The Stress of Politics
Endocrinology and Voter Participation

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Abstract

People vary in the way they respond to stressful situations. These variations can sometimes be seen in actions and facial expressions but they can be measured more precisely by determining the amount of cortisol, a well-known stress hormone, present in the body. Given the indisputable tendency of politics to generate stress, we hypothesized that individuals with the highest cortisol levels will be the least likely to participate in politics. We tested this hypothesis by collecting a series of saliva samples from over 100 individuals before and after they were subjected to a standardized and validated social stressor. We then conducted laboratory analyses of the samples to determine cortisol levels and correlated these levels with previously recorded levels of participation in various political activities, including data on actual (not reported) voter turnout in six recent elections. Even after controlling for a standard array of demographic traits as well as self-reported tendencies toward feeling stressed, people with the highest cortisol levels were indeed the least likely to vote in elections. Efforts to enhance voter turnout would be assisted by consideration of individual-level differences in stress reactivity.

Politics, it seems, is not for everyone and a central mission of scholars of democratic politics is explaining individual-level variation in political involvement. Though proximate events, including pleas to participate and particularly stimulating electoral contests (Green and Gerber 2004; Gerber, Green, and Larimer 2008; Franklin 2004) obviously can boost political activity, previous work on participation consistently documents remarkable longitudinal regularity in individual political involvement. Whether the focus is on political participation (Plutzer 2002; Gerber, Green and Shachar 2003; Green and Shachar 2000), political attitudes (Alwin and Krosnick 1991; Sears and Funk 1999) or levels of political interest (Prior 2010), stability reins, leading some scholars to refer to politics as a “habit” and others to conclude that, when it comes to politics, “you either have it or you don’t” (Prior 2010: 765).

While longstanding predispositions clearly play a powerful role in explaining person-to-person variations in political involvement the source of these predispositions is disputed and the potential mechanisms underlying them is all but ignored. Most scholars assume that, since political participation and interest are so stable throughout a lifetime, childhood socialization and other early formative events must be crucial (see, for example, Prior 2010). This is a reasonable interpretation but long-term stability is also consistent with a genetic explanation. In fact, given the relatively weak evidence for parental socialization on political behavior, except for party identification (Jennings and Niemi 1968), and given recent indications that variations in political participation are partially heritable (Fowler, Baker, and Dawes 2008), it is probably best not to rule out any possibility that fits with the empirical pattern.

Our intention here is not to determine whether longstanding, politically-relevant predispositions are innate or environmentally determined but to better understand their constitution. Despite their widely acknowledged existence and importance, investigations into the nature of longstanding political tendencies are surprisingly rare. Indeed, after acknowledging the vital importance of predispositions, most political scientists simply throw up their hands and move on. Thus, Zaller writes that "the sources of variability in individuals' political predispositions are beyond the scope of this book" (1992: 23); Barker and Tinnick similarly state that discovering the sources of variations in values is "beyond the scope of this particular study" (2006: 251); Hetherington and Weiler believe that "while it might be interesting to find the root of value systems, the crucial relationship is how values translate into political action" (2009: 36); and rational choice accounts of politics typically place the sources of political orientations explicitly outside the explanatory scope of their models by making the common initial assumption that preferences are exogenous.

Recall and self-reflection abilities being what they are, asking people to self-report their longstanding predispositions is doomed to be as unproductive as inferring predispositions strictly from demographic characteristics, so our strategy for uncovering the nature of these predispositions is to turn to physiological traits. The rationale is straightforward. It is physiology that makes it possible for people to sense the environment around them (sensory nervous system), to formulate a response (central nervous system), and to enact that response (motor nervous system). Given this, physiological measures unsurprisingly are known to index a variety of subconscious dispositions or orientations that have attitudinal and behavioral implications (Smith and

Hibbing 2011). This is because person-to-person variations in physiology mean some individuals sense, attend to, process, and respond to certain categories of environmental stimuli differently from other individuals and these differences are likely to connect to a variety of attitudes and behaviors, including political attitudes and behaviors.

Thus our theory is that longstanding, politically-relevant predispositions are likely to be physiologically instantiated, whether because of a trait present since birth or because some event, or series of events, left an impression to the point that it was incorporated into physiology in a politically relevant fashion. Certain incidents flit into consciousness but fail to alter physical response patterns in a tangible manner. Others leave their mark, sometimes without even entering people's conscious awareness (see Lodge and Taber 2005; Galdi 2008), by becoming incorporated into the way the body responds to subsequent situations. Regardless of the underlying source, physiology in this sense quite literarily embodies longstanding predispositions. Physiology can and does change but is at the same time a powerful source of inertia; established patterns written into physiology form behavioral defaults. Change is not something that occurs willy-nilly but rather requires sensory detection that established patterns for some reason must be overridden (Gray 1990; Marcus, Neuman, and MacKuen 2000). Viewing longstanding political predispositions as physiologically based thus makes a good deal of sense. Indeed, it is difficult to conceive of a longstanding political predisposition that is ethereally mentalistic and entirely devoid of any physical signature; mental states, even those outside of conscious awareness, are known to have measurable body characteristics (Smith and Hibbing 2011; Cacioppo 2007). The relative stability of physiological characteristics gives them the potential to account for the empirically documented reasonably high levels of stability of political interest, participation, and attitudes.

Cortisol and Politics

The broad category of physiological variables of interest here is stress physiology and the specific variable of interest is individual-level variation in cortisol levels. Cortisol (officially hydrocortisone) is a glucocorticoid that is at the center of bodily responses to stress. Stressful feelings result from physiological changes that occur within the body subsequent to detection of problematic forces in the environment. These changes center on the hypothalamic-pituitary-adrenal axis (or HPA). Physical or psychological events or situations that are interpreted as stressors trigger neuroendocrine signals (corticotropin-releasing hormone, CRH) that are passed from the hypothalamus to the pituitary where adrenocorticotropic hormone (ACTH) is released into general circulation. Upon arrival in the adrenal gland, ACTH causes several hormones to be released, the primary of which is the glucocorticoid cortisol. Physiological changes associated with HPA activation that are mediated by cortisol include increased heart rate, enhanced alertness and strength, accelerated gluconeogenesis (conversion of sugar into energy), enhanced sodium retention, and eccrine gland activity (sweating). Particularly if these chemical states persist, they can lead to the psychological feelings of tension and stress.

Given its vital role in HPA activity, cortisol is often referred to as the stress hormone. In small, temporary doses, cortisol's effects are positive, including a quick burst of energy, increased immunity, lower sensitivity to pain, and homeostasis. Chronically high levels, on the other hand, have been associated with impaired cognitive performance, decreased muscle tissue and bone density, obesity, lower immunity, reduced self-esteem, and lasting, unfavorable changes in neural activity (Pruessner et al. 2005; Wang et al. 2005).

Cortisol is always present but its levels vary markedly. Within individuals, cortisol levels typically follow a diurnal rhythm such that levels are higher in the morning and lower in the evening; they can be affected by recently ingested foods, and they spike subsequent to a stressful event (for a review, see McEwen 2007). More to the point of this study, cortisol levels differ widely from individual to individual. Variation exists in baseline cortisol levels, which tend to be reasonably stable within individuals but highly variable across individuals, meaning that differences from one individual to the next are relatively constant and predictable (Cohen and Hamrick 2003; de Weerth and van Geert 2002; Huizenga et al. 1998). There is also considerable variation in the response characteristics of the HPA, as revealed by responses to stress inducing stimuli (Roy et al. 2001), stimulation with CRH (Abelson et al. 2010), and negative feedback after a dexamethasone challenge (Neidart et al. 2010).

The reasons for these person-to-person variations are multiple. Certainly, key early developmental events have a role. Research (mostly using non-human models) has shown that poor maternal care at formative life stages (and even improper neonatal handling) can lead to increased HPA reactivity, probably due to epigenetic factors (Levine et al. 1967; Meaney et al. 2007). Similarly, chronically disadvantaged and unsupportive environments can increase cortisol baseline levels and responsiveness (Seeman et al. 2002) and one study reports that repeated exposure to restricted environmental stimulation sessions lowered both baseline cortisol levels as well as cortisol variability (Turner and Fine 1991). Finally, research has shown that there are clear genetic contributions to variation in cortisol levels, with the N3635 polymorphism of a gene relevant to glucocorticoid receptors being implicated (van Rossum and Lamberts 2004; see also McEwen 2007).

Regardless of the original source of the wide variations in cortisol levels, our interest is in determining whether variations in physiological patterns correlate with politics and, more specifically, whether cortisol levels correlate with political participation. Our reason for expecting such a relationship is best captured in the vast literature on the relationship between cortisol levels and behavior/psychological states. Much of this research has been conducted on adolescents and it finds that low cortisol individuals have an increased threshold for stress (Kruesi, Schmidt, Donnelly, Hibbs, and Hamburger 1989). They may revel in externalizing, arousing behavior at the same time that high cortisol individuals are mounting a physiological response to even benign stimulation (Raine 2002; Shirtcliff, Granger, Booth, and Johnson 2005). This conception of the role of cortisol is consistent with Gimbel and Booth's finding that, during the Vietnam War, individuals with the lowest cortisol levels were the most likely both to be assigned to and to seek out combat roles (1996), perhaps due to "superior stress management skills" and perhaps also due to a desire to seek out situations that provide "a sense of control, a psychological high, and/or admiration from others" (Shirtcliff, Granger, Booth, and Johnson 2005).

Politics, particularly in large, heterogeneous, open, democratic societies, is inherently stressful. Merely the act of going to the polling place can increase stress (Waismel-Manor, Ifergane, and Cohen 2011) as can supporting a winning or losing candidate (Stanton et al. 2010). If it is true, as the research just described seems to suggest, that low cortisol people have an increased threshold for stress and are more likely to seek external stimulation, it seems likely that they would be more likely to get involved in politics. They may even enjoy the unpredictable give and take or at least be less concerned that the situation might take a turn for the worse. High cortisol individuals, on the other hand, may be more likely to fail to understand how anyone could possibly enjoy political discussion and more generally why anyone would want to engage with the political environment. They would be in no need of (potentially) more stress in their lives and would be more likely to see politics as pointless. Accordingly, they would tend to keep politics at arm's length and to be authentically puzzled as to why other people do not behave similarly. Thus, we predict an inverse relationship between measurable cortisol levels (both baseline levels and degree of cortisol response to a social stressor) and the degree to which people are involved in the political process.

Research Design/Methods

We test this basic hypothesis in the following fashion. In the summer of 2010, we retained the services of a professional survey research organization. Employees of this organization contacted by phone (a statistically appropriate mix of landlines and cellphones) a random sample of adults within easy driving distance of our laboratory in a medium-sized city in the Midwest United States. Specifically, individuals contacted were asked if they would be willing to report to the lab to complete a comprehensive computer survey of their sociodemographics, political orientations, and personality tendencies, in addition to completing baseline cognitive and physiological tests. We recruited 345 individuals in this fashion. We then obtained from the Secretary of State of the pertinent state the voting records of these individuals in six recent elections (the primary and general elections of 2006, 2008, and 2010). As a result of these procedures, we have baseline information, including details of self-reported political activities and actual (not reported) voting behavior, on 345 individuals.

We make no claims that these individuals constitute a random sample of the entire adult population. The necessary restriction to individuals geographically proximate to our lab, the monetary reward promised ($50), and the requirement that the prospective participant be willing and able to spend approximately 90 minutes in the lab all are likely to skew the sample in various ways. However, our efforts to determine the relationship between political participation and degree of cortisol increases subsequent to social stress did not demand a random sample. Moreover, it should be noted that the group that was ultimately included is not a student sample and is in fact reasonably representative of the geographical area from which it was drawn (54% female; mean age = 46 ± 12.8; modal income range = $40,000-60,000; and modal education range = some college/college graduate).

It was not possible to collect full physiological data on all 345 original research participants but we did have the resources to obtain and assay the full complement of the necessary samples for 105 of the original 345 participants. In selecting the subset of the original respondents for the social stress/cortisol component of the study, we first identified those who indicated during their first visit to the lab that they would be willing to return later in the summer (again for $50 and again for approximately 90 minutes). Eighty-five percent of the 345 individuals in the initial pool said that they were willing to return, schedule permitting. In order to insure a reasonable amount of variation in the smaller group, using the answers provided in the survey administered during their first visit to the lab, we prioritized the people in the group of 345 who scored highest on political conservatism, highest on political liberalism, or highest on political apathy. We attempted to recruit these individuals first and proceeded toward the middle of the distribution as necessary.

A key requirement of this project was making these 105 individuals socially stressed in a fashion that was not overtly related to politics. The most widely accepted inducer of social stress is called the Trier Social Stress Test (TSST), so named because it was developed in the German city of Trier. The TSST's reasonably standard protocol, widespread usage, and acceptability to most Institutional Review Boards made it desirable for us, though we needed to make slight modifications to suit the specifics of our project. The TSST consists of two main parts. In the first phase, all participants are told to sit at a desk for 10 minutes and to prepare a short speech justifying why they would be a good person for a generic job. They are told that the speech must last 3-5 minutes and that it will be videotaped as well as observed by a panel of experts. The second task is a challenging math exercise conducted in front of another person, unknown to the participant. Specifically, respondents are asked to count backwards (without notes) by 17s, starting at 1020. They are encouraged to proceed as far (low) as possible as quickly as they can and if they make a mistake they are told without compassion that they must start at 1020 again. The combination of these two tasks back to back tends to raise stress levels (Kirschbaum, Pirke, and Hellhammer 1993).

After our participants completed the TSST, they sat quietly watching a nondescript and unemotional documentary of bucolic countryside scenery. This practice is relatively standard and is necessary because cortisol increases do not occur immediately but rather often lag behind the stressful event by a substantial period of time, perhaps 30-60 minutes. Saliva samples were obtained when the participant first reported to the lab (0 min), again right after completion of the TSST (15 min), at 20, 30, 45, 60, and 75 min. Thus, for each participant we have information on the cortisol levels before beginning the TSST (baseline) as well as detailed information on how cortisol levels were affected by social stress. Since cortisol levels give evidence of diurnal variations and can be affected by recently ingested foods, all testing began at either 1700 or 1800 h and all participants were asked to refrain from eating or drinking for two hours before testing. All told, the 105 participants provided 735 saliva samples for analysis.

Saliva collection, handling, and storage were conducted in accordance with Salimetrics® procedure. Subjects provided saliva samples by spitting through shortened, sterile drinking straws into 1.5 mL microcentrifuge vials labeled with the participant's ID number. After producing a sufficient sample, vials were sealed by participants and handed to the proctor. Upon completion of the protocol, saliva samples were frozen and stored at -20º C until asssayed.

Samples were assayed for cortisol concentration by enzyme immunoassay (EIA). The cortisol EIA has previously been validated for use in human participants (Minton et al., 2009; Elverson et al., in press). Microtiter plates were coated with anticortisol antibody and incubated overnight. Saliva samples were thawed by hot water bath and centrifuged at 2,000 rpm for 15 minutes. After centrifugation, 100 µL of the supernatant (liquid portion) of the sample was extracted and diluted with 300 µL of double-distilled water for a 1:4 dilution. Samples (50 µL) were assayed in duplicate on plates along with known cortisol standards (1,000-7.8 pg/well) and two concentrations of a quality control pool. Labeled cortisol was added to wells during a two-hour incubation. After separation of free from bound cortisol, substrate (hydrogen peroxide and 2,2'-azino-bis(3)-ethylbenzthiazoline-6-sulphonic acid) was added to each well, and absorbance (410 nm, reference 570 nm) was measured approximately 1 hour after incubation. A four-parameter sigmoid fit regression was used to calculate concentration values (Smith and French, 1997; Smith, McGreer-Whitworth, and French 1998). Cortisol concentrations were adjusted to values expressed as ng/mL. Duplicate test values that varied by more than 5 percent were reassayed. A quality control sample of pooled saliva was assayed on each plate, and the intra-assay and interassay coefficients of variation were 7.6% and 17.3%, respectively. All samples from a particular subject were assayed on the same plate, further minimizing procedural variance.

The measures of political involvement were obtained from two primary sources. First, the initial survey included six items on political participation. Five of these were dichotomous items asking whether the participant had ever attended a political meeting or rally, worked in a political campaign in any capacity, contributed money to a political cause, party, or candidate, communicated thoughts or requests to a government official, and held any government office no matter how minor. The sixth asked how often the participant engaged in political discussions and the possible responses were very often, somewhat often, rarely, or never. These items clearly tap into a single underlying dimension of participation (a principal components analysis yields a single factor with an eigenvalue greater than 1.0, which accounts for approximately 45 percent of the variance). Accordingly, we weighted these items equally and combined them into a simple additive index. The second source of information on political participation was the actual voting records obtained from the pertinent Secretary of State. From these records, we determined whether each participant voted in the primary election of 2006, the general election of 2006, the primary election of 2008, the general election of 2008, the primary election of 2010, and the general election of 2010. Voting records were not available for 7 of the 105 participants for whom we have cortisol data, perhaps because these individuals did not live in the state during the entire 2006-2010 period. As might be expected given the longitudinal stability of political involvement, voting in these six distinct elections also loaded on a single factor (a principal components analysis yielded a single factor with an eigenvalue greater than 1.0, which accounted for slightly more than 50 percent of the variance in voting), so they were combined into a single measure of voter turnout running from 0 (voted in none of the six elections) to 6 (voted in all of the elections). To get an overall measure of political involvement, we combined our composite voter turnout variable with our composite measure of non-voting political participation (the correlation between self-reported participation and observed voting was .38, $p < .01$; both the participation and the voting variables correlated with the combined variable at approximately .83, $p < .01$).

Results

As a first preliminary step, we noted that variations in baseline cortisol were substantial and that the distribution was reasonably normally distributed, though with the right tail that is characteristic of distributions bounded by 0 on the left. The minimum value was 0.79 ng/mL, the maximum 35.31, and the mean 7.37 (standard deviation of 5.52). Of course, all environments have some context so these "baseline" readings likely in part reflect the extent to which participants were affected by the need to come to a strange room in a strange building in order to undertake unknown procedures, or they may simply reflect the accumulated stresses of their day. Given all this and given the fact that cortisol is always present in saliva, it is to be expected that pre-TSST cortisol levels are not zero.

As another preliminary step, we demonstrated that the TSST did indeed increase cortisol levels. In Figure 1 we present the mean cortisol levels for all respondents for each of the seven saliva samples: the initial, pre-TSST reading (baseline), the reading immediately after administration of the TSST, and the remaining readings occurring at roughly 15 minute intervals after that. A one-way ANOVA indicates that, relative to baseline, mean cortisol levels are elevated at all time-points during the test, demonstrating that the TSST was effective in activating the HPA of this group. In terms of magnitude, though the social stress test does produce an immediate increase in cortisol levels, the mean peak does not come until the fifth reading, which was taken approximately 45 minutes after the end of the TSST. After that, cortisol levels begin to return to their pre-TSST levels. This pattern is consistent with the biology of cortisol (it is not a neurotransmitter but rather works through the bloodstream so takes time) as well as with other studies that have employed the TSST (Kirschbaum, Pirke, and Hellhammer 1993). It is also the case that substantial variation exists around this mean pattern, with some individuals reaching their peak post-TSST cortisol levels much earlier than others, with some individuals achieving a much higher peak than others, and with some individuals maintaining an elevated level for longer than others.

(Figure 1 about here)

We used the seven cortisol readings to calculate three types of cortisol production for each respondent. “Baseline” cortisol is simply the initial (pre-TSST) reading. Calculating “stress-induced” cortisol is slightly more involved and incorporates all seven readings. We treated the baseline measure as an intercept, drawing a horizontal line across the x-axis at that point and calculated the area under the curve created by the six points representing the cortisol levels in the sequential samples. We also created a “total” cortisol measure in exactly the same fashion except rather than using the baseline reading as an intercept we used the origin of the x- and y-axis (i.e., zero). Thus we have three cortisol measures: baseline, stress-induced, and total. These three measures allow us to break our broad prediction of an inverse relationship between cortisol and political participation into three testable hypotheses:

H1: Higher baseline (non-stress induced) cortisol is negatively correlated with political participation.

H2: Higher cortisol production in response to stressful social situations (stress-induced cortisol) is negatively correlated with political participation.

H3: Overall cortisol levels (total cortisol, or baseline and stress-induced combined) are negatively associated with political participation.

Being able to test both H1 and H2 separately will permit interesting comparisons of the role of cortisol levels that are more routine with cortisol levels that are the result of a socially stressful situation. If the results for these two measures are identical, one interpretation would be that the act of coming to the lab for the session was stressful in and of itself. The correlation between the two measures exceeds .6 but they are conceptually distinct. Differing results may give some indication of whether the effects pertain to people who typically display high cortisol levels or people whose cortisol levels are particularly responsive to social stress.

As a preliminary step we first made sure the measures of political involvement behave in the expected fashion within the sample available to us. In Table 1, we report the bivariate correlations between our composite measure of involvement (voting plus non-voting participation) and the variables we will employ in our multivariate analyses. Here we see that political involvement has the expected strong positive relationships with age, education, and partisan strength (0 = independent; 1 = weak partisan; and 2 = strong partisan), along with a weaker positive relationship with income and virtually no relationship with gender. These correlations are quite consistent with the established literature (for example, education has long been the most powerful single predictor of political participation and, while male political participation levels exceeded those of females for many decades, in recent years they have been similar to or even lower than female participation—see Verba, Schlozman, and Brady 1995).

Table 1 also reports the correlation of political participation and self-reported emotional stability/ neuroticism. This concept was measured with the two items pertaining to this personality dimension in the reduced (10-item) Big Five inventory, a battery that asks respondents to report the extent to which they believe pairs of traits apply to them. The options are strongly agree, moderately agree, agree a little, neither agree nor disagree, disagree a little, disagree moderately, or disagree strongly. The two pairs of descriptors that have been established as tapping the "neuroticism/emotional stability" personality dimension are "anxious, easily upset" and "calm, emotionally stable." Self-evaluations on these two dimensions correlate with each other ($r=.46$, $p <$

.10) so, consistent with previous work on personality (see, for example, Mondak et al. 2010) are combined. We included this self-report measure in order to determine whether information on cortisol levels is useful over and above that coming from individual reflections on the tendency to feel anxious and easily upset as opposed to calm and emotionally stable. Self-reports are certainly easier to collect so if high cortisol people are the same people who report being anxious and easily upset, there would be little reason to go to the trouble of collecting and assaying cortisol.

Self-reported neuroticism is not related to political participation but this result stands in sharp contrast to that for the three cortisol measures. Baseline and total cortisol are strongly, negatively, and significantly ($p < .05$) related to political involvement; stress-induced cortisol shows a weaker relationship, though this is still significant at $p < .10$. These correlations are consistent with our overall prediction of an inverse relationship between cortisol and political participation, but also suggest H1 and H3 offer the best explanations of this relationship. In the bivariate context at least, it appears as though individuals with higher baseline cortisol levels and higher total cortisol are significantly less likely to be involved in politics. Individuals with higher levels of stress-induced cortisol are also less likely to participate, but the relationship here is weaker. The question now becomes whether these relationships persist in a multivariate analysis.

(Table 1 about here)

Such an analysis is presented in Table 2. The first three models (columns) are designed to account for variations in the composite measure of voting and non-voting participation. All three models include the control variables listed in Table 1 plus one of three versions of the cortisol measures. The results of these regression equations indicate that, even controlling for traditional concepts known to be related to political involvement as well as controlling for self-reported neuroticism, baseline cortisol levels are inversely related to political involvement. Stress-induced and total cortisol levels are not significant.

The clear inference here is that baseline cortisol, rather than cortisol production in response to stressful social situations, is a significant biological marker for political participation. Further work with multiple "baseline" readings will permit more confidence in this conclusion; still, our findings are consistent with previous research (see especially Shirtcliff, Granger, Booth, and Johnson 2005) which finds stronger effects for baseline (what they call trait) than for event-specific (what they call state) cortisol levels. It should also be noted that those individuals who register high cortisol levels in the baseline condition are also likely to register the largest total cortisol ($p = .63$; $p < .01$).

(Table 2 about here)

The act of voting has a special place in democratic politics and is in many respects the quintessential act of political involvement, so in the final three models in Table 2 we focus exclusively on voting. Recall that our measure of voting records the number of actual recent elections in which the participant went to the polls, according to public records. When voting—rather than the broader measure of political involvement—is made the variable of interest it becomes clear that voting is the source of the relationship between cortisol levels and overall political participation. Even with the usual controls, including partisan strength and self-reported neuroticism, baseline cortisol is inversely and significantly ($p < .05$) related to propensity to vote, while total cortisol shows the same relationship albeit only at the more generous $p < .10$ level of statistical significance. Again, stress induced cortisol levels are statistically insignificant. To give some indication of substantive significance, the standardized betas for the cortisol measures in the voting models are .26 for baseline cortisol and .19 for total cortisol. The only control variable that consistently exceeds these impacts is age, which has standardized betas running from .25 to .29. Judged by the standardized betas, baseline cortisol actually equals or exceeds the impact on voting of self-reported partisan strength. Standardized betas for the latter are .20 in all three voting models and for all other control variables are a fraction of the comparable beta for cortisol (e.g., in all cases the standardized betas for neuroticism are a tenth of the size for the cortisol measure).

In sum, particularly when baseline, not stress-induced, cortisol levels are employed and particularly when actual voter turnout, not self-reported, non-voting participation, is employed, it is clearly the case that individuals with high cortisol levels are less likely to be involved with politics. This result is a rarity in political science: An individual-level analysis that does not use survey data for either key variable. Objectively measured cortisol levels are correlated with publicly available voting records. Survey data provide only control variables and reveal that objective cortisol levels are not just standing in for other concepts—at least the obvious ones. Quite apart from demographic variables and the extent to which individuals feel stressed and anxious, endocrinological levels have clear and important independent effects on political behavior.

In an initial, exploratory effort to learn more about the psychological mechanisms by which high levels of cortisol might be related to lower turnout, we ran simple bivariate correlations of the three cortisol measures on the one hand and several items tapping feelings toward politics on the other. These items were "I like to think about the implications of politics;" "I just don't understand why people get so worked up about politics;" "nothing beats a good political discussion;" "politics is boring;" "I feel uncomfortable when a political disagreement occurs in my presence;" and "politics is fascinating." We recoded the items so that higher values always indicate more interest in and comfort with politics. As expected, the signs are universally negative, meaning that high cortisol individuals are less keen on politics for a variety of reasons. Most of the correlations are significant for baseline and total cortisol ($p < .05$), but, consistent with the pattern in Tables 1 and 2, only one item is statistically significant for stress-induced cortisol ("I like to think about the implications of politics"). From a comparison of the coefficients, it appears (though there is the possibility of prevarication here) not to be the case that high cortisol individuals report politics to be discomforting, as might have been expected given the profile of high cortisol individuals offered in the literature; rather, high cortisol individuals say they find politics to be puzzling and uninteresting, even boring. An interpretation that fits with these results, as well as with existing knowledge of cortisol, is that low cortisol individuals are more likely to enjoy the stimulation that comes with the contested nature of politics; they find it fascinating and exciting in a fashion that low cortisol individuals do not, perhaps because their cortisol levels are high enough without getting a kick from politics.

Of course, this interpretation is mere speculation at this stage but it is consistent with one other suggestive result. One of the "non-voting" modes of participation included in our index asked research participants whether they had ever held public office, no matter how minor. As might be expected, very few individuals in a typical sample, including ours, meet this stringent criterion; in fact, only four of the 105 individuals on whom we have cortisol data reported holding office. Still, since low cortisol individuals may crave the give-and-take of real politics in a way that high cortisol individuals do not, it is interesting to note the differences between office holders and all others with regard to our two primary cortisol measures. Looking at baseline cortisol levels first, the four office holders have much lower levels than the rest of the sample: mean baseline cortisol for office holders = 4.0 ng/ml; mean for non-office holders = 7.5 ng/ml. In fact, even with so little variation in the "office holder" variable, the difference in baseline cortisol is almost statistically significant in a directional hypothesis test ($t=1.23$, $p=.11$). Turning to stress-induced cortisol production, the differences are even greater. Office holders' average area-under-the curve (intercept) is 240.02 while for non-office holders the corresponding mean is 741.67 and this difference in means, even with just four office holders, achieves statistical significance ($t = 2.0$; $p = .05$). In short, when placed in a socially stressful situation (the TSST), office holders reacted by producing only a third of the cortisol produced by non-office holders (it is potentially instructive that for office holders, unlike for members of the general public, the distinguishing physiological characteristic is their response to socially stressful situations). Whether this diminished cortisol production is a result of having held office or a trait of those attracted to the rambunctiousness of public office in the first place is a question that awaits future research (for one of the few previous studies relevant to this topic, see Madsen 1986).

(Table 3 about here)

Conclusion

These analyses provide strong confirmation of our prediction that cortisol is inversely related with political participation, and more specifically suggest that it is baseline levels of cortisol that are the key indicator and actual voting that is the key dependent variable. Our analysis shows that people with high levels of cortisol in non-political situations are significantly less likely to vote in elections. This effect is over and above the effects of standard demographic variables such as age, education, gender, and income, of political variables such as strength of partisanship, and of personality variables such as self-reported neuroticism. Certain indicators of people's physiological status appear to correlate with their tendency to vote, suggesting one reason for voter apathy is that physiologically instantiated predispositions lead many individuals to experience politics in a fashion that regular voters do not.

Initial reaction to these results might be to consider increasing voter turnout by chemically reducing people's cortisol levels. For numerous reasons, this impulse should be resisted. Manipulating cortisol would affect a variety of behaviors well beyond politics and some of these are likely to be undesirable and potentially even dangerous. Lower baseline cortisol levels and muted cortisol responses to stressful situations are not unreservedly salubrious. It is true that people who are lonely and have low self-esteem often register higher levels of cortisol upon awakening in the morning (Steptoe, Owen, Kunz-Ebrecht, and Brydon 2004) and that Cushing's disease, which is characterized by severe depressive symptoms, abdominal obesity, and bone degeneration, can be alleviated by surgically correcting the reason for the hypercortisolemia (perhaps a tumor on the pituitary or the adrenal gland) in order to reduce cortisol levels (Starkman and

Schteingart 1981). But it is also true that individuals who typically display low cortisol response to stressful situations appear to be more vulnerable to post-traumatic-stress disorder or PTSD (Schelling et al. 2001), a finding with parallels in animal research (Cohen et al. 2006). Moreover, some research indicates an increased likelihood of occupational burnout among individuals with lower than normal cortisol and higher than normal susceptibility to drug-induced suppression of cortisol levels (Pruessner, Hellhammer, and Kirschbaum 1999) though other research comes to different conclusions (McEwen 2007). Politics is only one part of life and taking extreme steps to get people involved in politics may not be worth it if medical and psychological welfare is adversely affected

In weighing the merits of decreasing cortisol to heighten turnout, not only should politics be placed in broader behavioral context but cortisol levels should be seen in a broader physiological context. Cortisol levels are part of a complex, interrelating package of physiological variables. Altering one of these variables without considering the implications for physiology generally is likely to be a source of disruption and potential problems. For example, indications are that, especially in males, a particularly troublesome combination is low cortisol and high testosterone; thus, lowering cortisol levels has the potential of creating behavioral and attentional problems among individuals with high testosterone (Shirtcliff, Granger, Booth, and Johnson 2005). Moreover, if pharmacological manipulation were to be taken seriously, questions would immediately arise over both the degree of reduction necessary to have an effect and the length of time this reduction would need to be sustained. The fact that baseline rather than stress-induced, cortisol is more relevant to politics implies that cortisol reduction treatment may need to be ongoing, making the potential for undesirable side effects even more severe.

With the above in mind, we should stress that the purpose of this research is not to divine a quick and easy, chemical solution to voter apathy but rather to provide a deeper understanding of the biological factors relevant to politics. This understanding, in turn, could have implications for more traditional approaches to increasing turnout. More specifically, by calling attention to the vast individual-level physiological differences that exist in the non-clinical range of the population, our results suggest that efforts to increase voter turnout could be more successful if they were nuanced and targeted. For some individuals, a lack of involvement in politics is traceable to insufficient resources (Verba, Scholzman, and Brady 1995) but for others the cause may be a physiological constitution that makes politics appear pointless and undeserving of the stress that is likely to accompany it. More concerted efforts at ferreting out those individuals for whom resources are and are not the key may allow solutions to low voter turnout to be targeted more effectively.

To take a specific example, consider the intriguing finding that, on average, voter turnout increases if it is made likely that neighbors will find out whether an individual voted (Gerber, Green, and Larimer 2008). It may be that high cortisol individuals would be less easily shamed into going to the polls since their reason for not voting is unrelated to social shame—or a lack of resources, for that matter. The more general point is that specific strategies for enhancing turnout are likely to be differentially successful depending upon cortisol levels and other physiological data. Incorporating endocrinological information into existing knowledge of the environmental situations that tend to enhance turnout has the potential to open up an exciting new approach to research on political involvement. Biological variations—in this case levels of the stress hormone cortisol—are relevant to people's involvement with the political system. Many of the shapers of these biological traits are changeable via treatment and environmental manipulation but the fact that political variables have a biological signature suggests that for certain people change may require a somewhat different strategy than simply telling them that it is their civic duty to vote or browbeating them into joining civic organizations.

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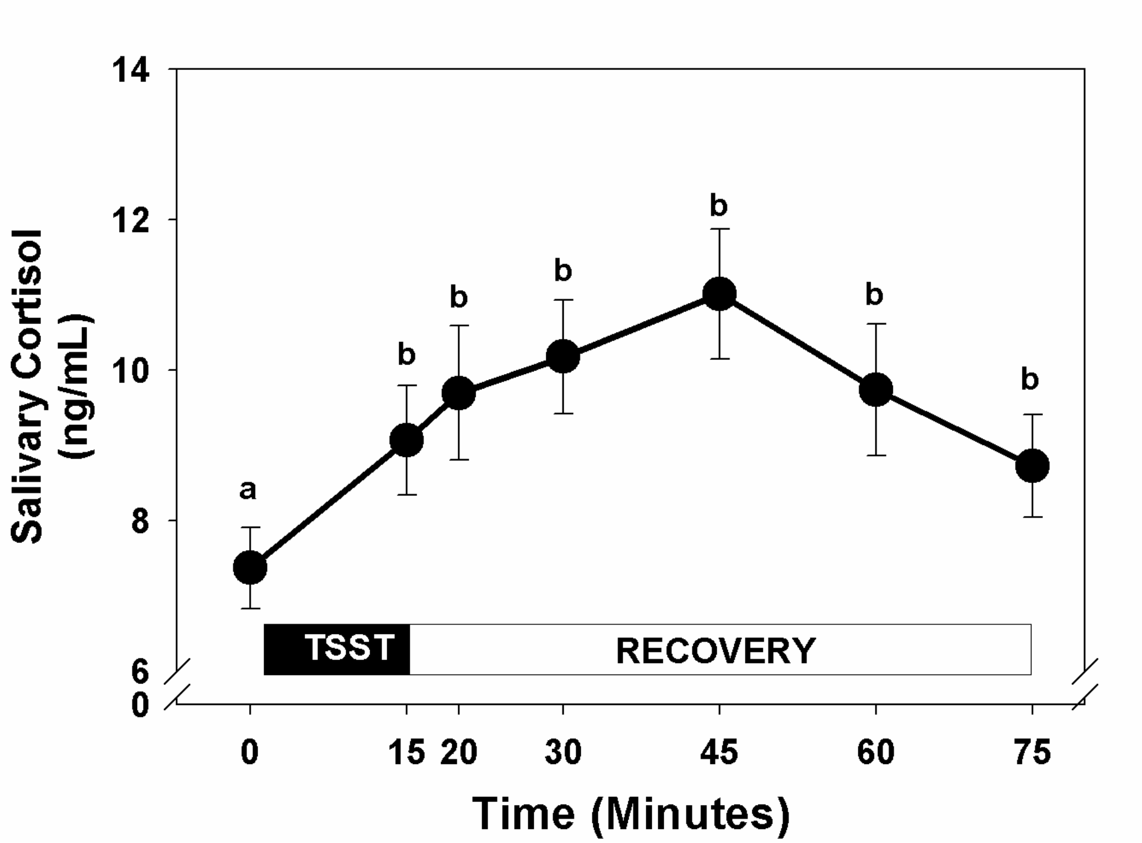
Figure 1: Cortisol Levels and the Trier Social Stress Test



Note: Error bars represent 1 standard deviation

Table 1: Bivariate Correlations

Variable	Participation and Voting
Gender	-.07
Age	.52**
Education	.21**
Income	.12
Partisan strength	.34**
Neuroticism	-.12
Baseline cortisol	-.38**
Stress-induced cortisol	-.17*
Total cortisol	-.33**

** = $p < .05$
N=98

Table 2: Cortisol and Political Participation

Variable	Participation and Voting	Participation and Voting	Participation and Voting	Voting Only	Voting Only	Voting Only
Baseline Cortisol	-.11** (.05)			-.09** (.03)		
Stress-Induced Cortisol		.00 (.00)			.00 (.00)	
Total Cortisol			-.00 (.00)			-.001* (.000)
Neuroticism	-.08 (.11)	-.06 (.11)	-.07 (.11)	-.01 (.07)	-.00 (.07)	-.01 (.07)
Gender	-.05 (.55)	-.23 (.57)	-.24 (.56)	-.14 (.36)	-.29 (.37)	-.28 (.36)
Education	.30 (.19)	.32* (.19)	.29 (.13)	.00 (.12)	.00 (.12)	-.03 (.12)
Age	.09** (.02)	.11** (.02)	.10** (.02)	.04** (.01)	.06** (.01)	.04** (.01)
Income	-.03 (.18)	.03 (.18)	.00 (.00)	.08 (.11)	.13 (.12)	.09 (.12)
Partisan Strength	.96** (.30)	.95** (.30)	.96** (.30)	.41** (.19)	.40** (.20)	.41** (.20)
Constant	.80 (2.4)	-1.15 (2.4)	.23 (2.67)	1.88* (1.6)	.75 (1.63)	2.05 (1.7)
N	95	95	95	95	95	95
F	8.17**	7.10**	7.31**	4.88**	3.72**	4.2**
R-2	.39	.36	.37	.28	.23	.25

Unstandardized coefficients (standard errors) reported. * = p < .10, ** p < .05

Table 3: Cortisol and Political Interest

Item	Baseline	Stress-Induced Cortisol	Total Cortisol
I like to think about the implications of politics *(1=strongly disagree 5=strongly agree)*	**-.29****	**-.17***	**-.27****
I just don't understand why people get so worked up about politics *(1=strongly agree 5=strongly disagree)*	**-.27****	**-.13**	**-.23****
Nothing beats a good political discussion *(1=strongly disagree 5=strongly agree)*	**-.10**	**-.08**	**-.11**
Politics is boring *(1=strongly agree 5=strongly disagree)*	**-.24****	**-.08**	**-.20****
I feel uncomfortable when a political disagreement occurs in my presence *(1=strongly agree 5=strongly disagree)*	**-.02**	**-.07**	**-.06**
Politics is fascinating *(1=strongly disagree 5=strongly agree)*	**-.21****	**-.12**	**-.20****
Combined Scale *(1 to 30, high numbers = strong interest in politics)*	**-.25****	**-.14**	**-.23****

N=105
** = p < .05