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### Supplementary data

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*Research*

# The political left rolls with the good and the political right confronts the bad: connecting physiology and cognition to preferences

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We report evidence that individual-level variation in people's physiological and attentional responses to aversive and appetitive stimuli are correlated with broad political orientations. Specifically, we find that greater orientation to aversive stimuli tends to be associated with right-of-centre and greater orientation to appetitive (pleasing) stimuli with left-of-centre political inclinations. These findings are consistent with recent evidence that political views are connected to physiological predispositions but are unique in incorporating findings on variation in directed attention that make it possible to understand additional aspects of the link between the physiological and the political.

**Keywords:** physiology; cognition; politics

## 1. INTRODUCTION

The most intense cultural conflicts tend to be disputes over the proper way to structure and maintain mass-scale social life. Accordingly, whether within or across national boundaries, disagreements regarding politics (and religion, as the other major force that regulates mass-scale social life) are much more likely to lead to acrimony and even violence than, say, disagreements over preferred personality traits or tastes in art. Politics can affect the lives of others in a way that personality and taste do not. It has been a flash-point over the centuries and serious attempts at understanding cultural conflict must address the reasons for political differences.

What is it that leads individuals—even in nearly identical social milieus—to hold such distinct, often persistent, and potentially explosive political orientations? Traditional social science approaches have ignored the role of biology in these differences and focused on variables directly relevant to political life. Scholars argued over the relative contributions of parental socialization and pertinent adult experiences [1–3], but until recently were little concerned with whether political differences have biological markers. Consistent with the theme of this issue, we test the possibility that differences relevant to cultural conflict are embedded in broad biological processes. In particular, we investigate the possibility that variations

in political orientations within a sample of United States research participants are instantiated in the patterns of each individual's physiological and cognitive responses to emotionally laden stimuli.

A growing body of research finds that political orientations vary with an array of broader constructs such as personality traits [4–7], moral foundations [8,9], core values [10–16], baseline neural structures [17], neural activation in response to unexpected stimuli [18], self-reported sensitivity to threat [19], tendency to perceive threat in faces [20], physiological response to threat [21], sensitivity to disgust [22,23] and possibly even genetics [24,25].

The focus of this previous research often is on responses to reasonably narrow categories of stimuli and equally narrow political attitudes (e.g. does a stronger disgust response correlate with opposition to gay marriage?) and this approach is perfectly reasonable. Human emotion encompasses a wide array of discrete affective states, including fear, anger, sadness and happiness, and each of these affective states activates unique neurophysiological pathways and politically relevant issue attitudes. To take one example, Neuberg *et al.* [26] detail the differences between the self-protection and disease-avoidance systems, with the former closely tied to threat responses and the latter to disgust. Each seems to engage different emotions, inferences and behavioural tendencies, and there is obvious value in studying responses to particular categories of stimuli seriatim.

Still, even amidst these distinct pathways, downstream commonality is present. Responding to an aversive feature of the environment, whether it is indicative of a violation of order, purity or security, must ultimately work via a sympathetic nervous system that will prejudice

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One contribution of 12 to a Theme Issue 'The biology of cultural conflict'.

a broad category of action such as avoiding or approaching [26]. Consequently, in addition to recognizing the uniqueness of individual categories of response, many researchers also have found useful a 'biphasic' model which holds that emotion is a product of varying activation of two motivational systems: appetitive and defensive [27,28]. Both of these systems 'are evolutionarily old, shared across mammalian species and have evolved to mediate the behaviours that sustain and protect life' [29, p. 30]. Gray [30,31] has described these two core systems as the behavioural inhibition system (BIS) and the behavioural activation system (BAS), with the BIS typically activated by aversive stimuli and the BAS activated by appetitive stimuli [32,33].

A conceptualization in which organisms are expected to approach appetitive and avoid negative stimuli is simplistic, but has the additional advantage of putting an equal emphasis on appetitive (that is, positive or pleasant) events and exposures. Previous work on the connection of political orientations and physiological responses has concentrated heavily and perhaps exclusively on aversive stimuli (an unexpected, disorderly event, a threatening occurrence or a disgusting scene) and thus the political implications of variations in response to appetitive situations have not yet been tested. Doing so is important because variations in physiology connected with approach behaviour could have just as much relevance to political orientations as variations in physiology subsequent to exposure to aversive stimuli.

In sum, though individual emotions clearly have unique neural and physiological characteristics, a number of empirical studies recognize the broader biphasic organization of two core motivation systems (aversive and appetitive) that mediate the actions of both the somatic (voluntary) and autonomic (involuntary) nervous systems, which are the proximate causes of behaviour [27,34–38].

This approach-avoidant behavioural dimension and the distinctive responses to appetitive and aversive stimuli that undergird it are likely to be relevant to political orientations. On the whole, people are risk-sensitive in that their physiological responses and cognitive attention are heightened by aversive stimuli, a pattern that makes sense from an evolutionary point of view [26]. Previous empirical research supports this line of thought and, on average, physiological [39] and cognitive [40,41] responses to aversive images outstrip those to appetitive images.

The operative phrase in the preceding passage, however, is 'on average' and substantial individual-level variation probably exists around the averages. Hair-trigger autonomic nervous systems generate rapid and elevated physiological responses to aversive stimuli and chronic sensitivity to violations of security, purity and order may rivet attention on the problematic aspects of the environment. Conversely, heightened physiological response to appetitive stimuli and a chronic craving of new experiential pleasures may lead an individual to devote more attention to appealing aspects of the environment. Whatever the source of these biological and psychological predispositions, people may accordingly self-select, often subconsciously, into situations likely to match their

physiological and cognitive biases, according to the approach-avoidant spectrum. For example, those whose physiology responds strongly to violations of their preferences for protection, purity and order and are known to devote high levels of attention to such violations, are likely to take steps in their personal lives to avoid situations in which they encounter violations of security, purity and order. In other words, these individuals may be more likely to display the personal values of tradition, conformity and security. On the other hand, those whose physiology responds strongly to stimuli portraying desirable situations and experiences, and/or those who devote relatively high levels of attention to appetitive stimuli may be more likely to subscribe to the personal values of hedonism, stimulation and self-direction [15].

Further, and more to the point of the present study, these individual-level physiological and cognitive variations are likely also to be correlated with political preferences. After all, political decisions affect the kind of environment in which one exists. Our theoretical assumption is that individuals will take steps to shape their environment into one that is as consistent as possible with their pre-existing physiological and cognitive tendencies. They do so by adopting certain personal values and by advocating certain political positions. From this perspective, it makes sense that people who are more attentive and responsive to hedonic stimuli would support tax dollars being spent on the arts and national parks, just as it makes sense that people who are more attentive and responsive to aversive stimuli would advocate policies promoting moral purity and harsh treatment for norm violators.

This theory is supported by recent evidence that individuals' personal values correlate with their political values [42] as well as evidence that people's political values are related to their motivations in making moral decisions. Those who, in relative terms, stress minimizing harm and maximizing equality tend to be left-of-centre in their political beliefs and those who stress purity and authority tend to be right-of-centre [8,9]. The missing links are (i) evidence that individuals to the right-of-centre do indeed respond more physiologically to aversive stimuli, while individuals to the left-of-centre respond more physiologically, in relative terms, to appetitive stimuli and (ii) evidence that individuals to the right-of-centre pay more attention to aversive than to appetitive stimuli while those to the left-of-centre pay more attention, in relative terms, to appetitive than to aversive stimuli. In the research described in §2, we provide initial evidence on these very points: first, that physiological responsiveness varies predictably across the political spectrum and, second, that patterns of attention also vary across the political spectrum in a fashion that complements the physiological results.

## 2. STUDY 1: PHYSIOLOGICAL RESPONSE

In the summer of 2007, 200 participants were brought to a computer laboratory in Lincoln, Nebraska, USA, to complete a survey soliciting their political, personality and demographic information subsequent to their having been contacted by phone at random by a

professional survey organization. Though in no way a representative sample, this group has the advantage of not being restricted to college undergraduates and, relatedly, having reasonably representative demographic characteristics given the target population: mean age = 42; 52 per cent female; mean income in the \$40 000–60 000 range; and mean educational level = some college. These 200 were intended to serve as a pool from which smaller groups could be culled for physiological testing. The particular group employed in the analysis here consisted of 48 individuals who were called back later that summer. They were selected because of availability and because they were the individuals most clearly falling on either the political left or the political right according to the survey responses provided during their first visit. Participants were paid \$50 for each of their two separate trips to the laboratory. The data on two participants had to be removed, one owing to a health issue, the other owing to a mechanical problem with a sensor.

To measure political orientation, several variables were combined. Since a US sample was used in our analyses, we used party labels, ideological labels and individual political issues that would be familiar to such a group. Thus, participants were asked to (i) report their ideological position on a scale running from strong liberal (left) to strong conservative (right), (ii) report their partisan affiliation, from strong Democrat (left) to strong Republican (right), (iii) answer 28 items on their specific policy preferences presented in the well-known Wilson–Patterson format [43], and (iv) complete a social principles index. The latter presented subjects with 15 forced choices between basic principles of social organization. As an example of items in this last category, participants indicated whether ‘society works best when ... those who break the rules are punished ... or ... when those who break the rules are forgiven’ ([44]; a full listing of these and the Wilson–Patterson items can be found in electronic supplementary material, appendices A and B). For both the Wilson–Patterson issue items and the ‘society works best’ items, an additive index was constructed (with the position on the political right always given the higher coding). These four diverse measures of political orientation are fairly strongly related, with bivariate correlations ranging from 0.57 to 0.75 ( $p < 0.05$  in all cases) and with a factor analysis confirming that these four measures tap into a single dimension (a principal components analysis yielded a single factor accounting for approx. 75% of the variance, and factor loadings for the individual variables were 0.79 or higher). The four indicators were weighted equally and added together to create a broad measure of left–right political orientation.

In the physiological session, participants were shown a series of 33 still images. Each image was shown once and was preceded by a fixation point that was displayed during an inter-stimulus interval. The order of slides was initially randomized and then presented in the same order to all participants. During the slide show, electrodermal activity (in the form of skin conductance readings) was collected

using a pair of Ag|AgCl electrodes and standard psychophysiological equipment. Since eccrine glands release moisture as part of sympathetic nervous system activation, and since the rate of movement of electricity across the surface of the skin is a good indicator of the presence of moisture, electrodermal activity has long been accepted as a fairly direct and pure representation of sympathetic activity, making it a good measure of the psychological concepts of emotion, arousal and attention. [45]. There are a number of approaches to measure skin conductance level (SCL) response to a stimulus; a common approach is to measure SCL at two different time points, which can be reported either as a raw or adjusted difference, or as a percentage or proportion [45,46]. This approach has the advantage of providing a means to control for wide variation in baseline electrodermal activity and is the approach followed here. SCLs for each image were measured as a proportion of the SCL recorded while the participant was viewing the fixation point prior to image exposure. This creates a standardized measure where 1 denotes no change in SCL between viewing a fixation point and an appetitive/aversive image, and numbers greater than 1 indicate an SCL increase. Several other measurement approaches were constructed to capture the difference between SCL during fixation point and SCL during image exposure, including calculating raw first differences and differences in logged means. The resulting variables were all correlated at levels greater than 0.90, and we report the proportion measure because it lends itself to easy and intuitive interpretation.

All of the images used in the present study were rated by 126 independent judges (none of whom was a participant in the studies reported here) who were asked to rate image valence on a nine-point scale whether each image gave them ‘happy/positive’ [1] or ‘unhappy/negative’ [9] feelings and to rate how strongly they felt an emotional reaction when looking at the image. Based on these ratings, the three most negatively valenced and the three most positively valenced images were selected for use during the physiological session. The negative (aversive) images were a spider on a man’s face (mean valence rating 7.65, s.d. = 1.68), an open wound with maggots in it (mean valence rating 7.94, s.d. = 1.15), and a crowd fighting with a man (mean valence rating 7.83, s.d. = 1.16). The three images judged to be the most positive (appetitive) were of a happy child (mean valence rating = 4.94, s.d. = 2.33), a bowl of fruit (4.36, s.d. = 2.21) and a cute rabbit (4.62, s.d. = 2.33). Raters were also asked to report the specific emotion they felt when looking at each image. The most frequently reported emotion for the spider image was fear (78% of raters reported the image evoked this emotion), for the maggot image, the most frequently reported emotion was disgust (96%), and for the crowd fighting with a man, the most frequently evoked emotion was anger (76%). Thus, these images would seem to capture an array of different negative emotional responses. Positive emotions have fewer discrete categories and, according to the raters, the most frequently evoked emotion for all three appetitive images was happiness.



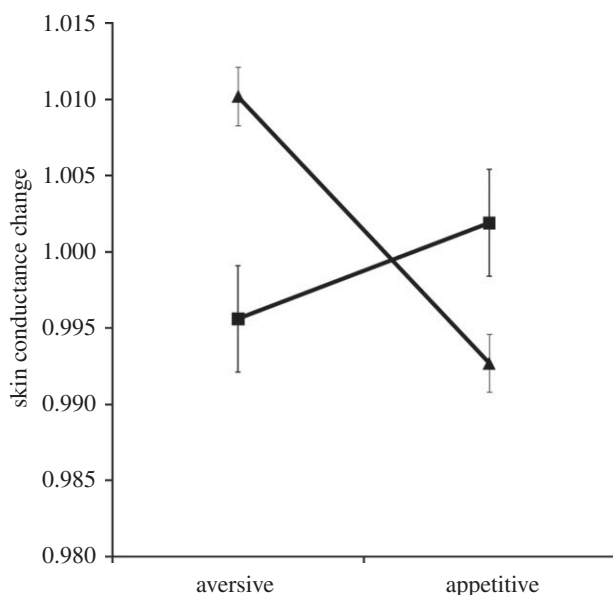


Figure 1. Mean skin conductance change (in microsiemens) as a function of political temperament (left versus right) and image type (appetitive versus aversive). Triangles with solid line, right-of-centre; squares with solid line, left-of-centre.

The relation between political temperament and electrodermal increases in response to aversive/appetitive images was initially examined by dividing participants at the mean on the composite measure of political orientations and then plotting separately the physiological response for the left-of-centre and right-of-centre groups. The consistent empirical finding in psychophysiology is that, while participants exhibit an enhanced physiological response to both appetitive and aversive stimuli, the response is typically greater for aversive stimuli [39]. Consistent with the theory outlined above and with previous research on narrower emotions [18,21], the hypothesis is that individuals on the right side of the political spectrum will exhibit increased electrodermal activity when viewing aversive images while those on the left side will exhibit increased electrodermal activity, in relative terms, when viewing the appetitive images. This prediction is confirmed by a 2 (image type: appetitive versus aversive)  $\times$  2 (ideology: left versus right) mixed analysis of variance (ANOVA) as there is a significant interaction between image type and ideology ( $F = 5.60$ ;  $p < 0.05$ ). As can be seen in figure 1, electrodermal increases for those on the political right are greater for aversive relative to appetitive images, whereas for those on the political left the opposite pattern of results is exhibited.

Though these initial findings are suggestive, political orientations are better characterized as continuous rather than dichotomous since many individuals are political moderates rather than ideologues. Moreover, other variables besides physiological patterns are likely to be relevant to political orientations. Therefore, we regressed the continuous measure of political orientation on the mean difference in physiological response depending on stimulus type (skin conductance increase in response to appetitive subtracted from skin conductance increase in response to

Table 1. Predicting political orientations with differential skin conductance reactivity to appetitive and aversive images. Dependent variable is an aggregate of standardized scores on the Wilson–Patterson index, society works best items, a seven-point political ideology scale and a seven-point party identification scale, scored such that higher values indicate political orientations towards the right of the political spectrum.

|                               | estimated coefficient | standard error |
|-------------------------------|-----------------------|----------------|
| skin conductance <sup>a</sup> | 12.17**               | 4.13           |
| age                           | -0.04                 | 0.02           |
| gender                        | -0.36                 | 0.30           |
| income                        | -0.09                 | 0.10           |
| education                     | -0.25*                | 0.10           |
| constant                      | 5.66                  | 0.59           |
| $n = 46$                      |                       |                |
| $R^2 = 0.39$ ;                |                       |                |
| adj. $R^2 = 0.31$             |                       |                |

<sup>a</sup>Degree to which skin conductance increases were greater for aversive than appetitive stimuli.

\* $p < 0.05$ ; \*\* $p < 0.01$  (two-tailed tests).

aversive), as well as on four standard demographic controls: age, gender, income and education. Higher values on the composite measure of political ideology indicate right-of-centre orientations and higher values on the physiological measure indicate relatively greater electrodermal increases to aversive stimuli, meaning that a positive relationship is expected. As can be seen in table 1, only one of the control variables is significantly related to political orientations: increasing levels of education correlate with left-of-centre political orientations. Importantly, however, relatively greater electrodermal increases when viewing aversive stimuli are indeed a strong predictor of right-of-centre political beliefs ( $b = 12.17$ ;  $p < 0.01$ ).

A parallel but more politically focused test of this hypothesis is afforded by the fact that people who care about politics (such as the group of participants being analysed here) are likely to find visible political figures to be either appetitive or aversive. Though there could be numerous reasons for a politician to be viewed favourably or unfavourably, an important factor for most politically attuned individuals is the degree of ideological similarity between themselves and the politician in question. A politician with an ideology that is consistent with that of the respondent is more likely to be viewed as appetitive, whereas a politician with an ideology that is inconsistent with that of the respondent is more likely to be viewed as aversive. Given the results in figure 1, we hypothesized that the electrodermal responses of individuals on the right would be greater, in relative terms, to ideologically dissimilar politicians, whereas the electrodermal responses of individuals on the left would be greater, in relative terms, to ideologically similar politicians. Kaplan *et al.* [47] report that neural activity in the dorsolateral pre-frontal cortex, the anterior cingulate cortex and the insula increased when political partisans viewed images of candidates from the opposing party (compared with images of the favoured party),

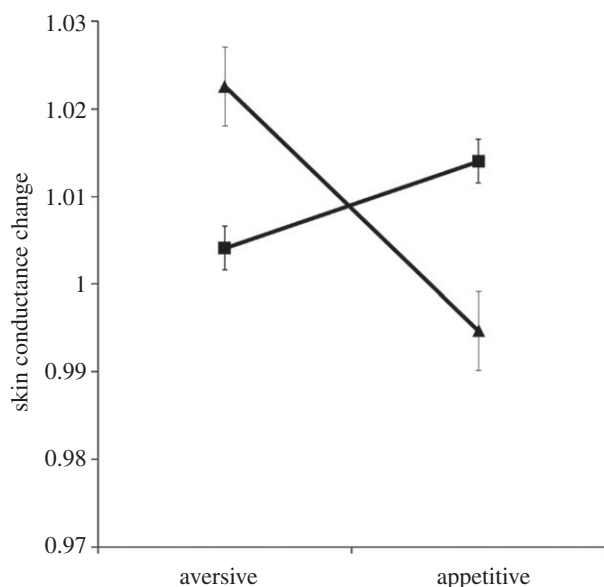


Figure 2. Mean skin conductance change (in microsiemens) as a function of political temperament (left versus right) and political image type (appetitive versus aversive). Triangles with solid line, right-of-centre; squares with solid line, left-of-centre.

but these researchers did not analyse partisan groups separately, meaning it is unknown whether activation to the opposing party was more noticeable among those on the right than among those on the left.

Images of well-known American political figures were included in the 33 stimuli presented; specifically, pictures of Ronald Reagan, Bill Clinton, Hillary Clinton and George W. Bush. These four seem appropriate since at the time of the study (summer of 2007), Barack Obama, John McCain and Sarah Palin had not yet arrived on the national political scene and pre-tests indicated that many participants could not identify pictures of other important national politicians, including (then Vice President) Richard Cheney, (then Speaker of the House) Nancy Pelosi and the previous two Democratic presidential nominees: John Kerry and Al Gore.

To test the hypothesis that left-of-centre participants respond more to ideologically similar (appetitive) politicians while right-of-centre participants respond more to ideologically dissimilar (aversive) politicians, a definition of ideological similarity is necessary. The ideology of the aforementioned four politicians is relatively easy to categorize. As of mid-2007, Bill and Hillary Clinton were nationally visible politicians associated with the left, just as George W. Bush and Ronald Reagan were highly salient touchstones of the right. Indeed, polls at the time suggested that George W. Bush and Hillary Clinton were the most polarizing political figures in American politics—and Ronald Reagan and Bill Clinton, as former two-term presidents on quite different sides of the ideological ledger, were still able to incite passions. The ideology of those participating in the physiological exercise was assessed with the same composite measure as before and the central measure of physiological change was again mean increase in the participants' SCLs from the preceding inter-stimulus interval to the images (pictures of politicians) in question.

Table 2. Predicting political orientations with differential skin conductance reactivity to ideologically similar and ideologically dissimilar political images. Dependent variable is an aggregate of standardized scores on the Wilson–Patterson index, society works best items, a seven-point political ideology scale and a seven-point party identification scale, scored such that higher values indicate political orientations towards the right of the political spectrum.

|                                   | estimated coefficient | standard error |
|-----------------------------------|-----------------------|----------------|
| skin conductance <sup>a</sup>     | 8.99**                | 3.63           |
| age                               | −0.03                 | 0.02           |
| gender                            | −0.39                 | 0.31           |
| income                            | 0.01                  | 0.11           |
| education                         | −0.29**               | 0.10           |
| constant                          | 5.42                  | 1.14           |
| <i>n</i> = 46                     |                       |                |
| <i>R</i> <sup>2</sup> = 0.35;     |                       |                |
| adj. <i>R</i> <sup>2</sup> = 0.27 |                       |                |

<sup>a</sup>Degree to which skin conductance increases were greater for ideologically dissimilar than for ideologically similar politicians.

\**p* < 0.05; \*\**p* < 0.01 (two-tailed tests).

Figure 2 presents the electrodermal response of participants on the left and participants on the right to images of politicians either ideologically similar to or different from the participant. As expected, the pattern of responses is similar to what was observed in figure 1. The increase in electrodermal activity of right-of-centre participants is greater for politicians with whom they are in ideological disagreement than for politicians with whom they are in ideological agreement, whereas the electrodermal activity of left-of-centre participants is greater for politicians with whom they are in ideological agreement than for politicians with whom they are in ideological disagreement. This was confirmed by a 2 (image type: appetitive versus aversive) × 2 (ideology: left versus right) ANOVA as there is a significant interaction between image type and ideology (*F* = 10.86; *p* < 0.01) but no other significant effects or interactions. Thus, whether the focus is on generically aversive/appetitive stimuli or on specifically political stimuli, the results suggest that individuals on the left are more responsive to appetitive relative to aversive stimuli, while individuals on the right are more responsive to aversive relative to appetitive stimuli.

Converting political orientation from a dichotomous to a more appropriate continuous form and adding the same controls as included in table 1 underscores these conclusions. As can be seen in table 2, political orientation is strongly predicted by electrodermal response to ideologically similar and dissimilar political figures. The further respondents are to the political right, the more their electrodermal response to negative images tends to outstrip their response to positive images (*b* = 8.99; *p* < 0.01). The control variables are, again, not significantly related to political orientation with the exception that increasing levels of education are associated with left-of-centre political orientations. Further tests should be run in case there is something particular about the political images employed here

but these initial indications are consistent with the results in table 1 and figure 1.

### 3. STUDY 2: ATTENTIONAL PATTERNS

Though physiology constitutes one element of orientation to categories of stimuli, a more complete understanding of the manner in which individuals are situated with respect to the aversive and the appetitive in life can be obtained by determining if individuals have attentional biases to particular stimulus types. Accordingly, we designed and administered a freeview eyetracking study in which individuals could direct their gaze towards either appetitive or aversive images when both types are present.

Participants in this study were undergraduates drawn from the psychology student subject pool at the University of Nebraska-Lincoln. Using an SR Research Ltd. EyeLink II system connected to a Pentium IV PC, participants were seated approximately 44 cm from the computer screen and viewed a series of collages for 8 s each, during which time participants were free to view the images in any manner they desired. At the end of the viewing period, a fixation point appeared on the screen until the space bar was pressed by the participant to initiate viewing of the next collage. Each collage was composed of four equally sized images, most taken from the IAPS database of pre-validated images [48] and others previously pre-rated from a separate study. Appetitive images were drawn from the top 20 per cent of positively rated images and aversive images were taken from the top 20 per cent of negatively rated images. Six of the collages contained three aversive images and one appetitive image, and six other collages contained three appetitive images and one aversive image. Critically, all participants saw the same set of collages.

The eyetracker allows for real-time recording of gaze behaviour, making it possible to document where in the collage the participant looks, when, and for how long. As such, our investigation focused on two critical measurements: Dwell time (ms)—the amount of time spent on each image in the collage, and first fixation time (ms)—the amount of time elapsing relative to the onset of the trial before participants look at each image type. To calculate gaze orientation to aversive as opposed to appetitive stimuli, the mean total amount of time the participants fixated the aversive quadrant (for those six trials on which such an image was the unique quadrant) was determined. The same calculation was then made for those six trials in which the appetitive image was the unique quadrant. Importantly, eyetracking is the only attentional measure that allows for an examination of not only bias towards specific items, but also avoidant behaviour. Given that those on the right exhibit greater increases in electrodermal activity when viewing aversive stimuli, it is worthwhile to determine whether they are biased towards or away from aversive stimuli when given a choice of multiple images to view.

To determine political orientation, participants were asked to indicate party identification, in addition to completing the Wilson–Patterson issue battery and

the ‘society works best’ battery of broader political preferences (see electronic supplementary material, appendices). As before, these indicators are combined by first weighting them equally and then creating an additive index. These procedures allowed each participant to be assigned an overall ideological score, with higher numbers indicating location further to the political right. Dividing these scores at the median makes it possible to divide participants into those who are (in relative terms) on the left and those who are on the right. Given that the control variables in the previous study were unrelated to political orientation (except for education, which would be invariant for this student sample), they were not collected here. Seventy-six participants completed both the eye gaze exercise and all the necessary survey items. The mean dwell time results for both collage types (single aversive image versus single appetitive image) can be observed in figure 3 separately for the 38 participants furthest to the left and then for the 38 participants furthest to the right.

A 2 (image type: appetitive versus aversive)  $\times$  2 (collage type: single aversive versus single appetitive)  $\times$  2 (ideology: left versus right) mixed ANOVA revealed a main effect of image type ( $F = 41.14$ ;  $p < 0.01$ ) as aversive stimuli are given more attention overall than appetitive stimuli. As mentioned above, from an evolutionary standpoint, this pattern makes sense since aversive stimuli can do harm and therefore merit more attention than stimuli that seem pleasant and probably harmless [26]. There is also a main effect of collage type ( $F = 34.04$ ,  $p < 0.01$ ), as an increase in the number of aversive images led to differences in dwell time for the various image types, as also indicated by a significant image type  $\times$  collage type interaction ( $F = 21.36$ ,  $p < 0.01$ ). Moreover, there is a main effect of ideology ( $F = 7.09$ ;  $p < 0.01$ ), but the critical test of the hypothesis that individuals on the political right pay more relative attention than individuals on the political left to aversive stimuli is the interaction between image type and ideology. This interaction is significant ( $F = 3.75$ ;  $p = 0.057$ ). Those on the left devote more attention to aversive than appetitive images; however, as expected, this ‘aversion bias’ is much more pronounced for the politically right half of the sample. For both trial types (single aversive versus single appetitive), in relative terms, individuals on the right spend a greater amount of time gazing at aversive images while individuals on the left spend a greater amount of time gazing at appetitive images.

Though total dwell time is an important measure, additional insight can be drawn from analysing first fixation time—the amount of time that elapses after the onset of the trial before participants look at each image type. Dwell time results relate to the total time spent gazing at an image, while first fixation time provides a measure of attentional bias in terms of how quickly an aversive or appetitive image is fixated. It is important to note that whereas large dwell time values are indicative of an attentional bias towards an image, small (rather than large) first fixation time values are also indicative of an attentional bias towards an image as lower values are representative of faster

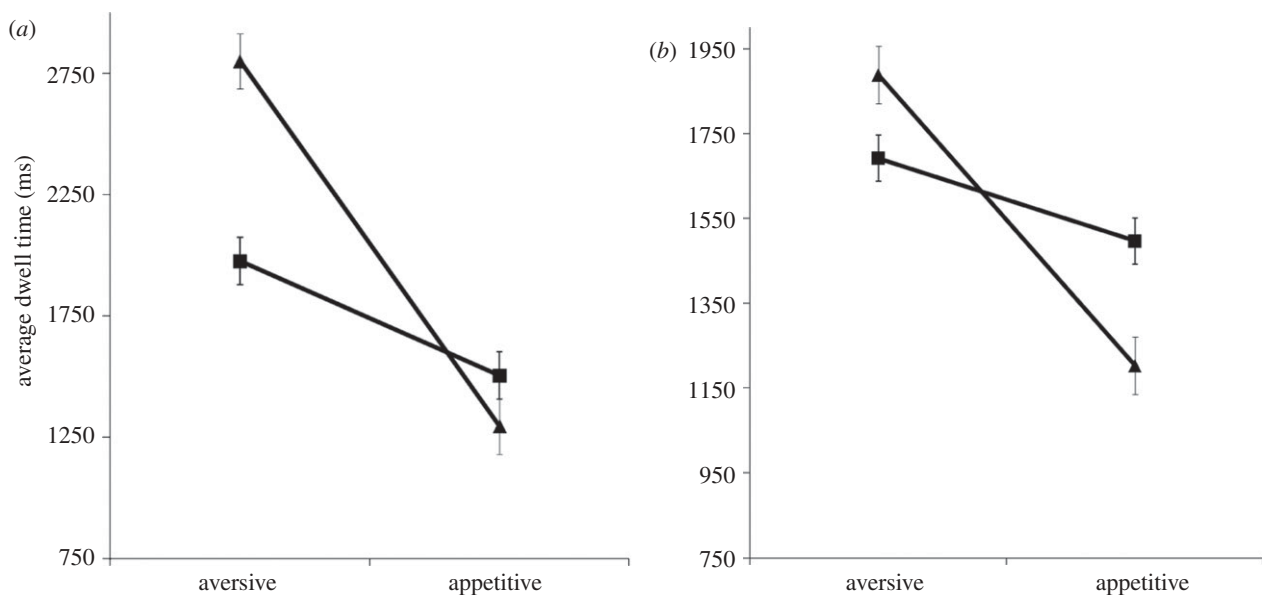


Figure 3. Mean dwell time values (in milliseconds) as a function of image type and trial type for left-of-centre and right-of-centre participants. (a) Represents dwell time on trials in which three appetitive and one aversive image are presented (predominantly appetitive), whereas (b) represents dwell time on trials in which one appetitive and three aversive images are presented (predominantly aversive). Note that the values reported are the average dwell time for each individual image, so on a trial with three appetitive images, the total dwell time for all appetitive stimuli would be the reported number multiplied by 3. Triangles with solid line, right-of-centre; squares with solid line, left-of-centre.

orientation. Consistent with theory and the results above, we hypothesize that, relative to those on the left, those on the right will be faster to orient to aversive images.

All of the main effects and interactions observed in the dwell time analyses above are also observed for the first fixation time analyses, with the exception of there being no main effect of political orientation ( $F = 75.08$ ,  $p < 0.01$  for the main effect of image type;  $F = 7.28$ ,  $p < 0.01$  for the main effect of collage type, and  $F = 8.26$ ,  $p < 0.01$  for the interaction between image type and collage type). Critically, however, there is again an interaction between image type and ideology ( $F = 10.62$ ,  $p < 0.01$ ). As can be seen in figure 4, those on the political left fixate appetitive images more quickly than those on the political right while those on the political right are faster to fixate aversive images relative to participants on the political left.

As in the physiology study, these findings can be enriched by using a continuous rather than dichotomous measure of political orientation. The continuous version of the composite measure of political orientation correlates with attentional bias towards aversive stimuli as it relates to both dwell time ( $r = 0.32$ ;  $p < 0.01$ ) and first fixation time ( $r = -0.19$ ,  $p < 0.05$ ). These correlations further confirm that political orientations tending towards the right of the spectrum are associated with both faster orienting towards, and greater total time spent attending to, aversive relative to appetitive images whereas the opposite is true for participants on the left of the ideological spectrum.

#### 4. DISCUSSION

Research placing politics in a deeper biological context is growing, and helpful reviews are available [49,50] but research focusing directly on the physiological

and especially cognitive differences of individuals with specific ideological leanings is still in its infancy. Our goal here was to further understand the nature of political differences by combining physiological and attentional measures in the same study. Doing so permits useful interpretational advances.

Our core finding is that, compared with individuals on the political left, individuals on the right direct more of their attention to the aversive despite displaying greater physiological responsiveness to those stimuli. This combination of physiological and attentional data is worth considering further. Previous research on the broader bases of political ideology is often interpreted as suggesting that locations on the right of the political spectrum are a deviation from the norm (or even a pathology) in need of explanation [10,51]. For example, McClosky [52, p. 40] concludes those on the right are 'distrustful of differences... fear change, dread disorder, are intolerant of nonconformity, and derogate reason' while Block & Block [53, p. 395] find that those on the right are 'easily victimized, easily offended, indecisive, fearful, rigid, inhibited, relatively over-controlled and vulnerable'.

Demonstrating that those on the right not only respond more strongly to aversive images but also devote more attention to aversive images suggests a different and perhaps less value-charged interpretation of those holding right-of-centre political orientations. It appears individuals on the political right are not so much 'fearful' and 'vulnerable' as attuned and attentive to the aversive in life. This responsiveness and attentiveness, in turn, is consistent with the fact that right-of-centre policy positions are often designed to protect society from out-group threats (e.g. by supporting increased defence spending and opposing immigration) and in-group norm violators (e.g. by supporting traditional values and stern penalties for



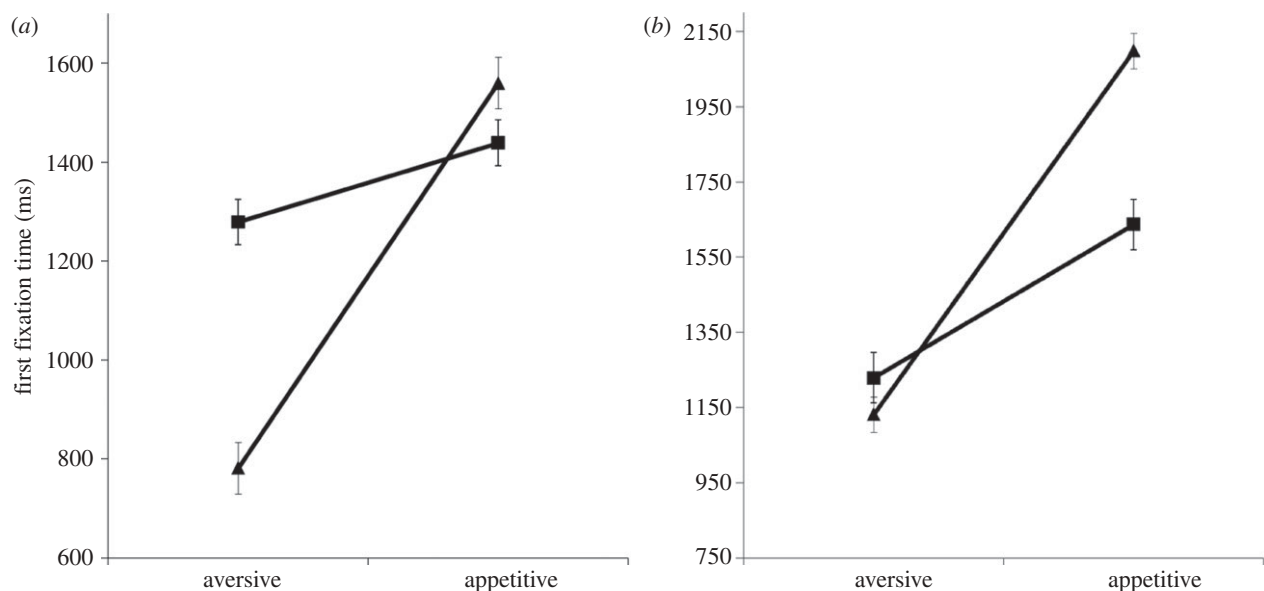


Figure 4. First fixation time values (in milliseconds) as a function of image type and trial type for left-of-centre (square with solid line) and right-of-centre participants (triangle with solid line). (a) Represents first fixation time to image types on trials in which three appetitive and one aversive image are presented (predominantly appetitive), whereas (b) represents first fixation time to image types on trials in which one appetitive and three aversive images are presented (predominantly aversive). Note that unlike dwell time—in which large values represent a greater attentional bias towards an image—small first fixation time values represent a greater attentional bias towards an image given that the lower the value, the faster the image was fixated.

criminal behaviour). Rather than using colourful adjectives, perhaps, the proper approach is simply to state that the aversive in life appears to be more physiologically and cognitively tangible to some people and they tend to gravitate to the political right.

As such, these results suggest that a simple distinction between approach and avoidant behaviours may be incomplete. Quite apart from whether an aversive situation is approached or avoided, it apparently is possible to attend to it even when it generates substantial physiological response. This is precisely the pattern in evidence among many of those on the political right. Seen from this perspective and given the compelling evolutionary logic for organisms to be particularly sensitive to aversive stimuli [26], it may be that those on the political left are more out of step with adaptive behaviours. The question becomes why those on the left display so little aversion bias either in their physiology or, to a lesser extent, in their patterns of attention despite the acknowledged adaptive value of an aversion bias. Of course, the naturalistic fallacy reminds us that behaving in an adaptive fashion does not necessarily equate with behaving in a desirable fashion.

Be this as it may, the central message of these findings is not that one political orientation is somehow superior to the other but rather that, in light of the connection between location on the political spectrum and physio-cognitive differences, those on the political right and those on the political left may simply experience the world differently. It is probably because of these differences that some on the right view those on the left as hedonists who ignore pressing issues while some on the left view those on the right as doomsayers who obsess over constructed threats and problems.

What does the evidence that political orientations are grounded partially in physiological and cognitive

experiential differences mean for cultural conflict? At first blush, the implications may appear dire; after all, the absence of an objective reality would seem to render fruitless any attempt at reasoning towards an optimal political solution. On the other hand, for several reasons, the normative implications regarding cultural conflict may not be the cause for alarm. First, our physiological study was weighted towards participants with strong political beliefs and therefore the results do not reflect the large percentage of individuals who probably are not physio-cognitively predisposed towards any political orientation. These individuals, often found in the political centre, likely are open to efforts at political persuasion.

Second, many of the individuals who do display politically relevant physiological and cognitive predispositions may be capable of changing. The ultimate source of physiological and cognitive predisposition is still to be determined (our results say little about ultimate sources), but is almost certainly a combination of genetics, early developmental experiences and more immediate environmental events. Physiological, neurological and cognitive patterns, for example, are known to be relatively stable over time [54] but hardly immutable [55]. What is suggested by our results is that for many, but certainly not all, of those individuals professing ideological convictions, their political beliefs have become biologically instantiated in a fashion that renders them sticky and slow to change—somewhere between wholly static and completely malleable. Evidence that political orientations are often physiologically and cognitively instantiated leads to the conclusion that change is possible but likely grudging and indeed this phrase seems an apt description of the lack of fluidity of the political positions of those with strong orientations. This evidence also implies that distinct campaign and advertising appeals are likely to be

differentially effective for those on the political right and those on the political left.

Finally and most hopefully, the choice available to society is not between people whose political orientations are either completely changeable or to some extent biologically predisposed. Rather, the choice is between recognizing that physiological and cognitive patterns lead to politically relevant variations in the manner in which the outside world is experienced or, alternatively, pretending that political orientations are rational, free-floating and unencumbered. Given this choice set, we suggest that there are real advantages to embracing the relevance of these deeper, biological variables. After all, it is far easier to tolerate differences if they are recognized to be in part biologically based (consider the debate over homosexuality where those acknowledging a biological source are typically more tolerant than those maintaining sexual preference is entirely environmentally determined). Rather than believing those with political views opposing ours are lazily uninformed or wilfully obtuse, political tolerance could be enhanced and cultural conflict diminished if it is widely recognized that at least part of our political differences spring from subconscious physiological and cognitive variations that lead people to experience the world in fundamentally different ways and therefore to believe that fundamentally different political policies are appropriate.

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