The Study of International Politics in the Neurobiological Revolution: A Review of Leadership and Political Violence

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Abstract
Neurobiological advances appear critical for explicating individual differences in attitudes, values, behaviors, cognition and evaluation, but only recently has the neurobiological tool kit been applied to questions of interest in international relations. In this review, we first provide an overview of historical approaches from two domains of enduring interest to the field: leadership and political violence. We then explicate the ways that the neurobiological revolution has so far furthered our understanding of these domains.

Keywords
international relations, leadership, neurobiology, political violence

Neurobiological advances have emerged as critical for explicating individual differences in attitudes, values, behaviors, cognition and evaluation, but only recently has the neurobiological tool kit been applied to questions of interest in international relations (IR). Following Hudson’s commentary that ‘a renewed emphasis on actor-specific theory will allow IR to more fully reclaim its ability to manifest human agency, with its attendant...
change, creativity, accountability, and meaning’,¹ we explain why scholars who focus on security studies or inter-state relationships should pay heed to the neurobiological revolution. We note that although this area of research remains in its infancy, significant advances have been made which warrant both current attention and future consideration.

The term ‘neurobiology’ can have many different meanings in academic discourse. For example, it is often described as the branch of biology that encompasses the anatomy, physiology and pathology of the nervous system. However, we find few terms that equally capture all the other facets of brains, biology and behavior that we are interested in examining in connection with international relations. In this review, we refer to neurobiology as incorporating all those biological factors in the genes–brains–behavior pathway; these include genetic and epigenetic processes, endocrinology, brain neurochemistry and physiology. We review recent work that considers the dynamic interactions between these domains that begin before birth, including the in-utero hormonal exchanges and all those genetic and environmental forces that contribute to the creation, maintenance and extinction of the downstream behaviors we wish to investigate. This constitutes a vast series of mechanisms, and scholars are only beginning to explore the importance of incorporating biological elements into understanding international behavior and outcomes of interest.

Traditionally, IR has ignored the causal role and influence of individual actors, assuming that such leaders remain primarily constrained by the overarching political structures within which they operate.² Thus, the existing literature in IR lies replete with models that ignore the variance in individual’s personal attributes. These theories provide little help in seeking to understand the actions or motivation of many aspects of foreign policy. This perspective remains especially problematic when important discretionary decisions clearly reside within the domain of individual preferences and action.

Even those studies which do examine political leaders tend to focus on personality and social factors which, while important, neglect additional potentially critical factors contributing to variance in individual choices. We suggest that a neurobiological approach can offer a novel set of hypotheses for investigation, highlighting the critical role of human biology in influencing judgement and decision making. This perspective can provide added value to existing models by offering a method of investigation that can help identify psychological mechanisms which are crucial for understanding the basic processes undergirding human choice. A neurobiological approach can thus provide an additional empirical basis upon which to understand, explain and predict individual differences. We do not claim that such factors replace or overwhelm other factors previously identified by IR theorists as important in explicating the foundations of international behavior; rather, we offer these considerations as useful supplements to those existing approaches.

As with previous work in IR which sought to investigate lower levels of analysis through an examination of the role of the individual in shaping international outcomes,


This new wave of research delves one level lower to further explore basic biological factors which help guide individual behavior, and help shape variance between leaders. Over the last 10 years, there has been increasing interest in integrating neurobiological mechanisms into the study of political preferences and behaviors within the larger political science literature. In most respects, this line of research remains in its infancy. However, this research programme has progressed to the point where it is has yielded numerous findings on topics inextricably linked to enduring problems in political science such as anxiety, fear, aggression, ethnocentrism, disease avoidance, personality, religiosity and cognition. More recently, neurobiological approaches been applied to topics of interest in international relations (IR). Nevertheless, these approaches and findings have remained largely unaddressed within mainstream debates in the field. However, the field of study has reached a point where a review of the literature is beneficial both to highlight what has been done and to communicate these findings to the larger IR community.

Therefore, in this review, we first explicate our definition of the neurobiological approach. We then address some of the ways that the neurobiological revolution has begun, and most likely will continue, to inform our understanding of international
politics by focusing on two domains of enduring interest to the field: leadership and political violence. We choose these topics not only because of their obvious relevance to IR’s central concerns, but also because they present examples of rare events and occurrences whose function and prediction can be enlightened by methods drawn from neurobiology in general, and behavior genetics in particular, to identify causal forces within the context of rare events in the domain of illness and disease. We thus provide two examples drawn from completely distinct areas in order to illustrate how the work on neurobiology can help illuminate the nature of individual differences.

We review the historical approaches to these areas and their central findings, followed by a discussion of more recent explorations of these topics using neurobiological methods. We conclude by outlining the implications of these findings for international relations theory and practice and our suggestions for future work along this line of inquiry.

The Neurobiological Approach

As noted above, the neurobiological approach entails a multistage and interactive model that addresses genes, neurochemical processes, cognition and physiological mechanisms interacting with environmental forces at all stages of human development within the life cycle. In this view, behavior resides within a particular context, and remains environmentally dependent. But this approach also realises that individuals constitute their own agents of change, complete with their own experiences, dispositions, abilities, psychopathologies and neurological designs. This approach does not exist in opposition to extant models in foreign policy analysis or attempt to replace existing anecdotal and environmental models, but rather provides an empirical foundation for individual differences, and modifies theories of decision making. For example, by examining some of the endogenous factors that may influence susceptibility to the environmental triggers which help shape an individual’s perception of risks and benefits, we can gain insight into some of the reasons people respond to similar events in divergent ways. Indeed, individual perceptions, as well as interpretations, of the same event often vary enormously. And such perceptions affect subsequent behavior, including among leaders. Some leaders govern through fear and coercion, while others marshal the widespread support of their constituency through inspiration.

We recognise that the change from explanations which focus on environment only models to those which highlight the importance of the neurobiological–environment interaction has the potential to inspire nature vs. nurture debates, especially among those who remain unaware of what genes do, or how hormones act, or who simply oppose the use of science. Indeed, despite careful attempts to clarify that genes or environments do not work in isolation,5 a common misperception surrounds the notion that there is a ‘gene’ for a given behavior or proclivity, such as ‘liberalism’, or that a hormone (like testosterone) ‘causes’ a complex behavior (like aggression); these inferences are then juxtaposed against environmental approaches that argue that parents ‘socialise’ their

children or people are ‘rational’. Such juxtapositions provide no value, and only serve to antagonise scholars whose focus and approach have historically relied on one or the other methodology. In this review, we join the mainstream of scholars who recognise and appreciate the need to explore biology and environment together to properly elucidate human behavior. There is no ‘silver bullet’ to explain why one person or population is different from another.

Neurobiological approaches to the study of individual differences in behavior vary greatly. Detailing every approach and the mechanism is not possible in one manuscript. However, one approach, psychiatric genetics, which fits under the larger neurobiological umbrella, provides an ideal example of how to begin this kind of application to the study of international relations. It has required more than half a century of trial and error to identify and evaluate the most fruitful research strategies to model successfully extreme human behaviors in complex and dynamic environments. Over the last 40 years, the purely ‘social’ paradigm which modeled the origins of extreme behavior has been replaced by a paradigm which includes ‘genetic’ influence. Research in this area has been directed towards identifying, quantifying and characterising the individual genes and environmental factors involved in susceptibility to various outcomes.

Gene–environment models have already been extended to the study of individual elite behavior and appear profitable in helping to illuminate central processes in IR, such as identifying factors which precipitate acts of political violence. In many ways, leadership and violent acts are both uncommon, and thus represent the more extreme tails of their relative distributions; employing techniques which have been used to predict precursors to similarly rare events can help leverage our understanding of the way biology and environment interact to create unique outcomes. The path from genes to behavior is long, complex and unfolds in various ways during development. While no clear consensus exists about which genetic factors remain influential in specific social, political or behavioral outcomes, the process of discovery proceeds along a set of assumptions about the nature of genetic liability within the context of specific environmental triggers. Locating the genetic influence, as well as the particular social cues, constitutes part of the ongoing goal of research in this area.

As noted, endogenous sources interact with environmental stimuli in a developing human. Initial applications to models of behavior focus on the two extremes, with genes on the one end and behavior on the other. Exploration of a specific trait may begin with

6. The earliest scientific attempts to understand the role of biology in human behavior took place more than a century ago with Francis Galton’s 1869 study of Hereditary Genius and Karl Pearson’s 1904 inquiry into the Inheritance of Mental and Moral Characteristics in Man. At that point, the burning question was ‘how important are genetic factors in behavioral differences?’ With this goal still in mind, the 1960s and 1970s were characterised by many studies of large numbers of measures taken from relatively small samples of twins and extended familial relations. The 1980s and 1990s saw the explosion of very large studies, using population-based samples to gain much-needed statistical power, but, more importantly, methodological and theoretical sophistication reached a stage which allowed the application of genetic models to complex social and psychological traits.

twin models, or with more complex multiple generation familial models, controlling for environmental moderators, interactions, mate assortment and other stimuli. More involved epidemiological samples which collect DNA, blood samples, neuroimaging, etc. can also be employed to identify specific genetic markers or hormones which operate within larger neurological processes. This is particularly important when assessing adult behavior and controlling for stimuli introduced during development. For example, in a recent meta-analysis of the relationship between anti-social personality and behavior, Ferguson found that a significant amount of the variance, 56 per cent, was due to genetic influences.8 This analysis is meaningful because it examines not only anti-social traits such as psychopathy but also anti-social behavior itself, including violence and aggression. This does not mean that unique and family factors do not contribute to the origins of such behavior, but rather illustrates that it may prove impossible to fully explain such behavior without taking genetic factors into account.

Gene expression is not static, however, and depends on the environment and behavior of the individual.9 Genetically healthy people can still suffer dire consequences as a result of environmental stresses and deprivations. Consider, for example, the studies with orphans taken from Romania in the 1980s. Children in many orphanages, abandoned due to the severe economic crisis after the collapse of communism, were left alone for up to 23 hours a day, receiving almost no stimulation or human interaction. As a result, they showed severe developmental impairments in many areas of brain function, including language, learning and attachment.10 These factors can place individuals at higher risk for many forms of social conflict because of their decreased capacity for empathy, among other things. Given that similar processes of social and material deprivation plague children throughout many areas of the world where famine and war are endemic, such as much of eastern Africa, these findings help elucidate the dire consequences for any prospects for peace or stability in the region. If foreign aid can help ameliorate some of these deprivations, targeted towards emotional support for children and not just food supplies, the long-term benefits for American national security might indeed improve.11

Measuring Variation

At the level of underlying aetiology, a large number of individual factors, both endogenous and experiential, may be required before someone crosses the threshold to enter into particular vulnerability or risk for certain behavior. For descriptive and diagnostic purposes, patients in medical studies are often assigned to discrete classes, for example either ‘depressed’ or ‘not depressed’, ‘hypertensive’ or ‘normotensive’. Such categories are frequently arbitrary, chosen either for convenience or because they reflect decisions about the relative costs and benefits of intervention, rather than describing the underlying aetiological mechanisms. Decisions about ‘where to draw the line’ change as researchers obtain better information about the long-term consequences of particular trait levels.

Many other measurement techniques follow a similar pattern. For example, fMRI studies show places where the brain appears to ‘light up’. Yet few people fully appreciate that those areas are a function of statistical choices; if significance levels on given studies were changed from .05 to .07, differences in brain function might change as much as hemispherically. In addition, knowing where something takes place in the brain, which is what MRIs can tell observers, does not explain why particular stimuli are processed in such a way, or inform scholars as to the dynamic psychological processes which drive such interpretation.12

Susceptibility to behavior such as political violence can be conceived in similar threshold terms. Individuals may differ in their background risk factors, their threshold for provocation, their propensity for revenge and vengeance, or their attraction to violence. The greater a person’s liability, the more likely they are to engage in violent behavior. However, the simple ‘all or nothing’ model does not provide an ideal measure of risk. For example, psychiatric disorders often show such wide variation in severity, age of onset, number of symptoms, levels of stress or family history that underlying susceptibility is likely better conceived as continuously graded, even though, for the purposes of diagnosis and treatment, a ‘yes/no’ decision has to be made about when intervention is indicated.13

An example from the literature in psychiatric genetics nicely illustrates our approach. In spite of environmental adversity, most men and women do not become depressed or act out violently. Only a minority of the population responds to adversity by adopting maladaptive or anti-social behavior such as suicide or violence directed at others. The same could be said of violent political actors. Importantly, genetic and neurobiological influences are pleiotropic14 and influence multiple processes that may produce...
conflicting inclinations in the context of certain modern social behaviors. Any predictive model has to cope with the fact that complex behaviors, such as leadership or terrorism, can only be understood as the culmination of a long network of biological and social influences whose effects are interwoven and time-dependent.

While these models do take into account one’s disposition, neurobiological paradigms do not assume everything is genetic or hormonal or neurological. Rather, researchers working within this paradigm acknowledge that the individual is a responsible agent for his/her behavior. Yet this approach also remains cognisant of the reality that ignoring a priori critical sources of individual differences, including neuro-genetic dispositions, may have grave consequences for our ability to accurately model variance in individual behavior once certain processes are triggered. If, for example, leadership or political violence bears any similarity to other kinds of extreme behavior, including violence, anti-social behavior, aggression or deviance, understanding the role of genetic differences in explaining this variation may be critical for understanding why one individual becomes a suicide bomber in the face of foreign occupation while another does not.

The concept that people’s behaviors and beliefs are partly shaped by genetic and other biological factors is widely accepted in the study of most human behaviors and diseases. Given that genetic factors appear to influence other kinds of apparently related extreme behaviors, as noted above, we would expect that models which exclude these forces in favour of solely environmental determinants would not provide as comprehensive an explanation for the aetiology of phenomena of interest to IR scholars as might

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15. One example of antagonistic pleiotropic effects in humans is the genes which lead to testosterone regulation. Testosterone has very positive effects in young adulthood, potentiating reproductive ability and increased capacity to build lean muscle mass. However, in older adults, high levels of testosterone increase the risk of prostate cancer, while rates which are too low can lead to depression in some men. Kyle Summers and Bernard Crespi, ‘The Androgen Receptor and Prostate Cancer: A Role for Sexual Selection and Sexual Conflict?’, Medical Hypotheses 70, no. 2 (2008): 435–43.


be possible by including them. Despite the centrality of politics to the modern human condition, genetic analyses and neuroscientific studies have been mostly absent from mainstream IR discussions of political leadership and violence. As a result, existing accounts of the sources of individual differences in political behavior which neglect such factors may remain theoretically incomplete and empirically deficient.

**Political Leadership**

Individual differences can exert a decisive influence on the qualities which define political leadership and distinguish good leaders from bad ones, and those who appear comfortable in the role (Kennedy) from those who do not (Nixon). Thousands of studies have been conducted to explore the sources of leadership qualities, skills and development. Situational and contextual factors both inform leadership behavior. However, over the last several decades there has been a renewed interest in dispositional predictors of leadership, including personality and cognitive style. This line of research has recently been extended to include neurobiological and genetic influences on leadership ability and style. In the following sections, we first outline some of the difficulties with exploring leaders from a historical approach. We then review recent advances in evolutionary, genetic and neurobiological models which have been applied to the study of leadership.

Leaders can prove very difficult to study not only because of their idiosyncrasy in time and place but also because many leaders do not want to risk having personal and private information revealed. They fear that such information may come back to haunt them if it appears in the hands of someone they do not know and trust. They have little incentive to participate in the study of their own experience. In addition, leaders tend to be very busy people who may not have the time or interest to participate in academic enterprises. As a result, it has been very challenging to investigate real world political leaders, although some experimental studies have been conducted on the influence of leadership on followers, and other studies have examined lower level leaders, including military leaders. But these logistical concerns have limited the number of studies that have been possible with real world leaders. However, by providing an enticing incentive, such as feedback on performance relative to other leaders, in combination with adequate assurances of confidentiality, some leaders might be induced into participating in certain kinds of studies by enterprising and persistent scholars.

A host of ethical challenges in the study of leadership exist as well. For example, imagine that a scholar conducting a functional brain imaging test of a leader were to discover a serious brain lesion. Ethical constraints might allow such a scholar to tell the

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leader but not to disclose this information beyond that, and yet if the leader’s activities might compromise the lives of others, such a prohibition would pose a serious ethical dilemma. Such an extreme example may seem unlikely, but lesser degrees of the same dynamic might occur if observers found clear evidence of some kind of personality disorder or cognitive impairment in a standard task or survey which was administered as part of any given study.

Most studies of political leadership have tended to use historical case study analyses, which often involve archival or interview work or other forms of analysis of leaders from a distance. Lasswell was one of the first scholars to systematically explore the relationship between personality and politics; drawing a psychodynamic paradigm, he argued that leaders project their personal struggles onto the larger political world in which they operate. Other scholars such as the Georges, also invoking a psychoanalytic approach, wrote incisive and influential psychobiographies of particular political leaders such as Woodrow Wilson.

One of the most impressive examples of survey work with real world leaders involved an examination of State Department officials undertaken by Etheredge. In his study, Etheredge administered personality batteries to 36 State Department officials and then correlated their responses with their tendency to use force in 49 crises in American foreign policy between 1898 and 1968. He found that he was able to predict their responses to the crises with greater than 75 per cent accuracy based on the answers they supplied in the personality inventories. Most tellingly, he reported that those who advocated the greatest use of military force in response to foreign policy challenges were those most likely to show high dominance displays towards their underlings at work, revealing a systematic pattern of belligerent response styles across personal and professional domains.

Perhaps the best known model of the relationship between personality and presidential leadership was the one put forth by James David Barber in *The Presidential Character*. Arguing that a president’s personality shapes his behavior, Barber examined leaders’ character, world-view and style in order to categorise American presidents into two dimensions: energy (passive/active) and affect (positive/negative). By classifying leaders into one of the four categories which emerge from the intersection of these categories, Barber argued that it was possible to explain and predict presidential performance.

Greenstein put forth a model of leadership and personality that remains in many ways consistent with the neurobiological model we put forward here. In particular, he argued

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that leaders can have an impact on their environment to the extent that the environment can be restructured in the light of a leader’s particular strengths and weaknesses. Significantly, he also writes that certain situations are more likely to provide a match with particular leaders’ personalities. Because, he suggests, leaders’ responses are based, at least in part, on these personality factors, certain types of responses to certain situations are more likely in some leaders than in others based on these dispositional factors. Intriguingly he notes that certain kinds of responses allow greater freedom of action to particular personality styles over others; for example, individuals comfortable with anger may have a wider repertoire of actions and responses available than those who are more fearful.

One of the most influential experimental studies of political leadership, and the influence of leadership style on outcomes of interest, was also one of the first. Kurt Lewin and his colleagues, motivated to understand how Hitler could have exerted such decisive control over the German population, sought to investigate the influence of leadership style on group dynamics and levels of aggression.27 They randomly assigned groups of boys to one of three conditions, which varied in their style of leadership. The leader of each group was a confederate of the experimenters. In one group, the leader was an autocrat. He made all the decisions himself, assigned individuals to tasks, and did not participate in the any of the group’s work. The second leader took a democratic approach, having boys participate in group decision making and planning. Participants decided for themselves who would take on what job and the leader participated in the work of the group. The third leader was a laissez-faire leader, who let everyone in the group do pretty much what he wanted to do with little oversight or surveillance.

Lewin’s results proved provocative and fascinating. In the autocratic group, the boys worked hardest, but only when they were under the surveillance of the leader. In the democratic group, the boys emerged as the most efficient overall, mostly because they tended to work regardless of whether the leader was observing them or not. In addition, these boys produced the most original and creative work. The laissez-faire group was characterised by laziness, not surprisingly, and the boys in this group essentially got nothing done.

The most intriguing aspect of the study, however, related to the primary dependent variable of aggression. The boys in the authoritarian group proved to be 30 times more aggressive than the boys in either of the other groups. In particular, members of this group were much more likely to scapegoat others, expressing their anger and frustration against weaker members. In addition, they were also more likely to destroy their own property. By contrast, boys in the democratic group showed more friendliness and loyalty towards other members of the group, and offered much more praise to one another, than members of either of the other groups.

A later experiment which similarly manipulated the effect of leadership training on followers’ performance in a real world sample administered either transformative or eclectic leadership training to a group of 54 military leaders, 90 of their direct followers

and 724 indirect followers. In a longitudinal field experiment design, these authors found that transformative leadership training exerted a more positive effect on followers’ performance. A later study using military leaders as subjects examined the officers’ responses to a counterterrorism scenario. Interestingly, in this study, Mintz and colleagues found that their student sample displayed responses that were dramatically different from those of the military sample. While a third of students advocated doing nothing, more than 90 per cent of military leaders preferred to take action in the face of threat. Military leaders also appeared more prone to satisficing than students. This discrepancy suggests that using student samples to imply leader responses may not provide a very accurate indicator of leaders’ preferences, encouraging caution in extrapolating or generalising from student samples to leader ones. Thus, the ability to generalise from accessible populations to leader behavior may not be as straightforward as scholars might hope, indicating that accurate samples would need to rely on leaders themselves, and not proxies drawn from populations who may differ in their disposition, background or experience in critical ways from other populations.

Note that these experiments investigate the influence of leadership on followers and do not actually interrogate or manipulate leaders themselves, or seek to understand the nature of leadership independent of followership. In fact, many studies of leadership actually constitute studies of the nature of followership. In many cases, these studies involve public perceptions of political leaders. Some of the most interesting work in this area involved the examination of public support for leaders based on their facial expression. Subjects viewed videotapes of leaders displaying either neutral or happy expressions; participants’ attitudes were more influenced by leaders’ facial expression, even without sound, than by such standard predictors as party identification or issue position. Subsequent work comparing viewer reaction to facial expressions in the United States and France showed some cultural differences, with the French responding more positively to angry expressions than Americans. Nonetheless, such work gets at some of the subtle physical and psychological factors which may influence the relative success of leaders in garnering public support for themselves and their policies.

One of the most evocative methods exploring public perception of political actors involves Q-sort techniques, whereby observers report their impressions about various traits and characteristics of particular leaders. Participants are typically presented with a list of descriptive adjectives and then asked to rank them according to some scale, for example from most to least characteristic, for a particular leader. These words might include traits such as ‘friendly’ or ‘strong’. The responses of many individuals are then

aggregated. Many of these kinds of studies of public opinion and mass political behavior, including experiments regarding voting behavior, are designed to examine public perceptions of political leaders in a more systematic light. However, such studies really focus on perceptions of leadership rather than undertake a systematic examination of the nature of leadership itself.

**Evolutionary and Neurobiological Models of Political Leadership**

So far the above approaches have focused almost entirely on psychoanalytic theory, anecdotal observations or environmental conditions to explicate leadership. An alternative line of reasoning which has focused on evolutionary and neurobiological perspectives has served to enlighten aspects of leadership which remain hidden from the perspective of traditional models in IR, thus increasing the ability of scholars to uncover the mechanisms which underlie preference structures, decisions, cognitions and emotions in leaders.

One of the most important and innovative scholars in this area, Mark Van Vugt examined the psychological literature to see whether particular characteristics predicted leadership. He found that, contrary to popular expectation, leadership was not correlated with dominance. In fact, in other work, leaders playing economic games earn less money than followers, suggesting that while the function of leadership may be beneficial for the group, it can be costly for the person in the leadership role. Further evidence suggests that social as opposed to selfish participants appear more willing to serve in leadership roles. In fact, leadership does appear to be related to certain individual characteristics such as initiative taking and social intelligence, as well as specific expertise in the domains of action, generosity, fairness and trustworthiness. In addressing the question of whether leaders are born or made, some evidence suggests that leaders emerge in the face of substantial threats or opportunities, since leaders are typically the people who move first in such situations. Such leadership provides the benefits of coordinated action which prove most helpful in times of stress or threat. Further, Van Vugt suggests that the reliable age, health and sex characteristics of leaders can be predicted with evolutionary models as well.

In other work using real world leader samples, Carnevale and colleagues find that leaders who scored higher on the need for cognition, meaning they seek out and enjoy cognitive effort, performed better on two of four tasks related to decision-making competence, specifically framing and honoring sunk costs. Interestingly, these leaders also

outperformed controls, suggesting that leadership, if only in this example, actually does reflect some aspect of increased skill or ability, at least in some domains.

To further examine the novel hypotheses an evolutionary perspective can bring to leadership studies, Van Vugt has conducted a number of experiments exploring the nature of leadership from an evolutionary perspective. Mark Van Vugt and colleagues have been particularly interested in the ability of leadership to help overcome social dilemmas such as collective action problems. Van Vugt et al. argue that leadership and followership evolved in the ancestral environment to help overcome the repeated challenges associated with social coordination problems, including the need for collective action.36 These repeated problems included the need for group movement, intragroup cohesion and successful intergroup competition. They note the inherent tension between the need for effective coordinated action, as potentiated by leadership, and the possibility that such action allows for the exploitation of followers, introducing the enduring ambivalence between leaders and followers. These studies point to the importance of coalitional behavior, and the signals that leaders send regarding group identity to their followers as well as opponents. In many cases, the motivation for assuring strong in-group identification relates to the repeated challenge of labour recruitment, particularly in the face of combat or the need to defend territory from incursion.

Van Vugt and colleagues have proposed that leadership can serve at least two functions: instrumental and relational. They posit that the relative importance of these functions can vary with the salience of group membership to any given potential follower. This model suggests that the effectiveness of leaders depends, in part, on the fit between leaders’ skills and abilities and followers’ needs and expectations. They have undertaken a great deal of experimental work to illuminate various aspects of this model. Their experimental work has largely confirmed their theoretical speculations, showing that when social identity is salient, committed leaders who show fairness towards group members prove more effective at raising the level of individual contributions to the group. However, when personal identity is salient, leaders with intrinsic skills proved more influential.37

Additional work drew upon the iconic paradigm described above, showing that members are more likely to leave groups with autocratic as opposed to democratic or laissez-faire leadership styles. Importantly, Van Vugt and colleagues found that such effects held regardless of the personal resources members derived from leaders, indicating that their objections to an autocratic leadership style resulted from procedural rather than distributive reasons.38 This finding runs contrary to arguments made by Bueno de Mesquita and

others who explicitly focus on how leaders stay in power through their ability to differentially distribute resources to their winning coalition members.\textsuperscript{39} By contrast, in the Van Vugt studies, individuals preferred democratic leaders who had a legitimate power base. This preference appeared much stronger when group identity remained high, in which case either instrumental or relational leaders proved equally efficient at garnering contributions from followers. However, when group identity was low, instrumental leaders were more effective at obtaining such benefits from members, possibly explaining those conditions under which the Bueno de Mesquita model holds true.\textsuperscript{40}

Perhaps most provocatively, Van Vugt and Spisak invoked evolutionary hypotheses to illuminate sex differences in leadership dynamics and, in so doing, helped enlighten some recurring questions in the literature about when and why followers will or will not follow female leaders.\textsuperscript{41} In their experimental work, they found that followers show a preference for female leaders when problems emerge related to competition within a group, but this preference switches to support for males when conflict between groups becomes salient. This is because participants believed that women were better at keeping a group together, while men were perceived as more likely to win intergroup competitions. Further, Spisak et al. show that different group coordination problems may expect and elicit different leadership preferences across sex.\textsuperscript{42} For example, followers expect masculine faces to behave competitively in intergroup conflicts and feminine faces to behave cooperatively in intragroup contexts. In addition, individuals prefer the face that best matches the adaptive challenges, desiring the masculine face in intergroup competition, for example. Thus, biological factors, such as human facial expression, may provide reliable and dependable signals regarding the emergence and appropriateness of particular leaders under specific kinds of group threat. Interestingly, both males and females participate more in a group headed by someone of their own sex. These results qualify the male warrior hypothesis, which suggests that men sacrifice more for the group than women; this appears to be the case only if their leader is also male.\textsuperscript{43}

Many of these leadership processes, including those that undergird the sex differences reported, appear potentiated by precisely the biological factors and precipitants we

\begin{itemize}
  \item \textsuperscript{39} Bruce Bueno de Mesquita et al., \textit{The Logic of Political Survival} (Cambridge: MIT Press, 2005).
  \item \textsuperscript{41} Mark Van Vugt and Brian R. Spisak, ‘Sex Differences in the Emergence of Leadership during Competitions within and between Groups’, \textit{Psychological Science} 19, no. 9 (2008): 854–8.
  \item \textsuperscript{43} Van Vugt et al., ‘Gender Differences in Cooperation and Competition’.
\end{itemize}
endorse examining in leadership studies. One of the most innovative new studies exploring this phenomenon involved the use of eye-tracking technology to examine how the gaze of political leaders affects the gaze of in-group and out-group followers. The authors hypothesised these relationships based on primate literature which suggested that the automatic tendency to follow the gaze of other group members can be affected by relative social status. In this study, researchers examined the directional gaze of right-wing Italian leader Silvio Berlusconi. They found that in-group members followed his gaze, whereas out-group members tended not to look where he was looking. Furthermore, the degree of perceived similarity in personality enhanced these effects. In this way, a leader’s gaze proved predictive of seemingly reflexive shifts in attention; this bias could either result from increased affiliation with in-group leaders or simply reflect shared differences in attentional bias between leaders and followers of the same political persuasion. In other words, behavior which may feel automatic and unconscious can nonetheless systematically reflect higher order social processes designed to track variables such as social rank and leader status. This work highlights one example of the way in which theories which draw upon evolutionary models, examining neurobiological factors such as eye gaze, can illuminate novel forms of association in seemingly unexpected areas, including the nature of leadership and followership.

A great deal of attention has been paid to the question of leadership being innate or learned. Certainly it is both, but neurobiological methods can provide greater specificity about the interaction of genes and environment in creating leaders. Perhaps those in management science and occupational leadership studies have made the greatest advances in these explorations. In a series of behavioral genetic studies, Richard Arvey and colleagues have found that genetic influences on leadership account for roughly 30–40 per cent of the variance. Reaffirming Arvey’s findings, using a sample of over 6,000 twin pairs, Chaturvedi et al. found that some 44 per cent of the variance in leadership emerged as a function of genetic influence. Genetic influence was greatest in explaining individual differences in middle-aged women and lowest for older women. In this way, there appears to be an interaction between culture (sex roles) and genetic disposition. These studies, along with others, inspired a special issue of the Leadership Quarterly in 2011 entitled ‘Towards a Biology of Leadership’.

As noted above, twin models partition sources of variance, but do not identify the specific neurological, genomic or hormonal systems that account for this variance. But genetic studies do not provide the only entry into the neurobiological study of leadership. Other techniques have been harnessed as well to gain traction on this inquiry. Balthazard

et al. utilised electroencephalography (EEG) to differentiate transformational leaders from non-transformational leaders on the basis of this additional neurobiological tool.\textsuperscript{47} In this way, specific leadership traits were shown to be related to different levels of electrical activity in different parts of the brain.

Additional work employing another technique involving hormonal assays to explore the endocrinology of leadership has also brought new light to bear on the neurobiology of leadership. For example, work conducted by Robert Josephs and colleagues finds a relationship between testosterone and social status, demonstrating that, in high status positions, high testosterone individuals do well regardless of task content, whereas they perform poorly on both spatial and verbal tasks when placed in a low status situation.\textsuperscript{48} In addition, the effect of testosterone also appears mediated by the role of cortisol, a stress hormone. Mehta and Josephs find a relationship between testosterone and dominance, but only in those individuals with low cortisol.\textsuperscript{49} When cortisol was high, the relationship between testosterone and dominance disappeared or reversed. This suggests a reason for the lack of relationship between leadership and dominance reported in the Van Vugt review noted above; it is entirely possible that individuals in Van Vugt’s review had high cortisol, a plausible conclusion if many subjects emerged from student samples, and found the experience of leadership stressful. In the Mehta and Josephs work, neuroendocrine effects appeared particularly pronounced under conditions of social threat or social defeat. This work offers truly profound evidence in support of an evolutionary hypothesis establishing a foundation for leadership by delineating the hormonal link between the reproductive (testosterone) and stress (cortisol) pathways in regulating dominance displays and behavior. Their work suggests that because testosterone potentiates status seeking in social hierarchies, only when stress and threat are low will high testosterone lead to higher status; when stress is high, high testosterone may instead be associated with lower status. This work demonstrates the kinds of novel insights into leader decision making and behavior that becomes possible using the tools garnered from a neurobiological perspective.

Josephs et al. suggest that it is precisely this mismatch between biological reality as embodied in testosterone and social status that can lead to dysfunction, discomfort and disease.\textsuperscript{50} When low testosterone individuals are placed in high status positions, they display greater emotional arousal, including higher heart rate, and poorer cognitive performance, just as occurs when high testosterone people are placed in low status positions. This suggests that particular individuals may be both more predisposed and more able to assume leadership roles. But such a tendency may only manifest under particular

\textsuperscript{47} Pierre A. Balthazard et al., ‘Differentiating Transformational and Non-transformational Leaders on the Basis of Neurological Imaging’, Leadership Quarterly 23, no. 2 (2012): 244–58.


environmental circumstances involving threat or opportunity for members of an in-group which holds high salience and meaning for participants. Under such circumstances, an incipient leader can then draw on relational skills and abilities to leverage social identity to overcome collective action challenges.

So far, however, the most important advances in the neurobiological study of leadership and its motivating factors have been made outside of political science. There is one very important exception, however. Doug Madsen, in a series of prescient experiments in the 1980s, provided a remarkable empirical demonstration of the use of whole blood serotonin to predict power seeking drives, defined as striving for social dominance, among individuals. Madsen’s work related this biochemical marker to several behavioral patterns, including aggressiveness, competitiveness and distrust. This work constituted the first, and so far only, clear documentation of a biochemical marker to discern differences among individuals in a critical area directly related to leadership drive. Such novel theoretical and methodological approaches can further deepen our understanding of the neurobiological processes undergirding such phenomena and help illuminate the basis of important characteristics that potentiate good leadership or precipitate poor leadership.

As should be evident, existing studies of leadership have no comprehensive model of individual variance. Employing a neurobiological perspective could help provide a model which combines both biological and environmental forces into a more cohesive model of how individual dispositions might inform political choice. In this way, the existing variety of theoretical perspectives can be enhanced by incorporating a neurobiological approach through obtaining DNA or saliva samples on subjects. Whereas before leadership studies remained largely idiosyncratic and anecdotal, new methods allow scholars the ability to map physiology into psychobiography in an integrated fashion which can provide a more holistic understanding and representation of not only individual leaders but also the nature of leadership itself.

**Political Violence**

The focus on individual differences makes the neurobiological model a plausible place for scholars of international relations to begin investigating potential endogenous sources of influence that might predict individual engagement in, and reaction to, political violence. In similar ways, although targeting different behaviors, the methods used in psychiatric genetics, neuroscience and endocrinology have addressed similar problems associated with selection bias and small sample size while relying on quantitative biometric traits, and thus avoiding the need to rely purely on anecdotal forms of investigation. We examine the way in which such a model might be applied to the investigation of terrorist action and political violence.

In order to provide a concrete example to illustrate the application of this approach to an important problem in foreign policy analysis, we outline the potential for investigating individual variance in the origins of violent action from this endogenous developmental perspective in order to help explain and predict this propensity. In so doing, we build on previous work which developed this argument.51 While political violence has

not been traditionally understood as an act of state policy, since 9/11 there has been an important shift from state-centred approaches to a focus on individual and non-state actors. Few would dispute the fact that acts of terrorism can potentiate foreign policy consequences, as occurred when the attacks of 9/11 led directly to the wars in Iraq and Afghanistan. In this way, understanding the acts of individuals committed to engaging in politically motivated violence remains a cause of great concern to foreign policy analysts.

Terrorist action and political violence constitute an element of foreign policy to the extent that individuals engaging in such action often undertake it with the goal of changing the international environment to more accurately reflect their desired goals or status. Common actions include establishing sovereignty for a separatist group, instantiating a particular religious or political style of leadership, or achieving a certain international status. While terrorist action may lie outside the traditional foreign policy analysis focus on leaders, actors engaging in political violence and terrorism provide an important example of the impact of individuals outside the realm of leadership on outcomes critical to securing peaceful international relations.

One of the areas where a neurobiological approach focused on uncovering the basis of individual differences can provide useful leverage in the realm of foreign policy lies in the individual motivation to engage in terrorism, whether religiously or politically inspired in origin. While some models of terrorist action locate individual differences in the realm of personality factors, many other theoretical models of terrorist action find that individuals who engage in terrorist action do not appear to differ very much from other individuals.\(^5\) As a result, much work on terrorist action has subsequently focused on structural and situational inducements for individuals to engage in terrorist action. Much of the work on individual variance suffers from serious methodological shortcomings, including problems associated with selection bias and small sample size.

A behavior-genetic approach can begin to address some of these concerns by placing the individual terrorist within the context of a specific population, as is done with similar investigations into rare illnesses. The approach also utilises proven models of familial transmission, where larger sample sizes are invoked to examine the differences between the target individual and similar others who nonetheless diverge on the behavior of interest. In this way, we might begin to examine some of the ways in which a specific subset of actors who appear to share a cloak of normality on most dimensions of behavior outside the terrorist one we seek to explain nonetheless distinguish themselves from others in a given population.

In some ways, it makes sense that most terrorists appear similar to others on the normal personality dimensions which are consistent across cultures, and remain fairly normally distributed within populations. After all, in order to become an effective terrorist, a person must retain at least a semblance of an ability to engage in efficacious, organised action, or his terrorist activities would only meet with failure. However, psychopathologies, such as anti-social disorders, schizophrenia and other personality disorders, affect only a small proportion of the population, are not normally distributed, and many result

in maladaptive behaviors or behaviors inconsistent with societal norms, such as extreme violence, and thus, at first, may appear to offer a potential avenue for identifying those that would be more likely to engage in political violence.

However, this turned out not to be the case. Studies of West German terrorists, Italian terrorists and IRA members provided evidence that, for Western terrorists, acts of political violence are largely not the result of mental pathologies. Moreover, insofar as more recent Middle Eastern terrorism is concerned, Atran’s review of the research suggests that terrorists are similar to other parts of the population in terms of education and income and do not show any systematic forms of mental illness. Furthermore, Ruby argues that political violence is conducted by rational people pursuing specific political goals and purposes.

The inconsistency could certainly reflect a reality that motivation for violent action results solely from cultural, environmental or structural determinants, or such results could derive from a failure to properly identify and characterise those features of individual difference which define, precipitate and perpetuate violent action. After all, these differences may not lie in personality characteristics that might be captured by blunt survey instruments. The measurements foreign policy analysts have traditionally used may not have been able to fully calibrate such differences, leading to systematic underlying factors becoming confounded with orthogonal factors and random noise. Familial models of transmission can help determine which aspects of behavior are indeed partially accounted for by biological markers, and how much of the variation in behavior is attributed to the environment and how these forces interact.

Recent scholarship has attempted to delineate the characteristics which best describe individuals prone to engage in terrorist action. For example, Pape argues that suicide bombing represents a strategic calculation on the part of an actor that this option offers the best chance of achieving desired political change. Atran suggests that while such a strategic incentive may exist on the part of leaders, followers remain motivated by religious belief. Leaders know this and choose to use and manipulate these beliefs in order to motivate followers to conduct acts whose purposes are designed by leaders.


57. Scott Atran, ‘Genesis of Suicide Terrorism’.

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for calculated political outcomes. Bueno de Mesquita et al. builds a formal model of negotiation predicated on policy makers being able to identify variance within the population of extremists. Powell similarly developed a formal model of interdiction by states with limited resources.

For current purposes of discussion, we delve more deeply into two opposing perspectives on the origins of terrorist activity which stipulate individual differences as an important causal factor in motivating such action, noting again that such studies often suffer from problems associated with selection bias and small sample size. In earlier work, Post argued that terrorists suffer from particular personality disorders, and their particular psychology drives them to commit terrorist acts. On the other hand, Crenshaw argues that social support structures provide the main motivation for terrorist action, and locates the primary inspiration for terrorist action in strategic goals and incentives. Yet it remains logically possible that terrorist action could plausibly result from a combination of these two incentives. The environment may create a situation which affects the population as a whole, but, due to divergences in genetic predilection, various aspects of the social situation trigger only certain individuals experiencing these events to act in response to them.

In attempting to define what constitutes a terrorist personality, Post argued that terrorists followed a kind of ‘psycho-logic’. From this perspective, terrorists should not be understood as rational, strategic actors, but rather as compulsive individuals driven to engage in violent acts at the relentless behest of their internal psychological demons and desires. Based on interviews with terrorists held in prisons, Post argued that such individuals constructed a particular psycho-logic which helped rationalise and justify their actions to themselves and others. Post described the central feature of this personality type in the typical rhetoric they employ, which he described as systematically polarised and absolutist. This rhetoric helps define an ‘us vs. them’ mentality whose particular cause or purpose may vary, but whose underlying dynamic remains identical. Thus, while such actors may be equally likely to be drawn to an American White Supremacist group as to a militant cult such as Aum Shinrikyo depending on circumstance, the representation of ‘them’ as producing all things evil, and ‘us’ as freedom fighters rising up to righteously combat such degradation, stays constant. Within this absolutist logic, it follows inevitably that the source of all evil, ‘they’, must be destroyed.

It is important to note here that there exists no clear relationship between particular forms of logical thinking and mental health. Many individuals who are perfectly mentally healthy are not able to solve a logical syllogism; indeed, SAT type standardised tests prey on just such individual variance in performance. Similarly, many mentally ill people

present delusions which stay true to many of the rules of logic, although their content defies rationality. One classic example of such a process comes from Doramus’s work on ‘paleologic’, which is the pseudo-logical thought process which often defines paranoia: ‘I am a virgin’, ‘Mary was a virgin’, ‘Therefore I am the virgin Mary’. Such styles of psycho-logic were seen by Post in many terrorist actors.

Post argued that individuals with particular personality characteristics were more likely to be drawn to terrorist groups as well, suggesting some self-selection mechanisms also at work in individuals seeking out environments in which they feel most comfortable given their basic dispositions. In particular, he argued that people whose main defence mechanisms relied on externalisation and splitting, most commonly found in narcissistic and borderline personality disorders, were among those most likely to join terrorist groups. In the psychodynamic paradigm from which the notion emerges, splitting is understood to emerge from the wounded essence of childhood abuse, where children fail to integrate the good and bad aspects of themselves and therefore split off the bad part and retain the good aspect of those images. The bad part is then projected onto others in the outside world, as externalisation, while the good, ideal part is retained in the overinflated narcissistic self-image. Individuals prone to such defence mechanisms look to others as the source of any weakness or difficulties they experience. Without an external enemy to hold accountable for their failings, such people crumble in the face of their own deficiencies. In order to retain a secure sense of self, such actors need to target, blame and attack the perceived source of their inadequacies, which they understand to always lie outside themselves. Such individuals find the polarising absolutist rhetorical style generated by terrorists to be extremely attractive as an explanation for their own inevitable unhappiness. To support his argument, Post cites a study which examined the life course of 250 West German terrorists. This group was comprised of 237 left-wing, Red Army faction members and 23 right-wing 2 June Movement adherents. Of these, 79 per cent admitted to severe conflict, especially with their parents (33 per cent). Most of these people had lost one or both parents by the time they were 14 years old. This study concluded that terrorists were ‘advancement oriented and failure prone’, and that their ‘terrorist career’ was ‘the terminal point of a series of abortive adaptation attempts’. Note, however, that not every person who joins a terrorist group suffers the kind of damaged childhood described in this study; similarly, very few of those with such childhoods become active terrorists.

However, it is possible that once an individual joins a terrorist group, living and acting within the context of a community which embodies such psycho-logical thought processes may gradually lead individuals to adopt some of these styles of thinking and acting through processes of social contagion and social reinforcement. Thus, it can prove very difficult to disentangle self-selection into groups which reflect shared interests from socialisation within the group once a person becomes a member without a sophisticated temporal analysis of which process instigated the initial action. In addition, social and structural factors can clearly consolidate such predilections, highlighting the inextricably intertwined nature of both innate and social forces in guiding and shaping all complex forms of social and political behavior.

There are other psychological forces which enforce the motivation and commitment of terrorists to their group. One of these, noted by Crenshaw in a slightly different
context, lies in the psychological benefits of joining with others in a cause larger than oneself.\textsuperscript{62} For many who join terrorist groups, this is the first time they ever feel like they belong to anything or anyone, and the first time they feel important, significant and efficacious in the world. This feature of group action becomes magnified by other aspects of group affiliation. Working from within a similar psychodynamic paradigm to that of Post’s original work, Lifton\textsuperscript{63} conducted a study of the members of Aum Shinrikyo, the Japanese terrorist group that released sarin gas in the Tokyo subway system in 1995, killing 12 people and injuring many others. He reports that most of the members lacked a coherent sense of self, resulting in an overly strong need to affiliate with others in order to create and sustain a sense of personal identity. An interesting consequence of such deep interpersonal identification on the part of adherents lies in the fact that withdrawal from the group becomes untenable, except through death. The way to get rid of doubt is to destroy the doubter, acts which further solidify group identification and cohesion. All these various psychological forces, embodied in particular personality types, add up to extreme pressures to commit acts of violence on the part of vulnerable individuals.

However, as presaged earlier, many other scholars take issue with this view and argue that most terrorists are in fact normal and that there is no such thing as a particular personality type which characterises terrorists. Indeed, in 1981 Marsha Crenshaw concluded that ‘the outstanding common characteristic of terrorists is their normality’. Evidence for this view comes from many diverse sources. Crenshaw’s studies of the National Liberation Front (FLN) in Algeria in the 1950s found members to be basically normal. In 1980 Heskin reported that members of the IRA were not emotionally disturbed.\textsuperscript{64} Nasra Hassan, a Pakistani relief worker, interviewed nearly 250 aspiring Palestinian suicide bombers and their recruiters: ‘None were uneducated, simple-minded, or depressed. They all seemed to be entirely normal members of their families.’\textsuperscript{65} In a review of the social psychology of terrorist groups, McCauley and Segal concluded that ‘the best documented generalisation is negative; terrorists do not show any striking psychopathology’.\textsuperscript{66} If this is the case, then it behoves scholars to begin to ascertain ways to distinguish those who will turn to political violence under provocation from those who will choose more peaceful forms of political protest when confronted with the same provocation. Below, we discuss a model which can help illuminate some of the neurobiological and environmental factors which may help observers more accurately ascertain those individuals at greatest risk for engaging in political violence. Such an approach may also help provide novel vectors for potential intervention to prevent such a transformation among those most susceptible to such vulnerability.

\textsuperscript{62} Ibid.
\textsuperscript{63} Robert Jay Lifton,\textit{ Destroying the World to Save It} (New York: Springer, 2007).
\textsuperscript{64} K. Heskin,\textit{ Northern Ireland: A Psychological Analysis} (New York: Columbia University Press, 1980).
Neurobiological Models of Violence

There are two critical constants across cultures which predict violence. Men are most likely to commit violent acts, and young people are more likely to be violent than older ones. Absent these two demographic discriminators, there are almost no conclusions regarding individual differences which may instigate political violence. Thus, the need to explore and identify individual differences in the source of violence among those most at risk remains paramount. However, as we have discussed, behavior results not only from individuals but also from their interaction with a given environment as well. As a result, it may be as important to understand and categorise the nature of violence as it is to understand and categorise the nature of the individual. The type of violence committed is indeed crucial to understanding what neurobiological mechanisms might be involved in its instigation and how such models can inform the study of international relations.

Violence is typically defined in two ways in the psychiatric literature. 1) Reactive violence encompasses acts of aggression which are unplanned, possibly enraged attacks against the (perceived) threat, antagonist or source of frustration. 2) Instrumental violence constitutes premeditated, goal directed, purposeful behavior. Even the law distinguishes punishment based on whether a crime was committed in the heat of passion (the first type) or as a premeditated act (the second), the latter typically being understood to represent the more serious offence. It is this latter form of violence that is of the utmost interest to those who wish to explore political violence. Yet, the majority of neurobiological research has focused on the former, more reactive forms of violence. If the studies above have shown anything, it is that political violence is not conducted by the mentally ill, impulsive or insane, but rather lies in the realm of goal directed, seemingly rational behavior, conducted with a particular purpose in mind.

Two critical features help define how neurobiological models may be specifically applied to help explain the origins and nature of political violence: 1) specific high risk environments have a stronger effect on dispositionally (e.g. neuro-genetic) sensitive individuals; 2) specific individuals at high risk tend to self-select into environments that reinforce their specific vulnerability (e.g. ‘genotype-environment correlation’). This approach locates causality at the intersection of individuals’ unique dispositions and their specific social contexts (e.g. ‘genotype x environment interaction’). That is, political violence cannot be understood if we ignore individual differences between people embedded within specific cultures; the roots of political violence are multifactorial, resulting from interactions between large numbers of biological (genetic) and social (environmental) factors, and these interactive effects may differ profoundly both within and across populations.

One of the earliest examples of the inclusion of biological elements into traditional profiles of behavior and identity was the introduction of the ‘unified biosocial’ model of personality. Originally developed to account for differences in the susceptibility of individuals to chronic anxiety, the model has been used broadly throughout the psychopathological literature to examine such traits as alcoholism and violent behavior.67 Unlike

models of personality based on factor analyses, or environmental-only cues, Cloninger’s tridimensional theory tied expressed trait variation in personality to neurobiological substrates with a focus on gene–environment interaction. Cloninger found that conventional personality and psychopathological factors are ‘composites of multiple genetically independent traits activated in response to shared environmental stimuli’.68

While the Cloninger measure is not an ideal one to use for exploring political violence, the method and model constituted an important step in neurobiological approaches to explicating violence, and have been applied directly to terrorist activity. Returning to the dichotomy displayed by Post and Crenshaw earlier, the application becomes clearer. Post’s concept relies on the assumption that there is a fundamental difference between those who engage in terrorist activity and those who do not, and the difference is likely a difference in psychopathology. However, Post’s conclusions were largely drawn from a single Western population and found no differences in mental health as identified in typical Diagnostic and Statistical Manual (DSM) psychiatric disorders. As noted above, numerous others studies found the same, namely that no psychopathological difference existed between actors willing to engage in political violence and others. However, adopting an epidemiological approach, and building a construct that takes into account neural activity, genetic predilection and familial transmission, offer scholars an opportunity to create and develop a model based on inherent differences, not simply expressed traits recognised in the DSM. If there are fundamental differences of ‘mind’ between terrorists and others in the same population, genetic models may thus begin to provide the evidence.

Alternatively, Crenshaw’s position, that those who engage in terrorist acts are not mentally ill, is supported by the data. Terrorists are in the normal range for typical DSM conditions. However, Crenshaw’s approach is based solely on social conditions and has no explanation for those who do not engage in political violence when faced with the same stressors. A key element to the findings reported by Crenshaw lies in the psychological value gained by joining the group. Yet, that valuable thesis has not been empirically explored in the more recent literature in any systematic way. It is certainly plausible that the desire to be part of a group may differ markedly across individuals. However, reward-dependent behavior has largely been explored in the psychiatric genetics, and not the political science, literature.

Thus, in order to better understand an individual’s willingness and ability to employ extrasystemic violence, a model which accounts for individuals’ genetic makeup and brain structures in interaction with particular environmental cues and triggers should be pursued. This model would incorporate how individuals interpret information within their environment. Indeed, in order to provide a truly comprehensive model of individual variance in the propensity for violent action, modelling how the brain, genes and environmental triggers interact and develop over time in ways which affect individuals’ responses is necessary.

One of the earliest studies adopting this approach focused on criminal behavior and criminal violence. A series of studies relying on classical twin designs and adoption

studies found criminal behavior was substantially heritable. However, these results remained contested due to the method used, or the small sample sizes. This changed with the Mednick et al. study on 14,427 non-familial adoptions in Denmark, which provided conclusive evidence that criminality, including violent behavior in biological parents, was associated with an increased risk of similar behavior in the offspring, even when the adopted parents exhibited no such behavior.

Since these early explorations of the neurobiological and genetic techniques in the social and political realm, sample sizes, controls and methods have vastly expanded and improved. And there has been a specific focus on violence, not simply criminality. The epidemiology, genetics and brain circuitry involved in violence, including cortex and limbic system/subcortical structures, neuromodulators, neurotransmitters, neuropeptides and neurocognitive-neuropsychological impairment, have been explored. Siever provides a thorough review of these explorations. While attempting such an overview here would be beyond the scope of our current task, we detail some of the more critical findings in this area in order to explicate how they might best apply to the study of IR.

A series of behavioral genetic analyses focused on twins and kinships suggest that aggression, particularly impulsive types of aggression, is substantially heritable; somewhere between 44 per cent and 72 per cent of the variance is due to genetic influence for a meta-analysis of more than 20 studies, according to Miles and Carey. However, genetic influences are not states, but rather only hint at the constant role of gene–environment interplay in observing, experiencing and taking part in aggression throughout one’s life, from infancy to adulthood. The combined social, familial, cultural and economic factors that interact with one’s disposition remain infinite. Perhaps the best known of these explorations focused on how serotonin transporter (5-HT) and monoamine oxidase type A (MAO-A) interact with childhood adversity to predispose one to violence.

These two factors have become prominent in explorations of violence and the likelihood of impulsive aggression. Serotonin is a neurotransmitter which has a major role in pre-frontal cortical activity, including the orbital frontal cortex and anterior cingulate cortex, both of which are involved in regulating aggressive behaviors. Deficiencies in serotonergic innervation act in a manner which removes the inhibitory processes on aggression. Its associated genotypes and hormones appear implicated in the control of

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74. Readers may be familiar with this neurotransmitter because of its widespread recognition as the chemical which is blocked in many modern anti-depressant therapies.
impulsive forms of aggression. For example, the promoter gene for serotonin (5-HT) has been associated with early onset alcoholism as well as violent behavior. Further, alcoholic offenders who had engaged in impulsive violence had fewer binding sites for 5-HT than healthy control individuals or non-violent alcoholics. This is likely related to the fact that receptor activation of 5-HT decreases aggression, while decreased activation of 5-HT increased aggression. Serotonin levels have been reduced in some impulsive offenders with personality disorders as well. However, in females with personality disorders, aggressive behavior may also result from variance in the gene for TPH (tryptophan hydroxylase). Although tryptophan depletion increases aggression in both men and women, this effect is mediated via the 5-HT1 receptor. Importantly, administration of 5-HT modulates and even suppresses aggression. In a related manner, reduced serotonin levels are also implicated in decreased learning and expression of cooperation and reduced trustworthiness.75

Only recently have studies begun to integrate neural patterns with genotype and hormonal levels with the context of specific environments, and to model the neurobiological and environmental pathways from genes, brains and environment to behavior. At the forefront of this neurobiological research on violence, Meyer-Lindenberg and colleagues conducted a path-breaking study in which they demonstrated the neurological basis for the differences found in men with high versus low variants on the monoamine oxidase A (MAOA) allele.76 Previous literature had found that low activity forms of the MAOA genetic polymorphism increased the risk for physical aggression and behavioral violence. This appears particularly true where individuals have suffered traumatic early life events or have been provoked.77 In an intergenerational study of four generations in a Dutch family which had exhibited excessively high rates of violence, including rapes, murders, assaults and arson, blood tests showed that these men were missing the MAO-A enzyme, which breaks down norepinephrine, serotonin and dopamine.

In their critical contribution, Meyer-Lindenberg and colleagues explored some of the ways in which such depletions might affect structures and processes in the brain critical to the instigation or suppression of violent action.78 Using brain imaging, they found that even healthy volunteers demonstrated pronounced differences in critical brain structures and functions depending on their genetic variant. In particular, they showed that individuals with the low activity form of the allele previously associated with instances of

78. A. Meyer-Lindenberg et al., ‘Neural Mechanisms of Genetic Risk for Impulsivity and Violence in Humans’.
impulsive violence had less volume in the part of their brain typically associated with emotion, the amygdala, and yet this area became hyper-responsive during emotional arousal. Concomitantly, these subjects displayed simultaneous reductions in the part of the brain associated with logical and rational decision making, the pre-frontal cortex. Together, these findings suggest that men with the low activity form of MAOA have reduced emotional regulation and less cognitive control over their responses than their high allele brethren.

However, serotonin and MAO are not the only hormones implicated in violence. More recently, the role of vasopressin and oxytocin have been implicated in both affiliative behaviors and aggression. Vasopressin and oxytocin are part of the hypothalamo-neurohypophysial system and are significantly related to parental behavior, territorial aggression, mating and affiliation. Cerebrospinal fluid corticotropin-releasing factor (CSF) vasopressin concentrations are significantly related to an increase in a life history of aggression. Indeed, in mice and primates, higher densities of vasopressin were associated with greater selective aggression towards unfamiliar others. However, mice with the vasopressin 1b receptor (genetic variant) ‘knocked out’ exhibited decreased levels of this type of aggression. These hormones do not always act in isolation. In fact, it appears that increases in serotonergic activity reduce concentrations of vasopressin. The second hormone in this group, oxytocin, is best known for its importance in trust and affiliative behavior. Lower amounts of oxytocin are believed to contribute to increased levels of fear, mistrust and potential aggression. This is exactly what has been found with oxytocin knockout mice, who also display intensified aggression.

Further, the GABA receptor complex also leads to an increase in the probability of reactive aggression. It appears to have no effect on instrumental aggression. This is likely because instrumental aggression, which is goal directed in nature, requires executive control in order to initiate and implement successfully. The only transmitters which might potentially modulate the biological systems crucial for processes of socialisation are likely related to such instrumental, as opposed to reactive, forms of aggression.

One of the structures implicated in such processes of socialisation is the amygdala, the part of the brain involved in emotion regulation and control. Norepinephrine in this area has been shown to be involved in the modulation of emotional memory. Some studies have reported a relationship between increased norepinephrine activity and increased aggression, and beta-adrenergic drugs which block its effect have proven clinically effective at suppressing violent behavior in psychiatric patients.

The amygdala likely plays a prominent role in the aetiology of aggression and violence more broadly. It is possible to increase aggression by modulating activation of the amygdala. For example, electrical stimulation of the amygdala increases all types of aggression. One of the most famous examples of the effect of amygdala impairment on the initiation of violence comes from a prominent case of mass murder. Charles Whitman, the former Marine who in 1966 perpetrated the horrific killing spree from the tower on the campus of the University of Texas at Austin which left 16 dead and 32 wounded, left a note begging for his brain to be studied. His autopsy revealed he had a tumour pressing into his amygdala.

One of the most interesting areas of research providing insight into and evidence for the origins of aggression and violence in humans derives from brain lesion studies, which explore the behavioral consequences of focal damage to human brains as a result of injury or illness. If a person loses part of their brain, or brain function, and shows subsequent changes in behavior, such sequelae can be linked to the functional capacity of the part of the brain whose tissue has been lost. In the realm of violence, damage to the prefrontal cortex part of the brain has been associated with increased risk of reactive aggression in humans. Neuroimaging studies show evidence of dysfunction in this part of the brain among aggressive individuals. In fact, otherwise healthy violent individuals show differences in other areas of brain structure as well. For example, reactive murderers had lower cerebral blood flow in their pre-frontal cortex than instrumental murderers.83 In addition, violent patients show reductions in N-acetylasparate, a marker of neural density.84

Humans are difficult to study, and it is not possible to truly isolate particular sources of specific behaviors without gene-knockout studies or research that would be unethical to conduct on humans. Indeed, much of what we know about the neurological mechanisms behind aggressive behavior is based on the kind of neurocognitive-neuropsychological impairment studies mentioned above. As a result, some of the most critical studies which inform our understanding of the relationship between neurobiological factors and the emergence of violence and aggression have come from explorations of animal models. Among many experimental methods, lesions and gene knockout studies have proven extremely fruitful. For example, rat lesion studies suggest that different types of aggression may be controlled by different subsets of brain structures. Specifically, damage to the septum of rats increases their predatory aggression but actually reduces their degree of social aggression.

A second example presents one of the most compelling illustrations of the importance of specific genotypes for the emergence of violence when provoked, and demonstrates how violence trains genotypic expression. A study by De Boer and colleagues engineered mice with specific kinds of serotonin receptors and found that constitutionally aggressive individuals develop gradually over the course of repetitive exposures to

victorious social conflicts involving offensive aggression. But this effect was prominent only through multiple victorious encounters. That is, brain serotonin activity decreases as a consequence of acquiring repeated victorious experiences and adopting unchecked forms of aggression. This study, along with work by Caramaschi et al., documents that only after repeated resident–intruder fighting experiences were serotonin levels in the pre-frontal cortex found to be significantly lower among highly aggressive mice. In this way, it appears that certain neurobiological pathways are rewarded by victory in combat and influence certain individuals to behave even more aggressively once provoked. Such a model could be applied to human aggression and war as well, suggesting that those who engage in more successful aggressive fighting, as might happen over multiple tours of deployment for example, will prove more likely to engage in aggression afterwards.

Social aggression appears related to increased levels of testosterone. Reducing testosterone in the alpha male eliminates his dominant social status, and restoring testosterone (through injection) causes him to regain his social status. However, giving testosterone to non-alpha dominant males does not make them dominant or alpha. This is reminiscent of the study with human males and testosterone discussed above. Thus, for animals, testosterone does not increase violence or aggression, but it does increase social aggression in alpha males. Similarly, abnormally high levels of testosterone in humans are related to increased social aggression, but there is no evidence that such individuals are more violent. Therefore, there is no evidence that testosterone levels have any predictive value in identifying violent behavior among specific individuals, nor is there any indication that it increases violent behavior in general among animals or humans. Rather, it appears to heighten responsivity to social challenge and threat in those whose loss of status would cost them most dearly because of their high place in the hierarchy.

Another interesting analogue to human studies comes from studies with blind mice that lack the MAO-A enzyme, similar to the factor that was missing in the study of Dutch men mentioned above. Normally, as social animals, mice who have plenty of room in their cage can happily share the same environment. However, mice with the MAO-A knockout attack other mice and animals that enter their cage.

To summarise the above literature, a great deal has been learned about impulsive and reactive aggression and violence using neurobiological tools. But, so far, less attention has been paid to instrumental aggression. What makes this area of great interest is that political violence in most ways represents a large-scale extension of social aggression. We can model political violence as a form of social aggression instigated by actors whose neurobiological and environmental backgrounds render them differentially susceptible to respond to threat or provocation with aggression and violence. So, it is plausible that widespread political violence may combine elements of both reactive and instrumental

aggression, or at least unify individuals who are inspired to such actions with both motivational systems. Depending on the environmental circumstances or provocations, some individuals may react to an immediate threat or oppression with violence, as when their town is being shelled, or when they have just witnessed a family member being killed. Others may engage in political violence for carefully planned strategic goals and purposes. Each of these kinds of actors may be best deterred using different incentives and restraints. And being able to distinguish between types of actors may prove key to developing effective instruments of deterrence.

Conclusions: Neurobiological Implications for International Policy

In discussing the relevance of a theoretical foundation rooted in evolutionary modelling, and employing methodological techniques extracted from work in behavior genetics to analyse and examine issues related to leadership and political violence, we offer an ecologically valid approach to the study of these endemic and recurring issues in international politics. This approach allows us to traction recent developments in psychology, neuroscience and genetics to examine both the foundations and the ramifications of individual variance for processes of great importance in an area where for half a century the dominant models have assumed individuals do not matter in determining outcomes of interest. This supposition remained convenient when such individual differences proved hard to examine.

Focusing on the examination of individual behavioral variation from this neurobiological perspective, we are building on well-developed models in psychiatric and behavior genetics to uncover those forces in the social environment that have greater influence on individuals with certain genetic profiles. Focusing on individual genetic differences within a population interacting with certain environmental triggers allows us to develop new tests to evaluate, assess and screen threats and to determine how best to respond to them. These tools and strategies offer novel hypotheses and routes to inquiry for those interested in getting at the biological as well as the structural roots of terrorist action.

In the current world, where the importance of individual leadership remains evident in everyday news, and the prospects for, and fear of, political violence control so much of the political debate, leveraging modern tools to deepen our understanding of the origin and nature of such differences, and investigating how such influences might exert their force on the world stage, seem an endeavor well worth the challenge. Scholars who wish to entertain a more comprehensive approach to the study of individual differences in generating foreign policy outcomes of interest would be well served by incorporating endogenous factors into their models of political leadership, behavior and action, particularly in seeking explanations for violent action.

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