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Neurocognitive correlates of liberalism and conservatism

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Political scientists and psychologists have noted that, on average, conservatives show more structured and persistent cognitive styles, whereas liberals are more responsive to informational complexity, ambiguity and novelty. We tested the hypothesis that these profiles relate to differences in general neurocognitive functioning using event-related potentials, and found that greater liberalism was associated with stronger conflict-related anterior cingulate activity, suggesting greater neurocognitive sensitivity to cues for altering a habitual response pattern.

Political scientists and psychologists have long noted differences in the cognitive and motivational profiles of liberals and conservatives in the USA and elsewhere. Across dozens of behavioral studies, conservatives have been found to be more structured and persistent in their judgments and approaches to decision-making, as indicated by higher average scores on psychological measures of personal needs for order, structure and closure[1]. Liberals, by contrast, report higher tolerance of ambiguity and complexity, and greater openness to new experiences on psychological measures. Given that these associations between political orientation and cognitive styles have been shown to be heritable, evident in early childhood, and relatively stable across the lifespan[2,3], we hypothesized that political orientation may be associated with individual differences in a basic neurocognitive mechanism involved broadly in self-regulation.

Behavioral research suggests that psychological differences between conservatives and liberals map onto the widely-studied self-regulatory process of conflict monitoring[4]. Conflict monitoring is a general mechanism for detecting when one's habitual response tendency is mismatched with responses required by the current situation, and this function has been associated with neurocognitive activity in the anterior cingulate cortex (ACC)[5]. For example, in the Go/No-Go task used in our study, participants must quickly respond to a frequently presented Go stimulus, such that the 'Go' response becomes habitual. However, on a small proportion of trials, a No-Go stimulus appears, signaling that one's habitual response should be withheld. Hence, a No-Go stimulus conflicts with the prepotent Go response tendency. Such response conflict is typically associated with enhanced ACC activity, measured using functional magnetic resonance imaging or event-related potentials (ERPs)[6,7]. We proposed that differences in conservatives' and liberals' responsiveness to complex and potentially conflicting information relates to the sensitivity of this general mechanism for monitoring response conflict.

To test the hypothesis that political liberalism (versus conservatism) would be associated with greater conflict-related ACC activity, we recorded electroencephalographs from 43 right-handed subjects (63% female) as they performed the Go/No-Go task. Subjects reported their political attitudes confidentially on a –5 (extremely liberal) to +5 (extremely conservative) scale. This single-item measure has been found to account for approximately 85% of the statistical variance in presidential voting intentions in American National Election studies between 1972 and 2004 (ref. 8). Among participants in the present study who reported voting in the 2004 presidential election, a more liberal (versus conservative) ideological orientation strongly predicted voting for John Kerry versus George Bush ($r(21) = 0.79$, $P < 0.001$).

In our study, conflict-related ACC activity was indexed by two ERP components. ERPs are scalp-recorded voltage changes reflecting the concerted firing of neurons in response to a psychological event. The response-locked error-related negativity (ERN), which peaks at approximately 50 ms following an incorrect behavioral response[9,10], reflects

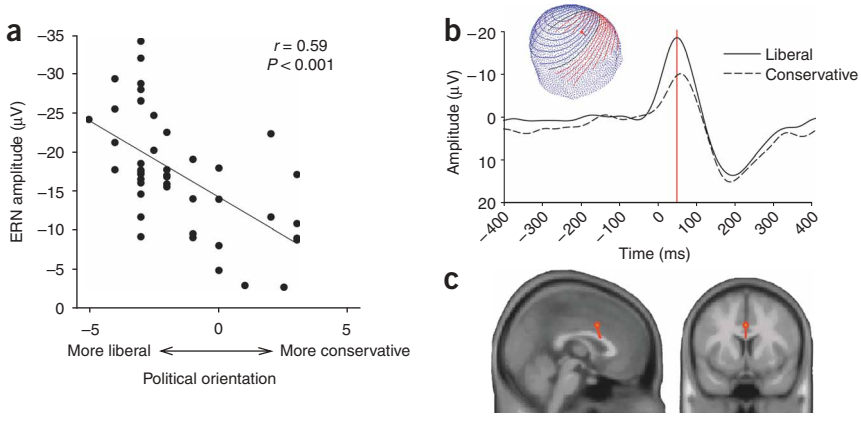

Figure 1 The relation between political orientation and a neurocognitive index of conflict monitoring. (**a**) Political liberalism was associated with larger No-Go error-related negativity (ERN) amplitudes, as indicated by more negative scores, suggesting greater neurocognitive sensitivity to response conflict. (**b**) ERP waveforms corresponding to No-Go errors, with the waveform for correct Go responses subtracted, are shown for both liberal and conservative participants (response made at 0 ms; ERN peaked at 44 ms postresponse), with the inset showing the voltage map of the scalp distribution of the ERN. (**c**) Source localization indicates a dorsal anterior cingulate generator for the ERN, computed at peak amplitude (red line in panel **b**).

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conflict between a habitual tendency (for example, the Go response) and an alternative response (for example, to inhibit behavior in response to a No-Go stimulus)[11]. We also examined the No-Go N2 component, which is believed to reflect conflict-monitoring activity associated with the successful inhibition of the prepotent Go response on No-Go trials[7]. Relationships between political orientation and these neurocognitive indices were examined using correlation analyses (two-tailed).

Political orientation was strongly correlated with ERN amplitudes ($r(41) = 0.59$, $P < 0.001$; **Fig. 1a**), as well as with No-Go N2 amplitudes ($r(41) = 0.41$, $P < 0.01$). Specifically, liberalism (versus conservatism) was associated with significantly greater conflict-related neural activity when response inhibition was required (that is, on No-Go trials; **Fig. 1b**). ERPs associated with correct Go responses, scored to correspond to the ERN and No-Go N2, were not related to political orientation (P's > 0.37). Supplementary source localization analyses confirmed that the ERN and the N2 originated from activity in the dorsal ACC (accounting for 90% and 91% of signal variance, respectively; **Fig. 1c**, see also **Supplementary Fig. 1** and **Supplementary Methods** online), which is consistent with previous results[7,10].

Larger average ERN amplitudes corresponded to better behavioral accuracy on No-Go trials ($r(41) = 0.49$, $P < 0.001$), but were unrelated to accuracy on Go trials. No-Go N2 amplitudes were not related to behavior. In addition, stronger liberalism was correlated with greater accuracy on No-Go trials ($r(41) = 0.30$, $P < 0.05$). This association suggests that a more conservative orientation is related to greater persistence in a habitual response pattern, despite signals that this response pattern should change (for example, on No-Go trials). This behavioral finding is consistent with the relationship that we observed between political orientation and neurocognitive sensitivity to response conflict. However, a partial correlation analysis revealed that the relation between political attitudes and the ERN remained strong after covarying behavioral accuracy ($r(40) = 0.53$, $P < 0.001$), suggesting that liberalism (versus conservatism) is associated with greater neurocognitive sensitivity to cognitive conflict, beyond what was observed from behavioral performance alone.

Taken together, our results are consistent with the view that political orientation, in part, reflects individual differences in the functioning of a general mechanism related to cognitive control and self-regulation[1–3]. Stronger conservatism (versus liberalism) was associated with less neurocognitive sensitivity to response conflicts. At the behavioral level, conservatives were also more likely to make errors of commission. Although a liberal orientation was associated with better performance on the response-inhibition task examined here, conservatives would presumably perform better on tasks in which a more fixed response style is optimal.

The study of personality variables that accompany differences in political opinions goes back more than fifty years[12]. Although recent work has demonstrated neural correlates of political information processing and candidate preferences[13,14], this is the first study connecting individual differences in political ideology to a basic neurocognitive mechanism for self-regulation. These findings may serve to promote the integration of theorizing in the traditionally disparate fields of political psychology and cognitive neuroscience. More broadly, this research demonstrates how integration across multiple levels of analysis can begin to elucidate how abstract, seemingly ineffable constructs, such as ideology, are reflected in the human brain.

Note: Supplementary information is available on the Nature Neuroscience website.

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AUTHOR CONTRIBUTIONS

D.A. designed and conducted the experiment, analyzed the data, and wrote the manuscript. J.J. contributed to theorizing and co-wrote the manuscript. S.M. assisted in experiment design, data collection, and writing the manuscript. C.Y. provided laboratory support and supervision, and assisted in writing the manuscript.

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