TITLE: Does Partisan Bias Modulate Neural Processing of Political Information? An Analysis of the Neural Correlates of Corruption and Positive Messages

RUNNING HEAD: Neural correlates of political communication

Abstract

Daily newspapers throughout the world print articles exposing government corruption. Yet these messages do not lead to a loss of votes for the corrupt parties. Partisan bias among sympathizers that respectively minimizes and maximizes both corruption and positive messages affecting their own party is widely considered as the main cause of the loss of effectiveness of political communications. Despite the well-established existence of such bias when processing political information, little is known as to its psychological origin. The current study therefore resorts to neuroscience tools (fMRI) to explore the underlying brain mechanisms linked to messages exposing corruption (negative) and positive political messages offered by two Spanish political parties (a conservative and a progressive party), as well as explore differences between their sympathizers. The findings reveal that negative (vs. positive) political messages exert the greatest neurological impact among the electorate, as revealed by activation of areas linked to aversion, risk and disappointment. Interestingly, the findings also reveal the existence of a partisan bias against opposite parties (and not a positive bias toward one's own party) that stems from activations of areas linked to higher risk, ambiguity and disbelief provoked by both positive and negative information about rival parties. Furthermore, this bias is more pronounced among the conservative electorate. The current findings could serve political parties to improve their communication campaigns.

Key words: corruption; positive communication; partisanship bias; fMRI; neural processing

Introduction

There is a reason for the lack of trust in government and business: corruption. Corruption does serious damage to economic growth, investment, tax revenues and, to a greater extent, to income distribution and inclusive growth.

(IMFBlog, 2017)

Daily newspapers throughout the world expose government corruption. This trend has seen a dramatic increase in the last 20 years, particularly in developed countries. Corruption in politics is defined as a behavior among public servants deviating from formal duties with the deliberate intention to gain pecuniary or status benefits for private interests (personal, family, clique). It violates codes against wielding influence (Anduiza, Gallego, & Muñoz, 2013). Businesses and individuals around the world pay out an estimated €1.5 trillion in bribes each year (The World Bank Group, 2017). In the case of European countries such as Spain the total is estimated at about €90.000 million. Corruption has therefore negative social and economic consequences as it impedes progressing in the challenges of current times such as creating jobs, growth in productivity, inequality, opportunity, and climate change (Chong, De La O, Karlan, & Wantchekon, 2015).

The rational-legal precepts of democratic theory and the predominant models of judgment and decision-making suppose that people are rational within a range of limits imposed by cognitive shortcuts and heuristics (Winters & Weitz-Shapiro, 2012). Accordingly, citizens should punish political parties when they are exposed as corrupt. In practice, however, punishment by the political electoral is not a reality in many democracies. There is, in fact, little research indicating that political messages exposing corruption have an influence on voting behavior (Chong, De La O, Karlan, & Wantchekon, 2015; de Sousa & Moriconi, 2013). The specialized literature on political psychology and communication advances five reasons that explain the lack of chastisement by the electorate: i) citizens may be willing to accept a corrupt representative during periods of general economic prosperity; ii) citizens see corruption as a personal flaw and while they do not support a corrupt candidate, they are still willing to vote for the candidate's party; iii) citizens fail to display the capacity to interpret allegations of corruption; iv) messages indicating good performance can compensate for those of corruption; and v) citizens may not give credibility to allegations of political corruption (Krause & Méndez, 2009).

A great amount of literature concludes that the last factor (credibility of corruption news) exerts the greatest impact on the judgment regarding political news (Riera, Barberá, Gómez, Mayoral, & Montero, 2013). Political psychology studies specifically suggest that the credibility afforded to information depends on which party is affected (Anduiza et al., 2013). In other words, sympathizers of specific parties tend to punish less (i.e. reveal less credibility to the message exposing corruption) and lend more credence to positive information (i.e. higher degree of credibility) in reference to practices of their own party, as opposed to their counterparts (Muñoz, Anduiza, & Gallego, 2016). Despite that this so-called "partisan bias" is bolstered by several empirical political studies, most research avoids delving into the origin of how party sympathizers process charges of corruption or positive political information in general, and specifically when it comes to their own or that of opposite parties. Moreover, no study to date has established whether partisan bias is more evident among conservative or liberal sympathizers who possess very different value schemes, decision-making processes and priorities (Chong et al., 2015).

This study therefore opts to address these research gaps by means of neuroscience, a growing method that political psychology researchers are implementing with the aim to gain a deeper understanding of political decision-making processes (Byung-Chul & Gabás, 2018; Krastev et al., 2016). The analysis is restricted to sympathizers of the two major parties in Spain, the more liberal Spanish Socialist Workers' Party (PSOE) and the more conservative People's Party (PP), as the number of corruption scandals linked to each is recently on the rise. The present study specifically resorts to fMRI to attain the three following goals: i) elucidate the neural background of the effects of political information referring to corruption and positive practices in general; ii) specifically explore the neural mechanisms triggered by the messages when they refer to supporters of each party; and iii) investigate whether sympathizers of the more conservative PP and more liberal PSOE differ in their judgments of corruption and positive political messages.

Theoretical Background

Corruption and positive political messages: self-reports and neural correlates

Political messages and self-reports

Specialists over the last 25 years, shave made remarkable progress in understanding how mass communications shape public opinion. The field has moved from being "one of the most notable embarrassments of modern social science" to introducing "compelling" concepts that have "had a major impact in political science and communications scholarship" (Druckman & Leeper, 2012). Specifically, research in experimental political psychology has largely backed the key role played by information regarding the actions taken by political parties to shape attitudes and perceptions of both politicians and parties, even in influencing voting behavior (Morris & Klesner, 2010). With those effects in mind, the communication departments of political parties and mass media design political campaigns on a daily basis that include both corruption scandals and positive information.

A great amount of research in fact has traditionally explored the influence of negative political messages on the electorate. Yet this research has not yielded a consensus as to its effects on audience and voting behavior (Garramone, 1985; Luque-Martínez, 1996). Several experiments such as those by Sousa and Moriconi (2013) and Riera et al. (2013) indicate that information about corruption (henceforth "corruption messages") has little impact on feelings, attitudes and voting behaviors. A number of other researchers, by contrast, identify that corruption messages affect the moods and emotions of citizens, in particular those bearing an influence on voting. This viewpoint stems, among others from the findings of Richey (2010) evidencing that information exposing corruption undermines *trust* in incumbent politicians and civil servants. References to corruption in political campaigning also elicit *negative feelings* and "*penalty domains*" among potential voters as they provoke anger leading the electorate to be more prone to punish when voting (Mattes & Redlawsk, 2015). Readers also may undergo *risk* and *ambiguity* while processing corruption messages, mechanisms derived from the erosion in the legitimacy of the political system and the uncertainty as to future negative consequences triggered by corruption scandals. There is evidence, furthermore, that information about incumbent political corruption reduces identification with the incumbent party and, consequently, may convey *regret* and *disappointment* feelings among the electorate (Chong et al., 2015).

Less attention has been paid, in turn, to the processing of messages that highlight the positive actions carried out by political parties. To our knowledge, only two studies follow that line of research. Arceneaux and Nickerson (2010) compared negatively and positively framed political messages and identified positive messages that engender *credibility, trust* and *enthusiasm*, whereas Gozzi, et al. (2010), identified reward- and positive value areas when participants were exposed to political opinions with which they agree. Positively framed-campaigns messages in other domains of communication (environment, health or social), also convey rewarding properties to the audience.

Neural correlates of political messages

Neurological tools offer an outstanding means to throw light on physiological processes resulting from political cognition and behavior (Jost, Nam, Amodio, & Van Bavel, 2014). Particular research in political psychology has recently begun to examine implicit (unconscious) mechanisms used in judging and evaluating political information. The fMRI study carried out by Rule et al. (2010), for example, concluded that individuals are more inclined to vote for candidates who are emotionally salient as evidenced by activation of the amygdala, a brain area linked to affection. Westen and et al. (2006) delved deeper into the underlying neural correlates of reading (in)congruent statements pronounced by the preferred candidate with findings indicating for the first time that subjects experience (distress) relief when processing such (in)congruent information, as seen in activation of areas in the brain linked to reward (pain). In a study on how the factor of political party affiliation modulates neural activity while viewing the faces of (own and opposite party) presidential candidates, Kaplan, Freedman and Iacoboni (2007) found that individuals regulate their emotional reactions to opposing candidates by activating cognitive control brain networks.

Despite the advances made by the research cited above in understanding the judging of political information, no study has yet to examine to what extent information exposed on a daily basis to the political electorate, namely positive and corruption messages, affect different neural networks. The present study is among the first to explore the neural basis of these two types of political messages. The likely reduction of trust conferred to corruption messages may convey negative information and hence lead to activation of brain regions linked to negative feelings and the penalty domain. These brain areas according to Bartra, McGuire and Kable (2013) include the amygdala, anterior insula, striatum and dorsomedial prefrontal cortex (DMPFC). The uncertainty of future negative consequences triggered by the corruption scandals may also activate regions responsible for risky and ambiguous decision-making processes such as the orbitofrontal cortex (OBC), thalamus, middle frontal gyrus or inferior parietal lobes (Krain, Wilson, Arbuckle, Castellanos, & Milham, 2006). In addition, brain regions involved with regret and disappointment, namely the precuneus, posterior and anterior insula, may modulate the processing of this type of corruption information (Chua, Gonzalez, Taylor, Welsh, & Liberzon, 2009). On the contrary, the reward value that is likely conveyed by messages expressing positive political measures may lead to involvement of the brain regions linked to reward and trust such as the pre-SMA and the dorsal part of the anterior cingulate cortex (ACC) as noted by Bartra et al. (2013) and Riedl, Hubert, and Kenning (2010).

The following formal hypotheses are garnered from the findings of both self-reports and brain analyses:

Hypothesis 1: Political messages reporting corruption elicit in general an increase in activity in the domains of penalty (amygdala, anterior insula, striatum and DMPFC), risk and ambiguity (OBC, thalamus, middle frontal gyrus and inferior parietal lobe), regret (ventral part of the anterior insula) and disappointment (precuneus and posterior insula).

Hypothesis 2: Positive political messages in general elicit an increase in activity in brain regions linked to reward (pre-SMA) and trust (ACC).

In a secondary exploratory analysis, the current paper assesses whether there are neural differences in the whole sample when processing corruption messages referred to PP versus PSOE, and vice versa, and positive messages connected to PP versus PSOE, and vice versa.

Partisanship bias: the processing of own and opposite party messages

It is well known that individuals tend to view the political world in a way that is consistent with their political predispositions (Gerber & Green, 1999). This argument is consistent with the theory of motivated information processing which argues that people's reaction to information is mediated by their beliefs through the attitude congruence bias "… where they tend to evaluate arguments and evidence that support their priors as stronger and more compelling than contrary arguments …" (Garramone, 1985).

Accordingly, sympathizers of incumbent parties when subject to corruption messages are likely to punish less and support more the positive information with regards to the practices of their own (vs. opposite) party. This process of "partisan bias" in political judgments is widely referred to in political psychology science as "motivated reasoning" and indicates a form of implicit affective regulation in which the brain reaches solutions that minimize negative and maximize positive affective states (Westen et al., 2006).

Westen et al. (2006) were the first to identify the neural circuits underlying the motivated reasoning in the political context. Their study subjected participants to reasoning tasks involving judgments as to a set of statements threatening to their own candidate, the opposite candidate, and neutral control targets. The findings indicate that reasoning about threatening information about their own candidate activates regions involved in implicit emotion regulation, notably the ventromedial prefrontal cortex (VMPFC), as well as regions eliciting negative emotion, notably the insula and amygdala. A more recent fMRI study by Yamada et al. (2012) measuring neural activity in ordinary citizens who are potential jurors as they decided on mitigation of punishment for murder. The authors conclude that the sentencing decision activated both brain regions related to negative affective responses as well as areas involved with sympathy, compassion and forgiveness (the precuneus and middle frontal gyrus).

Despite the fact that these authors have thrown light on the neural mechanisms involved in the motivated reasoning in political judgments, these studies suffer from several drawbacks: i) heterogeneous statements with no control of length or valence, ii) only applying exploratory whole-brain analyses, iii) resorting only to male participants, and iii) no exploration of positive information as to own or opposite political parties.

The current study therefore advances a step forward as it explores by means of an hypothesis-driven analysis the neural networks activated by both corruption and positive messages with regards to own and opposite political parties in a mixed-gender sampling. Specifically, it is expected that corruption messages from an own (vs. opposite) party elicit a neural network linked to both motivated reasoning and negative domain. Following the motivated reasoning theory, positive messages linked to the own (vs. the opposite) political party could convey greater activations in brain areas associated with reward and positive value.

These notions lead to the following hypotheses:

Hypothesis 3: Political messages exposing corruption at to one's own party (vs. opposite party) elicit an increase in activity in the brain areas regulating emotion (VMPFC, precuneus, middle frontal gyrus) and negative emotion, risk and ambiguity, regret and disappointment.

Hypothesis 4: Positive political messages as to one's own party (vs. opposite party) elicit an increase in activity in reward- and positive value-related brain areas (such as the pre-SMA and anterior cingulate cortex).

The last goal of the current study stems from the great amount of evidence indicating that there are ideological asymmetries in cognitive and motivational functioning among individuals bearing conservative (right) and liberal (left) persuasions. Political conservatism, in fact, has been associated with acceptance of inequality, system justification, need for order and structure, and sensitivity to dangerous stimuli, as well as to strong defense of patriotism and own party ideals. Orientation to the left, in turn, has been linked to openness to new experiences, defense of justice, auto-criticism, tolerance of ambiguity and uncertainty, and disappointment with the political system (Jost et al., 2014). Recent research has turned to neuroscientific techniques to examine the cognitive and motivational bases of ideology in an attempt to identify their origins, manifestations, and effects on behavior (Amodio, Jost, Master, & Yee, 2007; Weissflog, Choma, Dywan, van Noordt, & Segalowitz, 2013). Initial results indicate that political orientation is partially rooted in basic neurocognitive mechanisms (such as those involved in conflict monitoring) implicated in the processing of new, unexpected, and potentially contradictory informations. These studies, nevertheless, do not explore the neural differences between conservatives and liberals when it comes to judging real information as to their own and opposite parties. The higher defense of own party values and the higher acceptance of inequality characteristic of conservative (PP) citizens may lead them to stronger experiences of states of repulsion (i.e. higher levels of punishment and negative/punish brain areas) when exposed to corruption messages exposing the opposite party (i.e. PSOE) and more rewarding properties (i.e. more support) when judging own party positive messages. Accordingly, *Hypothesis 5* supposes that partisan bias is more evident among conservative sympathizers. PSOE supporters, in turn, appear to be more auto-critical and disappointed with the political system and, contrary to PP sympathizers, may experience more negative feelings when exposed to general messages exposing corruption (i.e. they reveal more punishing attitudes to all corruption messages), but do not display higher punishment values (or activation of negative brain areas) toward the opposite party because they may judge all corruption messages similarly. Therefore, *Hypothesis 6* would expect to identify greater activation of punishment and negative-related brain areas among liberal (vs. conservative) sympathizers when processing corruption information.

Method

Participants

Twenty right-handed subjects were recruited via social networks and the institutional website of the University of XXX between February and March 2018. The experiment applied standard fMRI exclusion criteria such as claustrophobia, pregnancy and metal implants. Access to private medical information and an ethical commitment consent form were obtained from each participant. Furthermore, the study was approved by a local ethical committee following the Protocol of the World Medical Association Declaration of Helsinki (2013).

Given that one of the main goals of the current study is to determine whether there are differences among PP and PSOE sympathizers when subject to corruption and positive political messages, the experiment only retained participants with ideologies very close to these two political parties. With this in mind, participants were asked to respond to the following question: "To which of the following parties do you feel more sympathy or which party do you consider closer to your own ideas?" with anchors at 1 = extremely far and 10 = extremely close (CIS

Centro de Investigaciones Sociológicas Ficha del Estudio, 2018). The average proximity of the 10 chosen (5 male, 5 female) PP sympathizers was 8.80 (SD: 1.31) and the average proximity of the 10 (5 male, 5 female) PSOE sympathizers was 8.60 (SD: 1.08). No party proximity differences were identified between the two groups (Z (9) = .318; p = .76).

Stimuli Experimental Design

The main objective of the experimental design was to simulate an environment in which participants are exposed to information about political corruption and positive political actions accompanied by PP and PSOE logos before being asked to disprove or approve the information.

Specifically, subjects were exposed to 30 different political corruption messages (15 PSOE,15 PP), 30 positive messages (15 PSOE, 15 PP) and 20 neutral messages (10 PSOE, 10 PP), the latter serving for control and comparison. A corruption message, for example, is “Fraud and documentary falsification.” A positive message, in turn, is “Good management of public money.” The third type of neutral message, serving as a control, is “It’s a Spanish political party.” Special care was taken in message selection to ensure controls of the complexity and length of the statements (between 3 and 5 words). In a pretest, an independent sample (n = 60) backed up the manipulation checks of the experimental stimuli: i) all corruption messages were perceived similarly as worrying (7-Likert scale, where 1= not worrying and 7= very worrying, mean = 6.17; SD = .84), ii) all positive messages triggered similar levels of pleasantness (7-Likert scale, where 1= not pleasant and 7= very pleasant, mean = 6.02; SD = .77), and iii) all neutral messages provoked indifference (7-Likert scale, with 1= very worrying, 4 = indifferent, and 7= very pleasant, mean = 3.81, SD = 1.00). After each message, participants were asked to express “To what extent would you approve/disapprove of the action?”

fMRI and Behavioral Tasks

The participants arrived at the laboratory one hour prior to the fMRI task. After receiving instructions and verifying that all the procedures were clear, they completed an informed consent form. They then initiated the experiment with a short practice session on a computer so as to familiarize themselves with the stimuli.

The fMRI experiment consisted of 160 trials broken down into 30 corruption, 30 positive and 20 neutral messages together with the corresponding 80 punish/support statements (Fig. 1). Each series of trials began with the display of a short period of fixation (1-3 s) followed by a 3 second randomly selected message accompanied by a random logo of an incumbent party. This was followed by the display of a fixation cross (1-3 s). The subjects were then required to express their approval or disapproval of the message by pressing one of four buttons: 1 = Lowest approval/disapproval and 4 = Highest approval/disapproval (maximum 5 seconds). The order of the messages and logos was counterbalanced among the subjects. At the end of the task the subjects received a 15€ payment. The fMRI stimuli were presented via E-Prime Professional 2.0 and lasted about 15 minutes. The timing of each trial was adapted from previous fMRI experiments (Casado-Aranda, Martínez-Fiestas, & Sánchez-Fernández, 2018). Randomization of the messages and logos was implemented by using the “Random” option in the layout of the E-Prime Professional 2.0 software.

After the scanning, participants were again asked to express through a self-administered questionnaire how much they would approve or disapprove the 80 messages they viewed during the scanning by means of a 7-Likert scale (1 = Lowest approval/disapproval and 4 = Highest approval/disapproval). The aim of this phase is to have available more detailed and richer data about judgments of political messages.

The fMRI Analyses

MRI scanning was carried out in a 3 Tesla Trio Siemens Scanner equipped with a 32-channel head coil. Functional scans were acquired by a T2*-weighted echo-planar imaging (EPI) sequence (TR = 2000 ms, TE = 25 ms, FA = 90°, slices = 35, thickness = 3.5 mm, slice order = descending). The distance factor was 20% and the slice matrix was of 64 x 64 mm.

The functional images were preprocessed and analyzed by a Statistical Parametric Mapping program (SPM12, http://www.fil.ion.ucl.ac.uk/spm/software/spm12/) run with MATLAB R2012a software. Statistical maps were generated for each participant by fitting a boxcar function to the time series convolved with the canonical hemodynamic response function. This resulted in the estimation of a general linear model (GLM) for each participant with the following regressors of interest:

i) Onset picture in messages exposing PSOE corruption (C_PSOE)

ii) Onset picture in messages exposing PP corruption (C_PP)

iii) Onset picture in positive PSOE messages (P_PSOE)

iv) Onset picture in positive PP messages (P_PP)

v) Onset picture in neutral PSOE messages (N_PSOE)

vi) Onset picture in neutral PP messages (N_PP)

vii) Onset picture in messages disapproving the PSOE (PU_PSOE)

viii) Onset picture in messages disapproving the PP (PU_PP)

ix) Onset picture in messages approving the PSOE (SU_PSOE)

x) Onset picture in messages approving the PP (SU_PP)

Furthermore, each GLM included a constant session term, six covariates to capture residual movement-related artifacts, and fixation crosses as regressors of no interest.

On the first level, the following contrasts were calculated: i) corruption (C_PSOE + C_PP) minus neutral (N_PSOE + N_PP), and vice versa; ii) corruption (C_PSOE + C_PP) minus positive (P_PSOE + P_PP) onsets, and vice versa**;** and iii) positive (P_PSOE + P_PP) minus neutral (N_PSOE + N_PP) onsets, and vice versa; iv) corruption PSOE (C_PSOE) minus corruption PP (C_PP), and vice versa; vi) positive PSOE (P_PSOE) minus positive PP (P_PP), and vice versa; vii) own corruption (C_PSOE for PSOE sympathizers + C_PP for PP sympathizers) minus neutral (N_PSOE for PSOE sympathizers + N_PP for PP sympathizers); viii) own corruption (C_PSOE for PSOE sympathizers + C_PP for PP sympathizers) minus own positive (P_PSOE for PSOE sympathizers + P_PP for PP sympathizers), and vice versa; and ix) own positive (P_PSOE for PSOE sympathizers + P_PP for PP sympathizers) minus neutral (N_PSOE for PSOE sympathizers + N_PP for PP sympathizers).

To determine which brain regions reveal different types of activation when exposed to the previous comparisons, the corresponding contrast images were subject to one-sample t-test analyses in the second level random-effects phase. To identify differences in brain activation between PP and PSOE sympathizers during the processing of political messages, the intra-subject contrast images for each of the previous contrasts were subject to two-sample t-tests between PP and PSOE sympathizers.

Random effect statistical analyses were run using small volume correction (SVC) as implemented in SPM. The use of SVC allows researchers to conduct principled correction resorting to the Gaussian Random Field Theory within a predefined region of interest (Bennett, Wolford, & Miller, 2009). Specifically, the authors created a mask containing spheres measuring

10 mm in radius based on a priori anatomical coordinates gleaned from previous studies analyzing the processing of implicit emotion regulation, punishment, risk, ambiguity, regret, disappointment and trust. The authors followed the lines of the studies by Westen et al. (2006) and Yamada et al. (2012) for the implicit emotion regulation process and negative/punishment emotions in political environments; Krain et al. (2006) for risk- and ambiguity- related brain areas; Bartra et al., (2013) for areas involved with the penalty and reward domains; Chua et al. (2009) for regret and disappointment areas; and Riedl et al. (2010) for trust processing. In other words, a mask was created using all these regions of interest serving for SVC in the whole-brain analyses. These Regions of Interest are depicted in Figure 2.

Results

Self-report results

Statistical analyses were carried out with the IBM Statistical Package of Social Science (IBM SPSS Version 20). Two Paired Sample t-tests (Wilkoxon due to the sample size) were designed out to explore whether there are significant differences in levels of punishment (support) conferred to messages exposing corruption (positive) about the own and opposite party. The results indicate that participants lend significantly less disapproval ($Z(18) = -3.11$; $p < .01$) of corruption messages concerning their own party ($M = 5.82$; $SD = 1.19$) as opposed to the opposite party ($M = 6.52$; $SD = .48$). Along the same line, the findings reveal that the subjects reveal a greater support ($Z(18) = 5.03$; $p < .01$) for positive messages from their own party ($M = 6.61$; $SD = .38$) when compared to those of the opposite party ($M = 5.04$; $SD = 1.34$).

Two independent-sample t-tests (Mann-Whitney due to the sample size) were also run to determine whether sympathizers of the PP and PSOE differ in their level of support in response to positive messages (conjointly or those referring specifically to the PP or the PSOE) and corruption messages (conjointly or those referring specifically to the PP or the PSOE). The results reveal that levels of support toward positive PSOE messages are significantly greater among PSOE sympathizers than those among the PP ($Z(18) = -3.45$, $p < .01$), whereas levels of support toward positive PP messages are greater among the PP voters than among those of the PSOE ($Z(18) = -2.27$, $p = .02$). Levels of disapproval toward messages exposing PSOE corruption are similar among PSOE and PP sympathizers ($Z(18) = -.31$, $p = .79$), whereas disapproval levels toward messages exposing PP corruption are greater among the PSOE than those of the PP ($Z(18) = -3.00$, $p < .01$). PSOE sympathizers, in turn, confer greater punishment to general corruption messages than PP sympathizers ($Z(18) = -2.12$, $p = .04$). PSOE and PP sympathizers, nevertheless, reveal similar levels of support toward general positive messages ($Z(18) = -.30$, $p = .80$). Behavioral responses within the scanner are similar to the patterns of disapproval and approval as those recorded outside the scanner. See Figure 3 for results.

Functional Imaging Results

Neural correlates of corruption and positive political messages

Messages exposing corruption (when compared to neutral and positive messages) provoke an increase in activation in the amygdala, anterior insula and DMPFC. They also elicit greater activation in both the orbitofrontal cortex, thalamus, middle frontal gyrus and inferior parietal gyrus, and the insula, precuneus and anterior insula. Positive political messages, in turn, only trigger activation when compared to neutral messages in the dorsal ACC. Exploratory whole-brain analyses bolster the results of the SVC approach. Online Appendix 1 lists all the peak coordinates and brain positions.

More precisely, the amygdala, middle and superior frontal gyri and the anterior insula reveal greater activation when comparing corruption messages referring to the PSOE versus those connected to the PP. The contrast of positive information about PSOE vs. PP yielded more suprathreshold activations in the pre SMA and ACC. Here again, whole-brain analyses support the results of the ROI approach. All these results can be consulted in the Online Appendix 2.

Neural correlates of own and opposite party messages

The study then turned to the question of how sympathizers of a party process corruption and positive messages affecting their own and the opposite party. In particular, only when messages referred to the opposite party were contrasted to others from the own party, suprathreshold significant activations at the hypothesized ROIs were found. More specifically, corruption messages referred to the opposite party elicited more significant activation in the insula. In turn, when positive messages connected to the opposite party were compared to positive own party information, the thalamus and striatum, caudate and anterior cingulate areas showed significant activation. Whole-brain analyses corroborated the results of the ROI approach. All results can be consulted in the Online Appendix 3.

Differences in Brain Activity in Function of Political Orientation

Two sample t-tests revealed significant differences between PP and PSOE sympathizers when processing i) general corruption versus positive political messages, ii) corruption information of the opposite versus own party, and iii) positive information linked to the opposite versus own party. Firstly, the results of brain analyses indicate that PSOE sympathizers, as opposed to those of the PP, reveal a greater activation in the lateral OBC, insula and superior/inferior frontal gyri when processing general messages exposing corruption. Secondly, when corruption messages exposing to the opposite party are compared to those of the own party, the amygdala and anterior insula were more greatly activated among PP sympathizers. Thirdly, PP (vs. PSOE) sympathizers also experienced more significant activation in several areas, notably the DMPFC and cingulate gyrus, when positive information about the opposite party was contrasted to positive messages of the own party. Whole-brain analyses therefore support the results gleaned from the ROI approach. Figure 4 and Online Appendix 4 offer details of the activations and their coordinates

Discussion

Despite the great amount of daily news exposing corruption of political parties, there are no research findings proving that corruption messages decrease the number of votes of a political party. Political psychology literature has largely concluded that partisan bias may be the main cause of the little degree of efficiency of such political messages as sympathizers as opposed to their nonpartisan counterparts, appear to punish parties linked to corruption less and offer stronger support to positive information concerning actions carried out by their own party. Exploring the physiological processes triggered by messages exposing corruption and positive political information in general, and regarding own and opposite party in particular, can objectively serve to clarify the origin of partisan bias and its influence on voting attitudes and intentions. This is the first study that resorts to a combination of neurological and self-report tools to examine this research gap. It aims to identify the neural background of the effects of corruption and positive political messages linked to own and opposite political parties, as well as to identify the differences in the neural patterns of activation provoked by these informations among sympathizers of conservative (PP) and liberal (PSOE) parties.

As regards self-report responses, this study infers that, in general, participants display a higher level of disapproval of corruption messages from the opposite (vs. own) party and display more energetic support for positive messages regarding their own party. These findings therefore bolster the notion of partisan bias (Muñoz et al., 2016). When observing the differences between conservative and liberal voters, the findings also reveal that partisans bias is less noticeable among liberal voters, as they disapprove of messages exposing corruption among both their own and the opposite party. Both groups of voters, however, reveal higher levels of support toward their party of preference than to their counterparts. These findings line up with those advanced by Anduiza et al. (2013) in that PSOE voters punish corrupt incumbents more intensively at the polls. They also confirm that left leaning individuals are more auto-critical and experience more disappointment with the political system than their conservative counterparts (Jost et al., 2014).

The neurological analyses carried out in this study are a step in the right direction as they reveal underlying brain mechanisms of the effects of positive political messages, as well as those exposing corruption, and the differences in the way they are processed by voters of distinct political affiliations. On the one hand, brain regions eliciting stronger activation during messages exposing corruption, as opposed to positive and neutral messages, include the anterior insula, DMPFC, amygdala, OBC, thalamus, precuneus, middle frontal gyrus and inferior parietal gyrus. The roles of the anterior insula, DMPFC and amygdala in the penalty domain are largely evidenced as a great amount of research confirms that these brain areas encode aversive and negative mechanisms (Bartra et al., 2013; Liddell et al., 2017). The OBC, thalamus, middle frontal gyrus and inferior parietal gyrus elicited by corruption messages constitute two brain areas previously identified as being involved with risk and distrust (Krain et al., 2006; Mohr, Biele, & Heekeren, 2010). In a study exploring the neural correlates of regret and disappointment, Chua et al. (2009) reveal that two brain areas elicited by corruption messages, notably the ventral part of the anterior insula and the precuneus, are implicitly active in disappointing contexts of decision-making. Hence, in general, involvement of the disapproval and negative systems when evaluating corruption messages supports *Hypothesis 1* stating, notably, that negative political information confers averse, risk and disappointment among potential voters. On the other hand, positive political information is only weakly elicited an area largely involved with the judgment of trust, notably the dorsal part of the ACC (Riedl et al., 2010). However, no activations linked to reward or optimistic values were found when positive (vs. corruption) messages were exposed to participants, notions thus partially supporting *Hypothesis 2*. Taken together, these findings reveal that messages exposing corruption, as opposed to positive messages, exert the greatest impact on individuals when evaluating political parties. This reasoning lines up with Tversky and Kanemahn's Prospect Theory (1986) indicating that loss frames (in line with corruption messages) in advertising are more effective in modifying attitudes and behaviors than gain frames (in line with positive messages) within high short-term risk contexts such as politics. Bizer, Larsen, and Petty (2010), in fact, offer support to this latter finding in the specific environment of politics.

A secondary exploratory analysis tested whether there are neural differences throughout the whole sample when processing corruption or positive messages with regards to the PP versus the PSOE. Interestingly, the findings reveal that political messages about the PSOE, either in the form of corruption or positive contents, exert the greatest unconscious impact. In fact, messages exposing corruption in the PSOE (vs. PP) elicit stronger activations of areas related to the penalty (amygdala, Bartra et al., 2013), risk (middle frontal gyrus, Krain et al., 2006), regret (anterior insula, Chua et al., 2009) and ambiguity (superior frontal gyrus, Krain et al., 2006).

Positive political messages referring to the PSOE are, furthermore, those perceived as more rewarding, as evidenced by activations of the pre-SMA and ACC, two areas involved in the dopaminergic reward system (Bartra et al., 2013). Overall, these results suggest that information referring to the Socialist Party, an organization that more clearly encourages good political practices and the defense of justice, may be judged in more detailed and have a greater effect on citizen evaluations.

The study then turned to evaluating partisan bias based on the processing of political information by both conservative and liberal sympathizers. This was carried out by assessing the neural correlates of corruption and positive political messages from own and opposite political parties. The hypothesis was advanced that political messages exposing corruption of one's own party (vs. opposite party) would activate the emotion regulation and negative emotion systems, whereas own party positive political messages would elicit significant increases in brain areas linked to reward and positive values. Unexpectedly, and in part supporting *Hypotheses 3* and *4*, only political messages linked to the opposite party exerted influence on the emotional and cognitive mechanisms. Information regarding dishonest practices, in particular by the opposite (vs. own) party, triggered ambiguity and obscurity, as evidenced in the activation of the bilateral insula, an area associated with ambiguity (Krain et al., 2006). The absence of activation in brain areas related to emotion regulation (such as the VMPFC or precuneus) may be derived from not requesting participants to explicitly "express whether the statements and actions are (in)consistent with their preferred political party," as carried out by Westen et al. (2006). Further research should explore the emotion regulation process by including the Westen et al. (2006) approach within the context of political messages. Surprisingly, messages including beneficial practices implemented by the opposite (vs. own) party also stimulated aversion and doubt, as revealed by activation in brain areas related to ambiguity (Krain et al., 2006), penalty (Bartra et al., 2013) and risk (Krain et al., 2006). However, no reward or trust related areas saw greater activation by positive information about one's own (vs. opposite) party. Taken together, the current findings illustrate for the first time that all information as to practices of the opposite (vs. own) political party, either linked to corruption or positive actions, has a greater affect on the evaluations of citizens and engages disbelief, aversion, even risk, thus supporting the hypothesis of partisan bias.

Given the well-established differences in the value schemes and priorities between conservative (PP) and liberal (PSOE) sympathizers (Jones, Feinberg, DeBruine, Little, & Vukovic, 2010), the last goal of this study was to evaluate whether different processing takes place during exposure to corruption and positive messages in general, and specifically those regard the own or opposite party. The findings indicate a consistent tendency lining up with *Hypothesis 5*: PP sympathizers reveal more partisan bias as they unconsciously experience a greater level of regret, aversion and ambiguity when comparing either positive or corruption-related messages about the opposite party to their own. A higher defense of own party values and aversion to the opposite party is thus characteristic of conservative sympathizers (van der Toorn, Nail, Liviatan, & Jost, 2014) that reveal a higher repulsion toward actions (either negative or positive) carried out by the opposite party. This is evidenced by neural circuits involved with regret and ambiguity. Consistent to *Hypothesis 6*, the findings indicate that liberal (vs. conservative) sympathizers are more sensitive to general corruption information, as shown by activation of areas known to be involved with punishment (lateral orbitofrontal cortex; Westen et al., 2006), regret (insula; Chua et al., 2009) and ambiguity (superior and inferior frontal gyri; Krain et al., 2006). These results line up with the higher disapproval among PSOE sympathizers toward general corruption and confirm their higher levels of disappointment and criticism of dishonest political practices (Jost et al., 2014).

Theoretically, the current findings contribute to the line of thought challenging the explainations of why political messages do not fully affect voting attitudes and behaviors of a specific political party. Earlier studies of these concepts focus on the impact of different types of political campaigns on both implicit and explicit attitudes (Carraro & Castelli, 2010) and analyze the economic context and level of education (de Sousa & Moriconi, 2013), political sophistication (Riera et al., 2013) and partisan bias (Anduiza et al., 2013) as main inhibitors of effective political communications. The current study likewise concludes that messages exposing corruption (vs. positive messages) may exert a greater impact on evaluations and attitudes toward political parties, a notion previously advanced by Bizer et al. (2010). This research also represents a step forward in the sense that it sheds light for the first time on the subconscious origin of the most relevant modulator of political communication effectiveness, namely partisan bias, while processing real positive and corruption news about Spanish parties. Moreover, it reveals the existence of partisan bias against opposite parties (and not a positive bias for an own party) that stems from a higher risk, ambiguity, disbelief and regret provoked in citizens by both corruption and positive messages from the opposite party. Previous research examined the cognitive and motivational bases of political ideology by resorting to self-reports or fictitious environments (Weissflog et al., 2013; Jost et al., 2014). This study, by contrast, takes a step forward as it resorts to neuroscience to conclude that conservative (vs. liberal) sympathizers experience a more evident unconscious partisan bias toward real information about opposite parties, whereas liberal supporters perceive general practices of corruption as more negative and riskier. Finally, this paper constitutes a step forward in the application of neurological tools to shed light on the physiological processes involved in political cognition, evaluation, judgment, and behavior. Previous research, by contrast, explored the origin of political beliefs (Angelidis & Ibrahim, 2004) or the modulating role of personality and ideological attitude in voting behavior (Cazzato, Liuzza, Caprara, Macaluso, & Aglioti, 2015). Hence, this study spells out the neural mechanisms underlying the processing of corruption and positive political messages.

The findings of this study therefore offer remarkable managerial implications. Firstly, they confirm that information about dishonest (vs. beneficial) political practices exerts the greatest impact on cognitive and affective mechanisms among the electorate. Hence political parties or the mass media, as noted by Tversky & Kahneman (1986), can make use of corruption messages when they desire to discredit opposite parties. Furthermore, the findings offer evidence that information about socialist or liberal (vs. conservative) parties (stronger defenders of more honest practices) affects the unconscious level of the electorate to a greater extent, as evidenced by the triggering of brain areas related to risk, ambiguity and disappointment by corruption messages, as well as the triggering of reward-related areas conveyed by positive information. These findings, in line those of Anduiza et al. (2013), should lead socialist parties (e.g. the PSOE) to invest greater effort in assuring honest practices and avoid and control negative information linked to them. The analysis of the subconscious origin of partisan bias suggests designing political campaigns placing emphasis on the practices (either negative or positive) of opposite political parties as a more efficient tool than alluding to positive information as to one's own party (Altheide, 2004). By carrying out these designs, political parties could induce an increase of sentiment of inclusion and affiliation among their sympathizers, and even reach new supporters. As conservative sympathizers experience are prone to this, their parties should focus efforts on messages focusing on their opposition.

A drawback to this study is that it only measures self-reported disapproval and support, and not real voting behavior. Future research should link neural responses during the processing of political messages to actual political affiliation change. Secondly, this study did not explicitly ask participants to express whether messages are consistent with their party or ideology. With the aim to capture emotion regulation processes, further research should include the previous approach to the field of political psychology. Further research exploring the modulating role of political sophistication or perception of economic context is also needed to advance in the understanding of the effects of political messages in voting behaviors.

Despite the vast amount of literature analyzing the psychological effects of political messages on voting behavior, it is surprising that most studies omit identifying the origin of the most relevant factor affecting that relationship, notably partisan bias. This is therefore the first study that not only applies a multi-methodological approach to face this research gap, but advances that negative (vs. positive) political messages exert the greatest neurological impact on the electorate, and that conservative sympathizers reveal a more intense partisan bias when exposed to political messages than their opposing counterparts.

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Figures

Figure 1. The structure of the fMRI task. The order corresponds to the first condition 'positive information about PSOE' (positive PSOE). The main conditions (positive PSOE, corruption PSOE, neutral PSOE, positive PP, corruption PP and neutral PP) are presented in random order in the subsequent repetitions. See Appendix A for a complete view of the stimuli. [2-column fitting image]

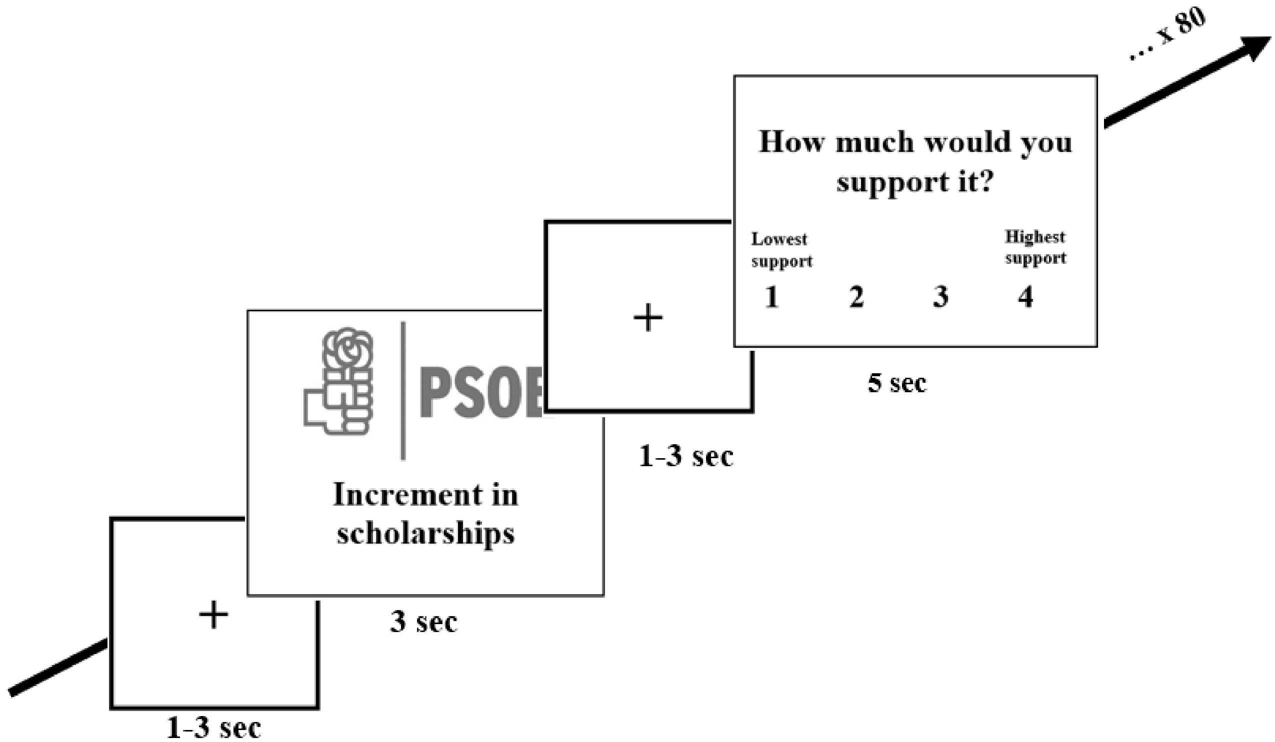
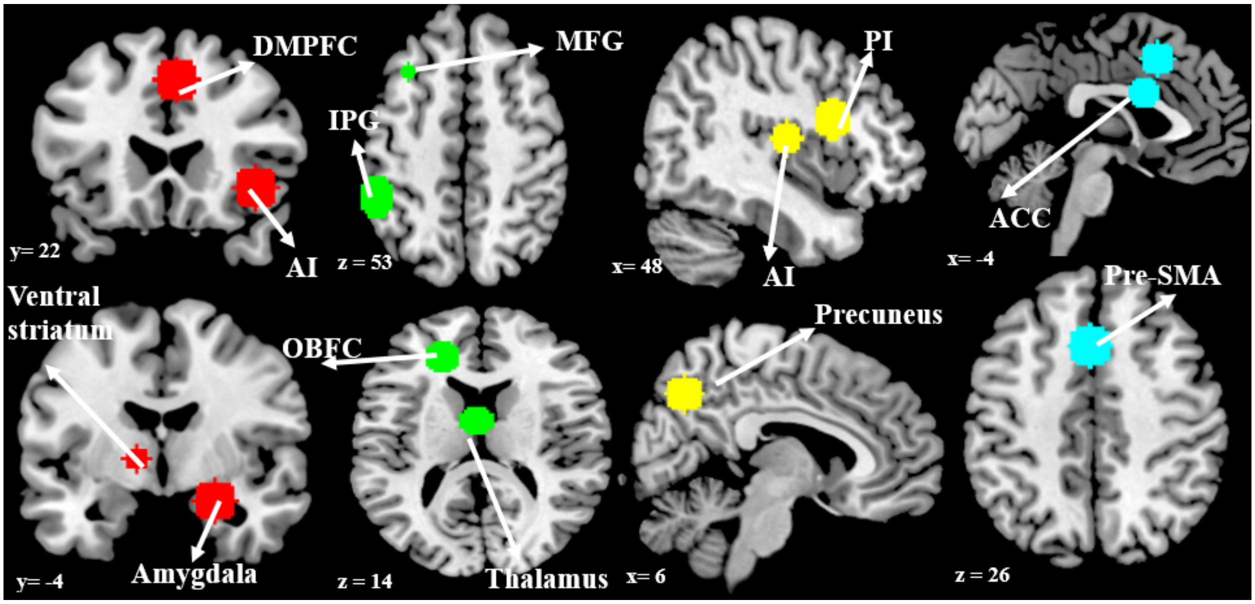


Figure 2. Illustration of the a priori Regions of Interest taken as 10-mm spheres and their attributes according to the specialized literature. Red: penalty domain (Bartra et al., 2013); Green: risk and ambiguity (Krain et al., 2006); Yellow: regret and disappointment (Chua et al., 2009); Blue: reward and trust (Bartra et al., 2013; Riedl et al., 2010). [2-column fitting image]



Note: DMPFC: Dorsolateral Prefrontal Cortex. OBFC: Orbitofrontal cortex. MFG: Middle frontal gyrus. PI: Posterior insula. ACC: Anterior Cingulate Cortex. Pre-SMA: Pre-superior motor area.

Figure 3. Results of the behavioral analysis. (A) y-axis: Levels of support of PP and PSOE sympathizers (At); x-axis: positive PSOE and positive PP messages. Levels of support of positive PSOE messages are greater among PSOE sympathizers than those of the PP. Levels of support of positive PP messages are greater among PP sympathizers than among PSOE sympathizers. **(B)** y-axis: Levels of disapproval of PP and PSOE sympathizers (At); x-axis: corruption PSOE and corruption PP messages. Disapproval levels of corruption of PSOE messages are similar among PSOE to those of PP sympathizers.

Disapproval levels of corruption PP messages are greater among PSOE than among PP sympathizers. **(C)** y-axis: Disapproval (of corruption messages) and supporting (of positive messages) levels of PP and PSOE sympathizers (At); x-axis: general positive messages (PSOE + PP) and general corruption messages (PSOE + PP). Disapproval levels of corruption messages are greater among PSOE than PP sympathizers. PSOE and PP sympathizers reveal similar levels of support toward general positive messages and corruption PP messages are greater among PSOE than PP sympathizers. Error bars indicate standard deviation. [1.5-column fitting image]

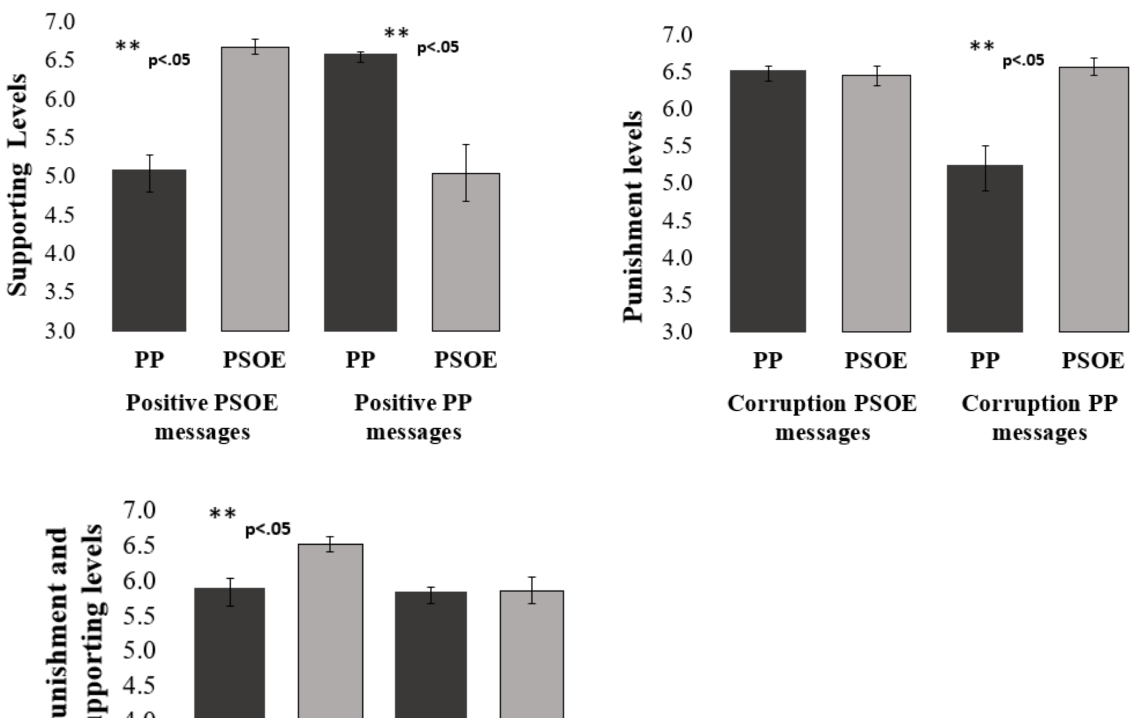
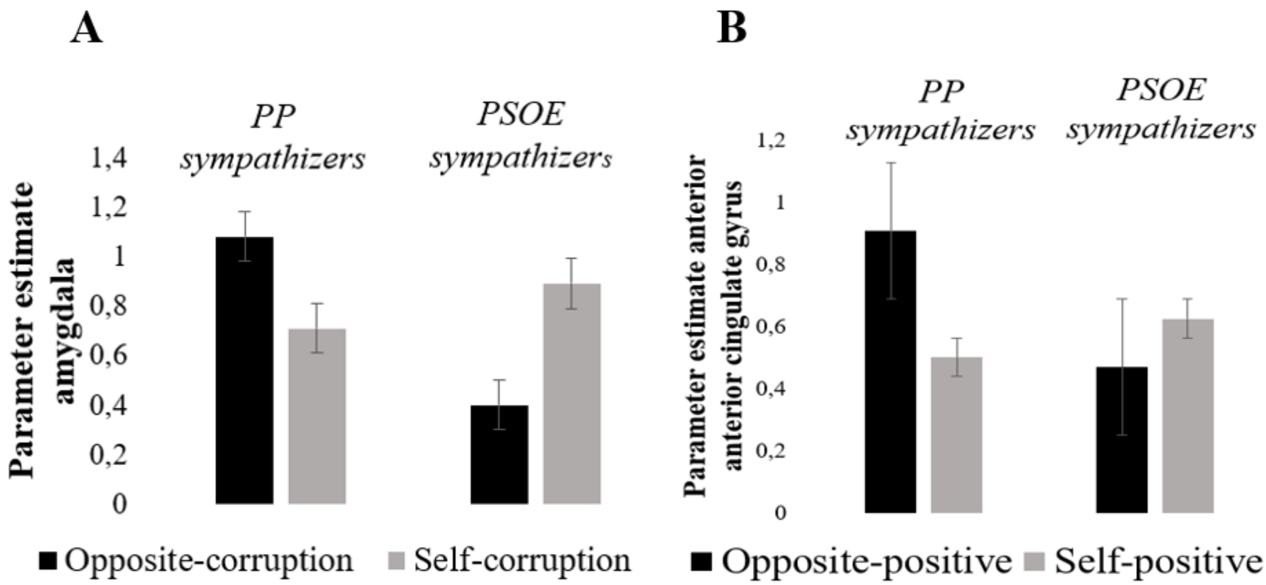


Figure 4. PP sympathizers exhibit greater activation in **(A)** the amygdala (MNI: -22, -24, -12) in response to corruption messages from the opposite (*vs*. own) party when compared to PSOE sympathizers. PP sympathizers also exhibit greater activation in **(B)** the anterior cingulate cortex (MNI: -4, 22, 37) in response to positive messages from the opposite (*vs*. own) party when compared to PSOE sympathizers. [2-column fitting image]



Online Appendix 1

Table 1. Brain regions resulting from the Small Volume Correction (e.g. SVC, whole-brain with mask) and whole-brain (without mask) analyses carried out in the contrast of general positive and corruption acts.

Contrasts and regions	Peak MNI coordinates (mm)			Cluster size	T	Study
	x	y	z			
Corruption > Neutral						
SVC analysis						
Anterior insula	40	22	-6	3	4.25	Bartra et al. (2013)
DMPFC	4	22	44	3	3.84	Bartra et al. (2013)
Amygdala	24	-4	-18	4	3.80	Bartra et al. (2013)
Orbitofrontal cortex/anterior insula	-20	39	14	11	4.31	Krain et al. (2006)
Thalamus	-2	-2	16	8	4.64	Krain et al. (2006)
Posterior Insula	48	-12	12	3	3.67	Chua et al. (2009)
Precuneus	6	-66	42	3	3.93	Chua et al. (2009)
Whole-brain analysis						
Insula	48	7	-2	65	5.87	
Precuneus	-8	-56	68	124	5.24	
Supramarginal	59	-25	19	89	5.39	
Postcentral	48	-21	40	89	5.19	
Middle frontal gyrus	31	32	26	46	4.79	
Corruption > Positive						
SVC analysis						
Middle frontal gyrus	-32	18	61	3	3.79	Krain et al. (2006)
Inferior parietal gyrus	-50	-41	53	4	4.02	Krain et al. (2006)
Precuneus	6	-66	42	9	4.18	Chua et al. (2009)
Anterior insula	39	12	21	3	3.64	Chua et al. (2009)
Whole-brain analysis						
Inferior parietal gyrus	-43	-42	40	20	3.87	
Middle frontal gyrus	-36	28	33	20	4.83	
Positive > Neutral						
SVC analysis						
Dorsal ACC	-4	8	26	3	3.76	Riedl et al. (2010)
Whole-brain analysis						
Insula	48	4	-2	272	5.93	
Postcentral	24	-39	68	40	5.10	
Precuneus	-8	-53	72	35	3.77	
Positive > Corruption						
SVC analysis						-
-	-	-	-	-	-	-

Note: Peak of clusters significant at p uncorrected = 0.001, k ≥ 20 voxels are reported in the whole-brain analysis

Online Appendix 2

Brain regions resulting from the Small Volume Correction (e.g. SVC, whole-brain with mask) and whole-brain (without mask) analyses carried out in the contrast of positive and corruption acts specifically carried out by PSOE and PP.

Contrasts and regions	Peak MNI coordinates (mm)			Cluster size	T	Study
	x	y	z			
Corruption PSOE > Corruption PP						
SVC analysis						
Amygdala	-22	-4	-12	5	4.00	Bartra et al. (2013)
Amygdala	-22	-4	-22	3	4.00	Bartra et al. (2013)
Amygdala	24	-4	-18	2	3.83	Bartra et al. (2013)
Middle frontal gyrus	32	56	0	2	3.77	Krain et al. (2006)
Anterior insula	-51	9	-6	3	4.09	Chua et al. (2009)
Superior frontal gyrus	40	40	30	3	4.12	Krain et al. (2006)
Whole-brain analysis						
Superior frontal gyrus	24	49	23	30	4.35	
Middle frontal gyrus	38	46	26	30	4.12	
Corruption PP > Corruption PSOE						
-	-	-	-	-	-	-
Positive PSOE > Positive PP						
SVC analysis						
Pre SMA	-2	16	46	2	3.60	Bartra et al. (2013)
ACC	-2	24	26	11	4.71	Bartra et al. (2013)
Whole-brain analysis						
Superior frontal gyrus	20	32	37	29	5.56	
Superior motor area	6	27	47	20	4.36	
Positive PP > Positive PSOE						
-						-
						-

Note: Peak of clusters significant at p uncorrected = 0.001, k ≥ 20 voxels are reported in the whole-brain analysis

Online Appendix 3

Brain regions resulting from the Small Volume Correction (e.g. SVC, whole-brain with mask) and whole-brain (without mask) analyses carried out when contrasting own and opposite party acts.

Contrasts and regions	Peak MNI coordinates (mm) x	y	z	Cluster size	T	Study
Own party corruption > Opposite party corruption						
SVC analysis						
-	-	-	-	-	-	-
Whole-brain analysis						
-						
Opposite party corruption > Own party corruption						
SVC analysis						
Insula	34	17	7	2	3.64	Krain et al. (2006)
Insula	-34	19	13	2	3.94	Krain et al. (2006)
Whole-brain analysis						
Insula	48	7	-2	20	4.66	
Insula	-40	4	-9	20	4.58	
Own party positive > Opposite party positive						
SVC analysis						
-	-	-	-	-	-	-
Whole-brain analysis						
-						
Opposite party positive > Own party positive						
SVC analysis						
Thalamus	-6	-8	6	2	3.81	Bartra et al. (2013)
Thalamus	6	-8	6	2	3.81	Bartra et al. (2013)
Striatum	-12	4	2	2	3.81	Bartra et al. (2013)
Caudate	-12	18	-3	2	4.28	Krain et al. (2006)
Anterior cingulate	-10	32	-2	3	4.28	Krain et al. (2006)
Whole-brain analysis						
Paracentra lobe	-1	-28	58	30	5.41	
Anterior cingulate	13	49	19	25	5.38	
Postcentral	-43	-11	40	20	4.91	
Caudate	-19	11	19	20	4.90	

Note: Peak of clusters significant at p uncorrected = 0.001, k ≥ 20 voxels are reported in the whole-brain analysis

Online Appendix 4

Brain regions resulting from the Small Volume Correction (e.g. SVC, whole-brain with mask) and whole-brain (without mask) analyses carried out among PP and PSOE sympathizers when processing corruption messages referring to the opposite (vs. own) party, and positive messages referring to the opposite (vs. own) party.

Contrasts and regions	**Peak MNI coordinates (mm)** x	y	z	**Cluster size**	**T**	**Study**
Corruption > Positive						
SVC analysis						
PSOE vs PP						
Lateral OBC	-28	24	-24	2	4.85	Westen et al. (2006)
Insula	-48	21	-12	7	4.64	Chua et al. (2009)
Superior frontal gyrus	40	40	30	2	3.71	Krain et al. (2006)
Inferior frontal gyrus	-46	16	19	2	3.71	Krain et al. (2006)
Whole-brain analysis						
Inferior orbitofrontal gyrus	-47	32	-13	21	4.79	
Positive > Corruption						
SVC analysis						
-	-	-	-	-	-	
Opposite-party corruption > Self-party corruption						
PP vs. PSOE						
SVC analysis						
Amygdala	-22	-24	-12	9	4.28	Westen et al. (2006)
Anterior insula	-51	9	-6	3	3.95	Chua et al. (2009)
Whole-brain analysis						
Superior frontal gyris	17	0	72	27	5.30	
Insula	41	4	-6	21	4.61	
PSOE vs. PP						
-	-	-	-	-	-	-
Opposite-party positive > Self-party positive						
PP vs. PSOE						
SVC analysis						
DMPFC	4	22	44	10	4.24	Bartra et al. (2013)
Cingulate gyrus	-4	22	37	20	4.85	Krain et al. (2006)
Whole-brain analysis						
Cingulate gyrus	13	49	19	20	5.35	
PSOE vs. PP						
-	-	-	-	-	-	-

Note: Peak of clusters significant at p uncorrected = 0.001, k ≥ 20 voxels are reported in the whole-brain analysis.