to wait too long to act, potentially missing valuable opportunities by delaying decisions or choosing options that are less confrontational than might be optimal. This is another example of an inverted-U type relationship. Too much risk acceptance can lead to disasters of over commitment, and too little can lead to missed opportunities or give others the opportunity to take the initiative.

[147] A. L Reed et al., "The forced-swim test and learned helplessness paradigm in juvenile rats model the lack of efficacy of tricyclic antidepressants in childhood and adolescent depression," *The FASEB Journal* 21, no. 6 (2007): A779

[148] J. Schulkin, P. W. Gold, and B. S. McEwen, "Induction of corticotropin-releasing hormone gene expression by glucocorticoids: implication for understanding the states of fear and anxiety and allostatic load," *Psychoneuroendocrinology* 23, no. 3 (1998): 219–243

[149] Jack van Honk et al., "Testosterone shifts the balance between sensitivity for punishment and reward in healthy young women," *Psychoneuroendocrinology* 29, no. 7 (August 2004): 937-943

[150] Jack van Honk et al., "Low cortisol levels and the balance between punishment sensitivity and reward dependency," *Neuroreport* 14, no. 15 (October 27, 2003): 1993-1996.

Empathy

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	Drive	Drive	Drive	Drive
	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity
	Curiosity	Creativity	Objectivity	- - -
	Empathy	**Empathy**	**Empathy**	**Empathy**
	Dominance	Dominance	Dominance	Dominance


151

Empathy involves two major processes: the identification of the emotional and mental state of others – are they sad, angry, or happy? – and the ability to analyze their perspective and motivations. The latter part of empathy is described as 'theory of mind' or, more colloquially, as 'mind reading' because it involves understanding other peoples' points of view, what they are thinking, and the logical next steps in their thought process. Together, these two abilities make up what is sometimes referred to as social cognition. They are sometimes described separately, but they will be subsumed here under the trait empathy.

The ability to identify and take the perspective of another person is partially dependent on the mirror neuron system (see sidebar, next page).[152] When one person views another who is in pain, the same areas of the brain that would be utilized to process pain in one's own body are activated. This not only allows for the identification of the state being experienced by others, but it also helps to understand their point of view because the activation of pain networks

[151] Picture taken from http://samueljscott.wordpress.com/category/marketing/

[152] Jennifer H. Pfeifer et al., "Mirroring others' emotions relates to empathy and interpersonal competence in children," *NeuroImage* 39, no. 4 (February 15, 2008): 2076-2085

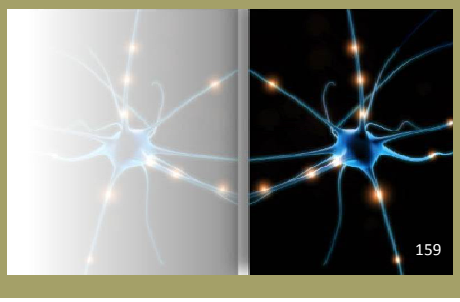
allows individuals to think like they themselves are in pain. Higher order theory of mind tasks also require areas of the prefrontal cortex. While different studies have identified a number of areas that are involved in theory of mind, the right ventromedial prefrontal cortex (R vmPFC) is crucial.[153,154] Because the mirror neuron system can respond to such a wide variety of observations of others, naming all the regions that are involved in its operation and in the emotion-identification portion of empathy would bring little value.

In addition to brain structures involved in empathy, scientists have identified that the neuropeptide oxytocin significantly improves accuracy on theory of mind tasks.[157] Oxytocin is released during social interaction and support, plays an important role in mother-child bonding, and can serve to lower stress levels and ameliorate HPA-axis activation. When it is experimentally administered to people, they become more trusting and more altruistic towards others.[158]

Empathy is important for leaders because they do not function in a vacuum. They are constantly working with

The Mirror Neuron System

The identification of the mirror neuron system (MNS) was rooted in the observation that neurons in the ventral premotor cortex of macaque monkeys fired when the monkeys used goal-related hand and mouth movements as well as when they observed these actions being performed in other macaques.[135] In humans, listening to sounds of actions (breaking a peanut, ripping a sheet of paper) and actually physically performing the actions activate the same region of the brain.[136] While the initial discoveries related to the MNS were related to motor activity, it was soon discovered that the human brain utilized the same method to identify emotions in others. When observing someone who is sad, the areas of your own brain that would be activated when you are sad are activated. For more complex tasks, however, such as identifying another's intent, higher areas of the brain, especially in the PFC (such as the R vmPFC), are critical for functioning empathy.


159

[153] Tom Smeets, Isabel Dziobek, and Oliver T. Wolf, "Social cognition under stress: Differential effects of stress-induced cortisol elevations in healthy young men and women," *Hormones and Behavior* 55, no. 4 (April 2009): 507-513

[154] J. K Rilling, B. King-Casas, and A. G Sanfey, "The neurobiology of social decision-making," *Current Opinion in Neurobiology* 18, no. 2 (2008): 159–165

[155] V Gallese et al., "Action recognition in the premotor cortex," *Brain: A Journal of Neurology* 119 (Pt 2) (April 1996): 593-609.

[156]Valeria Gazzola, Lisa Aziz-Zadeh, and Christian Keysers, "Empathy and the Somatotopic Auditory Mirror System in Humans," *Current Biology* 16, no. 18 (September 19, 2006): 1824-1829.

[157] Gregor Domes et al., "Oxytocin Improves "Mind-Reading" in Humans," *Biological Psychiatry* 61, no. 6 (March 15, 2007): 731-733

[158] Michael Kosfeld et al., "Oxytocin increases trust in humans," *Nature* 435, no. 7042 (June 2, 2005): 673-676

[159] Image taken from http://slog.thestranger.com/files/2008/07/neuron.jpg

and relying on other people for information, for social and cognitive support, and to help in implementing their decisions. Without the ability to identify what will motivate another person, a leader may quickly lose that individual's support. Theory of mind is also important for attempting to understand what motivates your adversary and potential allies. When gathering information to understand a crisis, subordinates might withhold information that they feel would bias a leader against their preferred course of action unless they can be convinced to support the leader. When generating solutions, empathy will support leaders in understanding what biases people carry and why they might be advancing a given solution, whether maliciously or simply because they themselves are unaware of their own biases. When weighing options, empathy supports leaders in understanding how their own actions may be viewed by others, and finally, empathy is crucial in the implementation stage of a crisis because the leader will likely want or need to convince others who are not in agreement to support the his or her decision. Thus, empathy is crucial for leaders to succeed because of the social and group aspects inherent in their work.

Effects of Stress on Empathy

Acute Stress

Only one study was identified that assesses the effects of acute stress on empathy. In men, there was no significant difference between those under stress and controls, but men who had a relatively high cortisol response to stress scored higher than controls, while men with a relatively low response performed worse. The opposite was true in women, whereby low cortisol responders scored significantly better than high responders. In women, there was also a significant overall improvement in scores between stressed participants and non-stressed controls.[160] Thus, more research is needed to assess the effects of acute stress on empathy, but individual variation appears to be the most important factor in the acute stress-empathy relationship.

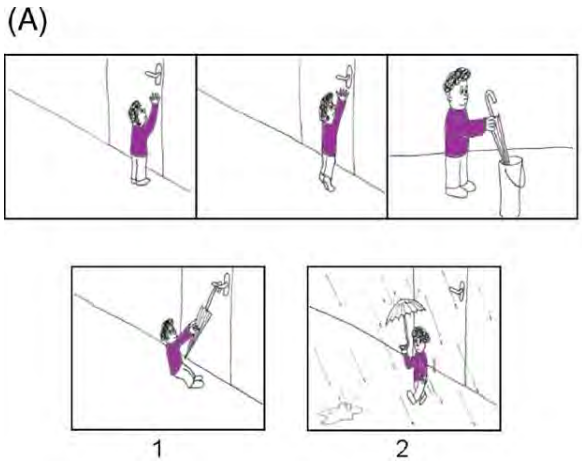
Sustained/Chronic Stress

Without direct evidence for the effects of long-term stress, depression provides the best proxy by which to examine its effects on empathy. **While depressed individuals are able to identify emotions in others, they are unable to properly assess their motives.** One task for examining theory of mind gives cartoon prompts to identify whether subjects can infer the intentions of a character.[161]

[160] Smeets, Dziobek, and Wolf, "Social cognition under stress."

[161] Birgit A. Völlm et al., "Neuronal correlates of theory of mind and empathy: A functional magnetic resonance imaging study in a nonverbal task," *NeuroImage* 29, no. 1 (January 1, 2006): 90-98.

[162]



Subjects are asked to indicate the outcome of the cartoon, either designating box 1 or box 2. Box 2 is a more common scene, but it is not supported by the top-row pictures, which show that the character is looking for something to help them get through the door.

Depressed individuals perform worse on this test as a result of their relative inability to infer the intentions of others. The decrease in dopamine levels and increase in basal cortisol levels in addition to other changes that accompany depression and long-term stress are implicated in PFC dysfunction. As the R vmPFC has been identified as crucial in theory of mind tasks, this overall dysfunction provides a broad mechanism for how long-term stress and depression might affect empathy. These deficits may also help to explain why depressed individuals withdraw from social contact. When others who interact with depressed people feel bad for them or become upset because they are unable to help alleviate the depression, the depressed people often believe that they have done something to create the negative feelings, creating a greater gulf between the two parties. This is the equivalent of mistaking someone who is laughing with you for someone who is laughing at you, leading to the person who is trying to help being driven away.[163]

For leaders, the inability to infer intentions and motivations might hamper them in a host of crucial activities, including knowing how to motivate others to provide information, understanding their adversary's intentions and how decisions would affect others, and implementing a solution. Howard Taft clearly demonstrates these dysfunctions during his unhappy Presidency.

---

[162] Ibid.

[163] Paul W. Andrews and J. Anderson Thomson Jr., "The Bright Side of Being Blue: Depression as an Adaptation for Analyzing Complex Problems," *Psychological Review* 116, no. 3 (July 2009): 620-654

Taft, Chronic Stress, and Empathy

Taft performed well in a number of government positions before becoming president. He served as Solicitor General of the U.S., federal appeals court judge, Governor of the Philippines, and Secretary of War.

Before Taft became president, he was described as playful, candid, trusting, with a sunny disposition, warm-hearted and likable. He was also a very hard worker. While serving as Theodore Roosevelt's secretary of war, he was known to work harder than any other cabinet officer. He also got along well with reporters.[164]


165

Taft disliked being president however, mostly because it meant he could not please everyone, had to deal with dissension and argument, and was often criticized, signs that he felt he was not in control, a factor in feeling uncontrollable stress. Once he became President, the criticism overwhelmed him and changed his personality. He became colder and more depressed. As one reporter wrote, "The old cordiality and friendliness were gone, and there was in its place a reserve that amounted almost to coldness." He confessed to the New York Press Club, "There are times at the White House…when you get really very discouraged. Things don't go right. Your motives are misconstrued…" He confessed to Theodore Roosevelt in 1910, "I have had a hard time. I do not know that I have had harder luck than other presidents, but I do know that thus far I have succeeded far less than have others." When Taft was preparing to sign the Panama Canal Bill in 1912, he observed: "I shall create enemies in signing the bill, but that is what one usually does and makes no friends. That is what politics is." Virtually every speech took on the air of an apology for his and his party's inadequacies. Taft spoke frequently about his reluctance to serve a second term.[166] These descriptions and statements suggest that Taft felt enormously stressed by the Presidency and that it led to depression.

Taft's empathy – his ability to understand what motivated people and how they could be swayed – faltered after he became president. Taft could not keep the names and faces of

[164] Judith Icke Anderson, *William Howard Taft: An Intimate History* (Norton: New York, 1981), pp. 22, 25.

[165] Picture from http://commons.wikimedia.org/wiki/File:William_Howard_Taft.jpg

[166] Anderson, *William Howard Taft,* pp. 25-27.

important supporters straight. He made ineffective and disruptive use of patronage by taking too long to fill vacancies. He tended to promise more than he could deliver, raising people's hopes and then dashing them later, and to reward his opponents, perhaps in hope of winning them over, instead of his friends. He also was reluctant to say no, which meant that petitioners often believed they had been successful when in fact they had not. Many Republicans deserted Taft because of his ineptitude and indifference. According to one historian, Taft left office in the wake of "the nastiest internal revolt the Republican Party had as yet experienced."[167]

Taft's problems with empathy were particularly apparent in the debate over tariff rates. During the campaign, Taft had supported a downward revision of the tariff. When he called a special session of Congress to consider the tariff soon after his inauguration, however, his message opening the session made no mention of lowering the rates. Congress soon split between revisionists and protectionists. Taft initially demanded a lowering of tariff rates or he would veto the bill; however, he soon began to try to reconcile the opposing factions. He invited representatives from both camps to dinner at the White House but he was unable to have any effect. Protectionists packed the committee and passed reduced rates on only six insignificant items.

When conservatives pushed through a bill by a narrow margin that increased over six hundred tariff rates, including rates on key products such as sugar, iron and steel, lumber, and cotton, everyone looked for Taft to react. He led progressive opponents of the bill to believe that he would veto it but soon began to talk about signing the bill. Taft's signing caused an uproar and infuriated progressives.

Taft later called for a new commission to investigate and report on each tariff rate separately. Two years later, Congress passed two tariff bills lowering a few rates and adding more goods to the duty-free list but Taft decided the new schedules were not low enough to silence the protests, so he vetoed the bills.[168]

The Bollinger-Pinchot affair also reflected Taft's lack of empathy. Taft appointed Richard A. Ballinger, a lawyer and former mayor of Seattle, as Secretary of Interior. Ballinger supported opening federal land in the West to private enterprise. The head of the Forest Service, Gifford Pinchot, had been appointed by Roosevelt and retained by Taft. Pinchot was an ardent conservationist. In August 1909, Pinchot made public charges that Ballinger had allowed the Morgan-Guggenheim interests to gain control of certain reserved coal land in Alaska. After trying unsuccessfully to reconcile Ballinger and Pinchot, Taft chose to stand by Ballinger "at

[167] Anderson, *William Howard Taft,* pp. 21, 24, 130, 132-33.

[168] Anderson, *William Howard Taft,* pp. 169-79.

whatever cost." In January 1910, Taft dismissed Pinchot and released a letter supporting Ballinger. When Taft's attorney general complained about the precipitous action, Taft quickly composed a letter of explanation and apology for each cabinet member. After asking a subordinate to draw up a list of charges against Pinchot, Taft denied that it existed. He then reversed course and confessed that it did exist. He claimed that he had simply forgotten that the list existed. Despite repeated calls by Republican leaders for Ballinger's ouster and three separate offers of resignation by Ballinger, Taft stuck with Ballinger until March 1911, when he finally accepted Ballinger's resignation. Taft appointed as the new Secretary of Interior Walter Fischer, a good friend of Pinchot who had been one of Ballinger's opponents.[169] Taft's inability to understand other people's motivations left him unable to find solutions to problems, and he vacillated between different extremes trying to find something that worked.

Thus, the chronic stress induced by Taft's dislike of the Presidency likely led to his inability to understand what would motivate others, and as such, he was unable to work effectively with anyone. Taft also shows the aversion to punishment – dislike by others in this case – which is consistent with the effects of chronic stress on objectivity. Because of this, Taft shuttles back and forth attempting to please each side in turn without realizing that this will please no one and only cause further damage his goals.

[169] Anderson, *William Howard Taft,* pp. 181-85.

Dominance

Tasks	Information Gathering & Sensemaking	Generating Solutions	Consideration and Decision Making	Implementation
Supporting Traits	Drive	Drive	Drive	Drive
	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity	Cognitive Complexity
	Curiosity	Creativity	Objectivity	- - -
	Empathy	Empathy	Empathy	Empathy
	Dominance	**Dominance**	**Dominance**	**Dominance**

Dominance is the interest in and ability to exert power over others. Outside of human society, dominance is primarily enforced through physical confrontations. However with national leaders, it is primarily psychosocially mediated. Dominant individuals seek to be in control or to achieve high status. Social scientists sometimes refer to this as power motivation, which "can be defined as the capacity of obtaining emotional satisfaction from having impact on others."[170]

While leaders must inevitably delegate some of their power to others, they will have significantly less effects on a country if they do not have a relatively high level of dominance over their subordinates. Because of the rigors of reaching the pinnacle of political power in a state, those who succeed in doing so can be reasonably assumed to have a relatively high power motivation.

[170] O. C Schultheiss, K. L Campbell, and D. C McClelland, "Implicit power motivation moderates men's testosterone responses to imagined and real dominance success," *Hormones and Behavior* 36, no. 3 (1999): 234–241.

[171] Picture taken from http://www.iwrc-online.org/kids/Facts/Mammals/m_gorilla2.htm

Dominance is strongly related to testosterone levels, both in humans and animals. The pioneering work of Robert Sapolsky and others in social endocrinology has shown that testosterone levels are significantly associated with achievement in social hierarchies.[172] In addition to the well known physical effects of testosterone, high physiological levels lead to lower fear, and this may increase the probability of someone seeking to climb a hierarchy, an activity which may be fraught with challenges and challengers. One study investigating the link between testosterone and activation of the amygdala and ventromedial prefrontal cortex (vmPFC), which is implicated in processing emotion, found that in males, increased testosterone levels were associated with decreased levels of activation of the amygdala when viewing angry and neutral faces. Furthermore, the authors noted that the level of testosterone in men was correlated positively with activation of the vmPFC when viewing these faces.[173,174] This suggests not only a lack of worry over potential challengers, but also a higher level of top down cognitive control over emotions, something which would be highly valuable in a number of potentially averse situations, especially by lowering the likelihood of a stress response.

Lawyers and Testosterone

Despite the fact that most Presidents have been lawyers, members of the legal profession do not have especially high levels of testosterone. When compared with other white collar professions, lawyers have similar testosterone levels, although trial lawyers tend to have higher levels on average. This puts them closer to the higher levels found in blue-collar professions.[175]


176

Testosterone also predicts the level of HPA-axis/cortisol activation after competition. Individuals with high testosterone experience stable cortisol levels after winning competitions and increased cortisol levels after losing. In contrast, low testosterone individuals see no effects

[172] R. A Josephs et al., "The mismatch effect: When testosterone and status are at odds," *Journal of personality and social psychology* 90, no. 6 (2006): 999.

[173] Ibid.

[174] Allan Mazur and Alan Booth, "Testosterone and Dominance in Men," *Behavioral and Brain Sciences* 21, no. 03 (1998): 353-363

[175] James M. Dabbs Jr, Elizabeth Carriere Alford, and Julie A. Fielden, "Trial Lawyers and Testosterone: Blue-Collar Talent in a White-Collar World," Journal of Applied Social Psychology 28, no. 1 (1998): 84-94

[176] Picture taken from http://www.csgv.org

on cortisol levels of losing but have increased cortisol levels when they win. This suggests that high testosterone individuals have a higher motivation to win in competitive encounters and low testosterone individuals have incentives against competing.[177] The negative effects of winning in low testosterone individuals may be related to the conscious or sub-conscious fear that they will have to compete again by virtue of their success.

However, in humans and other primates, high testosterone levels alone do not account for dominance. When combined with low serotonin levels, high testosterone tends to lead to inappropriate and violent behavior instead of dominance. It is suggested that serotonin mediates this effect by decreasing neuronal responsiveness to aversive stimuli.[178,179]


180

Dominance is crucial throughout the tasks that may support a leader in successfully navigating a crisis. When a stable dominance hierarchy is established in animals such as baboons, a lower-ranked individual will comply with a higher-ranked individual in the vast majority of cases, such as by relinquishing a kill, without a fight. This effect would be highly beneficial to a leader. It would increase the probability that subordinates would provide leaders with the information that they request instead of pursuing their own agenda. While generating a full solution set seems likely to improve the probability of success in a crisis, a leader may wish to exert control over those working with them to generate solutions that fit a specific goal which the group may or may not share. Having the confidence to make crucial decisions in crises and the ability to enforce them is another crucial role of dominance, and perhaps most importantly, dominance plays a critical role in convincing others, both consciously and unconsciously, to support a given decision or course of action in the

[177] Pranjal H Mehta, Amanda C Jones, and Robert A Josephs, "The social endocrinology of dominance: basal testosterone predicts cortisol changes and behavior following victory and defeat," *Journal of Personality and Social Psychology* 94, no. 6 (June 2008): 1078-1093.

[178] Dennis S. Charney, "Psychobiological Mechanisms of Resilience and Vulnerability: Implications for Successful Adaptation to Extreme Stress," *Focus* 2, no. 3 (July 1, 2004): 368-391.

[179] Justine M. Kent, Sanjay J. Mathew, and Jack M. Gorman, "Molecular targets in the treatment of anxiety," *Biological Psychiatry* 52, no. 10 (November 15, 2002): 1008-1030.

[180] Picture taken from http://dsc.discovery.com/news/2006/07/06/gallery/baboon2_zoom.jpg

implementation stage. Thus, dominance is a crucial trait for leaders who seek to control the process by which they and others handle crises.

The Effects of Stress on Dominance

Acute Stress

Acute stress will tend to buoy dominance. In high power motivation individuals, anticipation of a dominance contest – referred to as a 'dominance fantasy' – leads to increased testosterone levels.[181] Crises often represent a dominance contest, especially geopolitical crises where two countries oppose each other directly.

Cortisol release under acute stress can also be expected to buoy dominance behavior. When humans and animals are experimentally administered cortisol, they experience reduced anxiety, increased approach behavior and, in some cases, act aggressively.[182] The influence of cortisol on dominance behavior may be diminished, however, by the fact that higher levels of testosterone buffer people against the effects of stress. Through the quieting of the amygdala, PFC feedback into the stress response can raise the threshold for a cortisol dump. This might help to cement a leader's dominant position if he or she had high testosterone levels, as he or she would appear relatively more stable, stronger, and potentially provide a source of support for others who had lower testosterone levels and were feeling more stress. Thus, acute stress can be expected to maintain or increase the level of dominance of a leader, giving him (or her) the opportunity to utilize their position to affect the outcome of the crisis.

Sustained/Chronic Stress

In contrast to acute stress, sustained and chronic stress will tend to decrease a leader's dominance. Persistent activation of the HPA-axis, such as is created by extended periods of stress, significantly decreases testosterone production in the leydig cells of the testes. Cortisol appears to act directly on glucocorticoid receptors on the leydig cells, which affects the operation of enzymes in the cell critical for the production of testosterone.[183]

Ironically, people in positions of authority with low testosterone levels experience heightened stress levels, likely due to the mismatch of their position with their psycho-endocrine interest in

[181] Schultheiss, Campbell, and McClelland, "Implicit power motivation moderates men's testosterone responses to imagined and real dominance success."

[182] Peter Putman, Erno J. Hermans, and Jack van Honk, "Exogenous cortisol shifts a motivated bias from fear to anger in spatial working memory for facial expressions," *Psychoneuroendocrinology* 32, no. 1 (January 2007): 14-21

[183] M. P. Hardy and V. K. Ganjam, "Stress, 11beta-HSD, and Leydig cell function," *Journal of Andrology* 18, no. 5 (1997): 475–479

power. Some have also suggested that this is a latent fear of a challenge that should come from a more naturally dominant competitor.[184] Persistent HPA-axis activation is also likely to decrease dominance by increasing anxiety and fear.[185] Neither of these emotions is likely to inspire submission or cooperation in subordinates, and other high testosterone individuals may see an opportunity in perceived or real weakness. The case of Eisenhower in preparation for the four-power summit meeting in 1960 displays the potential negative effects of decreased dominance.[186]

Eisenhower, The U-2 Incident, and Decreased Dominance

By 1960, Eisenhower had already suffered a major heart attack and a stroke, the latter occurring in late 1957. These physical stressors, combined with the workload of being President, undoubtedly took their toll on him. Heart attacks are strongly associated with the development of depression.[187] From his stroke, Eisenhower was also left with a mild aphasia, or difficulty speaking.[188] Post-stroke aphasia is also strongly associated with depression, and major depression becomes more prevalent as time from the accident increases.[190] In stroke patients, subsequent

A piece of Gary Powers' U-2 currently on display in a military history museum in Yekaterinburg, Russia

[184] Josephs et al., "The mismatch effect."

[185] J. Schulkin, P. W. Gold, and B. S. McEwen, "Induction of corticotropin-releasing hormone gene expression by glucocorticoids: implication for understanding the states of fear and anxiety and allostatic load," *Psychoneuroendocrinology* 23, no. 3 (1998): 219–243

[186] Jack van Honk et al., "Testosterone shifts the balance between sensitivity for punishment and reward in healthy young women," *Psychoneuroendocrinology* 29, no. 7 (August 2004): 937-943

[187] Alexander H. Glassman et al., "Onset of Major Depression Associated With Acute Coronary Syndromes: Relationship of Onset, Major Depressive Disorder History, and Episode Severity to Sertraline Benefit," *Arch Gen Psychiatry* 63, no. 3 (March 1, 2006): 283-288.

[188] The New York Times, "Dwight David Eisenhower: A Leader in War and Peace," March 29, 1969, http://www.nytimes.com/learning/general/onthisday/bday/1014.html.

[189] Picture from the lead author's personal files.

depression is also related to disabled feedback loops in the HPA axis, likely resulting in elevated cortisol levels.[191]

Thus, despite the fact that Eisenhower was highly successful as a General and as a political leader - which suggest that he was likely to have had relatively high testosterone levels - his heart attack and stroke left him at much greater risk of depression and significantly elevated cortisol levels. Over time, these could also decrease his testosterone levels, combining to decrease his dominance. His actions in the lead-up to the Gary Powers U-2 incident display such a decreased level of dominance, and as such, it is possible that this was influenced by elevated cortisol levels and decreased testosterone levels.

At a four-power summit meeting to be held in Paris in May 1960, Eisenhower hoped to get Soviet agreement to a comprehensive test-ban treaty as part of a move to broader détente. To gain information that would be useful for the summit, CIA officials wanted to look at a Soviet missile base and a space center, since they expected the Soviet Union to launch a space mission or test a new ICBM before the summit.[192]

After a B-26 flown by a CIA pilot was shot down over Indonesia in 1958 and the pilot was captured, Eisenhower had ordered a reevaluation of all covert flights. The Board of Consultants on Foreign Intelligence Activities remained supportive of U-2 flights, so Eisenhower continued them against his better judgment. Thus, despite significant doubts about the U-2 program and the specific mission to be flown by Powers, Eisenhower agreed to the flight, but he set a hard deadline of 25 April 1960. When bad weather cancelled the 25 April flight, Eisenhower's advisors again convinced him to approve a new flight, and he subsequently agreed it could go as late as 1 May 1960.[193]

After Powers' plane was shot down on May 1st, the Paris summit collapsed before it even started. Eisenhower later acceded to Soviet demands and pledged to suspend U-2 flights for the remainder of his term. The Soviets had won a significant propaganda victory and used it to keep Eisenhower on the defensive for the remainder of his presidency. Khrushchev cancelled Eisenhower's invitation to visit the Soviet Union, and arms control negotiations stagnated. The

---

[190] M.-L. Kauhanen et al., "Aphasia, Depression, and Non-Verbal Cognitive Impairment in Ischaemic Stroke," *Cerebrovascular Diseases* 10, no. 6 (2000): 455-461.

[191] M. Astrom, T. Olsson, and K. Asplund, "Different linkage of depression to hypercortisolism early versus late after stroke. A 3-year longitudinal study," *Stroke* 24, no. 1 (1993): 52.

[192] Richard M. Pious, *Why Presidents Fail: White House Decision Making from Eisenhower to Bush* (Rowman & Littlefield: Lanham, MD, 2008), pp. 12, 15.

[193] Pious, *Why Presidents Fail,* pp. 14-15.

U-2 incident and the failure of the Paris summit left Eisenhower feeling even more depressed. In July 1960, he confessed to his science adviser that "he saw nothing worthwhile left for him to do now until the end of his presidency."[194]

Eisenhower's decreased dominance made it difficult to enforce his will on those around him. Had he done so, it appears that the ill-fated U-2 flight would never have occurred. While this does not mean that the Paris Summit would have been a success, it certainly had no chance after the U-2 incident.

[194] Pious, *Why Presidents Fail*, pp. 20-22.

Discussion

That stress affects decision making and leadership is not a new concept. However, where this paper has attempted to break new ground is by looking in a holistic manner at *how* the physiology behind the body's response to stress affects the psychological state of leaders. This work is based on research in the relatively new and expanding field of psychophysiology, and as a result, some of the conclusions reached here may be invalidated by future experiments or unforeseen confounding factors. However, this work can still be successful if it stimulates discussion and improves understanding of stress-brain interactions.

The mind is no longer totally a black box. Research shows that stress causes important changes in the way that people think and interact with others, and if this study can help people, especially leaders, to understand this and perhaps to identify some of these effects in themselves, their counterparts, and potentially in their adversaries, then it will have been useful. Also, while this study attempted to focus as much as possible on national level leaders, a significant portion of the research and analysis can be applied to other leaders who rely on these same traits because the research data does not specifically apply to national leaders.

The expanding understanding of psychophysiology suggests that, in the future, leaders may attempt to use a better understanding of the effects of stress to guide crises. States seeking to evoke an aggressive, action-oriented response might try to increase an opposing leader's stress level. Strategies might also attempt to exploit other psychophysiological propensities, such as the fact that a subset of people are more susceptible to the way messages are phrased, known as the 'framing effect' (see textbox). While the current state of knowledge is insufficient to support tailoring methods to individual situations and leaders, this cannot be excluded in the future.

Genes and Risk-Taking

In a recent study with 30 healthy adult males, researchers found a distinct difference in decision-making styles between carriers of different versions of the gene that encodes for a protein that transports serotonin. Serotonin can affect individuals' anxiety and arousal. This gene has previously been linked to vulnerability to depression and also been associated with the amount of activity in the amygdala, an area of the brain responsible for highly emotional reactions, elicited by conditions in which risk -taking is required. By "framing" a task in terms of gain or loss (e.g. telling someone that they would be losing 90% versus telling them that they would be keeping 10%), researchers found that carriers of one version (the short allele of the gene), are much more likely to be affected by the framing effect. This means that they were more likely to have an emotional reaction to situations where they foresaw a potential loss than "long" carriers and were more likely to choose a riskier option if the choice was framed in terms of potential gain rather than potential loss. See Roiser et al. (2009) "A Genetically Mediated Bias in Decision Making Driven by Failure of Amygdala Control", *Journal of Neuroscience* 29(18):5985-5991

As a result, physiological data may become an even more important intelligence collection target for understanding leaders. No longer would a leader's blood tests only be interesting for gauging their likelihood of heart attack or stroke; cortisol, epinephrine, and norepinephrine levels and genetic profiles might be much more important to analyze for clues about how the leader might respond under stress.

Perhaps even more likely, though, is the possibility that leaders will attempt to intervene in their 'natural' psychophysiological reaction to stress. In the discussion of working memory within the cognitive complexity section and in the creativity section, the effects of the neurotransmitter norepinephrine were highlighted by the ability of the drug propranolol to reverse the effects of stress without interfering with functions in unstressed individuals. Propranolol blocks a subset of the receptors for norepinephrine in the brain and for epinephrine and norepinephrine in the body. The FDA approved propranolol in 1967 for the treatment of high blood pressure, but this has not prevented others, such as musicians, from identifying that it counteracted some of the effects of psychosocial stress (see adjacent text box), despite a lack of FDA approval for this therapy. This suggests that there may be early adopters for drugs that have been or are shown in the future to counteract other deficits caused by stress.

Early Adopters of Anti-Stress Drugs

Performance artists have used propranolol to counteract the effects of stage fright – shortness of breath, fast heart beat, dry mouth, and loss of clear-headedness – since soon after its introduction. It is a relatively attractive drug due to low frequency of side effects. Prior to its introduction, musicians relied on alcohol or sedatives, which had undesirable side-effects such as drowsiness. Propranolol is also very inexpensive. Today, one dose costs less than eight cents.

Its usage has apparently been especially high in musicians who play wood-wind instruments, perhaps because dry mouth can be especially problematic for them. In a study of its effects during a mock-audition, judges from the Royal London College of Music assessed the performances of 24 musicians and found that they improved up to 73 percent.[195]

196

As research progresses and pathways for the effects of stress are more clearly elucidated, leaders are likely to be presented with a number of new options for mitigating the effects of stress in the form of other drugs, techniques, machines (such as those that interface with the brain), as well as genetic-changes to improve their performance. A number of candidates are already being studied. One is tamoxifen, a cancer-fighting drug that may affect similar pathways to propranolol but acts through a much more specific mechanism to restore PFC activity that is

[195] Blair Tindall, "Mixed reviews for a stage-fright remedy," *The New York Times*, October 21, 2004, http://www.nytimes.com/2004/10/20/arts/20iht-jitters.html?_r=2.

[196] Image from: http://myhealth.ucsd.edu/library/healthguide/en-us/drugguide/topic.asp?hwid=d00032a1

damaged under stress.[197] It is currently being studied in schizophrenics, who have major PFC dysfunction, and if it is successful, it might be adopted by others. Selective serotonin reuptake inhibitors (SSRIs), used to treat depression, are already some of the most prescribed drugs in the world, and leaders suffering from the effects of chronic stress might be aided by this class of drugs. Oxytocin, discussed earlier for its stress-reducing effects, could also be used to prevent or ameliorate the stress response, although it would have the side-effect of increasing trust.[198] This is certainly something that each side in a crisis might want the other side's leader to experience, but perhaps not for their own leader. And finally, emerging nutraceuticals may also help to mitigate the effects of stress. Fish oil, high in omega-3 fatty acids, has anti-inflammatory properties, which could counteract some of the effects of long-term stress on energy and drive, and citicoline, also referred to as CDP-choline, may increase dopamine function in the brain, potentially ameliorating some of the motivation-sapping effects of chronic stress.[199,200] Thus, there will likely be a number of modalities that leaders will be able to choose from in order to mitigate their stress levels or the effects of stress. This suggests that "knowing what drugs the other guys are on" will continue to be a crucial intelligence question.

The 'spider pill' has already been tested in pigs and may soon be ready for human testing. It is ½" in diameter by 1" long; continual improvements in miniaturization suggest that robots with similar or better functionality will continue to shrink in the future.[202]

Other advances may also facilitate the attempts by humans to control key aspects of their nature. Implantable biosensors that allow for the microenvironment in different parts of the body and brain to be continuously monitored will allow for the

[197] C. A Zarate and H. K Manji, "Protein Kinase C Inhibitors: Rationale for Use and Potential in the Treatment of Bipolar Disorder." *CNS drugs* 23, no. 7 (2009): 569.

[198] Michael Kosfeld et al., "Oxytocin increases trust in humans," *Nature* 435, no. 7042 (June 2, 2005): 673-676.

[199] P F Renshaw et al., "Short-term treatment with citicoline (CDP-choline) attenuates some measures of craving in cocaine-dependent subjects: a preliminary report," *Psychopharmacology* 142, no. 2 (February 1999): 132-138.

[200] Timothy Trebble et al., "Inhibition of Tumour Necrosis Factor-a and Interleukin 6 Production by Mononuclear Cells Following Dietary Fish-Oil Supplementation in Healthy Men and Response to Antioxidant Co-Supplementation," *British Journal of Nutrition* 90, no. 02 (2003): 405-412.

[201] Picture from: www.bbc.com

[202] Claudio Quaglia et al., "An endoscopic capsule robot: a meso-scale engineering case study," *Journal of Micromechanics and Microengineering* 19, no. 10 (2009): 105007.

development of more targeted and personal interventions, and more precise drug targets will make people more likely to choose drugs because side effects will be limited. People can already choose to swallow a pill with a camera inside in place of a more traditional colonoscopy. Future generations of such technology will only gain in capabilities. A 'spider pill' being developed by Italian scientists promises to allow doctors to perform less-invasive colonoscopies with more control over what parts of the intestines are viewed, as the robot can maneuver itself while inside the body.[203] If similar technologies are sufficiently miniaturized, they could be used to monitor a person's body from the inside on a long-term basis, with or without that person's knowledge.

Ecologically-Valid Studies

Some studies of leaders have been undertaken that provide a template for more ecologically valid studies of the psychophysiological effects of stress on leaders. Zaccaro et. al. conducted a study of leader problem-solving in military officers that showed a link between complexity of thought and rank achieved, suggesting that this is a crucial skill for leaders. They recruited 1,807 Army officers, including 597 second lieutenants, 228 first lieutenants, 529 captains, 216 majors, 183 lieutenant colonels, and 37 colonels from various Army schools and courses, including Officer Basic Courses, Officer Advanced Courses, the Command and Control Course, The Command and General Staff College, the Army War College and from Forces Command, Training Command, and the Military District of Washington. Similar studies incorporating psychophysiological variables would be highly beneficial to the discussion of the psychophysiological effects of stress on military leaders and would probably have greater ecological validity for national leaders than studies of college students. See: Mary Shane Connelly et al., "Exploring the relationship of leadership skills and knowledge to leader performance," The Leadership Quarterly 11, no. 1 (Spring 2000): 65-86

The Path Forward

While the future effects of expanding knowledge in the fields of psychophysiology, neurology, genomics, pharmacology, and others may be great, the current understanding of the psychophysiological effects of stress on leaders is preliminary at best, and more research of the following types is needed to provide a deeper and more valid discussion:

Data on the psychophysiological effects of stress on different traits. The analysis in this paper on the relationships between physiological changes and leader traits is still somewhat speculative, as more research is needed in all of the areas discussed. In particular, the effects of chronic stress require significantly more study, although ethical and financial considerations make this relatively difficult. The effects of acute stress on social cognition also require more attention due to the crucial nature of human interaction in almost all fields, especially leadership.

More ecologically valid data for leaders. For research to be truly applicable, it should be performed on the population trying to be understood and in appropriate contexts. A heart

[203] Ibid.

disease drug that works may show no effects on a sample of 20-30 year olds because they are highly unlikely to suffer heart attack until much later in their lives, irrespective of their risk factors. While national level leaders cannot be expected to participate in studies on psychophysiology, wherever possible, better surrogates should be used that experience similar types and levels of stress and who have risen through the ranks under similar selective pressure as current leaders. This topic of research will benefit, where possible, from the study of healthy people in the place of animals or those with clinical conditions, and if other populations of leaders are accessible, studies should be pursued utilizing them. Examples might include groups of upper level managers at corporations or high-ranking officers in military training schools. In addition, experimental protocols that more closely resemble real-world leader tasks can provide a higher fidelity understanding of the nuanced effects of stress.

Oxytocin and Trust

In the 'Trust Game,' players may choose to give some or all of their money to a trustee. If they choose to give money to the trustee, the trustee receives triple that value of money and then can choose to return some or all of it to the player. This means that with a maximum level of trust, both players can gain the most, with the player giving all of his money to the trustee and the trustee returning a greater value than the amount given by the player. Because of the risk involved, most people do not share the maximum amount. However, when people are given a nasal spray containing oxytocin, the amount who show the maximum trust levels more than doubles when compared to controls. People under the influence of oxytocin appear to be more willing to accept social risk and cooperate. See: Michael Kosfeld et al., "Oxytocin increases trust in humans," Nature 435, no. 7042 (June 2, 2005): 673-676

The push for more ecologically valid studies should not imply that all others are useless; they build the foundation for understanding and can help to design future studies, but the most accurate understanding will come from samples closest to the population trying to be understood (see text box, previous page).

A better understanding of individual variation with regard to the psychophysiology of stress. This study only broached the issue of individual variability of stress response, physiology, and psychology, but further research into how these factors affect the variables discussed herein will be crucial for individualizing this research and potentially being able to forecast effects. A better understanding of where someone lies on the U-shaped stress-performance curve will give insight into whether stress will increase or decrease their susceptibility to such tradeoffs as sensitivity to rewards or punishments, as can be seen in the earlier discussion of objectivity.

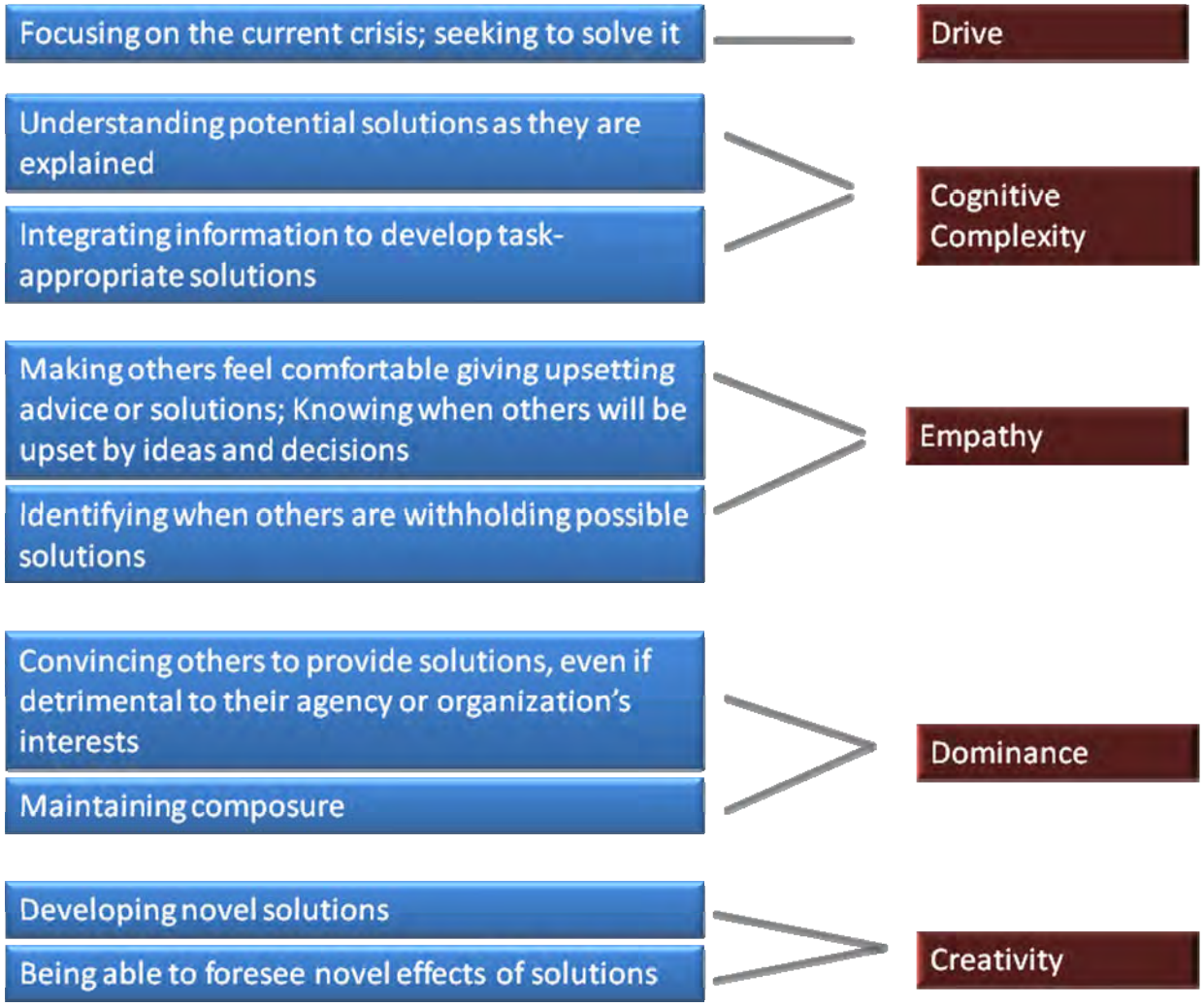
Further research on how a stressed leader affects the groups in which they work and how the group setting affects stress levels. Preliminary findings suggest that the extent to which one person's state of mind affects others' states of mind is larger and more complex than previously understood. For example, social support can dampen the stress response through release of

the hormone oxytocin, which is the same compound responsible for mother-child bonding and has been shown in studies to increase trust between people (see textbox, previous page).

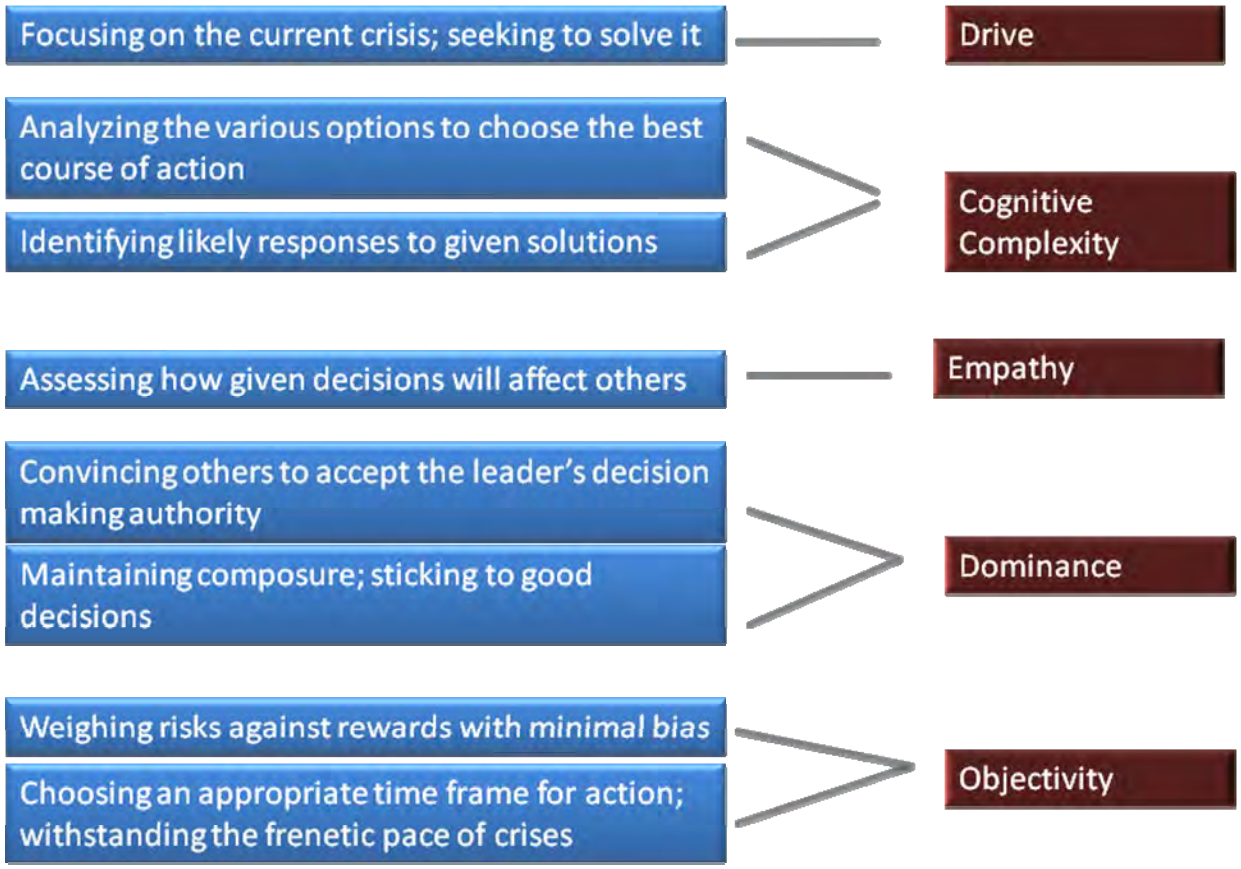
With additional research in the areas discussed above, future work can build on the discussion herein and has the potential to provide a more detailed and conclusive picture of the psychophysiological effects of stress on leaders. How this data is utilized, however, will partly be based on broader strategic, political, and ethical decisions about further steps into altering human performance. An era of precise and effective human performance modification is upon us in some areas and may soon be in others, but it is unclear the extent to which our society is prepared to face and utilize the tools that are and may become available. The authors of this study hope that this report and others like it can help to expand the discussion of the costs and benefits of pursuing performance modification strategies so that we can best leverage the opportunities deemed acceptable and mitigate the risks, both those emanating from within and those posed by other states which might be significantly less reticent about performance modification.

Appendix – Task-Trait Relationships

Developing solution sets, including identification of costs and benefits



Weighing options and deciding



Implementing the chosen solution