

The Neuroeconomics of Voting: Neural Evidence of Different Sources of Utility in Voting

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Which motives drive the decision of a voter to approve or reject a policy proposal? The Public Choice literature distinguishes between instrumental and expressive voting motives. We investigated the importance of these motives by analyzing the patterns of neural activity in different voting situations. We conducted a functional magnetic resonance imaging experiment that investigates neural activation at the moment of voting and used the altruism scale proposed by Tankersley, Stowe, and Huettell (2007) to differentiate between altruists and nonaltruists. Nonaltruists showed neural activation patterns that were consistent with expressive voting motives. Among nonaltruists, we also observed activation patterns that point at egoistic instrumental motives. Both results are in line with the corresponding Public Choice literature. On the other hand, we found no evidence for expressive voting motives among altruists. Their neural activation pattern was generally much less conclusive with respect to the underlying motives.

Keywords: voting behavior, expressive voting, instrumental voting, political decision making, charitable donation

Traditionally, the theory of voter behavior assumes that voting decisions are driven by preferences over policy proposals. The vote serves as an instrument to change the voter's living environment in the future (e.g., Downs, 1957). This so-called instrumental voting can be thought of as an investment under uncertainty: The voter bears the certain and immediate costs of voting and expects future utility gains from more favorable policies. He votes for his favorite policy proposal to increase the probability that it becomes accepted and pursued (e.g., Downs, 1957; Fiorina, 1976). The

essential shortcoming of the theory of instrumental voting is that it cannot explain the high voter turnout in real-life elections where the individual vote has a negligible chance of changing election outcomes (e.g., Downs, 1957; Tyran, 2004). To dissolve this "paradox of voting," it is necessary to assume some direct utility from the act of voting that does not relate to the policy outcomes expected in the future. According to the theory of expressive voting, a voter goes to the booth because the act of expressing his approval to a certain candidate or policy proposal yields immediate utility. Thus, voting is an act of consumption, much like cheering at a football game (e.g., Brennan & Hamlin, 1998; Fiorina, 1976). As long as an expressive voter does not expect to be pivotal, he votes for the proposal or candidate for which approving yields the highest immediate expressive utility. In those cases where he expects to be pivotal the instrumental utility outweighs the expressive utility. Given that the chance of being pivotal in real-world elections is negligible, expressive

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motives may—if existent in a large share of voters—drive the collective policy choices (Tullock, 1971). In this case, voting does no longer aggregate policy preferences. Instead, it promotes policies and candidates that make voters feel good when voting for them and impedes policies where the concomitant feeling is bad. Whenever expressive and instrumental motives collide, it is uncertain whether the policy chosen promotes the welfare even of the majority of voters who approved.¹ Moreover, it opens up another channel by which election polls can influence voting decisions: Policies where expressive and instrumental motives collide can be promoted or impeded by making expected outcomes seem less or more close.

So far, behavioral experiments provide only limited empirical support for a prominent role of expressive motives (e.g., Carter & Guerette, 1992; Feddersen, Gailmard, & Sandroni, 2009; Fischer, 1996; Kamenica & Egan, 2011; Shayo & Harel, 2012; Tyran, 2004).² In this article, we argue that the existing evidence from behavioral experiments does not necessarily mean that expressive motives are not as strong as predicted. The reason is that behavioral data—that is, the observed decision to vote YES or NO—leaves us with a measure that may be too crude to differentiate different voting motives. The observed voting decision supports the conclusion that—among two different conflicting voting motives—a particular motive dominates. However, it does not tell us whether the other motive is relevant at all, nor does it inform us about the relative strengths of both motives. To gain deeper insight into the role of different voting motives, we apply neuroscientific methods. These provide us with a detailed account of brain activities involved in the voting process. By providing us with measures for neural correlates of the utility involved in the voting decisions, they allow for additional tests for the presence of expressive motives in voting. Over the last years, the application of neuroscientific methods in economics enhanced the knowledge about economic behavior and decision making. Up to now, the political sciences have paid little attention to these new methods (for some exceptions see Amodio, Jost, Master, & Yee, 2007; Chorvat, 2007; Farmer, 2007; Harbaugh, Mayr, & Burghart, 2007; Tingley,

2006; Westen, Blagov, Harenski, Kilts, & Hamann, 2007). To our knowledge, we provide the first study using functional magnetic resonance imaging (fMRI) to investigate voting behavior.³ We find neural activation patterns that are consistent with the theory of expressive voting among subjects classified as non-altruists. For those classified as altruists, we do not find neural correlates of an expressive utility from voting. Moreover, our results are inconclusive with respect to the ultimate factors that determine their instrumental utility when voting.

The article proceeds as follows. After sketching the incentives involved in expressive and instrumental voting, the second section derives the central hypotheses to be tested. The third section describes the experimental set-up of our study. The results are presented in the fourth section and discussed in the fifth section; the sixth concludes.

¹ Similarly, Feddersen and Pesendorfer (1996) show that strategic voting may undermine the majority vote's ability to aggregate private information as proposed in Condorcet's Jury Theorem. The main difference between this strand of literature and the one followed here is the purpose of collective decisions: In the case these authors have in mind, majority voting is a means of aggregating private information on an uncertain state of nature. In our article, the aim is to aggregate individual policy preferences. In this context, the ethical voter central to the analysis of Feddersen and Pesendorfer votes instrumentally because his aim is improve policy outcomes (see also Battaglini, Morton, & Palfrey, 2010). Given only two choices, strategic voting is irrelevant.

² Most of these studies deliberately create treatments with different degree of pivotality changing the decision making environment (e.g., electorate size; for a review, see Shayo & Harel, 2012). Tyran (2004) is among the few who do not change the voting environment but elicit voters' expectations concerning the approval rate and infer the degree to which voters expect to be pivotal. In this article, we Tyran's approach.

³ The study by Rule et al. (2010) on the choice of political candidates in Japan and the U.S. may be regarded as an exception. However, it concentrates on judgments about personality and culture as drivers of choosing candidates for political offices. In addition, choices are hypothetical and the interaction of voters in the collective decision making framework is not captured by the procedures. Thus, we claim to provide the first fMRI-study on voters' interaction in voting decisions. We also focus on the choice of policies rather than candidates.

Expected Voting Decisions and Their Neural Correlates

Behavioral Predictions and Economic Experiments

The set-up of most experimental studies on expressive voting resembles Tullock's thought experiment (e.g., Tullock, 1971). It is based on a ballot in which a large number of individuals vote on the following proposal: Tax everyone and donate the revenues to charity. Throughout this article, voting refers to this type of redistributive policies; the proposal is to take money from the broad public and use it to help a clearly defined minority. This minority consists of individuals that—by a broad consensus in society—are considered to be in need. To identify the incentives that voters face when deciding on this proposal, consider the individual voter i . Let y_i denote the utility he witnesses if the proposal is rejected and he can keep the money for private use. Let z_i represent the utility from altruistic motives that subject i witnesses if the proposal is accepted and the minority in need witnesses an increase in consumption. The instrumental utility that subject i witnesses if the proposal is rejected is given by $x_i = y_i - z_i$. Individuals who draw a higher utility from the money being donated are hereafter called altruists. For them $z_i > y_i$ and thus, $x_i > 0$ while $z_i < y_i$ and $x_i < 0$ for nonaltruists who witness a higher utility when the money is available for private use.

Let ε_i denote voter i 's expressive utility from voting for the proposal. By voting in favor of donating the money, voter i complies with the predominant ethical standards in society and may think of himself as a generous person. Both aspects arguably yield utility (Mueller, 1986; Hillman, 2010).⁴ Thus, we follow Tullock (1971) and Tyran (2004) in assuming that the immediate expressive utility from voting in favor of donating the money is higher than from rejecting this proposal. We also assume that the instrumental utility dominates the expressive utility, (i.e., $0 \leq \varepsilon_i < |x_i|$). The expected utility from voting YES is then given by:

$$\begin{aligned}\hat{U}_i(\text{YES}) &= \hat{r}_i \cdot (x_i + \varepsilon_i) + \hat{p}_i \cdot \varepsilon_i + \hat{s}_i \cdot \varepsilon_i \\ &= \varepsilon_i - \hat{r}_i \cdot x_i\end{aligned}$$

Here, $\hat{p}_i$ denotes the probability at which voter i expects to be pivotal. The case where $\hat{p}_i > 0$ is hereafter called *close-decision case*. In most elections and ballots the approval rate among other voters is either sufficiently high to accept the proposal even if he votes against it or too low to accept the proposal even if he votes in favor of it. Hereafter, we denote the first case the *sure-donation case* and the second one the *sure-private-money case*. In both cases, $\hat{p}_i \approx 0$. The probability at which voter i expects the sure-donation (sure-private-money) case is denoted $\hat{r}_i$ ($\hat{s}_i$).

The expected utility from voting NO is given by:

$$\hat{U}_i(\text{NO}) = \hat{r}_i \cdot x_i + \hat{p}_i \cdot x_i$$

The difference between these two utilities is called the utility differential $\widehat{UD}_i$:

$$\widehat{UD}_i = \hat{U}_i(\text{YES}) - \hat{U}_i(\text{NO}) = \varepsilon_i - \hat{p}_i \cdot x_i$$

A risk-neutral voter will vote YES if the expected utility from voting YES is higher than the expected utility from voting NO (i.e., if the utility differential is positive). He will vote NO if the utility differential is negative. Depending on the instrumental and expressive utility (x_i resp. ε_i), we can differentiate four types of voters: (1) altruists who have expressive motives ($z_i > y_i \Leftrightarrow x_i < 0$, $\varepsilon_i < 0$), (2) altruists without expressive motives ($z_i > y_i \Leftrightarrow x_i < 0$, $\varepsilon_i = 0$), (3) nonaltruists who have expressive motives ($z_i < y_i \Leftrightarrow x_i > 0$, $\varepsilon_i < 0$), and (4) nonaltruists without expressive motives ($z_i > y_i \Leftrightarrow x_i < 0$, $\varepsilon_i = 0$).⁵ Altruistic voters vote YES because the utility differential is positive regardless of whether he expects to be pivotal or not. Whether or not they have expressive voting

⁴ The possibility that subjects have antisocial preferences cannot be ruled out ex ante (e.g., Coffman, 2010). To minimize this possibility, we choose a set-up in which subjects donate to charitable organizations that have been chosen for their high acceptance among subjects in pretests. The answers of our subjects in the postexperimental questionnaire support the notion that acceptance for the organizations is high among our subjects. None of our subjects generally rejects the importance of the organizations' work or states that they may be corrupt.

⁵ Nonaltruists are not defined by the absence of other-regarding motives but by the dominance of selfish motives over altruistic motives in the case of pivotality.

motives is irrelevant for their decision as well. Similarly, a nonaltruist who is not motivated by expressive motives votes NO regardless of whether he expects to be pivotal or not. The reason is that his utility differential ($\widehat{UD}_i = \hat{p}_i x_i$) is always negative.

On the other hand, the expected probability $\hat{p}_i$ of being pivotal is essential for a nonaltruist who is motivated by expressive motives because he faces a trade-off between expressive and instrumental motives. By voting YES, he has an immediate and certain gain in expressive utility ε_i . However, this utility comes at the costs of giving away the chance to tip the scales against donation by voting NO. In the close-decision case where $\hat{p}_i$ is large, the instrumental motives dominate his decision (i.e., $|\hat{p}_i x_i| > \varepsilon_i$) and he will vote NO. In the sure-donation case where $\hat{r}_i \approx 1$ as well as in the sure-private-money case where $\hat{s}_i \approx 1$, the individual cannot expect to tip the scales (i.e., $\hat{p}_i \approx 0$). Therefore, the expressive motive becomes dominant, (i.e., $|\hat{p}_i x_i| < \varepsilon_i$) and makes the nonaltruistic voter with expressive motives to vote YES—against his instrumental utility.

Expressed in nontechnical terms, the theory of expressive voting argues that nonaltruistic voters get the good feeling of approving to a proposal to donate money. In most cases, this good feeling comes at zero material costs because the proposal is rejected or approved anyway. As the chance of being pivotal is negligible in virtually all voting decisions, nonaltruists generally behave like altruists even though they really do not want to donate money. The true motivation of the nonaltruists only shows up in those rare cases when they expect to be pivotal and thus, approving bears the danger of material costs. In this case, they prefer the money over the good feeling and vote against donation. Altruistic voters always vote YES regardless of whether they expect to be pivotal or not and regardless of whether they have expressive motives or not. When it comes to testing for expressive motives, we cannot use behavioral data from altruists. Instead, all experimental tests for expressive motives in voting have to rely on observing the voting behavior of nonaltruistic subjects in situations with and without pivotality.

Tyran (2004) performed an economic experiment to test for expressive motives in voting. Therein, every participant was given a voucher worth approximately \$6. The proposal was to donate the endowments of all participants to charity (instead of cashing the voucher in at the end of the experiment). Participants voted on this proposal five times with five different quora. A quorum defines the minimum approval rate necessary for the proposal to be accepted. At the end of the experiment, one voting round was chosen at random and its decision was executed. By letting candidates vote on the same proposal using different quora, Tyran (2004) kept the instrumental utility x_i and the expressive utility of approving the proposal ε_i constant but induced changes in the expected probability $\hat{p}_i$ of being pivotal. He asked candidate for their estimated approval rates among fellow-voters for all five decisions. Based on these estimates, it was possible to identify whether voter i expected to take his vote in the sure-donation, sure-private-money or close-decision case. A substantial share of participants either disapproved or approved for all quora even when the expected approval rate suggested that $\hat{p}_i \approx 0$. Among those 40% who voted YES for some quora and switched to NO for others, only 25% (10% of all participants) showed a switching pattern consistent with the theory of expressive voting.

On the other hand, Tyran (2004) found a strong positive correlation between subjects' inclination to approve and the expected approval rates among fellow-subjects. He argued that this may point at the existence of bandwagon motives. However, as Bischoff and Egbert (2013) pointed out, the correlation observed by Tyran (2004) may also result from the so-called false consensus effect. The false-consensus effect describes the empirical regularity that subjects overestimate the degree to which other subjects have the same preferences and behavioral intentions as the subject himself (e.g., Bischoff & Egbert, 2013; Fields & Schuman, 1976). Bischoff and Egbert ran a series of experiments using a similar set-up as Tyran (2004) but provided subjects with social information to influence their expectations with respect to the behavior of their fellow-subjects. They found evidence for both bandwagon and expressive motives. At the same time, they could not rule

out the possibility that subjects' fall victim of the false-consensus effect.

The existing empirical evidence on expressive motives in voting is mixed (e.g., Bischoff & Egbert, 2013; Shayo & Harel, 2012; Tyran, 2004). At the same time, it is not clear what the result tells us about the importance of expressive motives: Do expressive motives exist only for a small fraction of subjects or are they relevant for most subjects yet dominated by instrumental motives? The essential shortcoming of behavioral data are that we can only infer the sign of the utility differential $\widehat{UD}_i$, but we cannot compare its magnitude $|\widehat{UD}_i|$ for different situations. Neuroeconomics allows for such comparisons. Therefore, neuroscientific methods can help us gain further insight into the process by which choices are generated.

Neuroscientific Methods and Relevant Experiments

Neuroeconomics seeks to explain both behavior and its causes (Kable & Glimcher, 2009). By providing measures for the intensity of the reward expected from a certain decision, neuroscientific methods enable us to test for differences in magnitude $|\widehat{UD}_i|$ for situations where its sign is unchanged. Moreover, they allow for a comparison of reward levels of different voting decisions in the same situation. Therefore, neuroscientific methods can help us to gain more insight into the decision making process that leads the individual to vote YES or NO.

In this article, we use fMRI in an experiment that is similar to the experiment by Tyran (2004). fMRI is a neuroimaging method that allows for a measurement of physiological changes while a subject performs an experimental task. These physiological changes are correlated with neural activity and can be linked to mental processes. The underlying idea is to compare the brain's condition during the exercise of a specific task with its condition during a control task or a second task. The resulting images show activations of the brain areas affiliated with the specific task and therefore provide information about differences in the underlying neu-

ral processes responsible for the overt act. fMRI permits discrimination of different causal processes even if they result in the same observable behavior. On the other hand, it reveals that the brain processes seemingly different stimuli in an analogous manner (e.g., Camerer, Loewenstein, & Prelec, 2005; Izuma, Saito, & Sadato, 2010). The main research focus in neuroeconomics is on the neural mechanisms underlying decision making—investigating the expected utility model, decision making under risk and uncertainty, intertemporal choice and so forth (see for an overview: Camerer et al., 2005; Loewenstein, Rick, & Cohen, 2008; Sanfey, Loewenstein, McClure, & Cohen, 2006). Over the past years, numerous studies in this field increased our knowledge about the neural processes of decision making extensively. Given that voting decisions are based upon the same processes, we can use this knowledge to examine the neurobiology of instrumental and expressive motives in voting. Although the brain operates as a network, we also learned a lot about the contribution of different brain areas to specific brain functions. We know that the brain does not code objective but subjective reward values and seems to convert values of different stimuli (e.g., primary and secondary reinforcers) to one “neural currency” (Izuma et al., 2010; Kable & Glimcher, 2009; Saxe & Haushofer, 2008). The striatum plays a major role in this encoding of rewards. Consequently, this brain region is of special interest for our present study. The striatum is a subcortical region located in the interior regions of both cerebral hemispheres of the human brain. It can be divided into two subregions called caudate nucleus and putamen. Caudate and putamen are often related to as dorsal (upper) striatum (whereas the lower ventral striatum refers to the nucleus accumbens); both are associated with encoding the subjective value of goods and actions. The striatum reveals reward responses referring to forecasted or experienced value (Kable & Glimcher, 2009). Former work showed that monetary gain but also monetary loss is processed in the striatum (Delgado, 2007; Seymour, Singer, & Dolan, 2007). Therefore, this region seems to be highly important for the encoding of value representation that guides the choice among different

options. Neuroeconomics commonly uses money as a reinforcer to investigate decision-making, but there is a growing body of research suggesting that not only monetary but also social rewards are represented in the striatum (Fliessbach et al., 2007; Izuma et al., 2010; Moll et al., 2006; Saxe & Haushofer, 2008) and that different types of rewards are translated into a common neural currency (Kable & Glimcher, 2009). For instance, Izuma and colleagues (2010) had subjects decide whether to donate an amount of money to charity or to keep the money for themselves. This decision was made in presence or absence of observers. The presence of observers increased donation rates and fMRI reveals the highest striatal activations (1) when subjects donate in public and they expect high social rewards and (2) when subjects keep the money for themselves in absence of observers and thus, expect monetary gain without social cost. Another study shows that striatal activity is also highest for monetary gain and non-costly donations when anonymity is guaranteed (Moll et al., 2006). The subjects in our voting experiment face a similar task—to donate money to charity or to keep it for private use. The essential difference between our experiment and those reported above is that our subjects make their decision collectively rather than individually. Nevertheless, the above literature suggests that the striatum is the primary region of interest for our study.

Harbaugh et al. (2007) analyzed the neural activity when individuals are forced to donate collectively. The subjects in one treatment were taxed to finance donations to charity while the subjects in the other treatment decided voluntarily and on an individual basis to donate an equivalent amount of money to charity or to keep it for private use. In their studies, altruists showed reward-related striatal activity even when being forced to give the money to charity. The activation in the ventral striatum was higher when charitable giving is voluntary compared with mandatory transfers. This supports the notion of warm glow in charitable giving (Andreoni, 1989). Warm glow describes the extra utility derived from the act of giving money for charity. Just like expressive motives in voting, charitable giving is then seen as an act of consumption that is intended to increase the utility or re-

ward of the donor. The question of whether others benefit from the donation is not of primary relevance. Contrary to that, altruistic motives see charitable giving as an investment where the utility or reward results from the consequences of being taxed, which is underlined by a recent study by Kuss et al. (2013) who found neural evidence for outcome orientation in donations. Thus, Harbaugh et al. (2007) showed that investment-related motives (i.e., instrumental motives—altruistic or egoistic) and consumption-related motives (warm glow) are important in charitable giving. In our study, we analyze the importance of these two types of motives when individuals vote on charity. With respect to voluntary and forced donations analyzed by Harbaugh et al. (2007), voting lies in between these two extremes: Each voter makes an individual decision when approving or rejecting the proposal but the final decision is largely determined by the other voters.

Hypotheses

Based on the theoretical considerations discussed earlier in the article and the evidence from previous experiments, we can derive a number of testable hypotheses to help us learn more about the voting decision. Given that this is to some extent an explorative study, we test for expressive motives as well as for the largely undisputed instrumental motives. The tests are based on comparisons of neural activation patterns for different constellations, depending on the subject's expectation concerning their fellow voter's behavior and on whether they vote YES or NO. Most tests are performed separately for altruists and nonaltruists. There are 12 different constellations that can be compared in tests. Each constellation is denoted by three-letter abbreviation (see Figure 1). The first letter states whether the subject is an altruist (A) or a nonaltruist (N). The second letter captures the subject's expectation with respect to the behavior of his fellow-subjects. It differentiates between sure-donation (D), sure-private-money (P), and close-decision case (C). The third letter in the abbreviation states Y (N) when the subject voted YES (NO). For example, APY captures a constellation in which an Altruist sees himself in a situation in which he expects to keep the money for Private use and votes YES.

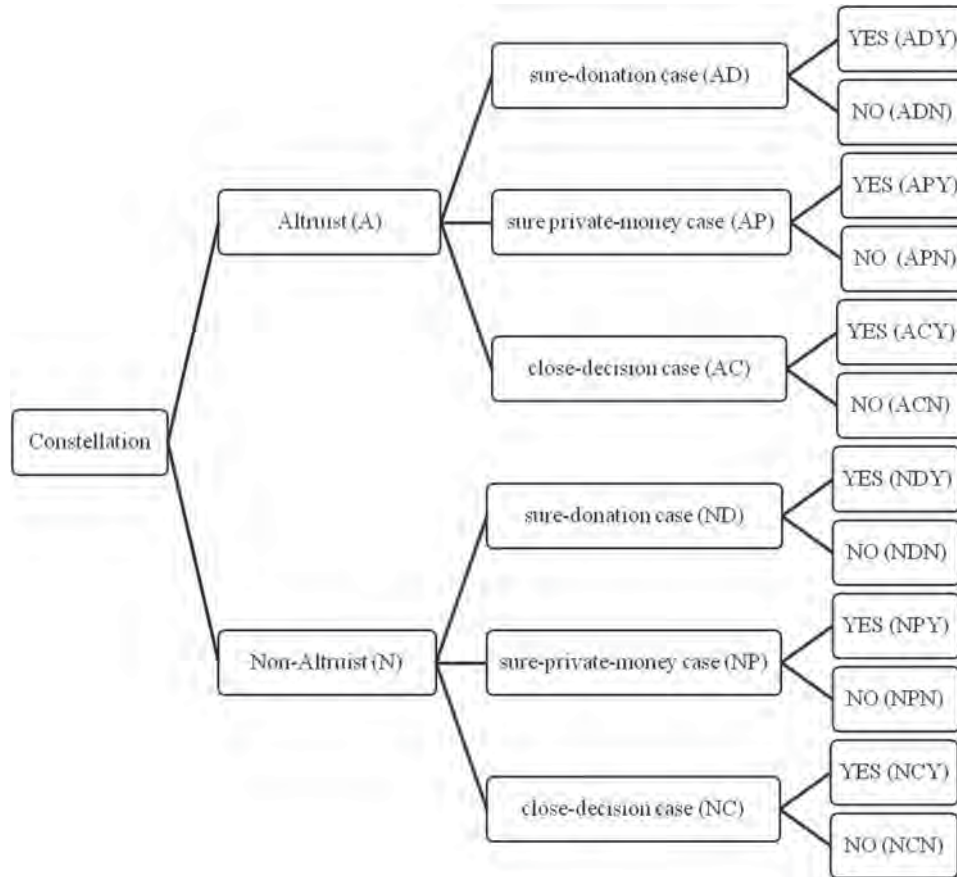


Figure 1. Constellations and corresponding abbreviations.

Whenever we do not differentiate between altruists and nonaltruists, the first symbol in the abbreviation is a wildcard (*).

Hypotheses concerning instrumental motives. We first derive a number of hypotheses to test for instrumental voting motives. The expected instrumental utility from voting YES, respectively, NO differs between sure-donation case ($x_i + \varepsilon_i$, respectively, x_i) and sure-private-money-case ($0 + \varepsilon_i$, respectively, 0). For nonaltruists ($x_i > 0$), keeping the money is more rewarding than donating the money and the utility from voting YES is always higher under the sure-private-money case than under the sure-donation case ($x_i + \varepsilon_i > \varepsilon_i$). Thus, we arrive at our first hypothesis H1⁶: Higher reward-related neural activity in the striatum for NPY than for NDY. The opposite applies to altruists who want the

proposal to be pursued (i.e., $x_i < 0$). Therefore, H2 states: Higher reward-related striatal activity for ADY than for APY. In the sure-private-money case, the altruist expects the

⁶ The same course of reasoning supports the mirror-inverted pendant to H1: Higher reward-related neural activity for NPN than for NDN. However, the small number of observations where subjects voted NO in the sure-donation case made it impossible for us to test this hypothesis. For the same reason, we cannot provide tests for a mirror-inverted pendant to H2 and H3. In addition, decisions of the category C (close decision) were not observed frequently. For this reason, we cannot test for differences in neural activations that result from increased uncertainty when $\hat{p}_i > 0$ and the individual voter is not sure about the outcome. For the same reason, we cannot test for possible activations because of warm glow as suggested by Harbaugh et al. (2007). We would expect activations in the associated regions to be higher for *CY than for *DY because only in *CY does the individual voter have the chance to give voluntarily.

majority to reject the proposal he approves. Evidence from earlier neuroscientific studies (e.g., Abler, Walter, & Erk, 2005; Siegrist et al., 2005) suggest that he may exhibit neural activation in areas that are related to “frustration,” especially the insula. Thus, Hypothesis H3 states: Neural activation related to “frustration” is present in APY but not in ADY. It is important to note that the three hypotheses on instrumental voting motives apply regardless of whether or not subjects are motivated by expressive motives.

Hypotheses concerning expressive motives. When it comes to expressive motives, we have to compare neural activity patterns in situation where an individual votes YES with patterns occurring when the individual votes NO. We recall that the expected utility from voting YES, respectively, NO is given by $x_i + \varepsilon_i$, respectively, x_i for the sure-donation case and $0 + \varepsilon_i$, respectively, 0 for the sure-private-money case. The utility differential between voting YES and voting NO is given by $\widehat{UD}_i = \varepsilon_i > 0$ for both sure-donation and sure-private-money case. It is important to note that this result applies to altruists and nonaltruists alike. Thus, we arrive at our final yet most important hypothesis H4: Higher reward-related activation in the striatum for *PY than for *PN.

Methods

Subjects

The experiment involved 30 healthy male subjects without any history of neurological or psychiatric disease. Because of insufficient task comprehension or technical problems during the fMRI-session, six subjects had to be excluded so that 24 subjects are finally analyzed (age: 26 ± 3 , range 19–37 years).⁷ All subjects were right-handed according to the Edinburgh Handedness Scale. All subjects gave written informed consent and the study was approved by the ethics committee of the University of Bonn.

Task

Before entering the fMRI scanner, the subjects were instructed about the experiment. Each participant was informed that he partic-

ipates in a group experiment on voter behavior where the total number of voters is 30. The set-up of our experiment resembles Tullock’s thought experiment as presented the previous chapter. As Tyran (2004) is recognized to offer a highly suitable yet simple and intuitive set-up to test for expressive motives that is frequently used in behavioral experiments, we choose a set-up that is similar to his.⁸ In every round of the experiment, the subjects were confronted with the following decision: Each participant is granted X € and is then asked to vote on the proposal to donate the money to a certain charitable organization. In every trial the proposal is presented naming the organization, the quorum (Q) and the stake (X). If more than Q% of the participants vote YES, the proposal is accepted and thus, the X € of all participants are donated. Furthermore, all subjects keep the X €. Given this information, each participant had to approve or reject the proposal by pressing respective buttons on the MRI-response-grips. The next trial began after the response entry (no time-limit) and a black screen (4–6 s) (see Figure 2). After subjects had read the written instructions and all questions had been resolved, we checked task comprehension via a questionnaire. In the MRI, each participant started with practicing-trials without image acquisition.

The experiment ran over 315 rounds in one session with three different values of Q (10, 50, and 80%) and three different values for X (5, 10, and 20 €). Each combination of Q and X was randomly presented with seven different charitable organizations (German Red Cross, SOS Children’s Villages, Médecins sans Frontières, Welthungerhilfe, UNO

⁷ Two of the six subjects revealed an insufficient performance in the prescanning task comprehension questionnaire. Despite further verbal task explanation before entering the scanner, we could not be sure of a sufficient comprehension of the different quora, though this was essential for the study. Four subjects were excluded because of incomplete scanning data—the scanning sessions of two subjects were cut short because of technical problems, the data corresponding to two further subjects was logged incompletely, again because of technical malfunction.

⁸ There are, however, a number of differences between our set-up and Tyran’s. We use only the first of two treatments of his study and use only three (10, 50, and 80) rather than five quora (1, 25, 50, 75, and 99). For technical reasons, we also elicited voters’ expectations only after the decisions were made.

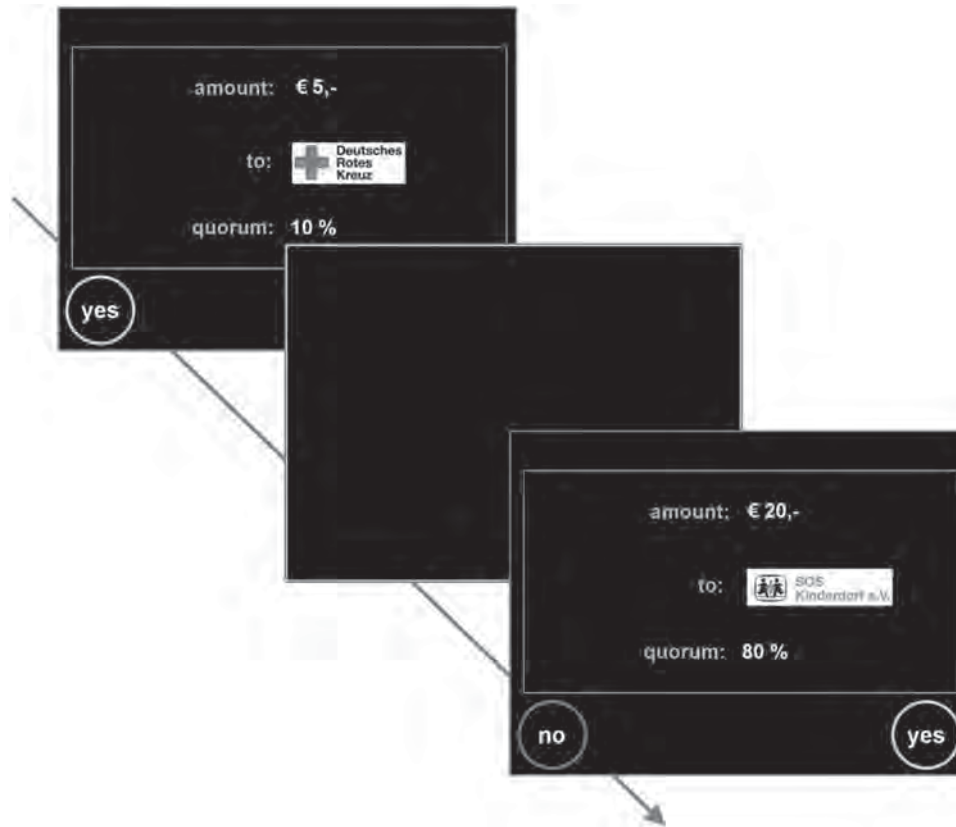


Figure 2. Task: The experiment runs over 315 rounds. In each round, the proposal is presented naming the relevant organization, quorum and stake of this ballot. Participants are allowed as much time to respond as desired. Responses are made by pressing one of two buttons on the response grips corresponding to the location of the options (Yes/No) on the screen. The location of the options interchange randomly from trial to trial to prevent correlation between key press and answer. The button press is followed by a black screen for 4–6 s (jittered) before the next trial begins.

Flüchtlingshilfe, Deutscher Kinderschutzbund, Terre des hommes), with five repetitions each. The seven organizations were used to provide some variety in the stimuli to prevent boredom. We conducted pretests with similar groups of participants and found these seven organizations to be equally well-known and similar with respect to reputation and other characteristics. Not differentiating between the seven organizations, the experiment contained 105 voting decisions per X and Q and 315 voting decisions in total. This number of repeated trials permits analysis for each value of X and Q. Without repetition the signal-to-noise ratio would be too low to detect significant task related differences in neu-

ral activity. The participants did not know the values of Q and X and the names of the relevant organizations beforehand. Throughout the experiment, the participants were not informed about the aggregate voting behavior of preceding rounds.

To ensure validity, the subjects were informed that their decisions will have real consequences because after the completion of the group experiment one round was chosen at random (the same round for all participants) and the decision made in this round was executed. In a postexperimental questionnaire, we elicited the participants' perception of the different charitable organizations using a 5-point-scale ("I know this organization," "I

attach importance to this organization's work," "With this organization, I'm sure the deserving poor receive the donated money," "This organization has a good reputation," and "This organization has to be supported"). We elicited the strength of the subjects' altruistic motives using the Personal Altruistic Level (PAL) proposed by Tankersley, Stowe, and Huettel (2007).⁹ We then asked the participants for all values Q, for X = 5 € and X = 20 € and for all organizations (separately), whether they expected a clear majority for or against the proposal and whether they expected the decision to be a close one ("For organization XY . . . Do you expect a clear majority to approve the proposal Q/X?" and "There is no clear majority for or against the proposal?").¹⁰ We used this information to elicit whether subjects expected to vote in a sure-donation, sure-private-money, or close-election case. Thus, we did not use false feedback or other forms of deception to artificially create these cases but we kept in line with the standards of experimental economics—as we do in the other aspects of the experiment. Finally, each participant received an allowance of 10 € per hour.

fMRI Data Acquisition

Scanning was performed on a 1.5 Tesla (T) Avanto Scanner (Siemens, Erlangen, Germany) using a standard eight channel head coil. Scan parameters were: number of slices: 33; slice thickness: 3 mm; matrix size: 64 × 64; field of view: 192 mm; interleaved slice acquisition; echo time (TE): 50 ms; repetition time (TR): 2.91 s. The task was presented via video goggles (Nordic NeuroLab, Bergen, Norway) using Presentation software (NeuroBehavioral Systems Inc.).

fMRI Data Analysis

fMRI data analysis was done using Statistical Parametric Mapping 5 (SPM5, www.fil.ion.ucl.ac.uk/spm/). Preprocessing included realignment with slice timing, unwarping, normalization to an EPI-template and smoothing with an 8 mm Gaussian kernel. The hemodynamic response to each event (each voting decision) was modeled by a canonical hemodynamic response function and its temporal derivative.

For the nonparametric first-level analysis, 18 vectors were constructed (YES/NO-vote for each X and each Q), using the stimulus onsets of the proposal. Parameter images for the respective contrasts of interest were generated for each subject and then subjected to two different second-level random effects analyses. Pre-defined linear combinations of the group con-

⁹ Based on the Self-Report Altruism Scale (SRAS), the PAL is more applicable to a sample of young adults from a university surrounding. Tankersley and colleagues report a high correlation between PAL and SRAS. Because our questionnaire already demands a great deal of concentration, we therefore decided to use only the PAL (instead of the SRAS) for keeping the total amount of questions as low as possible.

¹⁰ Note that we asked the questions concerning the expected behavior of fellow-subjects for X = 5 and X = 20 only. These amounted to 84 questions already. We were concerned that an additional 42 questions for X = 10 might cause subjects to get bored or tired by the repetition and thus, lead them to give increasingly similar answers for all three values of X. To avoid this, we restricted the questions to the situations where X = 5 and X = 20 because we expected significant differences especially between these extreme cases. The analysis to follow is restricted to those observations where we had the necessary information to classify them.

As the expectations concerning other subjects' behavior were elicited after the experiment, we decided to use a very rough set of categories in the questions concerning these expectations. For every institution and quorum and for X = 5 and X = 20 we asked subjects only two questions:

a) What do you expect the other subjects to do? (please pick one)

- i) A clear majority of subjects will approve.
- ii) A clear majority will reject.
- iii) There will be no clear majority in favor of approval or rejection.

b) Do you expect it to be a close decision? (Yes/No)

Based on this information, we can classify a large number of decisions to belong to one of the three cases. For instance: If the quorum is 10%, answers ai) and aiii) lead to the classification *sure donation case*. If the quorum is 50%, answer ai) leads to the classification *sure donation case* and answer aiii) leads to the classification *sure private money case*. For a quorum of 80%, answer aii) and aiii) lead to the classification *sure private money case*. The *close decision case* is assumed whenever subjects chose bi). Of course, we cannot classify all decisions made by using this scheme. However, we are able to classify most cases and thus, establish a sufficiently large number of observations to run our essential tests. The major advantage of our classification scheme is that the use of a very rough set of categories reduces the risk that the subjects report an expectation that differs to the one that drove their decision during the experiment. In addition, we wanted to prevent difficulties that subjects may have to report metric estimates for the approval rates to influence our results and create an illusion of accuracy that does not exist.

trast images were at first tested with two-sample t tests. In another second-level random effects analysis for the sure-private-money case, we used a full-factorial design with the factors “type” (two levels: altruist/nonaltruist) and “vote” (two levels: yes/no). Statistical threshold in both second-level analyses was set at a p value of .001 voxelwise (uncorrected for multiple comparisons) with a cluster size threshold of 10 voxels.

Results

We used a postexperimental questionnaire to differentiate between altruists and nonaltruists (see Table 1). Any participant who scored an above median score (≥ 30) on the altruism-score (toward strangers) proposed by Tankersley et al. (2007) was hereafter classified as an altruist, all other participants were classified nonaltruists. Thereby, we arrived at 13 altruists and 11 nonaltruists. No subject consistently approved or rejected the proposal in 100% of the trials but altruists showed significantly higher approval rates than nonaltruists for all three stakes (Bernoulli test, $p = .05$). The approval rate across all 24 participants was consistently declining with higher stakes and was higher for $Q = 10$ than for $Q = 80$ (Bernoulli test, $p = .05$). The same pattern was observed in the subsamples of altruists and nonaltruists.

We elicited subjects' expectations concerning the voting behavior of their fellow-subjects for the stakes 5 € and 20 € and all quora in the postexperimental questionnaire. Based on the answers, we classified whether subjects expected to be in a sure-donation, sure-private-money, or close-decision case when deciding about a certain stake X at a given quorum Q .

Table 1
Share of Participants That Expected a Clear Majority [%]

Q_j	$X = 5 \text{ €}$	$X = 20 \text{ €}$
Altruists ($n = 13$)		
10%	72.3	83.1
50%	72.3	33.7
80%	56.0	35.1
Nonaltruists ($n = 11$)		
10%	48.4	40.3
50%	34.1	5.20
80%	29.7	19.5

This classification was conducted separately for every subject and every X-Q-combination. Expectations varied substantially across subjects. Among altruists and nonaltruists, the expected approval rate for a quorum of 10% was higher than for a quorum of 80% (see Table 2). In addition, expected approval rates declined with stakes.¹¹

Instrumental Motives–fMRI Results

As hypothesized, nonaltruists showed significantly higher activation in the striatum (left putamen) when approving the proposal in the sure-private-money case in contrast to approving in the sure-donation case ($H1$: $NPY > NDY$, two-sample t test, $p < .001$ unc, $k > 10$) (see Figure 3).

For altruists, two-sample t tests confirmed higher activation in the left striatum (caudate and putamen) when approving in the sure-donation case in contrast to approving in the sure-private-money case (Figure 4a). This result supports $H2$ ($ADY > APY$, $p < .001$ unc, $k > 10$). We also found additional activation in the right parahippocampus (Figure 4b), left anterior rostral MFC (Figure 4c) and right pSTC (Figure

¹¹ Finally, we compared the approval rate in situations when subjects expected a clear majority of fellow-subjects to vote YES to the approval rate in situations when subjects expected the majority to vote NO. The average approval rate in the first case was significantly higher in the first situation than in the second one (Bernoulli test, $\alpha = .01$). This result is in line with Tyran's observation that subjects' inclination to vote YES is positively correlated with their expectations with respect to the approval rate among fellow-states (e.g., Bischoff & Egbert, 2013; Tyran, 2004). Therefore, we also test for these motives by contrasting the neural activities for *DY to the activities for *PY, both at the quorum of 50%. If bandwagon motives are present, the reward-related activation is expected to be higher in the *PY than in *DY constellations. However, we find no such pattern. One might argue that the results support the notion that bandwagon motives were not relevant in our study. In Bischoff and Egbert (2013) who found evidence for bandwagon behavior, subjects took their decision simultaneously and saw each other while deciding. This type of set-up is more likely to evoke bandwagon behavior than our current set-up where subjects decide in an extremely isolated situation. Alternatively, the behavioral regularity reported in the first sentence of this footnote may result from a false-consensus effect rather than from bandwagon motives in the first place. In any case, it is not clear how to interpret the lack of significant activations in the contrasts *PY versus *DY. Given that our major focus rests on the distinction between instrumental and expressive motives, we do not report in detail on this contrast.

Table 2
Average Approval Rates [%]

Q _j	X = 5 €	X = 10 €	X = 20 €
All participants (n = 24)			
10%	68.0	53.8	47.2
50%	70.2	48.3	31.7
80%	60.4	38.7	28.92
Altruists (n = 13)			
10%	75.2	67.0	56.7
50%	81.8	66.8	44.0
80%	73.0	53.2	41.1
Nonaltruists (n = 11)			
10%	60.2	39.5	36.8
50%	56.6	26.5	17.1
80%	45.5	21.6	13.0

4d). The opposite contrast (H3: APY > ADY, $p < .001$ unc.; $k > 10$) exhibited activation in the left insula (Figure 5a) as well as left caudate nucleus (Figure 5b) and middle prefrontal cortex (Figure 5c).

However, the observed striatal activation in the two opposing contrasts (ADY > APY and APY > ADY) originated in different processes. Plots of the contrast estimates reveal the influence of each factor of interest on the activation within the left putamen and left caudate (F-test for *AY, $p < .001$ (FDR), $k > 10$). As Figure 6a and 6b show, the striatal activity in contrast ADY > APY resulted from a negative signal change in the left putamen as well as in left caudate, so these regions were less activated in both cases. Because the negative signal changes were higher in the private-money case, the contrasts showed stronger signals in the sure-donation case (Figure 4a), although the effect size was negative in both cases. Contrary to that, the detected caudate activation in the contrast APY > ADY follows from a positive signal change in both cases. As Figure 6b shows, the signal change in the sure-private-money case was much higher than in the sure-donation case, therefore we observed a higher activation in the left caudate nucleus for sure-private-money than sure-donation in the contrast APY > ADY (Figure 5a).

Expressive Motives-fMRI Results

As expressive motives may apply to both altruists and nonaltruists alike, we did not initially distinguish between altruists and nonaltruists here. Instead, we contrasted approvals and

rejections of all subjects in the sure-private-money case (H4: *PY > *PN, $p < .001$ unc.; $k > 10$) and found no significant activation. With lowering the level of significance to $p < .005$ unc.; $k > 10$, two-sample t tests confirmed (among others) higher activation in the left caudate and left putamen when approving in contrast to rejecting the proposal in the sure-private-money case (see Figure 7). In a next step, we were interested to find out how much altruists and nonaltruists each contribute to the observed neural activity in *PY > *PN. Therefore, we conducted an analysis with a full-factorial-design for the sure-private-money case with the factors “type” (altruist/nonaltruist) and “vote” (yes/no). We conduct a conjunction analysis ($p < .005$) for the contrasts APY > APN and NPY > NPN and observed no voxels activated in both contrasts. We mask the contrast *PY > *PN inclusively with the contrast APY > NPY. This approach shows all voxel which are significant at .005 unc. with $k > 10$ across all subjects and at .05 unc. for altruists. None of the activations “survived” this masking. We then inclusively mask the contrast *PY > *PN with the contrast NPY > NPN on the same significance level and found all activations described for *PY > *PN. Thus, the observed neural activity in *PY > *PN seemed to be solely elicited by nonaltruists and not by altruists. We then plotted the contrast estimates for each region and found further support for this conclusion.

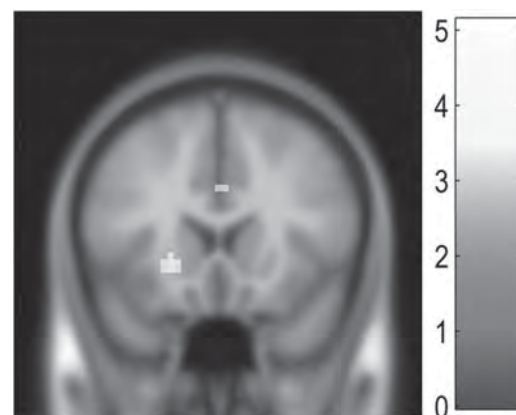


Figure 3. NPY > NDY: Nonaltruists exhibit higher activation in left striatum when approving the proposal in the sure-private-money case in contrast to the sure-donation case ($p < .001$ uncorrected; $k > 10$).

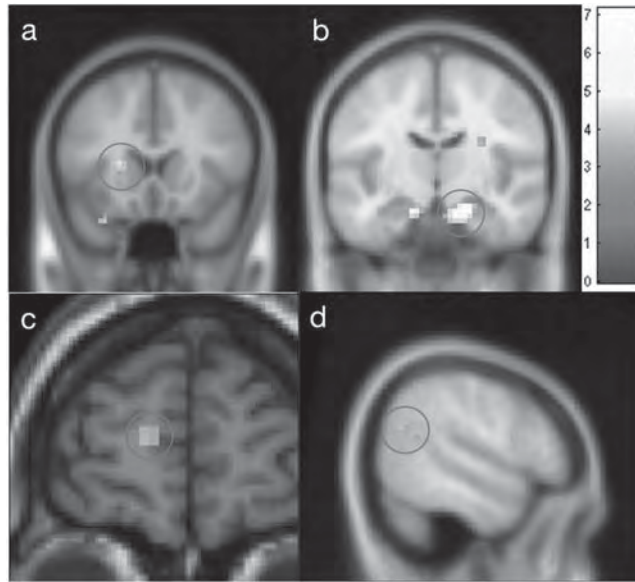


Figure 4. ADY > APY: Altruists show higher activation in (a) left striatum (putamen), (b) right parahippocampus, c) left anterior rostral medial frontal cortex (arMFC), and d) right posterior superior temporal cortex (pSTC) when approving the proposal in the sure-donation case in contrast to the sure-private-money case ($p < .001$ uncorrected; $k > 10$).

For the left caudate, APY elicited a small and NPY a large positive signal change, whereas APN showed no effect and NPN a negative signal change (see Figure 8). We also conducted a separate test for nonaltruists which yielded (among others) significant striatal activation (NPY > NPN, two-sample t test, $p < .005$ unc, $k > 10$). Plots of the contrast estimates revealed a positive signal change in the striatum for approvals and a negative signal change for rejections of the proposal (see Figure 9). For altruists, the same test revealed no significant activation (APY > APN, two-sample t test, $p > .005$ unc, $k > 10$) (Table 3).

Discussion

The purpose of this study was to achieve a better understanding of the motives in voting by using the neuroscientific method of fMRI. We wanted to learn more about rewarding aspects of the act of voting by investigating the activity of reward-related brain areas, especially the striatum.¹² We explored differences in the striatal activation between altruists and nonaltruists but our special focus rests on the importance of expressive motives in voting. We start by dis-

cussing the evidence on instrumental voting motives. Here, we expected altruists and nonaltruists to show distinctly different reward-related activation when confronted with the prospect to have to donate money (sure-donation case) as well as when expecting to keep the money for private use (sure-private-money case).

Instrumental Motives, Nonaltruistic Voters

We hypothesized that a nonaltruistic voter exhibits higher striatal activation when voting YES in the sure-private-money case than in the sure-donation case (H1: NPY > NDY). He approves the proposal in both cases presumably to attain the expressive utility (because $\varepsilon_i > \hat{p}_i x_i$) knowing that—with a very high probability, that his monetary payoff do not depend on his decision (i.e., $\hat{p}_i \approx 0$). The fMRI-results show that keeping the money in the sure-private money case (NPY) revealed an increased activity in the left putamen, whereas giving to char-

¹² The complete list of brain activation is available by the authors upon request.

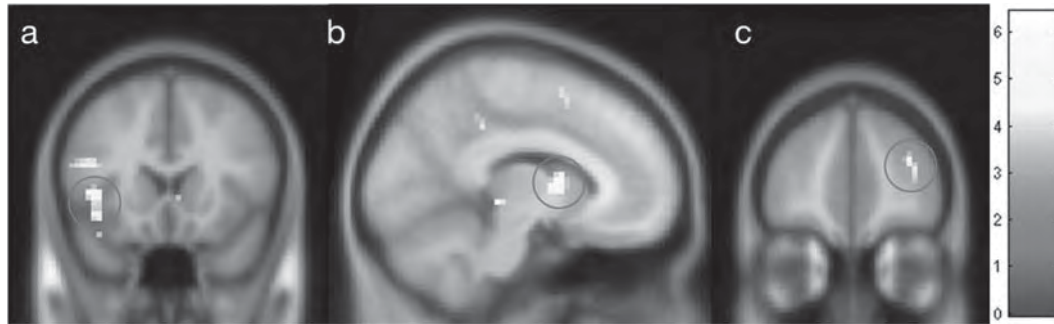


Figure 5. APY > ADY: Altruists exhibit activation (a) in the left insula, (b) in the dorsal striatum (left caudate nucleus), and c) in the middle prefrontal cortex when they approve the proposal in the sure private-money case ($p < .001$ uncorrected.; $k > 10$).

ity in the sure-donation case (NDY) showed a decreased activity in the same region. Thus, the nonaltruist showed the hypothesized neural activation consistent with materialistic and egoistic preferences.

Instrumental Motives, Altruistic Voters

An altruistic voter wants the proposal to be pursued when he approves it because it is in his instrumental interest. However, the donation is only pursued if the overall approval rate is sufficiently high. Thus, we hypothesized that the altruist shows higher reward-related activation when voting YES in the sure-donation case than in the sure-private-money case (H3: APY vs. ADY). The observed activation in the left striatum (caudate and putamen) supports this hypothesis at first sight, because these regions are known to represent monetary and social reward. However, for ADY as well as for APY the left putamen and caudate were deactivated, only the deactivation for APY was much higher, so contrasting both cases, the striatal activity was less negative for ADY. This pattern does not fit the logic underlying hypothesis H2. Given this result, we focus on the other activated regions (left arMFC, right parahippocampus and right pSTC) in the contrast ADY versus APY for a possible explanation. The additionally activated anterior rostral MFC (arMFC) is supposed to play a major role in social cognition (for an overview: Amodio & Frith, 2006). It is found to be associated with considering others' mental states and intentions, including reflections about what we want others to think about ourselves.

However, it is also referred to thinking about the self and processing of what feels like the right thing to do in a moral dilemma (Amodio & Frith, 2006). We also found a higher activity of the right pSTC that is associated with self-reported altruism (Tankersley et al., 2007) and willingness to give (Hare et al., 2010). Considering these additional activations, we might observe in this contrast (ADY > APY) not a clear reward processing but thinking about what is the right thing to do against the background of their own altruistic standards and the standards of others.

We further hypothesized that altruists should exhibit neural activation in areas which are related to "frustration" in the sure-private-money case in contrast to the sure-donation case, because they expect the majority to reject the proposal which they want to see pursued (H3). Contrasting APY > ADY, we found stronger activation in the dorsal striatum (caudate nucleus), left insula and middle prefrontal cortex. We found the hypothesized activation in the left anterior insula. The anterior insula is part of the pain processing system and also associated with unfairness in social interactions, frustration and a feeling of discomfort (Abler et al., 2005; Meyer-Lindenberg, 2008). Meyer-Lindenberg even links the anterior insula signal to "gut feeling." However, the insula is also associated with the processing of reward magnitude and showed a higher activity for a higher reward magnitude in former studies (Smith et al., 2009). The next activated region

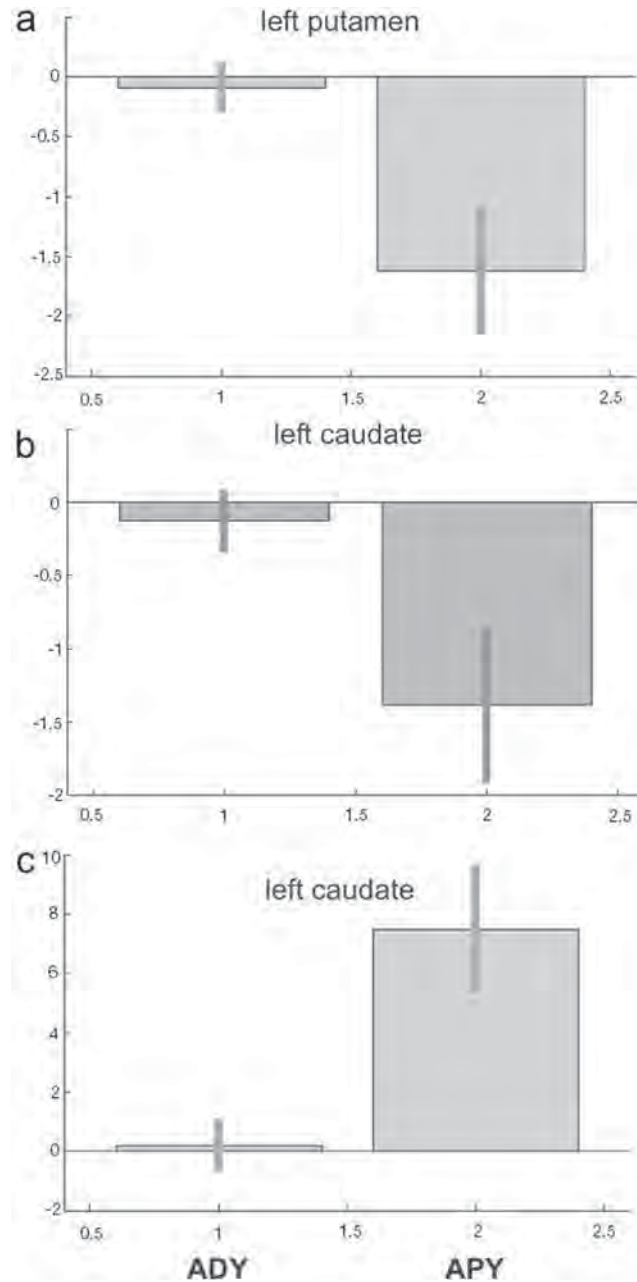


Figure 6. ADY > APY: The bars represent the signal change in (a) left putamen [MNI: -21, 18, 9] and (b) left caudate [MNI: -18, 19, 9] for altruists approving the proposal in the sure-donation case (left bars) and sure-private-money case (right bars). (c) Shows the signal change in the left caudate [MNI: -9, 3, 6] in the opposite contrast APY > ADY.

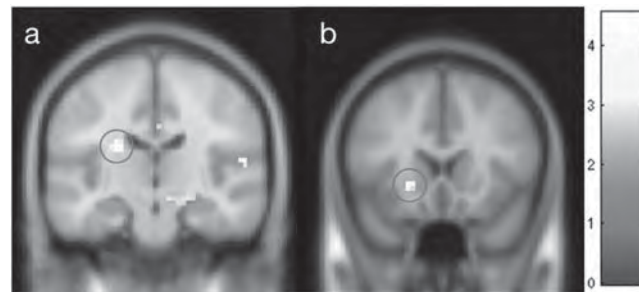


Figure 7. *PY > *PN: Without distinguishing between altruists and nonaltruists, activation for approvals in the sure-private-money case is observed in (a) left caudate and (b) left putamen ($p < .005$ uncorrected.; $k > 10$).

(the caudate nucleus) has been associated with social processes like trust (Baumgartner, Heinrichs, Vonlanthen, Fischbacher, & Fehr, 2008). King-Casas et al. (2005) suppose the caudate nucleus to compute “information about the fairness of a social partner’s decision.” However, just like the insula, the caudate nucleus, too, is also involved in anticipation and reception of reward (Valentin & O’Doherty, 2009; Dreher, Kohn, Kolachana, Weinberger, & Berman, 2009; Pizzagalli et al., 2009). The third activation in this contrast was in a middle prefrontal region (mPFC),

that is known to be related to expected reward value and variance (Tobler, O’Doherty, Dolan, & Schultz, 2007). Hence, on the one hand all three regions (insula, caudate, and mPFC) may indicate a more reward-related activity for APY than for ADY. On the other hand, insula and caudate can also be related to unfairness. While the nonaltruists revealed clear reward-related processes when they voted YES but expected not having to give the money away, the altruists may feel uncomfortable: Not to pursue the proposal may appear unfair to them, causing an un-

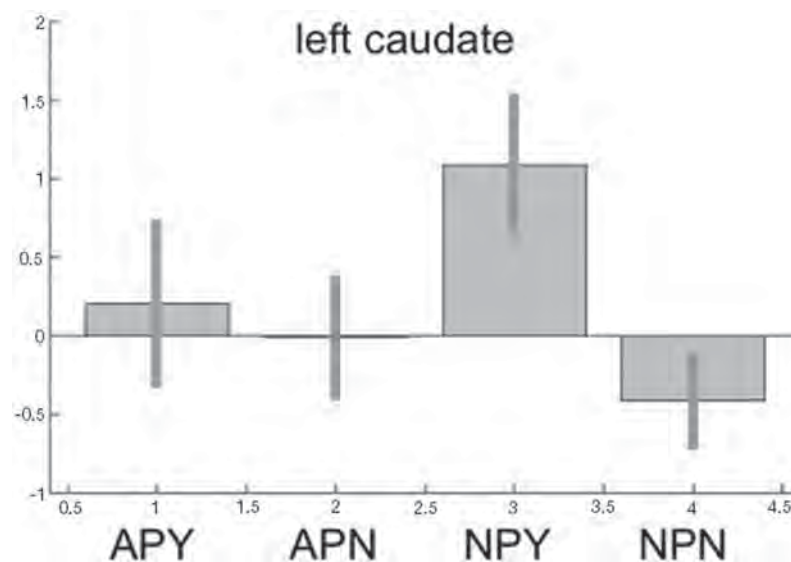


Figure 8. *PY > *PN: Plots of contrast estimates in the peak voxel of the left caudate (full-factorial $p < .005$, $k > 10$ voxel, MNI: $-24, -18, 21$). The difference in signal change is largest for NPY > NPN.

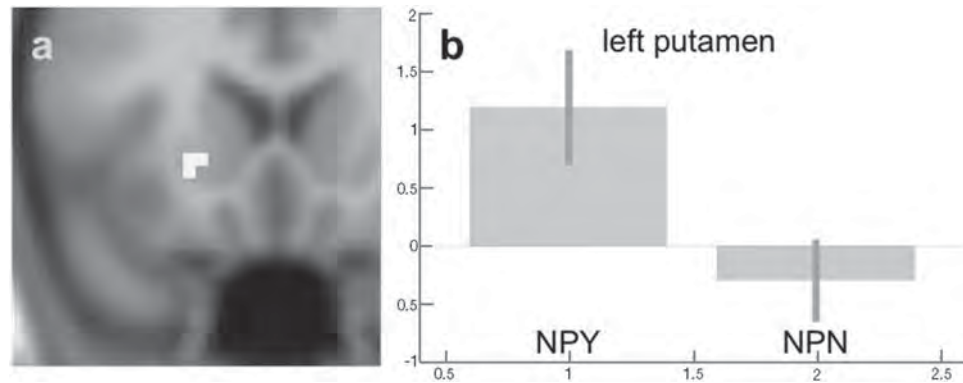


Figure 9. NPY > NPN: Plots of the contrast estimates for nonaltruists reveal a positive signal change in the left putamen [MNI: -21, 18, -3] when voting YES (left bar) and a negative signal change when voting NO (right bar). In both cases, the voters know that they can keep the money for themselves.

comfortable “gut feeling.” This interpretation supports the bottom line of hypothesis H3 with respect to the altruists motivation when voting YES in the sure-private-money case.

In a first general view, we observed distinct differences between altruists and nonaltruists in their neural representation of instrumental motives. While the nonaltruists revealed a clear reward-related brain activity in the sure-private-money case (H1), the neural activation pattern of altruists was less clear. Donating the money in the sure-donation case (ADY) elicited activ-

ity in regions known to be involved in social cognition, like processes about agency, altruism, willingness to give and consideration about the right thing to do (arMFC and pSTC). Donating the money in the sure-private-money case (APY) activated reward-related brain regions but as well regions that are associated with a feeling of discomfort and unfairness. If the altruists really wanted the proposal to be pursued—as an investment and consumption alike—reward-related activity should have been more prominent in ADY. Therefore, we could not find clear support for H2.

Table 3
MNI-Coordinates and Statistic Values for the Significant Activations

		MNI-coordinates			z-score ^a
		x	y	Z	
Brain region					
Nonparametric analysis: $p < .001$ (uncorrected for multiple comparisons, extent threshold of 10 voxels)					
Nonaltruists	Putamen (L)	−21	18	−3	4,0
NPY > NDY					
Altruists	Caudate (L)	−18	18	9	3,76
ADY > APY	Putamen (L)	−21	18	9	4,07
	Parahippocampus (R)	18	−12	−21	5,98
	Anterior rostral MFC (L)	−12	60	9	3,35
	pSTC (R)	54	−60	24	3,59
Altruists	Insula (L)	−42	18	3	4,52
APY > ADY	Caudate (L)	−9	3	6	4,53
	Middle prefrontal cortex	33	48	21	3,92
Nonparametric analysis: $p < .005$ (uncorrected for multiple comparisons, extent threshold of 10 voxels)					
All voters	Caudate (L)	−24	−18	21	3,98
*PY > *PN	Putamen (L)	−21	18	−3	3,16

^a z = z-score for the peak activation voxel.

Expressive Motives, Altruistic and Nonaltruistic Voters

Our final yet most important hypothesis aimed at testing for expressive motives in voting. Assuming that these motives are present, we expect all voters—no matter if they are altruists or nonaltruists—to perceive approvals in the sure-private-money case as more rewarding than rejections in this case ($H4: *PY > *PN$). The observed activation in the dorsal striatum (left caudate nucleus and left putamen) supports this hypothesis at first sight. However, further analyses revealed that the observed neural activity was nearly completely attributable to nonaltruists. Altruistic voters did not reveal this activation pattern. This finding is consistent with all other results of this experiment. Only the nonaltruists revealed a distinct reward-related neural activity namely when they approved the proposal in the sure-private-money case (NPY). The plots of the contrast estimates for the left caudate (see [Figure 8](#)) support this. Nonaltruists revealed a stronger positive signal-change than altruists when they approved the proposal in the sure-private-money case. Rejecting the proposal elicited a negative signal-change for nonaltruists and nearly no signal-change for altruists. Thus, the immediate expressive utility from the act of voting seemed to be less distinctive for altruists.

Despite its interesting first results, our study has a number of limitations. First, the number of subjects in each group was rather small, which might account for partly less conclusive results and the need for lowering the level of significance to $p < .005$, respectively. Second, we were unable to analyze voting behavior in close-decision cases because they were not sufficiently frequent to allow for a meaningful statistical analysis. The extreme rarity of close decisions is typical for majority voting and therefore limits behavioral experiments as well as field studies on expressive behavior alike. It can be avoided if the experimenters applies treatments in which they explicitly confront subjects with situations in which their decision is likely (or even certain) to tip the scales and other treatments where they are (almost certainly) not pivotal. However, these treatments cannot be framed as voting decisions in sizable groups but have to be presented as voting decisions in a group of three to five subjects. There-

fore, subjects are likely to perceive these treatments with large and small groups to differ in more than just the probability of being pivotal. Nevertheless, it may be interesting to observe the neural patterns of subject in such treatments.

To keep the task in the fMRI simple, we did not elicit subjects' expectations with respect to their fellow-voters' behavior at the point in time when they make their decision but only after the experiment. This bears the danger that the answers in the postexperimental questionnaire may deviate from the expectations that subjects entertained when performing the task in the fMRI. However, our results do not rely on the comparison of close and nonclose decisions. In our opinion, it seems unlikely that a voter expects a proposal to pass comfortably *ex post* while he expected a clear rejection while in the scanner. Thus, the time-lag between voting decisions and answers on expected behavior of fellow-subjects is unlikely to jeopardize our findings. Finally, we did not generate a sufficient number of cases in which nonaltruists reject the proposals and therefore we are unable to test the mirror-inverted versions of our hypotheses (e.g., $H1'$: Higher reward-related neural activities for NPN than for NDN). This is the price we pay for using charitable organizations that produced a high emotional involvement among subjects. However, we have deliberately chosen these organizations to make sure that expressive motives—if existent at all—are likely to have an impact on subjects' behavior. In a future experiment, it may be interesting to use higher stakes and/or emotionally less involving organizations and thereby produce a sufficient mix of rejections and approvals.

Conclusion

In this article, we provide a first fMRI-study on voting behavior. We follow [Tyran \(2004\)](#) in our experimental set-up and our primary focus on expressive motives. Furthermore, we use the altruism-score proposed by [Tankersley et al. \(2007\)](#) to differentiate between altruists and nonaltruists and investigate differences in striatal activation between them in the context of voting. Our results are in line with former experiments on social decision-making and charitable giving ([Harbaugh et al., 2007](#); [Izuma et al., 2010](#); [Moll et al., 2006](#)) but also shed further

light on the motivational basis of voting decisions.

Summarizing the first results generated by our study, we found different patterns of reward-related activity for altruistic and nonaltruistic voters. For nonaltruistic voters, we observed striatal activity when voting YES in the sure-private-money case. Keeping the money is rewarding for nonaltruists. This result shows the importance of investment-related, instrumental motives in voting. Though not surprising as such, the result indicates the validity of our set-up. However, for nonaltruistic voters, we furthermore found approving the proposal in the sure-private-money case to be more rewarding than a rejection. This result is noteworthy because it provides support for the existence of expressive motives among nonaltruists. This interpretation further strengthens the notion of expressive voting according to which votes—if not pivotal—do not refer to the policy outcome but to the immediate utility from the act of voting. For altruists, we observed a neural activation pattern that can be associated with investment (as well as consumption) related motives: In the sure-private-money case, altruists showed activation either indicating toward unfairness because the money will not be given to charity or indicating toward reward perception with an uncomfortable “gut feeling.” Approving the proposal in the sure-donation case activated brain regions associated with altruism, willingness to give and thinking about the right thing to do. At the same time, we did not observe expressive motives in nonaltruistic voters.

Like Harbaugh et al. (2007) found for charitable giving and taxation, we found that both investment-related (instrumental: altruism or egoism) and consumption-related (expressive) motives play a role in voting decisions. Previous studies using traditional economic methods had to rely on behavioral observations and found only limited support for expressive motives. Using neuroscientific methods, we provide evidence for a neural correlate of expressive utility. At this point, our conclusions are still partly interpretative and need further investigation in follow-up experiments.

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