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Publication date
2024

Document Version
Final published version

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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 build on the related literature on in-group/out-group dynamics that employs a face-viewing paradigm and electroencephalography methods to analyze biases. Reviewing this literature, we developed and preregistered several hypotheses about the extent to which partisanship is associated with neural processing of political faces. Our lab experiment was conducted in the Netherlands (N=51) and sufficiently-powered to pick up modest effect sizes for in-party/out-party comparisons. As preregistered, we find that faces of political leaders elicit a stronger N170 ERP response than faces of strangers, but we did not find the same pattern for the N250 component. Also contrary to our preregistered hypotheses, we find no statistically significant differences in the P200 and N200 components between in-party and out-party leader faces. The strength of partisanship also did not correlate with P200 or N200. We discuss whether different interpretations of these signals (e.g. familiarity or affective processing) guide our theories about how partisan bias emerges and operates.

Keywords: Partisanship, Electroencephalography, Event-Related Potentials, Face-viewing Paradigm, Politician

Introduction

Partisanship has been associated to biased reasoning, memory distortions, and altered perceptions of reality[1–3]. Ultimately, partisanship fuels affective polarization[4]; that is, the tendency to favor in-party individuals and to antagonize out-party individuals. Finding comprehensive ways of measuring partisanship and its pervasive impact on cognition is crucial for facilitating consensus and promoting informed decision-making in democratic societies. Yet, most of social science research has focused on the self-reported consequences of partisanship in survey-based[5] or task-based research[2]. Outside of the partisanship literature, we find that group-based identities - such as race and minimal groups - seem to condition how information is processed at the neural level[6]. However, the findings and designs from that research have not been applied to analyzing how partisanship conditions the neural processing of political information. Therefore, we first conduct an in-depth review on the literature of group-differences in neural processing. This literature review generates a set of hypotheses that we bring to the study of partisanship. We test our directional hypotheses in a preregistered laboratory experiment in the Netherlands using electroencephalography (EEG) methods (N=51) in a face-viewing paradigm .

Partisanship can be defined as adherence to a political party. This implies not only subscribing to the policies of a party, but also belonging to the group and relating emotionally to other group members[7]. Partisanship is present in democracies, regardless of the organization of the party system[5].

We study whether partisanship conditions neural processing. To do so, we use faces of political leaders as stimuli. Faces are powerful identifiers that prompt individuals with an array of important social and emotional cues[8]. As such, faces offer an ecological primer for partisan biases. The automatic recognition of the partisanship of faces (out-party vs in-party) may trigger attentional and affective processes. 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 non-invasive neurophysiological technique that measures fluctuations in electrical potential via electrodes placed on the scalp. ERPs are derived measures from EEG that represent brain responses that are time-locked to specific sensory, cognitive, or motor events. ERPs are characterised by a positive or negative deflection with specific timing and topography, and the experimental context in which they occur. We are interested in components such as the N170, N250, N200, and P200 due to their empirical and theoretical value derived from facial processing and group dynamics literature. Indeed, research mostly outside of the domain of politics has shown that faces can evoke early preconscious signs of group bias in neural processing in the components we are interested in[6].

To our best 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 and colleagues[9] investigated the neural correlates of receiving congruent and incongruent political primes. 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 prime. The incongruency (e.g., a positive word paired with a negative prime or a negative word paired with a positive prime) was expected to elicit an affective response[9]. As such, the N400 component, an index of semantic processing for complex and incongruent stimuli, was enlarged for incongruent stimuli. Second, a study using statements conflicting or congruent with participants' political preferences replicated the N400 finding[10]. Furthermore, ERP components resembling the N400 and the Late Positive Potential (LPP) showed increased amplitudes for incongruent statements. Two other studies showed an increase in the N400 when (a) populist voters were completing non-populist survey items and when voters of mainstream parties were completing populist survey items[11] and (b) when people received a statement that was incongruent with their policy position towards the European Union[12]. These results indicated that a swift attentional, semantic, and emotional reaction was in motion before engaging in deeper cognitive analysis. Additionally, statements conflicting with one's beliefs might be harder to process due to the anticipation of hearing something aligned with one's values[10].

We want to study the visceral response of partisanship within a more ecological paradigm. To do this, we turn to the presentation of politicians' faces. Which ERP components arise during facial recognition may have implications for how citizens perceive and develop affect towards political leaders. In face presentation paradigms, visual specialization and familiarity processes have been studied through the N170[13] and the N250[14,15] components, whereby familiar faces evoke an increased N170 and N250 response. As such, the N170 and N250 components are expected to be amplified during the observation of well-known and salient politicians (H1), in comparison to strangers. We preregistered the following two hypotheses.

- H1a: Political leader faces elicit greater N170 amplitude, as indicated by more negative ERP amplitude between 140 and 200ms 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 350ms after stimulus onset over posterior channels, than faces of strangers.

It is unlikely that all faces of politicians are processed similarly. To inform our expectations of to what extent partisanship conditions the processing of the faces of party leaders, we conducted an in-depth literature 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 dynamics and the components that would be activated upon seeing in-group vs. out-group political leaders.

In total, we collected 34 articles following these criteria: (1) the study must be empirical, (2) apply ERP methodology, (3) use a face presentation paradigm in which images of faces are shown over several trials within a laboratory context, and (4) use facial stimuli that invoke group dynamics (participants, in theory, identify faces as in-group or out-group). Most of these studies happen to be about racial group bias and minimal group bias, politics remaining relatively unexplored. Despite this, it is our expectation that politics is equally grounded in the development of social identity, explaining complex group actions such as political campaign involvement[7].

We limited the scope of our review to some components that are commonly explored in visual, facial and affective ERP study designs[6]: N100, N170, P200, N200, P300, N400 and LPP. Furthermore, we limited the scope to whether the components of interest were reported in each paper, the trial number, the sample, the sign of the difference in the effect between seeing out-group and in-group faces, the statistical significance, and - where possible - the mean difference were extracted. Table 1 summarizes the most important outcomes that informed our hypotheses: the ERP components (column 1), the expected direction of the difference upon seeing an in-party vs. out-party group member (column 2), the number of papers that reported this component in the study (column 3), the percentage of statistically significant differences for the component (column 3), and the percentage of statistically significant results that are in the expected direction (column 4). The total list of studies included can be found in a supplementary appendix which includes a reference list with citations to the 34 papers included in the review. The median sample size of the studies included in the review is 36 participants, taking the full number despite any task-related subsetting of the sample, ranging from 12 to 94. The median trial number of the studies is 90, taking the number of group-related faces presented for the main group of interest, ranging from 20 to 198.

Our review shows that the P200 and N200 components clearly stood out (see shaded panels in Table 1). These components were reported the most and resulted into the most consistent findings, indicating the relevance of the early processing of facial stimuli. To be specific, out of the 34 studies, 20 reported results for the P200 and 15 reported results for the N200. These components are reported at a factor of 2 to 10 times more than the other components (N100, P300, N400, LPP). Moreover, 70% or more of the tests were statistically significant (column 3) and in the expected direction (column 4): For the P200, exposure to an out-group member increased P200 activity compared to in-group, while for the N200, exposure to the in-group (vs. out-group) increased N200 activity. We extrapolated the findings from our literature review to the study of partisanship by formulating and preregistering two directional hypotheses for the P200 and the N200.

- H2a: Out-party leader faces elicit greater P200 amplitude, as indicated by more positive ERP amplitude between 150 and 250ms 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 350ms 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 expected direction, whereby in-group exposure leads to more N170 activity compared to out-group exposure. However, the direction of N170 differences were less consistent compared to the P200 and N200. So, while we preregistered (H1) that N170 would be activated in response to seeing politician faces (vs. strangers), we do not expect that there is a partisanship difference in the N170 based upon our literature review. Therefore, we did not preregister expectations for the N170 regarding in-party vs out-party differences.

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[7]. While the extent to which the strength of group identification conditions the neural processing of faces was not the goal of our literature, it has been demonstrated in one of the reviewed studies that greater in-group identification leads to a larger N200[16]. Stronger partisans should show stronger responses. Therefore, we preregistered the expectation that the strength of party identification would amplify the main effects of the P200 and N200. In particular, we preregistered the following two hypotheses:

- 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.

Table 1. Outcome of the ERP Group Dynamics Literature Review

Component	Measures			
	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	86.7	80.0
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

Note: For each ERP component, informative outcome values were extracted from the 34 reviewed papers and are displayed here. Expected direction indicates which condition is expected to increase the amplitude of the component; the nº of Reports indicates the raw prevalence; the nº of Sign(ificants) (%) indicates proportion of significant results out of all results; nº of Sign(cants) in expect(ed) direction (%) indicates the proportion of significant results out of all results reported that match the expected direction. Shaded rows mark two components that are simultaneously prevalent and consistent according to our review.

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[17] shows that our sample combined with our number of trials and a mean difference of 1μV is sufficient for us to reliably detect N170 effects. Is the N170 larger 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 1, 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 towards 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 this literature[18,19]. We thereby confirm hypothesis H1a that politician's faces elicit a greater N170 amplitude, possibly indicating intensified visual processing of facial features towards the decoding of politicians' identities.

Is the N250 larger 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, typically associated with the N250 (see Figure 1, 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 a lower mean voltage towards politicians' faces (M = 11.34, SD = 7.19) compared to strangers' faces (M = 11.38, SD = 6.31). This finding is not in line with our expectation of enhanced N250 amplitudes in response to politician's faces (Hypothesis H1b).

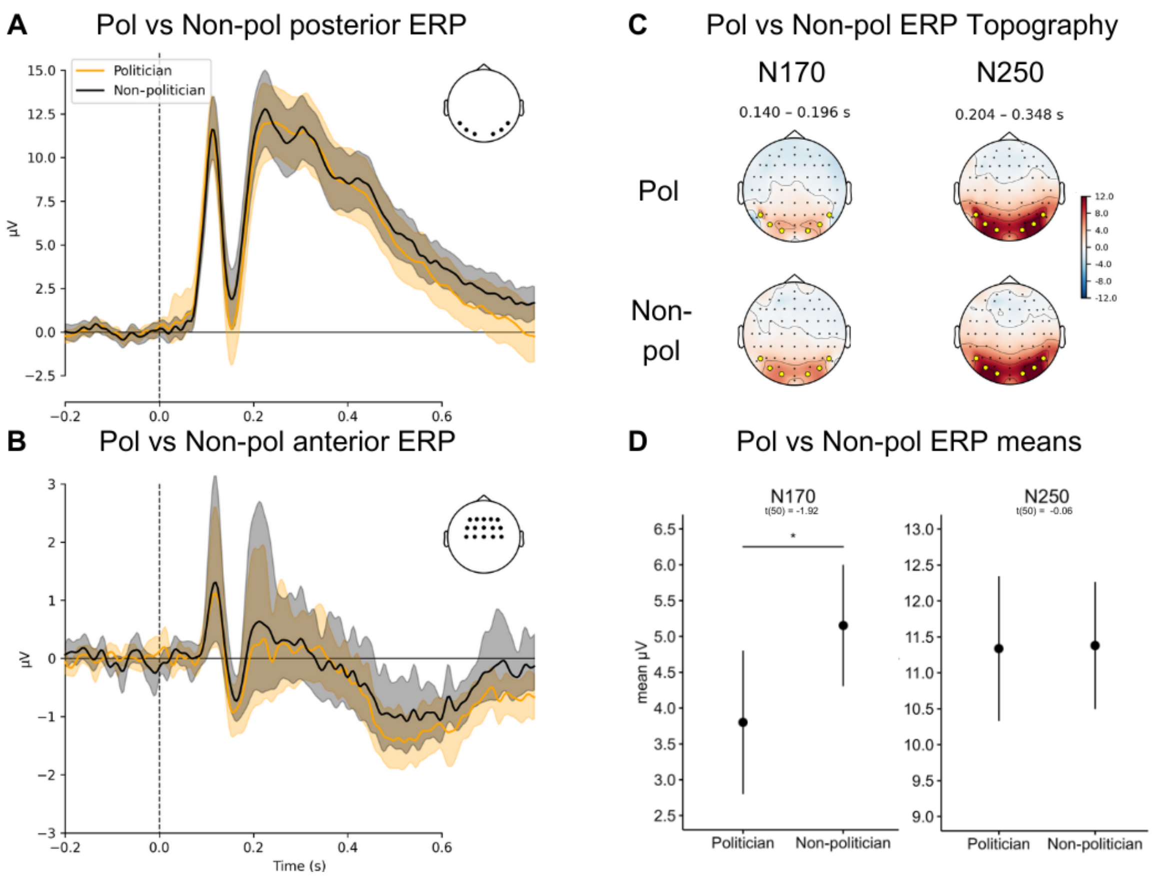

Figure 1. The ERP response evoked by Politician vs Non-politician faces. (A) Grand average plot of the time-locked ERP response over posterior channels. (B) Grand average plot of the time-locked ERP response over anterior channels. (C) Topographic plots for the time windows of the ERP components of interest. Yellow circles indicate electrodes of interest. (D) Mean and standard deviation plots of the ERP components of interest.

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 find that 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 able to reliably pick up population based effects sizes of d = .36 (values entered into the power contour estimation[20] to achieve b= .8, p(one-sided)=.05 with the smallest possible mean difference: sample size = 50, trial number = 20, $\alpha = 0.1$, $MD_{P200}/MD_{N200} = 1.48/1.46$, WS-SD = 13.8, $BS-SD_{P200}/BS-SD_{N200} = 2.75/2.66$. The WS-SD was picked from Baker's[20] P200 results as the closest reference, and the BS-SD was calculated by averaging the available results in our reviewed literature) when using Baker's[20] pooled-SD formula.

Is the P200 larger in response to faces of out-party leaders? No. For the P200, we preregistered the expectation of a positive deflection between 150-250 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 2, 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 a lower mean voltage towards out-party leaders' faces (M = -0.19, SD = 3.39) compared to in-party leaders' faces (M = -0.19, SD = 3.85). This finding contradicts our preregistered hypothesis H2a.

Is the N200 larger in response to faces of in-party leaders? No. We expected 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 2, 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 towards in-party leaders' faces (M = 0.15, SD = 3.04) compared to out-party leaders' faces (M = 0.16, SD = 2.99). We therefore reject our preregistered hypothesis H2b.

Partisanship and ERP amplitude difference

Does P200 amplitude difference 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. Greater partisanship strength has a positive but not statistically significant association with greater P200 amplitude difference, $\beta = 0.02$, and p (one-tailed) = .55. The result is in the expected direction, but not statistically significant and of a very small effect size. Therefore, we reject our preregistered hypothesis H3a.

Does N200 amplitude difference 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. In line with our expectation, the association was negative but the effect was not statistically significant, β = - 0.07, and p = .35; failing to confirm our preregistered 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. 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 versus out-party leader faces as captured from 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 neural processing of politicians' faces.

As expected, we observed an increase of the N170 component for the politician condition, generally signifying the allocation of more resources towards the visual processing of facial features. For the N170, this suggests we capture familiarity with the political leaders[13]. Yet, we do not find an effect for the N250, the other ERP component associated with familiarity[15]. We think it is unlikely that this null finding is caused by our operationalization of the N250 or the lack of statistical power - a point we return to later in the discussion. Alternatively, it is not familiarity that is driving our N170 effect. The faces of political leaders may be perceived as more emotionally arousing than faces of strangers and therefore increase the allocation

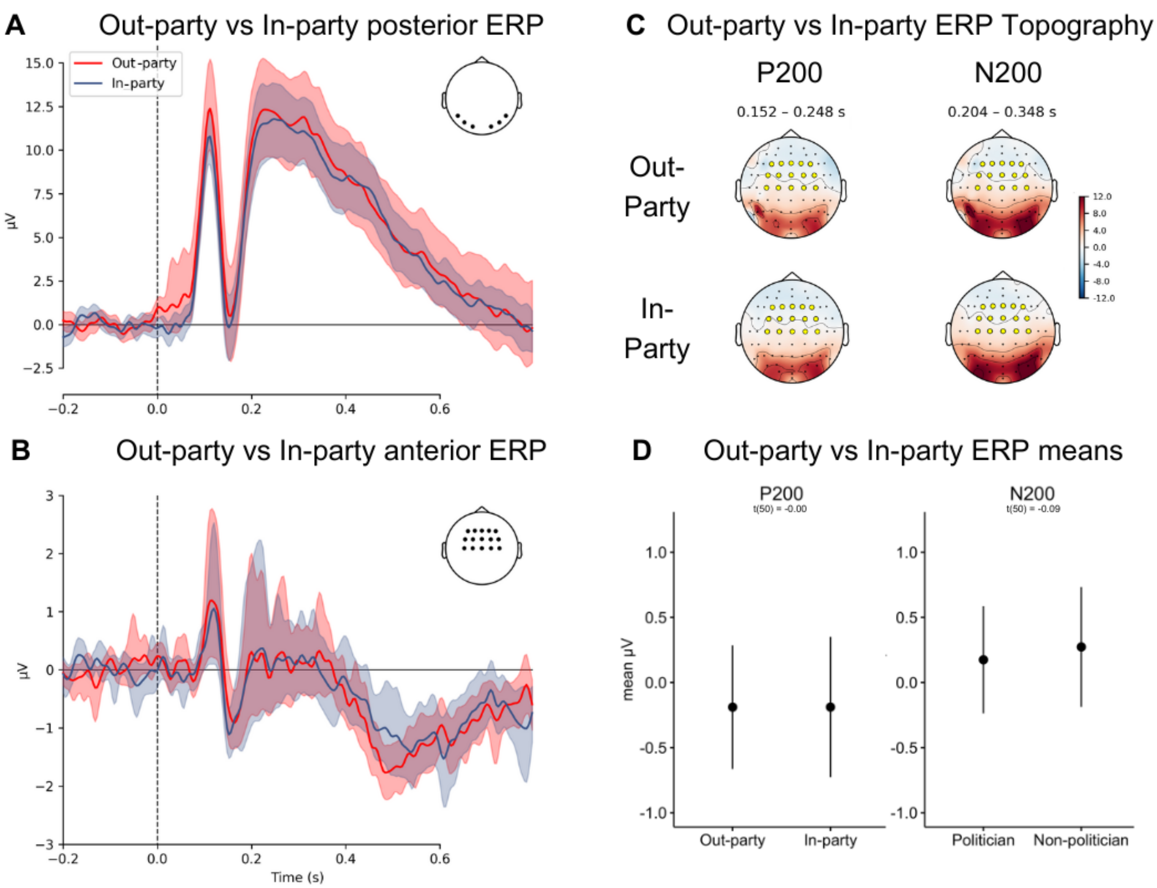

Figure 2. The ERP response evoked by Out-party vs In-party faces. (A) Grand average plot of the time-locked ERP response over posterior channels. (B) Grand average plot of the time-locked ERP response over anterior channels. (C) Topographic plots for the time windows of the ERP components of interest. Yellow circles indicate electrodes of interest. (D) Mean and standard deviation plots of the ERP components of interest.

of resources towards facial processing[21,22], as part of political socialization and media consumption. Unfortunately, our design cannot answer whether this interpretation is correct or not, but future studies could manipulate the familiarity of the politicians: exposing participants to in-party and out-party politicians that are known and unknown - see for instance, Laustsen and Petersen's design[23]; and measuring self-reported valence of each face stimulus used. Regardless, since the N170 component precedes several stages of high-order cognition, it not only introduces important implications for how top-down regulation may have gradually enhanced basic visual perception of identifiable politicians (be it due to frequency of exposure and/or affective relevance), it may also underlie bottom-up selective attention that causally conditions later components and behavior within political contexts.

Was it appropriate to base H2 and H3 on the literature that studied neural processing of other groups? Arguably, yes. We were inspired by the literature that uses EEG with groups such as race or minimal groups paradigms. Partisanship is generally considered a powerful and polarizing group identity in the life of citizens[1,7,24]. As such, we think it was an acceptable decision to base H2 and H3 on this literature. Yet, given the null findings, partisanship does not seem to be associated with the same neural processing differing between in-party and out-party that would be expected based on other group identity . Our design does not allow us to draw this conclusion. The P200 and N200 components are often reported across the ERP literature and are interpreted differently depending on the design, which has lead most researchers to broadly consider the P200 and the N200 markers of early selective attention mechanisms[25]. The lack of a concise conceptualization means that different aspects of the design and stimuli (e.g., arousal, valence, prediction error, inhibition) might render differences harder to capture. Studies manipulating social prejudice may tap into special mechanisms that have not been fully elucidated. We would welcome future research that manipulates partisanship but also includes another group manipulation (like race or minimal groups) in the same paradigm. Additionally, distance to the in-party or out-party could be manipulated to check for the strength of partisanship effect.

Do we fail to find evidence for H2 and H3 because of the context we studied? No, we think this is an unlikely explanation for the null findings. The Netherlands is a multiparty system in which partisanship is a validated construct[5] and where the causes and consequences of partisanship align with the literature on partisanship in other contexts (such as two-party systems)[24]. Moreover, studies on political preferences (including partisanship) and neural processing using fMRI[26] and physiological measures[27] align with the conclusions others drew in other contexts. At the same time, cross-cultural studies are needed to assess whether partisanship conditions neural processing depending on the social and political context.

Do we fail to reject H2 and H3 due to a lack of statistical power? Our a priori power analysis showed that our design could reliably detect effect sizes that were also reported by others using similar types of studies. Perhaps, the population based effect size for the P200 or N200 is smaller than the effect size that we could reliably detect. However, our study was sufficiently powered to detect the average effect size found in our review. A failure to reject the null hypothesis is therefore unlikely to be due to a lack of statistical power.

It is possible that partisanship is only constructed in the brain at later stages of processing. Based upon our literature review, we turned to early markers because they displayed the greatest prevalence in our review. Future studies could investigate later stages of processing (>400 ms after stimulus onset), even though the literature is not consistent enough to warrant firm hypotheses about later components. Yet, we want to observe that our review of 34 studies did not find as much evidence for later ERPs in group processing using face paradigms.

Going forward, future studies should follow established best practices such as obtaining sufficient statistical power for the expected effect size, preregistration, and publication of null findings. Research in this area is also likely to benefit from consortia that establish effects in larger samples and across different cultural contexts. Lastly, more extensive designs will be needed to understand the dimensions that drive neural differences. This may include obtaining behavioural ratings or selecting stimuli across several dimensions, such as familiarity and affective response

To conclude, our study did not find much evidence that partisanship is conditioning neural processing in a face-viewing paradigm. Without a doubt, partisanship leads to biased reasoning, memory distortions and altered perceptions of reality. Yet, the mere exposure to faces of politicians - without any context - does not seem to induce divergent neural processing of group dynamics. Going forward we need more, not less, research on the extent to which, when, and for whom partisanship is conditioning neural processing.

Methods

Preregistration

The study analyzes data obtained from a previous study that was conducted by MDH and DPP (https://osf.io/dsfgv). In this study MDH and DPP studied the Mu and Alpha rhythms (frequency domain methodology) evoked by politicians' faces. These measures are unrelated to this study. Also our analysis is based on a different part of each trial (see Figure 3). The expectations and planned analyses for the study we report here were preregistered before the authors who conducted this study (GCJ, JB, GS, BNB) got access to the data. We preregistered our expectations and planned analyses on OSF on February 1st, 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 analyse 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 in our literature review to study the N170, covering a broader area of the posterior scalp. Secondly, the frontocentral channels we used for the N200 and P200 were mistakenly attributed to analyse the N250 in our pre-analysis plan. Instead, and based on the literature, 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 approved by the Ethics Review Board of the University of Amsterdam (#2021-AISSR-13386). All participants provided written informed consent. Only subjects that report having no neurological disorders and have normal or corrected-to-normal vision are 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 was collected from February to May 2022.

After the inclusion of valid pilot data and the exclusion of participants 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, 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). Descriptive statistics - which can be derived from the replication files - show that we have sufficient variation in terms of in-party and out-party preferences of our respondents.

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 we rely upon in this study.

Upon obtaining informed consent, participants were randomly presented with three experimental protocols, two of which are unrelated to the current analysis. The stimuli were delivered using Presentation software (Version 18.0, Neurobehavioral Systems, Inc., Berkeley, CA). 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 period 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 presenting a static image of the expression for the final 2,000 ms (3). Each stimulus was presented randomly once per block, with each block being repeated four times - for details see pre-analysis plan (https://osf.io/dsfgv).

In this study, we preregistered the initial 800 ms of the static neutral expression as the only interval of interest. The remaining information of each trail is not taken into account in this project.

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[28], 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 seventeen parliamentary parties - at the time of conducting the study (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,

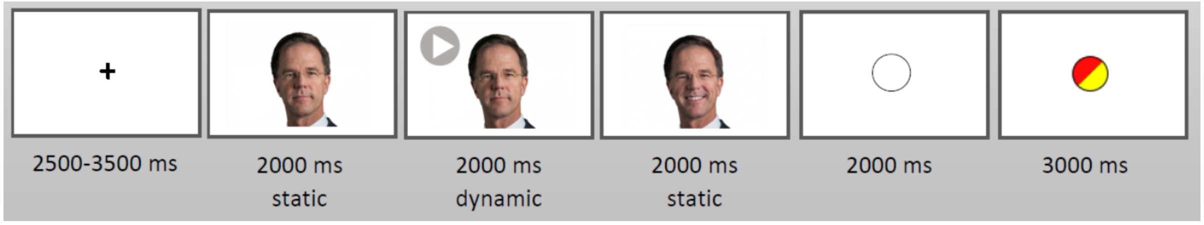

Figure 3. Schematic demonstration of a trial featuring a politician (Mark Rutte, party leader of the VVD at the time of the study, Credit: Ministerie van Buitenlandse Zaken, licensed with CC BY-SA 2.0). Of relevance to this study: The 6,000 ms video consists of a static 2,000 ms neutral expression, a dynamic 2,000 ms happy, and a static 2,000 ms happy expression. Only the first 800 ms of the static neutral expression were extracted for our ERP analysis.

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 seventeen 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; 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[24] in the Netherlands show 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 towards the political parties that are further away from their preferred party. As such, asking people to report two in-party and two out-party politicians is, in our opinion, justifiable. Our laboratory sample behaves in line with Harteveld's population based from the Netherlands, thereby justifying our design choice. To be specific in our study, 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), 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 feeling thermometers, a reliable measure reflecting participants' positive or negative sentiments towards specific political parties[5]. Following participants' identification of their two preferred in-parties and two out-parties, they were prompted to evaluate their affective responses towards 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 into an In-Party-strength score and doing the same for the feelings towards the Out-Party parties. The partisanship strength measure was calculated by subtracting the In-party partisanship score from the Out-party partisanship score.

EEG Recording

Subjects were positioned comfortably in a room that was softly lit and acoustically isolated. The recording of EEG signals utilised 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 to 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 digitised 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 camera during 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[29]. This analysis was conducted using MNE Python[30]. Our pipeline comprised several critical steps. Firstly, we applied a bandpass filter ranging from 0.5 to 40Hz. This was achieved using a linear-phase Finite Impulse Response (FIR) filter, which also included delay compensation to ensure phase accuracy. Secondly, we utilised Independent Component Analysis (ICA) set to 25 dimensions to isolate and subsequently remove components showing a high correlation with EOG or ECG signals. This step was facilitated by adaptive z-scoring, employing the 'find_bad_eog' and 'find_bad_ecg' functions within MNE Python for precise component identification and removal. The third step involved epoching, where we defined a window from -0.2 to 0.8 seconds. For the fourth step, we detected bad channels using the Random Sample Consensus (RANSAC) algorithm[31]. This algorithm helps in identifying and excluding faulty channels based on consensus from random samples of data. Fifthly, the Autoreject algorithm[29] was employed to identify and reject bad epochs.

Out of 48 trials, the politician condition retained a median of 39 trials, and the non-politician condition retained a median of 40 trials. Out of 24 trials, the out-party condition retained a median of 19 trials, 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 in minimizing reference-related biases and improving the overall quality of the signal interpretation. Together, these steps formed a robust framework for EEG data processing, aiming at enhancing the reliability and validity of our results.

We averaged the trials for each participant, producing ERP responses for the comparison between politician's and non-politician's faces, and for the in-party versus 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 F4, 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 F4, F3, F1, Fz, F2, and F4 electrodes.

Statistical Analysis

As preregistered, mean activity within channel regions and time windows of interest was compared between conditions using paired-sample t-tests, assuming the type of face stimulus as the independent variable, and the amplitude of the component as the dependent variable. Additionally, we performed linear regression analyses that assume 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 test. We applied Winsorisation to account for extreme values, which resulted in normally distributed data. This transformation does not change the significance of our results (these results can be derived from the replication files), therefore all values presented correspond to the original data.

Data availability

The raw data and script to reproduce the results presented in this paper will be made publicly available on our OSF page upon publication of this paper.

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Acknowledgements

This publication is part of the projects "IP-PAD" that received funding from the European Commission, "POLEMIC" a project that has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme under grant agreement No 759079, and "Under pressure: How citizens respond to threats and adopt the attitudes and behaviors to counter them" [project number VI.Vidi.211.055 awarded to Bert N. Bakker] of the research programme NWO Talent Programme VIDI which is financed by the Dutch Research Council (NWO).

Author contributions statement

Conceptualization: GCJ, BNB, GS, JB; Data Curation: GCJ, MDH, JB; Formal Analysis: GCJ, JB; Funding Acquisition: BNB, GS; Investigation: MDH, DP; Methodology: MDH, DP; Project Administration: MDH, DP; Resources: MDH, DP; Software: GCJ, JB; Supervision: GS, BNB; Validation: GCJ, JB; Visualization: GCJ, JB; Writing – original draft: GCJ, BNB, JB, GS; Writing – review & editing: GCJ, MDH, DP, BNB, JB, GS.

Conflict of interest

The authors confirm there are no conflict of interests.