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An ERP-study on the extent to which partisanship conditions the early processing of politicians' faces

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ABSTRACT
Partisanship has been associated with various cognitive biases. These findings are primarily based on self-reports and task performance and less on measures of neural activity. We reviewed the literature on in-group vs. out-group bias that employs face-viewing paradigms and ERP methodology to investigate unconscious bias in politics. We subsequently preregistered hypotheses about the extent to which partisanship is associated with early neural processing of political leaders' faces. Our lab experiment was conducted in the Netherlands ($N = 51$), a multi-party democracy, and sufficiently powered to pick up modest effect sizes for in-party vs. out-party comparisons. As expected, we find that politicians' faces elicit a stronger N170 ERP response than strangers' faces, but we did not find the same pattern for the N250 component. Contrary to our hypotheses, we did not find statistically significant differences in the P200 and N200 components for the in-party vs. out-party comparison. These findings, supported by our cluster-based permutation analysis, indicate that seeing faces of political leaders enhances attention during facial processing, regardless of party affiliation, possibly due to their frequent and affectively salient presence in media. Since in-party vs. out-party differences did not emerge early on, implications for partisanship are discussed relative to racial and minimal group bias findings.

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Partisanship; electroencephalography; event-related potentials; face processing; politician

Introduction

Party identification has been noted for its relevance in vote choice, political engagement, and the influence of partisan elites over civilians (Huddy et al., 2015), appearing as an essential element of politics. However, it has also been associated with biased reasoning, memory distortions, and altered perceptions of reality (Derreumaux et al., 2023; Theodoridis, 2017; Van Bavel & Pereira, 2018) and considered one of the main drivers of affective polarization (Iyengar & Krupenkin, 2018). Finding comprehensive ways of measuring partisanship and its impact on cognition is crucial for promoting informed decision-making in democratic societies and holding elites accountable. Yet, research has focused on the self-reported consequences of partisanship in survey-based (Rosema & Mayer, 2020) or task-based research (Derreumaux et al., 2023; Theodoridis, 2017). Outside of the partisanship literature, we find that group-based identities – such as race and minimal groups – condition how information is processed at the neural level (Amodio & Cikara, 2021; Van Bavel & Cunningham, 2010). These established neuroscience findings and designs have not been applied to analyzing how partisanship conditions the neural processing of political information. Therefore, we first conduct an in-depth review of the literature on group differences in neural processing with the goal of collecting statistically significant effects, effect directions, and effect sizes. This literature review generates a set of hypotheses that we bring to the study of partisanship. We test our directional hypotheses in a laboratory experiment in the Netherlands using electroencephalography (EEG) methods ($N = 51$) in a face-viewing paradigm.

Partisanship can be described as a social affiliation that promotes emotional attachment to a party and generates stable social identification (Huddy et al., 2015). While traditionally measured in bi-party systems, partisanship is also present in multi-party systems,

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where individuals can identify with more than one party (Rosema & Mayer, 2020). We study whether partisanship conditions neural processing. To do so, we use the faces of party leaders as stimuli. Faces are powerful identifiers that provide individuals with an array of important social and emotional cues (Zebrowitz, 2017) and gate the degree to which we humanize others (Deska & Hugenberg, 2017). As such, faces offer an ecological primer for partisan biases, as has been shown in studies where in-/out-party faces induced differences in emotion processing (Bakker, Schumacher, & Homan, 2020; Homan et al., 2023) and trait evaluations (e.g., attractiveness) (Mallinas et al., 2018; Nicholson et al., 2016; Zabinski & Bolsen, 2017). The recognition of the partisanship of faces (out-party vs. in-party) may trigger attentional and affective processes, as has been noted in racial and minimal group research (Cikara & Van Bavel, 2014). These processes can be potentially indexed by immediate brain activity at high temporal resolution, by applying Event-Related Potential (ERP) methodology to data collected using EEG methods. EEG is a noninvasive neurophysiological technique that measures fluctuations in electrical potential via electrodes placed on the scalp. ERPs are derived measures from EEG that capture brain responses that are time-locked to specific sensory, cognitive, or motor events. ERPs are characterized by a positive or negative deflection with specific timing and topography, and the experimental context in which they occur. Our study focuses on the N170, N250, N200, and P200 components because of their established importance in the literature on face processing and group dynamics. Research beyond the political domain has demonstrated that faces can trigger early preconscious neural responses in these components that indicate group bias (Amodio & Cikara, 2021; Kawakami et al., 2017). These responses reflect differences in how facial features are processed and how attention is selectively directed. The Categorization-Individuation Model helps explain these differences, suggesting that in-group bias in recognition occurs because people are motivated to process in-group members as distinct individuals while processing out-group members more categorically (Hugenberg et al., 2013; Van Bavel & Cunningham, 2010). This motivation leads to different patterns of attention allocation between in-group and out-group faces. Kawakami et al. (2017) propose that this motivational difference drives the N170 response patterns, though research has shown inconsistent directional effects. The P200 component reflects attention driven by goals, processes of perceptual matching, and responses to threat. This component is connected to both implicit and explicit goals the perceiver holds toward out-group faces (Amodio & Cikara, 2021; Correll et al., 2006). The N200 component is associated with processes of response selection and conflict resolution (Folstein & Van Petten, 2008). Amodio & Cikara (2021) suggest that the N200 response to in-group faces may indicate response conflict that occurs when making an in-group classification, as individuals initially tend to orient their attention toward out-group faces.

To the best of our knowledge, only a few studies have looked at the role of partisanship (and other political preferences) in conditioning political information processing using ERPs. First, Morris et al. (2003) investigated the neural correlates of receiving congruent and incongruent political primers. Each participant ($N = 14$ in total) rated a series of political words as negative or positive. The most consistently rated words were used for each participant. In the EEG paradigm, the words were paired with a positive or negative primer. The incongruency (e.g., a positive word paired with a negative primer or a negative word paired with a positive primer) was expected to elicit an affective response (Morris et al., 2003). As such, the N400 component, an index of semantic processing for complex and incongruent stimuli, was enlarged for the incongruent condition. Second, two studies using statements conflicting or congruent with participants' political preferences replicated the N400 finding (Mahieux et al., 2024; Van Berkum et al., 2009). Moreover, another study found increased N400 (Galli et al., 2021) when (a) populist voters were completing non-populist survey items and when voters of mainstream parties were completing populist survey items and (b) when people received a statement that was incongruent with their policy position toward the European Union. These results indicated that a swift attentional and semantic reaction was in motion before engaging in deeper cognitive analysis. Statements conflicting with one's beliefs might be harder to process due to the anticipation of hearing something aligned with one's values (Van Berkum et al., 2009). In general, these studies suggest that political information processing is influenced by one's preexisting attitudes, where incongruent information requires more cognitive effort and elicits early neural responses.

Building on these studies, we attempted to study the visceral response of partisans to political cues within a more ecological paradigm that emulates citizens' political media consumption and social interactions. Since political information is usually delivered by politicians, experts, journalists and other civilians, it is important to establish whether communicators and their perceived partisan identity can prime individuals prior to information delivery. To do this, we turn to the presentation of politicians' faces: the faces of well-known politicians should reliably facilitate the access of their party identity without relying on external cues (clothes, accessories) or memory training. Differences in neural processes during facial recognition have implications for how citizens perceive and develop affect toward political leaders. Beyond party representation, politicians are also regarded as highly influential within society, meaning that their personalities and actions are especially visible and affectively salient. In face-viewing paradigms, visual attention stimulated by familiarity and affective salience have been studied through the N170 component (Almeida et al., 2016; Caharel & Rossion, 2021; Schindler et al., 2023), while familiarity by itself is often studied through the N250 component (Abreu et al., 2023; Kovács et al., 2023; Sommer et al., 2021). Therefore, we preregistered the following two hypotheses:

H1a: Political leader faces elicit greater N170 amplitude, as indicated by more negative ERP amplitude between 140 and 200 ms after stimulus onset over posterior channels, than faces of strangers.

H1b: Political leader faces elicit greater N250 amplitude, as indicated by more negative ERP amplitude between 200 and 350 ms after stimulus onset over posterior channels, than faces of strangers.

It is unlikely that all faces of politicians are processed similarly. Salient social group categories accessed through faces are capable of inducing implicit stereotypes and prejudice in observers that seem to be somehow connected to neural findings (Amodio & Cikara, 2021; Kawakami et al., 2017). To guide our expectations regarding the extent to which partisanship conditions the processing of the faces of party leaders, we conducted an in-depth review of the literature on group bias in EEG research. The goal of this review was to inform hypotheses about in-group vs. out-group processing and the components that would be activated upon seeing in-group vs. out-group party leaders. In total, we collected 34 articles following these criteria: (1) the study must be empirical, (2) apply ERP methodology, (3) use a face-viewing paradigm in which images of faces are shown over several trials within a laboratory context, and (4) use facial stimuli that invoke social categorization and group-identification (participants, in theory, identify faces as in-group or out-group). See Supplementary data 1 for more details on the review procedure (S1a), list of articles included (S1b), and other in-depth descriptives (e.g., electrodes used, time intervals used, and list of effects by study, S1c). Most of these studies investigated racial bias ($n = 30$) and minimal group bias ($n = 6$), with politics remaining relatively unexplored. It is our expectation that politics is equally grounded in the development of social identity, explaining complex group-oriented behavior such as political campaign involvement (Huddy et al., 2015). Our review highlights the prevalence and consistency of P200 and N200 effects in the literature (Table 1), pointing to the relevance of selective attentional processing of facial stimuli. These components are frequently reported ($n \geq 15$) and at a factor of 2 to 10 times more than most components (N100, P300, N400, and LPP). Moreover, 70% or more of the tests are statistically significant and in the same (expected) direction.

We extrapolated the findings from our literature review to the study of partisanship by formulating and preregistering two directional hypotheses:

H2a: Out-party leader faces elicit greater P200 amplitude, as indicated by more positive ERP

Table 1. Outcome of the ERP group dynamics literature review.

	Measures			
Component	Expected direction	nº of Reports	nº of Sign. (%)	nº of Sign. in expect. direction (%)
N100	Larger for Out-party	8	37.5	37.5
N170	Larger for In-party	19	73.7	42.1
P200	Larger for Out-party	20	70.0	70.0
N200	Larger for In-party	15	80.0	73.3
P300	Larger for Out-party	8	62.5	62.5
N400	Larger for Out-party	2	100	100
LPP	Larger for Out-party	5	60.0	60.0

For each ERP component, outcome values were extracted from the 34 reviewed papers. "Expected direction" indicates which condition is expected to increase the component's amplitude; "nº of Reports" indicates raw prevalence; "nº of Sign. (%)" shows the percentage of significant results; and "nº of Sign. in expect. direction (%)" shows the percentage of significant results in the expected direction. Shaded rows mark two components that are both prevalent and consistent.

amplitude between 150 and 250 ms after stimulus onset over frontocentral channels, than in-party leader faces.

H2b: In-party leader faces elicit greater N200 amplitude, as indicated by more negative ERP amplitude between 200 and 350 ms after stimulus onset over frontocentral channels, than out-party leader faces.

The third component of interest is the N170: 19 out of the 34 studies reported results for the N170 and 73% of these studies reported a statistically significant result. Yet, only 42% of the studies reported an effect in the same (expected) direction, most likely reflecting design differences. So, while we preregistered (H1) that N170 would be enhanced in response to seeing politicians' faces (vs. strangers), we did not preregister hypotheses concerning N170 effects in any particular direction regarding in-party vs. out-party differences. As far as we know, both types of politicians may be equally salient to participants at the earliest stages of facial processing.

The extent to which people are attached to their party varies. Political science research shows that stronger partisans respond more strongly to messages from political parties (Huddy et al., 2015). While the extent to which the strength of group identification conditions the neural processing of faces was not the goal of our review, it has been demonstrated that greater in-group identification can enhance the N200 component (Derks et al., 2015). Therefore, we preregistered that partisanship strength would amplify our party-related main effects:

H3a: Greater partisanship strength is associated with larger P200 amplitude differences between out-party and in-party conditions.

H3b: Greater partisanship strength is associated with larger N200 amplitude differences between out-party and in-party conditions.

Materials and methods

Preregistration

The analyses were based on data obtained from a previous study that was conducted by MDH and colleagues (https://osf.io/dsfgv). In this study MDH and colleagues studied the Mu and Alpha rhythms (frequency domain methodology) evoked by politicians' emotional displays. These measures are unrelated to this study. Also, the current analysis is based on politicians' neutral faces, focusing on a different part of each trial (see Figure 1). The expectations and planned analyses for the study we report here were preregistered before the authors who conducted this analysis (GCJ, JB, GS, and BNB) had access to the data. We preregistered our expectations and planned analyses on OSF on 1 February 2024: https://osf.io/49h7k. After this date, the lead author who conducted the original study (MDH) sent the data to the lead author of this study (GCJ).

There were two deviations from the preregistration in how we selected channels for ERP analysis. First, based on the literature, we preregistered six electrodes, including the PO9 and PO10, to analyze the N170. The idea was to capture fluctuations of neural activity related to visual processing. Yet, it turned out these two electrodes were not present in the cap that was employed in this study and as such we did not have measures for these electrodes. Instead, we turned to two other electrodes (O1 and O2) that have been frequently used to study the N170 in the extant literature, covering a broader area of the posterior scalp. Second, the frontocentral channels we used for the N200 and P200 were mistakenly attributed to analyze the N250 in our pre-analysis plan. Instead, we used the same posterior channels as the ones used to capture the N170.

Participants

The study was conducted in accordance with the Declaration of Helsinki. The present study has been

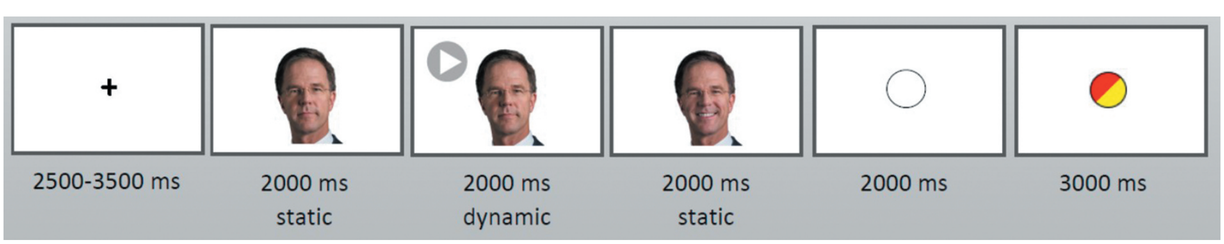

Figure 1. Schematic demonstration of a trial featuring a politician (Mark Rutte, party leader of the VVD at the time of the study, credit: Ministerie van Buitenlandse Zaken, licensed with CC BY-SA 2.0). Of relevance to this study: the 6,000 ms video consists of a static 2,000 ms neutral expression, a dynamic 2,000 ms happy, and a static 2,000 ms happy expression. Only the first 800 ms of the first static neutral expression were extracted for our ERP analysis.

approved by the Ethics Review Board of the University of Amsterdam (#2021-AISSR-13386). All participants provided written informed consent. Only participants that reported having no neurological disorders and have normal or corrected-to-normal vision were allowed to participate. Subjects were recruited through the online lab website and were rewarded with 4 hours of research credits or 45 euros for the full EEG study. Data were collected from February to May 2022. After the inclusion of valid pilot data and the exclusion of participants ($N = 9$) due to technical issues or raw data deemed too noisy after visual inspection, we were left with a sample size of $N = 51$ (age: $M = 21.94$ years, SD = 3.749; 32 females and 19 males; 33 participants having finished high-school education and 18 participants with a bachelor's degree or above). The distribution of in-party and out-party preferences (See S2) is characteristic of Dutch university student populations, where more than 80% in-party choices were left-wing parties and more than 68% out-party choices were far-right parties.

Task paradigm and stimuli

A detailed description of the entire protocol is reported in https://osf.io/dsfgv. Here, we discuss the main characteristics and the details of the part of the study protocol that are relevant to this analysis. The stimuli were delivered using Presentation software (Version 18.0, Neurobehavioral Systems, Inc., Berkeley, CA). Upon signing informed consent, participants were instructed to maintain a static facial expression and remain seated until further notice. The trial commenced with the presentation of a fixation cross, randomly shown for a duration of between 2,500 and 3,000 milliseconds (ms) to prevent anticipation of subsequent stimuli. A 6,000 ms video was presented to the participant. The initial 2,000 ms of the video showed a static face with a neutral expression, transitioning to an emotional expression over the subsequent 2,000 ms, and finally arriving at a static image of the expression for the final 2,000 ms (See Figure 1). Each face of a politician was presented randomly three times per block, across four blocks. In other words, each politician was presented 12 times throughout the experiment. With four politicians and four non-politicians per block, one experimental block consisted of 24 trials, which was repeated 4 times (96 trials in total) with breaks in between each block. In total, 48 of the trials presented showed politicians' faces – for details see pre-analysis plan (https://osf.io/dsfgv). We preregistered the initial 800 ms of the first static neutral expression as the only interval of interest. The remaining information of each trial is not taken into account in this analysis. Participants were also randomly presented two other experimental protocols that are unrelated to the current analysis in this study.

The stimuli comprised three distinct categories: in-party politicians, out-party politicians, and non-politicians displaying happy, angry, or neutral facial expressions. Neutral-faced non-politicians were sourced from the Amsterdam Dynamic Facial Expression Set (Schalk et al., 2011), while portraits of Dutch party leaders were obtained from the website of the Dutch parliament or their respective party websites. The study included images of the party leaders from 17 Dutch political parties that were in parliament in May 2021 – when the study was developed. Subsequently, both politician and non-politician expressions underwent manipulation to convey the target emotions. The happy expression entailed smiling faces with visible teeth, while for the neutral condition, mouth opening and closing movements were employed.

Survey measures

In-party & out-party assignment

The investigation was carried out within the context of the Netherlands, characterized by its multi-party system consisting of 17 parliamentary parties – at the time of conducting the study (during spring, 2022). At the onset of the study, participants were surveyed regarding their in-party affiliation: "which of the following two parties has the highest probability of receiving your vote during the next national elections?." The options included all 17 political parties represented in random order. Conversely, participants were also questioned about their out-party preference: "which two parties will certainly NOT receive your vote during the next national elections?" Once more, the options comprised the 17 parliamentary parties presented in random order. The composition of the Dutch parliament at the time of data collection encompassed the following parties: VVD, PVV, CDA, D66, GroenLinks, SP, PvdA, ChristenUnie, PvdD, 50Plus, SGP, Denk, FvD, Volt, JA21, BBB, and BIJ1. This design choice is justified, as EEG studies require a high number of trials, and just showing two politicians (1 of the in-party and 1 of the out-party) presents two core issues: it would make the task too repetitive; and the specific politician used for each party could drive the differences found, rather than a true in-party vs. out-party effect. Conversely, work by Harteveld (2021) in the Netherlands shows that people have positive attachments to political parties that are closely related to each other in terms of their ideological distance, while they tend to feel negatively toward the political parties that are further away from their preferred party. Our sample behaves in line with Harteveld's Dutch sample. To be specific, participants scored the in-party leaders (In-party1: $M = 75.04$; SD = 13.54; In-party2: $M = 81.25$; SD = 12.63) much higher than the out-party leaders (Out-party1: $M = 13.22$; SD = 15.20; Out-party2: $M = 9.04$; SD = 10.58) in feeling thermometers, on a scale from 0 to 100. The difference in the ratings between the in-party and out-party politicians is much bigger (a factor of 13) compared to the arbitrary differences between the ratings of the two in-parties and the differences between the ratings of the two out-parties.

Strength of partisanship

The strength of partisanship was assessed utilizing the closest available proxy: feeling thermometers, a reliable measure reflecting participants' positive affect toward specific political parties (Druckman & Levendusky, 2019; Gidron et al., 2022; Iyengar et al., 2012; Lelkes, 2016; Rosema & Mayer, 2020; Wagner, 2024). Following participants' identification of their two preferred in-parties and two out-parties, they were prompted to evaluate their affective responses toward each political party. Four sliders were presented, each corresponding to the name of one of the four designated parties, displayed in random order. Participants rated their feelings on a scale ranging from 0 (indicating very negative) to 100 (indicating very positive), with the slider positioned at the midpoint. Partisanship strength was calculated by averaging the two feeling thermometer scores of the in-party.

EEG recording

Subjects were positioned comfortably in a room that was softly lit and acoustically isolated. The recording of EEG signals utilized a Biosemi ActiveTwo system (Biosemi, Amsterdam, The Netherlands). A cap featuring 64 active electrodes was fitted onto the heads of the subjects according to the 10–20 system. An adjustable chin strap ensured the cap remained secure throughout the recording. For the detection of eye movements and blinks, four electrodes dedicated to recording the electrooculogram (EOG) were employed. To monitor horizontal eye movements, electrodes were placed just about 1 cm beyond the outer corners of both eyes. For tracking vertical movements and blinks, two electrodes were positioned about 1 cm above and left of the left eye. Enhancement of the signal-to-noise ratio was achieved by pre-amplifying the EEG signals at the electrode with a gain of 1 using the same BioSemi ActiveTwo system. This process also compensated for any high impedance at the electrodes, negating the requirement for impedance checks. Nonetheless, in compliance with Biosemi's guidelines, the offset voltage between the analog-to-digital converter box and the body was kept within 25–50 mV. The amplitude of the EEG was maintained below 50 μV. Electrode impedance was kept below 50 kω (kilo-ohms). Each electrode's signal was measured in real-time against a common mode sense active electrode, employing a monopolar (non-differential) channel setup. The signals were digitized at a 24-bit resolution and a sampling frequency of 512 Hz, with no application of hardware filters during recording. The lab-assistants monitored the subjects in the adjacent room via computers and a camera for the duration of the experiment.

EEG processing

To guarantee the reproducibility of our findings, we implemented an automated processing pipeline adhering to the best practices for EEG data analysis (Jas et al., 2018). This analysis was conducted using MNE Python (Gramfort et al., 2014). Our pipeline comprised several critical steps. Firstly, we applied a bandpass filter ranging from 0.5 to 40 Hz. This was achieved using a linear-phase Finite Impulse Response (FIR) filter, which also included delay compensation to ensure phase accuracy. Secondly, we utilized Independent Component Analysis (ICA) set to 25 dimensions to isolate and subsequently remove components showing a high correlation with EOG signals. This step was facilitated by adaptive z-scoring, employing the "find_bad_eog" function within MNE Python for precise component identification and removal. A median of 2 ICA components was excluded. The third step involved epoching, where we defined a window from −0.2 to 0.8 s. For the fourth step, we detected bad channels using the Random Sample Consensus (RANSAC) algorithm (Bigdely-Shamlo et al., 2015). A median of five bad channels per subject were detected and interpolated. This algorithm helps in identifying and excluding faulty channels based on consensus from random samples of data. Fifth, the Autoreject algorithm (Jas et al., 2018) was employed to identify and reject bad epochs. It is an unsupervised algorithm that removes epochs whose peak-to-peak amplitude exceeds a certain threshold from which it minimizes the cross-validation error, measured by the Frobenius norm between the average signal of the training set and the median signal of the validation set (Jas et al., 2017). After epoch rejection, out of 48 epochs, the politician condition retained a median of 39 epochs, and the non-politician condition retained a median of 40 epochs. Out of 24 epochs, the out-party condition retained a median of 19 epochs, and so did the in-party condition. This procedure included six steps of interpolation to ensure the exclusion of problematic data points while maintaining data integrity. Lastly, we referenced the EEG data to the average reference, a standard practice in EEG analysis that helps minimize reference-related biases and improves the overall quality of the signal. Together, these steps formed a robust framework for EEG data processing, aiming at enhancing the reliability and validity of our results.

We averaged the epochs for each participant, producing ERP responses for the comparison between politicians' and non-politicians' faces, and for the in-party vs. out-party condition. We calculated the mean activity within channel groups and time windows of interest based on a comprehensive literature review. To characterize the N170 we selected the 140–200 ms time window and the P7, P8, PO7, PO8, O1, and O2 electrodes. To characterize the N250, we selected the 200–350 ms time-window and the P7, P8, PO7, PO8, O1, and O2 electrodes. To characterize the P200 response, we selected the 150–250 ms time window and the C3, C1, Cz, C2, C4, FC3, FC1, FCz, FC2, FC4, F3, F1, Fz, F2, and F4 electrodes. To characterize the N200 response, we selected the 200–350 ms time window and the C3, C1, Cz, C2, C4, FC3, FC1, FCz, FC2, FC4, F3, F1, Fz, F2, and F4 electrodes. For more information on the selection of electrodes and time intervals, see S1a. To compensate for any effects of interest that we might be missing by using classic ERP methodology and relying on review-based ERP findings and operationalization, we run a supplementary cluster-based permutation (CBP) analysis that identifies channel clusters and temporal windows where the most significant differences emerge in our data (see S3).

Statistical analysis

As preregistered, mean activity within channel regions and time windows of interest was compared between conditions using paired sample t-tests, with the type of face stimulus as the independent variable and the average amplitude of the component as the dependent variable. Additionally, we performed linear regression analyses with the self-reported partisanship strength as the independent variable and difference in component amplitude between conditions as the dependent variable. The distribution of the mean amplitudes was assessed using Shapiro–Wilk tests that showed significant deviations from normality ($p < 0.05$) for at least 1 condition per paired t-test, except for the N250 component. We applied Winsorization to account for extreme values, which resulted in normally distributed data in all cases. We also applied Wilcoxon matched-pairs tests as non-parametric robustness checks. The winsorizing transformations and non-parametric tests do not change our results; therefore, all values presented correspond to the original data.

Results

ERP and political stimuli

Politician vs. non-politician

When comparing the conditions where politicians and non-politicians are presented, after preprocessing, around 39 trials remained per participant ($N = 51$). A study by Jensen and MacDonald (2023) demonstrated via Monte Carlo simulations that this sample size and number of trials is sufficient to resolve a mean difference as low as 1μV N170 amplitude. Do we observe a larger N170 in response to faces of politicians? Yes. Consistent with our preregistered hypothesis, we observed a negative deflection in response to politician and non-politician faces with a peak around 170 ms after the stimulus that was strongest in posterior channels (see Figure 2, panel A). This aligns with our expectations for the N170 component. The paired sample t-test indicated a statistically significant difference ($t(50) = -1.92$, p (one-tailed) = .03, Cohen's d = .21), with participants exhibiting a lower mean voltage toward politicians' faces (M = 3.8, SD = 7.14) compared to strangers' faces ($M = 5.15$, SD = 6.05). The standardized effect size is small (d = .21) but the mean difference is larger than other findings in the corresponding literature (Leleu et al., 2010; Wild-Wall et al., 2008). Our supplementary CBP analysis for the politician vs. non-politician comparison supports this finding, detecting a brain-wide cluster ($p = .019$) encompassing a time window from 116 ms to 244 ms, and with negative voltage differences peaking in the posterior left hemisphere (S3, Figure 1). We thereby confirm hypothesis H1a that politician's faces elicit a greater N170 amplitude, possibly indicating privileged processing of facial features toward the decoding of politicians' identities.

Do we observe a larger N250 in response to faces of politicians? No. Looking at the ERP for our second component of interest, the N250, the pattern is less clear. Contrary to our preregistered expectation, there was no persistent negative deflection over posterior channels in the time window between 200 and 350 ms post stimulus onset (see Figure 2, panel B). The paired sample t-test did not indicate a statistically significant difference ($t(50)$ = -0.06, p (one-tailed) = .48, Cohen's d < .01), with participants exhibiting nearly equivalent mean voltages toward politicians' faces ($M = 11.34$, SD = 7.19) and

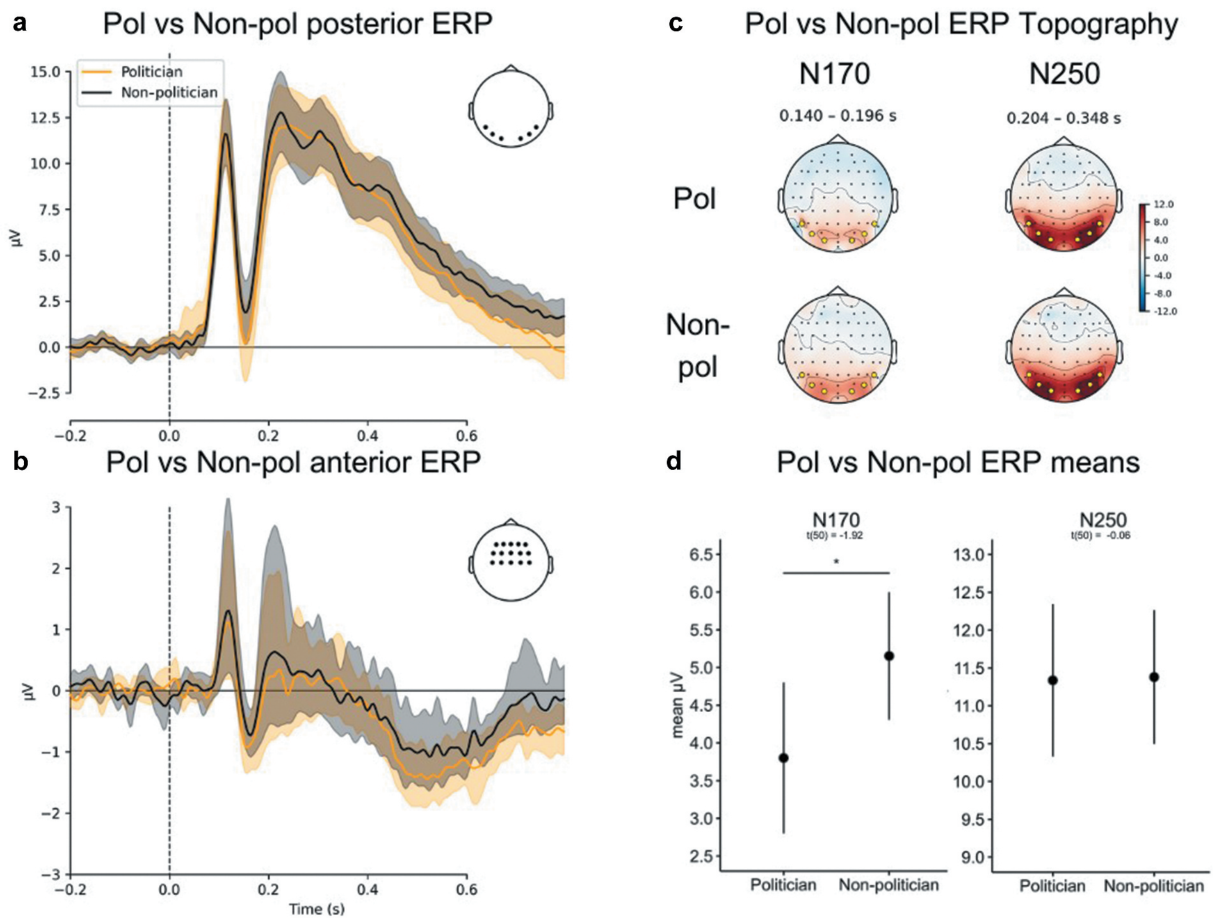

Figure 2. The ERP response evoked by politician vs. non-politician faces. (a) grand average plot of the time-locked ERP response over posterior channels. (b) grand average plot of the time-locked ERP response over anterior channels. (c) topographic plots for the time windows of the ERP components of interest. Yellow circles indicate electrodes of interest. (d) mean and standard deviation plots of the ERP components of interest.

strangers' faces ($M = 11.38$, SD = 6.31). The results of our CBP analysis support this (S3), as it did not find a cluster of interest that temporally matches the N250 component. This is not in line with our expectation of enhanced N250 amplitudes in response to politician's faces (Hypothesis H1b).

Out-party leader vs. in-party leader

When comparing the conditions where out-party leaders and in-party leaders are presented, after preprocessing, around 19 trials remained per participant. Based on our literature review, we calculated reported effect sizes from the studies that reported all information and that find P200 effects (d) range between 0.14 and 0.65 (4 studies, $M = 0.36$), and N200 effects (d) range between 0.37 and 0.55 (2 studies, $M = 0.46$). Our study is powered to reliably pick up population-based effects sizes of d = .36 (for more information on the power calculation, see S1a).

Do we observe a larger P200 in response to faces of out-party leaders? No. For the P200, we preregistered the expectation of a positive deflection between 150 and 250 ms, typically peaking around 200 ms, after stimulus onset with a frontocentral topography. Contrary to this expectation, we did not observe a positive deflection in frontocentral channels in this time window that could be clearly distinguished from background variation (see Figure 3, panel B). The paired sample t-test did not indicate a statistically significant difference ($t(50) = -.00$, p (one-tailed) = .50, Cohen's d < .01), with participants exhibiting equivalent mean voltages toward out-party leaders' faces ($M = -0.19$, SD = 3.39) and in-party leaders' faces ($M = -0.19$, SD = 3.85). The results

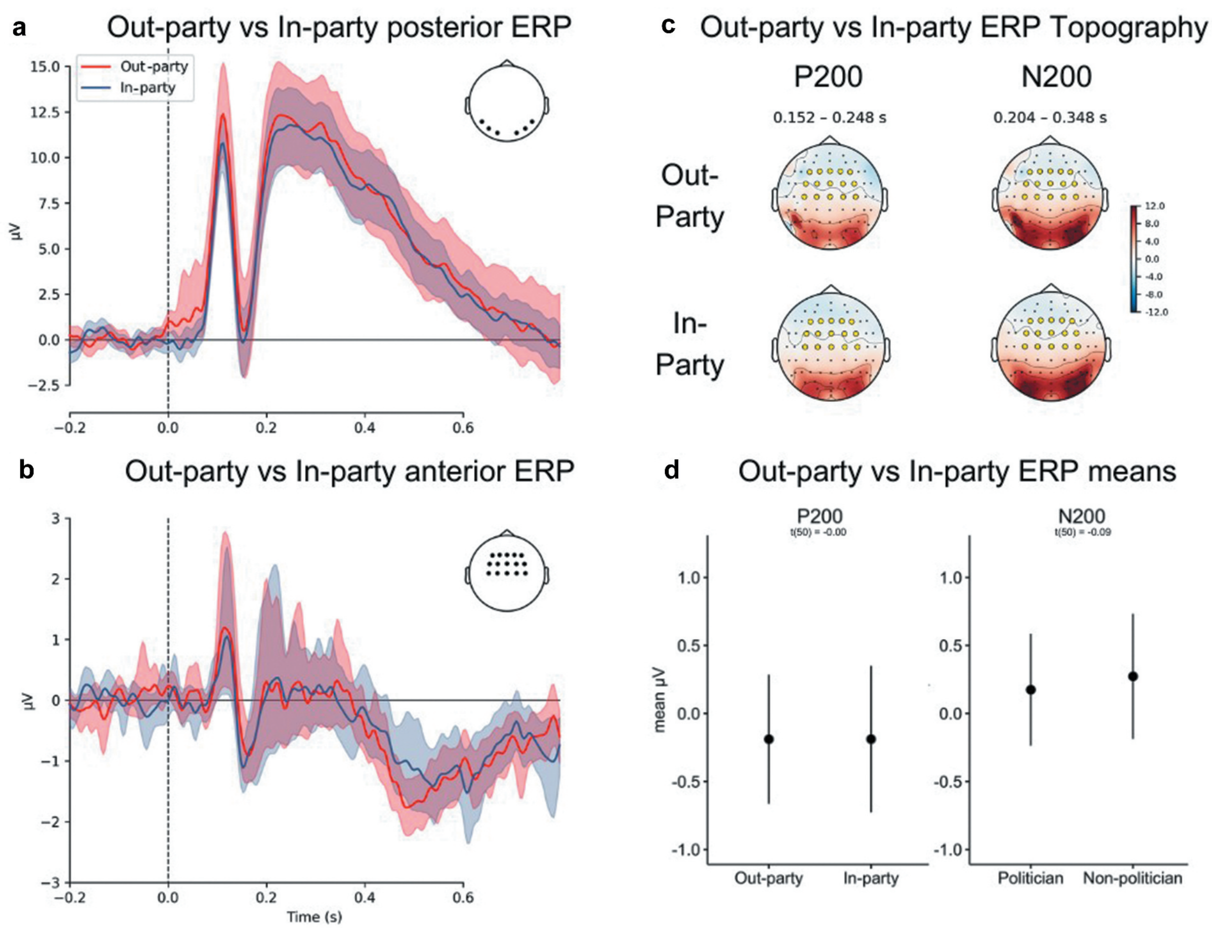

Figure 3. The ERP response evoked by out-party vs. In-party faces. (a) grand average plot of the time-locked ERP response over posterior channels. (b) grand average plot of the time-locked ERP response over anterior channels. (c) topographic plots for the time windows of the ERP components of interest. Yellow circles indicate electrodes of interest. (d) mean and standard deviation plots of the ERP components of interest.

of our CBP analysis support this (S3), as it did not find a cluster of interest that temporally matches the P200 component. This contradicts our hypothesis H2a.

Do we observe a larger N200 in response to faces of in-party leaders? No. We preregistered the expectation of a negative deflection between 200 and 350 ms post stimulus onset and a frontocentral topography. Contrary to this expectation, we did not observe a negative deflection in frontocentral channels in this time window that could be clearly distinguished from background variation (see Figure 3, panel B). The paired sample t-test did not indicate a statistically significant difference ($t(50) = -.09$, p (one-tailed) = .53, and Cohen's d < .01), with participants exhibiting a lower mean voltage toward in-party leaders' faces ($M = 0.15$, SD = 3.04) compared to out-party leaders' faces ($M = 0.16$, SD = 2.99). The results of our CBP analysis support this (S3), as it did not find a cluster of interest that temporally matches the N200 component. We therefore reject our hypothesis H2b.

Partisanship and ERP amplitude difference

Do we observe the P200 amplitude difference to increase with partisanship strength? No. As preregistered, a linear regression analysis was performed to examine the association between self-reported partisanship strength (independent variable) and the dependent variable: the difference in P200 amplitude between party conditions (in-party vs. out-party). Following the logic of H2a, in-party P200 mean voltage is expected to be lower than out-party P200 mean voltage, meaning that the direction of this association should be negative. The result was not statistically significant and the point estimate is very close to zero, $\beta = 0.01$, and p (one-tailed) = .53. Therefore, we reject hypothesis H3a. Do we observe the N200 amplitude difference to increase with partisanship strength? No. A linear regression analysis was performed to examine the relationship between the independent variable, self-reported partisanship strength, and the dependent variable, difference in N200 amplitude between party conditions (in-party vs. out-party). Such as with H2b, in-party

N200 mean voltage is expected to be lower than out-party N200 mean voltage, meaning that the direction of this association should be negative. The result was not in the expected direction, not statistically significant and of a very small effect size, $\beta = 0.08$, and $p = .72$; failing to confirm hypothesis H3b.

Discussion

Our study shows that people respond differently to politicians (compared to strangers) as is indicated by a statistically significant difference in the N170 component, a marker of the holistic visual processing of faces, and supported by supplementary data-driven results. Contrary to our expectations, we did not find the same pattern for the N250 component. Also, contrary to the preregistered hypotheses, we failed to find evidence for a partisan difference in the neural processing of in-party vs. out-party leader faces as captured by activity in the P200 and N200 components. The strength of partisanship also did not condition the P200 and N200 differences. These null findings suggest that, in our study, partisanship does not condition early neural processing of politicians' faces.

The increase of the N170 component for the politician condition generally signifies the allocation of more resources toward the visual processing of facial features. This suggests that the faces of political leaders are perceived as more salient, either due to familiarity (Caharel & Rossion, 2021) or affective salience (Schindler et al., 2023). Yet, we do not find an effect for the N250, the ERP component most consistently associated with familiarity (Abreu et al., 2023; Kovács et al., 2023; Sommer et al., 2021). We think it is unlikely that this null finding is caused by our operationalization of the N250, as our CBP analysis did not detect a statistically significant time window that matches the N250 (S3). It might be that our design is not well suited to capture familiarity effects. The faces of the politicians were familiar to people as they were prominent party leaders. Yet, the control condition consisted of unfamiliar faces. Future studies could disentangle whether our results are driven by responding to familiar faces or to politicians. One could, for instance, use faces of celebrities in an additional treatment condition (Abreu et al., 2023). Doing so, one could compare politicians to celebrities and unfamiliar people. Yet, variability in celebrity recognition and the risk that celebrities might evoke in-group vs. out-group effects (e.g., Andrew Tate, Taylor Swift) for reasons related or unrelated to politics illustrate how difficult it is to identify the familiarity effect. Consequently, we decided to compare political leaders – whose familiarity is inherently tied to their political roles – with unknown Dutch citizens, isolating the effects of political relevance. Instead, the N170 effect can be better explained by the accumulation of emotionally arousing episodes and the divisive political context that the faces of political leaders have come to be associated with. Even neutral faces are capable of signaling affective connotations to the extent of increasing the N170 component. In a review by Schindler et al. (2023), contingency-based learning showed larger N170 effects for neutral faces when they were associated to fear-conditioning, word/sentence-valence, sound-valence, or social/monetary reward. Instructed affective person knowledge, such as learning that a new face belongs to a criminal, also yielded similar effects. This may be a key part of quickly assessing the social environment for relevant individuals and allocating attentional resources proportionately. Unfortunately, our design cannot disentangle familiarity from affective salience, but future studies could manipulate the familiarity of the politicians (see, for instance, Laustsen & Petersen's (2016) design), and measure self-reported affect toward the stimuli. Regardless, because the N170 component precedes several stages of high-order cognition, it may underlie bottom-up selective attention that causally conditions later components and behavior within political contexts. This also opens up questions of how top-down modulation may interact with these earlier stages of processing.

Our findings indicate that partisanship does not seem to be associated with the differences in neural processing that were indicated by our literature review. In order to understand why we did not observe the expected effects, it is important to understand what differs between our stimuli and the stimuli present in the literature. The P200 and N200 components are often reported across the ERP literature and are interpreted differently depending on the design, which has led most researchers to broadly consider the P200 and the N200 markers of early selective attentional mechanisms (Amodio & Cikara, 2021; Ghani et al., 2020). The lack of a precise conceptualization across the reviewed literature means that different aspects of the design and stimuli (e.g., arousal, valence, prediction error, inhibition) might render differences harder to capture and compare across domains. Most studies in our review used racial groups. Therefore, it is possible that racial cues that are easily recognized before individual identification takes place determined the P200 and N200 results. This may reflect that early attentional mechanisms drive later biases in this particular context (Hugenberg et al., 2010, 2013; Lissa et al., 2024). This difference in stimuli might explain why the P200 and N200 effects are smaller in the current study. Indeed, from the minimal group studies featured in our review ($n = 6$), only two studies report significant differences for nonracial groups: one N170 effect and one N200 effect. We would welcome future research that manipulates partisanship alongside stigmatized groups (Gimenez-Fernandez et al., 2020) in the same paradigm for a direct comparison of these effects.

The fact that fMRI (Van Bavel & Cunningham, 2010) and early ERP findings do not converge in minimal group studies might be explained by timescale. It is possible that partisanship is only constructed in the brain at later stages of processing, when evaluation and reasoning occur (Mahieux et al., 2024). Based on our CBP analysis, voltage differences do not seem to emerge between in-party and out-party conditions until 800 ms, a period that could have captured stimulus-evaluation differences as a function of partisanship like it did for the politician vs. non-politician comparison between 372 ms and 796 ms (see Figure 2, S3). Later effects that would align with the time-scale of fMRI were outside the scope of this study.

Do we fail to find evidence for H2 and H3 because of the context we studied? Potentially. The Netherlands is a multi-party system in which partisanship is a validated construct (Rosema & Mayer, 2020) and where the causes and consequences of partisanship align with the literature on partisanship in other contexts (such as two-party systems) (Harteveld, 2021). Dutch parties that disagree on cultural issues and either support or oppose far-right populism are better at capturing citizens' polarized responses (Harteveld, 2021), and in our sample the majority of participants defend culturally progressive parties and oppose culturally conservative and far-right populist parties (See S2). Results from studies on political preferences (including partisanship) and physiological (Bakker, Schumacher, Gothreau, et al., 2020) or neural (Petalas et al., 2024) measures, respectively, align between the Netherlands and highly polarized two-party systems, such as the U.K. and the U.S. Still, the strength of polarization has been observed to vary by country and throughout time (Boxell et al., 2024), where the Dutch party system often scores low on affective polarization (Reiljan, 2020). This has been used to explain misaligned findings between the Netherlands and the U.S. with regard to interoceptive accuracy (Ruisch et al., 2022). Thus, cross-cultural EEG studies tapping into diverse demographics are needed to assess whether partisanship conditions neural processing depending on the social and political context.

To conclude, our study did not find sufficient evidence that partisanship conditions early neural processing in a face-viewing paradigm. While partisanship can act as a source of motivated reasoning (Van Bavel & Pereira, 2018; Williams, 2023), its activation during evaluation might be dependent on top-down influences such as task goals (e.g., competitive debate vs. conciliatory discussion), bottom-up influences (e.g., priming, visual cues) (Kawakami et al., 2017), quantity and quality of evidence relatively to prior beliefs (Bullock, 2009; Druckman & McGrath, 2019), and the degree of accuracy-oriented motivation (Van Bavel & Pereira, 2018). The mere exposure to faces of politicians – without any context – does not seem to induce differences in face processing according to partisan orientation. Going forward, we need more extensive designs to understand the dimensions that drive neural differences in responses to politicians of the in-group and out-group. One way forward is to experimentally manipulate or characterize distinct facial features, such as attractiveness, trustworthiness, familiarity, and specific emotional expressions. Even if not manipulated, assessing these features matters. For example, we did not assess familiarity through self-report, and it could be that not all participants were familiar with all politicians. This can add uncertainty to the estimates reported in this study. Future research is well advised to guarantee recognition of all politicians. Our study only marks the starting point to understand the neural processing of social identity in politics.

Data availability

The R scripts and processed data used to replicate the results of this study are available in https://osf.io/4ey75/. Raw data and Python scripts will be made publicly available upon publication.

Disclosure statement

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